REVUE SUISSE DE ZOOLOGIE

ANNALES

de la
SOCIÉTÉ SUISSE DE ZOOLOGIE
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TOME 100 — FASCICULE 3

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La préférence sera donnée aux travaux concernant les domaines suivants: Biogéographie, systématique, écologie, éthologie, morphologie, et anatomie comparée, physiologie.

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Vögel in der Agrarlandschaft der Schweiz*

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Birds in Swiss farmland. – From 1900 to 1988 362 bird species have been recorded in Switzerland, including 200 breeding species. 24 are at present abundant (>100,000 pairs), 34 are numerous (10,000 to 100,000) and 91 are rare (>1,000); 47 breed in 10,000 to 10,000 pairs.

38 species have been recorded for the first time in the 20th century, but only two of them have become established. Four have disappeared as breeders since the 1850ies and four have only been nesting sporadically in the past decades. A third of the Swiss avifauna, mainly habitat specialists, are actually or potentially endangered. A few species have enlarged their breeding range and increased in numbers.

The proportion of threatened breeding species is relatively high in the colline and montane regions, and in agricultural areas. In 91 species with up to 1,000 pairs, a third is depending on farmland, where 30 out of 57 species are endangered. At higher levels and in southern regions of Switzerland, bird populations are much more viable than in the densely populated and intensively farmed lowlands. The agricultural areas in the Alps are of special significance, holding populations much beyond their share of surface.

The increasingly more yield-oriented use of the alpine farmland leads to more intensive agriculture on productive parts, whereas poorer plots are abandoned and eventually covered by wood. Both these changes are to the disadvantage of the fauna and flora of open and semi-open landscapes. However, if more intensive farming on the favourable parts of the homesteads may prevent, that agriculture is given up locally, and where it can ensure continued, but extensive farming on the remaining, less productive parts, these exceptionally valuable habitats could be preserved.

Key-words: birds - farmland - population-size - population trend - Switzerland - endangered species - intensive agriculture.

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* Ausführungen zu einem Referat gehalten am 10.10.1991 anlässlich der 171. Jahresversammlung der SANW in Chur.

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Die Avifauna der Schweiz umfasste von 1900 bis 1988 362 Vogelarten, darunter 200 Brutvögel (Winkler 1984, Winkler *et al.* 1987, Winkler 1989). Diese Zahlen, vor allem aber auch die Verbreitung und Grösse der Populationen sind naturgemäss dynamischen Veränderungen unterworfen. Mögliche Ursachen sind beispielsweise kurzfristig ändernde Witterungsbedingungen und Schwankungen im Nahrungsangebot, oder mittel- bis langfristige Klimaveränderungen. Neben diesen «natürlichen» Umweltfaktoren spielt vor allem in diesem Jahrhundert zunehmend auch der Mensch eine Rolle. Die intensive Bodennutzung, beispielsweise durch die Landwirtschaft, hat zu markanten Veränderungen der Avifauna und ihrer Lebensräume in den Niederungen geführt. In den höher gelegenen Regionen blieben dagegen mosaikartig genutzte Kulturlandschaften erhalten, auf denen sich im Mittelland selten gewordene Vogelarten behaupten konnten. Der Alpenraum wird deshalb oft als «Naturreserve», «Rückzugsgebiet» oder «Refugium» bezeichnet. Durch eine immer nachhaltigere Nutzung und Erschliessung durch Tourismus, Land- und Forstwirtschaft droht diesem Lebensraum jedoch ein ähnliches Schicksal wie dem Mittelland (Salathé & Winkler 1989).

Die ornithologische Feldforschung hat sich seit Jahrzehnten mit der Verbreitung und Häufigkeit der einheimischen Avifauna befasst und verfügt deshalb über langjährige, von profesionellen Forschern und Amateuren gesammelte Daten. Die Schweizerische Vogelwarte Sempach dokumentiert und überwacht die Verbreitung und Häufigkeit der einheimischen Vogelwelt in Zusammenarbeit mit über 900 ehrenamtlichen Feldornithologen in der ganzen Schweiz (Zbinden & Schmid 1991).

Ein Schwergewicht liegt bei den Brutvögeln, auf deren Bestandsentwicklung wir uns in der vorliegenden Arbeit konzentrieren. Zuerst geben wir eine allgemeine Kurzübersicht über die Veränderungen der Avifauna der Schweiz, bevor wir auf die Vogelarten verschiedener Lebensräume, den Einfluss der Landwirtschaft und die Bedeutung der höher gelegenen Regionen im Besonderen eingehen:

1. Wie haben sich Artenzahl, Verbreitung und Häufigkeit der Brutvögel in den letzten Jahrzehnten verändert?
2. Welche Arten zeigen rückläufige Bestände und welche Lebensräume, Regionen und Höhenstufen besiedeln diese gefährdeten Brutvögel?
3. Wie gross sind die aktuellen Brutpopulationen?
4. Welche Bedeutung haben die Alpen für die Schweizer Avifauna, insbesondere für gefährdete Arten der Kulturlandschaft?
5. Wie könnten sich Änderungen in der Bewirtschaftung im Alpenraum auf die charakteristischen Vogelarten der Feldflur auswirken?

1. VERÄNDERUNGEN IN DEN LETZTEN JAHRZEHNTEN

1.1. Zahl der Brutvogelarten

Im 20. Jahrundert wurden bis 1991 38 Arten erstmals als Brutvögel festgestellt, vier davon seit 1989. Die zunehmende Zahl der Brutvogelarten darf aber nicht den Eindruck erwecken, dass unsere Vogelwelt immer vielfältiger werde. 36 der neu aufgetretenen Arten brüten nämlich nach wie vor nur in sehr kleiner Zahl, 25 davon nur lokal, unregelmässig oder sporadisch. Es bleibt offen, ob sie - wie der Nachtreiher - nach ein paar Jahren wieder verschwinden (SCHIFFERLI *et al.* 1980), oder sich dauerhaft ansiedeln können. Bisher haben sich einzig Türkentaube und Wacholderdrossel als erfolgreich erwiesen; sie sind heute weit verbreitet und häufig (GLUTZ VON BLOTZHEIM & BAUER 1980, 1988, SCHIFFERLI *et al.* 1980). Den neu aufgetretenen Arten stehen 4 seit Mitte des letzten Jahrhunderts als Brutvögel verschwundene und 4 weitere, früher zum Teil verbreitete, heute aber nur noch sporadisch brütende gegenüber.

Es gilt im weiteren zu beachten, dass die Dynamik der Artenvielfalt erst für das 20. Jahrhundert, und vor allem für die letzten Jahrzehnte gut belegt ist. Wesentliche Voraussetzung dafür sind die verbesserten Hilfsmittel zur Artbestimmung, die steigende Ausbildung und Erfahrung der Feldornithologen und deren grössere Mobilität und Freizeit. Kurzfristig neu auftretende Arten wurden früher wohl oft gar nicht entdeckt, oder konnten nicht sicher bestimmt werden.

1.2. VERÄNDERUNGEN IN VERBREITUNG UND HÄUFIGKEIT

GLUTZ VON BLOTZHEIM (1962) dokumentierte die Brutbiologie, Verbreitung und Bestandsveränderungen von 195 Arten bis Ende der fünfziger Jahre. Da meist keine langjährigen oder gesamtschweizerischen Erhebungen vorlagen, waren bei den häufigeren Arten oft nur lokale Bestandsangaben möglich. Von einzelnen Arten liegen jedoch Verbreitungskarten und Angaben über die Grösse der Schweizer Brutpopulation vor.

Im «Verbreitungsatlas der Brutvögel der Schweiz» (SCHIFFERLI *et al.* 1980) wurde 1972-1976 die Verbreitung aller Arten systematisch und flächendeckend aufgenommen. Als Beobachtungseinheiten wurden entsprechend dem Koordinatennetz der Landeskarte 468 Rasterquadrate von 10x10 km bearbeitet. Alle vorkommenden Brutvogelarten wurden registriert, doch wurden keine Häufigkeitsangaben erhoben. Um das Vorkommen einer Art im Quadrat von 100 km^2 zu belegen, genügte ein Nachweis in einem der 5 Untersuchungsjahre. Diese einfache, klar definierte und zu Vergleichszwecken wiederholbare Methode gibt eine grossräumige Übersicht über die aktuelle Brutverbreitung. Bei der Interpretation müssen allerdings ihre Grenzen berücksichtigt werden. Da die Rastereinheit für topographisch vielfältige Gebiete wie die Schweiz relativ gross ist, schliesst sie oft mehrere Höhenstufen ein. Das effektiv besiedelte Areal wird bei nicht lückenlos verbreiteten Arten flächenmässig überschätzt. Verbreitungsänderungen sind mit dieser Methode erst dann erkennbar, wenn grosse Flächen neu bzw. nicht mehr besiedelt werden.

Anhand der Rasterfrequenz (Anteil der 1972-1976 besiedelten Quadrate) kann die Verbreitung von 188 Brutvogelarten quantifiziert werden. 90 Arten (48%) waren in den siebziger Jahren weit verbreitet: 38 besiedelten mehr als 400 der 468 Quadrate, 27 Arten 301-400 und 25 Arten 201-300 Quadrate. 98 Arten (52%) waren unregelmässig oder regional verbreitet (Vorkommen in weniger als 200 Quadraten), darunter 45 seltene Arten (24%, 1-50 Quadrate), deren Bestand aufgrund von gesamtschweizerischen Erhebungen oder Schätzungen aus den siebziger Jahren 100 Paare vermutlich nicht überstieg.

Einzelne Brutvogelarten haben ihr Verbreitungsareal in den sechziger und siebziger Jahren ausgedehnt oder waren regelmässiger verbreitet als früher. Die Wacholderdrossel besiedelte innerhalb von rund 50 Jahren praktisch die ganze Schweiz. Die Türkentaube, welche 1952 erstmals als Brutvogel nachgewiesen wurde, ist heute in der Umgebung menschlicher Siedlungen bis gegen 700 m ü. M. heimisch, lokal bis 1600 m (SCHIFFERLI *et al.* 1980). Der Rotmilan hat sich vom Jura her gegen das Mittelland ausgebreitet. Inzwischen hat er den Rand der Alpen erreicht (MOSIMANN & JUILLARD 1988) und heute das um die Jahrhundertwende aufgegebene Brutareal zurückgewonnen.

Der Kolkrabe hat das Mittelland und den Jura, von wo er in der 2. Hälfte des 19. und zu Beginn des 20.Jahrhunderts verschwunden war, von den Alpen aus wieder besiedelt (Abb. 1). Vor 1950 fehlte er nördlich einer Linie von der Rhonemündung in den Genfersee bis zur Rheinmündung in den Bodensee. Bis 1960 brütete er an 26 Orten nördlich dieser Linie, stellenweise bis an den Jurasüdfuss (GLUTZ VON BLOTZHEIM 1962). 1972-76 wurden aus 76 Atlasquadraten, die bis 1960 noch nicht besiedelt waren, Brutnachweise erbracht. Der Brutbestand der siebziger Jahre wurde auf mindestens 1'000 Paare geschätzt (SCHIFFERLI *et al.* 1980); heute dürften es 1'500-2'500 sein. Damit

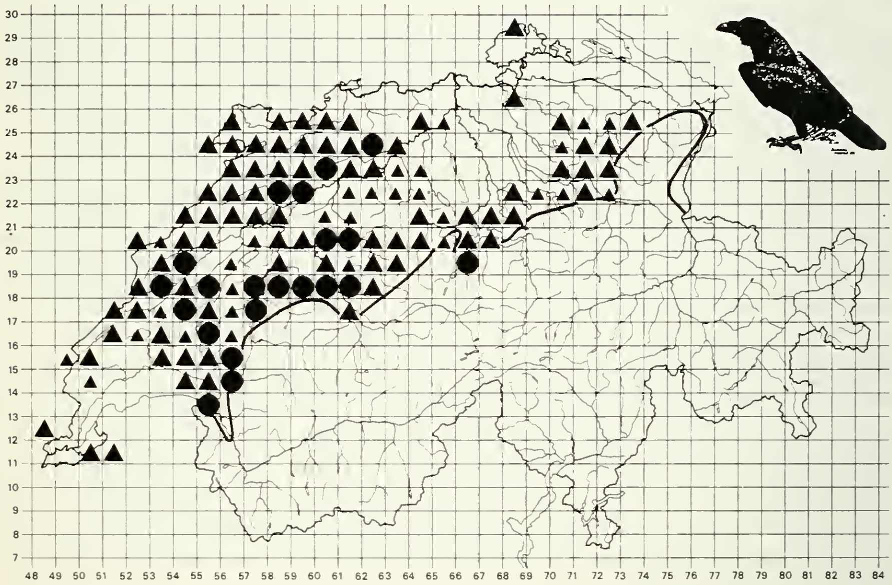

ABB. 1

Veränderungen der Brutverbreitung des Kolkraben seit 1950. Die Linie markiert die nördliche Verbreitungsgrenze um 1950. Grosse Punkte: Quadrate von 10x10 km mit Brutnachweisen in den fünfziger Jahren nördlich der Verbreitungsgrenze von 1950 (nach GLUTZ VON BLOTZHEIM 1962, umgezeichnet); Dreiecke: Quadrate nördlich der Verbreitungsgrenze von 1950 mit sichern (grosse Dreiecke) bzw. wahrscheinlichen Bruten (kleine Dreiecke), 1972-76 (nach SCHIFFERLI *et al.* 1980, Quadrate mit möglichen Bruten nicht berücksichtigt). Das Areal südlich der Verbreitungsgrenze von 1950 war 1972-76 praktisch vollständig besiedelt.

hat er ähnlich wie der Rotmilan sein ursprüngliches Verbreitungsgebiet wieder erreicht. Salathé & Winkler (1989) belegen weitere Beispiele von Arten, die vom Alpenraum aus den Jura (wieder) besiedelt haben.

Viele Arten unserer Avifauna waren in den siebziger Jahren weniger regelmässig verbreitet oder seltener als vor 1960. Sie haben in den letzten Jahrzehnten stark abgenommen und sind aus einzelnen Regionen verschwunden, wie beispielsweise Zwergreiher, Wiedehopf, Bekassine (Biber 1984), Rebhuhn, Steinkauz und Wachtelkönig. Bei anderen Arten, die ebenfalls deutlich abgenommen haben, wie beispielsweise Auerhuhn (Marti 1986), Gartenrotschwanz (Bruderer & Hirschi 1984) und Dohle (Vogel 1990), sind die Grundlagen in Schifferli *et al.* (1980) zu generell, um die Lücken im Verbreitungsareal zu dokumentieren. Die Rasterkarten mit grossen Einheiten geben oft ein zu optimistisches Bild der Verbreitung und dokumentieren den Rückgang vieler Arten zu wenig deutlich.

2. GEFÄHRDETE ARTEN

In den letzten Jahrzehnten wurden seltene und stark abnehmende Tier- und Pflanzenpopulationen auf Rote Listen der bedrohten Arten gesetzt. Die erste Rote Liste der Brutvögel (Bruderer & Thönen 1977) wurde inzwischen auf den neuesten Stand gebracht (Zbinden 1989). Sie fasst den Status von 196 Brutvogelarten zusammen:

- 83 Arten (42%) sind häufig und verbreitet (Kategorie 6);
- 32 (16%) sind aus biogeographischen Gründen oder wegen ihrer speziellen Biotopansprüche selten (Kategorie 5);
- bei 17 Arten (9%) trägt die Schweiz eine besondere Verantwortung für die Erhaltung der Brutpopulationen Mitteleuropas (Kategorie 4);
- bei 35 Arten (18%, Kategorien 1, 2) ist der Bestand gefährdet und bei weiteren 29 (15%, Kategorie 3) ist er verletzlich.

64 Arten, 33% der einheimischen Brutvogelarten, sind also aktuell oder potentiell bedroht (Kat. 1-3 in Zbinden 1989). Sie werden im folgenden als «bedrohte» oder «gefährdete» Arten bezeichnet. Ihr Bestand hat bei den meisten mittel- bis langfristig stark abgenommen und bei den am stärksten gefährdeten Arten ist die Schweizer Brutpopulation auf weniger als 100 Paare zurückgegangen. Die meisten stellen besondere Ansprüche an ihre Habitate und geben als Indikatorarten Hinweise auf den Gefährdungsgrad ihrer Lebensräume in verschiedenen Regionen und auf verschiedenen Höhenstufen.

2.1. Gefährdungsgrad in verschiedenen Höhenlagen, Habitaten und Regionen

Die Zahl der Brutvogelarten sinkt mit steigender Höhenlage (Tab. 1, Schifferli *et al.* 1980). Die colline und die montane Stufe beherbergen 87% bzw. 73% der Brutvogelarten der Schweiz und sind deshalb bedeutend artenreicher als die subalpine und alpine Stufe. Im Unterschied zu den beiden tiefer gelegenen Stufen, wo die gefährdeten 37% bzw. 30% der vorkommenden Arten ausmachen, sind in den höhern Regionen nur 21% bzw. 14% gefährdet.

TAB. 1

Anzahl der Brutvogelarten und der häufigen bzw. gefährdeten Arten in verschiedenen Höhenlagen. Die Prozentwerte in Klammern beziehen sich bei den vorkommenden Arten auf 193 berücksichtigte Brutvogelarten der Schweiz (=100 %), bei den häufigen bzw. gefährdeten Arten auf die Zahl der vorkommenden Arten. Besiedelte Höhenlagen (ohne Extremwerte) nach Angaben in GLUTZ VON BLOTZHEIM (1962) und SCHIFFERLI *et al.* (1980), häufige und gefährdete Arten nach ZBINDEN 1989 (Kat. 6, bzw. Kat. 1-3).

Artenzahl	collin	montan	subalpin	alpin
vorkommend	167 (87%)	140 (73%)	76 (39%)	14 (7%)
davon häufig	77 (46%)	82 (59%)	47 (62%)	5 (36%)
gefährdet	61 (37%)	42 (30%)	16 (21%)	2 (14%)

Eine Gruppierung der Brutvogelarten nach ihren Habitaten zeigt, dass der Wald besonders arten- und individuenreich ist (Tab. 2). Fast ebenso reichhaltig sind Kulturland/Siedlungen unterhalb der Waldgrenze und Feuchtgebiete. Der Anteil der gefährdeten Arten gibt erste Hinweise auf den Zustand dieser Lebensräume. Der vergleichsweise hohe Gefährdungsgrad bei den Arten der Feldflur weist darauf hin, dass die grossflächigen Veränderungen in der Bewirtschaftung dieses Lebensraumes alarmierende Auswirkungen auf die Avifauna der offenen und halboffenen Landschaft haben.

TAB. 2

Zahl der vorkommenden und gefährdeten Arten und Dichte der Brutvögel in verschiedenen Lebensräumen der Schweiz. Die Prozentwerte in Klammern beziehen sich bei den vorkommenden Arten auf 196 berücksichtigte Brutvogelarten der Schweiz (=100%), bei den gefährdeten Arten auf die Zahl der vorkommenden Arten. Artenzahl nach ZBINDEN (1989), Dichte nach GLUTZ VON BLOTZHEIM (1962).

	vorkommend	gefährdet	Paare/10 ha
Wälder/Gebüschlandschaften	64 (33%)	10 (16%)	80-140
Kulturland/Siedlungen	57 (29%)	32 (56%)	30-50
Gewässer/Feuchtgebiete	53 (27%)	16 (30%)	30
Gebirge oberhalb Waldgrenze	13 (7%)	2 (15%)	25
übrige Lebensräume	9 (5%)	4 (44%)	
Total	196 (100%)	64 (33%)	

Die nach Regionen vorgenommene Beurteilung der Situation der Avifauna (ZBINDEN *et al.* 1993) zeigt die grösste Artenvielfalt im Mittelland. Zwischen Bodensee und Genfersee ist jedoch auch der Gefährdungsgrad der Brutvögel am höchsten: mehr als ein Fünftel der Brutvogelarten sind regional stark bedroht oder verschwunden (ZBINDEN *et al.* 1993). Im Jura, den Nordalpen und der Nordost-Schweiz sind um 15% der Arten örtlich stark gefährdet oder verschwunden, in den Zentral- und Südalpen etwa 10%. Im Mittelland sind rund 40% der Brutvogelarten häufig, in allen übrigen Regionen mehr als die Hälfte.

Die höher gelegenen und die südlichen Regionen der Schweiz beherbergen also eine bedeutend vitalere Avifauna als das vom Menschen intensiv genutzte und dicht bevölkerte Mittelland. Von grösster Bedeutung als Lebensraum für die Schweizer Avifauna sind die traditionell bewirtschafteten Kulturlandschaften, die praktisch nur noch ausserhalb des Mittellandes zu finden sind.

3. GRÖSSE DER BRUTPOPULATIONEN

Im Rahmen eines gesamteuropäischen Projektes wurde die aktuelle Populationsgrösse jeder Brutvogelart für jedes Land geschätzt. In der Schweiz sind die Kenntnisse über 88 der 200 Arten sehr gut: von 54 Arten verfügen wir über publizierte aktuelle Erhebungen des Gesamtbestands; 34 weitere sind sehr selten und ihre Bestände werden der Vogelwarte regelmässig gemeldet (SCHMID 1991).

Bei rund der Hälfte der Brutvogelarten sind jedoch nur grobe Schätzungen möglich. Aus dem Mittelland liegen regional grossflächige Untersuchungen mit einer Totalfläche von rund 3900 km^2 vor (Kantone Genf, GÉROUDET *et al.* 1983, Aargau, LÜTHY 1989, Zürich, WEGGLER 1991; Bodenseeregion, SCHUSTER *et al.* 1983). Sie dokumentieren die Verbreitung der vorkommenden Arten und den Gesamtbestand einzelner oder aller Brutvögel. Diese Daten eignen sich als Grundlage für eine realistische Bestandsschätzung der Mittellandpopulationen. Aus dem Jura (GLAYRE & MAGNENAT 1984, GOBBO 1990, SCHAFFNER 1990), den Alpen (LUDER 1981a, 1981b, HESS 1982, GLUTZ VON BLOTZHEIM 1987) und der Südschweiz (LARDELLI 1988) sind jedoch nur Angaben über die Verbreitung, teilweise auch über den geschätzten Brutbestand von relativ kleinen Flächen aus einzelnen Regionen verfügbar. Sie werden ergänzt durch Stichproben von Kulturlandflächen aus dem Engadin, dem Wallis und dem Jura (SCHIFFERLI 1989).

Die Schweizer Bestandsschätzungen basieren also auf repräsentativen Angaben aus dem Mittelland und wenigen ausreichend grossen, lokalen Stichproben aus dem Jura, den Alpen und der Südschweiz. Hochrechnungen aufgrund von Bestandsangaben für Einzelflächen sind mit grossen Unsicherheiten belastet. Die berechnete Dichte kann nämlich sehr stark variieren. Sie ist zudem in relativ kleinen Untersuchungsflächen meist höher als in grossflächigen (für Kleinvögel bis rund 1 km^2, für grössere Arten bis 50 oder mehr km^2). Das folgende Beispiel soll zeigen, wie die Bestandsschätzungen gemacht wurden, um die Schwierigkeiten und Grenzen solcher Hochrechnungen deutlich zu machen.

Das Alpenschneehuhn lebt in Höhenlagen von 2000-2500 m ü.M. MARTI (1987) schätzte den Bestand anhand des «Verbreitungsatlas der Brutvögel der Schweiz» (SCHIFFERLI *et al.* 1980). In den 213 besiedelten Quadraten von je 10x10 km^2 liegen 21% der Fläche auf 2'000-2'500 m ü.M. (ermittelt anhand von 508 Punkten, deren Höhenlage auf der Landeskarte bestimmt wurde). Bei einer mittleren Dichte von 3 Hähnen/km^2 und einer höhenmässig besiedelbaren Fläche von 4'500 km^2 schätzte Marti den Frühlingsbestand auf 12'000 bis 15'000 Hähne.

Um der Ungenauigkeit der Bestandsschätzungen Rechnung zu tragen, und weil seltenere Arten in der Regel besser untersucht sind und genauer geschätzt werden können als häufige, wurden die Populationen in Grössenklassen auf logarithmischer Basis zusammengefasst. Dadurch konnten die Schätzungen mit einem vorsichtig weit gefassten Bereich in der Regel einer Grössenklasse zugeordnet werden.

3.1. SELTENE ARTEN

Abb. 2 zeigt die Verteilung nach der Bestandsgrösse der Schweizer Brutpopulationen von 196 Arten. Bei knapp der Hälfte der Arten brüten in der Schweiz höchstens 1'000 Paare, und nur 12% umfassen mehr als 100'000 Paare.

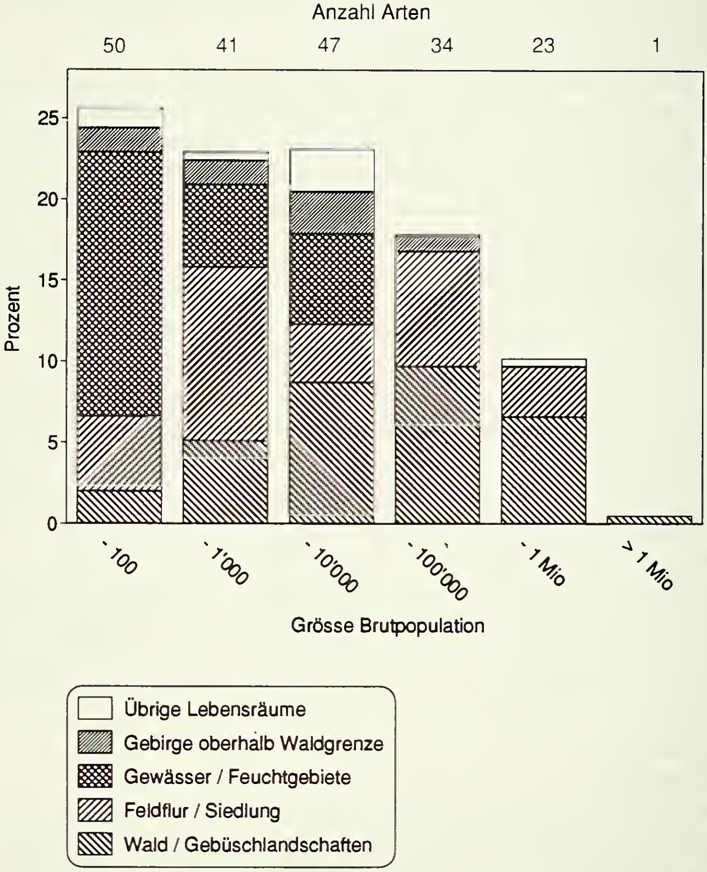

ABB. 2

Schweizer Population von 196 Brutvogelarten (Anzahl Paare) nach Grössenklassen (%) und Bruthabitaten. Die Zahlen über den Säulen entsprechen der Zahl der Arten.

27 der 50 Arten mit bis zu 100 Brutpaaren leben in Feuchtgebieten und an Gewässern, darunter 12 «neue», teilweise nicht alljährlich auftretende Arten, die nach 1950 erstmals als Brutvögel nachgewiesen worden sind. Unter diesen hat einzig die Reiherente inzwischen einen Bestand von 80-100 Paaren erreicht (BIRRER 1991), die anderen brüten nach wie vor nur vereinzelt. 5 der heute seltenen Arten von Feuchtgebieten waren dagegen früher bedeutend häufiger und weiter verbreitet, wie beispielsweise Bekassine und Grossbrachvogel. Sie sind heute sehr stark gefährdet.

Viele der im Kulturland und im Siedlungsraum brütenden Arten mit heute kleinen Brutpopulationen waren früher bedeutend weiter verbreitet und häufiger. 7 sind erst in den letzten Jahrzehnten sehr selten geworden, wie beispielsweise das Rebhuhn mit heute kaum 30 Brutpaaren; noch zu Beginn der sechziger Jahre lebten in der Schweiz schätzungsweise 15'000 bis 20'000 Paare (JENNY 1992). Fünf Arten sind nach 1950 neu aufgetreten, darunter die Schafstelze mit gegenwärtig rund 100 Paaren (SCHMID 1991).

Auch in der Bestandskategorie von 101-1000 Paaren dominieren die Brutvögel der Feldflur und des Siedlungsraumes (17 von 41 Arten). Es sind zur Hauptsache Arten mit mittelfristig rückläufigen Beständen.

3.2. HÄUFIGE ARTEN

Häufige und gleichzeitig weit verbreitete Vogelarten mit schätzungsweise mehr als 100'000 Brutpaaren leben fast ausschliesslich in der Feldflur oder im Wald, der als individuenreichster Lebensraum bereits erwähnt wurde. Der Buchfink, der in allen baumbestandenen Lebensräumen vorkommt, ist mit 2 Millionen Paaren die häufigste Brutvogelart der Schweiz (SCHIFFERLI *et al.* 1980). Viele der sehr häufigen Kulturlandvögel sind bezüglich ihrer Habitatwahl ebenfalls anspruchlose oder kulturfolgende Arten wie Rabenkrähe, Star und Bachstelze.

3.3. ARTEN DER FELDFLUR

Jede dritte der 91 Arten mit einem Brutbestand von bis zu 1000 Paaren lebt in der Agrarlandschaft, wo 30 von 57 Brutvogelarten selten sind. In den Niederungen sind einzig die Kulturfolger häufig. Diejenigen Arten, welche auch in höheren Lagen vorkommen und dort die extensiver genutzten Wiesen und Weiden besiedeln können, sind insgesamt mehrheitlich häufiger als die, welche auf die intensiv bewirtschafteten Tieflagen beschränkt sind. 21 der 30 seltenen Arten kommen nur bis 1000 m ü.M. vor. Unter den 22 häufigen Arten dagegen sind nur 3 Tieflandarten; 19 kommen bis auf 2000 m hinauf vor.

4. BEDEUTUNG DER FELDFLUR VON JURA UND ALPEN

In den extensiv und vielfältig genutzten Kulturlandschaften im Jura, den Alpen und in der Südschweiz sind die Indikatorarten der offenen und halboffenen Feldflur bedeutend weiter verbreitet und häufiger als im Mittelland. Im ganzen Kanton Zürich

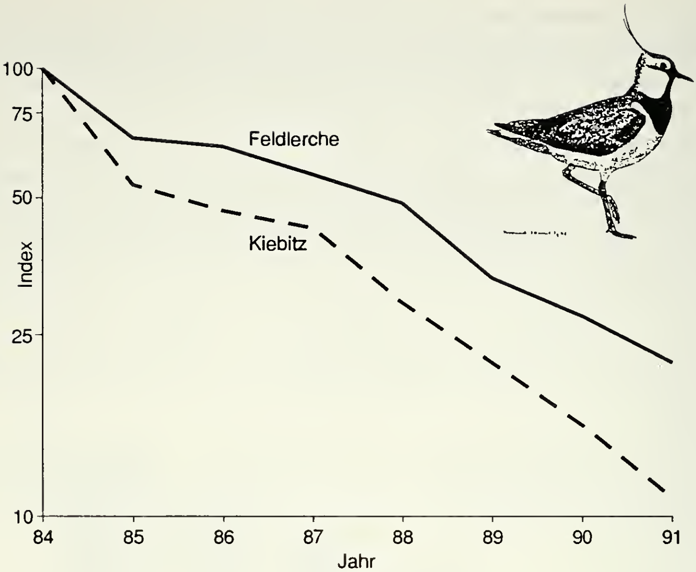

Abb. 3

Entwicklung der Brutpopulationen von Kiebitz und Feldlerche in der Schweiz. Der Index (1984=100) basiert auf Trendmeldungen von Stichproben vor allem aus dem Mittelland (Feldlerche N=191, Kiebitz N=182). Zur Berechnung des Index wurde die Paarzahl jeder Stichprobe mit derjenigen des Vorjahres verglichen und als «positiv», «negativ» bzw. «gleichbleibend» bezeichnet. Index (x) für das Jahr x = [Index (x-1) * d] + Index (x-1); d = Anzahl «positive» Stichroben minus Anzahl «negative» Stichproben/N. Da der Index nur das Vorzeichen der Entwicklung berücksichtigt (Trend), ist er *kein* Mass für die zahlenmässige Populationsdynamik (Quelle: Beobachtungsarchiv der Schweiz. Vogelwarte Sempach, H. Schmid).

mit einer landwirtschaftlichen Nutzfläche von 769 km^2 brüten beispielsweise nur noch 12 Paare des Braunkehlchens (Weggler 1991); das Unterengadin besiedelt es dagegen grossflächig und die ganze Zürcher Population fände auf 40 ha Platz (mittlere Dichte 3,1 Paare/10 ha, Schifferli 1989). Die Population des Baumpiepers umfasst im Kanton Zürich 370 Paare; an den Talflanken des Walliser Rhonetales sind es im Mittel 2,2 Paare pro 10 ha. Beide Arten waren ursprünglich im Mittelland verbreitet. Sie stehen heute wegen des starken und steten Rückgangs auf der Roten Liste. Der Grossteil der heutigen Restpopulation der Schweiz lebt in Höhenlagen oberhalb 1000 m ü.M. Im Mittelland, wo mehr als die Hälfte des an sich besiedelbaren Grünlandes der Schweiz liegt, sind es bei beiden Arten kaum 5% der Gesamtpopulation.

Die Feldlerche erreicht in den Ackerbaugebieten höhere Dichten als im Grasland. Deshalb ist sie in den Niederungen lokal häufiger als in traditionell als Heuwiesen und Weideland genutzten Mosaiklandschaften der Voralpen und Alpen (Jenny 1990b, Schläpfer 1988, Luder 1983). Lange Zeit schien dieser Charaktervogel der offenen Feldflur von der Intensivierung der Landwirtschaft trotz eines geringen Bruterfolges wenig betroffen. Trendmeldungen der achtziger Jahre von über 100 Stichproben aus dem ganzen Mittelland weisen aber auf einen starken Rückgang hin (Abb. 3), wie er auch aus anderen Ländern Mitteleuropas bekannt geworden ist (Abb. 4).

Die Alpen beherbergen schon jetzt einen namhaften Teil der Populationen vieler, ehemals auch im Mittelland verbreiteter Kulturlandarten, der weit über ihrem flächenmässigen Anteil liegt. Ende der siebziger Jahre brüteten im Wallis beispielsweise mehr als drei Viertel der Schweizer Population des Ortolans sowie die Hälfte aller Wiedehopf- und Heidelerchen- und ein Drittel der Schwarzkehlchen-Paare (BIBER 1984).

ABB. 4

Entwicklung der Brutpopulation der Feldlerche in Dänemark (Index, 1976=100, nach BRAAE *et al.* 1988).

Die Bedeutung der Alpen als wichtige Lebensräume nimmt stetig zu, denn noch heute gehen viele der ohnehin selten gewordenen Arten der Agrarflächen im Mittelland weiter zurück. Trendmeldungen von 32 Arten zeigten in den achtziger Jahren bei 11 eine Zunahme (34%), bei 16 einen Rückgang (50%). Bei den restlichen 5 (16%) war kein Trend erkennbar. In der Bodenseeregion haben von 47 im Siedlungsraum und in der Kulturlandschaft brütenden Arten 15 (32%) in Bestand und Verbreitung von 1980 bis 1990 abgenommen. 5 (11%) besiedelten 1990 eine grössere Fläche und waren zahlreicher als 1980 (BAUER & HEINE 1992).

5. AUSWIRKUNGEN DER INTENSIVIERUNG DER LANDWIRTSCHAFT

Die Auswirkungen der auf einen maximalen Ertrag ausgerichteten Landwirtschaft auf die Avifauna der Feldflur sind gut belegt. Inzwischen sind auch die Folgen dieser auf die Alpen übergreifenden Entwicklung erkennbar. Noch ist beispielsweise der

Neuntöter in der Ebene des Walliser Rhonetales bedeutend häufiger (0,5 Paare/10 ha, SCHIFFERLI 1989) als im Mittelland, doch ist er seltener als an den Talflanken und auf den Hochebenen (2,8 Paare/10 ha). Dieser Unterschied, der in ähnlicher Weise bei anderen Kulturlandarten festgestellt wurde, hängt direkt und indirekt mit der Bewirtschaftung zusammen. Direkte Ursachen, die zu hohen Brutverlusten bei Bodenbrütern führen können, sind beispielsweise die frühe Mahd (MANUEL & BEAUD 1982, LABHARDT 1988), welche durch die Grassilierung ermöglicht wird und die Häufigkeit der Schnitte, welche durch die Düngung gefördert wird. Goldammer, Neuntöter und Wendehals sind umso häufiger, je mehr Hecken vorhanden sind; dies gilt auch für den Baumpieper, bei dem jedoch Waldränder die Hecken ersetzen können (SCHIFFERLI 1989). Auf einer 548 ha grossen Untersuchungsfläche bei Courtelary liegen Baumpieperterritorien in einem mittleren Abstand von 51 m zu den nächstgelegenen Hecken oder Waldrändern (s.d. 35 m, n=24, Abb. 5); bei gleichmässiger Verteilung wären es 142 m (s.d. 10, n=24 regelmässig verteilte Punkte). Feldlerche und Braunkehlchen bevorzugen dagegen eher heckenarme Landschaften oder halten einen Abstand zu Hecken und Waldrändern ein (OELKE 1968). Bei Courtelary (Abb. 5) liegen die Mittelpunkte der Feldlerchenterri-

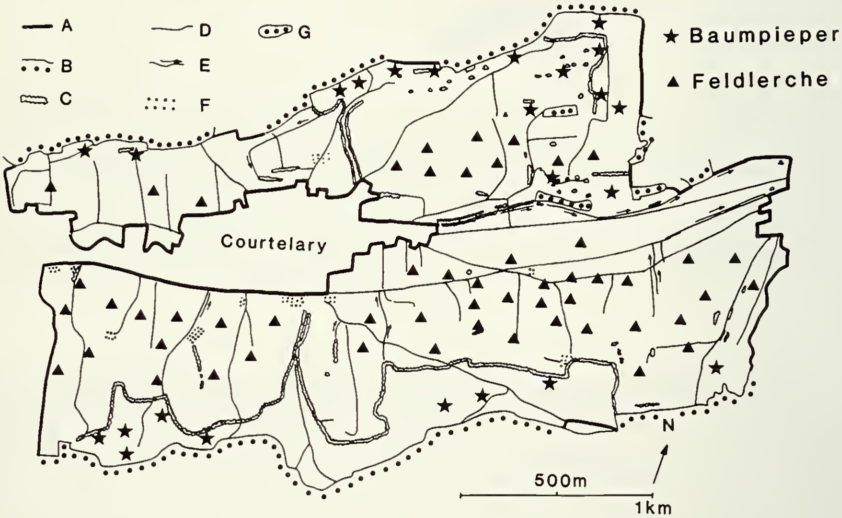

ABB. 5

Brutverbreitung von Feldlerche (54 Paare) und Baumpieper (24 Paare) auf einer Fläche von 548 ha Kulturland bei Courtelary, 1987 (Daten Schweiz. Vogelwarte Sempach, Bearbeiter: A. Perrenoud, Le Foyard). Die Fläche wird zu 6% extensiv, zu 13% mittel-intensiv und zu 81% intensiv bewirtschaftet und als Grünfläche (15% Weiden, 59% Heuwiesen) und Ackerland (25%) genutzt. Signaturen: Grenze des Untersuchungsgebietes (A nicht bewaldet, B bewaldet), Hecken (C), Fahrstrassen und Feldwege (D), Fliessgewässer mit Fliessrichtung (E), Obstgärten (F) und Feldgehölze (G): Die Feldlerche besiedelt vor allem die offenen Bereiche, der Baumpieper brütet in der Nähe von Hecken und Waldrändern (vgl. Text).

torien durchschnittlich 206 m von den nächstgelegenen Hecken oder Waldrändern (s.d. 105, n=54), bedeutend mehr als bei regelmässiger Verteilung (152 m, s.d. 87, n=50).

Braunkehlchen und Baumpieper sind im extensiv bewirtschafteten Wiesland zahlreicher als in Ackerbaugebieten. Letztere werden von der Feldlerche und der Goldammer dichter besiedelt. Je mehr Mais angebaut wird, desto seltener sind Braunkehlchen, Neuntöter und Wendehals. Keine einzige der erwähnten Arten zeigt eine positive Korrelation mit dem Flächenanteil der intensiv bzw. als Maiskultur genutzt wird (SCHIFFERLI 1989).

Obschon die grösseren inneralpinen Ebenen heute intensiver genutzt werden als die höher gelegenen Stufen, sind sie doch bedeutend reicher an Vogelarten und Brutpaaren als das Mittelland. Im Leukerfeld VS beispielsweise, das zu 46% intensiv bewirtschaftet wird (je knapp zur Hälfte Wies- und Weide- bzw. Ackerland), brüten auf 69 ha 13 Feldlerchen- und 16 Braunkehlchenpaare (Dichte 1,9 bzw. 2,3 Paare/10 ha; SCHIFFERLI 1989). Wegen der geringen Heckendichte von 300 m/km^2 sind dagegen Goldammer und Neuntöter selten (0,1 bzw. 0,3 Paare/10 ha). Das Kulturland wird durch Wassergräben durchzogen, deren Randvegetation erst spät gemäht wird. 1987 brüteten 8 von 18 untersuchten Braunkehlchenpaaren erfolglos. Ihre Bodenbruten dürften zum grössten Teil der Mahd zum Opfer gefallen sein. Von den 10 erfolgreichen Paaren haben 3 sicher und 5 vermutlich in der Vegetation entlang der Gräben gebrütet. Der späte Schnitt entlang dieser flächenmässig unbedeutenden Kleinstrukturen dürfte mit dafür verantwortlich sein, dass die Hälfte der Braunkehlchen sich erfolgreich fortpflanzen konnte. Solche «Grenzflächen», wie Brachstreifen, ungenutzte Wegränder und Böschungen sind oft auch für die Nahrungssuche von grosser Bedeutung (Feldlerche, JENNY 1990a; Baumpieper, MEURY 1989; Neuntöter, SOLARI & SCHUDEL 1988).

Wie Abb. 6 zeigt, beeinflusst die Bewirtschaftung das Verteilungsmuster von Indikatorarten. Dichte und Artenvielfalt sind in den strukturreichen, extensiv bewirtschafteten Teilflächen grösser als in den mittelintensiv genutzten. Auf den ertragsmässig günstig gelegenen, hofnahen Flächen, die intensiver bewirtschaftet werden, fehlen dagegen die sonst typischen Indikatorarten. Trotzdem weist die für das Berggebiet charakteristische Fläche insgesamt eine bemerkenswerte Arten- und Paarzahl auf.

Ob und wie die Kulturlandschaft im Berggebiet künftig bewirtschaftet wird, hängt von Ertrag und Einkommen des Bauern ab. Es kann durch einen Nebenerwerb im Tourismus oder im lokalen Kleingewerbe sowie eine intensivere Bewirtschaftung auf geeigneten Parzellen verbessert werden. Wo sich dagegen eine Ertragssteigerung nicht lohnt, wird die Bewirtschaftung oft aufgegeben. Solche Flächen verbuschen und sind während der ersten Jahre der Vergandung optimale Lebensräume für Tier- und Pflanzenarten der halboffenen Landschaft. Sie gehen jedoch verloren, wenn sie allmählich zu Wald werden. Beide Entwicklungstendenzen, die Intensivierung und die Aufgabe der Bewirtschaftung, haben Auswirkungen zum Nachteil der Fauna und Flora der Feldflur. Wenn die intensivere Bewirtschaftung von Teilflächen verhindert, dass die Berglandwirtschaft ganz aufgegeben wird, und wenn dadurch sichergestellt werden kann, dass die restlichen Parzellen weiterhin extensiv bewirtschaftet werden, bleiben wertvolle Lebensräume erhalten (SCHIFFERLI 1987).

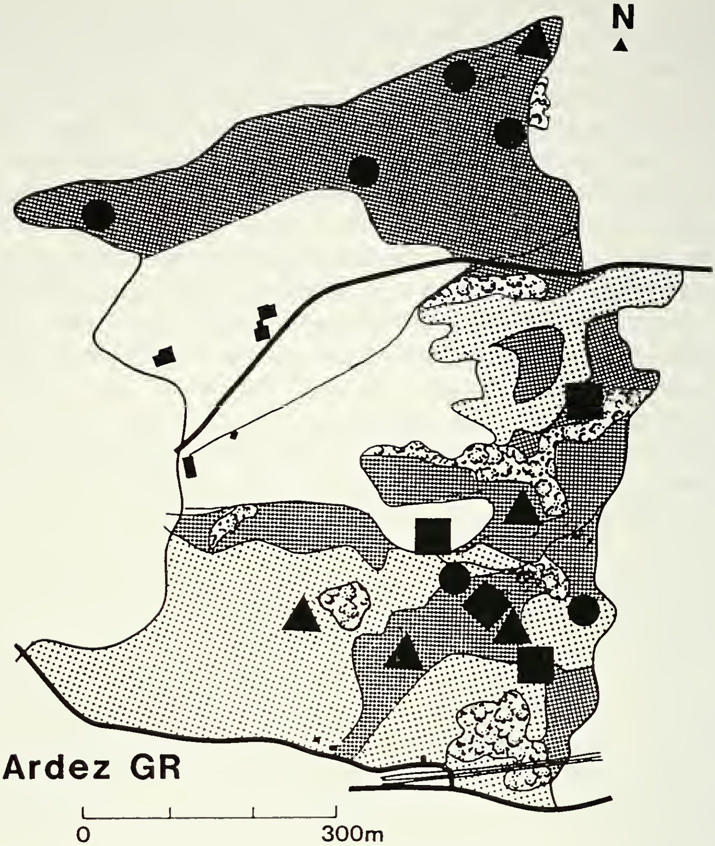

Abb. 6

Brutverbreitung von vier Indikatorarten auf einer 45 ha grossen Grünlandfläche bei Ardez GR, 1986 (70% Heuwiesen, 6% Weiden, 20% Trockenrasen, 4% Getreide). Neuntöter (Punkte), Braunkehlchen (Dreiecke), Baumpieper (Quadrate) und Goldammer (Rhomben) besiedeln vor allem die nicht oder extensiv genutzten (dunkel, 28%) und mittelintensiv bewirtschafteten Flächen (hell punktiert, 40%), fehlen dagegen in den intensiver genutzten, hofnahen Parzellen (weiss, 32%); aus Schifferli (1987).

Dank

Für die kritische Durchsicht des Manuskriptes danke ich vor allem Prof. Dr. Paul Ingold, Ethologische Station Hasli und meinen Kollegen Dr. Hans Peter Pfister, Dr. Niklaus Zbinden und Dr. Verena Keller. Mein Dank geht auch an die unzähligen Feldornithologen, welche ihre in der Freizeit gesammelten Beobachtungen zu den verschiedensten Projekten der Vogelwarte beigetragen haben.

ZUSAMMENFASSUNG

Die Avifauna der Schweiz umfasste von 1900 bis 1988 362 Vogelarten, darunter 200 Brutvögel. 24 Arten sind heute sehr häufig (>100'000 Brutpaare), 34 umfassen 10'000-100'000 Paare, 47 1000-10'000 und 91 sind selten (<1000 Paare).

38 Arten sind im 20. Jahrhundert in der Schweiz erstmals als Brutvögel nachgewiesen worden; allerdings sind nur zwei von ihnen heute verbreitet und häufig. Vier Arten sind seit Mitte des letzten Jahrhunderts als Brutvögel verschwunden, 4 weitere brüten nur noch sporadisch. Ein Drittel der einheimischen Brutvogelarten ist aktuell oder potentiell bedroht, vor allem bezüglich ihres Habitats anspruchsvolle Arten; nur wenige haben ihr Brutareal ausgeweitet und sind häufiger geworden.

Vergleichsweise hoch ist der Gefährdungsrad in der collinen und montane Stufe, ebenso bei den Arten der Feldflur. Jede dritte der 91 Arten mit einem Brutbestand von bis zu 1000 Paaren lebt in der Agrarlandschaft, wo 30 von 57 Brutvogelarten selten sind. Die höher gelegenen und die südlichen Regionen der Schweiz beherbergen dagegen eine bedeutend vitalere Avifauna als das vom Menschen intensiv genutzte und dicht bevölkerte Mittelland. Von grösster Bedeutung als Lebensraum sind die traditionell bewirtschafteten Kulturlandschaften in höheren Lagen. Die Alpen beherbergen bereits jetzt einen namhaften Teil der Populationen vieler Kulturlandarten, der weit über ihrem flächenmässigen Anteil liegt.

Die zunehmend nachhaltigere Nutzung der alpinen Kulturlandschaft führt oft zu einer intensiveren Bewirtschaftung hofnaher und ertragsgünstiger Parzellen. Wenig produktive Flächen werden dagegen nicht mehr genutzt, verbuschen und werden zu Wald. Beide Entwicklungstendenzen haben nachteilige Auswirkungen auf die Fauna und Flora der Feldflur. Wenn die intensivere Bewirtschaftung von Teilflächen verhindert, dass die Berglandwirtschaft ganz aufgegeben wird, und wenn dadurch sichergestellt werden kann, dass die restlichen Parzellen weiterhin extensiv bewirtschaftet werden, bleiben wertvolle Lebensräume erhalten.

LITERATUR

BAUER, H.-G. & G. HEINE 1992. Die Entwicklung der Brutvogelbestände am Bodensee: Vergleich halbquantitativer Rasterkartierungen 1980/81 und 1990/91. *J. Orn.* 133: 1-22.

BIBER, O. 1984. Bestandesaufnahmen von elf gefährdeten Vogelarten der Schweiz. *Orn. Beob.* 81: 1-28.

BIRRER, S. 1991. Besiedlung der Schweiz durch die Reiherente *Aythya fuligula* bis 1990. *Orn. Beob.* 88: 321-335.

BRAAE, L., H. NØHR, & B.S. PETERSEN 1988. Fuglefaunaen på konventionelle og økologiske landbrug. *Miljøprojekt* nr. 102, Miljøstyrelsen.

BRUDERER, B. & W. HIRSCHI 1984. Langfristige Bestandsentwicklung von Gartenrötel *Phoenicurus phoenicurus* und Trauerschnäpper *Ficedula hypoleuca*. *Orn. Beob.* 81: 285-302.

BRUDERER, B. & W. THÖNEN 1977. Rote Liste der gefährdeten und seltenen Vogelarten der Schweiz. *Orn. Beob.* 74, Beiheft 3.

GÉROUDET, P. *et al.* 1983. Les oiseaux nicheurs du canton de Genève. *Genève.*

GLAYRE, D. & D. MAGNENAT 1984. Oiseaux nicheurs de la haute vallée de l'Orbe. *Nos Oiseaux* 37, Fascicule spécial.

GLUTZ VON BLOTZHEIM, U.N. 1962. Die Brutvögel der Schweiz. *Aarau.*

– 1987. Verbreitung, Siedlungsdichte und Brutbiologie der Vögel des Urserentales, insbesondere der Lorbeerweiden-Gesellschaft zwischen Realp und Hospental. *Orn. Beob.* 84: 249-274.

GLUTZ VON BLOTZHEIM, U.N. & K. BAUER 1980, 1988. Handbuch der Vögel Mitteleuropas. Bd. 9. *Akad. Verlagsges., Wiesbaden*; Bd. 11. *Aula-Verlag, Wiesbaden.*

GOBBO, D. 1990. Avifaune nicheuse du pâturage boisé du Jura neuchâtelois. *Nos Oiseaux* 40: 385-406.

HESS, R. 1982. Die Vogelwelt des Karstgebietes Bödmerenwald-Twärenenräui-Silberenalp. *Ber. Schwyz. Naturf. Ges.*, Heft 8: 87-100.

JENNY, M. 1990a. Nahrungsökologie der Feldlerche *Alauda arvensis* in einer intensiv genutzten Agrarlandschaft des schweizerischen Mittellandes. *Orn. Beob.* 87: 31-53.

– 1990b. Populationsdynamik der Feldlerche *Alauda arvensis* in einer intensiv genutzten Agrarlandschaft des schweizerischen Mittellandes. *Orn. Beob.* 87: 153-163.

– 1992. Das Rebhuhn, Symbol der intakten Kulturlandschaft. Nachtrag in Zbinden, N., T. Imhof & H.P. Pfister 1987. Ornithologische Merkblätter für die Raumplanung. *Schweiz. Vogelwarte, Sempach.*

LABHARDT, A. 1988. Zum Bruterfolg des Braunkehlchens (*Saxicola rubetra*) in Abhängigkeit von der Grünlandbewirtschaftung in den Westschweizer Voralpen. *Beih. Veröff. Naturschutz Landschaftspfleg Bad.-Württ.* 51: 159-178.

LARDELLI, R. 1988. Atlante degli uccelli nidificanti nel Mendrisiotto. *Società Ticinese di Scienze Naturali. Lugano.*

LUDER, R. 1981a. Qualitative und quantitative Untersuchungen der Avifauna als Grundlage für die ökologische Lanwdschaftsplanung im Berggebiet. *Orn. Beob.* 78: 137-192.

– 1981b. Die Avifauna der Gemeinde Lenk. *Orn. Beob.* 78: 193-208.

– 1983. Verteilung und Dichte der Bodenbrüter im offenen Kulturland des schweizerischen Mittellandes. *Orn. Beob.* 80: 127-132.

LÜTHY, M. 1989. Ornithologisches Inventar des Kantons Aargau 1985-1987. *Mitt. Aarg. Naturf. Ges.* 31: 167-215.

MANUEL, F. & P. BEAUD 1982. L'installation de silos à herbe et ses répercussions sur un échantillonnage de Traquet tariers, *Saxicola rubetra*, nicheurs au Pays d'Enhaut. *Nos Oiseaux* 36: 277-281.

MARTI, C. 1986. Verbreitung und Bestand des Auerhuhns *Tetrao urogallus* in der Schweiz. *Orn. Beob.* 83: 67-70.

– 1987. Statut et protection des tétraonidés en Suisse. Actes Coll. Galliformes du montagne, *Grenoble*: 331-337.

MEURY, R. 1989. Siedlungsdichte und Raumnutzung des Baumpiepers *Anthus trivialis* im inselartig verteilten Habitat des aargauischen Reusstals. *Orn. Beob.* 86: 105-135.

MOSIMANN, P. & M. JUILLARD 1988. Brutbestand und Winterverbreitung des Rotmilans *Milvus milvus* in der Schweiz. *Orn. Beob.* 85: 199-206.

OELKE, H. 1968. Wo beginnt bzw. wo endet der Lebensraum der Feldlerche? *J. Orn.* 109: 25-29.

SALATHÉ, T. & R. WINKLER 1989. Die Bedeutung der Alpen für die Schweizer Avifauna. *Orn. Beob.* 86: 155-161.

SCHAFFNER, U. 1990. Die Avifauna des Naturwaldreservates Combe-Grède (Berner Jura). *Orn. Beob.* 87: 107-129.

SCHIFFERLI, A., P. GÉROUDET & R. WINKLER 1980. Verbreitungsatlas der Brutvögel der Schweiz. *Schweiz. Vogelwarte Sempach.*

SCHIFFERLI, L. 1987. Vögel und Landwirtschaft. Bericht zuhanden der «Gemeinschaft der Freunde der Vogelwarte». *Schweiz. Vogelwarte Sempach.*

SCHIFFERLI, L. 1989. Die naturnahen Walliser Kulturlandschaften: Biotope von nationaler Bedeutung für Vogelarten. *Bull. Murithienne* 107: 9-19.

SCHLÄPFER, A. 1988. Populationsökologie der Feldlerche *Alauda arvensis* in der intensiv genutzten Agrarlandschaft. *Orn. Beob.* 85: 309-371.

SCHMID, H. 1991. Die wichtigsten ornithologischen Ereignisse 1989 und 1990 in der Schweiz. *Orn. Beob.* 88: 101-109.

SCHUSTER, S. *et al.* 1983. Die Vögel des Bodenseegebietes. *Orn. Arbeitsgemeinschaft Bodensee, Konstanz.*

SOLARI, C. & H.R. SCHUDEL 1988. Nahrungserwerb des Neuntöters *Lanius collurio* während der Fortpflanzungszeit. *Orn. Beob.* 85: 81-90.

VOGEL, C. 1990. Brutverbreitung und Bestand 1989 der Dohle *Corvus monedula* in der Schweiz. *Orn. Beob.* 87: 185-208.

WEGGLER, M. 1991. Brutvögel im Kanton Zürich. *Zürcher Vogelschutz* (ZKV), Zürich.

WINKLER, R. 1984. Avifauna der Schweiz, eine kommentierte Artenliste. I. Passeriformes. *Orn. Beob.* Beiheft 5.

WINKLER, R., R. LUDER & P. MOSIMANN 1987. Avifauna der Schweiz, eine kommentierte Artenliste. II. Non-Passeriformes. *Orn. Beob.* Beiheft 6.

WINKLER, R. 1989. Liste der Vogelarten der Schweiz. *Orn. Beob.* 86: 243-257.

ZBINDEN, N. 1989. Die Entwicklung der Vogelwelt in der Schweiz. Bericht zuhanden der «Gemeinschaft der Freunde der Vogelwarte». *Schweiz. Vogelwarte Sempach.*

ZBINDEN, N. & H. SCHMID 1991. Situation der Brutvögel - Möglichkeiten und Probleme ihrer Überwachung. *Info Bull. Schweiz. Vogelwarte Sempach* Nr. 15.

ZBINDEN, N., U.N. GLUTZ VON BLOTZHEIM, H. SCHMID & L. SCHIFFERLI 1993. Liste der Schweizer Brutvögel mit Gefährdungsgrad in den einzelnen Regionen. In: DUELLI, P. *et al.* Rote Listen der gefährdeten Tierarten der Schweiz. BUWAL-Reihe Rote Listen, Bern: 23-29.

ANHANG: Wissenschaftliche Namen der zitierten Vogelarten

Alpenschneehuhn *Lagopus mutus*
Auerhuhn *Tetrao urogallus*
Bachstelze *Motacilla alba*
Baumpieper *Anthus trivialis*
Buchfink *Fringilla coelebs*
Bekassine *Gallinago gallinago*
Braunkehlchen *Saxicola rubetra*
Dohle *Corvus monedula*
Feldlerche *Alauda arvensis*
Gartenrotschwanz *Phoenicurus phoenicurus*
Goldammer *Emberiza citrinella*
Grossbrachvogel *Numenius arquata*
Heidelerche *Lullula arborea*
Kiebitz *Vanellus vanellus*
Kolkrabe *Corvus corax*
Nachtreiher *Nycticorax nycticorax*
Neuntöter *Lanius collurio*
Ortolan *Emberiza hortulana*

Rabenkrähe *Corvus corone*
Rebhuhn *Perdix perdix*
Reiherente *Aythya fuligula*
Rotmilan *Milvus milvus*
Schafstelze *Motacilla flava*
Schwarzkehlchen *Saxicola torquata*
Star *Sturnus vulgaris*
Steinkauz *Athene noctua*
Türkentaube *Streptopelia decaocto*
Wacholderdrossel *Turdus pilaris*
Wachtelkönig *Crex crex*
Wendehals *Jynx torquilla*
Wiedehopf *Upupa epops*
Zwergreiher *Ixobrychus minutus*

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Beeinflussung der Fauna alpiner Böden durch Sommer- und Wintertourismus in West-Österreich
(Ötztaler Alpen, Rätikon)*

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The impact of summer- and winter tourism on the fauna of alpine soils in western Austria (Oetztal Alps, Rätikon). – Every kind of touristic impacts on the natural landscape has a negative effect on the soil fauna. Damage to the high-alpine vegetation as a result of trampling in summer is usually spatially and temporally restricted, so that regeneration of both plants and soil fauna is possible. Disturbances due to the shearing effect of skis on hilltops are more serious, since the damage is repeated year for year on the same site and leads to complete destruction of the upper layer of soil. Overheating, desiccation and erosion during the summer impair the edaphic conditions still further. On such bare spots in a subalpine meadow the abundance of earthworms was diminished by 85%, its biomass by 94%. Compaction of the snow cover by snowmobiles for ski runs reduces the abundance of the whole soil fauna by 70%. Preparation of ski slopes by bulldozers completely destroys the vegetation, the top soil and the life within it. The succession in the raw soils at high altitudes proceeds extremely slowly, so that a functioning soil system is lost for years.

Key-words: soil fauna - tourism - alpine soils - earthworms - insects - spiders - mites - Austria.

EINLEITUNG

Welches Ausmaß die Erschließungen der mitteleuropäischen Bergregionen für den Tourismus bereits angenommen haben, erkennt man aus der Tatsache, daß es im Alpenbogen zwischen Grenoble und Schladming (Steiermark) über 12.000 Liftanlagen und Seilbahnen und an die 40.000 Schiabfahrten gibt (CERNUSCA 1986a, b). Im

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Bundesland Tirol beträgt die Pistenfläche 0,55% der Gesamtlandesfläche, auf sämtliche Verkehrsflächen entfallen 0,56%. In größeren Wintersportgebieten hat die Schipistenfläche schon 5-10% der Gemeindefläche erreicht. Diese Eingriffe bleiben natürlich nicht ohne Folgen für den Naturhaushalt. Im Bereich des Waldes schaffen großflächige Rodungen vor allem hydrologische Probleme. Oberhalb der Waldgrenze verursachen Geländekorrekturen bei der Anlage von Schipisten irreversible Schäden an Vegetation und Boden, Begrünungen sind nach wie vor nur Hilfsmaßnahmen und können keinen standortsgerechten Pflanzenbestand schaffen (HOLAUS & KÖCK 1989). Angesichts der weltweiten Übernutzung der Natur wurde bereits 1970 von der UNESCO das "Man and the Biosphere" - Programm ins Leben gerufen. Einer der 14 formulierten Zielpunkte stellte auch die Frage nach der Nutzung des Alpenraumes und der Belastbarkeit von Gebirgsökosystemen (MaB 6: Man and mountain and tundra ecosystems). Sowohl in der Schweiz (z.B. Grindelwald, Aletsch, Davos) als auch in Österreich (Obergurgl, Hohe Tauern) wurden seither zu diesem Problemkreis umfangreiche multidisziplinäre Arbeiten durchgeführt (z.B. CERNUSCA 1978, 1989, FRANZ 1980, WILDI & EWALD 1986, PATZELT 1987).

Welche Auswirkungen die vielen Formen derartiger anthropogen-touristischer Belastungen auf die Bodenfauna alpiner Lagen haben, wird nachfolgend an Hand einiger Beispiele zu erläutern versucht. Ergebnisse, die im Rahmen von ökologischen Untersuchungen an Wirbellosen im Raum Obergurgl (JANETSCHEK *et al.* 1987) und in den Hohen Tauern (THALER *et al.* 1978, MEYER 1980, 1981, THALER 1989) erarbeitet wurden, bieten die notwendigen Vergleichsmöglichkeiten zur Beurteilung des "Istzustandes" bei herkömmlicher Nutzung des Naturraumes.

UNTERSUCHUNGSGEBIETE

1. OBERGURGL (Ötztaler Alpen)

– Mähwiese (1960 m) an einem westexponierten Hang südlich des Dorfes Obergurgl, treppenartig in flachere und steilere Abschnitte gegliedert. Unter den Kräutern dominieren: *Peucedanum ostruthium*, *Ligusticum mutellina*, *Geranium sylvaticum*, *Rumex acetosa*, *Ranunculus acer*, *Trollius europaeus*. Vorherrschende Gräser: *Poa alpina*, *Luzula alpinopilosa*, *Festuca alpestris*. Der Boden ist eine podsolige Braunerde auf Podsolkolluvium; lehmiger Sand; Mull; pH = 4,3.

– Grasreicher Alpenrosen-Zirbenwald südlich des Dorfes Obergurgl (2100 m), *Rhododendro-Vaccinietum* durchsetzt mit Weidewiese (Calluno-Nardetum), Podsolkolluvium, steiniger Sand, pH = 3,4.

– Zwergstrauchheide (Gurgler Heide, 2200 m): *Empetro-Vaccinietum* mit hohem Flechtenanteil (*Cladonia sylvatica*, *Cetraria islandica*), *Loiseleuria procumbens*, *Empetrum nigrum*, *Vaccinium uliginosum*, *V. myrtillus*). Eisenhumuspodsol, Rohhumus, pH = 3,8.

– Hochalpiner Rasen (Hohe Mut, 2600 m): Ein flechtenreiches *Curvuletum* mit geringem Anteil von Krautartigen, auf einem langgestreckten (nordwest - südost) gerundeten Rücken gelegen mit steil gegen das Rotmoos- und Gaisbergtal abfallenden Hängen, pseudovergleyte flachgründige Rasenbraunerde, pH = 3,8.

2. FRASTANZ, BAZORA (Rätikon)

Nordexponierter Schihang (Bazora-Alpe, 1200 m), geologischer Untergrund: Vorarlberger Flysch mit Moränenschutt, Weidefläche (*Nardetum*), außerhalb der Schiabfahrt eine tiefgründige Braunerde (A_h -5cm, B_{v1} -40 cm, B_{v2} -80 cm), Infiltrationsrate 9 mm min.$^{-1}$; auf der Schiabfahrt tiefgründige pseudovergleyte Braunerde ohne A_h, verdichtet, Infiltrationsrate nur 2 mm min.$^{-1}$, geringe Durchwurzelung.

ERGEBNISSE

1. TRITTSCHÄDEN

Eine der Auswirkungen des Sommertourismus ist die Trittbelastung der hochalpinen Rasengesellschaften, besonders in der Umgebung von Bergstationen. Um die Folgen dieser Störung quantifizieren zu können, wurde der Touristenstrom während einer Vegetationsperiode auf einem 2 m breiten und 50 m langen Pfad auf bislang unberührtem *Curvuletum* (Hohe Mut, 2600 m) kanalisiert. Es ergab sich eine Passage von ca 2000 Personen. Der entstandene Trampelpfad wurde im darauffolgenden Jahr mit 5 Schlüpftrichtern (Grundfläche: 50 x 50 cm) bestückt. Im zweiten Jahr nach der Trittbelastung wurden auf dem Pfad Bodenproben (ø 30 cm) entnommen und mit einer Kempson-Apparatur extrahiert.

Tabelle 1 zeigt die Schlüpfabundanzen von Makroarthropoden auf dem Trampelpfad und dem unberührten *Curvuletum*. Die Zahlen sind erstaunlich ausgeglichen. Lediglich die epigäische Fauna (Spinnen) war, wie zu erwarten, merklich beeinträchtigt.

TAB. 1

Abundanz von Makroarthropoden aus Schlüpftrichtern im degradierten (Trampelpfad) und unberührten *Curvuletum* der Hohen Mut (2600 m, Obergurgl, Ötztaler Alpen). Angegeben ist die Summe der über den Untersuchungszeitraum (11.6.-8.10.1977) gefangenen Individuen pro m^2.

Ind./m^2/Vegetationsperiode	Trampelpfad	*Curvuletum*
Nematocera	364,8	448,8
Brachycera	445,6	402,4
Hymenoptera	143,0	280,8
Coleoptera	67,4	53,6
Rhynchota	11,6	25,6
Lepidoptera	4,0	5,4
Aranei	51,2	102,0
Opiliones	3,4	0,0

Mit der Zerstörung der gewohnten Bestandesstruktur (64% der oberirdischen Phytomasse bestehen in diesem *Curvuletum* aus Flechten) war aber auch oberflächennah lebenden Kleintieren der Lebensraum genommen. Nach Ergebnissen von SCHATZ (1983) blieben von ursprünglich 13.000 Hornmilben (Oribatei) pro m^2 nur mehr 400 übrig. Obwohl die oberirdische Biomasse von *Carex curvula* und der wichtigsten Begleitpflanzen des *Curvuletums (Avenochloa versicolor, Oreochloa disticha, Polytrichum cf. formosum, Cetraria islandica)* fast zur Gänze zerstört war, bildete das kräftige, dicht bewurzelte Rhizomsystem von *C. curvula* im 1. Jahr nach der Störung noch ein geeingnetes Wachstums - und Entwicklungssubstrat für die bodenlebenden Insekten-Larven. Rhizome und Wurzeln von *C. curvula* sind sehr langlebig und akkumulieren viel unterirdische Biomasse, Verhältnis von unter- zu oberirdischer Biomasse wie 12:1 (GRABHERR *et al.* 1978). Es ist bezeichnend, daß sich auch das Porenvolumen (61,6 Vo. % für den Trampelpfad, 60,8% für das *Curvuletum*) auf den Vergleichsflächen nicht unterschied.

Das volle Ausmaß der Zerstörung wurde erst im zweiten Jahr nach der Trittbelastung deutlich. Abb. 1 zeigt den starken Rückgang der Makrofauna gegenüber der Vergleichsfläche. Die Bodenoberflächenfauna fehlt wie schon im 1. Jahr nahezu vollständig, die Anzahl der Enchytraeidae beträgt nur mehr ein Zehntel. Unter den Insekten-Larven dominieren auf dem Trampelpfad am Beginn der Vegetationsperiode Individuen der Gattung *Helophorus* (Hydraenidae, Coleoptera), die sich bevorzugt an schmelzwasserfeuchten Barflecken entwickeln (SCHATZ-DE ZORDO 1980).

2. SCHERWIRKING VON SCHIKANTEN, PISTENPRÄPARIERUNG

Schäden durch das Abrasieren der oberirdischen Vegetation durch Schifahrer treten besonders an stark befahrenen Kuppen und Geländekanten auf. In der Höhenlage von 2200-2500 m wächst an solchen Stellen die windharte *Loiseleuria* (Gemsheide). Sie ist der mechanischen Beanspruchung der Schikanten nicht gewachsen und geht zugrunde (DUELLI 1987). Entscheidend ist, daß sich die Schädigung meist jedes Jahr an der gleichen Stelle wiederholt, es kommt an diesen dunklen Kahlstellen zu starker Überhitzung (bis über 60°C, KÖRNER 1980) und zu totaler Austrocknung. Diesem Stress sind auch tolerante Arten mit unterirdischen Regenerationsorganen nicht gewachsen und sterben ab (GRABHERR 1987). In der Folge wird der Rohhumus erodiert und der mineralische Rohboden tritt zutage. Abb. 1 (untere Hälfte) stellt die Besiedlungsdichten der Bodenfauna auf einer solchen kleinräumigen, noch nicht erodierten Kahlstelle auf der Gurgler Heide (2200 m) jener in einer ungestörten Zwergstrauchheide gegenüber. Wie zu erwarten, wird auch hier die Bodenfauna durch die geänderten mikroklimatischen und edaphischen Bedingungen stark beeinträchtigt.

Der Schipistenbetrieb auf Grünland (Mähwiesen, Weidewiesen) an und unterhalb der Waldgrenze bringt durch die Zerstörung der schützenden Schneedecke, Schneeverdichtung, Eisbildung sowie die großflächige mechanische Beanspruchung der Grasnarbe nachgewiesenermaßen Ertragseinbußen und Verluste an Futterwert. Bei sehr intensivem Schibetrieb kann der Ertragsverlust auf einer Mähwiese in ca 1000 m Seehöhe bis zu 42% ausmachen (KÖCK *et al.* 1989).

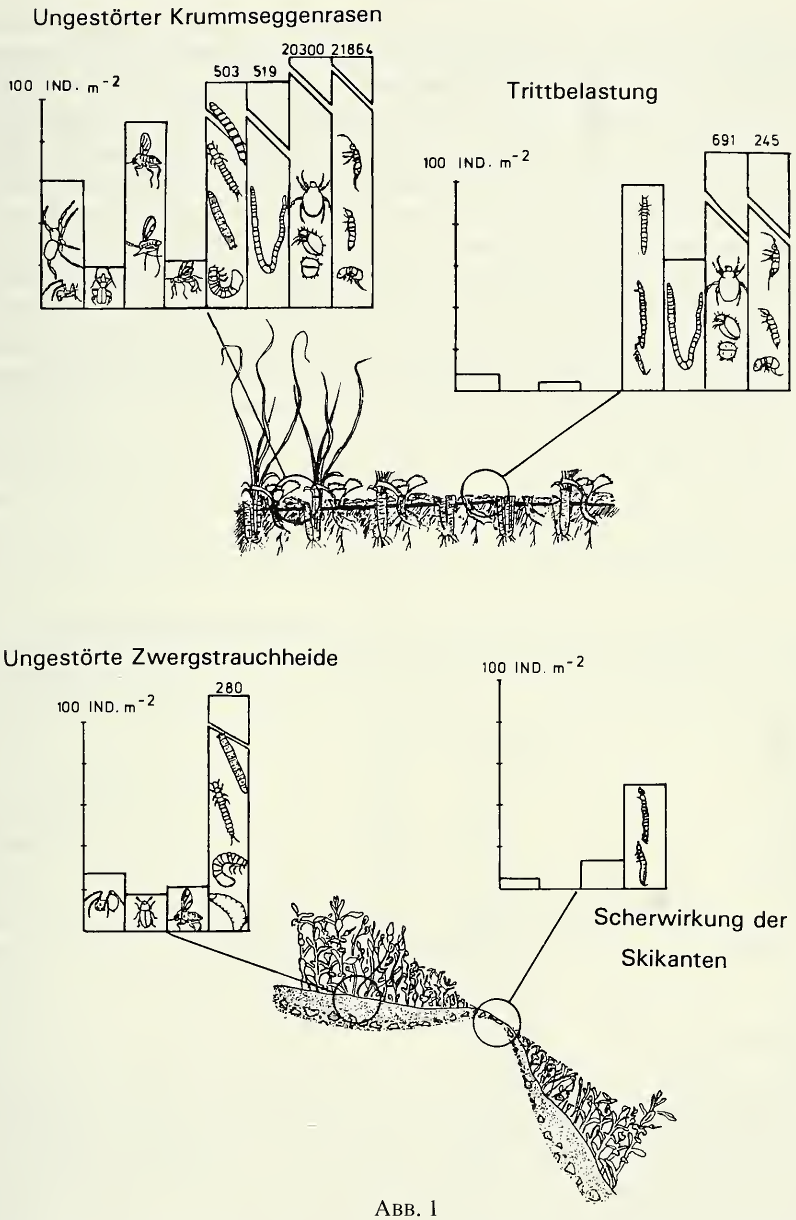

ABB. 1

Auswirkung von Trittbelastung und Scherwirkung durch Schikanten auf die Bodenfauna im Raum Obergurgl (Ötztaler Alpen). Angegeben sind Besiedlungsdichten von Spinnen (Aranei), Käfern (Coleoptera), Fliegen und Mücken (Diptera), Hautflüglern (Hymenoptera), bodenlebenden Insektenlarven, Enchytraeidae, Milben (Acari) und Springschwänzen (Collembola) im natürlichen und im gestörten Areal eines Krummseggenrasens (Hohe Mut, 2600 m) und einer Zwergstrauchheide (Gurgler Heide, 2200 m).

Bodenzoologische Ergebnisse aus einer Mähwiese südlich des Dorfes Obergurgl (1960 m) sind in Tabelle 2 zusammengefaßt. An stark beanspruchten Stellen besteht nur mehr die Hälfte der ursprünglichen Zahl an Bodentieren. Am stärksten sind natürlich die Tiere der oberflächennahen Streuschicht betroffen. Aber auch die vorkommenden Regenwürmer (*Octolasium lacteum* 68 Ind./m^2, *Lumbricus rubellus* 44 Ind./m^2, *Dendrobaena octaedra* und *D. rubida* 25 Ind./m^2) verzeichnen einen starken Abundanz- (minus 85%) und Massenverlust (minus 94%) (KÜBELBÖCK & MEYER 1981).

Ein ähnliches Bild zeigt Tabelle 3. Langjährige Pistenpräparierung und Schibetrieb auf einer Almweide (Bazora, 1200 m) im Rätikon führte zu einer Veränderung im Profilaufbau des Bodens, der ursprünglich 8 cm mächtige A_h-Horizont verschwand, das Infiltrationsvermögen von Wasser in den Boden verringerte sich von ursprünglich 9 auf 2 mm min.$^{-1}$ (STEIDL 1993). Der Abundanzverlust an Regenwürmern beträgt 64%. Die Besiedlungsdichte der Bodenfauna ging um 70% zurück.

TAB. 2

Abundanz von Makroarthropoden (Ind./m^2) an Scherstellen im Bereich einer Skiabfahrt durch eine Mähwiese bei Obergurgl (1960 m).

	Mähwiese (1960 m)	
Individuen /m^2	Barfleck	Kontrolle
Lumbricidae	20,6	136,7
Aranei	6,5	85,0
Chilopoda	1,2	44,8
Coleoptera	14,2	59,0
Diptera	10,6	76,8
Hymenoptera	2,4	28,4
Insecta-Larvae	977,9	1680,3

Erläuterung: Mittelwert aus 4 Probenentnahmen während der Vegetationsperiode (Juni-Oktober 1978). Die Werte für Lumbricidae nach KÜBELBÖCK und MEYER (1981).

3. SCHIPISTENANLAGE

Die Vegetations- und Bodenzerstörung im Zusammenhang mit den bei der Anlage und beim Bau von Schipisten einhergehenden Erdbewegungen ist zweifellos der schwerwiegendste Eingriff. Mechanische Resistenz und Regenerationsfähigkeit der Pflanzen spielen hier keine Rolle, da das Bodenprofil meist bis zum Muttergestein abgetragen wird. Überläßt man solche hochalpine Rohböden ihrem Schicksal, wandern in einem langfristigen Prozeß Arten der Gletchervorfelder (*Cerastium uniflorum*, *Trifolium pallescens*), der Nival- und Schuttfluren (*Linaria alpina*, *Ranunculus glacialis*), aber auch der alpinen Rasen (*Tanacetum alpinum*, *Agrostis schraderiana*) ein (GRABHERR 1987). In Ermangelung an geeignetem Substrat wird jedoch meist "humuslos" begrünt, eine nachhaltig geschlossene Vegetationsdecke ist damit aber nicht zu erreichen. Der Gehalt des Bodens an organischem Material ist zu gering, der Wasserhaushalt gestört, die gewohnte mikobielle Aktivität wird nicht erreicht (MOSER *et al.* 1987), auch bei Protozoen (Ciliaten und Testaceen) sind die Abudanzeinbußen auf einer derart verarmten Schipiste eklatant (FOISSNER & ADAM 1980).

Erhebungen über die Verteilung von Artenzahlen und Häufigkeiten von Bodentieren auf einer im Bereich der Waldgrenze bei Obergurgl planierten Schipiste ergaben folgendes. Sie wurden 10 Jahre nach der Anlage der Schipiste gemacht. Die Zerstörung des Oberbodens ist für die an den Rohhumus gebundenen Oribatei katastrophal. Auch andere streubewohnenden Tiergruppen (Diplopoda, Chilopoda) finden auf den trotz intensiver Bemühungen nur schlecht bewachsenen Schipiste keinen Lebensraum. Ein Vergleich auf Artniveau zeigt, daß auf der Piste zwei Laufkäfer (*Nebria gyllenhali*, *Bembidion nitidulum*) auftreten, die für vegetationsarme, sandiglehmige Böden, auch Bachufer typisch sind. Die Arten des angrenzenden Zirbenwaldes (z.B. *Omalium ferrugineum*, *Atheta leonhardi*, *Quedius punctatellus*) fehlen auf der Piste (DE ZORDO 1979). Die hohe Fangzahl von *Pardosa oreophila* Simon (= *P. saltuaria* auct.) entspricht möglicherweise dem auf der Piste fehlenden Raumwiderstand.

TAB. 3

Mittlere Besiedlungsdichte der Bodenmakrofauna auf einer Almweide der Bazora Alpe bei Frastanz (1200 m, Vorarlberg) und einer seit 30 Jahren intensiv genützten Skipiste. Angegeben sind die Mittelwerte (Ind./m^2) von 3 Entnahmeterminen (13. Juni, 2. September, 17. Oktober 1988) nach STEIDL (1993).

Jahresmittel	Nicht präpariert	Präpariert
Gehäuseschnecken	27,8	18,4
Nacktschnecken	29,3	12,3
Lumbricidae	249,2	89,2
Aranei	18,5	10,9
Opiliones	2,8	
Isopoda	51,9	9,4
Chilopoda	204,4	40,6
Pauropoda	34,0	17,0
Symphyla	287,4	67,0
Diplopoda	67,5	48,6
Protura	73,2	40,6
Coleoptera-Larv.	219,9	115,0
Coleoptera-Imag.	127,0	97,7
Lepidoptera-Larv.	21,7	2,8
Hymmenoptera	284,1	15,6
Diptera-Larv.	507,4	465,3
Brachycera	4,2	–
Nematocera	14,7	7,6
Homoptera	1854,5	123,7
Heteroptera	10,9	10,4
Psocoptera	2,8	1,4
Thysanoptera	50,0	42,5
Summe	4143,2	1236,0

Die pisteneigene Wolfsspinne *Pardosa amentata* gilt als sehr eurytop (PUNTSCHER 1980). Insgesamt verringerte sich bei Spinnen die Artenzahl von 40 (im Alpenrosen-Zirbenwald) auf 22 (Schiabfahrt), 47 Käferarten im Wald stehen 24 auf der Schipiste gegenüber, von den 55 Oribatidenarten im Zirbenwald verblieb nur eine einzige Art auf der Piste. Winterbetrieb und Pistenpflege auf einer Schiabfahrt bei Achenkirch (1000 m, Tirol) dezimierten besonders bodennah überwinternde Spinnenarten (THALER 1977).

ZUSAMMENFASSUNG

Alle Formen touristischer Belastung der Naturlandschaft wirken sich negativ auf das Bodenleben aus. Schäden an hochalpinen Rasen durch Trittbelastung im Sommer erlauben bei räumlicher und zeitlicher Begrenztheit meist eine Regeneration und Wiederbesiedlung. Störungen durch die Scherwirkung der Schikanten an Geländekuppen sind verhängnisvoller, da sich die Schädigung meist jedes Jahr an der gleichen Stelle wiederholt. Überhitzung, Austrocknung, Erosion verschlechtern die edaphischen Bedingungen zu stark. Der Abundanzverlust der Regenwürmer auf solchen Kahlstellen beträgt in einer subalpinen Mähwiese 85%, der Masseverlust 94%. Auch langjähriger mit Pistenpräparierung verbundener Schibetrieb auf einer Almweide vermag die ursprüngliche Besiedlungsdichte der Bodenfauna um 70% zu reduzieren.

Die Vegetations- und Bodenzerstörung im Zusammenhang mit der Planie von Schipisten ist zweifellos der schwerwiegendste Eingriff. Eine nachhaltig geschlossene Vegetationsdecke wird nur selten erreicht, der Gehalt des Bodens an organischem Material ist zu gering, der Wasserhaushalt gestört, ein funktionierendes Bodenleben ist auf Jahrzehnte zunichte gemacht.

LITERATUR

CERNUSCA, A. (Hrsg.) 1978. Ökologische Analysen von Almflächen im Gasteiner Tal. *Veröff. Österr. MaB-Programm* 2, 390 p.

– 1986a. Ökologische Auswirkungen des Baues und Betriebes von Schipisten. *Sammlung Naturschutz* 33, 253 p., Conseil de l'Europe, Strasbourg.

– 1986b. Probleme von Wintersportkonzentrationen für den Naturschutz. *Jb. Naturschutz u. Landschaftspflege (Bonn)* 38: 33-48.

– (Hrsg.) 1989. Struktur und Funktion von Graslandökosystemen im Nationalpark Hohe Tauern. *Veröff. Österr. MaB-Programm* 13, 625 p.

DE ZORDO, I. 1979. Ökologische Untersuchungen an Wirbellosen des zentralalpinen Hochgebirges (Obergurgl, Tirol). III. Lebenszyklen und Zönotik von Coleopteren. *Alpin-Biol. Stud.* 11 (*Veröff. Univ. Innsbruck* 118): 131 p.

DUELLI, M.T. 1987. Die Vegetation des Gaisbergtales, Obergurgl, Ötztal. *Veröff. Österr. MaB-Programm* 10: 205-231.

FOISSNER, W. und H. ADAM 1980. Abundanz, Vertikalverteilung und Artenzahl der terrestrischen Ciliaten und Testaceen einer Almweide und einer Schipiste auf der Schloßalm bei Bad Hofgastein (Österreich). *Zool. Anz.* 205: 181-187.

FRANZ, H. (Hrsg.) 1980. Untersuchungen an alpinen Böden in den Hohen Tauern 1974-1978, Stoffdynamik und Wasserhaushalt. *Veröff. Österr. MaB-Programm* 3, 295 p., 1 Vegetationskarte.

GRABHERR, G., E. MÄHR und H. REISIGL 1978. Nettoprimärproduktion und Reproduktion in einem Krummseggenrasen (*Caricetum curvulae*) der Ötztaler Alpen, Tirol. *Oecol. Plant.* 13: 227-251.

GRABHERR, G. 1987. Tourismusinduzierte Störungen, Belastbarkeit und Regenerationsfähigkeit der Vegetation in der alpinen Stufe. *Veröff. Österr. MaB-Programm* 10: 243-256.

HOLAUS, K. und L. KÖCK 1989. Verbesserung und Erhaltung der Vegetation auf Schipistenflächen durch Düngungsmaßnahmen. 50 Jahre Landesanstalt f. Pflanzenzucht u. Samenprüfung, Rinn (Tirol): 31-58, Selbstverlag.

JANETSCHEK, H., E. MEYER, H. SCHATZ und I. SCHATZ-DE ZORDO 1987: Ökologische Untersuchungen an Wirbellosen im Raum Gurgl unter Berücksichtigung anthropogener Einflüsse. *Veröff. Österr. MaB-Programm* 10: 218-315.

KÖCK, L., K. HOLAUS, R. SCHNITZER und A. WALCH 1989. Quantitative und qualitative Veränderungen der Vegetation durch den Einfluß des Schisports auf Pisten und Langlaufloipen. 50 Jahre Landesanstalt f. Pflanzenzucht u. Samenprüfung, Rinn (Tirol): 59-79, Selbstverlag.

KÖRNER, CH. 1980. Zur anthropogenen Belastbarkeit der alpinen Vegetation. *Verh. Ges. f. Ökol.* VIII: 451-461.

KÜBELBÖCK, G. und E. MEYER 1981. Ökologische Unterschungen an Wirbellosen des zentralalpinen Hochgebirges Obergurgl, Tirol). VI. Abundanz und Biomasse der Oligochaeta (Lumbricidae, Enchytraeidae). *Alpin-Biol. Stud.* 15 (*Veröff. Univ. Inssbruck* 130): 52 p.

MEYER, E. 1980. Ökologische Untersuchungen an Wirbellosen des zentralalpinen Hochgebirges (Obergurgl, Tirol). IV. Aktivitätsdichte, Abundanz und Biomasse der Makrofauna. *Alpin-Biol. Stud.* 13 (*Veröff. Univ. Innsbruck* 125), 54 p.

– 1981. Abundanz und Biomasse von Invertebraten in zentralalpinen Böden (Hohe Tauern, Österreich). Veröff. Österr. MaB-Programm 4: 153-178.

MOSER, M., J. HOFMANN, A. PFITSCHER, W. RIDL und R. WIESER 1987. Mikrobielle Parameter als Indikatoren für die anthropogene Beeinflussung alpiner Böden, besonders durch Massentourismus. Veröff. Österr. MaB-Programm 10: 258-279.

PATZELT, G. (Hrsg.) 1987. MaB-Projekt Obergurgl. *Veröff. Österr. MaB-Programm* 10, 352 p., 1 Bodenkarte.

PUNTSCHER, S. 1980. Ökologische Untersuchungen an Wirbellosen des zentralalpinen Hochgebirges (Obergurgl, Tirol). V. Verteilung und Jahresrhythmik von Spinnen. *Alpin-Biol. Stud.* 14 (Veröff. Univ. Innsbruck 126): 108 p.

SCHATZ, H. 1983. Der Einfluß des Tourismus auf Mesoarthropoden des Hochgebirges. *Ber. nat.-med. Ver. Innsbruck* 70: 93-97.

SCHATZ-DE ZORDO, I. 1980. Auswirkung der Betrampelung auf epigäische Coleoptera (Insecta) der alpinen Grasheide (Obergurgl, Tiroler Zentralalpen). *Ber. nat-med. Ver. Innsbruck* 67: 137-144.

STEIDL, P. 1993. Ökologische Untersuchungen über die Auswirkungen der mechanischen Pistenpräparierung am Beispiel des Schigebietes Bazora in Frastanz (Vorarlberg). *Dissertation, Universität Innsbruck*, 204 p.

THALER, K. 1977. Epigäische Makroarthropoden, insbesondere Spinnen, im Bereich einer begrünten Schiabfahrt (Achenkirch, Tirol). *Beitr. zur Umweltgestaltung* A 62: 97-105.

THALER, K. 1989. Epigäische Spinnen und Weberknechte (Arachnida: Aranei, Opiliones) im Bereich des Höhentransektes Glocknerstraße-Südabschnitt (Kärnten, Österreich). *Veröff. Österr. MaB-Programm* 13: 201-215.

THALER, K., I. DE ZORDO, E. MEYER, H. SCHATZ und H. TROGER 1978. Arthropoden auf Almflächen im Raum von Badgastein (Zentralalpen, Salzburg, Österreich). *Veröff. Österr. MaB-Programm* 2: 195-233.

WILDI, O. und K. EWALD (Hrsg.) 1986. Der Naturraum und dessen Nutzung im alpinen Tourismusgebiet von Davos. Ergebnisse des MaB-Projektes Davos. *Eidg. Anst. forstl. Versuchswes. Ber.* 289, 336 p., + Kartenbeilagen.

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Tourismus und Freizeitsport im Alpenraum - ein gravierendes Problem für Wildtiere?*

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Tourism and sport in the alps - a serious problem for wildlife? – The paper deals with the question to what extent increasing tourist and leisure activities are a serious problem for wildlife. It presents the project "Tourismus und Wild" carried out between 1990 and 1993. The aim of the project is to measure the effects of different forms of tourism and leisure activities (hiking, paragliding etc.) as a basis for optimizing the relationship between tourism/recreation and wildlife.

The studies were carried out on chamois, ibex, alpine marmots and ptarmigan in several areas of the Swiss alps differing in their amount of tourist and leisure activities: a) in the same area in the course of the day and on different days; b) in different sections of an area and in different areas.

Several examples from the current study are used for illustration. Hikers and alpine marmots: the example shows that hiking can have a stronger effect than would be expected from the greatly reduced flight distances of the animals. It shows as well that it matters whether hikers keep to the path and whether they are accompanied by a dog or not. Hikers and chamois: moderate hiking activity on a path leading across a preferred grazing area of male chamois influences their use of the area in the course of the day. When hikers are present the chamois avoid the attractive grazing areas. Hikers and ptarmigan: By measuring heart-rate it was shown that bradycardia (decrease in frequency) occurs when a person is approaching the nest. Bradycardia is a subtle indicator for stimuli to which incubating hends in the context of predator avoidance. Paragliders and chamois: in

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* Vortrag des Erstautors, gehalten am Fachsymposium "Der Lebensraum der Alpentiere unter dem Einfluss des Menschen" der Schweiz. Gesellschaft für Wildforschung, der Schweiz. Zoologischen Gesellschaft und der Schweiz. Entomologischen Gesellschaft an der 171. Jahresversammlung der SANW in Chur, 9.-12. Oktober 1991.

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areas which so far have been rarely used by paragliders experimental flights provoked strong reactions (escape to the woods at great distances). The development of the responses is followed up. It is not yet possible to present definite results on the behaviour of animals in areas where paragliding has been carried out for a long time.

Criteria are listed to clarify the question as to when certain events have to be considered as a "serious problem": reduced survival and/or reproduction rate (even if a direct proof is lacking, as long as there is a strong indication from the analysis of the behaviour); habitat loss; effects on further elements of the habitat (e.g. damage to the vegetation due to overgrazing).

There is an urgent need to solve the problem of "flying objects (particularly paragliders) and wildlife". In collaboration with the federal office for the environment and the groups concerned (e.g. paragliding association) it is planned to work out measures to limit the effect on wildlife.

Key-words: Tourism - sport - Swiss alps - wildlife - disturbance.

1. EINLEITUNG

Der Alpenraum ist heute die in Mitteleuropa grösste, noch weitgehend naturnahe Landschaft, Lebensraum einer grossartigen Vielfalt an Tier- und Pflanzenarten. Seit einiger Zeit sind jedoch Prozesse im Gange, welche diese Vielfalt gefährden. Dazu gehört beispielsweise die Intensivierung der Land- und Forstwirtschaft aber auch der Tourismus und Freizeitsport, die sowohl im Sommer als auch im Winter in immer neuen Formen auftreten. Immer mehr Menschen gelangen dank dem feinen Netzwerk an Strassen und Bahnen in Gebiete, die bis vor kurzem noch wenig berührt waren. Vom Boden her schwer zugängliche Gebietsabschnitte (Steilhänge, Felsen), die Wildtieren bisher als Rückzugsräume dienten, werden zunehmend häufiger durch die verschiedensten Flugobjekte (Kleinflugzeuge, Helikopter, Deltas, Gleitschirme) überflogen. Angesichts dieser Entwicklung fragt sich, ob daraus nicht ein gravierendes Problem für Wildtiere resultiert.

Zwar kann mit einem gewissen Anpassungsvermögen der Tiere gerechnet werden (phylogenetische Anpassung durch Auslese, adaptive Modifikation durch individuelle Erfahrung), z.B. auch, sich bis zu einem gewissen Grade an regelhaft auftretende und damit vorhersagbare Ereignisse zu gewöhnen. Ein Merkmal der gegenwärtigen Entwicklung ist aber gerade die Unvorhersagbarkeit, hervorgerufen durch die zunehmende Vielfalt an Aktivitäten, durch Verlassen der vorgegebenen Wanderrouten oder durch Überfliegen der Gebiete aus verschiedensten Richtungen in unterschiedlichsten Höhen. In den letzten Jahren mehrten sich denn auch die Anzeichen dafür, dass Wildtiere in zunehmendem Masse nachteilig betroffen sein könnten, und zwar nicht nur im Winter (bekanntlich ist schon seit längerer Zeit das Variantenskifahren als Gefährdung für Wildtiere erkannt worden, JENNY 1987), sondern auch im Sommerhalbjahr. Erwähnt seien etwa der seit einiger Zeit vorliegende Bericht (EISFELD 1989), wo nachteilige Auswirkungen des Deltafliegens auf

Vögel, die an Felswänden brüten, aufgezeigt werden, oder Arbeiten, welche sich mit Teilaspekten des Einflusses von Tourismus auf Säugetiere (Gemsen, Rehe) beschäftigen (CEDERNA & LOVARI, 1983; GROSS 1985; JEPPESEN 1987). Hingewiesen sei auch auf die vielen Zeitungsberichte, in denen oftmals von panikartiger Flucht z.B. von Gemsen beim Auftauchen von Gleitschirmen die Rede ist. Bisher fehlten jedoch umfassende, gut dokumentierte wissenschaftliche Grundlagen für eine verlässliche Beurteilung der Situation im Sommer sowie für allenfalls nötige Vollzugsmassnahmen. Dies gab Anlass zur Durchführung unseres Projektes "Tourismus und Wild", in dem wir den Einfluss von touristischen Aktivitäten und Freizeitsport auf Wildtiere im Sommer untersuchen.

Da alle Formen von Tourismus und Freizeitsport zur Verschärfung der Situation beitragen können, wurde das Projekt von Anfang an entsprechend breit angelegt. So wird z.B. der Einfluss von Wanderern ebenso untersucht wie jener von Gleitschirmfliegern. Allerdings liegt ein Schwerpunkt des Projektes auf der besonders aktuellen Problematik "Flugobjekte (speziell Gleitschirme) und Wildtiere".

Im folgenden seien die Zielsetzung dieses von 1990 bis 1993 laufenden Projektes, die Untersuchungsgebiete, die untersuchten Arten und Grundsätzliches zur Methodik kurz vorgestellt. Danach soll anhand von einigen ausgewählten Beispielen Einblick in die laufenden Untersuchungen gewährt werden. Am Schluss geben wir an, unter welchen Bedingungen wir von einem "gravierenden Problem" sprechen würden und weisen auf das weitere Vorgehen hinsichtlich Umsetzung der Ergebnisse in die Praxis hin.

2. "TOURISMUS UND WILD" - EIN OEKO-ETHOLOGISCHES PROJEKT IM SCHWEIZERISCHEN ALPENRAUM

2.1 ZIEL DES PROJEKTES

Ziel des Projektes "Tourismus und Wild" ist es, die Auswirkungen von verschiedenen Formen von Tourismus und Freizeitsport auf das Verhalten, die Raum-, Zeit- und Sozialorganisation, auf körperliche Parameter (z.B. Gewicht) und die Fortpflanzung der Individuen verschiedener Arten sowie (mit längerfristiger Perspektive) auf bestimmte Eigenschaften ihres Lebensraumes (z.B. Vegetation) zu untersuchen. Damit und mit der Ermittlung der Ansprüche von Wildtieren hinsichtlich "Ungestörtheit" ihres Lebensraumes sollen Grundlagen als Beitrag zu einer Optimierung der Beziehung von Tourismus/Freizeitsport und Wildtieren erarbeitet werden.

2.2 UNTERSUCHUNGSGEBIETE

Die Untersuchungen werden vor allem in zwei Gebieten des Berner Oberlandes durchgeführt, in den Eidgenössischen Jagdbanngebieten Augstmatthorn (Region Interlaken) und Schwarzhorn (Grindelwald).

Das Gebiet Augstmatthorn betrachten wir als Modellfall eines relativ kleinräumigen, durch eine Strasse erschlossenen und durch Wanderwege stark zerschnittenen Gebietes. Das Gebiet Schwarzhorn kann als Modell eines grossräumigen, touristisch durch eine Bahn mit einer Förderkapazität von über tausend Personen pro Stunde gut erschlossenen Gebietes angesehen werden, auf dessen Wegen zum Teil ein sehr intensiver Wanderbetrieb herrscht, wo aber zusätzlich bisher noch wenig begangene Gebietsabschnitte vorhanden sind. Beide Gebiete weisen einen mässigen bis starken Flugbetrieb auf, wobei das Gleitschirmfliegen vor einigen Jahren neu aufgetreten war und seither stark zugenommen hat. Für spezielle Fragestellungen (z.B. Gewöhnung im Fall der Gleitschirme) werden weitere Gebiete einbezogen (z.B. Kandersteg).

2.3 Untersuchte Arten

Weil seitens der Tiere je nach Art mit unterschiedlichen Reaktionen zu rechnen war, führen wir die Untersuchungen an mehreren Arten durch, und zwar an Gemsen, Steinböcken, Murmeltieren und Schneehühnern (z.T. auch an Birkhühnern). Es sind typische Vertreter der Gebirgsregion, die in guten, lokal z.T. in sehr hohen Beständen vorkommen. Sie repräsentieren unterschiedliche Lebensformen, indem sich z.B. die Gemsen bei Gefahr grossräumig oder die Murmeltiere als sesshafte Tiere auch nur kleinräumig verziehen können, während die Schneehühner sich vorerst einmal drücken, statt zu flüchten. Gemsen und Steinböcke können, namentlich wenn sie in hohen Beständen vorkommen, stark lebensraumgestaltend wirken. Für die meisten der untersuchten Arten sind die offenen Gebiete oberhalb der Waldgrenze wichtige Teile ihres Lebensraumes im Sommer (Steinböcke leben zu dieser Zeit fast ausschliesslich hier). Sie sind deshalb menschlichen Aktivitäten, jenen am Boden und in der Luft, besonders stark ausgesetzt.

2.4 Fragen, Untersuchungsmethode

Konkret untersuchen wir, wie und auf welche Distanz die Tiere reagieren, wohin sie sich verziehen, dann auch, ob sie im Verlauf der Zeit weniger stark reagieren, sich also gewöhnen. Ferner untersuchen wir, ob es zur Aufsplitterung bzw. zum Zusammenschluss von sozialen Einheiten kommt, ob stark begangene bzw. beflogene Gebiete zeitweise oder ganz gemieden werden und dementsprechend andernorts Konzentrationen von Tieren auftreten mit möglichen weiteren Folgen (z.B. für Vegetation). Schliesslich prüfen wir, soweit dies möglich ist, ob Auswirkungen auf die Kondition und Fortpflanzung der Tiere festzustellen sind.

Die Gebietswahl ermöglicht grundsätzlich die Durchführung von Untersuchungen in Situationen mit und ohne bzw. mit unterschiedlich starkem Tourismus/Freizeitsport: a) im selben Gebietsabschnitt im Verlauf des Tages und an verschiedenen Tagen; b) in unterschiedlichen Abschnitten eines Gebietes sowie in regional verschiedenen Gebieten. Aufgenommen werden Fluchtdistanzen (Distanz Tier-Objekt im Augenblick des Fluchtbeginns), Fluchtwege und Zufluchtsorte, Abstände zwischen Gruppenangehörigen, Ort und Dauer der Nahrungsaufnahme etc.

Die erwähnten Parameter werden sowohl unter den jeweils gegebenen Bedingungen als auch in experimentell erzeugten Situationen untersucht, in denen z.B.

verschiedene Formen des Wanderns (auf und abseits von Wegen, mit und ohne Hund etc.) simuliert werden oder in denen ein speziell dazu engagierter Gleitschirmpilot auf vorbesprochener Route und in gewünschter Höhe Flüge durchführt.

2.5. Beispiele aus Untersuchungen

2.5.1. Einfluss von Wanderern auf Murmeltiere im Gebiet First/Schwarzhorn

Murmeltiere galten bisher als Tiere, welche durch Tourismus kaum betroffen werden. B. Mainini und P. Neuhaus untersuchten im Gebiet First/Schwarzhorn ob Grindelwald, wie die Tiere auf Wanderer reagieren, und wie stark sie durch den Betrieb entlang der Hauptrouten First-Bachalpsee und First-Grosse Scheidegg allenfalls beeinflusst werden.

2.5.1.1. *Reaktionen der Murmeltiere und Aktivitätsverlauf entlang und abseits der Hauptwanderwege.*

Mainini und Neuhaus führten in beiden Gebietsabschnitten gleichartige Experimente durch, in denen sie Wanderer simulierten. Zusätzlich verglichen sie das Verhalten der Tiere in beiden Gebietsabschnitten im Tagesverlauf.

Es zeigte sich, dass die Tiere entlang der Hauptwanderrouten wesentlich kleinere Fluchtdistanzen aufweisen, also weniger scheu sind, als jene abseits von ihnen (Abb. 1). Dies deutet auf eine mögliche Anpassung der Tiere an diese Bedingungen hin.

Die Berücksichtigung von weiteren Verhaltensparametern hat dann allerdings gezeigt, dass entlang der Hauptwege in der Zeit zwischen ca. 10 und 16 Uhr, wenn besonders viele Wanderer durchgingen, sich wesentlich weniger Tiere ausserhalb der Baue aufhielten (Neuhaus *et al.* 1989), und dass sie insgesamt weniger lang im Nahrungsgebiet waren, als in den abgelegeneren Gebietsabschnitten (Abb. 2)*. Falls aus der offensichtlich verminderten Beschäftigung mit Nahrungsaufnahme eine entsprechend ungenügende Bedarfsdeckung resultieren sollte, könnte sich dies nachteilig auf die Anlegung von Fettreserven und das Überleben im Winter, eventuell auch auf die Fortpflanzung im folgenden Frühjahr auswirken. Stark verminderte Fluchtdistanzen bedeuten also nicht automatisch, dass Anpassung im Sinne einer erfolgreichen Auseinandersetzung mit den gegebenen Bedingungen erfolgt ist. Klarheit können allerdings erst weiterführende Untersuchungen schaffen.

2.5.1.2. *Reaktionen der Murmeltiere je nach Art des Auftretens von Wanderern.*

Mainini *et al.* (1993) untersuchten auch, ob die Murmeltiere unterschiedlich reagieren, je nachdem, ob Wanderer sich an den Weg halten oder quer durchs Gebiet

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* Als im Sommer 1991 der Betrieb der Firstbahn wegen der Neuanlage der Bahn eingestellt wurde und deutlich weniger Leute im Gebiet waren, hielten sich die Tiere entlang der Hauptwanderwege vermehrt ausserhalb der Baue auf, und sie waren mehr mit Nahrungsaufnahme beschäftigt als vorher (K. Roth und R. Zimmerli mdl.).

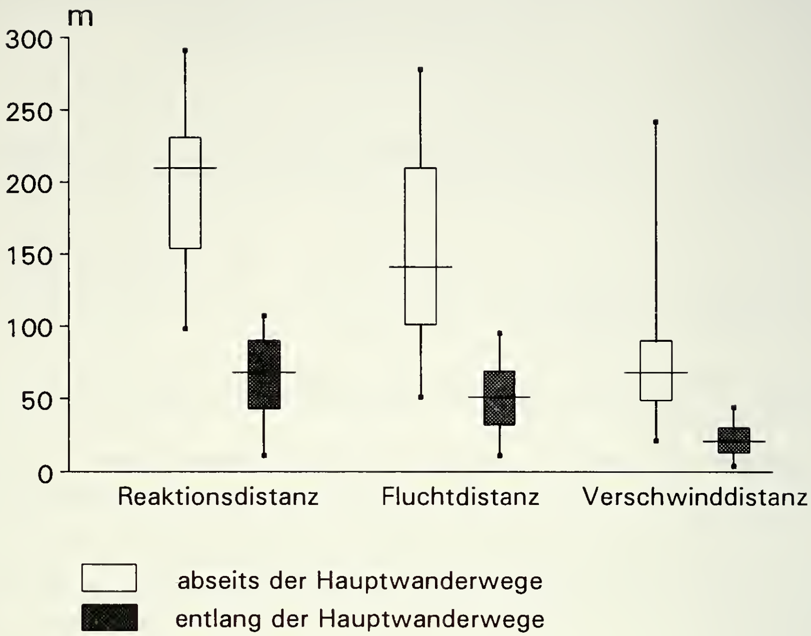

Abb. 1

Reaktionen von Murmeltieren in einer experimentellen Situation (s. Text) entlang von stark begangenen Wegen (Säulen mit Raster) und abseits von ihnen (weisse Säulen) im Gebiet First/Schwarzhorn. Reaktionsdistanz: Distanz zwischen "Wanderer" und Murmeltier beim ersten Aufschauen, Fluchtdistanz: Distanz beim Fluchtbeginn, Verschwinddistanz: Distanz beim Verschwinden im Bau. Angegeben sind die Mediane (Querstrich), 1. und 3. Quartile, Minima und Maxima. n = je 20. Vergleiche zwischen den Werten der Tiere entlang der stark und schwach begangenen Wege: Mann-Whithney U-Test je $p < 0.001$.

gehen und allein sind oder zusätzlich einen Hund bei sich haben. Sie führten entsprechende Experimente durch: Wanderer mit und ohne Hund auf Weg bzw. quer durchs Gebiet gehend.

Die Untersuchung ergab, dass die Fluchtdistanzen in der Reihenfolge "Wegwanderer" (Median = 30 m), "Querfeldeinwanderer" (Median = 50 m), Wanderer mit Hund ("Wegwanderer" mit Hund Median = 95 m; "Querfeldeinwanderer" mit Hund Median = 98 m) zunahmen. Die Unterschiede in den Fluchtdistanzen zwischen "Wegwanderer" und "Querfeldeinwanderer" und zwischen diesen und den Wanderern mit Hund sind signifikant (Mann-Whitney U-Test, $p < 0.001$, n = je 20). Es spielt also eine Rolle, ob Wanderer sich an die Wege halten oder querfeldein gehen, und ob sie zusätzlich einen Hund mit sich führen.

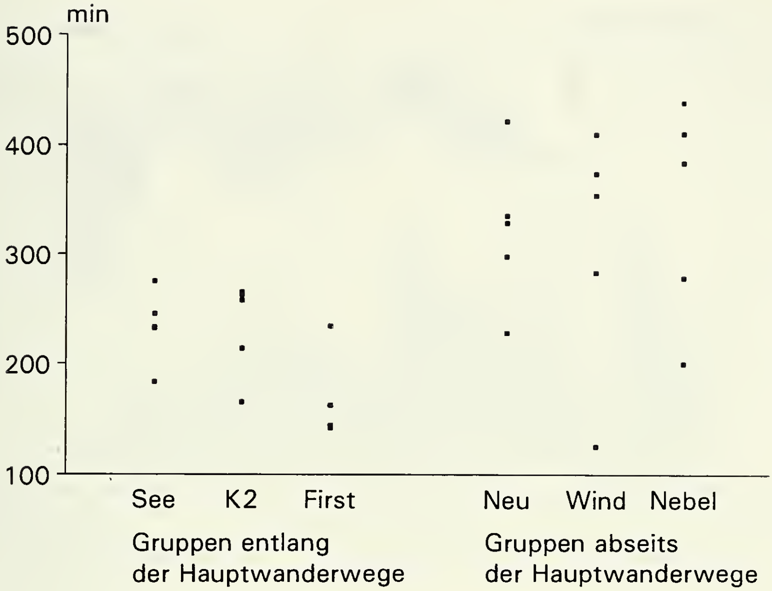

ABB. 2

Dauer des Aufenthalts im Nahrungsgebiet bei je drei Murmeltiergruppen entlang sowie abseits der Hauptwanderwege. Dargestellt sind pro Gruppe die Mittelwerte von fünf Ganztagesaufnahmen. Nested ANOVA, $F_{1,22} = 49{,}724$, $p < 0{,}001$.

2.5.2. EINFLUSS VON WANDERERERN AUF GEMSBÖCKE AM AUGSTMATTHORN

In einem Teil der Nordflanke des Augstmatthorns befindet sich ein wichtiges Sommereinstandsgebiet von Gemsböcken. Ein schon lange bestehender Wanderweg, der in jüngster Zeit zunehmend stärker begangen wird, zerschneidet dieses Gebiet namentlich im Bereich der durch die Böcke bevorzugten Weiden.

ZELLER (1991) untersuchte im Rahmen seiner Lizentiatsarbeit, wie die Tiere auf Wanderer, die diesen Querweg benützen, reagieren und wie sich dies auf die Nutzung der Weiden durch die Gemsböcke auswirkt. Einige Ergebnisse dieser Untersuchung seien hier kurz vorgestellt:

Wenn Wanderer den Querweg begingen, flüchteten Böcke, die sich in den Weiden aufhielten und suchten felsige und geröllhaltige, z.T. mit Gebüschen und Fichten durchsetzte Abschnitte auf, in die sie sich normalerweise zum Ruhen und Wiederkäuen zurückziehen (Abb. 3). Dabei spielte es eine Rolle, wo sich die Wanderer befanden: Gingen sie oberhalb der Tiere durch, flüchteten diese auf wesentlich grössere Distanz, als wenn sie unterhalb von ihnen durchwanderten (Median 160 m, n = 19 gegenüber Median = 105 m, n = 17; Mann-Whitney U-Test $p < 0.01$). Insgesamt ergab die Untersuchung, dass sich die Böcke früher aus den Weiden zurückziehen, wenn Wanderer den Querweg begehen und ihnen bei anhaltendem Betrieb weitgehend

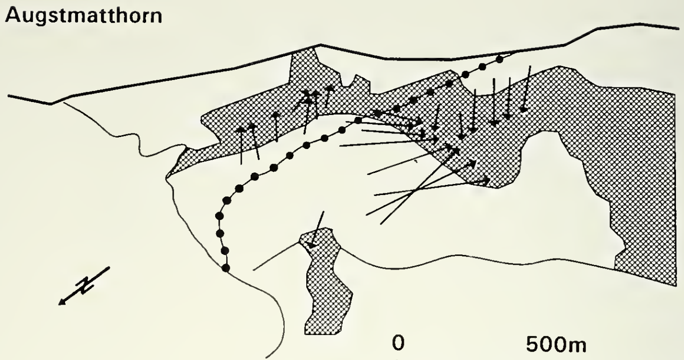

Abb. 3

Fluchtwege und Zufluchtsorte von Gemsböcken, wenn Wanderer den "Querweg" (Linie mit Punkten) begingen. Weisse Flächen: Weiden; Flächen mit Raster: Gebietsabschnitte mit Felsen und Geröll, unterhalb des Weges z.T. mit Büschen und Fichten. Augstmatthorn 2137 m ü.M., unterer Rand des Untersuchungsgebietes (in der Abb. unten) ca. 1600 m ü.M.

fernbleiben. Als Beispiel sei hier die Verteilung der Tiere an je einem wettermässig vergleichbaren Tag mit und ohne Wanderer vorgestellt (Abb. 4 und Abb. 5): Am Tag ohne Wanderer hielten sich am Morgen weitaus die meisten Tiere in den Weiden auf. Sie verzogen sich in die Felsen und in das Geröllfeld, als zwei Helikopter das Gebiet in

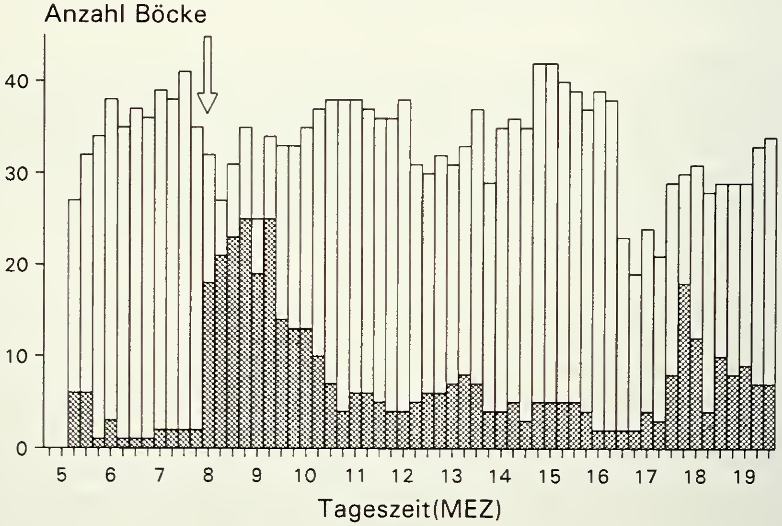

Abb. 4

Anzahl der Gemsböcke in den Weiden (weiss) und im Rückzugsgebiet mit Felsen, Geröll etc. (Raster) im Tagesverlauf am 21.8.1990. Tag ohne Wanderer im Gebiet. Der Pfeil markiert den Zeitpunkt, als zwei Helikopter das Gebiet überflogen.

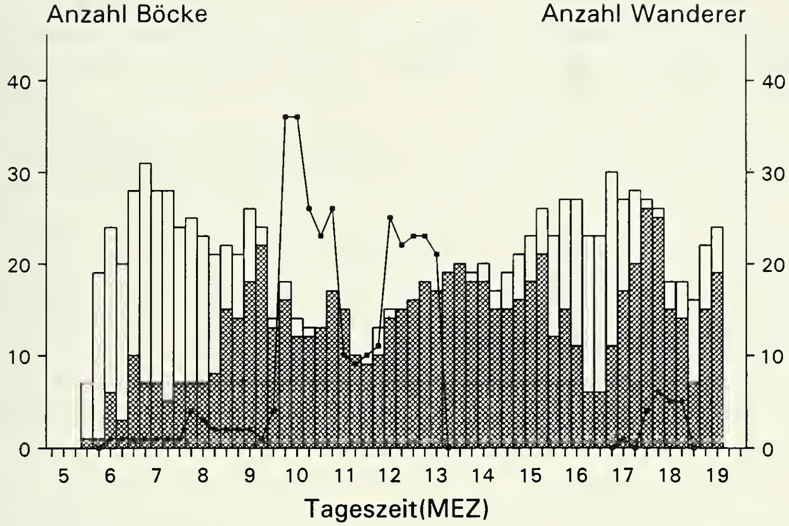

Abb. 5

Anzahl der Gemsböcke in den Weiden und im Rückzugsgebiet im Tagesverlauf am 4.9.1990. Tag mit Wanderern bereits am Morgen (Kurve).

geringer Höhe überflogen. Gegen Mittag kehrten sie allmählich wieder zurück, wobei viele bis am Abend hier blieben (am späteren Nachmittag waren insgesamt weniger zu sehen; etliche hatten sich in unübersichtliches Gelände verzogen). Am Tag, als schon am Morgen vereinzelt Wanderer auftraten, nahm der Anteil der Tiere, die in den Weiden ästen, rasch ab und stieg im Verlauf des Nachmittags abermals an, als keine Wanderer im Gebiet waren. Mit dem erneuten Auftreten von Wanderern gegen Abend zogen sich viele Tiere wieder zurück.

Die Untersuchung zeigt, dass Wanderer offensichtlich einen starken Einfluss auf die Gebietsnutzung der Tiere im Tagesverlauf ausüben: Wenn Wanderbetrieb herrscht, meiden die Böcke die für sie attraktiven Weiden. Ob sie diese dafür in der Nacht aufsuchen, wissen wir bisher nicht. Solange dies offen bleibt, ist schwierig abzuschätzen, inwieweit den Tieren nachteilige Folgen erwachsen, wenn sie infolge Wanderbetrieb die Weiden verlassen müssen. Die Untersuchungen werden deshalb weitergeführt.

2.5.3. Reaktion von Alpenschneehühnern auf Wanderer

Schneehühner haben eine andere Feindvermeidungstaktik als Murmeltiere und Gemsen: statt zu flüchten, drücken sie sich bei Gefahr. Brütende Hennen bleiben sitzen, auch wenn jemand nahe am Nest vorbeigeht. Inwieweit sie solche und andere Ereignisse überhaupt beachten, intersuchte B. Huber mit der Methode der Herzfrequenzbestimmung. Er nahm die Herzschläge über ein unter dem Nest montiertes, an ein Stethoskop angeschlossenes Mikrophon auf (Methode nach Hüppop & Hagen 1990, Hüppop mdl.). Die folgenden Angaben stammen aus einer Untersuchung an einer brütenden Henne im Gebiet Augstmatthorn. Sie haben sich an einer weiteren Henne im Gebiet First/Schwarzhorn bestätigt.

Beim Brüten ohne besondere Vorkommnisse lag die Herzschlagfrequenz bei 150-200 Schlägen pro Minute (Abb. 6). Sie stieg nach einem Brutunterbruch, wenn die Henne die Eier aufwärmen musste, bis auf ca. 300 Schläge pro Minute an.

Beim Auftreten eines Wanderers ging die Herzschlagfrequenz augenblicklich zurück, wie das Beispiel zeigt, wo ein Wanderer simuliert wurde (Abb. 7): Sobald der Experimentator am Beobachtungsplatz aufstand, wodurch gewisse Geräusche entstanden, verminderte sich die Herzschlagfrequenz bis auf ca. 75 Schläge pro Minute. Sie erreichte normale Höhe, sobald der "Wanderer" für die Henne sichtbar wurde, ging wieder etwas zurück, als er sich ein Stück weit (ca. 10 m) vom Nest entfernte und dort, für die Henne nicht sichtbar, verweilte. Der Herzschlag verlangsamte sich sofort, als er sich wieder in Bewegung Richtung Nest setzte.

Herzschlagerniedrigung (Bradycardie) trat auch auf, wenn z.B. in einiger Entfernung ein Helikopter vorbeiflog. Bradycardie ist offensichtlich ein feiner Indikator für Dinge, welche brütende Hennen zumindest im Kontext "Feindvermeidung" in ihrer Umgebung beachten. Sie erlaubt der Henne möglicherweise ein besseres akustisches Wahrnehmen (Verminderung körpereigener Geräusche; Gabrielsen *et al.* 1985).

Abb. 6

Abstände zwischen den Herzschlägen einer brütenden Henne des Alpenschneehuhnes. Aufgetragen sind die Mittelwerte von jeweils 5 Schlägen. Anhand der Skala auf der Ordinate rechts kann die dazugehörige Herzschlagfrequenz abgelesen werden.

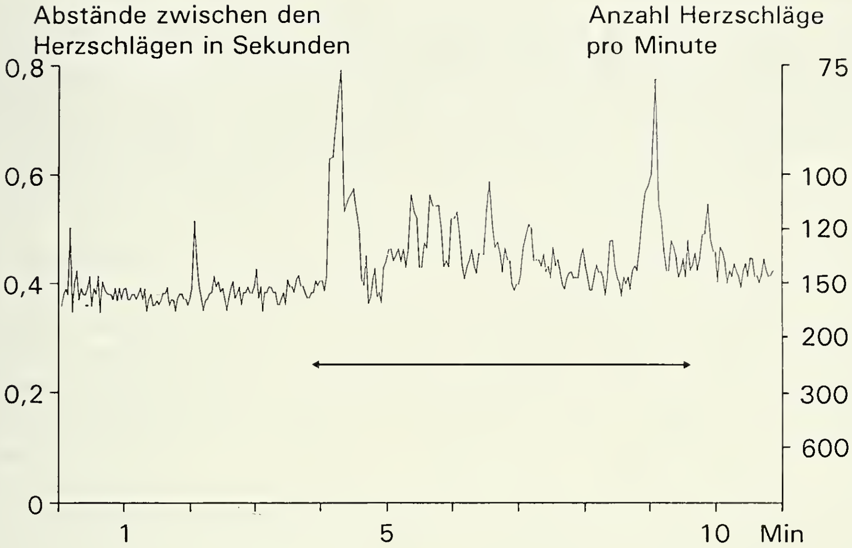

ABB. 7

Abstände zwischen den Herzschlägen einer brütenden Henne des Alpenschneehuhnes während eines Experimentes (durch Pfeil markiert, Beschreibung s. Text).

Wenn äusserlich am Tier keine Verhaltensänderungen festzustellen sind, heisst dies also nicht, dass die entsprechenden Ereignisse keine Bedeutung haben. Gewöhnlich tritt statt Bradycardie wohl das Gegenteil auf, nähmlich Steigerung der Herzschlagfrequenz (z.B. beim Austernfischer; HÜPPOP & HAGEN 1990). Diese wird oft als Ausdruck einer Stresssituation betrachtet.

Mit Hilfe der Herzschlagfrequenz könnte auch ermittelt werden, ob Gewöhnung an bestimmte Ereignisse (z.B. Wanderbetrieb) stattfindet.

2.5.4. ZUM EINFLUSS VON GLEITSCHIRMEN AUF GEMSEN

Das in der Schweiz erst vor einigen Jahren aufgetretene Gleitschirmfliegen erfreut sich grosser Beliebtheit (1985 erste brevetierte Piloten, 1992 bereits rund 14000). Gleitschirmflieger starten meist von Orten, die mit einem Verkehrsmittel erreichbar sind; der relativ leichte Schirm kann aber auch irgendwo hin getragen und bei guter Thermik kann stundenlang den Hängen entlanggeflogen werden. Es gibt Orte mit bisher wenig Gleitschirmbetrieb und solche, wo seit mehreren Jahren intensiver Betrieb herrscht. Zur ersten Kategorie gehört das Augstmatthorn, zur zweiten die Allmenalp ob Kandersteg. Es sind zwei der Gebiete, in denen R. Schnidrig-Petrig und H. Marbacher ihre Untersuchung durchführen. Im folgenden beschreiben wir beispielhaft einige Ereignisse.

2.5.4.1. *Gebiet Augsmatthorn*

Die Nordflanke des Augstmatthorns (Abschnitt "Emmengraben") ist im Sommer ein wichtiges Einstandsgebiet für Gemsgeissen mit Kitzen. An schönen Tagen wechseln am Morgen zuweilen bis gegen hundert Tiere hierhin, halten sich tagsüber in kleinen Gruppen verteilt im Hang auf und ziehen am Abend wieder auf die Südseite.

Am 24. August 1990, um 12.00 Uhr, waren insgesamt 42 Tiere zu beobachten. Um 12.30 Uhr führte Wildhüter Abbühl einen Flug auf vorbestimmter Route (Höhe über Boden 150-200 m) über das Gebiet mit den Geissen und Kitzen durch. Dabei war der Gleitschirm ca. 3 Minuten lang sichtbar. Kurz nach dem Start des Schirmes begannen die Tiere überall im Hang zu flüchten (Distanz der Erstflüchtenden zum Schirm 600-700 m), kleine Gruppen schlossen sich zu einer grösseren zusammen, nach ca. 15 Minuten waren die Tiere im Wald verschwunden. Die Distanz, die sie zurücklegten, betrug bis rund 800 m. Die eine Gruppe verzog sich über die Krete auf die Südseite. Ähnliche Reaktionen mit Flucht in den Wald traten im Sommer 1990 auch auf, wenn ein Gleitschirm vom Brienzer Rothorn herkommend der Krete entlangflog. Die Frage, die sich hier natürlich stellt und die wir klären möchten: Wie reagieren die Gemsen im Verlauf der Zeit, wenn sie vermehrten Kontakt mit Gleitschirmen hatten? Reagieren sie weniger stark als Zeichen einer gewissen Gewöhnung oder treten nach wie vor heftige Reaktionen auf? Weitere kontrolliert durchgeführte Flüge sollen Aufschluss geben.

2.5.4.2. *Gebiet Allmenalp (Kandersteg)*

Auf der Allmenalp befindet sich nicht weit entfernt von der Bahnstation der Hauptstartplatz, von wo aus bei guten Bedingungen täglich über 200 Flüge stattfinden können. Im Sommer 1990 wurde hier festgestellt, dass die Gemsen teils vor, teils mit dem Eintreffen der ersten Piloten am Startplatz den nahen Wald aufsuchten. Weiter entfernt im Gebiet äsende Tiere verzogen sich, wenn Flüge abseits der "Normalroute" stattfanden, oftmals aber auch schon vorher. Nach dem Einstellen des Betriebes am späteren Nachmittag erschienen die Tiere jeweils wieder in den Äsgebieten. Verziehen sich die Tiere hier gewissermassen prophylaktisch vor dem Betrieb und bleiben sie wegen ihm tagsüber verschwunden oder gehört dies zum "normalen" Tagesablauf? Um diese Frage beantworten zu können, wird u.a. die Verteilung der Tiere im Gebiet auch an Tagen ohne Betrieb bei sonst gleichen Bedingungen (z.B. hinsichtlich Wetter) ermittelt.

Im Gebiet Allmenalp konnten Schnidrig und Marbacher mit Hilfe kontrolliert durchgeführter Flüge zeigen, dass die Gemsen auf wesentlich grössere Distanzen flüchten, wenn der Schirm über ihnen auftaucht, als wenn der Schirm etwa auf gleicher Höhe an ihnen vorbeifliegt (Median = 600 m, $n = 9$ gegenüber Median = 290 m, $n = 9$; Kolmogorov-Smirnov-two-sample-Test, $p < 0.01$). Schnidrig und Marbacher prüfen gegenwärtig auch, ob sich zwischen Tieren der Allmenalp und nahegelegener Gebiete ohne Gleitschirmbetrieb Unterschiede hinsichtlich Kondition feststellen lassen. Sie vergleichen dazu verschiedene Parameter (Körper- und Hornmasse, Fettreserveaufbau) von Tieren, die auf der Jagd erlegt wurden.

Wenn hier lediglich ansatzweise gewisse Ergebnisse bekanntgegeben werden können, so liegt dies zum einen an den Fragen, die einer umfassenden Ablärung bedürfen, zum andern an den eingeschränkten Möglichkeiten jene Bedingungen vorzufinden bzw. experimentell herzustellen, welche ein wissenschaftlich einwandfreies Vorgehen und damit verlässliche Aussagen ermöglichen. Beispielsweise müssen oftmals geplante Flüge nach aufwendigen Vorbereitungen wegen ungeeigneten Windverhältnissen verschoben werden.

3. SCHLUSSBETRACHTUNG

Zur Klärung der Frage, inwieweit touristische Aktivitäten und Freizeitsport Wildtiere so beeinflussen, dass für sie ein "gravierendes Problem" resultiert, sind umfassende Untersuchungen nötig. So sind sowohl Aspekte des Verhaltens (unmittelbare Reaktion, Raum-Zeit-Organisation) als auch -soweit dies möglich ist- körperliche Parameter (z.B. Gewicht) und solche der Fortpflanzung, letztlich auch Eigenschaften des Lebensraumes zu berücksichtigen.

Im Bestreben, ungünstige Bedingungen zu erkennen, bevor alarmierende Folgeerscheinungen des Tourismus und Freizeitsportes eingetreten sind, kann das Verhalten der Tiere als Ausgangspunkt der Beurteilung einer Situation wichtige Dienste leisten, weil Verhaltensänderungen auf Umgebungsänderungen hinweisen, die zu weiteren Folgen für die Individuen, deren Population und Lebensraum führen können. Wie die Beispiele zeigen, sind die Ergebnisse auf der Verhaltensebene aber mit der nötigen Vorsicht zu interpretieren. Wenn Tiere ein Gebiet tagsüber verlassen (Beispiel Gemsböcke), könnten sie es eventuell nachts aufsuchen oder an einen andern Ort hin ausweichen und dort den Nahrungsbedarf decken (kompensieren).

Das Verlassen eines bevorzugten Gebietes würde sich allerdings nachteilig auswirken, falls die Tiere andernorts ungünstigere Bedingungen vorfänden. Die Aufgabe eines bevorzugten Gebietes kann nicht nur nachteilige Folgen für die betroffenen Individuen, sondern auch für ihre Population haben, weil dies schliesslich zu einer Schrumpfung oder Verinselung ihres Lebensraumes führt. Darüber hinaus sind weiterreichende Folgen möglich: Wenn Tiere (Gemsen, Steinböcke) bestimmte Gebiete meiden und vermehrt andere aufsuchen, kann dies im einen Fall zu einer Mindernutzung der Vegetation mit entsprechenden weiteren Auswirkungen, im anderen zu einer verstärkten Nutzung bis hin zu Schäden (z. B. am Wald) führen. Um solches festzustellen, sind längerfristig angelegte Untersuchungen nötig.

Verhaltensänderungen, die sich in einer Verkürzung z.B. der Fluchtdistanzen ausdrücken, dürfen andererseits nicht voreilig als Anpassung und die entsprechenden Einflüsse von menschlichen Aktivitäten demzufolge als belanglos interpretiert werden (Beispiel Murmeltiere): Weil gleichzeitig andere Verhaltensweisen betroffen sein können, sind nachteilige Folgen nicht auszuschliessen. Das bedeutet, dass letztlich mit Sicherheit nur unter Einbezug von Fortpflanzungsparametern bestimmt werden kann, ob Anpassung erfolgt ist oder nicht. In manchen Fällen ist dies allerdings schwierig oder erst aufgrund von langandauernden Erhebungen festzustellen.

Natürlich ist nicht auszuschliessen, dass mit der Zeit Anpassung an veränderte Bedingungen erfolgt. Weil aber die Bilanz unserer Umweltsituation zeigt, dass dies offensichtlich sehr oft nicht gelingt, sollten wir uns von einer vorsichtigen Haltung leiten lassen (Handeln nach dem sog. Vorsichtsprinzip; RUH 1992) und von einer Beurteilung der aktuellen Situation ausgehen. Damit sind auch gewisse Änderungen im Verhalten der Tiere durchaus als Indiz für erhebliche Schwierigkeiten zu nehmen; so etwa, wenn festgestellt wird, das infolge von Wanderbetrieb wichtige Nahrungsgebiete nicht mehr genutzt werden können und deutliche Hinweise vorliegen, dass ein Ausweichen in ein ebenbürtiges Gebiet und damit vollständige Kompensation nicht möglich sind und/oder damit der Verlust eines wichtigen Teils des Lebensraumes einer Population verbunden ist.

Antwort auf die Frage, unter welchen Bedingungen Tourismus und Freizeitsport ein "gravierends Problem" darstellen, möchten wir nun etwa wiefolgt geben:

a) Als gravierend ("gravierendes Problem") ist ein Einfluss zu bezeichnen, durch den das Verhalten der Individuen so verändert ist, dass letzlich eine erhöhte Mortalität und/oder eine verminderte Fortpflanzungsrate resultieren, welche den Rückgang einer Population erwarten lassen. Gleiches müsste im Sinne der Früherkennung und in Anwendung des Vorsichtsprinzipes auch dann gelten, wenn vom Verhalten her entsprechende Auswirkungen auf die Mortalität und/oder Fortpflanzungsrate zu erwarten sind, auch wenn der entsprechende Nachweis innert nützlicher Frist nicht zu erbringen ist.

b) Als gravierend wären auch Ereignisse zu bezeichnen, aufgrund derer Tiere ihr Verhalten so ändern, dass als Folge davon eine Schrumpfung oder Verinselung des ursprünglichen Lebensraumes einer Population (Art) eintritt. Natürlich ist möglich, dass gleichzeitig neue, günstige Räume erschlossen werden. Doch auch dies wäre wahrscheinlich in der Regel nicht belanglos, könnten dadurch doch andere Elemente (Tiere, Pflanzen) nachteilig betroffen sein.

c) Ganz allgemein können durch das Verlassen eines Gebietes und das Aufsuchen anderer Gebiete eine Reihe von nur schwer überblickbaren weiteren Folgen resultieren wie z.B. eine verstärkte Konkurrenz mit anderen Arten und daraus resultierende nachteilige Folgen oder die Minder- oder Übernutzung von Gebieten im Fall von grossen Säugetieren. An sich ist auch das Gegenteil möglich, nämlich, dass dadurch gewisse Arten gefördert werden. Es ist dann eine Frage der Wertung, welchen Kriterien bei der Beurteilung einer Situation Priorität eingeräumt wird.

Vielfach wird im Zusammenhang mit der hier besprochenen Thematik der Begriff "Störung" verwendet. Er kommt beispielsweise auch im "Bundesgesetz über die Jagd und den Schutz wildlebender Säugetiere und Vögel" vor (JSG 1986, Art 7: "Die Kantone sorgen für einen ausreichenden Schutz der wildlebenden Säugetiere und Vögel vor Störung"). Mit dem Begriff "Störung" meint man wohl in der Regel Einzelereignisse (z.B. das Auftauchen eines Wanderers, eines Gleitschirmes), welche Tiere veranlassen, die momentane Tätigkeit zu unterbrechen und einen Ort zu verlassen (s. z.B. BAUER *et al.* 1992). Eine solche "Störung" ist als Einzelereignis zumindest für eine Population vernachlässigbar, in der Regel wohl auch für die betroffenen Individuen. Solche Ereignisse würden wir auch nicht als ein "gravierends Problem" bezeichnen. Hingegen kann ein massiertes Auftreten desselben Ereignisses (Wanderbetrieb, Gleitschirmbetrieb) zu erheblichen Nachteilen führen, wie wir sie oben angegeben haben. In diesem Fall würde man dann etwa von einer "erheblichen Störung" sprechen. Zumindest vor solchen Störungen wären Tiere zu schützen.

In unserem Projekt zeichnet sich ab, dass Tourismus und Freizeitsport Wildtiere unter bestimmten Bedingungen tatsächlich erheblich stören. Es ist deshalb geplant, in Zusammenarbeit mit dem BUWAL und unter Beizug auch der betroffenen Kreise seitens des Tourismus und Freizeitsportes realisierbare Massnahmen zu erarbeiten, damit die Auswirkungen auf ein für Wildtiere tolerierbares Mass beschränkt werden können. Wie eingangs erwähnt, können alle zur Verschärfung einer Situation beitragen, in der die einen (Menschen) auf Kosten der andern (Tiere, Pflanzen) ihre Bedürfnisse nach Erholung, Naturerlebnis und Abenteuer zu befriedigen versuchen. Alle (nicht nur z.B. einzelne Sportarten) müssen daher ihren Beitrag dazu leisten, bisherige und neue Entwicklungen in vernünftige Bahnen zu lenken und jenes Mass zu finden, das sowohl die menschlichen Bedürfnisse als auch jene anderer Lebewesen in angemessener Weise berücksichtigt.

ZUSAMMENFASSUNG

Der vorliegende Beitrag beschäftigt sich mit der Frage, inwieweit der zunehmende Tourismus und Freizeitsport ein gravierendes Problem für Wildtiere darstellen könnte. Dabei wird das von uns durchgeführte, von 1990 bis 1993 laufende Projekt "Tourismus und Wild" vorgestellt. Ziel dieses Projektes: Ermitteln der Auswirkungen von verschiedenen Formen von Tourismus und Freizeitsport (Wandern, Gleitschirmfliegen etc.) auf Wildtiere als Grundlage zu einer Optimierung der Beziehung zwischen Tourismus/ Freizeitsport einerseits und Wildtieren andererseits.

Die Untersuchungen werden in verschiedenen Gebieten des schweizerischen Alpenraumes an Gemsen, Steinböcken, Murmeltieren und Schneehühnern durchgeführt, und zwar in Situationen mit und ohne bzw. mit unterschiedlich starkem Tourismus/Freizeitsport: a) im selben Gebietsabschnitt im Verlauf des Tages und an verschiedenen Tagen; b) in unterschiedlichen Abschnitten eines Gebietes sowie in regional verschiedenen Gebieten.

An einigen Beispielen wird Einblick in die laufenden Untersuchungen gegeben. Wanderer und Murmeltiere: Das Beispiel zeigt, dass der Wanderbetrieb einen stärkeren Einfluss haben kann, als von den stark reduzierten Fluchtdistanzen der Tiere her zu erwarten wäre. Es zeigt auch, dass es eine Rolle spielt, ob sich Wanderer an den Weg halten und ob sie einen Hund bei sich haben oder nicht. Wanderer und Gemsböcke: Mässiger Wanderbetrieb auf einem Weg, der quer durch ein bevorzugtes Äsgebiet von Gemsböcken führt, beeinflusst deren Nutzung des Gebietes im Tagesverlauf. Wenn Wanderbetrieb herrscht, meiden die Böcke die für sie attraktiven Weiden. Wanderer und Alpenschneehühner: Mit der Methode der Herzschlagfrequenzbestimmung wurde nachgewiesen, dass Bradycardie (Frequenzverminderung) auftritt, wenn sich jemand dem Nest nähert. Bradycardie ist ein feiner Indikator für Dinge, welche brütende

Hennen im Kontext "Feindvermeidung" beachten. Gleitschirme und Gemsen: In Gebieten mit bisher wenig Flugbetrieb traten bei experimentell durchgeführten Flügen starke Reaktionen auf (Flucht auf grosse Distanz in den Wald). Die weitere Entwicklung der Reaktionen wird untersucht. Umfassende Aussagen zum Verhalten der Tiere in schon lange stark beflogenen Gebieten können noch keine gemacht werden.

Als Kriterien zur Klärung der Frage, inwieweit bestimmte Ereignisse als "gravierendes Problem" zu bezeichnen sind, werden am Schluss angegeben: Eine erhöhte Mortalität und/oder Fortpflanzungsrate (auch wenn kein Nachweis, von einer Verhaltensanalyse her aber deutliche Hinweise bestehen), Verlust von Lebensraum einer Population, nachteilige Auswirkungen auf weitere Elemente eines Lebensraumes (z.B. Schäden an der Vegetation infolge Übernutzung).

Vordringlich scheint die Lösung des Problems "Flugobjekte (insbesondere Gleitschirme) und Wildtiere" zu sein. Es ist geplant, zusammen mit dem Bundesamt für Umwelt, Wald und Landschaft und betroffenen Kreisen (z.B. Hängegleiterverband) Massnahmen zur Begrenzung des Einflusses auf Wildtiere zu erarbeiten.

DANK

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LITERATUR

BAUER, H.-G., H. STARK & P. FRENZEL (1992): Der Einfluss von Störungen auf überwinternde Wasservögel am westlichen Bodensee. *Orn. Beob.* 89: 93-110.

CEDERNA, A. & S. LOVARI (1983): Behavioural Interactions between Tourists and Abruzzo Chamois. *Monitore Zool. Ital.* 17: 184-185.

EISFELD, D. (1989): Hängegleiter im Naturschutzgebiet "Belchengipfel". Gutachten *Forstzoolog. Institut Universität Freiburg.*

GABRIELSEN, G.W., A.S. BLIX & H. URSIN (1985): Orienting and Freezing Responses in Incubating Ptarmigan Hens. *Physiol. and Behav.* 34: 925-934.

GROSS, B. (1985): Zur Raumnutzung und Verhaltensökologie der Gemse *Rupicapra rupicapra* L. in einem touristisch stark belasteten Gebiet der nördlichen Kalkalpen, Raxalpe. *Dissertation, Universität Wien*: 1-98.

HÜPPOP, O. & K. HAGEN (1990): Der Einfluss von Störungen auf Wildtiere am Beispiel der Herzschlagrate brütender Austernfischer *Haematopus ostralegus. Vogelwarte 35*: 301-310.

JENNY, R. D. (1987): Variantenskifahren - Grundlagenbericht. *Bundesamt für Forstwesen (BFL), Bern*: 1-92.

JEPPESEN, J.L. (1987): Impact of Human Disturbance on Home Range, Movements and Activity of Red Deer (*Cervus elaphus*) in a Danish Environment. *Dan. Rev. Game Biol.* 13: 4-38.

MAININI, B., P. NEUHAUS & P. INGOLD (1993): Behaviour of marmots *Marmota marmota* under the influence of different hiking activities. *Biol. Cons.* 64: 161-164.

NEUHAUS, P. B. MAININI & P. INGOLD (1989): Concerning the influence of hikers on the behaviour of the Alpine Marmot *Marmota marmota* L. *Acta biol. mont.* 9: 107-114.

RUH, H. (1992): Argument Ethik. 2. Auflage, *Verlag TVZ, Zürich.*

ZELLER, R. (1991): Zum Verhalten von Gemsböcken *Rupicapra rup. rup.* unter dem Einfluss von Wandertourismus. *Lizentiatsarb. Univ. Bern.*

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A review of Turkish jumping plant-lice (Homoptera, Psylloidea)

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A review of Turkish jumping plant-lice (Homoptera, Psylloidea). – Existing literature and available material of Turkish psyllids are analysed. Of the 82 previously recorded species, 66 are confirmed based on the revision of material, and another 10 are considered likely to be correctly identified. Five previously recorded species were misidentified. One species involved a wrong citation. Ten species are new for Turkey, bringing the number of confirmed and probable species to 85. Two species are synonymised: *Livilla smyrnensis* = *Livilla hodkinsoni*, *Spanioneura pechai* = *Spanioneura turkiana*. A key to adults of the 86 presently known species is provided.

Key-words: Psylloidea - Homoptera - Turkey - Taxonomy - Host plants.

INTRODUCTION

The vast land mass of Turkey, some 780,600 km^2, lies between 36° to 42°N and 26° to 42°E. It is split into a larger Asian portion in the East (Anatolia) and a smaller European part in the Northwest (Thrace). Its geographical position at the cross-roads of three biogeographical regions accounts, in part, for its rich flora and fauna. The Euro-Siberian Region extends along most of North Anatolia and along the Black Sea Coast of Turkey-in-Europe, a region with a humid climate and often heavy rainfall. The Mediterranean Region covers all the areas bordering the Mediterranean Sea and is characterised by a climate with hot dry summers and mild winters. Most of Central and East Anatolia belongs to the Irano-Turanian Region, being the largest of the three biogeographical regions. Here the climatic extremes are larger than elsewhere, with hot, dry summers and cold winters. Turkey comprises a large number of relatively narrow,

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variously orientated mountain ranges, separated by deep valleys. This influences the local climate, creating a variety of ecological conditions within relatively small areas, resulting in a diverse flora and fauna (DAVIS, 1965-1988; ERINÇ, 1959, 1984; KOÇMAN, 1991; ZOHARY, 1973).

The homopterous psyllids or jumping plant-lice are a small group of generally highly host-specific plant bugs. In the Palaearctic they are probably most diverse in semi-desertic regions. This is well-documented for Central Asia (GEGECHKORI & LOGINOVA, 1990) and, to a lesser extent, also for North Africa (Morocco: LOGINOVA, 1972; Egypt: SAMY, 1973; Algeria: BURCKHARDT, 1989a). Apart from Israel (BURCKHARDT & HALPERIN, 1992, and papers cited herein), little is known about the psyllid fauna of the Middle East and Turkey is no exception.

Many records of Turkish psyllids are based on occasional finds and are scattered in the literature. It is difficult to derive from these sources a clear picture of the faunistic composition and relationships of the Turkish fauna. Vondráček (1953) studied the small amounts of material from an expedition by the Natural History Museum, Prague to Turkey. More substantial collections were made in the İzmir area (KLIMASZEWSKI & LODOS, 1977, 1979, 1980; ÖNUÇAR, 1983; ÖNUÇAR & ULU, 1991) and in Northeast Anatolia (BURCKHARDT, 1988). Other papers concentrate on particular groups, such as the *Pistacia*-feeding psyllids (ÇELIK, 1981; LODOS & ÖNUÇAR, 1985; BURCKHARDT & LAUTERER, 1989) or the pear psyllids (BURCKHARDT & HODKINSON, 1986).

This paper reviews literature records and lists information on revised material. Specimens of 75 species were examined, confirming the occurrence of 66 previously reported species. Of the 15 remaining literature records, 10 seem probable, 5 are misidentifications and 1 is a wrong citation.

The records of *Camarotoscena unicolor* Loginova from İzmir (KLIMASZEWSKI & LODOS, 1977; ÖNUÇAR, 1983) are misidentifications and concern *C. subrubescens*. It is unlikely that *C. unicolor* occurs in the Mediterranean part of Turkey.

The records of *Euphyllura olivina* (Costa) from İzmir (KLIMASZEWSKI & LODOS, 1977, 1979; ÖNUÇAR, 1983) are misidentifications and concern *E. phillyreae*. The occurence of *E. olivina* in Turkey is unlikely as this is a west Mediterranean species (BURCKHARDT, 1989a).

The records of *Agonoscena succincta* (Heeger) from İzmir (KLIMASZEWSKI & LODOS, 1977, 1979; ÖNUÇAR, 1983), İçel, Gaziantep, Kahramanmaraş and Urfa (ÇELIK, 1981) are misidentifications and include both *A. targionii* and *A. pistaciae*. Based on the drawing of the female genitalia and the larvae, the species of ÇELIK (1981) is probably *A. pistaciae*. ÖNUÇAR (1983) illustrated a forewing and female terminalia of *A. pistaciae* (as *A. succincta*) and male terminalia of *A. targionii* (as *A. succincta*).

Psyllopsis fraxini (L.) was reported from Asia Minor by KLIMASZEWSKI (1973) citing AULMANN (1913) as source of this record. The latter, however, does not list this locality.

The records of *Cacopsylla alaterni* (Förster) from İzmir (KLIMASZEWSKI & LODOS, 1979; ÖNUÇAR, 1983) are misidentifications and concern *C. myrthi*.

The records of *Cacopsylla pyricola* (Förster) from İzmir (KLIMASZEWSKI & LODOS 1977, 1979; ÖNUÇAR, 1983) are misidentifications and concern *C. notata*.

If compared to the much better studied region of the Caucasus with over 200 species (GEGECHKORI, 1984), the 85 known species from Turkey are perhaps less than half the number of existing species. For 38 of the 76 provinces exist no records.

MATERIAL AND METHODS

Unless indicated otherwise, the material is deposited in the collection of the Zirai Mücadele Araştırma Enstitüsü, Bornova-Izmir (ZMAE). Additional material was examined from: Muséum d'Histoire naturelle, Genève (MHNG); Natural History Museum, Prague (NMP); the Natural History Museum, London (BMNH); John Moores University, Liverpool (JMUL); Muséum National d'Histoire Naturelle, Paris (MNHN).

FIG. 1.

The 76 administrative districts (provinces) of Turkey. 1, Edirne; 2, Kırklareli; 3, Tekirdağ; 4, İstanbul; 5, Çanakkale; 6, Balıkesir; 7, Bursa; 8, Kocaeli; 9, Sakarya; 10, Bilecik; 11, Kütahya; 12, Uşak; 13, Manisa; 14, İzmir; 15, Aydın; 16, Muğla; 17, Denizli; 18, Burdur; 19, Antalya; 20, İsparta; 21, Afyon; 22, Eskişehir; 23, Bolu; 24, Zonguldak; 25, Kastamonu; 26, Çankırı; 27, Ankara; 28, Konya; 29, İçel; 30, Hatay; 31, Adana; 32, Gaziantep; 33, Kahramanmaraş; 34, Kayseri; 35, Niğde; 36, Kırşehir; 37, Nevşehir; 38, Yozgat; 39, Çorum; 40, Amasya; 41, Sinop; 42, Samsun; 43, Tokat; 44, Ordu; 45, Giresun; 46, Sivas; 47, Malatya; 48, Adıyaman; 49, Urfa; 50, Mardin; 51, Diyarbakır; 52, Elazığ; 53, Tunceli; 54, Erzincan; 55, Gümüşhane; 56, Trabzon; 57, Rize; 58, Artvin; 59, Erzurum; 60, Bingöl; 61, Kars; 62, Ağrı; 63, Muş; 64, Bitlis; 65, Van; 66 Siirt; 67, Hakkâri; 68, Şırnak; 69, Batman; 70, Ardahan; 71, Bayburt; 72, Bartın; 73, Kırıkkale; 74, Aksaray; 75, Karaman; 76, Iğdır.

For each species, when available, recorded and new distributional data are provided, using the 76 administrative districts (or provinces) (fig. 1). Plant taxa, cited according to the "Flora of Turkey" (DAVIS, 1965-1988), are listed in the material section and refer to plants on which the insects were collected, and are not necessarily hostplants. Host data, compiled from the literature, are given in the key.

Morphological terminology follows mainly HODKINSON & WHITE (1979).

LIST OF SPECIES

PSYLLIDAE: APHALARINAE

Aphalara grandicula (Gegechkori)

Reported from GÜMÜŞHANE, KARS (BURCKHARDT, 1988) (examined).

Additional material examined: KONYA: Ilgın, 29.v.1979; Meram, 28.v.1984 (A. Kalkandelen). NEVŞEHİR: Ürgüp, 2.x.1969.

Colposcenia aliena (Löw)

Reported from KARS (BURCKHARDT, 1988) (examined).

Colposcenia bidentata Burckhardt

Reported from ARTVİN (BURCKHARDT, 1988) (examined).

Colposcenia osmanica Vondráček

Reported from ANKARA (Vondráček, 1953); ARTVİN, KARS (BURCKHARDT, 1988) (examined).

Additional material examined: KIRIKKALE: Kırıkkale, 22 km, 4.xi.1968, *Tamarix* sp. (A. Kalkandelen).

Colposcenia spp.

In the absence of the taxonomically important males, following material cannot be identified to species. ERZİNCAN: Taşköprü, 22.viii.1979, *Tamarix* sp. (A. Kalkandelen). ARTVİN: Fidanlık, 30.viii.1975, *Vitis vinifera*. ERZURUM: Tortum, Gölbaşı, 9.vii.1970, *Tamarix* sp.

Craspedolepta armazhi Gegechkori

Recorded from KARS (BURCKHARDT, 1988) (examined).

Craspedolepta bulgarica Klimaszewski

Reported from ANKARA (as *Cerna asetipennis*) (KLIMASZEWSKI & LODOS, 1980); ARTVİN (BURCKHARDT, 1988) (examined).

Additional material examined: KONYA: Akşehir, Tekke, 29.v.1984 (A. Kalkandelen). ERZINCAN: Çağlayan, 4.vii.1970. KIRIKKALE: Kırıkkale, 4.v.1975, on weeds.

Craspedolepta innoxia (Förster)

Material examined: İZMİR: Menderes-Özdere E Gümüldür, 27.iv.1990, swept from low vegetation (D. Burckhardt) (MHNG).

Craspedolepta malachitica (Dahlbom)

Material examined: KARS: Sarıkamış Forest, 11.vii.1970, *Pinus* spp. (A. Kalkandelen).

Craspedolepta omissa Wagner

Reported from HAKKÂRİ (as *Cerna omissa*) (KLIMASZEWSKI & LODOS, 1979).

Craspedolepta pontica Dobreanu & Manolache

Reported from ARTVİN, KARS (BURCKHARDT, 1988) (examined).

Craspedolepta setosa (Wagner)

Reported from ANKARA (as *Xanioptera setosa*) (Vondráček, 1953).

Craspedolepta sp.

Material examined: KONYA: Karapınar, 12.vi.1966, *Artemisia herba-alba* (G. Remaudière) (MNHN).

Comment. The single male resembles *C. conspersa* (Löw), *C. arnazhi* Gegechkori and related species in the broad, curved parameres. It differs in the absence of dark spots on the forewings and the detailed structure of the parameres and aedeagus. More material is needed to identify this species.

Crastina myricariae Loginova

Reported from VAN (KLIMASZEWSKI & LODOS, 1979).

PSYLLIDAE: PAUROCEPHALINAE

Aphorma lichenoides (Puton)

Reported from İZMİR (as *Aphorma renova*) (KLIMASZEWSKI & LODOS, 1980) (examined).

Additional material examined: İZMİR: Menderes-Özdere, E Gümüldür, 27.iv.1990, swept from low vegetation (D. Burckhardt) (MHNG).

Camarotoscena fulgidipennis Loginova

Reported from KAHRAMANMARAŞ (LOGINOVA, 1975).

Camarotoscena hoberlandti Vondráček

Reported from ADANA (as *Paurocephala (Camarotoscena) hoberlandti*) (VONDRAČEK, 1953); VAN (KLIMASZEWSKI & LODOS, 1979).

Camarotoscena speciosa (Flor)

Reported from İZMİR (KLIMASZEWSKI & LODOS, 1977, 1979; ÖNUÇAR, 1983) (examined).

Additional material examined: ANKARA: Ankara University, 10.x.1951, *Populus alba* (BMNH). KONYA: Akşehir, 22.iv.1979, *Salix* sp.

Camarotoscena subrubescens (Flor)

Reported from İZMİR (as *C. subrubescens*) (KLIMASZEWSKI & LODOS, 1979; ÖNUÇAR, 1983) (examined), (as *C. unicolor*) (KLIMASZEWSKI & LODOS, 1977; ÖNUÇAR, 1983) (examined).

Comment. The records of *C. unicolor* Loginova from Turkey concern *C. subrubescens.*

PSYLLIDAE: LIVIINAE

Euphyllura phillyreae Förster

Reported from Asia Minor (KLIMASZEWSKI, 1973); İZMİR (as *E. phillyreae* and *E. olivina*) (KLIMASZEWSKI & LODOS, 1977, 1979; ÖNUÇAR, 1983) (examined).

Addidional material examined: İzmir: Selçuk-Efes, 29.iv.1990, *Olea europaea* (D. Burckhardt) (MHNG); Bornova, 3.viii.1961 (E. Bozkurt) (BMNH).

Comment. The records of *E. olivina* (Costa) from Turkey (KLIMASZEWSKI & LODOS, 1977, 1979; ÖNUÇAR, 1983) are misidentifications and concern *E. phillyreae.*

The occurence of *E. olivina* in Turkey is unlikely as this is a west Mediterranean species (BURCKHARDT, 1989a).

Euphyllura straminea Loginova

Reported from İZMİR (ÖNUÇAR & ULU, 1991) (examined).

Livia crefeldensis Mink

Reported from ANKARA (as *Diraphia crefeldensis*) (VONDRÁČEK, 1953).

Comment. This record needs verification as LOGINOVA (1974) described the morphologically similar *L. mediterranea* Loginova with which *L. crefeldensis* is often confused.

Livia juncorum (Latreille)

Reported from ANKARA (VONDRÁČEK, 1953).

PSYLLIDAE: RHINOCOLINAE

Agonoscena cisti (Puton)

Reported from İZMİR (LODOS & ÖNUÇAR, 1985) and from Turkey without further indications (BURCKHARDT & LAUTERER, 1989).

Material examined: İZMİR: Menderes-Claros, 4.v.1990, *Pistacia lentiscus* (D. Burckhardt) (MHNG).

Agonoscena pistaciae Burckhardt & Lauterer

Reported from İZMİR (KLIMASZEWSKI & LODOS, 1977, 1979 (as *A. succinata* (sic!); ÖNUÇAR, 1983 (as *A. succincta*)); İÇEL, GAZİANTEP, KAHRAMANMARAŞ, URFA (as *A. succincta*) (ÇELIK, 1981); ADANA, GAZİANTEP (BURCKHARDT & LAUTERER, 1989) (examined).

Additional material examined: İZMİR: Bergama Kınık, 26.vii.1978, *Pistacia vera* (A. Önuçar & O. Ulu).

Comment. Most of the records of *A. succincta* (Heeger) from Turkey concern *A. pistaciae* (KLIMASZEWSKI & LODOS, 1977, 1979; ÇELIK, 1981). ÖNUÇAR (1983) illustrated under *A. succincta* a forewing and female terminalia of *A. pistaciae* and male terminalia of *A. targionii*.

Agonoscena targionii (Lichtenstein)

Reported from İZMİR, GAZİANTEP (LODOS & ÖNUÇAR, 1985) (examined).

Additional material examined: AYDIN: Kuşadası, 29.iv.1990, *Pistacia lentiscus* (D. Burckhardt) (MHNG).

Comment. The records of *A. targionii* are a mixture of *A. targionii* and *A. pistaciae*.

Lisronia varicicosta (Hodkinson & Hollis)

Material examined: İZMİR: Menderes-Özdere, E Gümüldür, 27.iv.1990, *Cistus salviifolius*, *C. creticus* (D. Burckhardt) (MHNG); Claros, 4.v.1990, *Cistus salviifolius*, *C. creticus* (D. Burckhardt) (MHNG). AYDIN: Akköy, 1.v.1990, swept from shrubs (D. Burckhardt) (MHNG).

Megagonoscena viridis (Baeva)

Reported from GAZİANTEP (as *Agonoscena viridis*) (KLIMASZEWSKI & LODOS, 1979); İÇEL, GAZİANTEP, KAHRAMANMARAŞ, URFA (as *A. viridis*) (ÇELIK, 1981); İÇEL, ADANA, GAZİANTEP, KAHRAMANMARAŞ, ADIYAMAN, URFA, MARDİN, DİYARBAKIR, SİİRT (as *A. viridis*) (LODOS & ÖNUÇAR, 1985); from Turkey without further indications (BURCKHARDT & LAUTERER, 1989) (examined).

Comment. Maybe some of the records concern the closely related *M. gallicola* Burckhardt & Lauterer.

Rhinocola aceris (L.)

Reported from TUNCELİ (BURCKHARDT, 1988; BURCKHARDT & LAUTERER, 1989) (examined).

Additional material examined: ÇANKIRI: Ilgaz Dağları, Ilgazdağı Geçidi, 24.vi.1966, *Tanacetum parthenifolium* (G. Remaudière) (MNHN). ANKARA: Karagöl, 1500 m, 9.vi.1966, *Acer* sp. (G. Remaudière) (MNHN).

PSYLLIDAE: DIAPHORININAE

Diaphorina putonii (Löw)

Reported from ANKARA (as *D. putoni* (sic!)) (VONDRÁČEK, 1953); URFA (as *D. putoni* (sic!)) (KLIMASZEWSKI & LODOS, 1979).

Comment. The records need confirmation as they may refer to other species (BURCKHARDT, 1984).

Psyllopsis fraxinicola (Förster)

Reported from HAKKÂRİ (KLIMASZEWSKI & LODOS, 1977, 1979).

Material examined: ESKİŞEHİR: 19.vi.1964 (N. Tuatay).

Psyllopsis machinosus Loginova

Reported from TUNCELİ (BURCKHARDT, 1988) (examined).

Psyllopsis securicola Loginova

Reported from KARS (BURCKHARDT, 1988) (examined).

PSYLLIDAE: ARYTAININAE

Arytainilla cytisi (Puton)

Reported from İZMİR (as *Arytaina cytisi*) (KLIMASZEWSKI & LODOS, 1979; ÖNUÇAR, 1983) (examined).

Additional material examined: İZMİR: Menderes-Özdere, E Gümüldür, 27.iv.1990, *Calicotome villosa* (D. Burckhardt) (MHNG); Claros, 4.v.1990, *Calicotome villosa* (D. Burckhardt) (MHNG). AYDIN: Kuşadası, 29.iv.1990, *Calicotome villosa* (D. Burckhardt) (MHNG); Bafa Gölü, 1.v.1990, *Calicotome villosa* (D. Burckhardt) (MHNG).

Cyamophila glycyrrhizae (Becker)

Reported from ANKARA (as *Psylla glycyrrhizae*) (VONDRÁČEK, 1953); BİTLİS, VAN [65], SİİRT (as *Cacopsylla glycyrhizae* (sic!)) (KLIMASZEWSKI & LODOS, 1977); MUŞ, VAN, IĞDIR (as *Cacopsylla glycyrhizae* (sic!)) (KLIMASZEWSKI & LODOS, 1977); İZMİR (as *Cyamophila odontopyx*) (Klimaszewski & Lodos, 1979); KARS (Burckhardt, 1988) (examined).

Additional material examined: İZMİR: 7.viii.1977, *Castanea sativa*; Merkez, Karagöl, 19.viii.1977, *Juniperus* sp. (A. Önuçar & O. Ulu). ANKARA: Kalecik-Hacıköy, 17.vii.1985 (H. Zeki). ERZINCAN: Demirpınar-Kırbağlar, 15.vii.1980, *Phaseolus* sp.; Ortayurt, 16.vii.1980, *Phaseolus* sp. ARTVIN: 24.vi.1971 (S. Kornoşor). KARS: Ararat, Kara Su Springs, 2400 feet, 28.viii.1960 (Guichard & Harvey) BM 1960-364 (BMNH). KIRIKKALE: Keskin, 15.viii.1985, *Helianthus* sp. IĞDIR: 6.viii.1977, *Glycyrrhiza* sp.

Cyamophila stoklosai Klimaszewski & Lodos

Reported from BİTLİS (KLIMASZEWSKI & LODOS, 1979); GÜMÜŞHANE (BURCKHARDT, 1988) (examined).

Livilla hodkinsoni (Burckhardt)

Floria hodkinsoni BURCKHARDT, 1979: 391. Holotype ♂, Greece: Peloponnesus, Messinia, Messini, 16.v.1979, *Genista acanthoclada* (D. Burckhardt) (MHNG), examined.

Livilla hodkinsoni (Burckhardt); HODKINSON & HOLLIS, 1987: 33.
Livilla smyrnensis BURCKHARDT, 1989b: 320. Holotype ♂, Turkey: İzmir, Karaburun, 28.viii.1978, *Genista* sp. (A. Önuçar & O. Ulu) (MHNG), examined. **Syn. n.**

Reported from İZMİR (as *Livilla smyrnensis*) (BURCKHARDT, 1989b) (examined).

Additional material examined: AYDIN: Milet, 30.iv.1990, *Genista acanthoclada* (D. Burckhardt) (MHNG); Akköy, 1.v.1990, *Genista acanthoclada* (D. Burckhardt) (MHNG); Bafa Gölü, 1.v.1990, *Genista acanthoclada* (D. Burckhardt) (MHNG).

Comment. A comparison of the holotypes of *L. hodkinsoni* and *L. smyrnensis* showed that the former has a slightly darker forewing pattern but does not differ otherwise from the latter. The two are therefore synonymised.

Livilla horvathi (Scott)

Reported from İZMİR (as *Floria horvathi*) (KLIMASZEWSKI & LODOS, 1979; ÖNUÇAR, 1983); KARS (Burckhardt, 1988) (examined).

Additional material examined: KONYA: 10 km S Ereğli, 18.vi.1966, ? *Genista* sp. (G. Remaudière) (MNHN).

Livilla spectabilis (Flor)

Reported from İZMİR (ÖNUÇAR & ULU, 1991) (examined).

PSYLLIDAE: PSYLLINAE

Cacopsylla affinis (Löw)

Material examined: İSTANBUL: Yalova, 15.v.1964, *Mespilus* sp. (Chararas) (MNHN, MHNG). BURSA: Inegöl, 17.v.1964, *Pyrus* sp. (O. Karagöz) (BMNH). MUĞLA: 30 km E Muğla, 750 m, 2.v.1990, *Crataegus* sp. (D. Burckhardt) (MHNG).

Cacopsylla albipes (Flor)

Reported from GÜMÜŞHANE (BURCKHARDT, 1988) (examined).

Cacopsylla breviantennata (Flor)

Reported from GÜMÜŞHANE (BURCKHARDT, 1988) (examined).

Cacopsylla costalis (Flor)

Reported from İÇEL, ADANA, GAZİANTEP, HÂKKARİ (KLIMASZEWSKI & LODOS, 1977, 1979).

Additional material examined: ADANA: Pozantı, 2.v.1978, *Malus sylvestris*; 6.vi.1979, *Malus sylvestris* (A. Yigit).

Cacopsylla fasciata (Löw)

Reported from KARS (Burckhardt, 1988) (examined).

Cacopsylla cf. **hippophaes** (Förster)

Material examined: ERZURUM: Hasankale, 11.vii.1970, *Elaeagnus* sp. (A. Kalkandelen). NEVŞEHIR: Ürgüp, 15.viii.1979, on weeds.

Comment. This species resembles *C. hippophaes* and *C. nasuta* (Horvath) in coloration, and shape and structure of the genal cones, forewings and terminalia. It differs from *hippophaes* in the longer and narrower genal cones, and the apex of the male parameres which is suddenly constricted to form an angular, narrow, forward directed point. From *C. nasuta* it differs in the relatively shorter genal processes, the stronger curved foremargin of the forewings which gives the wing a more elliptic shape, the vein Rs which is less strongly bent towards the foremargin, the presence of surface spinules in all cells, the longer setae on the female proctiger which are leaving seta-free areas on either side of the pore-ring, the more abundant setosity on the sides of the subgenital plate, and the downward curved valvulae 1 and 2. Without a revision of the Elaeagnaceae-feeding species of the *Cacopsylla hippophae* group, a task which is outside the scope of this study, the identity of the material at hand remains doubtful.

Cacopsylla incerta (Loginova)

Reported from KARS (Burckhardt, 1988) (examined).

Cacopsylla mali (Schmidberger)

Reported from KARS (Burckhardt, 1988) (examined).

Cacopsylla mariannae (Baeva)

Reported from İZMİR (ÖNUÇAR & ULU, 1991) (examined).

Additional material examined: İSTANBUL: Bahçeköy, 110 m, 18.vi.1964, *Crataegus* sp. (H. Çanakçıoğlu) (BMNH). MUĞLA: 30 km E Mugla, 750 m, 2.v.1990, *Crataegus* sp. (D. Burckhardt) (MHNG). KAYSERİ: Felahiye, 22.vi.1966, *Quercus* sp. (G. Remaudière) (MHNG). VAN: Lake Van, 17.vii., *Crataegus* sp. (G. Remaudière) (MHNG).

Cacopsylla moscovita (Andrianova)

Reported from TUNCELİ (Burckhardt, 1988) (examined).

Cacopsylla myrthi (Puton)

Reported from ANKARA (as *Psylla myrti* (sic!)) (VONDRÁČEK, 1953); MANİSA, ERZİNCAN (as *Cacopsylla myrti* (sic!)) (KLIMASZEWSKI & LODOS, 1979); İZMİR (as *Cacopsylla alaterni*) (KLIMASZEWSKI & LODOS, 1979; ÖNUÇAR, 1983).

Additional material examined: İZMİR: Dikili, 20.iii.1979, *Rhamnus alaternus* (A. Önuçar & O. Ulu).

Comment. The Turkish records of *C. alaterni* concern *C. myrthi.*

Cacopsylla notata (Flor)

Reported from İZMİR (as *Cacopsylla pyricola*) (KLIMASZEWSKI & LODOS 1977, 1979; ÖNUÇAR, 1983); from Turkey without further indications (BURCKHARDT & HODKINSON, 1986) (examined).

Additional material examined: İZMİR: Merkez, Karagöl, 19.viii.1977, *Juniperus* sp. (A. Önuçar & O.Ulu); Menderes-Claros, 4.v.1990, *Pyrus amygdaliformis* (D. Burckhardt) (MHNG). MUĞLA: 30 km E Muğla, 750 m, 2.v.1990, *Pyrus amygdaliformis* (D. Burckhardt) (MHNG).

Cacopsylla peregrina (Förster)

Material examined: ERZİNCAN: Ortayurt, viii-ix.1980, *Phaseolus* sp. (M. Aydemir).

Cacopsylla permixta Burckhardt & Hodkinson

Reported from KONYA, ADANA (BURCKHARDT & HODKINSON, 1986); GÜMÜŞHANE (BURCKHARDT, 1988) (examined).

Additional material examined: MARDİN: Nurhak Dağları, Karahan Pass, 1880 m, 16.vi.1970, no. 13 (Exp. Nat. Mus. Praha) (NMP).

Cacopsylla pulchella (Löw)

Reported from İZMİR (KLIMASZEWSKI & LODOS, 1977, 1979; ÖNUÇAR, 1983) (examined).

Additional material examined: AYDIN: Nyssa, 3 km N Sultanhisar, 3.v.1990, *Cercis siliquastrum* (D. Burckhardt) (MHNG).

Cacopsylla pyri (L.)

Reported from İZMİR (KLIMASZEWSKI & LODOS, 1979; ÖNUÇAR, 1983) (examined); Turkey without further indications (BURCKHARDT & HODKINSON, 1986).

Additional material examined: ANKARA: Polatlı, 5.v.1979, *Armeniaca vulgaris*; 29.xi.1985, *Pyrus communis* (C. Zeki). ERZİNCAN: 3.ix.1979, *Malus sylvestris*.

Cacopsylla pyrisuga (Förster)

Reported from Turkey without further indications (BURCKHARDT & HODKINSON, 1986).

Additional material examined: İZMİR: 13.vi.1979, on weeds (A. Önuçar & O. Ulu); Merkez, İnciraltı, 24.vi.1980, *Solanum melongena* (P. Hincal).

Cacopsylla rhamnicola (Scott)

Reported from ARTVİN, KARS (BURCKHARDT, 1988) (examined).

Cacopsylla saliceti (Förster)

Reported from KARS (BURCKHARDT, 1988) (examined).

Comment. The 4 females were tentatively identified by BURCKHARDT (1988) as *C. saliceti*. Males are required to confirm the identification.

Cacopsylla zetterstedti (Thomson)

Material examined: ERZİNCAN: Refahiye, 5.vii.1970, *Elaeagnus* sp.; İspir, Serceme, 10.vii.1970 (A. Kalkandelen).

Psylla alni (L.)

Reported from İZMİR (KLIMASZEWSKI & LODOS, 1979; ÖNUÇAR, 1983) (examined).

Psylla foersteri Flor

Reported from İZMİR (KLIMASZEWSKI & LODOS, 1979; ÖNUÇAR, 1983) (examined), TUNCELİ, ARTVİN (as *Baeopelma foersteri*) (BURCKHARDT, 1988) (examined).

Spanioneura caucasia Loginova

Reported from ARTVİN (BURCKHARDT, 1988) (examined).

Spanioneura turkiana (Klimaszewski & Lodos)

Amlyrhina turkiana KLIMASZEWSKI & LODOS, 1977: 3. Holotype ♂, Turkey: Elazığ, Harput, 15.vi.1976, *Amygdalus communis* (depository unknown), not traced.

Spanioneura turkiana (Klimaszewski & Lodos); HODKINSON & HOLLIS, 1987: 11.
Amblyrhina pechai KLIMASZEWSKI & LODOS, 1977: 4. Holotype ♀, Turkey: Mardin, 3.vi.1976, *Prunus domestica* (depository unknown), not traced. **Syn. n.**
Spanioneura pechai (Klimaszewski & Lodos); HODKINSON & HOLLIS, 1987: 11.

Reported from MALATYA, ADIYAMAN, ELAZIG, SİİRT (as *Amblyrhina turkiana*) (KLIMASZEWSKI & LODOS, 1977, 1979) (examined); from MARDİN (as *Amblyrhina pechai*) (KLIMASZEWSKI & LODOS, 1977).

Additional material examined: ELAZIĞ: Harput, 20.vi.1977, *Amygdalus communis*; Harput, 1977 (Badem) (JMUL).

Comment. According to the original descriptions (KLIMASZEWSKI & LODOS, 1977), *A. pechai* differs from *A. turkiana* only in the shape of cell m1+2 and the forewing coloration. The material at hand, paratypes and locotypical specimens of *A. turkiana*, is slightly variable in respect to these characters indicating that they are of intraspecific, rather than specific significance. The holotypes were unavailable for examination, as, contrary to the indications of KLIMASZEWSKI & LODOS (1977), they are preserved neither in the Aegean University İZMİR (Lodos, pers. comm.), nor in the Silesian University, Aegean University, Katowice. Despite the absence of the holotypes, the two taxa are synonymised here.

CALOPHYIDAE

Calophya rhois (Löw)

Reported from ARTVİN (BURCKHARDT, 1988) (examined).

HOMOTOMIDAE

Homotoma ficus (L.)

Reported from İZMİR (as *Homotoma viridis*) (KLIMASZEWSKI & LODOS, 1977, 1979; ÖNUÇAR, 1983); ARTVİN (as *H. viridis*) (BURCKHARDT, 1988) (examined).

Additional material examined: İZMİR: Ödemiş and Tire, viii-ix.1984, *Castanea sativa* (A. Önuçar & O. Ulu). ADANA: Hasanbeyli, 20.viii.1979, *Malus sylvestris* (A. Yigit).

Comment. There are different opinions regarding the validity of *Homotoma viridis* Klimaszewski. Based on the adult morphology, BURCKHARDT (1989a) concluded that *H. viridis* is synonymous with *H. ficus*. Differences in the number of the larval marginal sectasetae, on the other hand, were used by RAPISARDA (1989) to show specific distinctness of the two taxa. We attribute the latter differences also to individual, intraspecific differences and follow the concept of BURCKHARDT (1989a).

TRIOZIDAE

Egeirotrioza populi (Horvath)

Reported from KARS (BURCKHARDT, 1988) (examined).

Eutrioza opima Loginova

Reported from KONYA (as *E. bifasciata*) (KLIMASZEWSKI & LODOS, 1980).

Trioza achilleae Wagner

Reported from ARTVİN, KARS (BURCKHARDT, 1988) (examined).

Trioza alacris Flor

Reported from İZMİR (as *Heterotrioza alacris*) (KLIMASZEWSKI & LODOS, 1979; ÖNUÇAR, 1983).

Additional material examined: İSTANBUL: İstanbul, 29.vii-4.viii.1925 (G. Edwards) (BMNH). İZMİR: Seferihisar, Teos, 4.v.1990, *Laurus nobilis* (D. Burckhardt) (MHNG).

Trioza albiventris Förster

Reported from ANKARA (VONDRÁČEK, 1953); TUNCELİ, KARS (as *Bactericera albiventris*) (BURCKHARDT, 1988) (examined).

Additional material examined: KONYA: 30 km S Beyşehir, 15.xi.1965, *Salix* (G. Remaudière) (MNHN).

Trioza anthrisci Burckhardt

Reported from ARTVİN, KARS (BURCKHARDT, 1988) (examined).

Trioza brassicae Vasil'ev

Reported from GÜMÜŞHANE (as *Bactericera brassicae*) (BURCKHARDT, 1988) (examined).

Trioza centranthi (Vallot)

Material examined: SAKARYA: Sapanca Gölü, 13.vi.1970, no. 1 (Exp. Nat. Mus. Praha) (NMP). ÇANKIRI: Ilgaz Dağları, Ilgazdagı Geçidi, 24.vi.1966, *Valeriana* sp. (G. Remaudière) (MNHN).

Trioza crithmi Löw

Reported from ANKARA, ADANA (VONDRÁČEK, 1953).

Trioza foersteri Meyer-Dür

Material examined: SAKARYA: Sapanca Gölü, 13.vi.1970, no. 1 (Exp. Nat. Mus. Praha) (NMP).

Trioza galii Förster

Reported from URFA (as *Trioza galli* (sic!)) (KLIMASZEWSKI & LODOS, 1979); KARS (BURCKHARDT, 1988) (examined).

Additional material examined: AYDIN: Priene, 30.iv.1990, swept from low vegetation (D. Burckhardt) (MHNG).

Trioza ilicina (de Stefani)

Material examined: KONYA: 30 km S Beyşehir, 15.xi.1965, *Quercus* sp. (G. Remaudière) (MNHN); same but 40 km S Beyşehir. ADANA: 55 km E Osmaniye, 19.xi.1965, *Quercus coccifera* (G. Remaudière) (MNHN).

Trioza kantshavelii Gegechkori

Reported from ARTVİN (BURCKHARDT, 1988) (examined).

Trioza magnisetosa Loginova

Reported from İÇEL, ADANA (as *Heterotrioza magnisetosa*) (KLIMASZEWSKI & LODOS, 1977).

Additional material examined: NEVŞEHİR: Ürgüp, 15.vi.1970 , no. 6 (Exp. Nat. Mus. Praha) (NMP). TUNCELİ: Munzur Dağları, Pülümür Pass, 1955 m, 17.vi.1970, no. 17 (Exp. Nat. Mus. Praha) (NMP).

Trioza neglecta Loginova

Reported from NEVŞEHİR (LOGINOVA, 1978); URFA, ELAZIĞ (as *Heterotrioza neglecta*) (KLIMASZEWSKI & LODOS, 1979); KARS (BURCKHARDT, 1988) (examined); ADANA (LAUTERER & JANIČEK, 1990).

Additional material examined: BURDUR: 22.vi.1983, *Vitis vinifera*. KONYA: Ereğli, 13.xi.1965, *Elaeagnus angustifolius* (G. Remaudière) (MNHN). ADANA: Pozantı, 25.viii.1979, *Malus sylvestris* (A. Yigit). NIĞDE: Ulukışla, 2.v.1979, on weeds. NEVŞEHIR: Gülşehir, 16.viii.1979, *Elaeagnus angustifolia*; Ürgüp, 15.vi. 1970, no. 6 (Exp. Nat. Mus. Praha) (NMP).

Trioza nigricornis Förster

Reported from ANKARA (VONDRÁČEK, 1953).

Material examined: BURDUR: Karamanlı, 21.vi.1983, *Cicer arietinum*. ANKARA: Sereflikoçhisar, 25.vii.1983 (A. Kalkandelen). KONYA: Ereğli, 7.x.1969; İvriz (=Aydınkent), Ereğli, 16.vi.1966, *Astragalus* sp. (G. Remaudière) (MNHN). TUNCELI: Munzur Dağları, Pülümür Pass, 1955 m, 17.vi.1970, no. 17 (Exp. Nat. Mus. Praha) (NMP). AĞRI: Tahir, 2400 m, 18.vi.1970, no. 21 (Exp. Nat. Mus. Praha) (NMP).

Comment. VONDRÁČEK's (1953) record needs verification as it may concern other members of the *T. nigricornis* group.

Trioza remota Förster

Reported from İZMİR (ÖNUÇAR & ULU, 1991) (examined).

Additional material examined: İÇEL: N Tarsus, 300 m, 22.xii.1965, *Quercus* sp. (G. Remaudière) (MNHN).

Trioza rhamni (Schrank)

Reported from KARS (BURCKHARDT, 1988) (examined).

Trioza scottii Löw

Reported from KONYA (as *Heterotrioza scotti* (sic!)) (KLIMASZEWSKI & LODOS, 1980).

Trioza tremblayi Wagner

Reported from ERZURUM (as *Bactericera tremblayi*) (KLIMASZEWSKI & LODOS, 1979).

Material examined: KONYA: Ereğli, 9.x.1969, *Raphanus sativus* (A. Kalkandelen). GÜMÜŞHANE: 9.viii.1984, *Allium cepa* (K. Serdar). ERZURUM: Erzurum, 15.vii.1975, *Allium cepa* (N. Lodos) (BMNH).

Trioza trigonica Hodkinson

Reported from İZMİR (HODKINSON, 1981) (examined).

Additional material examined: SAKARYA: Adapazarı, viii.1980, yellow tray (F. Ereslan) (BMNH).

Trioza trisignata Löw

Reported from İZMİR (ÖNUÇAR & ULU, 1991) (examined).

Trioza urticae (L.)

Reported from İÇEL, ADANA (KLIMASZEWSKI & LODOS, 1979); ARTVİN (BURCKHARDT, 1988) (examined).

Trioza sp.

Material examined: NIĞDE: 50 km N Niğde, 21.vi.1966, *Chenopodium* sp. (G. Remaudière) (MNHN).

KEY TO ADULTS

1 Antennal flagellar segments flattened bearing long black setae. Male proctiger distinctly 2-segmented. On *Ficus carica*. .... Homotomidae: *Homotoma ficus* (L.)

– Antennal flagellar segments more or less cylindrical. Male proctiger 1-segmented, sometimes indistinctly subdivided.. 2

2 Basal portion of aedeagus straight. Forewings with costal break and pterostigma, anal break in distance of apex of Cu1b; cell cu1a much larger than m1+2, vein Cu1b distinctly longer than Cu1. On *Cotinus coggyria* (sic!), *Rhus* spp. .... Calophyidae: *Calophya rhois* (Löw)

– Basal portion of aedeagus U-shaped. Forewings with different combination of characters 3

3 Forewings with vein R+M+Cu1 bifurcating into R and M+Cu1; if trifurcating then anal break close to apex of vein Cu1b and metabasitarsus with 1 or 2 black spurs. Costal break and/or pterostigma often developed. .... Psyllidae 4

– Forewings with vein R+M+Cu1 trifurcating into R, M and Cu1 or bifurcating into R+M and Cu1, or R and M+Cu1; anal break distant from apex of vein Cu1b; costal break and pterostigma always absent. Metabasitarsus without black spurs. .... Triozidae 64

4 Metacoxae without meracanthus; trochanteral cavity with weakly sclerotised tubercle... Rhinocolinae 5

– Metacoxae with horn-shaped meracanthus; trochanteral cavity without tubercle... 10

5 Head in profile cuneate. Forewings with plate-like microsculpture basally. Propleurites situated on the ventral body surface. On *Acer* spp. .... *Rhinocola aceris* (L.)

– Head in profile rounded anteriorly. Forewings with spinules basally. Propleurites in lateral position. 6

6 Forewings without expanded pattern. Male parameres simple, lanceolate. 7

– Forewings with dark, sometimes very faint pattern forming a zig-zag band along outer margin. Male parameres with posterior process. On *Pistacia* spp... *Agonoscena* 8

7 Antenna length/head width ratio more than 1.5. Coronal suture fully developed. On *Pistacia* spp.......................... *Megagonoscena viridis* (Baeva)

– Antennae length/head width ratio less than 1.2. Coronal suture reduced basally. On *Cistus* spp. .... *Lisronia varicicosta* (Hodkinson & Hollis)

8 Forewings with two narrow brown bands in apical part, without continuous band stretching from base of pterostigma to apex of Cu1b, and without large dark patches in this area. Male parameres with large posterior lobe arising in

basal part of anterior lobe and about as long as the latter. Dorsal margin of female proctiger with large hump in the middle. On *Pistacia lentiscus*. .... *Agonoscena targionii* (Lichtenstein)

– Forewings with one broad dark band in apical part, and a continuous band or large patches in the middle, stretching from base of pterostigma to apex of Cu1b. Male parameres with small posterior lobe, arising in distal half. Dorsal margin of female proctiger concave or sinuous without large hump. 9

9 Vein C+Sc of forewings concave. Antennal segment 10 with both terminal setae distinctly longer than segment 10. Pattern of forewings very dark and well-defined. On *Pistacia* spp. .... *Agonoscena cisti* (Puton)

– Vein C+Sc of forewings convex. Antennal segment 10 with at least one terminal seta shorter than segmental length. On *Pistacia* spp. .... *Agonoscena pistaciae* Burckhardt & Lauterer

10 Vertex longer than large.. Liviinae: *Livia* 11

– Vertex larger than long.. 12

11 Antennal segment 2 long pear-shaped. Forewings oval. On *Juncus* spp. .... *Livia juncorum* (Latreille)

– Antennal segment 2 short, cylindrical. Forewings oblong with subparallel fore and hind margins. On *Carex* spp. .... *Livia crefeldensis* Mink

12 Head with large anterior flattened lobes enclosing median ocellus which is, therefore, visible only in dorsal view. .... Liviinae: *Euphyllura* 13

– Head different, either regularly rounded anteriorly, or with separated lobes or cones. Median ocellus visible in frontal and/or ventral view. 14

13 Pterostigma of forewings long, more than 3 times the distance between the apices of pterostigma and vein Rs; with transverse veins which are more or less well-developed. Parameres in profile short with flattened anterior lobe in apical two thirds. Apex of female proctiger pointed. On *Olea europaea*. .... *Euphyllura straminea* Loginova

– Pterostigma short, shorter than twice the distance between the apices of pterostigma and vein Rs; usually without transverse veins. Parameres in profile long with subparallel fore and hind-margins. Apex of female proctiger truncate. On *Olea europaea, Phillyrea latifolia, Osmanthus* spp. .... *Euphyllura phillyreae* Förster

14 Head with genal cones; apical metatibial spurs forming a crown. .... Diaphorininae 15

– Either head without genal cones or apical metatibial spurs grouped. 18

15 Antennae shorter than head width. Male parameres cuneiform. Aedeagus 3-segmented. Female subgenital plate ending in a single point apically. On *Thymelaea hirsuta*. .... *Diaphorina putonii* (Löw)

– Antennae longer than 1.5 times head width. Male parameres in profile complex, hammer or ax-shaped. Female subgenital plate ending in two points. On *Fraxinus* spp. .... *Psyllopsis* 16

16 Male parameres with large anterior and posterior lobes in apical half. Dorsal margin of female proctiger almost straight with indistinct subapical incision separating a short evenly tapering apical process. On *Fraxinus* sp. .... *Psyllopsis machinosus* Loginova

– Male parameres only with a large anterior lobe. Female proctiger with either strongly sinuous dorsal margin, or with long subparallel apical process. 17

17 Male parameres, in profile, strongly incised dorsally. Female proctiger with relatively long subparallel apical process. On *Fraxinus excelsior*. .... *Psyllopsis fraxinicola* (Förster)

– Male parameres, in profile, only weakly concave dorsally. Female proctiger truncate apically, without apical process. On *Fraxinus* sp. .... *Psyllopsis securicola* Loginova

18 Basal metatibial spine always absent. Apical metatibial spurs more or less evenly spaced, forming a crown, or grouped and then vertex flattened, rectangular with anterior lobes. 19

– Basal metatibial spine often developed. Apical metatibial spurs always grouped. Vertex trapezoidal; head with genal cones. 35

19 Metabasitarsus without black spurs. Posterior margin of male proctiger more or less straight.......... Paurocephalinae 20

– Metabasitarsus with two black spurs. Posterior margin of male proctiger bearing wing-like processes. .... Aphalarinae 24

20 Forewings without pterostigma; membrane covered in large tubercular microsculpture. Host plant unknown. .... *Aphorma lichenoides* (Puton)

– Forewings with distinct pterostigma; membrane covered in small spinules. On *Populus* spp. .... *Camarotoscena* 21

21 Body coloration and wing membrane orange, sometimes with light brown maculae. .... *Camarotoscena subrubescens* (Flor)

– Body coloration yellowish or ochreous with many fine dark brown spots. Forewings transparent or whitish with more or less strongly fused dark brown maculae. 22

22 Forewings transparent, with very fine surface spinules hardly visible at 50x magnification. .... *Camarotoscena hoberlandti* Vondráček

– Forewings semitransparent to whitish, with large surface spinules visible at 50x magnification. 23

23 Surface spinules of forewings dense, irregularly spaced. .... *Camarotoscena speciosa* (Flor)

– Surface spinules of forewings sparser, forming irregular, transverse rows. .... *Camarotoscena fulgidipennis* Loginova

24 Proepimeron much larger than proepisternum; propleural suture diagonal. 25

– Proepimeron and proepisternum subequal; propleural suture vertical. 28

25 Vertex rounded anteriorly, without lobes. Vein Rs of forewings turned towards outer wing margin. On *Myricaria* spp. ... *Crastina myricariae* Loginova

– Vertex forming two rounded, flattened lobes anteriorly. Vein Rs of forewings turned towards anterior wing margin. On *Tamarix* spp. .... *Colposcenia* ... 26

26 Forewing pattern consisting of irregularly distributed brown maculae on yellowish ground. Pterostigma very small or absent. Posterior lobes of male proctiger broad basally, evenly tapering to apex. .... *Colposcenia bidentata* Burckhardt

– Forewing pattern complex always with more or less expanded white patches in apical half. Pterostigma broad basally, well-developed. Posterior lobes of male proctiger in profile irregularly hexagonal. ………………… 27

27 Apices of veins along outer forewing margin with dark spots. Hindmargin of posterior lobes of male proctiger almost straight.
………………………………………………….. *Colposcenia aliena* (Löw)

– Apices of veins along outer forewing margin without dark spots. Hindmargin of posterior lobes of male proctiger distinctly concave.
……………………………………………… *Colposcenia osmanica* Vondráček

28 Vertex with distinct anterior lobes which are separated from the genae by a fine suture; lower head surface, between antennal insertion and eye, forming a pronounced tubercle. On *Rumex* sp.
……………………………………………… *Aphalara grandicula* (Gegechkori)

– Vertex with weakly developed anterior lobes which smoothly pass into the genae; lower head surface without tubercles. ……... *Craspedolepta* 29

29 Pattern of forewings consisting of well-defined, brown maculae. …………… 30

– Forewings without pattern or with indistinct spots or bands. ………………… 32

30 Body and forewing membrane witout setae. On *Artemisia absinthium, A. maritimum*. ………………………………*Craspedolepta malachitica* (Dahlbom)

– Body and forewings bearing setae. ………………………………………… 31

31 Setae on forewings short and inconspicuous. Male parameres in profile with angled posterior margin. Dorsal margin of female subgenital plate concave. On *Artemisia* sp. ………………… *Craspedolepta armazhi* Gegechkori

– Setae on forewings long, conspicuous. Male parameres in profile with almost straight posterior margin. Dorsal margin of female proctiger sinuate. On *Artemisia* sp.……………………… *Craspedolepta setosa* (Wagner)

32 Forewings transparent without brown pattern. …………………………… 33

– Forewings with indistinct fumose areas along the outer wing margin. ………. 34

33 Surface spinules arranged in irregular transverse rows. Male parameres with large triangular apex and long straight anterior process on inner surface. Female proctiger more than 4 times pore ring length. On *Daucus carota, Seseli* sp. …………………………… *Craspedolepta innoxia* (Förster)

– Surface spinules of forewings widely spaced, sometimes partially reduced; not forming transverse rows. Male parameres with rounded head-like apex, and with short, claw-like anterior process. Female proctiger shorter than 4 times pore ring length. On *Artemisia vulgaris*.
……………………………………………….... *Craspedolepta omissa* Wagner

34 Antennae 10-segmented. On *Achillea* spp.
……………………………………… *Craspedolepta bulgarica* Klimaszewski

– Antennae 9-segmented. On *Achillea* spp.
……………………………… *Craspedolepta pontica* Dobreanu & Manolache

35 Metabasitarsus without or with a single black spur. …… Arytaininae p. p....... 36

– Metabasitarsus with two black spurs. ……………………………………… 39

36 Genal cones about half vertex length. On *Calicotome* spp.
…………………………………………………… *Arytainilla cytisi* (Puton)

– Genal cones longer than 3/4 vertex length. …………………..... *Livilla* ….. 37

37 Forewing pattern consisting of two subparallel brown bands, one along apical part of vein Rs and one stretching from apex of vein M1+2 to bifurcation of M+Cu1. On *Chamaecytisus austriacus*. . *Livilla horvathi* (Scott)

– Forewing pattern not consisting of two bands. 38

38 Forewing pattern consisting of dark brown maculae. Genal cones about as long as vertex. Antennae shorter than 3.4 mm. On *Genista acanthoclada*. .... *Livilla hodkinsoni* (Burckhardt)

– Forewing pattern consisting of indistinctly delimited brown area in apical part. Genal cones longer than 1.3 times vertex length. Antennae longer than 3.4 mm. On *Spartium junceum*. .... *Livilla spectabilis* (Flor)

39 Forewings with long cell m1+2 and high cell cu1a. Male parameres truncate apically. .... Arytaininae: *Cyamophila* 40

– Forewings with shorter and lower m1+2 and cu1a cells. Male parameres different.. Psyllinae 41

40 Forewings, along outer margin, with dark spots in the middle of cells m1+2, m3+4 and cu1a, sometimes very faint. Vertex flattened. Male parameres with large postero-apical tooth. Dorsal margin of female proctiger almost straight. On *Glycyrrhiza* spp.
.... *Cyamophila glycyrrhizae* (Becker)

– Forewings, along outer wing margin, without dark spots. Vertex with strongly indented pits. Male parameres with large antero-apical tooth. Dorsal margin of female proctiger distinctly sinuous. On *Astragalus* spp.
.... *Cyamophila stoklosai* Klimaszewski & Lodos

41 Antennae longer than twice head width................................. *Psylla* 42

– Antennae shorter than twice head width. 43

42 Veins of forewings, apart from marginal vein and pterostigma dark brown to black; wing membrane clear. Apex of distal aedeagal segment weakly expanded. Dorsal margin of female proctiger almost straight. On *Alnus* spp. .... *Psylla alni* (L.)

– Forewings with yellow veins and membrane. Apex of distal aedeagal segment distinctly expanded, rounded. Dorsal margin of female proctiger distinctly concave, serrate apically. On *Alnus* spp. .... *Psylla foersteri* (Flor)

43 Forewings rhomboidal.. *Spanioneura* 44

– Forewings oblong-oval. .... *Cacopsylla* 45

44 Genal cones about three quarters vertex length, pointed apically. Male parameres pointed apically. On *Buxus sempervirens*. ....
.... *Spanioneura caucasica* Loginova

– Genal cones about half vertex length, broadly rounded apically. Male parameres truncate apically. Host plant unknown, perhaps on *Amygdalus communis*. .... *Spanioneura turkiana* (Klimaszewski & Lodos)

45 Forewings without dark pattern; pterostigma regularly tapering, triangular; surface spinules in cell c+sc restricted to apex or completely absent; always absent from base of cell rs proximal to bifurcation of vein R; leaving broad spinule-free stripes along the veins; fields of spinules tapering along outer wing-margin; spinules more or less evenly spaced in about 20 µ distance to form rhombes or squares. 46

– Combination of characters absent. 47

46 Antennae shorter than 1.2 mm. On *Crataegus* spp. .... *Cacopsylla peregrina* (Förster)

– Antennae longer than 1.3 mm. On *Malus* spp. ... *Cacopsylla mali* (Schmidberger)

47 Surface spinules of forewings densely spaced in 2-10 μ distance; forewings with brown band along outer wing margin. Male subgenital plate with terminal hump. Female proctiger and subgenital plate with spiniform apex. On *Sorbus aria*. .... *Cacopsylla breviantennata* (Flor)

– Surface spinules more or less evenly spaced in about 20 μ distance to form rhombes, squares, or irregular transverse rows. 48

48 Cells m1+2 and cu1a of forewing very long; vein M1+2 almost as long as M, and vein Cu1a distinctly longer than Cu1; pterostigma short. Forewings elongate, narrow, widest in about the middle. On *Spiraea* sp. .... *Cacopsylla fasciata* (Löw)

– Cells m1+2 and cu1a of forewings shorter; vein M1+2 distinctly shorter than M, and vein Cu1a shorter than Cu1; pterostigma long. Forewing broader. 49

49 Upper surface spinules of forewings covering the whole cell c+sc apart from narrow stripes along the veins, in other cells forming broad fields, which are tapering apically towards outer wing margin; spinules present in cell rs proximal to bifurcation of vein R; without dark, contrasting patch along vein Cu1b. 50

– Combination of characters absent. 52

50 Antennae usually longer than 1.2 mm. Genal processes broad and widely rounded apically. Parameres broad, lanceolate. Dorsal margin of female proctiger with hump in the middle and narrowly rounded apically. On *Pyrus* spp. .... *Cacopsylla pyrisuga* (Förster)

– Antennae usually shorter than 1.1 mm. Parameres narrow of with two apical processes. Female proctiger either with concave dorsal margin in the middle or distinctly truncate apically. 51

51 Parameres, in profile, with rectangular base bearing two apical processes. Dorsal margin of female proctiger concave distal to anus, apex narrowly rounded. On *Malus sylvestris*. .... *Cacopsylla costalis* (Flor)

– Parameres, in profile, lanceolate, narrowing to apex. Dorsal margin of female proctiger with hump in the middle, apex truncate. On *Crataegus* spp. .... *Cacopsylla affinis* (Löw)

52 Surface spinules present in all cells forming broad fields; apart from narrow stripes along the veins, covering the whole surface of cell c+sc; spinules present in basal part of cell rs proximal to bifurcation of vein R; fields in apical part not tapering towards wing margin. 53

– Combination of characters absent. 54

53 Parameres in profile with large postero-basal lobe. On *Salix* spp. .... *Cacopsylla saliceti* (Förster)

– Parameres in profile without postero-basal lobe. On *Salix* spp. ....*Cacopsylla moscovita* (Andrianova)

54 Forewings with dark band, patches or spots along outer margin, or with infuscate membrane around vein Cu1b contrasting from adjacent area. 55

– Forewing pattern different; membrane adjacent to vein Cu1b light or concolorous with sourrounding area... 58

55 Pattern of forewings consisting of well defined dark patches at the apices of pterostigma and veins Rs, M1+2, M3+4, Cu1a and Cu1b, as well as more or less interrupted band from apex of vein Rs to the middle of vein Cu1a. On *Cercis siliquastrum*. .... *Cacopsylla pulchella* (Löw)

– Pattern of forewings different. 56

56 Membrane adjacent to vein Cu1b of forewings and clavus infuscate, otherwise clear. On *Sorbus aria*. .... *Cacopsylla albipes* (Flor)

– Wings with brown band along outer margin. 57

57 Surface spinules, apart from radular spinules, in apical half of forewings absent; apices of veins on outer wing margin light. On *Rhamnus pallasii*. .... *Cacopsylla incerta* (Loginova)

– Surface spinules in apical half of forewings present; apices of veins along outer wing margin dark. On *Crataegus* spp. .... *Cacopsylla mariannae* (Baeva)

58 Forewings with brown clavus. On *Pyrus* spp. 59

– Forewings with clavus of the same colour as surrounding membrane. On Rhamnaceae or Elaeagnaceae 61

59 Parameres sickle-shaped. Female proctiger with strong constriction in the middle.. *Cacopsylla pyri* (L.)

– Parameres in profile lamellar. Female proctiger cuneate. 60

60 Parameres with forward directed apical tooth; fore-margin constricted in basal third. Dorsal segment of aedeagus with weakly curved apical dilatation. Female proctiger often clearly exceeding subgenital plate. .... *Cacopsylla permixta* Burckhardt & Hodkinson

– Parameres with inwardly directed blunt apex, fore-margin not constricted. Distal segment of aedeagus with apical dilatation forming a hook. Female proctiger only slightly exceeding subgenital plate. .... *Cacopsylla notata* (Flor)

61 Surface spinules forming broad fields in apical half of forewings. 62

– Surface spinules forming narrow stripes in apical half of forewings. 63

62 Body coloration green. Wings yellowish. Host plant unknown. .... *Cacopsylla* cf. *hippophaes* (Förster)

– Body coloration brown. Wings ochreous to brown. On *Hippophaë rhamnoides*...................................... *Cacopsylla zetterstedti* (Thomson)

63 Antennae shorter than 1.1 mm. On *Rhamnus* spp. ..... *Cacopsylla myrthi* (Puton)

– Antennae longer than 1.3 mm. On *Rhamnus catharticus*. .... *Cacopsylla rhamnicola* (Scott)

64 Forewings with vein R+M+Cu1 bifurcating into veins R+M and Cu1. Host plant unknown.. *Eutrioza opima* Loginova

– Forewings with vein R+M+Cu1 strictly trifurcating into R, M and Cu1, or bifurcating into R and M+Cu1. 65

65 Forewings with vein R+M+Cu1 indistinctly bifurcating into R and M+Cu1; vein Cu1b almost as long as Cu1. On *Populus* spp. .... *Egeirotrioza populi* (Horvath)

– Forewings with vein R+M+Cu1 strickly trifurcating into R, M and Cu1; vein Cu1b less than half as long as Cu1. .... *Trioza* 66

66 Metatibiae with 1+3 black apical spurs. 67

– Metatibiae with 1+2 black apical spurs. 73

67 Vein Rs of forewings short, more or less concave. 68

– Vein Rs of forewings long, sinuous. 69

68 Genal processes long. Terminal setae on antennal segment 10 strongly unequal. Parameres in apical quarter regularly narrowed to apex. Female subgenital plate evenly tapering to apex, dorsal margin more or less straight. On *Galium* spp., *Sherardia arvensis*. .... *Trioza galii* (Förster)

– Genal processes short. Terminal setae on antennal segment 10 subequal. Parameres, in profile, strongly narrowed in apical quarter forming an anterior and a posterior process. Female subgenital plate truncate apically, dorsal margin consequently strongly convex. On *Centranthus* spp., *Valerianella* spp., *Fedia cornucopiae*. .... *Trioza centranthi* (Vallot)

69 Forewings, apart from radular spinules, without surface spinules in apical half. Parameres simple, slender, pointed apically. Female terminalia long. Dorsal margin of proctiger almost straight. On *Urtica* spp. .... *Trioza urticae* (L.)

– Forewings with surface spinules in apical half. 70

70 Thoracic dorsum and abdomen orange reddish, dark brown or black. Terminal setae on antennal segment 10 strongly unequal; shorter seta very short, annular, truncate.. 71

– Thoracic dorsum and abdomen green or yellow. Terminal setae on antennal segment 10 subequal; shorter seta several times longer than wide at base. 72

71 Genal processes short triangular; their axes converging towards the apex. On *Mycelis muralis, Prenanthes purpurea*. .... *Trioza foersteri* Meyer-Dür

– Genal processes long, fusiform; their axes subparallel. On *Rhamnus* spp. .... *Trioza rhamni* (Schrank)

72 Apical sclerotized process of male parameres with pronounced postero-apical angle. Female proctiger short, with almost straight or slightly concave dorsal margin and rounded apex. On *Achillea* spp. .... *Trioza achilleae* Wagner

– Apical sclerotized process of male terminalia rounded postero-apically. Female proctiger long, with strongly concave dorsal margin, and truncate apex. Host plant unknown. .... *Trioza kantshavelii* Gegechkori

73 Bifurcation of vein M of forewings distinctly distal to line from apices of veins Rs to Cu1a. 74

– Bifurcation of vein M of forewings on, or proximal to line from apices of veins Rs to Cu1a. 77

74 Vein Rs of forewings sinuous to almost straight; vein M1+2 more than twice the length of vein M3+4; fore margin of forewings strongly arched, hind margin only weakly curved. Male proctiger with large posterior lobes. Female proctiger long. On *Rubus* spp. .... *Trioza trisignata* Löw

– Vein Rs of forewings concave; vein M1+2 less than twice as long as M3+4; fore margin of forewings only slightly stronger curved than hind margin. Hind margin of male proctiger weakly produced. Female terminalia short. 75

75 Forewings narrow, more than 2.7 times as long as wide, without surface spinules in apical half. On *Laurus* spp. .... *Trioza alacris* Flor

– Forewings wide, less than 2.7 times as long as wide, with surface spinules. 76

76 Surface spinules present in all cells of forewings, forming large fields. On deciduous *Quercus* spp. .... *Trioza remota* Förster

– Surface spinules largely reduced in apical half of forewings. On evergreen *Quercus* spp. .... *Trioza ilicina* (de Stefani)

77 Forewings with surface spinules in apical half developed. 78

– Forewings without surface spinules in apical half. 79

78 Male parameres in profile triangular, distinctly shorter than proctiger. Female subgenital plate with styliform apical process. Oligophagous on Apiaceae, particularly on *Anthriscus* spp. .... *Trioza anthrisci* Burckhardt

– Male parameres slender, in profile sinuous, about as long as proctiger or longer. Female subgenital plate without styliform apical process. On *Salix* spp. .... *Trioza albiventris* Förster

79 Genal cones longer than half vertex length. 80

– Genal cones shorter than half vertex length. 83

80 Vein M of forewings more than 3 times as long as M1+2. Male proctiger with long, wing-like posterior lobes. On *Crithmum maritimum*. .... *Trioza crithmi* Löw

– Vein M of forewings less than twice as long as M1+2. Male proctiger produced posteriorly but without wing-like processus. 81

81 Body coloration ochreous or brown with more or less expanded dark brown pattern. Forewing length less than 3.0 mm. On *Berberis vulgaris*. .... *Trioza scottii* Löw

– Body coloration green or yellow. Forewing length over 3.7 mm. On *Elaeagnus* spp. 82

82 Posterior lobes of male proctiger large semicircular. Female proctiger with long dorsal setae ending almost at apex of proctiger. On *Elaeagnus angustifolia*. .... *Trioza neglecta* Loginova

– Posterior lobes of male proctiger narrow. Female proctiger with long dorsal setae ending at about the middle of apical process. On *Elaeagnus angustifolia*. .... *Trioza magnisetosa* Loginova

83 Forewings narrow, widest in the middle; vein Rs relatively short and straight. Male proctiger in profile triangular, parameres slender in apical half. On *Daucus carota*. .... *Trioza trigonica* Hodkinson

– Forewings broad, widest in apical third; vein Rs longer and strongly sinuate. Male proctiger in profile broadly rounded, parameres relatively broad in apical half.. 84

84 Male parameres in profile relatively broad, apex broadly truncate. Distal segment of aedeagus with longer basal shaft and relatively small rounded apical dilatation. Genal cones more slender. Polyphagous, often on *Allium cepa*. .... *Trioza tremblayi* Wagner

– Male parameres in profile relatively slender, apex obliquely truncate. Distal segment of aedeagus with relatively short basal shaft and large, subrectangular apical dilatation. Genal cones more broadly rounded. 85

85 Third antennal segment dark brown to black. Polyphagous. .... *Trioza nigricornis* Förster

– Third antennal segment clear. Polyphagous. .... *Trioza brassicae* Vasil'ev

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REFERENCES

AULMANN, G., 1913. Psyllidarum Catalogus. W. Junk, Berlin, 92 pp.

BURCKHARDT, D., 1979. *Floria hodkinsoni* sp. n., eine neue Psyllide aus Griechenland (Sternorrhyncha, Psyllodea). *Mitt. schweiz. ent. Ges.* 52: 391-393.

– 1984. The Mediterranean species of *Diaphorina* Löw (Homoptera, Psylloidea). *Phytophaga, Palermo* 2: 1-30.

– 1988. Angaben zur Psyllidenfauna der Nordosttürkei (Homoptera: Psylloidea). *Mitt. ent. Ges. Basel* 38: 31-44.

– 1989a. Les psylles (Insecta, Homoptera, Psylloidea) de l'Algérie. *Archs. Sci. Genève* 42: 367-424.

– 1989b. Zur Kenntnis einiger westpaläarktischer Ginsterblattflöhe (Homoptera, Psylloidea). *Mitt. schweiz. ent. Ges.* 62: 315-322.

BURCKHARDT, D. & HALPERIN, J., 1992. Additions to the psyllid fauna of Israel (Homoptera: Psylloidea). *Israel J. Ent.* 25-26: 41-50.

BURCKHARDT, D. & HODKINSON, I. D., 1986. A revision of the west Palaearctic pear psyllids (Hemiptera: Psyllidae). *Bull. ent. Res.* 76: 119-132.

BURCKHARDT, D. & LAUTERER, P., 1989. Systematics and biology of the Rhinocolinae (Homoptera: Psylloidea). *J. nat. Hist.* 23: 643-712.

ÇELIK, M., Y., 1981. Gaziantep ve çevresinde antep fıstıklarında Psylloidea'ya bağlı önemli zararlı türlerin tanınmaları, yayılışları, konukçuları, kısa biyolojileri ve dogal düsmanlari üzerinde arastirmalar. *T. C. Tar. Orm. Bak. Zir. Müc. ve Zir. Kar. Gn. Md. Adana Bölge Zir. Müc. Ar. Enst. Md. Ar. Eserl. Ser.* No. 51, 108 pp.

DAVIS, P. H., 1965-1988. Flora of Turkey. 10 vols. The University Press, Edinburgh.

ERINÇ, S., 1959. Regional and seasonal distribution of climatic elements in Turkey and its dynamic-genetic background. *Rev. geogr. Inst. Univ. Istanb.* 5: 23-76.

– 1984. Klimatoloji ve Metodları. (3rd ed.). Istanbul Univ. Yay. No. 3278, *Deniz Bilimleri ve Coğrafya Enst. Yay. No. 2. Gür-Ay Matbaası, İstanbul*, lx+529 pp.

GEGECHKORI, A. M., 1984. Psillidy (Homoptera, Psyllodea) Kavkaza. *Akad. Nauk Gruz. SSR*, 296 pp.

GEGECHKORI, A., M. & LOGINOVA, M. M., 1990. Psillidy (Homoptera, Psylloidea) SSSR. *Gosudarstv. Muzei Grusii*, Tbilisi, 164 pp.

HODKINSON, I. D., 1981. Status and taxonomy of the *Trioza (Bactericera) nigricornis* Förster complex (Hemiptera: Triozidae). *Bull. ent. Res.* 71: 671-679.

HODKINSON, I. D. & HOLLIS, D., 1987. The legume-feeding psyllids (Homoptera) of the west Palaearctic Region. *Bull. Br. Mus. nat. Hist. (Ent.)* 56: 1-86.

HODKINSON, I. D. & WHITE, I. M., 1979. Homoptera, Psylloidea. *Handbk Ident. of Br. Insects* 2(5a), 98 pp.

KLIMASZEWSKI, S. M., 1973. The jumping plant lice or psyllids (Homoptera, Psyllodea) of the Palaearctic. An annotated check-list. *Annls zool. Wars.* 30: 155-286.

KLIMASZEWSKI, S. M. & LODOS, N., 1977. New information about jumping plant lice of Turkey (Homoptera: Psylloidea). *Ege Üniversitesi Ziraat Fakültesi Dergisi* 14: 1-9.

KLIMASZEWSKI, S. M. & LODOS, N., 1979. Further data about jumping plant lice of Turkey (Homoptera, Psylloidea). *Türk. Bit. Kor. Derg.* 3: 3-16.

– 1980. Three new species of jumping plant lice (Homoptera, Psylloidea) from Turkey. *Türk. Bit. Kor. Derg.* 4: 219-227.

KOÇMAN, A., 1991. Türkiye İklimi. Ege Üniv. Edebiyat Fak. Coğrafya Böl. (Unpublished).

LAUTERER, P. & JANIČEK, R., 1990. *Trioza neglecta* Loginova, a new species for the fauna of Hungary and Bulgaria (Homoptera, Psylloidea). *Folia ent. hung.* 51: 163-165.

LODOS, N. & ÖNUÇAR, A., 1985. The review of the Turkish species of the genus *Agonoscena* Enderl. (Homoptera: Psylloidea: Aphalaridae). *Türk. Bit. Kor. Derg.* 9: 231-236. (In Turkish).

LOGINOVA, M. M., 1972. On the fauna of Psylloidea (Homoptera) from Morocco. *Commentat. biol.* 47: 37 pp.

– 1974. Systematics of the family Liviidae (Homoptera, Psylloidea). *Zool. Zh.* 53: 858-864. (In Russian).

– 1975. A revision of the genus *Camarotoscena* Haupt (Psylloidea, Aphalaridae). *Ent. Obozr.* 54: 43-61. (In Russian).

– 1978. Novye vidy psillid (Homoptera, Psylloidea). *Tr. zool. Inst.* 61: 30-123.

ÖNUÇAR, A., 1983. İzmir ve Çevresinde Bitkilerde Zararlı psyllid (Homoptera: Psyllinea) Türlerinin Tanınmaları Konkçuları ve Taksonomileri Üzerinde Araştırmalar. *T. C. Tar. Orm. Bak. Zir. Müc. ve Zir. Kar. Gn. Md. İzmir Bölge Zir. Müc. Ar. Enst. Md. Ar. Eserl. Ser.* No. 44: 122 pp.

ÖNUÇAR, A. & ULU, O., 1991. Five jumping plant lice species (Homoptera, Psylloidea) new for Turkish fauna. *Türk. entomol. derg.* 15: 153-155.

RAPISARDA, C., 1989. Presenza in Sicilia della psilla verde del fico (*Homotoma viridis* Klimaszewski) e descrizione della sua ninfa di ultima età. *Boll. Soc. ent. ital., Genova,* 121 (1): 13-18.

SAMY, O., 1973. Psyllids of Egypt. *Bull. Soc. ent. Egypte* 56: 437-480.

VONDRÁČEK, K., 1953. Results of the zoological scientific expedition of the National Museum in Praha to Turkey. 14. Hemiptera III. Homoptera-Psyllinea. *Acta ent. Mus. natn. Pragae* 27: 435-450.

ZOHARY, M., 1973. Geobotanical Foundations of the Middle East. Gustav Fischer Verlag, Stuttgart, 739 pp.

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New species in the genus *Stilicastenus* Coiffait (Coleoptera, Staphylinidae, Paederinae, Astenina) 27th contribution to the knowledge of Staphylinidae

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New species in the genus *Stilicastenus* Coiffait (Coleoptera, Staphylinidae, Paederinae, Astenina) 27th contribution to the knowledge of Styphylinidae. - *Stilicastenus* Coiffait, a distinctive genus in the subtribe Astenina, was hitherto known only by the female types of *S. fasciatus* Coiffait from Nepal. New taxa are here described from southern India, Ceylon, continental S.E. Asia and Borneo. The genus is remarkable for the great variation in the shape of the anterior margin of the labrum. Species exhibit four main types of labrum, each particular to a geographic area. The outline of the labrum of the type species thus cannot be used to define this genus.

Key-words: Coleoptera - Styphylinidae - Paederinae - *Stilicastenus* - taxonomy.

A series of beetles which I collected in the Kathmandu Valley in February 1982, belonging to a distinctive genus that was as yet unknown to me, was readily identified from Coiffait's description as *Stilicastenus fasciatus* Coiff. The following month I collected another series in northern Thailand which obviously represented a new species of *Stilicastenus*. This species is remarkably similar to *S. fasciatus*, even in punctuation and colour pattern, differing only slightly in the outline of the forebody and in the shape of the ventral blade of the aedeagus. The new species left me perplexed however, because the labrum was distinctly lobed, whereas the anterior margin of the labrum of *Stilicastenus fasciatus* is evenly rounded, unnotched and unlobed.

Subsequently the collections of the Geneva Natural History Museum and the BMNH revealed further new species, all immediately recognisable as *Stilicastenus*, but showing yet more extreme variations in the shape of the labrum (Fig. 5). They are described below. A brief redescription of the genus is given, as well as a redescription of *S. fasciatus*, for the sake of comparisons with the new taxa.

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Stilicastenus Coiffait

Stilicastenus Coiffait 1975: 172. Type species: *Stilicastenus fasciatus* Coiffait.

Fascies characteristic (Figs 1, 2), resembling *Rugilus* (*Eurystilicus*) *ceylanensis*, but body more depressed, pronotum broader, and smaller eyes equidistant from anterior and posterior margins of head. Punctuation of head and pronotum finely reticulate-umbilicate (much more finely than in most *Astenus*, *Stilicopsis* and *Dibelonetes*).

Prosternum entirely keeled; mesosternum not keeled; ventral surface of abdomen keeled at base between posterior coxae. Anterior and middle coxae connate, elongate.

Antennae long, slender, all antennomeres elongate, the last three equal or sub-equal in length, the last only slightly thicker than preceding two.

Labrum variable, the anterior margin either evenly rounded or more or less deeply lobed or toothed (Figs 1, 2), the lobes or teeth all on the same plane. Mandibles long, slender, devoid of prostheca, built as in *Astenus*. Maxillae with short galea and lacinia, internally (distally) covered in dense fine pubescence; 1st segment of palpi 3 times as long as broad; 2nd segment about 5 times as long as broad; 3rd slightly shorter than 2nd; 4th minute, subulate. Mentum transverse. First segment of labial palpi 3 times as long as broad; 2nd a little shorter, furnished with a long black seta just before apex and external to the 4th segment which is subulate.

Anterior tibia with a rather deep concavity on inner face in basal half, furnished internally with a broad whitish ctenidium, externally with 3-4 fine black setae. Meso- and especially metatibia obliquely truncate apically. Tarsi simple, slender; tarsomere I almost as long as II and III together, longer than V. Fourth tarsomeres neither lobed nor thickened.

Aedeagus simple, the ventral blade fused to median lobe; lateral lobes not visible; parameres absent; internally devoid of sclerotised structures.

Key to the species of *Stilicastenus*

1 (2) Labrum simple, the anterior margin evenly rounded, devoid of a median emargination (Fig. 1.1). Nepal, Sikkim .... *fasciatus* Coiff.
2 (1) Labrum with a distinct median emargination and lateral lobes or teeth 3
3 (10) Labrum quadri-sinuate, i.e. the median emargination feeble, the anterior margin on either side produced into two slight lobes (Figs 1.2-5). SE Asia: Meghalaya south to Thailand 4
4 (5) Size (length ca 5 mm.) of *S. fasciatus*; outline of forebody: Fig. 1.2; colour of *S. fasciatus* (forma typica) or body entirely fuscous except yellow posterior margins of elytra (var. *niger* nov.). N. Thailand *siamensis* n. sp.
5 (4) Larger or smaller than *S. fasciatus*; colour as *fasciatus* or sightly darker, reddish-brown 6
6 (7) Larger (ca. 5.4 mm.): anterior margins of pronotum concave (Fig. 1.3). N. Thailand .... sp. A cf. *siamensis*
7 (6) Smaller (under 4.5 mm.) than *S. fasciatus* 8

8 (9) Larger (ca. 4.3 mm.); Fore-body: Fig. 1.4. Naga Hills .... sp. B cf. *siamensis*

9 (8) Smaller (3.2 mm.); Figs 1.5, 3.5, 4.5. Meghalaya .... *minor* n. sp.

10 (3) Labrum with a single blunt or acute lobe on either side of median emargination (not bisinuate) of with four acute equal teeth 11

11 (18) Labrum bi-lobed. S. India and Ceylon 12

12 (13) Larger (5.4-6 mm.), very elongate sp.; pronotum subparallel-sided; Figs 2.9, 4.9. Ceylon .... *elongatus* n. sp.

13 (12) Smaller (less than 5 mm.); pronotum trapezoidal 14

14 (15) Micropterous, elytra as long as pronotum, shorter than head; labrum deeply emarginate, with more acute lobes (fig. 27). Ceylon .. *micropterus* n. sp.

15 (14) Macropterous, elytra much longer than pronotum, longer than head; emargination of labrum shallower, the lobes blunt 16

16 (17) Punctuation of head and pronotum coarser, interstices of umbilicate-reticulate sculpture sharper, more prominent, tending to form longitudinal rugae on head; pronotum elongate. Figs 2.10, 3.10, 4.10. S. India .... *tamul* n. sp.

17 (16) Punctuation of head and pronotum finer, interstices less prominent, not longitudinally confluent on head; pronotum as broad as long. Fig. 2.9. Ceylon .... *sinhala* n. sp.

18 (11) Labrum with four equal acute teeth. Figs 2.6, 3.6, 4.6. Borneo .... *borneensis* n. sp.

DESCRIPTIONS AND DATA

Stilicastenus fasciatus Coiffait

Stilicastenus fasciatus COIFFAIT, 1975: 172; COIFFAIT, 1982: 26.

In addition to the localities cited by Coiffait from around the Annapurna range, I can now record this species from a much wider range in central and eastern Nepal:

7 exx.: NEPAL, above Godavari, Kathmandu Valley, 13.III.1981 & 3.II.1982, G. de Rougemont (coll. m.); 2 exx.: E. NEPAL, Kosi Val. Induwa Khola 2100 m, 17.V.84, Löbl & Smetana (Mus. Geneva); 12 exx.: NEPAL: Taplejung Distr. SE Yamputhin 2000-1650 m, forest mainly *Alnus*, 26 & 30 Apr. 88, Martens & Schawaller; Taplejung Distr., Hellk in Tamur Valley, 2000 m, forest remnant, bushes, 17 May 1988, J. Martens & W. Schawaller; Sankhua Sabha Distr., Arun Valley, S Mure, tree rich cult. land 1900-2100 m, 8 June 1988, J. Martens & W. Schawaller; Sankhua Sabha Distr., Arun Valley, Chichila 1900-2000 m, *Quercus* forest, bushes, nr village, 18-20 June 88, Martens & Schawaller; Ilam Distr. betw. Ilam & Mai Pokhari 1600-2000 m, cult. land, trees, 9 April 1988. J. Martens & W. Schawaller; Ilam Distr., Gitang Khola Valley, *Alnus* forest along river, 1750 m, 11-13 April 1988, Martens & Schawaller (Mus. Stuttgart); 1 ex.: SIKKIM (in BMNH).

Length: 4.5-5.2 mm. Head and thorax rufous; basal half of elytra rufous, sometimes slightly paler than head and pronotum; third quarter of elytra occupied by an ill-defined transverse fuscous fascia, posterior quarter ochreous yellow; abdomen rufous, tergites V, VI and VIII, and sometimes IV fuscous; antennae, labrum and mandibles rufo-testaceous; palpi and legs testaceous. Variability: some specimens from eastern Nepal are slightly darker with more extensive elytral fascia and much reduced ochreous preapical area.

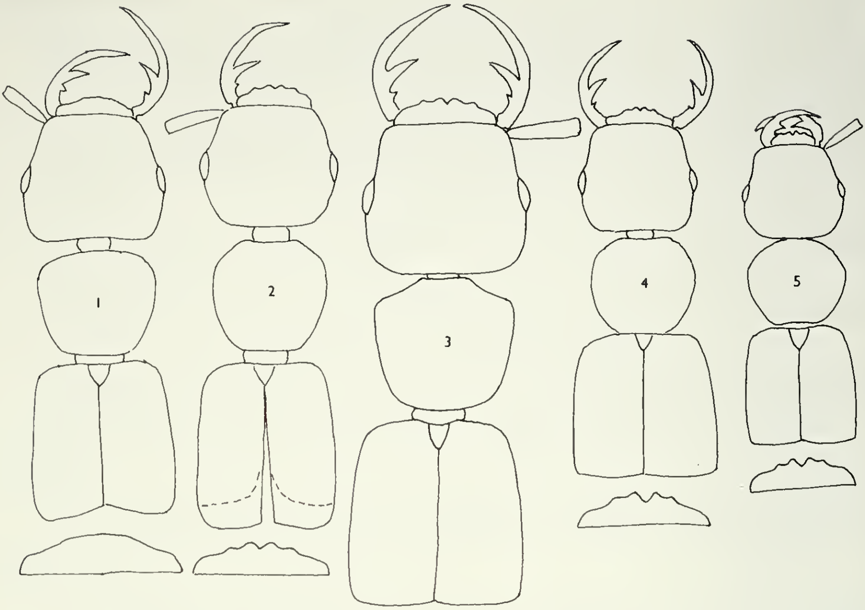

FIG. 1

Fore-body and labrum of species of *Stilicastenus* (to same scale, except 3 slightly larger), 1: *S. fasciatus* Coiff.; 2: *S. siamensis* n. sp.; 3: S. sp. A cf. *siamensis*; 4: S. sp. B cf. *siamensis*; 5: *S. minor* n. sp. Dotted line on 2 shows extent of ochreous apical area on elytra of *S. fasciatus* and *S. siamensis*.

Outline of fore-body: Fig. 1.1. Proportions: Length of head (excluding labrum): 65; breadth of head (including eyes): 76; antennomeres: I: 30; II: 8; III: 14; IV-V: 13; VI: 12.5; VII: 12; VIII: 11; IX-XI: 10; Antennomere I stout, cylindrical, about twice as thick as III-X, the latter all very elongate, sub-cylindrical, scarcely dilated apically. Length of pronotum: 60; breadth of pronotum: 75; length of elytron: 85; breadth of elytra: 80; metatibia: 60; metatarsomeres: I: 14; II: 6.5; III: 6; IV: 5; V: 12.

Punctuation of head and pronotum finely, isodiametrically, uniformly umbilicate-reticulate. Punctuation of elytra simple, diameter of punctures about equal to that of umbilicate punctures of pronotum, more widely spaced, interstices flattened, shiny, without microsculpture, tending to form transverse rugae in parts. Punctuation of abdomen very fine, moderately close, integument shiny; tergite VIII with a membranous apical fringe. Entire body surfaces with dense, short, erect pubescence.

Male: Sternite VII unmodified. Sternite VIII (Fig. 4.1) with a simple emargination. Aedeagus (Fig. 3.1) with basal blade apically truncate both in lateral and ventral views.

Stilicastenus siamensis n. sp.

♂ Holotype, 1 ♂ & 2 ♀♀ Paratypes: THAILAND, Chiang Mai Prov., Doi Inthanon 2300 m, from dead leaves in stream gully, 15.III.1982, G. de Rougemont (coll. Rougemont, 1 Paratype in Mus. Geneva). var. *niger* nov.: 1 ♂ & 3 ♀♀: Ibid. (coll. Rougemont, 1 in Mus. Geneva).

Length: ca. 5 mm. Proportions: Length of head: 68; breadth of head: 79; antennomeres: I: 30; II: 8; III: 16; IV: 13.5; V: 13; VI: 12; VII: 11; VIII: 10.5; IX-XI: 10; length of pronotum: 58; breadth of pronotum: 61; length of elytron: 88; breadth of elytra: 82; metatibia: 60; metatarsomeres: I: 15; II: 7; III: 6; IV: 5; V: 11. Outline of fore-body: Fig. 1.2.

Colour of *S. fasciatus*, except that only abdominal tergites VI and VIII are infuscate, tergites IV and V concolorous with III. Scarcely distinguishable from *S. fasciatus* except for the shape of the labrum, with distinct median emargination, anterior margin bisinuate on either side, more strongly convergent temples, slightly longer elytra (somewhat variable in both species), slightly narrower emargination of male sternite VIII, and aedeagus: apex of basal blade acuminate, tip slightly recurved (Figs 3.2, 4.2). var. *niger* nov.: Body entirely pitchy black except for posterior 1/8th-1/4th of

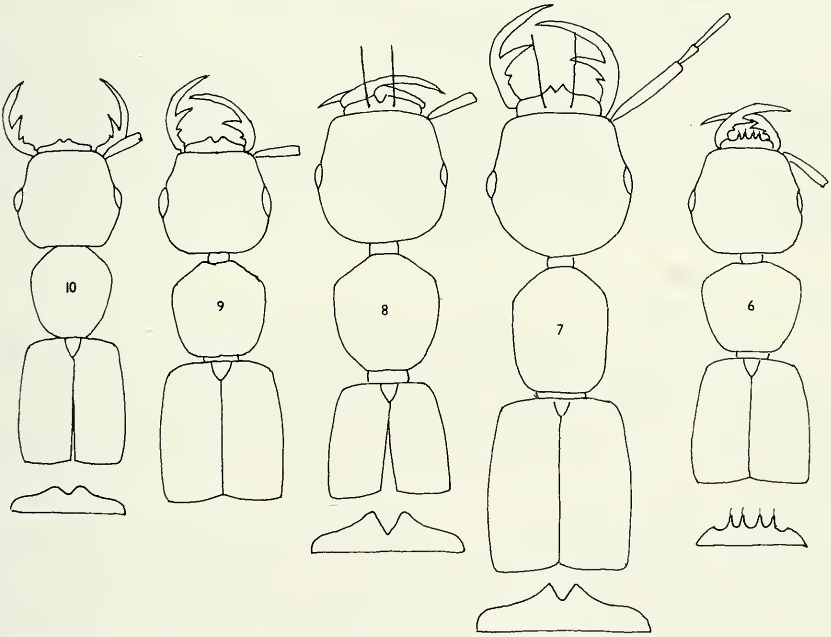

FIG. 2

Fore-body and labrum of species of *Stilicastenus* (to same scale). 6: *S. borneensis* n. sp.; 7: *S. elongatus* n. sp.; 8: *S. micropterus* n. sp.; 9: *S. sinhala* n. sp.; 10: *S. tamul* n. sp.

elytra which retain the light ochreous colour seen in typical form and in *S. fasciatus*. Legs, mouthparts and antennae as in typical form, but antennomeres II-X darkened in distal halves.

The marked difference in colour of these two forms appears to be constant, with no intermediary forms.

Stilicastenus sp. A cf. **siamensis**

1 ♀: Thailand, Chiang Mai Prov., Doi Inthanon, 2300 m, 15.III.1982, G. de Rougement (coll. Rougemont); 1 ♀: Ibid., 1650 m, 7.XI.1986, Burkhardt-Löbl (Mus. Geneva).

These specimens differ from *S. siamensis* n. sp. in larger size, shape of the pronotum, with concave anterior margins (less marked in Geneva Museum specimen), in darker elytra, without an evident transverse fascia, but only a few indistinct fuscous spots, and without ochreous posterior margins. Outline of fore-body: Fig. 1.3.

Without males it is impossible to decide whether they represent a new species or are merely an aberrant form of *S. siamensis*.

Stilicastenus sp. B cf. **siamensis**

1 ♀: INDIA, assam Naga Hills nr Kohima, Mnt. Japvo 5000 ft., from rotten leaves, roots & wood, evergreen forest, 30.I.1952, T. Clay (BMNH).

This form is a little smaller than *S. siamensis* or *S. fasciatus*, the head is sub-quadrate, in that more similar to the latter, but the labrum is of the *siamensis* type. In colour it resembles the large form (sp. A) described above. Outline of fore-body: Fig. 1.4.

This speciemen is not sufficiently well differentiated from *S. siamensis* n. sp. to risk describing it as new species without confirmation of its originality by the male sexual characters.

Stilicastenus minor n. sp.

♂ Holotype & 4 ♀♀ Paratypes: INDIA, Meghalaya, Khasi Hills, Weloi 1700 m, 27.X.1978, Besuchet-Löbl (Mus. Geneva; 2 Paratypes in coll. Rougemont).

Length: 3.2-3.4 mm. Length of head: 52; breadth of head: 57; antennomeres: I: 22; II: 6.5; III-IV: 9; V-VI: 8; VII: 7.5; VIII: 7; IX-XI: 6; length of pronotum: 45; breadth of pronotum: 50; length of elytron: 61; breadth of elytra: 61; metatarsomeres: I: 9; II-IV: 4; V: 8.

Outline of fore-body: Fig. 1.5. Approximate facies of *S. fasciatus* and *S. siamensis*, but much smaller, with proportionately smaller (quadrate) elytra, and larger median emargination of labrum. Punctuation almost as coarse as in those species, therefore proportionately a little coarser. Colour darker, head dark reddish brown, almost fuscous, pronotum and elytra paler, rufous albeit darker than *S. fasciatus*; elytra with a broad, ill defined transverse fuscous fascia, posteriorly concolorous with anterior half, not ochreous yellow; abdomen with all tergites except VII more of less infuscate, or with tergites III & IV paler.

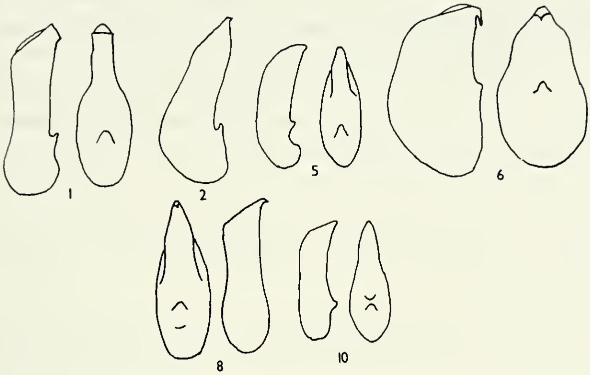

FIG. 3

Aedeagi of *Stilicastenus* species in lateral and ventral views: 1: *S. fasciatus* Coiff.; 2: *S. siamensis* n. sp.; 5: *S. minor* s. sp.; 6: *S. borneensis* n. sp.; 8: *S. micropterus* n. sp. 10: *S. tamul* n. sp.

Male: Sternite VIII: Fig. 4.5. Aedeagus (Fig. 3.5) with ventral blade lanceolate, reflexed at tip.

Stilicastenus borneensis n. sp.

♂ Holotype, 1 ♂ & 4 ♀♀ Paratypes: Sarawak, 4th Division, Gunung Mulu National Park, alluvial forest litter, BM 1978 (BMNH, 1 Paratype in coll. Rougemont).

Length: ca. 4.2 mm Length of head: 65; breadth of head: 69; antennomeres: I: 30; II: 10; III: 13; IV: 12; V-VI: 11; VII-VIII: 10; IX: 9; X: 8; XI: 9. Length and breadth of pronotum: 57; length of elytron: 75; breadth of elytra: 73; metatarsomeres: I: 10; II: 6; III: 5; IV: 4.5; V: 9.

A little smaller than *S. fasciatus*, whole body more depressed; antennae more slender; pronotum narrower, sides more strongly convergent posteriorly. Punctuation of head and pronotum coarser, that of head tending to form longitudinal rugae. Colour of head and pronotum as in *S. fasciatus*, rufous; elytra rufous at base, gradually darkened to posterior margins; abdominal tergites all uniformly rufous. Outline of fore-body: Fig. 2.6.

Labrum (Fig. 2.6) quite different from all other species of *Stilicastenus*. Anterior margin is broadly excavate, inside excavation with four nearly equal acute teeth, each tooth bearing a single apical pale seta.

Male: Sternite VIII: Fig. 4.6. Aedeagus (Fig. 3.6) relatively large, median lobe very broad, apex of basal blade recurved to 180°.

Stilicastenus elongatus n. sp.

♂ Holotype & 1 ♀ Paratype: CEYLON, Hakgala, 1700-1800 m, 28.I.70, Mussard, Besuchet, Löbl; 3 ♀♀ Paratypes: CEYLON, Nuwara Eliya, 1950 m, 29.I.70, Mussard, Besuchet, Löbl. (Mus. Geneva; 2 Paratypes in coll. Rougemont).

A distinctive species owing to its elongate habitus (Fig. 2.7) and very long antennae which almost reach the distal margins of elytra when reflexed.

Length: 5.5-6 mm. Head and pronotum pitchy black with obscure reddish patches; elytra obscure reddish-brown; abdomen pitchy black, the paratergites lighter; palpi and legs pale testaceous; labrum, mandibles and antennomeres I and II rufo-testaceous; antennomeres III-XI infuscate.

Length of head: 76; breadth of head: 79; antennomeres: I: 40; II: 10; III: 23; IV: 20; V: 20; VI: 19; VII: 18; VIII: 16; IX: 14; X: 13; XI: 14; Length of pronotum: 67; breadth of pronotum: 53; length of elytron: 92; breadth of elytra: 76; metatarsomeres: I: 16; II: 8; III: 7; IV: 5; V: 13.

Labrum (Fig. 2.7) bilobed, apices of lobes acute. Among normal sparse very fine setae born by labrum are a pair of exceedingly long (as long as antennomere I) ones inserted near base equidistant from each other and lateral margins of labrum.

Punctuation of head a little coarser than in *S. fasciatus*, closer and tending to form longitudinal rugae in anterior half, coarser and isodiametrical posteriorly; punctuation of pronotum similar to that of occipital area of head, markedly coarser than in *fasciatus*; punctuation of elytra coarser, deeper and sparser than in *S. fasciatus*. The sculpture of abdomen, unlike that of *S. fasciatus* and the other species described above, consists of coarse punctures, about equal in diameter but shallower than those of elytra.

Abdominal tergites III and IV with a median keel in basal half. Sternite VII with an apical membranous fringe.

Male: Sternite VIII: Fig. 4.7. The aedeagus of the only male was unfortunately lost before examination.

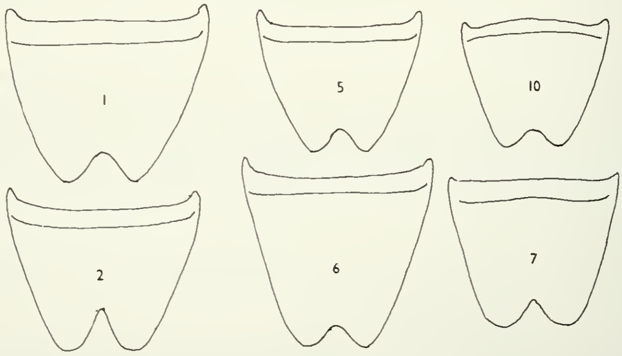

FIG. 4

Outline of male sternite VIII of *Stilicastenus* species: 1: *S. fasciatus* Coiff.; 2: *S. siamensis* n. sp.; 5: *S. minor* n. sp.; 6: *S. borneensis* n. sp.: 8: *S. elongatus* n. sp.; 10: *S. tamul* n. sp.

Stilicastenus micropterus n. sp.

♂ Holotype, 3 ♂♂ & 3 ♀♀ Paratypes: CEYLON, Hakgala, 1700-1800 m, 28.I.70, Mussard, Besuchet, Löbl (Mus. Geneva; 2 Paratypes in coll. Rougemont).

This species is also very distinctive by its facies (Fig. 2.8) with proportionately large head, punctuation, and short antennae.

Length: ca. 4.7 mm. Rufo-testaceous, the distal 3/4rs of elytra and abdominal tergite VI infuscate; palpi and legs pale testaceous; labrum, mandibles and antennae rufo-testaceous.

Length of head: 70; breadth of head: 72; antennomeres: I: 27; II: 7; III: 10; IV: 9.5; V: 8.5; VI-VII: 7; VIII: 6.5; IX: 6; X: 7; XI: 8. Last three antennomeres thickened, forming a loose club. Length of pronotum: 62; breadth of pronotum: 55; length and breadth of elytra: 60; metatarsomeres: I: 12; II: 6; III: 5; IV: 4; V: 11.

Labrum (Fig. 2.8) similar to that of *S. elongatus*, but apices of lobes somewhat blunter; furnished, as in *S. elongatus*, with a pair of exceedingly long (42) fine setae among other, shorter setae.

Punctuation of whole body coarser and sparser than that of any other species of *Stilicastenus* (a common trend, among other modifications, among montane, micropterous Staphylinidae). The punctuation of head remains umbilicate, but less dense, not reticulate, interstices flattened, very shiny; punctuation of elytra simple, comparable in density to that of head and pronotum; punctuation of abdomen coarse and sparse, as in *elongatus*.

Elytra small, trapezoidal, dorsal surface concavely depressed; wings atrophied, shorter than elytra. Abdominal tergites without a median keel. Sternite VII devoid of an apical membranous fringe.

Male: Sternite VIII shallowly emarginate. Adeagus: Fig. 3.8.

It is interesting that *S. micropterus* n. sp. and *S. elongatus* n. sp., which are evidently closely related (synapomorphies: the shape of labrum, the presence of a pair of very long setae on the labrum, the coarse abdominal punctuation), exhibit opposite extremes of certain proportions within the genus, the one micropterous and with the shortest antennae, the other with the longest elytra and antennae, and that both species occur in the same locality.

Stilicastenus sinhala n. sp.

Holotype: CEYLON, S. Mululla 750 m, 4.II.70, Mussard, Besuchet, Löbl (Mus. Geneva). (Sex unknown: the holotype lacks abdominal urites VIII-X).

Length: ca. 3.8 mm. Length of head: 52; breadth of head: 60; antennomeres: I: 25; II: 7; III: 9.5; IV: 10; V: 9; VI-VII: 8; VIII: 7; IX-X: 6; XI: 7; length and breadth of pronotum: 48; length of elytron: 70; breadth of elytra: 60; metatarsomeres: I: 9.5; II: 5; III: 4; IV: 3; V: 9.

Approximate facies of *S. fasciatus* (cf. Figs 1.1, 2.9) but smaller, the temples convergent posteriorly, comparable to *S. siamensis*, and anterior margin of labrum quite different, bilobed as in other south Indian and Ceylanese species. The labrum bears a pair of long very fine setae comparable to but shorter than those of the two Ceylanese species described above.

Colour of head and pronotum as in *S. fasciatus* (but the specimen is somewhat immature; the species may typically be darker, like the following new species, *S. tamul*). Elytra with a broader fascia, the posterior margins narrowly, the postero-lateral angles more broadly pale testaceous; abdomen entirely rufous like head and pronotum.

Punctuation of head, pronotum and elytra comparable to that of *S. fasciatus*, comensurately finer, but punctuation of abdominal tergites, especially tergites III-V coarse, as in other south Indian and Ceylanese species.

Male sexual characters unknown.

This species most closely resembles the following new species, *S. tamul*.

FIG. 5

Distribution pattern and possible evolution of *Stilicastenus* species according to type of labrum. 1: *S. fasciatus* Coiff.; 2: *S. siamensis* n. sp., sp. A, sp. B, *S. minor* n. sp.; 3: *S. borneensis* n. sp.; 4: *S. elongatus* n. sp., *S. micropterus* n. sp., *S. tamul* n. sp., *S. sinhala* n. sp.

Stilicastenus tamul n. sp.

♂ Holotype and 1 ♀ Paratype: India, Madras, Anaimalai H. 18 km N. de Valparai, 1650 m, 18.XI.72, Besuchet, Löbl, Mussard. (coll. Mus. Geneva; Paratype in coll. Rougemont).

Length: ca. 3.6 mm. Length of head: 51; breadth of head: 57; antennomeres: I: 24; II: 6.5; III: 9.5; IV-V: 9; VI: 8; VII: 7.5; VIII: 7; IX: 6; X: 5.5; XI: 6; length of pronotum: 50; breadth of pronotum: 43; length of elytron: 67; breadth of elytra: 59; metatarsi: I: 9; II: 5; III: 4; IV: 3; V: 8.5.

This new species is close to *S. sinhala* n. sp., differing in its slightly lesser size (cf. Figs 2.9, 2.10), less transverse head, narrower (elongate) pronotum, darker colour (but see description of S. sinhala, above) and in coarser punctuation of head and pronotum, interstices of umbilicate-reticulate sculpture sharper, more prominent, tending to form longitudinal rugae on head.

The whole body, including mandibles, antennae and legs, darker than in S. fasciatus, more or less infuscate, the broader elytral fascia less well defined, and only abdominal tergite VI is perceptibly darker than the rest of abdomen.

The labrum is bilobed, as in *S. sinhala*, the apices of lobes more rouded and less prominent than in the larger Ceylanese species *S. micropterus* and *S. elongatus*, and as in those species bears a pair of exceedingly long fine setae (length: 13, or about 2/3rds the length of mandibles).

Male: Abdominal sternite VIII: Fig. 4.10 aedeagus: Fig. 3.10.

REFERENCES

Coiffait, H. 1975. Xantholininae, Paederinae et Euaesthetinae récoltés au Népal par le Professeur Franz (Col. Styphylinidae). *Nouv. Rev. Ent.* 5(2): 153-186.

Coiffait, H. 1982. Contribution à la connaissance des staphylinides de l'Himalaya (Népal, Ladakh, Cachemire) (Insecta: Coleoptera: Staphylinidae). *Senckenberg biol.* 62 (1981): 21-179.

REVUE SUISSE DE ZOOLOGIE, 100 (3) : 587-593; septembre 1993

Dyschirius crinifer sp. nov. and *Dyschirius hipponensis* (Pic, 1894) from North Africa (Coleoptera, Carabidae, Scaritinae)

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Dyschirius crinifer sp. nov. and _Dyschirius hipponensis_ (Pic, 1894) from North Africa (Coleoptera Carabidae, Scaritinae). – *Dyschirius crinifer* sp. nov. from North Africa is described, and the North African *Dyschirius hipponensis* (Pic, 1894) is redescribed. Main diagnostic differences are illustrated and the species are arranged into the keys of Müller (1922) and Antoine (1955).

Key-words: Coleoptera - Carabidae - Scaritinae - taxonomy - Algeria.

Members of the speciose genus *Dyschirius* bear characteristic patterns of setiferous punctures (BOUSQUET, 1988; LINDROTH, 1961). On the elytra these punctures can be divided into the following groups: - one setigerous punctures present at base; - three discal setigerous punctures located on the third interval or in the adjoining striae; - two subapical setigerous punctures at the apex within the 8th stria; - three subhumeral setigerous punctures. These punctures can be reduced interspecifically as pairs or competely as a group. Although puncutre pairs or single punctures may certainly be missing intraspecifically, they have a relatively high degree of constancy and are therefore of great taxonomic value. In addition, two other groups can be described, which have not been particularly mentioned taxonomically: - up to three lateral setigerous punctures, separated by a wider interval from the subhumeral setigerous pores (umbilical series); - more than three setigerous punctures located on the third interval of the elytra or/and on the other odd intervals (row of punctures).

Up to now only a few species with more than three punctures on the odd intervals have been described:

from North America:

- *Dyschirius setosus* LeConte, 1857 (= *D. alternatus* Hatch, 1949), 3rd, 5th, 7th interval with a row of setigerous punctures
- *Dischirius pilosus* LeConte, 1857 (= *D. hispidus* LeConte, 1863)

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- *Dyschirius comatus* Bousquet, 1988, in both of these species 1st, 3rd, 5th, 7th interval with a row of punctures

from India:

- *Dyschirius mahratta* Andrewes, 1929, 3rd and 5th interval with a row of punctures
- *Dyschirius stellula* Andrewes, 1936, interval 3 with 5 punctures

from North Africa:

- *Dyschirius hipponensis* Pic, 1894, 3rd, 5th and 7th interval with a row of punctures

Among the unidentified material of African Scaritinae deposited in the Muséum d'Histoire naturelle, Genève (MHNG), there were 11 specimens of a second *Dyschirius* species bearing rows of setigerous punctures on the odd intervals of the elytra.

Dyschirius crinifer sp. nov.

Type Material: Holotype: ♂, Algeria: Gde Kabylie, Forêt d'Akfadou, 9 km W Adekar, 1300 m, 17.V.88, leg. Besuchet, Löbl, Burckhardt (in MHNG).

Paratypes: 2 ♂, 3 ♀ same data as holotype; 1 ♂, 4 ♀ same data as holotype, but 8 km E Adekar, 15.V.88 (in MHNG and coll. of author).

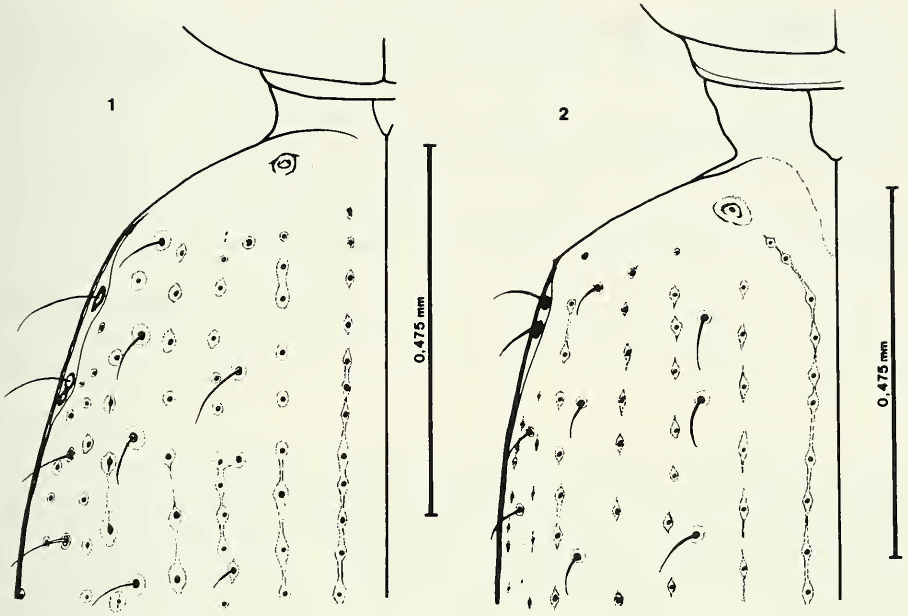
Measurements: Length 2.86 - 3.24 mm ($\bar{x}$ = 2.99 mm*), width 0.93 - 1.08 mm ($\bar{x}$ = 0.98 mm*), ratio length/width of pronotum 0.97 - 1.06 ($\bar{x}$ = 1.02*), ratio length/width of elytra 1.54 - 1.66 ($\bar{x}$ = 1.62*); (* n = 11).

Colour: Black with piceous lustre, surface shiny; mandibles and palpi brown, antennae dark brown, basal segment of antennae yellowish-brown, following three segments pale at base. Ventral surface piceous black.

Head: Anterior margin of clypeus without median tooth, straight and bordered distinctly, separated from frons by deep straight transverse suture, broad hump in front of transverse suture increasing evenly from clypeal margin and falling steeply in last quarter to transverse suture. Frons vaulted with scattered, very finely sticked punctures.

Pronotum: Globose, as long as wide, maximum width at end of 2nd third, narrowing almost straightly from there to anterior setigerous puncture. Lateral margin stops at end of 1st third and is more fine behind anterior setigerous puncture than in front of. Median line fine but distinct. With few transverse wrinkles on sides, very finely sticked punctures on entire surface. Foveae in furrow of basal margin rounded.

Elytron (Fig. 1): Anterior half of elytron flattened, posterior half evenly vaulted. Oval, lateral margin evenly rounded from humerus to apical setigerous punctures. Base unmargined, basal granula absent; humerus indistinct, almost completely rounded, denticulation at humerus absent; basal setigerous puncture isolated, situated in projected extension of 2nd stria (holotype) or 3rd interval (in some paratypes). Two subhumeral setigerous punctures, 3rd absent, one preapical setigerous pore. First stria straight, not extended towards basal setigerous pore; punctures in first 2-3 rows formed as striae due to more-or-less distinct impressions, other striae appearing as rows of



Figs 1-2

Left elytron, shoulder. The impressions around the punctures are symbolized by dotted lines. 1. *D. crinifer* sp. nov.; 2. *D. hipponensis* Pic.

punctures, striae fade to apex, 7th stria consisting of only few punctures covering one third of elytron, arrangement of punctures somewhat irregular. Eight to nine prominent discal setigerous punctures on interval 3, approaching 3rd stria, 8-9 in middle of interval 5, 4 on interval 7.

Protibia: Upper spine turned evenly outward, movable spur slightly curved, much smaller and thinner than spine. Preapical outer denticle well developed and sharp, 2nd much smaller, not sharp but clearly visible.

Aedeagus: See Fig. 3.

Habitat: All specimens were extracted from oak leaf litter in May, one near the wood's edge and one in a clearing with large oaks below a brook. Altitude 1300 m.

Relationship: The species appears to be closely related to *D. hipponensis* (Pic, 1894) with which it shares the elytral punctation.

In order to point out the relevant characters of *D. hipponensis* Pic and to show the differences between the two species, *D. hipponensis* Pic is redescribed.

Dyschirius hipponensis Pic, 1894

Material examined: One ♂, labelled (handwritten): *Dyschirius hipponensis* Pic, Thery dedid 1912 and (printed): St. Charles, Algerie, A. Thery (in Muséum National d'Histoire naturelle, Paris, MNHP).

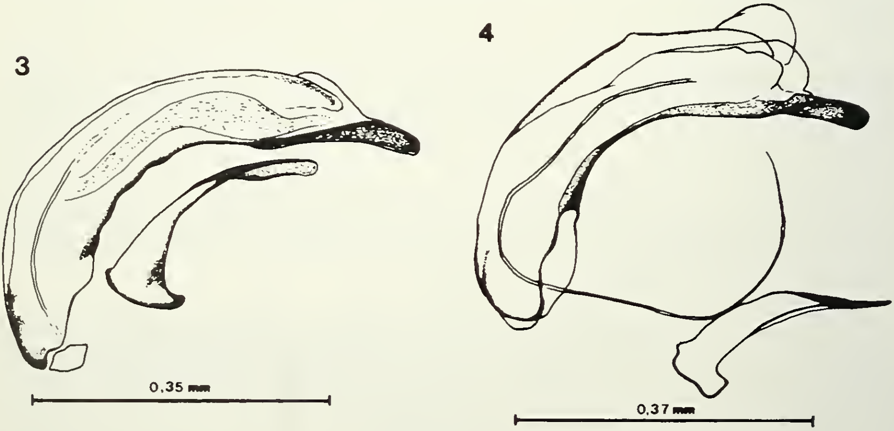
Measurements: Length 2.52 mm, width 0.89 mm, ratio length/width of pronotum 1.00, ratio length/width of elytra 1.51.

Colour: Cherry-reddish to red-brown, shiny, mandibles and palpi ligth reddish-brown, antennae reddish-brown like whole body, but with metallic lustre, 1st and 2nd segment of antennae as well as base of 3rd yellowish. Ventral surface red-brown.

Head: Anterior margin of clypeus without median tooth, straight and very finely bordered, separated from frons by a straight transversal suture, broad curvature in front to the transversal ridge, not hump-like; frons vaulted with scattered, very finely sticked punctures.

Pronotum: Strongly globose, as long as wide, maximum width at end of 2nd third. Sides evenly rounded from anterior angles to posterior setigerous puncture. Lateral margin stops at end of first third, equally distinct in back of and in front of anterior setigerous pore. Median line distinct throughout. Sides with few fine cross wrinkles, entire surface very finely sticked. Foveae in furrow of basal margin elongated.

Elytron (Fig. 2): Evenly vaulted from front to back. Oval, evenly rounded from humerus to apical setigerous punctures. Base without margin, basal granula absent; humerus pronounced with small tooth visible from above; basal pore isolated, located in extension of 2nd stria. Two subhumeral punctures, rear one absent, one preapical setigerous puncture. Base at suture somewhat depressed. Striae deep and pronounced, first curves outward at base and runs directly toward basal pore; punctures of first 2-3 rows forming striae by deeper impressions, other striae appearing more or



Figs 3-4

Aedeagus (left lateral view): 3. *D. crinifer* sp. nov.: 4. *D. hipponensis* Pic less like rows of punctures, all striae fainter but still distinct toward apex, 7th covers two-thirds of elytron length, punctures arranged more or less irregularly. Five prominent discal setigerous punctures in the middle of interval 3; 6 on interval 5 approaching 5th stria; 3 on interval 7.

Protibia: Upper spine evenly curved outward, movable spur much thinner and shorter than spine. Preapical outer denticle sharp and well-developed, 2nd intimated but still visible.

Aedeagus: As shown in Fig. 4.

Distribution: Algeria. Recorded from: Bone (lat. Hippo, -nis / today: Annaba), banks of the river Seybouse after a flood (type). - Saint Charles (today: Ramdane Djamal) south of Skikda.

Habitat: Unknown, the type was collected in February.

DISCUSSION

The type of *Dyschirius hipponensis* Pic has not been located although it should be deposited in the MNHP. Therefore the redescription is based on annother specimen from Peyerhimhoff's sollection (also MNHP). Comparing all specimens (1 and 11, respectively) with the original relativly comprehensive description of PIC (1894), the following may be stated: Several diagnostic characters are common for both species and agree with the description. Other characters (e.g. humeri, colour, size) can only be found in the single specimen from Saint Charles, but not in the 11 new specimens. Pic's description does not give any character which is not found in the single specimen from Saint Charles. Thus it is assumed that it is conspecific with the type of *Dyschirius hipponensis* Pic.

It is to be mentioned that Bone is 80 km apart from Saint Charles, while the localities at which the new species was found are about 300 km to the west.

The type of *D. hipponensis* Pic was found after the river had flooded and was probably washed to the site from higher areas. This permits the assumption that the two species have similar habitats (litter and humus layers) in which numerous sensory hairs are of great benefit. Paralleles are found for example in the related genus *Reicheia* Saulcy. Representatives of this genus, which also show characteristic hair patterns on the elytrae, were found in Algeria and Tunesia at about the same altitude as *D. crinifer* sp. nov. in leaf and humus litter and under large stones (JEANNEL, 1957).

NORMAND (1933, 1938 a, b) does not mention *D. hipponensis*. Only BEDEL (1895) and MÜLLER (1922) quote PIC (1894) and include the description of *D. hipponensis* verbatim at the end of their key. Neither of the authors saw the species ("mihi invisae"). In BEDEL (1895), *D. hipponensis* Pic is distinguished from other species (p. 45) by the character "with long, protruding hairs on the disk and on the sides".

For the western Palaearctic species, the only useful key is that of MÜLLER (1922: 38). Both treated species may be easily placed into this key within a new (7th) group (The addition to the key is given in German, because the original key is written in German):

2 Halsschildseiten vollständig gerandet 3

– Halsschildseiten nur vorn oder bis zur Mitte gerandet, 2-3 Dorsalpunkte, 3 Posthumeralpunkte. .... 6. Gruppe (S. 50)

– Halsschildseitenrand über den vorderen, aber nicht bis zum hinteren Borstenpunkt gerandet. Mit vielen langen, abstehenden Borsten auf den Elytren. 2 Posthumeralpunkte .... 7. Gruppe

7. Gruppe

(Clypeus ohne Mittelzahn. Halsschildseiten über den vorderen, aber nicht bis zum hinteren Borstenpunkt gerandet. Flügeldecken mit basalem Porenpunkt, an der Basis ungerandet. Mehr als 3 Dorsalpunkte, 2 Subhumeralpunkte, 1 Praeapikalpunkt. Oberseite nicht chagriniert).

1 Schultern ausgeprägt. 1. Flügeldeckenstreifen biegt vorn nach außen und zielt auf den basalen Porenpunkt. Der 7. Flügeldeckenstreifen nimmt 2 Drittel der Flügeldeckenlänge ein. .... *D. hipponensis* Pic

– Schultern eingezogen, fast vollständig verrundet. 1. Flügeldeckenstreifen vorn gerade, zielt nicht auf den basalen Porenpunkt. Der 7. Flügeldeckenstreifen nimmt nur ein Drittel der Flügeldeckenlänge ein. .... *D. crinifer* sp. nov.

Another key, provided by ANTOINE (1955), describes the *Dyschirius* spp. of Marocco and neighboring regions in North West Africa. The two species can also be placed into this key by creating a new group, which is to be placed between the *rufoaeneus* and the *globosus* group. Following keynumber 18 (ANTOINE, 1955: 70), the new group can be characterized by the lateral border of pronotum and in bearing more than 3 discal setigerous punctures.

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I would like to express my heartful thanks to Dr. I. Löbl (MHNG), who gave me the opportunity to examine the specimens and for reading of the manuscript. He also has answered all of my questions regarding geographical items as well as the habitat of the new species. Thanks are also due to Dr. T. Deuve (MNHP) for the loan of the *D. hipponensis* Pic.

REFERENCES

ANTOINE, M. 1955. Coléopteres Carabiques du Maroc (Première Partie) - *Mém. Soc. Sci. Nat. Phys. Maroc, Zool.*, N.S.. 1: 1 - 177.

BEDEL, L. 1895. Catalogue Raisonné des Coléoptères du Nord de l'Afrique (Maroc, Algérie, Tunisie et Tripolitaine) avec Notes sur la Faune des Iles Canaries et de Madère. - *Soc. Entomol. de France, Paris*: 1 - 320.

BOUSQUET, Y. 1988. *Dyschirius* of America North of Mexico: Descriptions of new species with keys to species groups and species (Coleoptera: Carabidae). - Can. Ent. 120: 361 - 387.

JEANNEL, R. 1957. Révision des petits Scaritides endogés voisins de Reicheia Saulcy. - *Rev. Franc. d'Entom.* 24: 129 - 212.

LINDROTH, C.H. 1961. The ground-beetles (Carabidae, excl. Cicindelidae) of Canada and Alaska. Part 2. - *Opusc. Ent. Suppl.* 20: 1 - 200.

MÜLLER, J. 1922. Bestimmungstabelle der *Dyschirius*-Arten Europas. - *Kol. Rdsch., Wien*, 10: 33 - 120.

NORMAND, H. 1933. Contribution au Catalogue des Coléoptères de la Tunisie. - *Bull. Soc. Hist. Nat. Afr. Nord* 24: 1 - 20.

– 1938a. Contribution au Catalogue des Coléoptères de la Tunisie (13e fasc.) (1). - *Bull. Soc. Hist. Nat. Afr. Nord* 29: 274 - 308.

– 1938b. Contribution au Catalogue des Coléoptères de la Tunisie (14e fasc.). - *Bull. Soc. Hist. Nat. Afr. Nord* 29: 310 - 346.

PIC, M. 1894. Deux Coléoptères nouveaux. - *Feuille des Jeunes Nat., Paris*, 24: 140.

REVUE SUISSE DE ZOOLOGIE, 100 (3) : 595-607; septembre 1993

Paraguayan bats of the genus *Myotis*, with a redefinition of *M. simus* (Thomas, 1901)

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Paraguayan bats of the genus *Myotis*, with a redefinition of *M. simus* (Thomas,1901). - Based on measurements and odontology taken from more than 180 specimens of *Myotis* spp. from Paraguay and nearby areas of Argentina and Brazil, the systematics of members of this genus is reviewed. Four species are found in Paraguy : *M. nigricans*, *albescens*, *levis* and *ruber*. *M. simus* auct. from Bolivia to Argentina in fact refers to various other species; it is not found within the borders of Paraguay. This species, i. e. *M. simus*, is easily recognizable and seems to be restricted to the Amazon basin.

Key-words: Chiroptera - *Myotis* - Odontology - Taxonomy - *M. simus* - Paraguay.

I - INTRODUCTION

Since 1979 the Muséum d'Histoire Naturelle de Genève (MHNG) has had the opportunity to study the fauna of Paraguay in collaboration with the Ministry of Forest and Agriculture. During various expeditions we collected more than ten genera of bats; two of them are new for Paraguay: *Phillostomus hastatus* and *Macrophyllum macrophyllum* (BAUD 1981 and 1989).

However, the identification of *Myotis* spp. is difficult, and the systematics of some taxa is open to question. The more numerous the captures, the more difficult was the separation at the specific level based on literature records for this country (MYERS 1977, MYERS & WETZEL 1979, 1983). For this reason we adopted two different ways of investigations; one of us identified the specimens using standard measurements, whereas the other one - independently ("blind method") - relied on odontological features.

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MATERIAL AND METHOD

One hundred and eighty specimens were randomly selected for this study; this material originates from all localities of Paraguay visited during our various field trips (Fig. 1). We included, however, all individuals with peculiarities in coloration as well as the larger ones. Two collections from Argentina, i. e. 20 specimens from Eldorado (Misiones) and 11 individuals from Ituzaingo (Corrientes), and one of 12 bats from Nova Teutonia (Santa Catarina) in Brazil were included for comparison.

Extracted skulls were known only by their field number. The two authors, each one using his own method, compared the identifications afterwards.

FIG. 1

Map of collecting localities in Paraguay.

1. Standard measurements expressed by means of indexes

After several attempts, we found that the best way to represent the morphology of the skull by numerical data is expressed by the "Maxillary Index" (MXI) and the "Cranial Index" (CRI). These indexes are defined by the following formulae:

$$MXI = \frac{(CC + MM)\ \overline{CM}^3}{2}$$

$$CRI = \frac{(POC + LC)\ GLS}{2}$$

CC = greatest external breath at the upper canines
MM = greatest external breath at the upper molars
$\overline{CM}^3$ = perpendicular distance between the posterior tangent at the level of the last molars and the anterior tangent of CC
POC = post-orbital constriction
LC = breadth of the brain case
GLS = greatest length of the skull in front of the incisives.

All measurements were made with a Nikon V-12 profile projector, permitting to measure at 1/1000 mm. We measured at 1/100 mm precision and rounded to the upper or lower unity at 1/10th of milimeter. This method allows to avoid calculation errors.

2. Odontology

We adopted the odontological characters defined in the "Etude des morphotypes dentaires des Vespertilionidae" (Menu 1985, 1987)[1]. The nomenclature is that of Van Valen (1966) with some modifications.

RESULTS

1. Measurements and indexes (see table I and II and Fig. 2)

It is obvious that more than 90 % of the 181 individuals examined, have a MXI of 20 and 25,5 for both sexes. Due to the fact that the components of this index overlap, it is not useful to distinguish the various species. The CRI of this series, however, permits the separation of two clearly distinct groups,i.e. I and II, the first ranging from 63 to 73,8 and the second one from 75,5 to 85,7.

Two more clusters are clearly recognized: the first with a CRI ranging from 86,6 to 88 and a MXI between 25,8 and 26,4 (3 bats), the second (5 specimens) with values between 79,8 to 82,6 (CRI) and 29,2 to 31,1 (MXI), respectively. We call them group III and IV.

2. Odontology

Concerning the dentition, group I to IV belong to the "*Leuconoe*" type (Cf. Menu 1987) but in the case of the IV th group some peculiarities in various features

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[1] In the present paper the term "*Leuconoe*" is used in a morphological context and does not refer to the nomenclature (cf. Menu 1987).

TABLE I

Maximum and minimum of standard measurments of the Paraguayan *Myotis*.
(Here, the results are not rounded to the upper or lower unit)

Gr.	Specie	Forearm	GLS	$\overline{CM^3}$	POC	C-C	M-M	LC
I	*M. nigricans*	30,90	13,10	4,80	3,30	3,21	5,08	6,12
	(n = 77)	36,00	14,20	5,40	3,65	3,68	5,57	6,89
II	*M. albescens*	33,70	13,58	4,72	3,61	3,44	5,06	7,01
	(n = 95)	37,80	14,89	5,36	4,35	3,93	5,61	7,54
III	*M. levis*	36,50	14,87	5,40	4,05	3,84	5,54	7,44
	(n = 3)	38,20	15,15	5,45	4,21	3,97	5,81	7,64
IV	*M. ruber*	40,10	15,17	5,86	3,52	4,04	5,89	7,00
	(n = 5)	41,10	15,36	6,04	3,69	4,24	6,04	7,10

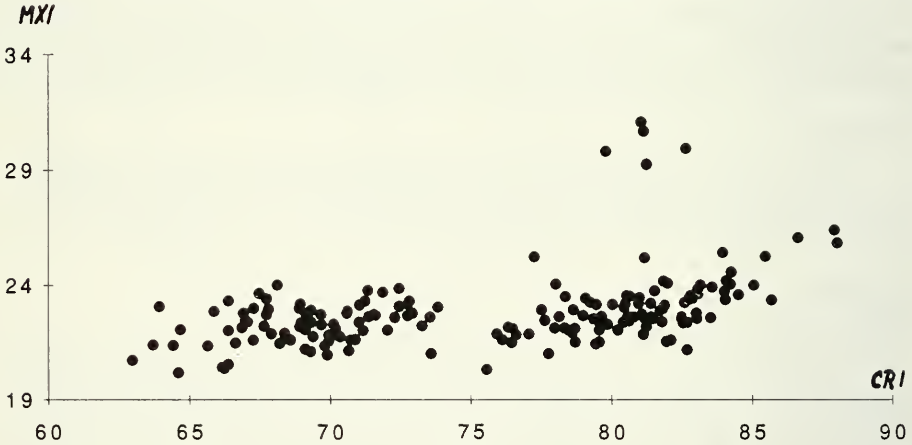

FIG. 2.

Cranial (CRI) and maxillary (MXI) indexes of *Myotis* spp. from Paraguay.

TABLE II

Maximum and minimum of calculated Maxillarly and Cranial Indexes

	M. nigricans	*M. albescens*	*M. levis*	*M. ruber*
MXI	20,193 24.030	20,343 25,424	25,820 26,405	29,241 31,076
CR1	62,989 73.829	75.573 85,682	86,612 88,022	79,794 82.637

are found (see conclusions). For group I to III the morphological characters (Fig. 3 and Menu 1985) are:

- I^1 E-type and I^2 A-type.
- Upper canine A type. The values calculated by the depth of C and P^4 are similar to those of European species including, e. g., *M. daubentoni* and *nattereri*; no increasing processus is found for C.
- P^2 and P^3: all populations usually show the typical reduction observed in many *Myotis* spp.; even lingual occlusion of P^3 (often crowned) cannot be considered to be a distinctive character at the specific level.
- P^4 A-type, with antero-lingual cingular cuspid. The distal border is concave, but without indentation: this characteristic is important, and generally stable in European forms in witch it is useful to separate *daubentoni* from *cappaccinii.*
- M^1 and M^2 A-type. The protofossa is closed posteriorly, the metaconul is reduced in size; the postprotocrista is declivous and only slightly deviated at the connection with the metaloph. The latter feature directs to the anterior point of the tooth and turns around the crest of the metaconul from inside. The paraloph is strong and elicits an inflexion of the fore-protocrista, imitating a residual paraconul.
- M^3 is A-type (Fig 35 in Menu 1985). It is on the way towards a more evolved morphology. The metacone is not voluminous and does not form a pertinent distal protuberance.
- As in all "*Leuconoe*", the morphology of the mandibular toothrows is virtually identical. Apart from the dimensions, they do not permit to separate the species.

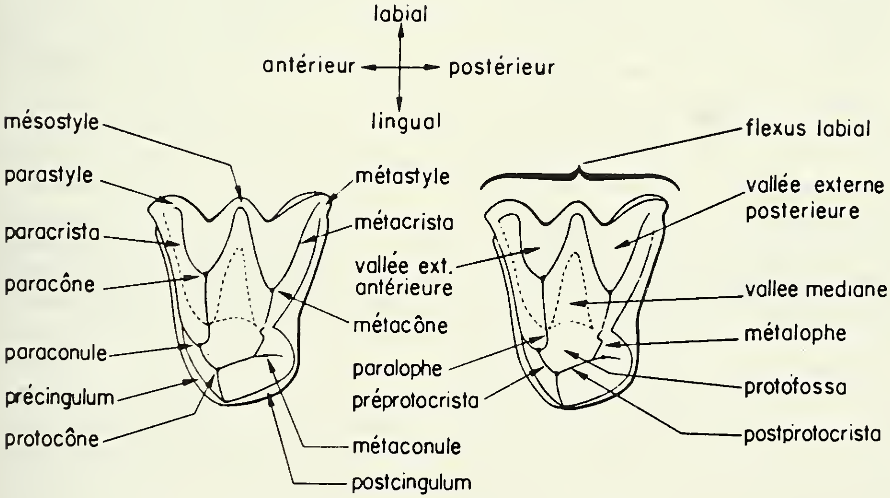

Fig. 3

Descriptive terminology of the upper molars of Vespertilioninae (Menu 1985).

However, the homogenity of the mandibular teeth is an important character in defining the genus.

CONCLUSIONS

Our results show clearly that the groups I to III are identical as to the odontology; they differ only in their dimensions (Fig.4 a-c). There can be no doubt that these groups belong to the genus *Myotis*. Incidentally, colouration is not a useful character in distinguishing the various species because this feature depends on subjective criteria of the observer, varies seasonally, and depends on the state of conservation of the skin. Therefore, we propose the following identifications:

– *Myotis nigricans* (Schinz, 1821) for group I. This is a small uniformly black or deep brown species. The type locality lies between Itapemirim and the Río Iconha (Espirito Santo) on the eastern coast of Brazil, at about the same latitude as northern Paraguay. It is is a well known species widely distributed over South America and ranging southward to northern Argentina (Koopmann 1982).

– *Myotis albescens* (E. Geoffroy, 1806) for group II. This species was described from "... la estancia de San Solano, junto al estero de Ibera"; at the time of the original description, this locality was in Paraguay; nowadays, this place lies within Argentina's borders. LaVal (1973) designated a neotype coming from Yaguaron (Paraguari) in Paraguay. This small to medium sized species differs in colouration from *M. nigricans* only by its lighter underparts and a slightly "frosty" aspect of his back. The distribution is identical with that of *nigricans*.

– *Myotis levis* (E. Geoffroy, 1824) for group III. The third group is less clearly separable when the forearm length is used; the values range from 36,5 to 38,2 mm and overlap with the data of the preceding species. Therefore, this character is not useful to separate it from Paraguayan *M. albescens*. Moreover, our data set is highly limited because we had only three specimens on hand: one from Paraguay and two from El Dorado (Misiones), Argentina. The MXI and CRI, however, are within the limits of some *Myotis levis* (I. Geoffroy, 1824) deposited in the British Museum (Baud 1979) and also within the limits of the data of the same species from Uruguay examinated by LaVal (MXI = 26,8 and CRI = 87,9). *M. levis* lacks the precise type locality, the author giving just "South Brazil" as the origin of this bat. To this day, it is known from southern Brazil, Uruguay and the northeastern corner of Argentina. This makes it highly probable that this species also occurs in Paraguay, and we do not hesitate to assign to *M. levis* the specimen from west of the Río Parana, at the edge of the Río Pyrayu-i (Itapua) . It appears to be the first record for this country.

– *Myotis ruber* (E. Geoffroy, 1806) for group IV. As we stated above, group IV differs from the remaining groups in MXI and CRI as well as in the morphology of some of its teeth (Fig. 4 d). The P^4 has a rectilinear posterior border, i. e. it is neither concave nor indented. The metacone of the M^3 is only slightly developed, and its basis protrudes only moderately distally. Based on colour pattern which is cinnamon-rufous in all specimens examined, we allocate them to *Myotis ruber* (E. Geoffroy, 1806). This species was described from Paraguay; likewise, the neotype designated by LaVal (1973) comes from Sapucay (Paraguari). Two specimens were captured at Salto Tembey on the Río Pirayu-i (Itapua) and three are from Nova Teutonia in Santa-Catarina province of Brazil.

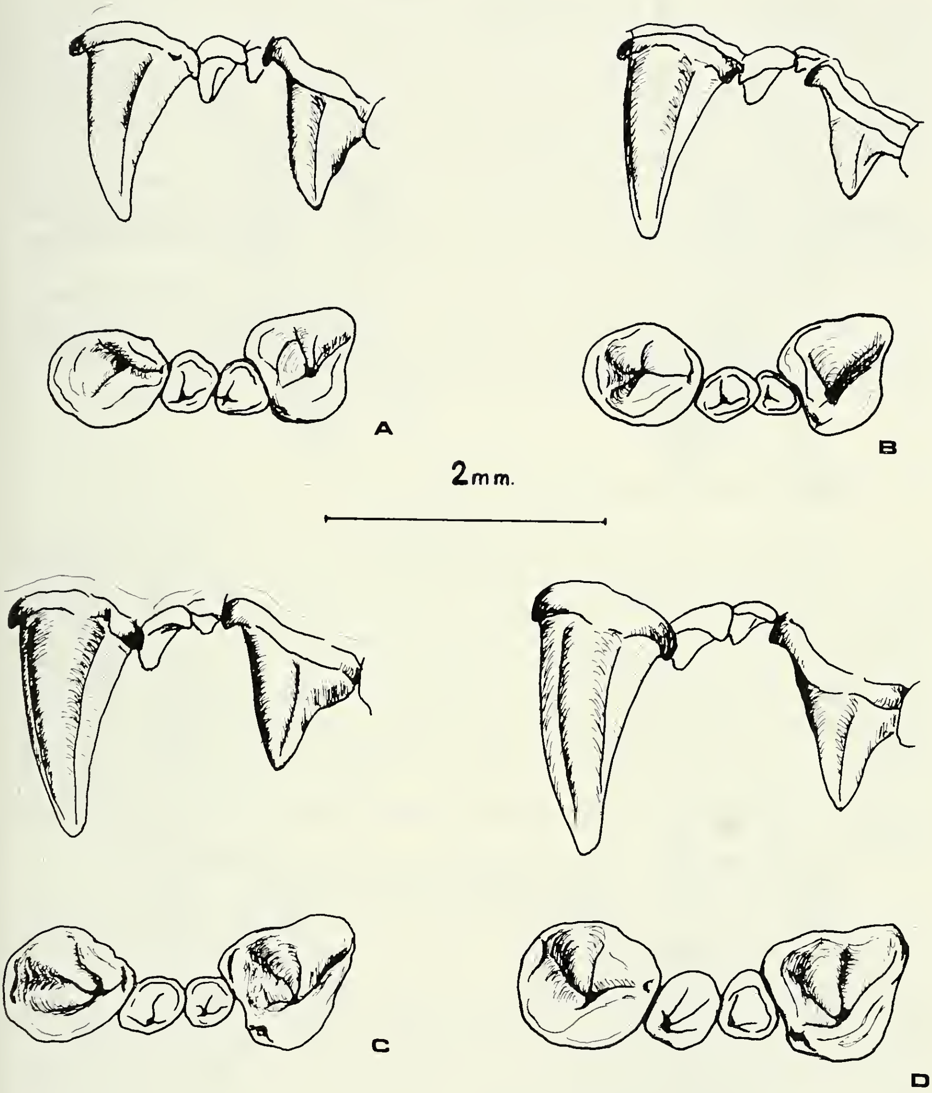

FIG. 4

Occlusal and labial view of the left upper toothrow in Paraguayan *Myotis* (without molars).
a.- *M. nigricans*; b.- *M. albescens*; c.- *M. levis*; d.- *M. ruber*.

Contrary to our initial expectation, there seems to be only four species of *Myotis* found in Paraguay. Using the data given by WETZEL & LOVETT (1974) and MYERS (1977), BAUD (1981) identified a specimen from the Río Apa region as *M. riparius* (Handley, 1960); in fact, the data of this individual are within the limits of *M. nigricans*. We examined two bats deposited in the Museum of Vertebrate Zoology at Berkeley collected by the American authors and originally identified as *riparius*; one represents *nigricans*, the second belongs to the *albescens*-group.

The same institution kindly loaned us two other *Myotis* from Paraguay identified as *simus* and cited by WETZEL, LOWETT & MYERS in their respective papers. MYERS first labeled them as *M. ruber*. Based on the two cranial indexes, odontology and colouration, it seems to us that this determination was correct.

MILLER & ALLEN (1928) and LAVAL (1973) consider *Myotis simus* (Thomas, 1901) to be a strictly Amazonian species. We do not understand why this species should have penetrated suddenly as far south as Paraguay and northern Argentina (FORNES 1972) after 1960 ?.... This leads us to the second part of our work.

II. - REDIFINITION OF *Myotis simus* (Thomas,1901)

According to Thomas' description there are several differences between *M. simus* and all other species of this genus, among which the following character: "Wings attached to the ankle...". Moreover, in their monograph on the American *Myotis*, MILLER & ALLEN emphasize on this character and add: "The canines, in particular, are larger than those of other South American species." These authors gave two types of colouration, i. e. "red ... nearly the ochraceous-tawny of RIDGWAY, slightly paler, approaching yellow-ocher on the underparts..." being the more frequent, or "...brown...nearly Mars-brown, the underparts with a slight ochraceous cast ..."

Concerning the composition of these colours, RIDGWAY (1886) defined them as follows:

"Ochraceous-tawny "= burnt sienna + burnt umber + yellow ochre
"Mars-brown" = burnt umber + yellow ochre + burnt sienna.

It turns out that these colours are in fact very close to each other, differing only in the proportions of their components.

Based on the original description of *M. ruber* and on MILLER & ALLEN in the same monograph, it becomes evident that this species is most similar - the dentition excepted- as to colouration, being either "ochraceous-tawny" or "Mummy-brown" (= raw umber + burnt sienna); the dark phase is mixed up with "Prout's-brown" (= raw umber + burnt umber + sepia). We came to realize that these faint differences are in fact purely subjective and depend only on the conditions of preservation. It is a well known phenomenon that "foxing" or decolouration of the skins in alcohol affects the colours of all museum specimens within a short time. Therefore, colour characters are not considered to be an "a priori" systematic criterion to us, although all living and preserved *M. ruber* we had on hand were "Cinnamon-rufous" whereas all *simus* we have seen are "Mummy-brown"and never ochraceous; this last observation concerns specimens stored in alcohol during three weeks only as well as old material (dry skins) in the American Museum.

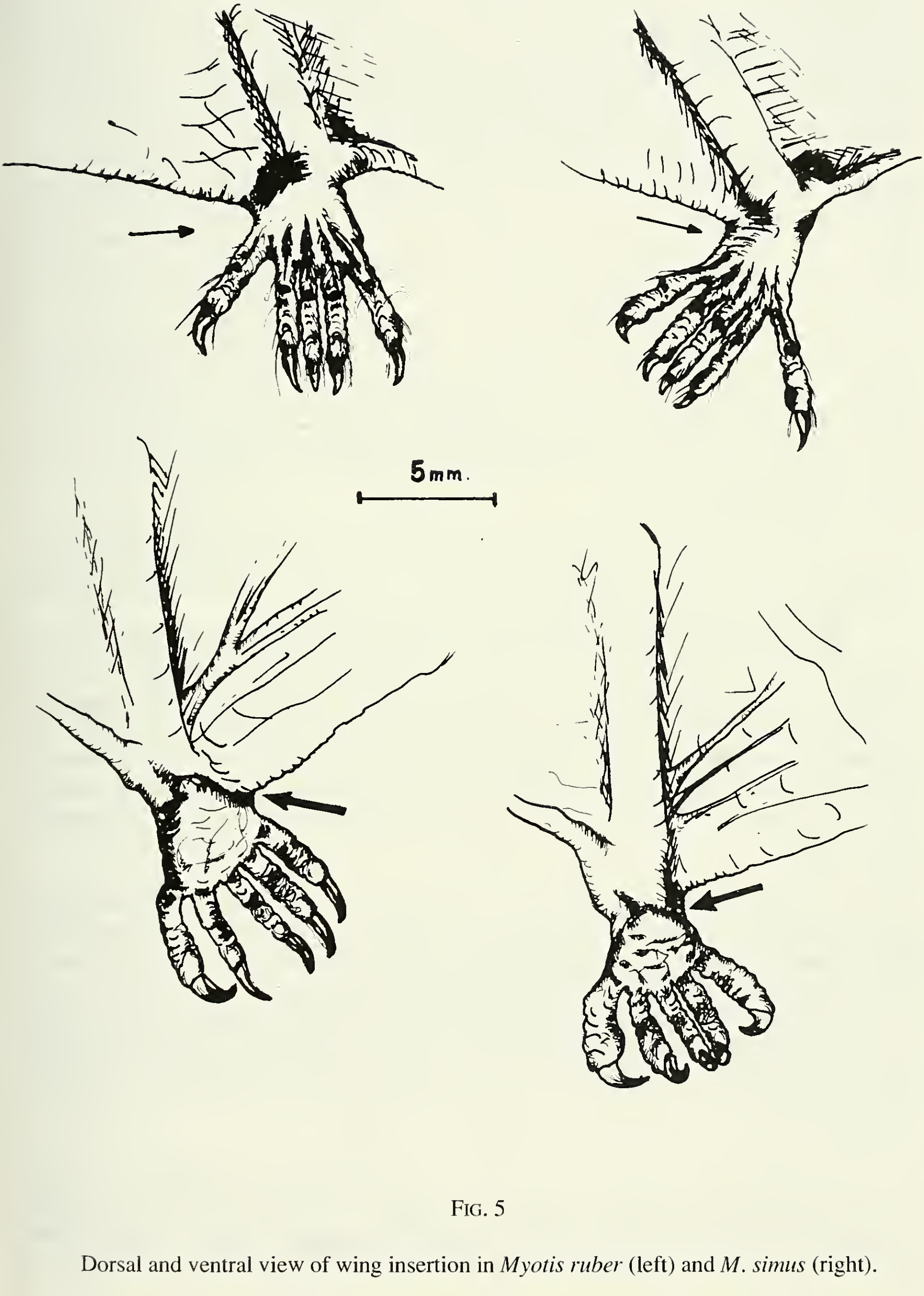

FIG. 5

Dorsal and ventral view of wing insertion in *Myotis ruber* (left) and *M. simus* (right).

What about the morphology and in particular the attachement of the wing to the ankle, an important character of THOMAS' diagnosis? Incidentally, HANDLEY (1960), in his description of *M. simus riparius* - further *M. riparius* - says that "...the supposed insertion of the wing at the ankle..." of *simus* is "...an artefact", and that "...actually the wing is attached to the base of the toes as in most *Myotis*." This firm statement was accepted by all subsequent authors including LAVAL (1973). As a consequence they considered this "detail" to be a negligible feature. At the same time this explains why *M. simus* is reported from South America as far as Argentina...!

In 1980, our collegue of the MHNG, Dr. C. Vaucher, collected two bats of the genus *Myotis* at Samiria on the Río Samiria (Dept. of Loreto) in Peru, about 100 km north of the type locality of *simus*: Sarayacu, situated in the Upper Peruvian Amazon (Río Ucayali). The examination of the foot leaves no doubt that the attachment of the wing is at the ankle, leaving the foot free, in agreement with Thomas' description (Fig.5).

Upon written request on the condition of this character in the type specimen of *simus* (BMNH 8.5.12.2, adult ♀, in alcohol), Dr.P.D. Jenkins of the British Museum replied: "... the foot is free". To bring more light to this problem, we borrowed two specimens from the American Museum (AMNH 71 485-86) that formed part of the series examined by MILLER & ALLEN. In both individuals the wing is inserted at the ankle. This peculiarity is characteristic for this species, and separates *simus* from all other Neotropical *Myotis* spp.

Another character of *M. simus*, emphasized by MILLER & ALLEN is the unusual size of the upper canine in its length as well as in its basal section. This, however, is not due to geographical variation as supposed by HANDLEY, but probably represents an evolutionary trend found in South American endemics.

Odontologically, the reduction of the distance C-P^4 has several consequences: a regression of P^2 and especially P^3, with a considerable lingual removal of the two teeth (Fig.6). Most specimens exhibit a crowding of P^3, in a way that P^2 seems to be in contact with P^4. The fourth upper premolar is characterized by a conspicuous indentation at the distal border, forming a striking inner lobe (postero-lingual heel). The antero-lingual singular cuspid is missing : this is a highly constant specific character in some Palearctic species as for instance *Myotis nattereri*, *M. emarginatus* and *M. cappaccinii*. But the general aspect of P^4 is referable to the B-type (MENU 1985, p. 104).

M^1 and M^2 are of the A type, i. e. in evolution. They show a strong metalophe, directed towards the interior of the protofossa, and permitting the development of a conspicuous metaconule. The M^3 belongs to the A-Type, poorly evolved. Its metacone is voluminous, and the base constitutes the distal projection of the tooth.

The mandibular toothrow is of the "*Leuconoe*"-type (sensus MENU). The regression of the upper P^2 and P^3 as well as the constriction of the length of C-P^4 have no incidence on the arrangement of the homologous lower teeth.

CONCLUSION

We found that *Myotis simus* is a highly distinct species. It is easily recognizable and differs from all other South American representatives of the genus by the structure of the upper canine and the insertion of the wings. Our findings do

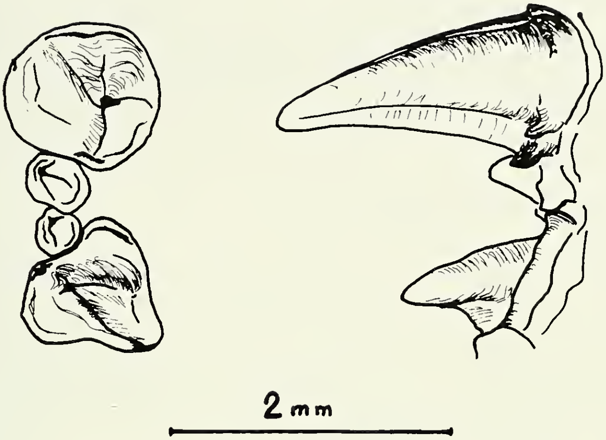

FIG. 6

Occlusal and labial view of the upper toothrow in *Myotis simus* (without molars).

not support its separation as a distinct sub-genus (*Hesperomyotis*) as proposed by CABRERA (1957) on the basis of these characters. Re-examination of all material from outside the Amazon Basin assigned to *M. simus* is recommended in order to get a better idea of the distribution of this species.

ACKNOWLEGMENTS

For the opportunity to examine specimens, we wish to express our sincere gratitude to G.G. Musser of the American Museum of Natural History - AMNH – (*M. simus*), B. R. Stein, Museum of Vertebrate Zoology of the University of California - MVZ (*Myotis* from Paraguay), P.D. Jenkins, British Museum of Natural History - BMNH - (description and measurements of the type specimen of *M.simus*) and X. Misonne, Institut Royal des Sciences Naturelles de Belgique - IRSNB - (*Myotis* from Paraguay).

MATERIAL EXAMINATED (MHNG)

Myotis levis
Paraguay: -Itapua: Pyrayu-i (1 ♂).
Argentina: -Misiones: El Dorado (2♀).

Myotis ruber
Paraguay: -Itapua: Rio Tembey (1♀) ; Pyrayu-i (1♀).
Brazil: -Santa Catarina: Nova Teutonia (3♀).

Myotis albescens
Paraguay: -Concepcion: Rio Tagatya-Guazù (1♂/2♀); Estancia Santa Sofia (1♂); Etancia Primavera (1♀). - San Pedro: San Pedro, Rio Jejui-Guazù (4♂/14♀). - Presidente Hayes: Trans Chaco, km 170, Estero Patino (1♂/1♀); Rio Aguaray-Guazù (1♂/4♀); Trans Chaco, Rio Verde (7♂/19♀); Trans Chaco, Monte Lindo (4♂/2♀); Rio Salado, north Pozo Colorado (1♂); Trans Chaco, km 293, Estancia Apendice (1♂). - Cordillera: north Emboscada, Rio Piribebuy (1♂). - Alto Parana: Itakyry (2♂/4♀); Taty Yupi, Itaipu (1♂). - Caazapa: Yegros, Rio Pirapo (2♀). - Alto Paraguay: General Diaz (1♂). - Caaguazù: Rio Yucuyry, south Yhù (1♂).
Argentina: - Misiones: El Dorado (2♂/16♀).
Brazil: - Santa Catarina: Nova Teutonia (1♂).

Myotis nigricans
Paraguay: - Concepcion: Estancia San Luis (1♂); Arroyo Allegre, Estancia Primavera (2♀); Estancia Santa Sofia (3♂/6♀); 25 km south Estancia Estrella (1♂/2♀); Rio Aquidaban-Rio Paraguay (4♂/1♀); Rio Trementina, Laguna Negra (1♂); Arroyo Azotey, north Cororo (1♂). - Presidente Hayes: Estancia Apendice (2♂/4♀); Rio Aguaray (1♂/11♀); Trans Chaco, Rio Verde (4♂/5♀); Rio Salado, north Pozo Colorado (1♀). - Guaira: Numi, Arroyo Yaca-Mi (3♂). - Itapua: San Benito (4♀). - Boqueron: Estancia La Conquista, Pratt Gill (1♂).
Argentina: - Corrientes: Ituzaingo (11♀).
Brazil: - Santa Catarina: Nova Teutonia (5♂/3♀)

Myotis simus
Peru: - Samiria, Rio Samiria, Station Pithecia (2♂), MHNG 1694.41-42.

OTHER MATERIAL

Paraguay: - Presidente Hayes: Trans Chaco, 275 km NW Villa Hayes (1♂, MVZ 144758, "*M. riparius*" = *M. nigricans*); Trans Chaco, km 205 -20 km SW, Retiro Mandeyù (1 ♀, MVZ 144676, "*M. riparius*" = *M. albescens*); Trans Chaco, 230 km NW Villa Hayes (2 ♀, MVZ 144483-4, "*M. simus*" = *M. ruber*). - Alto Parana: Taty Yupi (1♂ IRSNB, *M. albescens*)

M. ruber
Paraguay: - Paraguari: Sapucay (2 ♀, BMNH 2.11.7.19 and 2.11.7.1).
Uruguay: - Aroyo Grande (1♂/ 1♀, MHNG).
Brazil: - Quebrangulo, Alagoas(1♂, MHNG).

M. levis
Brazil: - Palmeiras, Parana (2 ♂/ 1♀/ 1 ind, BMNH 0.6.29.21-24).
Argentina: -Los Ingleses, Ajo Géneral Laval, Buenos Aires (1♀, BMNH 9.12.1.67).
Uruguay: - sans origine (2♀, BMNH 29.3.17.12-13)

M. simus
Peru: - Sarayacu, type specimen (female alcohol, BMNH 81.5.12.2)
Ecuador: - Boca del Rio Curaray (1♂/1♀, AMNH 71484-6) .

BIBLIOGRAPHY

BAUD, F.J. 1979. *Myotis aelleni*, nov. spec., chauve-souris nouvelle d'Argentine (Chiroptera, Vespertilionidae). *Revue suisse Zool.* 86 (1): 267 - 278.

– 1981. Expédition du Muséum de Genève au Paraguay: Chiroptères. *Revue suisse Zool.* 88 (2):567-581.

– 1989. Présence de *Macrophyllum macrophyllum* Schinz (Chiroptera, Phyllostominae) au Paraguay. *Mammalia.* 53 (2):308-309.

CABRERA, A. 1957. Catalogo de los Mamiferos de America del Sur. *Revta Mus. argent. Cienc. nat."Bernardino Rivadavia". Cienc. Zool.* 4 (1): 1-307.

FORNES, A. 1972. *Myotis (Hesperomyotis) simus* Thomas, nueva especie para la Argentina (Chiroptera, Vespertilionidae). *Neotropica* 18 (56): 87-89.

HANDLEY, C. O. Jr. 1960. Descriptions of new bats from Panama. *Proc. U. S. nat. Mus.* 112: 459-479.

KOOPMAN, K.F. 1982. Biogeography of the Bats of South America. *In*: Mammalian biology in South America. (M.A. Mares & H.H. Genoways, eds) *Spec. Publ. Ser., Pymatuning Lab. Ecol.*, 6 : 273-302.

LAVAL, R.K. 1973. A revision of the Neotropical bats of the genus *Myotis. Los Angeles Co. Mus. Sci. Bull.* 15: 1-54.

MENU, H. 1985. Morphotypes dentaires actuels et fossiles des Chiroptères vespertilioninés. 1ère partie: Etude des morphologies dentaires. *Paleovertebrata, Montpellier*, 15 (2):71-128.

– 1987. Morphotypes dentaires actuels et fossiles des Chiroptères vespertilioninés. 2ème partie: Implications systèmatiques et phylogeniques. *Paleovertebrata, Montpellier*, 17 (3): 77-150.

MILLER, G. S. & G. M. ALLEN. 1928. The American Bats of the genera *Myotis* and *Pizonyx Bull. U. S. natn. Mus.* 144: 1-218.

MYERS, P. 1977. Patterns of reproduction of four species of Vespertilionid bats in Paraguay. *Univ. Calif. Publs. Zool.* 107: 1-41.

MYERS, P. & R.M. WETZEL, 1979. New records of mammals from Paraguay. *J. Mammal.* 60 (3): 638-641.

– 1983. Systematics and Zoogeography of the Bats of the Chaco Boreal. *Misc. Publ. Mus. Zool. Univ. Michigan.* 165: 59 pp.

RIDGWAY, R. 1886. A nomenclature of colours for naturalists, and compendium of useful knowledge for ornithologists. *Little & Brown*, Boston.

THOMAS, O. 1901. New *Myotis*, *Artibeus*, *Sylvilagus*, and *Metachirus* from Central and South America. *Ann. Mag. nat. Hist.* 7 (7): 541-545.

VAN VALEN, L. 1966. *Deltatheria*, a new order of mammals. *Bull. Am. Mus. nat. Hist.* 132 (1): 1-126.

WETZEL, R.M. & J.W. LOVETT, 1974. A collection of mammals from the Chaco of Paraguay. *Occ. Papers Univ. Connecticut. Biol. Sci. ser.* 2 (13): 203-206.

REVUE SUISSE DE ZOOLOGIE, 100 (3) : 609-612; septembre 1993

Stenus (Parastenus) hannibal sp. n. aus dem Kleinen Atlas in Nordafrika (Coleoptera, Staphylinidae)

234. Beitrag zur Kenntnis der Steninen

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Stenus (Parastenus) hannibal **sp. n. from the Tell-Atlas Mountains in Northern Africa (Coleoptera, Staphylinidae) 234th Contribution to the Knowledge of Steninae.** - Description of *Stenus (Parastenus) hannibal* sp. n. (Algeria) and of the edeagus of *S. (P.) cyanomelas* Puthz.

Key-words: Coleoptera - Staphylinidae - Steninae - *Stenus* - North Africa - taxonomy.

Die Genfer Kollegen Besuchet, Löbl und Burckhardt waren 1988 in Algerien, wo sie neben mehreren anderen Arten auch eine neue Spezies aus der Gruppe des *Stenus glacialis* Heer festgestellt haben, die ich hier beschreibe.

Die genannte Artengruppe ist mit mehreren Spezies, darunter auch polytypische wie *S. glacialis* Heer, im gesamten Mittelmeerraum weit verbreitet, östlich bis Pakistan (*Stenus pakistanicus* Puthz). Sie gehört zur arborealen Fauna und ist im Laufe der Devastierung der ursprünglichen Bewaldung immer wieder in Refugien zurückgedrängt worden. Aus Nordafrika war bisher nur eine einzige Art, *S. cyanomelas* Puthz, bekannt, die im Hohen Atlas Marokkos lebt (ich sah davon bisher nur 4 Stücke aus der Umgebung von Marrakesch). Die Tatsache, daß FAUVEL in seinen Katalogen der nordafrikanischen Staphyliniden (zuletzt 1902) keinen Vertreter dieser Gruppe nennt, zeigt, daß es sich hier um außerordentliche Raritäten handelt. Die hier beschriebene neue Art aus dem Kleinen oder Tell-Atlas, südlich von Algier, beweist, daß die *glacialis*-Gruppe ursprünglich rund um das Mittelmeer gelebt hat: die nächsten Gruppenvertreter sind noch in unserem Jahrhundert auf der Sinai-Halbinsel nachgewiesen worden (PEYERIMHOFF, 1907). Häufiger werden Gruppenvertreter dann über Israel-Libanon bis in die Türkei, wo die Gruppe vielgestaltig und bisher noch nicht zureichend analysiert ist. Sie dringt übrigens mit den Spezies *S. par-*

Manuskript angenommen am 3.10.1992.

cior limonensis Fagel und *S. glacialis* Heer nördlich bis nach Mitteleuropa (die letztere Art sogar bis nach England/Irland) vor (PUTHZ, 1967, 1971, 1986).

Stenus (Parastenus) hannibal sp. n.

Diese neue Art gehört in die *glacialis*-Gruppe und hier in die Nähe der gruppenbezeichnenden Art, mit der sie auf den ersten Blick verwechselt werden kann. Wegen großer Ahnlichkeit der Arten dieser Gruppe untereinander, aber auch wegen ihrer bedeutenden Variabilität ist eine detaillierte Beschreibung wenig sinnvoll, ein ausführlicher Vergleich aber unbedingt erforderlich.

Schwarz, stark messingglänzend, Vorderkörper grob und dicht, Abdomen mäßig grob bis fein, wenig dicht bis ziemlich weitläufig punktiert; Beborstung lang, anliegend. Fühler rötlichgelb, die Keule gebräunt. Taster gelblich, das 3. Glied etwas verdunkelt. Beine rötlichgelb, etwa die Apikalhälfte der Hinterschenkel, deutlich abgesetzt, braun bis dunkler, die Apikalpartien der Mittel- und Vorderschenkel ebenfalls, aber weniger deutlich, verdunkelt, Tarsengliedspitzen kurz gebräunt. Oberlippe schwarzbraun. Clypeus und Oberlippe ziemlich dicht, aber dünn beborstet.

Länge: 3,4 - 4,3 mm (Vorderkörper: 2-0 - 2,1 mm).

♂ - Holotypus: Algerien: Atlas de Blida, Chréa sur Blida, 1400 m, 3.V.1988, Besuchet, Löbl & Burckhardt; 1 ♀- Paratypus: Gorges de la Chiffa, Ruisseau des Singes, 280-300 m, 4.V.1988, Besuchet, Löbl & Burckhardt.

Holotypus im Muséum d'histoire naturelle, Genf, Paratypus in meiner Sammlung.

Proportionsmaße des Holotypus und, in Klammern, des Paratypus: Kopfbreite: 36,5 (38,5); mittlerer Augenabstand: 19 (20); Pronotumbreite: 27 (29); Pronotumlänge: 27 (30); größte Elytrenbreite: 37 (40); größte Elytrenlänge: 35,5 (39); Nahtlänge: 29 (31,5).

Männchen: Schenkel etwas stärker gekeult als beim Weibchen. 8. Sternit mit flacher, wenig breiter, runder Apikalausrandung etwa im hinteren Dreißigstel. 9. Sternit apikolateral (ohne vorherige Einrückung nach innen) spitz. Aedoeagus (Fig. 1, 2), der Medianlobus vergleichsweise schlank, Ausstülphakenapparat stark sklerotisiert, breit, median verbunden.

Weibchen: 8. Sternit zur Hinterrandmitte leicht dreieckig vorgezogen, insgesamt daselbst abgerundet. Valvifera apikolateral spitz. Spermatheka (Fig. 3), distal aus mehreren gedrehten Schläuchen bestehend, proximal schlank (im Gegensatz zu *S. glacialis* z.B.).

Der Kopf ist fast so breit wie die Elytren, dadurch unterscheidet sich die neue Art von *S. parcior* Bernh. und *S. parcior limonensis* Fagel. Die Stirn ist vergleichsweise breit, insgesamt eingesenkt, der Mittelteil aber deutlich breitrund erhoben; wenn er auch nicht das Augeninnenrandniveau erreicht, so ist er doch nicht so tief eingesenkt wie bei *S. cyanomelas* Puthz, *S. bussacoensis* Puthz und *S. festivus* L. Benick, um die südwestmediterranen Arten der *glacialis*-Gruppe zu nennen. Die Stirnpunktierung ist grob und dicht, besonders auch die der Stirnseiten: der mittlere Punktdurchmesser liegt hier deutlich über dem größtem Querschnitt des 3. Fühlergliedes, erreicht etwa den apikalen Querschnitt des 2. Fühlergliedes; die Punkt-

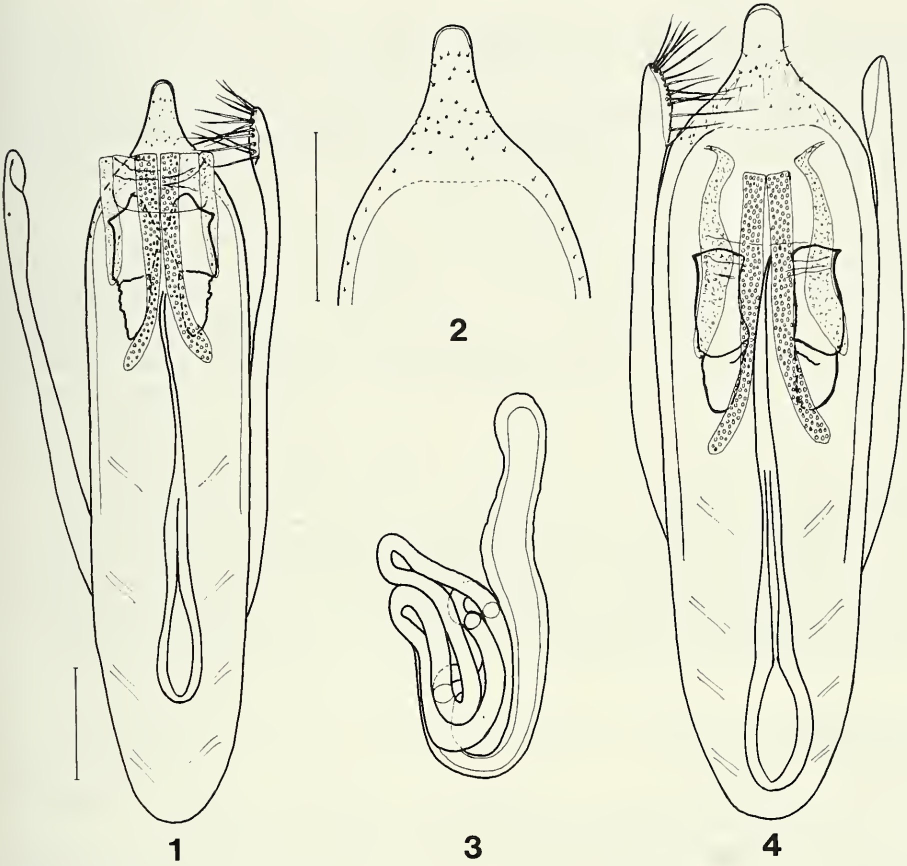

ABB. 1-4

Ventralansichten der Aedoeagen (1, 2, 4) und Spermatheka (3) von *Stenus (Parastenus) hannibal* sp. n. (1, 2 Holotypus, Innensack teilweise ausgestülpt, 2 vergrößertes Detail von 1; 3 Paratypus) und von *S. (P.) cyanomelas* Puthz (4, Agelm. Azigza, Marokko). Maßstab = 0,1 mm.

abstände sind meist etwas kleiner als die Punktradien (bei den genannten südwestmediterranen Spezies sind die Punktabstände viel größer, mehrfach größer als die Punkte, die Punkte sind bei *S. cyanomelas* und bei *S. festivus* erheblich kleiner, kleiner als der Querschnitt des 3. Fühlergliedes !). Fühler und Pronotum ohne auffällige Merkmale, ähnlich wie bei den Verwandten, letzteres mit den üblichen Unebenheiten, grob und dicht punktiert. Elytren im Ummriß deutlich trapezoid, Schultern also etwas schräger als bei den meisten *S. glacialis*, grob und dicht punktiert. Abdomenskulptur nicht deutlich von der des *S. glacialis* zu unterscheiden . Tarsen wie bei *S. glacialis*, das 4. Tarsenglied kurz und schmal, aber deutlich gelappt. Oberseite ohne Netzung.

Stenus hannibal sp. n. - ich nenne ihn nach dem großen nordafrikanischen Feldherren, der seinerzeit auch Nordalgerien beherrscht hat - unterscheidet sich von seinen Verwandten u.a. so: von *S. cyanomelas* Puthz, *S. bussacoensis* Puthz und *S. festivus* L. Benick sofort durch seinen Messingglanz (die genannten Spezies besitzen einen Blau-/Blei-Schimmer) und geringere Größe, von *S. festivus* weiter durch gröbere und dichtere Punktierung, vor allem des Abdomens, von *S. abruzzorum* Puthz durch erheblich feinere Abdominalpunktierung und schmäleren Kopf, von *S. armeniacus* Puthz und *S. limicola* Korge durch gelapptes 4. Tarsenglied, von *S. clainpanaini* Bernh. durch längere, weniger grob punktierte Elytren, feinere Abdominalpunktierung und geringere Größe, von *S. glacialis* Heer äußerlich nur schwer, sicher aber durch die Sexualcharaktere, von *S. glacialis cyaneus* Baudi durch breiteren Kopf und gröbere Punktierung des Vorderkörpers, von *S. glacialis sublaeviventris* Bernh. durch breiteren Kopf und gröbere sowie dichtere Abdominalpunktierung, von *S. muscorum* Bris. durch breiteren Kopf mit weniger erhobener Stirnmitte, von *S. parcior* Bernh. und *S. parcior limonensis* Fagel durch breiteren Kopf, weniger erhobene Stirnmitte und etwas unebeneres Pronotum, von allen durch den Aedoeagus und die Spermatheka.

Von *S. cyanomelas* war der Aedoeagus bisher unbekannt; ich bilde ihn hier zum Vergleich ab: Fig. 4. Sein Umriß ist deutlich breiter als der des *S. hannibal*, die Apikalpartie ist seitlich stärker konkav ausgebuchtet, die Ausstülphaken zeigen eine andere Gestalt als bei *S. hannibal*.

LITERATUR

FAUVEL, A. 1902. Catalogue des Staphylinides de la Barbarie et la Basse-Egypte et des Iles Açores, Madères, Salvages et Canaries (éd. 5). *Revue Ent.* 21: 45-189.

PEYERIMHOFF, P. de. 1907. Liste des Coléoptères du Sinai. *L'Abeille* 31: 1-48, 1 pl.

PUTHZ, V. 1967. Über westmediterrane, insbesondere marokkanische *Stenus*-Arten (Coleoptera, Staphylinidae) 35. Beitrag zur Kenntnis der Steninen. - *Bull. Soc. nat. phys. Maroc* 46 (1966): 267-280.

– 1971. Ueber einige Steninen aus der Sammlung H. Coiffait (Toulouse) (Coleoptera, Staphylinidae) 97. Beitrag zur Kenntnis der Steninen. *Nouv. Revue Ent.* 1: 165-172.

– 1986. Steninen aus Pakistan (Coleoptera, Staphylinidae) 207. Beitrag zur Kenntnis der Steninen. *Revue suisse Zool.* 93: 951-964.

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Terrestrial isopods (Crustacea: Oniscidea) from the remote Greek island Antikithira and its surrounding islets

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Terrestrial isopods (Crustacea: Oniscidea) from the remote Greek island Antikithira and its surrounding islets. - Terrestrial isopods from the southwestern Aegean island group of Antikithira are recorded here for the first time. Collecting was done on three islands, Antikithira, Prassonisi and Lagouvardhos, and a total of 20 species was found. One of them is new for science and is described here. Finally, a biogeographic interpretation of the results is attempted.

Key-words: Crustacea - Isopoda - taxonomy - biogeography - Aegean Islands.

INTRODUCTION

The insular invertebrate fauna of Greece and especially that of the small remote islands, is insufficiently known. A serious effort in the direction of intensive collecting on many isolated islets of greek seas has been undertaken by a group of researchers from the University of Athens (author included), under the supervision of Dr. M. Mylonas and financially supported by the "A. Leventis Foundation". The present study has resulted from this research program. Its aim is to present the first references of Oniscidea from the group of islands that ly between the northwestern corner of Crete and the southern parts of Kithira and is composed by Antikithira, Prassonisi, Lagouvardhos and several smaller bare-rock islets (Fig. 1). As the research project is currently going on, records from other islands will be considered in future publications.

There is a lot of biogeographic interest for this island group because it lies at a key location of the southern Aegean Arc. It forms a "stepstone" bridge between conti-

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FIG. 1

Map of study area. Isobaths of 200 m and 100 m are represented by solid and dotted lines, respectively. A: Antikithira; K: Kithira; P: Prassonisi; L: Lagouvardhos; C: Crete.

nental Greece (to where Kithira biogeographically belongs) and Crete. The faunal composition of the Antikithira group can provide a lot of information on the paleogeography and zoogeography of this region.

Terrestrial isopods are fairly well known from Crete (SCHMALFUSS, 1972a; 1979) and southern Greece (Peloponnese) (STROUHAL, 1938; SCHMALFUSS, 1979). For Kithira island only a few sparse references exist (see revision in SCHMALFUSS, 1979; 1982) and no reference at all from Antikithira.

The material collected has been deposited at the following institutions: Zoological Museum of the University of Athens (ZMUA), Muséum d'Histoire naturelle de Genève (MHNG), Staatliches Museum für Naturkunde, Stuttgart (SMNS) and Museo Zoologico dell'Universitá, Firenze (MZUF).

SITES AND METHODS

Collecting has been carried out during 17, 18, 19 and 22.1.1992 (Antikithira), 21.1.1992 (Lagouvardhos) and 20, 21.1.1992 (Prassonisi). On Lagouvardhos islet only Dr. M. Mylonas was able to climb and collect, while on the other islands collecting was carried out by the author, occasionally helped by other colleagues.

Collecting was done by hand, but also leaf litter samples from the most abundant plants were taken and placed in Berlese-Tullgren funnels for arthropod extraction.

A brief description of the study area is given below:

a) Antikithira. (Data from VERIKIOU, 1986). The largest island of the group, with an area of 20 km^2 and a maximum altitude of 378 m a.s.l. Its shape is rhomboid with the large axis 10 km and the small one 3.3 km long. It consists mainly of limestones (Triassic and Cretaceous), but there are also some Neogene deposits. Vegetation is dominated by maquis and phryganic formations, while part of the island (especially Neogene deposits) is cultivated with Gramineae. Antikithira is one of the drier locations of Greece, receiving annually less than 200 mm of rainfall.

b) Prassonisi. No data have been published for this small islet. Its area (estimated from a 1:10000 map (VERIKIOU, 1986) is about 0.27 km^2 and its distance from Antikithira is 7.5 km. Its heighest point lies lower than 100 m a.s.l. The geological underground consists totally of limestones. The vegetation cover is mainly of herbaceous plants (phrygana and halophytes) but there is a thick copse of maquis shrubs at the western side.

c) Lagouvardhos. No published data. Area estimated around 0.06 km^2 and maximum altitude of around 25 m a.s.l. Its shape is almost quadrangular and its morphology characterized by steep, vertical sides and a plateau at the top. The only plants growing there are some halophilic herbs and a few Gramineae. The geological underground is limestone. The distance from Antikithira is 7.2 km and from Prassonisi 3 km.

Bathymetry of the area (Fig. 1) can help towards an understanding of its paleogeographic history. Antikithira is connected with Kithira by the 200 m isobath, while inbetween Antikithira and Crete there are depths greater than 400 m. On the contrary, all the islands composing the investigated group are connected by the isobath of 100 m, a strong indication that during Pleistocene glaciations they formed a coherent piece of land. The geotectonic history of the area, though, is complex and its paleogeography not easily inferred. According to ANASTASAKIS (1988) the greatest portion of the Kithiran - Antikithiran margin and the Antikithiran - W. Cretan strait was submerged during the Middle-Upper Quaternary but the process had already started during Lower-Middle Pliocene. It is difficult to estimate the age of these islands' isolation because tectonic movements in the region have been abrupt and of dramatic scale (DERMITZAKIS, 1972; FLEMMING and PIRAZZOLI, 1981). An uplift of 2.7 m during the last 2000 yrs has been recorded for Antikithira by these authors, while for surrounding areas the scores are even higher. Therefore, one cannot safely assume the actual pattern and sequence of past land connections. Thus, biological information can prove of great value in unfolding the history of this area.

RESULTS

A total of 20 species were found on the three islands, 18 on Antikithira, 10 on Prassonisi and 6 on Lagouvardhos. One species is new to science, while for all species this is the first record from this island group.

The species list and the description of the new species follows below.

Abbreviations: m: males; f: females; j: juveniles.

LIGIIDAE

1. **Ligia italica** Fabricius, 1798

Numerous individuals were observed on all islands.

This halophilous species is present on all islands in large densities throughout the rocky shores. It is a species distributed all over the Mediterranean shores but also present on many Atlantic sites too.

TYLIDAE

2. **Tylos latreillei** Audouin, 1825

1 m, 1 f, Antikithira, 19.1.1992 (ZMUA)

This sand-dwelling halophilous species was collected at a beach lying at the northeastern shoreline of the island. On neither of the other islets is there any such habitat.

HALOPHILOSCIIDAE

3. **Halophiloscia hirsuta** Verhoeff, 1928

3 m, 2 f, 2 j, Antikithira, 19.1.1992 (ZMUA); 4 f, Prassonisi, 20.1.1992 (ZMUA)

This halophilous species has been found at rocky shores among stones and halophilous plants. It is distributed all over the northern Mediterranean coasts.

TRICHONISCIDAE

4. **Monocyphoniscus caniensis** (Vandel, 1958)

35 m, 34 f, Antikithira, 18.1.1992 (ZMUA); 2 m, 4 f same collecting data (MHNG)

This species inhabits the litter-layer of maquis vegetation (*Pistacia lentiscus*) at the central part of the island. It is a blind, small, humicolous species previously recorded only from certain caves of Crete. Even though, until now, it has been considered as a troglobitic species, I have collected it from several locations outside caves, especially in places with very humid soil conditions. These locations lie on some of the Cyclades islands (personal data) and therefore the actual distribution of the species is wider than recorded in the literature.

5. **Thrichoniscus** sp.

2 m, 11 f (some with eggs), Antikithira, 17-18, 22.1.1992 (ZMUA); 1 m, 1 f, Prassonisi, 21.1.1992 (ZMUA)

The specimens were collected from the litter-layer of several plants (mainly maquis) wherever there was enough humidity. The present state of our knowledge on the greek species of *Trichoniscus* is far from being satisfactory. A sound revision of the genus in Greece is necessary before any safe determination is possible. For the moment it suffices to say that the same species is present on both Antikithira and Prassonisi and that it seems to be related to *T. halophilus* Vandel, 1951.

BATHYTROPIDAE

6. **Rodoniscus anophthalmus** Arcangeli, 1934

2 m, 2 f, Prassonisi, 20.1.1992 (ZMUA)

This endogean species has been recorded so far only from the Dhodhekanese (southeastern Aegean sea). In my personal collection (unpublished data) there are specimens also from Crete and the Cyclades.

PLATYARTHRIDAE

7. **Platyarthrus schoebli** Budde-Lund, 1885

1 m, 9 f, Antikithira, 17-19.1.1992 (ZMUA); 2 f, Prassonisi, 20.1.1992 (ZMUA); 1 m, 3 f, Lagouvardhos, 21.1.1992, leg. Mylonas (ZMUA)

This species lives in ant-nests and is distributed all around the Mediterranean countries.

PHILOSCIIDAE

8. **Chaetophiloscia cellaria** (Dollfus, 1884)

3 m, 19 f (10 with eggs), Antikithira, 17-19, 22.1.1992 (ZMUA); 1 m, 16 f (12 with eggs), Prassonisi, 20.21.1.1992 (ZMUA); 1 f, Lagouvardhos, 21.1.1992, leg. Mylonas (ZMUA)

This species was found in the humid litter-layer of several plants and at several other humid microsites. It is distributed all over the northern Mediterranean countries.

PORCELLIONIDAE

9. **Leptotrichus naupliensis** (Verhoeff, 1901)

4 m, 4 f, Antikithira, 17-19.1.1992 (ZMUA)

This species is present on cultivated land and on sandy soil. It is distributed throughout the eastern Mediterranean.

10. **Porcellinionides pruinosus** (Brandt, 1833)

4 m, 5 f, Antikithira, 17-19.1.1992 (ZMUA); 11 m, 16 f, Prassonisi, 20, 21.1.1992 (ZMUA); 18 m, 13 f, 6 j, Lagouvardhos, 21.1.1992, leg. Mylonas (ZMUA)

This species is present in most kinds of terrestrial habitat. It is anthropophilous and cosmopolitan.

11. **Porcellionides myrmecophilus** (Stein, 1859)

5 m, 3 f, 1 juv., Antikithira, 17-19.1.1992 (ZMUA)

A species very similar to *P. pruinosus* but which is usually found near ant-nests. On Antikithira it was collected at humous-rich sites of cultivated land and in ant-nests. It is distributed all around the Mediterranean countries.

12. **Porcellio laevis** Latreille, 1804

4 m, 4 f, 5 j, Antikithira, 18.1.1992 (ZMUA)

This species was found at very humid sites near water. It is anthropophilous and has a cosmopolitan distribution.

13. **Porcellio obsoletus** Budde-Lund, 1885

3 m, 4 f, Antikithira, 17.18.1.1992 (ZMUA); 2 m, 3 f, Prassonisi, 20.1.1992 (ZMUA)

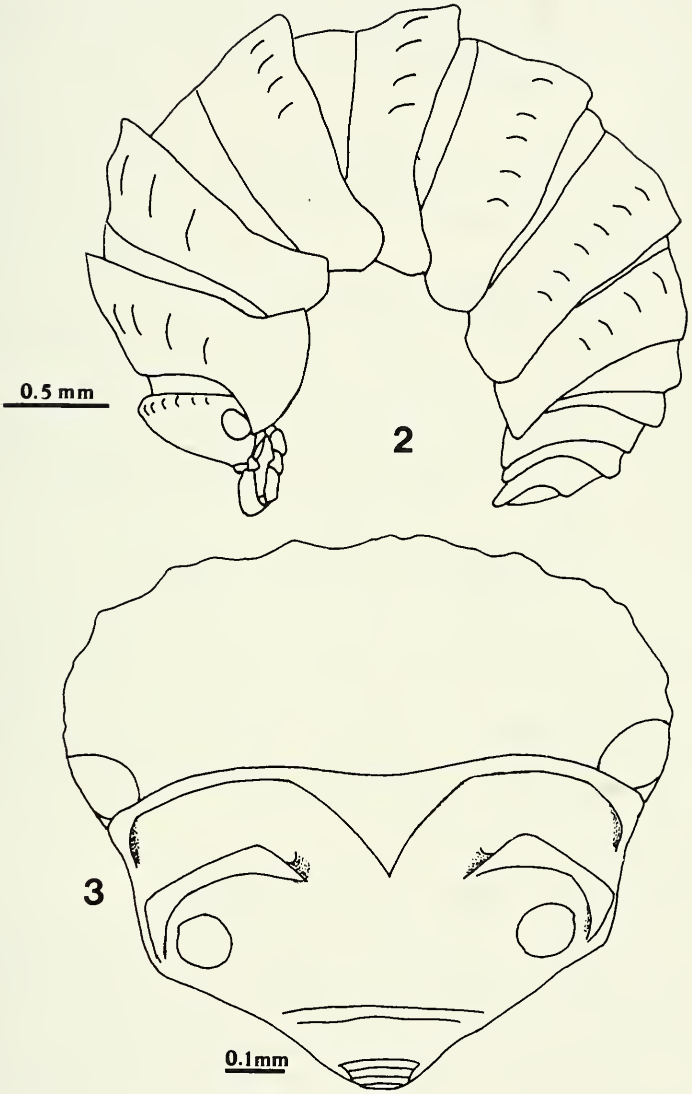
This species inhabits maquis vegetation but can also be found in various habitats with enough calcium and humidity. It is an eastern Mediterranean species.

ARMADILLIDIIDAE

14. **Troglarmadillidium ariadni** (Vandel, 1958)

3 f, Prassonisi, 20.1.1992 (ZMUA); 1 f. Lagouvardhos, 21.1.1992, leg. Mylonas (ZMUA)

No safe identification can be made because only females were collected. The similarity of these specimens to those *T. ariadni* is very striking and since no other species with such character states has been described from the region, it is almost certain that they belong to this species. All specimens were found under stones deep in the soil. *T. ariadni* has been recorded from Cretan caves and has been regarded as a troglobitic species. If the present identification proves to be correct, then we are again in front of the same phenomenon as with *M. caniensis* described above: certain species considered troglobitic are also living in very humid sites away from caves or are humicolous. This phenomenon may prove important in understanding the process of acquiring troglobitic adaptations.



Figs 2-3

Troglarmadillidium halophilum n. sp. Holotype (male, 4.3 mm). 2: Lateral view of whole animal; 3: Cephalon in frontal view.

15. **Troglarmadillidium halophilum** n. sp.

Holotype: 1 m, 4.3 mm, Antikithira, 19.1.1992, leg. Sfenthourakis (ZMUA)

Paratypes: 7 m, 3 f, same collecting data (ZMUA), 2 m, 2 f, same collecting data (MHNG), 1 m, 1 f, same collecting data (MZUF-4035), 1 f, same collecting data (SMNS); 2 f, Lagouvardhos, 21.1.1992, leg. Mylonas (ZMUA)

Colour. Yellowish-white with brown patches wich are denser on tergites than on epimera.

Ornamentation. Cephalon and tergites covered by small and diffuse tubercules that fade towards epimera and pleon.

Antennula. Consisting of three joints. There is a bunch of aesthetascs on the apex of third joint.

Antenna. First flagellar joint 2.5 times shorter than second (Fig. 7).

Eyes. Functional, consisted of 10 ommatidia.

Cephalon. (Fig. 3) The posterior margin of the frontal triangle is complete and formed by the frontal line (*Eluma*-type). Antennal lobes are oblique.

Pereion. There is no schisma at the first epimeron. The posterior margin of pereion-epimeron i is moderately arched (Fig. 2). Seventh pereiopod of males sexually differentiated but to a minimal degree: the ischium of males is slightly concave at the ventral side and with a few more hard setae than that of females (Fig. 4).

Pleon. Male pleopod 1 as in Fig. 5-6.

Telson. Trapezoidal, with rounded angles (Fig. 8).

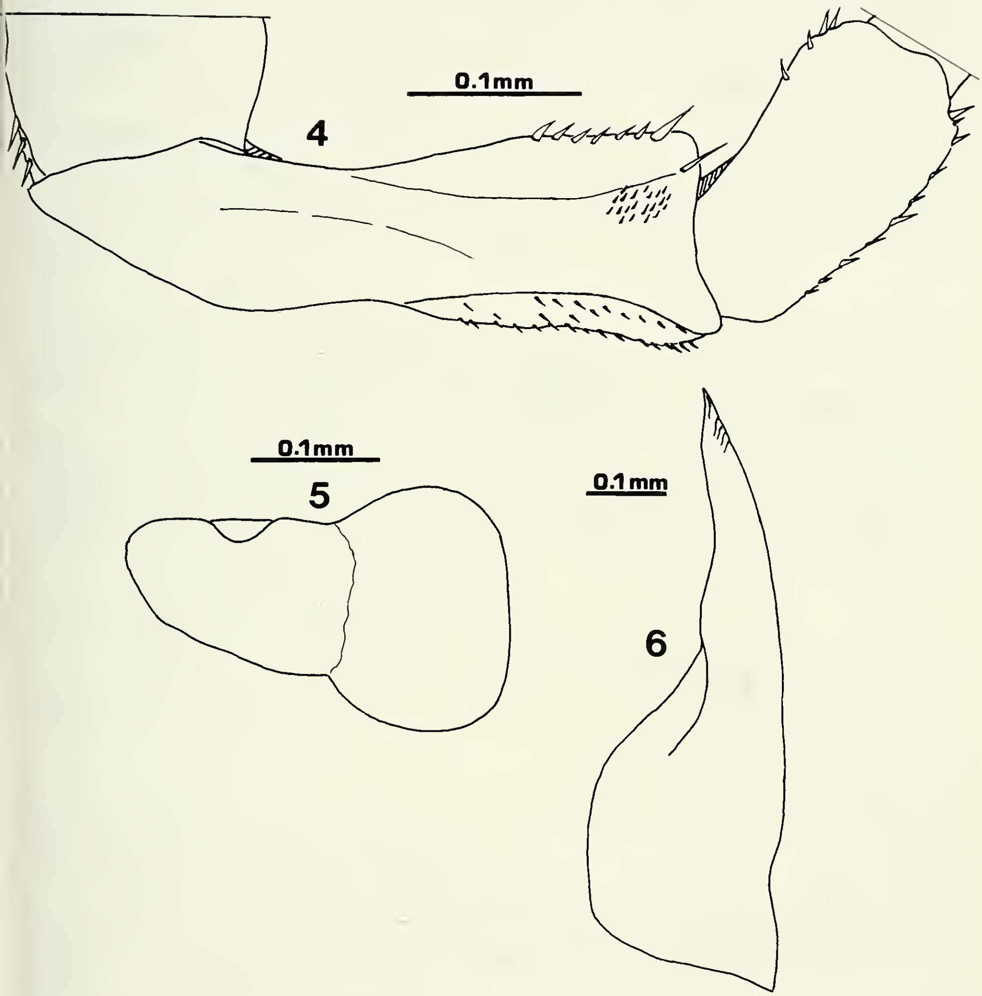
Uropods. As in Fig. 9. Exopodite as wide as long.

Remarks. SCHMALFUSS (1972b) described a species of *Cristarmadillidium* Arcangeli, 1935 from the greek island of Gavdos (*C. gavdense*) which he later ascribed to the genus *Troglarmadillidium* Verhoeff, 1900 (SCHMALFUSS, 1975). In the original descriptions of the two genera there are no safe diagnostic criteria and the taxonomic status of various related taxa (e.g. *Platanosphaera* Strouhal, 1956 and *Illyricosphaera* Verhoeff, 1933, sometimes considered as subgenera of *Troglarmadillidium* and sometimes as separate genera) remains obscure.

T. halophilum is very similar to *T. gavdense* and therefore I preferred to ascribe it in the same genus until a revision of this group is available.

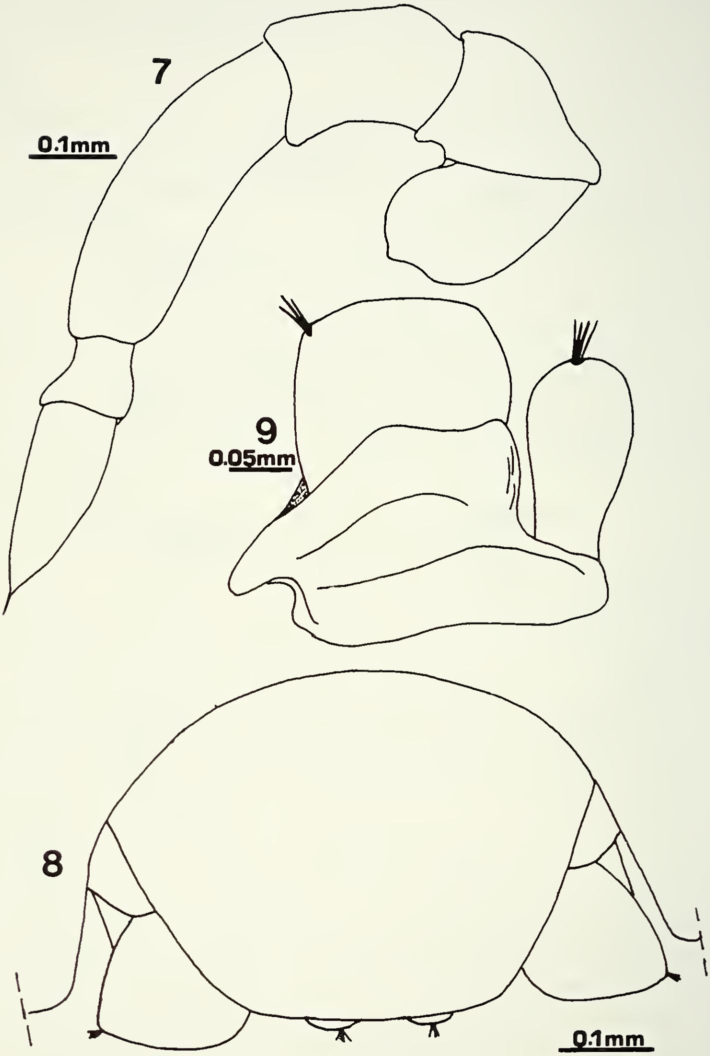
The two species differ in the number of ommatidia (10 in *T. halophilum*, 5 in *T. gavdense*), in the presence of small tubercules (only in the former), in the shape of male pleopod 1, in the stronger coloration of *T. halophilum* and in the male pereiopod 7 (not sexually dimorphic in *T. gavdense*). From the other greek species of the genus (*T. ariadni* and *T. beieri* Strouhal, 1956) it is easily distinguished by the presence of functional eyes, the trapezoidal telson, the coloration and the concave posterior margin of the first pereionepimere.

Epigean habits of this species and related character states (eyes, coloration) indicate a primitive status in the genus, as most *Troglarmadillidium* species are blind and unpigmented. The evolutionary trends for ommatidia reduction and loss of coloration are present in various degrees in greek species. A possible transformation series is the following: *T. halophilum* - *T. gavdense* - *T. beieri* - *T. ariadni*. The first three are epigean and the last troglobitic-endogean.



FIGS 4-6

Troglarmadillidium halophilum n. sp. Holotype (male, 4.3 mm). 4: Ischium and merus of pereiopod 7; 5: Pleopod-exopodite 1; 6: Pleopod-endopodite 1.



FIGS 7-9

Troglarmadillidium halophilum n. sp. Holotype (male, 4.3 mm). 7: Antenna; 8: Telson; 9: Uropod.

Ecology. The specimens from Antikithira were collected under stones and in the sandy soil of a rocky formation a few meters away from the shoreline, at the northeastern part of the island. The specimens from Lagouvardhos were found under stones lying among several halophilic plants at the only plant-covered plateau of this tiny islet, around 25 m above sea level. Both sites are affected by sea-spray throughout the year and even by waves during stormy days. Therefore, the species should be considered as a real halophilic or, at least, as an euryoecious, very tolerant of saline environment.

16. **Armadillidium bicurvatum** Verhoeff, 1901

18 m, 18 f, Antikithira, 17-19.1.1992 (ZMUA); 1 m, 4 f, same collecting data (MHNG)

This species was abundant in cultivated land but also present in certain maquis sites. It is distributed on both continental Greece (Epirus, Peloponnese, Kithira) and Crete.

17. **Armadillidium cythereium** Strouhal, 1937

20 m, 11 f, 113 j, Antikithira, 17-19, 22.1.1992 (ZMUA); 2 m, 5 f, same collecting data (MHNG); 28 m, 17 f, 2 j, Prassonisi, 20-21.1.1992 (ZMUA)

The commonest species in most habitats (minus littoral and sub-littoral). It has been reported only from Kithira island but SCHMALFUSS (personal communication) considers the south-Peloponnese species *A. laconicum* Strouhal, 1938 as its synonym. Specimens from Prassonisi are smaller and have lighter coloration, probably because of the extreme and harsh ecological conditions met on this small islet.

18. **Armadillidium granulatum** Brandt, 1833

1 f, Antikithira, 18.1.1992 (ZMUA)

This species is present on most calcareous Mediterranean areas that are influenced by the sea.

ARMADILLIDAE

19. **Armadillo officinalis** Dumeril, 1816

12 m, 25 f, 1 j, Antikithira, 17-19.1.1992 (ZMUA)

Abundant at maquis vegetation and near cultivated land. It is characteristic of mediterranean-type ecosystems and is distributed in most mediterranean countries.

20. **Armadillo tuberculatus** Vogl, 1876

8 m, 9 f, Antikithira, 17-19, 22.1.1992 (ZMUA); 2 m, 2 f, same collecting data (MHNG)

This species has been collected at various habitat types but prefers maquis vegetation on calcareous substrate. It is a variable species that is distributed in insular Greece (Cyclades, eastern Aegean islands, Crete and Kithira). The same form of this species is present on Antikithira and Kithira but a distinct one on Crete (SPENTHOURAKIS, 1991).

DISCUSSION

The three islands that constitute the investigated group can be regarded as one biogeographic unit concerning their terrestrial isopods. Some minor differences are due to the exceptional ecological conditions of small islets. Actually, the absence of *R. anophthalmus* and *T. ariadni* from the larger "source" island of Antikithira can be explained in terms of their cryptic behavior: both species are small and cryptic endogean isopods that come near the soil surface (and thus can be found) only when the humidity at their understone microhabitat is very high. Therefore it is easier to collect them on such small islets where understone humidity is almost continuously higher than that of larger islands because of the constant influence of sea spray and of halophilic plants, whose litter layer is maintained humid. Both species can be, therefore, expected from Antikithira too.

TABLE 1

The terrestrial isopods collected on Antikithira island group. AN: Antikithira; PR: Prassonisi; LG: Lagouvardhos; CR: Crete; KY: Kithira; ?: Not recorded here, but widely distributed.

	AN	PR	LG	CR	KY
Ligia italica	+	+	+	+	+
Tylos latreillei	+			+	+
Halophiloscia hirsuta	+	+		+	?
Trichoniscus sp.	+	+		?	?
Monocyphoniscus caniensis	+			?	?
Rodoniscus anophthalmus		+		+	?
Platyarthrus schoebli	+	+	+	+	+
Chaetophiloscia cellaria	+	+	+	+	+
Leptotrichus naupliensis	+			+	+
Porcellionides pruinosus	+	+	+	+	+
Porcellionides myrmecophilus	+			+	+
Porcello laevis	+			+	+
Porcellio obsoletus	+	+		+	+
Troglarmadillidium ariadni (?)		+	+	+	
Troglarmadillidium halophilum	+		+		
Armadillidium bicurvatum	+			+	+
Armadillidium cythereium	+	+			+
Armadillidium granulatum	+			+	+
Armadillo officinalis	+			+	+
Armadillo tuberculatus	+			+	+
TOTAL	18	10	6		

Even though the ecological biogeography of such small and isolated islands is of great scientific interest, it is premature to proceed to such a consideration, because no adequate data on the specific conditions met in this type of Mediterranean ecosystem have been published and not enough islets have been sampled yet. On the other hand, this island group is of particular historical biogeographic interest, as it is located at a key position of the southern Hellenic Arc (for the significance of this region see

ANGELIER and LE PICHON, 1978; LE PICHON and ANGELIER, 1979; PAPANIKOLAOU and DERMITZAKIS, 1981 etc.).

As stated before the predominant question related to biologists, concerns the pattern of successive disjunctions between Antikithira, Crete and Kithira-Peloponnese. Biogeographical approaches can largely contribute in estimating the relative timing of break-ups of connecting landbridges. Did Crete separate at a time very different from that of Kithira? The following discussion is related to this problem.

The species comprising the terrestrial isopod fauna of the Antikithira island group are, in majority, widely distributed in Greece. From a total of twenty, only two species (*A. cythreium* and *T. ariadni*) have a locally restricted distribution and only one (*T. halophilum*) is a local endemic (*Trichoniscus* sp. is very likely to be the same species as the one found on Kithira, southern Peloponnese and probably also Crete).

Therefore, the affinities of the investigated area with Crete and continental Greece are obscured by the poverty of indicative elements. Nevertheless, some comments on certain characteristic distributions can help towards an understanding of past processes:

One endemic species is shared with Kithira (*A. cythereium*) and one with Crete (*T. ariadni*). An additional indication of closer relation with Kithira could be the presence of the same form of *A. tuberculatus* on these two islands alone. But according to SFENTHOURAKIS (1991) this is a weak argument, as the various forms of this species are often distributed in patterns incompatible with known paleogeographic reconstructions.

On the other hand the sommon species of Antikithira and Crete belongs to a genus mostly differentiated in the Cretan area. Also, the local endemic species of Antikithira belongs to this same genus and is related to *T. gavdense* that is an endemic of Crete. Such relationships at the generic level or based on troglobitic-endogean species are, in all possibility, indicative of relatively old connections.

A reasonable combination of the data results in the following hypothesis: A first break-up between Kithira and Antikithira happened early, resulting in a relatively long isolation of Antikithira plus Crete (period of *Troglarmadillidium* differentiation). The splitting of these islands followed at a later time and Antikithira remained isolated for long until a temporary reconnection with Kithira took place, probably during some period of sea-level retraction such as the Würm glaciation. This resulted to the expansion of *A. cythereium* and *A. tuberculatus* on both islands. The separation of the small islets Lagouvardhos and Prassonisi from Antikithira may have happened any time afterwards.

In this reconstruction, the main ambiguity is about the degree of sea-level retraction during glaciations. Scores larger than 100 m have been proposed by several researchers (GREUTER, 1970). In the case of the southwestern Aegean these numbers must be combined with tectonic movements of land that can be of large scale, as already discussed (see “sites and methods”. Therefore, an algebric sum of relative sea-level retraction around 200 m is a sound possibility, justifying the proposed scenario.

As a conclusion, it should be stressed that the terrestrial isopod fauna of Antikithira does not support an old continuous isolation of this island group from neighboring regions, since it supports only one local endemic species, while it shares other endemics with both Kithira and Crete.

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REFERENCES

ANASTASAKIS, G.C. 1988. The continental margin of the Kithira- Andikithira-NW Cretan straits: Shallow structure and evolution during the upper Cenozoic. *Bull. Geol. Soc. Greece* 20: 369-381.

ANGELIER, J. and X. LE PICHON. 1978. L'arc hellénique, clé de l'évolution cinématique de la Mediterranée orientale depuis 13 M.A. *C.R. Acad. Sc. Paris* 287: 1325-1328.

DERMITZAKIS, M. 1972. Pleistocene deposits and old strandlines in the peninsula of Gramboussa in relation to the recent tectronic movements of Crete island. *Ann. Geol. des Pays Hell.* 24: 205-240.

FLEMMING, N.C. and P.A. PIRAZZOLI. 1981. Archaeologie des côtes de la Crète. *Histoire et Archaeologie, Dossiers* 50: 66-81.

GREUTER, W. 1970. Zur Paläogeographie und Florengeschichte der südlichen Ägäis. *Feddes Repertorium* 81: 233-242.

LE PICHON, X. and J. ANGELIER. 1979. The Hellenic Arc and Trench system: a key to the neotectonic evolution of the Eastern Mediterranean area. *Tectonophysics* 60: 1-42.

PAPANIKOLAOU, D. and M. DERMITZAKIS. 1981. The Aegean Arc during Burdigalian and Messinian; a comparison. *Riv. Ital. Paleont.* 87(1): 83-92.

SCHMALFUSS, H. 1972a. Die Isopoden von Kreta. *Biol. gallo-hellenica* 4(1): 33-60.

– 1972b. Zwei neue Landisopoden-Arten aus Griechenland. *Senckenberg. biol.* 53: 427-430.

– 1975. Neues Isopoden-Material aus Griechenland. *Sitz.-Ber. osterr. Akad. Wiss., math.-nat. Kl., Abt. 1* 184: 27-66.

– 1979. Revidierte Check-list der Landisopoden (Oniscoidea) Griechenlands. *Stuttgarter Beitr. Naturk.*, Ser. A. Nr. 331: 1-42.

– 1982. Die Landisopoden (Oniscoidea) Griechenlands 3. Beitrag: Gattung *Armadillidium*, Teil 2 (Armadillidiidae). *Spixiana*, 5(3): 217-230.

SFENTHOURAKIS, S. 1991. The subspecific problem of *Armadillo tuberculatus* Vogl, 1876 (Isopoda, Oniscidea). In : The Biology of Terrestrial Isopods III, eds. Juchault, P. and J.P. Mocquard, Univ. of Poitiers, pp. 17-22.

STROUHAL, H. 1938. Oniscoidea Peloponnesi. *Acta Inst. Mus. zool. Univ. Athen.* 2: 1-56.

VERIKIOU, E. 1986. Geomorphological study of the Cape Maleas-Elaphonissos- Kithira-Antikithira- Gramvoussa region. Unpublished thesis, Athens, 128 pp. (in Greek).

REVUE SUISSE DE ZOOLOGIE, 100 (3) : 627-640; septembre 1993

Neue und bekannte Regenwürmer aus Chile (Oligochaeta) (Regenwürmer aus Südamerika 19)

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New and already known earthworms (Oligochaeta) from Chile. - Earthworm species of different families (Acanthodrilidae Claus, 1880, Glossoscolecidae Michaelsen, 1900, Megascolecidae Rosa, 1891, Octochaetidae Michaelsen, 1900, and Lumbricidae Rafinesque-Schmalz, 1815) are discussed which had been collected in Chile between 1963 and 1969. Two new species of the genus *Eodrilus* Michaelsen, 1907 (Acanthodrilidae) are described and figured: *andrassyi* n. sp. and *loksai* n. sp.; *Eodrilus occidentalis* (Beddard, 1895) is redescribed. Ten other species are recorded for the first time from Chile.

Key-words: Oligochaeta - Chile - taxonomy.

EINLEITUNG

Seit den grundlegenden Arbeiten von BEDDARD (1895, 1896), COGNETTI (1904) und MICHAELSEN (1889, 1898, 1899 a, b, 1910, 1911, 1921, 1923, 1936) über Regenwürmer aus Chile ist nur mein Beitrag über die Vertreter der Gattung *Yagansia* Michaelsen, 1899 veröffentlicht worden (ZICSI, 1989). Da auch seither keine weiteren Angaben über die Regenwurm-Fauna Chiles erfolgt sind, besitzen die Bekanntmachungen der Oligochaeten-Aufsammlungen der Ungarischen Bodenzoologischen Expedition in den Jahren 1965-1966 (Teilnehmer: Dr. I. Andràssy, Dr. J. Balogh, Dr. I. Loksa, Dr. S. Mahunka und Dr. A. Zicsi) für die Fauna Chiles ein besonderes Interesse. Gleichzeitig wird neben diesen Daten auch ein Teil des von den damaligen Mitarbeitern des Instituto de Higiene y Fomento de la Produccion Animal (Prof. Dr. F. di Castri, Dr.

Manuskript angenommen am 22.9.1992.

R. Covarrubias, Dr. E. Hajek und Dr. W. Hermosilla) in Chile und auf verschiedenen chilenischen Inseln gesammelte Material berücksichtigt.

Für einen Arbeitsplatz im Naturhistorischen Museum Genf, wo ich meine Aufsammlungen aus verschiedenen Ländern Südamerikas fortlaufend bearbeite, spreche ich der Direktion sowie Herrn Dr. Cl. Vaucher, Leiter der Abteilung Invertebrata, auch an dieser Stelle meinen besten Dank aus.

In vorliegender Arbeit sollen Vertreter verschiedener Familien bekannt gegeben werden. Eine Ausnahme bilden die Arten der Gattung *Chilota* Michaelsen, 1896, da die in meiner Sammlung befindlichen Spezies vorerst noch mit dem im Zoologischen Institut und Museum der Universität Hamburg befindlichem Typen-Material verglichen werden müssen.

FUNDORTLISTE

Von den Fundorten 1-24 ist das Material von den Teilnehmern der Ungarischen Bodenzoologischen Expedition, insbesondere aber vom Verfasser selbst gesammelt worden (vgl. auch ANDRÀSSY *et al.* 1967). Von den Fundorten 25-71 wurde das Material von den Chilenischen Kollegen des damaligen Instituto de Higiene y Fomento la Produccion Animal, Santiago de Chile, gesammelt und mir zur Bestimmung überlassen. Für ihre Bemühungen spreche ich ihnen auch an dieser Stelle meinen besten Dank aus.

1. Antofagasta (Prov. Antofagasta); in der Spritzzone des Meeresufers. 21.IX.1965.
2. Maipu, Quebrada, La Plata (Prov. Santiago), Fundo: La Rinconada, 25 km SW von Santiago de Chile; schwarzer, feuchter Wiesenboden. 28.IX.1965.
3. Farellones (Prov. Santiago), 30 km O von Santiago de Chile; 2300 m. 6.X.1965.
4. Farellones (Prov. Santiago), 30 km O von Santiago de Chile; 1800 m, entlang eines Wasserlaufes. 6.X.1965.
5. El Arrayan (Prov. Santiago), 10 km O von Santiago de Chile; 1300 m. 9.X.1965.
6. Concón (Prov. Valparaiso), 5 km von Concón am Wege nach Quintero; Sanddünen am Seeufer. 10.X.1965.
7. Umgebung von Valdivia (Prov. Valdivia), 20 km von der Stadt entfernt, auf dem Weg nach La Unión; unter der Brücke. 24.X.1965.
8. Fundort wie zuvor; unter Kuhfladen, Holzrinde und Steinen. 24.X.1965.
9. Zwischen Loncoche und Villarrica (Prov. Valdivia); unter Baumstämmen und Kuhfladen. 25.X.1965.
10. Umgebung von La Unión (Prov. Valdivia); neben der alten Verkehrstrasse. 26.X.1965.
11. Baños de Morales (Prov. Santiago), 100 km SO von Santiago de Chile; in kahlen Hochgebirsgegenden, 2300 m. 30.X.1965.
12. Cuesta El Melón (Prov. Santiago), 130 km NW von Santiago de Chile; lehmiger Boden. 3.XI.1965.
13. Tiltil, Cuesta La Dormida (Prov. Santiago), sandiger, lehmiger Boden und in der Laubstreu. 5.XI.1965.
14. Los Vilos (Prov. Coquimbo); feuchter Waldboden. 11.XI.1965.
15. Azapa (Prov. Tarapaca), 25 km O von Arica, entlang des Flusses Rio Lauca. 18.XI.1965.
16. Azapa (Prov. Tarapaca), 25 km O von Arica, entlang des Flusses Rio Lauca. 18.-22.XI.1965.
17. Azapa (Prov. Tarapaca); sandiger Boden. 20.XI.1965.
18. Azapa (Prov. Tarapaca), Luzernenfeld. 22.XI.1965.
19. Azapa (Prov. Tarapaca), Ufergebiet. 23.XI.1965.

20. Azapa (Prov. Tarapaca); unter Steinen am Bachufer. 23.XI.1965.
21. Maipu (Prov. Santiago), Quebrada, La Plata, 25 km SW von Santiago de Chile, Fundo: La Rinconada. 10.XII.1965.
22. Santiago de Chile (Prov. Santiago), Plaza de Armas. 10.XII.1965.
23. Santiago de Chile, Berg San Cristóbal, unter Steinen. 12.XII.1965.
24. Zwischen Concón und Quintero (Prov. Valparaiso), am Seeufer. 14.XII.1965.
25. Ahui, Chiloé Island; künstliche Prärie. 13.II.1964.
26. 20 km von Valdivia entfernt, in N Richtung; temperierter Regenwald. 13.X.1963.
27. Cuesta Soto-Valdivia (Prov. Valdivia); temperierter Regenwald. 20.VIII.1964.
28. Futrono (Prov. Valdivia); temperierter Regenwald. 9.X.1964.
29. Insel Mulchey, Hafen Ballenas; temperierter Regenwald. 19.IX.1969.
30. Puerto Edén; degradierter patagonischer Wald. 23.IX.1969.
31. Hafen Charrua; Torfmoor. 24.IX.1969.
32. Insel Grant; hydrophiles Gebüsch. 25.IX.1969.
33. Insel Mornington, Hafen Alert; unter Steinen. 26.IX.1969.
34. Insel Juan, Bucht Wide; patagonischer Wald, im gefallenen Baumstamm. 30.IX.1969.
35. Insel Desolation, Bucht Tuesday; Steine ohne Vegetation. 4.X.1969.
36. Puerto Bueno; Torfmoor. 2.X.1969.
37. Forido Peel, Caleta Amalia; Wald mit *Nothofagus pumilio*. 1.X.1969.
38. Insel Desolation, Hafen Charrua; unter Steinen am Waldweg. 5.X.1969.
39. Puerto Fontescue; patagonischer Wald. 6.X.1969.
40. Bahia Pond; patagonischer Wald, gefallene Baumstämme. 8.X.1969.
41. La Parva (Berge vor Santiago); Hochgebirgssteppe. 26.X.1963.
42. Fray Jorge National Park (Prov. Coquimbo); Nebelwald. 27.VIII.1963.
43. Portezuelo de Buenos Aires (Prov. Coquimbo); buschige Steppe. 16.VIII.1963.
44. Quebrada Las Palmas (Prov. Coquimbo); Hartholz-Wald. 28.V.1964.
45. Lago Puyehue (Prov. Osorno); temperierter Regenwald. 17.X.1964.
46. Hafen Charrua; patagonischer Wald. 26.IX.1969.
47. Mornington Island; patagonischer Wald. 26.IX.1969.
48. Williams Island, Tribune Bucht; gefallener Baumstamm im patagonischen Wald. 23.IX.1969.
49. Peninsula Brunkswick, Bahia San Nicolás; sehr feuchter Prärie-Boden, unter Steinen. 9.X.1969.
50. General Graz (Prov. Nuble). 8.X.1963.
51. Rio Los Molles (Prov. Coquimbo). 26.V.1964.
52. Rio Los Molles 23.IX.1964.
53. Cabreria- Rapel (Prov. Coquimbo). 25.V.1964.
54. Los Burros (Prov. Coquimbo). 23.IX.1964.
55. San Bernardo (Prov. Santiago). 11.I.1963.
56. San Bernardo. 12.I.1963.
57. San Bernardo. 10.I.1963.
58. San Bernardo. 15.I.1963.
59. San Bernardo. 24.I.1963.
60. San Bernardo. 30.I.1963.
61. Vallenar (Prov. Atacama). 16.VIII.1963.
62. Vallenar. 26.IX.1964.
63. Lago Riuihue (Prov. Valdivia). 16.X.1964.
64. Politechnico San Bernardo (Prov. Santiago). 5.VIII.1963.
65. El Arrayán (Prov. Santiago). 20.XI.1963.
66. Camino Nancul - Los Lagos (Prov. Valdivia). 16.X.1964.
67. Banos Calientes - Puyehue (Prov. Osorno). 17.X.1964.
68. Isla Mancera (Prov. Valdivia). 2.X.1964.
69. Bahia Boya; 7.X.1967.
70. Zwischen Chiu-Chiu und Lasane (Prov. Antofagasta), Kulturland. 23.VIII.1963.
71. Conchi (prov. Antofagasta) hydrophiler Buschwald. 22.VIII.1963.

RESULTATE

ACANTHODRILIDAE Claus, 1880

Eodrilus Michaelsen, 1907 emend. Pickford, 1937

Der Einteilung Pickford's folgend werden der Gattung *Eodrilus* diejenigen acanthodrilinen Formen zugeteilt, die einen holoandrischen männlichen Geschlechtsapparat und Meganephridien ohne Endblase besitzen. Dieser Einteilung nach sind aus Chile bisher *E. magellanicus* (Beddard, 1896), *E. occidentalis* (Beddard, 1896), *E. albus* (Beddard, 1896) und *E. philippi* (Michaelsen, 1899) angeführt worden. Wie aus den Originalbeschreibungen ersichtlich, sind die Arten *E. albus* und *E. philippi* auf Grund eines Exemplares, letztere ohne entwickeltes Gürtelorgan, beschrieben worden. Von *E. occidentalis* lagen zur Beschreibung ebenfalls nur juvenile Tiere vor. Von *E. magellanicus* und *E. albus* wurde später von MICHAELSEN (1910, 1911) anhand von neuem Material (*E. albus*) eine Ergänzung zur Beschreibung Beddard's gegeben, so dass diese Arten mit Sicherheit identifizierbar sind. Bedeutend schwerer ist es *E. occidentalis* zu bestimmen.

Im vorliegendem Material konnten Exemplare von *E. albus* und *E. occidentalis* vorgefunden werden. Ausserdem erwiesen sich 2 Arten neu für die Wissenschaft.

Eodrilus occidentalis (Beddard, 1896)

Exemplare von drei Fundorten konnten zu dieser verhältnismässig grossen Art gestellt werden. Dem juvenilen Typenmaterial fehlen viele Kennzeichen, ein Vergleich mit dem Originalmaterial erschien erforderlich. Durch das freundliche Entgegenkommen von Herrn Prof. Dr. M. Dzwillo, Hamburg, wurde es mir ermöglicht, das unter Inv. Nr. V. 4136 aufbewahrte Typen-Material einzusehen. Leider liessen sich an diesen Exemplaren keine äusseren Merkmale (Gürtel, Pubertätspapillen usw.) erkennen. Auch die inneren Organe wie Prostata, Samentaschen und Samensäcke zeigten nur frühe Stadien der Entwicklung. Aus diesen Gründen ist es sehr schwer zu beurteilen, ob die von den 3 verschiedenen Fundorten stammenden Tiere, die sich in gewissen Kennzeichen (Grösse, Länge der Samentaschen-Divertikel, Lage der Pubertätspapillen) voneinader und von den Typenexemplaren unterscheiden, konspezifisch sind. Ich betrachte sie als eine Art und mit *E. occidentalis* identisch und gebe nachstehend eine sehr ausführliche Beschreibung meiner Exemplare.

Länge 130-300 mm, Dicke 5-10 mm, Segmentzahl 240-450. Farbe grau, auch lebend unpigmentiert.

Kopf epilobisch 1/2 offen bis tanylobisch. Erstes und die Hälfte des 2. Segmentes mit Längsfurchen dicht besetzt. 2. Segment einfach geringelt, 3. - 4. Segment doppelt geringelt. 5. - 6. Segment 4-ringlig, 7. und 9. Segment 3-ringlig, 8. Segment einfach geringelt, 10. - 13. Segment doppelt geringelt. Borsten vom 2. Segment erkennbar, am ganzen Körper eng gepaart. Borsten *ab* = *cd*, Borsten aa etwas grösser als *bc*. Borstenverhältnis hinter dem Gürtel *aa* : *ab* : *bc* : *cd* : *dd* wie 1 : 18 : 13 :

1 : 80. Erster Rückenporus auf Intersegmentalfurche 12/13. Nephridialporen am Gürtel insbesondere deutlich in der Borstenlinie *cd* zu erkennen.

Gürtel vom 13. - 20. Segment, drüsig, fast ringförmig, nur in der Mitte der Ventralseite nicht drüsig angeschwollen. Weibliche Poren auf dem 14. Segment, etwas vor der Borste *a*. Männliche Poren auf dem 18. Segment, liegen in der Samenrinne und treten als kleine Höcker hervor. Prostataporen auf dem 17. und 19. Segment, liegen in der Mitte des Segmentes. Die Poren sind mit einer halbkreisförmigen Samenrinne verbunden. Pubertätspapillen sind auf verschiedenen Segmenten vorhanden. Bei den grossen Tieren am häufigsten in der Nähe der Samentaschenporen auf 7/8 und 8/9 grosse Papillen in der Borstenlinie *ab* des 14., 15., 16., 17. und 19. Segmentes. Manchmal sind Papillen auch auf dem 10. und 11. Segment, oder nur auf einer Seite dieser Segmente und selten auf dem 23. und 24. Segment (Abb. 1). Die Papillen variieren jedoch auch innerhalb einer Population sehr stark. Bei den kleineren Form sind die Papillen anders gelegen. Auch hier sind sie in der Umgebung der Samentaschenporen am häufigsten, es können auch bis zu 4 Papillen auf einem Segment vorkommen (Abb. 2). An den Originalstücken konnten überhaupt keine Papillen erkannt werden.

Innere Organisation. Dissepimente 6/7 - 10/11 stark, 11/12 etwas schwächer verdickt. Speicheldrüsen bis ins 4/5 Segment reichend. Muskelmagen im 6. Segment, gross. Letztes Paar Herzen im 13. Segment. Hoden und Samentrichter im 10. und 11. Segment. Samensäcke im 11. und 12. Segment. Ovarien im 13. Segment, Ovarientrichter auf dem 13/14 Dissepiment. Nephridien meganephridisch ohne Endblase. Prostata im 17. und 19. Segment, kompakter, nur wenig gewundener Drüsenteil mit kurzem, muskulösen Ausführungsgang. Penialborsten nur zwei in einem Drüsensack erkannt. Länge 0,68 mm, Dicke 0.015 mm, gerade, nur am Ende etwas gebogen. Ornamentierung nicht erkannt. Mitteldarm im 17. Segment beginnend, Typhlosolis dünn, sehr klein. Samentaschen im 8. und 9. Segment mit schlauchförmiger Ampulle. Am Ausführungsgang entspringt ein dünnes, längliches Divertikel, welches bedeutend länger als die Ampulle ist (Abb. 3 u. 4.)

Fundorte: Nr. 6. AF/731,* 39 + 37 juv. Ex. G/**965/169. 2 Ex. Nr. 12. AF/734, 21 + 12 juv. Ex., AF/735, 10 + 1 juv. Ex. G/965/177. 1 Ex.

Eodrilus andrassyi sp. n.

Von einem weiteren Fundort der Küsten-Kordillere liegen aus einer Höhe von 1800 m 3 Exemplare vor, die trotz einer gewissen Ähnlichkeit mit *E. occidentalis* und den erwähnten Schwierigkeiten bei der Festlegung dieser Art als selbständige Spezies betrachtet werden.

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* Die Numerierung bezieht sich auf die Sammlung des Tiersystematischen und Ökologischen Lehrstuhles der Universität, Budapest.

** Die Numerierung bezieht sich auf die Sammlung des Naturhistorischen Museums Genf.

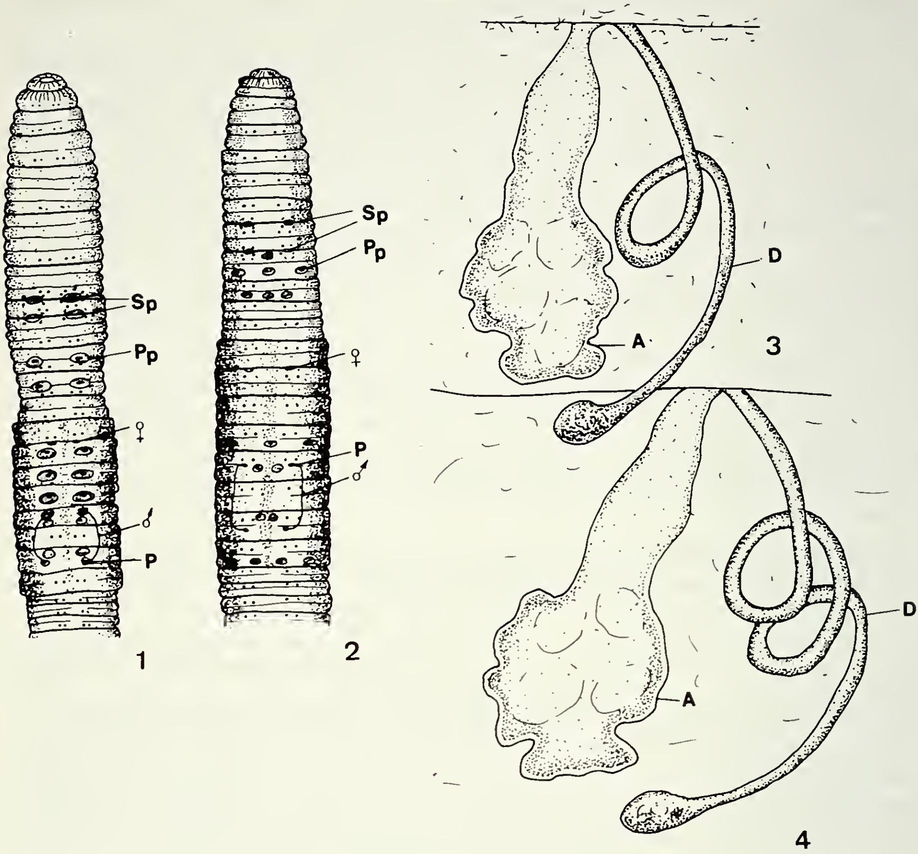

Abb. 1-4

Eodrilus occidentalis (Beddard, 1986) 1. Ventralansicht der grossen Formen Sp. = Samentaschenporen, Pp = Pubertätspapillen, P = Prostataporen. 2. Ventralansicht der kleinen Formen. Sp. = Samentaschenporen, Pp. = Pubertätspapillen, P = Prostataporen. 3-4. Samentaschen des 8. und. 9. Segmentes. A = Ampulle, D = Divertikel.

Länge des Holotypus 130 mm, Dicke 4 mm, Segmentzahl 299. Bei den Paratypen fehlt das Körperende.

Farbe grau, unpigmentiert.

Kopf tanylobisch. Erstes und 1/4 des 2. Segmentes dicht mit Längsfurchen besetzt. 2. - 4. Segment einringlich, 5. - 6. Segment 2-ringlig, 7. - 8. Segment 4-ringlig, 9.-13. Segment 2-ringlig.

Borsten am ganzen Körper eng gepaart und vom 2. Segment beginnend deutlich zu erkennen. Borstendistanz *aa* etwas grösser als *bc*; *ab* nur etwas grösser als *cd*. Borstenverhältnis hinter dem Gürtel *aa* : *ab* : *bc* : *cd* : *dd* wie 20 : 1,5 : 12 : 1 : 60.

Erster Rückenporus auf Intersegmentalfurche 9/10 und von da nach hinten sehr deutlich zu erkennen. Nephridialporen oberhalb der Borstenlinie *cd*.

Gürtel vom 13. - 19. Segment, sattelförmig. Weibliche Poren auf dem 14. Segment vor und zwischen der Borstenlinie *ab*. Männliche Poren auf dem 18. Segment in der Samenrinne gelegen.

Samentaschenporen auf Intersegmentalfurche 7/8 und 8/9 in der Borstenlinie *ab*.

Prostataporen in der Mitte des 17. und 19. Segmentes. Samenrinne, die die Poren verbindet, nicht gebogen. Pubertätspapillen variieren bei den 3 Exemplaren. Konstant sind die kleinen Papillen in der Umgebung der Samentaschenporen, im 9., 15., 17., 19., 20. u. 21. Segment. Manchmal sind sie nur auf einer Seite ausgebildet oder an Zahl an einem Segment verschieden (Abb. 5).

Innere Organisation. Dissepimente 6/7 - 7/8 etwas verdickt, 8/9 - 10/11 stark, 11/12 weniger stark verdickt. Speicheldrüsen reichen bis ins 4/5 Segment. Muskelmagen im 6. Segment mit kragenförmigem Rand, der auch die Hälfte des 5. Segmentes einnimmt. Hoden und Samentrichter im 10. und 11. Segment, frei. Zwei Paare traubenförmiger Samensäcke im 11. und 12. Segment. Letztes Paar Herzen im 13. Segment.

Prostata des 17. Segmentes grösser als die des 19. Segmentes und mehrfach gewunden, nicht verwachsener Drüsenteil. Ausführungsgang kurz, muskulös. Hintere Prostata einfach, weniger gewunden.

Penialborsten beinahe gleich gross, 2 in einem Borstensack, Länge 0,8 mm, Dicke 0,01 mm, Ende zugespitzt, sehr schwach gebogen, nicht ornamentiert.

Mitteldarm beginnt im 17. Segment, Typhlosolis schwach entwickelt. Nephridien meganephridisch ohne Endsack.

Samentaschen im 8. und 9. Segment. Ampulle schlauchförmig am Ende angeschwollen, Divertikel entspringt beim Ausführungsgang und reicht kaum bis zur Hälfte der Ampulle (Abb. 6 u. 7).

E. andrassyi sp. n. steht der *E. occidentalis* am nächsten. Sie unterscheidet sich jedoch von dieser in der Ausdehnung des Gürtels, in der Form und Länge der Samentaschen und Divertikel sowie in der Form der Prostata.

Die neue Art wird zu Ehren nach meinem Freund und Kollegen Dr. I. Andràssy, dem bekannten Nematoden-Fachmann benannt, der mir auch beim Sammeln dieses Materiales behilflich war.

Fundort. Holotypus AF/2373, Chile, Küsten-Kordillere 84 km NÖ von Santiago de Chile, Cerro "El Rolle" 1800 m, 29.9.1965 leg. Zicsi et al. AF/2374. 1 Ex., Paratypus, G/965178, 1. Ex. Paratypus, Fundort wie bei der Holotype.

Eodrilus loksai sp. n.

Aus der Umgebung von Valdivia liegen zahlreiche, an Grösse die *E. occidentalis* z.T. übertreffende Exemplare einer neuen Art vor.

Länge 200 - 350 mm, Dicke 0,7 - 13,5 mm, Segmentzahl 251-398. Länge des Holotypus 240 mm, Dicke 10 mm, Segmentzahl 266.

Kopflappen setzt sich nicht deutlich vom ersten Segment ab. Farbe grau, nicht pigmentiert.

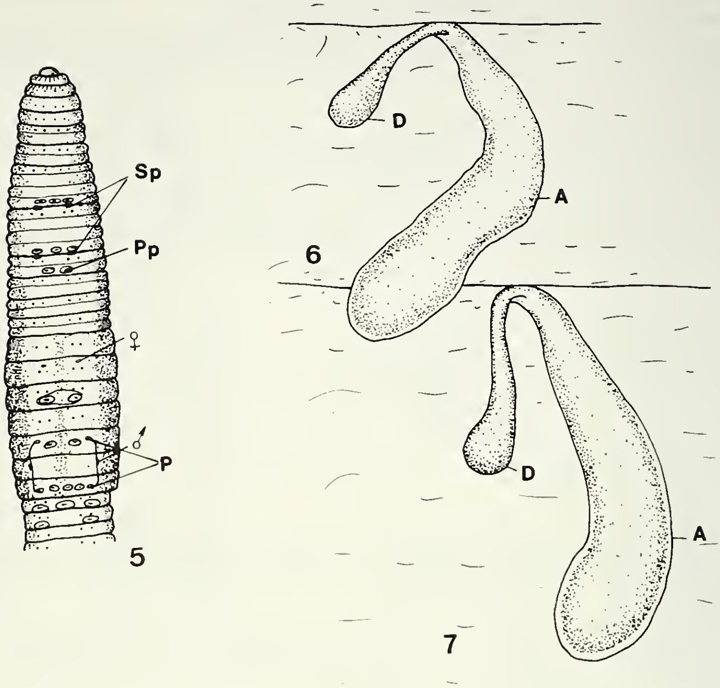

ABB. 5-7

Eodrilus andrassyi sp. n. 5. Ventralansicht. Sp = Samentaschenporen. Pp = Pubertätspapillen, P = Prostataporen. 6-7. Samentaschen des 8. und 9. Segmentes. A = Ampulle, D. Divertikel.

Erstes und die Hälfte des 2. Segmentes mit Längsfurchen dicht besetzt. 2. - 4. Segment 2-ringlig, 5. - 6. Segment 4-ringlig, 7. - 8. Segment 5-ringlig, 9. - 12. Segment doppelt geringelt, 13. - 19. mehrfach gefurcht, ohne deutliche Ringelung.

Borsten vom 9. Segment beginnend erkannt. Am ganzen Körper eng gepaart. Borsten vor dem Gürtel *aa* = *cd*; *aa* etwas grösser als *bc*. Borstenverhältnis hinter dem Gürtel *aa* : *ab* : *bc* : *cd* : *dd* = 8,3 : 1,3 : 7,6 : 1 : 23,3.

Rückenporen auf Intersegmentalfurche 12/13 beginnend vorhanden. Nephridialporen am Vorderkörper oberhalb der Borstenlinie *cd* erkannt.

Gürtel sattelförmig vom 1/2 12, 12., 13. - 1/2 19., 19. Segment. Beim Holotypus vom 1/2 12. - 19. Segment. Gürtel stark drüsig. Weibliche Poren auf dem 14. Segment vor der Borstenlinie *ab*. Männliche Poren auf dem 18. Segment in der Samenrinne gelegen. Prostataporen in der Mitte des 17. und 19. Segmentes, kleine Schlitze in der Borstenlinie *ab*. Pubertätspapillen variieren innerhalb der Population. Am häufigsten kommen kleine Papillen um die Samentaschenporen 7/8 und 8/9, aber auch auf dem 9., 10., 14., 15., 16., 17., und 18. Segment vor. Bei einigen Exemplaren konnten auch hinter dem Gürtel bis zum 25. Segment Papillen nachgewiesen werden. Die grossen Papillen sind kleine Punkte, die von einem dunkleren Fleck umrandet sind (Abb. 8).

Samentaschenporen auf Intersegmentalfurche 7/8 und 8/9, als kleine Schlitze.

Innere Organisation. Dissepimente 6/7 - 9/10 sehr stark verdickt, 10/11 - 13/14 mässig verdickt. Speicheldrüse bis ins 4/5 Segment reichend. Ein Vormuskelmagenartiges Gebilde im 5. Segment, grosser Muskelmagen im 6. Segment. Hoden und Samentrichter im 10. und 11. Segment, frei. Samensäcke im 11. und 12. Segment, an der hinteren Wand des 10/11 und 11/12 Dissepimentes angeheftet. Mächtige, fächerfömig liegende Ovarien im 13. Segment, Ovarientrichter auf Dissepiment 13/14. Letztes Paar Herzen im 13. Segment. Die inneren Samenrinnen verlaufen unvereint bis zur Ausführung im 18. Segment.

Mitteldarm im 17. Segment beginnend, Typhlosolis sehr klein.

Prostata im 17. und 19. Segment, grosser, schlingenförmig öfters gweundener Drüsenteil mit kurzem muskulösen Ausführungsgang. Vorderes Knäuel der Prostata grösser als hinteres.

Penialborsten fehlen.

Samentaschen im 8. und 9. Segment, runde Ampulle, im Ausführungsgang mit zahlreichen Samenkämmerchen, die mit Samenmassen gefüllt sind. Die Samentaschen beider Segmente beinahe gleich gross (Abb. 9 u. 10).

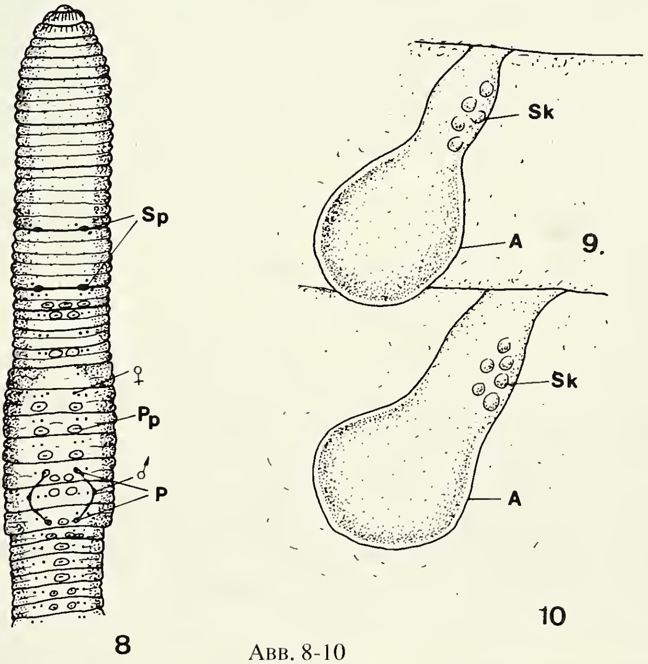

Abb. 8-10

Eodrilus loksai sp. n. 8. Ventralansicht. Sp = Samentaschenporen, Pp = Pubertätspapillen, P. = Prostataporen. 9-10. Samentaschen des 8. und 9. Segmentes. Sk = Samenkämmerchen, A = Ampulle.

Die neue Art steht der *E. occidentalis* am Nächsten, Unterscheidet sich jedoch von dieser in der Länge des Gürtels, in der Form der Samentaschen und durch das Fehlen eines Divertikels und der Penialborsten.

Die neue Art wird dem unlängst verstorbenen Doz. Dr. I. Loksa, der mich auf mehreren Expeditionen in Südamerika begleitet hat, zu Ehren gewidmet.

Fundort. Holotype AF/732. 20 Km nördlich von Valdivia in Richtung Union, 24.X.1965 leg. Zicsi et al. Paratypen AF/733,15 + 10 juv. Ex., G/965179, 3 Ex. Fundort wie bei der Holotype.

Eodrilus albus (Beddard, 1896)

Obwohl Michaelsen (1910) and Hand neuere Materials die Originalbeschreibung ergänzt hat, füge ich dieser auf Grund meiner sehr gut erhaltenen Tiere einige weitere Kennzeichen zu.

Kopf epilobisch 1/4 offen. Rückenporen nur hinter dem Gürtel erkannt. Borsten hinter dem Gürtel *aa* etwas grösser als *bc*, *ab* = *cd*. Samentaschenporen und Drüsenporen, erstere auf Intersegmentalfurche 7/8, 8/9, letztere auf dem 17. und 19. Segment, in der Borstenlinie *b*.

Gürtel vom 13. - 17. Segment deutlich drüsig, sattelförmig. Weibliche Poren auf dem 14. Segment vor der Borstenlinie a. Männliche Poren auf dem 18. Segment in der schwach ausgebildeten, gerade verlaufenden Samenrinne.

Innere Organisation. Dissepimente 6/7-10/11 schwach verdickt. Muskelmagen im 6. Segment von einem Kragen berandet, der auch etwas das 5. Segment einnimmt. Speicheldrüsen reichen bis ins 4/5. Segment. Letztes Paar Herzen im 12. Segment, Nephridien ohne Endblasen. Penialborsten 0,95 mm lang, 0.01 mm dick, etwas gebogen.

Fundorte. Nr. 25. AF/1112.7 + 1 juv. Ex. G/964717. 1 Ex.; Nr. 32. AF/1058, 1 Ex.; Nr. 37. AF/1042. 1 Ex.

Microscolex Rosa, 1887 emend. Pickford, 1937

Ebenfalls der Gattungseinteilung Pickford's folgend, werden sämtliche acanthodrilinen Formen mit holoandrischem männlichen Geschlechtsapparat und meganephridischen Nephridien mit Endblase in die Gattung *Microscolex* Rosa eingereiht. Aus Chile sind bisher neben den beiden kosmopolitsch verbreiteten Arten *M. dubius* (Fletcher, 1887) und *M. phosphoreus* (Ant. Dugès, 1837) die Spezies *M. aquarum-dulcium* (Beddard, 1893), M. bovei (Rosa, 1889), *M. falclandicus* (Beddard, 1893) und *M. michaelseni* (Beddard, 1985) beschrieben worden. In der vorliegenden Aufsammlung sind einige dieser Arten angetroffen worden.

Microscolex dubius (Fletcher, 1887)

Fundorte. Nr. 2. AF/686.32 Ex., AF/701. 3 Ex., G/965166. 1 Ex., Nr. 6. AF/700. 4 Ex., Nr. 23. AF/684. 3 Ex., AF/697 15 Ex.

Microscolex phosphoreus (Ant. Dügés, 1837)

Fundorte. Nr. 2. AF/687. 1 Ex., AF/692. 2 Ex., Nr. 22. AF/ 699. 1 Ex., Nr. 23. AF/693. 1 Ex., AF/696. 6 Ex., G/965167. 1 Ex.

Microscolex bovei (Rosa, 1889)

Ohne auf die Fragen der Synonyme dieser Art hier eingehen zu müssen (*M. falclandicus*, *M. georgianus* (Michaelsen, 1888)) betrachte ich das vorliegende Material der *M. bovei* Rosa angehörend, da meine Tiere in allen wesentlichen Merkmalen mit der Beschreibung von Rosa übereinstimmen. Es sei hier bemerkt, dass bei den geöffneten Tieren im 10. und 11. Segment zwei mächtige periösophageale Testikelblasen erkannt werden konnten, die auf der Dorsalseite miteinander verbunden waren. Ob es sich nur um verhärtete Samenmassen handelt, ist fraglich. Allenfalls sind solche bei Vertretern der Familie Lumbricidae von mir als aufgefranste Testikelblasen erwähnt worden.

Fundorte. Nr. 31. AF/1045. 1 Ex., Nr. 34. AF/1041. 1 Ex., Nr. 37. AF/1051. 11 + 3 juv. Ex., G/969194. 2 + 1 juv. Ex., Nr. 38. AF/1097. 2 Ex., Nr. 69. AF/1105. 4 Ex.

Microscolex michaelseni (Beddard, 1895)

Michaelsen gab 1911 eine ausführliche Neubeschreibung dieser Art und hob sie aus der Gattung *Yagansia* heraus. Das Merkmal mit dem Vorhandensein von Endblasen bei den Meganephridien wird als gutes generisches Kennzeichen anerkannt (ZICSI, 1989).

Fundorte. Nr. 70. AF/709. 5 Ex, G/963136. 2 Ex., Nr. 71. AF/707-708. 5 Ex.

GLOSSOSCOLECIDAE Michaelsen, 1900

Pontoscolex corethrurus (Fr. Müller, 1857)

Es ist der erste Nachweis dieser zirkumtropisch und subtropisch verbreiteten Art in Chile.

Fundort. Nr. 20. AF/710. 2 + 5 juv. Ex.

MEGASCOLECIDAE Rosa, 1891

Amynthas morrisi (Beddard, 1892)

Fundort. Nr. 16. AF/2371. 28. Ex. G/965180. 2 Ex. Nr. 15. AF/2384. 29. Ex. Nr. 18. AF/2387. 15 Ex.

Ebenfalls neu für die Fauna von Chile.

OCTOCHAETIDAE Michaelsen, 1900

Dichogaster affinis (Michaelsen, 1890)

Diese Art wurde ebenfalls nicht aus Chile erwähnt

Fundort. Nr. 26. AF/1095. 1 Ex.

LUMBRICIDAE Rafinesque-Schmalz, 1815

Die Familie Lumbricidae ist nur durch verschleppte Arten in Chile vertreten. Um die Jahrhundertwende waren nur 7 Arten (*A. caliginosa*, *A. rosea*, *A. chlorotica*, *E. t. tetraedra*, *E. foetida*, *D. rubida* und ihre Unterarten sowie *D. hortensis*) angeführt worden. Im Vergleich zu den damals nachgewiesenen über 40 endemischen Arten (BEDDARD, 1895, 1896, MICHAELSEN, 1899) ist dies noch verhältnismässig bescheiden. Wie aus der nachstehenden Aufzählung hervorgeht, ist diese Zahl auf das doppelte gestiegen. Von einer Verdoppelung der endemischen Fauna in der Zwischenzeit kann dagegen nicht gesprochen werden (vergl. MICHAELSEN, 1910, 1936, ZICSI, 1989 und die vorliegende Arbeit), obwohl in beiden Fällen Spezialisten der Gruppe am Sammeln des Materiales beteiligt waren und so ein fachgemässes Sammeln vorausgesetzt werden kann. Wie aus dieser kurzen Erörterung hervorgeht, verbreiten sich die eingeschleppten Arten in bedeutenden Ausmassen, die Einschleppungsgefahr neuer Arten hält andauernd an.

Allolobophora caliginosa (Savigny, 1826)

Fundorte: Nr. 1. Z/5750. 1 Ex. - Nr. 2. Z/5747. 14. Ex., Z/5782. 4 Ex. - Nr. 6. Z/5791. 3 Ex., Z/5800. 6 Ex. - Nr. 7. Z/5771. 10 Ex. - Nr. 8. Z/5737. 3 Ex. - Nr. 9. Z/5764, Z/5766. 30 Ex. - Nr. 10. Z/5735. 8 Ex., Z/5761. 20 Ex. - Nr. 11. Z/5774. 8 Ex. - Nr. 13. Z/5756. 3 Ex. - Nr. 15. Z/5788. 5 Ex. - Nr. 16. Z/5767. 16 Ex. - Nr. 17. Z/5752. Z/5754. 23 Ex. - Nr. 18. Z/5745. 13 Ex. - Nr. 19. Z/5793. 2 Ex. - Nr. 20. Z/5807. 1 Ex. - Nr. 24. Z/5810. 2 Ex. - Nr. 26. Z/5816. 1 Ex., Z/5827. 1 Ex., Z/5829. 2 Ex., Z/5833. 1 Ex. - Nr. 27. Z/5853. 1 Ex. - Nr. 57. Z/5844. 2 Ex. - Nr. 58. Z/5840. 1 Ex. - Nr. 60. Z/5843. 1 Ex. Nr. 61. Z/5818. 2 Ex. - Nr. 64. Z/5815. 5 Ex. Nr. 2. G/544. 10 Ex. Nr. 10. G/546. 15 Ex. Nr. 17. G/545. 10 Ex. Nr. 18. G/543. 7 Ex.

Allolobophora chlorotica (Savigny, 1826)

Fundorte: Nr. 2. Z/5776. 2 Ex. - Nr. 6. Z/5802. 1 Ex. - Nr. 13. Z/5760. 1 Ex. - Nr. 21. Z/5796. 6 Ex. - Nr. 53. Z/5835. 1 Ex. - Nr. 54. Z/5823. 1 Ex. - Nr. 55. Z/5839. 1 Ex. - Nr. 2. G/380. 2 Ex.

Allolobophora rosea (Savigny, 1826)

Fondorte: Nr. 2 Z/5748. 1 Ex., Z/5751. 15 Ex., Z/5777. 2 Ex. - Nr. 5. Z/5786. 10 Ex. - Nr. 6. Z/5801. 1 Ex. Nr. 8. Z/5739. 11 Ex. - Nr. 11. Z/5775. 14 Ex. - Nr. 13. Z/5757. 17 Ex. - Nr. 14. Z/5799. 12 Ex. - Nr. 15. Z/5789. 2 Ex. - Nr. 16. Z/5768. 12 Ex. - Nr. 17. Z/5753. 19 Ex. - Nr. 18. Z/5746. 7 Ex. - Nr. 25. Z/5820. 2 Ex. - Nr. 53. Z/5834. 1 Ex. - Nr. 55. Z/5821. 1 Ex. - Nr. 56. Z/5842. 1 Ex., Z/5846. 1 Ex. - Nr. 59. Z/5845. 1 Ex. - Nr. 17. G/621. 15 Ex.

Octolasium cyaneum (Savigny, 1826)

Fundorte: Nr. 8 Z/5743. 1 Ex.

Octolasium lacteum (Örley, 1885)

Fundorte. Nr. 11. Z/5773. 1 Ex. - Nr. 23. Z/5805. 1 Ex. - Nr. 50. Z/5812. 4 Ex.

Eiseniella tetraedra tetraedra (Savigny, 1826)

Fundorte: Nr. 1. Z/5749. 1 Ex. - Nr. 2. Z/5778. 54 Ex. - Nr. 4. Z/5787. 17 Ex. - Nr. 5. Z/5785. 11 Ex. - Nr. 6. Z/5792. 4 Ex., Z/5803. 1 Ex. - Nr. 11. Z/5772. 15 Ex. - Nr. 13. Z/5755. 14 Ex. - Nr. 21. Z/5797. 5 Ex. - Nr. 24. Z/5811. 2 Ex. - Nr. 51. Z/5822. 1 Ex., Z/5825. 2 Ex., Z/5832. 4 Ex. - Nr. 52. Z/5826. 5 Ex. - Nr. 53. Z/5836. 2 Ex. - Nr. 54. Z/5824. 1 Ex. - Nr. 62. Z/5819. 4 Ex. - Nr. 65. Z/5817. 4 Ex. - Nr. 2. G/473. 30 Ex.

Eiseniella tetraedra intermedia (Cernosvitov, 1934)

Fundorte: Nr. 5. Z/5784. 1 Ex.

Dendrobaena hortensis (Michaelsen, 1889)

Fundorte: Nr. 2. Z/5783. 1 Ex.

Dendrobaena octaedra (Savigny, 1826)

Fundorte: Nr. 7. Z/5770. 1 Ex. - Nr. 8. Z/5741. 2 Ex. - Nr. 45. Z/5855. 1 Ex. - Nr. 7. G/445. 2 Ex.

Dendrobaena cognettii (Michaelsen, 1903)

Fundorte: Nr. 23. Z/5804. 9 Ex.

Dendrodrilus rubidus (Savigny, 1826) **subrubicundus** (Eisen, 1874), **tenuis** (Eisen, 1874)

Fundorte: Nr. 2. Z/5781. 59 Ex. - Nr. 8. Z/5740. 5 Ex. - Nr. 9. Z/5765. 4 Ex. - Nr. 10. Z/5763. 3 Ex. - Nr. 13. Z/5759. 1 Ex. - Nr. 15. Z/5790. 27 Ex. - Nr. 20. Z/5808. 16 Ex. - Nr. 21. Z/5795. 3 Ex. - Nr. 23. Z/5806. 9 Ex. - Nr. 45. Z/5856. 1 Ex. - Nr. 51. Z/5831. 2 Ex. - Nr. 63. Z/5852. 2 Ex. - Nr. 2. G/638. 20 Ex. Nr. 15.. G/639. 20 Ex.

Eisenia foetida (Savigny, 1826)

Fundorte: Nr. 2. Z/5779. 3 Ex. - Nr. 8. Z/5742. 5 Ex. - Nr. 13. Z/5758. 1 Ex. - Nr. 21. Z/5798. 1 Ex.

Lumbricus rubellus (Hoffmeister, 1843)

Fundorte: Nr. 7. Z/5769. 3 Ex. - Nr. 8. Z/5738, Z/5744. 29 Ex. - Nr. 10. Z/5734, Z/5736. 35 Ex., Z/5762. 1 Ex. - Nr. 26. Z/5813. 1 Ex., Z/5828. 5 Ex. - Nr. 27. Z/5854. 1 Ex. - Nr. 28. Z/5849. 1 Ex. - Nr. 66. Z/5857. 1 Ex. - Nr. 67. Z/5851. 1 Ex. - Nr. 68. Z/5850. 4 Ex. - Nr. 210. G/505. 15. Ex. Nr. 8. G/506. 10 Ex.

Lumbricus terrestris (L., 1758)

Fundorte: Nr. 2. Z/5780. 1 Ex. - Nr. 21. Z/5794. 1 Ex. - Nr. 22. Z/5809. 3 Ex.

LITERATUR

ANDRÀSSY, I., BALOGH, J., LOKSA., MAHUNKA, S. & ZICSI, A. 1967. The scientific results of the Hungarian Soil Zoological Expedition to Chile, Argentina and Brasil. I. Report on the Collectings. *Folia ent. hung.* 20: 247-296.

BEDDARD, F. E. 1895. Preliminary account of new species of earth-worms belonging to the Hamburg Museum. *Proc. zool. Soc. Lond.* 15: 210-239.

– 1896. Naiden, Tubificiden und Terricolen. *Erg. Hamb. Magelh. Sammelreise* 1: 1-62.

COGNETTI DE MARTIIS, L. 1904. Diagnosi di un nuovo lombrico del Chile. *Boll. Musei Zool. Anat. comp. R. Univ. Torino.* 19: 1-2.

MICHAELSEN, W. 1889. Oligichaten des Naturhistorischen Museums in Hamburg. *Jb. hamb. wiss. Anst.* 6: 1-16.

– 1898. Die Oligochaeten der Sammlung Plate. Zool. *Jb., Suppl.* 4: 471-480.

– 1899 a. Revision der Kinberg'schen Oligochaeten-Typen. *Öfvers. K. Vetensk Akad. Förh.* 56: 413-447.

– 1899 b. Terricolen (Nachtrag). *Erg. Hamb. Magelh. Sammelreise* 3: 1-28.

– 1910. Oligochaeten von verschiedenen Gebieten. *Mitt. hamb. zool. Mus. Inst.* 27: 47-170.

– 1911. Zur Kenntnis der Eodrilaceen und ihrer Verbreitungsverhältnisse. *Zool. Jb., Syst.* 30: 527-572.

– 1921. Neue und wenig bekannte Oligochaeten aus skandinavischen Sammlungen. *Ark. Zool.*, 13: 1-25.

MICHAELSEN, W. 1923. Oligochaeten von Peru und West-Patagonien. *Göteborgs K. Vetensk. Vitter. Samh. Handl.* 32: 2-12.

– 1936 Oligochaeten aus Chile und von der Osterinsel. *Zool. Anz.* 113: 193-200.

PICKFORD, G. E. 1937. A Monograph of the Acantodriline Earthworms of South Africa. *Heffer & Sons, Cambridge.* 612 pp.

ZICSI, A. 1989. Revision der Gattung Yagansia Michaelsen, 1899 (Oligochaeta, Acanthodrilidae). Regenwürmer aus Süd-Amerika 11. *Acta zool. hung.* 35: 413-430.

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Über wenig bekannte Zwergspinnen aus den Alpen - IX (Arachnida: Aranei, Linyphiidae: Erigoninae)*

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On poorly known Erigonine spiders from the Alps - IX (Arachnida: Aranei, Linyphiidae: Erigoninae). - From the East Alps, mainly Austria and Northern Italy, 7 rare Erigonine spiders are recorded: *Caviphantes saxetorum* (Hull), *Hylyphantes nigritus* (Simon), *Mecopisthes nicaeensis* (Simon), *Metopobactrus rayi* (Simon), *Minicia candida* Denis, *Panamomops inconspicuus* (Miller & Valesova), *Sisicus apertus* (Holm), together with notes on habitat, distribution and morphology. Taxonomy: The female of *Erigone jaegeri* Baehr is figured from Austria (Vorarlberg). *Gongylidium soror* n. sp., close to *G. rufipes* (L.), is described from Trentino and Lombardia. The new combination *Wiehlenarius tirolensis* (Schenkel) (from *Asthenargus*) is established, *W. tirolensis* from the East Alps and from Greece (Mt. Olympus 2700 m) apparently being congeneric with *W. boreus* Eskov from E-Siberia.

Key-words: Arachnida - Linyphiidae - Erigoninae - taxonomy - East Alps.

EINLEITUNG

Dieser Beitrag behandelt 10 Arten aus den Ostalpen und aus dem südlichen Vorland. Neue Nachweise und faunistisch-taxonomische Ergänzungen für 7 Arten betreffen überwiegend in Mittel- und Südeuropa sehr zerstreut auftretende Zwergspinnen, besonders auffällig die isolierten Vorkommen von *Minicia candida* Denis und *Metopobactrus rayi* (Simon) in einem inneralpinen Trockental (Vinschgau), und eine boreomontane Form, *Sisicus apertus* (Holm). Doch sind die Aufgaben der alpha- und beta-Taxonomie im Alpenraum noch nicht abgeschlossen: Für *Erigone jaegeri* Baehr wird das ♀ mitgeteilt. *Gongylidium soror* n. sp. stammt vom Südabfall der Alpen (Trentino und Lombardia). Die rezente Entdeckung des lange als Ostalpen-

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endemisch geltenden *Asthenargus* (?) *tirolensis* Schenkel auch in N-Griechenland (Olymp) war Anlaß zu einer Neu-Überprüfung der Gattungszugehörigkeit. Die Art ist offensichtlich kongenerisch zu *Wiehlenarius boreus* Eskov aus E-Sibirien und somit die zweite Form dieser soeben (ESKOV 1990) errichteten Gattung.

DANK: Für die Übermittlung bedeutsamer Funde und Belege sowie für verschiedene Unterstützungen danke ich Frau Dr. Barbara Baehr (München), Frau Barbara Knoflach, Frau Dr. Maria-Theresia Noflatscher (Brixen) und Frau Dr. Irene Schatz sowie den Herren W. Breuss, Doc. Dr. J. Buchar (Praha), UD Dr. E. Meyer, Prof. Dr. A. Minelli (Padova), Prof. Dr. M. Paoletti (Padova), Dr. H. Schatz, Dr. K.-H. Steinberger, Dr. M. Valle (Bergamo). - Funde ohne Angabe eines Sammlers vom Verf.

ABKÜRZUNGEN: BF Barberfalle. CN Arbeitssammlung Notflatscher. CTh Arbeitssammlung Thaler. MCV Museo Civico di Scienze naturali, Bergamo. MHNG Muséum d'Histoire naturelle, Genève. NMW Naturhistorisches Museum Wien.

E Embolus. L "Lamella, modified type", sensu MERRETT (1963). M Mittlere Membran. MI Mittelplatte. PT Protegulum. R Radixabschnitt. RP Radixfortsatz. ST Suprategulum. T Tegulum.

FAUNISTIK

Caviphantes saxetorum (Hull, 1916) (Figs 1, 2)

Nordtirol: Lechtal, Stanzach. Geröllufer des Lech; 1♀ CTh 13. Juli 1990, leg. Breuss.

Neu für Österreich. Epigyne/Vulva charakteristisch, Figs 1, 2. Einführungsöffnungen durch den zungenförmigen Fortsatz der Epigyne verdeckt, von aboral zugänglich. Habitat wie in Großbritannien, siehe die meisterhafte Nachbeschreibung der lange verschollenen Art nach Neufunden in England, Schottland und Wales durch COOKE & MERRETT (1967). Seither auch in Mitteleuropa nachgewiesen: Polen (STAREGA 1972), Rumänien (GEORGESCU 1973), und abweichend an Trocken- und Ruderalstandorten in S-Deutschland (WUNDERLICH 1975) und der Schweiz (MAURER & HÄNGGI 1989). Ein schwer interpretierbarer Fund in USA, Oregon (CRAWFORD 1990).

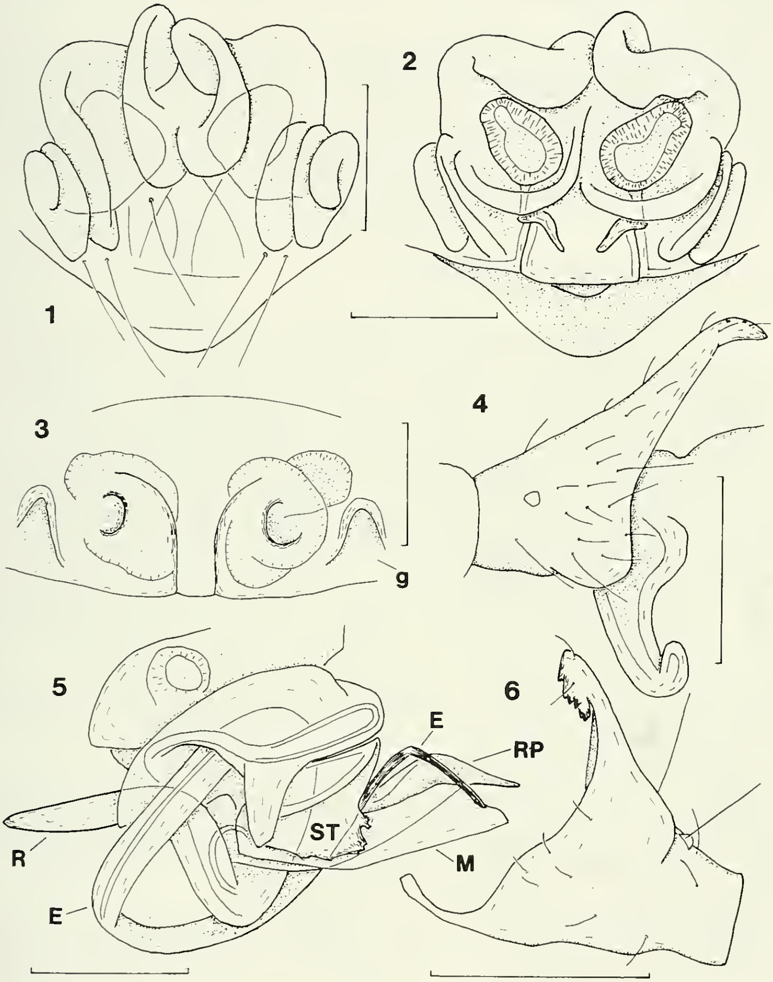
Hylyphantes nigritus (Simon, 1881) (Fig. 3)

Trentino: Lago di Levico; 1♀ CTh 17. Aug. 1989, leg. Minelli.

"Auf Gebüsch .. in Gehölzen" des außeralpinen Mitteleuropa; willkommener Nachweis im Süden des Gesamtareals. Das Exemplar stimmt gut zu der Beschreibung bei WIEHLE (1960): Gesamtlänge 2.8, Prosoma-Länge 1.09, Breite 0.79 mm. Beine 1423. Position des Becherhaares auf Metatarsus I (IV) 0.65 (0.62). Epigyne: Fig. 3; seitlich neben jeder Einführungsöffnung eine auffällige Verankerungsgrube *g*.

Mecopisthes nicaeensis (Simon, 1884) (Figs 4, 5)

Veneto: Treviso, Riese, "Wiese"; 1♂ CTh BF 11. März - 13. April 1991, leg. Schiroto & Paoletti.



FIGS 1-6

Caviphantes saxetorum (Hull) (1, 2, Lechtal). *Hylyphantes nigritus* (Simon) (3, Lago di Levico). *Mecopisthes nicaeensis* (Simon) (4, 5, Treviso). *Panamomops inconspicuus* (Miller et Valesova) (6, Mt. Bondone). - Epigyne/Vulva von ventral (1, 3) und von dorsal (2), ♂-Taster-Tibia von retrolateral (4) und von prolateral (6), Endapparat (5). - Maßstäbe: 0.10 mm.

Determination: MILLIDGE (1977a), bisher nur Meeralpen, Nizza (SIMON 1884, 1926). Anscheinend erster Wiederfund der durch den erhöhten Scheitelhügel gut charakterisierten Art nach > 100 Jahren. ♂-Taster-Tibia Fig. 4, Endapparat Fig. 5; die stark vorspringende Tibialapophyse gemeinsam mit *M. alter* Thaler (S-Tirol, THALER 1991b, MILLIDGE 1977b).

Beinmerkmale (♂): 4123, Bein I 1.32, IV 1.43 mm. Tibien I (0.08) - IV (0.30) mit 1 dorsalen Stachelborste, diese auf I-III kurz-stiftförmig, 0.2 Tibien-Durchmesser lang, auf IV länger (0.4 Durchmesser). Metatarsen I (0.58) - III (0.53) mit Becherhaar. Tarsalorgan I/II 0.70, III/IV 0.45. Tarsen I-III (IV) 0.85 (0.70) des jeweiligen Metatarsus (Gesamtlänge 1.3, Prosoma-Länge 0.55, Breite 0.46 mm).

Metopobactrus rayi (Simon, 1881) (Figs 7-11)

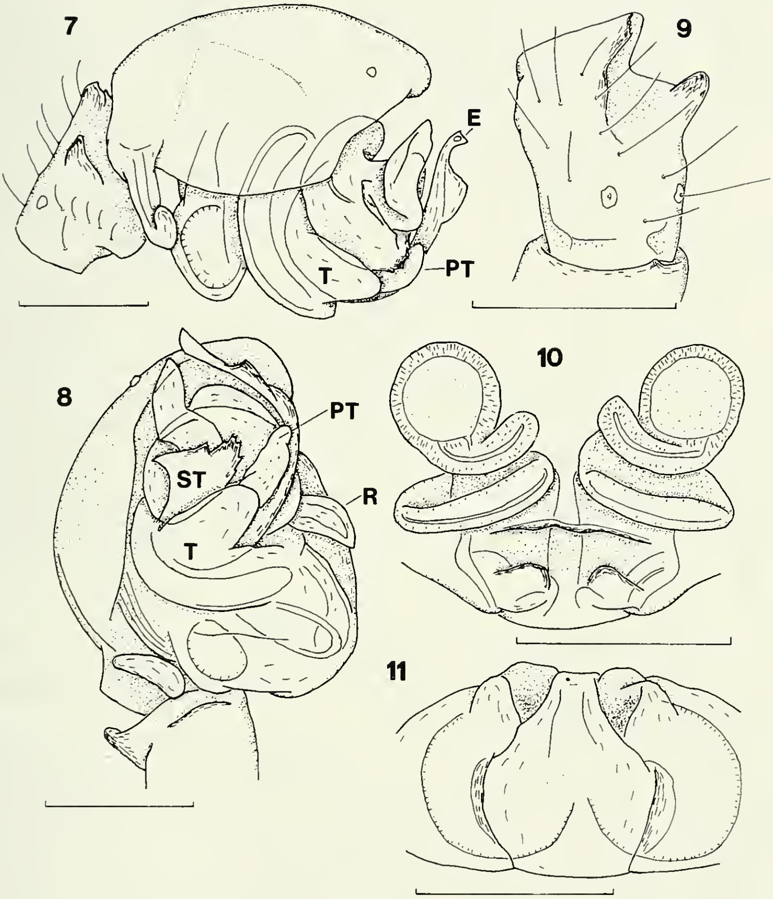
Südtirol: Vinschgauer Sonnenberg 700-1350 m, Trockengürtel an den Südhängen zwischen Naturns und Mals; BF 1990, leg. Noflatscher: 5♂2♀ 16. Juni, 1♂ 9. Juli 1990 - NOFLATSCHER (1992). Deponierung CN (2♂ 1♀), CTh (1♂ 1♀), MHNG (1♂), NMW (1♂).

Determination: MILLER (1966), MILLER & ZITNANSKA (1976), sub *Trichopterna fatrensis*; MILLIDGE (1977a). Die so auffällige Bewehrung des Scheitelhügels mit zwei Paar "bogenförmig frontalwärts gerichteten, parallel verlaufenden Stachelborsten" haben erst BERLAND & FAGE (in SIMON 1926: 358) erkannt. Die von CHYZER & KULCZYNSKI (1894: 96) bemerkte Abweichung ihres ♂ aus Dalmatien von der Beschreibung in SIMON (1884), 3 vs. 2 Scheitelborsten, ist somit ein Scheinproblem. - Gesamtlänge (♂/♀) 1.5/2.0, Prosoma-Länge 0.65/0.71, Breite 0.57/0.59 mm. Beinmerkmale (♂♀): 4123. I 1.78/1.71, IV 2.07/2.01 mm. Tibien I-III (IV) mit 1 dorsalen Stachelborste in Position 0.10 (0.30), deren Länge 0.3 - 0.5 Tibien-Durchmesser. Metatarsen I (0.74) - IV (0.76) mit Becherhaar, Tarsalorgan I/II 0.80, III/IV 0.65, Tarsen I-III (IV) 0.75 (0.60) des Metatarsus.

Epigyne-Vulva (Figs 10, 11) und ♂-Taster (Figs 7-9) markant, mit den Abbildungen von MILLER übereinstimmend: Taster-Tibia dorsal mit 2 kurzen Apophysen, Protegulum fingerförmig, Ende des Suprategulums abgestutzt-lamellös, fein gezähnelt, Radixabschnitt hinten spangen-, vorn polsterförmig, Embolus nahezu einen vollen Kreis beschreibend, subterminal lamellös verbreitert.

Beziehungen: "Außenseiter" in der Gattung *Metopobactrus*, für MILLIDGE (1977a: 25) "somewhat abnormal": abweichend besonders Radixfortsatz und Epigyne-Vulva (THALER 1976). Der von MILLER & ZITNANSKA (1976) bedingt vorgeschlagene Gattungsname *Bothriopterna* allerdings ist gemäß ICZN Art. 15 nicht verfügbar.

Verbreitung: Auffällig dispers an "xerothermen" Standorten des südlichen Mitteleuropa. Früh aus E-Frankreich (Dép. Aube, SIMON 1926) und Dalmatien (Bakar = Buccari, CHYZER & KULCZYNSKI 1894) gemeldet; in der zweiten Hälfte dieses Jahrhunderts noch in der Slowakei (SVATON 1989), in Slowenien (POLENEC 1978) und in Bayern (STUBBEMANN 1980) wiedergefunden. Der neue Fundort im Vinschgau weist *M. rayi* erstmals im Alpenbogen nach.



Figs 7-11

Metopobactrus rayi (Simon) (Vinschgau). ♂-Taster von retrolateral (7) und von ventral (8), ♂-Taster-Tibia von dorsal (9), Epigyne/Vulva von ventral (10) und von aboral (11). - Maßstäbe: 0.10 mm.

Minicia candida Denis, 1946 (Figs 12-14)

Südtirol: Vinschgauer Sonnenberg 700-1350 m, wie bei *Metopobactrus rayi*; BF 1990/91, leg. Noflatscher: 8♂7♀ 17. April 1990, 1♂2♀ 6. Mai, 1♂ 26. Mai, 1♂ 23. Nov., 1♂1♀ 22. Jan., 6♂ 23. März 1991 - NOFLATSCHER (1992). Deponierung CN (8♂ 3♀), CTh (3♂ 2♀), MHNG (4♂ 3♀), NMW (3♂ 2♀).

♂: Gesamt-Länge 1.5, Prosoma-Länge 0.73, Breite 0.55 mm. Beine: auffällig sexualdimorph, Borsten auf Tibia I-III beim ♂ kurz-stiftförmig (DENIS 1965), Abfolge 4123. I 1.56, IV 1.77 mm. Tibien I (0.23)-IV (0.33) mit je 1 dorsalen Stachelborste, diese auf I-III 0.1-0.3, auf IV 1.6 Tibien-Durchmesser lang. Metatarsen I-IV mit apikalem Becherhaar (0.9), Tarsalorgan I/II 0.65, III/IV 0.40.

♂-Taster: Figs 12-14, nach Cymbium-Fortsatz, Suprategulum und Endapparat gut von *M. marginella* (Wider) (Fig. 15) zu unterscheiden. Cymbium-Fortsatz rechtwinkelig nach retrolaterad gekehrt, distal zweigeteilt. Suprategulum scheibenförmig; Embolus verhältnismäßig kurz, bandförmig; Radix-Fortsatz breit endend.

Verbreitung: Bisher Frankreich, Atlantikküste (Vendée) und Camargue (DENIS 1965). Die Entdeckung der Art im Vinschgau (NOFLATSCHER 1992) bestätigt die Identität des von PUNTSCHER (1980) in den Ötztaler Alpen (Obergurgl, Festkogel 2550 m, Barberfalle in flechtenreichem Loiseleurietum) gefangenen, offenbar windverfrachteten ♀ (THALER 1986); die ♂ stimmen bestens zur Beschreibung von DENIS (1965). Verfrachtung durch Wind wird auch von *M. marginella* berichtet (THALER 1988). Verbreitung demnach auffällig disjunkt; die Beziehungen von *candida* zu der nach 1♀ aus dem Kaukasus beschriebenen *M. alticola* Tanasevitch sind noch zu untersuchen (TANASEVITCH 1987, 1990).

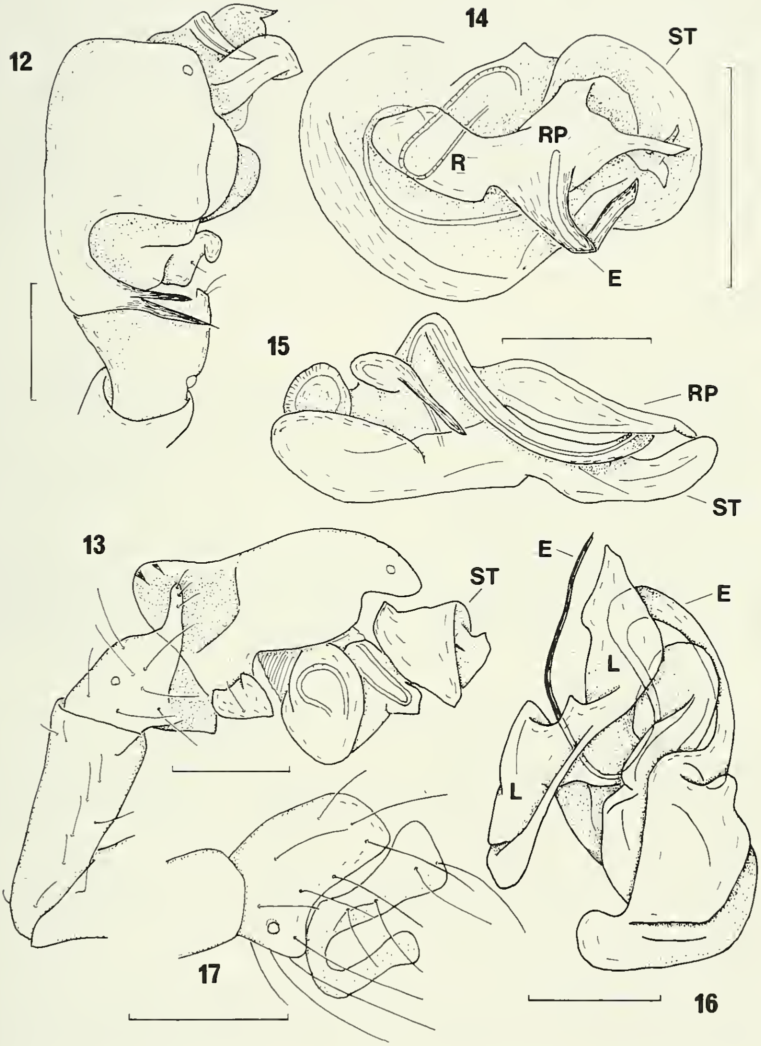
Panamomops inconspicuus (Miller et Valesova, 1964) (Fig. 6)

Trentino: Mt. Bondone 1500 m, Mähwiese; 1♀ CTh 14. Juni 1991 (Bodenprobe), 1♂ CTh 13.-22. Juni 1991 (BF), leg. H. & I. Schatz.

Neu für Italien: der neue Fundort verbindet die Vorkommen am südlichen (Tessin, MAURER & HÄNGGI 1990) und östlichen Alpenrand (Niederösterreich, MALICKY 1972) der sonst von wenigen Xerotherm-Standorten des außeralpinen Mitteleuropa (Deutschland, Tschechoslowakei) bekannten Art. - Begründung der Art-Zuordnung wie bei HÄNGGI (1989) und MILLER & VALESOVA (1964: 187); ♂-Taster-Tibia: Fig. 6. Augenfeld gewölbt, Clypeus steil wie bei *inconspicuus* (abgebildet bei MILLER & VALESOVA 1964, MORITZ 1973); weder vorspringend wie bei *P. mutilus* (Denis) (Pyrenäen, DENIS 1962) noch abgeflacht wie bei *P. fedotovi* (Charitonov) (Krim, Kaukasus, TANASEVITCH 1987). Genitalmorphologisch stimmen die drei Formen überein.

Sisicus apertus (Holm, 1939) (Figs 16, 17)

S-Tirol: Sextener Dolomiten, Schluderbach 1350 m, zwischen überwachsenem Ruhschutt unter Fichte, Lärche; 1♂ CTh 13. Okt. 1970. - Graubünden: Ramosch 1145 m, moosreiches Piceetum subalpinum auf Blockmaterial, BF 1970/71; 1♀ 7. Nov. - 6. Dez., 1♂ 17. Jan. - 21. März, 7♂ 21. März - 17 April 1971. CTh (4♂ 1♀), MHNG (3♂), NMW (1♂).



FIGS 12-17

Minicia candida Denis (12-14, Vinschgau). *M. marginella* (Wider) (15, Innsbruck-Ahrnkopf, 29. Mai 1965). *Sisicus apertus* (Holm) (16, 17, Schluderbach). ♂-Taster von dorsal (12) und von retrolateral (13), ♂-Taster-Tibia von retrolateral (17), Endapparat (14-16). - Maßstäbe: 0.10 mm.

Die ♂ stimmen gut zu den Abbildungen bei HOLM (1945), MILLIDGE (1977a); erstaunlich der komplexe Endapparat mit langem Embolus und stark entwickelter "Lamella", Fig. 16. - Diese arktomontane Art ist in ihrem S-Areal noch immer nur durch sehr wenige Punkte belegt, Nachweise bisher in Graubünden ca. 1900 m "im Koniferenwald .. zwischen den Felsblöcken aus Moos" (VOGELSANGER 1948), in N-Tirol (THALER 1969) und in der Slowakei (MILLER 1951, SVATON 1983). *S. apertus* ist anscheinend sehr stenotop, Funde in den Alpen an Moos-überwachsenem, verfestigtem Blockschutt in subalpinem Nadelwald 1100-1900 m, einmal (1969) 1♀ in der Grasheidenstufe bei 2300 m. Zyklustyp nach den Fallenfängen im Unterengadin wohl diplochron, mit kurzer ♂-Aktivität im Vorfrühling. Im N-Areal scheint *S. apertus* häufiger aufzutreten, PALMGREN (1975), HAUGE (1989).

TAXONOMIE

Erigone jaegeri Baehr, 1984 (Figs 31, 32)

Fundort und Material: Vorarlberg: Fußach, Rheindelta ca. 400 m, Pfeifengraswiese, Zwischenmoor; 6♂ 2♀ BF 17. Mai - 9. Juni 1992, leg. Meyer & Steinberger, CTh (3♂ 1♀), MHNG (3♂ 1♀).

Schreibweise des Artnamens gemäß ICZN Art. 32 d (i, 2) zur Behandlung des deutschen Umlautes - KRAUS (1986).

♂: Siehe die sorgfältige Erstbeschreibung, BAEHR (1984). Die vorliegenden ♂ entsprechen genitalmorphologisch gut den Angaben von BAEHR (Endapparat: Fig. 32), sind aber kleiner (in Klammern die Maßangaben von BAEHR): Gesamtlänge 1.2 (1.4-1.7), Prosoma-Länge 0.59 (0.7-0.85), Breite 0.44 (0.55-0.65), Länge Bein I 1.55 (2.07), IV 1.56 (2.10) mm.

♀: Gesamtlänge 1.5, Prosoma-Länge 0.56, Breite 0.43 mm.

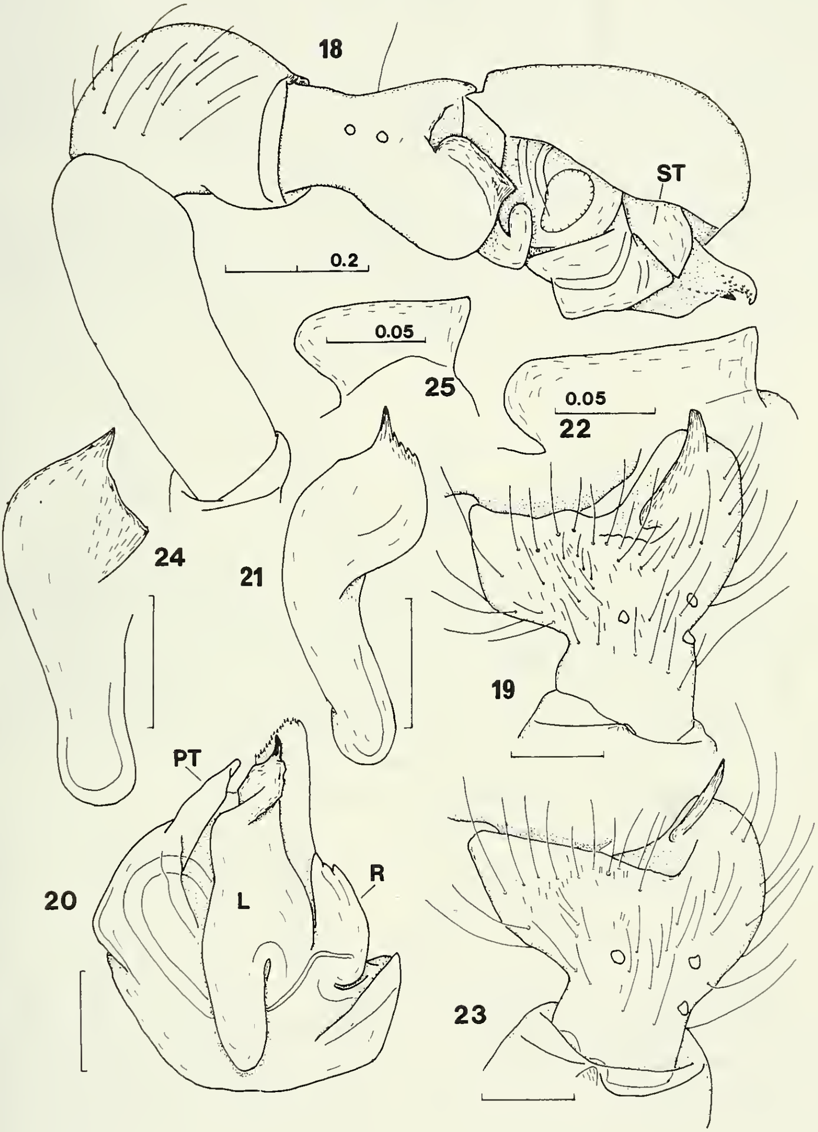
Beine: 4123. Länge Bein I (IV) 1.51 (1.55) mm. Tibien I-III mit je 2, IV mit je 1 Stachelborste (n), deren proximale auf I (IV) 1.5 (2.2) Tibien-Durchmesser lang. Metatarsen I (0.39) - III (0.37) mit Becherhaar, Tarsen I (IV) gleich 0.84 (0.74) des jeweiligen Metatarsus, Tarsalorgan I (IV) 0.77 (0.57).

Epigyne - Vulva: Fig. 31; von den in Mitteleuropa im Tiefland heimischen Arten der Gattung mit entfernt stehenden Rezeptakeln (KNÜLLE 1954, WIEHLE 1960) gut durch die Gestalt der medianen Eindellung *e* und den Verlauf des Innenrandes der Deckplatte *i* zu unterscheiden.

Verbreitung: SW-Deutschland (Baden-Württemberg), Locus typicus Tegernmoos; Schweizer Mittelland (MAURER & HÄNGGI 1989), Bayern (BLICK & SCHEIDLER 1991). Möglicherweise stenotop in Feuchtgebieten des außeralpinen Mitteleuropa.

Gondylidium soror nov. spec. (Figs 18-22, 29, 30)

Fundorte und Material: Trentino: Lago di Levico; 1♀ CTh 30. Juni 1989. 3♂ 1♀ MHNG (1♂ Holotypus, 1♂), CTh (1♂ 1♀) 17. Mai 1990. Pergine, S. Cristoforo; 1♀ MHNG 16. Juni 1990. Alle leg. Foddai & Minelli. Lombardia: Capralba-Farinate nördl. Crema; 1♀ MCB 25. April 1991, leg. Pisone. Es ist nur der Holotypus bezeichnet; die übrigen Exemplare gelten als Paratypen.



Figs 18-25

Gongylidium soror n. sp. (18-22, Lago di Levico). *G. rufipes* (L.) (23-25, Innsbruck-Roßau, 23. Mai 1962). ♂-Taster von retrolateral (18), ♂-Taster-Tibia von dorsal (19, 23), deren Gratfortsatz (22, 25), Bulbus von ventral (20), "Lamella" (21, 24). - Maßstäbe: 0.05 (22, 25), 0.10 (19-21, 23, 24), 0.20 mm (18).

Diagnose: Von *G. rufipes* (L.) verschieden durch das Bild der Epigyne (Fig. 29) und Details des ♂-Tasters: die sklerotisierte "Platte" (WIEHLE 1960: 418) der retrolateralen Apohpyse der Taster-Tibia breiter als bei der Vergleichsart (Fig. 19), das Vorderende der "Lamella" (sensu MERRETT 1963: 389) abgeschrägt (Fig. 21).

Etymologie: lat. *soror* = Schwester. Substantiv in Apposition, also invariabel.

♀: Gesamtlänge 3.2-3.8 (n=2), Prosoma-Länge 1.29, Breite 1.03. Einfärbig. Prosoma rötlich-braun mit schwärzlicher Zeichnung (Radiärstreifen), Beine gelbrötlich, Abdomen schwärzlich, mit lichter Mittelbinde.

Beine: 4123. Tibien I/II mit je 2, III/IV mit je 1 Stachelborste(n), deren proximale auf I (IV) 1.9 (2.4) Tibien-Durchmesser lang. Metatarsen I (0.70) - IV (0.72) mit Becherhaar, Tarsen I (IV) gleich 0.61 (0.50) des jeweiligen Metatarsus, Tarsalorgan I (IV) 0.68 (0.64).

Absolute Maße der Beinglieder (mm, Prosoma-L. 1.3):

	Fe.	Pat.	Ti.	Mt.	Ta.	Ges.-L.
I	1.22	0.40	1.12	1.04	0.65	4.43
II	1.19	0.42	1.09	1.04	0.63	4.37
III	1.08	0.39	0.88	0.92	0.52	3.79
IV	1.38	0.40	1.26	1.23	0.62	4.89
Pp	0.48	0.22	0.36	–	0.51	1.57

Epigyne-Vulva: Figs 29, 30; Mittelplatte im Unterschied zu *G. rufipes* median tief V-förmig ausgerandet, ihr Seitenrand dadurch wulstförmig. Einführungsöffnungen am Vorderende dieses Wulstes, Einführungsgang sehr kurz.

♂: Gesamtlänge 3.1. Prosoma-Länge 1.33, Breite 1.07 mm. Färbung wie beim ♀, Habitus wie *G. rufipes*, Cheliceren ebenfalls divergierend, vorn mit konischem Zahn.

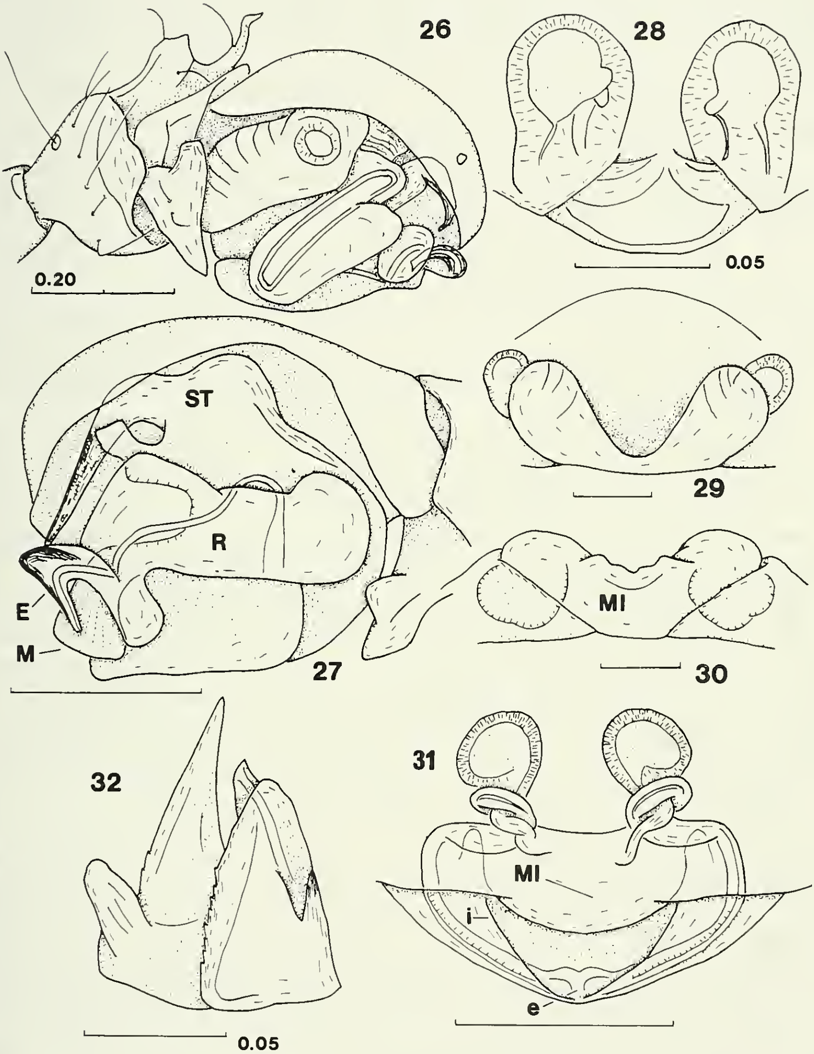
Beine: Beinproportionen und -bewehrung wie beim ♀; Position des Becherhaares auf Metatarsus I (IV) 0.75; Tarsalorgan I (IV) 0.60 (0.62).

Absolute Maße der Beinglieder (mm, Prosoma-L. 1.3):

	Fe.	Pat.	Ti.	Mt.	Ta.	Ges.-L.
I	1.07	0.36	1.00	0.95	0.61	3.99
II	1.08	0.37	0.97	0.92	0.57	3.91
III	0.95	0.35	0.77	0.81	0.46	3.34
IV	1.17	0.36	1.07	1.07	0.56	4.23

♂-Taster: Fig. 18, ebenfalls ein "Rundknie" (MENGE 1868) mit stark entwickelter Patella. Tibia markant (Fig. 19), "becherförmig" (WIEHLE 1960), dorsal mit zahlreichen Sinnesspalten, der "Gratfortsatz" ihrer retrolateralen Apophyse breiter als bei *G. rufipes*, Figs 22 vs. 25. Paracymbium hakenförmig, Protegulum unscheinbar. Endapparat ähnlich wie bei *rufipes*, siehe die Analyse des Bulbus bei MERRETT (1963) und Fig. 20, jedoch distale Kante der "Lamella" hinten gerundet und nicht eckig vorgezogen (Figs 21 vs. 24).

Beziehungen: *G. soror* n. sp. erscheint als Vikariante und augenscheinlich nahe Verwandte des im mittleren und nördlichen Europa weitverbreiteten *G. rufipes*. - Auch zwei andere häufige Arten der Feuchtstandorte Mitteleuropas werden am Südabfall der Alpen (Bergamasker Alpen, Trentino und Südtirol) durch nahestehende



FIGS 26-32

Wiehlenarius tirolensis (Schenkel) (26-28, Olymp). *Gongylidium soror* n. sp. (29-30, Lago di Levico). *Erigone jaegeri* Baehr (31-32, Rheindelta). ♂-Taster von retrolateral (26) und von prolateral (27), Endapparat (32), Epigyne-Vulva von ventral (28, 29), von dorsal (31) und von aboral (30). - Maßstäbe: 0.05 (28, 32), 0.10 (27, 29-31), 0.20 mm (26).

Vikarianten ersetzt: *P. listeri* Sundevall durch *P. terilis* Th., *Tapinocyba insecta* (L. Koch) durch *T. maureri* Th. (THALER 1991 a, b).

Verbreitung und Vorkommen: Bisher nur an Feuchtstandorten in tiefen Lagen des Trentino nahe dem Südrand der Ostalpen und aus der Po-Ebene nahe Cremona. Phänologie und Lebenszyklus anscheinend wie *G. rufipes*, siehe BAERT (1981).

Wiehlenarius tirolensis (Schenkel, 1939) nov. comb. (Figs 26-28)

Asthenargus (?) *tirolensis*: THALER (1969: 197) ♀; (1980: 583) ♂.

Fundort und Material: A Steiermark: Dachstein-Gebirge, Gruberscharte-Hohe Rams 2100-2500 m; 1♂ CTh 29. Juni 1985. - GR Thessalien, Olymp, Ag. Antonios 2750 m; 1♂ 3♀ MHNG 25. Sept. 1987.

♂♀ (GR): Periphere Merkmale und Kopulationsorgane wie bei Exemplaren aus den Alpen. Gesamtlänge ♂/♀ 1.4, Prosoma-Länge 0.63/0.59, Breite 0.48/0.44 mm, Femur I 1.66/1.60, IV 1.71/1.70. Tibien I-IV mit je 2 (I-III ca. 0.15-0.70, IV 0.20-0.83) dorsalen Stachelborsten, diese auf I 1.7, auf IV 2.5 Tibien-Durchmesser lang. Metatarsen I (0.38/0.45) - III (0.31/0.42) mit Becherhaar, Tarsalorgan I (IV) ca. 0.63 (0.47).

Epigyne-Vulva: Fig. 28.

♂-Palpus: Fig. 26, 27. Tibia, Paracymbium, Protegulum, Suprategulum und Endapparat völlig mit den Exemplaren aus N-Tirol übereinstimmend (THALER 1980).

Kombination: Die schon anläßlich der Nachbeschreibung des ♀ geäußerten Zweifel an der ursprünglichen Kombination wurden durch die Wiederentdeckung des ♂ verstärkt, ohne daß sich eine befriedigende Neu-Kombination angeben ließ. Nunmehr erweist sich die Art als zweiter Vertreter der rezent (ESKOV 1990) aus E-Sibirien (Kolyma, Magadan) beschriebenen Gattung *Wiehlenarius*, Typusart *W. boreus* Eskov. Beide Formen zeigen gleichen Bauplan der ♂♀ Kopulationsorgane: überzeugend die Ausbildung des Suprategulums, konform (aber doch spezifisch verschieden) auch Endapparat, Paracymbium, Tibialapophyse und Vulva. Abweichungen geringeren Gewichts scheinen hinsichtlich der Zahl der Becherhaare der ♂-Taster-Tibia (nur 1 bei *W. boreus*) und der Borstenformel (2.2.2.1 bei *W. boreus*) zu bestehen.

Vorkommen, Verbreitung: Lange nur aus den Zentralalpen von N-Tirol in Höhenlagen zwischen 2200-3030 m bekannt, Verbreitungsschwerpunkt anscheinend Windheide ohne Vegetationsschluß. Inzwischen sind noch zwei angrenzende Nachweise im Dachstein-Gebirge und in Graubünden (MAURER & HÄNGGI 1989) erfolgt. Das Auftreten von *W. tirolensis* in N-Griechenland in den kahlen Trümmerfluren des Olymp bedeutet allerdings eine erhebliche und überraschende Areal-Ausweitung und läßt weitere zerstreute Vorkommen der Art in den Gebirgen von SE-Europa erwarten. Überraschend ist auch ihre Verwandschaft zu einer aus dem äußersten Osten der Paläarktis beschriebenen Art.

LITERATUR

BAEHR, B. 1984. *Erigone jägeri* sp. nov. aus Südwestdeutschland (Araneae, Erigonidae). *Spixiana* 7: 245-249.

BAERT, L. 1981. Autecology of *Gongylidium rufipes* (Sundevall, 1829) (Araneae, Linyphiidae) 2. Habitatpreference, phenology and life-cycle. *Bull. Inst. r. Sci. nat. Belg.* 53 (2): 1-16.

BLICK, TH. & M. SCHEIDLER 1991. Kommentierte Artenliste der Spinnen Bayerns (Araneae). *Arachnol. Mitt.* 1: 27-80.

CHYZER, C. & L. KULCZYNSKI 1894. Araneae Hungariae 2 (1): 1-151, Tab. 1-5. *Acad. Sc. Hung., Budapest.*

COOKE, J.A.L. & P. MERRETT 1967. The rediscovery of *Lessertiella saxetorum* in Britain (Araneae: Linyphiidae). *J. Zool. (Lond.)* 151: 323-328.

CRAWFORD, R.L. 1990. Discovery of *Caviphantes saxetorum* in North America; Status of *Scironis tarsalis* (Araneida, Linyphiidae). *J. Arachnology* 18: 235-236.

DENIS, J. 1962. Quelques araignées d'Espagne centrale et septentrionale et remarques synonymiques. *Bull. Soc. Hist. nat. Toulouse* 97: 276-292.

– 1965. N.s.l.E. 30. Le genre *Minicia* Thorell. *Bull. Soc. Hist. nat. Toulouse* 100: 181-205.

ESKOV, K. Yu. 1990. [New monotypic genera of the spider family Linyphiidae (Aranei) from Siberia. Communication 2]. *Zool. Zhurn.* 69: 43-53.

GEORGESCU, M. 1973. Le développement postembryonnaire de l'espèce cavernicole *Lessertiella dobrogica* Dumitrescu & Miller (Araneida, Micryphantidae). *Trav. Inst. Spéol. "E. Racovitza"* 12: 63-73.

HÄNGGI, A. 1989. Beiträge zur Kenntnis der Spinnenfauna des Kantons Tessin 2-Bemerkenswerte Spinnenfunde aus Magerwiesen der Montanstufe. *Mitt. schweiz. entom. Ges.* 62: 167-174.

HAUGE, E. 1989. An annotated check-list of Norwegian spiders (Araneae). *Insecta Norvegiae* 4: 1-40.

HOLM, A. 1945. Zur Kenntnis der Spinnenfauna des Torneträsk-Gebietes. *Ark. Zool.* 36 A (15): 1-80.

KNÜLLE, W. 1954. Zur Taxonomie und Ökologie der norddeutschen Arten der Spinnen-Gattung *Erigone* Aud. *Zool. Jb. Syst.* 83: 63-110.

KRAUS, O. 1986. Internationale Regeln für die Zoologische Nomenklatur: Bericht über die Neufassung des Code und die wichtigsten Änderungen. *Verh. naturwiss. Ver. Hamburg* NF 28: 195-198.

MALICKY, H. 1972. Vergleichende Barberfallenuntersuchungen auf den Apetloner Hutweiden (Burgenland) und im Wiener Neustädter Steinfeld (Niederösterrreich): Spinnen (Araneae). *Wiss. Arbeiten Burgenland* 48: 109-123.

MAURER, R. & A. HÄNGGI 1989. Für die Schweiz neue und bemerkenswerte Spinnen (Araneae) 3. *Mitt. schweiz. entom. Ges.* 62: 175-182.

– & – 1990. Katalog der schweizerischen Spinnen. *Documenta Faunistica Helvetiae* 12: ohne Paginierung. *Neuchâtel.*

MENGE, A. 1868. Preussische Spinnen. *Schr. naturf. Ges. Danzig* NF 2: 153-218, Taf. 28-43.

MERRETT, P. 1963. The palpus of male spiders of the family Linyphiidae. *Proc. zool. Soc. Lond.* 140: 347-467.

MILLER, F. 1951. [Araneous-fauna of the peat-bogs near Rejviz (High-Jesenik, CSR)]. *Prirod. Sborn. Ostravsk. Kraje (Opava)* 12: 202-247.

– 1966. Einige neue oder unvollkommen bekannte Zwergspinnen (Micryphantidae) aus der Tschechoslowakei (Araneidea). *Acta entom. bohemoslov.* 63: 149-164.

MILLER, F. & E. VALESOVA 1964. Zur Spinnenfauna der Kalksteinsteppen des Radotiner Tales in Mittelböhmen. *Cas. Cs. Spol. ent.* 61: 180-188.

MILLER, F. & O. ZITNANSKA 1976. Ein Beitrag zur Kenntnis der slowakischen Spinnenfauna. *Biologia (Bratislava)* 31: 313-318.

MILLIDGE, A.F. 1977a. The conformation of the male palpal organs of Linyphiid spiders, and its application to the taxonomic and phylogenetic analysis of the family (Araneae: Linyphiidae). *Bull. Br. arachnol. Soc.* 4: 1-60.

– 1977b. The genera *Mecopisthes* Simon and *Hypsocephalus* n.gen. and their phylogenetic relationships (Araneae: Linyphiidae). *Bull. Br. arachnol. Soc.* 4: 113-123.

Moritz, M. 1973. Neue und seltene Spinnen (Araneae) und Weberknechte (Opiliones) aus der DDR. *Dtsch. ent. Z.* N.F. 20: 173-220.

Noflatscher, M.-Th. 1992. Zur Spinnenfauna "xerothermer" Standorte in Südtirol. *Dissertation Univ. Innsbruck*, 133 S., Tab. 1-7, Abb. 1-69.

Palmgren, P. 1975. Die Spinnenfauna Finnlands und Ostfennoskandiens 6 (Linyphiidae 1). *Fauna Fennica* 28: 1-102.

Polenec, A. 1978. Zusammensetzung und Besonderheiten der epigäischen Spinnenfauna des Seslerio-Ostryetum am Berge Slavnik (1028 m) (Nord-Istrien, Jugoslawien). *Symp. zool. Soc. Lond.* 42: 367-377.

Puntscher, S. 1980. Ökologische Untersuchungen an Wirbellosen des zentralalpinen Hochgebirges (Obergurgl, Tirol) 5. Verteilung und Jahresrhythmik von Spinnen. *Veröff. Univ. Innsbruck* 129, *Alpin-biolog. Stud.* 14: 1-106.

Simon, E. 1884, 1926. Les Arachnides de France 5 (3): 421-885, Pl. 27; 6 (2): 309-532. *Roret, Paris.*

Starega, W. 1972. [Für die Fauna Polens neue und seltenere Spinnenarten (Aranei), nebst Beschreibung von *Lepthyphantes milleri* sp. n.]. *Fragm. Faun. (Warszawa)* 18: 55-98.

Stubbemann, H.N. 1980. Ein Beitrag zur Faunistik, Ökologie und Phänologie der Bodenspinnen des Lorenzer Reichswalds bei Nürnberg (Arachnida). *Spixiana* 3: 273-289.

Svaton, J. 1983. [Spiders (Araneida) of the central part of the High Tatras]. *Zbor. Prac Tatr. Narod. Parku* 24: 95-154.

– 1989. [Beitrag zur Kenntnis der Spinnenfauna (Araneae) im staatlichen Naturschutzgebiet Ohniste in der Niederen Tatra]. *Stredne Slovensko. Prirod. ved.* 8: 101-114.

Tanasevitch, A.V. 1987. The Linyphiid spiders of the Caucasus, USSR (Arachnida .. Linyphiidae). *Senckenbergiana biol.* 67: 297-383.

– 1990. (The spider family Linyphiidae in the fauna of the Causasus (Arachnida, Aranei)]. *Faune terrestre des Invertébrés du Caucase* (Ed. B.R. Striganova): 5-114. Moscow.

Thaler, K. 1969. Über einige wenig bekannte Zwergspinnen aus Tirol (Arachn. .. Erigonidae). *Ber. nat.-med. Ver. Innsbruck* 57: 195-219.

– 1976. Über wenig bekannte Zwergspinnen aus den Alpen, 4 (Arachnida .. Erigonidae). *Arch. Sc. Genève* 29: 227-246.

– 1980. Über wenig bekannte Zwergspinnen aus den Alpen - 6 (Arachnida .. Erigonidae). *Rev. suisse Zool.* 87: 579-603.

– 1986. Über wenig bekannte Zwergspinnen aus den Alpen - 7 (Arachnida .. Erigoninae). *Mitt. schweiz. entom. Ges.* 59: 487-498.

– 1988. Arealformen in der nivalen Spinnenfauna der Ostalpen (Arachnida, Aranei). *Zool. Anz.* 220: 233-244.

– 1991a. *Pachygnatha terilis* n. sp. aus den Südalpen, mit Bemerkungen zu einigen Araneidae der Alpenländer (Arachnida .. Araneidae). *Ber. nat.-med. Ver. Innsbruck* 78: 47-57.

– 1991b. Über wenig bekannte Zwergspinnen aus den Alpen - 8 (Arachnida .. Erigoninae). *Revue suisse Zool.* 98: 165-184.

Vogelsanger, T. 1948. Beitrag zur Kenntnis der Spinnenfauna des Kantons Graubünden. *Mitt. Naturf. Ges. Schaffhausen* 22: 33-72.

Wiehle, H. 1960. Spinnentiere oder Arachnoidea (Araneae) 11: Micryphantidae-Zwergspinnen. *Tierwelt Deutschlands* 47: 12 + 1-620. *Fischer, Jena.*

Wunderlich, J. 1975. Spinnen vom Kaiserstuhl (Arachnida: Araneae). *Entom. Germ.* 1: 381-386.

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Contribution to the knowledge of European Bourletiellidae (Collembola, Symphypleona) . I .

On a standard of description and on the genus *Fasciosminthurus* Gisin, 1960 sensu Bretfeld, 1992.

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Contribution to the Knowledge of European Bourletiellidae (Collembola, Symphypleona) . I . On a standard of description and on the genus *Fasciosminthurus* **Gisin, 1960 sensu Bretfeld, 1992.** – We discuss the recent BRETFELD's works (1992a, 1992b). This author distinguishes the genera *Prorastriopes* and *Fasciosminthurus* which have been considered as synonymous by BETSCH (1977). The characters used for separating these two genera and also *Cyprania* Bretfeld, 1992 are discussed. Further information is given about the description of *Fasciosminthurus lacazei* (Denis, 1924). One new species is described: *Fasciosminthurus dictyostigmatus* n. sp. A standardization of the description of Symphypleona is proposed. So, for each species a standardized table of appendicular chaetotaxy is given.

Key-words: Collembola - Symphypleona - Bourletiellidae - taxonomy - Europe

1. INTRODUCTION

The genus *Prorastriopes* was created by DELAMARE DEBOUTTEVILLE in 1947, for an African species: *Prorastriopes pulcher*. The original description was insufficient. A study of the material by BETSCH (1977) shows that the empodium ends in a long filament and a strong spike and that the spinelike setae on the inner side of tibiotarsi are flattened at their tip (obliquely truncate setae). In 1955, STACH created the genus *Andiella* for two andean species (*A. paryskii* and *A. domeykoi*) diplaying an empodium ending in a long filament and a strong spike, and displaying also obliquely truncate setae on the inner side of tibiotarsi. One of the conclusions of BETSCH's (1977) paper was to consider *Prorastriopes* and *Andiella* as synonymous, because these two taxa had the same generic characters (morphology of the empodium and tibiotarsal setae).

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In 1956, JEANNENOT showed that the European species *Deuterosminthurus quinquefasciatus* Krausbauer, 1902 presents the same kind of empodium and tibiotarsal setae as *Andiella* (at this time JEANNENOT could not know that *Prorastriopes* has also these characters). GISIN in 1960 did not follow JEANNENOT, and he gathered the European species of Bourletiellidae with a long empodial filament into the *Fasciosminthurus* sub-genus (included in *Bourletiella* genus). Later, BETSCH (1977) considered *Fasciosminthurus* and *Prorastriopes* (= *Andiella*) as synonymous.

From a study on new characters of an abundant material, particularly the types of *Prorastriopes pulcher* Delamare Deboutteville, 1947 (generotype of *Prorastriopes*) and *Andiella paryskii* Stach, 1955 (generotype of *Andiella*), BRETFELD (1992a, 1992b) showed that the synonymy established by BETSCH (1977) between *Prorastriopes* and *Fasciosminthurus* Gisin, 1960 might be questioned. On the other hand, the synonymy of *Andiella* and *Prorastriopes* genera has been retained.

In this paper, the *Fasciosminthurus* - *Prorastriopes* distinction will be conserved, but with a list of discriminant characters more restricted than that proposed by BRETFELD (1992b).

Finally, we will deal with some methodological aspects of Symphypleona description. We will propose a standardization of chaetotaxic tables and a typical plan.

In the descriptions the following abbreviations will be used: abd. = abdomen — ad. = adult — alt. = altitude — an. app. = anal appendage — ant. = antennal segment — dep. = department — ceph. diag. = cephalic diagonal — ex. = example — juv. = juvenile — ov. org. = oval organ — prov. = province — st. = stage.

2. THE PROBLEM OF DESCRIPTION AND CHAETOTAXIC NOMENCLATURE IN SYMPHYPLEONA

BRETFELD (1990, 1992a, 1992b) did not discuss the plesiomorphic or apomorphic state of the characters he used. That led him to refrain from making any phylogenetical considerations: "Well-founded phylogenetical considerations will not be possible until more taxa are completely described" (BRETFELD 1992a, p. 7). Such an argument does not resolve the problem of the phyletic value of the *Prorastriopes* - *Fasciosminthurus* separation.

According to us, our works about the appendicular chaetotaxy of Symphypleona are now sufficiently well on to allow the distinction for some characters between the plesiomorphic and apomorphic states. A first set of works (NAYROLLES 1988, 1990a, 1990b, 1991a) was to establish the general chaetotaxy that we can define as a synthesis of the chaetotaxy of one body area. This synthesis has been reached after having studied some species chosen among a large taxonomic range (in our studies it was at least one species for each European family of Symphypleona). During this work, it is necessary to be particularly interested in the chaetotaxic development. A rigorous distinction of the homologies can be then realized (what is not the case in a simple setae counting). Once this step is passed, the study of the European Sminthuridae and

Bourletiellidae that we have set about, allows to give us some ideas about both the evolutive trend of some characters and the relative importance of these characters.

So, our approach noticeably conflicts with the BRETFELD's idea (1992a, p. 7): "The first goal was to demonstrate that one can describe one species completely and in detail as the standard, and can describe rather briefly the other species without loss of precision by noting mainly the differences from the standard". Because the standardization of the chaetotaxic patterns cannot be established on only one species, or, as BRETFELD (1990) did it, on only one family (he studied 4 species of Bourletiellidae, each of them belonging to one genus). As a matter of fact, the lack of taxonomic wide-ranging of such studies prevents any schematization based on theoretical considerations. Therefore, the taxonomist cannot understand a chaetotaxy which is too different from the chaetotaxic pattern that it had been regarded, somewhat arbitrarily, as standard.

There is here an old dilemma: some people advocate the use of a dialectic between observations themselves and theorization of these observations, other people prefer a more immediate approach which sticks to the observed realities. The approach we adopted in our works about appendicular chaetotaxy of Symphypleona follows the first turn of mind. It results a certain complexity of the descriptions; so, about the chaetotaxy of the basis of legs, BRETFELD (1992a, p. 10) writes: "I did not follow NAYROLLES, but preferred a practical scheme because the nomenclature of NAYROLLES is rather complicated though derived from postembryonic development, and because the tables are so difficult to survey as are long chaetotaxic formulae." Probably, the theorization of the observations leads to a surplus of complexity or information. Nevertheless, for studies about chaetotaxy, we think that some theoretical processes are necessary, in order to establish what are the homologous setae between species. So, BETSCH & WALLER (1989, p. 16) write: "la recherche des homologies doit être une priorité absolue actuellement si l'on veut tirer des conclusions sur les affinités des unités taxonomiques, quel que soit leur niveau hiérarchique. [...] La systématique gagnera à une propositon cohérente de nomenclature des structures morphologiques, en particulier au plan chétotaxique."

A current mistake consists in realizing a simple setae counting, that may lead to a mix up of two situations that are very distinct from a phyletic point of view. For example, it is the case when we make a counting of the setae on the posterior generatrix, Gp, of the median tibiotarsus (NAYROLLES 1991b). The present setae on Gp can be the 5 primary setae Ip, IIp, IIIp, IVp and Vp, as the two secondary setae 3p and 4p. A simple counting giving the number of 5 setae on Gp can be realized on different ways; for example: Ip, IIp, IIIp, IVp, Vp for a taxa and Ip, IIp, IIIp, 3p, 4p for another one. The confusion between these two situations, through a simple setae counting, leads to wrongly consider as homologous two chaetotaxies that are not. This problem could be met if the BRETFELD's (1990, p. 477) formula about tibiotarsal chaetotaxy would be strictly applied.

We recall the BRETFELD's formula: a first item gives each seta on the first whorl (the most distal) with the character "–" used for lacking; a second item gives, for each pair of legs and on each generatrix, a counting of the setae at the basis of the first whorl. As we just have been explaining, the counting of setae on their generatrix leads to find for two taxa the same number made up by two distinct chaetotaxies. Besides, BRETFELD (1992a, 1992b), certainly conscious of this problem, has added to his formula a further information raising the ambiguities about the present setae. This formula can also be open to criticism through its first item. As a matter of fact, this item gives the present setae on the first whorl, supposing that for this whorl the 3 pairs of tibiotarsi are the same; concerning this subject, BRETFELD (1990, p. 477) writes: "the pattern of which was identical for all tibiotarsi". Yet, in *Dicyrtomina ornata* (Nicolet, 1842) the seta Ia (on the first whorl and on the anterior generatrix) is lacking on foreleg, but is present on median and hind legs (NAYROLLES 1988). BRETFELD himself met this problem when he described *Prorastriopes cingulus cingulus*; he got around this difficulty noting between brackets the setae Jp and Ia which are indicated in his "Additions to the formulae" as wanting on foreleg and mesoleg but present on hindleg. The BRETFELD's formula aimed at a more practical presentation than the table-form given in our study. So, dealing with our presentation, BRETFELD (1990, p. 472) writes: "Such systems are rather complicated, and knowledge of juveniles, especially of the 1st and 2nd instars, is necessary, a condition that cannot always be maintained in the practical work of species description and determination." We contest the fact that one ought to study the tibiotarsal chaetotaxy of the first two stages in order to build up the adult one. In absolute terms, it is excellent to be able to study the chaetotaxy of every stage, in order to get ontophylogenetical studies prospects. Nevertheless, one can easily build up tibiotarsal chaetotaxy of one species only from the adults. In fact, BRETFELD followed this approach in his description of *Fasciosminthurus obtectus*, when he described this species on exclusively adults composed material.

For all these reasons, we prefer to keep our presentation in table-form. A size reduction of chaetotaxic tables that we have presented until now, yet turns out to be necessary. This problem will be discussed farther on. As far as the chaetotaxy of the basal segments of legs, or furcula, or antenna is concerned, we take up again our nomenclature (NAYROLLES 1990a, 1990b, 1991a) which allows an interpretation of setal arrangements and the building up of a general nomenclature for the whole Symphypleona group.

3. THE DISTINCTION OF THE GENERA *Fasciosminthurus* GISIN, 1960 *sensu* BRETFELD, 1992 AND *Prorastriopes* DELAMARE DEBOUTTEVILLE, 1947 *sensu* BRETFELD, 1992

First, we question some characters used by BRETFELD (1992b, p. 49) for separating *Fasciosminthurus* from *Prorastriopes*. Then, we will discuss the phylogenetical value of some characters.

The character 4 of BRETFELD's list: "Ant. IV dist. whorls without V", corresponds, from our nomenclature of antennal setae (NAYROLLES 1991a), to the number of whorls without seta on Hipi from the whorl AIII inclusive and by counting towards the basis. For this character, the number 1 given by BRETFELD corresponds to the presence of the seta M1ipi, the numbers above 1 (2 or 3) correspond to the absence of this seta. According to BRETFELD, the seta M1ipi is present in *Fasciosminthurus* (because he gave the number 1 for the character in question), whereas we have observed that *Fasciosminthurus raynalae* (Nayrolles, 1988) and *Fasciosminthurus dictyostigmatus* n. sp. do not have the seta M1ipi. The character 4 in BRETFELD's list so cannot be conserved to separate *Fasciosminthurus* from *Prorastriopes*.

The character 5 of BRETFELD's list: "Ant. IV tip sensilla" corresponds to the number of bacilliform setae at the apex of Ant. IV. According to our work about the antennal chaetotaxy, these setae are: AA, those of whorl AI, as AIIai, AIIi and AIIpi, thus 12 setae in total. According to BRETFELD, *Prorastriopes* has 12 setae, while *Fasciosminthurus* presents only 11 of them. The absent seta of *Fasciosminthurus* corresponds to AIp. We have observed a species of *Fasciosminthurus*, *F. lacazei* (Denis, 1924), keeping AIp. So the character 5 in BRETFELD's list cannot be conserved in order to separate *Fasciosminthurus* from *Prorastriopes*. We can remark that BRETFELD has indeed examined the DENIS' type material of *lacazei* (one slide with the head and the body, another one with the legs); he could not yet distinguish the 12 bacilliform setae at the apex of ant. IV. As a matter of fact, as we saw ourselves, the bad preservation of the DENIS' slides does not allow the observation of this character.

The character 14 of BRETFELD's list: "Tibt. I seta 4i" corresponds to the presence (+) or to the absence (–) of the seta (TI1)4i1 (see the tibiotarsal setae nomenclature, NAYROLLES 1988 and the legs segments nomenclature, NAYROLLES 1990a). The seta in question is given by BRETFELD as absent in *Fasciosminthurus*, but as present into *Prorastriopes*, however we will see that *Fasciosminthurus dictyostigmatus* n. sp. has this seta. Thus, the character 14 in BRETFELD's list cannot be conserved in order to separate *Fasciosminthurus* from *Prorastriopes*.

The character 17 of BRETFELD's list: "Tibt. oval organs" corresponds to the number of ov. org. on the tibiotarsi. BRETFELD gives the number 1 for *Fasciosminthurus* (O2pe is only present) and 2 for *Prorastriopes* (O2pe and O3pe are present). However, *Fasciosminthurus lacazei* (including the type material) has 2 ov. org. Then, the character 17 in BRETFELD's list cannot be conserved in order to separate *Fasciosminthurus* from *Prorastriopes*.

Except the characters 2, 5, 14 and 17, which do not have value to distinguish *Fasciosminthurus* from *Prorastriopes*, there are 12 characters left in BRETFELD's list separating *Fasciosminthurus* from *Prorastriopes*.

As we already said, BRETFELD did not discuss the evolutive state of the characters he used for separating *Prorastriopes* from *Fasciosminthurus*. That sets the problem of the phyletic value as regards to the separation of these two genera. According to our studies, we think that we can give quite surely the evolutive trend of some characters as their relative importance.

From a phyletic point of view, the primary setae turn out to be the most interesting. On that subject, two characters seem to us particularly remarkable. It is a matter of the character 13 noted "Tibt. I, II seta Jp", which corresponds to the presence/absence of (TI1,2)Jp and the character 15, noted "Tibt. III seta Ia", which corresponds to the presence/absence of (TI3)Ia. *Fasciosminthurus* has (TI1,2)Jp, while this one is lacking into *Prorastriopes*. It is the opposite for (TI3)Ia. Into the others Symphypleona families, Jp is present and incontestably its disappearance constitutes an apomorphy. Ia is present in most Symphypleona families, and when it is lacking its absence is manifestly evolved: on the foretibiotarsus of Dicyrtomidae, in *Caprainea bremondi* (Delamare & Bassot, 1957) (Sminthuridae), in *Sphaeridia* (Sminthurididae) in which the absence is connected with the intense paurochaetosis.

The conclusions that we can give are the following ones: for (TI1,2)Jp *Fasciosminthurus* is primitive and *Prorastriopes* evolved and for (TI3)Ia *Fasciosminthurus* is evolved and *Prorastriopes* primitive. From a phylogenetical point of view, this couple of characters allows to separate *Fasciosminthurus* from *Prorastriopes*. However, according to the cladistic concepts, this argument is not sufficient to justify the evolutive separation of the two genera, since all the characters have not been considered: the explanation we have given was a necessary condition for putting forward the hypothesis of the distinction between the two genera, but this explanation is not sufficient.

The biogeographical argument is certainly at least as much convincing to justify the separation between *Fasciosminthurus* and *Prorastriopes*. *Fasciosminthurus* has a palearctical distribution (the presence of *F. quinquefasciatus* in Australia is due to an introduction, GREENSLADE & IRESON 1986). Besides, as BRETFELD (1992a) underlines it, the hypothesis of DELAMARE DEBOUTTEVILLE & MASSOUD (1963) in which *F. quinquefasciatus* would have been imported from South America to Europe is wrong. *Prorastriopes* is present in Africa (with the type species *P. pulcher*) and in Southern America. The Southern American species were described (STACH 1955, DELAMARE DEBOUTTEVILLE & MASSOUD 1963) as *Andiella*. *Prorastriopes cingulus* (Bonet, 1933) is present in Australia and Japan, probably this species was introduced in these countries (BRETFELD 1992b).

4. ABOUT THE GENUS *Cyprania* BRETFELD, 1992

BRETFELD (1992b) described a new genus in Cyprus: *Cyprania*, which has only one species: *C. gisae*. This genus seems to be very close to *Fasciosminthurus*. Three characters of BRETFELD's list (1992b, p. 49) used for separating *Fasciosminthurus* from *Cyprania* ought to be questioned.

The first is the character 3: "Ant. IV sens. P, whorl from distal". On ant. IV, the blunt setae of the intergeneratrix Hppe are called by BRETFELD (1990) with p or P whether their thickness is respectively weak or strong. The character "Ant. IV sens. P, whorl from distal" designates the first whorl on ant. IV from the apex that bears a thick cucumiform seta. When in fact, according to our observations, the distinction done by BRETFELD in his work of 1990 between thick seta (P) and thin seta (p) is really open to criticism, the differences of thickness being so weak and gradual along the antennal segment.

The second character that needs to be questioned is the 5th: "Ant IV tip sensilla", for the same reasons as the ones given about the distinction between *Fasciosminthurus* and *Prorastriopes* (see above). Note that (AQ)AIp is present in *Cyprania.*

The third character that needs to be questioned is the 17th: "Tibt. oval organs". As we have seen, one or two ov. org. can be present on the tibiotarsi of *Fasciosminthurus* (in his list, BRETFELD noted only one of them); it is also true for *Cyprania.*

The remaining characters used for separating *Fasciosminthurus* from *Cyprania* are:

- character 6 of BRETFELD's list: "Gr. Abd. row 5". We are not competent for discussing the importance of this character.
- character 19: "Female circumanal setae". In *Cyprania* several circumanal setae are serrated, they are all smooth in *Fasciosminthurus* and *Prorastriopes.*
- character 23: "App. an. to unguis III". The an. app. is short, wide ("ribbonlike"), with a truncate and toothed apex in *Cyprania*. The an. app. of *Fasciosminthurus* and *Prorastriopes* remains spinelike.
- a character absent from BRETFELD's list but which is quoted by the author, concerns the mucronal anterior lamella. This last-mentioned is double in *Fasciosminthurus*, i.e. it is built with two separated crests (NAYROLLES 1990b). BRETFELD writes about the one of *Cyprania* (1992b, p. 47): "mucro anterior furrow very narrow". Then, we do not know if the anterior lamella is double but narrow or if it is simple (in this case the two crests are jointed).

The morphology of circumanal setae and an. app. is not always sufficiently important for justifying a generic separation. For instance, in *Bourletiella* the shape of these setae really varies from *radula - pistillum* group to *hortensis - viridescens* group. On the other hand, according to our observations on the whole Symphypleona group, the state "double" or "simple" of mucronal anterior lamella could be a good criterion to justify a generic separation. Regretfully we do not know the state of this character in *Cyprania.*

The number and the value of the differences between *Fasciosminthurus* and *Cyprania* seem sufficiently reduced to suggest the hypothesis that *Cyprania gisae* could only be a particular species into *Fasciosminthurus* genus. The absence of difference in biogeography of these two genera can also be remarked: both of them are met in Europe. This question will perhaps be resolved with a better prospecting of the Mediterranean area, *Cyprania gisae* having been collected there and this area corresponding to the greatest diversification of *Fasciosminthurus.*

5. ABOUT THE TAXONOMIC STATUS OF *Fasciosminthurus albanicus pontignanoi* BRETFELD, 1992 AND *Prorastriopes cingulus venezuelae* BRETFELD, 1992.

BRETFELD (1992a) distinguished two sub-species of *Fasciosminthurus albanicus* (Stach, 1956): *F. albanicus albanicus* and *F. albanicus pontignanoi*. Both forms have the same coloration and share several characters. These are the reasons why BRETFELD considered them as sub-species. Nevertheless, two characters separating *F. a. albanicus* from *F. a. pontignanoi* present a great importance from a phyletic point of view. Thus, according to us (from our observations of the whole Symphypleona group), these two characters are sufficient to fully attribute the species status to both of these forms. These characters are the presence/absence of (TI2)IVp and the presence/absence of (TI3)IIIp (these setae are present in *F. a. albanicus* and absent in *F. a. pontignanoi*). As regards the problem of coloring, it is not surprising that these two taxa are similar. As a matter of fact, nothing is remarkable in the colour of the body which is composed of a diffuse pigment, essentially distributed in the behind area of the great abd.: it has not the coloring specificity of *F. raynalae* or *F. quinquefasciatus*. The head has a horizontal colored stripe below the antennae, whereas this attribute can also be found in other species.

Thus, we propose *Fasciosminthurus albanicus pontignanoi* to be raised to specific rank: *Fasciosminthurus pontignanoi* Bretfeld, 1992, stat. nov.

The same problem arises for two *Prorastriopes* sub-species distinguished by BRETFELD (1992b): *P. cingulus cingulus* and *P. cingulus venezuelae*. In the first one, (TI1,2)Ia, (TI1,2)IIi, (TI2)Vp and (TI3)IVp are absent, while they are present in the second one. These differences are widely sufficient for proposing *Prorastriopes cingulus venezuelae* to be raised to specific rank: *Prorastriopes venezuelae* Bretfeld, 1992, stat. nov.

6. SOME PROPOSITIONS FOR STANDARDIZING THE SPECIES DESCRIPTION

6.1. GENERAL POINTS

The aim of our statement is to standardize species description. This account will be used in our coming works about Bourletiellidae. Most of our explanations are similar to those that we give in a current work about the Sminthuridae family.

The body and head chaetotaxy is not yet sufficiently well-known to be used. BRETFELD's (1990) work, limited to the Bourletiellidae, will have to be reviewed in the light of a study on the whole Symphypleona group (like the one given by BETSCH & WALLER 1989 about the trichobothrial pattern). Besides, it would be proper to underline the difficulties of studying the great abd. As a matter of fact, specimens in slide are laid on their flank, and the digestive tube, which is often full of pollen or mycelium, can considerably limit the examination of the farthest side from the observer.

As far as the appendicular chaetotaxy is concerned, we have observed each stage of development. For each species, our observations generally concern one population, with sometimes some comparisons with other specimens from other populations.

Sometimes, some setae are variable. For each case of variable seta, we can generally observe a great proportion of dissymmetrical specimens. That can be interpreted by considering that the frequencies distribution of one variable seta approximates a binomial law. Consequently, as regards the presence/absence of a variable seta, both sides of one specimen can be considered as approximately independent. This model of variability had been previously noticed in Acari by GRANDJEAN (1939, 1949, 1952).

In a previous work we studied for every species one (sometimes two) 1st stage specimen, two 2nd stage specimens and four specimens for every later stage. At this step, we determined, for every stage of every species, the absent, or present, or variable setae. In most cases, the variable setae appear either at the 3rd stage, or at the 4th stage, which is the adult in Bourletiellidae. For defining with better precision their frequencies, other preparations were made. During these new observations, only the setae defined as susceptible to be variable were studied. When the number of specimens was sufficient, we made around six complementary preparations for each stage, so as to lead the observations on about ten specimens. Seeing that the appendages are paired, it results about twenty observations. Thanks to the complementary observations, for each stage, we can definitively define the setae that we consider as present, or absent, or variable. According to some of our previous works (NAYROLLES 1989, 1991a), in a general way, we consider a seta as variable when it is present between the one fifth and the four fifths of the observations (below one fifth the seta is considered as absent, and above four fifths the seta is considered as present and constant). The rate of presence will be given through the occurrence (noted oc) which corresponds to the probability of presence given by one digit.

The appendicular chaetotaxy (antennae, legs and furcula) is presented in a table which takes up only one page. The chaetotaxic tables that we have given in our studies about the general chaetotaxy of the Symphypleona appendages (NAYROLLES 1988, 1990a, 1990b, 1991a) required in all two pages and a half. Thus, a size reduction of these tables becomes useful. So, it will be possible to make identification sheets, in the future a computer filing will be interesting. This one would allow the achievement of a data bank which would be provided by the researches of all the specialized in Symphypleona Collembologists.

With the chaetotaxic table, we give a text for the description of each species. We propose for this text a standardized plan.

6.2. MAKING UP STANDARDIZED CHAETOTAXIC TABLE

The idea consists in replacing the legend on the left side by a set of symbols.

The symbols of the different segments are written in the left column.

In the second column, on several occasions, two Greek letters are used: Π for absent primordial setae (in this case, the character – means that none of these setae are absent), and Δ for secondary setae present, or setae with a particular form, or any remark.

The first table concerns the antennae with symbols as follows (adapted from NAYROLLES 1991a): AP = first antennal segment, AD = second antennal segment, AT = third antennal segment, AQ = fourth antennal segment. Concerning AQ, in the second column, "str" is used for the chaetotaxic structure, A, M and B for the different sections of this segment. M and B are gathered, the H setae are distinguished from the G setae.

The second table concerns the legs and is vertically divided in three parts. From left to right, these three parts correspond respectively to the anterior, median and posterior legs. The following symbols are used (NAYROLLES 1990a): SB = basal subcoxa, SA = apical subcoxa, CX = coxa, TR = trochanter, FE = femur, TI = tibiotarsus. In the second column, prc = subcoxal process, K = presence (noted +) / absence (noted –) of K setae, FP = presence/absence of FP setae. As far as the tibiotarsi are concerned, we consider that the set of primary setae on the whorls constitutes the primordial chaetotaxy (for the definition of the primordial chaetotaxy, see NAYROLLES 1990a, 1990b, 1991a).

The third table concerns the furcula. Here, the symbols used (NAYROLLES 1990b) are: MA = manubrium, DE = dens, MU = mucro.

Into the three tables, the stage of appearance of a seta is given by a letter: P for a primary seta, D for a seta emerging at the 2nd stage, T for a seta emerging at the 3rd stage, Q for a seta emerging at the 4th stage and C for a seta emerging at the 5th stage (symbols from NAYROLLES 1991a). When a seta is variable at the stage in which it appears, the letter that symbolizes this stage is written between brackets; if during a stage of the development it becomes constant, this stage is also indicated. For example, (T) means that a seta appears with variability at the 3rd stage and remains variable; (T)Q means that a seta appears with variability at the 3rd stage and becomes constant at the 4th.

In comparison with the already published tables, the following rubrics are not taken up here:

- for AT: "Papille tégumentaire" = "integumentary protuberance" as RICHARDS (1968)
- for DE: "Papilles dentales" = "dental papillae" as RICHARDS
- for FE: "cup" = "organe en cupule" which we can translate into cuplike organ.

The integumentary protuberance of ant. III and the dental papillae are lacking into Bourletiellidae. The cuplike organ, which is very slender, may present an observation too difficult to be systematically reproduced. Nevertheless, the good optical material we could use allowed us to search the existence of this organ. Its presence will be quoted in the text.

As regards AQ, we give the occurrence of H setae on each intergeneratrix by the following mean: for example, concerning Heae of *Fasciosminthurus lacazei*, 1-1-1-1-0/0 signifies that, from the apex to the basis, each of the first four whorls of M (M1, M2, M3, M4) bears one seta (oc = 1), the last (M5) does not (oc = 0) and the section B (separated by the character /) does not either. Besides, we give the mean (m) of the antennal variable h^*. With $h^* = (Heae^* + Hppe^*)/2$, wherein $Heae^*$ is the number of setae on Heae which are present on M and B; $Hppe^*$ is the number of setae on Hppe which are present on M and B.

6.3. STANDARDIZED PLAN FOR DESCRIPTION

We propose the following typical plan:

- Development. We give the number of juvenile stages.

- Size of adults. The body length is measured from specimens in alcohol, from the face to the tip of the small abd.
- Colour. The description is based on specimens in alcohol.
- Great abd. The trichobothrial pattern is given in accordance with the criteria of Betsch & Waller (1989).
- Antennae. We give the means of the antennal ratios ant. I : II : III : IV and ant. : ceph. diag. Then, we give the values of 3 chaetotaxic variables (noted G, ISh^* and RSh) which are characteristic of ant. IV. G is equal to the number of G setae on ant. IV. $ISh^* = h^*/(V+1)$, wherein h^* (already seen) is equal to the half of the number of setae on Heae and Hppe present on the sections M and B, and V is equal to the number of whorls on M. RSh is equal to four times the total number of setae on Heae and Hppe divided by G. For G we give the mean (m), the minimum (min), and the maximum (max), for ISh^* and RSh we just give the mean.
- Head.
- Legs.
- Ventral tube.
- Retinaculum. The number of teeth per ramus is given. We recall that the basal horn on the corpus is not to be considered as a tooth.
- Furcula.
- Small abd. We give the ratio an. app. : mucro.

7. ACCOUNT OF SPECIES

7. 1. **Fasciosminthurus lacazei** (Denis, 1924)

The study of both Denis' slides, kindly loaned by J.-M. Betsch, allows us to identify some specimens of our collects as belonging to the species *lacazei* (from the criteria of the empodial filament morphology and the presence of (TI.)O3pe).

Material

SPAIN, prov. Lérida, near Seo de Urgel, just before the road going to Artedó, northern side of Sierra del Cadí, alt. 950 m; Garrigue on a stony limestone slope with pubescent leaves oaks and *Lavandula vera, Thymus vulgaris, Quercus ilex, Genista scorpius, Stæhelina dubia, Buxus sempervirens, Amelanchier vulgaris, Euphorbia serrata, Lonicera etrusca, Helleborus fœtidus*, etc.; collected with a net (LE9). 14-VI-1987: 1 juv. in preparation and 2 ad. — Prov. Huesca, Collado de Eripol, alt. 860 m; Garrigue with *Genista scorpius, Thymus vulgaris, Rosmarinus officinalis, Dorycnium pentaphyllum, Lavandula latifolia, Juniperus communis, Juniperus phœnicea, Buxus sempervirens, Pinus silvestris, Arctostaphylos uva-ursi*, etc.; collected with a net (HU18). 31-VII-1987: 7 ex.; 2 juv. and 2 ♀ in preparation. 30-V-1990: 1 ♂ and 1 juv.; all in preparation. 21-VI-1990: 22 ex.; 5 juv., 3 ♂ and 3 ♀ in preparation.

Deposit of material. — Muséum d'Histoire naturelle de Genève, SWITZERLAND: station HU18, 21-VI-1990, 6 ex. in alcohol. — Laboratoire de Zoologie, Ecobiologie des Arthropodes édaphiques, Université Paul Sabatier, Toulouse, FRANCE: the rest of the material.

Description

Development. — Number of juv. st. = 3.

Size ad. — ♂: 0.5 - 0.7 mm; ♀: 0.6 - 0.8 mm.

Colour (fig. 1). — Background varying from white to yellow. Flanks of great abd. with many grey-black spots, especially in the posterior area. In the anterior area the spots are laid in two or three transverse alignments which are often broken in the medio-dorsal area. Small abd. with the back of abd. V grey as the apical outline of the upper anal flap. Head with grey maculae behind the eyes, on the sides and face. Eyepatch surrounding light. Between the eyes, an ochred brown, more or less orangey, stripe getting wider between the antennae which are brown. Eyepatches black. Legs and furcula white.

Great abd. — Trichobothria: A, B and C in linear pattern. Dorsal setae: mesochaetae.

Antennae (figs 5-8). — Antennal ratios: nearly the same for both sexes, ant. I : II : III : IV = 1 : 1.9 : 2.4 : 5.9 and ant. : ceph. diag. = 1.6. Chaetotaxic variables: for *G*: m = 88.5 / min = 84 / max = 92 ; m(*ISh**) = 0.58 ; m(*RSh*) = 0.41.

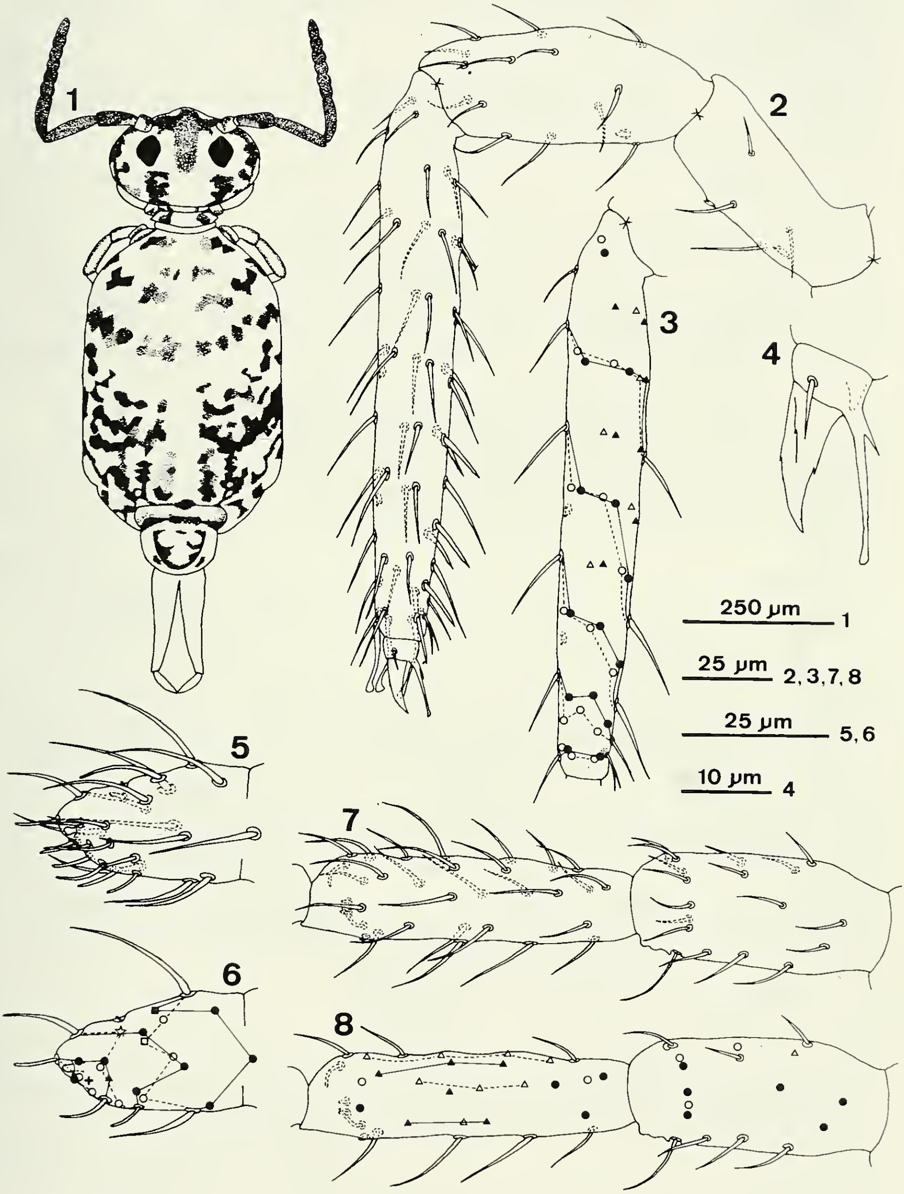
Head. — Eyes: 8+8; eyepatch with 2 setae. Cephalic setae: mesochaetae. 1+1 ov. org. behind the head (except one specimen with 2+2). Labral formula: 6/5-5-4.

Legs (figs 2-4). — Femur: cup present. Numbers of obliquely truncate setae on the fore, median and hind tibiotarsi: 7, 8, 9. Claw with a small tooth on the inner crest. The empodial filament overhangs the claw. It is thick but narrower in its subterminal part. It is also weakly clavate.

Ventral tube. — At the 1st st., sacs very weakly warty, probably wholly warty from the 2nd (unobserved at the 2nd st.). Chaetotaxy: apical flaps with one pair of primary setae, corpus without seta.

FIGS 1-8

Fasciosminthurus lacazei ad.; 1: habitus; 2: foreleg, anterior view; 3: schematic representation of foretibiotarsus (from fig. 2). The setae of Ge and Gi as the ov. org. are drawn; the others are schematized according to the following understanding: a full symbol for a seta on the reader's side (thus on the anterior side), an empty symbol for a seta on the opposite reader's side, a ring for a primary seta, a triangle for a secondary seta. The setae belonging to a same whorl are linked together by a line which is continuous on the anterior side and discontinuous on the other side; 4: forepraetarsus, anterior view; 5: section A of ant. IV, anterior view; 6: schematic representation of the fig. 5. The setae of Ge and Gi are drawn; a full symbol for a seta on the reader's side (thus on the anterior side), an empty symbol for a seta on the opposite reader's side. A square for the H setae, a cross for AA, a star for AIIpe, a triangle for the secondary seta (AIai), a ring for the other setae. The setae belonging to a same whorl are linked together by a line which is continuous on the anterior side and discontinuous on the other side; 7: ant. II and III, anterior view; 8: schematic representation of the fig. 7. The setae of Ge and Gi as those of antennal III organ (Xe, Xi) and its guard setae (Aai, Api, Ape) are drawn; the others are schematized according to the following understanding: a full symbol for a seta on the reader's side (thus on the anterior side), an empty symbol for a seta on the opposite reader's side, a ring for a primary seta, a triangle for a secondary seta. The symbols of secondary setae belonging to a same generatrix are linked together by a line which is continuous on the anterior side and discontinuous on the other side.


1
2
3
4
5
6
7
8
250 μm 1
25 μm 2, 3, 7, 8
25 μm 5, 6
10 μm 4

Appendicular chaetotaxy of *Fasciosminthurus lacazei*

AP	Δ		—
AD	Π		—
	Δ		D: i0 T: i+1, e+1, pe+1 Q: i-1 Ai is a trichobothrium.
AT	Π		—
	Δ		Other setae: Q: pe+2

	Ge	Gae	Ga	Gai	Gi	Gpi	Gp	Gpe
Setae -1	Q	T		T			T	T
Setae 0		D	D	Q	D	D	T	D
Setae +1		T			T		Q	T

AQ	str		B is completely zoned. Section M euwhorled with 5 whorls. Right euwhorlation. Subsegmentation formula: 1 + 5 + 1 = (A) + (M1, 5) + (B). Right subsegmentation.
	A	Π	—
		H	AIIIeae, AIIIppe
		Δ	Apical bulb: in part invaginated Subapical organ: very small D: AIai AIIpe is a blunt microchaeta
	M & B	H	The occurrences of H setae on M & B are: for Heae 1-1-1-1-0/0. for Hipi 1-1-0-0-0/0 and for Hppe 1-1-1-0-0/0. m(h^*) = 3.5.
		G	Setae of BB: P: BBe, BBae, BBa, BBp, BBpe / BA with one variable seta: BAe (oc = 0.7) / n80%(*BM*) = 9-14 / n80%(*B*) = 21-27 / all G setae on M are present / n80%(*G*) = 86-92. BBae is a blunt microchaeta upon a wide base. This seta undergoes a reduction size during its development. BBa is a cucumiform seta upon a wide base.

SB	prc	—	—	—
	Δ	P: 1 seta	P: 1 seta	P: 1 seta
SA	Δ	—	P: 1 seta	P: 1 seta
CX	Δ	P: i1	P: ae, i1, ms T: Qi1 Q: a	P: ae, i1, ms T: a, ai2, Oi1
TR	Π	—	—	—
	Δ	T: Oi1, Oi2	T: a2, Oi1, Oi2 Q: ae	T: a2, Oi1, Oi2 (T)Q: ae (oc = 0.7)
FE	Π	—	—	pe1
	Δ	delaied primordial seta: Q: ae3 T: pe2, Op Q: pe4	T: a5, pe2, Op Q: pe4	T. a5, ai2, pe2 Q: ai3, ai4, pe4, Oi
TI	Π	Ia	Ia	Ia, IVp, Vp
	K	—	—	—
	FP	+	+	+
	Δ	T: 4ai1, Vai, Vpi, FSa, Q2pe Q: 3a, 3p, 4a1, 4p1, 4pi1, 4ai2, FSai, FSpi, O3pe (Q): 4pi2 (oc = 0.4) Ipi, Ip and Ipe are spatulate setae. Iai, IIai, IIpi, IIIai, IIIpi, IVai, IVpi are obliquely truncate setae.	T: 4ai1, 4i1, Vai, Vpi, FSa, O2pe Q: 3a, 3p, 4a1, 4pi1, 4ai2, 4pi2, FSai, FSpi, Q3pe (Q): 4p1 (oc = 0.4) Ipi, Ip and Ipe are spatulate setae. Iai, IIai, IIpi, IIIai, IIIpi, IVai, IVi, IVpi are obliquely truncate setae.	T: 3ai, 3i, 4ai1, 4i1, Vai, Vpi, FSa, Q2pe Q: 2a, 3a, 3pi, 4a1, 4pi1, 4ai2, 4pi2, FSai, FSpi, Q3pe (Q): 2p (oc = 0.2) Ip and Ipe are spatulate setae. Iai, Ipi, IIai, IIpi, IIIai, IIIi IIIpi, IVai, IVi are obliquely truncate setae.

MA	Π	—
	Δ	(T)Q: pe3 (oc = 0.6) (Q): pe2 (oc = 0.5)
DE	Δ	Other setae: P: 2pe

		Ge	Gae	Ga	Gai	Gi	Gpi	Gp	Gpe
Whorls I to VI	I	P	P	P	P	P	P	P	P
	II		P	P			P	P	P
	III			P			P	P	P
	IV			P				P	P
	V						T	T	T
	VI						Q		T
Whorl B		T		P			P	P	P

MU	Δ	Chaetotaxy: — Morphology: anterior lamella double, outer and inner lamellae smooth.

Retinaculum. — At the 1st st. rami tridentate, bidentate from the 2nd. Chaetotaxy: on the anterior lobe two setae appear at the 3rd st. and another one in the ad.

Furcula. — On Gpi of the dens, only IVpi is lacking.

Small abd. — Made up of abd.V + abd. VI. Trichobothria: D and E. The genital papilla of the ♂ with 14 to 17 setae. An. app. spinelike, straight, with or without small teeth at the tip (variable character). Ratio an. app. : mucro = 0.55.

7.2. **Fasciosminthurus dictyostigmatus** n. sp.

Material

Type material. — FRANCE, dep. Aveyron, district Montrozier, Causse Comtal, road of Gages, alt. 620 m; calcareous sheep meadow with *Bromus erectus, Kœleria valesiaca, Festuca* gr. *ovina, Coronilla minima, Hippocrepis comosa, Lotus corniculatus, Anthyllis vulneraria, Carduncellus mitissimus, Eryngium campestre, Teucrium chamædrys*, etc.; collected with a net (AV2a). 13-VI-1987. Syntypes: a thousand of ex.; 16 juv. and 10 ad. in preparation.

Other material. — Same station. 23-V-1987: 8 ex. 10-VII-1987: 4 ex.

Deposit of material. — Muséum d'Histoire naturelle de Genève, SWITZERLAND: 100 ex. of the type material in alcohol. — Muséum National d'Histoire Naturelle, Paris, FRANCE: 100 ex. of the type material in alcohol. — Laboratoire de Zoologie, Ecobiologie des Arthropodes édaphiques, Université Paul Sabatier, Toulouse, FRANCE: the rest of the material.

Description

Development. — Number of juv. st. = 3.

Size ad. — ♂: 0.55 - 0.65 mm; ♀: 0.7 - 0.9 mm.

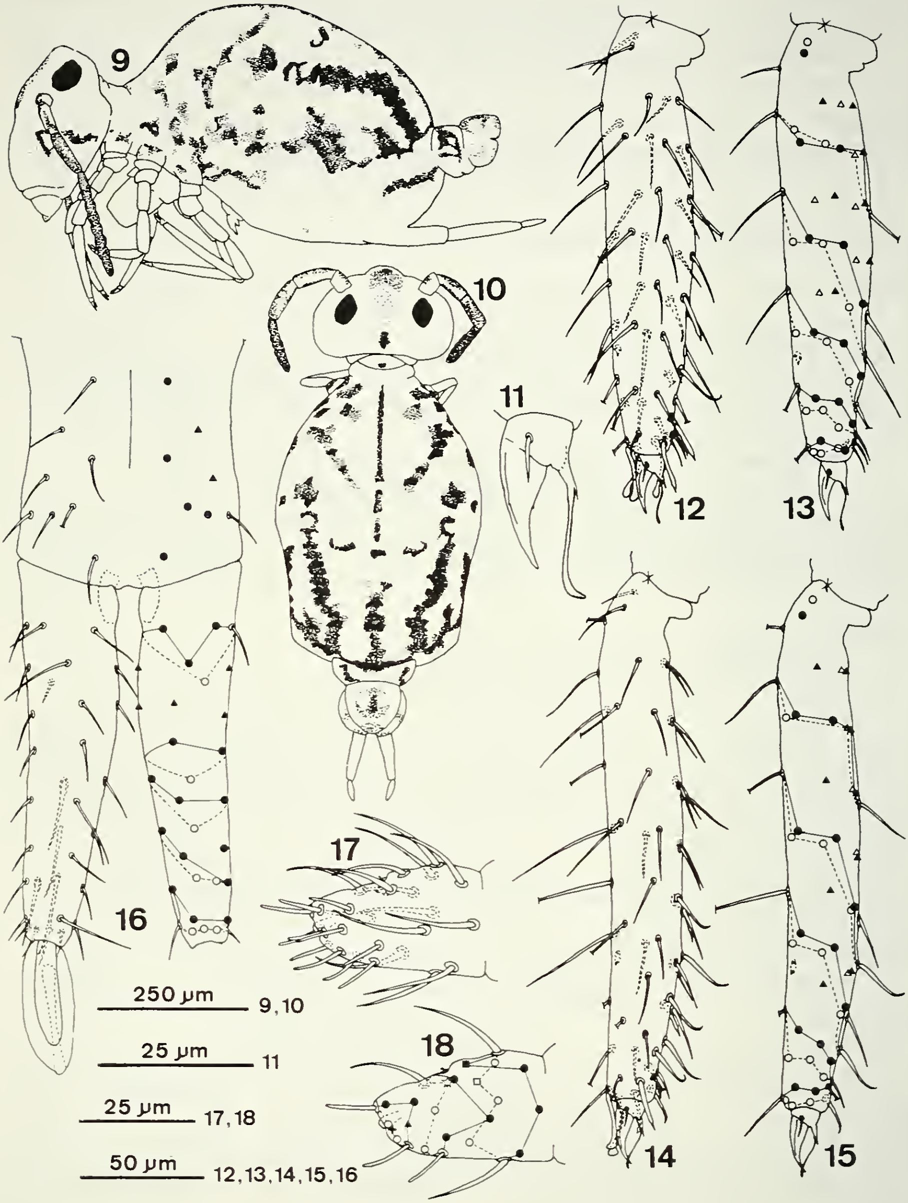
Colour (figs 9-10). — Very constant and very characteristic coloring pattern, made up of small more or less dark grey-bluish spots on yellow background. Great abd. with one dorsal line, flanked of two more lateral other ones. These longitudinal stripes are linked by cross rows of pigment. There are still some spots under the most lateral of the cross rows. Small abd. with three spots (one median and two dorso-lateral) on abd. V and with a spot on the upper anal flap. Head with a cross stripe under the antennae, this stripe is cut in its middle. An orangey macula between the antennae which are brown. Eyepatches black. Legs and furcula without dark pigment.

Great abd. — Trichobothria: A, B and C in linear pattern. Dorsal setae: mesochaetae.

Antennae (figs 17-18). — Antennal ratios: in the ♀, ant. I : II : III : IV = 1 : 1.9 : 2.4 : 5.0 and ant. : ceph. diag. = 1.5 ; in the ♂, ant. I : II : III : IV = 1 : 1.9 : 2.5 : 5.4 and ant. : ceph. diag. = 1.7. Chaetotaxic variables: for G: m = 90.3 / min = 86 / max = 95 ; m(ISh^*) = 0.51 ; m(RSh) = 0.36.

Head. — Eyes: 8+8; eyepatch with 2 setae. Cephalic setae: mesochaetae. Head without ov. org. Labral formula: 6/5-5-4.

Legs (figs 11-15). — Femur: cup present. Numbers of obliquely truncate setae on the fore, median and hind tibiotarsi: 7, 9, 11. A tiny tooth, or even none, on the inner crest of the claw. The empodial filament overhangs the claw. It is rather thin, S curved and weakly thickened in its subterminal part.


9
10
11
12
13
14
15
16
17
18
250 µm 9, 10
25 µm 11
25 µm 17, 18
50 µm 12, 13, 14, 15, 16

Ventral tube. — At the 1st st., sacs very weakly warty, wholly warty from the 2nd. Chaetotaxy: apical flaps with one pair of primary setae, corpus without seta.

Retinaculum. — At the 1st st. rami tridentate, bidentate from the 2nd. Chaetotaxy: on the anterior lobe two setae appear at the 3rd st. and another one into the ad.

Furcula (fig.16). — Dental chaetotaxy as in *F. lacazei.*

Small abd. — Made up of abd.V + abd. VI. Trichobothria: D and E. The genital papilla of the ♂ with about 18 setae. An. app. spinelike, straight. Ratio an. app. : mucro = 0.48.

Etymology

dictyostigmatus = reticulum of maculae, that refers to the coloring of this species.

Discussion

Bretfeld (1992a) described in detail the chaetotaxy of the following species belonging to the *Fasciosminthurus* genus: *albanicus, circumfasciatus, obtectus, pontignanoi, quinquefasciatus, strigatus* and *virgulatus*. We studied the appendicular chaetotaxy of *cugnyi, lacazei, quinquefasciatus, raynalae, sauteri*, and *virgulatus* (the results will be published in a future paper). In comparison with the species of *Fasciosminthurus* in which the appendicular chaetotaxy has been observed, *F. dictyostigmatus* n. sp. can be distinguished by the presence of (TI1)4i1 and (TI3)IVp. The coloring is also characteristic of this species.

Résumé

Nous discutons les récents travaux de Bretfeld (1992a, 1992b). Cet auteur distingue les genres *Prorastriopes* et *Fasciosminthurus* qui avaient été mis en synonymie par Betsch (1977). Les caractères établissant la séparation entre ces deux genres sont discutés, de même que ceux qui ont servi à la distinction de *Cyprania* Bretfeld, 1992. Nous complétons la description de *Fasciosminthurus lacazei* (Denis, 1924). Une nouvelle espèce est décrite: *Fasciosminthurus dictyostigmatus* n. sp. Une standardisation de la description des Symphypléones est proposée. Un tableau standardisé de la chétotaxie des appendices est ainsi donné pour chaque espèce.

Figs 9-18

Fasciosminthurus dictyostigmatus ad.; 9-10: habitus; 11: mesopraetarsus, anterior view; 12: foretibiotarsus, anterior view; 13: schematic representation of the fig. 12 - same understanding as the fig. 3; 14: hind tibiotarsus, anterior view; 15: schematic representation of the fig. 14 - same understanding as the fig. 3; 16: furcula, posterior view. On the right, schematic representation with the following understanding: the setae of Ge and Gi are drawn, a full symbol for a seta on the reader's side (thus on the posterior side), an empty symbol for a seta on the opposite reader's side, a ring for a primary seta, a triangle for a secondary seta. On the dens, for the whorls I to IV and B, the setae belonging to a same whorl are linked together by a line which is continuous on the posterior side and discontinuous on the other side; 17: section A of ant. IV, anterior view; 18: schematic representation of the fig. 17 - same understanding as the fig. 6.

Appendicular chaetotaxy of *Fasciosminthurus dictyostigmatus* n. sp.

AP	Δ	—
AD	Π	—
	Δ	D: i0 T: i+1, e+1 Q: i-1, pe+1 Ai is a trichobothrium.
AT	Π	—
	Δ	Other setae: — oc(e-1) = 0.3 oc(pi-1) = 0.7 oc(p+1) = 0.7

	Ge	Gae	Ga	Gai	Gi	Gpi	Gp	Gpe
Setae -1	(Q)	T		T		(Q)	T	T
Setae 0		D	D		D	D	T	D
Setae +1				T			(Q)	T

AQ	str		B is completely zoned. Section M euwhorled with 5 whorls. Right euwhorlation. Subsegmentation formula: 1 + 5 + 1 = (A) + (M1, 5) + (B). Right subsegmentation.
	A	Π	AIp
		H	AIIleae, AIIIppe
		Δ	Apical bulb: in part invaginated Subapical organ: very small D: AIai AIIpe is a blunt microchaeta
	M & B	H	The occurrences of H setae on M & B are: for Heae 1-1-1-0-0/0. for Hipi 0-1-1-0-0/0. and for Hppe 1-1-1-0.1-0/0. $m(h^*) = 3.0$.
		G	Setae of BB: P: BBe, BBae, BBa, BBp, BBpe / BA: complete whorl / n80%(*BM*) = 11-16 / n80%(*B*) = 24-29 / all G setae on M are present / n80%(*G*) = 88-93. BBae is a blunt microchaeta upon a wide base. This seta undergoes a reduction size during its development. BBa is a cucumiform seta upon a wide base.

SB	prc	—	—	—
	Δ	P: 1 seta	P: 1 seta	P: 1 seta
SA	Δ	—	P: 1 seta	P: 1 seta
CX	Δ	P: i1	P: ae, i1, ms T: Qi1 Q: a	P: ae, i1, ms T: ai2, Qi1 Q: a
TR	Π	—	—	—
	Δ	T: Qi1, Qi2	T: a2, Qi1, Qi2 Q: ae	T: ae, a2, Qi1, Qi2
FE	Π	—	—	pe1
	Δ	T: pe2, Qp Q: ai2, pe4	T: ai2, a5, pe2, Op Q: pe4	T: a5, ai2, pe2 Q: ai3, ai4, pe4, Qi
TI	Π	Ia	Ia	Ia, Vp
	K	—	—	—
	FP	+	+	+
	Δ	T: 4ai1, 4i1, Vai, Vpi, FSa, Q2pe Q: 3a, 3p, 4a1, 4pi1, 4p1, 4ai2, 4pi2, FSai, FSpi Ipi, Ip and Ipe are spatulate setae. Iai, IIai, IIpi, IIIai, IIIpi, IVai, IVpi are obliquely truncate setae.	T: 4ai1, 4i1, Vai, Vpi, FSa, Q2pe Q: 3a, 4a1, 4pi1, 4ai2, 4pi2, FSai, FSpi (Q): 3p (oc = 0.4) Ipi, Ip and Ipe are spatulate setae. Jp, Iai, IIai, IIpi, IIIai, IIIpi, IVai, IVi, IVpi are obliquely truncate setae.	T: 3ai, 3i, 4ai1, 4i1, Vai, Vpi, FSa, Q2pe (T)Q: 2a (oc = 0.4), 3a (oc = 0.7), 4a1 (oc = 0.7), 4pi1 (oc = 0.5) Q: 3pi, 4ai2, 4pi2, FSai, FSpi Ip and Ipe are spatulate setae. Jp, Iai, Ipi, IIai, IIpi, IIIai, IIIi, IIIpi, IVai, IVi, IVpi are obliquely truncate setae.

MA	Π	—
	Δ	T: pe3 Q: pe2
DE	Δ	Other setae: P: 2pe

		Ge	Gae	Ga	Gai	Gi	Gpi	Gp	Gpe
Whorls I to VI	I	P	P	P	P	P	P	P	P
	II		P	P			P	P	P
	III			P			P	P	P
	IV			P				P	P
	V						T	T	Q
	VI						Q		T
Whorl B		T		P			P	P	P

MU	Δ	Chaetotaxy: — Morphology: anterior lamella double, outer and inner lamellae smooth.

REFERENCES

Betsch, J. M. 1977. Mise au point sur la systématique des Collemboles Symphypléones. *Rev. Ecol. Biol. Sol* 14: 211-215.

– 1980. Eléments pour une monographie des Collemboles Symphypléones (Hexapodes, Aptérygotes). *Mem. Mus. natn. Hist. nat., Paris*, A, 116: 1-227.

Betsch, J. M. & A. Waller. 1989. L'armement en trichobothries des Collemboles Symphypléones. Recherche de schémas chétotaxiques. *In* R. Dallai (ed.). *Third International Seminar on Apterygologia*. Università di Siena, Italy: 15-31.

Bretfeld, G. 1990. Chaetotaxy of four Species of the Genera *Heterosminthurus, Bourletiella, Deuterosminthurus* and *Prorastriopes* (Insecta, Collembola, Symphypleona). *Zool. Jb. Syst.* 117: 441-489.

– 1992a. Description of old and new European taxa of the genus *Fasciosminthurus* GISIN, 1960 n. com. (Collembola Symphypleona) mainly based on chaetotaxy. *Mitt. Zool. Mus. Kiel, Suppl.* 4: 7-36.

– 1992b. Generic division of *Prorastriopes* BETSCH, 1977 with description of *Cyprania* n. g. from Cyprus (Collembola Symphypleona). *Mitt. Zool. Mus. Kiel, Suppl.* 4: 37-60.

Delamare Deboutteville, C. 1947. Collemboles nouveaux du Sénégal. Contribution à la connaissance des Bourletiellini C. B. *Bull. Soc. entomol. France* 52: 103-107.

Delamare Deboutteville, C. & Z. Massoud. 1963. Collemboles Symphypléones. *In*: Biologie de l'Amérique australe, éd. C. N. R. S., 2: 169-289.

Gisin, H. 1960. Collembolenfauna Europas. *Mus. Hist. nat., Genève*, 312 pp.

Grandjean, F. 1939. La répartition asymétrique des organes aléatoires. *C. R. Acad. Sci. Paris* 208: 861-864.

– 1949. Au sujet des variations individuelles et des polygones de fréquence. *C. R. Acad. Sci. Paris* 229: 801-804.

– 1952. Sur les variations individuelles. Vertitions (écarts) et anomalies. *C. R. Acad. Sci. Paris* 235: 640-643.

Greenslade, P. & J. E. Ireson. 1986. Collembola of the southern australian culture steppe and urban environments: a review of their pest status and key to identification. *J. Aust. ent. Soc.* 25: 273-291.

Jeannenot, F. 1956. Contribution à l'étude des Collemboles. *Deuterosminthurus quinquefasciatus* (Krausbauer). *Trav. Lab. Zool. Dijon* 19: 1-25.

Nayrolles, P. 1988. Chétotaxie tibiotarsale des Collemboles Symphypléones. *Trav. Lab. Ecobiol. Arthr. édaph. Toulouse* 5 (4): 1-19.

– 1989. Données nouvelles sur l'évolution ontogénétique des Collemboles Symphypléones. *Nouv. Revue Ent.* (N.S.) 6 (3): 231-244.

– 1990a. Chétotaxie de la base de la patte des Collemboles Symphypléones. *Trav. Lab. Ecobiol. Arthr. édaph. Toulouse* 6 (2): 1-26.

– 1990b. Chétotaxie furcale des Collemboles Symphypléones. *Trav. Lab. Ecobiol. Arthr. édaph. Toulouse* 6 (2): 27-50.

– 1991a. La chétotaxie antennaire des Collemboles Symphypléones. *Trav. Lab. Ecobiol. Arthr. édaph. Toulouse* 6 (3): 1-94.

– 1991b. Contribution à l'étude ontophylogénétique et écologique des Collemboles Symphypléones épigés. *Thèse de l'Université P. Sabatier, Toulouse*, 329 pp.

Richards, W. R. 1968. Generic classification, evolution and biogeography of the Sminthuridae of the world (Collembola). *Mem. Ent. Soc. Canada*, 53: 1-54.

Stach, J. 1955. A new genus *Andiella* n. g. from the Andes, and revision of the genera of the tribe Bourletiellini (Collembola). *Ann. Zool. Warszawa*, 16: 51-59.

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A review of the species of *Baeocera* Erichson (Coleoptera, Staphylinidae, Scaphidiinae) of America north of Mexico

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A review of the species of *Baeocera* Erichson (Coleoptera, Staphylinidae, Scaphidiinae) of America north of Mexico. - The species of the genus *Baeocera* of America north of Mexico are reviewed. Diagnostic characters and figures are given for all 38 species recognized. The following new species are described: *Baeocera amicula*, *B. borealis*, *B. chisosa*, *B. compacta*, *B. elongata*, *B. hamata*, *B. hesperia*, *B. impunctata*, *B. indistincta*, *B. lenczyi*, *B. obesa*, *B. pecki*, *B. similaris*, *B. solida*, and *B. sticta*. *Baeocera dybasi* (Cornell) is placed in synonymy with *B. texana* Casey, and *B. kingsolveri* (Cornell) with *B. robustula* Casey. *Baeocera speculifer* Casey and *B. youngi* (Cornell) are removed from synonymy and treated as valid species. Lectotypes are designated for *B. robustula* Casey, *B. rubriventris* Casey, *B. speculifer* Casey and *B. texana* Casey. Species groups, based on male genitalia characters, are defined, and a key to species is provided.

Key-words: Coleoptera - Staphylinidae - Scaphidiinae - *Baeocera* - taxonomy.

INTRODUCTION

Baeocera Erichson is one of the more diverse genera of scaphidiine beetles consisting of approximately 180 species with a cosmopolitan distribution. Members of the genus are commonly encountered in samples from moist forest floor litter, on fungi, and, more recently, in flight intercept traps. Little is known about their biology. They apparently feed on slime molds (CORNELL, 1967; LAWRENCE & NEWTON, 1980; NEWTON, 1984; NEWTON & STEPHENSON, 1990) and on sporophores of basidiomycete fungi (NEWTON, 1984). The most reent account on scaphidiine larvae was was given by NEWTON (1991); it also includes information on *Baeocera* life history.

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Although the Nearctic *Baeocera* have been revised relatively recently (CORNELL, 1967), to which additional data have been published (LÖBL, 1976; 1987), many species are difficult to distinguish and their distributions are poorly known.

Many species of *Baeocera* exhibit diagnostic external characters. In addition, their aedeagi are diverse and provide numerous characters. The lack of information on details of these features in former papers was the main source of difficulties the students of North American *Baeocera* experienced in the past.

The aim of this paper is to define the *Baeocera* species occurring in America north of Mexico, to provide a useful key for these species and to provide more information on the distribution of the species. Two problems concerning taxonomy and nomenclature remain unsolved. The identity of *B. discolor* Casey is unknown. The sole original specimen in the USNM is a female belonging possibly to the *picea* group which includes several very similar species, positively distinguished only by the aedeagal characters. Secondly, our definition of *B. cerbera* is based on the examination of one paratype which we hope is conspecific with the holotype, which was not available for study.

In absence of a phylogenetic hypothesis and of more detailed knowledge of the distribution of many species it is not possible to provide a biogeographical analysis of the New World *Baeocera*. However, some patterns may be pointed out: 1. *Baeocera* of America north of Mexico with 38 species are more speciose in comparison with the western Palaearctic area with 3 species; 2. the wide distributional range of most of the Eastern species; 3. the paucity of *Baeocera* in the Pacific area in which only the widely distributed *B. humeralis* occurs, and absence of *Baeocera* from the southern portions of the Pacific area, i.e., from California, and also from Oregon and Washington; 4. the high diversity of *Baeocera* of Arizona and Texas, with 10 species in Arizona (amongst which *B. sticta*, *B. elongata*, *B. lenczyi*, and *B. solida* may be endemic) and 12 species in Texas (with *B. chisosa*, *B. hamata*, and *B. obesa* as possible endemics); 5. the genus is relative speciose in the Florida Keys where 4 species have been found. *Baeocera amicula*, *B. compacta*, and *B. pecki* are known only from the Florida Keys although the area is inhabited by widely distributed species (Peck, 1989).

MATERIAL AND METHODS

We have examined and identified 3277 adult specimens, and examined lectotypes or syntypes of species described by CASEY (1893; 1900) and holotypes and/or paratypes of several critical species described by CORNELL (1967). Most species described by Cornell were identified using his descriptions and figures of aedeagi. Species described by other authors, i.e., LECONTE (1860), REITTER (1880), FALL (1910), and CHAMPION (1913) have been revised and sufficiently redefined by CORNELL (1967) and LÖBL (1976; 1987), respectively. The types of the Mexican and Central American species of *Baeocera* were examined by LÖBL (1992b).

The measurements and terminology are the same as in LESCHEN *& al.* (1990), except for the following: The true mesepimeron is not exposed in *Baeocera*. The ridge delimiting a small area along posterior margin of mesepisternum is an external structure called "mesepimeral ridge" in Löbl (1992a). The area is useful for identification purpose and is termed here as "mesepimeron".

The aedeagus of many scaphidiines, including the species of *Baeocera*, has rotated 90°. The "ventral", "dorsal", "left", and "right" sides referred to the primitive position within the abdomen, i.e. parameres facing ventral side of the abdomen.

Most species occurring in America north of Mexico, may be distinguished by their external characters. However, examination of the aedeagi is necessary to identify species in the *picea* group and most species in the *congener* group. Diagnostic characters of the male genitalia usually allow reliable identifications. For rapid identification, it is sufficient to glue the extracted aedeagus to the plate with the specimen. The characters of the aedeagus may be best seen if it is glued by its proximal end and the apical end is oriented upwards. For detailed observation and better protection, the aedeagus is mounted in Canada balsam on a transparent acetate label which is pinned below the specimen. The figures of the aedeagi, provided for all species, are based on such preparates. Descriptions of the parameres in the species of the *congener* group are also based on the dry aedeagi glued to the plate with the specimen.

Detailed locality data are given for new species and for a few rare species, otherwice only state records are given.

Sections on the material examined does not include data of type specimens or of other specimens covered by Löbl (1976; 1987).

The following acronyms indicate depositories for specimens seen:

CMNC	Canadian Museum of Nature, Ottawa
CNCI	Canadian National Collection, Ottawa
CUIC	Cornell University Insect Collection, Ithaca
DENH	University of New Hamshire, Durham
FMNH	Field Museum of Natural History, Chicago
FSCA	Florida State Collection of Arthropods, Gainesville
JFCC	James F. Cornell, Jr. private collection, Charleston
JPIC	James Pakaluk private collection, Washington, D.C.
KSC	Karl Stephen private collection, Red Oak, Oklahoma
MUIC	Mississippi Entomological Museum, Mississippi State
MHNG	Muséum d'Histoire naturelle, Geneva
OSUC	Ohio State University Collection, Columbus
SEMC	Snow Entomological Museum, University of Kansas, Lawrence
UAIC	University of Arizona Insect Collection, Tucson
TAMU	Texas A & M University, College Station
USNM	United States National Museum, Washington, D.C

TAXONOMY

Baeocera Erichson

Baeocera Erichson, 1845; type species: *Baeocera falsata* Achard, 1920 - by Opinion 1221, ICZN, 1982.

Sciatrophes BLACKBURN, 1903; type species: *Sciatrophes latens* BLACKBURN, 1903 - by monotypy.
Cyparella ACHARD, 1924; type species: *Scaphisoma rufoguttatum* FAIRMAIRE, 1898 - by monotypy.
Eubaeocera CORNELL, 1967; type species: *Baeocera abdominalis* CASEY, 1900 - by original designation.
Amaloceroschema (sg) LÖBL, 1967; type species: *Baeocera (Amaloceroschema) freudei* LÖBL, 1967 - by original designation.

Diagnosis. Antennal segment 3 elongate, not triangular, antennal segments 7 to 11 flattened, forming a loose club; mandible with single apical tooth; maxillary galea slender; apical segment of maxillary palpus narrower than preceding segment; eye moderately or hardly notched near antennal insertion; prothorax with a pair of internal cavities coated by denticulate or spinose structures; procoxal cavities closed; mesepimeral ridge distinct; metacoxae usually widely separated; first visible abdominal sternum lacking postcoxal lines.

Distribution. Worldwide. Most of the presently described species are from the Indoaustralian zoogeographical realm.

Nomenclature. The generic name *Baeocera* Erichson, 1845 was placed on the Official List of Generic Names in Zoology with the Name Number 2163. The specific name *falsata* Achard ,1920 is placed on the Official List of Specific Names in Zoology with the Name Number 2813.

Discussion. The Old World *Baeocera* were assigned to several species groups defined basically, or exclusively, by the male genital characters (LÖBL, 1979; 1984; 1992). The American species occurring north of Mexico may be placed into the following groups defined below:

The *apicalis* group (*B. apicalis* LeConte, *B. chisosa* sp.n., *B. eurydice* (Cornell), *B. obesa* sp.n., *B. pallida* Casey, and *B. sticta* sp.n.): median lobe subsymmetrical, narrow, with basal bulb strongly vaulted, apical portion slender, valves weakly sclerotized, ventral process distinct. Parameres simple, symmetrical. Internal sac with long, flattened flagellum, and flagellar guide-sclerite strongly curved to circular basally; ejaculatory duct visible; one or both sclerites circular in basal portion.

The *pecki* group (*B. pecki* sp.n.): median lobe symmetrical, basal bulb elongate, moderately vaulted, valves weakly sclerotized, closing ostium, ventral process distinct. Parameres simple, symmetrical. Internal sac with long, flattened flagellum strongly curved basally, joined to flagellar guide-sclerite; ejaculatory duct not traceable.

The *picea* group: (*B. borealis* sp.n., *B. charybda* (Cornell), *B. hesperia* sp.n., *B. indistincta* sp.n., *B. picea* Casey, *B. scylla* (Cornell), and *B. similaris* sp.n.): median lobe and parameres symmetrical, basal bulb moderately vaulted, ventral process inconspicuous, valves weakly sclerotized, not covering apically situated ostium. Parameres simple. Internal sac complex, with flagellum extruding, one median sclerite hook-like basally, and additional small sclerotized pieces connected by membranous structures.

The *nana* group (*B. nana* Casey): median lobe symmetrical, with large basal bulb overlapping short narrow apical portion; ventral process small, valves weakly sclerotized, lying apicad of ostium, situated at base of apical portion of median lobe.

Parameres simple, symmetrical. Internal sac with ejaculatory duct very long, extruding, with basally curved flagellum and additional central sclerite.

The *compacta* group (*B. compacta* sp.n.): aedeagus similar to that described for *picea* group, but median lobe with large ventral process and base of parameres expanded dorsally and ventrally; hook-like sclerite of internal sac absent.

The *humeralis* group (*B. humeralis* Fall): median lobe large, symmetrical, with conspicuously thick apical portion and small ventral process, valves weakly sclerotized, covering ostium. Parameres simple, symmetrical. Internal sac with complex of sclerites joined by membranous structures. Ejaculatory duct not traceable.

The *irregularis* group (*B. irregularis* Champion, and *B. wheeleri* Löbl from Mexico): median lobe large, asymmetrical, with large ostium situated between two dorsal valves; ventral process moderately large. Parameres simple, symmetrical, with base extended proximally. Internal sac bearing robust sclerites joined basally, one sclerite protruding (possibly homologous to flagellum), ejaculatory duct not traceable.

The *deflexa* group (*B. deflexa* Casey, *B. flagellata* (Löbl), *B. valida* (Löbl), and *B. major* Matthews from Mexico and Guatemala): median lobe large and asymmetrical, valves moderately sclerotized, partly covering narrow, subapical ostium; ventral processes small or moderately large. Parameres simple, symmetrical. Internal sac with flagellum long, curved basally and with flagellar guide-sclerite robust; ejaculatory duct not traceable.

The *congener* group (*B. cerbera* (Cornell), *B. congener* Casey, *B. falsata* Achard, *B. impunctata* sp.n., *B. inexspectata* sp.n., *B. lenczyi* sp.n., *B. securiforma* (Cornell), *B. solida* sp.n., *B. speculifer* Casey, and *B. youngi* (Cornell)): median lobe large, asymmetrical, with strongly sclerotized valves; ostium subapical, uncovered, situated at right half of median lobe; ventral processes small. Parameres somewhat asymmetrical or symmetrical, usually wide, with weakly sclerotized inner margin, rim partly covering inner surface. Internal sac with robust, basally curved, enlarged flagellum and with flagellar guide-sclerite robust, joined basally to a transverse sclerite; ejaculatory duct not traceable. The associated Old World species (LÖBL, 1984) do not share the characters of the internal sac (basally enlarged and curved flagellum, flagellar guide-sclerite joined to a transverse sclerite); they are here excluded from the *congener* group as defined above.

The *abdominalis* group (*B. abdominalis* Casey, *B. amicula* sp.n., *B. laevis* (Reitter), *B. robustula* Casey, and *B. texana* Casey): median lobe symmetrical, apically notched or bifid, with single short valve; basal bulb bearing ventral keel; ostium large, apical; ventral process large. Parameres symmetrical, simple, with base strongly enlarged, apex with or without setae. Internal sac usually with distinct flagellum, additional sclerites present or absent. Ejaculatory duct not traceable.

The *elongata* group (*B. elongata* sp.n., *B. hamata* sp.n., and *B. galapagoensis* Löbl from the Galapagos): median lobe symmetrical, trifid apically, with single ventral arm and two curved dorsal arms; ostium situated between latter, not covered by single dorsal valve; ventral process moderately large. Parameres symmetrical, with strongly enlarged bases, with or without apical setae. Internal sac complex, armed with strongly sclerotized pieces, ejaculatory duct not traceable.

The number of 38 North American species may seem high compared to 20 species of *Baeocera* described so far from South and Central America. This proportion may drastically change when larger collections of Neotropical scaphidiines will be studied. Members of the *apicalis*, *abdominalis*, *congener* and *elongata* groups from Argentina, Brazil, Paraguay, Mexico and from the Antilles are represented among numerous unidentified species of *Baeocera* housed in the MHNG.

KEY TO THE SPECIES OF *Baeocera* OF AMERICA NORTH OF MEXICO

1 Sutural stria of elytron short, starting beyond level of pronotal lobe (Fig. 50) .... *pecki* sp.n.
– Sutural stria of elytron longer, curved along pronotal lobe and extended laterally, forming basal stria 2
2 Basal stria interrupted (Figs 3, 7, 9) 3
– Basal stria uninterrupted, joined to lateral stria (Figs 1, 5, 14) 16
3 Large species 2.2 - 2.6 mm long .... *deflexa* Casey
– Smaller species 1.0 - 1.8 mm long 4
4 First abdominal ventrite with basal pits elongate, extended apically by striae or grooves (Figs 49, 57) 5
– First abdominal ventrite with basal pits short, not extended apically by striae or grooves (Figs 4, 6, 8) 6
5 Entire elytral disc very finely punctured .... *elongata* sp.n.
– Center of elytral disc much more coarsely punctured than remaining surface (Fig. 56) .... *hamata* sp.n.
6 Scutellum not visible or its exposed portion extremely small 7
– Apical portion of scutellum distinct 8
7 Lateral contours of pronotum and elytra continuously arcuate in dorsal view (Fig. 37) .... *abdominalis* Casey
– Lateral contours of pronotum and elytra separately arcuate in dorsal view (Fig.3) .... *pallida* Casey
8 Metepisternum wide, with strongly arcuate suture (Figs 12, 13) .... *nana* Casey
– Metepisternum narrow or moderately wide, with straight or weakly arcuate suture (Fig. 8) 9
9 Elytron with very fine discal punctures and with a few scattered larger punctures .... *obesa* sp.n.
– Entire elytron very finely punctured 10
10 Apical portion of median lobe almost as wide as basal bulb (Fig. 12) .... *picea* Casey
– Apical portion of median lobe much narrower than basal bulb 11
11 Parameres in lateral view curved away from curvature of median lobe for at least half of their length (Fig. 77, 81) 12
– Parameres in lateral view straight or curved toward curvature of median lobe ...13
12 Parameres in lateral view evenly curved throughout their length (Fig. 81) .... *similaris* sp.n.

– Parameres in lateral view S-shaped, in apical portion curved away from curvature of median lobe (Fig. 77) .... *charybda* (Cornell)

13 Parameres in lateral view as wide as apical portion of median lobe (Fig. 79) .... *scylla* (Cornell)

– Parameres in lateral view much narrower than apical portion of median lobe ..14

14 Apical portion of median lobe in ventral view slender, nearly parallel-sided (Fig. 82) .... *indistincta* sp.n.

– Apical portion of median lobe in ventral view robust and tapering toward rounded tip; parameres notched near tip, curved toward each other ... 15

15 Tip of median lobe wide in dorsal view, thick in lateral view. Parameres weakly sinuate in in lateral view (Figs 84, 85) .... *borealis* sp.n.

– Tip of median lobe pointed in dorsal view, narrow in lateral view. Parameres not sinuate in lateral view (Figs 86, 87) .... *hesperia* sp.n.

16 Lateral portion of metasternum coarsely punctured (Figs 6, 30) 17

– Lateral portion of metasternum very finely punctured 18

17 Lenght 1.2 - 1.3 mm. Body rather pale reddish-brown .... *sticta* sp.n.

– Length 2 - 2.4 mm. Body blackish-brown to black .... *solida* sp.n.

18 Tip of scutellum exposed 19

– Scutellum completely covered by pronotal lobe 25

19 Large species 1.8 - 2.4 mm long 20

– Smaller species 1.1 - 1.7 mm long 21

20 Elytral punctation much coarser than that of pronotum. Pronotal apical angle S-shaped in oblique view. Length 2.2 - 2.4 mm (Fig 32) ... *valida* (Löbl)

– Elytral punctation very fine, not coarser than that of pronotum. Pronotal apical angle not S-shaped. Length 1.8 - 2.0 mm .... *impunctata* sp.n.

21 Mesocoxal line parallel to coxal cavity 22

– Mesocoxal line arcuate (Fig. 2) .... *eurydice* (Cornell)

22 Basal pits of first abdominal ventrite elongate and extended apically by striae. Pits margining mesocoxal line extended along anapleural suture. Elytron usually maculate (Fig. 15) .... *humeralis* Fall

– Basal pits of first abdominal ventrite not extended by striae. Pits margining mesocoxal line extended at most to tip of "mesepimeron". Elytron immaculate 23

23 Pits margining mesocoxal line elongate (Fig. 46) .... *texana* Casey

– Pits margining mesocoxal line not elongate.. 24

24 Metepisternal suture straight or weakly arcuate (Fig. 42) .... *laevis* (Reitter)

– Metepisternal suture distinctly arcuate (Fig. 40) .... *amicula* sp.n.

25 Anterior half of elytron densely and coarsely punctured, apical third of elytron almost impunctate .... *irregularis* Champion

– Elytral punctation not as above 26

26 Pronotal margin strongly curved in lateral view .... *compacta* sp.n.

– Pronotal margin moderately curved in lateral view 27

27 Smaller species 1.2 - 1.4 mm long 28

– Larger species at least 1.55 mm long 30

28 Elytral disc very finely punctured and with several scattered large punctures 29
– Elytral disc only very finely punctured .... *robustula* Casey
29 Pronotal margin evenly arcuate in lateral view. Large elytral punctures shallow but distinct .... *apicalis* LeConte
– Pronotal margin more arcuate in middle, in lateral view. Large elytral punctures deep, very distinct .... *chisosa* sp.n.
30 Basal pits of first abdominal ventrite extended apically by striae (Fig. 53) .... *lenczyi* sp.n.
– Basal pits of first abdominal ventrite not extended by striae 31
31 Elytral disc with a few scattered large punctures 32
– Elytral disc without any large punctures 33
32 Parameres asymmetrical, right paramere arcuate, left one almost straight (Figs 102, 103) .... *cerbera* (Cornell)
– Parameres symmetric, arcuate (Fig. 121) .... *speculifer* Casey
33 Antennomere 3 about as long as antennomere 4 34
– Antennomere 3 shorter than antennomere 4 35
34 Aedeagus wide, with robust, basally curved flagellum (Fig. 106) .... *falsata* Achard
– Aedeagus narrow, with slender, almost straight flagellum (Figs 98, 99) .... *flagellata* (Löbl)
35 Flagellar guide-sclerite with small subapical denticle, tapering toward pointed tip (Figs 122, 123) .... *youngi* (Cornell)
– Flagellar guide-sclerite without subapical denticle 36
36 Flagellar guide-sclerite with simple, pointed tip; middle portion of each paramere extended by wide membranous lobe (Fig. 109) .... *inexspectata* sp.n.
– Flagellar guide-sclerite with wide tip; middle portion of each paramere not extended 37
37 Parameres in lateral view subangulate, with rounded apical margin (Fig. 105) .... *congener* Casey
– Parameres in lateral view curved, tip of left one with minute point (Fig. 117) .... *securiforma* (Cornell)

THE *apicalis* GROUP

Baeocera apicalis LeConte

Baeocera apicalis LECONTE,1860:323; CASEY, 1893: 518; LÖBL, 1987: 317.
Scaphisoma distincta BLATCHLEY,1910: 496.
Eubaeocera apicalis; CORNELL, 1967: 7.

Description. Length 1.3 - 1.4 mm. Body dark reddish-brown to black. Antennomere 3 shorter than 2, as long as or somewhat shorter than 4. Lateral contours of pronotum and elytron separately arcuate in dorsal view (Fig. 16). Pronotal microsculpture distinct at 50x magnification. Scutellum completely covered by pronotal lobe. Elytron with complete basal stria. General punctation of elytral disc fine, or very fine, similar to pronotal punctation, a few scattered, much coarser punctures always present. Mesocoxal line moderately convex, with marginal pits not elongate and not extended laterally (Fig. 17). Lateral portion of metasternum very finely punctured. Metepisternum wide, parallel- or subparallel-sided, its suture straight or somewhat rounded and impunctate. First abdominal ventrite with coarse, round basal pits, lacking microsculpture. Aedeagus (Figs 58, 59) 0.50 - 0.53 mm long. Median lobe with basal bulb about as long as apical portion; apical portion in dorsal view parallel-sided, with apical margin broadly rounded. Apical portion of median lobe in lateral view parallel-sided, with straight ventral and dorsal margins, except for curved and pointed asymmetrical apex. Valves asymmetrical. Internal sac with fairly wide flagellum, distinct flagellar guide-sclerite and small additional basal sclerite. Ejaculatory duct traceable in basal portion of internal sac. Parameres slender, indistinctly curved, with moderately enlarged base.

Type material. For *B. apicalis* see CORNELL, 1967: 7, for *S. distincta* see LÖBL, 1987: 317.

Material examined, 727 specimens: UNITED STATES: 2, Arkansas; 12, Connecticut; 19, Florida; 1, Georgia; 3 Illinois; 1, Indiana; 21, Kansas; 10, Kentucky; 2, Maryland; 34, Massachussets; 6, Michigan; 4, Minnesota; 4, Mississippi; 12, Missouri; 2, Nebraska; 99, New Hampshire; 13, New Jersey; 10, New York; 20, North Dakota; 7, North Carolina; 16, Ohio; 143, Oklahoma; 24, Pennsylvania; 6, Rhode Island; 1, Tennessee; 34, Texas; 1 Vermont; 2, Virginia; 18, West Virginia; 12, Wisconsin; CANADA: 11, Manitoba; 3, New Brunswick; 125, Ontario; 49, Quebec.

Distribution. This common species occurs throughout eastern North America, from Quebec to Florida, west to Manitoba, North Dakota and Texas.

Biology. This species occurs in forest litter of all kinds (sphagnum moss, fungi, litter, leaf duff, cedar duff). It has been found throughout the year, but it is most numerous in late fall and in early winter.

Remarks. The distinctive body contour, in combination with the scattered coarse punctures on the elytra, allow rather easy recognition of this species. *Baeocera apicalis* can be confused with *B. pallida* and *B. chisosa*. See remarks under those species.

Baeocera chisosa sp.n.

Description. Length 1.25 - 1.4 mm, width 0.78 - 0.83 mm. Body rather pale reddish-brown. Antennomere 3 as long as 4, shorter than 2. Lateral contours of pronotum and of elytron separately arcuate in dorsal view (Fig. 35). Pronotal microsculpture well visible at 50x magnification. Scutellum completely covered by pronotal lobe. Elytron with complete basal stria. Most of elytral punctures are very fine, similar to those on pronotum. Several additional very coarse punctures present on basal half of elytron (Fig. 35). Mesocoxal line subparallel to coxa, with marginal pits coarse, round and not extended laterally. Lateral portion of metasternum with extremely fine, almost obsolete punctuation. Metepisternum wide, anteriad may or may not be weakly narrowed, with oblique impunctate suture (Fig. 36). First abdominal ventrite not microsculptured (90x magnification), with somewhat elongated basal pits. Aedeagus

(Figs 66, 67) 0.38 - 0.44 mm long. Apical wall of basal bulb oblique, with minute tubercle. Apical portion of median lobe as long as, or longer, than basal bulb, parallel-sided, with obliquely truncate apical margin in dorsal view; evenly thick, moderately curved and pointed at tip in lateral view; ventral wall evenly and weakly concave. Valves asymmetrical. Flagellum and flagellar guide-sclerite moderately wide in both dorsal and lateral views. Ejaculatory duct traceable at base of flagellum, additional sclerite absent. Parameres slender, moderately widened basally.

Type material. Holotype, male: UNITED STATES: Texas, Brazos Co., Koppe's Bridge, 5 mi SE College Sta, 21-22.I.1988, R. Anderson, Berlese ravine litter (USNM).

Paratypes, 5: 2 males, same data as holotype (TAMU); 1 female: Texas, Big Bend National Park, Chisos Mts., Maple Canyon, 5000 ft, 27.IV.1952, H. S. Dybas (FMNH); 1 male, 1 female, Texas, Brewster Co., Big Bend N. P., Oak Canyon, 1463 m, 8.IX.1980, R. Anderson (TAMU. KSC).

Distribution. Texas.

Biology. Unknown (the specimens were taken in berlese samples).

Remarks. *Baeocera chisosa* is quite similar to *B. apicalis*. Both have an elongate-oval body outline, and lack a visible scutellum. The most striking feature of *B. chisosa* are the coarse punctures in the basal half of the elytra.

Baeocera eurydice (Cornell)

Eubaeocera eurydice Cornell, 1967: 8.

Description. Length 1.1 - 1.2 mm. Body dark reddish-brown. Antennomere 3 as long as 4, much shorter than 2. Lateral contours of pronotum and elytron separately, regularly arcuate in dorsal view (Fig. 1). Pronotal microsculpture visible at 50x magnification. Exposed portion of scutellum very small. Elytron with complete basal stria. Discal punctation very fine, most punctures similar to those on pronotum, several additional punctures distinctly coarser. Mesocoxal line moderately convex, with coarse, round marginal pits extended laterally to mesepimeral ridge (Fig. 2). Lateral portion of metasternum with very fine punctures, or with a few coarser punctures along anterior margin. Metepisternum wide, parallel- or subparallel-sided, with straight, punctured suture. First ventrite has barely visible microsculpture and moderately elongate, coarse basal pits. Aedeagus (Figs 62, 63) 0.32 - 0.35 mm long. Median lobe has rather narrow, high basal bulb about as long as apical portion; apical portion gradually narrowed in dorsal view, with fairly stout, weakly curved and rounded tip. Ventral wall of apical portion of median lobe convexly rounded in lateral view, notched above ventral process. Valves symmetrical. Flagellum and flagellar guide sclerite of internal sac very thin, of about same width in lateral view, moderately wide in dorsal view. Ejaculatory duct traceable only in lateral view. Parameres somewhat sinuate, notably enlarged apically.

Type material. See Cornell, 1967: 8.

Material examined: 73 specimens, all from UNITED STATES: Arizona.

Distribution. This species seems to be confined to the mountains of southeastern Arizona.

Biology: *Baeocera eurydice* is an inhabitant of the oak-zone. It lives in oak and sycamore litter, and was once found in dead yucca. Adults were taken during January, March, May, July, August, October and December.

Remarks: *Baeocera eurydice* is the smallest of the western species. It differs from the slightly larger *B. hesperia* by the convex mesocoxal lines, which are parabolic in the latter species.

Baeocera pallida Casey

Baeocera pallida CASEY, 1900: 58.
Eubaeocera pallida; Cornell, 1967: 7.

Description. Length 1.3 - 1.4 mm. Body more or less dark reddish brown, pronotum as dark as or darker than elytra. Antennomere 3 as long as 4, shorter than 2. Lateral contours of pronotum and elytron separately arcuate in dorsal view (Fig. 3). Pronotal microsculpture almost indistinct (90x magnification). Minute tip of scutellum exposed, or scutellum completely covered by pronotal lobe. Elytron with basal stria broadly interrupted. Elytral punctation very fine, near base and on apical area similar to pronotal punctation, coarser on middle of disc. Mesocoxal line convex, with marginal pits round, extended laterally to tip of "mesepimeron". Lateral portion of metasternum with very fine punctures. Metepisternum wide, parallel-sided or somewhat narrowed anteriorly, with straight impunctate suture (Fig. 4). First abdominal ventrite lacking microsculpture, with basal pits coarse, elongated only somewhat or not at all. Aedeagus (Figs 60, 61) 0.36 - 0.39 mm long. Basal bulb of median lobe slender and rather high, as long as apical portion of median lobe; apical portion gradually narrowed toward tip, with narrow apex (dorsal view), ventral wall sinuate in lateral view, tip fairly stout, curved. Valves almost symmetrical. Flagellum and flagellar guide-sclerite of internal sac very thin, except for the moderately widened (dorsal view), curved basal portion. Parameres not or only somewhat curved, almost evenly slender.

Type material. See CORNELL, 1967: 7.

Material examined, 31 specimens: UNITED STATES: 1, Illinois; 1, Missouri; 1, Nebraska; 1, New Hampshire; 1, Ohio; 5, Oklahoma; 3, Texas; 2, Vermont; CANADA: 10, Ontario; 6, Quebec.

Distribution. This rare species seems to be confined to eastern North America. From Vermont through Quebec and Ontario to Nebraska and eastern Oklahoma.

Biology. Some of the specimens bear the following data “sifted leaf litter on spring edge, sifted forest litter, sifted red oak and chestnut oak litter, humus”. Adults were taken from April to October.

Remarks. *Baeocera pallida* resembles *B. apicalis* with which it is sympatric throughout its range. The most outstanding difference between these two species is the basal stria of the elytra. It is incomplete in *B. pallida* and complete in *B. apicalis*. In addition, *B. apicalis* has no visible scutellum, which may be exposed, though minute, in *B. pallida* and the elytron in B. apicalis has a few scattered larger shallow intermixed punctures, which are absent from *B. pallida*.

Baeocera sticta sp. n.

Description. Length 1.2 - 1.3 mm, width 0.75 - 0.83 mm. Body rather pale reddish-brown. Antennomere 3 as long as 4, much shorter than 2. Pronotal microsculpture usually distinct at 50x magnification. Lateral contours of pronotum and elytron separately arcuate in dorsal view (Fig. 5). Point of scutellum exposed. Elytron with complete basal stria, discal punctation fairly coarse, with punctures about as large as intervals, only apical portion of elytron very finely punctured. Mesocoxal line moderately convex, with marginal pits not or only somewhat elongated, extended to tip of "mesepimeron". Lateral portion of metasternum shows coarse punctation, except near apical margin (Fig. 6). Metepisternum rather wide, parallel-sided or somewhat narrowed anteriad, with straight, punctate suture. First abdominal ventrite with coarse elongate basal pits and microsculpture indistinct or visible at 90x magnification. Aedeagus (Figs 64, 65) 0.39 - 0.42 mm long. Basal bulb of median lobe rather narrow and high, as long as apical portion of median lobe or somewhat shorter. Median lobe barely narrowed apically in dorsal view, weakly tapering, somewhat inclined in lateral view, at tip stout, apex somewhat curved, with rounded margin in dorsal view. Ventral margin of apical portion of median lobe almost straight in lateral view. Valves asymmetrical. Flagellum and flagellar guide-sclerite very thin in lateral view, moderately wide in dorsal view, indistinct apically. Apical portion of ejaculatory duct extruded. Parameres slender, almost straight in dorsal view, with weakly enlarged base in lateral view.

Type material. Holotype, male: UNITED STATES: Arizona, Chiricahua Mts, east Turkey Crk. 7 mi W. 22.VII.1969, A. Smetana (CNCI).

Paratypes 18, all from Arizona: 4, Cochise Co, Chiricahua Mts. 5 mi W. Portal, 5500' 23.VII. 1969, A. Smetana (CNCI); 1, Cochise Co., Chiricahua Mts., Portal 5000',21.VII.1969, A. Smetana (MHNG); 1, Cochise Co., 3 mi. SW Portal 5000', 3.VIII.1985, J. & D. Pakaluk (KSC); 3, Huachuca Mts, Ramsey Cn. 2.VIII.1969, A.Smetana (MHNG); 1, Huachuca Mts, Miller Cn. 5500', 1.VIII.1969, A. Smetana (MHNG); 3, Santa Cruz Co., Madera Cyn., 20.XI.1971, D.S. Chandler, berlese oak duff (OSUC); 4, Santa Cruz Co., Madera Cyn., 6-15.X.1971, R. Lenczy (USNM); 1, Santa Cruz Co., 3 mi. N Ruby, 23.III.1979, F. Werner, oak duff (UAIC).

Distribution. Southern Arizona.

Biology. Specimens were found in forest habitats, in sifted moist ground litter.

Remarks. *Baeocera sticta* is the only species having coarse punctation on both the elytra and the lateral portions of the metasternum.

Baeocera obesa sp.n.

Description. Length 1.25 mm, width 0.82 mm. Body dark brown, elytron and abdomen paler than pronotum, apex of elytron paler than elytral disc. Antennomere 2 shorter than 3 and 4 combined, 3 as long as 4. Lateral contours of pronotum and elytron separately arcuate in dorsal view. Pronotal microsculpture distinct at 50x magnification. Exposed tip of scutellum relatively large. Basal stria of elytron becoming finer laterally, interrupted in humeral area. Elytral punctation consisting of very fine punctures similar to those of pronotum, with several scattered larger punctures present. Mesocoxal line arcuate, with round, moderately large marginal pits that do not extend laterally. Lateral portion of metasternum very finely punctured. Metepisternum wide, with straight, impunctate suture. First abdominal ventrite with elongate basal pits; microsculpture obsolete. Aedeagus (Figs 68, 69) 0.32 mm long. Median lobe similar to that of *B. eurydice*, with basal bulb longer than apical portion, latter sinuate ventrally, deeply notched above protruding ventral process, with tip stout, obtuse, not inclined. Valves symmetrical. Internal sac with thin flagellum narrowed gradually toward apex. Flagellar guide-sclerite absent. Ejaculatory duct not traceable. Parameres weakly sinuate, strongly enlarged apically in lateral view, moderately narrowed toward apex in dorsal view.

Type material. Holotype, male: Texas, Culberson Co., Guadalupe Mt. N.P., Mc. Kittrick Can., 5300 ft, 22-26.VII.1975, S. Peck Ber. 310 (CNCI).

Distribution. Western Texas.

Biology. The specimen was taken in ground litter sample from a maple (*Acer grandidentata*) forest.

Remarks. This species appears to be particularly similar to *B.eurydice*. It may be distinguished from the latter species by the interrupted basal stria of the elytron and by the parameres of the aedeagus not widened apically in dorsal view.

THE *pecki* GROUP

Baeocera pecki sp.n.

Description. Length 1.65 mm, width 1.10 mm. Body dark reddish-brown, elytra paler than thorax. Lateral contours of pronotum and elytron continuously arcuate in dorsal view (Fig. 50). Pronotal microsculpture indistinct at 90x magnification. Scutellum completely covered by pronotal lobe. Elytron without basal stria, sutural stria short, starting beyond level of pronotal lobe, not curved outward, discal punctation extremely fine, similar to that of pronotum. Mesocoxal line parallel to coxa, with marginal pits elongate, extended along anapleural suture past tip of "mesepimeron" (Fig. 51). Lateral portion of metasternum very finely punctured. Metepisternum wide, suture impunctate, straight or weakly arcuate. First abdominal sternite not microsculptured, with round basal pits. Aedeagus (Figs 70, 71) 0.58 mm long. Median lobe slender, with basal bulb elongate, longer than apical portion; latter inclined, weakly narrowed apically, with ventral wall almost straight in lateral view; tip not curved. Dorsal valves symmetrical. Ventral process small, not protruding. Internal sac bearing slender flagellum joined proximally to flat, circular sclerite. Parameres weakly narrowed apically, almost straight in both dorsal and lateral views.

Type material. Holotype, male: UNITED STATES: Florida, Monroe Co., Layton, Long Key, Ber. 225, 8.VIII.1974, S. Peck (CNCI).

Paratype female: same data as holotype.

Distribution. Florida Keys.

Biology. The specimens were taken in a ground litter sample from hardwood hammock forest.

Remarks. Both specimens have the antennae broken off. This species may be readily distinguished from all other North American species of *Baeocera* by the short sutural striae of the elytra. The aedeagal characters indicate possible close relationship with the species of the *picea* group. The species is named in honor of S. B. Peck, Carleton University Ottawa, whose field work revealed several new species of *Baeocera*.

THE *picea* GROUP

Baeocera picea Casey

Baeocera picea CASEY, 1893: 520.
Eubaeocera picea; CORNELL, 1967: 8.

Description. Length 1.0 - 1.2 mm. Body more or less dark reddish-brown to black-brown. Antennomere 2 about as long as 3 and 4 combined, antennomere 3 much shorter than 4. Lateral contours of pronotum and elytron continuously arcuate in dorsal view (Fig. 7). Pronotal microsculpture barely visible at 50x magnification. Apical portion of scutellum exposed. Elytron with basal stria broadly interrupted in humeral area. Elytral punctation very fine all over, near base similar to that on pronotum, on apical half of elytron usually more distinct. Mesocoxal line parabolic (Fig. 8), with fine, rounded or only somewhat elongate marginal pits extended laterally to tip of "mesepimeron". Lateral portion of metasternum very finely punctured. Metepisternum wide, parallel-sided or somewhat narrowed anteriorly, with straight or weakly arcuate, very finely punctured suture. First abdominal ventrite not microsculptured (90x magnification), basal pits strongly elongate and extended by striae. Aedeagus (Figs. 72 to 74) 0.38 - 045 mm long. Median lobe wide and relatively flat, with apical portion weakly narrowed and barely inclined. Ventral margin near apex almost straight in lateral view. Tip pointed in lateral view. Valves asymmetrical. Internal sac with protruding ejaculatory duct and complex sclerotized pieces. Basal and dorsal membranes possessing hairy and papillose structures. Parameres slender, narrowed and incurved apically, central portion straight and parallel-sided in dorsal view, base moderately enlarged.

Type material. See CORNELL, 1967: 8.

Material examined. 433 males: UNITED STATES: 28 Arkansas; 8, Florida; 3, Georgia; 7, Illinois; 4, Indiana; 4, Kansas; 34, Kentucky; 6, Massachusett; 5, Maryland; 5, Michigan; 29, Mississippi; 2, Missouri; 3, New Hampshire; 1, New Jersey; 7, North Carolina; 27, Ohio; 227, Oklahoma; 1, Pennsylvania; 22, Texas; 32, Virginia; 9 West Virginia; CANADA: 2, Ontario, 1 Quebec: MEXICO: 2, Tamaulipas, 2 mi W Gomez Faria, 5.VII.1986, P. Kovarik, rotting log (TAMU).

Distribution. This common species occurs from New Hampshire to Florida, west to Michigan, Kansas, Oklahoma,Texas, and Mexico.

Biology. *Baeocera picea* has been found in all sorts of plant debris, such as forest litter, wood rat nest, grass clippings, old hay, rotten wood, saw dust pile, stump debris, also in flood debris. Adults are present throughout the year. Records from slime molds are given by LAWRENCE & NEWTON, 1980: 137 and NEWTON, 1984:

319. Specimens from Virginia and West Virginia (CUIC) were taken from *Arcynia incarnata, A. denudata, Tubifera ferruginosa, Stemonitis exifera, Ceratiomyxa fruticulosa, Comatrichia typhoides*.

Remarks. *Baeocera picea* and all eastern members of the *picea* group may be recognized by their small size, parabolic or subangulate mesocoxal lines, by the incomplete basal striae of the elytra, and visible tip of the scutellum. Male genitalia must be examined to identify them to species. Females cannot be identified at present.

Baeocera borealis sp.n.

Description. Length 1.4 mm, width 0.84 mm. Body dark reddish-brown with paler apex of abdomen. Lateral contours of pronotum and of elytron continuously arcuate in dorsal view. Pronotal microsculpture distinct at 90x magnification. Apex of scutellum exposed. Elytron with basal stria broadly interrupted and lateral margin straight in middle; punctation coarser than that of pronotum, except near base. Mesocoxal line parabolic, with fine marginal pits rounded and not extended laterally. Lateral portion of metasternum very finely punctured. Metepisternum wide, with straight impunctate suture. First abdominal ventrite with elongate basal pits, and obsolete microsculpture at 90x magnification. Aedeagus (Figs 84, 85) 0.54 mm long. Median lobe fairly thick, with apical portion robust, rather strongly inclined, laterally margined, and with deep median depression and sinuate contours in lateral view. Tip of median lobe short, truncate in dorsal view, obtuse, not curved in lateral view. Internal sac with basal transverse sclerite extended proximally and forming moderately sclerotized, spiral structure (dorsal view). Flagellum extruding, joined proximally with membranous structures. Parameres in dorsal view wide basally, slender in apical half; each paramere almost parallel-sided toward apical third, then tapering in lateral view, gradually narrowed toward somewhat widened and curved apical portion in dorsal view.

Type material. Holotype male: UNITED STATES: North Dakota, Richland Co., Mirror Pool, 10.X.1965, R. Gordon (USNM).

Distribution. North Dakota.

Remarks. The holotype has the antennae broken off.

Baeocera charybda (Cornell)

Eubaeocera charybda Cornell, 1967: 9.

Description. Length 1.20 - 1.35 mm. Most external characters as in *B. picea* (Figs 7, 8). Antennomere 3 somewhat longer, antennomere 2 shorter than 3 and 4 combined. Lateral contours of pronotum and of elytron continuously or separately arcuate in dorsal view. Pits margining mesocoxal line round and not extended laterally. Metepisternum with more or less arcuate, impunctate suture. Aedeagus (Figs

75 to 77) 0.53 - 0.55 mm long. Median lobe with normally thick basal bulb and slender, distinctly curved and tapering apical portion. Apical portion of median lobe with ventral wall deeply notched medially and with concave contours. Valves almost symmetrical. Internal sac complex, with protruding flagellum and membranes bearing papillose and spinose structures. Parameres slender, sinuate, apically somewhat narrowed, at base weakly enlarged.

Type material. See CORNELL, 1967: 9.

Material examined, 85 males: UNITED STATES: 2, Arkansas; 2, Illinois; 1, Kentucky; 4, Maryland; 6, Michigan; 10, Mississippi; 2, New Hampshire; 12, Ohio; 43, Oklahoma; 2, Virginia; 1, Wisconsin.

Distribution. This species occurs from New Hampshire to Virginia, west to Wisconsin and Oklahoma.

Biology. The species is a typical forest litter inhabitant. Specimens were collected in leaf litter, in rotten wood and in log debris. Adults are present throughout the year. Taken on *Stemonitis exifera*. Slime mold record is given by LAWRENCE & NEWTON, 1980:137.

Remarks. It is likely that this species is the same as *B. discolor* Casey, but since the only known specimen is a female, its identity remains doubtful. It bears the following labels: *discolor* Csy.; Mic /Michigan/; Casey bequest 1925; Type USNM 48755; 965126-1; a vial with body parts and parts on slide.

Baeocera indistincta sp. n.

Description. Length 1.15 - 1.20 mm, width 0.75 - 0.77 mm. Body dark brown to black, apex of elytron paler. Antennomere 2 shorter than 3 and 4 combined, antennomere 3 shorter than 4. Lateral contours of pronotum and of elytron separately arcuate in dorsal view. Pronotal microsculpture visible at 90x magnification. Point of scutellum exposed. Elytron with basal stria broadly interrupted in humeral area, discal punctation even and very fine, similar to that on pronotum. Mesocoxal line with marginal pits fine, round and not extended laterad. Lateral portion of metasternum very finely punctured. Metepisternum wide, with suture impunctate, more or less arcuate. First abdominal ventrite with elongate basal pits and obsolete microsculpture (90x magnification). Aedeagus (Figs 82, 83) 0.37 - 0.40 mm long. Median lobe slender, with basal bulb moderately high and apical portion moderately inclined. Median lobe distinctly narrowed only near apex, and with rounded apical margin; ventral wall somewhat convex, at apex weakly curved in lateral view. Base of internal sac with extremely fine and short hairy structures. Flagellum enlarged in middle, with basal and apical portions very slender, extruding apically, joined basally with one long, irregularly shaped sclerite. Parameres very slender, gradually narrowed apically, in dorsal view almost straight, except for their curved apex, in lateral view weakly sinuate or curved, and at base moderately enlarged.

Type material. Holotype: UNITED STATES: New Hampshire, Strafford Co., 1 mi SW Durham, 27.V. - 10.VI.1987, D.S. Chandler (UNHC).

Paratypes, 56 males: UNITED STATES: 1, Alabama, Franklin Co., The Dismals, 665 K, 30.VIII.1958, H.R. Steeves Jr., rock crevice debris (FMNH); 1, Arkansas, Pike Co., Delight, 8.XII.1976, R.T. Allen (SEMC); 1, Illinois, McHenry Co., Moraine Hills State Park, 7.IV.1984, L.E. Watrous, litter at log (FMNH); 2, Indiana, Porter Co., Indiana Dunes state Park, 22.VIII.1946, H.S. Dybas (FMNH); 1, Maryland, Offutts Isl., 16.VII.1916, Loomis & Barber (USNM); 7, Mississippi, Oktibbeha Co., Noxubee Ref., 5.II.1982, G.L. Snodgrass, berlese - litter hardwood forest (MUIC) and 4, same data but 28.II.1981, R.L. Brown, hardwood litter (MUIC); 1, Noxubee Co., Noxubee Wild. Ref., 8.III.1984, T. Wofford, berlese - under log (MUIC); and 1, Noxubee Wild. Ref. 15.I.1986, St. MacDonald (MUIC); 4, Washington Co., Stoneville, 25.I.1982, 25.II.1982, 12.III.1982, 14.II.1983, G. Snodgrass, rotten logs, litter hardwood forest (MUIC); 1, New Jersey, Midvale, 11.XI.1939, E. Shoemaker (USNM); 1, New Hampshire, Carroll Co., 1 mi N Wonalance E Fork. Spring Brook., 2-10.VII.1985, 1900 ft., D.S. Chandler, FIT (DENH); 3, New York, LI (Long Island) Flushing (DENH); 13, Oklahoma, Latimer Co., VII.1988, XI. 1984, and IV - XI.1991, K. Stephan, sifting forest litter (KSC, MHNG); 1, Ohio, Franklin Co., Columbus, 30.X.1975, Q.D. Wheeler (CUIC); CANADA: 1, New Brunswick, Kouchibouguac N.P., 30.VI.1977, J.R. Vockeroth, Code-54535; 1, Ontario, Rondeau Pr. Pk., end Lakeshore Rd., 1.VI.1985, A. Davis & J.M. Campbell (CNCI).

Distribution. This rare species occurs from New Brunswick to Alabama, west to Oklahoma.

Biology. The species inhabits forest litter. Adults were found from January to November.

Baeocera hesperia sp.n.

Description. Length 1.30 - 1.45 mm, width 0.81 - 0.94 mm. Body reddish-brown, elytra paler than pronotum, yellowish at apices. Antennomere 2 about as long as 3 and 4 combined, antennomere 3 shorter than 4. Lateral contours of pronotum and of elytron continuously arcuate in dorsal view (Fig. 9). Pronotal microsculpture distinct at 90x magnification. Apical portion of scutellum exposed. Elytron with basal stria broadly interrupted in humeral area; entire elytral punctation very fine, similar to that of pronotum. Mesocoxal line strongly parabolic (Fig. 10), with marginal pits round and not extended laterally. Lateral portion of metasternum very finely punctured. Metepisternum wide, its suture very finely punctured, straight or somewhat arcuate. First abdominal ventrite lacking microsculpture (90x magnification), with somewhat elongate basal pits. Aedeagus (Figs 86, 87) 0.47 - 0.50 mm long. Median lobe almost evenly narrowed and rather strongly curved apically, gradually tapering in dorsal view. Ventral wall of apical portion of median lobe broadly concave, tip pointed (lateral view). Internal sac armed with several sclerites joined by membranes, lacking distinct flagellum. Central and basal sclerites flattened, base with additional moderately sclerotized structures. Parameres somewhat curved beyond base, almost parallel-sided (holotype) or parallel-sided (paratypes) in lateral view; narrowed in middle portion, evenly slender and moderately curved in apical half.

Type material. Holotype, male: UNITED STATES: Colorado, Ouray, 7500 - 8000 ft., 1 - 15.VII. 1897, H. F. Wickham (USNM).

Paratypes, 12 males, all from UNITED STATES, Arizona: 1, Chiricahua Mts., 10.VIII.1907, J. L. Webb (USNM); 2, Huachuca Mts., Bear Saddle, 8100', 5.VII.1979, A. Smetana (CNCI); 1; Huachuca Mts., Carr Cyn., 2150m, 23.VII.1967, J. M. Campbell (CNCI); 1, Huachuca Mts., Miller Cyn., 7200-7800', 4.VIII.1979, A. Smetana (CNCI); 7, Santa Rita Mts., Mt. Wrightson, 8000-8500', 9.VIII.1979, A. Smetana (CNCI).

Distribution. This rare species occurs in the mountains of Colorado and Arizona.

Biology. Unknown. The collectors of this material are avid sifters, and it is likely the specimens were collected thus.

Remarks. *Baeocera hesperia* is one of two western members of the *picea* group. As all members of the group, it can be recognized by the aedeagal characters, in combination with the distinct scutellum, the incomplete basal stria of the elytron, and the parabolic mesocoxal line.

Baeocera scylla (Cornell)

Eubaeocera scylla CORNELL, 1967: 8.

Description. Length 1.0 - 1.1 mm. Very similar to *B. picea* but with lateral contours of pronotum and of elytron separately arcuate in dorsal view, metepisternal suture impunctate, more or less distinctly arcuate, and elongate basal pits of first abdominal ventrite not extended apically by striae. Aedeagus (Figs 78, 79) 0.38 - 0.41 mm long. Median lobe with moderately thick basal bulb and slender, curved apical portion. Median lobe tapering in lateral view, weakly narrowed with wide apical margin in dorsal view. Tip pointed (lateral view). Ventral wall of apical portion concave apically, notched medially. Valves symmetrical. Internal sac with protruding flagellum joined to flat, L-shaped sclerite (dorsal view) bearing wide and narrow apophysis. Basal portion of internal sac lacking membranous papillae or spinose structures. Ejaculatory duct traceable between basal orifice and base of sclerites. Parameres rather wide, with apical portion abruptly narrowed and curved internally, sinuate in lateral view, almost straight (apex excepted), at base barely enlarged, in dorsal view.

Type material. See CORNELL, 1967: 9.

Material examined, 24 males: UNITED STATES: 1, Alabama; 2, Mississippi; 3, New Jersey; 2, North Carolina; 14, Oklahoma; 1, Texas; 1, Virginia.

Distribution. This rare species occurs from New Jersey to Alabama, west to Texas.

Biology. The specimens seen were collected in forest litter, sphagnum moss, yellow pine stump, debris from rock crevice, forest floor. Adults were present from May to November.

Baeocera similaris sp.n.

Description. Length 1.0 - 1.2 mm, width 0.65 - 0.75 mm. Body dark brown to black, elytra paler at apex. Antennomere 2 about as long as 3 and 4 combined, antennomere 3 much shorter than 4. Lateral contours of pronotum and of elytron separately arcuate in dorsal view. Pronotal microsculpture obsolete or barely visible at 90x magnification. Apical portion of scutellum exposed. Elytron with basal stria broadly interrupted in humeral area, elytral punctation very fine near base, similar to that on pronotum. Most of discal punctures coarser than those on pronotum.

Mesocoxal line with fine, round and laterally not extended marginal pits. Lateral portion of metasternum very finely punctured. Metepisternum wide, with impunctate, convexly rounded suture. First abdominal ventrite lacking microsculpture (90x magnification), with basal pits elongate. Aedeagus (Figs 80, 81) 0.37 mm long. Median lobe with moderately thick basal bulb and slender, curved apical portion, moderately narrowed apically, with broadly rounded apical margin in dorsal view. Ventral wall of apical portion of median lobe humped beyond level of ventral process, gradually narrowed toward apex in ventral view. Tip fairly stout, moderately curved. Valves symmetrical. Flagellum of internal sac very slender basally and apically, widened in middle. Base of flagellum joined to a stick-like sclerite, apex extruding from ostium. Membranes of internal sac lacking particular structures. Parameres almost straight, with moderately narrowed and somewhat curved apex in dorsal view, weakly arcuate in middle and tapering apically in lateral view.

Type material. Holotype, male: UNITED STATES: Oklahoma, Latimer Co., VI. 1988, K.Stephan, sifting forest litter (FSCA).

Paratypes, 10 males: UNITED STATES: 1, same data as holotype and 4, same data as holotype but XII.1987 (MHNG) and VIII - XI.1991 (KSC, USNM); 1, Alabama, Jefferson Co., Mountainbrook, 23.III.1988, G. Ostroy (CUIC); 1, Jefferson Co., Hoover, UV (light), 9.IX.1982, T. King (CMNC);1, Arkansas, Saline Co., Woodson Lateral Rd. off Hwy 65, lot 77-13, berlese, 11.II.1977, R.T. Allen (SEMC); 1, Mississippi, Lucedale, 10.X.1929, H. Dietrich (CUIC); 1, Mississippi, Scott Co., Forest, 30.XI.1991, K. Stephan (KSC).

Distribution. This rare species has been found in Alabama, Arkansas, Mississippi and Oklahoma.

Biology. Adults were collected by sifting forest litter from March to December.

THE *nana* GROUP

Baeocera nana Casey

Baeocera nana CASEY, 1893: 521.
Baeocera rubriventris CASEY, 1900: 58.
Eubaeocera nana; CORNELL, 1967: 15.

Description. Length 0.90 - 1.20 mm. Body more or less dark reddish-brown to black, abdomen usually reddish and paler than thorax and elytra. Antennomere 3 shorter than 2 or 4. Lateral contours of pronotum and of elytron variable, continuously (Fig. 11), or separately arcuate in dorsal view. Pronotal microsculpture distinct, often visible at 50x magnification. Apical portion of scutellum exposed. Elytron with basal stria broadly interrupted. Elytral punctation like pronotal punctation, extremely fine, almost obsolete at 90x magnification. Mesocoxal line indistinctly subangulate, with row of marginal pits slightly elongated, extending laterally at least to tip of "mesepimeron", usually extending outward to, or past, middle of anapleural suture (Figs 12, 13). Lateral portion of metasternum very finely punctured. Metepisternum wide, with suture convexly arcuate, and usually distinctly punctured, rarely impunctate. First abdominal ventrite with barely visible microsculpture and with basal pits elongate, extended apicad by striae. Aedeagus (Figs 88, 89) 0.25 - 0.31 mm long. Median lobe with apical edge of basal bulb overlapping slender apical portion. Latter moderately inclined, shorter than half the length of basal bulb and tapering; tip not curved, but pointed. Internal sac with very long, extruding portion of ejaculatory duct. Flagellum moderately wide, basally strongly curved to semicircular. Relatively short flagellar guide-sclerite distinct in dorsal view. Parameres straight and somewhat enlarged apically in dorsal view, weakly sinuate in lateral view.

Type material. For *B. nana* see Cornell, 1967: 15. Lectotype of *B. rubriventris*, in the collection of USNM, is here designated. It bears the following labels: R.I. /Rhode Island/; 965126-2; Casey bequest 1925; Type USNM 45757 /red label/; *rubriventris* Csy.; a vial with body parts; parts on slide; and label Lectotype *Baeocera rubriventris* Csy det. K. Stephan 1990.

Material examined, 395: UNITED STATES: 3, Alabama; 1, Arkansas; 2, Connecticut; 1, District of Columbia; 29, Florida; 9, Georgia; 9, Illinois; 7, Indiana; 1, Iowa; 1, Kansas; 6, Kentucky; 4, Maryland; 9, Massachussets; 1, Michigan; 62, Mississippi; 8, Missouri; 26, New Hamshire, 6, New Jersey; 3, North Carolina; 1, North Dakota; 10, Ohio; 152, Oklahoma; 1, South Carolina; 1, Tennessee; 1, Texas; 10, Virginia; 4, West Virginia: CANADA: 10, Ontario; 17, Quebec.

Distribution. This common species occurs throughout most of eastern North America; from Quebec to Florida, west to North Dakota, Oklahoma and Texas.

Biology. The species occurs in a broad range of habitats. Specimens were taken from forest floor litter, hard-wood litter, cypress log, mixed hard-wood conifer litter, flood debris, rotten wood, debris in hollow log, fungus ridden basswood, cabbage palm litter, and on fungi. Also in flight intercept traps in forest. Adults are present throughout the year. Recorded from slime mold by Lawrence & Newton, 1980:137; recorded from *Comatrichia typhoides*, *Stemonitis fusca*, *Badhamia affinis*.

Remarks. Two alternative sets of characters have been found in the material examined: In most specimens, the lectotype of *B. rubriventris* including, the metasternal suture is distinctly punctate, in combination with the laterally strongly extended row of the marginal pits of the mesocoxal line, and the always rufous abdomen. In the lectotype of *B. nana* and in several other specimens the metasternal suture and the margin of the "mesepimeron" are impunctate, in combination with the usually darker abdomen. Other characters, including the aedeagus with the shape of the sclerites of the internal sac are the same in all males examined. As the two "forms" do not exhibit any distinct distribution pattern, we prefer to retain the synonymy of *B. nana* and *B. rubriventris*, as proposed by Cornell, 1967.

The *compacta* group

Baeocera compacta sp.n.

Description. Length 1.45 - 155 mm, width 0.95 - 1.05 mm. Head and thorax blackish, elytron very dark brown with paler apical portion. Abdomen about as dark as most of elytral disc. Lateral contours of pronotum and elytron continuously arcuate in dorsal view (Fig. 55). Antennomeres 2, 3, and 4 each about of same length. Pronotum with strongly curved lateral margin in lateral view. Pronotal microsculpture obsolete. Scutellum completely covered. Elytron with complete basal stria; lateral contour arcuate in dorsal view; discal punctation very fine, similar to that of pronotum. Mesocoxal line parallel to coxa, margined by round pits extending laterally to tip of "mesepimeron". Lateral portion of metasternum very finely punctured. Metepisternum moderately wide, with straight, impunctate suture (Fig. 55a). First abdominal ventrite not microsculptured, with round basal pits. Aedeagus (Figs 90, 91) 0.50 mm long. Median lobe slender, with apical portion about as long as basal bulb, moderately inclined, tapering, with weakly curved and pointed tip; ventral wall almost evenly arcuate, bearing low tubercle, not notched above ventral process. Internal sac with flagellum extruding apically, widened and circular basally. Parameres strongly expanded basally, sinuate and distinctly narrowed toward apex in dorsal view, almost straight and weakly narrowed apically in lateral view.

Type material. Holotype, male: UNITED STATES: Florida, Monroe Co., Leyton, Long Key, Ber. 225, 8.VIII.1974, S.Peck (CNCI).

Paratypes, 2 females: same data as holotype (CNCI).

Distribution. Florida Keys.

Biology. The specimens were taken in a ground litter sample from hardwood hammock forest.

Remarks. This species may be readily recognized by the aedeagal characters, especially by the strongly expanded parameral base, in combination with the circular, widened base of the flagellum and the ventrally tuberculate apical portion of the median lobe. The general body shape is similar to that of *B. robustula*. The strongly curved lateral pronotal margin, as seen in lateral view, is diagnostic.

THE *humeralis* GROUP

Baeocera humeralis Fall

Baeocera humeralis FALL, 1910: 116.
Baeocera humeralis; HATCH, 1957: 281.
Eubaeocera humeralis; CORNELL, 1967: 13.

Description. Length 1.45 - 1.65 mm. Head and pronotum dark brown to black, elytron entirely reddish or dark with reddish basal and apical spots. Antennomere 3 shorter than 2 or 4. Lateral contours of pronotum and of elytron variable, continuously or separately arcuate in dorsal view. Pronotal microsculpture absent. Scutellum visible. Elytron with basal stria complete (Fig. 14), sometimes faint but traceable in humeral area. Elytral punctation very fine, consisting of well delimited punctures, coarser than pronotal punctures. Mesocoxal line parallel to coxa, with marginal pits rather coarse, rounded and extended laterally along anapleural suture past middle of "mesepimeron" (Fig. 15). Lateral portion of metasternum very finely punctured. Metepisternum narrow, with suture impunctate and straight. First abdominal ventrite distinctly microsculptured at 50x magnification, basal pits coarse, elongate, extended apically by striae. Aedeagus (Figs 92, 93) 0.58 - 0.63 mm long. Median lobe with wide, stout, curved apical portion. Apex of median lobe pointed (lateral view), covered by single valve. Ventral wall of apical portion almost evenly arcuate. Internal sac bearing slender central sclerites joined to membranes covered by spinose structures. Parameres slender, weakly sinuate, moderately enlarged basally and apically in lateral view, almost parallel-sided in dorsal view.

Type material. See CORNELL, 1967: 13.

Material examined, 102 specimens: UNITED STATES: 38, Arizona; 4, Colorado; 6, Idaho; 30, New Hampshire; 4, New Mexico; CANADA: 19, British Columbia; 1, Manitoba.

Distribution. This species occurs from southern Arizona north to British Columbia, east to Manitoba and New Hampshire.

Biology. Label information indicates that the species inhabits forest litter. Also in rotten wood, litter along stream, under conifer bark, and in flight intercept traps. Specimens were captured from May to September.

Remarks. *Baeocera humeralis* is the only species in the study area with a distinct colour pattern. However, those specimens lacking the reddish maculae may be readily recognized by the combination of other external characters.

THE *irregularis* GROUP

Baeocera irregularis Champion

Baeocera irregularis CHAMPION, 1913: 70.
Sciatrophes irregularis; LÖBL, 1976: 209.

Description. Length 2.0 - 2.15 mm. Body dark reddish-brown, with pronotum darker, brownish-black to black. Antennomere 3 almost as long as 2 or 4. Lateral contours of pronotum and of elytron separately arcuate in dorsal view. Pronotum not microsculptured. Scutellum not visible. Elytron with complete basal stria. Elytral punctation very coarse from base to middle or to apical third, almost obsolete on apical third (Fig. 33). Mesocoxal line subparallel to coxa, with marginal pits rounded, extended laterally beyond "mesepimeron". Lateral portion of metasternum very finely punctured. Metepisternum moderately wide, with somewhat sinuate and distinctly punctate suture (Fig. 34). First abdominal ventrite not microsculptured, with very coarse, round or barely elongate basal pits. Aedeagus (Figs.94, 95) 0.92 mm long. Median lobe with rather thick basal bulb and slender, in lateral view sinuate apical portion; tip slender, rounded in dorsal view, pointed and curved in lateral view. Valves somewhat asymmetrical, situated proximally. Flagellum of internal sac stout, fairly long, apically thickened and extruded; flagellar guide-sclerite flattened, apically thickened, joined with curved slender basal sclerite. Parameres moderately curved and evenly wide.

Type material. See LÖBL, 1976: 211.

Material examined. See data in LÖBL, 1976:211.

Distribution. Arizona and Mexico.

Remarks. *Baeocera irregularis* is the only large western species having elytral punctation as described. A similar, closely related species (*B.wheeleri* Löbl) occurs in Mexico. It exhibits almost the same external diagnostic characters, but differs by the shape of the parameres, of the apical portion of the median lobe and of the sclerites of the internal sac.

THE *deflexa* GROUP

Baeocera deflexa Casey

Baeocera deflexa CASEY, 1893: 517; Casey, 1900: 57.
Eubaeocera deflexa; CORNELL, 1967: 9

Description. Length 2.2 - 2.6 mm. Body dark brown to black. Antennomeres 2, 3, and 4 of almost same length. Lateral contours of pronotum and of elytron separately arcuate in dorsal view (Fig. 21). Pronotal microsculpture more or less distinct, sometimes well visible at 50x magnification. Pronotal disc moderately arcuate in lateral view (Fig. 23). Scutellum completely covered by pronotal lobe. Elytron with basal stria broadly interrupted in humeral area. Most elytral punctures very fine, somewhat coarser than pronotal ones, some punctures eventually notably larger. Mesocoxal line moderately convex, with marginal pits coarse, rounded, somewhat extended laterally, not reaching tip of "mesepimeron". Lateral portion of metasternum very finely punctured. Metepisternum wide, parallel-sided, with straight, punctured suture (Fig. 22). First abdominal ventrite with almost obsolete microsculpture (90x magnification). Aedeagus (Figs 96, 97) 0.94 - 1.03 mm long. Median lobe with thick basal bulb and apically protruding ventral process; apical portion with ventral wall almost straight up to curved, pointed tip. Flagellum of internal sac slender, very long, enlarged and curved basally, extruding apically, abruptly enlarged in center, forming a sharp tooth. Flagellar guide-sclerite fairly stout, with bidentate apex. Parameres sinuate in dorsal view, widest before middle, from there gradually narrowed apically in lateral view. Base of parameres distinctly enlarged.

Type material. See CORNELL, 1967: 11.

Material examined, 128 specimens: UNITED STATES: 12, Arkansas; 2, Colorado; 1, Connecticut; 7, Kentucky; 1, Illinois; 1, Louisiana; 1, Maine; 1, Massachusetts; 14, New York; 3, North Carolina; 22, Ohio; 29, Oklahoma; 1, Pennsylvania; 2, South Carolina; 1, Tennessee; 1, Vermont; 4, Virginia; 3, Wisconsin; CANADA: 1, New Brunswick; 13, Ontario; 8, Quebec.

Distribution. This fairly common species occurs from New Brunswick south to Louisiana, west to Wisconsin and Colorado. With the Colorado record, from Lime Creek, 9500ft, 6 mi S. Molas Pass, 29.VII.1973, J. M. Campbell, which is about 1000 km westward of the nearest localities, the species seems to be represented by an isolated population west of the 100th meridian.

Biology. The species has been sifted from hard wood litter and occasionally from pine litter. Adults were collected throughout the year.

Remarks. *Baeocera deflexa* is the only of the larger eastern species with the basal stria of the elytron broadly interrupted and the lateral pronotal margin sharply deflected downward near the hind angle.

Baeocera flagellata (Löbl)

Eubaeocera flagellata LÖBL, 1976: 207.

Description. Length 2.40 - 2.55 mm. Body brown-black to black. Antennomere 2 about as long as 3 or 4. Lateral contours of pronotum and of elytron separately arcuate in dorsal view (Fig. 27). Pronotal microsculpture very fine, barely visible at 90x magnification. Scutellum completely covered by pronotal lobe. Elytron with complete basal stria. Elytral punctation coarser than that of pronotum, fairly regular and visible at 12x magnification. Mesocoxal line parallel to coxa, with marginal pits rounded, extended to tip of "mesepimeron". Lateral portion of metasternum very finely punctured. Metepisternum moderately wide, parallel-sided or moderately narrowed anteriad, with straight punctured suture (Fig. 28). First abdominal ventrite with microsculpture visible at 90x magnification, and with elongate basal pits. Aedeagus (Figs 98, 99) 1.12 - 1.26 mm long. Median lobe narrow, relatively slender, with rather large, protruding ventral process of basal bulb. Apical portion of median lobe with weakly sinuate ventral wall, tip pointed, weakly curved. Flagellum slender, extruding from ostium, basally curved and strongly thickened. Flagellar guide-sclerite apically bidentate, almost straight, relatively narrow. Parameres almost straight, narrowed at apex, not enlarged basally in lateral view.

Type material. See Löbl, 1976: 208.

Material examined, 76 specimens: UNITED STATES: 74, Arizona; MEXICO: 1, Mexico, Mor., 7 mi S Tres Cumbres, 7.VII:1975, Q. D. Wheeler (CUIC); 1, Mexico, Dgo, 26 mi W Durango, 13.VII.1975, Q. D. Wheeler (CUIC).

Distribution. Arizona and Mexico. This uncommon species is found in southeastern Arizona at high elevation.

Biology. *Baeocera flagellata* has been sifted from rotten wood, oak duff, and thicker layers of forest litter.

Remarks. *Baeocera flagellata* and *B. irregularis* are the only two larger western species lacking a visible scutellum. The former has finer elytral punctuation, distinct even near the apex, while the latter has coarser elytral punctation, which is obsolete near the apex.

Baeocera valida (Löbl)

Sciatrophes valida Löbl, 1976: 209.

Description. Length 2.25 - 2.40 mm. Body brownish-black to black, usually elytra paler toward apex. Antennomeres 3 and 4 about of same length, somewhat shorter than antennomere 2. Lateral contours of pronotum and of elytron separately arcuate in dorsal view (Fig. 31). Pronotal microsculpture obsolete at 90x magnification. Lateral margin of pronotal angle S-shaped apically in oblique view (Fig. 32). Scutellum visible. Basal stria of elytron uninterrupted. Elytral punctation coarse, distinct at 12x magnification; scattered larger punctures present. Mesocoxal line convex, marginal pits rounded, extended laterally to tip of "mesepimeron", one or two of pits situated beyond "mesepimeron". Lateral portion of metasternum very finely punctured. Mesepisternum wide, parallel-sided, with straight, punctured suture. First abdominal ventrite lacking microsculpture, with basal pits rounded. Aedeagus (Figs 100, 101) 1.18 - 1.26 mm long. Median lobe elongate, relatively slender, notably asymmetrical, with flattened, laterally curved apex. Ventral wall of apical portion irregular, sinuate. Ventral process small, not protruding. Flagellum fairly thin, sinuate, apically extruded. Flagellar guide-sclerite flattened, wide, curved basally. Central part of internal sac bearing small sclerites joined to flagellum and to flagellar guide-sclerite. Parameres slender, weakly sinuate, with enlarged middle in lateral view, moderately curved apically in dorsal view.

Type material. See LÖBL, 1976: 209.

Material examined, 10 specimens: UNITED STATES: 4, Arizona, Graham Co., Pinaleno Mts., Wet Canyon, 5.IX.1976, D. S. Chandler; 1, Arizona, Cochise Co., Chiracahua Mts., 29. VI. 1949, D. J. & J. N. Knull; 1, Arizona, Pinal Mts., Gila Co., Pioneer Pass, 25.VII.1976, J. M. Campbell; 1, Arizona, Huachuca Mts., Miller Cyn., 7200-7800 ft, 4.VIII.1979, A. Smetana; 2, New Mexico, Las Vegas, Barber & Schwarz; 1, Colorado, Colorado Springs, 7000 ft, Wickham.

Distribution. Arizona, New Mexico, and Colorado.

Biology. This species is confined to habitats at high elevations. The specimens from Wet Canyon were sifted from litter along a creek, those from Miller Canyon from oak leaf litter in a mixed deciduous and coniferous forest.

Remarks. *Baeocera valida* is readily recognized by its large size and the S-shaped lateral margin of pronotal hind angle, as seen in oblique view.

THE *congener* GROUP

Baeocera cerbera (Cornell)

Eubaeocera cerbera CORNELL, 1967: 13.

Description. Length 1.55 -1.75 mm. Body dark reddish-brown to black, elytra apically paler. Antennomeres 2 and 4 about of equal length, antennomere 3 distinctly shorter. Lateral contours of pronotum and of elytron separately arcuate in dorsal view. Pronotal microsculpture usually visible at 50x magnification, sometimes very fine to obsolete. Scutellum completely covered by pronotal lobe. Elytron with complete basal stria, elytral punctation very fine, similar to that of pronotum, with few additional large, fairly coarse punctures. Mesocoxal line moderately convex, with marginal pits rounded, more or less extended laterally along anapleural suture. Lateral portion of metasternum very finely punctured. Metepisternum moderately wide, parallel-sided or narrowed anteriad, with straight impunctate suture. First abdominal ventrite not microsculptured at 90x magnification, with coarse, rounded basal pits. Aedeagus (Figs 102, 103) 0.57 - O.67 mm long. Median lobe with thick basal bulb, long and fairly asymmetrical apical portion; ventral processes protruding. Flagellum thick and wide; basal curved portion strongly widened. Flagellar guide-sclerite with left arm long, hook-shaped, pointed at tip, right apophyse robust. Parameres conspicuously asymmetrical, with weakly arcuate ventral ridge, each bearing membranous rim on inner side of apical half. Right paramere almost straight with unevenly shaped margin in dorsal view, left paramere arcuate beyond widened base; both parameres widest in middle portion in lateral view; membranous lobe absent.

Type material. See CORNELL, 1967: 13.

Material examined, 22 specimens: UNITED STATES, Arizona: 4, Cochise Co., Chiracahua Mts., Greenhouse Cyn., 6400 ft, 2.VIII.1979 (CNCI); 1, Cochise Co., Dragoon Mts., Slavin Gulch,18. VIII.1974, K. Stephan (FSCA); 3, Graham Co., Pinaleno Mts., Noon

Ck., 5200 ft, 13. II.1973 (OSUC); 1, Graham Co., Pinaleno Mts., Marijilda Cyn., 4350 ft, 3. V. 1977, C. A. Janus-Chandler (OSUC); 2, Pima Co., Mt. Lemmon Hwy, 7600 ft, 3. X. 1971 (OSUC); 11, Santa Cruz Co., Santa Rita Mts., Madera Cyn., 11. and 15. X. 1971 and 3. and 8.XI.1971 (USNM).

Distribution. Mountains of southeastern Arizona.

Biology. Specimens of this species were taken by sifting duff and litter in oak forest.

Remarks. The concept of this species is based on the study of the single paratype of *B. cerbera*. The medium size, elongate-oval form, a few large shallow punctures on the otherwise very finely punctured elytra, the widely spaced punctures along anapleural suture, and the absence of a visible scutellum, will separate this species from all others, *B. speculifer* excepted. The contours of the body are similar to Fig. 54.

Baeocera congener Casey

Baeocera congener CASEY, 1893: 517.
Eubaeocera congener; CORNELL, 1967: 11.

Description. Length 1.7 - 2.2 mm . Body black-brown to black, with wide apical portion of elytra usually notably paler. Antennomere 3 distinctly shorter than 2 or 4. Lateral contours of pronotum and of elytron separately arcuate (Fig. 18). Pronotum usually without visible microscuplture at 90x magnification, evenly arcuate apically in lateral view (Fig. 20). Scutellum completely covered by pronotal lobe. Basal stria of elytron uninterrupted. Elytron with discal punctation almost evenly fine, similar to that of pronotum. Mesocoxal line parallel to coxa, with marginal pits rounded, extended laterally to tip of "mesepimeron". Lateral portion of metasternum very finely punctured. Metepisternum wide, parallel-sided, with straight, punctured suture. First abdominal ventrite with microsculpture not visible or hardly visible (90x magnification), basal pits rounded or barely elongate (Fig. 19). Aedeagus (Figs 104, 105) 0.68 - 0.83 mm. Median lobe with thick basal bulb, apical portion of median lobe wide and relatively short. Ventral processes indistinct. Flagellum thick, with moderately widened base. Left arm of flagellar guide-sclerite hook-shaped, gradually narrowed apically in dorsal view, tip acute in lateral view; right apophyse robust. Parameres symmetrical except near strongly widened base, bearing membranous rim on inner side, left paramere strongly, right paramere weakly sinuate and narrowed apically in dorsal view; both with arcuate ventral ridge in ventral view, and almost evenly wide, subangulate in middle portion, with ventral margin sinuate, dorsal margin arcuate in lateral view.

Type material. See CORNELL, 1967: 11.

Material examined, 125 specimens: UNITED STATES: 1, Alabama; 1, Arkansas; 5, Arizona;1, District of Columbia; 1, Connecticut; 4, Florida; 1, Indiana; 1, Illinois; 15, Kansas; 1, Massachusetts; 3, Michigan; 17, Missouri; 2, Montana; 4, New Mexico; 12, North Dakota; 3, Pennsylvania; 40, Oklahoma; 1, South Carolina; 2, Tennessee; 2, Texas; 1, Virginia; 2, Wyoming; CANADA: 4, Ontario.

Distribution. *Baeocera congener* is the most wide-spread member of the larger species. It occurs from Ontario to Alabama, west to Montana and Arizona.

In Montana it follows the Missouri River as far as Helena. The New Mexico specimens come from the Sangre de Cristo Range which gives rise to the Canadian River. This river is part of the Mississippi drainage basin. The species may turn up in collections from the eastern slopes of the Rocky Mountains.

Biology. The species has been taken in a variety of forest litter. Adults were collected throughout the year.

Remarks. *Baeocera congener* may be easily distinguished from the similar *B. falsata* by the evenly arcuate dorsal convexity of the pronotum (Fig. 18), while it drops off sharply near the apex, giving a humped look in *B. falsata* (Fig. 26).

Baeocera falsata Achard

Baeocera falsata ACHARD, 1920: 307; LÖBL, 1987: 315
Baeocera concolor CASEY, 1900; nec (*Scaphidium concolor*) FABRICIUS, 1801.

Description. Length 2.2 - 2.6 mm. Body brownish-black to black. Antennomeres 2, 3, and 4 almost of same length. Lateral contours of pronotum and of elytron separately arcuate in dorsal view (Fig. 24). Pronotal disc dropping off sharply near apex, giving a humped look (Fig. 26). Pronotal microsculpture distinct at 50x magnification. Scutellum not visible. Elytron with uninterrupted basal stria. Elytral punctation fine, notably coarser than that of pronotum, with several punctures distinctly enlarged. Mesocoxal line parallel with coxa, with marginal pits rounded and not extended laterally. Lateral portion of metasternum very finely punctured. Metepisternum moderately wide, parallel-sided, with straight, punctate suture (Fig. 25). First abdominal ventrite with microsculpture distinct at 90x magnification, basal pits rounded. Aedeagus (Figs 106, 107) 0.87 - 1.02 mm long. Median lobe with fairly long, moderately wide apical portion. Basal bulb with apically protruding left wall. Ventral processes inconspicuous. Flagellum of internal sac thick, moderately widened basally. Left arm of flagellar guide-sclerite long, hook-shaped and tapering, bearing small, subapical denticle distinct in dorsal view. Parameres with straight ventral and lateral ridges and narrow membranous rim along inner edge; lateral margins almost straight, at apex weakly widened, more or less sinuate in dorsal view; widest in middle, moderately curved and narrowed apically in lateral view.

Type material. See ICZN 1982: 186.

Material examined, 30 specimens: UNITED STATES: 1, Kentucky; 2, New York; 15, Oklahoma; 1, South Carolina; 1, Virginia; CANADA: 8, Ontario; 2, Quebec.

Distribution. This species occurs sporadically, from Ontario south to South Carolina, west to Michigan and Oklahoma.

Biology. *Baeocera falsata* seems to prefer rather wet habitats. It has been taken in leaf litter at the edge of logs, by sifting sphagnum, damp leaf litter, and pine duff. In Oklahoma it occurs together with *B. deflexa*. Adults have been found in February, and April throught December. They possibly occur throughout the year.

Remarks. *B. falsata* may be confused with *B. congener*. For a discussion of the distinguishing characters, see remarks under that species.

Baeocera impunctata sp.n.

Description. Length 1.8 -2.0 mm. In external and aedeagal characters very similar to *B. congener* (Figs 54, 114,115). It may be readily distinguished by the exposed tip of the scutellum, and it differs also by slightly finer elytral punctation. Aedeagus 0.73 - 0.77 mm long. Flagellum with single basal lobe in lateral view. Flagellar guide-sclerite not narrowed or weakly narrowed apically, with bidentate tip. Apical two thirds of parameres evenly wide and weakly arcuate in dorsal and ventral view, base of parameres symmetrical; each paramere widest in middle, apically narrowed, with more or less arcuate ventral margin in lateral view.

Type material. Holotype, male: UNITED STATES: Arizona, Pantano Wash 3 mi N Mt. View, Pima Co., 27.X.1971, D. S. Chandler (OSUC).

Paratypes, 9: UNITED STATES: Arizona:1 male, 1 female, same data as holotype; 1 female, Tucson, Hubbard & Schwarz (USNM); 1 male, Madera Cn, Pima Co. 11.VIII.1971, R. Lenczy (USNM); 1 male, Santa Catalina Mts., Molino Basin, 24.VII.1972, R. Gordon (USNM); 3 males, 1 female, New Mexico, Las Vegas, Barber & Schwarz coll.(USNM).

Distribution. Arizona and New Mexico.

Biology. This species is found by sifting litter in moist places at medium elevation.

Baeocera inexspectata sp.n.

Description. Length 2.1 mm. External characters as those in *B. congener*. Aedeagus (Figs 108 to 110) 0.83 mm long. Apical portion of median lobe slender, long, extended somewhat beyond tip of parameres, with ventral margin weakly arcuate, tip of pointed. Flagellum (base excepted) relatively thin in dorsal view, gradually narrowed apically in lateral view. Left arm of flagellar guide-sclerite almost evenly wide, with simple, pointed tip curved dorsally in lateral view; right apophyse moderately large. Parameres weakly asymmetrical, with arcuate outer margin in dorsal view, irregularly arcuate dorsal margin and almost straight ventral margin in lateral view; inner margin of parameres extended by membranous lobe widest in middle.

Type Material. Holotype, male: CANADA, Saskatchewan, Saskatoon, 3.X.1923, K.M.King (CNCI).

Distribution. Saskatchewan.

Remarks. This is one of the smaller species of the *congener* group. It may be recognized by the parameres bearing a membranous lobe and by the shape of the sclerites of the internal sac.

Baeocera lenczyi sp.n.

Description. Length 1.7 mm, width 1.1 mm. Head, thorax and basal portion of elytra very dark reddish-brown, elytra gradually paler apically. Antennomeres 3 and 4 of about same length, each somewhat shorter than 2. Lateral contours of pronotum and elytron separately arcuate in dorsal view (Fig. 52). Pronotal microsculpture visible at 24x magnification. Scutellum completely covered by pronotal lobe. Elytron with uninterrupted basal stria; discal punctation fine, rather irregular in basal half, punctures on apical portion finer than those on center, almost as small as pronotal punctures; large scattered discal punctures absent. Mesocoxal line parallel to coxal margin, with marginal pits elongate, extended laterally to tip of "mesepimeron". Lateral portion of metasternum very finely punctured. Metepisternum moderately wide, with punctate, almost straight suture. Basal pits of first abdominal ventrite strongly elongate, each extended apically by a stria (Fig. 53); microsculpture of first ventrite hardly visible at 90x magnification. Aedeagus (Figs 111 to 113) 0.60 mm long. Median lobe with fairly thick apical portion, tip hardly curved, ventral margin sinuate in lateral view. Ventral process small, not protruding. Flagellum wide, curved and conspicuously enlarged basally, with slender, strongly sclerotized apex. Flagellar guide-sclerite with long, gradually narrowed left arm, curved at tip in lateral view. Parameres strongly asymmetrical, each strongly enlarged, with external margin evenly arcuate.

Type material. Holotype, male: UNITED STATES: Arizona, Santa Cruz Co, Santa Rita Mts., Madera Canyon, R. Lenczy (USNM).

Distribution. Arizona.

Biology. Dr. Lenczy never collected at higher elevations nor did he sift. Hand-picking, UV light and sweeping were his favorite collecting methods (KS). It may therefore be assumed that the specimen was taken in the oak-zone of the Madera Canyon, by one of these methods.

Remarks. The single specimen of *B. lenczyi* has somewhat rugose elytral disc. This is likely an anomaly instead of a species character. The species may be readily distinguished from other members of the *congener* group by the extended basal punctures of the first ventrite and by the conspicuously large parameres of the aedeagus. It differs from the sympatric *B. cerbera* by the absence of the scattered large punctures on the elytral disc. The species is named in honor of the late, long time friend of the junior author, Rudolph Lenczy, MD, who devoted most of his later years to beetles.

Baeocera securiforma (Cornell)

Eubaeocera securiforma Cornell, 1967: 13.

Description. Externally very similar to *B. congener*, on average larger, and with antennomere 3 longer and pronotal and abdominal microsculpture usually distinct at 50x magnification. Length 2.0 - 2.35 mm, antennomere 3 usually somewhat shorter than 4, rarely as long as 4, and as long as or somewhat shorter than antennomere 2. Aedeagus (Figs 116, 117) 0.88 - 0.98 mm long. Median lobe with long, relatively slender apical portion. Basal bulb not protruding above base of parameres. Flagellum wide, with indistinct, membranous apical portion. Left arm of flagellar guide-sclerite curved, apically not or weakly narrowed, with abruptly bent tip (lateral view), apex in lateral view usually distinctly securiform. Right apophyse indistinct. Parameres asymmetrical, with hardly widened bases, right paramere almost straight or weakly sinuate in dorsal view, left paramere distinctly sinuate. Dorsal and inner side of both parameres with short ridge. Subbasal portion of parameres narrow, apical half to two thirds widened, with widest point in middle or before middle portion (lateral view). Tip of parameres asymmetrical in lateral view, that of right paramere bearing minute point curved outwardly or ventrally.

Type material. See Cornell, 1967:13.

Material examined, 23 specimens: UNITED STATES: 1, Florida; 2, Massachusetts; 1, Manitoba; 3, New York; 4, Oklahoma; 1, Virginia; CANADA: 1, Ontario; 10, Quebec.

Distribution. This species inhabits all of eastern North America, but its occurence is sporadic.

Biology. The habits seem to be the same as those of B. congener.

Remarks. The species may be distinguished by the shape of the parameres, in combination with the shape of the flagellar guide-sclerite.

Baeocera speculifer Casey

Baeocera speculifer Casey, 1893: 518.
Eubaeocera congener; Cornell, 1967: 11.

Description. Length 1.7 mm. In external characters very similar to *B. cerbera*. Aedeagus (Figs 120, 121) 0.57 mm. Apical portion of median lobe slender, strongly inclined, with almost straight ventral margin in lateral view, and pointed, straight tip. Flagellum in dorsal view relatively slender, with moderately widened basal portion. Flagellar guide-sclerite with left arm bidentate at apex; somewhat narrowed near tip in dorsal view, with fairly long, regularly curved and evenly thick apical portion in lateral view; right apophyse short, inconspicuous. Parameres symmetrical, evenly wide and moderately curved in dorsal view (base excepted), widest near middle, apically gradually narrowed in lateral view.

Type material. Lectotype, male, in the collection of the United States National Museum, Washington, D.C., is here designated. It bears the following labels: Ia ; *speculifer*; Casey bequest 1925; Type USNM 48748; 965126-11; *speculifer* Csy. det. K. Stephan 1990, and adequate lectotype designation label.

Distribution. Iowa.

Remarks. *Baeocera speculifer* may be distinguished from other species of similar size by the elytra having a few scattered large punctures, in combination with the aedeagal characters.

Baeocera solida sp.n.

Description. Length 2.0 - 2.4 mm, width 1.30 - 1.60 mm. Body blackish-brown to black. Antennomere 3 somewhat shorter than 2 or 4. Lateral contours of pronotum and of elytron separately arcuate in dorsal view, lateral contour of pronotum subangulate (Fig. 29). Pronotal microsculpture distinct, usually visible at 24x magnification. Point of scutellum exposed. Elytron with complete, uninterrupted basal stria. Elytral punctation rather coarse, similar to that of pronotum, visible at 12x magnification. Mesocoxal line parallel to coxa, with marginal pits coarse, round and not extended laterally. Lateral portion of metasternum show coarse punctation, except on area near apical margin. Metepisternum wide, narrowed anteriad, with straight or barely sinuate and punctured suture (Fig. 30). First abdominal ventrite distinctly microsculptured, with coarse, round basal punctures. Aedeagus (Figs 118, 119) 0.74 - 0.83 mm long. Median lobe with thick basal bulb, long, asymmetrically narrowed apical portion, and rather large ventral process. Tip of median lobe pointed, weakly curved, ventral margin irregular in lateral view. Flagellum wide, with strongly sclerotized basal margin and weakly sclerotized apex. Flagellar guide-sclerite with long, extruded left arm ending by simple, gradually narrowed and curved apex; right apophyse strongly developed. Parameres almost straight with somewhat sinuate outer and inner margins in dorsal view, incurved, widest beyond middle and tapering apically in lateral view. Base of parameres distinctly enlarged in lateral view.

Type material. Holotype, male: UNITED STATES: Arizona, Santa Rita Mts., Madera Cyn., 21.IX.1968, K. Stephan (FSCA).

Paratypes, 61, all from Arizona: 12, Huachuca Mts., Miller Cyn., 7200-7800ft, 4.VIII.1979, A. Smetana (CNCI); 2 Huachuca Mts., Carr Cyn., 23.VII.1976, J. M. Campbell (CNCI); 3, Huachuca Mts., Bear Saddle, 8100 ft, 5.VIII.1979 A. Smetana (CNCI); 9, Pinal Mts., Gila Co., Pioneer Pass, 1660m, 25.VII.1976 J.M.Campbell (CNCI); 1, Pima Co., Santa Catalina Mts., Spencer Cyn., 5.VIII.1985, 8000 ft, J. Pakaluk (JPIC); 2, Santa Catalina Mts., 8000 ft, 27.VII.1968, K. Stephan ; 1, same but 16-VI-1966, K. Stephan ; 1, same but 9000 ft, 4.IX.1968, K. Stephan ; 1, Pima Co., Peppersauce Cyn., 25-I-1969, K. Stephan ; 1, Mt. Lemmon Hwy., 7600 ft; 3.X.1971, D. S. Chandler, berlese oak duff (OSUC) ; 1, Pima Co., Bear Canyon on Mt, Lemmon Hwy., 3.X.1971, D. S. Chandler, oak-sycamore duff (OSUC) ; 2, Santa Cruz Co., Santa Rita Mts., Madera Canyon, 21.IX.1968, K. Stephan ; 1, Madera Canyon, 11.VIII.1969, A. Smetana (MHNG) and 1, Madera Cyn. 5500 ft, 3.VII.1969, A. Smetana (CNCI); 1, Madera Canyon, 23.X.1971, D. S. Chandler, oak duff (OSUC); 2, Pajarito Mts., Sycamore Cyn., 24.VIII.1968, K. Stephan; 1, 3 mi. N Ruby, 23.III.1979, F. Werner, leaf litter (UAIC) ; 2, Cochise Co., Chiricahua Mts., Portal 5000 ft, 21.VII.1969, A. Smetana (MHNG, CNCI) ; 1, Chiricahua Mts., 8500 ft, 3.VIII.1969, K. Stephan ; 1, same but 5.X.1968 ; 2, same but 7000 ft, 23.VI.1973 ; 1, same but 5000 ft, 18.X.1975; Chiricahua Mts., Sunny Flat Cpgd., 5200 ft, 29.VII.1979, A. Smetana (CNCI); Chiricahua Mts., Rucker Cyn, 1760m, 22.VII.1976, J. M. Campbell (CNCI); 2, Rustler Park, 14.VIII.1965, H. Dybas, pine floor litter near pine log (FMNH) ; 1, VII (no other data), (USNM) ; Texas Cyn., Dragoon Mts., 22.VII.1981, Olson & Burne (UAIC) ; Graham Co., Turkey Creek nr. Araviapa Canyon, 24-27.VI.1989, Y. Bousquet (CNCI); 1, Graham Co., Pinaleno Mts., Turkey Fla., 7200 ft, 27.VII.1969, A. Smetana (MHNG); 2, same but Wet Canyon, 11 & 30.IV.1977, D. S. Chandler, pine litter and under bark (OSUC) ; 1, 2mi. W Black Lake, Sitgreaves N.F. Navajo Co., 2240m, 14.VII.1976, J. M. Campbell (CNCI); 1, Greenly Co., White Mts., Hannegans Meadow, 14.X.1972, K. Stephan (all specimens collected by K.Stephan are in FSCA or KSC).

Distribution. Only known from the mountains of southern Arizona.

Biology. This species occurs in moist forest habitats at high elevations; it is found in various leaf-litter, such as oak, pine and sycamore.

Remarks. *Baeocera solida* cannot be confused with any other sympatric species. The peculiar pronotal shape is diagnostic.

Baeocera youngi (Cornell)

Scaphidium concolor Erichson, 1845; nec (*Scaphidium concolor*) Fabricius, 1801: 576.
Eubaeocera youngi Cornell, 1967: 11.
Baeocera falsata; Löbl, 1987: 315.

Description. In external characters very similar to *B. congener*, in average larger, with pronotal and abdominal microsculpture usually distinct at x90x magnification, and antennomere 3 somewhat longer. Length 2.15 - 2.5 mm. Antennomere 3 somewhat shorter than 4 , antennomere 4 as long as 2. Aedeagus (Figs 122 - 124) 0.84 - 1.18 mm long. Median lobe with long and slender apical portion, tip pointed, ventral margin sinuate in lateral view. Basal bulb lacking apical protuberance. Internal sac with flagellum moderately wide, not or weakly narrowed. Flagellar guide-sclerite long, with left arm relatively slender, apically narrowed and pointed, with small subapical denticle; right apophyse small, inconspicuous. Parameres weakly asymmetrical, each with strong, basally bifid ventral ridge; outer margin more or less sinuate and base moderately widened in dorsal view; each paramere moderately curved, widest in middle portion, basally and apically distinctly narrowed in lateral view.

Type material. See CORNELL, 1967: 11.

Material examined, 40 specimens: UNITED STATES: 1, Louisiana; 1, Minnesota; 1, Oklahoma; 4, Texas; CANADA: 2, Manitoba; 1, Nova Scotia; 21, Ontario; 5, Quebec, 4, Saskatchewan.

Distribution. This species is confined to northeastern and central North America. It seems to be absent from the Southeast.

Biology. The specimens have been sifted from moist hard-wood litter.

Remarks. The synonymy of *B. youngi* and *B. falsata* (LÖBL, 1987) was based on examination of the holotype of *B. youngi* which is in poor condition. Study of additional material confirms the validity of *B. youngi*: both species may be readily distinguished by the shape of both the parameres and the median lobe.

THE *abdominalis* GROUP

Baeocera abdominalis Casey

Baeocera abdominalis CASEY, 1900: 58.
Eubaeocera abdominalis; CORNELL, 1967: 6.

Description. Length 1.0 - 1.1 mm. Body dark reddish-brown to black, apical portion of elytra paler. Antennomere 3 as long as 4, somewhat shorter than 2. Lateral contours of pronotum and of elytron continuously arcuate in dorsal view (Fig. 37). Pronotal microsculpture distinct at 50x magnification. Scutellum not visible. Elytron with basal stria broadly interrupted in humeral area. Elytral punctation almost obsolete at 90x magnification. Mesocoxal line somewhat convex or parallel to coxa, with marginal pits rounded, extended laterally to tip of "mesepimeron" (Fig. 38). Lateral portion of metasternum very finely punctured. Metepisternum wide, parallel-sided, with straight, impunctate suture. First visible abdominal ventrite with distinct microsculpture at 90x magnification, and with rounded, coarse basal pits. Aedeagus (Figs 125, 126) 0.37 - 0.40 mm long. Median lobe slender, with strongly keeled basal bulb. Apical portion of median lobe straight, apically moderately narrowed, much longer than basal bulb; apex curved and extended at left side. Valves symmetrical. Ventral process small. Internal sac with distinct, protruding ejaculatory duct and slender, basally enlarged sclerite. Parameres sinuate in dorsal and lateral views, with narrow apex, each bearing single apical seta.

Type material. See Cornell, 1967: 6.

Material examined, 17 specimens: UNITED STATES: 1, Georgia; 2, Mississippi; 9, New Jersey; 3, North Carolina; 1, Texas; 1, Virginia.

Distribution. This apparently rare species occurs from Maine to Georgia, westward to Texas.

Biology. The only available habitat record is pine litter. The few specimens seen were collected in February, March, August, October and November.

Remarks. See discussion under *B. robustula.*

Baeocera robustula Casey

Baeocera robustula Casey, 1893: 519.
Eubaeocera kingsolveri Cornell, 1967: 6 - **syn. nov.**

Description. Length 1.20 - 1.35 mm. Body very dark brown to black. Antennomere 3 as long as 4, shorter than 2. Lateral contours of pronotum and of elytron continuously arcuate in dorsal view (Fig. 43). Pronotal microsculpture distinct at 50x magnification. Scutellum not visible. Elytron with complete, uninterrupted basal stria. Elytral punctation extremely fine, as fine as or finer than that on pronotum, almost obsolete at 90x magnification. Mesocoxal line parallel to coxa, with marginal pits elongate and extended laterally to tip of "mesepimeron". Lateral portion of metasternum very finely punctured. Metepisternum wide, with impunctate, barely curved suture. First visible abdominal ventrite lacking microsculpture (90x), with basal pits strongly elongate (Fig. 44). Aedeagus (Figs 127, 128) 0.50 - 0.55 mm long. Median lobe weakly narrowed apically, with basal keel very large, ventral process small, and apical portion bifid, longer than basal bulb, barely narrowed apically in dorsal view. Dorsal valve single. Internal sac with slender flagellum joined to robust elongate sclerite. Parameres somewhat sinuate, wider in lateral view than in dorsal view, each bearing two apical setae.

Type material. The lectotype of *B. robustula* is here designated. It is in the collection of the United States National Museum, Washington, D.C. and bears the following labels: Ala ; Casey bequest 1925; Casey determ. *robustula*-2; and Lectotype *Baeocera robustula* Csy. det. K. Stephan 1990 (USNM). For *E. kingsolveri* see Cornell, 1967: 6.

Material examined, 108 specimens: UNITED STATES: 4, Arkansas; 4, Florida; 7, Mississippi; 9, New Jersey; 1, Ohio; 82, Oklahoma; 1, Tennessee.

Distribution. This species occurs from southern New Jersey to Florida, west to Oklahoma.

Biology. The species is not rare but is under-represented in collections. In eastern Oklahoma it is often found in decaying centers of large clumps of perennial grasses, especially those near water. Label data mention also sphagnum moss, swamp debris, sifted wood chips. Adults were found every month of the year, except in July and September. The majority are from January to March.

Remarks. *Baeocera robustula* and *B. abdominalis* share a round-oval body outline, minute size, and the scutellum completely covered by pronotum.The basal stria of the elytron is complete, and the pits along the mesocoxal line are large and elongate in *B. robustula*, while *B. abdominalis* has the basal stria of the elytron incomplete, and the pits along the mesocoxal line are small and round. Mature specimens of *B. robustula* are usually darker than those of *B. abdominalis*.

Baeocera texana Casey

Baeocera texana CASEY, 1893: 520.
Eubaeocera dybasi CORNELL, 1967: 6. - **syn. nov.**

Description. Length 1.40 - 1.65 mm. Body black-brown to black. Antennomere 3 as long as 4, shorter than 2. Lateral contours of pronotum and of elytron forming two indistinct arcs in dorsal view (Fig. 45). Pronotal microsculpture distinct at 50x magnification. Tip of scutellum exposed. Elytron with complete, uninterrupted basal stria. Elytral punctation even and very fine, not or barely coarser than that of pronotum. Mesocoxal line moderately convex, with marginal pits coarse, weakly elongate, extended to tip of "mesepimeron" (Fig. 46). Lateral portion of metasternum very finely punctured. Metepisternum wide, with suture punctured, straight in posterior half, arcuate in anterior half. First abdominal ventrite lacking microsculpture, with elongate basal pits; in male with two fovea (Fig. 47). Aedeagus (Figs 129, 130) 0.76 - 0.83 mm long. Median lobe with large basal keel, apical portion about as long as basal bulb, apically bifid, with single dorsal valve. Ventral process small. Internal sac with oblique central sclerite joined with robust basal and narrower apical apophysis. Parameres wide, arcuate, curved apically, each bearing several very short and rather stout apical setae.

Type material. Female lectotype of *B. texana*, in the collection of the United States National Museum, Washington, D.C., is here designated. It bears following labels: 965126-8; Columbus Texas, 13.8; texana; Type USNM 48754; a vial with body parts; parts on slide; and the label Lectotype *Baeocera texana* Csy. det. K.Stephan 1990. For type data of *B. dybasi* see CORNELL, 1967: 6.

Material examined, 47 specimens: UNITED STATES: 13, Texas, Brazos Co., Koppe's Bridge, 5 mi SW College Sta., 6.IV.1987, R. Anderson; 2, Brazos Co., College Station, X.1974, J. S. Ashe; 1, Brazos Co., Peach Chat Hwy, 5 mi SW College Sta., 14. IV. 1987, R .Anderson and 1, same data, but 8 mi S College Sta.; 4, Texas, Llano Co., Enchanted Rock St. Pk., 20.V.1986, P. W. Kovarik; 1, Texas, Brownsville, V (no other data); 13, Brownsville, Sabal Palm Grove, 10.VIII. 1983, S. & J. Peck; 2, Texas, Bastrop Co., Bastrop State Park, 24-27. V.1983, S. & J. Peck, 2, Texas, Hidalgo Co., G. Wheeler; 6, Florida, Destin, I., II., III. 1976, E. J. Kiteley; 1, Florida, Ft. Walton Beach, II.1976, E.J.Kiteley; 1, Florida, Archer, 25.I.1979, E. C. Becker.

Distribution. Texas and northwestern Florida.

Biology. Specimens were collected in forest litter, leaf litter, and in a riparian ravine.

Remarks. See discussion under *B. laevis*.

Baeocera laevis (Reitter)

Scaphisoma laeve REITTER, 1880: 47.
Eubaeocera mitchelli CORNELL, 1967: 15.
Baeocera laevis: LÖBL, 1987: 316.

Description. Length 1.4 - 1.5 mm. Body usually black, sometimes dark reddish-brown. Antennomere 3 about as long as 4, shorter than 2. Lateral contours of pronotum and elytron continuously arcuate in dorsal view (Fig. 41). Pronotal microsculpture distinct at 50x magnification. Tip of scutellum exposed. Elytron with complete basal stria; very fine discal punctures of uniform size, larger than those on pronotum. Mesocoxal line weakly convex, with marginal pits moderately large, rounded, extended laterally to tip of "mesepimeron". Lateral portion of metasternum very finely punctured. Metepisternum wide, with suture impunctate, weakly arcuate in apical half (Fig. 42). First abdominal ventrite lacking microsculpture at 90x magnification, with basal pits non-elongate. Aedeagus (Figs 131 to 133) 0.64 - 0.70 mm long. Basal bulb large, somewhat longer than apical portion of median lobe, with small, inconspicuous ventral keel. Apical portion of median lobe asymmetrical, with curved and sinuate apicoventral arm covered by large dorsal valve. Ventral margin of apical portion strongly arcuate, with inclined, pointed tip in lateral view. Internal sac with two robust curved sclerites, pair of extruding lamilar vesicles and two apical lobes. Parameres wide, curved, each with tooth-like apophysis in center.

Type material. For *B. laevis* see LÖBL, 1987: 316; for *B. mitchelli* see CORNELL, 1967: 15.

Material examined, 483 specimens: UNITED STATES: 6, Alabama; 367, Florida; 1, Georgia; 2, Louisiana; 1, North Carolina; 1, South Carolina; 5, Mississippi; 2, Missouri; 13, New Jersey; 5, New York; 67, Oklahoma; 12, Texas; 1, West Virginia.

Distribution. This common species occurs from New Jersey south to Florida, west to Oklahoma and Texas. It is more numerous in the south.

Biology. The species inhabits a broad range of litter habitats. Specimens were taken from leaf litter, wood rat nest, river drift, base of rotten pine, palmetto gumbo-limbo litter, oak-cabbage palm litter, cypress litter, and dead tree. It was found throughout the year. The Florida specimens were found in flight intercept traps.

Remarks. *Baeocera laevis* may be confused with *B. texana* and *B. amicula*, which are sympatric in Texas and in south Florida, respectively. These three species are about of the same size, have a visible scutellum, and complete basal stria of the elytron. In *B. texana* the punctures along the mesocoxal line are coarse and elongate, and the body outline is weakly parallel-sided. In *B. amicula* and *B. laevis* the punctures along the mesocoxal line are round and small. The body is elongate-oval in *B. laevis* while in *B. amicula* it is more rounded. In addition, the metepisternal suture is moderately rounded in *B. amicula*, but almost straight in *B. laevis*.

Baeocera amicula sp.n.

Description. Length 1.35 - 1.45 mm, width 0.87 - 0.98 mm. Body usually black. Antennomere 3 shorter than 2 or 4. Lateral contours of pronotum and of elytron separately arcuate in dorsal view (Fig. 39). Pronotum lacking microsculpture (90x magnification). Tip of scutellum exposed. Elytron with complete, uninterrupted basal stria. Elytral punctation even and very fine, somewhat more distinct than that of pronotum. Mesocoxal line parallel to coxa, with marginal pits rounded, moderately large, not extended laterally. Lateral portion of metasternum very finely punctured. Metepisternum wide, suture convexly rounded, impunctate

(Fig. 40). First abdominal ventrite not microsculptured (90x magnification), with basal pits not or barely elongate. Aedeagus (Figs 134, 135) 0.50 - 0.56 mm long. Median lobe with relatively slender basal bulb and long, very low keel. Ventral process well developed. Dorsal valves asymmetrical. Apical portion of median lobe thick, with ventral margin almost regularly concave in lateral view, dorsally deeply notched and gutter-like. Internal sac with flagellum, long and large sclerite curved basally, and with thinner ventral sclerites. Ejaculatory duct traceable from basal orifice to apex, apically extruded. Parameres slender, with strongly enlarged base, somewhat incurved and apically narrowed in lateral view, curved in apical half and not narrowed towards apex in dorsal view.

Type material. Holotype, male. UNITED STATES: Florida, Monroe Co., Sugarloaf Key, Kitchings, 29.VIII. - 14.XII.1986, S. & S. Peck (CNCI).

Paratypes, 87, all from Florida: 5, same data as holotype (MHNG); 1, same data as holotype, but 4. XI.1984 - 3.III.1985 (MHNG); 9, same but 26.II. - 6.VI.1986, S.& J.Peck, forest hammock, malaise & FIT (CNCI, KSC); 11, Fat Deer Key, 24.II. - 4.VI.1986, S. & J.Peck (MHNG) and 1, same but 4.III. - 28.IV.1985, hammock malaise - FIT (CNCI); ; 36, N. Key Largo, Sec. 35, 4.III. - 28.IV.1985, S. & J. Peck (MHNG); 8, Key Largo, Pennekamp St. Pk., 22. II. 2.VI.1986, S. & J. Peck (MHNG); 2, Big Pine Key, Watsons Hammock, 28. VIII. - 13. XII. 1986, S. & J. Peck (MHNG); 3, Big Pine Key, Cactus Hammock, 30.VII. - 1.VIII.1985, S. & J. Peck, hammock forest litter (CNCI); 2, Vaca Key, Marathon, 1.IX. 1986, S. & J. Peck (MHNG); 7, No Name Key, 23.II. - 3.VI.1986, S. & J.Peck, hammock malaise - FIT (CNCI); 2, Dade Co., Palma Vista Hammock, Everglades Nat. Pk., 18.IV.1965, W. Suter, forest floor litter, Palmetto-Gumbo-Limbo upland.

Distribution. *Baeocera amicula* is at present known only from Monroe and Dade Counties in extreme southern Florida, where it is sympatric with the similar *B. laevis*.

Biology. Most specimens were found in Malaise and flight intercept traps those from Vaca Key were taken in leaf litter.

Remarks. *Baeocera amicula* is likely to be confused with *B. laevis*. Males can be distinguished by the very different genitalia. In addition, the new species differs from *B. laevis* by the more rounded form of the body and by the curved metepisternal suture.

THE *elongata* GROUP

Baeocera elongata sp.n.

Description. Length 1.4 - 1.5 mm, width 0.83 - 0.90 mm. Body dark brown, elytra paler apically. Antennomere 3 as long as 4, shorter than 2. Lateral contours of pronotum and elytron separately arcuate in dorsal view (Fig. 48). Pronotal microsculpture barely visible at 90x magnification. Tip of scutellum exposed. Elytron with basal stria broadly interrupted in humeral area. Very fine elytral punctation near base, similar to that of pronotum. rather coarse on large central area (visible at 12x), fine near apex (visible at 24x). Mesocoxal line almost parallel to coxa, with marginal pits fine, round, not extended laterally. Lateral portion of metasternum very finely punctured. Metepisternum moderately wide, almost parallel-sided, with straight impunctate suture. First abdominal ventrite lacking microsculpture (90x magnification), basal pits strongly elongate, forming grooves or striae laterally extending 1/3 upon segment (Fig. 49). Aedeagus (Figs 136, 137) 0.67 mm long. Median lobe with basal bulb about as long as thick, trifid, curved apical portion. Ventral process small. Valve single, distinct in lateral view. Internal sac strongly sclerotized, complex, ejaculatory duct not traceable. Parameres slender, except for enlarged base, bearing few apical setae; moderately sinuate in lateral view, curved in dorsal view.

Type material. Holotype, male. Arizona, Pima Co., Colossal Cave Park, 27.X.1971, D. S. Chandler, sifting rotten Opuntia (OSUC).

Paratypes, 17, UNITED STATES: Arizona: 5, Santa Cruz Co., Madera Cyn., 9 - 11.IX.1970, A. Newton (FMNH, KSC); 1, Santa Cruz Co., Madera Cyn., 20.XI.1971, D.S.Chandler (OSUC); 1, Santa Cruz Co., Las Guijas Mts., N Arivaca, 4000 ft, above old mining camp, 2.II.1965, J. Bequaert (UAIC); 2, Pima Co., Santa Catalina Mts., Molino Cyn., on Mt. Lemmon Hwy, 4100 ft, 25.XI.1971, D. S. Chandler (UAIC, MHNG); 1, Pima Co., Santa Catalina Mts., Bear Cyn. on Mt. Lemmon Hwy, 5600 ft, 3.X.1971, D. S. Chandler (UAIC); 4, Santa Catalina Mts., Molino Basin, 20.III.1964, J. C. Bequaert, (UAIC); 1, Pima Co., Tucson, Santa Catalina foothills, 2.VIII.1962, W. L. Nutting & P. Mehringer (UAIC); 1, Texas, El Paso, 28.VII.1914, J. C. Bradley (CUIC); 1, Portal, 26.VI.1956, H. & A. Howden (CNCI); 1 mi E Portal, 28.VI.1956, H. & A. Howden (CMNC).

Distribution. Most specimens were found in the mountains of southeastern Arizona.

Biology. *Baeocera elongata* is an inhabitant of the oak-zone. Specimens were taken in oak and sycamore duff, and three times found in wood rat nests. Adult were found in February, March, and July to November.

Remarks. The El Paso specimen is a female. As it exhibits all diagnostic features of the Arizona specimens, it is considered to be conspecific.

Baeocera hamata sp.n.

Description. Length 1.75 mm, width 1.25 mm. Head, pronotum and basal portion of elytra blackish, elytra gradually paler apically. Antennomere 3 as long as 4, shorter than 2. Lateral contours of pronotum and elytron separately arcuate in dorsal view (Fig. 56). Pronotal microsculpture hardly visible at 50x magnification, punctation distinct at 24 x magnification. Exposed portion of scutellum large. Elytron with basal stria broadly interrupted, not extended beyond middle of elytral base. Punctation very fine on basal fifth to fourth and on inclined lateral portion. Central portion of elytron with coarse and dense punctation (many punctures about as large as intervals); punctation toward apical margin and near sutural stria finer than that on center. Mesocoxal line parallel to coxa, marginal pits rounded and not extended laterally. Lateral portion of metasternum very finely punctured. Metepisternum parallel-sided except near angles, with straight, punctured suture. First abdominal ventrite with microsculpture hardly visible at 90x magnification, basal pits elongate, extended by striae. Apical margin of sixth ventrite bisinuate, with median lobe short, pointed. Aedeagus (Figs 138, 139) 0.72 mm long. Median lobe asymmetrical, with basal bulb fairly large, longer than trifid apical portion. Ventral process small, protruding. Apical portion of median lobe gradually narrowed toward strongly curved tip. Dorsal valves narrow, strongly sclerotized, apically curved and pointed. Internal sac bearing large sclerotized pieces. Dorsal pair of sclerites overlapping apically, joined basally. Parameres symmetrical, wide and moderately arcuate in dorsal view, slender and weakly curved in lateral view; setae absent.

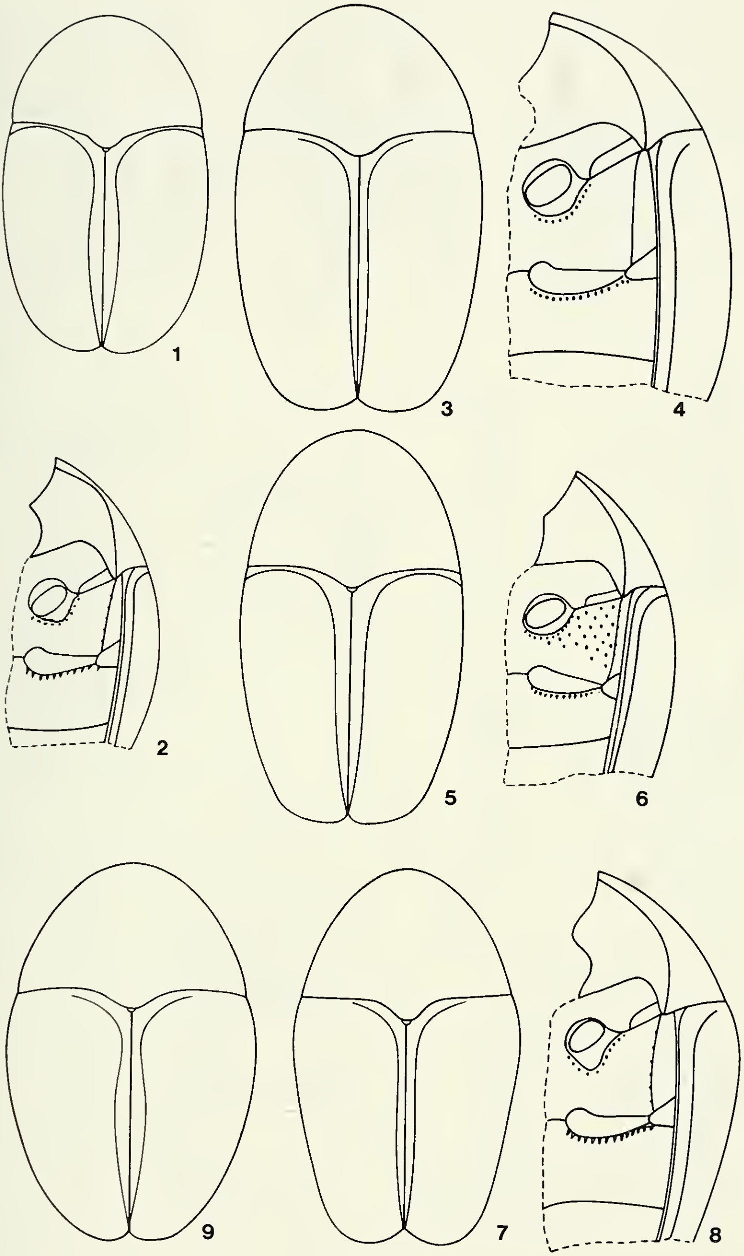
Type material. Holotype, male: UNITED STATES: Texas, Welder Wildlife Refuge, 17 km NE Sinton, 17-25.V.1985, H. & A. Howden, C.Scholtz. Malaise trap (CMNC).

Distribution. Texas.

Remarks. This species may be readily distinguished from other Nearctic *Baeocera* by the elytral punctation in combination with the interrupted basal stria and the size of the body.

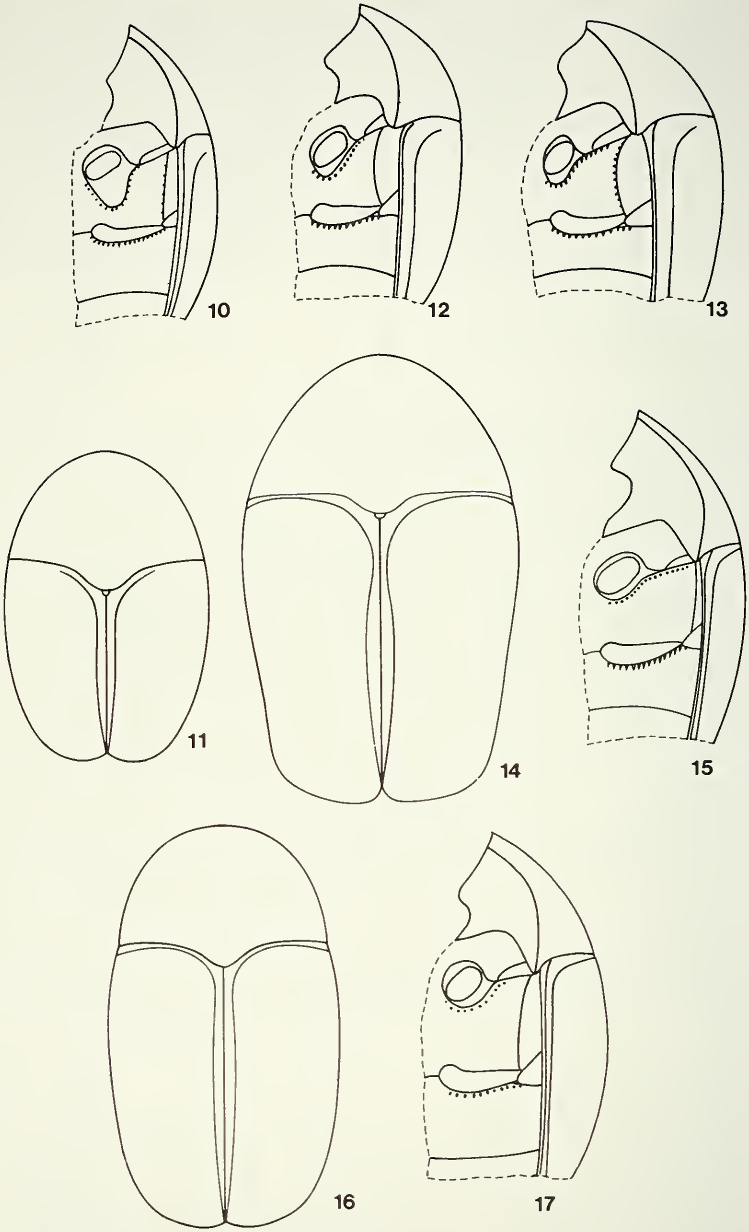
ACKNOWLEDGEMENTS

We thank the following individuals and institutions for the loan of specimens in their care: Albert Allen, Boise, Idaho; Robert C. Anderson, Canadian Museum of Nature, Ottawa; Horace R. Burke and Edward Riley, Texas A. & M. University, College Station; J. M. Campbell and Ales Smetana, Canadian National Collection, Ottawa; Chris E. Carlton, University of Arkansas, Fayetteville; Donald S. Chandler, University of New Hampshire, Durham; James F. Cornell, Charlotte, North Carolina; Stephan P. Cover and David G. Furth, Museum of Comparative Zoology, Cambridge; Michael G. Goodrich, Eastern Illinois University, Charleston; Gary F. Hevel, Gloria N. House and James Pakaluk, United States National Museum, Washington, D.C.; R. Hoebeke and Krista E. M. Galley, Cornell University, Ithaca; P. K. Lago, University of Mississippi, University; Alfred F. Newton, Jr., Field Museum of Natural History, Chicago; Stewart B. Peck, Carleton University, Ottawa; Terence Schiefer, Mississippi Entomological Museum; Charles A. Triplehorn, Ohio State University, Columbus; Robert H. Turnbow, Fort Rucker; Howard V. Weems, Jr. and Michael C. Thomas, Florida State Collection of Arthropods, Gainesville; F. G. Werner and C. A. Olson, University of Arizona, Tucson. Nicolette Lavoyer, Geneva, made most of the drawings. Useful comments on the manuscript were provided by Ales Smetana, Richard A. B. Leschen, Marion Davies and Alfred F. Newton, Jr. Their help and stimulating advice are gratefully acknowledged.



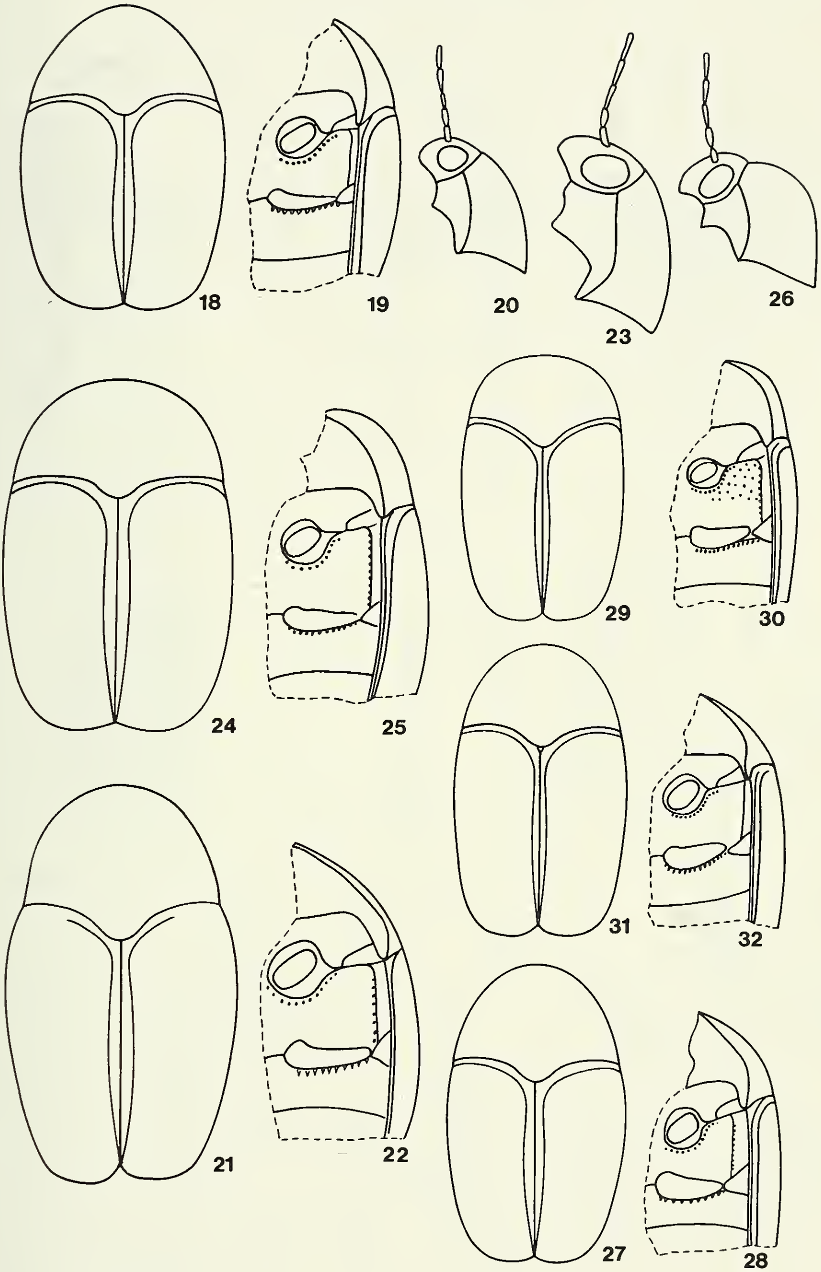
FIGS 1-9

Baeocera in dorsal and lateral view; 1 and 2. *B. eurydice* (Cornell); 3 and 4. *B. pallida* Casey; 5 and 6. *B. sticta* sp.n.; 7 and 8. *B. picea* Casey; 9. *B. hesperia* sp.n.



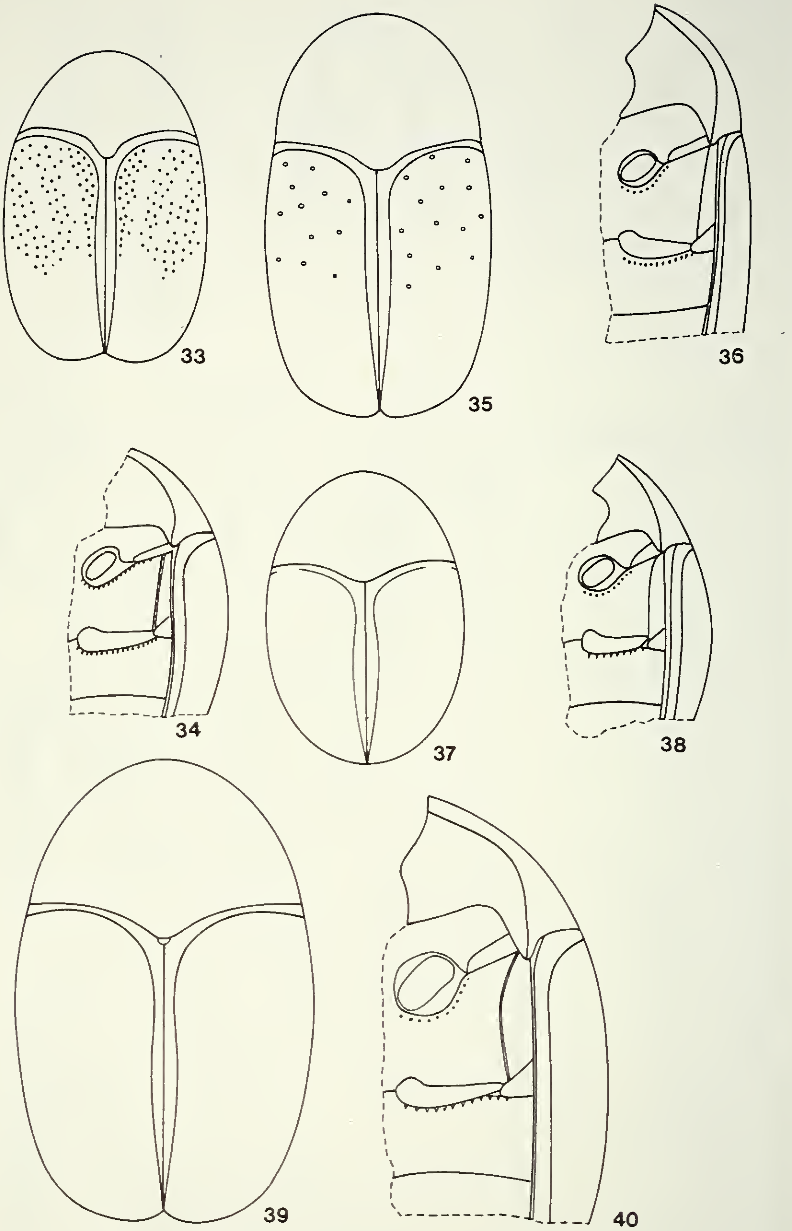
FIGS 10-17

Baeocera in dorsal and lateral view; 10. *B. hesperia* sp.n.; 11 to 13. *B. nana* Casey; 14 and 15. *B. humeralis* Fall; 16 and 17. *B. apicalis* Casey.



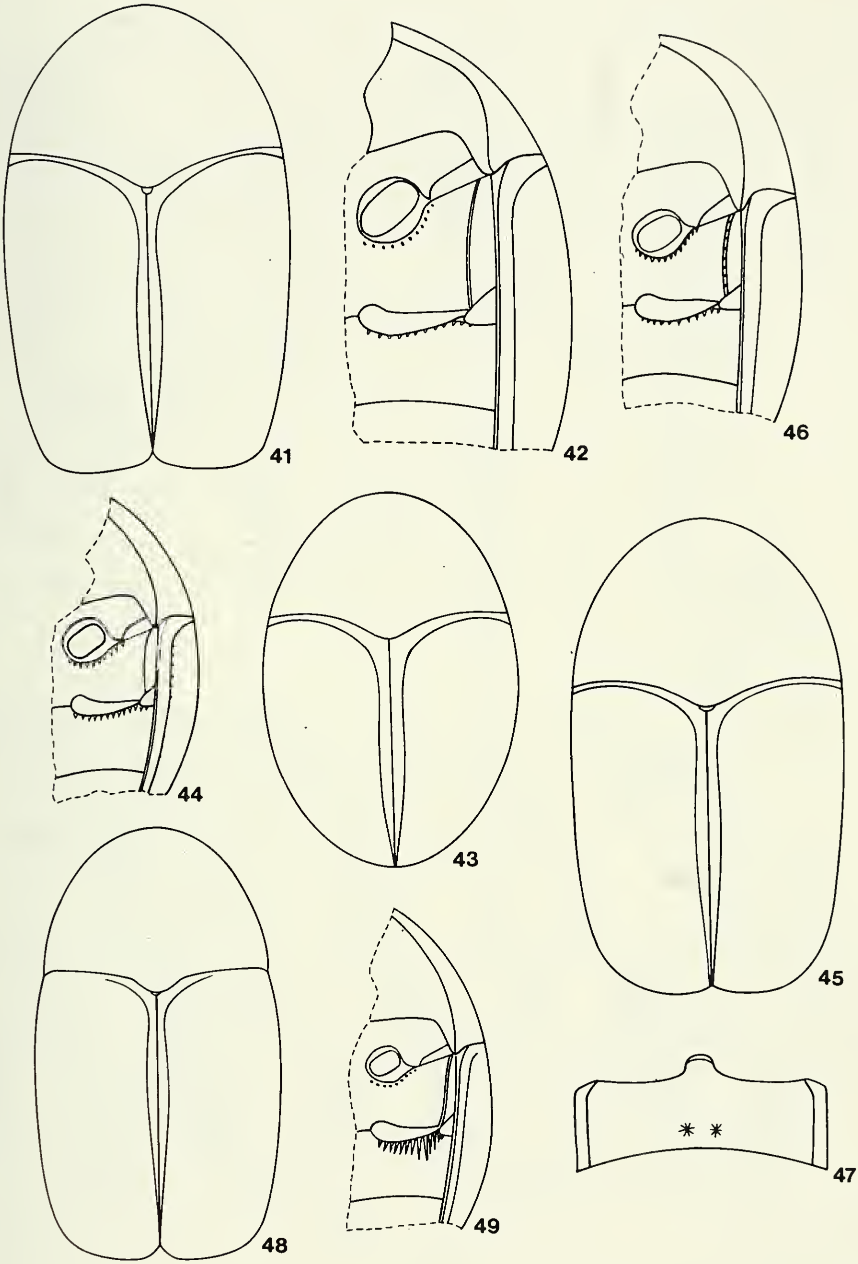
Figs 18-32

Baeocera in dorsal and lateral view; 18 to 20. *B. congener* Casey; 21 to 23. *B. deflexa* Casey; 24 to 26. *B. falsata* Achard; 27 and 28. *B. flagellata* (Löbl); 29 to 30. *B. solida* sp.n.; 31 and 32. *B. valida* (Löbl).



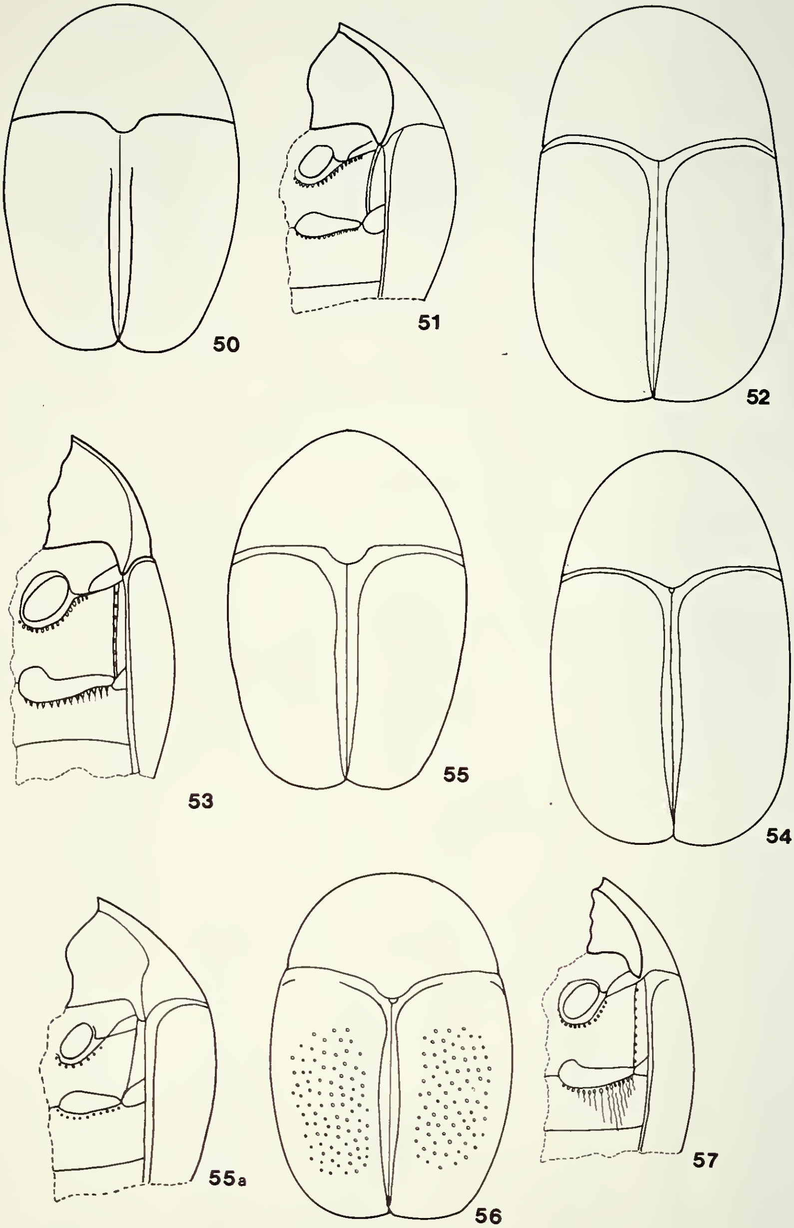
Figs 33-40

Baeocera in dorsal and lateral view. 33 and 34. *B. irregularis* Champion; 35 and 36. *B. chisosa* sp.n.. 37 and 38. *B. abdominalis* Casey; 39 and 40. *B. amicula* sp.n.



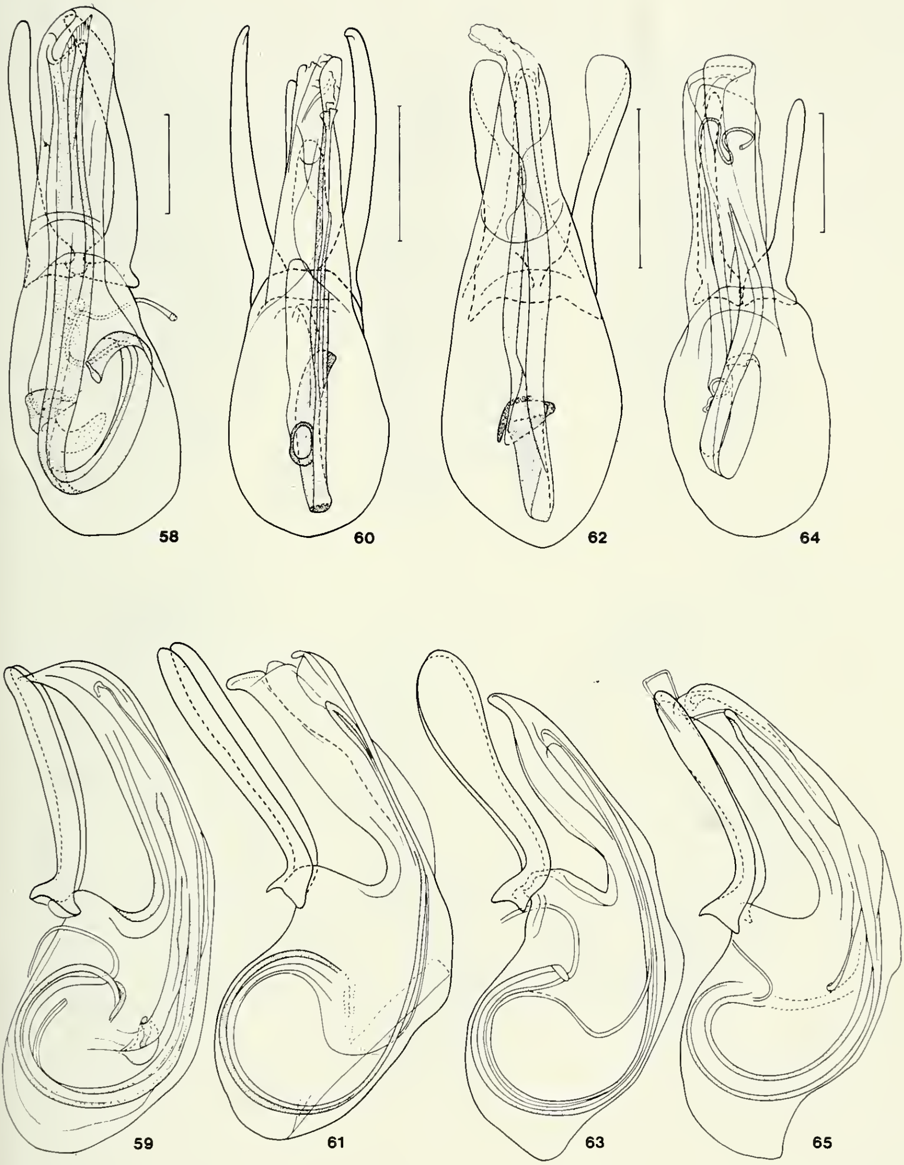
Figs 41-49

Baeocera in dorsal and lateral view; 41 and 42. *B. laevis* (Reitter); 43 and 44. *B. robustula* Casey; 45 to 47. *B. texana* Casey (47. first visible ventrite in male); 48 to 49. *B. elongata* sp.n.



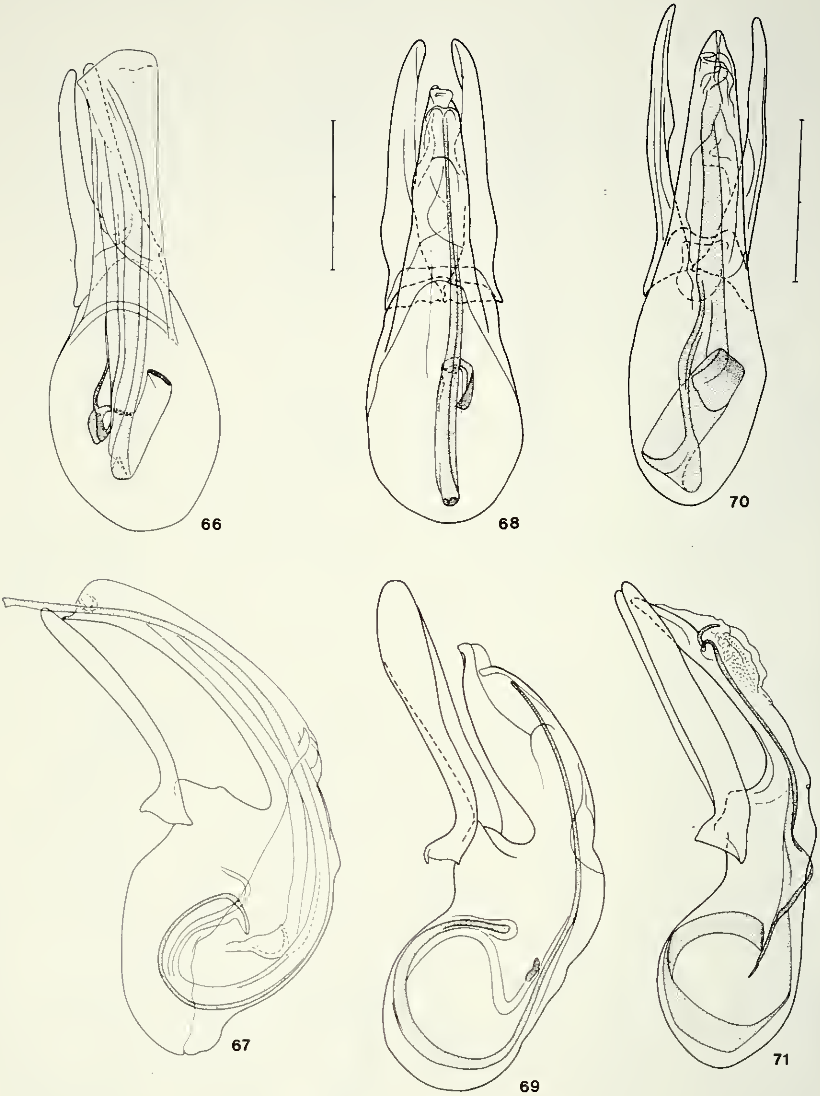
FIGS 50-57

Baeocera in dorsal and lateral view; 50 and 51. *B. pecki* sp.n.; 52 and 53. *B. lenczyi* sp.n.; 54 . *B. impunctata* sp.n.; 55 and 55a. *B. compacta* sp.n.: 56 and 57. *B. hamata* sp.n.



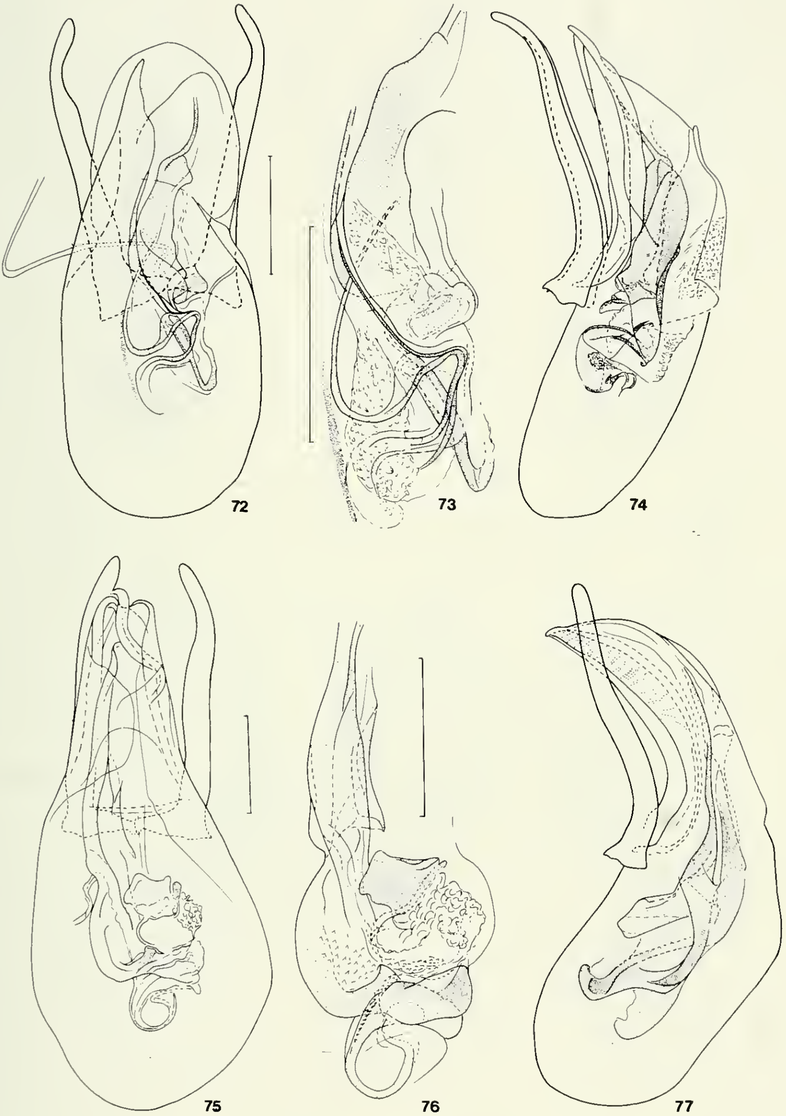
FIGS 58-65

Aedeagi of *Baeocera* in dorsal and lateral view; 58 and 59. *B. apicalis* Casey; 60 and 61. *B. pallida* Casey; 62 and 63. *B. eurydice* (Cornell); 64 and 65. *B. sticta* sp.n. Scale bar = 0.1 mm.



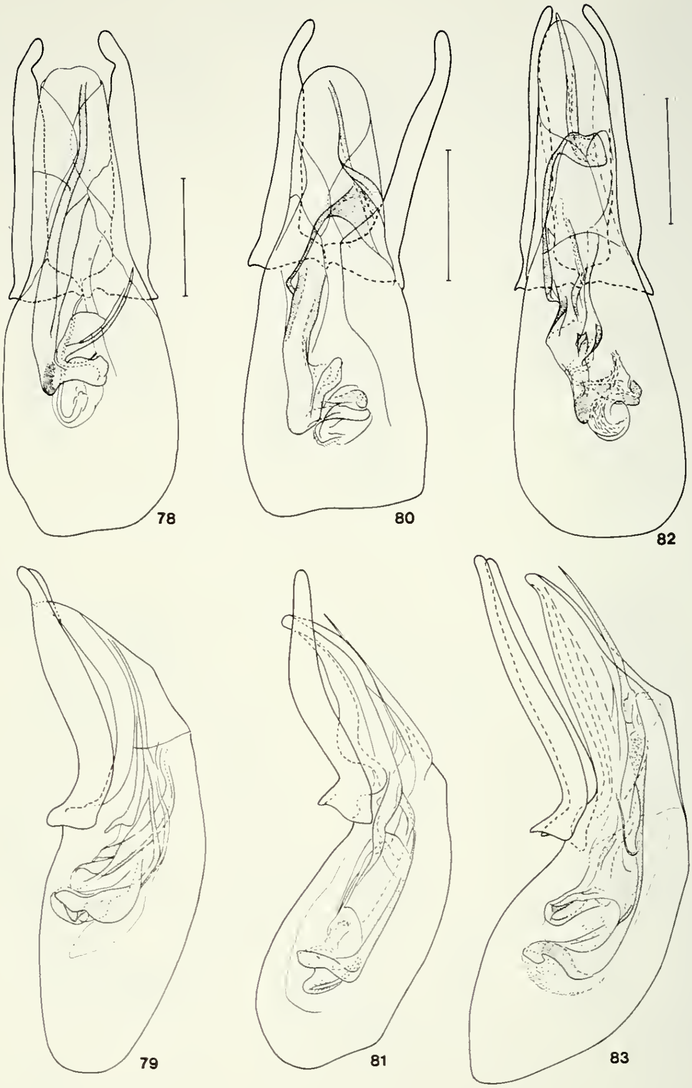
FIGS 66-71

Aedeagi of *Baeocera* in dorsal and lateral view; 66 and 67. *B. chisosa* sp.n.; 68 and 69. *B. obesa* sp.n.; 70 and 71. *B. pecki* sp.n. Scale bar = 0.2 mm.



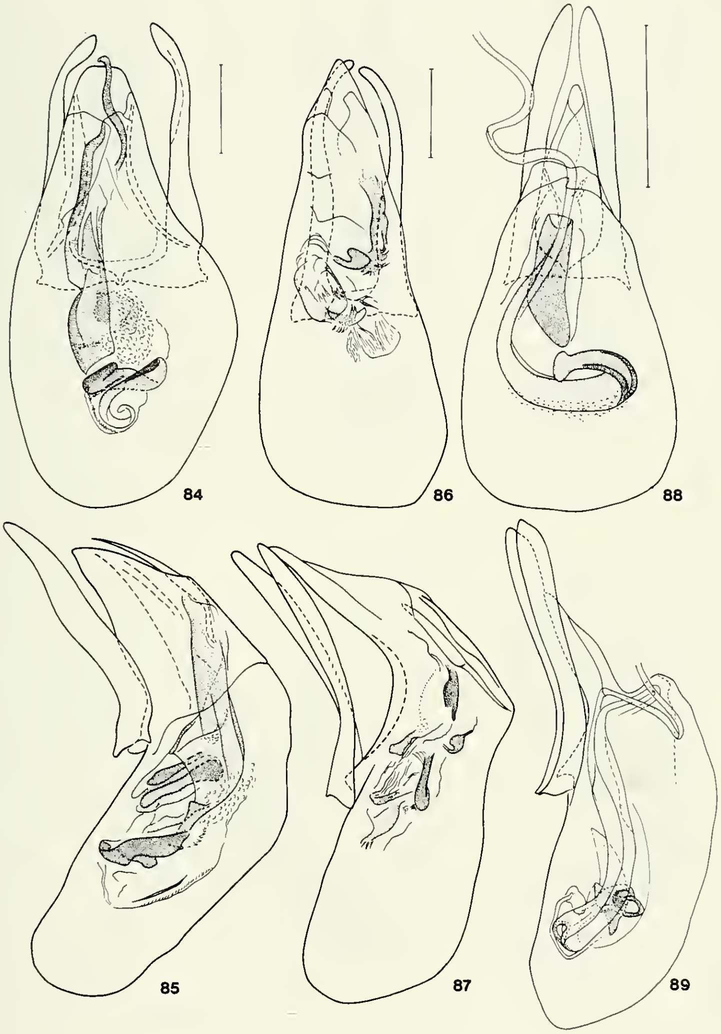
Figs 72-77

Aedeagi of *Baeocera* in dorsal and lateral view; 72 to 74. *B. picea* Casey; 75 to 77. *B. charybda* (Cornell); 73 and 76, internal sac in detail. Scale bar = 0.1 mm.



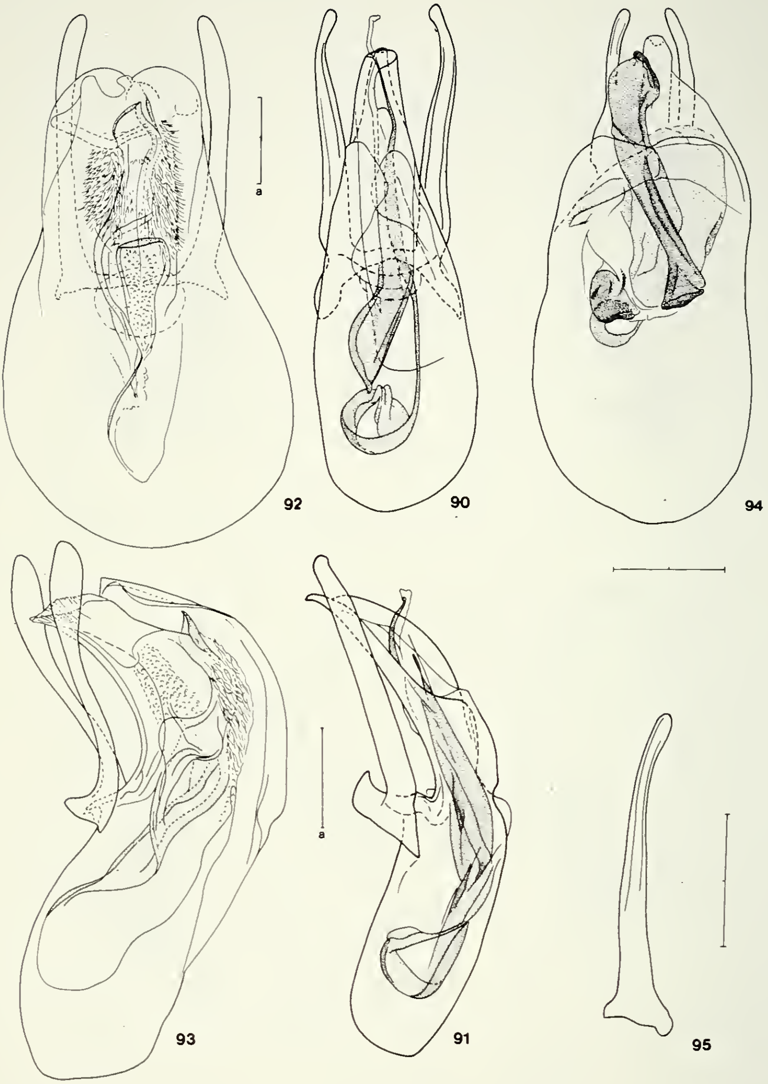
Figs 78-83

Aedeagi of *Baeocera* in dorsal and lateral view; 78 and 79. *B. scylla* (Cornell); 80 and 81. *B. similaris* sp.n.; 82 and 83. *B. indistincta* sp.n. Scale bar = 0.1 mm.



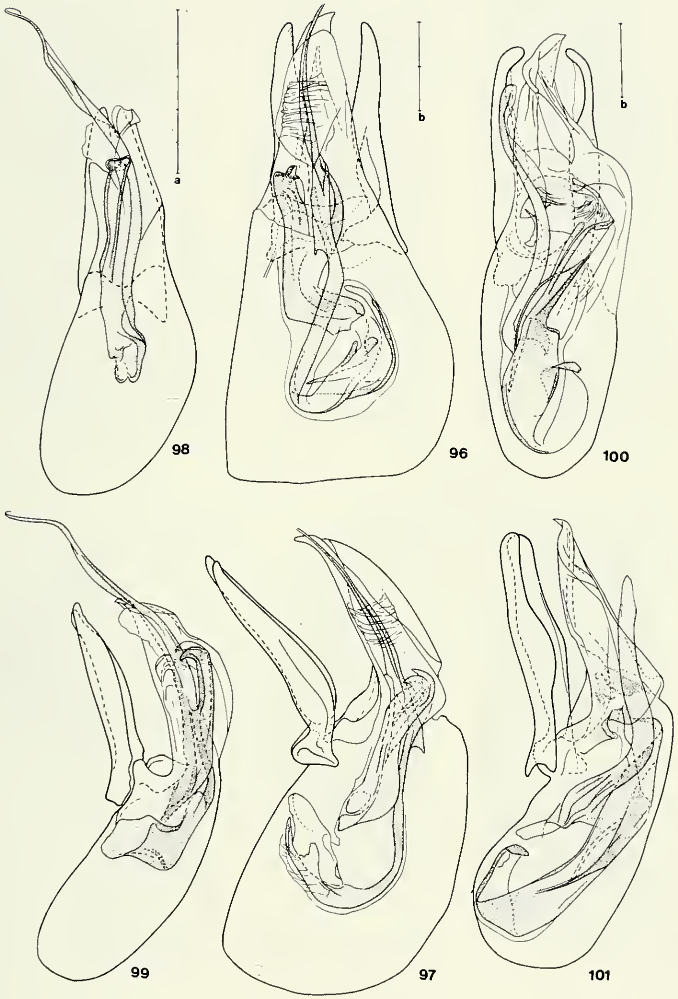
Figs 84-89

Aedeagi of *Baeocera* in dorsal and lateral view; 84 and 85. *B. borealis* sp.n.; 86 and 87. *B. hesperia* sp.n.; 88 and 89. *B. nana* Casey. Scale bar = 0.1 mm.



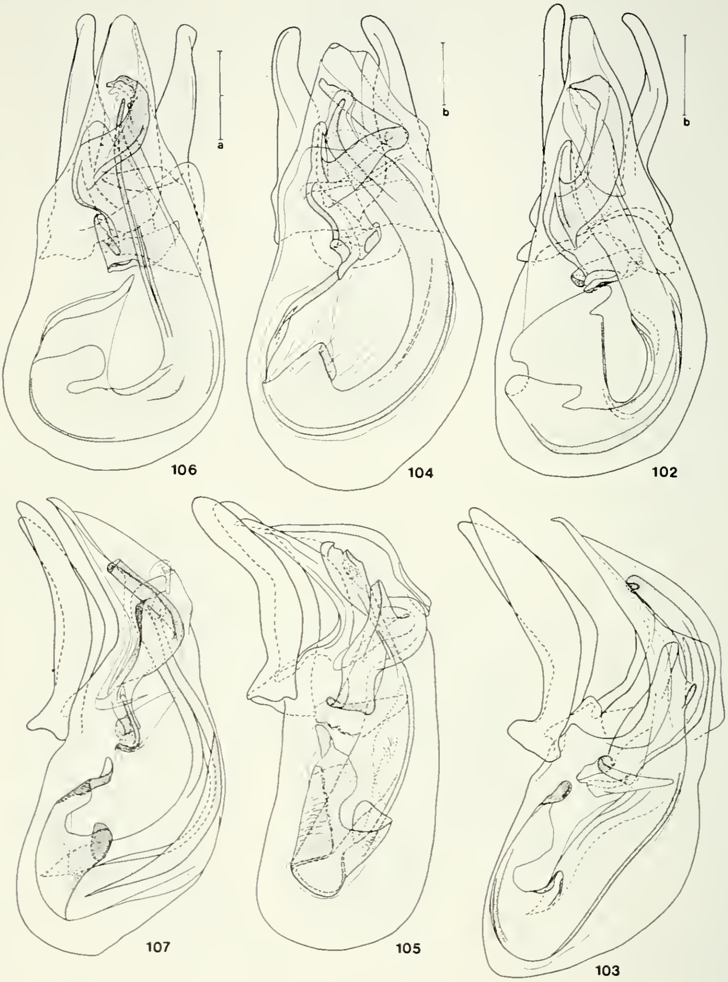
Figs 90-95

Aedeagi of *Baeocera* in dorsal and lateral view; 90 and 91. *B. compacta* sp.n.; 92 and 93. *B. humeralis* Fall; 94 and 95. *B. irregularis* Champion, paramere (95) in ventral view. Scale bar a = 0.1 mm, b = 0.2 mm.



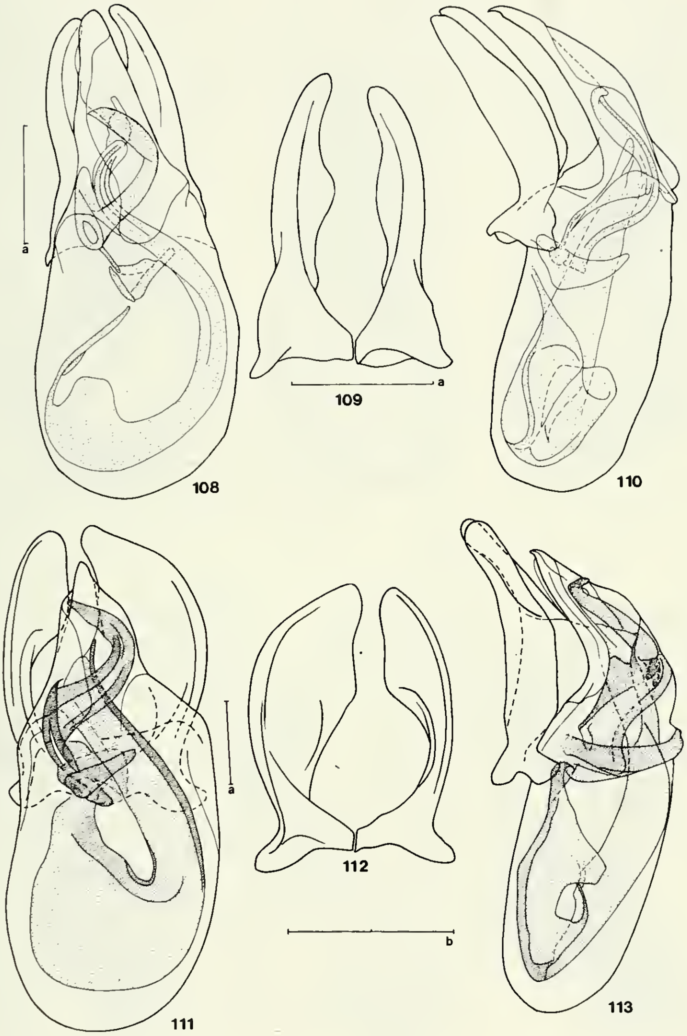
FIGS 96-101

Aedeagi of *Baeocera* in dorsal and ventral view; 96 and 97. *B. deflexa* Casey; 98 and 99. *B. flagellata* (Löbl); 100 and 101. *B. valida* (Löbl). Scale bar a = 0.5 mm, b = 0.2 mm.



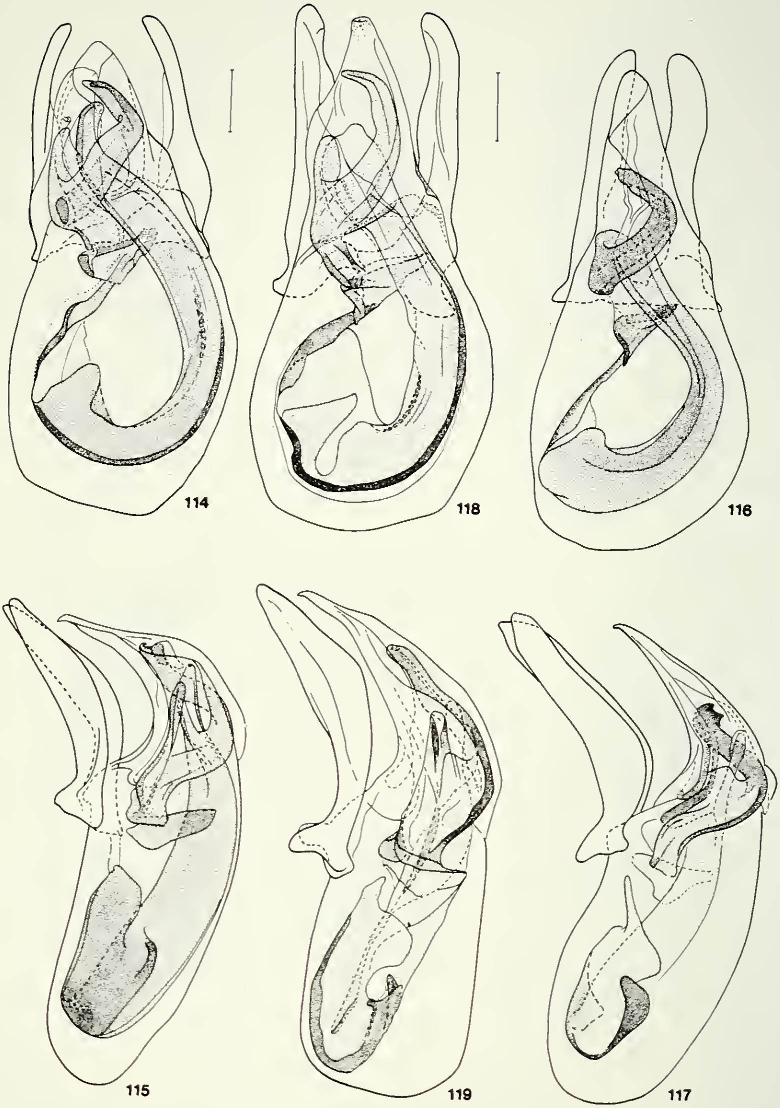
FIGS 102-107

Aedeagi of *Baeocera* in dorsal and lateral view; 102 and 103. *B. cerbera* (Cornell); 104 and 105. *B. congener* Casey; 106 and 107. *B. falsata* Achard. Scale bar a = 0.2 mm, b = 0.1 mm.



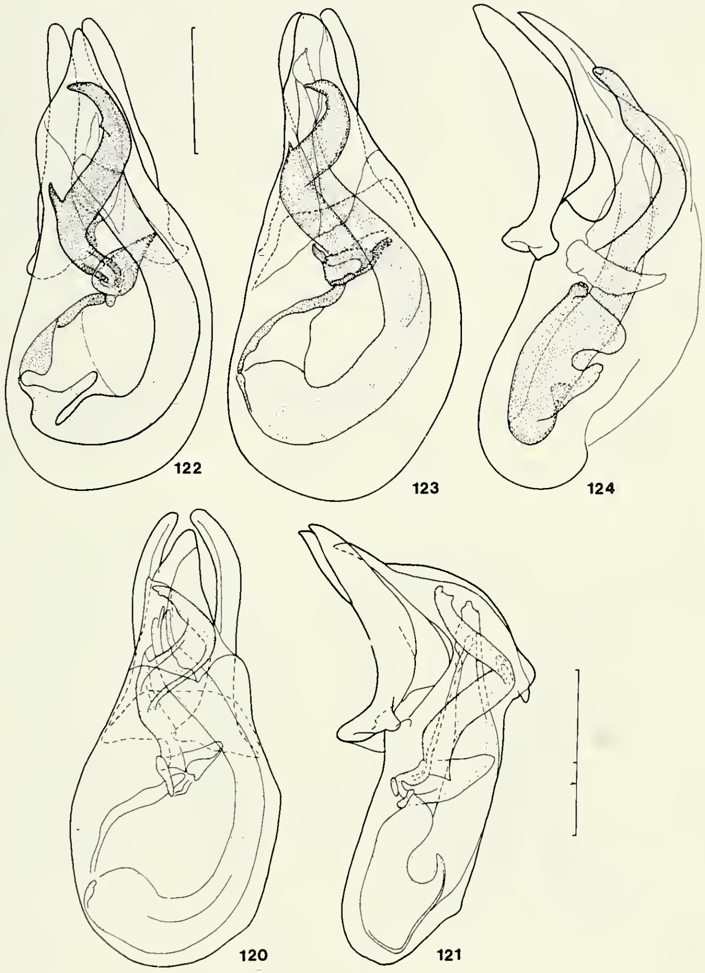
FIGS 108-113

Aedeagi of *Baeocera* in dorsal and lateral view; 108 to 110. *B. inexspectata* sp.n.; 111 to 113. *B. lenczyi* sp.n. Scale bar a = 0.1 mm, b = 0.2 mm.



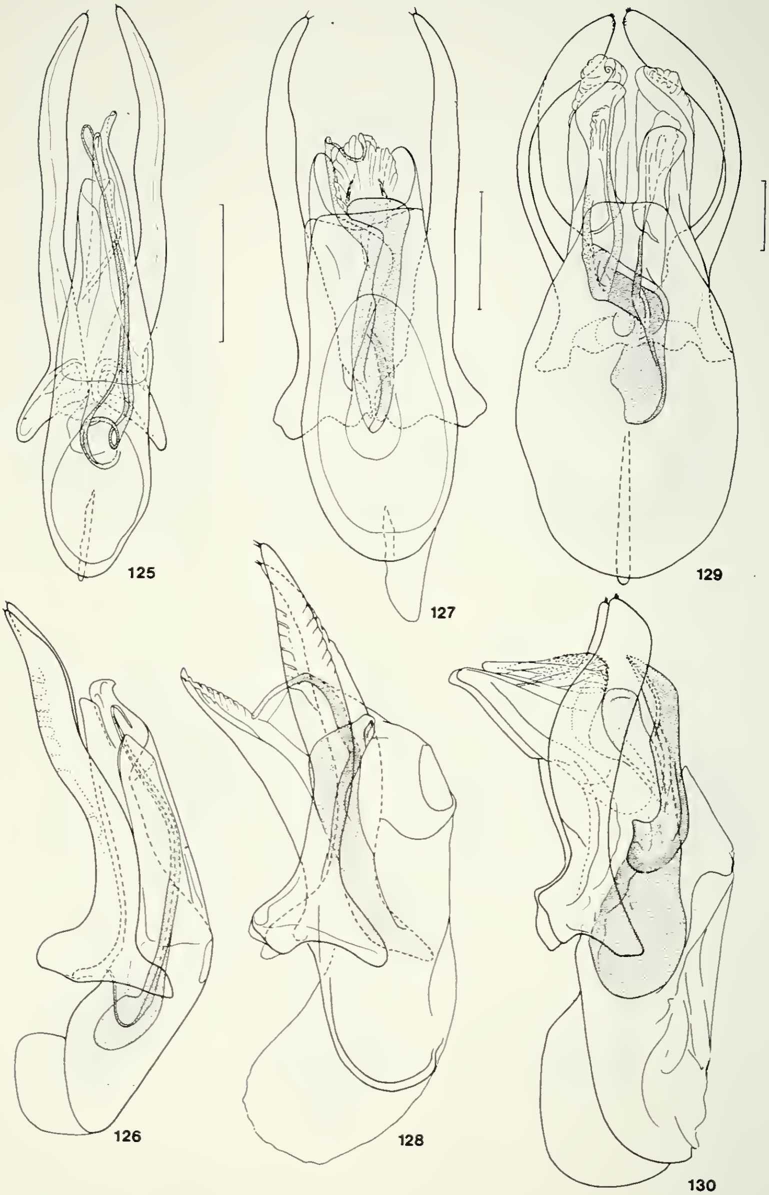
FIGS 114-119

Aedeagi of *Baeocera* in dorsal and lateral view; 114 and 115. *B. impunctata* sp.n.; 116 and 117. *B. securiforma* (Cornell); 118 and 119. *B. solida* sp.n. Scale bar = 0.1 mm.



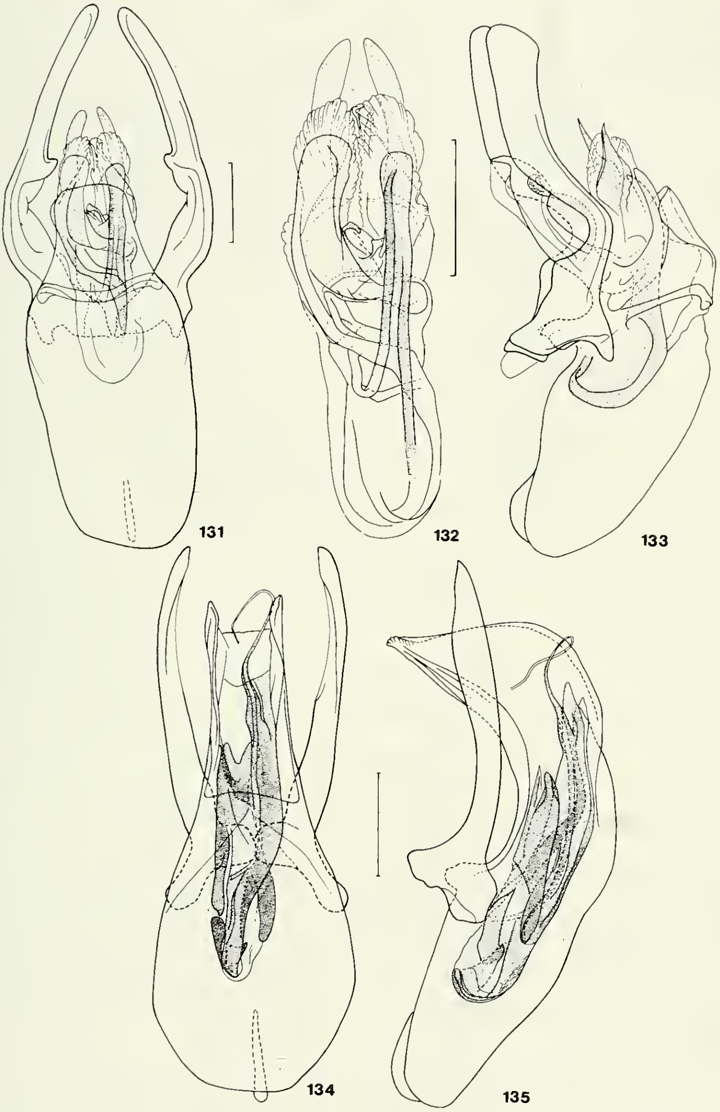
FIGS 120-124

Aedeagi of *Baeocera* in dorsal and lateral view; 120 and 121. *B. speculifer* Casey; 122 to 124. *B. youngi* (Cornell). Scale bar = 0.1 mm.



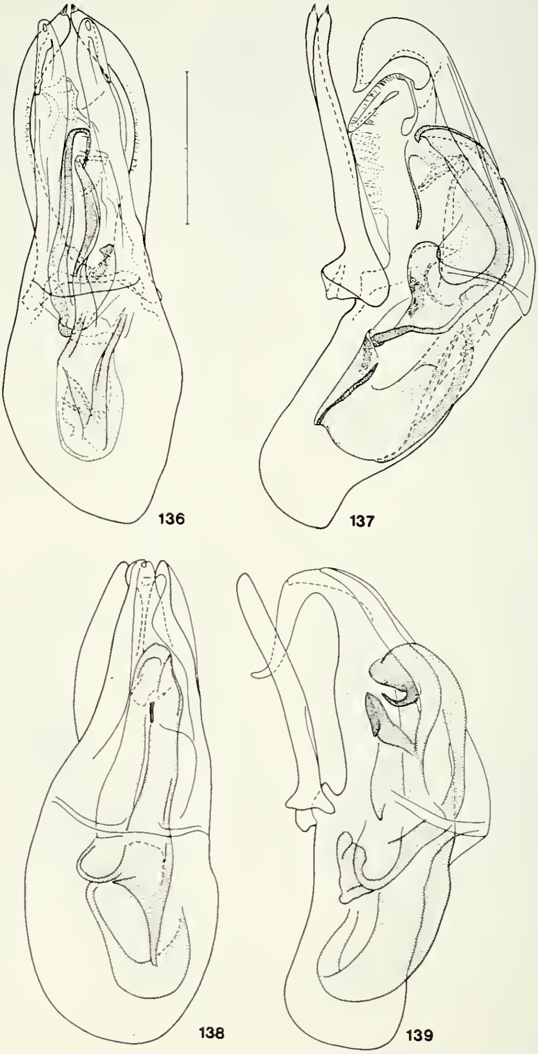
Figs 125-130

Aedeagi of *Baeocera* in dorsal and lateral view; 125 and 126. *B. abdominalis* Casey; 127 and 128. *B. robustula* Casey, 129 and 130. *B. texana* Casey. Scale bar = 0.1 mm.



FIGS 131-135

Aedeagi of *Baeocera* in dorsal and lateral view; 131 to 133. *B. laevis* (Reitter), 132. internal sac in detail; 134 and 135. *B. amicula* sp.n. Scale bar = 0.1 mm.



Figs 136-139

Aedeagi of *Baeocera* in dorsal and lateral view, 136 and 137. *B. elongata* sp.n.; 138 and 139. *B. hamata* sp.n. Scale bar = 0.2 mm.

REFERENCES

ACHARD, J. 1920. Identification du *Scaphidium concolor* F. (Col. Scaphidiidae). *Bull. Soc. ent. France* 1920: 307.

CASEY, T. L. 1893. Coleopterological Notices. V. Scaphidiidae. *Ann. N. Y. Acad. Sci.* 7: 510 - 533.

CASEY, T. L. 1900. Review of the American Corylophidae, Cryptophagidae, Tritomidae and Dermestidae, with other studies. *J. New York Ent. Soc.* 8: 51 - 172.

CHAMPION, G. C. 1913. Notes on various Central American Coleoptera, with descriptions of new genera and species. *Trans. Ent. Soc. London*, 1913: 58 - 169, pl.III, IV.

CORNELL, J. F. 1967. A taxonomic study of *Eubaeocera* new genus (Coleoptera: Scaphidiidae) in North America north of Mexico. *Coleopts Bull.* 21: 1 - 17.

ERICHSON, W. F. 1845. Naturgeschichte der Insecten Deutschlands. Erste Abtheilung. Coleoptera. Dritter Band. Berlin.

FABRICIUS, J. C. 1801. Systema Eleutheratorum, II. Kiliae.

FALL, H.C. 1910. Miscellaneous notes and descriptions of North American Coleoptera. *Trans. Amer. Ent. Soc.* 36: 89 - 197.

ICZN (International Commission on Zoological Nomenclature). 1982. Opinion 1221. *Baeocera* Erichson, 1845 (Insecta, Coleoptera): Designation of type species.

LAWRENCE, J.F. & A. F. NEWTON Jr. 1980. Coleoptera associated with the fruiting bodies of slime molds. *Coleopts Bull.* 34: 129-143.

LECONTE, J. L. 1860. Synopsis of the Scaphidiidae of the U.S. *Proc. Acad. Nat.Sci. Philadelphia* 1860: 321 - 324.

LESCHEN, R. A. B., LÖBL, I. & K. STEPHAN. 1990. Review of the Ozark Highland *Scaphisoma* (Coleoptera: Scaphidiidae). *Coleopts Bull.* 44: 274 - 294.

LÖBL, I. 1976. New species of the genus *Sciatrophes* Blackburn from Arizona (Coleoptera: Scaphidiidae). *Coleopts Bull.* 30: 207 - 211.

LÖBL, I. 1979. Die Scaphidiidae (Coleoptera) Südindiens. *Revue suisse Zool.* 86: 77-129.

LÖBL, I. 1984. Les Scaphidiidae (Coleoptera) du nord-est de l'Inde et du Bhutan I. *Revue suisse Zool.* 91: 57 - 107.

LÖBL, I. 1987. Notes synonymiques sur trois Scaphidiidae (Coleoptera) néarctiques. *Mitt. schweiz. ent. Ges.* 60: 315 - 317.

LÖBL, I. 1992a. The Scaphidiidae (Coleoptera) of the Nepal Himalaya. *Revue suisse Zool.* 99: 471 - 627.

LÖBL, I. 1992b. On some Scaphidiinae (Coleoptera, Staphylinidae) from Mexico and Central America. *Mitt. schweiz. ent. Ges.* 65: 379-384.

NEWTON, A. F., Jr. 1984. Mycophagy in Staphylinoidea (Coleoptera). In: *Wheeler & Blackwell*, Fungus/Insect Relationship: Perspectives in Ecology and Evolution, pp. 302-353. Columbia University Press, New York.

NEWTON, A. F., Jr. 1991. Scaphidiidae (Staphylinoidea). In Immature Insects. Vol. 2. Kendall/ Hunt, Dubuque.

NEWTON, A. F., Jr. & S. L. STEPHENSON. 1990. A beetle/slime mold assemblage from Northern India (Coleoptera; Myxomycetes). *Oriental Insects* 24: 197-218.

PECK, S. B. 1989. A survey of insects of the Florida Keys: post-pleistocene land-bridge islands: introduction. *Florida Entomologist* 72: 603-612.

REVUE SUISSE DE ZOOLOGIE, 100 (3) : 735-745; septembre 1993

Une lignée danubienne du genre *Plusiocampa* (Diploures Campodéidés)

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A Danubian lineage in the genus *Plusiocampa* (Diplura Campodeidae). - Descriptions of two species of the genus *Plusiocampa* s. str. from caves in the Danubian area: *Plusiocampa isterina* n. sp., from a recently discovered cave in Southern Dobrogea, Romania, and *Plusiocampa dobati* Condé in DOBAT 1975, found in several caves of the Schwäbische Alb. The two species share a shortening of the telotarsal process, an exclusive and new feature for the genus.

Key-words: Diplura - Campodeidae - taxonomy - Danube.

INTRODUCTION

Cette note tire son origine de l'examen des deux Campodéidés récoltés par Serban Sarbu, en 1990, dans la cavité dite Movile Cave, récemment découverte dans la Dobroudja méridionale, en Roumanie, et dont la faune diffère profondément de celle des autres grottes de la même région, ce qui laisse supposer un très long isolement (SARBU 1990, 1991). Ces spécimens partagent un caractère unique dans le genre *Plusiocampa*, avec une espèce qui peuple les grottes du Jura souabe (Schwäbische Alb): *Plusiocampa dobati* Condé in DOBAT 1975: 321. Ces dernières cavités sont situées sur le cours supérieur du Danube et à proximité d'affluents de la rive gauche (Bära, Schmiecha), Movile Cave se trouvant à l'extrémité orientale du même système fluvial. Il est donc permis de supposer que la lignée, jadis répandue dans le domaine endogé du système danubien, aurait fait souche dans les grottes où les populations se sont diversifiées à la faveur d'un isolement plus ou moins strict.

Manuscrit accepté pour publication le 26.09.1992.

MATÉRIEL ET MÉTHODES

Les spécimens, fixés dans l'éthanol, ont été éclaircis et conservés dans le médium II de Marc André, avec ou sans passage en étuve à 30-40°C. Sur les 23 spécimens examinés de *Plusiocampa dobati*, 3 (Elsachbröller, Eppenzkllhöhle) ont été détruits lors d'une dérive de la température de l'étude, 19 ont été communiqués au Dr H. Neuherz (01.III.1977) en vue d'une étude de la variation et un seul restait en ma possession lors de la rédaction de cette note. Depuis, le matériel confié à H. Neuherz m'a été remis par le Dr L.C. Genest, le 21 mai 1991, mais n'a pas encore fait l'objet d'un nouvel examen.

Tous les spécimens cités dans ce travail sont déposés au Muséum d'Histoire naturelle de Genève, Département des Arthropodes et d'Entomologie II.

La mise au propre de l'illustration est due au talent de Madame E. Seraoui que je remercie chaleureusement de son aide.

Plusiocampa (s. str.) **isterina** n. sp.[1]

Station. - Roumanie, Dobroudja méridionale. Movile Cave, 01.10.1990, S. Sarbu leg.: 2 femelles adultes.

Holotype: femelle n° 1 de 4,08 mm; paratype: femelle n° 2 de 4 mm.

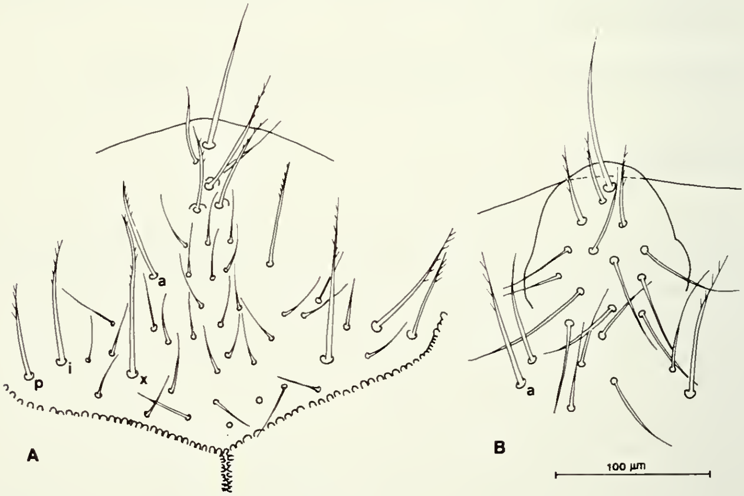

FIG. 1

Plusiocampa isterina, femelle holotype. *A*. Portion frontale de la capsule céphalique. - *Plusiocampa dobati*, femelle lectotype. *B*. Processus frontal. *a*, *i*, *p* = macrochètes antérieur, intermédiaire et postérieur de la marge antennaire; *x* = macrochète de la suture en Y.

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[1] Du latin *ister*, nom du Danube inférieur chez Virgile.

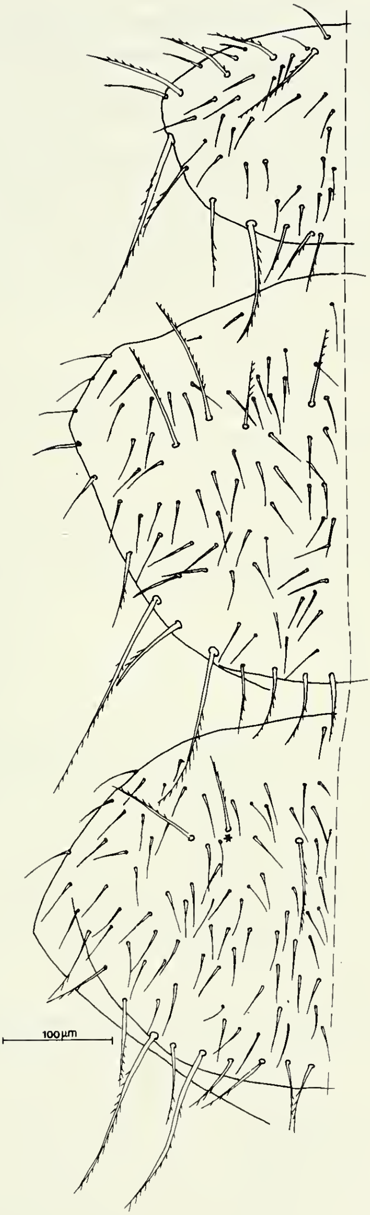

FIG. 2

Plusiocampa isterina, femelle holotype. Pro-, méso- et métanotum. Le macrochète du métanotum marqué d'un astérisque (la_2) est fluctuant.

Longueurs. - Corps: 4 et 4,08 mm; cerques: 2,25 et 2,14 mm; X corps/cerques: 1,84; patte métathoracique depuis la coxa (holotype): 1,39 mm; corps/p. III = 2,93.

Tête. - Trois antennes de 23 articles, la quatrième brisée après le 12e article; le sensille du IIIe article, subcylindrique, court (11 µm) est postéro-sternal (entre *d* et *e*). Le rapport longueur/largeur de l'article apical est 1,60-1,64 et le rapport longueur de l'article / profondeur de l'organe cupuliforme est égal, en moyenne, à 5,15 (extrêmes 4,62-5,53); les 4 sensilles du cupuliforme sont simples, comme ceux d'une espèce endogée. Sensilles du palpe maxillaire et du palpe labial de forme semblable à celui du IIIe article antennaire, mais un peu plus volumineux (13 et 15,5 µm). Le palpe labial porte, outre le sensille latéro-externe et ses deux poils de garde, une rangée antérieure de 6 à 8 phanères ordinaires et un champ de phanères gustatifs au nombre de 84 et 91 chez l'holotype, de 92 et 91 chez le paratype.

Processus frontal peu saillant, avec un long macrochète glabre médian antérieur (93) et 3 macrochètes insérés en triangle, l'antérieur (84) plus long que les autres (65), les embases de ces trois phanères très légèrement tuberculées; de rares barbules sur les deux phanères les plus postérieurs. Phanères de la marge antennaire faiblement barbelés sur leur portion apicale; longueurs relatives: *a*=67, *i*=82,5, *p*=62. Les phanères *x*, en avant des branches latérales de la suture, sont les plus longs de tous (100). Soies occipitales ressemblant, en plus barbelées, aux phanères précédents.

Thorax. - Répartition des macrochètes:

	ma	*la*	*lp*
Th. I et II	1+1	3+3	2+2
Th. III	1+1	1(2)+1	2+2

Tous ces macrochètes sont bien différenciés et barbelés sur la plus grande partie de leur longueur ou sur leur moitié distale au moins. En II, la_1 ressemble à *ma* et il est distinctement plus court que la_2 et la_3 (*ma*=78, la_1=75, la_2=136, la_3=113). En III, la_2 n'est présent que sur la moitié gauche du tergite de l'holotype: il est plus court (78) que *ma* (105) ou la_3 (103). Les *lp* sont très différenciés aux trois tergites, lp_2 étant beaucoup plus court que lp_3 en I et II (111,5/201,5 et 135/212), et à peine en III (170,5/175). Les soies marginales postérieures, au nombre de 6,10 et 8 entre les lp_2, de 2, 1, 1 entre lp_2 et lp_3, sont toutes barbelées.

L'apex des pattes métathoraciques atteint ou dépasse un peu le bord postérieur du IVe segment de l'abdomen en extension, les longueurs relatives des articles étant 40, 27, 92, 88,72, de la coxa au tarse. On notera que le fémur III est un peu plus long que le tibia (*fe/ti* = 1,04) et environ 3 fois aussi long que large (3,15), sa largeur mesurée au niveau de l'insertion du macrochète tergal. Ce dernier s'insère un peu en deçà du milieu du bord tergal (43/92), le macrochète sternal étant nettement plus proximal. Les macrochètes de la série distale n'appellent pas de remarque. Tibia III presque 5 fois aussi long que large (4,88), sa largeur mesurée au niveau de l'insertion du macrochète sternal distal; les deux macrochètes sternaux sont insérés sur la moitié distale de l'article. Les phanères du tarse sont, pour une bonne part d'entre eux, délicatement barbelés sur tout ou partie de leur moitié distale, mais ceux de la paire subapicale sternale, de même que les 3 longues soies subapicales, sont entièrement glabres. Les griffes sont inégales, ornementées sur le corps et les crêtes latérales, ces dernières beaucoup plus réduites à la griffe antérieure qu'à la postérieure où il existe un talon bien marqué. Aux pattes III, les longueurs relatives des griffes sont 75,7/58,5 (1,29) pour l'holotype et 87/63 (1,38) pour le paratype. Les processus télotarsaux sont courts, celui de la griffe antérieure davantage (24-26) que celui de la griffe postérieure (34-36); ils sont, en moyenne, un peu moins de 2 fois et demi plus courts que la griffe correspondante (2,37 extrêmes: 2,23-2,62) Chez l'holotype, le bord sternal du processus télotarsal de la griffe antérieure des pattes II et III apparaît serratulé à l'immersion, car il porte une rangée de très courtes barbules raides et régulièrement espacées; 2 ou 3 barbules peuvent aussi occuper le milieu du bord tergal.

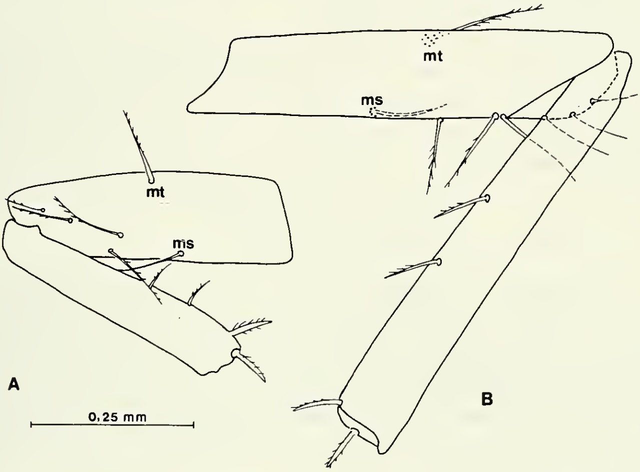

FIG. 3

Plusiocampa isterina, femelle holotype. *A*. Fémur et tibia III, face antérieure. - *Plusiocampa dobati*, femelle lectotype. *B*. Fémur et tibia III, face postérieure. *ms* et *mt* = macrochètes sternal et tergal du fémur.

Abdomen. - Répartition des macrochètes tergaux et des soies marginales postérieures (*smp*) entre les $post_1$:

	la	*post*	*smp*
Ab. I-II	0	1+1 $post_1$	6
Ab. III	0	2+2 $post_{1,3}$	8
Ab. IV-V	1+1	5+5 $post_{1 \text{ à } 5}$	11
Ab. VI-VII	2+2	5+5	11
Ab. VIII	0	6+6	10
Ab. IX	0	8+8 (total)	6

Tous ces macrochètes sont bien différenciés et fortement barbelés; de IV à VII, les $post_2$ sont distinctement plus courts (59) et un peu plus grêles que leurs voisins,

$post_1$ (75) et $post_3$ (94,5); en IV, les $post_5$ sont faibles (50), mais aux tergites suivants ils sont en moyenne égaux aux $post_1$ (75,3). L'écartement des $post_1$ augmente de II à V (73, 100, 127, 139) et diminue un peu en VI et VII (136, 133); sauf en II, les $post_1$ sont beaucoup plus courts que leur écartement ($post_1/\epsilon = 1{,}69$).

La chétotaxie des sternites est banale (7+7 en I, 5+5 de II à VII, 2+2 en VIII). Les appendices du sternite I, subcylindriques, portent à l'apex 17 phanères a_1 chez l'holotype, 11 et 12 chez le paratype. Soie apicale des styles avec une dent basilaire et une ou deux minuscules barbules au plus sur la région moyenne; soie subapicale barbelée sur sa moitié proximale et soie moyenne ventrale barbelée sur sa portion distale. Papille génitale avec 6 et 7 poils sur les volets (holotype et paratype) et 24 (holotype) ou 21 sur le tubercule formant 2 rangées distales de 5 ou 6 et 6 poils courts et une rangée proximale de 12 ou 10 poils longs.

Cerques un peu moins de 2 fois plus courts que le corps (1,84) formés d'une base et de 7 (3 cas) ou 6 articles dont les longueurs relatives sont les suivantes (nombres entre parenthèses concernant le paratype): 119 (124, 83), 36 (40), 42 (44), 49 (49), 54 (51), 59 (59,5), 62 (66), 62 (73,5). Macrochètes densément barbelés sur leurs 3/4 distaux ou la moitié distale au moins.

Plusiocampa (s. str.) **dobati** Condé in Dobat, 1975.

Stations. - *Schwäbische Alb.* Friedrichshöhle, 0,7 km NO Königsheim, n° 7819/06, 28.05.67: 5 femelles. - Mühlheimer Felsenhöhle, 2 km SSO Kolbingen, n° 7919/19, 26.05.67: untere Halle, 3 mâles; oben, 1 femelle. - Linkenboldshöhle, 2,2 km SO Onstmettingen, n° 7720/01, 28.06.63: 1 mâle, 2 femelles (dont le lectotype), 1 larve. - Falkensteiner Höhle, 4,5 km NO Urach, n° 7422/02, 06.03.71: 2 mâles, 2 femelles. - Elsachbröller, près de la grotte précédente, n° 7422/20, 22.10.66: 1 mâle juvénile. - Eppenzillhöhle, Südlicher Gang, près d'Urach, n° 7522/08, 29.06.68: 2 femelles. - Laichinger Tiefenhöhle, 1,5 km SSO Laichingen, n° 7524/01, Sandhalle, auf feuchten Steinen und Lehm, 30.12.65: 1 mâle juvénile, 2 femelles. Au total, 23 spécimens: 8 mâles, 14 femelles, 1 larve.

La liste des stations de cette espèce qui figure dans Dobat (*loc. cit.*: 321-322) appelle les remarques suivantes:

1°. Une femelle est citée de Vogelherd-Nebenhöhle, n° 7427/01, 07.66; il s'agit en fait d'un spécimen provenant d'une cavité voisine, sans n° de cadastre (Dobat, *in litt.* 21.VIII.67), et qui appartient à une espèce de *Plusiocampa* encore indéterminée, mais bien distincte de *P. dobati* (Condé *in litt.* 14.09.1967); cette station est la plus orientale de toutes celles prospectées par Dobat.

2°. Je n'avais trouvé trace, ni dans la correspondance, ni dans mes collections, de la Bärenhöhle/Lonetal, n° 7427/02, voisine de Vogelherd-Nebenhöhle, mais la présence de *P. dobati* dans cette cavité est à présent confirmée, car un spécimen (femelle, 20.09.1970) se trouvait dans le matériel, préparé et identifié par H. Neuherz, que m'a remis le Dr L.C. Genest, le 21.05.1991.

Il n'en va pas de même pour la Schreiberhöhle n° 7226 (02.02.1968) d'où aucun spécimen ne se trouve ni dans ma collection, ni dans celle de H. Neuherz.

Remarque. L'espèce a fait l'objet d'une brève diagnose différentielle dans le travail de Dobat (1975: 322), sans désignation d'un holotype.

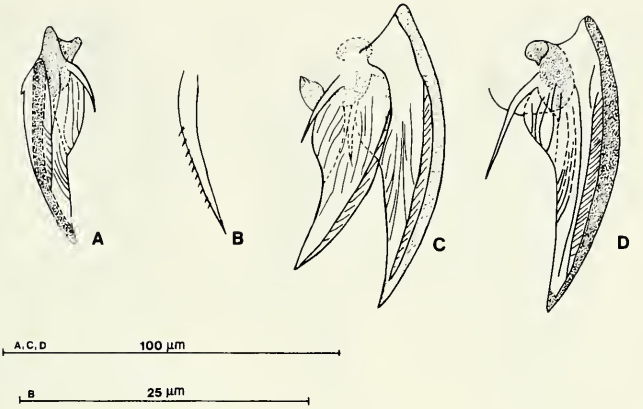

FIG. 4

Plusiocampa isterina, femelle paratype. *A*. Griffe antérieure II droite. *C*. Griffes III gauches, face antérieure. *D*. Griffe postérieure III droite. - Femelle holotype. *B*. Processus télotarsal de la griffe antérieure III gauche.

Longueurs du lectotype. - Corps: 4,85 mm en extension moyenne; patte métathoracique depuis la coxa: 2,21 mm; cerques absents.

Tête. - 28 antennes appartenant à 15 individus ne sont pas brisées, mais 8 d'entre elles ayant 20 à 26 articles sont certainement des régénérats. Le nombre d'articles le plus fréquent (28) est présenté par des mâles, des femelles et l'unique larve, et doit correspondre au nombre de base; le nombre maximum (29) appartient à 1 mâle et 2 femelles.

Nombre d'articles:	20	21	22	23	24	25	26	27	28	29
Nombre de cas:	1	–	1	–	3	1	2	2	13	5

Le sensille du IIIe article, subcylindrique, assez court (16,5 µm) est postéro-sternal (entre *d* et *e*). Chez le lectotype, le rapport longueur/largeur de l'article apical est 1,85 à l'antenne droite de 28 articles et de 2,19 à l'antenne gauche qui est un régénérat de 24 articles; le rapport longueur de l'article/profondeur de l'organe cupuliforme varie dans le même sens (4,80 à droite et 5,75). L'organe cupuliforme renferme 7 à 9 sensilles de forme complexe aux antennes intactes et 8,9 ou 14 aux régénérats.

Nombre de sensilles:	7	8	9	14
Nombre de cas:				
Antennes intactes	9	7	3	–
Régénérats	–	1	4	1

Sensilles du palpe maxillaire et du palpe labial de forme semblable à celui du IIIe article antennaire, mais plus volumineux (22,5 µm). Le palpe labial porte, outre le sensille latéro-externe et ses deux poils de garde (très proches l'un de l'autre ici), une

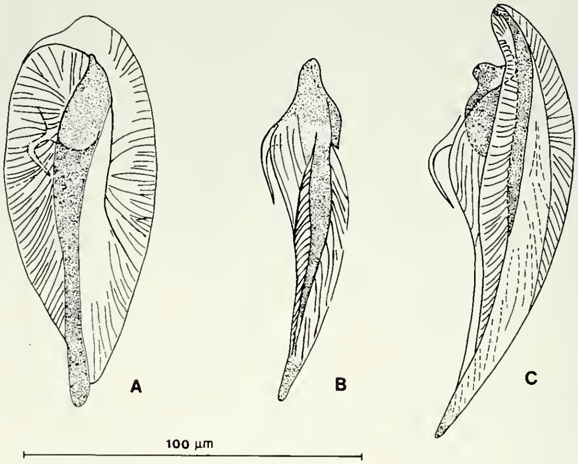

FIG. 5

Plusiocampa dobati, femelle lectotype. *A*. Griffe postérieure II gauche en vue tergale. *B*. Griffe antérieure III gauche en vue latéro-tergale. *C*. Griffe postérieure III droite en vue latéro-tergale.

rangée antérieure de 6 et 7 phanères ordinaires et un champ de phanères gustatifs au nombre de 53 et 55 (lectotype).

Processus frontal bien délimité avec un long macrochète glabre antérieur (109) et 3 macrochètes avec quelques barbules insérés en triangle, l'antérieur (46) un peu plus court que les postérieurs (51). Phanères de la marge antennaire finement barbelés sur leur portion apicale; longueurs relatives: $a = 100$, $i = 119$, $p = 94$. Les phanères x, en avant des branches latérales de la suture, sont les plus longs de tous (137). Soies occipitales grêles, glabres ou très peu barbelées à l'apex.

Thorax. - Répartition des macrochètes:

	ma	*la*	*lp*
Th. I	1+1	3+3	2+2 (3+3 si lp_3, dédoublé)
Th. II	1+1	2+2 (3+3 si la_1)	2+2
Th. III	1+1	1+1 (2 si *la* surnuméraire asymétrique)	2+2

Ces macrochètes sont bien différenciés et barbelés sur la plus grande partie de leur longueur. En II, la_1 est fluctuant et ordinairement plus court que ses voisins; longueurs relatives des macrochètes chez le lectotype: $ma = 87$, la_1 (à gauche seulement) = 71, $la_2 = 116$, $la_3 = 90$. En III, *ma* est plus long (92) que la_2 (69). Les *lp* sont très différenciés aux trois tergites, lp_2 étant beaucoup plus court que lp_3 en I (96/132), un peu plus court seulement en II (125/139) et subégal en III (127/129). Les soies marginales postérieures, au nombre de 6,11 et 6 entre les lp_2, de 4,2 et 1 entre lp_2 et lp_3, sont grêles, les plus latérales avec des barbules subapicales seulement.

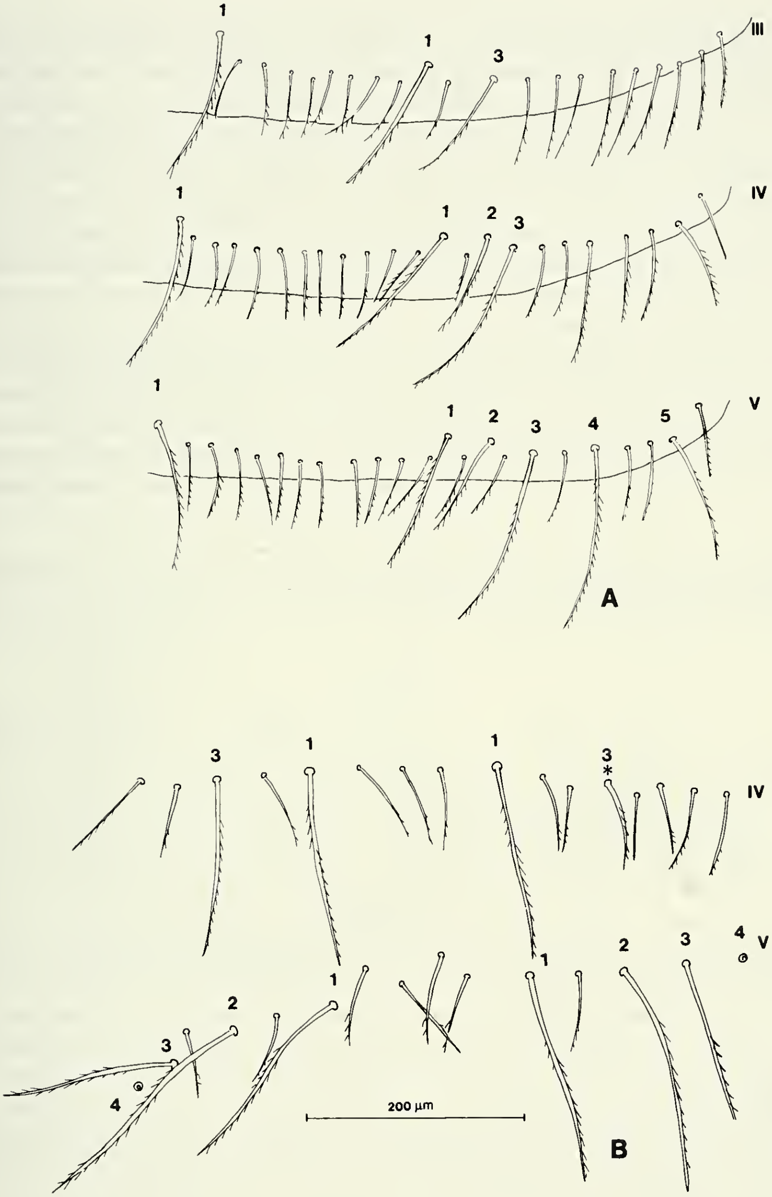

Fig. 6

Plusiocampa isterina, femelle holotype. A. Marge postérieure des urotergites III à V. - *Plusiocampa dobati*, femelle lectotype. B. Phanères postérieurs des urotergites IV et V. 1 à 5 = macrochètes postérieurs; le macrochète 3, marqué d'un astérisque, est très peu différencié.

L'apex des pattes métathoraciques atteint le bord postérieur du VIe segment de l'abdomen en extension moyenne, les longueurs relatives des articles étant 59, 31, 130, 160, 112, de la coxa au tarse. Le fémur est un peu plus court que le tibia (*fe/ti* = 0,81) et environ 4 fois 1/3 aussi long que large (4,33) , sa largeur mesurée au niveau de l'insertion du macrochète tergal. Ce dernier s'insère au milieu du bord tergal, le macrochète sternal étant nettement dans la moitié proximale de l'article; le macrochète tergal est beaucoup plus épais et plus long que le sternal (106/65). Les macrochètes de la série distale n'appellent pas de remarque. Tibia III près de 7 fois aussi long que large (6,95), sa largeur mesurée au niveau de l'insertion du macrochète sternal distal; les deux macrochètes sternaux sotn insérés de part et d'autre du milieu du bord sternal. Les phanères du tarse sont tous glabres.

Les griffes sont inégales (approximativement 150/95 en III), ornementées sur le corps et les crêtes latérales qui sont bien développées à la griffe postérieure et forment un talon qui recouvre un peu l'apex du tarse. Les processus télotarsaux sont sétiformes, rudimentaires, leur longueur comprise entre le 1/4 et le 1/6 de celle de la griffe (4,05 en III); leur base est élargie et un coude plus ou moins prononcé marque le milieu de leur longueur.

Abdomen. - Répartition des macrochètes tergaux et des soies marginales postérieures (*smp*) entre les $post_1$:

	la	*post*	*smp*
Ab. I-II	0	1+1 $post_1$	2-4
Ab. III	0	2+2 $post_{1,3}$ (2+1)	2-4
Ab. IV	0 (1+1, 0+1)	2+2 $post_{1,3}$ (2+1)	2-4
Ab. V	1+1 (1+2)	5+5 $post_{1 \text{ à } 5}$	2-4
Ab. VI	2+2 (1+2, 2+3)	5+5	2-5
Ab. VII	2+2 (1+2)	5+5	2-3-5
Ab. VIII	0	6+6	2-3
Ab. IX	0	8+8 (total)	2

On constate une fluctuation des macrochètes postérieurs en III et IV, et des latéraux antérieurs de IV à VII, avec de nombreuses asymétries (nombres entre parenthèses). A l'exception du tergite IV, la formule des macrochètes est analogue à celle de *P. isterina*. Une différence essentielle concerne le nombre de soies marginales postérieures entre les $post_1$ qui est de 2 à 5 chez *P. dobati* et de 6 à 11 chez *P. isterina*.

Sauf exception - cas d'asymétries, par exemple, dans lesquels un macrochète se confond plus ou moins avec les soies marginales postérieures - les macrochètes sont très différenciés et fortement barbelés. Les $post_1$ s'allongent progressivement (74 à 124) de I à VII; en même temps, leur écartement augmente (54 à 101) jusqu'à VI, pour diminuer légèrement en VII (96), en restant toujours inférieur à la longueur des phanères correspondants: $post_1 / \epsilon = 0{,}82$. De III à VI, les $post_3$ sont les plus courts (78 à 95), n'atteignant 120 qu'en VII. De V à VII, les $post_2$ sont les plus longs des macrochètes (124 à 136). En V et VI, les $post_5$ sont de longueurs intermédiaires entre $post_3$ et $post_4$(88, 109), tandis qu'en VII ils sont les plus courts (114).

Chétotaxie des sternites banale (cf. *P. isterina*). Les appendices du sternite I sont subcylindriques, avec 10 et 11 phanères a_1 à l'apex (lectotype). Sternite I des mâles adultes sans champ glandulaire, ses appendices beaucoup plus larges que ceux de la femelle et arrondis, avec 14-22, 26-31 ou 48-60 a_1 en fonction de l'âge. Papille génitale femelle (lectotype) avec 8 et 9 poils sur les volets et 17 sur le tubercule.

Discussion. - Les deux espèces décrites ici présentent un degré de similitude suffisant pour estimer qu'elles sont étroitement apparentées et peut-être directement issues d'un ancêtre endogé à plus vaste répartition. Par ses caractères, le talon de la griffe postérieure excepté, *P. isterina* ne se distingue pas d'une forme endogée. *P. dobati*, en revanche, présente un allongement des antennes (28-29 articles, vs 23); une évolution de l'organe cupuliforme apical (7-9 sensilles vs 4); une élongation des fémur et tibia III (4 fois 1/3 et presque 7 fois aussi longs que larges, vs 3 et presque 5 fois), la longueur du tibia surpassant celle du fémur (*fe/ti* = 0,81 vs 1,04); un plus grand développement des crêtes latérales des griffes, tous ces critères étant communs aux espèces dites "troglomorphes". La régression des processus télotarsaux, particulièrement poussée chez *P. dobati*, constitute le caractère unique et partagé de ces deux espèces[2].

Bien que la chétotaxie tergale soit très voisine dans sa formule, il existe, surtout au niveau de l'abdomen, des différences notoires dans les longueurs relatives des macrochètes, l'écartement des $post_1$ et le nombre de soies marginales postérieures entre eux (6-11 vs 2-5).

BIBLIOGRAPHIE

CONDÉ, B., 1955. Campodéidés cavernicoles des Baléares. *Notes biospéol.* 9: 121-132.

DOBAT, K., 1975. Die Höhlenfauna der Schäbischen Alb mit Einschluss des Dinkelberges, Schwarzwaldes und des Wutagebietes. *Jh. Ges. Naturk. Württ.* 130: 260-381.

SARBU, S., 1990. The unusual fauna of a cave with thermomineral waters containing H_2S,from Southern Dobrogea, Romania. *Mém. Biospéol.* 17: 191-195.

SARBU, S., 1991. Contributions to the biological investigation of the "Movile Cave": the species composition and trophic structure of the cave community and the origin of the fauna. *Mém. Biospéol.* 18: 193-197.

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[2] L'holotype de *P. breuili* CONDÉ, 1955, d'une grotte d'Ibiza, possède des griffes émoussées et des processus télotarsaux beaucoup plus courts qu'elle, mais l'examen de topotypes (1 mâle, 4 femelles) récoltés en septembre 1958 par Bishoff et communiqués par le Dr St. von Keler (Humboldt-Universität, Zoologisches Museum, Berlin), montre qu'il s'agit d'un accident individuel (usure, malformation ?).

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Carpelinus caecus nuova specie del Rwanda (Coleoptera, Staphylinidae)

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Carpelinus caecus, a new species from Rwanda (Coleoptera, Staphylinidae). – A new subgenus, *Anopinus*, of the genus *Carpelinus* Samouelle and a new species, *C. (Anopinus) caecus*, of the subfamily Oxytelinae from Rwanda, are described and illustrated.

Key-words: Coleoptera - Staphylinidae - *Carpelinus* - taxonomy - Rwanda.

INTRODUZIONE

Le specie appartenenti al genere *Carpelinus* Samouelle, sono Staphylinidae ripicoli di piccola taglia. Solo alcune specie vivono nei fitodetriti, altre, più rare, nei nidi di micromammiferi.

Nella fauna mondiale del genere *Carpelinus* finora non era compresa alcuna specie anoftalma, pertanto quella che viene qui di seguito descritta, è la prima specie attera e anoftalma del genere citato.

In base alla forma delle parti boccali, alla formula tarsale (4-4-4) e alla struttura della spermateca, non si notano modifiche morfologiche tali da giustificare l'istituzione di un genere distinto da *Carpelinus*.

IL NUOVO SOTTOGENERE *ANOPINUS* DI *CARPELINUS*

Constatati l'anoftalmia, le elitre più corte del pronoto e le antenne molto corte è qui proposto un nuovo sottogenere vicino al sottogenere *Myopinus* Scheerpeltz, 1937. Essi si distinguono in base alla seguente chiave:

1 – Antennomeri 4° a 10° poco o non trasversi; occhi presenti, lunghi circa la metà della lunghezza delle tempie; elitre più lunghe o appena più lunghe del pronoto. Regione Paleartica. .... Subgen. *Myopinus* Scheerpeltz
(typus subgen.: *C. (M.) elongatulus* (Erichson)

– Antennomeri 4° a 10° nettamente trasversi; occhi assenti; elitre più corte del pronoto. Regione Etiopica. .... Subgen. *Anopinus* n.
(typus subgen. : *C. (A.) caecus* sp. n.)

Manoscritto accettato l'1.03.1993.

DESCRIZIONE

Carpelinus (Anopinus) caecus sp. n. (Figg. 1-3)

Holotypus ♀, Rwanda, Rangiro, 1800 m, 4.IX.1976 (Werner leg., Muséum d'hist. nat. Genève).

Paratypus: 1 ♀, stessa provenienza (coll. Pace).

Descrizione. Lungh. 1,2 mm. Corpo debolmente lucido e giallo-bruno con estremità addominale giallo-rossiccia; antenne giallo-rossicce; zampe gialle. Il capo e il pronoto sono coperti di microreticolazione vigorosa a maglie relativamente ampie. Il pronoto presenta due deboli impressioni mediane, confluenti all'indietro: esse non raggiungono il margine anteriore del pronoto stesso. Le elitre sono coperte di distinti tubercoletti posti su un fondo a reticolazione superficiale. Gli uroterghi sono coperti da reticolazione vigorosa composta di maglie più ampie di quelle del capo e del pronoto.

Spermateca fig. 2; maschio sconosciuto.

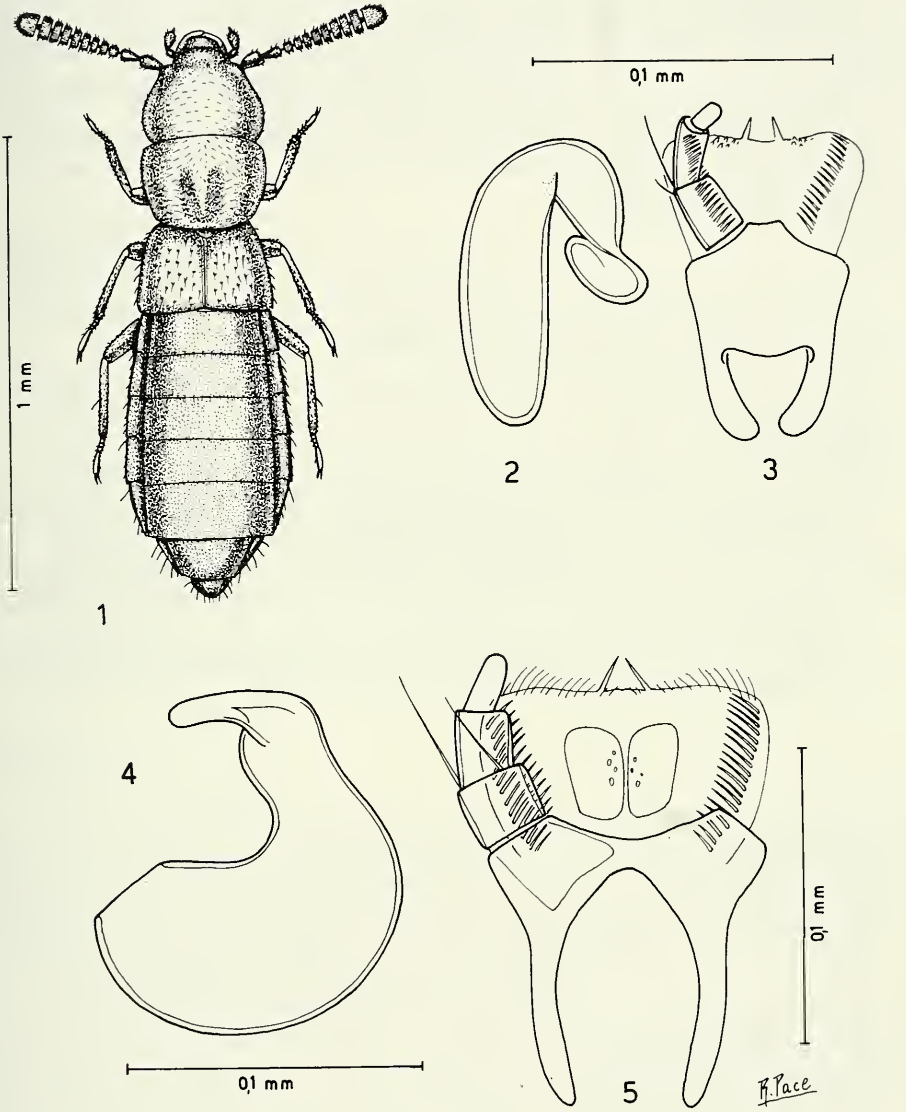
Comparazioni. La struttura generale della ligula e delle paraglosse di *C. caecus* sp. n., è identica a quella di *C. rivularis* Motschulsky, 1860 (figg. 3 e 5): ampie paraglosse e due lembi mediani strettissimi e convergenti in avanti. L'unica differenza morfologica si nota nell'assenza sul margine anteriore delle paraglosse di *C. caecus* sp. n. di una fila di setole, sostituita da un gruppo di papille gustative situato a ciascun lato degli stretti lembi mediani. Altre differenze sulle parti boccali si osservano sui palpi labiali che in entrambe le specie sono composti di tre articoli. Il primo articolo dei palpi labiali di *C. rivularis* è corto, perciò più largo che lungo, mentre nella nuova specie questo stesso articolo è nettamente più lungo che largo. Anche il secondo articolo dei palpi labiali nelle due specie ha proporzioni tra lunghezza e larghezza differenti: appena allungato in *rivularis* e molto lungo nella nuova specie.

Il confronto tra la forma della spermateca della nuova specie e la forma delle spermateca di *C. rivularis*, permette di rilevare differenze, anche se non rilevanti: per questo motivo e per altri, la nuova specie è qui attribuita al genere *Carpelinus*, come è stato accennato nell'introduzione. La spermateca della nuova specie ha dimensioni nettamente inferiori a paragone della spermateca di *rivularis*; la sua parte prossimale è stretta e lunga, mentre in *rivularis* questa medesima parte è larga e corta.

La completa anoftalmia e la presenza di elitre più corte del pronoto, con omeri sfuggenti sono caratteri che distinguono la nuova specie dalle note.

Due sole specie paleartiche tendono alla microftalmia e hanno elitre corte, ma non più corte del pronoto come nella nuova specie: *C. (Myopinus) subtilis* (Erichson, 1839) della Regione Olartica, pur avendo taglia simile a quella della nuova specie (1,3 mm, invece di 1,2 mm), ha corpo molto slanciato e non tozzo come nella nuova specie. *C. (Myopinus) subterraneus* (Smetana, 1960) della Boemia, presenta corpo tozzo come nella nuova specie, ma ha taglia maggiore (1,9-2,0 mm), presenta occhi ben sviluppati ed elitre un po' più lunghe del pronoto.

Ecologia. Il solo dato sull'ecologia della nuova specie è che è stata raccolta a 1800 m d'altitudine.



FIGG. 1-5

Habitus, spermateca e labio con palpo labiale. Figg. 1-3: *Carpelinus (Anopinus) caecus* sp. n. del Rwanda. Figg. 4-5: *Carpelinus* (s. str.) *rivularis* Motschulsky di Punta Sabbioni, Venezia.

RINGRAZIAMENTI

Ringrazio vivamente il Dr. I. Löbl e il Dr. C. Besuchet del Museo di Storia Naturale di Ginevra per avermi affidato in studio il raro Coleottero oggetto del presente lavoro.

Un particolare ringraziamento rivolgo alla memoria del Dr. H. Coiffait dell'Università di Tolosa, che donandomi i suoi schedari e materiale bibliografico relativi ai *Carpelinus* mondiali, mi ha permesso di condurre a termine il presente lavoro senza difficoltà insormontabili.

RÉSUMÉ

L'auteur décrit et illustre une nouvelle espèce appartenant à un nouveau sous-genre de *Carpelinus*: *C. (Anopinus) caecus* originaire du Rwanda.

BIBLIOGRAFIA

MOTSCHULSKY, V. 1860. Enumération des nouvelles espèces de Coléoptères rapportées de ses voyages (3e article). Vol. 4. Staphylinides de Russie. *Bull. Soc. Natur. Moscou* 33: 539-588.

SCHEERPELTZ, O. 1937. Eine neue Art des Gattung *Trogophloeus* Mannh. nebst einer Bestimmungstabelle der aus Nord-und Mitteleuropa bekannt gewordenen Arten dieser Gattung. *Notulae Ent.* 17: 97-119.

SMETANA, A. 1960. Eine neue Art der Gattung *Trogophloeus* Mannh. aus Nestern von *Microtus arvalis* Pall. *Acta Soc. ent. Čsl.* Prague 57: 154-157.

REVUE SUISSE DE ZOOLOGIE, 100 (1) : 751-772; septembre 1993

Revision der *Bolitobius setiger* - Gruppe (Coleoptera, Staphylinidae: Tachyporinae)

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Revision of the *Bolitobius setiger* group (Coleoptera, Staphylinidae: Tachyporinae). - The *Bolitobius setiger* group is revised and characterized as a monophyletic group sensu HENNIG (1982), based on synapomorphies of male sexual characters. Three species of the group are redescribed, a fourth, *Bolitobius loebli* n. sp. from Nepal, is described as new. A key to the species is given. Lectotypes are designated for *Megacronus setiger* Sharp, 1874 and *Bryocharis humeralis* Cameron, 1926.

Keywords: Coleoptera - Staphylinidae - Tachyporinae - *Bolitobius* - taxonomy- biogeography.

EINLEITUNG

Die Gattung *Bolitobius* Leach in Samouelle (nec Mannerheim) [= *Bryocharis* Jaquelin du Val] ist mit ca. 20 gegenwärtig als valid geltenden Arten über den größten Teil der Holarktis verbreitet. Die Gattung wurde bisher im Gesamtumfang noch nicht revidiert. Die letzte zusammenfassende Darstellung der westpaläarktischen Vertreter erfolgte durch LUZE (1901). Über die Verwandtschaftsverhältnisse zwischen den Arten der Gattung gibt es bis heute wenig gesicherte Erkenntnisse.

Die Artgruppe um *Bolitobius setiger* (Sharp) ist mit bisher drei bekannten Arten, eine vierte wird nachfolgend beschrieben, in den südlichen und östlichen Teilen der Paläarktis verbreitet. Die bisher bekannten Arten wurden in den Gattungen *Bolitobius* Leach in Samouelle, *Megacronus* Stephens und *Bryocharis* Jaquelin du Val beschrieben. *Bryocharis* und *Megacronus* sind zu *Bolitobius* Leach in Samouelle synonym. Als erste Arten der Gruppe wurden aus Japan *Megacronus setiger* Sharp und *M. princeps* Sharp beschrieben (SHARP, 1874). Zumindest eine der beiden Arten kommt auch auf dem asiatischen Festland vor. 1923 wurde *Bolitobius septemseriatus*

Manuskript angenommen am 23.10.1992.

Champion aus dem Himalaya bekannt, zu dem später die aus der gleichen Region beschriebene Art *Bryocharis humeralis* Cameron, 1926, als Synonym gestellt wurde (CAMERON, 1932). Die Arten der *Bolitobius setiger* - Gruppe sind über Ostasien (Japan, China, Ostsibirien?) und das Himalayagebiet verbreitet. Über die Lebensweise der Arten ist ebenso wie bei den anderen Gattungsvertretern wenig bekannt, die Informationen beschränken sich in diesem Fall auf die durch die Bezettelung zugänglichen Daten (Höhenlage etc.). Insgesamt lagen 45 Exemplare zur Untersuchung vor.

UNTERSUCHUNGSMETHODIK

Die Untersuchungen der Imagines und die notwendigen Präparationsarbeiten wurden mit Hilfe eines Binokulars bei 8- bis 100facher Vergrößerung vorgenommen. Meßwerte sind mit der gleichen Optik bei Vergrößerungen zwischen 12,5x und 100x mittels Okularmikrometer (1/100 Skalenteile) gewonnen worden.

Die Untersuchung der Mikroskulptur erforgte mit einem Auflichtmikroskop mit indirekter Beleuchtung bei 280facher Vergrößerung (15 x 0,63 x 30; 1 Skalenteil = 10 µm).

Präparate der Abdominalsegmente, der Aedoeagi und anderer, zur Untersuchung herauspräparierter Körperteile, wurden nach Säuberung und Entwässerung in Optal in Kanadabalsam auf durchsichtigen Plastplättchen eingebettet und unter einem Durchlichtmikroskop bei Vergrößerungen von 25 bis 360x untersucht. Zeichnungen wurden am Binokular mit Hilfe eines Zeichennetzes (20x20) und am Durchlichtmikroskop mit Zeichenspiegel und Mikroprojektionseinrichtung angefertigt.

Sinngemäß gelten für Präparation, Optik und Zeichentechnik sowie für die Bewertung von Merkmalen die bei SCHÜLKE & UHLIG (1989) gemachten Ausführungen. Die Lokalisierung der Fundorte in Nepal erfolgte nach COIFFAIT (1982) und SMETANA (1988).

DANKSAGUNG

Für die Ausleihe von Typen- und Sammlungsmaterial der Gattung *Bolitobius* für die vorliegende Arbeit bin ich folgenden Institutionen und Kollegen zu herzlichem Dank verpflichtet:

British Museum (Natural History), London, Miss E. DeBoise (BMNH);

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Museum G. Frey, Tutzing (MFT);
Dr. T. Ito, Yawata, Kyoto (cITO).

Material in der Sammlung des Autors ist mit (cSCHÜ) gekennzeichnet.

Für ihre tatkräftige Hilfe bei der Beschaffung seltener Literatur und die Diskussion inhaltlicher Probleme danke ich Dr. M. Thayer (Field Museum, Chicago), Dr. M. Uhlig (Museum für Naturkunde der Humboldt-Universität zu Berlin) und Dr. L. Zerche (Deutsches Entomologisches Institut, Eberswalde).

CHARAKTERISIERUNG DER ARTGRUPPE

Die Arten der *Bolitobius setiger* - Gruppe lassen sich ohne Untersuchung der männlichen Geschlechtsorgane nicht sicher von anderen Vertretern der Gattung trennen. Weibchen unbekannter Arten sind deshalb nicht immer sicher einer Artengruppe zuzuordnen. Erst eine Untersuchung aller Artengruppen der Gattung *Bolitobius* kann klären, ob andere Charakteristika der Artengruppe als Synapomorphien zu werten und für eine sichere Unterscheidung der Artengruppen zu benutzen sind. Die bisher bekannten Arten der *Bolitobius setiger* - Gruppe sind durch folgende Merkmale charakterisiert, die in anderen Artengruppen nicht, oder nur teilweise auftreten:

Flügeldecken einfarbig rot, schwarz oder schwarz mit hellem Humeralfleck (Abb. 8-10), Flügeldecken mit 5 Diskalreihen kräftiger Borstenpunkte, von denen die inneren Reihen reduziert sein können (Abb. 5-7, 11), Mentum mit nur zwei Paaren größerer Tastborsten (Abb. 2), Sternit VIII des Männchens mit zwei Feldern feiner Borsten am Apikalrand (Abb. 16, 18, 20, 22), Medianlobus des Aedoeagus sehr kurz, mit stumpfer Spitze. Parameren lang, den Medianlobus um ca. zwei Drittel seiner Länge überragend (Abb. 24, 26, 28, 30).

REVISION DER ARTEN

Bolitobius setiger (Sharp, 1874) (Abb. 1-4, 10-12, 16, 17, 24, 25, 31, 35)

Megacronus setiger Sharp, 1874: 18 (Locus Typicus: Japan, Nagasaki).

Färbung: Kopf schwarz. Halsschild schwarz, ohne hellere Ränder. Flügeldecken schwarz mit hellgelben Schultermakeln (welche ein Drittel bis die Hälfte der Flügeldeckenlänge erreichen) und einem hellgelben Hinterrand (Abb. 10). Abdomen schwarz mit schmal aufgehelltem Hinterrand der Tergite III - VI. Hinterleibssegment VII mit breitem hellen Hinterrand, die Segmente VIII - X vollständig gelbbraun. Hüften dunkelbraun bis schwarz, Schenkel auf der Vorderseite braun, die Hinterseite dunkler, Schienen und Tarsen braungelb. Fühlerglieder 1 und 2 gelbbraun, 3 - 6 schwarzbraun bis schwarz, 7 - 10 braun bis gelbbraun, zur Spitze der Fühler heller werdend, Fühlerglied 11 gelb. Labrum, Kiefertaster und Lippentaster gelbbraun.

Habitus: Gestreckt, etwas schmaler als die größeren Arten der Gattung, Vorderkörperlänge durchschnittlich 3,15 mm (2,8 - 3,4 mm), Gesamtlänge 6 - 7 mm.

Kopf vom Vorderrand des Clypeus bis zum Hinterrand etwas länger als die Kopfbreite über den Augen (Index 1,06 : 1). Augen gewölbt, aus der Kopfrundung hervortretend, Schläfen lang, hinter den Augen breit halbkreisförmig abgerundet. Augenlänge (seitlich gemessen) etwas größer als die Schläfenlänge (Index 1,11 : 1).

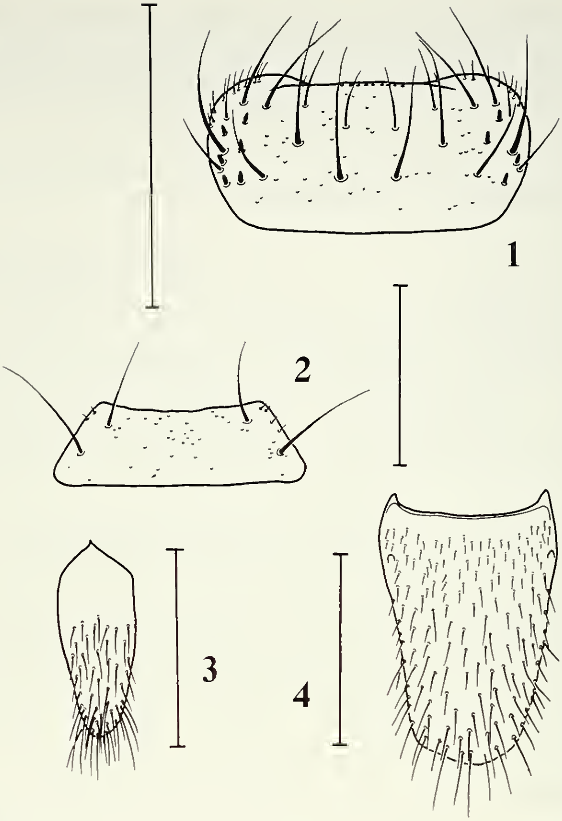

ABB. 1-4

Bolitobius setiger (Sharp): 1) Labrum, Japan, Osaka, ZNr. 073, 2) Mentum, Japan, Osaka, ZNr. 095, 3) ♀-Tergit X, Japan, Nara, ZNr. 129, 4) ♀-Tergit VIII, Japan, Nara, ZNr. 128, Maßstab 0,25 mm (1,2), 1 mm (3, 4).

Neben der Fühlerbasis und dem Hinterrand der Augen befindet sich beiderseits je eine längere Tastborste. Kopf unterhalb der Augen mit deutlicher Seitenrandleiste.

Fühler relativ gedrungen, zurückgelegt den Hinterrand des Halsschildes erreichend, Glied 7 etwa so lang wie breit, die Glieder 8 bis 10 quer. Sexualdimorphismus des Gliedes 11 nur schwach entwickelt.

Halsschild quer, Verhältnis Breite (max.) zu Länge (Mittellinie) etwa 1,25 : 1, größte Breite hinter der Mitte. Nach vorn stark, nach hinten weniger verengt. Vorderecken vorgezogen und einen abgerundeten spitzen Winkel bildend, die Hinterecken breit stumpfwinklig abgerundet. Halsschild mit 4 Seitenrandborsten, die um die Breite des letzten Hintertarsengliedes vom Seitenrand entfernt sind, 4 Vorderrandborsten, von denen die beiden mittleren um die Hälfte weiter vom Vorderrand entfernt stehen als die äußeren, sowie 4 Hinterrandborsten, von denen die beiden äußeren fast doppelt so weit

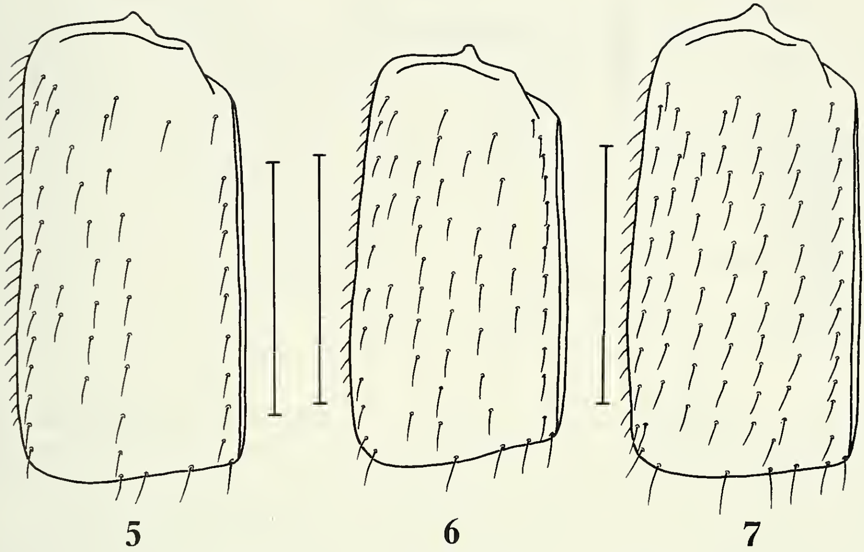

Abb. 5-7

Flügeldeckenbeborstung von 5) *Bolitobius loebli* spec. nov., HT, Nepal, Manang, ZNr. 100, 6) *Bolitobius septemseriatus* Champion, Indien, Darjeeling, ZNr. 101, 7) *Bolitobius princeps* (Sharp), China, Peking, ZNr. 099, Maßstab 1 mm.

wie die inneren vom Hinterrand entfernt sind. Beiderseits stehen die beiden Hinterrandborsten mit der hinteren Seitenrandborste etwa in einer Reihe.

Schildchen dreieckig mit breit abgerundeter Spitze.

Flügeldecken gestreckt, ihre größte Breite kurz vor dem Hinterrand erreichend. Verhältnis Flügeldeckenschulterlänge zu Flügeldeckenbreite etwa 1 : 1 (0,97 : 1,07). Flügeldecken außer der Nahtreihe und der Seitenrandreihe mit 5 Reihen kräftiger aufrechtstehender Borsten sowie einer Borstenreihe am Hinterrand (Abb. 11). Auf den Epipleuren befindet sich unmittelbar unter dem Flügeldeckenseitenrand eine Reihe zahlreicher kleinerer Borsten. Einzelnstehende Borsten zwischen den Reihen auf den Flügeldecken kommen in Einzelfällen vor.

Abdomen gestreckt, zum Ende zugespitzt. Tergite ab V deutlich und kräftig, besonders stark in den Basalgruben punktiert. Tergit III in der Mitte mit einer breiten unpunktierten Fläche. Die Punktur wird von der unpunktierten Mitte zum Rand hin stärker, erreicht aber nur in den Hinterecken des Tergits die Stärke von Tergit V. Tergit IV mit schmaler punktfreier Mitte, sonst wie Tergit V punktiert. Tergit VII am Hinterrand mit deutlichem Hautsaum.

Beine schlank. Vordertarsen des ♂ erweitert, von Tarsenglied 1 - 5 gleichmäßig schmaler werdend.

Mundteile wie bei den anderen Arten der Gattung gebaut. Labrum mit einer hinteren Borstenreihe aus jederseits 3 Borsten, einer mittleren Borstenreihe aus

TABELLE 1

Flügeldeckenbeborstung von *Bolitobius setiger* (Sharp)

	Durchschnitt	Minimum	Maximum
Suturalreihe	13	11	15
Diskalreihe 1 (innen)	11	8	13
Diskalreihe 2	11	9	12
Diskalreihe 3	11	9	13
Diskalreihe 4	11	8	12
Diskalreihe 5 (außen)	12	11	14
Lateralreihe	11	10	13
Apikalreihe	6	6	7
Epipleuralreihe	20	17	22

jederseits 2 Borsten sowie jeweils 3 Borsten im Außenbereich des Vorderandes und zwei Borsten im Mittelbereich. Vorderrand des Labrums im Mittelteil ohne Borsten. Die vordersten Borsten im Mittelbereich sind soweit vom Vorderrand wie voneinander entfernt (Abb. 1). Mentum stark quer, jederseits mit zwei großen Borsten (Abb. 2).

Männchen: Vordertarsen erweitert, Endglied der Fühler nur wenig verlängert (Länge zu Breite 1,3: 1). Sternit VII am Hinterrand ohne oder mit maximal 2 kleinen Borsten (Abb. 12). Sternit VIII mit spitz vorgezogenem Hinterrand, davor mit zwei dichten Feldern kleinerer dunkler Borsten (Abb. 16). Sternit X gestreckt, nur im Spitzenberich beborstet (Abb. 17). Aedoeagus kurz mit sehr stumpfer, etwas nach vorn umgeknickter Spitze und langen, den Medianlobus um zwei Drittel seiner Länge überragenden Parameren (Abb. 24, 25). Internalsack mit deutlicher Struktur aus Skleriten und parallelen, bandförmigen Ausstülpkörpern, die keine Borsten tragen (Abb. 31). Parameren in Höhe der Spitze des Medianlobus verbreitert und an dieser Stelle mit einigen kurzen Borsten an der Innenseite. An der Paramerenspitze befinden sich auf der Innen- und Außenseite jeweils zwei Tastborsten.

Weibchen: Vordertarsen einfach, Endglied der Fühler kurz (Länge zu Breite 1,1 : 1). Sternit und Tergit VIII (Abb. 4) einfach, Tergit X (Abb. 3) einfach beborstet, am Apikalrand ohne feinen Haarsaum.

Mikroskulptur: Kopf, Halsschild, Flügeldecken und Abdomen mit Mikroskulptur. Maschenweite auf dem Kopf ca. 4 Maschen/10 µm, auf dem Halsschild feiner (etwa 6-8 Maschen/10 µm). Flügeldecken etwas enger als der Halsschild chagriniert (ca. 6 Maschen/10 µm). Abdomen mit zur Spitze engerer Mikroskulptur (Tergit III, Mitte: 5-6 Maschen/10 µm; Tergit VIII, Mitte: 6-8 Maschen/10 µm).

Untersuchtes Typenmaterial: Aus dem British Museum (Natural History) lag mir ein Männchen mit folgender Etikettierung vor: Type (rund mit rotem Rand), Japan G. Lewis, Sharp Coll. 1905-313., *Megacronus setiger* type D.S. (handschriftlich), Japan. Das Exemplar wird hiermit als Lectotypus designiert.

Ein weiteres als Typus bezetteltes Exemplar, das SHARP (1888) zur irrtümlichen Beschreibung der männlichen Sexualcharaktere diente, ist auf Grund der Sammeldaten (Ichiuchi, Lewis, 1.5.1881) nicht als Syntypus zu betrachten. Es gehört zu einer unbeschriebenen, mit *setiger* nicht näher verwandten Art (SCHÜLKE, 1993).

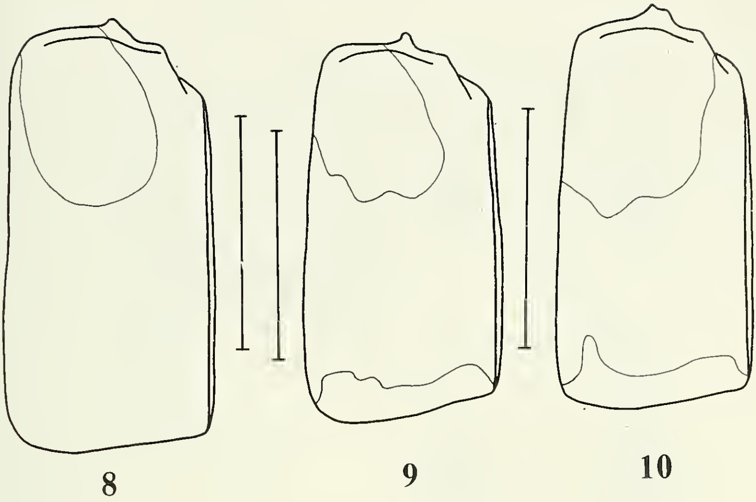

Abb. 8-10

Lage der hellen Humeral- und Apikalmakeln auf den Flügeldecken von 8) *Bolitobius loebli* spec. nov., HT, Nepal, Manang, ZNr. 100, 9) *Bolitobius septemseriatus* Champion, Indien, Darjeeling, ZNr. 101, 9) *Bolitobius setiger* (Sharp), Japan, Osaka, ZNr. 098, Maßstab 1 mm.

Auch das zweite von Sharp (1888) gemeldete Exemplar von Kiga gehört nicht zu *B. setiger*, sondern zu einer Art der Gattung *Carphacis* Des Gozis.

Verbreitung: Japan, südlicher Teil der Insel Honshu, Kyushu, Shikoku (Abb. 35), nach Tichomirova (1974) auch in Ostsibirien. Ob die Art auf dem asiatischen Festland vorkommt, erscheint mir auf Grund des Vorhandenseins ähnlicher Arten, die nicht zur *setiger*-Gruppe gehören, vorerst zweifelhaft. Die bekannten Funddaten stammen aus den Monaten März bis Oktober (1:3:2:2:4:5:3:1).

Untersuchtes Material (23 Exemplare): JAPAN: Ehime, Matsuyama, Shiroyama, 14b, 10.08.1980, Cl. Besuchet, 2♂ (MHNG, cSCHÜ); Ehime, Oku-Dohgo, 2.V.1989, T. Ito, 1♀ (cITO); Gifu, 8 km SE Osaka, 750 m, 25b, 1.08.1980, Löbl, 1♀ (MHNG); Hyogo, Mt. Shosha, 19.III.1988, T. Ito, 1♀ (cITO); Kobe, Mayasan, 18.X.21, J.S.A. Lauro, 1 Ex. (BMNH); Kobe, Japan, G. Lewis, 1910-320, *Megacronus setiger* mihi D.S., Chicago Nat. Hist. Mus. (ex. D. Sharp Colln. by exchange with Brit. Mus. Nat. Hist.), 1♂ (FMNH); Kyoto, Yaseyuen/Kyoto, 9b, 4.08.1980, Cl. Besuchet, 1♂ (MHNG); Kyoto, Yawata, 29.IV.1980, 30.IV.1979, T. Ito, 1♂, 2♀ (cITO, cSCHÜ); Nagasaki pref., Isl. Hirado, 8.06.1977, H. Ohishi, 1♂ (NHMC); Nara, Nara, 2c, 27.-31.07.1980, Cl. Besuchet, 1♀ (MHNG); Okayama, Mt. Gagyu, 28.08.1977, H. Oishi, 1♂ (NHMC); Tottori, Misasa Spa, 28.IX.1986, T. Ito, 3 Ex. (cITO, cSCHÜ); Wakayama pref., Mt. Gomanodan, 22.-23.06.1981, S. Naomi, 1♂ (NHMC); Yamanashi, Daibosatsu, 6.VII.1988, T. Ito, 1♂ (cITO); Yamanashi pref., Hirogawara, Mt. Shirane, 9.-13.07.1982, S. Naomi, 1♀ (cSCHÜ); Yamanashi pref., Jigokudani, Mt. Yatsu, 8.07.1982, S. Naomi, 1♂ (NHMC); Unzen, Shimabara Spa, 29.V.1987, T. Ito, 1♀ (cITO).

Bolitobius princeps (Sharp, 1874) (Abb. 7, 13, 18, 19, 26, 27, 32, 35)
Megacronus princeps Sharp, 1874: 19 (Locus Typicus: Japan, Kawatchi).

Färbung: Kopf und Halsschild schwarz, Flügeldecken rotbraun, Hinterleib schwarz mit schmal aufgehellten Hinterrändern der Tergite, Tergit VII am Hinterrand

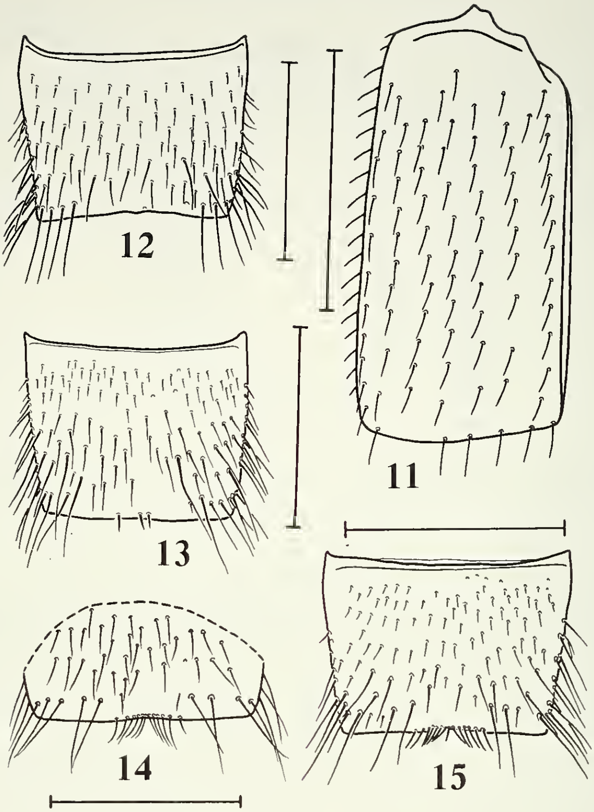

ABB. 11-15

11) Flügeldeckenbeborstung von *Bolitobius setiger* (Sharp), Japan, Osaka, ZNr. 098 und ♂-Sternite VII von 12) *Bolitobius setiger* (Sharp), Japan, Ehime, Matsuyama, ZNr. 127, 13) *Bolitobius princeps* (Sharp), China, Peking, ZNr. 153, 14) *Bolitobius septemseriatus* Champion, Nepal, Bagmati, Pokhare, ZNr. 157, 15) *Bolitobius loebli* spec. nov., PT, Nepal, Lalitpur, ZNr. 114, Maßstab 1 mm.

breiter aufgehellt. Labrum, Kiefer- und Lippentaster gelb, Fühler mit zwei gelben Basalgliedern, ab Glied 3 schwarz, die Fühlerspitze (Glied 11 und meist auch Glied 10) gelb. Beine gelb.

Habitus: Gestreckt, etwa der häufigen mitteleuropäischen Art *B. castaneus* (Stephens) entsprechend, etwas kräftiger als *B. setiger* (Sharp). Vorderkörperlänge durchschnittlich 3,25 mm (3,1 - 3,5 mm), Gesamtlänge etwa 7,5 mm.

Kopf vom Vorderrand des Clypeus bis zum Hinterrand etwas länger als die Kopfbreite über den Augen (Index 1,08 : 1). Augen gewölbt, aus der Kopfrundung hervortretend, Schläfen lang, hinter den Augen breit halbkreisförmig abgerundet. Augenlänge (seitlich gemessen) etwas kleiner als die Schläfenlänge (Index 0,91 : 1). Neben der Fühlerbasis und dem Hinterrand der Augen befindet sich beiderseits je eine längere Tastborste. Kopf unterhalb der Augen mit deutlicher Seitenrandleiste.

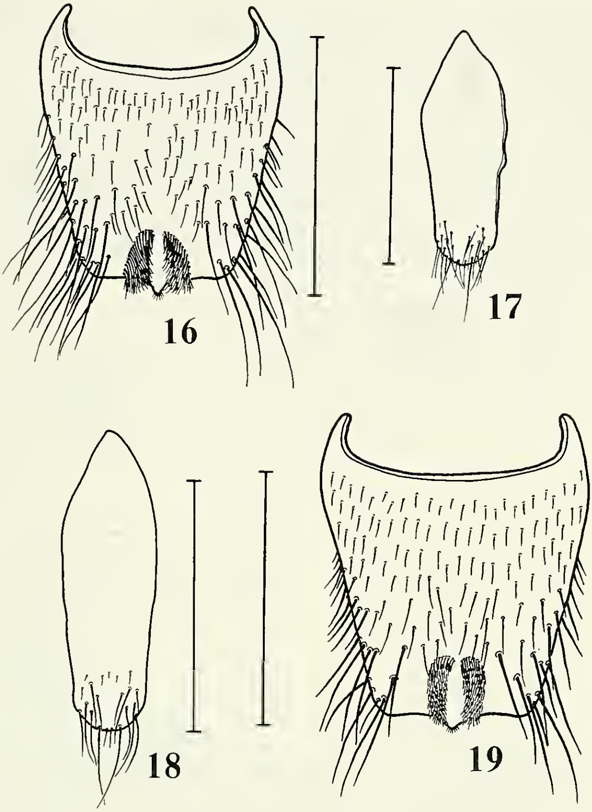

ABB. 16-19

♂-Sternite VIII von 16) *Bolitobius setiger* (Sharp), Japan, Shiroyama, ZNr. 092 und 18) *Bolitobius princeps* (Sharp), China, Peking, ZNr. 102, ♂-Sternite X von 17) *Bolitobius setiger* (Sharp), Japan, Shiroyama, ZNr. 093 und 19) *Bolitobius princeps* (Sharp), China, Peking, ZNr. 108, Maßstab 1 mm.

Fühler etwas schlanker als bei *B. setiger* (Sharp), zurückgelegt den Hinterrand des Halsschildes etwas überragend. Fühlerglied 8 etwa so lang wie breit, die Glieder 9 und 10 leicht quer. Sexualdimorphismus des 11. Fühlergliedes deutlich entwickelt.

Halsschild quer, Verhältnis Breite (max.) zu Länge (Mittellinie) etwa 1,20 : 1, größte Breite hinter der Mitte. Nach vorn stark, nach hinten weniger verengt. Vorderecken vorgezogen und einen abgerundeten spitzen Winkel bildend, die Hinterecken breit stumpfwinklig abgerundet. Halsschild mit 4 Seitenrandborsten, die um die Breite des letzten Hintertarsengliedes vom Seitenrand entfernt sind, 4 Vorderrandborsten, von denen die beiden mittleren etwas weiter vom Vorderrand entfernt stehen als die äußeren, sowie 4 Hinterrandborsten, von denen die beiden äußeren fast doppelt so weit wie die inneren vom Hinterrand entfernt sind. Beiderseits stehen die beiden Hinterrandborsten mit der hinteren Seitenrandborste etwa in einer Reihe.

Schildchen dreieckig mit breit abgerundeter Spitze.

Flügeldecken gestreckt, ihre größte Breite kurz vor dem Hinterrand erreichend. Verhältnis Flügeldeckenschulterlänge zu Flügeldeckenbreite etwa 1 : 1 (0,94 - 1,06). Flügeldecken außer der Nahtreihe und der Seitenrandreihe mit 5 Reihen kräftiger aufrechtstehender Borsten sowie einer Borstenreihe am Hinterrand (Abb. 7). Auf den Epipleuren befindet sich unmittelbar unter dem Flügeldeckenseitenrand eine Reihe zahlreicher kleinerer Borsten. Einzelnstehende Borsten zwischen den Reihen auf den Flügeldecken kommen in Einzelfällen vor. Zwischen den Examplaren aus China und Japan besteht kein signifikanter Unterschied.

TABELLE 2

Flügeldeckenbeborstung von *Bolitobius princeps* (Sharp)

	Durchschnitt	Minimum	Maximum
Suturalreihe	12	10	14
Diskalreihe 1 (innen)	10	8	11
Diskalreihe 2	9	7	12
Diskalreihe 3	10	8	11
Diskalreihe 4	9	8	11
Diskalreihe 5 (außen)	10	9	12
Lateralreihe	12	11	13
Apikalreihe	6	5	7
Epipleuralreihe	21	18	22

Abdomen gesteckt, zum Ende zugespitzt. Tergite ab V deutlich und kräftig, besonders stark in den Basalgruben punktiert. Tergit III in der Mitte mit einer breiten unpunktierten Fläche. Die Punktur wird von der unpunktierten Mitte zum Rand hin stärker, erreicht aber nur in den Hinterecken des Tergits die Stärke von Tergit V. Tergit IV mit schmaler punktfreier Mitte, sonst wie Tergit V punktiert. Punktur im Ganzen etwas weitläufiger als bei *B. setiger* (Sharp). Tergit VII am Hinterrand mit deutlichem Hautsaum.

Beine schlank. Vordertarsen des ♂ erweitert, von Tarsenglied 1 - 5 schmaler werdend.

Mundteile wie bei den anderen Arten der Gattung gebaut. Labrum mit einer hinteren Borstenreihe aus jederseits 3 Borsten, einer mittleren Borstenreihe aus jederseits 2 Borsten sowie jeweils 3 Borsten im Außenbereich des Vorderrandes und zwei Borsten im Mittelbereich. Vorderrand des Labrums im Mittelteil ohne Borsten. Mentum stark quer, jederseits mit zwei großen Borsten.

Männchen: Vordertarsen erweitert, Fühlerglied 11 verlängert (Länge zu Breite etwa 1,6:1). Sternit VII am Hinterrand mit wenigen (3 - 4) Borsten (Abb. 13). Sternit VIII mit spitz vorgezogenem Hinterrand, davor mit zwei dichten Feldern kleinerer dunkler Borsten (Abb. 18). Sternit X gestreckt, nur im Spitzenbereich beborstet (Abb. 19). Aedoeagus kurz mit sehr stumpfer, etwas nach vorn umgeknickter Spitze und langen, den Medianlobus um zwei Drittel seiner Länge überragenden

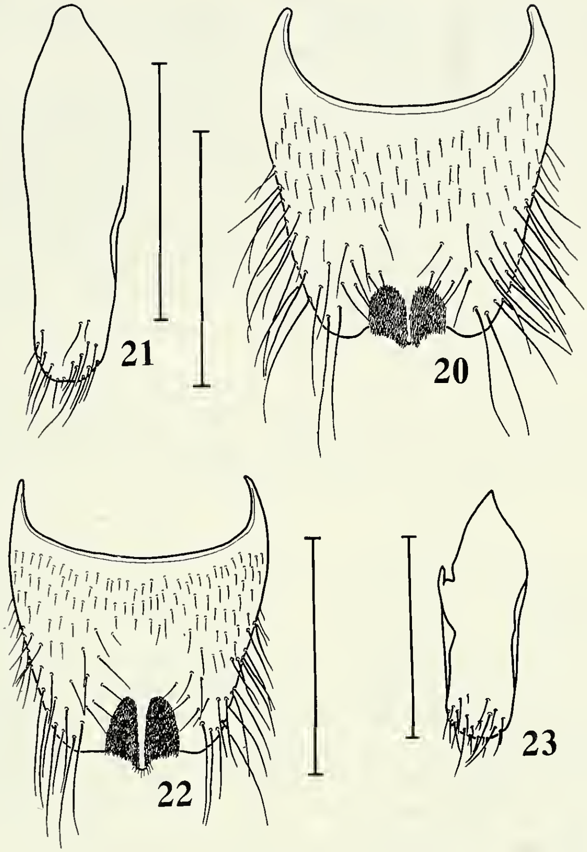

Abb. 20-23

♂-Sternite VIII von 20) *Bolitobius loebli* spec. nov., PT, Lalitpur, ZNr. 103 und 22) *Bolitobius septemseriatus* Champion, Indien, Darjeeling, ZNr. 104, ♂-Sternite X von 21) *Bolitobius loebli* spec. nov., PT, Nepal, Lalitpur, ZNr. 107 und 23) *Bolitobius septemseriatus* Champion, Indien, Kumaon, ZNr. 154, Maßstab 1 mm.

Parameren (Abb. 26, 27). Internalsack mit deutlicher Stuktur aus Skleriten und parallelen, bandförmigen Ausstülpkörpern, die keine Borsten tragen (Abb. 32). Parameren in Höhe der Spitze des Medianlobus verbreitert und an dieser Stelle mit einigen kurzen Borsten an der Innenseite. An der Paramerenspitze befinden sich auf der Innenseite zwei und auf der Außenseite drei Tastborsten.

Weibchen: Vordertarsen einfach, Fühlerglied 11 nur wenig länger als breit (1,3:1). Tergit und Sternit VIII einfach, Tergit X mit feinem Haarsaum am Apikalrand.

Mikroskulptur: Kopf, Halsschild, Flügeldecken und Abdomen mit Mikroskulptur. Maschenweite auf dem Kopf ca. 4 Maschen/10 µm, auf dem Halsschild feiner (etwa 6-8 Maschen/10 µm). Flügeldecken wie der Halsschild chagriniert (ca 6-8 Maschen/10 µm). Abdomen mit zur Spitze engerer Mikroskulptur (Tergit III, Mitte: 4 Maschen/10 µm; Tergit VIII, Mitte: 5-6 Maschen/10 µm).

Untersuchtes Typenmaterial: Aus dem British Museum (Nat. Hist.) lag mir der Holotypus (ein Weibchen) mit folgender Bezettelung vor: Type (rund mit rotem Rand)/ Japan, G. Lewis, 1910-320/ Hiogo/ *Megacronus princeps* type D.S./ Holotypus - ♀, *Megacronus princeps* Sharp, 1874 (rot). Das Tier stimmt mit der Beschreibung überein, es ist auf ein Papp-Plättchen geklebt und bis auf den fehlenden rechten Fühler (Glieder 3-11) komplett.

Warum die Fundortangabe des Holotypus nicht mit der Angabe der Originalbeschreibung übereinstimmt, konnte ich nicht klären. Wahrscheinlich handelt es sich bei der Fundortangabe "Kawatchi" um die zur Präfektur Hiogo gehörende Insel Awaji (Awatchi).

Verbreitung: Bisher aus Japan (Kyushu, Honshu, Is. Yaku, Is. Awaji (?)) und NO-China bekannt (Abb. 35). Die bekannten Funde verteilen sich auf die Monate April bis September (1:2:0:0:1:5).

Untersuchtes Material (10 Exemplare): JAPAN: Yoshida Wada, 15.05.1953, Suhara leg., 1♀, ex coll. Scheerpeltz (NHMW); Kumamoto pref., Naidaijin, Mt. Kunimi, 11.VIII.1977, 1♀, leg. Naomi (NHMC); Hitoyoshi, 4.V.1881, Lewis, 1♀ (BMNH); Yaku Is., Miyanoura, 30.IV.1984, T. Ito, 1♂ (cITO). CHINA: B.M. 1980-491, P.M. Hammond, Peking: Wofuci, 5.IX.1980, 3♂, 2♀, (BMNH, cSCHÜ).

Bolitobius septemseriatus Champion, 1923 (Abb. 6, 9, 14, 22, 23, 30, 33, 36)

Bolitobius septemseriatus CHAMPION, 1923: 46 (Locus Typicus: Indien, Lansdown Division, Uttar Pradesh).

Bryocharis humeralis CAMERON, 1926: 176 (Locus Typicus: Indien, Simla Hills, Theog).

Färbung: Kopf schwarz bis pechbraun, Halsschild ebenso gefärbt, seine Ränder nur sehr schmal heller durchscheinend. Flügeldecken pechbraun mit großem gelben Humeralfleck und breitem gelben Hinterrand (Abb. 9). Hinterleib pechbraun mit rötlich aufgehellten Hinterrändern der Segmente. Beine und Mundteile gelbbraun, Fühler mit zwei gelben Basalgliedern, die anschließenden Fühlerglieder 3-10 dunkelbraun, Glied 11 vollständig oder wenigstens an der Spitze gelb.

Habitus: Gestreckt, etwas kräftiger als *B. setiger* (Sharp), Vorderkörperlänge im Durchschnitt 3,0 mm (2,8 - 3,2 mm), Gesamtlänge 6,5 - 7,5 mm.

Kopf vom Vorderrand des Clypeus bis zum Hinterrand kaum länger als über den Augen breit (Index 1,04 : 1). Augen gewölbt, etwas aus dem Kopfumriß hervortretend. Schläfen hinter den Augen breit abgerundet, wenig länger als die Augen (Index 1,09 : 1). Neben der Fühlerbasis und dem Hinterrand der Augen befindet sich beiderseits je eine lange Tastborste. Kopf dicht unter dem Augenrand mit deutlicher Seitenrandleiste.

Fühler kräftig entwickelt, zurückgelegt den Hinterrand des Halsschildes etwas überragend, Glied 7 etwa so lang wie breit, vorletzte Glieder deutlich quer, letztes Glied beim ♂ kaum erweitert.

Halsschild quer, Verhältnis von Breite (max.) zu Länge (Mittellinie) etwa 1,20 : 1, größte Breite etwas hinter der Mitte. Der Halsschild ist nach vorn stark, nach hinten weniger verengt. Vorderecken vorgezogen und einen abgerundeten, wenig spitzen Winkel bildend, die Hinterecken breit stumpfwinklig abgerundet. Halsschild mit 4 Seitenrandborsten, die alle etwa um die Breite des letzten Hintertarsengliedes vom Halsschildrand entfernt stehen, 4 Vorderrandborsten, von denen die beiden mittleren

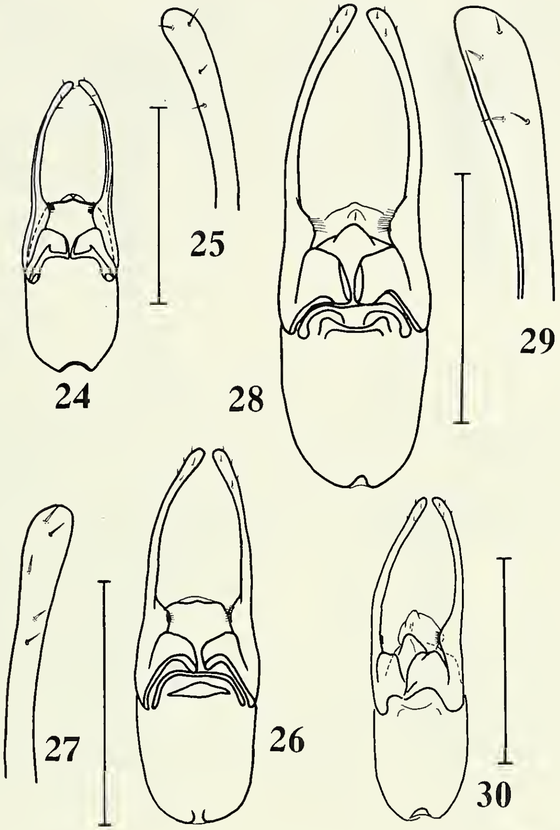

ABB. 24-30

Aedoeagi von 24) *Bolitobius setiger* (Sharp), Japan, Shiroyama, ZNr. 094, 26) *Bolitobius princeps* (Sharp), China, Peking, ZNr. 106, 28) *Bolitobius loebli* spec. nov., PT, Nepal, Lalitpur, ZNr. 108, 30) *Bolitobius septemseriatus* Champion, Nepal, Bagmati, Pokhare, ZNr. 155, und Paramerenspitzen von 25) *Bolitobius setiger* (Sharp), Japan, Shiroyama, ZNr. 097, 27) *Bolitobius princeps* (Sharp), China, Peking, ZNr. 111, 29) *Bolitobius loebli* spec. nov., PT, Nepal, Lalitpur, ZNr. 112, Maßstab 1 mm (24, 26, 28, 30).

etwa ein Drittel weiter vom Vorderrand entfernt stehen als die äußeren, sowie 4 Hinterrandborsten, von denen die beiden äußeren um die Hälfte weiter vom Hinterrand entfernt sind als die beiden inneren. Beiderseits bilden die beiden Hinterrandborsten und die hinterste Seitenrandborste eine gerade Linie.

Schildchen wie bei den anderen Arten der Gattung, dreieckig mit abgerundeter Spitze.

Flügeldecken etwa so lang wie zusammen breit (Index Schulterlänge zu Breite 0,98 - 1,04 : 1), nach hinten breiter werdend, die größte Breite im letzten Viertel

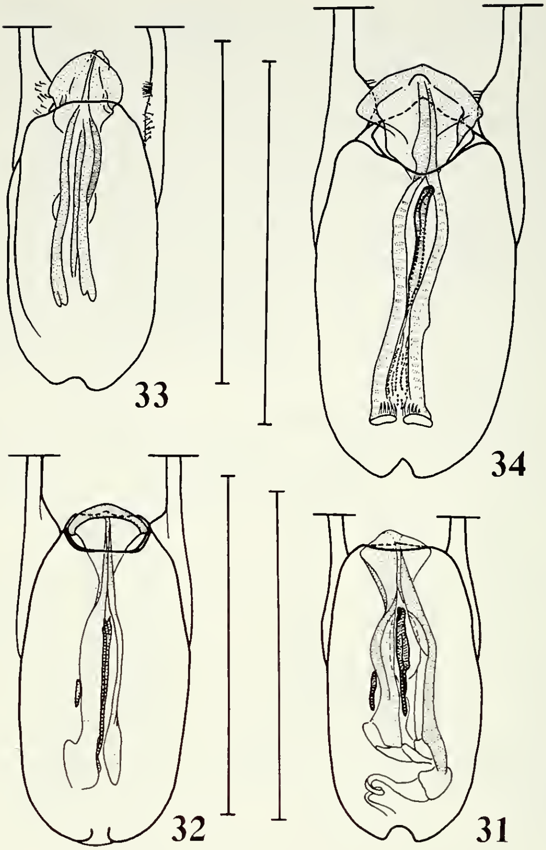

Abb. 31-34

Innenstrukturen des Aedoeagus-Medianlobus von 31) *Bolitobius setiger* (Sharp), Japan, Shiroyama, ZNr. 096, 32) *Bolitobius princeps* (Sharp), China, Peking, ZNr. 110, 33) *Bolitobius septemseriatus* Champion, Nepal, Bagmati, Pokhare, ZNr. 156, und 34) *Bolitobius loebli* spec. nov., PT, Nepal, Lalitpur, ZNr. 113, Maßstab 1 mm..

erreichend. Flügeldecken außer der Nahtreihe und der Seitenrandreihe mit 5 Reihen abstehender, kräftiger Tastborsten sowie einer Borstenreihe am Flügeldeckenhinterrand (Abb. 6). Auf den Epipleuren befindet sich unmittelbar unter dem Flügeldeckenseitenrand eine Reihe zahlreicher kleinerer Borsten.

Die Flügeldeckenbeborstung ist bei *B. septemseriatus* scheinbar variabler als bei anderen Arten, statistische Aussagen sind bei dem geringen bisher vorliegenden Material jedoch noch nicht möglich.

Abdomen gestreckt, zum Ende zugespitzt. Tergite ab V deutlich und kräftig, besonders in den Basalgruben punktiert. Tergite III und IV nur an der Seite und in den

TABELLE 3

Flügeldeckenbeborstung von *Bolitobius septemseriatus* Champion

	Durchschnitt	Minimum	Maximum
Suturalreihe	12	11	14
Diskalreihe 1 (innen)	7	5	9
Diskalreihe 2	9	7	11
Diskalreihe 3	10	8	12
Diskalreihe 4	9	6	10
Diskalreihe 5 (außen)	7	3	11
Lateralreihe	11	9	13
Apikalreihe	6	5	7

Basalgruben mit Punktur, in der Mitte mit breiter punktfreier Fläche. Auch die Tergite V und VI besitzen in der Mitte eine kleinere punktfreie Fläche, die etwa in der Mitte durch eine querliegende Borstenreihe unterbrochen ist. Diese Borstenreihe ist auch auf Tergit IV angedeutet. Tergite VII und VIII fast gleichmäßig punktiert. In der Punktur der Tergite inseriert eine längere gelblich-graue Beborstung. Tergit VII besitzt einen deutlich ausgebildeten Hautsaum.

Beine schlank, Vordertarsen des ♂ etwas erweitert, von Tarsenglied 1 - 5 gleichmäßig schmaler werdend.

Mundteile grundsätzlich wie bei den anderen Arten der Gattung gebildet. Labrum mit einer hinteren Borstenreihe aus jederseits drei Borsten, einer mittleren Borstenreihe aus jederseits zwei (drei) Borsten, sowie jeweils drei Borsten in den Vorderecken und einer Borstengruppe aus jeweils zwei Borsten im Mittelbereich. Vorderrand in der Mitte ohne Borsten. Mentum quer, jederseits mit zwei größeren Borsten.

Männchen: Vordertarsen etwas erweitert, Fühlerglied 11 nur wenig verlängert (Länge zu Breite 1,3:1). Sternit VII in der Mitte des Hinterrandes mit einem Saum von etwa 10 kurzen Borsten (Abb. 14). Sternit VIII mit vorgezogener Spitze am Hinterrand, davor mit zwei dichten Borstenfeldern (Abb. 22).

Aedoeagus kurz mit sehr stumpfer, etwas nach vorn umgeknickter Spitze und langen, den Medianlobus um mehr als zwei Drittel seiner Länge überragenden Parameren (Abb. 30). Internalsack mit deutlicher Struktur aus Skleriten und parallelen, bandförmigen Ausstülpkörpern, die keine Borsten tragen (Abb. 33). Parameren in Höhe der Spitze des Medianlobus verbreitert und an dieser Stelle mit einigen kurzen Borsten an der Innenseite. An der Paramerenspitze befinden sich auf der Innen- und Außenseite jeweils zwei Tastborsten.

Weibchen: Vordertarsen einfach, Fühlerglied 11 nur wenig länger als breit (1,2 : 1), Tergit und Sternit VIII einfach.

Mikroskulptur: Kopf, Halsschild, Flügeldecken und Hinterleib mit deutlicher quermaschiger Mikroskulptur. Maschenweite auf dem Kopf ca. 4 Maschen/10 µm, auf dem Halsschild etwa genauso dicht, auf den Flügeldecken etwas dichter, ca. 5 Maschen/10 µm, auf dem Hinterleib weitläufiger, etwa 3 Maschen/10 µm.

ABB. 35

Verbreitung von *Bolitobius setiger* (Sharp) und *Bolitobius princeps* (Sharp) in Ostasien.

Untersuchtes Typenmaterial: *Bolitobius septemseriatus* Champion: Aus dem British Museum (N.H.) lag der Holotypus der Art, ein ♀ mit entfalteten Hautflügeln und fehlendem rechten Fühler (ab Glied 3) vor. Der Holotypus besitzt eine Gesamtlänge von 6,75 mm und ist mit folgenden Etiketten versehen: 1) TYPE H.T. (rund mit rotem Rand) 2) Lansdowne Division U-P. India, F.W.C. 3) Brit. Mus. 1923-24 4) *Bolitobius 7-seriatus* Type (handschriftlich) 5) *Bolitobius septemseriatus* Champ. 6) Ent. Mon. Mag 1923, Det. G.C.C. 7) Holotypus-♀, *Bolitobius septemseriatus* Champion, 1923, M. Schülke det. 1990 (rot).

Bryocharis humeralis Cameron: Auch von dieser Art lag mir aus dem British Museum (N.H.) ein Syntypus mit folgender Ettikettierung vor: 1) SYNTYPE (rund mit hellblauem Rand) 2) TYPE (rund mit rotem Rand) 3) Theog 7600', Simla Hills 4) Dr. Cameron, 11.IX.1921 5) *Bryocharis humeralis* CAM Type (handschriftlich, "Type" rot) 6) B. *7-seriatus* Champ. (handschriftlich) 7) M. Cameron, Bequest. B.M. 1955-147 8) *Bryocharis humeralis* Cam., P. Hammond det. 1989 SYNTYPE. Das Tier wird hiermit als Lectotypus designiert!

Der Lectotypus, ein ♀ von etwa 7,5 mm Länge mit fehlenden Tarsen des linken Hinterbeines, wurde von mir umpräpariert. Die Hinterleibssegmente ab VIII und die Mundteile wurden herauspräpariert und in Kanadabalsam eingebettet. Die Präparate befinden sich an der gleichen Nadel wie das Tier.

Auch ohne Vergleich des männlichen Genitalbaus ist die Konspezifität mit *Bolitobius septemseriatus* Champ. sicher, was die von CAMERON (1932) selbst getroffene Zuordnung bestätigt.

Verbreitung: Im Himalaya zumindest zwischen den Provinzen Himachal Pradesh und West-Bengalen in Indien und Nepal verbreitet (Abb. 36). Die Fundmeldungen stammen aus Höhenlagen zwischen 1500 und 2800 m.

Untersuchtes Material (9 Exemplare): INDIEN: India bor., Dehra Dun, Mussoorie, 2000 m, 08. 1961, leg. G. Scherer 1 Ex. (MFT); Darjeeling, 1 ♂ (IRSNB); Kumaon (UP), Bhim Tal env., 1500 m, 4.X.1979, I. Löbl, 1Ex. (MHNG). NEPAL: Prov. Bagmati, Pokhare NE Barahbise, 2800 m, 2.V.1981, Löbl & Smetana, 2 Ex. (MHNG, cSCHÜ); E Nepal, Kosi, Val. Induwa Kola, 2100 m, 17.IV.1984, Löbl - Smetana, 2 Ex. (MHNG, cSCHÜ).

Bolitobius loebli sp. n. (Abb. 5, 8, 15, 20, 21, 28, 29, 34, 36)

Holotypus - ♂: Nepal, Manang, Distr. For. W Bagarchhap, 2250 m, 22.IX.1983, Smetana & Löbl; Holotypus - ♂, *Bolitobius loebli* nov. spec., M. Schülke det. 1990; (MHNG).

Paratypus - ♂♀: Nepal, Lalitpur, Distr. Phulcoki, 2600-2700/2700 m, 15.X.1983, Smetana & Löbl, 1♂, 1♀; Paratypus - ♂♀, *Bolitobius loebli* nov. spec., M. Schülke det. 1990/1991 (MHNG, cSCHÜ.).

Färbung: Kopf schwarz bis pechbraun, Halsschild ebenso gefärbt, seine Ränder nur sehr schmal heller durchscheinend. Flügeldecken pechbraun bis schwarz mit gelbem, unscharf begrenztem Humeralfleck (Abb. 8) oder einfarbig schwarz (PT-♂, Lalitpur). Hinterleib pechbraun mit rötlich aufgehellten Hinterrändern der Segmente. Beine dunkelbraun, Schienen +/- geschwärzt. Mundteile gelbbraun, die vorletzten Glieder der Kiefertaster gebräunt, Fühler mit zwei gelben Basalgliedern, die anschließenden Fühlerglieder 3-10 dunkelbraun, Glied 11 nur schwach aufgehellt.

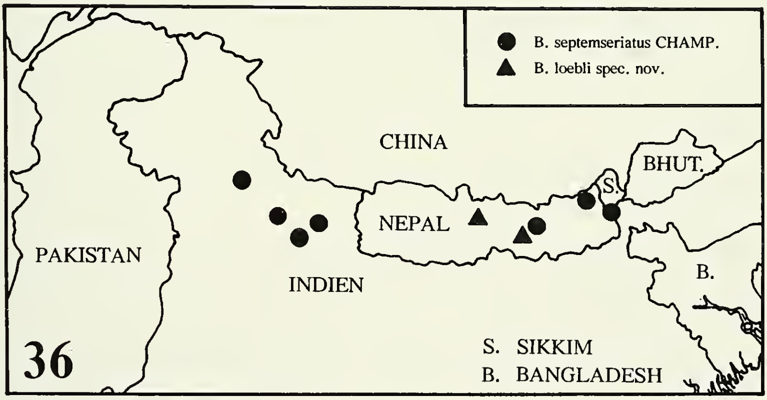

ABB. 36

Verbreitung von *Bolitobius septemseriatus* Champion und *Bolitobius loebli* spec. nov. im Himalaya-Gebiet.

Habitus: Gestreckt, etwas kräftiger als *B. septemseriatus* Champ., Vorderkörperlänge im Durchschnitt über 3,0 mm (3,0 - 3,4 mm), Gesamtlänge etwa 7,5 mm.

Kopf vom Vorderrand des Clypeus bis zum Hinterrand so lang wie über den Augen breit. Augen gewölbt, etwas aus dem Kopfumriß hervortretend. Schläfen hinter den Augen breit abgerundet, etwas länger als die Augen (Index 1,20:1). Neben der Fühlerbasis und dem Hinterrand der Augen befindet sich beiderseits je eine lange Tastborste. Kopf dicht unter dem Augenrand mit deutlicher Seitenrandleiste.

Fühler kräftig entwickelt, zurückgelegt den Hinterrand des Halsschildes etwas überragend, Glied 8 etwa so lang wie breit, vorletzte Glieder quer, letztes Glied beim ♂ kaum erweitert.

Halsschild quer, Verhältnis von Breite (max.) zu Länge (Mittellinie) etwa 1,20 : 1, größte Breite etwas hinter der Mitte. Der Halsschild ist nach vorn stark, nach hinten weniger verengt. Vorderecken vorgezogen und einen abgerundeten, wenig spitzen Winkel bildend, die Hinterecken breit stumpfwinklig abgerundet. Halsschild mit 4 Seitenrandborsten, die alle etwa um die Breite des letzten Hintertarsengliedes vom Halsschildrand entfernt stehen, 4 Vorderrandborsten, von denen die beiden mittleren etwa ein Drittel weiter vom Vorderrand entfernt stehen als die äußeren sowie 4 Hinterrandborsten, von denen die beiden äußeren um die Hälfte weiter vom Hinterrand entfernt sind als die beiden inneren. Beiderseits bilden die beiden Hinterrandborsten und die hinterste Seitenrandborste eine gerade Linie.

Schildchen wie bei den anderen Arten der Gattung, dreieckig mit abgerundeter Spitze.

Flügeldecken etwa so lang wie zusammen breit (Index Schulterlänge zu Breite 0,94 - 1,0 : 1), nach hinten breiter werdend, die größte Breite im letzten Viertel erreichend. Flügeldecken außer der Nahtreihe und der Seitenrandreihe mit 3 Reihen abstehender, kräftiger Tastborsten sowie einer Borstenreihe am Flügeldeckenhinterrand. Auf der Innenseite der Flügeldecken sind die Diskalreihen 1 und 2 bis auf Einzelpunkte reduziert, so daß die dritte Borstenreihe in der Mitte der Elytren die erste vollständige ist (Abb. 5). Auf den Epipleuren befindet sich unmittelbar unter dem Flügeldeckenseitenrand eine Reihe zahlreicher kleinerer Borsten.

Bolitobius loebli sp. n. ist von *B. septemseriatus* Champ. durch die unterschiedliche Flügeldeckenbeborstung sofort zu unterscheiden. Statistische Aussagen sind bei der geringen Materialbasis nicht möglich.

Abdomen gestreckt, zum Ende zugespitzt. Tergit ab V deutlich und kräftig, besonders in den Basalgruben punktiert. Tergite III und IV nur an der Seite und in den Basalgruben mit Punktur, in der Mitte mit breiter punktfreier Fläche. Auch die Tergite V und VI besitzen in der Mitte eine kleinere punktfreie Fläche, die etwa in der Mitte durch eine querliegende Borstenreihe unterbrochen ist. Diese Borstenreihe ist auch auf Tergit IV angedeutet. Tergit VII und VIII fast gleichmäßig punktiert. In der Punktur der Tergite inseriert eine längere gelblich-graue Beborstung. Tergit VII besitzt einen deutlich ausgebildeten Hautsaum.

Beine schlank, Vordertarsen des ♂ etwas erweitert, von Tarsenglied 1 - 5 gleichmäßig schmaler werdend.

TABELLE 4

Flügeldeckenbeborstung von *Bolitobius loebli* sp. n.

	Durchschnitt	Minimum	Maximum
Suturalreihe	11	9	12
Borsten auf der Innenhälfte der Flügeldecke	3	1	5
Diskalreihe 3	10	8	11
Diskalreihe 4	8	7	8
Diskalreihe 5 (außen)	4	1	5
Lateralreihe	12	10	13
Apikalreihe	5	4	5
Epipleuralreihe	21	18	22

Mundteile grundsätzlich wie bei den anderen Arten der Gattung gebildet. Mentum quer, jederseits mit zwei größeren Borsten.

Männchen: Vordertarsen etwas erweitert, Fühlerglied 11 nur wenig verlängert (Länge zu Breite 1,3:1). Sternit VII (Abb. 15) in der Mitte des Hinterrandes mit einem Saum kurzer Borsten (HT: 16, PT: 11). Sternit VIII mit vorgezogener Spitze am Hinterrand, davor mit zwei dichten Borstenfeldern (Abb. 20).

Aedoeagus kurz mit sehr stumpfer, etwas nach vorn umgeknickter Spitze und langen, den Medianlobus um mehr als zwei Drittel seiner Länge überragenden Parameren (Abb. 28, 29). Internalsack mit deutlicher Struktur aus Skleriten und parallelen, bandförmigen Ausstülpkörpern, die keine Borsten tragen (Abb. 34). Parameren in Höhe der Spitze des Medianlobus verbreitert und an dieser Stelle mit einigen kurzen Borsten an der Innenseite. An der Paramerenspitze befinden sich auf der Innen- und Außenseite jeweils zwei Tastborsten. *Bolitobius loebli* ist anhand der männlichen Geschlechtsmerkmale nur schwer von *B. septemseriatus* zu unterscheiden, beide Arten sind eng miteinander verwandt.

Weibchen: Vordertarsen einfach, Fühlerglied 11 nur wenig länger als breit (1,2 : 1). Tergit und Sternit VIII einfach.

Mikroskulptur: Kopf, Halsschild, Flügeldecken und Hinterleib mit deutlicher quermaschiger Mikroskulptur. Maschenweite auf dem Kopf ca. 5 Maschen/10 µm, auf dem Halsschild etwa genauso dicht, auf den Flügeldecken etwas dichter, ca. 6-8 Maschen/ 10 µm, auf dem Hinterleib weitläufiger, etwa 5 Maschen/10 µm.

Differentialdiagnose: *Bolitobius loebli* sp. nov. ist mit *B. septemseriatus* Champion nahe verwandt und von dieser Art durch die reduzierte Beborstung der Flügeldecken (Abb. 5) und den dunklen Hinterrand der Flügeldecken (Abb. 8) einfach zu unterscheiden.

Kollegen Dr. Ivan Löbl, dem ich die Möglichkeit zum Studium des reichen Bolitobiini-Materials des Museums Genf verdanke, freundlichst gewidmet.

BESTIMMUNGSTABELLE DER ARTEN DER *Bolitobius setiger* - GRUPPE

Anmerkung: Die vorliegende Bestimmungstabelle umfaßt lediglich die bisher bekannten Vertreter des Monophylums *B. setiger* - Gruppe. Neben den Vertretern dieser Artengruppe kommen sowohl in Ostasien als auch im Himalaya weitere Arten der Gattung vor, die sich durch das Fehlen der weiter unten diskutierten Merkmale auszeichnen.

1 Arten der östlichen Paläarktis (Japan, China, Ostsibirien?), Flügeldecken einfarbig rot oder braun bis schwarz mit gelbem Humeralfleck 2

– Arten der südlichen Paläarktis (Südabhang des Himalaya), Flügeldecken schwarz mit oder ohne Humeralfleck. 3

2 Flügeldecken einfarbig rot, Körperbau etwas kräftiger, Endglied der Fühler beim Männchen stärker verlängert (Länge zu Breite 1,6:1). China, Japan. .... *Bolitobius princeps* (Sharp)

– Flügeldecken zweifarbig, dunkelbraun bis schwarz mit hellgelber Humeralmakel (Abb. 10), Körperbau etwas graziler, Endglied der Fühler beim Männchen nur wenig verlängert (Länge zu Breite 1,3:1). Japan. .... *Bolitobius setiger* (Sharp)

3 Flügeldecken zweifarbig, dunkelbraun bis schwarz mit deutlicher heller Humeralmakel und hellem Hinterrand (Abb. 9). Beine hell, Halsschild schmal, deutlich schmaler als die nach hinten erweiterten Flügeldecken. Flügeldecken neben der Lateral- und der Suturalborstenreihe mit fünf deutlichen Borstenreihen (Abb. 6). Himalaya zwischen Himachal Pradesh und Westbengalen. .... *Bolitobius septemseriatus* Champion

– Flügeldecken dunkelbraun bis schwarz, einfarbig oder mit undeutlicher heller Humeralmakel aber nie mit hellem Hinterrand (Abb. 8). Beine dunkel. Halsschild breit, so breit oder noch etwas breiter als die nach hinten wenig divergierenden Flügeldecken. Auf den Flügeldecken sind die beiden inneren Diskalborstenreihen bis auf Einzelborsten reduziert (Abb. 5). Nepal. .... *Bolitobius loebli* n. sp.

VERWANDSCHAFTSBEZIEHUNGEN

MONOPHYLIE DER ARTGRUPPE

Im Gegensatz zu den meisten anderen Vertretern der Tribus Bolitobiini, wie den meisten Arten der Gattungen *Lordithon* Thomson, *Bryoporus* Kraatz oder *Mycetoporus* Mannerheim, sind die *Bolitobius*-Arten in ihrer Mehrzahl durch komplizierte Bildungen der Hinterleibssternite VII und VIII des Männchens ausgezeichnet. Anhand dieser Merkmale sowie zusätzlicher Synapomorphien im Bau des Aedoeagus ist die *Bolitobius setiger* - Gruppe als Monophylum im Sinne HENNIGS (1982) sicher nachweisbar. Auf die Einbeziehung weiterer Merkmale, die besonders im Bau der Mundteile zu finden sein sollten, wurde vorerst verzichtet, da für die Wertung der Ergebnisse die noch ausstehende Untersuchung aller Gattungsvertreter notwendig ist.

Folgende Merkmale erscheinen als Synapomorphien der Arten der *Bolitobius setiger* - Gruppe abgesichert (plesiomorphe Merkmalsausprägung in Klammern):

- Sternit VIII am Hinterrand in der Mitte mit einem +/- spitzen Mittelfortsatz, der Hinterrand beiderseits +/- bogenförmig zurücktretend (plesiomorph: Mittelfortsatz am Hinterrand des Sternits VIII breit und abgerundet);
- vor dem Mittelfortsatz des Sternits VIII befinden sich zwei langgestreckte, in der Mitte durch einen schmalen Zwischenraum getrennte, sehr dichte Borstenfelder (plesiomorph: vor dem Hinterrand von Sternit VIII sind keine Borstenfelder vorhanden);
- Aedoeagus mit sehr kurzem Medianlobus (plesiomorph: Medianlobus des Aedoeagus länger);
- Parameren sehr lang, den Medianlobus des Aedoeagus fast um seine Länge überragend (plesiomorph: Parameren kürzer, den Medianlobus weniger stark überragend);
- Medianlobus an der Spitze stumpf, ventral abgeknickt (plesiomorph: Medianlobus zugespitzt, nicht ventral abgeknickt);
- Aedoeagus mit charakteristischer Innenstruktur aus zwei langgestreckten und teilweise chitinisierten Ausstülpkörpern (plesiomorph: Aedoeagus ohne deutliche, paarige Ausstülpkörper).

Alle genannten Synapomorphien stellen zweifellos Sonderbildungen dar und sind damit von hohem konstitutiven und diagnostischen Wert.

Die Frage nach dem Adelphotaxon der Artgruppe um *B. setiger* ist zum gegenwärtigen Zeitpunkt nicht schlüssig zu beantworten.

VERWANDTSCHAFTSVERHÄLTNISSE DER ARTEN

Die Verwandtschaftsverhältnisse innerhalb der *B. setiger* - Gruppe sind heute noch nicht völlig geklärt. Das liegt darin begründet, daß es für eine Anzahl von Merkmalen noch nicht möglich ist, die Lesrichtung der Merkmaltransformation festzustellen. Wahrscheinlich sind die beiden aus dem Himalaya beschriebenen Arten *B. septemseriatus* Champ. und *B. loebli* sp. n. Schwesterarten (Synapomorphien: zahlreiche Borsten am Hinterrand von Sternit VII der ♂♂; Borstenfelder am Hinterrand von Sternit VIII der ♂♂ verbreitert; Flügeldeckenbeborstung mit Reduktionserscheinungen der Diskalreihen 1 und 2 (innen)).

Ob das Adelphotaxon der Himalaya-Arten *Bolitobius setiger* (Sharp) (Variante A) oder *Bolitobius setiger* (Sharp) + *B. princeps* (Sharp) ist (Variante B), ist vorerst noch nicht sicher. Für beide Hypothesen lassen sich Argumente ins Feld führen. So weist der Komplex *B. septemseriatus* + *loebli* + *setiger* (Variante A) als mögliche Synapomorphie eine Reduktion des Sexualdimorphismus des Fühlergliedes 11 bei den ♂♂ auf, wogegen *Bolitobius setiger* und *B. princeps* beide durch eine extreme Verkürzung und Abstumpfung der Medianloben der Aedoeagi ausgezeichnet sind (Variante B).

ZOOGEOGRAPHISHE ANALYSE

Zoogeographische Aussagen zur Verbreitung und Herkunft der *Bolitobius setiger* - Gruppe sind durch die geringe Materialbasis sehr erschwert. Die zwischen den Fundorten im Himalaya und NO-China bestehende Verbreitungslücke halte ich eher für einen Ausdruck der geringen Sammelaktivität in den dazwischenliegenden Gebieten (N-Burma, China). Die Artengruppe ist wahrscheinlich ostasiatischen Ursprungs und hat erst später von Osten her das Himalaya-Gebiet besiedelt (siehe auch SMETANA, 1988). Direkte Beziehungen der im Himalaya-Gebiet vorkommenden Arten zu weiter westlich oder nördlich vorkommenden Gattungsvertretern bestehen nicht.

LITERATUR

CAMERON, M. (1926): New species of Staphylinidae from India. - *Trans. Ent. Soc. London 1926*: 171-191.

CAMERON, M. (1932): The fauna of British India, including Ceylon and Burma, Coleoptera, Staphylinidae - Vol. III. - London, 443 p., 4 tab.

CHAMPION, G.C. (1923): Some indian Coleoptera (10). - *Entomologist's Mon. Mag.* 59: 43-47.

COIFFAIT, H. (1982): Contribution à la connaissance des Staphylinides de l'Himalaya (Népal, Ladakh, Cachemire). - *Senkenbergiana biol.* 62 (1981): 21-179.

HENNIG, W. (1982): Phylogenetische Systematik. - Berlin - Hamburg, 246 p.

LUZE, G. (1901): Bolitobiini Revision der paläarktischen Arten der Staphyliniden - Gattungen *Bryocharis* Boisd et Lac., *Bolitobius* Mannh., *Bryoporus* Kraatz und *Mycetoporus* Mannh. - *Verh. zool.- bot. Ges. Wien*, 1901 : 662-746.

SCHÜLKE, M. (1993): *Bolitobius parasetiger* spec. nov.- eine neue Art aus Japan (Coleoptera, Staphylinidae), 11. Beitrag zur Kenntnis der Tachyporinen. - *Ent. Bl. Biol. Syst. Käfer* 89: 75-82.

SCHÜLKE, M. & M. UHLIG (1989): *Sepedophilus*-Studien 1: *S. pedicularius* (Gravenhorst, 1802) (= *Tachyporus truncatellus* Gravenhorst, 1806) und *S. obtusus* (Luze, 1902). - *Ent. Bl. Biol. Syst. Käfer* 85: 147-164.

SHARP, D. (1874): The Staphylinidae of Japan. - *Trans. Ent. Soc. London* 1874: 1-103.

SHARP, D. (1988): The Staphylinidae of Japan. - *Ann. Mag. nat. Hist.* 6 (2): 451-464.

SMETANA, A. (1988): Revision of the tribes Quediini and Atanygnathini. Part II. The Himalayan region (Coleoptera, Staphylinidae). - *Quaestiones Entomologicae* 24: 163-464.

TICHOMIROVA, A.L. (1973): Morfoekologitscheskie osobenosti i filogenes Stafilinid (s katalogom fauny SSSR). - Moskau, 191 p.

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Mertens, R. & H. Vermuth. 1960. Die Amphibien und Reptilien Europas, Kramer, Frankfurt am Main, XI + 264 pp.
Handley, C.O. Jr. 1966. Checklist of the mammals of Panama, pp. 753-795. In: Ectoparasites of Panama (R.L. Wenzel & V.J. Tipton, eds.). Field Mus. Nat. Hist. Chicago, XII+ 861 pp.

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ABSTRACTS

SATELLITE SYMPOSIUM

Short Papers

Jonas Barandun (Zürich): Reproductive strategy of *Bombina variegata* (Anura): an approach.

Bombina variegata is typically found to spawn in small, temporary pools. The preference of many anuran species for temporary pools for oviposition is generally explained by a strategy of escaping predation on larvae. Stable or old ponds can contain a variety of predators which are rare or absent in pools drying out from time to time. The cost of spawning in temporary pools without predators is the risk of desiccation. The likelihood of desiccation mainly depends on pool shape and exposition, but its dynamic and extent depends on weather conditions, thus being largely unpredictable. This raises a dilemma in respect of optimizing reproductive success: In pools with low risk of desiccation, larval mortality caused by predation is predictably high. To avoid predation, toads should avoid pools containing essential densities of predators. On the other hand, pools without predators are likely to dry to an unpredictable extent. To minimize this risk, toads are expected to avoid oviposition in ephemeral pools and to distribute eggs over time and among different pools.

Preliminary results from a recent field study show that the toads oviposit in the whole range of pools in respect of duration and predator density. Only clearly perennial ponds are avoided, probably due to unsuitable correlated temperature. They also distribute eggs over the whole summer. In a dry summer, reproduction is successful only in durable pools with substantial predator densities. In a rainy summer however, additional success is possible in more temporary pools. This risk distributing strategy provides a minimum success in any situation but allows boom reproduction under optimal environmental conditions.

Bruno Bruderer & **Les G. Underhill** (Sempach & Cape Town): Altitude choice by migrating birds over the Negev Desert.

Nocturnal migrants are constrained by their energy and water reserves when crossing large desert areas. A nocturnal long-distance migrant should fly as high as available oxygen allows, because lower temperatures at higher altitudes reduce evaporative water loss, and flight speed should increase as air density decreases. Water loss might also be reduced by flying at a level with high relative humidity. Saving energy and time is most efficient when flying at a level with maximum support by following winds. - Conically scanning the sky at different elevation angles by the pencil-beam of an X-band radar provided data on the height distribution of nocturnal migrants (recorded three times around mid-night, as birds/km^3 for 20 height strata up to an altitude of 4000 m AGL). The relevant meteorological parameters (wind speed, wind direction, temperature, humidity, pressure) to test the hypotheses were measured by radar-tracked pilot ballons and radio sonds. - Statistical treatment of the data was difficult as a distribution had to be predicted using 5 x 20 = 100 explanatory variables and a restricted sample size (40 nights in autumn, 80 nights in spring). A sensible parametrisation for the height distributions was not obvious. The problem was solved by assuming that the birds tell us their degree of preference between a pair of height intervals by their proportions flying within these intervals. The number of compared intervals (sample size) was now 1782 for 40 autumn nights (40 x 3 x number of occupied height intervals). Based on the assumption that individual birds are choosing between pairs of height intervals, the model generates height distributions using the observed meteorological data for a night. The simulated height distributions of birds compare well with the observed distributions. Among all the explanatory variables, only the change of tail-wind speed proved to be significant in the autumn data.

Stephan Durrer (Zürich): Parasites and competition in bumblebee communities.

Philipp Heeb (Bern): A test of coloniality in tree sparrow.

Michel Genoud (Lausanne) & **Nicolas Perrin** (Bern): Fecundity versus offspring size in a shrew *Crocidura russula*: Trade-offs and strategy.

Bernd Hägele (Basel): Seasonal changes in the food choice of the generalist herbivore *Arianta arbustorum* (L.) (Helicidae, Gastropoda) in habitats dominated by plants from the tribe Senecioneae (Asteraceae).

The current theory of generalist herbivore-plant-interaction does not predict whether secondary plant compounds should optimally be toxic, deterrent or digestibility reducing. Much depends on the actual feeding behavior of the herbivore in the field. I therefore investigated feeding by snails in six different sites, all dominated by plants from the tribe Senecioneae (Asteraceae). In May and August I sampled 25 snails and one m^2 surface vegetation from each site. I identified all plants and measured for each species dry weight per m^2, water, carbon, nitrogen and sugar content of the leaves. From the snails I collected the feces and used them to determine the quantity and quality of its food plants. To see which factor had the most influence on snail feeding I calculated a multiple regression between the relative percentage of the plants in the feces and the measured plant characteristics. In May I found significant regressions only in habitats that were dominated by *Petasites albus* and in August I found significant regressions in habitats dominated by both *Petasites albus* and *Adenostyles alliariae*. Out of plant parameters only the dry weight consistently explained most of the observed variance in snail feeding. Since the measures of plant quality did not explain any of the variance observed in snail feeding in habitats dominated by *Adenostyles alliariae* in May, I conclude that plant chemistry might be important here. An investigation of apolar plant compounds of the Senecioneae revealed a negative correlation between the presence of one particular substance and avoidance by snails. Preliminary results indicate that this substance is a sesquiterpene of the furanoeremophilan type.

Tadeusz Kawecki (Basel): Accumulation of deleterious mutations and the evolutionary cost of being a generalist.

Barbara Imhoof (Zürich): Dear enemy recognition in wall lizards (*Podarcis muralis*).

Laurent Keller (Bern): Founder event causes 90% sterility in an ant species.

Matthias Kestenholz (Sempach): Movement patterns of diving ducks in winter: Overwintering or nomadism?

150'000 Tufted Ducks *Aythya fuligula* and 60'000 Pochards *Aythya ferina* spend their winter time on the lakes and rivers of Switzerland where they mainly feed on benthic Zebra mussels *Dreissena polymorpha*. High turnover rates in their populations are contradictory to the traditional definition of a wintering site. The present study combining nocturnal radar observations, colour-tagging, and short-term ringing recoveries demonstrates that movements of diving ducks occur regularly during the whole wintering period. In contrast to normal autumn and spring migration, these movements are less directed and cover shorter distances. Ringing recoveries from year to year provide evidence for site fidelity between different winters but there are also changes in wintering sites. The flexible and exogenously triggered migratory behaviour of wintering diving ducks enables them to avoid unfavourable conditions, such as restricted food availability, fluctuations in water levels, hunting pressure, freezing and cold spells.

Christine B. Müller (Basel): When fewer doesn't pay: Temperature exploitation as a defence against parasitoids in bumblebees.

Francis Saucy (Fribourg): Delayed density-dependence in fluctuating populations of the water vole.

Hagen Zandt (Basel): On tree condition, leaf quality and caterpillar growth performance.

Pascal Steullet (Neuchâtel): Olfaction in the host-parasite relationship of the tick *Amblyomma variegatum*.

Establishment of a host-parasite relationship between adults of the tropical tick, *Amblyomma variegatum*, and their hosts (wild and domestic herbivores) involves two successive phases of infestation. Pioneer male *A. variegatum* are excited by two vertebrate-breath compounds, CO_2 and H_2S, and are attracted by the host-emitted infrared radiations. Once on the host, successful males find a suitable feeding site, attach and feed on blood for few days until sexual maturation. These males then emit an aggregation-attachment pheromone which, mixed with host odour (i.e. CO_2), initiates host finding in conspecifics and induce them to aggregate and attach near mature males. This chemical communication elaborated by this tick species makes an infested host more attractive and favours meeting of the sexes on an adequate host where mating and a complete blood meal can be achieved.

The aggregation-attachment pheromone of *A. variegatum* is known to contain 2-nitrophenol, methylsalicylate, and nonanoic acid, whereas the pheromone of the related species *A. hebraeum* is composed of 2-nitrophenol, benzaldehyde, nonanoic acid, and 2-methylpropanoic acid. Analysis of bovine odour with gas chromatography coupled electrophysiology recording of olfactory sensilla of *A. variegatum* has revealed that all of these compounds except methylsalicylate also occur as minor constituents in the odour of cattle. Could it be that evolution has lead mature males of both tick species to secrete high amounts of volatiles associated with the odour of their main hosts in order to reinforce attractivity of colonized herbivores for conspecifics? Mimicry of a part of the host bouquet in the aggregation-attachment pheromone would thus not have involved a profound modification of the olfactory system used for host finding as would have been the case with the use of a more autonomous pheromone system.

Werner Suter (Sempach): Foraging in cormorants: How to take advantage of the prey's antipredator behaviour.

Claus Wedeking & Markus Frischknecht (Bern): Handicaps not necessary in mate choice for resistance genes.

Manfred Milinski & Theo Bakker (Bern): Sequential mate choice in female sticklebacks.

Erika Bucheli (Zürich): Have symptomless grass endophytes lost the ability of sexual reproduction?

Matthias Rickli (Liebefeld): Stimuli for host finding and recognition in *Varroa jacobsoni*, a honeybee parasite.

Host location in parasites often consists of a sequence of behavioral responses towards specific stimuli. Host finding and recognition are elements of such a sequence. In our study we analysed responses of the parasitic mite *Varroa jacobsoni* to chemical cues of its host, the honeybee *Apis mellifera*, at two levels of the behavioral sequence. Firstly we tested the hypothesis that mites may be attracted by olfaction towards bee larvae, the host stage on which *V. jacobsoni* reproduce. On a servosphere the mites turned systematically from across or downwind walking to upwind when either the odour of living larvae or extracts of this odour were offered in an airstream. Palmitic acid was identified as an active component of the odour. During the subsequent steps of the invasion of honeybee brood cells, the mites will stay in very close contact with the hosts if not actually on the larvae themselves. At this level we supposed that contact chemostimuli play a major role in host recognition. Mites are strongly arrested on patches of a substrate coated with cuticle extracts of bee larvae. Here, fractions of cuticle extract containing a mixture of paraffines and olefines proved active. Compounds active in olfaction were not active as contact chemostimuli, and vice-versa. We may consequently think of host selection in *V. jacobsoni* as a sequence of behavioral elements to different stimuli representing different sensory modalities.

Gérard Donzé (Liebefeld-Bern): Behavioural adaptations to limited space during reproduction in the parasitic mite *Varroa jacobsoni*.

Many arthropods reproduce in habitats of limited space. Some acarine species partition the space they use, but little is known about genesis of such structuring and its biological role.

Varroa jacobsoni (Acari: Mesostigmata) reproduces in the capped brood of the honeybee *Apis mellifera* and feeds on hemolymph. A reproductive cycle starts after capping of the cell and ends at the emergence of the adult bee. The available time to reproduce is thus limited to 270 hours in worker and to 330 hours in drone brood. *Varroa*'s development is thus a race against time. An optimal reproductive cycle consists of producing one male and 2-4 females fertilised by their single brother.

In the infested brood cells, the host develops normally and *Varroa* has to cope with its morphological changes (i.e. spinning larva, prepupa, pupa, adult bee). This metamorphosis radically transforms the space available for the parasite and could provoke dispersal and destruction of offspring. *Varroa* diminishes these risks by partitioning the space available in the cell. Different behaviours are observed at specific sites. This leads to a stable structure which permits the reduction of displacement activity and thus helps conserve energy.

Urs Leugger (Basel und Sempach): Effect of habitat quality on parental expenditure in Red-backed Shrikes *Lanius collurio.*

Several field studies have demonstrated that birds in low quality habitats show reduced reproductive success compared to those in high quality ones - but do they show the same investment? Parents in low quality habitats could compensate for this disadvantage by expending more time and/or energy on reproduction to achieve the same reproductive output as parents in high quality habitats. In order to assess parental expenditure and reproductive output of Red-backed Shrikes *Lanius collurio* in relation to habitat quality, variation of the following parameters was studied: arrival of adults, timing of breeding season, time budget and weight changes of adults as well as reproductive output in the form of number and weight of nestlings.

The study was carried out in an agricultural area with high structural diversity and different intensities of landuse. The evaluation of habitat quality included scoring of agricultural landuse, structure of the vegetation, and perch supply. The time spent in energetically expensive activities, e. g. flight, and the individual weight changes of breeding birds were used to measure parental expenditure.

High quality habitats were occupied first, and birds spent less time in energetically costly flight activities than in the worse habitats. During the egglaying and incubation stage there was no habitat specific difference in adult body weight. During the nestling stage, however, adult birds in the good habitat lost less weight than adults breeding in low quality habitats. They also produced nestlings of heigher body weight at day eight which might influence the future survival of their offspring. In conldusion, Shrikes in the poorer habitat type invested more in a brood but could not fully compensate for the disadvantage of raising their offspring in a low quality habitat.

Véronique Perrot (Basel): The evolution of haploidy - diploidy.

Paul Ward (Zürich). Habitat structure and male-male competition in *Gammarus pulex.*

1. THEMENBEREICH: AGRARÖKOLOGIE

HAUPTVORTRAG

Keith Sunderland (Littlehampton, GB): Invertebrate polyphagous predators in cereals and the quantification of predation.

Cereal pests are attacked by predators, parasitoids and pathogens. Generalist, or polyphagous, predators (whose diet consists of more than one prey type) constitute a large and varied functional group. There are at least 350 species in UK cereals, belonging to a wide range of taxonomic groups, and including Araneae (spiders), Acari (mites), Opiliones (harvestmen), Chilopoda (centipedes), Carabidae (ground beetles), Staphylinidae (rove beetles), Cantharidae (soldier beetles), Diptera (predatory flies), Heteroptera (bugs), Neuroptera (lacewings). Dermaptera (earwigs) and Formicidae (ants). Approximately 100 species can be abundant in cereals. They are a diverse group in many respects, such as size, phenology, degree and timing of daily activity, vertical stratum occupied, method of prey capture, dispersal capacity and population dynamics strategy. Many of the species that occur in cereals are highly mobile and are also to be found in abundance in a wide range of crops throughout northern Europe. An emphasis is given (below) to spiders, as one of the dominant groups of polyphagous predators, in order to illustrate methods for quantifying predation and for elucidating their population dynamics.

Linyphiidae (money spiders) usually constitute c. 90% of spiders in northern European crops, both in terms of numbers of species and number of individuals. Their density often exceeds 100 m^{-2} in cereals in summer. Most species build non-sticky horizontal sheet webs with vertical silk "trip-wires" to force flying prey onto the sheet below. Large prey can escape from the web if not immobilised by the spider. Linyphiids of the sub-family Linyphiinae (eg. *Lepthyphantes tenuis*) tend to build large webs in the canopy, whilst those of the sub-family Erigoninae (eg. *Erigone atra*) build much smaller webs over small depressions on the ground. Their main prey is Collembola (springtails), followed by aphids; small quantities of other prey (including flies, thrips, leafhoppers and mites) are also taken.

Carabidae and Dermaptera ingest parts of the exoskeletons of their prey and dissection of the alimentary canal showed how the frequency of consumption of each prey type varied between species. All other polyphagous predators are, however, fluid feeders, and a serological method (enzyme-linked immunosorbent assay, ELISA) was used to detect predation on cereal aphids. This indicated that polyphagous predators would find and consume aphids at aphid densities as low as 1 aphid per 50 shoots and 20% of spiders gave positive ELISA reactions at this low density, suggesting that these predators might play a useful role in slowing the development of an aphid infestation at a crucial early stage. A predation index (incorporating predator density, proportion positive by ELISA and digestion rate of the meal) was used to compare the relative contribution of species to overall aphid consumption. This analysis suggested that spiders were making a greater contribution than ground beetles or rove beetles. However, when ELISA was used more quantitatively to estimate the mean biomass of the aphid *Sitobion avenae* consume per predator, it could be seen that ground beetles consumed more than rove beetles or spiders at low aphid densities in the period before flowering of the cereals. Such estimates of consumption rates could be useful in energetics studies, but conversion of the data to give rates of predation is problemmatical because (i) polyphagous predators are often also scavengers (i.e. dead prey may have been consumed) (ii) the aphid label may have been derived from lower in the food chain (eg a predator that fed on a predator of an aphid) (ii) conversion of biomass data to number of aphids consumed requires additional information on the relative availability of the various aphid instars to each predator species and the prey size preference of the predator (iv) some predators (eg rove beetles of the genus *Tachyporus*), even if semi-satiated, can exhibit "wasteful killing" behaviour inside an aphid colony - i.e. they kill many but consume few. These limitations also apply to other post-mortem methods for quantifying predation, such as electrophoresis.

A more direct means of quantifying predation by web-building species of linyphiid spiders was found. The predation rate is given by the product of three values; (i) rate of aphids falling from the cereals (ii) proportion of ground covered by webs (iii) capture efficiency of aphids by spiders. Aphid falling rates were measured using horizontal sticky traps to simulate webs; one set was put on the ground (representing Erigoninae webs) and the other in the canopy at the mean height of Linyphiinae webs each week. Webs in the field were revealed with atomised water, their major dimensions measured and web cover calculated. Capture efficiencies were measured in the laboratory. Web cover was low (less than 2%) in May and June and remained low on the ground but increased rapidly in the canopy to *c.* 50% by late July. More than 90% of the shoot population of *S. avenae* fell to the ground in May and early

July. Such fallen aphids are not automatically removed from the population; work by other authors has demonstrated that the proportion of fallen *S. avenae* that re-climb cereals is reduced in the presence of predators. In the Littlehampton study 16% of the shoot population of *S. avenae* were estimated to encounter webs each day by early July. The laboratory studies showed that adult aphids all escaped from unoccupied webs, first instars did not escape and other instars had an intermediate rate of escape. Attack rates by spiders and capture efficiencies varied with species of spider and were greater for the smaller aphid instars. Calculated predation rates reached a peak of 31 *S. avenae* m^{-2} day^{-1} in mid-July and this was estimated to have reduced the *S. avenae* population by 37%. In this instance aphid numbers always remained below the economic threshold, but if the same percentage reduction were to be achieved at higher aphid densities it would make the difference between spraying and not having to apply an aphicide. It should also be noted that spiders are not required to operate alone; they are part of a large complex of natural enemies able to exert an influence on the aphid population.

The predation rate in the above study was less than 1 *S. avenae* m^{-2} day^{-1} until mid-June and was limited more by low web cover early in the season than by the availability of falling aphids. Web cover was measured between 26 and 30 May in 9 cereal fields in two years and found to vary ten fold between fields and twelve fold between years. The lack of understanding of the causation of such important variability stimulated a study of the basic determinants of change in linyphiid abundance in farmland.

The aim of the linyphiid population dynamics study was to measure accurately changes in density in a field of winter wheat and to apportion such changes to the processes of natality, mortality and migration. The latter process was included because all common species of agricultural linyphiids are frequent aeronauts and can be seen dispersing through the air ("ballooning"), making use of the frictional drag of air against their silken sails to keep them aloft.

Density in the field was determined, weekly, from fifteen 0.5 m^2 quadrats which were first sampled with a vacuum insect net and then immediately ground searched (each method yielded, on average, 50% of the catch). There were less than 10 spiders m^{-2} until May, after which numbers increased steadily to reach a peak of 120 m^{-2} in mid-August at harvest. Density in the stubble stabilised at *c.* 60 m^{-2} until the end of sampling in late September. To estimate natality, adult female linyphiids were collected at weekly intervals and incarcerated individually in Petri dishes in a ventilated box in the study field. Dishes were inspected weekly and the following information recorded and used (together with density data) to calculate natality rates; (i) proportion of spiders producing eggsacs in the first week of incarceration (ii) time to emergence of spiderlings (iii) number of spiderlings emerging (iv) number of undeveloped eggs (by dissection of the eggsac). Natality rates were *c.* 4 m^{-2} day^{-1} in the spring, briefly 10-15 m^{-2} day^{-1} in late July, then 8 m^{-2} day^{-1} in August. The pattern of natality was similar to the pattern for spiderling density, providing circumstantial evidence that there were no major episodes of spiderling migration which would have disrupted this agreement. Further information on net migration was obtained from the use of ten 0.5 m^2 spider-proof field cages. These were moved to a new location in the field each week so that the slightly altered microclimate inside the cages did not have time to affect rates of natality and mortality. Weekly changes in density in the field were due to natality, mortality and migration, but migration was completely suppressed within the cages, therefore differences in density inside and outside cages over a period of a week were attributable to net migration. There was an absence of large-scale migration in winter and early spring and a fairly high probability of some emigration in late spring; thereafter the confidence limits on the migration statistic became too great to be certain what was ocurring (sampling variability increased greatly because spiders aggregated in patches of weeds that developed in the field during the summer). Three independent indices of aerial activity were obtained; (i) from seven 1 m^2 deposition traps (a tray containing trapping fluid placed inside a similar, but larger, tray. The outer tray acts as a barrier preventing spiders walking from the crop to the inner tray, which therefore samples only aerial immigrants.) (ii) a 10 m radius rotary insect net sampling the airspace 25 cm above the top of the crop canopy (iii) suction traps sampling air at 1.5 m and 12.2 above ground level. The three indices of aerial activity gave results in good agreement with each other. The pattern of seasonal change in instar composition of the most abundant species (*Lepthyphantes tenuis*) was remarkably similar for all three methods and quite different from the pattern seen in the density samples. It showed that there was more aerial activity of adults than immatures relative to the numbers of each stage on the ground. It is commonly speculated in the literature that immatures balloon more readily than adults. This view has probably arisen because in summer immatures greatly outnumber adults in all habitats and so there are also more in the air. However, this study suggests that the mean ballooning frequency per individual could be less for immatures than for adults. It might be speculated that adults disperse in order to find suitable new habitats in which to deposit eggsacs.

Since data are available from the above study on density, natality and migration, future analyses should allow estimation of the overall magnitude of mortality (as the only missing variable); laboratory and field studies will then be directed towards obtaining an approximate estimate of the relative contribution to overall mortality of abiotic mortality, predation and eggsac parasitism.

In summary it appears that, in the field studied, linyphiid populations began at a low density (probably due to a combination of survivors in the field and some very small scale immigration) and that the driving force for increase came from natality tempered by mortality, rather than by large-scale immigration; there may even have been some net emigration, especially by adults, in late spring. It remains to be seen whether such a pattern is a general feature of thepopulation ecology of agricultural linyphiids.

Polyphagous predators are an abundant, widespread group of natural enemies that appear to make a significant contribution to pest control in agriculture. Given the strong global trend towards reducing inputs of chemical pesticides and the consequent need to develop alternative methods of pest control, an increasing value will be placed on developing methods for conserving and increasing their populations. To underpin this effort, research is needed to increase our very limited understanding of their population ecology.

KURZVORTRÄGE

Heinz Müller-Schärer (Wädenswil): Untersaaten im Gemüsebau: Einfluss auf Unkräuter, Schädlinge und Stickstoffdynamik im Boden.

Untersaaten stellen im Feldgemüsebau eine theoretisch ideale Kulturmassnahme dar, um 1) Unkräuter zu unterdrücken, 2) Schädlingspopulationen zu reduzieren durch direkte Störung des Wirtserkennungs- und Eiablageverhaltens der Schädlinge, oder indirekt durch Förderung ihrer Antagonisten, und 3) um der Nährstoffauswaschung über den Herbst und Winter entgegenzuwirken. Der Einfluss von verschiedenen Untersaaten und unterschiedlichem Einsaatzeitpunkt auf die 3 oben erwähnten Parameter wurde in einer Reihe von Versuchen in gepflanztem Porree (*Allium porrum* L. 'Zefa Plus'), Rotkabis (*Brassica oleracea* L. 'capitata L.' f. *rubra* (L.) Thell.) und Rhabarber (*Rheum rhabarbarum* L. 'Stockbridge Arrow') untersucht. Dabei stellte die Bestimmung des optimalen Einsaattermins für eine genügende Unkrautunterdrückung - ohne die Kultur sichtbar zu konkurrieren - das grösste Problem dar. Zum Beispiel durfte Englisches Raygras (*Lolium perenne* L. 'Elka'; 5 g/m^2), erst 5 Wochen nach der Pflanzung von Lauch gesät werden, damit der Lauchertrag nicht reduziert wurde. Später keimende Unkräuter wurden dabei noch genügend unterdrückt. Zurätzlich führte diese Untersaat zu einer signifikanten Reduktion einerseits der Stickstoffauswaschung über den Herbst und Winter, und andererseits des Thripsbefalls (*Thrips tabaci* Lind.). Die Intensität des Thripsbefalls war negativ korreliert mit der Länge der Untersaatperiode, d.h. je früher die Grasuntersaat eingesät wurde, desto kleiner war der Befallsgrad. Die Tatsache, dass die Pflanzdichte von Lauch bei allen Verfahren keinen Einfluss auf den Thripsbefall hatte, schliesst einen reinen "Verdünnungseffekt" aus. Auf den Lauchmottenbefall (*Acrolepiopsis assectella* Zeller) hatten die Untersaaten, ebenso wie die Pflanzdichte, jedoch keinen Einfluss.

Wolfgang Nentwig (Bern): Ackerkrautstreifen als Systemansatz für eine umweltverträgliche Landwirtschaft.

Die Artenarmut der heute stark ausgeräumten Kulturlandschaft und der damit verbundene hohe chemische Regelungsbedarf ist ursächlich auf ein Fehlen von Pflanzen zurückzuführen, die als "Unkraut" auch an Randstandorten stark verdrängt worden sind. Um diesem Prozess entgegenzuwirken, haben wir daher streifenförmige Ansaaten von Ackerkräutern vorgenommen, wobei die von uns eingesetzte Mischung aus vielen Pflanzenarten durchaus variiert werden kann, im Prinzip aber auf umfangreichen Freilandstudien zur Attraktivität dieser Pflanzen für Arthropoden basiert. Solche Ackerkrautstreifen bestehen aus einer schnellauflaufenden, rasch deckenden Pflanze (z.B. Klee-Arten), welche eine Verunkrautung mit Problemumkräutern verhindert, einer hochaufragenden, strukturgebenden Deckfrucht (z.B. Raps), die ein deutliches Signal für Syrphiden und andere Blütenbesucher nach aussen abgibt, sowie einer dritten Gruppe von Pflanzen, welche aus sehr vielen Arten bestehen kann und eine hohe botanische Diveristät über mehrere Jahre gewährleistet. Innerhalb von ein bis zwei Jahren findet sich etwa die gleiche Zahl an nicht angesäten Pflanzenarten in, so dass Ackerkrautstreifen recht attraktiv für viele Tiergruppen sind und in kurzer Zeit eine starke Zunahme der Artenzahlen zu beobachten ist. Da es aus Ackerkrautstreifen, die in regelmässigen Abständen von etwa 50 m grosse Felder unterteilen sollen, einen faunenaustausch mit dem Ackerland gibt und da diese im Winter ungestörten Randbereiche ein wertvolles Überwinterungsareal für viele Arten der offenen Ackerlandschaft darstellen, fördern unsere angesäten Strukturen auch den Artenreichtum bzw. die Individuendichte im Acker selbst. Durch solch eine Förderung von Nützlingen ist ihr Regulationspotential v.a. in der Nähe der Ackerkrautstreifen erhöht, so dass dort die Dichte einzelner Kulturschädlinge deutlich reduziert ist. Bei grossräumiger Etablierung von Ackerkrautstreifen kann vermutlich mit einer deutlichen Senkung der Notwendigkeit des Bedarfes von Insektizideinsätzen gerechnet werden. Ackerkrautstreifen sind daher zusammen mit begrünten Ackerrändern, Hecken, Flurgehölzen und flächenhaften Schutzgebieten ein wichtiger Ansatz für eine umweltverträgliche Landwirtschaft.

Thomas Frank (Bern/Wien): Arten- und Individuenvielfalt epigäischer und blütenbesuchender Insekten in Ackerkrautstreifen und angrenzenden Äckern.

Es wurden drei in Äcker eingesätze Ackerkrautstreifen unterschiedlichen Alters (1-2jährig) hinsichtlich Arten- und Individuenvielfalt mit ihren angrenzenden Äckern verglichen.

Carabidae, Syrphidae und Tagfalter wurden von April-September 1992 untersucht. Die Carabidae wiesen in den Streifen signifikant höhere Artenzahlen als in den Äckern auf, wobei die Artenzahlen mit zunehmender Entfernung von den Streifen abnahmen.

Die Ackerkrautstreifen lockten sehr viele Syrphidae an, von denen fast nur aphidophage Arten in die Äcker eindrangen. Aufgrund der Anlockwirkung durch die Streifen ist zu erwarten, dass mehr Aphidophage ihre Eier in den Ackerkulturen ablegen als dies beim Fehlen der Streifen der Fall wäre.

Die Ackerkrautstreifen erwiesen sich als sehr attraktive Nektarquellen für Tagfalter. Zudem wuchsen in den Streifen die Futterpflanzen der Raupen einiger Arten. So konnten etwa mehrere Raupen des Schwalbenschwanzes (*Papilio machaon*) an *Daucus carota* und *Pastinaca sativa* beobachtet werden.

Alle drei Tiergruppen wiesen mehr Arten in den Streifen als in den angrenzenden Äckern auf, wobei stets im zweijährigen Streifen die Artenzahl höher war als in den beiden einjährigen.

M. Mouci & G. Ferch (Bern): Der Einfluss verschiedener Mahdregimes auf den Insektenbestand und die Physiologie von Pflanzen.

Während eines Jahres wurde in einem Ackerkrautstreifen an verschiedenen mehrjährigen Kräutern untersucht, welche Auswirkungen eine einmalige Mahd an zwei unterschiedlichen Terminen (Mai und August) auf den Insektenbestand und die Physiologie dieser Pflanzen hat. Die Spätmahd wirkte sich negativ auf die Ueberwinterung von Arthropoden aus, und die Frühmahd hatte einen Unterbruch oder ein Ausbleiben der Blühzeit zur Folge, was zu einer Verminderung der Blütenattraktivität gegenüber Insekten führte. Sonst zeigten die Pflanzenreservestoffe, sowie der Insektenbesatz im Sommerhalbjahr bei verschiedenen Mahdregimes nur kurzfristige Unterschiede auf. Bei starker Verunkrautung eines Ackerkrautstreifens ist eine einmalige, partielle Mahd empfehlenswert. Weder die Pflanzen noch die Insekten zeigten eine längerfristige, grössere Störung.

Igor Kramer (Zürich): Die Bedeutung der Wanderbrachen für den Artenschutz.

Wanderbrachen sind 5 bis 8 m breite Streifen auf der ganzen Länge eines Ackers, in denen keine Kulturpflanzen, sondern eine Auswahl geeigneter Pflanzenarten gesät werden. Diese gehören zur Gruppe der Ackerbegleit-, Ruderal- und Wiesenpflanzen. Es entstehen Lebensräume für diverse Tierarten, die insbesondere an Wildkräuter und ungestörte Vegetationsstrukturen angepasst sind. Für die Insektenfamilien der Laufkäfer (Carabidae), Syrphidae (Schwebfliegen) und der Wildbienen (Apoidea) wurde ein Arteninventar erstellt.

Es zeigte sich, dass von 88 nachgewiesenen Schwebfliegenarten deren 18 zu den Kuturflächen gehören und auf allen Standorten nachweisbar sind. Die anderen Arten gesellen sich je nach der Entfernung der Wanderbrachen von naturnahen Biotopen, insberondere Wäldern, dazu. Wanderbrachen mit 300-500 m Entfernung vom Wald blieben in der Regel unentdeckt, obwohl alle Arten theoretisch weit aus grössere Distanzen zurücklegen könnten. Offenbar besteht eine Hemmung, Kulturflächen zu überfliegen.

Gewisse Tiergruppen eignen sich als Bioindikatoren für Umweltbelastungen der Landwirtschaft. Demgegenüber entfällt die Lebensfeindlichkeit der Bewirtschaftung auf den Wanderbrachen. Dieser Ausgleichseffekt wurde anhand der Laufkäfer nachgewiesen. Wanderbrachen wiesen stets ähnliche und maximale Individuen- und Artenzahlen auf. Im Vergleich dazu konnte in den benachbarten Feldern eine Abhängigkeit der Individuen- und Artenzahlen von der Intensität der Bewirtschtung beobachtet werden. Bei verdoppeltem Ertrag verringert sich die Artenzahl auf 2/3 Arten, die Individuenzahl auf ein 1/5 Individuen. Während die Laufkäferbestände im Mai noch allgemein hoch sind, fallen sie im Laufe der Monate Juni und Juli erst zusammen. Besonders gut gedüngte und dicht geschlossene Weizenbestände werden offenbar bevorzugt gemieden.

Der Herkunft einiger besonderer Laufkäferarten der Wanderbrachen wurde an einem Standort nachgegangen. Zwei xerotherme Kleinstandorte (Acker und Trockenrasen) in 200 m Entfernung wiesen ähnliche Artenidentitäten wie die Wanderbrache auf. Dies erklärt, wieso die Wanderbrachen stets höhere Artenzahlen aufwiesen als die Felder. Laufkäfer weisen innerhalb der Kuturflächen ein hohes Ausbreitungspotential auf. Wanderbrachen eignen sich deshalb besonders für den Schutz regional gefährdeter Laufkäferarten.

Lukas Pfiffner (Oberwil): Auswirkungen biologisch-dynamischer, organisch-biologischer und konventioneller Bewirtschaftung auf die Regenwurm-Populationen (DOK-Langzeitversuch).

Im DOK-Systemvergleichsversuch in Therwil (Schweiz) werden seit 1978 zwei ökologische (bio-Dynamisch, Organisch-biologisch), zwei Konventionell/integrierte (organisch-mineralisch bzw, rein mineralisch gedüngt) und ein ungedüngtes Kontroll-Verfahren auf einer skelettfreien Parabraunerde auf Löss miteinander verglichen. Die Verfahren unterscheiden sich hauptsächlich in der Düngungs- und Pflanzenschutzintensität. Die 7jährige Fruchtfolge ist überall gleich, ebenso ist der Eintrag an organischer Substanz in den drei organisch gedüngten Verfahren ähnlich. Bezüglich Bodenbearbeitung bestehen keine relevanten Unterschiede zwischen den Verfahren.

Die Regenwurm-Populationen wurden mit Hilfe der doppelten Handauslese im Herbst 1990 und 1991 nach Rote Beete und im Frühjahr 1991 nach Winterweizen untersucht. In den beiden ökologisch bewirtschafteten Parzellen wurden eine signifikant höhere Regenwurm-Biomasse und Regenwurm-Dichte sowie ein höheres Vorkommen anözischer Arten (vertikal grabende) im Frühling und Herbst 1991 festgestellt im Vergleich zu den konventionell/ integriert bewirtschafteten Parzellen. Das seit 12 bzw. 13 Jahren ungedüngte Verfahren wies einen ähnlichen Regenwurmbesatz auf wie die konventionell/integriert bewirtschafteten.

Mit ingesamt zehn Regenwurmarten weist dieser Acker-Lössboden eine grosse Artenvielfalt auf; wobei *Lumbricus castaneus*, *Allolobophora chlorotica* und *A. icterica* jeweils nur in einem Verfahren in geringer Anzahl aufgetreten sind. Regenwurmarten wie *Nicodrilus longus*, *N. nocturnus*, *N. caliginosus* und *Allolobophora rosea* waren in allen Verfahren die dominanten Arten.

Die Art und die Intensität des Pflanzenschutzregimes wird als hauptsächlicher Begrenzungsfaktor für die Regenwurm-Populationen diskutiert. Die organische Düngung, abhängig von der Qualität und Menge, hat eine nachhaltige Wirkung auf die Regenwurm-Populationen. Die mit Frischmist gedüngten organisch-biologischen Parzellen besassen zu allen drei Untersuchungszeitpunkten einen tendenziell höheren Regenwurm-Besatz als die biodynamischen, die mit Mistkompost gedüngt wurden.

Rémy Kopp (Nyon): Les préférence alimentaires de la forme fouisseuse du campagnol terrestre *Arvicola terrestris scherman* (Shaw) et leur expression dans la prairie.

Les préférences alimentaires de la forme fouisseuse du campagnol terrestre ont été étudiées au moyen d'essais en enclos extérieurs et de tests de type cafétéria en cage. Dans les deux cas, le campagnol terrestre s'est montré sélectif dans sa façon de s'alimenter. Il préfère les trèfles, *Trifolium pratense* et *T. repens*, la dent-de-lion, *Taraxacum officinale*, et la luzerne, *Medicago sativa*, tandis qu'il dédaigne les graminées et les ombellifères proposées.

Des essais en enclos mettant en jeu différents mélanges de graminées-légumineuses ont été réalisés. Non seulement les campagnols ont préféré les mélanges riches en légumineuses mais ils ont provoqué une nette diminution de la proportion de celles-ci dans tous les mélanges.

Ces résultats sont mis en relation avec la dynamique de la végétation étudiée dans une prairie de fauche du Jura vaudois entre 1985 et 1991. Durant cette période, qui correspond à un cycle d'abondance des campagnols terrestres, on a assisté à un net recul du trèfle blanc, *Trifolium repens*, et de la dent-de-lion, *Taraxacum officinale*, lors de la période de forte densité. Seules quelques rares graminées de haute valeur fourragère ont subi une évolution analogue. Par contre, on a pu observer, pendant la même période, une forte progression de graminées pionnières, telles que *Poa trivialis* qui ont colonisé les taupinières et les surfaces dépourvues de végétation suite au passage des campagnols.

Enfin, la quasi disparition des légumineuses lors de la pullulation est discutée en relation avec le rôle possible de la végétation, notamment de la qualité de la nourriture disponible, dans le phénomène des cycles d'abondance des campagnols.

2. THEMENBEREICH: INSEKTEN-PFLANZEN-WECHSELWIRKUNGEN

HAUPTVORTRAG

Ken W. Richards (Alberta): Non-Apis bees as crop pollinators.

KURZVORTRÄGE

Daniel Burckhardt (Genève): The plant-louse genus *Notophorina* (Insecta, Homoptera) and *Nothofagus* (Fagaceae): an example of coevolution?

The term coevolution means different things to different people. Most definitions include physiological and ecological aspects, but a few are of exclusively historical nature, e.g. two groups of organisms share a common history of association by descent. The relationships of the hosts are often inferred from the phylogeny of the parasites (=Fahrenholz's rule). This may be useful for narrating coevolutionary scenarios, but it is inadequate for formulating testable hypotheses. For the latter purpose the phylogenies of host and parasite have to be inferred independently. Coevolution is thus defined as the congruence between host and parasite cladograms. Humphries et al. (1986) argued that coevolution can be viewed as biogeographical problem and therefore be examined with the methods of vicarience biogeography.

Southern beeches of the genus *Nothofagus*, which are widely distributed across the southern Pacific, are a popular group in biogeography. They were used to illustrate many, sometimes contradictory, ideas. Their well-examined phylogeny qualifies them also for coevolutionary studies. Eight of the 9 South American species are parasitised by some 20 species of the highly host specific Psylloidea. They all belong to the neotropical genus *Notophorina* which includes also species on other hosts. The cladistic relationships suggest that the psyllids on *Nothofagus* form a monophyletic group. With the Brooks Parsimony Analysis (BPA) a diagram is produced for *Nothofagus* which contains the cladistic information of psyllids. This diagram is then compared to the morphological cladogram of *Nothofagus* for testing whether psyllids coevolved with *Nothofagus*. Two shared components are found. This means that the hypothesis of coevolution cannot be entirely falsified, and that the two coevolved at least partially.

Urs Schaffner (Bern): Biologie einer auf die Pflanzengattung *Veratrum* (Melanthiaceae, Liliales) spezialisierten Blattwespe.

Phytophage Insekten mit freilebenden Larven sind anfällig auf Prädation und Parasitierung. Die Larven der auf *Veratrum* spezialisierten Blattwespe *Rhadinoceraea nodicornis* Konow (Hymenoptera, Tenthredinidae) umgehen den Prädationsdruck, indem sie die toxischen Alkaloide der Wirtspflanze, die als Insektizide eingesetzt wurden, in der Hämolymphe einlagern und so auf potentielle Prädatoren wie Ameisen und Spinnen stark abstossend wirken. Die einzigen zwei Parasiten, die nachgewiesen wurden, sind monophage Ichneumoniden. Die Auswirkungen der effizienten Verteidigung auf die Biologie von *R. nodicornis* werden diskutiert. Die spezialisierte Blattwespe wird mit der polyphagen Blattwespe *Aglaostigma (fulvipes?)* verglichen, die u.a. auf *Veratrum album* L. frisst.

Beat Oertli (Genève): How does cattail (*Typha latifolia*) senescence affect epiphytic macroinvertebrate community?

In wetlands, a cattail stem is usually present for more than two years: the first year alive and the second senescent. By comparison of first and second year stems, we assessed the qualitative and quantitative influence of senescence on aquatic epiphytic macroinvertebrates.

At taxonomic level, some taxa showed a clear preference for younger stems (Lepidoptera. *Donacia vulgaris*) or for older (Ceratopogonidae, Chironomidae, *Limnephilus* sp., Limoniidae, Stratiomyidae). On the other side, other macroinvertebrates were rather indifferent (*Ferrissia wautieri*, *Cloeon dipterum*). Most of these differences are related with food requirement. Herbivorous macroinvertebrates feed directly on living tissues of young green stems, and detritivorous feed on detritus (senescent stems). Indifferent taxa are algivorous and feed on epiphytic algae bored by cattail independent of stem age.

For the whole macroinvertebrate community, density, biomass and production were all clearly more important on older stems. Expressed on pond surface basis, mean annual density was 2990 ind./m^2 on young stems and 5465 on older; mean annual dry mass was 122 mg/m^2 on young stems and 232 on older; annual production was 5.5 kcal/m^2 on young stems, and 17.1 on older.

In conclusion, senescence of cattail stems is responsible for a shift in macrofauna composition. A partly herbivorous community is associated with young stems, and is replaced in time by a partly detritivorous community. This later is clearly more dense and is three times more productive.

3. THEMENBEREICH: FREIE THEMEN

KURZVORTRÄGE

Cornelis Neet (Saint-Sulpice): Field studies on the population and community consequences of habitat fragmentation.

This paper reviews the results of 55 field studies (21 of which were devoted to bird and forest relationships) that have examined the consequences of habitat fragmentation at the population and community levels and discusses implications for the management of natural areas.

The definition of habitat fragmentation varied among the studies, ranging from subdivision by roads and other barriers without significant reduction of habitat surface, to considerable habitat modifications, with insularisation effects. At both extremes negative effects have been demonstrated for single species. Unlike population studies where there were allways either negative or no effects, several community studies demonstrated positive effects such as habitat and species diversification in relation to fragmentation and increased richness in smaller fragments.

It appears that it would be misleading to consider habitat fragmentation as a negative phenomenon per se. In fact, management principles that can be drawn from the field evidence lead to a series of contradictory rules that turn out to indicate that the best general strategy for natural areas management should be to maintain a diversified landscape with a high diversity of habitats, surfaces and shapes. The fact that there are contradictory conclusions is related to the complex and multifactorial nature of the process of fragmentation.

Mathias Loertscher (Bern): Microdistribution of five butterfly in a mosaic-like habitat species.

In a mosaic-like habitat, brought about by secondary succession, the microdistribution of five butterfly species over their flying season was analyzed. In order to explain the patterns observed, activity patterns and the use and distribution of nectar sources were determined. Emphasis was laid on the changing flower preferences and changing abundances of flowers during the season. The use of nectar sources was basically limited to three flower species, i.e. *Centaurea scabiosa*, *C. bracteata* and *Serratula tinctoria*. As a consequence, niche breadth values were generally low and niche overlaps generally high. Some butterflies changed preferences according to the availability of certain flower species and therefore reduced niche overlap with the other butterfly species. The microdistribution of *Melanargia galathea*, *Lysandra coridon*, *Ochlodes venatus* and *Lictoria achilleae* was strongly influenced by the distribution of their respectively preferred nectar sources as well as by areas generally rich in flowers. Changing flower preferences of *L. coridon* males during the course of the season were also expressed by changes in the correlation between the distribution of these butterflies and their nectar plants. The distribution of nectar sources was not found to be of importance for *C. arcania*, a species which rarely visided flowers.

R. Hoess & M. Zimmermann (Bern): Emergenzphänologie von 21 syntopen Libellenarten (Insecta: Odonata).

Vom 13. Mai bis 12. September 1991 sammelten wir ein- bis zweimal wöchentlich im Naturschutzgebiet Auried (Gemeinde Kleinbösingen, Kanton Freiburg) an 11 Uferabschnitten (Länge total: 555,5 m, Fläche der Ufervergetation total: 949,75 m2) insgesamt 13'865 Exuvien von 21 Libelleanarten (Zygoptera: 7 Arten, 4348 Exuvien; Anisoptera: 14 Arten, 9517 Exuvien). Diese Methode gab uns einerseits Auskunft über die zeitliche und räumliche Einnischung der verschiedenen Arten und andererseits über das Geschlechterverhältnis während der Metamorphose in diesem spezifischen Habitat. Für die vier häufigsten Anisopteren stellten wir Männchenanteile fest, die signifikant vom Erwartungswert 50% abwichen (Geschlecht genetisch festgelegt: XY oder X0 beim ♂ und XX beim ♀): *Ortbetrum cancellatum* 44,6%, *Sympetrum vulgatum* 46,2%, *S. striolatum* 46,3% und *Anax imperator* 46,4%. Mit Hilfe der Emergenzkurven lassen sich die Arten leicht in Früh-, Spät- und Langschlüpfer einsteilen. *Sympetrum fonscolombei* war partiell bivoltin mit einer 2. Generation im Herbst, die aber wahrscheinlich nicht mehr zur Fortpflanzung gelangte (von dieser 2. Generation konnten keine maturen Tiere beobachtet werden). Nennenswerte Unterschiede zwischen den Schlüpfkurven von Männchen und Weibchen konnten bei keiner Art festgestellt werden. Es zeigte sich auch bei dieser Untersuchung, dass die Schlüpfverteilungen linksgipflig sind, was bedeutet, dass deutlich mehr als 50% der Imagines bereits vor dem mittleren Schlüpfdatum geschlüpft waren. Arten deren medianes Schlüpfdatum in die Mitte des Sommers fiel, schlüpften meist über einen deutlich längeren Zeitraum als Früh- und Spätschlüpfer. Unter Einbezug der Imaginalbeobachtungen konnten wir die ungefähre Dauer der Reifephase ermitteln.

Jürg Zettel & Ursula Zettel (Bern): Anpassungen von *Isotomurus alticola* (Collembola: Isotomidae) an alpine Umweltbedingungen.*

Populationen auf 880 m.ü.M. (Guttannen) und 2400 m.ü.M. (Oberaar) dieser endemisch in den Alpen vorkommenden Art wurden bezüglich ökophysiologischen Anpassungen und Phänologie untersucht.

Durch die eng an fliessendes Wasser gebundene Lebensweise halten sich die Tiere immer in einem thermisch gut gepufferten Mikroklima auf. Deshalb wurden keine Differenzen in der Kältetoleranz gefunden, weder zwischen den Jahreszeiten noch zwischen den Standorten. Im Oberaar konnte kein erhöhter Metabolismus als Anpassung an die tieferen Mitteltemperaturen festgestellt werden.

Die Reproduktion der univoltinen Art setzt an beiden Standorten bei Wassertemperaturen oberhalb 3.5°C ein. Trotz unterschiedlichen Temperaturen (mittlere Wassertemperatur bei Guttannen im Sommer 7.4°C, im Oberaar 4.5°C) und potentieller Entwicklungszeit (bei Guttannen März-Oktober, im Oberaar Juli-Oktober) erreichen die Tiere an beiden Standorten die adulte Körpergrösse zur gleichen Zeit, Ende Herbst (bei Guttannen Entwicklungszeit 5-6 Monate, im Oberaar 2.5 Monate).

Für diesen unerwarteten Befund sind 2 Erklärungen möglich: 1) die Tiere im Oberaar bleiben signifikant kleiner als bei Guttannen, was auf eine reduzierte Anzahl von Entwicklungsstadien zurückgeführt werden könnte; diese Möglichkeit kann aber allein nicht verantwortlich sein. 2) eine Anpassung im Verhalten: im Oberaar konnte *I. alticola* oft im vollen Sonnenschein beobachtet werden, wo ihr Metabolismus dank der dunkeln Körperfarbe

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* mit finanzieller Unterstützung des Schweizerischen Nationalfonds.

stark über die Umgebungstemperatur angehoben wird. Dadurch könnte die für die Entwicklung benötigte Temperatursumme in beträchtlich kürzerer Zeit erreicht werden.

Corina Suter, Jürg Zettel & Ursula Zettel (Bern): Zur Nahrungsökologie der winteraktiven Collembolenart *Ceratophysella sigillata* (Hypogastruridae).*

Mehrere ausserordentliche Phänomene prägen die Biologie von *C. sigillata*: als eigentlich bodenbewohnende Art zeigt sie klar strukturierte Phasen von Oberflächenaktivität, während denen sie in individuenreichen Kolonien auftritt, Wanderungen ausführt und intensiv frisst; jedes Individuum durchläuft pro Jahr 2 Polymorphismen mit insgesamt 4 Morphen; im Gegensatz zu anderen winteraktiven Collembolen erfolgen auch in den 2 winterlichen Aktivitätsperioden Nahrungsaufnahme und Wachstum.

Temperaturen unter -2°C und Trockenheit hindern *C. sigillata*, auf der Oberfläche aktiv zu sein. Die Oberflächenaktivitäten werden zur intensiven Nahrungsaufnahme genutzt, im Boden wird nur wenig Nahrung aufgenommen. Nur 2 Morphen können als Fressstadien bezeichnet werden: während der Epitokie (reproduzierende Morphe) und der Sommerdormanz wird höchstens ausnahmsweise gefressen (diese Morphen verbleiben im Boden). Oberflächenaktivität und Nahrungsaufnahme unterliegen einer temperaturabhängigen Tagesrhythmik; bei -2°C kann der Darm innerhalb von 23 h gefüllt werden, oberhalb 0°C dauert der Vorgang noch maximal 4 h. In dichten Ansammlungen und wandernden Kolonien ist die Darmfüllung maximal. Bei Nahrungsentzug kann der Darminhalt zurückbehalten werden. Mit Hilfe von Darmanalysen konnten Grünalgen, Pilzhyphen und Pilzsporen als Nahrungbestandteile nachgewiesen werden; sie werden vorwiegend von Totholz und Baumstämmen abgeweidet. In Wahlversuchen wurden Mischfutter reiner Algenkost vorgezogen. Es wird vermutet, dass das Wanderverhalten mit den limitierten Nahrungsressourcen im Boden und auf der Bodenoberfläche zusammenhängt und die Algenrasen die ergiebigsten Nahrungsquellen für individuenreiche Kolonien darstellen.

Carlo Largiadèr & Adolf Scholl (Berne): Genetic variation of Swiss Brown Trout (*Salmo trutta* L.) populations - allozyme data.

Studies of genetic variation in economically important fish species are crucial for conservation and future management of natural populations. A unique and interesting opportunity for such investigations is found in Switzerland where the water sheds of the main European drainages are located within a small geographic area.

Brown Trout are potentially anadromous freshwater fish and the headwaters are the outermost possible areas of their range. Trout repeatedly had to recolonize these areas after glaciations. Therefore, we would expect to find high differentiation between populations of the various drainage systems in Switzerland (Adige, Danube, Po, Rhine and Rhone). Based on extensive studies in other European countries which showed high genetic differentiation and allozyme markers for Brown Trout of the Atlantic and the Mediterranean drainages, we make assumptions on the genetic composition of undisturbed Swiss populations and we expect to detect restocking effects due to the introduction of foreign hatchery strains.

So far our studies cover 29 populations (550 specimens) and indicate medium to strong contamination from foreign genomes in most samples. Nevertheless, Swiss Brown Trout populations show high genetic variation and even within a single tributary we find considerable differentiation between samples from various sites.

Of particular interest are observations in the Adriatic drainages where we find hybrids between races and subspecies, notably hybrids with genes from *Salmo trutta marmoratus*, a subspecies which was previously reported extinct in Switzerland. (Supported by grants from BUWAL).

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Roman Köpfli & Manfred Zimmermann (Bern): Life history traits of nondiapause and diapause females of the wing-dimorphic waterstrider species *Gerris odontogaster* (Hemisptera, Gerridae).

Body size, fecundity, development time, adult longevity, preoviposition period, dispersal and also voltinism are important life history traits of temperate insect species. As shown earlier, voltinism of Swiss waterstrider species is determined by both genetic and environmental factors. Using laboratory pair cultures of *G. odontogaster* from a polyvoltine population on the Swiss Plateau we studied the influence of reproductive status (diapause/nondiapause) and wing morph on several life history traits.

Both reproductive status and wing morph had no influence on adult longevity. Fecundity (total number of eggs laid), on the other hand, was significantly higher in overwintered (diapause) females. Among the dimorphic nondiapause individuals, short winged females had significantly shorter preoviposition periods and also higher fecundities than long winged females, despite the fact that these females had significantly longer body lengths. No overall obvious time dependence was observed in fertility, embryonal mortality and hatching rate.

On the Swiss Plateau fluctuating selection due to the variable onset of winter will only affect bugs in late fall. These individuals are offspring of the first or maybe the second nondiapause generation. This selection regime together with the observed life history traits of nondiapause breeders will favor polyvoltinism of *G. odontogaster* on the Swiss Plateau, where we observe bi- and partial trivoltinism.

Bruno Condé (Nancy): Premiers Campodéidés cavernicoles de Chine, comme exemple de l'évolution souterraine du groupe.

POSTER

Elmar Auf der Maur, Marianne Haffner & Vincent Ziswiler (Zürich): Mikroskopisch-anatomische Untersuchungen an Duftorganen und Freilandbeobachtungen zum Markierungsverhalten von Zwergfledermäusen *Pipistrellus pipistrellus* (Schreber, 1774) (Mammalia, Chiroptera).

Ob Zwergfledermäuse ihr Tagesschlafversteck markieren, wird anhand der Histoarchitektur des Analkanals in Kombination mit Freilandbeobachtungen und Experimenten abgeklärt.

An Wochenstubenquartieren im Kanton Luzern wurde das Aus- und Einflugsverhalten beobachtet. In der Zeit von Juni bis Juli können vier Phasen unterschieden werden. In der ersten (Trächtigkeit) und letzten Phase (Entwöhnung) bleibt die Kolonie die ganze Nacht vom Quartier weg, während in der zweiten (frühe Laktationszeit) und dritten Phase (späte Laktation) nächliche Ein- und Ausflüge stattfinden.

Die geringe Anzahl der unter dem Einflugsschlitz klebenden Kotballen und die nicht feststellbare Verhaltensänderung bei Experimenten mit Fremdmarkierungen deuten darauf hin, dass das Markieren des Quartieres mit Kot während der Jungenaufzucht keine wesentliche Rolle spielt.

Die mikroskopische Untersuchung von je sieben männlichen und weiblichen Zwergfledermäusen zeigte, dass die Männchen absolut und relativ voluminösere Analkanaldrüsen haben als die Weibchen. Die sekretorische Aktivität der Proktodäaldrüsen ist bei Jungtieren gering und bei den Erwachsenen während der herbstlichen Paarungszeit am grössten. Der Sexualdimorphismus und die saisonalen Aenderungen der Drüsen weisen darauf hin, dass diese Duftstoffe sezernieren könnten, welche in der Paarungszeit, z.B. beim auffälligen Verhalten der Männchen in der Umgebung ihrer Balzquartiere, eine wichtige Rolle spielen. Interessant ist in diesem Zusammenhang die Frage, wie die Weibchen paläarktischer Fledermausarten, die vor dem Winterschlaf begattet werden, aber erst im Frühling ihren Oestrus haben, den Männchen im Herbst ihre Paarungsbereitschaft "mitteilen".

Daniel Bauer (Oberstammheim): Diversity of arthropods in dependence of vegetation-structure in the Dischma-valley.

I investigated the occurence of arthropods in a study area, measuring 74 ha, between the subalpine and alpine zone in the Dischma-valley near Davos. Two study sites were investigated, one of them located on the north and one on the south slope. 8 vegetation-types were distinguished within these areas. 106 plots were distributed evenly over the study area and marked. The vegetation was surveyed and arthropod samples were taken twice in June and July in each plot. On the south slope *Juniperus nana* and *Calluna vulgaris* are the dominant plant species. The bottom of valley consists of pasture and the north slope is dominated by *Rhododendron ferrugineum* in the lower parts and by *Loiseleura procumbens* and *Lychenes* in the higher parts. The arthropods were analysed later in the laboritory. The results show that the occurence of the insects depends on the vegetation. Abiotic factors as humidity or temperature have little influence on their distribution. The occurence of arthropod-groups in relation to the vegetation-type is shown graphically. A comparison between June and July shows that many abundant arthropod-groups are more commen in higher places later in the saison.

Fabio Bontadina, Sandra Gloor & Therese Hotz (Zürich): Igel *Erinaceus europaeus* in der Stadt Zürich.

Über die Bestandesentwicklung des Igels in der landschaftlich stark gewandelten Schweiz ist nur wenig bekannt. Es wird vermutet, dass er durch die Intensivierung der Landwirtschaft einen grossen Lebensraumverlust erlitten, jedoch im ländlichen Siedlungsraum und in Stadtrandgebieten ein neues Auskommen gefunden hat.

Zwischen April und August 1992 wurde in der Stadt Zürich eine Untersuchung zur Verbreitung und Raumnutzung des Igels im städtischen Gebiet durchgeführt. Dabei wurden Igel-Meldekarten an 18'000 Personen verschickt und in zwei städtischen Untersuchungsgebieten 11 sendermarkierte Igel während total 31 Nächten beobachtet.

Es wurden 1383 Igelbeobachtungen gemeldet, womit auf 69% des Stadtgebietes Igel nachgewiesen werden konnten. Im Stadtzentrum wurden keine Igel beobachtet, in zentrumsnahen Gebieten scheinen sie in geringerer Dichte vorzukommen. Gebiete mit einer hohen berechneten Igeldichte zeigen einen grössere Grünanteil und einen kleineren Versiegelungsgrad als Flächen ohne Igelnachweise. In zwei städtischen Gebieten schätzen wir die Dichte auf 0.5-1 Igel/ha. Die Grösse der Aktivitätsgebiete mit Daten aus 3 Beobachtungsnächsten pro Igel liegt zwischen 0.7 und 48.6 ha. Die Aktivitätsgebiete werden selektiv genutzt: Kompostanlagen und extensiv gepflegte Rasenflächen sind bedeutende Futtersuchorte. Die Igel halten sich häufiger als erwartet auf *gemeinschaftlich genutzten Grünflächen* und in *Hintergärten* auf. Die Untersuchung zeigt, dass städtische Gebiete bedeutende Lebensräume für Igel sein können. Die geschätzte Dichte der Igel übersteigt Angaben aus ländlichen Siedlungsräumen. Die Aktionsradien und Streifgebiete der Igel in der Stadt sind kleiner als diejenigen in ländlichen Gebieten. Eine grosse Mortalität durch Strassenunfälle könnte durch eine geringere Wintersterblichkeit und durch Zweitwürfe im Spätsommer ausgeglichen werden.

Christoph Bürki (Bern): Phytophage am einheimischen Bärenklau *Heracleum sphondylium* und der Invasionsart *Heracleum mantegazzianum*.

Von Mai bis Oktober 1992 wurden sechs verschiedene Standorte (3 *H. sphondylium* und 3 *H. mantegazzianum*) auf phytophage Insekten abgesucht. An beiden Pflanzenarten wurden die gleichen Phytophagen festgestellt, wobei auf *H. mantegazzianum* mehr Tiere zu finden waren als auf *H. sphondylium*. An den Blüten war *Depressaria pastinacella* (Oecophoridae Lepid.) zu finden, welche Gespinströhren in den reifenden Samenanlagen baute. Vereinzelt wurden auch Depressaria -Raupen auf Blättern gefunden, doch was hier der festgestellte Frass gering. In den Blüten konnten auch Aphiden und Miriden (*Orthops, Calocoris*) festgestellt werden. An Stengeln und Blättern waren Aphiden, Miriden (*Orthops, Calocoris, Dicyphus*) und Auchenorrhyncha (*Eupteryx, Aphrodes*) zu finden, wobei sich die meisten von ihnen auf der Blattunterseite aufhielten. Curculioniden zählten zu den häufigsten Coleopterenarten, die auf den Blättern anzutreffen waren. Agromyziden (*Melanagromyza, Phytomyza*) befielen Stengel und Blätter.

Mollusken (Arionidae, Bradybaenidae, Helicidae) waren häufig an vegetativen Pflanzenteilen zu finden. Bei *H. sphondylium* sind einzelne Samenanlagen von Mollusken gefressen worden. Schäden dieser Art wurden bei *H. mantegazzianum* nicht festgestellt.

Frassspuren waren bei über der Hälfte der mehrjährigen Wurzeln zu finden. Meist waren es Frasskanäle, die sich zum Teil über die ganze Wurzellänge zogen, einzelne wurden innen ausgehöhlt. In diesen wurden Curculionidenlarven gefunden. *Hepialus humuli* (Hepialidae, Lepid.) frass an Wurzeln beider Arten. An einjährigen Wurzeln ist der Frass ausgesprochen gering.

Im Gegensatz zu *H. mantegazzianum*, konnten bei *H. sphondylium* vereinzelte durch Phytophagenfrass zerstörte Pflanzen gefunden werden. Es stellt sich jedoch die Frage, inwieweit sich der Frass auf die Reproduktion der beiden *Heracleum*-Arten auswirkt.

Véronique Chanon (Genève): Influence d'un abri sur la microdistribution du zoobenthos épilithique (Léman).

Le but de cette recherche est d'évaluer l'influence d'un microchangement du milieu sur la composition du zoobenthos épilithique.

Nous avons ici modifié les microconditions (notamment l'intensité lumineuse) par l'introduction d'abris artificiels et créé deux microhabitats distincts.

Des substrats artificiels (carreaux de granit, 131 cm^2) ont été disposés sur les cailloux de la zone littorale (profondeur: 2,3 m). Des abris protègent la moitié de ces substrats. Dix prélèvements issus de chaque type de microhabitat (abrité, non abrité) ont été réalisés en plongée bimensuellement d'avril à décembre 1991.

Parmi les 43 taxons trouvés, 29 sont suffisamment abondants pour permettre un test statistique (test de Wilcoxon) sur les densités dans les deux microconditions.

Une très forte proportion de taxons (75% = 22 taxons) montrent au moins à un moment de leur cycle de vie des préférences pour l'un ou l'autre des microhabitats. Parmi eux, 48% (14 taxons) préfèrent le microhabitat abrité, 17% (5 taxons)celui non abrité et 10% (3 taxons) ont des préférences marquées mais opposées selon la période de l'année.

Deux taxons font un choix très net tout au long de l'année. Il s'agit de *Dreissena polymorpha* qui choisit les microhabitats abrités et *Tinodes waeneri* qui préfère les microhabitats non abrités.

La tendance générale suivante se dégage pour la plupart des taxons montrant une préférence significative: recherche des microhabitats abrités en hiver et préférence pour ceux qui ne le sont pas en été.

Les mollusques, les triclades, les hirudinées et les crustacés ont tendance à rechercher l'abri, alors que les chironomidés préfèrent les microhabitats non abrités. C'est dans le groupe des trichoptères à fourreau que l'abri a le moins d'influence.

Afin de tester si les carreaux sont adéquats pour l'étude de la macrofaune des fonds de cailloux, les communautés de macroinvertébrés vivant sur substrats artificiels ont été comparées avec celles du zoobenthos épilithique. Les substrats artificiels utilisés se sont avérés être de bons échantillons pour l'étude de la faune épilithique.

Il apparaît donc qu'un changement des microconditions (ici par l'introduction d'abris) influence nettement la composition des communautés de macroinvertébrés. Ce type d'information devrait à l'avenir être intégré tant dans la stratégie d'échantillonnage que dans l'interprétation des résultats pour toute étude portant sur les macroinvertébrés.

A. Ducommun, Ph. Thorens & A. Wittwer (Neuchâtel): Colonisation des substrats de nivellement de chemins agricoles à bandes de roulement.

Les chemins agricoles à bandes de roulement sont une des alternatives aux chemins entièrement bétonnés ou asphaltés. Le substrat de nivellement (matériau graveleux) posé entre les 2 bandes bétonnées (interbandes) peut-il offrir des avantages écologiques (colonisation par la flore et la petite faune) en plus des aspects paysagers et techniques plus favorables? Un chemin nouvellement aménagé à Bassecourt (Jura) a été étudié pour répondre à cette question. Des relevés floristiques (ensemble des végétaux) et faunistiques (Araignées, Coléoptères, Hyménoptères, Diptères et quelques autres groupes d'Invertébrés) ont été effectués durant 2 saisons (1990 et 1991) sur plusieurs secteurs du chemin différant quant à la nature du substrat de nivellement et quant à son ensemencement ou non. Après 2 ans, le recouvrement végétal est satisfaisant et montre l'aspect clairsemé et diversifié attendu. La petite faune utilise également l'interbandes avec succès (au total 324 taxons, soit environ 5'000 individus, l'ont utilisé dans des mesures diverses), en particulier plusieurs taxons des milieux secs et pionniers (l'écologie de chaque espèce a été examinée); avec 63% des taxons, les prédateurs et parasitoïdes sont dominants, et parmi eux plusieurs auxiliaires des cultures. Le substrat de nivellement répond ainsi globalement aux attentes. Dans les limites de l'étude, l'analyse des différents substrats de nivellement ne renseigne pas clairement sur l'intérêt d'un matériau ou d'un ensemencement particulier: un suivi et un élargissement de la recherche permettront de généraliser valablement leurs potentialités écologiques.

Samuel Furrer (Seon): Lebensgeschichte und Fressverhalten der Trichterspinne *Agelena labyrinthica.*

*Agelena*spinnen wurden bei verschieden hohen Beutedichten gehalten. Dabei zeigte sich bald die enorme, phänotypische Plastizität dieser Spinnen.

Sie wuchsen schneller oder langsamer, wurden deshalb früher oder später geschlechtstreif, waren grösser oder kleiner und hatten einen grösseren oder kleineren Reproduktionserfolg.

Das Fressverhalten (Beuteausnutzungsrate) untersuche ich mithilfe quantitativer (Trockengewicht) und qualitativer (Fette, Proteine, Kohlenhydrate) Analysen der Beutereste. Die Beuteausnutzungseffizienz war dabei signifikant von der Dreifachinteraktion (Geschlecht der Spinne x Beutedichte, bei der die Spinne gehalten wurde x Entwicklungsstadium der Spinne) beeinflusst. Die Resultate lassen sich unter anderem mit einem modifizierten Grenzwerttheorem erklären, welches von der Annahme ausgeht, dass sich durch die natürlich Selektion ein immer optimaleres Nahrungserwerbsverhalten evoluiert hat.

S. Gloor, H.-P. B. Stutz & V. Ziswiler (Zürich): Nutritional habits of the Noctule bat *Nyctalus noctula* (Schreber, 1774) (Mammalia, Chiroptera) in the northern part of Switzerland.

During one season (from April to November 1989) feces of the Noctule bat are collected in three roosts in houses. At seven roosts in trees in the town of Zurich, Noctule bats are caught every two weeks from April to November an fecal pellets are collected from these bats. The fecal pellets are analysed both in terms of quality and quantity and compared regionally and seasonally.

Nyctalus noctula preferably feeds on Diptera (Chironomidae, Anisopodidae) and Trichoptera, insects which fly in swarms over water, e.g. along riverbanks. These insects are mostly soft, small and fly localy in large number, so it is possible for the Noctule bat to hunt and catch a lot of prey in very short time (filter feeding). Nevertheless it is surprising, that the Noctule bat with its powerful and strong teeth hunts such soft and small insects, but in times during the year, when bigger insects such as Lepidoptera or Coleoptera (e.g. *Melolontha* sp. in spring, *Geotrupes* sp. in autumn) are frequent, they are also hunted by the Noctule bat, a fact that points to an opportunistic hunting strategy.

Marianne Haffner (Zürich): Die Möglichkeiten der Duftmarkierung beim Grossen Mausohr *Myotis myotis* und beim Grossen Abendsegler *Nyctalus noctula* (Mammalia, Chiroptera).

Duftdrüsen, welche spezialisierte Haarbalgdrüsen sind, können bei Säugetieren prinzipiell am ganzen behaarten Körper vorkommen. Trotzdem konzentrieren sie sich besonders auf den Kopf, die Extremitäten und den Schwanz. Diese Körperteile eignen sich dank ihrer Beweglichkeit für eine flächeneffiziente Sekretauftragung besonders gut.

Bei Glattnasen-Fledermäusen (Vespertilionidae) ist die Verteilung von Duftdrüsen am Körper durch die Integration der Extremitäten und des Schwanzes in die Flughaut massiv-eingeschränkt. Abgesehen vom Genital- und Analbereich sind solche Drüsen bei ihnen im Kopfbereich konzentriert und zeigen dort eine Vielfalt, wie sie wohl kaum auf einer derart begrenzten Körperoberfläche innerhalb anderer, näher miteinander verwandter Taxa bei Vertebraten zu finden ist.

Beim Grossen Mausohr nimmt auf jeder Gesichtshälfte eine riesige Talgdrüse praktisch den gesamten Hautbereich der Schnauze ein und wird von der subkutanen Muskulatur wie eine Tube ausgepresst. Das Sekret wird mit einem Haarpinsel über der Drüsenmündung konzentriert und gezielt aufgetragen.

Der Grosse Abendsegler hat bedeutend kleinere dafür zahlreichere vergrösserte Talgdrüsen, die in je drei Reihen auf der Schnauze angeordnet sind. Das Sekret wird durch leichten Druck von aussen ausgepresst und die subkutane Muskulatur wirkt dabei als Widerlager. Um die umstehenden Tasthaare vor mechanischer Abnutzung zu schonen, verstreichen Grosse Abendsegler ihre Drüsensekrete mit dem Kinn, was Verdickungen der Epidermis und Wunden an der prominentesten Symphysenstelle aufzeigen. Anhand von mikroanatomischen Untersuchungen können die den Tieren zur Verfügung stehenden Möglichkeiten der Duftmarkierung aufgezeigt werden, was besonders bei in der Freiheit schlecht zu beobachtenden Arten die Kenntnisse über deren Lebensweise erweitert.

Philippe Jeanneret (Nyon): Isolation influence of apple orchard on the inhabitant tortricid fauna (Lepidoptera, Tortricidae).

In the cultivated apple orchards of the area of Nyon-La Côte as in the other regions where apple is cultivated, tortricid species occur at different densities depending on the ecology of the species and the intrinsic factors of the orchard management. Under more and more specific means applied against the main tortricid pests (codling moth, *Cydia pomonella* L. and the summer fruit tortrix. *Adoxophyes orana* F.v.R.) other species population increase. We may suppose that the influence of the adjacent habitats is important because the studied tortricids are known to be very polyphagous (at least, oligophagous for one considered area). In order to understand the influence of the adjacent habitats on the species composition and densities, diversity analysis is conducted in old untreated orchards. Two years or leaf samplings in 19 orchards show that the species rank/abundance follows the log normal model. A calculation method for an isolation index is presented and take into account the proximity of potential source pools for tortricids (particularly the presence of other host plant species). Two common landscape situations for apple orchards in the area of Nyon are drawn and show the possible connections between the orchards and the surroundings. A calculated regression shows that diversity indexes are correlated with the isolation index.

Beatrice Lanzrein, Christa Grossniklaus-Bürgin, Toni Wyler & Andreas Gruber (Bern): Disruption of host development by parasitic wasps: involvement of polydnavirus?

Wasps of the genus *Chelonus* (Braconidae) are solitary egg-larval parasitoids of various lepidopterous species. They induce in their hosts the precocious onset of metamorphosis and developmental arrest in the precocious prepupal stage. The wasp females inject, together with the egg, venom and calyx fluid which contains polydnaviruses. These viruses appear to be essential for successful parasitoid development.

We observed that the polydnaviruses of *Chelonus inanitus* have a spherical-cylindrical shape and that some have a tail. The genome consists of at least 10 different classes of circular double-stranded DNA molecules with a length of 7-31 kb. Injection of calyx fluid, sucrose gradient purified poldnavirus or calyx fluid together with venom from *Chelonus inanitus* into eggs of *Spodoptera littoralis*did not induce precocious onset of metamorphosis but in some cases developmental arrest in the prepupal stage. It thus appears that polydnavirus together with venom can cause developmental arrest but that additional factors are necessary for induction of precocious metamorphosis.

Analyses of the major developmental hormones, namely ecdysteroids and juvenile hormone, revealed that in parasitised larvae the changes typical for premetamorphosis occur one instar earlier than in non-parasitised larvae. This indicates that parasitisation interferes with the endocrine system of the host.

P. Mäder (Oberwil): Auswirkungen biologischer und konventioneller Bewirtschaftung auf Bodenmikroorganismen (DOK-Langzeitversuch).

Seit 1978 werden im sogenannten DOK-Versuch in Therwil (BL) die drei Anbausysteme biologisch-dynamisch, organisch-biologisch und konventionell in einer 7-jährigen Ackerbaufruchtfolge miteinander verglichen. Die beiden biologischen Anbausysteme und das konventionelle System werden mit Hofdüngern von 1.2 DGVE/ha versorgt. Im biologisch-dynamischen System wird Mistkompost, im organisch-biologischen System angerotteter Mist und im konventionellen System Stapelmist angewandt. Das konventionelle System wird zusätzlich mit Mineraldüngern auf 1.2 Normdüngung gemäss den Richtlinien der Eidg. Forschungsanstalten aufgedüngt. Eine ungedüngte Kontrollvariante wird biologisch-dynamisch gepflegt, eine rein mineralisch gedüngte Kontrollvariante mit konventionellem Pflanzenschutz wird ebenfalls auf 1.2 Norm gedüngt. In der Bodenbearbeitung bestehen nur geringfügige Unterschiede zwischen den Verfahren.

Einen Forschungsschwerpunkt im DOK-Versuch bildet der Boden. Mittels Messung bodenchemischer, bodenphysikalischer und bodenbiologischer Parameter sollen die Auswirkungen unterschiedlicher Bewirtschaftung auf wichtige Komponenten der Bodenfruchtbarkeit erfasst werden.

Folgende bodenmikrobiologischen Untersuchungen wurden im DOK-Versuch 1990 und 1991 in Winterweizenparzellen durchgeführt: Mikrobielle Biomasse, abgeschätzt durch substratinduzierte Respiration (SIR) und ATP, Bodenatmung, Aktivitäten von 5 verschiedenen Bodenzymen (Dehydrogenase, Katalase, Protease, Phosphatase und Saccharase) sowie Stickstoff-Mineralisierung und Celluloseabbau. Zudem wurde die Mykorrhizierung der Weizenwurzeln bestimmt.

Zu allen 8 untersuchten Zeitpunkten zeichneten sich beide biologischen Anbauverfahren sowohl durch eine höhere mikrobielle Biomasse als auch durch höhere Enzymaktivitäten aus. Das ungedüngte und das mineralisch gedüngte Kontrollverfahren hatten die tiefsten Werte, das konventionelle System nahm eine Mittelstellung ein. Als sehr sensibler Parameter zur Differenzierung der Anbausysteme aufgrund der Gesamtaktivität der Mikroorganismen stellte sich die Dehydrogenase heraus. Celluloseabbau und Stickstoff-Mineralisierung waren mit wenigen Ausnahmen in allen Anbausystemen vergleichbar. Der Mykorrhizierungsgrad war bei den biologischen Anbauverfahren höher als beim konventionellen und mineralischen Verfahren.

Die mikrobielle Biomasse korrelierte mit $r > 0.65$ mit dem pH-Wert (Spannweite pH 5.4-7.32) sowie mit dem C- und N-Gehalt des Bodens. Ein verfahrensabbhängiger Quotient C-Mineralisierung zur mikrobiellen Biomasse (CO_2-C/C_{mik}) lässt vermuten, dass es aufgrund der unterschiedlichen Bewirtschaftung zu Verschiebungen in der Population der Mikroorganismen gekommen ist. Als mögliche Ursachen für die gemessenen Unterschiede kommen sowohl Menge als auch Form der ausgebrachten Düngemittel sowie Pflanzenschutzmassnahmen in Betracht.

Claudia Poznik (Fällanden): Brutökologie beim Haussperling (*Passer domesticus*).

Im Rahmen einer Diplomarbeit am Zoologischen Institut der Universität Zürich-Irchel wurde im Sommer 1992 der Einfluss der Nistplatzqualität, gemessen an den vier Temperaturtypen Nistplatzdurchschnittstemperatur, Nistplatzmaximaltemperatur, Nistplatzminimaltemperatur und Nistplatztemperaturschwankung, sowie der Elternqualität, gemessen an der Grösse des schwarzen Brustflecks des Männchens, auf den Bruterfolg einer Haussperlingspopulation am Irchel untersucht. Die dabei gefundenen, vom Nistplatz abhängigen, unterschiedlichen Ueberlebensraten der Jungvögel wurden in einem zweiten Schritt mit den unterschiedlichen, ebenfalls von der Nistplatzqualität und der Elternqualität beeinflussten Fütterfrequenzen der Elterntiere zu erklären versucht.

Die Resultate lassen keine zwingenden Schlüsse zu, es lässt sich jedoch ein Modell mit zwei verschiedenen Fortpflanzungsstrategien bei Haussperlingen ableiten.

Ueli Rehsteiner (Zürich): Influence of age and relationship on song-structure of the Water Pipit *Anthus spinoletta*.

Song-structure of the Water Pipit *Anthus spinoletta* was investigated in the Dischma-Valley, Graubünden (Switzerland). The song of this bird generally shows great interindividual variability in the first part (named elements A and B) and an amazing interindividual similarity in the second part (elements C and Snarr). The individual song-structures are very constant during the breeding season.

The songs of twelve yearlings and twenty older males were recorded and analyzed sonagrafically. 33 variables were measured on each of the 241 songs. The results of the discriminant analysis showed no differences between the songs of the two age-classes.

Five of the sampled males were related: one father and two sons in one case and two brothers in the other case. In both cases the songs of the individuals were compared sonagrafically. In the first case it was obvious that both sons sang differently from their father in the first part of their songs. The song-structures of the two brothers were relatively similar, however. The second two brothers showed no similarity in song-structure of elements A and B.

Jörg Rüetschi (Bern): Inventory of molluscs of Aceri-Fraxinion forests in Switzerland.

Until recently only inventories of vertebrates and flowering plants were considered for the evaluation of natural habitats. However, invertebrates outnumber all other taxa, both in number of species and also number of individuals. From this it is clear that arthropods and molluscs, the two dominant terrestrial invertebrate groups, should be used in landscape ecology, and also in the monitoring of nature reserves.

We used a (semi-) quantitatived sampling method to monitor the molluscs of Aceri-Fraxinion forests. These forests can be found in most parts of Switzerland, and they are characterized by high mollusc density and high mollusc species richness.

On each site we searched for and collected all molluscs. Additionally, five randomly placed soil-samples were dug out. Furthermore, an arbitrary placed supplement sample was taken in order to find as many species as possible. The samples were soaked in H_2O_2, washed, dried and sieved. The sieve-fractions were quantitatively analysed for shells under magnification.

A total of 111 of about 240 species recorded in Switzerland have been found, 56 of them in at least ten sites. The number of species found at one site ranged between three and 48. The three poorest sites are in the Tessin, the richest sites in the Jura. The average number of species was 31.2 and it decreased from the Jura to the Plateau and to the Prealps.

The quantity of the shells found in the soil-samples was about the same in the Jura and in the Plateau, whereas it decreased in the Prealps. Shell-rich soils are at sites with old Aceri-Fraxinion forests and neutral or basic soil, whereas shell-poor soils are at sites with intensively exploited Aceri-Fraxinion forests (e.g. afforestations) or with acid soil.

The three regions north of the Alps have about the same set of species. Therefore, a characteristic species combination in Aceri-Fraxion forests in Switzerland can be defined.

A. Scholl, R. W. Throp*, J. A. Bishop & E. Obrecht** (Bern,*Davis, California, USA, **Fairbanks, Alaska): The relationship of *Bombus alboanalis* Franklin (Hymenoptera: Apidae), a bumble bee from Alaska.

Bombus alboanalis Franklin, 1913 has either been regarded as a distinct species or has been synonymized with *B. frigidus* Smith, 1854, from which it differs in coat color of the abdomen. However, both taxa are sympatric in Alaska and we have found no evidence for intergradation from coat color variation. We have used enzyme electrophoresis as additional information to investigate if these taxa are genetically separated in areas of sympatry.

We surveyed 18 enzymes by vertical starch-gel electrophoresis and compared *B. alboanalis* with *B. frigidus* and other species of the subgenus *Pyrobombus*. We found that *B. alboanalis* differs from *B. frigidus* at two enzyme loci. The electrophoretic data indicate that these taxa have no common gene pool. According to the enzyme survey *B. alboanalis* belongs to a group of closely related *Pyrobombus* species which includes *B. frigidus*, *B. cingulatus* Wahlberg and *B. jonellus* (Kirby), and more distant *B. sitkensis* Nylander, *B. mixtus* Cresson, *B. pratorum* (Linnaeus), and *B. pyrenaeus* (Pérez).

The close genetic relationship of *B. alboanalis* and *B. jonellus* are of interest. Both taxa are almost identical in structure and coloration and they are parapatric in distribution according to present knowledge. *Bombus alboanalis* has only been recorded from Alaska and from Bering and Copper Island, while *B. jonellus*, a polytypic species, has a very wide range in the palaearctic region and is recorded from Europe to the western Aleutian Islands. We speculate that future studies will show that *B. alboanalis* is conspecific with *B. jonellus*.

Hans-Peter B. Stutz (Zürich): Versuch der Schätzung der Populationsgrösse des Grossen Mausohrs *Myotis myotis* (Mammalia, Chiroptera) in der Schweiz.

In den drei Jahren 1990, 1991 und 1992 wurden adulte Mausohrweibchen in 64 Wochenstubenkolonien in der östlichen Landeshälfte in Zuzsammenarbeit mit ehrenamtlich tätigen Fledermausschützern und den Regionalen Fledermausschutzexperten der Koordinationsstelle Ost für Fledermausschutz mit vergleichbaren Methoden erfasst. Entweder wurden mehrmals zwischen April und September abendliche Ausflugzählungen durchgeführt oder die Tiere wurden tagsüber am Hangplatz ausgezählt.

Es wurden total 6'525 (1990), 7'768 (1991) und 8'741 (1993) adulte Mausohrweibchen gezählt. Zur Schätzung der Gesamtpopulation wurde angenommen, dass zusätzlich ebenso viele Männchen zu erwarten sind und dass nur 75% der Wochenstubenkolonien bekannt sind. Dies führt zu einer geschätzten Gesamtpopulation in der östlichen Landeshälfte von fast 22'000 Mausohren (1992). Für die gesamte Landesfläche dürfte mit rund 40'000 bis 45'000 Mausohren zu rechnen sein.

Mausohren sind flugfähige und darum äusserst mobile Kleinsäuger, welche sich tagsüber in uns unzugänglichen Verstecken aufhalten können. Es stellt sich darum bei der Schätzung der Populationsgrösse im Speziellen die Frage nach der Bedeutung der Qualität der Einzelzählung unter der Annahme, dass nur 75% der Wochenstubenkolonien bekannt sind. Zur Abschätzung von Populationsveränderungen stellt sich im Falle des Grossen Mausohrs grundsätzlich die Frage, ab welchem Ausmass der Veränderung in der Anzahl gezählter erwachsener Weibchen bei diesen k-Strategen auf eine Veränderung der Populationsgrösse geschlossen werden kann, unter der Annahme, dass nur 75% der Wochenstubenkolonien bekannt sind und dass der Individuenaustausch zwischen Kolonien und insbesondere mit solchen im benachbarten Ausland weitgehend unbekannt ist.

Peter Ulmann & **Arthur Kirchhofer** (Berb): Die Verteilung verschiedener Altersklassen der Nase (*Chondrostoma nasus*) im anthropogen veränderten Fliessgewässer.

Die Nase (*Chondrostoma nasus*) ist ein bestandesbildender Bewohner des Mittellaufes grosser Flüsse. Trotz mässiger Verbreitung ist diese Art in der Schweiz gefährdet, da fast die Hälfte aller bekannten Populationen in den letzten Jahren stark abgenommen hat. Dies gilt auch für die Nasenbestände der Aare in der Region Bern. Da Larven und Sömmerlinge aufgrund einer Veränderung der Ernährungsweise während der Ontogenese andere Lebensräume benötigen als erwachsene Tiere, ist das Vorhandensein geeigneter Habitate für die verschiedenen Lebensstadien von zentraler Bedeutung für die Populationsentwicklung. Unzureichende Habitatsbedingungen könnten somit eine Ursache für Bestandesabnahmen sein.

Der 25 km lange hydroelektrisch genutzte Flussabschnitt der Aare bei Bern wird durch Stauwehre begrenzt, und mit Restwasserstrecke, Fliessstrecke und Laufstau ergibt sich eine grossräumige Zonierung. Die natürliche Fortpflanzung von *C. nasus* ist in der Restwasserstrecke gewährleistet, und die adulten Tiere nutzen die tieferen, durchströmten Stellen in der Restwasser- und in der Fliessstrecke. Erste Resultate zeigen, dass die Jugendstadien dagegen nur im seeähnlichen Laufstau, in ruhigen Hinterwassern und seichten Ausbuchtungen, adäquate Bedingungen finden, so dass eine grossräumige Sortierung der verschiedenen Altersklassen in den einzelnen Flussbereichen erkennbar wird. Für andere rheophile Arten, die in Restwasser- und Fliessstrecke an denselben Stellen gefunden wurden, trifft dies nicht zu. Aufgrund der grossen Distanz zwischen Jungnasen-Habitaten in der Staustrecke und den Laichplätzen in der Restwasserstrecke stellt sich die Frage, ob mit diesem weit entfernten "Ersatzlebensraum" die Aufrechterhaltung der Population gewährleistet sei, und ob die Adulten-Bestände in der Restwasserstrecke durch die heranwachsenden Tiere aus dem Staubereich langfristig genügend ergänzt werden können.

Anne Catherine Wacker (Le Vaud): The educational and research potential of wild animals in captivity.

The International Association of Zoo Directors has declared that a well-functioning zoo of today should be a centre for leisure, preservation of rare species, education and research. However, despite these guidelines, only three out of eighty-six zoos in Switzerland have attained these four objectives.

Anyone can open a private zoo, with the necessary permits, as long as the animals are maintained in accordance with the law. But times have changed, and keeping wild animals no longer has the same significance. In previous eras, only the priviledged held certain exotic species to display their political or occult power. Zoos of today by necessity should invest their efforts not only in entertainment and preservation of menaced species, but also in providing possibilities for research and education. The captive animals provide concrete evidence of theoretical knowledge, e.g. classification, animal behaviour or morphology, studies during academic training in biology. The animals can also serve to heighten the public's appreciation of the life of wild creatures and their role in the ecosystem.

The reality is that the majority of small zoos in Switzerland are not aware of the educational environnement that they can offer, nor do they have the financial means to exploit this. In order to achieve the objectives of the International Association of Zoo Directors interest have to be awakened in universities, schools and the responsible government departments.

Ursula Zettel & **Jürg Zettel** (Bern): Polymorphisms and life span in *Ceratophysella sigillata* (Uzel) (Collembola: Hypogastruridae).*

C. sigillata is the only springtail known with 2 polymorphisms combined; both were unknown in this species before. Within one year, it runs through 4 different morphs: A (surface-active), B (surface-active, transition to C), C (inactive in the soil, summer dormancy) and E (in the soil, epitoky, reproduction in spring). C and E are morphologically closely related and cannot be determined with actual keys; they show similar characteristics to those of other epitokic *Ceratophysella* species. A and B have some morphological features in common and represent the feeding instars. The following morphological characters affected by the polymorphisms were checked in our study: mucro, setae on dens, tibiotarsal spur hair, protrusile antennal vesicle. The succession of the different morphs during ontogeny shows a striking regularity: 2 active instars are always followed by a morph which is not surface-active, and the sequence is A-A-E-B-B-C; the only deviation occurs at the beginning, the two first instars being A and followed by C. The life cycle is highly synchronized within a population, all individuals being in the same morph at the same time. As the life span of an individual may extend beyond 2 years, which is unique for springtails in temperate climate, two age classes can be identified within each population sample: the animals younger than one year are smaller and lighter coloured than the older ones.

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Non-*Apis* bees as crop pollinators*

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Non-*Apis* bees as crop pollinators. – The agronomic and economic value of bee effected pollination is discussed in terms of world food production, our diet and the well-being of society. Improved agronomic practice has increased food supply over the past 50 years, but has caused a depopulation in both numbers and species of native bee pollinator within agricultural environments. This negative impact has resulted from land clearing, cultivation, irrigation, pesticides, overgrazing, and large tract of monocultures. Populations of honey bees available for crop pollination are also decreasing. As a result, we need to develop management systems for non-*Apis* species. The overall direction of these studies has been to provide options to seed growers or horticulturists and beekeepers in their choice of pollinator for several crops. In Europe, preservation and management of habitat has been proposed as the principal method to maintain pollinator numbers with some effort directed toward developing management systems for native bee species including bumble bees, *Bombus* spp., for specific crops. In North America, efforts have focused on the development of non-*Apis* species with significant success for the alkali bee, *Nomia melanderi*, various mason bees, *Osmia* spp., and the alfalfa leafcutter bee, *Megachile rotundata*. Three of these non-*Apis* species are briefly discussed in terms of biology and management system. For the alfalfa leafcutter bee, the detailed studies necessary to successfully integrate a native bee into a sustainable agricultural system are outlined.

Key-words: Non-*Apis* bees - *Nomia* - *Osmia* - *Megachile* - *Crop pollinators.*

INTRODUCTION

Worldwide, more than 3000 plant species have been used as food. Only 300 of these are now widely grown, and just 12 species furnish nearly 90% of the world's food. These 12 include rice, wheat, corn, sorghum, millet, rye, barley, potatoes, sweet

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potatoes, cassavas, bananas, and coconuts (THURSTON, 1969). These crops are either wind-pollinated or self-pollinated. Superficially, it appears that insect pollination has little effect on the world's food supply-possibly no more than 1% (MCGREGOR, 1976). However, when total animal and plant products are considered, it appears that perhaps one-third of our total diet is dependent, directly or indirectly, on insect-pollinated plants.

The importance of insect pollinators can be put in perspective by examining the total Canadian food production scene as an example. In 1991, about 68 million ha of land were cultivated. About 45 million ha were devoted to wind- or self-pollinated crops such as grains or rangeland. About 3 million ha were devoted to self-pollinated crops such as rapeseed, flax, beans, peas, soybeans, and peanuts that may receive some benefit from insect pollination. A small improvement in yield or grade can have a large positive impact on profit. The remaining 9 million ha were devoted to fruits, vegetables, and legume crops and are completely dependent on, or produced from, insect-pollinated seed. About 11 million ha were summerfallowed. Animal food products such as beef, pork, poultry, lamb, milk, and cheese contribute about half of the North American diet. These products are derived in part from insect-pollinated legumes such as alfalfa, clover, or trefoil. Insects also have a major impact on oilseed crops. More than half of the world's diet of vegetable fats and oils comes from rapeseed, sunflower, peanuts, cotton, and coconuts. Many of these plants depend on or benefit from insect pollination.

The agronomic and economic value of bee-effected pollination has been an internationally contentious issue since at least the turn of the century. Attempts to value the pollination activity of bees have ranged from "guesstimates" of no empirical substance, to informed estimates (largely by apiculturists) to a few concerted efforts by economists (see GILL, 1991). Estimates by US researchers of the value of pollination to US agriculture have ranged from US $1.6 billion to US $40 billion (MARTIN, 1975; LEVIN, 1983; ROBINSON *et al.*, 1989; SOUTHWICK & SOUTHWICK, 1992). Others have estimated Australia's benefits at A$156 million (GILL, 1991) and for Canada C$1.2 billion (WINSTON & SCOTT, 1984). The major insect-pollinated crops in the European Community were calculated to have a total annual market value of 65000 million ecus, to which pollination by insects contributes 5000 million ecus, and that by domesticated honey bees 4250 million ecus (BORNECK & MERLE, 1989). The estimates are used to justify continued public financing of honey price support schemes, increase public funding of bee related research and extension programs, enhance the efficiency of the policy making process, and to recognize the contribution beekeepers make to the well-being of society. The estimates are derived primarily for honey bee pollinated crops. Honey bees have often been credited with pollination services that are actually performed by other bee species (PARKER *et al.*, 1987). There are few estimates of the value of non-Apis pollination, and these insects are generally not appreciated. The benefits we derive from native pollinators are believed to be increasing as the honey bee industry experiences continued difficulties from mites, Africanized bees and diseases, and as crops that are better pollinated by bees other than honey bees are grown more intensively.

Recent technological advances in agronomic practices have focused primarily on improving yield, increasing the number of crops grown, and increasing the area of harvestable crops. These advances have been applied indiscriminately to the majority of crop species and have transformed farms to intensive monoculture systems. The positive results of these practices are impressive: the quality and quantity of food have increased; food costs have decreased; numerous fresh fruits and vegetables of high quality are available for much longer periods; the quality and types of prepared food products have greatly improved; and, the large labour force once required has been reduced at the same time as crop areas have increased.

Accompanying the technical advances and intensive farming practices, a negative impact on crop pollination and non-*Apis* populations evolved. For example, clearing land of trees and increased cultivation have inadvertently eliminated many of the nesting areas previously used by non-Apis pollinators. Frequent applications of broad spectrum pesticides have been responsible for the rapid decline of pollinator numbers within agricultural areas. Planting cross-pollinated crop species (ie. alfalfa in Canada, almond, apple, melons, and blueberry in the USA) in large tracts of unbroken land in disjunct areas has artificially created shortages of pollinators available for these crops. Changing irrigation practices have had negative long-term effects on soil-nesting pollinators. And, overgrazing of rangeland and the use of herbicides has indirectly reduced the presence of pollinators by decreasing diversity of pollen-nectar resources and by eliminating required plant resources that are utilized by various pollinator species in nest construction. One of the consequences of an increased food supply for the world has been a depopulation of both numbers and species of native pollinators within agricultural environments. This situation must be addressed if our agricultural ecosystems are to be sustainable.

Honey bees can no longer be relied on to consistently pollinate all crops. The North American honey bee industry continues to experience pressure from tracheal, Varroa and other mite infestations; the rapid expansion of Africanized honey bees in the New World; contamination from several diseases so that the number of colonies available for pollination is becoming alarmingly low; and the withdrawal by government (US) of the honey price support program. Thus, the honey bee industry may not be able to adequately meet the pollination needs of intensive farming, increased area of crops requiring pollination, and of developing greenhouse crops. International concerns are also being expressed that honey bees may not benefit the native biota. They have been shown to displace native pollinators from flowers, may not trigger the pollination mechanisms of the flowers they visit, may force native bees to switch to less profitable resources when they are abundant at the richest patches of flowers, and instill aggressive interactions with native *Apis* species (see Paton, 1993). These problems will have long-term, negative consequences resulting in shortages of honey and native bee populations reserved for crop pollination. The continued evaluation and development of management practices for non-Apis pollinators will help ensure adequate pollination for a diversity of crops.

Several reviews summarize the above problems (FREE, 1982; PARKER *et al.*, 1987; ROBINSON *et al.*, 1989; SOUTHWICK & SOUTHWICK, 1992; TORCHIO, 1990, 1991;

Corbet *et al.*, 1991; Osborne *et al.*, 1991; Williams *et al.*, 1991). Recommendations for and approaches used to increase the availability of pollinator numbers has varied. In Europe, preservation and management of habitats thought suitable for bees' forage or nesting sites have been repeatedly proposed as a method to maintain or increase pollinator numbers. Enhancing native pollinator populations by habitat management is a potentially cost-effective option that deserves attention, and may become essential if honey bees become less readily available (Corbet *et al.*, 1991). Habitat management will be most effective if planned on a scale larger than that of an individual farm, and it therefore requires coordination on a regional scale across government levels. For the few crops and many native flowering plant species unsuited to pollination by managed colonies of bees, this is the only viable option. There has been some development in Europe of non-*Apis* species as managed pollinators (Tasei, 1975, 1977; Krunic & Brajkovic, 1991; Heemert *et al.*, 1990). In North America, efforts have focused on the development of non-Apis species as managed pollinators for specific crops with significant success for the alkali bee, *Nomia melanderi* Ckll., various mason bees, *Osmia* spp. and especially for the alfalfa leafcutter bee, *Megachile rotundata* F. There have been proposals for habitat management programs, but little positive action, especially in intensive agricultural systems. Robinson *et al.* (1989) suggested that additional research resources for honey bees would satisfy all future crop pollination requirements. Throughout the world, a few other successful programs exist which enhance native pollinator numbers, (i.e., mason bees for apple pollination in Japan, Maeta, 1978).

The remaining part of this paper summarizes successful commercial management systems for four non-Apis pollinators: the alkali bee, mason bees, bumble bees, and the alfalfa leafcutter bee.

ALKALI BEE, *Nomia melanderi*

The alkali bee is endemic to certain arid and semi-arid portions of the western United States. It was a valuable native pollinator of alfalfa, onion, sweet clover, and mint, especially during the 1960's and 1970's (Johansen *et al.*, 1982). It has decreased in importance recently because of the increased use of the alfalfa leafcutter bee for these crops. It is a solitary, gregarious bee that usually nests in large aggregations of about one million nests per acre in alkali flats with a continuous source of subsurface moisture, and in saline soils with a silt loam to fine sandy loam texture.

Adults emerge in early summer and females construct nests and collect pollen for their young over a period of about 30 days. Usually only one nest is prepared and provisioned per female. Nests vary little in their architecture with each having a main burrow leading from the entrance hole to a carved out chamber 12-60 cm below the soil surface. On average, each female has 15 to 20 progeny in well-managed or artificial beds, depending on the type of nesting site. Daily flight periods normally begin 2-3 hours after sunrise and end by 4-5 pm during mid-summer periods. They can visit and trip up to 12 alfalfa florets per minute. The alkali bee, unlike other alfalfa pollinators, flies through the canopy of the crop as it visits flowers and thereby increases its pollination efficiency on that crop.

Often, after a natural nesting site has maintained a large bee population for a few years, it becomes unsuitable and the bee population rapidly declines. Decline may bedue to flooding, decreased moisture, development of a thick and hard crust on the soil surface, diseases, parasites and predators of immature stages, pesticides, trampling by livestock, traffic by vehicles, and encroachment of salt-tolerant vegetation. Management techniques have been developed to protect natural nesting sites from these hazards and to maintain the sites either by regulating the water supply, reworking the soil surface or eradicating encroaching vegetation (STEPHEN, 1960a, b; JOHANSEN *et al.*, 1982). Attempts have been made to create new sites where they are needed. The new nesting sites or bee beds must have an adequate moisture supply, be relatively free of weeds, and protected from pests. The alkali bee may migrate to thenew beds or be transported in undisturbed soil from established beds and imbedded at the new site during the winter while the bees are in the overwintering stage.

MASON BEES, *Osmia* spp.

Mason bee species from several countries are recognized as potential pollinators for diverse crops, including orchard, vegetable, greenhouse, and field crops. The osmiine bees, unlike other Megachilinae, collect mud, or mud mixed with macerated leaf material, or only macerated leaf material to construct their cells. Generally the bees are solitary yet gregarious. The following three examples of different species demonstrate the needs and evaluations required for successful commercial management. Other *Osmia* spp. (i.e., *rufa*, *ribifloris*, *coerulescens*, *sanrafaelae*, *bruneri*, *atriventris*) also have potential as crop pollinators, but considerable effort to understand their biology and to develop appropriate management systems (TASEI, 1973a, b; KRISTJANSSON, 1989; TORCHIO, 1991) is still required.

The blue orchard bee, *Osmia lignaria propingua* is distributed across the continental US and southern Canada. Studies on this species began about 20 years ago when the number of honey bee colonies in the US was declining and the area planted to orchard crops was increasing; a pollination crisis for many cross-pollinated orchard crops, specifically apple ad plum was forecast (TORCHIO, 1976). Commercial success for *O. lignaria* can be attributed to TORCHIO (1976, 1982, 1985, 1990) who found: apple pollination is maximized when 250 female bees are nesting per acre; 300 females/acre for almond; pollination by this bee continues when honey bees cease flight during inclement weather; pollination is evenly distributed across orchards when nest materials are evenly distributed throughout orchards; population sizes can be increased under intensively farmed orchard systems; exposure to insecticides is minimized because the nesting cycle can be completed during the flowering period; nesting populations can be moved; management systems have been developed for commercial-sized populations; inexpensive but successful control methods have been developed for the more important nest associates; large field-trapped populations have been obtained; and populations have been successfully transported intercontinentally.

The horned-faced bee, *Osmia cornifrons* is native to Japan where it has long been established as a commercial pollinator of apple and plum (MAETA & KITAMURA, 1965a, b, 1974). Commercial apple production in Japan has required the application of toxic materials during the flowering period. Use of pesticides, combined with clean cultural practices, were responsible for significantly reducing pollinator populations. Orchardists resorted to labour intensive hand-pollination, but this was not cost effective. Viable management systems were subsequently developed to utilize this bee as a cost-effective pollinator (MAETA, 1978). The system requires the increase of populations away from the orchards. From these, subpopulations are introduced annually back into the orchard environments. The bees moved into orchards are treated as an expendable commodity.

In Europe, *Osmia cornuta* has been evaluated as a pollinator of apple, almond and other crops (TASEI, 1973a, b; ASENSIO, 1983; TORCHIO & ASENSIO, 1985; KRUNIC & BRAJKOVIC, 1991). Its potential value can be summarized as follows: large natural populations occur in some areas of Europe, and field-trapping efforts have been successful in those areas; its biology is similar to other *Osmia* spp. and hence is amenable to management systems developed for other species; it has few nest associates; its foraging biology is similar to other species hence its effectiveness is significant; managed populations readily accept commercial nesting materials; and populations released in orchards increase.

BUMBLE BEES, *Bombus* spp.

Bumble bees have drawn the attention of biologists for more than a century. Considerable knowledge on their biology, nesting site and flower preference, colony architecture and size, and associated pests is known (SLADEN, 1912; FREE & BUTLER, 1959; ALFORD, 1975; HEINRICH, 1979). Until recently, bumble bee colonies were reared mainly for specific scientific purposes. Methods have been described to induce *Bombus* species to start and maintain colonies in captivity (PLOWRIGHT & JAY, 1966; POMEROY & PLOWRIGHT, 1980). Renewed interest in year-round rearing of bumble bees for high-value crops (i.e., tomato, cucumber) in greenhouse industries in Europe and kiwi fruit in New Zealand has resulted in refinements of techniques (ROSELER, 1985; HEEMERT *et al.*, 1990; EIJNDE *et al.*, 1991) making the efforts economically viable. Savings in labour costs and reliability of the bee are the principle reasons for success. Other successes in using bumble bees for greenhouse crops are now being reported (BANDA & PAXTON, 1991; KEVAN *et al.*, 1991; STRAVER & PLOWRIGHT, 1991). Bumble bee rearing has been commercialized and some companies specialize in providing colonies at specific stages of colony development. With the refinements in rearing techniques, there is potential now to place bumble bees on field crops, although the economic viability needs to be determined.

ALFALFA LEAFCUTTER BEE, *Megachile rotundata*

Historical perspective: The alfalfa leafcutter bee is the most important pollinator of alfalfa in Canada and the Pacific Northwest of the USA and is increasing in importance throughout the world. Flowers of alfalfa must be cross-pollinated to produce seed. Alfalfa seed production in western Canada has been highly variable over the past 50 years, ranging from a high of 9.7 million kg, in 1948 (12.7 M kg in 1989) to a low of 450 thousand kg in 1969. During the 1940's, southern Alberta was Canada's main alfalfa seed production area, but this shifted during the 1950's to the parkland areas of the prairie provinces. Eventually production in both areas greatly decreased because increased irrigation, cultivation, land clearing, or pesticide use destroyed the nesting sites or populations of native pollinators. Honey bees are of negligible value for alfalfa pollination because only 0.8% or less of the flowers visited are pollinated (HOBBS & LILLY, 1955). By 1950, Canada was importing alfalfa seed to meet domestic needs rather than exporting excess production. However, this situation has now reversed. In 1988, 1.1 million kg of seed were exported from western Canada; this was the largest amount in 30 years. Increases in growing area of 40 to 60% in recent years reflect the rapid growth of the industry (RICHARDS, 1987a). In 1976, 1625 ha were in pedigree seed production and by 1992, this had increased to 25100 ha plus about 3000 ha of common seed. Expansion of the industry can be attributed to the alfalfa leafcutter bee and to the good demand for hardy, adapted, Canadian-bred cultivars, low production costs and good economic returns for both bees and seed in comparison with competitive cash crops. During the last few years, seed yields on irrigated land in southern Alberta have averaged 350 kg/ha and the yearly production of bees has almost doubled. Experienced managers sometimes produce yields of up to 1100 kg/ha. Without leafcutter bees, only 50 kg/ha of seed would be produced.

Management objectives: The first leafcutter bees were imported into Canada in 1961. Since then, improved management practices have resulted in the steady expansion of the alfalfa seed and leafcutter bee industries. Large numbers of bees are needed to pollinate the crop. For this reason, the loose-cell system of bee management was developed (HOBBS, 1964, 1973; RICHARDS, 1984a, 1987a). This system places the optimum number of bees on the crop at the appropriate time to obtain a high seed set and an adequate return of viable bees for the following year (RICHARDS, 1982). This system enables easy removal of bee cells from laminated grooved nesting materials for storage over the winter, without destroying the nesting material. The system enables control of parasites, predators, and diseases through various management procedures, including hive construction, incubation, and removal and tumbling of cells from the hives. It also makes efficient use of cold storage and incubation facilities to synchronize bee emergence with the beginning of flower bloom. Beekeepers can take samples of cells from their current production to accurately estimate numbers of intact cocoons, females, parasites, and diseases (HOBBS & RICHARDS, 1977; RICHARDS & KOZUB, 1979). Therefore, improvements in beekeeping practices can be monitored and guidelines provided when bees are bought, sold, exported, and rented by alfalfa-seed growers. Although the loose-cell system of bee management requires substantial initial financial investment in specialized equipment and demands intensive and proper handling of bees, careful managers realize profits from the sale of excess bees.

Various levels of leafcutter bee management exist (BOHART, 1972; RICHARDS, 1982). The higher levels of management tend to require more skill, knowledge, and capital, and incorporate more sophisticated equipment than the lower levels. Of course those managers operating at higher levels of management have reduced much of the risk and uncertainty they face, have allocated resources through management decisions which have allowed a greater flexibility of choice, and hence, have an increased chance that expectations will be consistently fulfilled.

The alfalfa leafcutter bee is of Eurasian origin. It is solitary and gregarious. At the hive, the female constructs about 30 cells in a life time. The cells are built of leaf pieces and provisioned with pollen and nectar. One egg is laid in each cell. The larvae pass through 4 instars (WHITFIELD *et al.*, 1987) and a base temperature of 15 C and 166 degree-days are required to complete immature stage development (WHITFIELD & RICHARDS, 1992). One generation per year is normal in Canada, but up to three generations per year are possible in southern California (BITNER, 1992). The normal sex ratio is near 2:1 M:F.

Bloom synchrony: The usefulness of this bee begins when alfalfa starts to bloom and ends when no flowers remain to be pollinated or when tripped flowers do not have time to set mature seed before harvest. The optimum relationship of bee population and flower density to time can be described as curvilinear. The relationship can only be achieved by synchronizing bee emergence with the commencement of flower bloom. Techniques to synchronize the bees with the bloom have been easier to develop than techniques to control the bloom of the crop. The development and emergence of bees can be regulated more easily by using controlled incubation facilities than by relying on field conditions (RICHARDS, 1984a; STEPHEN, 1981). Various incubator designs are used for different purposes (RICHARDS, 1982).

In general, cells containing prepupae are removed from hives at the end of the season and stored at low temperatures for several months to retard development and synchronize emergence. Early the following June, cells are placed in high temperature incubators (about 30 C) for about 3 weeks to synchronize adult emergence with the beginning of alfalfa bloom. Development and emergence of bees can be regulated easily by modification of incubation temperature and can be delayed for several days with no mortality (RANK & GEORZEN, 1982; UNDURRAGA & STEPHEN, 1980). Temperatures in incubators should be lowered when inclement weather (cold, rain, wind) reduces the chance of successful field release of bees, when an insecticide needs to be applied to control a pest insect, when waiting for an insecticide residue to dissipate, and when, through improper incubation timing, insufficient bloom and food for the bees occur on the field (RICHARDS, 1982). Males emerge before females. Emergence is usually completed in field shelters.

A more detailed study (RICHARDS & WHITFIELD, 1988) on the survival and development of prepupae from different locations revealed no significant interaction in emergence between sex and temperature across locations for incubation temperatures from 15 to 37 C. For the intermediate range of temperatures of 25-35 C, the range commonly encountered in commercial beekeeping operations, a lack of significant interaction between temperature and location occurred. This means all bees responded to temperature similarly. Survival was high, except for high temperatures. As expected, rate of development increased with increasing temperatures up to 32 C and then decreased slightly. Base temperature was 15.7 C for development, and number of degree-days for 50% emergence was 295.

A chalcid wasp, *Pteromalus venustus*, the most common pest insect associated with the bee in western Canada emerges over a 4-day period starting on the 8th or 9th day of incubation. Temperature also influences its rate of postdiapause development and emergence during incubation (WHITFIELD & RICHARDS, 1985, 1987). This information is especially valuable for timing control measures for this parasitoid. Base temperature for 50% emergence is 15.0 C and DD necessary to attain 5 and 50% emergence were 151.5 and 162, respectively. Note the close similarity between the base temperature for the bee (15.7) and the main parasite (15.0). The wasp develops so rapidly at 30 C that, if it is poorly controlled during its first emergence, another emergence can occur before or just as the bees are taken to the field, resulting in further loss of bees. The influence of temperature on survival and development of non-diapausing *Pteromalus* has been determined. The most common methods of control during incubation include the use of UV light traps placed over water, and placing dichlorvos resin strips in the incubator just prior to parasite emergence.

Nesting materials: Leafcutter bee hives are used by the female to construct and provision cells and lay eggs; parasitism occurs primarily in hives. A hive requires precise construction of good-quality material to ensure high return of viable cells by providing an acceptable, parasite-free home for the bee (RICHARDS, 1978, 1984a, 1987a). Various nesting materials with optimum tunnel length and diameter have been evaluated and each have advantages and disadvantages. One of the main premises of the loose-cell system of bee management is that the cells must be easily removed from the nesting material, without destroying the material. Laminated grooved nesting material of either pine wood or polystyrene are commonly used and are adapted for easy cell removal.

Most Canadian beekeepers use automatic cell removers to ease the removal of cells from the nesting material. The cells are then passed through cylindrical tumblers to remove debris, debris-feeding insects, predators, plant foliar moulds, and chalk-brood cadavers. This sanitation practice can remove up to 17% by weight of unwanted material (RICHARDS, 1984b).

Shelters: Shelters protect the hives and nesting bees from adverse weather. The size of shelter is governed by economic use of construction materials, transportability to and from seed fields and between fields, volume of overwinter storage space, and area to be pollinated (RICHARDS, 1984a). Because they are large and easily visible, the shelters help the bees return to their hives. Some shelter designs encourage efficient use of the bees and others do not (STEPHEN, 1981; RICHARDS, 1983). Shelter designs have been evaluated for construction materials, heat build-up, light intensity, wind turbulence, orientation patterns, effect on foraging activity of the bee, bee quality and reproduction, and dropping of leaf pieces used in cell construction. Shelters are faced easterly and evenly spaced through the crop with one shelter per 1.2 ha. In general, bees tend to pollinate alfalfa about twice as far to the east as to the west of the shelter; therefore, shelters are generally placed closer to the western edge of the crop than the eastern edge. Seed yields are usually highest immediately in front of shelters and decrease with distance from the shelter (RICHARDSS, 1983, TASEI & DELAUDE, 1984). The amount of seed yield decrease varies by year and is related to total flying hours.

Population recommendations: When the bee was first imported into Canada only 500 female bees/ha were recommended (HOBBS, 1964). The large population required for pollination did not exist, but as the number of bees increased, the recommended rate also increased (20000 bees/ha Hobbs, 1967; 50000 bees/ha HOBBS, 1973; RICHARDS, 1984a). In some years 50000 bees/ha appears sufficient to provide a near uniform seed set across a field, but in many years it is not enough. Therefore, a theoretical approach was developed to predict the probability of an individual flower being pollinated under various pollinator and flower densities. These estimates are a necessary prerequisite to recommending the numbers of pollinators needed per unit area of crop for maximum pollination. The pollination model has been used to compare pollinator species, leafcutter, honey, and bumble bees for cicer milkvetch and sainfoin (RICHARDS, 1987b; RICHARDS & EDWARDS, 1988). Providing realistic recommendations to producers on the optimum number of pollinators (for any non-*Apis* pollinator) required for a crop is one of the most important and basic pieces of knowledge that we should be generating. Because of the complexity of integrating the bee, bee-crop interaction, and other related components, it is also one of the most complex and difficult.

Winter storage: Leafcutter bee hives are removed from the field during August and bee cells are removed from the hives during September through December. Cells containing prepupae are normally stored at 0-10 C for 7-10 months to reduce losses by parasites and predators, to protect them from excessively cold temperatures, and to arrest prepupal development until the spring or when adult bees are needed (RICHARDS *et al.*, 1987). Duration and temperature of cold storage and subsequent temperature of incubation are important factors that influence the emergence of adult leafcutter bees.

Pests and diseases: The loose-cell system of bee management facilitates control of natural parasites and predators that prey on the bees or feed on stored products. The system has been criticized because the types of hives, the laminated grooved nesting materials, and the incubation of loose cells in trays, were thought to be conducive to an increase of harmful pests. These criticisms are unfounded. Over the last 30 years the bee has been in Canada, mortality attributable to the 21 species of parasites or predators associated with the bee has accounted for about 1% of the total bee population. Under the intensive loose-cell system, parasites and predators can be controlled by precise construction of hives (HOBBS, 1973; RICHARDS, 1983a), controlled incubation and light traps, immersion of cells in insecticides (not practised) (BRINDLEY, 1976; PARKER, 1979), placement of dichlorvos strips in incubators (HILL *et al.*, 1984) and fall storage areas, and physical separation during the removal and subsequent tumbling of cells from the hives (RICHARDS, 1984a). Many of the techniques have been directed at reducing the population of emerging adult parasites and preventing parasitism during incubation. This has required accurate prediction of the emergence of parasites during incubation and the scheduling of appropriate control measures.

Some viral, bacterial, and fungal diseases of leafcutter bees are known (HACKETT, 1980; INGLIS *et al.*, 1992). Chalkbrood disease, caused by *Ascosphaera* *aggregata*, is the most serious and was first found in Canada in 1982 (RICHARDS, 1985). In Canada, the disease is found mainly in southern Alberta, where levels (less than 3%) have not reached those in parts of the US (up to 60%) (STEPHEN *et al.*, 1981). Mode of dispersal, infestation of bee larvae, sporulation, and associated symptoms caused by this pathogen have been described (MCMANUS & YOUSEFF, 1984; VANDENBERG *et al.*, 1980, 1982). Effective control measures have been sought (STEPHEN *et al.*, 1982) with trhe most promising being the fumigant paraformaldehyde (GOERZEN & WATTS, 1991).

Productivity indicators: Reliable productivity indicators are required by beekeepers to improve their operations, to assist them in evaluating management decisions, and to warn of new problems (pest or diseases). They are needed when the bees become items of commerce so that sellers obtain fair prices and their customers obtain fair value (HOBBS & RICHARDS, 1977; RICHARDS & KOZUB, 1979). Methods to provide statistically accurate estimates using x-radiography have been developed and incorporated into an industry-run quality control laboratory. Samples submitted by beekeepers since 1970 indicate a gradual improvement in the quality of bees produced. Productivity has increased while the percentage of incomplete (dead) cells has decreased. The productivity indicators for the incubation test show that about 33%+ of the incubated cocoons contained females. These estimates indicate that beekeepers are incorporating new and recommended procedures into their operations.

The loose-cells system has made Canadian leafcutter beekeepers the world's leading suppliers of quality cells. In the past few years, 150-300 million surplus bees have been exported annually, mainly to the US, but also to Argentina, countries formerly part of the USSR, and several European countries.

Pollination of other crops: The usefulness of the bee for legume forage crops other than alfalfa, and on field and horticultural crops for seed or fruit production has been assessed only in a few commercial fields and experimental plots. The bee's potential to pollinate legume forage crops in western Canada was investigated through mass-screening of 30 plant species (RICHARDS, 1991). Most perennial and biennial legumes currently grown in Canada require cross pollination and had favourable seed sets and yields when exposed to leafcutter bees. Most annual legumes did not benefit from leafcutter bees. The intent of these studies was to provide an option to seed growers in their choice of pollinator for these crops. We have begun detailed studies comparing pollinator species for some of the more promising crops. The theoretical model presented earlier was used to predict the bee population required to pollinate varying flower densities. The effectiveness or seed-setting ability of the various pollinators determines the choice of pollinator and management recommendations. When recommendations are being developed, it is important to determine whether or not the crop can support the recommended pollinator. This is especially important for non-Apis bees because of their short flight ranges. Estimates of potential leafcutter bee productivity for most crops are still required. These estimates are expected to vary within a country and by country.

Future concerns: The alfalfa leafcutter bee industry in western Canada and North America has become well established through the organization and promotion of alfalfa seed grower associations. Many of the management techniques developed to date are directed towards controlling or modifying particular problems. Parasites and predators have made the development of specific control practices necessary. Application of pesticides is another major problem where the impact of interactions needs further research. With increased emphasis on sustainable agriculture and integrated pest management, losses to pesticides should become minimal. Bee diseases, including chalkbrood, are poorly known and new and modified equipment will be needed for effective control. Solutions to these management problems are important and in most cases achievable. Risk reduction is possible. Leafcutter bees could be used in combination with honey bees in California to improve alfalfa pollination. The usefulness of the alfalfa leafcutter bee as a pollinator of diverse forage legume crops and other crops for seed production needs to be thoroughly investigated.

REFERENCES

ALFORD, D. V. 1975. Bumblebees. *Davis-Poynter, London*, 352 pp.

ASENCIO, E. 1983. *Osmia (Osmia) cornuta* Latr. pollinisateur potentiel des arbres fruitiers en Espagne (Hymenoptera, Megachilidae). 5th symp. Inter. sur la polinisation. Versailles. 461-466.

BANDA, H. J. & R. J. PAXTON. 1991. Pollination of greenhouse tomatoes by bees. *Acta Horticulturae* 288: 194-198.

BOHART, G. E. 1972. Management of wild bees for pollination of crops. *Ann. Rev. Ent.* 17: 287:312.

BORNECK, R. & B. MERLE. 1989. Essai d'une évaluation de l'incidence économique de l'abeille pollinisatrice dans l'agriculture européenne. *Apiacta* 24: 33-38.

BRINDLEY, W. A. 1976. Carbaryl control of chalcidoid parasites from alfalfa leafcutting bees. *J. Econ. Ent.* 69: 225-228.

BITNER, R. 1992. Multi-generation management of the alfalfa leafcutting bee, *Megachile rotundata* (Fabricius). *Proc. Internat. Workshop on non-Apis bee and their role as crop pollinators*. Logan, Utah. p. 5.

CORBET, S. A., I. H. WILLIAMS & J. L. OSBORNE. 1991. Bees and the pollination of crops and wild flowers in the European Community. *Bee World* 72: 47-59.

EIJNDE, J., A. DE RUIJTER & J. VAN DER STEEN. 1991. Method of rearing *Bombus terrestris* continuously and the production of bumble bee colonies for pollination purposes. *Acta Hort.* 288: 154-158.

FREE, J. B. 1982. Bees and mankind. *George Allen and Unwin, London.*

FREE, J. B. & C. G. BUTLER. 1959. Bumblebees. *Collins, London*, 208 pp.

GILL, R. A. 1991. The value of honeybee pollination to society. *Acta Hort.* 288: 62-68.

GOERZEN, D. W. & T. C WATTS. 1991. Efficacy of the fumigant paraformaldehyde for control of microflora associated with the alfalfa leafcutting bee, *Megachile rotundata* (Fabricius) (Hymenoptera: Megachilidae). *Bee Sci.* 1: 212-218.

HACKETT, K. J. 1980. A study of chalkbrood and viral infection of the alfalfa leafcutter bee. *Univ. California, Berkely, USA; Ph.D. thesis.*

HEEMERT, C. VAN, A. DE RUIJTER, J. VAN DEN EIJNDE & J. VAN DEN STEEN. 1990. Year-round production of bumble bee colonies for crop pollination. *Bee World* 71: 54-56.

HEINRICH, B. 1979. Bumble bee economics. *Harvard University Press. Cambridge, Massachusetts*, 248 pp.

HILL, B. D., K. W. RICHARDS & G. B. SCHAALJE. 1984. Use of dichlorvos resin strips to reduce parasitism of alfalfa leafcutter bee (Hymenoptera: Megachilidae) cocoons during incubation. *J. Econ. Ent.* 77: 1307-1312.

HOBBS, G. A. 1964. Importing and managing the alfalfa leafcutter bee. Pub. 1209. *Canada Dept. Agriculture*, 8 pp.

HOBBS, G. A. 1967. Domestication of alfalfa leaf-cutter bees. Pub. 1313. *Canada Dept. Agriculture*, 19 pp.

HOBBS, G. A. 1973. Alfalfa leafcutter bees for pollinating alfalfa in western Canada. Pub. 1495. *Canada Dept. Agriculture*, 30 pp.

HOBBS, G. A. & C. E. LILLY. 1955. Factors affecting efficiency of honey bees as pollinators of alfalfa in southern Alberta. *Can. J. Agr. Sci.* 35: 422-432.

HOBBS, G. A. & K. W. RICHARDS. 1977. An examination of methods used in Western Canada to estimate populations of alfalfa leafcutter bees. *Bee World* 58: 67-70.

INGLIS, G. D., L. SIGLER & M. S. GOETTEL. 1992. *Trichosporonoides megachiliensis*, a new hypomycete associated with alfalfa leafcutter bees, with notes on *Trichosporonoides* and *Moniliella*. *Mycologia* 84: 555-570.

JOHANSEN, C. A., D. F. MAYER, A. STANFORD & C. KIOUS. 1982. Alkali bees: their biology and management for alfalfa seed production in the Pacific Northwest. *Pac. Northw. Coop. Ext. Bull.* PNW 155. 19 pp.

KEVAN, P. G., W. A. STRAVER, M. OFFER & T. M. LAVERTY. 1991. Pollination of greenhouse tomatoes by bumble bees in Ontario. *Proc. Ent. Soc. Ont.* 122: 15-19.

KRISTJANSSON, K. 1989. Investigations on the possibilities of using the solitary bee Osmia rufa L. as a pollinator in Denmark. *PhD. Thesis, Royal Vet. and Agr. Univ., Copenhagen.*

KRUNIC, M. D. & M. M. BRAJKOVIC. 1991. Management and utilization of *Osmia cornuta* Latr. for orchard pollination in Yugoslavia. *Acta Hort.* 288: 190-193.

LEVIN, M. D. 1983. Value of bee pollination tu US agriculture. *Bull. Ent. Soc. Am.* 29: 50-51.

MAETA, Y. 1978. Comparative studies on the biology of the bees of the genus *Osmia* of Japan, with special reference to their management for pollination of crops (Hymenoptera: Megachilidae). *Bull. Tohoku Nat. Agr. Exp. Sta.* 57: 1-221.

MAETA, Y. & T. KITAMURA, 1965a. Studies on the apple pollination of Osmia I. Ideal and present conditions in utilizing *Osmia* pollinators of apples in Japan. *Tohoku Konkyu 1964* 1,2: 45-52.

MAETA, Y. & T. KITAMURA. 1965b. Studies on the apple pollination of *Osmia*. II. Characteristics and underlying problems in utilizing *Osmia*. *Kontyu* 33: 17-34.

MAETA, Y. & T. KITAMURA. 1974. *How to manage the Mame-kobachi, Osmia cornifrons* Radoszkowski for pollination of the fruit crop. Ask Co. Lts., 16 pp.

MARTIN, E. C. 1975. The use of bees for crop pollination in Dadant and Sons, The Hive and the Honeybee, Dadant and Sons, Hamilton, Illinois.

MCGREGOR, J. E. 1976. Insect pollination of cultivated crop plants. *US Dept. Agric. Handb.* No. 496, 411 pp.

MCMANUS, W. R. & N. N. YOUSEFF. 1984. Life cycle of the chalbrood fungus, *Ascosphaera aggregata*, in the alfalfa leafcutting bee, *Megachile rotundata*, and its associated symptomatology. *Mycologia* 76: 830-842.

OSBORNE, J. L., I. H. WILLIAMS & S. A. CORBET. 1991. Bees, pollination and habitat change in the European community. *Bee World* 72: 99-116.

PARKER, F. D. 1979. Alfalfa leafcutter bee-reducing parasitism of loose cells during incubation (Hymenoptera: Megachilidae). *Pan Pacific Ent.* 55: 90-94.

PARKER, F. D., S. W. T. BATRA & V. J. TEPEDINO. 1987. New pollinators for our crops. *Agr. Zool. Rev.* 2: 279-304.

PATON, D. C. 1993. Honeybees in the Australian environment. *Bioscience* 43: 95-103.

PLOWRIGHT, R. C. & S. C. JAY, 1966. Rearing bumble bee colonies in captivity. *J. Apic. Res.* 5: 155-165.

POMEROY, N. & R. C. PLOWRIGHT. 1980. Maintenance of bumble bee colonies in observation hives (Hymenoptera: Apidae). *Can. Ent.* 112: 321-326.

RANK, G. H. & D. W. GOERZEN. 1982. Effect of incubation temperatures on emergence of *Megachile rotundata* (Hymenoptera: Megachilidae). *J. Econ. Ent.* 75: 467-471.

RICHARDS, K. W. 1978. Comparisons of nesting materials used for the alfalfa leafcutter bee, *Megachile pacifica* (Hymenoptera: Megachilidae). *Can. Ent.* 110: 841-846.

RICHARDS, K. W. 1982. Inputs, expectation, and management of the alfalfa leafcutter bee, *Megachile rotundata. Proc. 1st Internat. Symp. on Leafcutter Bee Management*, Saskatoon, Sask. 113-135 p.

RICHARDS, K. W. 1983. Relationship of leafcutter bee productivity to alfalfa seed yield. *Proc. Vth Internat. Symp. Pollination.* Versailles, France. 449-453.

RICHARDS, K. W. 1984a. Alfalfa leafcutter bee management in western Canada. *Pub. 1495E. Agriculture Canada*, 30 pp.

RICHARDS, K. W. 1984b. Comparison of tumblers used to remove debris from cells of the alfalfa leafcutter bee, *Megachile rotundata* (Hymenoptera: Megachilidae). *Can. Ent.* 116: 719-723.

RICHARDS, K. W. 1985. Detection of chalkbrood fungus, *Ascosphaera aggregata*, in larvae of the alfalfa leafcutter bee (Hymenoptera: Megachilidae) from western Canada. *Can. Ent.* 117: 1143-1145.

RICHARDS, K. W. 1987a. Alfalfa leafcutter bee management in Canada. *Bee World* 68: 168-178.

RICHARDS, K. W. 1987b. Diversity, density, efficiency, and effectiveness of pollinators of cicer milkvetch, *Astragalus cicer* L. *Can. J. Zool.* 65: 2168-2176.

RICHARDS, K. W. 1991. Effectiveness of the alfalfa leafcutter bee as a pollinator of legume forage crops. *Acta Hort.* 288: 180-184.

RICHARDS, K. W. & G. C. KOZUB. 1979. Estimating the number of cocoons of alfalfa leafcutter bees in a population. *Canadex 616*, 3 pp.

RICHARDS, K. W. & P. EDWARDS. 1988. Density, diversity and efficiency of pollinators of sainfoin, *Onobrychis viciaefolia* Scop. *Can. Ent.* 120: 1085-1100.

RICHARDS, K. W. & G. H. WHITFIELD. 1988. Emergence and survival of leafcutter bees, *Megachile rotundata*, held at constant incubation temperature (Hymenoptera: Megachilidae). *J. Apic. Res.* 27: 197-204.

RICHARDS, K. W., G. H. WHITFIELD & G. H. SCHAALJE. 1987. Effects of temperature and duration of winter storage on survival and period of emergence for the alfalfa leafcutter bee (Hymenoptera: Megachilidae). *J. Kansas. Ent. Soc.* 60: 70-76.

ROBINSON, W. S., R. NOWOGRODSKI & R. A. MORSE. 1989. The value of honey bees as pollinators of US crops. Parts I & II. *Am. Bee J.* 129: 411-423, 477-487.

ROSELER, P. F. 1985. A technique for year-round rearing of *Bombus terrestris*. *Apidologie* 16: 165-170.

SLADEN, F. W. L. 1912. The Humble-bee, its life history, and how to domesticate it. *London.*

STEPHEN, W. P. 1960a. Artificial bee beds for the propagation of the alkali bee, *Nomia melanderi. J. Econ. Ent.* 53: 1025-1030.

STEPHEN, W. P. 1960b. Studies in the alkali bee (Nomia melanderi Cockerell). III. Management and renovation of native soils for alkali bee inhabitation. *Oregon State Coll. Agr. Ext. Sta. Tech. Bull.* 52: 27-39.

STEPHEN, W. P. 1981. The design and function of field domiciles and incubators for leafcutting bee management. *Megachile rotundata* (Fabricius). *Oregon State Univ. Agr. Expt. Stn. Bull.* No. 654. 13 pp.

STEPHEN, W. P., J. D. VANDENBERG & B. L. FICHTER. 1981. Etiology and epizootiology of chalkbrood in the leafcutting bee, *Megachile rotundata* (Fabricius) with notes on Ascosphaera species. *Oregon State Univ. Agr. Expt. Sta. Bull.* No. 653, 10 pp.

Stephen, W. P., J. D. Vandenberg, B. L. Fichter & G. Lahm. 1982. Inhibition of chalkbrood spore germination in vitro (*Ascosphaera aggregata*: Ascosphaerales). *Oregon State Univ. Agr. Expt. Sta. Bull.* no. 656, 35 pp.

Straver, W. A. & R. C. Plowright. 1991. Pollination of greenhouse tomatoes by bumblebees. *Greenhouse Canada* 11: 10-12.

Southwick, E. E. & L. Southwick. 1992. Estimating the economic value of honey bees (Hymenoptera: Apidae) as agricultural pollinators in the United States. *J. Econ. Ent.* 85: 621-633.

Tasei, J. N. 1973a. Le comportement de nidification chez *Osmia* (*Osmia*) *cornuta* Latr. et *Osmia* (*Osmia*) *rufia* L. (Hymenoptera: Megachilidae). *Apidologie* 4: 195-225.

Tasei, J. N. 1973b. Observations sur le développement d'*Osmia cornuta* et *Osmia rufa* L. (Hymenoptera: Megachilidae). *Apidologie* 4: 295-315.

Tasei, J. N. 1975. Le problème de l'adaptation de *Megachile* (*Eutricharaea*) *pacifica* Panz. (Megachilidae) américain en France. *Apidoligie* 6: 1-57.

Tasei, J. N. 1977. Possibilité de multiplication du pollinisateur de la luzerne *Megachile pacifica* Panz. en France. *Apidologie* 8: 61-82.

Tasei, J. N. & A. Delaude. 1984. Efficacité pollinisatrice de *Megachile rotundata* F. (Hym., Megachilidae) utilisée sur luzerne (*Medicago sativa* L.). *Agronomie* 4: 653-662.

Thurston, H. D. 1969. Tropical agriculture-a key to the world food crisis. *Bioscience* 19: 29-34.

Torchio, P. F. 1976. Use of *Osmia lignaria* Say (Hymenoptera: Apoidea: Megachilidae) as a pollinator in an apple and prune orchard. *J. Kansas Ent. Soc.* 49: 475-482.

Torchio, P. F. 1982. Field experiments with *Osmia lignaria propingua* Cresson as a pollinator in almond orchards. I. 1975 studies (Hymenoptera: Megachilidae). *J. Kansas Ent. Soc.* 55: 101-116.

Torchio, P. F. 1985. Field experiments with pollinator species, *Osmia lignaria propingua* Cresson, in apple orchards: V. (1979-1980), methods of introducing bees, nesting success, seed counts, fruit yields. *J. Kansas Ent. Soc.* 58: 448-464.

Torchio, P. F. 1987. Use of non-honey bee species as pollinators of crops. *Proc. Ent. Soc. Ontario*. 118: 111-124.

Torchio, P. F. 1990. Diversification of pollination strategies for US crops. *Environ. Ent.* 19: 1649-1656.

Torchio, P. F. 1991. Bees as crop pollinators and the role of solitary species in changing environments. *Acta Hort.* 288: 49-61.

Torchio, P. F. & E. Asensio. 1985. The introduction of the European bee, *Osmia cornuta* Latr. into the US as a potential pollinator of orchard crops, and a comparison of its manageability with *Osmia lignaria propingua* Cresson. *J. Kansas Ent. Soc.* 58: 42-52.

Undurraga, J. M. & W. P. Stephen. 1980. Effect of temperature on development and survival of post-diapausing alfalfa leafcutting bee pupae *Megachile rotundata* (F.). II. Low temperature. *J. Kansas Ent. Soc.* 53: 669-676.

Vandenberg, J. D., B. L. Fichter & W. P. Stephen. 1980. Spore load of *Ascosphaera* species on emerging adults of the alfalfa leafcutting bee, *Megachile rotundata*. Applied and Environmental Microbiology 39: 650-655.

Vandenberg, J. D. & W. P. Stephen. 1982. Etiology and symptomatology of chalkbrood in the alfalfa leafcutting bee, *Megachile rotundata*. *J. Invert. Path.* 39: 133-137.

Whitfield, G. H. & K. W. Richards. 1985. Influence of temperature on survival and rate of development of *Pteromalus venustus* (Hymenoptera; Pteromalidae), a parasite of the alfalfa leafcutter bee. (Hymenoptera: Megachilidae). *Can. Ent.* 117: 811-818.

Whitfield, G. H. & K. W. Richards. 1987. Postfiapause development and adult emergence of *Pteromalus venustus* (Hymenoptera: Pteromalidae) during alfalfa leafcutter bee incubation. *Can. Ent.* 119: 491-493.

Whitfield, G. H. & K. W. Richards. 1992. Temperature-dependent development and survival of immature stages of the alfalfa leafcutter bee, *Megachile rotundata* (Hymenoptera: Megachilidae). *Apidologie* 23: 11-23.

WHITFIELD, G. H., K. W. RICHARDS & T. M. KVEDER. 1987. Number of instars of larvae of the alfalfa leafcutter bee, *Megachile rotundata* (F.) (Hymenoptera: Megachilidae). *Can. Ent.* 119: 859-865.

WILLIAMS, I. H., S. A. CORBET & J. L. OSBORNE. 1991. Beekeeping, wild bees and pollination in the European Community. *Bee World* 72: 170-180.

WINSTON, M. L. & S. C. SCOTT. 1984. The value of bee pollination to Canadian apiculture. *Canadian Beekeeping* 11: 134.

REVUE SUISSE DE ZOOLOGIE, 100 (4) : 823-828; décembre 1993

Premiers Campodeidae cavernicoles de Chine, comme exemple de l'évolution souterraine de la Famille (Diplura)[1]

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First cave-dwelling Campodeidae from China, as an example of hypogean evolution in the family (Diplura). - A new species, *Plusiocampa (Didymocampa) lipsae*, from a cave in Southern China (Hubei) is compared with the most closely related endogean species, *P. (D.) sinensis*, from Hong Kong. The large size, long legs and antennae, as well as an increased number of sensory receptors, are shared by most of the troglobite species and held to be cave adapted features. Frequently, the endogean species and the derived cave-dwelling ones are geographically not too much separated.

Key-words: Diplura - Campodeidae - *Plusiocampa* - New species - Hong Kong - Hubei - Hypogean evolution.

INTRODUCTION

Les Diploures Campodéidés rencontrés dans les grottes sont parfois des représentants d'espèces endogées locales qui trouvent là des conditions de vie favorables. Des *Campodea* dans les régions tempérées et des *Lepidocampa* sous les tropiques, sont des témoins de la tendance troglophile de certaines espèces. Beaucoup plus souvent, il s'agit d'espèces cavernicoles (troglobies) qui présentent quelques-unes au moins des apomorphies suivantes: hypertélie de l'organe cupuliforme de l'antenne, allongement des appendices (antennes, pattes, cerques), modification de la forme des griffes, diminution ou augmentation du nombre des phanères, régression de caractères sexuels secondaires, accroissement de la taille.

Endogés et troglobies d'un même genre occupant fréquemment des aires géographiques jointives, voire communes; leur comparaison est enrichissante, car elle permet des rapprochements conformes à l'histoire des lignées.

Le sous-genre *Didymocampa* Paclt, avec pour type une petite espèce endogée de Hong Kong, fut jusqu'ici l'unique représentant asiatique du genre *Plusiocampa*

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[1] Travail présenté à Zoologia 93.

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Silvestri. Une espèce inédite, récoltée dans une grotte du Hubei par Josiane Lips, au cours d'une expédition de l'AKL (Aventures karstiques lointaines), extrêmement différente à première vue de l'espèce endogée géographiquement la plus voisine, partage néanmoins avec elle des caractères qui en font sa plus proche parente connue et témoignent d'une origine vraisemblablement commune.

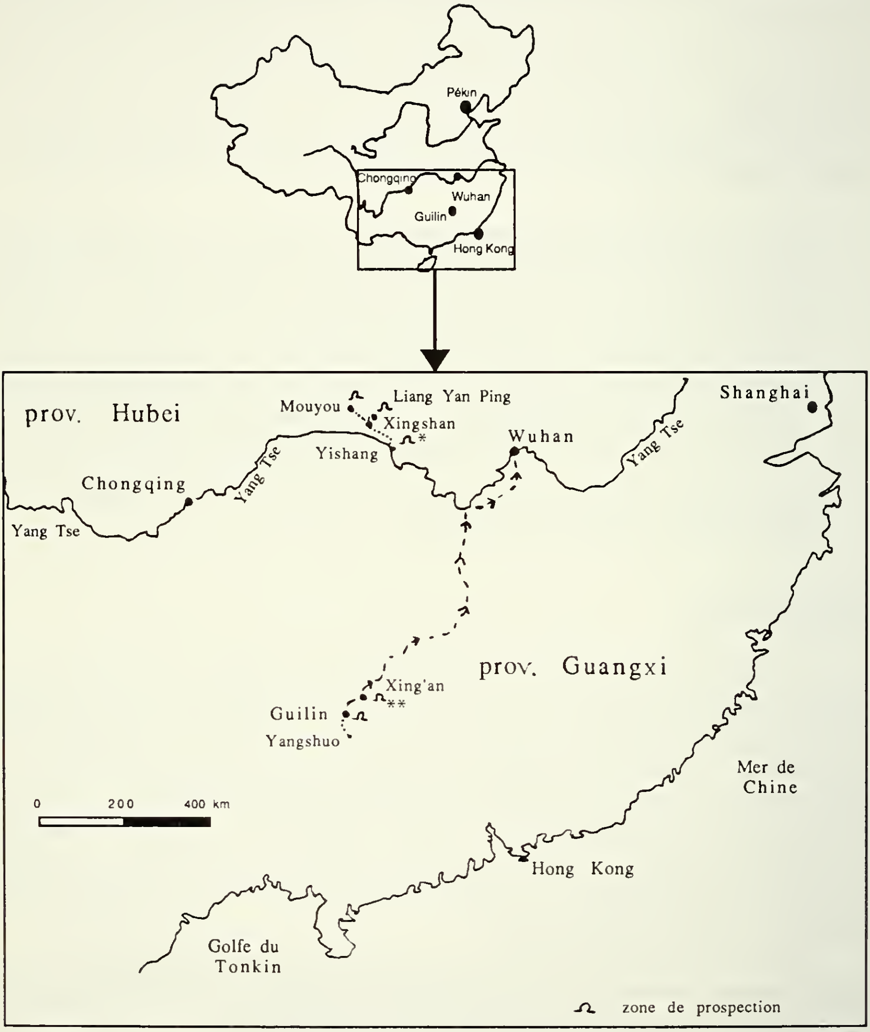

FIG. 1

Carte de la région visitée (B. et J. Lips). La grotte marquée d'un astérisque, près de Yishang, est celle où a été récolté *Plusiocampa* (*D.*) *lipsae* n. sp. La grotte marquée de deux astérisques, près de Xing'an, a livré un unique spécimen d'une espèce non décrite.

DESCRIPTIONS

Le tableau 1 qui regroupe *P.* (*D.*) *sinensis* et *P.* (*D.*) *lipsae* n. sp. met en évidence, chez le second, l'accroissement de la taille; l'allongement des appendices (antennes plus longues que le corps: X = 1,07 vs 0,54 et 0.60 chez *sinensis*; pattes métathoraciques égales aux 2/3 environ du corps: X = 0,65 vs 0,35 chez *sinensis*); le nombre plus élevé de sensilles dans l'organe cupuliforme; une légère réduction de la chétotaxie des mésonotum, métanotum et urotergite V, une augmentation de celle de l'urosternite I.

Tableau 1

Espèces	Longueurs (mm)				Ant.	Cup.	Th. (*ma*, *la*, *lp*)				Abd., tergites (*post*)				Abd., sternites		
	corps	ant.	p. III	cerq.			I	II	III	I-III	IV	V	VI-VII	VIII	I	II-VII	VIII
P. (D.) sinensis Silv.								(*ma*, *la*, 2*lp*)	(*ma*, 2*lp*)								
Types: femelle, sexe ?	1,90	1,15	0,65	1,10	22-26	?	4+4	4+4	3+3	1+1	1+1	3+3	3+3	5+5	5-6?	4.5?	1+1
Bru-88/56: larve	1,56	1,02	0,68	1,32	20-20	4	"	"	"	"	2+2	4+4	4+4	"	8+8	4+4	"
larve	1,76	1,01	0,65	?	20-20	"	"	"	"	"	"	"	"	"	"	"	"
mâle juv.	2,28	1,17	0,79	?	20-20	"	"	"	"	"	3+2	"	"	"	9+9	"	"
P. (D.) lipsae .								(*ma*, 2*lp*)	(*ma*, *lp*)								
Paratype mâle	4,03	?	3,37	?	?	?	4+4	3+3	2+2	1+1	1+1	3+3	4+4	5+5	12+12	4+4	1+1
Paratype mâle	4,85	?	3,63	?	?	?	"	"	"	"	"	2+2	"	"	11+12	"	"
Holotype femelle	6,22	6,47	3,62	?	44-?	ca 10	"	"	"	"	"	"	"	"	"	"	"
Paratype femelle	6,98	7,57	4,22	?	41-?	"	"	"	"	"	"	2+3	"	"	12+11	"	"
Paratype femelle	7,10	7,69	4,23	?	43-40	"	"	"	2+1	"	"	3+2	"	"	9+10	"	"

$\bar{X}$ corps/ant. *sinensis*: 1,82 $\bar{X}$ corps/ p. III *sinensis*: 2,81
lipsae: 0,93 *lipsae*: 1,53

Plusiocampa (Didymocampa) sinensis Silvestri, 1931

La description de *Plusiocampa sinensis* Silvestri (1931) repose sur 2 spécimens récoltés par son auteur à Hong Kong, dans le milieu endogé (“*in humo infossa*”). Le texte ne mentionne pas les sexes, mais la papille génitale représentée (fig. XVII, 14) est celle d'une femelle. On ignore si les mensurations sont celles d'un seul des individus ou les moyennes des deux.

Quatre spécimens de *Plusiocampa*, récoltés par B. Hauser à Hong Kong (New Territories, Tai Mo Shan Country Park, env. 200 m, 02.XII.1988 n° mat.: Bru-88/56), avec le Palpigrade *Koeneniodes madecassus* Remy (Condé 1993: 29), ont été étudiés en détail. Nous les rapportons à *P. sinensis*, en dépit de divergences dont certaines sont attribuables à des insuffisances de la description originale, d'autres relevant sans doute de la variation (tableau 1).

Compléments à la description originale

Tête. Sensille du IIIe article de l'antenne postéro-tergal (entre *b* et *c*), subcylindrique, allongé (21 µm). Sensille du palpe labial (11 µm) plus épais, les 2 poils de garde à proximité de son embase (SILVESTRI 1931, fig. XVII, 5); une rangée antérieure de 7-8 poils banaux et ca 75 phanères gustatifs (mâle de 2,28 mm).

Abdomen. Sternite I des mâles sans phanères glandulaires. Chez tous les spécimens, les appendices sont ovalaires avec un champ latéro-interne de petits phanères, plus courts que ceux du champ apical, au nombre de 4 à 6 chez les larves et de 9 chez le mâle le plus avancé (2,28 mm) qui possède 19 a_1. Une seule paire de macrochètes au sternite VIII; 12 soies en rosette autour du gonopore du mâle de 2,28 mm.

Le seul cerque intact (larve) est formé d'une base, divisée en 2 articles secondaires, et de 4 articles dont les 3 derniers sont revêtus de courtes soies glabres et de verticilles de macrochètes fourchus de même longueur qu'elles. Peut-être s'agit-il d'un caractère transitoire.

Plusiocampa (Didymocampa) lipsae n. sp. (Fig. 2 A-C)

Les cinq représentants de cette remarquable espèce ont été découverts dans une grotte dite «des Quatre Porches», située à 10 km au Nord de Yishang (Hubei), le 17.VIII.1992 (Fig. 1). Cette cavité comprend un réseau fossile et une rivière au voisinage de laquelle les spécimens ont été récoltés.

Matériel. Holotype ♀; paratypes: 2 ♂♂, 2 ♀♀, Muséum d'Histoire naturelle de Genève.

Téguments. Cuticule sans ornementations, soies de revêtement glabres.

Tête. Les antennes de 43 et 44 articles sont vraisemblablement intactes. Les 16-23 premiers articles sont allongés avec au moins 2 verticilles de macrochètes, les suivants étant à peine plus longs que larges ou même quadrangulaires avec un seul verticllle de macrochètes. Article apical en moyenne 3 fois plus long que large ($\bar{X}$ = 3,16; marges = 2,8-3,5; la dernière valeur concerne l'antenne de 40 articles qui est vraisemblablement un régénérat, car sa symétrique de 43 articles présente un rapport de 3,20). L'organe cupuliforme est petit, n'occupant qu'un 7e à un 8e de la longueur de l'article; en conséquence, les sensilles y sont très serrés et de lecture difficile: de forme globuleuse, ils présentent de minuscules digitations apicales (aspect de choux-fleur). Sensille de l'article III sternal (entre *d* et *e*), subcylindrique (22 µm); sensille latéral du palpe labial de même longueur, mais un peu plus épais, dissocié des 2 poils de garde située à au moins 1 fois 1/2 sa longueur; sensille du palpe maxillaire légèrement plus court que les précédents, mais de même forme. Palpe labial avec une rangée antérieure de 11 à 13 phanères ordinaires, insérés sur une ligne brisée, et 98 (mâle de 4,85 mm) à 113 (femelle de 7,57 mm) phanères gustatifs.

Macrochètes de la capsule céphalique (3 frontaux, *a*, *i*, *p*, *x*) très développés.

Thorax. Au pronotum, les macrochètes de la paire la plus postérieure (lp_2 ou lp_1) sont proches du plan sagittal, séparés l'un de l'autre par 2 soies marginales, 4 à 6 de ces soies les séparant du lp_3 correspondant. Tous les macrochètes sont très différenciés.

Fémur III plus court que le tibia (fe/ti = 0,72-0,86; $\bar{X}$ = 0,78), avec 2 macrochètes très différenciés au niveau du 4/6 distal du bord tergal, le plus proximal plus long que l'autre (72/57); pas ce macrochète sternal; 5 macrochètes sur la face antérieure du bord distal. Tibia III avec 2 macrochètes sternaux très brièvement fourchus à l'apex; les

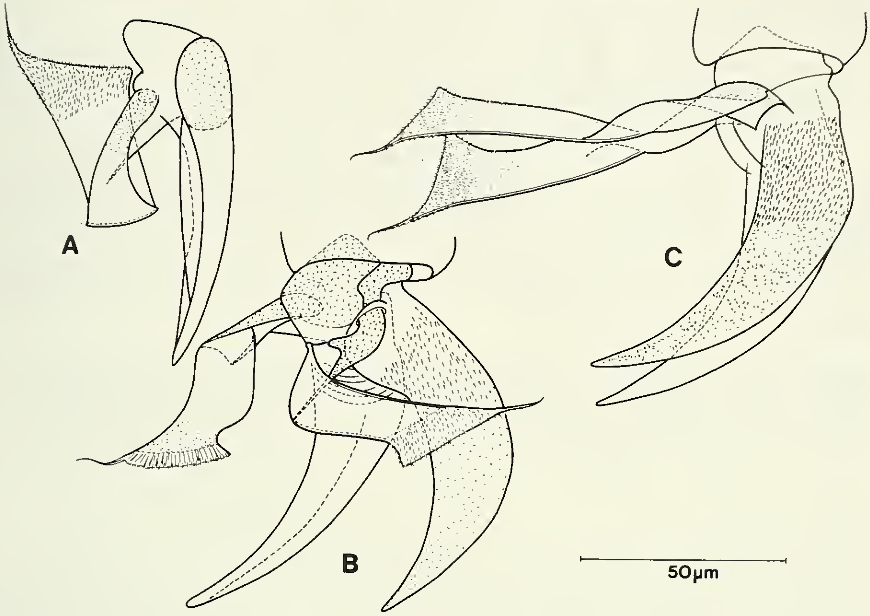

FIG. 2

Plusiocampa (*Didymocampa*) *lipsae* n. sp., ♀ holotype. A. Griffe postérieure de la patte mésothoracique droite, face tergale, montrant une crête latérale de dimension réduite. - B. Télotarse de la patte mésothoracique gauche, face antérieure (une crête latérale vue par transparence). - C. Télotarse de la patte métathoracique gauche, face antérieure (crêtes latérales non visibles).

calcars leur sont semblables, quoique légèrement plus épais; les uns et les autres portent une pubescence extrêmement ténue, visible aux plus forts grossissements du microscope photonique. Tarse III de longueur égale au fémur ($\bar{X}$ = 68,8 et 68 respectivement), une pseudo-articulation un peu au-delà de son tiers distal. Griffes subégales, coudées, à crêtes latérales très réduites; la cuticule de la portion basilaire porte de minuscules épines, le reste étant très finement ponctué. Processus télotarsaux lamellaires, dépassant largement l'extrémité des griffes, et de forme complexe; la région basilaire, à cuticule un peu plus épaisse, est creusée d'une gouttière et la portion lamellaire qui lui fait suite présente une torsion hélicoïdale plus ou moins lisible; la région distale de la lame est élargie, avec un bord apical oblique et asymétrique, l'angle externe étant prolongé par une expansion sétiforme; une très fine pubescence recouvre la face sternale de la lame sur sa portion distale.

Abdomen. La chétotaxie figure au tableau 1, comparée à celle de *P.* (*D.*) *sinensis.* Marge postérieure du sternite I des mâles sans phanères glandulaires; les appendices sont subcylindriques chez les deux sexes avec $7a_1$ chez la femelle holotype, 10 chez la femelle de 7,10 mm, 13 et 14 chez celle de 6,98 mm, 9 et 10 chez le mâle de 4,03 mm et 11 chez celui de 4,85 mm.

Les soies apicale, subapicale et moyenne sternale des styles ressemblent aux calcars tibiaux en un peu plus mince.

Papille génitale de l'holotype avec 8 + 8 soies sur les volets et 3 + 2 seulement sur la marge libre du tubercule. Chez les autres femelles, les volets portent 11 + 12 (spécimen de 6,98 mm) et 13 + 12 (spécimen de 7,10 mm) soies; les tubercules possèdent une rangée antérieure de 5 longues soies et 2 + 3 phanères courts sur la marge postérieure.

Papille mâle avec une rosette de 19 soies autour du gonopore et, vers l'avant, une plage de 29 courts phanères barbelés.

Derivatio nominis. L'espèce est dédiée à Madame Josiane Lips, de Villeurbanne, qui était préposée à la récolte de la faune au cours de l'Expédition qui a visité une quarantaine de cavités dans le Sud de la Chine, dont 14 sont localisée sur la carte (Fig. 1).

CONCLUSION

P. (*D.*) *lipsae* est le second représentant indiscutable du sous-genre *Didymocampa* que l'on peut caractériser à présent par les deux macrochètes tergaux du fémur en position distale, l'absence de macrochète sternal au fémur et de macrochètes latéraux antérieurs (*la*) à tous les urotergites, une seule paire de macrochètes au VIIIe urosternite et des griffes à crêtes latérales rudimentaires.

Cette espèce présente la plupart des tendances évolutives de la famille, liées à la vie dans les grottes, qui ont été rappelées plus haut. Le faible développement des crêtes latérales des griffes fait exception, de même que la persistance d'une chétotaxie à peine modifiée - mis à part le premier urosternite - vis-à-vis de l'espèce endogée la plus proche. Les remarquables processus télotarsaux qui auraient pu jadis susciter la création d'un genre nouveau, sont considérés à présent avec prudence, compte tenu d'exemples de polymorphisme constatés dans les populations d'une même espèce et chez un même individu au cours d'une mue (CONDÉ 1959).

L'évolution souterraine des Campodéidés semble, dans bien des cas, s'être déroulée à partir d'une souche locale plus superficielle d'où la nécessité de connaître la faune endogée de la région considérée pour effectuer des rapprochements en accord avec la phylogénie.

BIBLIOGRAPHIE

CONDÉ, B. 1959. Métamorphose des processus télotarsaux d'un Campodéidé (Insecte Diploure) au cours d'une mue postpubérale. *C.R. Acad. Sci.* Paris 248: 1402-1405.

CONDÉ, B. 1993. Palpigrades de Brunei et de Hong Kong. *Revue suisse Zool.* 100 (1): 25-29.

SILVESTRI, F. 1931. Campodeidae (Insecta Thysanura) dell'Estremo Oriente. *Boll. Lab. Zool. gen. agr. Portici* 25: 286-320.

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The jumping plant-lice of Iran (Homoptera, Psylloidea)

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The jumping plant-lice of Iran (Homoptera, Psylloidea). - The Iranian psyllid fauna is reviewed, based on literature records and extensive collections. The bulk of the material comes from 3 expeditions by the National Museum, Prague to Iran in 1970, 1973 and 1977, and from G. Remaudière who collected in Iran from the 1950's to 1970's. Of the 33 previously recorded species, 28 are substantiated by material, 3 are probably correct but no specimens were available, and 2 records concern a possible misidentification and a wrong citation. The studied material also contains 45 species previously unrecorded from Iran, 11 new species and 8 species which remain unidentified as the material is incomplete. The new species described and illustrated are: *Aphalara loginovae, Colposcenia agnata, Colposcenia cavillosa, Colposcenia paula, Craspedolepta remaudierei, Cacopsylla iranica, Spanioneura persica, Homotoma caroliquarti, Egeirotrioza corporosa, Egeirotrioza gemina,* and *Egeirotrioza justa*. The following synonymies are established: *Diaphorina zygophylli* (= *D. kopetdaghi*, = *D. halimiphylli*, = *D. media*), and *Cyamophila glycyrrhizae* (= *C. eremita*). Three new combinations are proposed: *Egeirotrioza gardneri* (Laing) comb. nov., stat. rev. (from *Phylloplecta*), *E. bifurcata* (Mathur) comb. n. and *E. longiantennata* (Mathur) comb. n. (both from *Trioza*). The biogeographical relationships of nine areas of endemism in Iran are analysed using the method of PAE (with PAUP). The relationships derived from psyllid distributions are compared to mammal data; some methodological aspects are briefly discussed.

Key-words: Psylloidea - Homoptera - Iran - Taxonomy - Biogeography.

INTRODUCTION

Iran is one of the largest Middle Eastern countries with a surface area of 1,648,000 km^2. It has a unique geobotanical position, linking the Irano-Turanian, the Euro-Siberian, the Saharo-Arabian and the Sudanian phytogeographical regions

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(ZOHARY, 1963). Iran is delimited by the River Aras, the eastern margin of Mesopotamia, the Persian Gulf, the Caspian Sea, the plains of Kara Kum and the mountains of Afghanistan and Baluchistan. Together with Afghanistan and Baluchistan, Iran forms the larger Iranian Plateau, a geomorphological and biogeographical unit. Iran is predominantly mountainous with four-fifths of its surface >1000 m a.s.l. The Elburz Mountains in the North reach 5670 m a.s.l. and in the South the Zagros Mountains, stretching southeastwards from the River Aras to the Persian Gulf, rise over 4500 m a.s.l. Between them are highlands, at an altitude of c. 1000 m a.s.l., subdivided by mountain ranges, and lacking river systems reaching the sea. The Central Plateau is subdivided into two, the Dasht-e-Kavir, a predominantly saline desert, and the Dasht-e-Lut to the South, mainly a sand and gravel desert. Only the short rivers of the border mountains drain to the sea. The lowlands are restricted to narrow fringes along the Caspian Sea and the Persian Gulf and to the Iranian part of the Euphrates delta (figs 1-3) (LAY, 1967; PARSA, 1978; ZOHARY, 1973). Thus, Iran can be subdivided into 5 main sectors: the Caspian, the Armeno-Zagrosian, the Central Iranian, the Khurusanian and the Laro-Baluchistanian sectors (ZOHARY, 1963).

Iran's climate is diverse and strongly influenced by orography. ZOHARY (1973) recognised 8 climatic provinces, ranging from the humid-subtropical Caspian region, the temperate and arid-subtropical mountains and interior, to the tropical Gulf region. Climatic conditions, particularly the amount and seasonal distribution of precipitation, influence the type and species richness of vegetation locally. Most of Iran belongs to the Armeno-Iranian floristic Province of the Irano-Turanian Region with the exception of part of the South Iranian Province of the Sudano-Zambezian Region (ZOHARI, 1973; TAKHTAJAN, 1986). The Armeno-Iranian Province is rich in endemic species in genera such as *Calligonum*, *Atraphaxis*, *Prunus*, *Astragalus*, *Hedysarum*, *Onobrychis*, *Convolvulus*, *Galium*, *Achillea*, *Anthemis* and *Artemisia*. MOBAYEN & TREGUBOV (1970) recognized slightly different floristic regions namely: 1. the Hyrcanian region along the Caspian coast; 2. the Irano-Turanian region covering the whole centre towards the east and west; 3. the Zagros region, and 4. the Khalidjo-Ommanian region. In addition, PARSA (1978) defined the following 9 biotic provinces: Caspian, Elburzian, Azerbaidzhanian, Zagrozian, Suzian, Farsian, Bazmanian, Lutian and Kavirian (fig. 2). Closed, dense forests are restricted and most of the area is covered by steppe vegetation dominated by hemi-cryptophytes (chiefly grasses) and chamaephytes (chiefly dwarf shrubs) or in the deserts, halophytic vegetation (PARSA, 1978; RECHINGER, 1963 ff.).

Steppe and desert plants bear a rich fauna of the highly host-specific jumping plant-lice (Homoptera, Psylloidea). In the Palaearctic this is well-documented for the territory of the former USSR (GEGECHKORI & LOGINOVA, 1990) and Mongolia (KLIMASZEWSKI, 1973; LOGINOVA, 1972b) but there is less information for the Middle East. Species lists, sometimes accompanied by identification keys or species descriptions exist for the following countries: Egypt (SAMY, 1973), Israel (BURCKHARDT & HALPERIN, 1992, and papers cited herein), Turkey (BURCKHARDT & ÖNUÇAR, 1993) and Saudi Arabia (BURCKHARDT, 1986a).

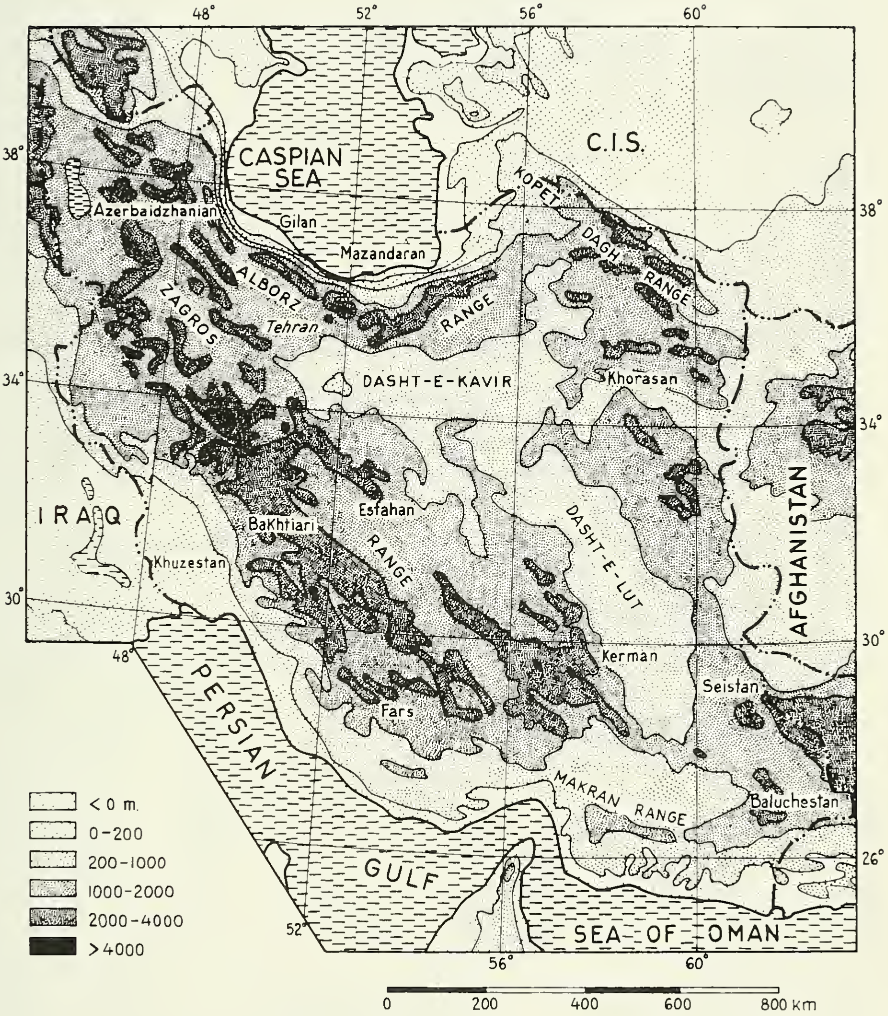
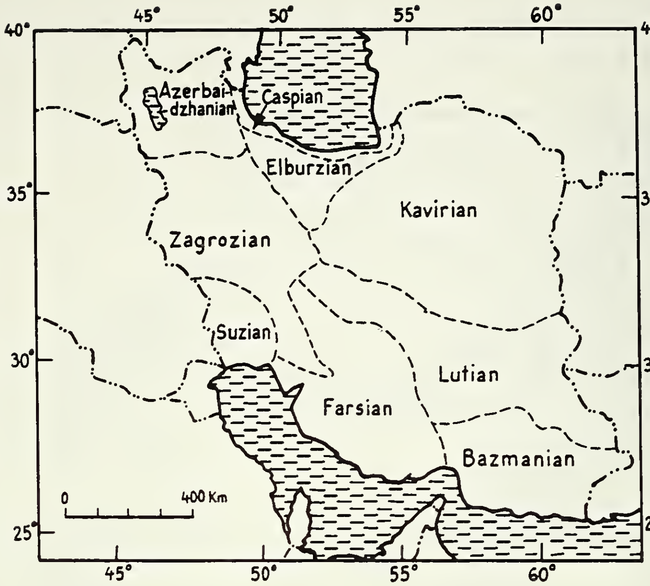


FIG. 1

Relief map of Iran.



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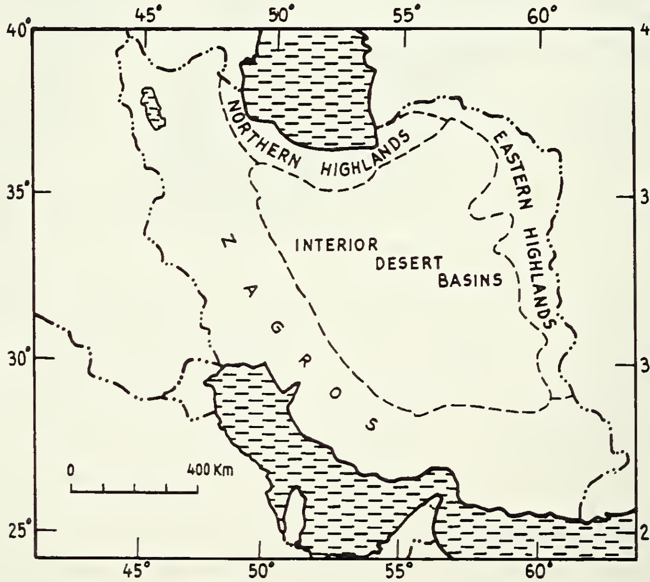

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Figs 2, 3

2. Biotic provinces of Iran after Parsa (1978). 3, Physiographic units of Iran.

HISTORICAL ASPECTS

Rübsaamen (1902) first recorded psyllids from Iran when he described galls on *Fraxinus oxyphylla, Populus euphratica* and *P. nigra* f. *pyramidalis*, attributed to *Psyllopsis fraxini* and to three unidentified species of Psylloidea. Later, Bergevin (1926) described one of the species on *Populus euphratica* as *Trioza ceardi* based on material from Morocco (not Tunisia as stated by Boselli, 1931, and repeated by Mathur, 1975, and Hodkinson, 1986) and on descriptions by Rübsaamen (1902), Houard (1922) and other cited authors.

Heslop-Harrison (1949) recorded *Livia juncorum* from Iraq, near the Iranian border, stating that it was likely to occur in Iran. Loginova (1962, 1972a) and Mathur (1975) list *L. juncorum* from Iran but do not indicate if they have seen material.

Davatchi (1958) recorded 4 species collected by himself and G. Remaudière (deposited in the USNM and in the MNHN) from Iran: *Homotoma ficus*, *Agonoscena* aff. *menozzii*, *A. targionii* and *Psylla* sp. The specimen referred to *Homotoma ficus* belongs to *H. caroliquarti* sp. n. while the "*Agonoscena targionii*" is *A. pistaciae* (Burckhardt & Lauterer, 1989). The material of "*A.* aff. *menozzii* " is close to *A. bimaculata*. The "*Psylla* sp." could not be traced but is probably *Megagonoscena viridis*.

Loginova recorded or described several species from Iran namely: *Psyllopsis repens* and *P. securicola* (Loginova, 1963); *Colposcenia aliena* (Loginova, 1972b); *Psylla glycyrrhizae* (Loginova & Baeva, 1972); *Camarotoscena fulgidipennis* (Loginova, 1975a); *Diaphorina tamaricis*, *D. kopetdaghi*, *D. enormis*, *D. luteola*, *Cyamophila odontopyx*, *Trioza neglecta* (Loginova, 1978a); and *Caillardia accola* (Loginova, 1978b).

In a study on the ecology and control of pear psyllids, Radjabi & Behechti (1975) recorded *Psylla pyricola* Förster and Hodkinson (1984) listed both *P. pyricola* Förster and *P. vasiljevi* Šulc. These records concern *Cacopsylla bidens* (Šulc) (Burckhardt & Hodkinson, 1986; Hodkinson, 1989). Gegechkori (1977) and Naeem & Behdad (1988) recorded *Cyamophila astragalicola* (Gegechkori) and *C. dicora* Loginova, both on *Astragalus*. *C. dicora* sensu Naeem & Behdad is identical with *C. astragalicola* but differs from *C. dicora* sensu Loginova in the forewing coloration. Further investigations will decide whether *C. dicora* sensu Loginova is conspecific with *C. astragalicola*. The larvae of *C. astragalicola* secrete a manna-like substance which is collected for preparing candy (Naeem & Behdad, 1988). Hodkinson (1981) described *Trioza trigonica* and Halperin *et al.* (1982) recorded *E. straminea* Loginova from Iran. *Trioza chenopodii* Reuter and *T. dichroa* Scott were listed by Burckhardt (1986b). Another 9 species were added by Gegechkori & Loginova (1990): *Agonoscena pegani, Caillardia robusta, Colposcenia kiritshenkoi, Eremopsylloides amirabilis, Diaphorina propinqua, Euphyllura phillyreae*, a record which is questionable, *Cyamophila coluteae, Cyamophila erenita*, and *Bactericera perrisii*. Finally, Baeva & Alekseev (1991) described *Brachystetha loginovae* from Soviet and Iranian localities.

MATERIAL AND METHODS

The material comes from two main sources. First, a large mainly unrecorded collection by G. Remaudière which is preserved in the MNHN, USNM, and MHNG. Host information and the presence of larvae make this collection particularly valuable and this material is signified with the letter "R" followed by a collecting number referring to a locality list. Material, unless otherwise stated, is preserved in the MNHN.

The second material was that collected on three expeditions (1970-1977) by the National Museum, Prague. Detailed itineraries, with descriptions of the localities and biotopes, are provided by HOBERLANDT (1974, 1981, 1983). Collection numbers are cited following the museum acronym "NMP". This material was, partly, studied by Loginova.

Morphological terminology follows mainly HODKINSON & WHITE (1979) and WHITE & HODKINSON (1982). Measurements were made from slide mounted material and are in mm. The following abbreviations are used in the descriptions:

Adult:

HW	head width
AL	antenna length (including scape and pedicel)
WL	forewing length
MP	male proctiger length
FP	female proctiger length
PL	male paramere length
AEL	length of distal segment of aedeagus
ALHW	antenna length : head width ratio
FAS	relative length of flagellar segments of antennae from base to apex
LLHW	length of apical two labial segments : head width ratio
TLHW	metatibia length : head width ratio
WLHW	forewing length : head width ratio
WLW	forewing length : width ratio
MPHW	male proctiger length : head width ratio
FPHW	female proctiger length : head width ratio
FPC	female proctiger length : circumanal ring length ratio
FSP	female proctiger length : subgenital plate length ratio

Fifth instar larva:

AL	antenna length (including scape and pedicel)
WL	forewing pad length
BL	body length
CPB	caudal plate breadth
AWL	antenna length : forewing pad length ratio
BBL	body length : breadth ratio
CPR	caudal plate breadth : length ratio

Owing to different ways of transliterating the Farsi to the Latin alphabet, variation is encountered in the nomenclature of locality names from literature records and locality labels. The spelling of places from the literature is cited unchanged. Names for the Prague expeditions material are as on the locality labels. For additional information, including coordinates and descriptions of biotopes, HOBERLANDT (1974, 1981, 1983) should be consulted. The remaining names are cited according to the Gazetteer of official standard names (ANONYMOUS, 1956) and, where judged useful, map coordinates are added.

Material was examined or is cited from the following collections:

BMNH = Natural History Museum, London
MHNG = Muséum d'histoire naturelle, Geneva
MMB = Moravian Museum, Brno
MNHN = Muséum National d'Histoire Naturelle, Paris
NMP = National Museum, Prague
R = Collection G. Remaudière, in MNHN
USNM = United States National Museum (psyllid collection in USDA, Beltsville, MD.)
ZI = Zoological Institute, St. Petersburg [Leningrad]

SYSTEMATIC LIST

The classification and sequence of the families and subfamilies adopted here is that proposed by WHITE & HODKINSON (1985) with the family concept of BURCKHARDT (1987). Within families and subfamilies the sequence of genera and species is alphabetical.

KEY TO FAMILIES

1 Antennal flagellar segments flattened bearing long conspicuous bristles (figs 88, 89). Male proctiger distinctly 2-segmented (fig. 92). . . Homotomidae
\- Antennal flagellar segments more or less cylindrical, without dense conspicuous bristles (figs 12, 34, 63). Male proctiger 1-segmented, sometimes indistinctly subdivided. 2
2 Forewings with vein $R+M+Cu_1$ bifurcating into R and $M+Cu_1$; if trifurcating then anal break close to apex of vein Cu_{1b} and metabasitarsus with 1 or 2 black spurs. Costal break and/or pterostigma often developed. . . . . Psyllidae
\- Forewings with vein $R+M+Cu_1$ trifurcating into R, M and Cu_1 or bifurcating into R+M and Cu_1, or R and $M+Cu_1$; anal break distant from apex of vein Cu_{1b}; costal break and pterostigma always absent. Metabasitarsus without black spurs. . . . . Triozidae

PSYLLIDAE

KEY TO SUBFAMILIES

1 Metacoxae without meracanthus; cavity of trochanter with weakly sclerotised tubercle. . . . . Rhinocolinae

- Metacoxae with horn-shaped meracanthus; cavity of trochanter without tubercle. 2

2 Head with large anterior flattened lobes enclosing median ocellus which is, therefore, visible only in dorsal view, or vertex longer than broad. . . . . Liviinae

- Head different, either regularly rounded anteriorly, or with separated lobes or cones. Median ocellus visible in frontal and/or ventral view; vertex always broader than long. 3

3 Head with genal cones; apical metatibial spurs forming a crown. . . . . Diaphorininae

- Either head without genal cones or apical metatibial spurs grouped. 4

4 Basal metatibial spine absent. Head without conical genal processes; vertex often rectangular and sometimes ending in anterior lobes. Apical metatibial spurs often forming more or less even crown. 5

- Basal metatibial spine usually developed. Apical metatibial spurs always grouped. Vertex trapezoidal; head with genal cones. 7

5 Metabasitarsus without black spurs. . . . . Paurocephalinae

- Metabasitarsus with two black spurs. 6

6 Posterior margin of male proctiger straight or weakly produced but without wing-like processes. Metatibiae short, less than twice as long as both metatarsal segments together. . . . . Pachypsylloidinae

- Posterior margin of male proctiger bearing wing-like processes. Metatibiae long, more than twice as long as metatarsal segments together. . . . . Aphalarinae

7 Metabasitarsus without or with a single black spur, or with two black spurs and then male parameres lamellar with truncate apex, and forewings with long cell m_{1+2} and high cell cu_{1a}. . . . . Arytaininae

- Metabasitarsus always with two black spurs. Male parameres different (fig. 72). Forewings usually with shorter and lower m_{1+2} and cu_{1a} cells. . . . . Psyllinae

APHALARINAE

KEY TO GENERA AND SPECIES

1 Vertex at most half as long as wide, passing smoothly, without distinct transition, into genae. 2

- Vertex more than half as long as wide, anterior margin forming angular or rounded lobes, or humps. 3

2 Pterostigma of forewing relatively long and broad; sometimes a crossvein rm developed. Thorax in profile stongly arched. On *Haloxylon* spp. and *Hammada* spp. . . . . *Caillardia* Bergevin
(for identification of species cf. LOGINOVA, 1978b)

\- Pterostigma of forewings absent. Thorax in profile weakly arched. On *Petrosimonia* spp., *Salicornia* spp., *Salsola* spp. and *Suaeda* spp. .... *Rhodochlanis bicolor* (Scott)

3 Propleurites divided by diagonal suture into unequal components.......... 4

\- Propleurites divided by longitudinal suture into subequal components..... 12

4 Head with two flattened, rounded anterior lobes. Apex of vein Rs of forewings bent towards fore margin.................. *Colposcenia* 5

\- Head rounded anteriorly, vertex passing smoothy into genae. Vein Rs of forewings more or less straight, ending at outer wing margin. .... *Crastina* 11

5 Apices of veins in forewings along outer margin bearing each a dark conspicuous spot.. 6

\- Apices of veins in forewings along outer wing margin light............... 7

6 Posterior lobe of male proctiger relatively narrow at base, widening towards apex. Dorsal margin of female proctiger irregularly concave. On *Tamarix* spp............................ *Colposcenia aliena* (Löw)

\- Posterior lobe of male proctiger wide at base and tapering towards apex. Dorsal margin of female proctiger sinuous. On *Tamarix* spp. .... *Colposcenia vicina* Loginova

7 Branches of vein M of forewings more or less straight. Posterior process of male proctiger short and wide. On *Tamarix* spp. .... *Colposcenia kiritshenkoi* Loginova

\- Branches of vein M of forewings distinctly curved. Posterior processes of male proctiger long and narrow.................................. 8

8 Anterior tubercle of metacoxae large (figs 8, 9, 30). Terminalia as in figs 39, 42, 43, 50........................... *Colposcenia agnata* sp. n.

\- Anterior tubercle on metacoxae small (figs 31, 32). Terminalia different.... 9

9 Forewing surface flat in apical third; wing relatively long and narrow, with subparallel margins. On *Tamarix* sp.... *Colposcenia elegans* (Bergevin)

\- Forewing surface convexly inflated in apical third (fig. 7); wing relatively short and broad, distinctly widening towards apex (figs 28, 29)...... 10

10 Male parameres short, clavate (fig. 51). Forewing pattern strongly constrasted (fig. 28)......................... *Colposcenia cavillosa* sp. n.

\- Male parameres long, lamellar (figs 52, 53). Forewing pattern relatively homogenous (fig. 29)......................... *Colposcenia paula* sp. n.

11 Forewings oblong-oval, with very narrow pterostigma. General body colour orange. On *Myricaria bracteata*. .... *Crastina myricariae* Loginova

\- Forewings trapezoidal, with well-developed pterostigma. General body colour green. On *Tamarix* spp............... *Crastina tamaricina* Loginova

12 Clypeus flat; not visible in profile, hidden by the genae. On *Zygophyllum* spp. and *Halimiphyllum* sp..... *Brachystetha loginovae* Baeva & Alexeev

\- Clypeus, in profile, distinctly protruding from genae................... 13

13 Lower head surface, between eyes and antennal insertions with conspicuous tubercle.................................... *Aphalara* 14

\- Tubercles absent from lower head surface between eyes and antennal insertions. .... *Craspedolepta* 15

14 Clypeus short, pyriform. Forewings less than 2.2 times as long as wide. .... *Aphalara loginovae* sp. n.

\- Clypeus long, tubular. Forewings more than 2.3 times as long as wide. On *Polygonum* spp. .... *Aphalara polygoni* Förster

15 Forewings with pattern consisting of small brown dots. 16

\- Dark forewing pattern absent or consisting of streaks or bands. 18

16 Membrane of forewings without setae. On *Artemisia baldschuanica*. .... *Craspedolepta tadshikistanica* Baeva

\- Membrane of forewings with at least some setae. 17

17 Setae on forewing membrane sparse, shorter than 0.03 mm. On *Artemisia* spp. .... *Craspedolepta convexa* Baeva

\- Setae on forewing membrane dense, longer than 0.10 mm. Possibly on *Artemisia cina*. .... *Craspedolepta remaudierei* sp. n.

18 Antennae 9-segmented. On *Achillea* spp. .... *Craspedolepta pontica* Dobreanu & Manolache

\- Antennae 10-segmented. On *Achillea* spp. .... *Craspedolepta bulgarica* Klimaszewski

Aphalara loginovae sp. n. (Figs 10-16)

Description. Adult. Coloration. Dirty yellow; foveal pits, two spots on mesopraescutum and four longitudinal stripes on mesoscutum orange to brown. Antennae with segments 1 and 2 brown, 3-8 yellow, and 9 and 10 dark brown. Lower head surface brown to dark brown. Thorax laterally and abdominal sclerites dark brown. Forewings whitish with semitransparent membrane bearing a dark brown, well-defined pattern consisting of isolated spots and a transverse band near the outer margin (fig. 10); hindwings whitish.

Structure. Head (fig. 11), from above, slightly wider than pronotum, about as wide as mesoscutum; vertex flat with indented foveal pits, its anterior margin with large tubercle in the middle of each half and a small antero-lateral tubercle on either side. Lower head surface with small lateral tubercles and short, pyriform clypeus. Antennae 10-segmented with a single rhinarium on each of segments 4 to 9; both terminal setae longer than segment 10. Forewings (fig. 10) oval, cell cu_{1a} low, vein Cu_{1a} evenly curved. Surface spinules present in all cells, larger basally than apically, arranged in an irregular hexagonal pattern, covering the whole membrane up to the veins. Terminalia as in figs 13-16. Parameres with large, thumb-like subapical inner process. Distal portion of aedeagus with distal portion widened towards apex. Female terminalia relatively short, dorsal margin of proctiger sinuous.

Measurements. (1♂, 2♀♀). HW 0.73-0.77; AL 0.77-0.78; WL 2.37-2.62; MP 0.21; PL 0.24; AEL 0.21; FP 0.49-0.50; ALHW 1.00-1.03; LLHW 0.24-0.40; TLHW 0.64-0.72; WLHW 3.25-3.50; WLW 2.01-2.12; MPHW 0.28; FPHW 0.63-0.67; FPC 2.43-2.74; FSP 1.23-1.29; FAS 1.0 : 0.4 : 0.5 : 0.4 : 0.4 : 0.4 : 0.4 : 0.4.

Larva unknown.

Holotype ♂, N Iran: Tehran - Evin, Elborz, 1700-2000 m, 9-10.iii.1973 (NMP-123).

Paratypes. Iran: 2♂♂, 6♀♀, same data as holotype (NMP, MHNG)

Comment. *Aphalara loginovae* is similar to *A. grandicula* (GEGECHKORI, 1981) in the short, adpressed clypeus, the relatively wide, semitransparent forewings, the arrangement of the surface spinules, and body dimensions, characters which separate them from other Palaearctic congeners. *A. loginovae* differs from *A. grandicula* as follows: 1. the clypeus is slightly less adpressed in *A. loginovae*; 2. *A. loginovae* has apically more rounded forewings with evenly rounded vein Cu_{1a} which, in *A. grandicula*, are apically more truncate with vein Cu_{1a} irregularly curved (fig. 17); 3. the inner subapical process of the parameres is relatively slender and straight in *A. grandicula* (fig. 18) and broad and weakly curved in *A. loginovae*; 4. the apical dilation of the distal segment of aedeagus is more slender in *A. grandicula* (fig. 19) than in *A. loginovae*; 5. the female terminalia of *A. grandicula* (fig. 20) are much longer than those of *A. loginovae* (fig. 16).

Aphalara polygoni Förster

Material examined. N Iran: 37♂♂, 37♀♀, 10 km S Behshahr, 480 m, 23-24.vi.1977 (NMP-380).

Brachystetha loginovae Baeva & Alekseev (Figs 21-26)

Description. Adult. Coloration. Yellow with indistinct ochreous dorsal patches on thorax. Antennae with apices of segments 4 and 6, and entire segments 8-10 brown to dark brown. Ventral surface of head and thorax, and abdominal tergites light brown in male, yellow to ochreous in female. Female proctiger with light brown patches. Forewings whitish with pattern composed in males of brown maculae as in fig. 21, and in females of light brown weak maculae and mat, dark yellowish bands.

Structure. Similar to *B. zygophylli* Loginova in the shape of the forewings (fig. 21), with a relatively short and high cell cu_{1a}, and a relatively short vertex with short anterior lobes (fig. 22). Terminalia as in figs 23-26. Ventral margin of male subgenital plate weakly curved; parameres with weakly expanded, apical dilatation. Female proctiger with concave dorsal margin, subgenital plate angular ventrally.

Measurements. (1♂, 1♀). HW 0.61-0.63; AL 0.80-0.82; WL 1.86-2.05; MP 0.22; PL 0.23; AEL 0.18; FP 0.55; ALHW 1.29-1.32; LLHW 0.24-0.25; TLHW 0.75-0.78; WLHW 3.05-3.24; WLW 2.09-2.16; MPHW 0.36; FPHW 0.87; FPC 2.98; FSP 1.06; FAS 1.0 : 0.6 : 0.6 : 0.6 : 0.5 : 0.5 : 0.4 : 0.3.

Recorded from Iran: 30-45 km NNE Bazman (BAEVA & ALEKSEEV, 1991).

Material examined. SE Iran: 1♂, 1♀, 30-45 km NNE Bazman, 14.iv.1973 (NMP-163); 1♀, 12 km SSE Bazman, 13.iv.1977 (NMP-160).

Comment. In some specimens the forewings (fig. 21) are narrower and vein Rs less curved than in the original description (BAEVA & ALEKSEEV, 1991). These differences probably reflect individual variation.

Caillardia accola Loginova

Recorded from Iran: E Kerman, source of Hun-i-Kaka, SW Temina (LOGINOVA, 1978b; GEGECHKORI & LOGINOVA, 1990).

Material examined. E Iran: 3♀♀, 25 km NNW Shusf, 6.vi.1977 (NMP-359).

Comment. In the absence of males the material is only provisionally referred to *C. accola*.

Caillardia azurea Loginova

Material examined. Iran: 3♀, Abadeh, Varamin, 20.v.1986, *Haloxylon* (Abai) (BMNH); 1♂, 2♀♀, 143 km SE Tehran, 20.v.1986, *Haloxylon* (Abai) (BMNH).

Caillardia dilatata Loginova

Recorded from Iran: SE Iran, 12 km SSE Bazman; Iranshar (LOGINOVA, 1978a).

Material examined. Iran: E Iran, 1♀. 8.45 km E Hadjiabad, 9.v.1973 (NMP-193).

Caillardia inedita Loginova

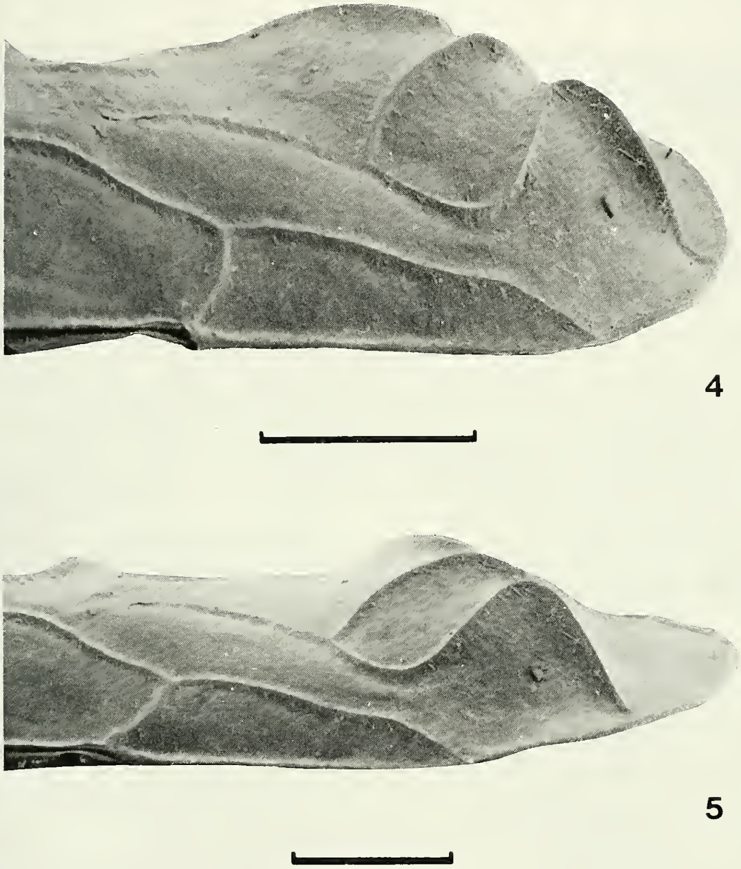
Material examined. Iran: 9♂♂, 8♀♀, 7 larvae. 143 km SE Tehran, 20.v.1986, *Haloxylon* (Abai) (BMNH).

Caillardia robusta Loginova

Recorded from Iran (ZI) (GEGECHKORI & LOGINOVA, 1990).

Colposcenia agnata sp. n. (Figs 4-6, 8, 9, 27, 30, 33, 34, 39, 42, 43, 50)

Description. Adult. Coloration. Light green with whitish and ochreous spots on vertex and pronotum. Antennae green with dark apices on segments 3-8, and ochreous to brown segments 9 and 10. Mesoscutum green with four large longitudinal ochreous stripes. Legs green with yellow dots. Forewings semitransparent basally,



Figs 4, 5

Apex of forewing of *Colposcenia agnata* (scale bar 300 μm).

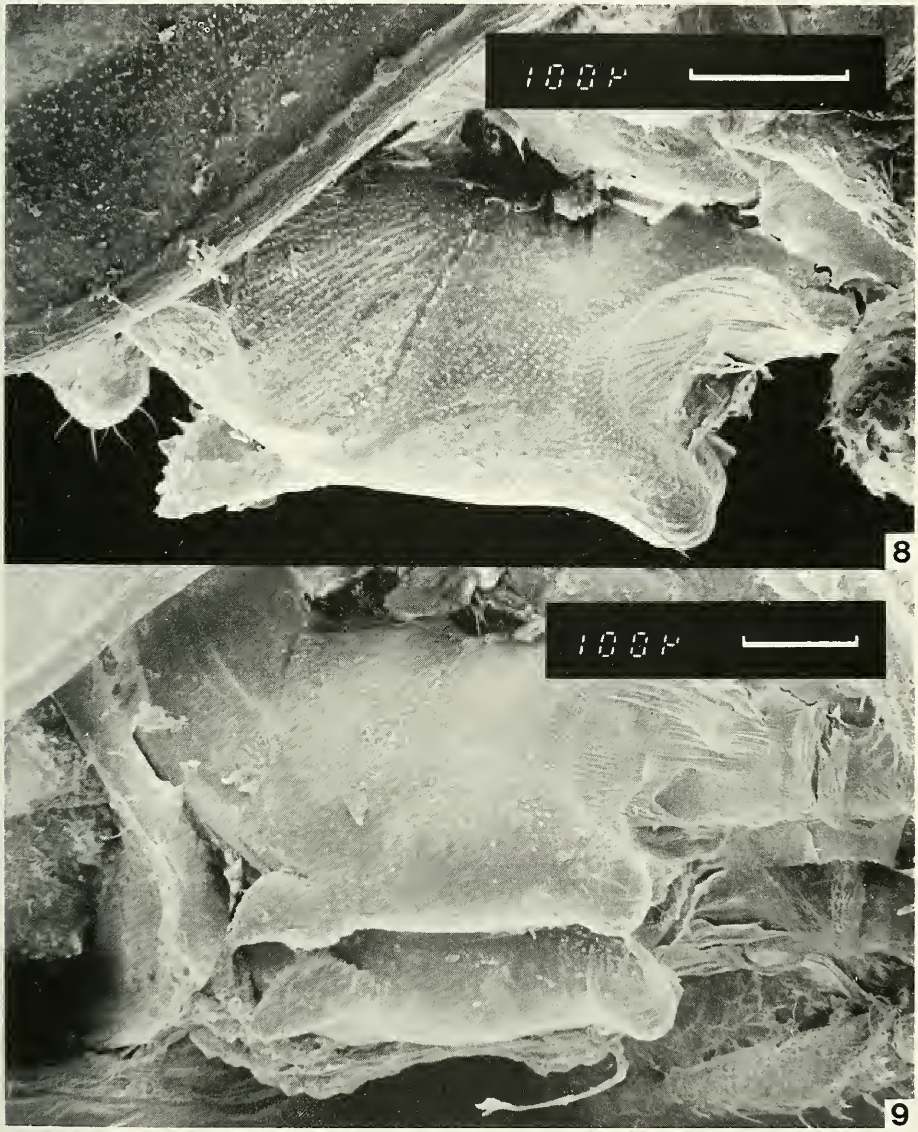
otherwise whitish with greenish, ochreous or light brown pattern and scattered dark dots, apices of veins without dark spots (fig. 27); females often with dark brown patch composed of more or less confluent dots stretching between the apical half of veins Rs and M_{3+4}.

Structure. Head (fig. 33) with flattened vertex bearing indistinctly angular anterior lobes; antero-lateral part of genae between eye margin and antennal insertion forming a relatively large tubercle; surface sculpture consisting of indistinct transverse folds. Antennal segment 10 longer than wide (fig. 34). Forewings (fig. 27) relatively long, widened towards the apex, surface strongly bulged between apical quarter of vein Rs and the middle of vein M_{3+4} (figs 4-6, 27); pterostigma relatively short and massive, vein Rs strongly sinuate, branches of vein M strongly diverging apically, vein Cu_1 relatively straight. Surface spinules small, dense and irregularly spaced, covering all cells up to the veins except for a narrow band in cell c+sc along

FIGS 6, 7

Colposcenia spp., dorsal view; 6. *C. agnata*; 7. *C. cavillosa*.

veins R+M+Cu_1 and R. Metacoxae with large anterior tubercle (figs 8, 9, 30). Terminalia as in figs 39, 42, 43, 50. Processes of male proctiger longer than subgenital plate, slightly widened apically; subgenital plate with distinct posterior tubercle, sparsely setose. Parameres with subapical anterior process, obliquely



Figs 8, 9

Metacoxae of *Colposcenia agnata*.

truncate apically. Distal portion of aedeagus with small apical dilatation. Dorsal margin of female proctiger evenly concave, shortly setose.

Measurements. (2♂♂, 2♀♀). HW 0.69-0.79; AL 0.76-0.80; WL 2.02-2.60; MP 0.23-0.24; PL 0.24-0.26; AEL 0.26-0.27; FP 0.81-0.82; ALHW 0.96-1.09; LLHW 0.28-0.34; TLHW 0.77-0.82; WLHW 2.88-3.28; WLW 2.57-2.74; MPHW 0.31-0.32; FPHW 1.03-1.04; FPC 3.63-3.70; FSP 1.14-1.17; FAS 1.0 : 0.7 : 0.6 : 0.6 : 0.6 : 0.7 : 0.4 : 0.3.

Larva unknown.

Holotype ♂, SE Iran: 13 km SSE Nikshar, river, 8-9.iv.1973 (NMP-152).

Paratypes. Iran: 3♂♂, 9♀♀, same data as holotype; 2 adults, same data but (ZI); 3♂♂, 1♀, S Iran, 7 km W Kahkom, 27-28.v.1973 (NMP-215); 1 adult, same data but (ZI); 1♂, 6♀♀, SE Iran, Bahu-Kalat, 3-4.iv.1973 (NMP-147); 1♀, S Iran, Irin, 28.iv-6.v.1977 (NMP-320); 27 adults, 140 km S Sirjan [=Sa'idabad], 29°28'N 55°42'E, 26.x.1977 (Sugonaev & Kozlov) (ZI).

Comments. Based on the absence of dark spots at the apices of the forewing veins and the presence of long posterior lobes on the male proctiger, *C. agnata*, *C. cavillosa* sp. n. and *C. paula* sp. n. belong to species group II of LOGINOVA (1974). This includes the West Palaearctic *Colposcenia elegans* (Bergevin), *C. rubricata* Loginova and *C. faceta* Loginova, and the Indian *C. constricta* Mathur. The three new species share the strongly diverging apical branches of vein M with *Colposcenia elegans* (Bergevin), to which they may be closely related. *C. agnata* is characterised by the subapically strongly bulged forewings, the posterior tubercle on the male subgenital plate, the shape of the posterior processes of the male proctiger and the parameres, and the relatively large anterior tubercle on the metacoxae.

Colposcenia aliena (Löw)

Recorded from Iran by LOGINOVA (1972a) and GEGECHKORI & LOGINOVA (1990).

Material examined. Iran: 1 adult, Jarjarud, probably N Tehran, 7.v.1937 (Jenjeurist) (ZI); 42 adults, Tehran to Evin, 17.v.1974, *Tamarix* (Safavi) (ZI).

Colposcenia cavillosa sp. n. (Figs 7, 28, 31, 34, 35, 40, 44, 45, 48, 51)

Description. Adult. Coloration. Pale yellow with two spots on mesopraescutum and four longitudinal stripes on mesoscutum which are darker yellow, in mature specimens also brown spots on pronotum. Apices of antennal segments 3-8 brown, segments 9 and 10 dark brown. Abdominal tergites and parts of terminalia brown. Forewings in basal quarter semitransparent, whitish, otherwise with brown pattern consisting of small dots as in fig. 28; apices of veins without dark spots. Younger specimens without brown patches on thorax and abdomen.

Structure. Head (fig. 35) with flattened vertex, anterior lobes evenly rounded; tubercle between eye and antennal insertion long, slender; surface sculpture present, relatively indistinct. Antennal segment 10 much broader than long (fig. 36). Forewings (figs 7, 28) short and broad, surface weakly inflated between apical fifth of vein Rs and middle of vein M_{3+4}, pterostigma short, vein Rs strongly sinuous, branches of M strongly diverging apically, vein Cu_{1a} weakly curved. Surface spinules irregularly and densely spaced, covering all cells up to veins, except for narrow stripe in cell c+sc and along veins $R+M+Cu_1$ and R. Metacoxae with small anterior tubercle (fig. 31). Terminalia as in figs 40, 44, 45, 48, 51. Processes of male proctiger longer than subgenital plate, with transversely rugose microsculpture on the inner surface subapically (fig. 48). Subgenital plate weakly produced posteriorly. Parameres strongly dilated apically, with each an anterior and posterior tooth on the inner surface. Distal portion of aedeagus with relatively large apical dilatation. Dorsal margin of female proctiger irregularly concave, shortly setose.

Measurements. (3♂♂, 3♀♀). HW 0.67-0.78; AL 0.61-0.66; WL 1.56-2.02; MP 0.17-0.19; PL 0.17-0.18; AEL 0.18-0.20; FP 0.69-0.70; ALHW 0.84-0.94; LLHW 0.30-0.36; TLHW 0.64-0.72; WLHW 2.30-2.59; WLW 2.14-2.54; MPHW 0.25-0.29; FPHW 0.90; FPC 2.83-3.44; FSP 1.16-1.17; FAS 1.0 : 0.7 : 0.6 : 0.6 : 0.5 : 0.6 : 0.4 : 0.2.

Larva unknown.

Holotype ♂, S Iran: 57 km S Minab, 22.v.1973 (NMP-206).

Paratypes. Iran: 82♂♂, 45♀♀, same data as holotype; 10 adults, same data but (ZI); 1♂, S Iran, Hassan Langi, 24-25.v.1973 (NMP-211).

Comment. See comments under *C. agnata*. *C. cavillosa* is characterised by the subapically inflated forewings, the relatively broad forewings with characteristic venation, and the structure of the terminalia.

Colposcenia elegans (Bergevin)

Material examined. SE Iran: 2♂♂, Tis, 6-7.iv.1973 (NMP-150).

Colposcenia kiritshenkoi Loginova

Recorded from Iran (ZI) (Gegechkori & Loginova, 1990).

Material examined. SW Iran: 3♂♂, 2♀♀, Shushtar, 13.iv.1977 (NMP-287).

Colposcenia paula sp. n. (Figs 29, 32, 37, 38, 41, 46, 47, 49, 52, 53)

Description. Adult. Coloration. Light green with whitish spots on vertex and whitish, narrow longitudinal stripes on thoracic dorsum. Antennae ochreous, with apices of segments 3-8 brown, and entire segments 9 and 10 dark brown. Forewings semitransparent, with indistinctly delimited green spot in cells along outer margin, and scattered brown maculae as in fig. 29.

Structure. Head (fig. 37) with flattened vertex, anterior lobes weakly rounded; tubercle between eye and antennal insertion small, flattened; surface sculpture present, better developed marginally than on disc. Antennal segment 10 much wider than long (fig. 38). Forewings (fig. 29) relatively evenly rounded apically, weakly inflated between apical fifth of vein Rs and middle of vein M_{3+4}, pterostigma short, vein Rs strongly sinuous, branches of M strongly diverging apically, vein Cu_{1a} distinctly curved. Surface spinules irregularly, densely spaced, covering all cells up to veins except for narrow stripe in cell c+sc along vein $R+M+Cu_1$ and R. Metacoxae with very small anterior tubercle (fig. 32). Terminalia as in figs 41, 46, 47, 49, 52, 53. Processes of male proctiger longer than subgenital plate, with oval, well-defined region apically on the inner surface, which bears a transversely rugose microsculpture (fig. 49). Subgenital plate not produced posteriorly. Parameres lamellar, weakly widened apically with a large antero-apical tooth, and a subapical sclerotised ridge on the inner surface. Distal portion of aedeagus with relatively large apical dilatation. Dorsal margin of female proctiger evenly concave, covered in long setae.

Measurements. (1♂, 2♀♀). HW 0.56-0.69; AL 0.51-0.62; WL 1.38-1.88; MP 0.19; PL 0.22; AEL 0.21; FP 0.55-0.64; ALHW 0.86-1.01; LLHW 0.27-0.33; TLHW 0.67-0.68; WLHW 2.48-2.73; WLW 2.27-2.57; MPHW 0.34; FPHW 0.91-0.93; FPC 2.58-3.18; FSP 1.19-1.21; FAS 1.0 : 0.4 : 0.4 : 0.4 : 0.3 : 0.4 : 0.2 : 0.1.

Larva unknown.

Holotype ♂, S Iran: Bilai, 23-24.v.1973 (NMP-209).

Paratypes. Iran: 1♂, 9♀♀, same data as holotype; 2 adults, same data but (ZI); 1♀, SE Iran, Bahu-Kalat, 3-4.iv.1973 (NMP-147).

Material not included in type series. Iran: 1 damaged adult, same data as holotype.

Comment. See comment under *C. agnata*. Apart from the subapically bulged forewings, *C. paula* is characterised by the shape of the terminalia, particularly of the male, and the forewing venation.

Colposcenia vicina Loginova

Material examined. NE Iran: 2♂♂, 1♀, Hessar, 50 km ESE Nishabur, 12-13.vi.1977 (NMP-364).

Colposcenia sp. A

Material examined. SE Iran: 1♀, Ghasemabad, 10 km Bampur Valley, W Iranshar, 11-12.iv.1973 (NMP-157).

Comment. The single female may represent a new species but male material is required for confirmation.

Craspedolepta bulgarica Klimaszewski

Material examined. N Iran: 7♂♂, 16♀♀, 4 larvae, 20 km E Tehran, 2.v.1966. *Achillea albicaulis* (R-218).

Craspedolepta convexa Baeva

Material examined. Iran: 1♀, Pol-e Veresk, Istgah-e, 35°55'N 52°56'E, 1300 m, 2.vi.1966, *Artemisia chamaemelifolia* (R-227); 2♂♂, 2♀♀, E Iran, Taftan, Tamandan, 2200 m, 18.iv.1973 (NMP-168); 1♀, same but 17-18.iv.1973, 2100 m, (NMP-167); Central Iran, 3♀♀, Qanat Marvan, 22-24.v.1977, 2850 m (NMP-346).

Comment. *Craspedolepta convexa* Baeva and *C. armazhi* Gegechkori share similar wing and genital characters but differ, according to the original descriptions (BAEVA, 1970; GEGECHKORI, 1973), in the narrower forewings and shorter apical process of the female proctiger in *C. convexa*. Differences in the male terminalia given in the original descriptions are more difficult to interpret and require examination of type material. Some specimens of *C. armazhi* examined have possible type status (ZI) but types of *C. convexa* were not available. The material here attributed to *C. convexa* on the basis of the narrow forewings and the relatively short female proctiger, is variable in the extent of the dark forewing pattern, and the size and arrangement of surface spinules.

Craspedolepta pontica Dobreanu & Manolache

Material examined. N Iran: 1♀, Kandavan Pass, 2700-2900 m, S slope, 4- 9.vii.1977 (NMP-395).

Craspedolepta remaudierei sp. n. (Figs 54, 56-59)

Description. Adult. Coloration. Green with indistinct yellow spots on vertex, pronotum yellowish, mesoscutum with indistinct yellow longitudinal bands, abdomen light greenish yellow. Antennae green with dark apices of segments 3-10. Forewings transparent with small brown maculae scattered over most of the wing, with transverse light brown band along outer wing margin and dark brown spot at the base of vein M (fig. 54). Setae on head, body and wings white.

Structure. Dorsal surface of head and thorax, and forewings covered in long conspicuous setae. Forewings (fig. 54) subtrapezoidal, surface spinules present in all cells, irregularly spaced, much denser apically than basally. Terminalia as in figs 56-59. Male parameres broad, weakly curved; inner surface with subapical anterior process and oblique row of tubercles. Female terminalia cuneate.

Measurements. (1♂). HW 0.61; AL 0.55; WL 1.81; MP 0.22; PL 0.24; AEL 0.24; ALHW 0.91; LLHW 0.39; TLHW 0.58; WLHW 2.79; WLW 2.39; MPHW 0.36.

Larva unknown.

Holotype ♂, Central Iran: Kuh-e-Lalehzar, S Kerman, 2800 m, 24-30.v.1977 (NMP-347).

Paratypes. Iran: 1♂, 1♀, Kuh-e-Lalehzar, S Kerman, 26.vi.1955, *Artemisia cina* (R-35) (USNM).

Comments. *C. remaudierei* resembles *C. setosa* (Wagner) in the long setae on the dorsal body surface and forewings but differs in the wing shape and coloration, and the shape of the male and female terminalia.

Craspedolepta tadshikistanica Baeva

Material examined. Central Iran: 18♂♂, 26♀♀, Kuh-e-Lalehzar, S Kerman, 2800 m, 24-30.v.1977 (NMP-347).

Craspedolepta sp. A (Figs 55, 60)

Description. Adult. Coloration. General body coloration yellowish. Forewings semitransparent with brown to dark brown, distinct dots which are confluent along the veins in the apical part of wing (fig. 55).

Structure. Head and body covered in short setae coated in waxy secretions and resembling small scales. A few similar setae also present on forewings, particularly along the veins. Forewings (fig. 55) oblong-oval, without surface spinules. Male unknown. Female terminalia as in fig. 60.

Host plant. *Artemisia herba-alba*.

Material examined. Iran: 2♀♀, 1 larva, S Rafsendjan, 13.ix.1972, *Artemisia herba-alba* (R-250).

Comment. Specimens resemble *C. alevtinae* (Andrianova) in the presence of setae on the body surface and the lack of surface spinules on the forewings but differ in the smaller body size. Without males it is not possible to decide whether this is an undescribed species.

Crastina myricariae Loginova

Material examined. N Iran: numerous ♂♂ and ♀♀, Meygun, N Teheran, 15.xi.1962, *Myricaria germanica* (R-207); 1♂, Meygun, 2000 m, 26.iv.1963 (R-209); 6♂♂, 3♀♀, 6 larvae, Meygun, 2100 m, 15.xi.1962, *Myricaria germanica* (R-213).

Crastina tamaricina Loginova

Material examined. NE Iran: 4♂♂, 12♀♀, Hessar, 50 km ESE Nishabur, 1400 m, 12-13.vi.1977 (NMP-364).

Rhodochlanis bicolor (Scott)

Material examined. Iran: 1♂, Talkh Ab-e Taj od Din [=Talkh Ab-i-Kalat], 32°09'N 49°03'E. 15.v.1966, *Suaeda* (R-221); 1♂. 1♀, 23 miles NE Gonbad-e Kavus, 37°17'N 55°17'E, 50 feet, 5-9.v.1956 (G.B. Vogt-126) (USNM); 2♂♂, 2♀♀, 1 forewing, 12 miles NE Gonbad-e Kavus. 37°17'N 55°17'E. 100 feet, 1-9.v.1956 (G.B. Vogt-159) (USNM); 3♂♂, 2♀♀, Khuzestan, Golestan, Ahwaz, 11.iii.1978, *Suaeda (Schanginia) baccata* (V. F. Eastop) (BMNH); 6♂♂, 3♀♀, same but 15.iii.1978; 3♂♂, 7♀♀, 8 larvae, same but 11-12.iv.1978.

PAUROCEPHALINAE

Camarotoscena Haupt

Comments. A species collected on *Populus nigra* f. *pyramidalis* (RÜBSAAMEN, 1902) and given an Iranian origin by HOUARD (1922) was, judging by Rübsaamen's description and drawings, a *Camarotoscena* sp.

KEY TO SPECIES

1 Forewings transparent without pattern (fig. 61). Male parameres straight in profile, slightly narrowed in the middle; subgenital plate indented posteriorly (figs 64, 65). Female subgenital plate evenly tapered to apex (fig. 67). On *Populus* spp. .... *Camarotoscena unicolor* Loginova

\- Forewings bearing a dark pattern consisting of small dots. Male parameres curved backwards in profile, not visibly narrowed in the middle. Female subgenital plate abruptly narrowed subapically. 2

2 Surface spinules of forewings large, arranged in short chains of 2-3. On *Populus ?pyramidalis*. .... *Camarotoscena fulgidipennis* Loginova

\- Surface spinules of forewings very small, indistinct, irregularly spaced. On *Populus* spp. .... *Camarotoscena hoberlandti* Vondráček

Camarotoscena fulgidipennis Loginova

Recorded from Iran: Zergende (LOGINOVA, 1975a; GEGECHKORI & LOGINOVA, 1990).

Material examined. Iran: 1♂, 1♀, Deh Pagah, 30°08'N 52°05'E, 1950 m, 24.x.1967, *Populus nigra* (R-231); 1♀, same but *Salix* sp. (R-232); 4♂♂, 3♀♀, numerous larvae, Karaj, 35°48'N 50°59'E, 28.x.1967, galls on *Populus* sp. (R-234); 1♂, 1♀, 3 larvae, Gatgesar, 37°41'N 49°03'E, 2250 m, 7.ix.1972, *Populus alba* (R-248); 1♂, Khonsar, 33°12'N 50°18'E, 2700 m, 23.xi.1974, *Astragalus* sp. (R-i3986b) (USNM); 4 larvae, Fars, Ardakan, 32°19'N 53°59'E, 10.x.1955, *Populus* (R-33) (USNM); 1♂, 1♀, Tehran, 8.viii.1978, *Populus* sp., galls (S. H. Hodjat) (BMNH).

Camarotoscena hoberlandti Vondráček

Material examined. N Iran: 2♂♂, Tehran, prov. Karadj, 17.vi.1974, *Populus nigra* (Abai) (MMB); 2♂♂, 1♀, Tehran, 8.viii.1978, *Populus* sp., galls (S. H. Hodjat) (BMNH).

Camarotoscena unicolor Loginova (Figs 61-67)

Description. Adult. Coloration. Dorsal surface of head and body evenly brown, ventral surface ochreous. Antennae yellowish with apical two segments brown. Wings transparent, whitish, veins light ochreous. Younger specimens lighter with less extensive brown colour.

Structure. Head (fig. 62) with fine microsculpture and short setae. Antennae (fig. 63) with subequal terminal setae, both longer than segment 10. Forewings (fig. 61) oblong-oval; surface spinules present in all cells, fine, irregularly spaced, leaving spinule-free stripes along the veins. Veins along nodal line narrower and thinner; costal and anal breaks present. Terminalia as in figs 64-67. Male subgenital plate indented posteriorly. Parameres obliquely truncate with each an anterior and posterior sclerotised tooth apically. Basal portion of aedeagus with transverse folds apically on the inner side.

Measurements. (1♂, 2♀♀). HW 0.59-0.67; AL 0.55-0.62; WL 1.47-1.91; MP 0.21; PL 0.14; AEL 0.18; FP 0.61-0.79; ALHW 0.92-1.03; LLHW 0.24-0.42; TLHW 0.62-0.66; WLHW 2.51-2.83; WLW 2.25-2.59; MPHW 0.35; FPHW 1.03-1.18; FPC 4.25-5.08; FSP 1.45-1.47; FAS 1.0 : 0.3 : 0.3 : 0.3 : 0.3 : 0.4 : 0.2 : 0.1.

Larva unknown.

Material examined. Iran: 1♂, Ahvaz, 31°19'N 48°42'E, 15.v.1977, *Populus diversifolia* (Gharib) (R-306); 4♀♀, same but 10.iv.1978, sweeping (V. F. Eastop) (BMNH); 3♂♂, 3♀♀, same but 11-12.iv.1978, *Populus euphratica*; 1♂, same but 16.iv.1978, *Punica granatum*; 2♂♂, 3♀♀, Khuzestan, Ahvaz, Golestan, 21.iv.1978, *Populus euphratica*, same; 6♂♂, 23♀♀, SW Iran, Shushtar, 13.iv.1977 (NMP-287).

LIVIINAE

KEY TO GENERA AND SPECIES

1 Vertex broader than long. Third antennal segment the longest. On *Olea europaea*. . . . . *Euphyllura straminea* Loginova

\- Vertex longer than broad. Second antennal segment the longest. On *Juncus* spp. . . . . *Livia juncorum* (Latreille)

Euphyllura Förster

Comment. GEGECHKORI & LOGINOVA (1990) mentioned *Euphyllura phillyreae* Förster from Iran referring to LOGINOVA (1972b) which does not list the species! It is thus doubtful whether the species occurs there.

Euphyllura straminea Loginova

Recorded from Iran by HALPERIN *et al.* (1982).

Material examined. Iran: 1♀ (Nuri Mahdi) (BMNH).

Livia juncorum (Latreille)

Recorded from localities in Iraqi Kurdistan by HESLOP-HARRISON (1949) and assumed by him to occur in Iran. LOGINOVA (1962, 1972b) and MATHUR (1975) listed Iran but did not indicate, whether they had seen material.

Material examined. Iran: 1♂, 3♀♀, W Kakan, Kuh-e-Dena, 30°38'N 51°45'E, 2500 m, 25.x.1967, *Scirpus* (R-233); 1♀, N Iran, Rezvandeh, 28.vi.1977 (NMP-389).

RHINOCOLINAE

KEY TO GENERA AND SPECIES

1 Forewings without extensive pattern. Antennae more than 1.5 times head width. On *Pistacia* spp. . . . . *Megagonoscena viridis* (Baeva)

\- Forewings with dark pattern consisting of dark spots and band forming a zig-zag line along outer margin. Antennae less than 1.2 times head width. . 2

2 Forewings without pterostigma. On *Peganum harmala*. . . . . *Agonoscena pegani* Loginova

\- Forewings with well-developed pterostigma. 3

3 Dorsal margin of distal portion of aedeagus with distinct incision in basal third. Dorsal margin of female proctiger convex; circumanal ring, in dorsal view, angular apically. On *Pistacia khinjuk* and *mutica*. . . . . *Agonoscena bimaculata* Mathur

\- Dorsal margin of distal segment of aedeagus concave but without well-defined incision in basal third. Dorsal margin of female proctiger concave; circumanal ring, in dorsal view, oval. On *Pistacia* spp. . . . . *Agonoscena pistaciae* Burckhardt & Lauterer

Agonoscena bimaculata Mathur

Recorded from Iran on *Pistacia khinjuk* as "*Agonoscena* aff. *menozzii*" (DAVATCHI, 1958).

Material examined. Iran: 4♂♂, 4♀♀, 8 larvae, Kerman, Sang Bur, 30°00'N, 56°45'E, v.1955, *Pistacia khinjuk* (Davatchi & Remaudière, R-7) (USNM); many larvae, Kerman, Kuh-e Sorkh, 31°19'N 58°44'E, ix.1955, *Pistacia khinjuk* (R-14, R-191) (MNHN, USNM); 1♂, 1♀, Kerman, 15.viii.1959, *Pistacia mutica* (Taghizadeh & Hambleton #60-3119) (USNM); few adults, many larvae, Deh Bakri, SW Bam, 29°03'N 57°56'E, ix.1955, *Pistacia khinjuk* (R-15, R-190) (MNHN, USNM); 1♀, 4 larvae, Baluchistan, 70 km S Khash, 28°14 61°14'E, vi.1955, *Pistacia khinjuk* (R-19) (USNM).

Comments. Iranian specimens differ from type material from Pakistan: Peshawar in the smaller body size, and the smaller number of marginal lanceolate setae on the wing bud in the larvae. They share however the dark wing pattern, the abruptly thickened distal portion of aedeagus and the apically relatively angular circumanal ring, characters which separate both forms from *A. pistaciae*. More material is required to decide whether they represent clinal variations of the same species.

Agonoscena pegani Loginova

Recorded from Iran (ZI) (Gegechkori & Loginova, 1990).

Material examined. Iran: numerous ♂♂, ♀♀ and larvae, Rafsanjan 30°24'N 56°01'E, 13.ix.1972, *Peganum harmala* (R-249).

Agonoscena pistaciae Burckhardt & Lauterer

Recorded from Iran: Kerman (Rafsanjan, Sirjan), Kazvin, Saveh, Yadz (Kermanshah) and Khorassan (Khaf) as *Agonoscena targionii* (Lichtenstein) (Davatchi, 1958); and as *A. pistaciae* from Rafsanjan and Sadeghabad (Burckhardt & Lauterer, 1989).

Material examined. Iran: several ♂♂ and ♀♀, 1 larva, 12 km from Zahedan, Balutchistan, v.1955, *Pistacia mutica* (R-4, R-178) (MNHN, USNM); numerous ♂♂, ♀♀ and larvae, Rafsanjan, Kerman, vi.1955, *Pistacia vera* (R-3, R-179) (MNHN, USNM); 2♂♂, 2♀♀, E Iran, same, 22.iii.1973 (NMP-131); many ♂♂ and ♀♀, Kerman, 12.vi.1956, *Pistacia vera* (R. Gardenhire) (USNM); numerous larvae, Gazin, 31°33'N 49°23'E, vi.1955, *Pistacia vera* (Chodjai) (R-2, R-181) (MNHN, USNM); numerous adults, same but 17.viii.1955 (R-11, R-187); 3♂♂, 3♀♀, 4 larvae, 40 km Sanandaj, 35°19'N 47°00'E, 14.viii.1955, *Pistacia mutica* (R-13, R-186) (MNHN, USNM); many adults and larvae, road of Shemshak, N Tehran, ix.1955, *Pistacia vera* (R-12. R-192) (MNHN. USNM); 1♀, 1 larva, 20 km N Bam, 36°58'N 57°59'E, 1955, *Pistacia mutica* (Farehbakhch, R-5) (USNM); many ♂♂, ♀♀ and larvae, Sadeqabad, 27.x.1986, *Pistacia* sp. (BMNH).

Megagonoscena viridis (Baeva)

Material examined. Iran: 3♀♀, 1 larva, Kuh-e-Sardar, 1.vi.1958, *Pistacia vera* (R-196); 2♂♂, 7♀♀, 5 larvae, Firuzabad, 34°21'N 51°16'E, 1.v.1959, *Pistacia mutica* (R-198); 1♂, 1 larva, Zarand, 30°48'N 56°35'E, 10.iv.1958, *Pistacia vera* (Taghizadeh) (USNM).

Comments. Davatchi's (1958) records of *Psylla* sp. from Kazvin, Kerman (Rafsanjan) and Teheran (Chahriar) on *Pistacia vera* probably concern *Megagonoscena viridis*.

Diaphorininae

Key to genera and species

1 Antennae shorter than head width. . . . . *Diaphorina* 2
- Antennae more than 1.5 times head width. . . . . *Psyllopsis* 8

2 Genal processes slender, conical, symmetrical, subacute apically, as long as or longer than vertex along mid-line. On *Cordia* spp. .... *Diaphorina aegyptiaca* Puton

\- Genal processes robust, asymmetrical, truncate apically or shorter than vertex along mid-line. 3

3 Genal processes robust, broadly truncate apically. Cell m_{1+2} of forewings broad; distance between the apices of the two M branches only little shorter than the branches. .... *Diaphorina enormis* Loginova

\- Genal processes less robust, rounded or subacute apically. Cell m_{1+2} of forewings elongate; distance of apices of the two M branches much shorter than the branches. 4

4 Forewing pattern consisting of 3 large patches, one forming a long streak from the outer wing margin to the base of cell rs, one a triangular spot at the outer wing margin and one an irregular spot covering mostly cell cu_{1a}. Female subgenital plate with large ventral tubercle. On *Tamarix* sp. .... *Diaphorina tamaricis* Loginova

\- Forewing pattern usually forming a more or less continuous band along the outer wing margin or greatly reduced. Female subgenital plate without ventral tubercle. 5

5 Forewings relatively slender. Female subgenital plate evenly curved ventrally. On *Convolvulus* spp. .... *Diaphorina chobauti* Puton

\- Forewings relatively broad. Female subgenital plate distinctly angular ventrally. 6

6 Forewing pattern dark brown, well-defined, strongly contrasted with white membrane. On *Lycium* spp. .... *Diaphorina lycii* Loginova

\- Forewing pattern lighter, not strongly contrasted with membrane. 7

7 Genal processes about half as long as vertex along mid-line. .... *Diaphorina luteola* Loginova

\- Genal processes longer than half vertex length. On *Zygophyllum* spp. and *Halimiphyllum* spp. .... *Diaphorina zygophylli* Loginova

8 Forewings with dark brown or black pattern or dark brown to black, well-contrasted veins. Usually (except in teneral specimens) black spots on head and/or thorax. 9

\- Forewings yellowish with concolorous veins. Head and thorax without dark pattern. 10

9 Forewings with well-defined dark brown or black pattern. Male parameres forming, in profile, a forward directed triangle. Female proctiger with relatively robust apical process. On *Fraxinus* spp. .... *Psyllopsis fraxini* (Linnaeus)

\- Forewings without distinct dark brown to black pattern. Male parameres, in profile, with anterior lobe and dorsal incision. Female proctiger with slender apical process. On *Fraxinus oxycarpus*. .... *Psyllopsis repens* Loginova

10 Male parameres, in profile, with both a forward and a backwards-directed

lobe. Female proctiger subacute apically. On *Fraxinus* spp.
.... *Psyllopsis machinosus* Loginova

- Male parameres, in profile, only with anterior lobe. Female proctiger truncate apically. On *Fraxinus oxycarpus*. .... *Psyllopsis securicola* Loginova

Diaphorina aegyptiaca Puton

Material examined. Iran: 1♂, 21 km SW Saravan, 29.iii.1973 (NMP-140).

Diaphorina chobauti Puton

Recorded from Iran (ZI) as *D. propinqua* Löw (GEGECHKORI & LOGINOVA, 1990).

Material examined. Iran: 1♀, N Iran, Ahyek, 24.vi.1970 (NMP-30); 1♀, N Iran, Central Elburz, Kahha-ye Tu-Chal, 3600-3900 m, 18-19.vii.1970 (NMP-61); 28♂♂, 21♀♀, N Iran, Wildlife Park Robat-e Quareh Bil, 1000 m, 30.vii.1970 (NMP-78); 1♂, N Iran, Teheran - Evin, Elburz, 1700-2000 m, 9-10.iii.1973 (NMP-123); 2♂♂, 2♀♀, SE Iran, 21 km SW Saráván, 29.iii.1973 (NMP-140); 1♂, 1♀, SE Iran, Zábol, 31.iii.1973 (NMP-142); 1♂, 2♀♀, SE Iran, 40 km Zábol, 31.iii.1983 (NMP-143); 6♀♀, SE Iran, Sekand, 27 km ENE Sarbáz, 31.iii-1.iv.1973 (NMP-144); 3♂♂, 2♀♀, Deh Bakri, SW Bam, 1700-1750 m, 30.iv-1.v.1973 (NMP-186); 30♂♂, 30♀♀, Mian Jangal, 30.v-5.vi.1973 (NMP-223); 1♂, S Iran, Maharlu, 5-6.vi.1973 (NMP-227); 1♂, S Iran, 13 km SSW Yasuj, 1800 m, 12-13.vi.1978 (NMP-239); 1♂, S Iran, Sisakht, Kuh-e-Dena, 2500-3000 m, 13-14.vi.1973 (NMP-241); 1♂, 1♀, S Iran, Komehr, 2000 m, 17.vi.1973 (NMP-246); 34♂♂, 33♀♀, S Iran, 7 km NW Shul, 2100 m, 17.vi.1973 (NMP-247); 5♂♂, 9♀♀, S Iran, 6 km SSE Shul, 2190 m, 17-18.vi.1973 (NMP-248); 1♀, S Iran, 13 km NW Ghaderbad, 2120 m, 21.v.1973 (NMP-253); 1♂, 3♀♀, E Iran, 36 km N Gonabad, 830 m, 7-8.vi.1977 (NMP-316); 1♂, S Iran, Kuh-e Geno Mountains, 400-600 m, 1-4.v.1977 (NMP-321); 8♂♂, 10♀♀, C. Iran, 30 km N Sabzevaran, 1650 m, 17-19.v.1977 (NMP-337); 15♂♂, 10♀♀, C. Iran, Qanat Marvan, 2850 m, 22-24.v.1977 (NMP-345); 25♂♂, 13♀♀, C. Iran, Qanat Marvan, 3000-3100 m, 24.v.1977 (NMP-346); 2♂♂, 2♀♀, C. Iran, Lalehzar, 2800 m, 24-30.v.1977 (NMP-347); 2♂♂, 2♀, NE Iran, 10 km W Sabzevar, 15-16.vi.1977 (NMP-368); 4♂♂, 3♀♀, N Iran, 3 km N Dasht, Golestan forest, 960 m, 18-19.vi.1977 (NMP-375); 3♂♂, 1♀, Golhak, near Tehran, 1700 m, 9-23.vi.1961 (J. Klapperich) (MMP, MHNG); 1 forewing, numerous larvae, Gorogh, E Tehran, 10.x.1955, *Convolvulus* sp. (R-21, R-193) (MNHN, USNM); numerous ♂♂, ♀♀ and larvae, Takht-e-Jamshid, NE Chiraz, 27.iv.1959, *Convolvulus* (R-197); 1♂, Karaj, 1.v.1966, *Artemisia herba-alba* (R-216).

Comments. Adults of *Diaphornia chobauti* Puton, *sensu* BURCKHARDT (1985), vary in the shape and coloration of the forewings and in the shape of the genal processes. Specimens from Gorokh, Takht-e Jamshid, Karadj and Golhak have relatively long genal cones, and forewings with distinct brown pattern and a relatively straight vein C+Sc (as in types of *D. montana* Loginova); specimens from Gonabad and Sabzevar have shorter genal processes and lack a dark, defined forewing pattern (as in types of *D. turanica* Loginova). Iranian larvae differ from North African and Israeli material in the presence of small lanceolate setae on the dorsal surface of head, body and wing pads (BURCKHARDT, 1985). *D. chobauti sensu* BURCKHARDT (1985) may be a complex of closely related species or a single, polymorphic species.

Diaphorina enormis Loginova

Recorded from Iran: S Iran, Makran, Shahva, 12 km NW Minab, 18-19.v.1973 (NMP-202) (Loginova, 1978a).

Material examined. Iran: 1♀, S Iran, 12 km NW Minab, 18-19.1973 (NMP-202).

Diaphorina luteola Loginova

Recorded from Iran: 15 km NE Chah Bahar, 5.iv.1973 (NMP-148); Tis, 6-7.iv.1973 (NMP-150); Iranshahr, 12.iv.1973 (NMP-158) (Loginova, 1978a).

Material examined. Iran: 1♂, 2♀♀, S Iran, Bezan, 15 km NW Furk, 1000-1400 m, 28-29. v.1973 (NMP-218); 4♂♂, 8♀♀, Borozjan, 19.iv.1977 (NMP-299); 1♂, 5♀♀, area around Golshan, 24.iv.1977 (NMP-310); 2♂♂, 6♀♀, Maloo W Bandar Lengeh, 25.iv.1977 (NMP-312); 2♂♂, 5♀♀, Bandar-e-Mahtabi, 26.iv.1977 (NMP-315); 1♂, 6 km W Geno, 400 m, 7-9.v.1977 (NMP-323); 2♀♀, 22 km N Kohnuj, 580 m, 16.v.1977 (NMP-333).

Diaphorina lycii Loginova

Material examined. Iran: 5♀♀, NE Iran, Kuh-e-Binauld, Southern slope, 15 km NE Nishobur, 1600-2300 m, 13-15.vi.1977 (NMP-165); 2♂♂, 1♀, S Iran, 15 km NW Miandangal, 5.vi.1973 (NMP-224); 1♀, S Iran, 15 km SE Taheri, 22-23.iv.1977 (NMP-307); 1♂, 1♀, C. Iran, Qanat Marvan, 2850 m, 22-24.v.1977 (NMP-345); 2♀♀, C. Iran, Qanat Marvan, 3000-3100 m, 24.v.1977 (NMP-346); 1♀, C. Iran, Kuh-e-Lalehzar, Northern slope, 3200-3800 m, 24-30.v.1977 (NMP-348); 1♀, C. Iran, Shahdad, 570 m, 31.v-1.vi.1977 (NMP-353); 8♂♂, 15♀♀, E Iran, 17 km N Nehbandan, 1250 m, 5-6.vi.1977 (NMP-358); 9♂♂, 14♀♀, E Iran, 25 km NNW Shusf, 6.vi.1977 (NMP-359); 5♂♂, 6♀♀, E Iran, 36 km N Gonobad, 830 m, 7-8.vi.1977 (NMP-361); 37♂♂, 59♀♀, C. Iran, Gowk, 31.v.1977 (NMP-362); 1♀, NE Iran, 5 km W Sabzevar, 16.vi.1977 (NMP-369); 1♂, N Iran, 3 km N Dasht Golestan forest, 960 m, 18-19.vi.1977 (NMP-375).

Diaphorina tamaricis Loginova

Recorded from Iran: Sistan, Kolodez Cha-i-Novar, 6-8.viii.1898 (Zarudnyi); N Iran, Tehran-Evin, 1700 m, 13.iii.1973, garden (NMP-124); E Iran, Dowlatabat, 8-9.v.1973 (NMP-192); S Iran, 15 km NW Mian Jangal, 5.vi.1973 (NMP-224) (Loginova, 1978a; Gegechkori & Loginova, 1990).

Material examined. Iran: 1♀, SW Iran, Mollasani, 45 km NW Ahwaz, 13-14.iv.1977 (NMP-288); 1♀, SW Iran, 34 km SE Omidiyen, 16-17.iv.1977 (NMP-292).

Diaphorina zygophylli Loginova

Diaphorina zygophylli Loginova, 1978a: 44. Holotype ♂: C.I.S.: Kirgizia, nr Zhekaftar, foothills of Chatkalskoy Chain, 19.iv.1966 (ZI), examined.

Diaphorina kopetdaghi Loginova, 1978a: 40. Holotype ♂: C.I.S.: Turkmeniya, Kopedag, dam of river Arvaz, 30 km SE Baharden, 18.vi.1972 (Loginova) (ZI), examined. Syn. n.

Diaphorina halimiphylli Loginova, 1978a: 42. Holotype ♂: C.I.S.: Tadzhikistan, Koktau Chain, 800 m, Aktau Mountains, 25 km NW Kurgan-Tyube, 20.vi.1964 (Sugonyaev) (ZI), examined. Syn. n.

Diaphorina media Baeva, 1978: 40. Holotype ♂: C.I.S.: Usbekistan, nr Sairob rd to Gagrisyabe, 20.v.1964 (V. Baeva) (ZI) examined. Syn n.

Recorded from Iran: E Iran, 70 km NW Bam, Khatunabad, 15.iv.1973 (NMP-179) as *D. kopetdaghi* (Loginova, 1978a; Gegechkori & Loginova, 1990).

Material examined. Iran: 1♂, 1♀, Kerman, Sang Bur, 30°00'N 56°45'E, vi.1955, *Zygophyllum eurypterum* (Davatchi & Remaudière, R-8) (USNM); 1♂, 1♀, Kerman, ix.1955, *Salicornia* sp. (R-20) (USNM); 2♂♂, 4♀♀, Shiraz S Yasuj, pass at 2400 m, 21.ix.1974, *Astragalus* sp. (R-i3965) (USNM);

Comments. Examination of the types of *Diaphorina zygophylli* Loginova, *D. halimiphylli* Loginova, *D. kopetdaghi* Loginova and *D. media* Baeva has shown that the four taxa are conspecific and they are synonymised.

Psyllopsis fraxini (Linnaeus)

Recorded from Iran: SE Iran, Kerman, 2000 m, vi.1892 (Rübsaamen, 1902).

Comment. This record needs verification.

Psyllopsis machinosus Loginova

Material examined. Iran: 1♀, Varamin, 15.v.1959, *Fraxinus* sp. (Safavi) (USNM).

Psyllopsis repens Loginova

Recorded from Iran: Kerman, v.1928 (Siyazov) (Loginova, 1963, 1968; Gegechkori & Loginova, 1990).

Material examined. Iran: 1♂, 1♀, Garmsar, 35°20'N 52°13'E, 15.xi.1962, *Fraxinus* (R-208).

Psyllopsis securicola Loginova

Recorded from Iran: Kerman, v.1928 (Siyazov) (Loginova, 1963; Gegechkori & Loginova, 1990).

Material examined. Iran: 1♂. Varamin. 15.v.1959, *Fraxinus* sp. (Safavi) (USNM).

PACHYPSYLLOIDINAE

KEY TO GENERA AND SPECIES

1 Pterostigma of forewings narrower at base than adjacent portion of cell r_1. On *Calligonum* sp. . . . . *Eremopsylloides amirabilis* Loginova

\- Pterostigma of forewings as wide as or wider at base than adjacent portion of cell r_1. On *Calligonum* spp. . . . . *Pachypsylloides errator* Loginova

Eremopsylloides amirabilis Loginova

Recorded from Iran (ZI) (GEGECHKORI & LOGINOVA, 1990).
Material examined. SE Iran: 1♂, 30 km N Bampur, 12-13.iv.1973 (NMP-159).

Pachypsylloides errator Loginova

Material examined. E Iran: 1♀, 25 km NNW Shusf, 6.vi.1977 (NMP-359).

Comment. A single female is provisionally attributed to *P. errator*, a species which strongly resembles *P. reverendus* Loginova.

ARYTAININAE

KEY TO SPECIES

1 Genal cones about as long as vertex along mid-line. Distal segment of aedeagus with large apical hook. 2

\- Genal cones about half to three quarters vertex length along mid-line. Distal segment of aedeagus rounded apically or with small hook (in *C. astragalicola*). 3

2 The shorter of the two terminal setae on antennal segment 10 very short, about as long as wide. On *Colutea* spp. . . *Cyamophila coluteae* (Baeva)

\- The shorter of the two terminal setae on antennal segment 10 distinctly longer than wide at base. On *Halimodendron halodendron*. . . . . *Cyamophila oshanini* (Loginova)

3 Forewings with dark spots along outer margin in the middle of cells m_{1+2}, m_{3+4}, and cu_{1a}, sometimes very faint. Male parameres with strongly developed posterio-apical tooth. Distal segment of aedeagus with weakly curved, apical portion which is little dilated. Dorsal margin of female proctiger almost straight, apex evenly tapered. Vertex flattened. On *Glycyrrhiza* spp. . . . . *Cyamophila glycyrrhizae* (Becker)

- Forewings without dark spots along outer margin in the middle of the cells. Male parameres with weakly developed posterio-apical tooth. Distal segment of aedeagus with small apical hook. Dorsal margin of female proctiger sinuous. Vertex with strongly indented pits or raised anterior tubercles. On *Astragalus* spp. .... *Cyamophila astragalicola* (Gegechkori)

Cyamophila astragalicola (Gegechkori)

Recorded from Iran: Khonsar, 15.viii.1974, *Astragalus* sp. (Safavi); v.1974, *Astragalus* sp. (Lansar) as *Cyamophila astragalicola* (GEGECHKORI, 1977; GEGECHKORI & LOGINOVA, 1990); recorded from Iran as *Cyamophila dicora* Loginova by NAEEM & BEHDAD (1988).

Material examined. Iran: 1♀, S Iran, 13 km SSW Yasuj, 1800 m, 12-13.vi.1973 (NMP-239); 33♂♂, 29♀♀, S Iran, Zagros, Yasuj, 16.vi.1973 (NMP-243); 2♀♀, S Iran, 27 km E Yasuj, 2650 m, 16.vi.1973 (NMP-244); 3♂♂, 6♀♀, S Iran, 7 km NW Shul, 2100 m, 17.vi.1973 (NMP-247); 3 5th instar larvae, Firuzabad, 28°50'N 52°36'E, 2.v.1959, *Astragalus* (R-199); 6♂♂, 6♀♀, E Garmandar, 40 km NE Tehran, 3000 m, on snow, 13.xi.1962 (R-206); 1♂, 20 km W Shiraz, 22.x.1967, *Astragalus* (R-229); 2♂♂, 2♀♀, 4 larvae, Khonsar, 33°12'N 50°18'E, Esfahan, x.1972, *Astragalus adscendens* (R-251); many ♂♂, ♀♀ and larvae, same but 2700 m, 23.ix.1974, *Astragalus* sp. (R-i3986a); many ♂♂ and ♀♀, same but x.1972, *Astragalus adscendens* (Sanei & Lessani) (USNM); 20♂♂, 20♀♀, same but 22.x.1984 (A. Naeem) (MHNG); 3♂♂, 1♀, same but 10.xii.1982, *Astragalus adscendens* (A. Naeem) (BMNH); 2 larvae, Daran, 32°59'N 50°24'E, 2500 m, 23.ix.1974, *Astragalus* sp. (R-i3984b) (USNM); 1♂, 1♀, Kashan, 33°59'N 51°29'E, x.1978, *Astragalus* sp. (J. Onillon) (USNM).

Comments. The specimens from Esfahan, previously identified as *C. dicora*, show the characteristic, entirely brownish forewings of *C. astragalicola* and are therefore identified as such. The forewings of type material of *C. dicora* from Tadzhikistan, by contrast, bear distinct apical brown patches. The terminalia and head structure of *C. astragalicola* and *C. dicora* are similar and both develop on *Astragalus*. Without revising the genus, it is not possible to judge the taxonomic significance of these differences.

Cyamophila coluteae (Baeva)

Recorded from Iran (GEGECHKORI & LOGINOVA, 1990).

Material examined. Iran: 2♂♂, 1♀, E Iran, Taftan, Tamandan, 2100 m, 17-18.iv.1973 (NMP-167); 1♂, S Iran. SSW Yasuj, 1800 m, 12-13.vi.1973 (NMP-239); 4♂♂, 10♀♀, SW Iran, Pol-e Tang, 60 km NW Andimeshk, 10-11.iv.1977 (NMP-284); 6♂♂, 1♀, C. Iran, Qanat Marvan, 2800 m, 22-24.v.1977 (NMP-345); 2♂♂, 4♀♀, C. Iran, Qanat Marvan, 3000-3100 m, 24.v.1977 (NMP-346); 1♂, C. Iran, Lalehzar, 2800 m, 24-30.v.1977 (NMP-347); 1♀, N Iran, 3 km N Dasht, Golestan forest, 960 m, 18-19.vi.1977 (NMP-375); 7♂♂, 4♀♀, 9 5th instar larvae, 140 km W Bojnurd, 37°28'N 57°19'E, 26.v.1966, *Colutea* (R-224).

Cyamophila glycyrrhizae (Becker)

Psyllodes glycyrrhizae BECKER, 1864: 486. Lectotype ♂: C.I.S.:Russia, Sarepta, *Glycyrrhiza glabra* (Becker) (ZI), examined.

Cyamophila eremita Loginova, 1978a: 88. Holotype ♂: C.I.S.: Turkmeniya, Farab at Amudarya, 25.iv.1912 (Golbek) (ZI), examined. Syn. n.

Recorded from Iran: Village Tamin nr mountains of Kuh-e-Taftan, Kerman, 24.viii.1898 (Zarudnyj) as *Psylla glycyrrhizae* (Loginova & Baeva, 1972); NW Iran, Qazvin, 24.vi.1970 (NMP-29); N Iran, Teheran-Evin, garden on 1700 m, 13.ii.1970 (NMP-124); SW Iran, Shiraz (North), 4.vii.1973 (NMP-42); Shiraz (West), 4.vii.1973 (NMP-43); S Iran, 10 km W Shiraz, 8.vi.1973 (NMP-228); Fasa, 9.vii.1970 (NMP-50); Mian Jangal, 5.vi.1973 (NMP-224); Kamalabad, 5.vi.1973 (NMP-225); 7 km NW Kuhenjan, 5.vi.1973 (NMP-226); 29 km E Yasuj, 2300 m, 16-17.vi.1973 (NMP-245); E Iran, Rafsanjan, 26-28.iv.1973 (NMP-181); Deh Bakri, 1700-1750 m, 30.iv-3.v.1973 (NMP-186); Mohammadabad, 1600 m, 3-5.v.1973 (NMP-187); Kurdistan pers., Shakhlawa (Kálalová-DiLotti); Kurdistan, Badawa Erbil, 31.vi. (Kálalová-DiLotti) as *Cyamophila odontopyx* (Loginova, 1978a); as *C. eremita* by Gegechkori & Loginova (1990) (ZI); Hodkinson & Hollis (1987).

Material examined. Iran: 1♀, E Iran, Taftan, 2100 m, 20.iv.1973 (NMP-167); 10♂♂, 19♀♀, E Iran, Bam, 24-25.iv.1973 (NMP-177); 90♂♂, 104♀♀, E Iran, Rafsanjan, 26-28.iv.1973 (NMP-181); 11♂♂, 11♀♀, E Iran, Deh Bakri, 1750 m, 30.iv-3.v.1973 (NMP-186); 1♂, 1♀, E Iran, Mohammadbad, 1600 m, 3-5.v.1973 (NMP-187); 3♂♂, 1♀, E Iran, 33 km W Sabzvaran, 1100 m, 6-7.v.1973 (NMP-189); 1♀, E Iran, Banue - Charehar, 1800-2000 m, 8.v.1973 (NMP-191); 1♂, 1♀, S Iran, 5 km E Furk, 900 m, 28.v.1973 (NMP-217); 1♂, 1♀, S Iran, Korsiah, 29-30.v.1973 (NMP-220); 52♂♂, 52♀♀, S Iran, Mian Jangal, 3.v-5.vi.1973 (NMP-223); 1♂, 1♀, S Iran, 7 km NW Kuhenjan, 5.vi.1973 (NMP-226); 1♀, S Iran, Maharlu, 5-6.vi.1973 (NMP-227); 3♀♀, S Iran, 10 km W Shiraz, 8.vi.1973 (NMP-228); 7♂♂, 7♀♀, S Iran, 29 km E Yasuj, 2300 m, 16-17.vi.1973 (NMP-245); 2♂♂, 1♀, C. Iran, Qanat Marvan, 2850 m, 22-24.v.1977 (NMP-345); 1♂, C. Iran, Kuh-e Lalehzar, Northern slope, 3200-3800 m, 24-30.v.1977 (NMP-348); 1♂, 1♀, NE Iran, Kuh-e Binolud, Southern slope, 15 km NE Nishabur, 1600-2300 m, 13-15.vi.1977 (NMP-365); 13♂♂, 10♀♀, NE Iran, Assadli, 30 km S Bojnurd, 1970 m, 17-18.vi.1977 (NMP-374); 4♂♂, N Iran, 3 km N Dasht, Golestan forest, 960 m, 18-19.1977 (NMP-375); 13♂♂, 1♀♀, N Iran, 8 km NE Zairan, 2400 m, 10-16.vii.1977 (NMP-400); 1♂, 2♀♀, Kurdistan pers., Shokhlawa (Kálalová-DiLotti) (ZI); 1♂, several ♀♀, many young instar larvae, Baluchestan, Gavater, 35°09'N 61°31'E, vi.1955, *Glycyrrhiza glabra* (R-18, R-183) (MNHN, USNM); 3♂♂, Takht-e Jamshid, 29°57'N 52°52'E, 4.v.1959, *Carex* sp. (R-201); many ♂♂, ♀♀ and larvae, Varamin, 35°20'N 51°39'E, 9.v.1954, *Glycyrrhiza glabra* (R-202); 1♂, 1♀, Dehkhvareqan [=Azar Shahr], 37°45'N 45°59'E, viii.1972, *Heliotropium* sp. stem and leaves (CIE) (BMNH).

Comment. Morphologically the type material of *Cyamophila eremita* falls within the range of variation found in *C. glycyrrhizae*, and the two are synonymised.

Cyamophila oshanini (Loginova)

Material examined. Iran: 1♂, SW Iran, Bidruyeh, 36 km NNW Andimeshk, 440 m, 11-12.iv.1977 (NMP-285); 11♂♂, 9♀♀, NE Iran, Hassar, 50 km ESE, Nishabur, 1400 m, 12-13.vi.1977 (NMP-364).

Psyllinae

Key to genera and species

1 Forewings rhomboidal (figs 75, 76). Genal processes short, broad, irregularly rounded; head covered in long setae (figs 77, 79). .... *Spanioneura persica* sp. n.

- Forewings oblong-oval (fig. 68). Genal processes longer, slender, conical; head without long setae (fig. 69). . . . . *Cacopsylla* 2

2 Surface spinules of forewings densely spaced at 2-10 µ intervals. On *Prunus* spp. . . . . *Cacopsylla pruni* (Scopoli)

- Surface spinules more or less evenly spaced at about 20 µ intervals, forming rhomboids, squares, or irregular transverse rows. 3

3 Upper surface spinules of forewings covering the whole of cell c+sc, apart from narrow stripes along the veins, in other cells forming broad fields, which taper apically towards outer wing margin; spinules present in cell rs proximal to bifurcation of vein R; forewing without dark contrasting patch along vein Cu_{1b}. On *Pyrus* spp. . . . . *Cacopsylla pyrisuga* (Förster)

- This combination of characters absent. 4

4 Surface spinules present in all cells forming broad fields; apart from narrow stripes along the veins, covering the whole surface of cell c+sc; spinules present in basal part of cell rs proximal to bifurcation of vein R; fields in apical part not tapering towards wing margin. On *Salix* spp. . . . . *Cacopsylla saliceti* (Förster)

- This combination of characters absent. 5

5 Forewings with dark spots along outer margin and with infuscate membrane around vein Cu_{1b} contrasting from adjacent area. On *Crataegus* spp. . . . . *Cacopsylla crataegi* (Schrank)

- Forewing pattern different; membrane adjacent to vein Cu_{1b} light or concolorous with sourrounding area. 6

6 Forewings with brown spot on apex of clavus, strongly contrasting with surrounding area. On *Pyrus* spp. 7

- Forewings without brown, strongly contrasting spot on apex of clavus. 11

7 Parameres sickle-shaped. Female proctiger in profile with strong constriction in the middle. . . . . *Cacopsylla pyri* (Linnaeus)

- Paramere in profile lamellar. Female proctiger cuneate. 8

8 Parameres with forward-directed apical tooth; fore margin constricted in basal third. Dorsal segment of aedeagus with weakly curved apical dilatation. Female proctiger often clearly exceeding subgenital plate. . . . . *Cacopsylla permixta* Burckhardt & Hodkinson

- Parameres with one or two inwardly directed points, fore margin not constricted. Distal segment of aedeagus with apical dilatation distinctly curved. Female proctiger only slightly exceeding subgenital plate. 9

9 Paramere apex with two inwards directed teeth. Genal processes relatively robust. . . . . *Cacopsylla bidens* (Šulc)

- Paramere apex with one inwards directed blunt tooth. Genal processes relatively slender. 10

10 Forewings with brown veins. . . . . *Cacopsylla pyricola* (Förster)

- Forewings with whitish veins. *Cacopsylla notata* (Flor)

11 Forewings (fig. 68) parallel-sided, broadest in the middle. .... *Cacopsylla iranica* sp. n.

\- Forewings widening towards apical quarter. On *Rhamnus* spp. 12

12 Male parameres in profile narrowly lamellar. Female proctiger truncate apically. .... *Cacopsylla suturalis* (Horvath)

\- Male parameres in profile broadly oval. Female proctiger pointed apically. .... *Cacopsylla incerta* (Loginova)

Cacopsylla bidens (Šulc)

Recorded from Iran (BURCKHARDT & HODKINSON, 1986).

Material examined. Iran: 1♂, Karaj, cotton field (M. Chojaï) (NMP); 7♀♀, same but viii.1960, *Pyrus* sp. (MNHN); 1♂, 1♀, Azerbaijan, Rezaiyeh, 37°33'N 45°04'E, 8.viii.1955, *Pyrus communis* (R-23) (USNM); 6 larvae, Tehran, 9.v.1955, *Pyrus* sp. (R-26) (USNM).

Cacopsylla crataegi (Schrank)

Material examined. Iran: 2♂♂, 1♀, 1 5th instar larva, Pol-e-Sefid, 36°06'N 53°01'E, 500 m, 1.vi.1966, *Crataegus* sp. (R-226).

Cacopsylla incerta (Loginova)

Material examined. Iran: 1♂, E Dasht Nazir, 36°25'N 51°26'E, 1250 m, 10.xi.1967, *Artemisia absinthium* (R-246).

Cacopsylla iranica sp. n. (Figs 68-74)

Description. Adult. Coloration. Head and thorax reddish brown with fine yellow or whitish pattern. Antennae ochreous, with dark apices on segments 4, 6 and 8, segments 9 and 10 entirely dark. Tibiae dirty yellow. Forewings membranous, transparent, irregularly yellowish with concolorous veins. Abdomen light green.

Structure. Head (fig. 69) slightly wider than mesothorax, weakly inclined from longitudinal body axis; genal processes slightly shorter than vertex along mid-line, blunt apically. Terminal setae on antennal segment 10 (fig. 70) subequal. Forewings (fig. 68) elongate with narrowly rounded outer margin; surface spinules absent apart from cell cu_{1b} and along outer margin in cells rs, m_{1+2}, m_{3+4}, cu_{1a} and at base of rs; surface spinules in cell cu_{1b} relatively large and irregularly spaced. Metatibiae with very small basal spine and 1+3+1 apical spurs, metabasitarsus with 2 black spurs.

Genitalia as in figs 71-74. Male proctiger weakly sinuous in profile; paramere lamellar with sinuous fore margin and strongly sclerotised, inward and forward-directed apical tooth; distal portion of aedeagus with flattened, slightly curved apical dilatation. Dorsal margin of female proctiger irregularly convex.

Measurements. (1♂, 1♀). HW 0.58-0.62; AL 0.55-0.59; WL 1.33-1.55; MP 0.22; PL 0.24; AEL 0.22; FP 0.61; ALHW 0.94-0.97; LLHW 0.39-0.41; TLHW 0.53-0.55; WLHW 2.32-2.47; WLW 2.15-2.57; MPHW 0.39; FPHW 0.97; FPC 4.13; FSP 1.74.

Larva unknown.

Holotype ♂, S Iran: 13 km NW Ghaderabad, 2120 m, 26.vi.1973 (NMP-253).

Paratypes. Iran: 38♂♂, 38♀♀, same data as holotype; 4♀♀, S Iran, Mian Jangal, 3.v-5.vi.1973 (NMP-223); 1♀, C. Iran, Qanat Marvan, 3000-3100 m, 24.v.1977 (NMP-246).

Comments. *Cacopsylla iranica* belongs to the complex of species developing on *Rhamnus* and *Cerasus* as defined by LOGINOVA (1975b). It is closest to *C. kopetdaghi* (Loginova) from which it differs in the reddish and green body coloration, the slightly stouter genal processes, the shorter antennae, the narrower, yellowish forewings lacking dark spots in the middle of the cells along the outer wing margin, and the shorter female terminalia.

Cacopsylla notata (Flor)

Material examined. Iran: 1♂, 3♀♀, 16 5th instar larvae, 30 km S Yasuj, 1900 m, 26.x.1967, *Pyrus* sp. (R-234).

Comments. The Iranian specimens differ from Mediterranean material in the presence of dark veins on the forewings of adults, in the somewhat narrower apical dilatation of the distal segment of aedeagus, and in the lack of marginal capitate setae on the caudal plate in the larvae. The dark veins could result from storage in alcohol.

Cacopsylla permixta Burckhardt & Hodkinson

Material examined. Iran: many ♂♂, ♀♀ and 5th instar larvae, Hajjiabad, near Garmsar, 35°20'N 52°13'E, 8.v.1966, *Pyrus* sp. (R-219); 1♂, 4♀♀, 1 5th instar larva, Khoshbeylagh Pass, S Gonbad-e-Kavus, 2000 m, 29.v.1966, *Acer cinerascens* (R-225).

Comment. In Iranian material the lateral capitate setae on the larval caudal plate are longer than in specimens described by BURCKHARDT & HODKINSON (1986).

Cacopsylla pruni (Scopoli)

Material examined. N Iran: 1♂, 1♀, 20 km NNE Khalkhal, 2160 m, 29.vi-1.vii.1977 (NMP-391); 3♂♂, 3♀♀, Mazandaran, Now Shahr, 36°39'N 51°31'E, 23.iii.1978, *Prunus spinosus* (V. F. Eastop) (BMNH).

Comment. Iranian specimens differ from Central European material in the dark pattern of the forewings which forms a well-defined band along the outer wing margin.

Cacopsylla pyri (Linnaeus)

Material examined. NW Iran: 1♂, 10 km NW Zanjan, 4-5.vii.1973 (NMP-264).

Cacopsylla pyricola (Förster)

Material examined. Iran: 1♀, Karaj, 35°48'N 50°59'E, 11.xi.1962, *Pyrus* sp. (R-205); 1♀, Tehran Evin, 4.xi.1967, *Pyrus communis* (R-242).

Comment. These two females are only provisionally assigned to *C. pyricola.*

Cacopsylla pyrisuga (Förster)

Material examined. Iran: many 5th and 4th instar larvae, Elburz, 2300 m, 20.vii.1955, *Pyrus syriacus* (R-22, R-185) (USNM).

Cacopsylla saliceti (Förster)

Material examined. Iran: 1♀, C. Iran, Lalehzar, 2800 m, 24-30.v.1977 (NMP-347).

Comment. The identification of the specimen is provisional and males are required to confirm it.

Cacopsylla suturalis (Horvath)

Material examined. Iran: 4♂♂, 2♀♀, 1 adult without abdomen, S Iran, Zagros, Sísakht, 2400 m, 13-15.vi.1973 (NMP-240); 2♂♂, 1♀, C. Iran, Qanat Marvan, 3000-3100 m, 24.v.1977 (NMP-346); 2♀♀, C. Iran, Lalehzar, 2800 m, 24-30.v.1977 (NMP-347); many ♂♂ and ♀♀, Fars, Kuh-e-Dena, 3300 m, ix.1955, *Ferula* sp. (R-189) (MNHN, USNM, MHNG).

Comment. The Iranian specimens differ from Yugoslavian material in the absence of a brown marginal band and surface spinules on the forewings. Similar differences are found in the closely related *C. incerta* (Loginova).

Cacopsylla sp. A

Material examined. N Iran: 2♀♀, E Elburz, Gaduk Pass, 2200 m, 2.viii.1970 (NMP-82).

Comment. The two females may be an undescribed species. They are characterised by forewings with long branches of the veins M and Cu_1, a long vein R_1, a short pterostigma, and a short vein $M+Cu_{1a}$. Similar venational characters are present in *Cacopsylla fasciata* (Löw), *C. sarmatica* (Löw), *C. zaicevi* (Klimaszewski) and *C. junatovi* (Loginova) to which the Iranian specimens may be related. Males, larvae and host data are needed to identify this material.

Psylla sp. A

Material examined. Iran: 5♀♀, N Iran, W Elburz, Kalardasht Plain NE Rudbarak, 12.viii.1970 (NMP-90).

Comment. The specimens belong probably to an undescribed species but males are needed for formal description.

Spanioneura persica sp. n. (Figs 75, 77, 78, 80, 82, 84, 85)

Description. Adult. Coloration. Head dirty yellowish above, light greenish yellow underneath. Antennae yellow, with segments 4 to 9 bearing dark brown apices, segment 10 black. Thorax light yellowish to straw-coloured, with broad darker longitudinal stripes on mesopraescutum and mesoscutum. Legs yellowish to greenish. Forewings whitish; veins in basal half indistinctly brownish, veins in apical half and fore margin whitish to greenish; apices of veins Rs, M_{1+2}, M_{3+4}, Cu_{1a}, Cu_{1b} with dark brown to black spots; apices of cells m_{1+2}, m_{3+4}, and cu_{1a} with light brown, indistinct patch; membrane transparent to whitish opaque. Abdomen light greenish.

Structure. Head from above (fig. 77) about as wide as thorax, in profile strongly inclined from longitudinal body axis; covered in long setae. Genal processes short, broad, irregularly rounded. Antennae 10-segmented, filiform, bearing a subapical rhinarium on each of segments 4, 6, 8 and 9; segment 10 with two subequal setae which are both shorter than the segment (fig. 78). Thorax moderately arched above, sparsely covered in long setae. Propleurites higher than wide; epimeron and episternum subequal in surface, narrowly elongate. Forewing (fig. 75) narrowly oval, apex asymmetrical and irregularly rounded; veins bearing conspicuous setae; costal break present, pterostigma short and small; cell m_{1+2} long, vein M_{3+4} sinuous; vein Cu_{1a} gently curved; surface spinules sparsely covering membrane, arranged in irregular transverse rows or rhomboids, leaving broad spinule-free stripes along the veins; reduced or entirely absent in cell r_1. Hindwing membranous, almost as long as forewings. Metatibia with basal spine and 1+3+1 apical spurs; metabasitarsus with 2 black spurs. Genitalia as in figs 80, 82, 84, 85. Male proctiger simple. hind margin weakly produced, shortly setose; subgenital plate densely setose latero-apically. Parameres lamellar, obliquely truncate and heavily sclerotised apically, with antero-apical tooth. Distal segment of aedeagus straight with irregularly oval apical dilation. Female terminalia long, dorsal margin of proctiger indistinctly concave in the middle, apex blunt.

Measurements. (1♂, 1♀). HW 0.87-0.88; AL 1.11-1.16; WL 2.74-2.89; MP 0.50; PL 0.47; AEL 0.30; FP 1.51; ALHW 1.25-1.33; LLHW 0.55-0.59; TLHW 0.66-0.67; WLHW 3.16-3.27; WLW 2.91-3.02; MPHW 0.57; FPHW 1.71; FPC 5.27; FSP 1.44; FAS 1.0 : 0.9 : 0.7 : 0.9 : 0.9 : 0.8 : 0.4 : 0.4.

Larva and host plant unknown.

Holotype ♂, S Iran, Zagros, Yasuj, 16.vi.1973 (NMP-243).

Paratypes. Iran, 1♂, 4♀, 1 adult without abdomen, same data as holotype; 2♂, 4♀, E Iran, Deh Bakri, SW Bam, 1700-1750 m, 30.iv-3.v.1973 (NMP-186); 1♂, C. Iran, Qanat Marvan, 2850 m, 22-24.v.1977 (NMP- 345).

Comments. *Spanioneura persica* is closely related to *S. turkiana* (KLIMASZEWSKI & LODOS, 1977) (figs 76, 79, 81, 83) from which it differs in: 1. the slightly longer setae on head, thorax and forewings; 2. the somewhat more massive genal processes; 3. the forewing coloration, which is yellowish to ochreous, with indistinct dark spots at the apices of the veins in *S. turkiana*, and whitish with indistinct brown patches in the cells along the outer wing margin and dark with well-contrasted spots on the apices of the veins in *S. persica*; 4. the slightly smaller body dimensions; 5. the longer cell m_{1+2} and the more sinuous vein M_{3+4} of the forewings (in *S. turkiana* vein M_{3+4} is evenly curved); 6. the broader spinule-free stripes along the veins in the forewings, and the mostly bare cell r_1; 7. the shorter and somewhat thicker male parameres.

Spanioneura turkiana and *persica* are probably not closely related to the type species *S. fonscolombii* Förster. However, without larvae and host data it is not possible to examine the phylogenetic relationships of this group, and we adopt the tentative classification proposed by HODKINSON & HOLLIS (1987).

The relationships between Turkish *Spanioneura turkiana* (Klimaszewski & Lodos) and *S. pechai* (Klimaszewski & Lodos) are discussed by BURCKHARDT & ÖNUÇAR (1993).

HOMOTOMIDAE

KEY TO SPECIES

1 Vertex with well-defined dark pattern. Antennal segments relatively short and wide (fig. 88); segment 9 light. Male paramere relatively straight (fig. 93). Possibly on *Ficus* spp. . . . . *Homotoma caroliquarti* sp. n.

\- Vertex without well-defined dark pattern. Antennal segments relatively long and narrow (fig. 89); segment 9 dark. Male paramere distinctly bent backwards. On *Ficus carica*. . . . . *Homotoma ficus* (Linnaeus)

Homotoma caroliquarti sp. n. (Figs 86-88, 90-94)

Description. Adult. Coloration. Pale yellowish. Head with well-defined transverse brown stripe along anterior margin and with brown margin of antennal insertion. Antennal segments 1 to 9 straw-colored, segment 10 slightly darker, rhinaria with dark brown margin; flagellar setae almost black strongly contrasting with underlying colour. Forewing hyaline, veins yellow, with indistinct light brown pattern consisting of a narrow band along vein M_{1+2} and spots around the apices of veins Cu_{1a}, Cu_{1b} and the clavus. Metacoxae reddish to brownish dorsally.

Structure. Head (fig. 87), from above, concave anteriorly bearing relatively large, apically pointed genal processes. Antennae (fig. 88) with laterally flattened flagellomeres; scape with large ventral tubercle; length to width ratio of segments in lateral view as follows (from segments 1 to 10): 1.0, 0.8, 2.5, 1.8, 1.3, 1.8, 1.5, 1.6, 1.5, 1.6 (same values for *H. ficus*: 1.2, 1.0, 3.3, 2.2, 1.8, 1.8, 1.6, 1.4, 1.5, 0.9); relative length of flagellar segments from base to apex as follows: 1.0 : 0.6 : 0.4 : 0.5 : 0.4 : 0.4 : 0.3 : 0.1 (same values for *H. ficus*: 1.0 : 0.6 : 0.5 : 0.4 : 0.4 : 0.3 : 0.3 : 0.1); ultimate antennal segment with one long pointed and one short, apically truncate terminal seta. Thorax weakly arched, pronotum without anterior projections. Forewings (fig. 86) transparent, subacute apically, relatively evenly curved anteriorly, veins R and $M+Cu_1$ separated; Rs long, almost straight, reaching wing margin in apical half of wing; M_{3+4} 1.6-2.0 times as long as M_{1+2} (1.2-1.5 in *H. ficus*) which reaches wing margin anterior to apex; cell cu_{1a} large, clavus ending adjacent to apex of Cu_{1b}; radular areas diffuse. Metatibiae with basal spine and 0 + 6 apical spurs; metabasitarsus with 2 spurs. Genitalia as in figs 90-94. Lateral lobes of ♂ proctiger well-developed, anal tube of moderate length; paramere relatively straight and slender, inner surface with short, anterior sclerotised ridge; basal aedeagal segment curved and moderately expanded in apical half. Dorsal margin of ♀ proctiger concave distal to circumanal ring.

Measurements. (1♂, 1♀). HW 0.84-0.86; AL 1.56-1.62; WL 3.68-3.91; MP 0.36; PL 0.25; AEL 0.32; FP 0.71; ALHW 1.85-1.89; LLHW 0.54; TLHW 0.76-0.78; WLHW 4.37-4.56; WLW 2.54-2.63; MPHW 0.43; FPHW 0.83; FPC 5.11; FSP 1.03.

Larva unknown.

Recorded from Iran: Kerman as *Homotoma ficus* (DAVATCHI, 1958); examination of this material (USNM) showed that this concerns *H. caroliquarti*.

Holotype ♂, Iran: Kerman, 50 km W Rafsanjan, vi.1955, *Ficus* sp. (R-180) (MNHN).

Paratypes. Iran: 11♂♂, 6♀♀, same data as holotype (MNHN, USNM, MHNG); 1♂, 1♀, same data as holotype but on *Pistacia khinjuk* (R-182) (MNHN, USNM); 1♂, 130 km E Shahabad, 34°06'N 46°31'E, 1200 m, 28.x.1967, *Quercus persica* (R-236); 1♂, Estahbanat, 100 km E Chiraz, 5.iv.1972, *Ficus carica* (Safavi) (MMB).

Afghanistan: 3♂♂, 6♀♀, Nuristan, Bashgultal, 1100 m, 17.iv.1953 (J. Klapperich) (NMP).

Pakistan: 1♂, Kashmir, Indus Valley, Sasli, 50 km W Gilgit, 1300 m, 18.viii.1970 (O. Štěrba) (WP-11) (MMB); 3♂♂, 2♀♀, Kashmir, Karakoram, Haramosh Range, N slope of Haramosh, end of Kutwal Valley, alpine meadows, 18.ix.1970 (O. Štěrba) (WP-15) (MMB); 1♂, Kashmir, Gilgit, park, 26.ix.1970, light trap (O. Štěrba) (WP-18) (MMB).

Comments. The forewing venation of *H. caroliquarti* is of the "*Homotoma*" type (HOLLIS & BROOMFIELD, 1989). Based on forewing venation, the antennal and the genital morphology, *H. caroliquarti* is closest related to *H. ficus* (including *H. viridis* Klimaszewski) from which it differs in the following features: 1. presence of a well-defined dark pattern on the vertex; 2. antennal segment 9 light; 3. genal processes longer and more pointed; 4. antennal segments in lateral view relatively wider than in *H. ficus*; 5. scape with larger apical tubercle ventrally; 6. setae on antennae thicker and darker; 7. forewing more evenly curved anteriorly; 8. vein M_{1+2} relatively shorter compared to M_{3+4}; 9. vein Rs straighter; 10. male paramere straighter; 11. cell m_{1+2} longer and narrower.

H. caroliquarti is named after Charles IV of Luxemburg, Roman Emperor, King of Bohemia, called "pater patriae", and founder of the Charles University in Prague. He was the first author who published (in 1346) entomological observations in Czech.

Homotoma ficus (Linnaeus) (Fig. 89)

Material examined. Iran: 2♀♀, S Iran, Central Elburz Mazar Chay, S Amol, 400 m, 23-24.vii.1970 (NMP-69); 2♂♂, S Iran, Mian Jangal, 30.v-5.vi.1973 (NMP-223); 1♂, 1♀, S Iran, 7 km NW Kuhenjan, 5.vi.1973 (NMP-226); 8♂♂, 16♀♀, S Iran, 5-6.vi.1973 (NMP-227); 2♂♂, 3♀♀, S Iran, Kushk N Masírí, 1800 m, 12.vi.1973 (NMP-237); 1♀, S Iran, 48 km N Masírí, 2230 m, 12.vi.1973 (NMP-238); 1♂, S Iran, Dasht-e-Arjan, 1700 m, 9.vi.1973 (NMP-320).

Comment. The record from Iran: Kerman (DAVATCHI, 1958) concerns *H. caroliquarti*.

TRIOZIDAE

KEY TO GENERA AND SPECIES

1 Outer apical metatibial spur on a large claw-like tubercle (fig. 102). .... *Egeirotrioza* 2

\- Outer apical metatibial spur not on large claw-like tubercle. 5

2 Forewings angular apically (fig. 95). Possibly on *Populus diversifolia*. .... *Egeirotrioza corporosa* sp. n.

\- Forewings rounded apically (figs 96, 97). 3

3 Male parameres lamellar. Female subgenital plate irregularly tapered apically but not ending in parallel-sided process. On *Populus* spp. .... *Egeirotrioza ceardi* (Bergevin)

\- Male parameres bifid (figs 113, 114). Female subgenital plate (figs 119, 121) ending in parallel-sided process. 4

4 Forewings broadly rounded apically (fig. 96). Male parameres with relatively narrow basal portion (fig. 113). Female proctiger with a truncate, heavily sclerotised apex (fig. 119). .... *Egeirotrioza gemina* sp. n.

\- Forewings narrowly rounded apically (fig. 97). Male parameres with relatively broad basal portion (fig. 114). Female proctiger with a subacute, not particularly heavily sclerotised apex (fig. 121). On *Populus diversifolia*. .... *Egeirotrioza justa* sp. n.

5 Metatibiae with 1+3 black apical spurs. .... *Trioza* p. p. 6

\- Metatibiae with 1+2 black apical spurs. 8

6 Vein Rs of forewings short, concavely curved towards fore margin. On *Galium* spp. . . . . *Trioza galii* Förster

\- Vein Rs of forewings long, sinuous. 7

7 Forewings, apart from radular spinules, without surface spinules in apical half. On *Urtica* spp. . . . . *Trioza urticae* (Linnaeus)

\- Forewings with surface spinules in apical half. On *Rumex* spp. . . . . *Trioza rumicis* Löw

8 Genal processes shorter than half vertex length. 9

\- Genal processes longer than half vertex length. 14

9 Antennal segments 4-7 light with dark brown to black apex. . . . . *Paratrioza* 10

\- Antennal segments 4-7 entirely dark brown to black. . . . . *Bactericera* p. p. 11

10 Male parameres obliquely truncate apically. Female subgenital plate pointed apically. On *Lycium ruthenicum*. . . . . *Paratrioza lycii* Loginova

\- Male parameres pointed apically. Female subgenital plate truncate apically. On *Lycium depressum*. . . . . *Paratrioza petiolata* Loginova

11 Antennal segment 3 much thicker than remainder of flagellomeres. On *Artemisia* spp. . . . . *Bactericera perrisii* Puton

\- Antennal segment 3 not strongly thickened. 12

12 Forewings narrow, widest in the middle, vein Rs weakly sinuate. Male proctiger, in profile, angular posteriorly; parameres slender in apical half; apex of distal aedeagal segment short and thick. Probably on *Daucus carota*. . . . . *Bactericera trigonica* Hodkinson

\- Forewings broad, widest in apical third; vein Rs strongly sinuous. Male proctiger, in profile, rounded posteriorly; parameres broad and truncate apically; apex of distal aedeagal segment more slender. 13

13 Genal processes, in general, slender. Male parameres, in profile, broad with horizontally truncate apex; base of distal aedeagal segment long, apical dilatation globular. *Allium* spp., possibly polyphagous. . . . . *Bactericera tremblayi* (Wagner)

\- Genal process, in general, broadly rounded. Male parameres, in profile, slightly more slender and obliquely truncate apically; base of distal aedeagal segment short, apical dilatation oblong. Polyphagous. . . . . *Bactericera nigricornis* (Förster)

14 Cell m_{1+2} of forewings very large, much larger than cell cu_{1a}. Female proctiger with long, upturned apical process which is much longer than subgenital plate. On *Elaeagnus angustifolia*. 15

\- Cell m_{1+2} of forewings about as large as or smaller than cell cu_{1a}. Female proctiger without long, upturned apical process. 17

15 Forewings blunt apically. . . . . *Trioza elaeagni* Scott

\- Forewings acute apically. 16

16 Posterior lobes of male proctiger large, semicircular. Female proctiger with long dorsal setae ending almost at apex of proctiger. . . . . *Trioza neglecta* Loginova

\- Posterior lobes of male proctiger narrow. Female proctiger with long dorsal setae ending at the middle of apical proctigal process. . . . . *Trioza magnisetosa* Loginova

17 Vein Rs of forewings long and distinctly sinuous. . . *Bactericera* p. p. 18

\- Vein Rs of forewings relatively short, straight or curved towards fore margin. . . . . *Trioza* p. p. 20

18 Surface spinules of forewings present in all cells. On *Salix* spp. . . . . *Bactericera albiventris* (Förster)

\- Surface spinules of forewings absent from apical cells. 19

19 Antennal segments 4-8 entirely dark brown to black. On *Salix* spp. . . . . *Bactericera striola* (Flor)

\- Antennal segments 4-8 light, with at most dark apices. On *Ligularia thomsonii*. . . . . *Bactericera ligulariae* (Baeva)

20 Branching of vein M of forewings distal to line between apices of veins Rs and Cu_1. 21

\- Branching of vein M of forewings proximal to or on line between apices of veins Rs and Cu_1. On *Berberis* spp. 24

21 Antennal segments 4 and 5 dark brown, strongly contrasted with light segment 3. Large species. On deciduous *Quercus* spp. . . *Trioza remota* Förster

\- Antennal segments 4 and 5 light to ochreous, not strongly contrasted with light segment 3. Small species. 22

22 Male parameres with backwards directed sclerotised apex; distal segment of aedeagus with two long tubular processes. Third antennal segment long. On Chenopodiaceae. . . . . *Trioza chenopodii* Reuter

\- Male parameres with forwards directed sclerotised apex; distal segment of aedeagus with two tubercles. Third antennal segment short. 23

23 Male parameres obliquely truncate so that highest point is at posterior margin; sclerotised end tube of ductus ejaculatorius short, weakly curved. On *Atriplex tatarica*. . . . . *Trioza dichroa* Scott

\- Male parameres obliquely truncate so that highest point is at anterior margin; sclerotised end tube of ductus ejaculatorius long, strongly sinuous. On *Eurotia ceratoides*. . . . . *Trioza eurotiae* Loginova

24 Male parameres with one apical tooth. Female proctiger globular. . . . . *Trioza scottii* Löw

\- Male parameres with two apical teeth. Female proctiger cuneate. . . . . *Trioza berbericola* Loginova

Bactericera albiventris (Förster)

Material examined. Iran: 1♀, S Iran, 13 km SSW Yasuj, 1800 m, 12-13.vi.1973 (NMP-239); 5♂♂, 7♀♀, N Iran, Shahi. 24.vi.1977 (NMP-381); 7♂♂, 9♀♀, N Iran, Hashtgerd, 10.vii.1977 (NMP-399); 1♀, N Iran, 8 km NE Zairan, 2400 m, 10-16.vii.1977 (NMP-400); 1♂, 1♀, Fasham, N Tehran, 2000 m, 4.xi.1955, *Prunus domestica* (R-194); 3 5th instar larvae, Varamin, S Tehran, 6.xi.1965, *Salix* (R-212); 6♂♂, 2♀♀, 3 5th instar larvae, Roudak, N Tehran, 3.xi.1967, *Salix* (R-241); 4♂♂, 2♀♀, 17 5th instar larvae, Gach Sar, N Karaj, 2230 m, 9.xi.1967, *Salix* sp. (R-243); 1♂, 2♀♀, same but *Prunus domestica* (R-244); 2♂♂, 1♀ (teneral), same but 1770 m, *Salix purpurea* (R-245).

Bactericera ligulariae (Baeva)

Material examined. Iran: 10♂♂, 11♀♀, 1 adult without abdomen, N Iran, C. Elburz, Kuhha-ye Tu Chal, 3600-3900 m, 18-19.vii.1970 (NMP-61); 4 larvae, Elburz, Gatgere, E Gach Sar, 14.viii.1955, *Ligularia persica* (R-34) (USNM).

Comment. The larvae are provisionally assigned to *B. ligulariae* on the basis of their host plant. Larvae found together with adults are needed to confirm the identification.

Bactericera nigricornis (Förster)

Material examined. Iran: 1♂, 2♀♀, E Iran, 1700 m, Máhán, 23-24.iii.1973 (NMP-61); 1♀, N Iran, C. Elburz, Gazanak, Haraz Chay, 1400 m, 20-21.vii.1970 (NMP-63); 2♀♀, E Iran, Taftan, Tamandan, 2100 m, 20.iv.1973 (NMP-167); 1♀, S Iran, Mian Jangal, 30.v-5.vi.1973 (NMP-223); 1♀, S Iran, 10 km W Shiraz, 8.vi.1973 (NMP-228); 1♂, 1♀, S Iran, 48 km N Masírí, 2230 m, 12.vi.1973 (NMP-238); 4♂♂, 1♀, S Iran, 13 km SSW Yasuj, 1800 m, 12-13.vi.1973 (NMP-239); 3♂♂, S Iran, Zagros, Sísakht, 2400 m, 13-15.vi.1973 (NMP-240); 2♂♂, 5♀♀, S Iran, Sísakht, Dean, 2500-3000 m, 13-14.vi.1973 (NMP-241); 1♂, NE Iran, Assadii, 30 km S Bojnurd, 17-18.vi.1977 (NMP-374); 1♂, 1♀, Fasa, 28°56'N 53°42'E, 9.ix.1967 (Minessian) (NMP); 5♂♂, Hamadan, 34°48'N 48°30'E, 1966, yellow pan tray (Klett) (R-214, R-215); 6♂♂, same but 15.v.1966 (R-222); 1♂, 30 km S Darreh Gaz, 37°27'N 59°07'E, Northern slope, 1300 m, 18. v.1966, *Rosa* sp. (R-223); 10♂♂, 3♀♀, Khuzestan, Dezful, 32°23'N 48°24'E, iii-iv.1978, yellow trays (V. F. Eastop) (BMNH); 9♂♂, Khuzestan, Ramin, iv.1978, yellow tray, same; 1♀, Shushtar, 32°03'N 48°51'E, 25.iii-iv.1978, yellow trays, same; 1♀, Now Shahr, 36°39'N 51°31'E, iv.1978, yellow tray (S. H. Hodjat) (BMNH); 1♂, 1♀, Borujen, 31°59'N 51°18'E, Konark, 30°40'N 51°20'E, viii.1985, potato field (CIE) (BMNH).

Comment. Most of the Iranian specimens have a light antennal segment 3. This form was originally described as *B. brassicae* (Vasiljev) (Hodkinson, 1981).

Bactericera perrisii Puton

Recorded from Iran (ZI) (Gegechkori & Loginova, 1990).

Material examined. Iran: 1♂, NW Iran, Qazvin, 24.vi.1970 (NMP-29); 2♂♂, 9♀♀, S Iran, 33 km S Sabzevaran, 17.v.1977 (NMP-335).

Bactericera striola (Flor)

Material examined. Iran: 1♂, 1♀. 5 5th instar larvae, Gach Sar, 36°07'N 51°19'E, 1770 m, 9.xi.1967, *Salix purpurea* (R-245).

Comment. The two adult specimens lack the dark clavus in the forewing.

Bactericera tremblayi (Wagner)

Material examined. Iran: 1♀, E Garmandar, 40 km NE Tehran, 13.xi.1962, on snow (R-206); 2 teneral ♂♂, many 5th instar larvae, Karaj, 35°48'N, 50°59'E, 1967, *Allium cepa* (Esmaeli) (R-228).

Bactericera trigonica Hodkinson

Recorded from Iran: Tehran; Ahvaz (HODKINSON, 1981).

Material examined. Iran: 1♀, N Iran, C. Elburz Kandavan Valley, 2545 m, 10-11.viii.1970 (NMP-86); 2♀♀, N Iran, C. Elburz, Kandavan Pass, 3000 m, 11.viii.1970 (NMP-87); 16♂♂, 38♀♀, N Iran, Kandavan Pass, S slope, 2700-2900 m, 4-9.vii.1977 (NMP-395); 5♂♂, 3♀♀, Tehran, v.1971, *Nasturtium* sp. (CIE) (BMNH); 3♂♂, same but on vegetables; 1♂, same but vii.1978, water trap (S. H. Hodjat); 1♂, Ahvaz, 2-4.ii.1978, yellow tray (V. F. Eastop), same.

Bactericera sp. A

Material examined. Iran: 4 ♂♂, N Iran, C. Elburz, Kuhha-ye Tu Chal, 3600-3900 m, 18-19.vii.1970 (NMP-61).

Comment. This probably undescribed species is close to *B. seselii* (Loginova) from which it differs in the less curved arched fore margin of the forewings, the darker body coloration and the obliquely truncate parameres which taper regularly in *B. seselii*. Without more material, it is not possible to determine this material.

Egeirotrioza Boselli

Comments. *Egeirotrioza* Boselli is heterogeneous in respect of adult and larval morphology and LOGINOVA (1976) subdivided it into the two subgenera, *Egeirotrioza* with 8 species and *Astutia* Loginova with 3 species. The former group is linked to host species of the subgenus *Turanga*, the latter develop on species of the subgenus *Populus*. MATHUR (1975) recorded *E. ceardi* (as *Trioza ceardi*) from Iraq, Pakistan and Tunisia, discussed the questionable synonymy of *Phylloplecta gardneri* Laing (with *E. ceardi*), and described two poplar feeding triozids from Pakistan: *Trioza bifurcata* and *T. longiantennata*.

According to LOGINOVA (1976), the subgenus *Egeirotrioza* is characterised by the presence of an apical metatibial process which bears one of the apical spurs (fig. 102) and the two subapical ventral teeth on the distal portion of the aedeagus. These characters are shared by *Trioza bifurcata* and *T. longiantennata*, which are closely related to other poplar feeding triozids. They are therefore transferred to *Egeirotrioza*: as *Egeirotrioza bifurcata* (Mathur) comb. n. and *E. longiantennata* (Mathur) comb. n.

In the absence of type material, MATHUR (1975) accepted HESLOP-HARRISON'S (1946) synonymy of *Phylloplecta gardneri* with *E. ceardi*, but pointed out the striking differences in the forewings shown in the descriptions of LAING (1930) and LOGINOVA-DUDYKINA & PARFENTIEV (1958). Examination of the types of *P. gardneri* (India: Punjab, Ghazighat, Multan, ex leaf galls on *Populus euphraticus* (R. N. Mathur) (BMNH)) confirmed the differences from *E. ceardi* mentioned by MATHUR (1975). In addition to the apically pointed forewings (rounded in *E. ceardi*), *P. gardneri* differs in the slightly larger body dimensions; in the antennal segment 3 which is about 3 times as long as segment 4 (2 times in *E. ceardi*); the male proctiger (fig. 108) which is evenly rounded posteriorly in basal half (concavely angular in *E. ceardi*); in the apically blunter female proctiger (fig. 117) and possibly also in the wider male parameres (fig. 112). The head (fig. 104) and aedeagus (fig. 99) are similar in the two species. These differences suggest that *P. gardneri* is a species distinct from *E. ceardi* and following new combination is proposed: *Egeirotrioza gardneri* (Laing) comb. n., stat. rev.

The subgenus *Egeirotrioza* comprises three species with lamellar parameres (*E. ceardi*, *E. gardneri* and *E. intermedia*), one species with quadrate parameres (*E. rufa*), and the remainder with more or less distinctly bifid parameres, having a shorter anterior and a longer posterior arm. This last group is again subdivided into a group with a rounded outer wing margin (*E. nigracapitata*, *E. verrucifera* and *E. cerina*), and one with a distinctly angular outer wing margin (*E. maculosa* and *E. gracilis*). *E. bifurcata* and *E. longiantennata* are, based on these characters, closest related to *E. maculosa* and *E. gracilis* from which they differ in the relatively longer anterior arm of the parameres.

RÜBSAAMEN (1902) described galls and larvae from *Populus euphratica* in Iran which he attributed to two unidentified species of Psylloidea. One was described by BERGEVIN (1926) as *Trioza ceardi*, the other is probably also referable to *Egeirotrioza* but more material is needed. Apart from *E. ceardi*, there are three new species represented in the Iranian material.

Egeirotrioza ceardi (Bergevin)

Recorded from Iran: SE Iran, Kerman, District Sirjan, Cheirabad, 30.ix.1892; Seidabad, 29°30'N 55°30'E, 30.ix.; Sarvestan, 9.x. (RÜBSAAMEN, 1902; HOUARD, 1922; BERGEVIN, 1926).

Material examined. Iran: many larvae and galls, Kerman, Kavir-e-Namak-e-Sirjan, W Sirjan, ix.1955, *Populus euphratica* (R-25, R-188) (MNHN, USNM); galls and 1st instar larvae, Saadatabad, N Shiraz, 12.iii.1967, *Populus diversifolia* (= *P. euphratica*) (R-203); several 5th instar larvae, 40 km N Dezful, 32°23'N 48°24'E, 28.x.1967, *Populus diversifolia* (R-235); 5♂♂, 3♀♀, Khuzestan, Ahvaz, Golestan, 25.ii.1978, *Populus euphratica* (V.F. Eastop) (VFE-15866) (BMNH).

Egeirotrioza corporosa sp. n. (Figs 95, 98, 102, 103, 107, 111, 115, 116)

Description. Adult. Coloration. Similar in both sexes. Head and thorax above light orange-yellowish, genal processes, lower head surface and thorax laterally and ventrally yellow. Antennae yellow, with segments 9 and 10 dark brown to black. Legs yellow. Forewings membranous, transparent; veins yellow, membrane almost colourless. Hindwings whitish. Abdomen, depending on age, entirely greenish or yellowish, or with orange-yellowish dorsum.

Structure. Head (fig. 103), from above, slightly narrower than thorax; foveae forming very fine pits; genal processes conical, well-developed, blunt apically. Third antennal segment 2.9-3.8 times as long as segment 4. Forewing (fig. 95) narrow, outer margin angular; vein Rs almost straight, hardly curved towards fore margin in apical third. Metatibia with 1 + (1+2) apical spurs (fig. 102); outer spur on distinct process. Terminalia as in figs 98, 107, 111, 115, 116. Male proctiger with long narrow apical tube, broadly bulged posteriorly; paramere with a narrow, long, straight anterior process, and a long, apically weakly widened, slightly anteriorly curved posterior process; distal portion of aedeagus with two large ventral subapical hooks and a large triangular dorsal process; sclerotised end-tube of ductus ejaculatorius short, straight. Female proctiger with weakly convex dorsal margin, subacute, not particularly sclerotised apically; subgenital plate with short apical process; valvula ventralis with several large, strongly sclerotised teeth ventrally.

Measurements. (2♂♂, 2♀♀). HW 0.67-0.81; AL 1.25-1.48; WL 3.71-3.97; MP 0.37-0.39; PL 0.39-0.40; AEL 0.33-0.37; FP 0.54-0.56; ALHW 1.62-1.96; LLHW 0.40-0.44; TLHW 0.72-0.79; WLHW 4.86-4.93; WLW 2.77-2.93; MPHW 0.49-0.51; FPHW 0.67-0.72; FPC 4.24-4.54; FSP 1.68-1.73.

Larva unknown.

Holotype ♂, Iran: S Iran, 15 km NW Mian Jangal, 3.vi.1973 (NMP-224).

Paratypes. Iran: 12♂♂, 31♀♀, 1 adult without abdomen, same data as holotype; 6 adults, same data but (ZI); 2♂♂, 3♀♀, N Iran, Tehran - Evin, 1700 m, 13.iii.1973, garden (NMP-124); 2 adults, same data but (ZI); 1♀, SW Iran, Shushtar, 13.iv.1977 (NMP-287); 2♂♂, 2♀♀, Khuzestan, Ahvaz, 11-12.iv.1978, *Populus euphratica* (V. F. Eastop) (BMNH); 1♀, same but Golestan, 21.iv.1978.

Comment. Based on the bifid parameres and the apically pointed forewings, *E. corporosa* is closely related to *E. maculosa*, *E. gracilis*, *E. bifurcata* and *E. longiantennata*. It differs from the latter two species in the longer genal processes, from *E. bifurcata* and *E. maculosa* in the shorter female terminalia with a shorter apical process of the subgenital plate, and from *E. gracilis* in the posteriorly more produced male proctiger, and the longer anterior arm on the parameres. All the material at hand of *E. corporosa* is light coloured without dark patches or marks as described for *E. longiantennata*, *E. maculosa* and *E. gracilis*. More material is needed to judge if colour differences are constant.

Egeirotrioza gemina sp. n. (Figs 96, 100, 105, 109, 113, 118, 119)

Description. Adult. Coloration. Similar in both sexes; light yellowish, vertex and thoracic dorsum straw-coloured. Antennae yellow with light brown segments 9 and 10. Legs yellow, slightly darker that thorax laterally and ventrally. Forewings yellowish, membrane and veins concolourous; hindwings whitish, transparent. Abdomen depending on age greenish or yellowish.

Structure. Head (fig. 105), from above, slightly narrower than thorax; foveae forming coarse, deep pits; genal processes conical, well-developed; subacute apically. Third antennal segment 2.7-2.9 times as long as segment 4. Forewing (fig. 96) elongate, broadly rounded apically; veins Rs weakly sinuous; vein Cu_{1a} evenly curved in basal half. Metatibia with 1+3 or, rarely, 1+2 or 2+3 apical spurs; outer spur on distinct process. Terminalia as in figs 100, 109, 113, 118, 119. Male proctiger without apical tube and relatively straight posteriorly; paramere with short anterior arm and long, apically widened posterior arm which is weakly curved backwards; distal portion of aedeagus with two short ventral subapical hooks, weakly concave along dorso-apical margin; sclerotised end tube of ductus ejaculatorius short, straight. Female proctiger weakly sinuous dorsally, truncate and heavily sclerotised apically; subgenital plate with long apical process; valvula ventralis with a pair of indistinct ventral teeth; dorsal margin of valvula dorsalis weakly concave.

Measurements. (1♂, 1♀). HW 0.73-0.82; WL 3.14-3.60; MP 0.43; PL 0.43; AEL 0.38; FP 0.78; LLHW 0.34-0.35; TLHW 0.92-1.06; WLHW 4.28-4.36; WLW 2.27-2.41; MPHW 0.58; FPHW 0.94; FPC 4.70; FSP 1.33.

Larva unknown.

Holotype ♂, Iran: S Iran, 15 km NW Mian Jangal, 5.vi.1973 (NMP-224).

Paratypes. Iran: 4♂♂, 3♀♀, same data as holotype; 3 adults, same data but (ZI).

Comment. Based on the apically rounded forewings and the bifid parameres *E. gemina* is related to *E. nigracapitata*, *E. verrucifera*, *E. cerina*, and *E. justa* sp. n. described below. It differs from them in the apically truncate female proctiger and the very short anterior arm of the male paramere. Additionally it is separated from *E. justa* in the dark-yellow, apically broadly rounded forewings which are almost colourless and narrowly rounded in *E. justa*. Vein Cu_{1a} is more evenly rounded in the basal half in *E. gemina* than in *E. justa*.

Egeirotrioza justa sp. n. (Figs 97, 101, 106, 110, 114, 120, 121)

Description. Adult. Coloration. Similar in both sexes; greenish or light yellowish with slightly darker, straw-coloured vertex and thoracic dorsum. Antennae yellow with light brown segments 9 and 10. Legs yellow. Forewings transparent, whitish; veins slightly darker and more yellowish than membrane. Hindwings whitish. Abdomen light greenish or yellowish.

Structure. Head (fig. 106), from above, narrower than thorax; foveae forming coarse, deep pits; genal processes conical, well-developed, blunt apically. Third antennal segment 2.5 times as long as segment 4. Forewings (fig. 97) oblong-oval, narrowly rounded apically; vein Rs weakly sinuous, vein Cu_{1a} angularly rounded in basal half. Metatibia with 1+3 or, rarely 2+3 apical spurs; outer spur on distinct process. Terminalia as in figs 101, 110, 114, 120, 121. Male proctiger without apical tube, with almost straight posterior margin; paramere with a short anterior and a long apically strongly dilated posterior arm which is weakly curved backwards; distal portion of aedeagus with a pair of short subapical, ventral teeth, and an almost straight apico-dorsal margin; sclerotised end tube of ductus ejaculatorius short, straight. Female proctiger with weakly convex dorsal margin, subacute and not heavily sclerotised apically; subgenital plate with long apical process; valvula ventralis with a pair of indistinct ventral teeth; dorsal margin of valula dorsalis strongly concave.

Measurements. (1♂, 1♀). HW 0.65-0.70; AL 1.06; WL 2.87-3.08; MP 0.44; PL 0.42; AEL 0.31; FP 0.50; ALHW 1.63; LLHW 0.42; TLHW 0.94-1.06; WLHW 4.40-4.43; WLW 2.51-2.52; MPHW 0.68; FPHW 0.72; FPC 4.74; FSP 1.20.

Fifth instar larva. Coloration (material preserved in alcohol). Dorsal surface ochreous with light brown thorax and two longitudinal stripes on abdomen. Eyes dark. Ventral surface yellow.

Structure. Oval in out-line, flattened and relatively ridgid dorsally, convex and soft ventrally. Fore margin of head with 1 dense, regular and 1-3 sparse, irregular rows of sectasetae. Antennae curved, indistinctly 6 to 7-segmented with 4 rhinaria, segment 3 large, strongly narrowing to apex. Humeral lobes on forewing pads pointed, long and narrow, reaching level of anterior half of eyes. Sectasetae of wing pads and abdominal margin forming a regular row of dense setae and a band of irregularly scattered setae. Tarsal arolium longer than claws, simple triangular, without pedicel or visible unguitractor. Outer circumanal pore ring consisting of a single row of pores. Ventral surface covered in very long simple setae.

Measurements. (2 larvae). AL 0.28-0.30; WL 1.01-1.11; BL 1.59-1.92; CPB 1.01-1.22; AWL 0.25-0.29; BBL 1.23-1.25; CPR 1.78-1.83.

Holotype ♂, Iran: S Iran, 15 km NW Mian Jangal, 5.vi.1973 (NMP-224).

Paratypes. Iran: 1♂, 2♀♀, 1 adult without abdomen, same data as holotype; 2 adults, same data but (ZI); 1♀, Ahwaz, 15.v.1977, *Populus diversifolia* (Gharib) (R-306).

Iraq: 1♂, Mosul, 1.vi.1968, *Populus euphratica* (H. E. Knopf) (BMNH); 1♀, same but 25.v.1968, ex galls on *Populus euphratica*; 1♀, Ninevah, Hammam-Al-Alil, 16.iv.1975, on current year's shoots of *Populus euphratica* (A. Al-Kinany) (BMNH).

Material not included in type series. Iran: many 5th instar larvae, Ahwaz, 15.v.1977, *Populus diversifolia* (Gharib) (R-306).

Comment. Adults of *E. justa* are similar to *E. nigracapitata*, *E. verrucifera*, *E. cerina* and *E. gemina* in the apically rounded forewings and the bifurcate male paramere but differ in the apically narrower forewings, the apically more dilated posterior arm of the paramere, and details of the male and female terminalia (see comments to *E. gemina*).

The larva is similar to *E. longiantennata* in the general body form, the long humeral lobes on the forewing pads and the simple circum anal ring. It differs in the slightly shorter humeral lobes and the shorter marginal sectasetae which form, in addition to the dense regular row, 1-3 sparse irregular rows.

Paratrioza lycii Loginova

Material examined. Iran: 3♀♀, NW Iran, Maku, 19-20.vi.1970 (NMP-25); 1 ♂, 110 km E Mashhad, 34°48'N 48°30'E, 13.v.1966, *Zygophyllum eurypterum* (R-220).

Paratrioza petiolata Loginova

Material examined. Iran: 1 ♀, SE Iran, Ghasemabad, Bampur Valley, 10 km E Bampur, W Iranshahr, 11-12.iv.1973 (NMP-157).

Trioza berbericola Loginova

Material examined. Iran: 5♂♂, 4♀♀, C. Iran, Quanat Marvan, 2850 m, 24-25.v.1977 (NMP-345).

Trioza chenopodii Reuter

Recorded from Iran (LAUTERER, 1982; BURCKHARDT, 1986b).

Material examined. Iran: 25♂♂, 41♀♀, SW Iran, Shushtar, 13.iv.1977 (NMP-287); 1♂, 1♀, Khuzestan, Ahvaz, 17.ii.1978, sweeping (V. F. Eastop) (BMNH); 5♂♂, 7♀♀, same but 26.ii.1978, *Chenopodium* sp. or *Atriplex* sp.; 2♂♂, 3♀♀, same but 10.iv.1978, sweeping; many ♂♂, ♀♀ and 5th instar larvae, Ahvaz, 25. xii.1963, *Beta vulgaris* (Chodjaï) (R-210) (MNHN, USNM); 1♂, Shiraz, Minassian, 13.x.1967 (NMP).

Comment. The material from Ahvaz constitutes the first record of *T. chenopodii* f. *autumnalis* from *Beta vulgaris* in nature, though the species was bred before, under laboratory conditions on *Beta* (LAUTERER, 1982). LAUTERER & ŠRÁMKOVÁ (1983) considered the possible pest status of this species on sugar beet.

Trioza dichroa Scott

Recorded from Iran (BURCKHARDT, 1986b).

Material examined. Iran: 4♂♂, 3♀♀, Khuzestan, Ahvaz, Golestan, 25.ii.1978, *Chenopodium* sp. or *Atriplex* sp. (V. F. Eastop) (BMNH); 5♂♂, 2♀♀, same but 12.iv.1978, *Atriplex* sp.

Trioza elaeagni Scott

Material examined. Iran: 1♂, S Iran, Kushk, N Masírí, 1800 m, 12.vi.1973 (NMP-237); 1♂, 1♀ (teneral), many 5th instar larvae, N Iran, Tehran, 1955, *Elaeagnus* sp. (R-177); 4♂♂, 3♀♀, many 5th instar larvae, 50 km W Shiraz, 22.x.1967, *Elaeagnus* sp. (R-230).

Trioza eurotiae Loginova

Material examined. Iran: 3♂♂, 5♀♀, Zardband, N Karaj, 15.x.1955, *Kochia cana* (R-211).

Comment. As in *T. chenopodii* and *dichroa*, the autumnal generation of *T. eurotiae* is characterised by shorter forewings and greyish general body coloration.

Trioza galii Förster

Material examined. Iran: 1♂, 2♀♀, Hamadan, 34°48'N 48°30'E, 15.v.1966, yellow pan tray (Klett) (R-222).

Trioza magnisetosa Loginova

Material examined. Iran: 4♂♂, 2♀♀, NW Iran, Marand, 20.vi.1970 (NMP-26); 2♂♂, 2♀♀, Taftan, Tamadan, 2100 m, 20.iv.1973 (NMP-167); 1♂, E Iran, Mohammadabad, 1600 m, 3-5.v.1973 (NMP-187); 2♂♂, 2♀♀, S Iran, Zagros, Yasuj, 16.vi.1973 (NMP-243).

Trioza neglecta Loginova

Recorded from Iran: NW Iran, Maku, 19.iv.1970 (NMP-25) (Loginova, 1978a; Gegechkori & Loginova, 1990).

Material examined. Iran, 3♂♂, NW Iran, Maku, 19-20.vi.1970 (NMP-25); 1♂, S Iran, Zagros, Yasuj, 16.vi.1973 (NMP-243).

Trioza cf. **remota** Förster

Material examined: Iran: 1 4th instar larva, 15 km NW Khorramabad, 33°30'N 48°20'E, 1650 m, 29.x.1967, *Quercus persica* (= *Quercus brantii* Lindley) (R-238); 1♀, same but 25 km W Khorramabad, 30.x.1967 (R-240).

Comments. The material at hand is insufficient for a definitive identification. It is possible that the specimens do not belong to the two described European oak-feeding triozids: *Trioza remota* Förster and *Trioza iliciua* (de Stefani). *Quercus brantii* is a deciduous shrub or small tree confined to E and SE Anatolia, the Syrian Desert, N Iraq, W and S Iran (Hedge & Yaltirik, 1982).

Trioza rumicis Löw

Material examined. Iran: many ♂♂, ♀♀ and larvae, road Gash Sar, N Karaj, 1900 m, 7.ix.1972, *Rumex scutatus* (R-247).

Trioza scottii Löw

Material examined. Iran: 2♂♂, many exuviae of 5th instar larvae, road of Shemshak, N Tehran, 2000 m, 4.xi.1955, *Berberis integerrima* (R-195); 1♂, Rudak, N Tehran, 2.v.1966, *Berberis* sp. (R-217).

Trioza urticae (Linnaeus)

Material examined. Iran: 11♂♂, 13♀♀, N Iran, 6 km E Zibar, 24-26.vi.1977 (NMP-382); 1♂, 3♀♀, 10 km N Polur, 35°52'N 52°03'E, 2850 m, 1.v.1962 (R-204); 2♂♂, 2♀♀, Now Shahr, 36°39'N 51°31'E, v.1978 (J. H. Hodjat) (BMNH); 1♂, same but 21.iii.1978, *Urtica dioica* (V. F. Eastop); 1♂, 3♀♀, same but, Mazandran, Now Shahr, 22-25.iii.1978, sweeping.

Trioza spp.

Comment. The following three lots of material represent additional species but cannot be identified in the absence of the taxonomically relevant males.

Material examined. Iran: 1♀, 2 larvae, 50 km SE Kerman, 20.vi.1955, *Hertia intermedia* (R-184) (MHNG, USNM).

Iran: 1♀, E Iran, Deh Bakri, 1700-1750 m, 30.iv-3.v.1973 (NMP-126); 1♀, C. Iran, Lalehzar, 2800 m, 24-30.v.1977 (NMP-347) .

Iran: 1♀, S Iran, Zagros, Yasuj, 16.vi.1973 (NMP-243).

BIOGEOGRAPHY

BACKGROUND

An aim of historical biogeography is the study of area interrelationships. These can be investigated with the techniques of cladistic biogeography (NELSON & PLATNICK, 1981; HUMPHRIES & PARENTI, 1986; HUMPHRIES, 1992) or panbiogeography (CRAW, 1988, 1989). The area relationships are derived from taxon cladograms in cladistic biogeography and from tracks, joining plotted distributions of taxa, in panbiogeography (BASTOW WILSON, 1991). In both approaches, most information is drawn from taxa endemic to the areas under consideration. However, in practice taxa often occur in more than one area. Different statistical methods exist to measure the degree of similarity among areas on the basis of number of shared taxa, but, as they are phenetic, they are of little use in investigating historical aspects. ROSEN (1985, 1988) introduced a parsimony analysis of endemicity (PAE) in which, by analogy with cladistic analysis, the shared presence (synapomorphies) of taxa (characters) is used to formulate hypotheses of historical relationships (phylogenies) of areas (taxa). This approach was used by CRACRAFT (1991) to analyse Australian areas of endemism on the basis of vertebrate distributions. ROSEN (1988) stressed that this method was experimental and CRACRAFT (1991) discussed its merits and limitations.

For continents or other large geographical units, the degree of endemism is often sufficiently high to use the methods of cladistic biogeography or panbiogeography. For smaller geographical units, such as Iran, this is often not possible due to the very low degree of endemism. Here we use PAE.

AREAS

PARSA (1978) subdivided Iran into nine biotic provinces (fig. 2), but without giving much detail on the criteria he chose for delimiting the areas. They correspond partly with the physical-geographical areas proposed by PETROV (1955). The geographical/geological (=historical) character makes these subdivisions useful units for analysis in historical biogeography and they are adopted here. Based on the study of the Iranian rodent fauna NERONOV (1976) proposed a similar zonation. For the following analyses 6 additional areas outside Iran were added: Turkey, the territory South of the Caucasus of the former USSR, Central Asia (Tadzhikistan, Uzbekistan and Kazakhstan), Afghanistan/Pakistan, the Arabian Peninsula, and Palestine (Israel, Lebanon and Syria). Mesopotamia was excluded owing to a lack of records.

TECHNIQUES

The presence/absence of species, genera, subfamilies and families in each of the 9 biotic Iranian provinces and the 6 regions outside Iran was coded in a matrix for analysis with PAUP 3.0 (SWOFFORD, 1989). The most parsimonious trees were selected using the heuristic search algorithm. Trees were rooted with an artificial "outarea" lacking taxa (Lundberg rooting).

Three sets of data were analysed:

Analysis 1: All species, genera, subfamilies and families known from Iran (= 131 taxa) with their occurrences in each of the areas inside Iran (fig. 122).

Analysis 2: Same taxa but with their occurrences in all of the areas inside and outside Iran (fig. 124).

Analysis 3: All known psyllid taxa occurring in the 9 areas within and the 6 areas outside Iran (= 492 taxa). The information is taken from following sources: BURCKHARDT & ÖNUÇAR (1993) (Turkey), GEGECHKORI & LOGINOVA (1990) (South Caucasus and Central Asia), HODKINSON (1986) (Afghanistan/Pakistan), BURCKHARDT (1986a) (the Arabian Peninsula) and BURCKHARDT & HALPERIN (1992) (Palestine). These sources were supplemented by material deposited in the MHNG (fig. 125).

For comparison the distributions of mammals were analysed based on the data in MISONNE (1960) using the classification of NOWAK (1991) (fig. 123).

DISCUSSION

Analysis 1 yielded 3 trees with following informations: tree length = 197, consistency index excluding uninformative characters = 0.504, retention index = 0.400. A strict consensus tree is illustrated in fig. 122. Analysis 2 yielded 1 tree (fig. 124) with following informations: tree length = 312, consistency index excluding uninformative characters = 0.389, retention index = 0.486. Analysis 3 yielded 9 trees with following informations: tree length = 743, consistency index excluding uninformative characters = 0.472, retention index = 0.499. A strict consensus tree is illustrated in fig. 125. The analysis of the mammal data yielded 2 trees with following informations: tree length = 358, consistency index excluding uninformative characters = 0.495, retention index = 0.548. A strict consensus tree is illustrated in fig. 123.

In all three cladograms derived from psyllid data (figs 122, 124, 125) the Caspian and Azerbaidzhanian regions occupy a relatively basal position; in analysis 2 they even form a monophyletic group. This is mainly due to the small number of species known from these areas. Similarly the sister group relationships of the South Caucasus and Central Asia is probably a result of the much better knowledge of the psyllid faunas of these areas compared to others; the number of recorded taxa is almost twice that known from Iran as a whole. The close relationships of the Elburzian and Lutian regions in all three analyses, grouped together with Turkey, South Caucasus and Central Asia in analyses 2 and 3 may indicate true historic relationships. The position of the remaining areas varies greatly in the three analyses and there is no congruence between any of them and the mammal cladogram (fig. 123).

The discrepancies between the four cladograms suggest that the psyllid data are insufficient. The PAE (performed with PAUP) is strongly dependant on similar levels of faunistic knowledge among the different regions which are compared. This is because shared absence of taxa is equally weighted as shared presence of taxa. In biogeography absence is however not "homologous", as it can be due to different histories. 1. A taxon may be lacking in an area because its ancestors did not inhabit the area. 2. A taxon may be lacking from an area even though ancesters occured there, as the species became extinct. 3. A taxon may occur in an area but has not yet been dicovered. Cladistic biogeography and panbiogeography are more robust as they depend only on presence of taxa.

Another problem is the delimitation of areas of endemism which could be solved with a better knowledge of the detailed distribution of all analysed taxa.

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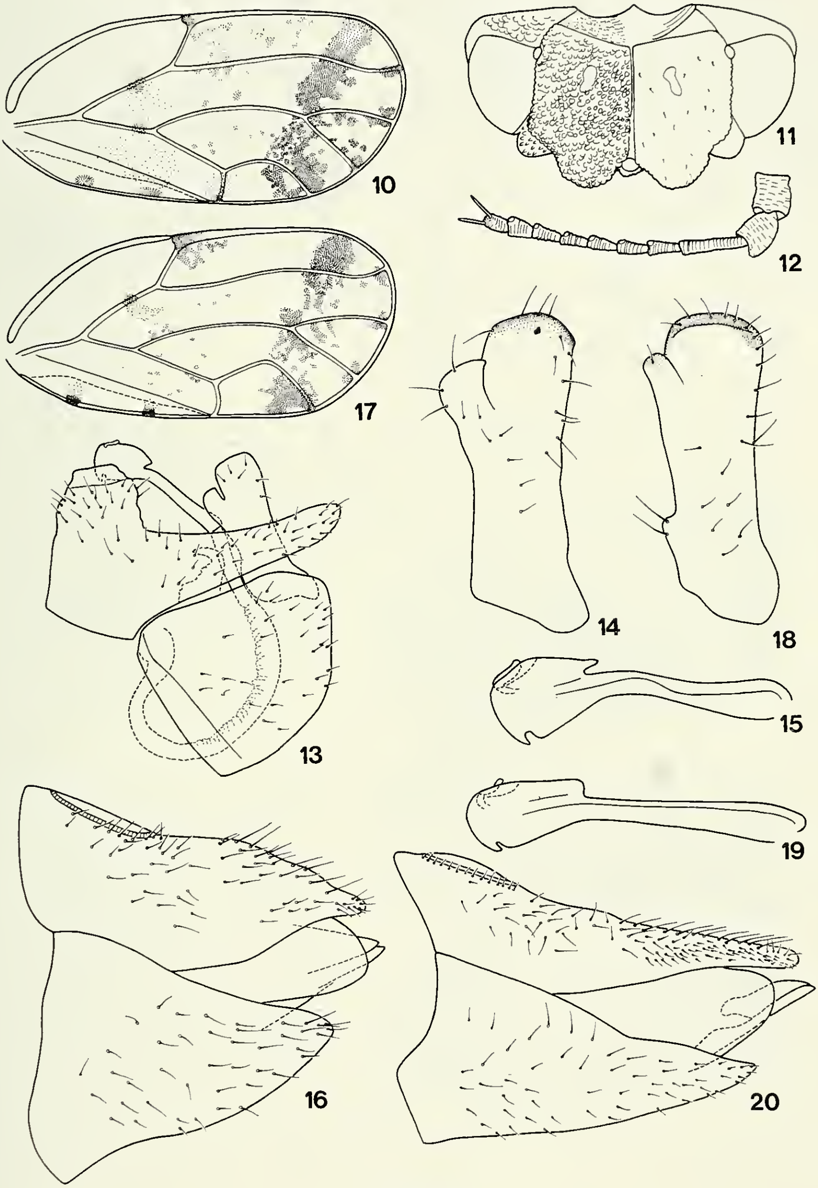
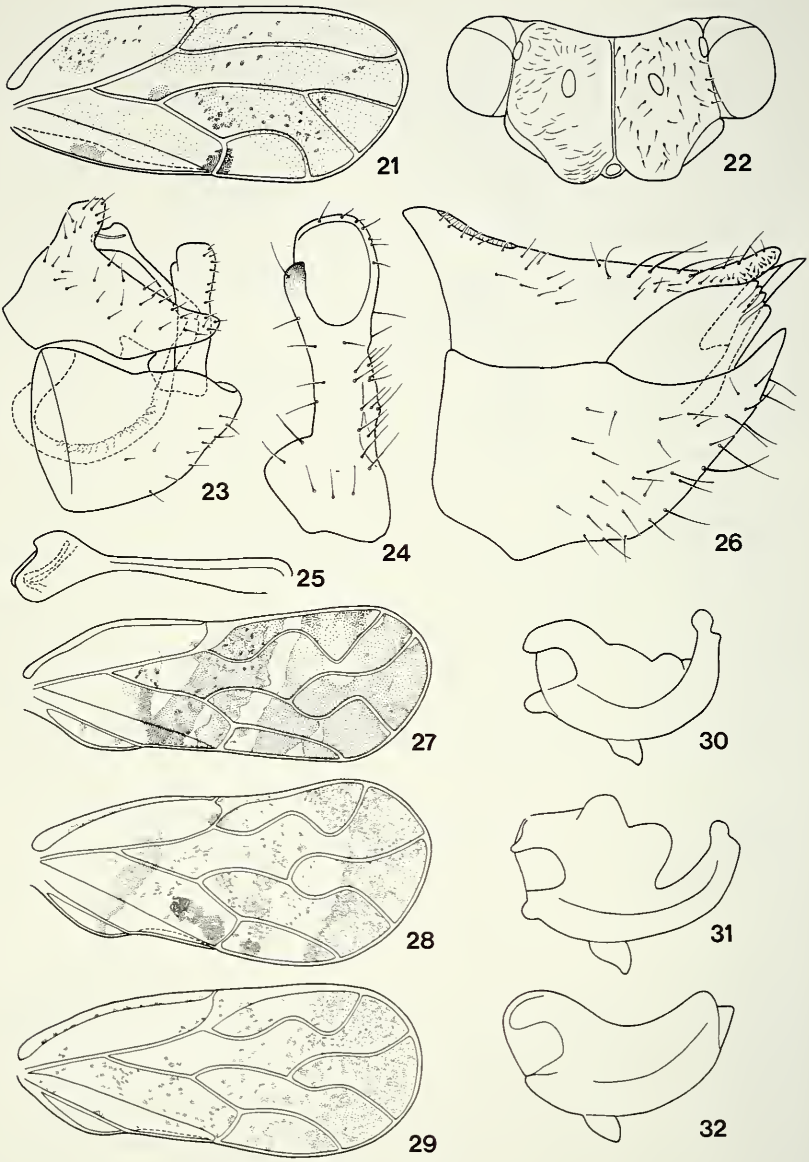


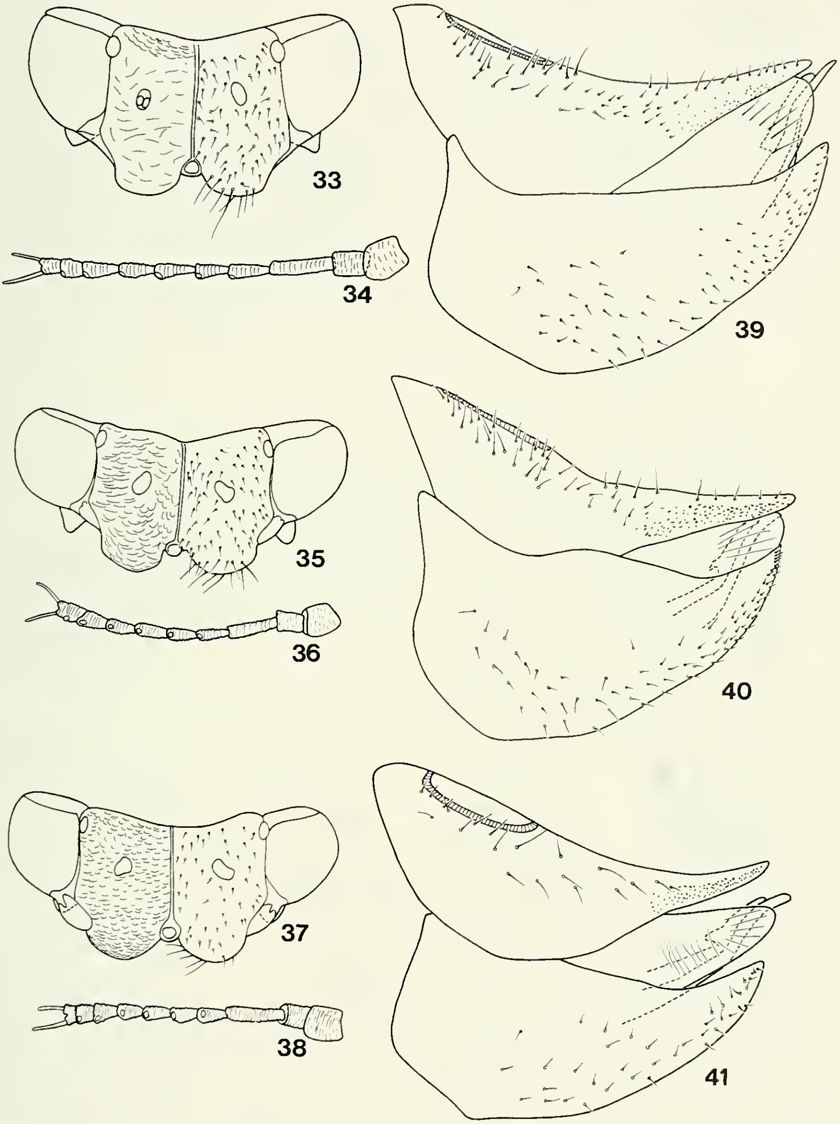
Figs 10-20

Aphalara spp.; 10-16, *A. loginovae*; 17-20, *A. grandicula*. 10, 17, Forewing; 11, head, dorsal view: 12, antenna; 13, male terminalia in profile; 14, 18, inner aspect of male paramere; 15, 19, distal portion of aedeagus; 16, 20, female terminalia in profile.



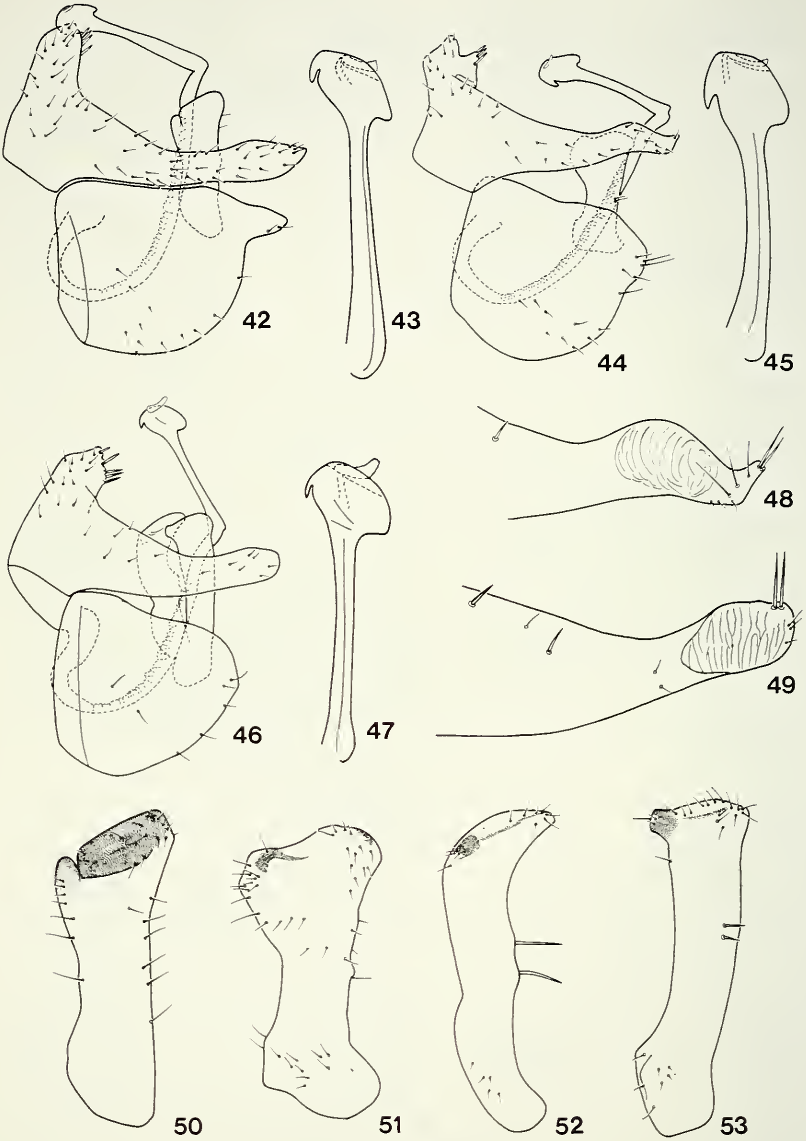
FIGS 21-32

21-26, *Brachystetha loginovae*; 27-32, *Colposcenia* spp.; 27, 30, *Colposcenia agnata*; 28, 31, *C. cavillosa*; 29, 32, *C. paula*. 21, 27-29, Forewing; 22, head, dorsal view; 23, male terminalia, in profile, 24, inner aspect of male paramere; 25, distal portion of aedeagus; 26, female terminalia, in profile; 30-32, metacoxae.



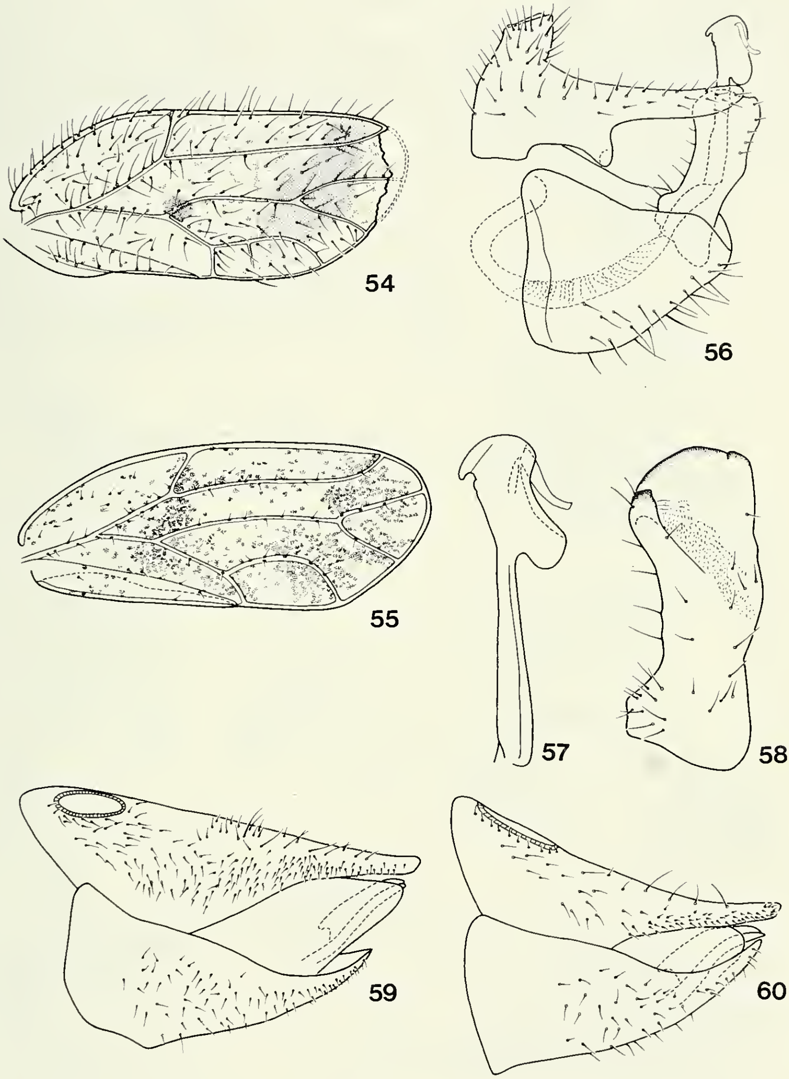
FIGS 33-41

Colposcenia spp.; 33, 34, 39, *C. agnata*; 35, 36, 40, *C. cavillosa*; 37, 38, 41, *C. paula*. 33, 35, 37, Head, dorsal view; 34, 36, 38, antenna; 39-41, female terminalia, in profile.



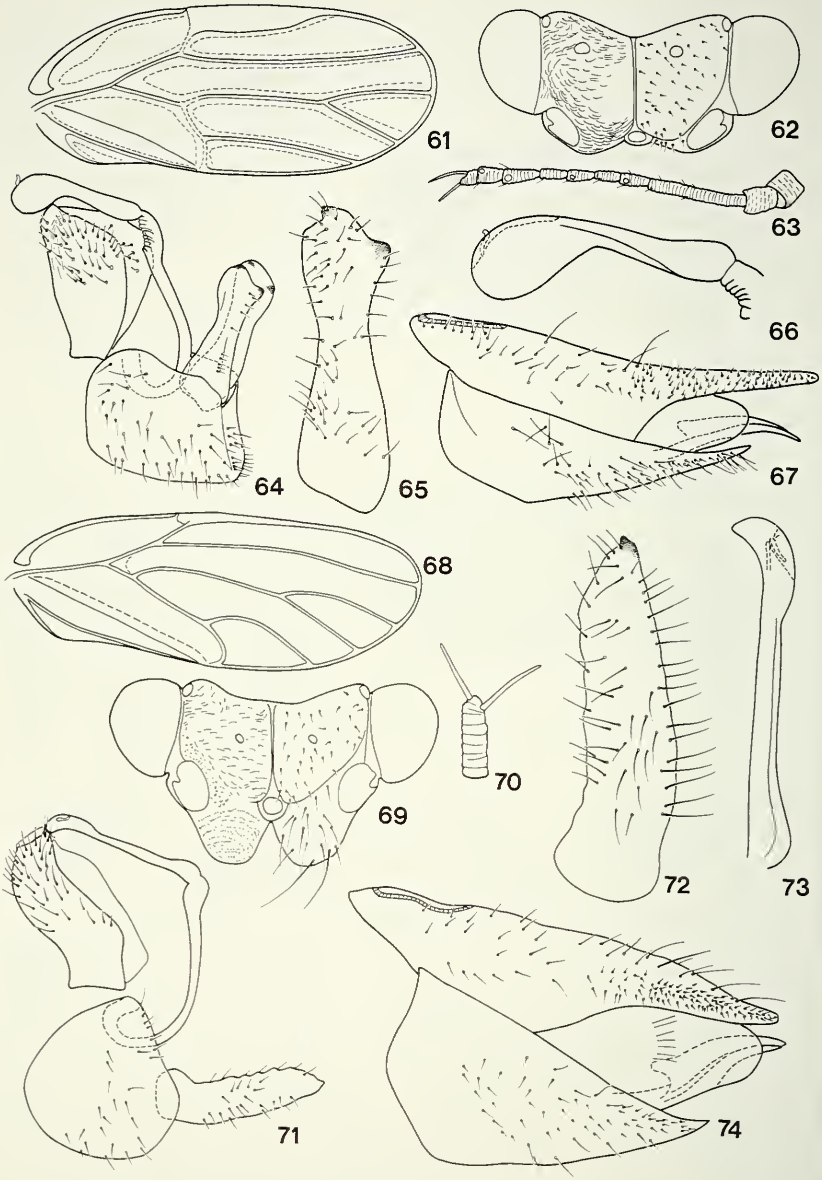
FIGS 42-53

Colposcenia spp.; 42, 43, 50, *C. agnata*; 44, 45, 48, 51, *C. cavillosa*; 46, 47, 49, 52, 53, *C. paula*. 42, 44, 46, Male terminalia, in profile; 43, 45, 47, distal portion of aedeagus; 48, 49, apex of inner surface of posterior lobes of male proctiger; 50-52, inner surface of male paramere; 53, male paramere, antero-interior view.



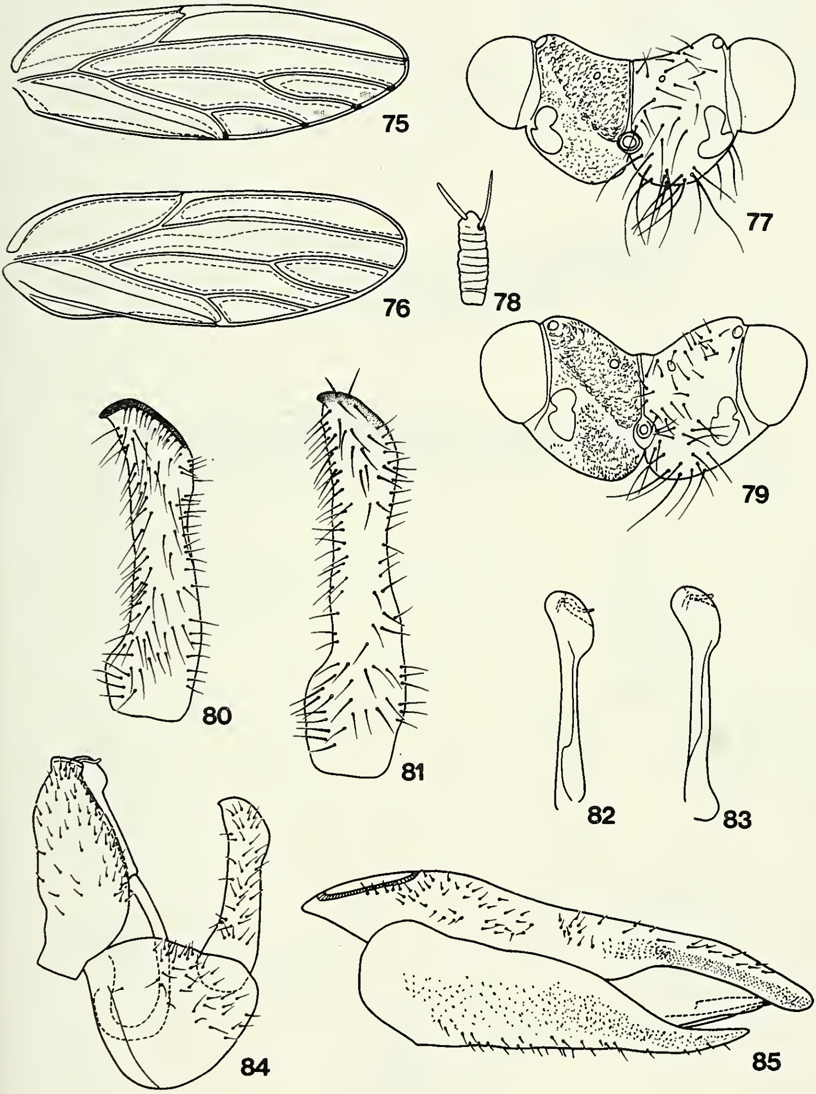
Figs 54-60

Craspedolepta spp.; 54, 56-59, *C. remaudierei*; 55, 60, *Craspedolepta* sp. A. 54, 55, Forewing; 56, male terminalia, in profile; 57, distal portion of aedeagus; 58, inner surface of male paramere; 59, 60, female terminalia, in profile.



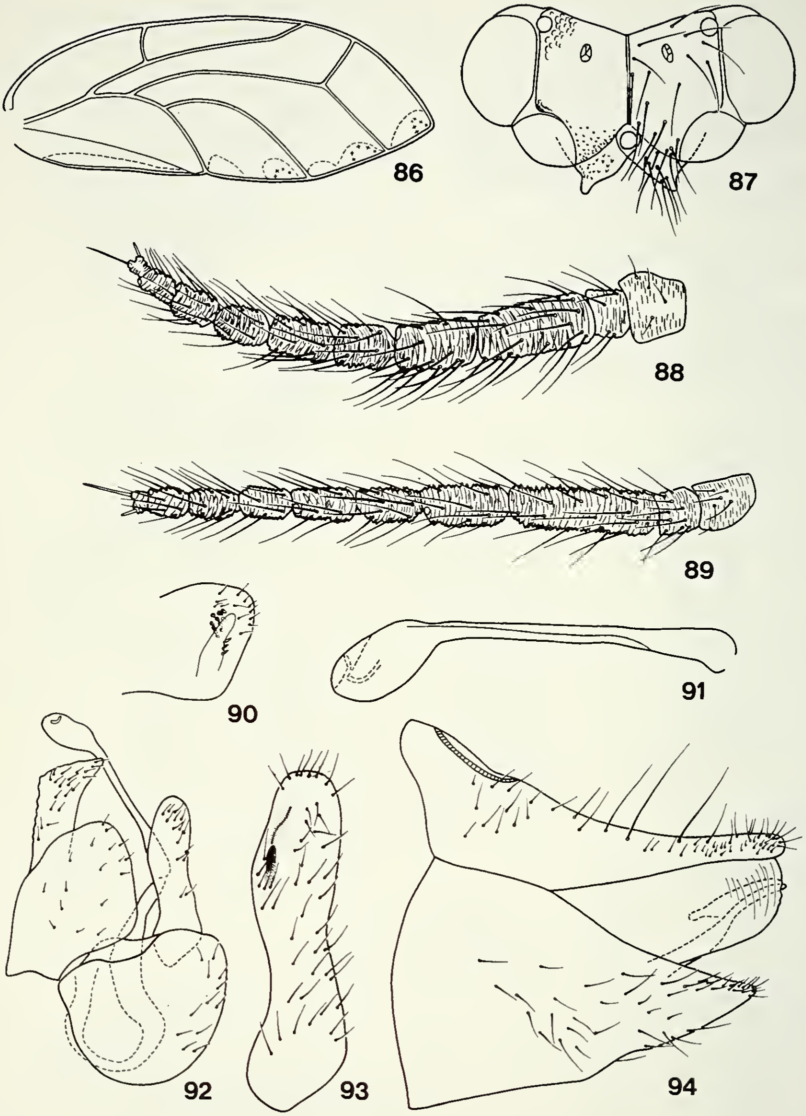
Figs 61-74

61-67, *Camaroroscena unicolor*; 68-74, *Cacopsylla iranica*. 60, 68, Forewing; 62, 69, head, dorsal view; 63, antenna; 64, 71, male terminalia, in profile; 65, 72, inner surface of male paramere; 66, 73, distal portion of aedeagus; 67, 74, female terminalia, in profile; 70, antennal segment 10.



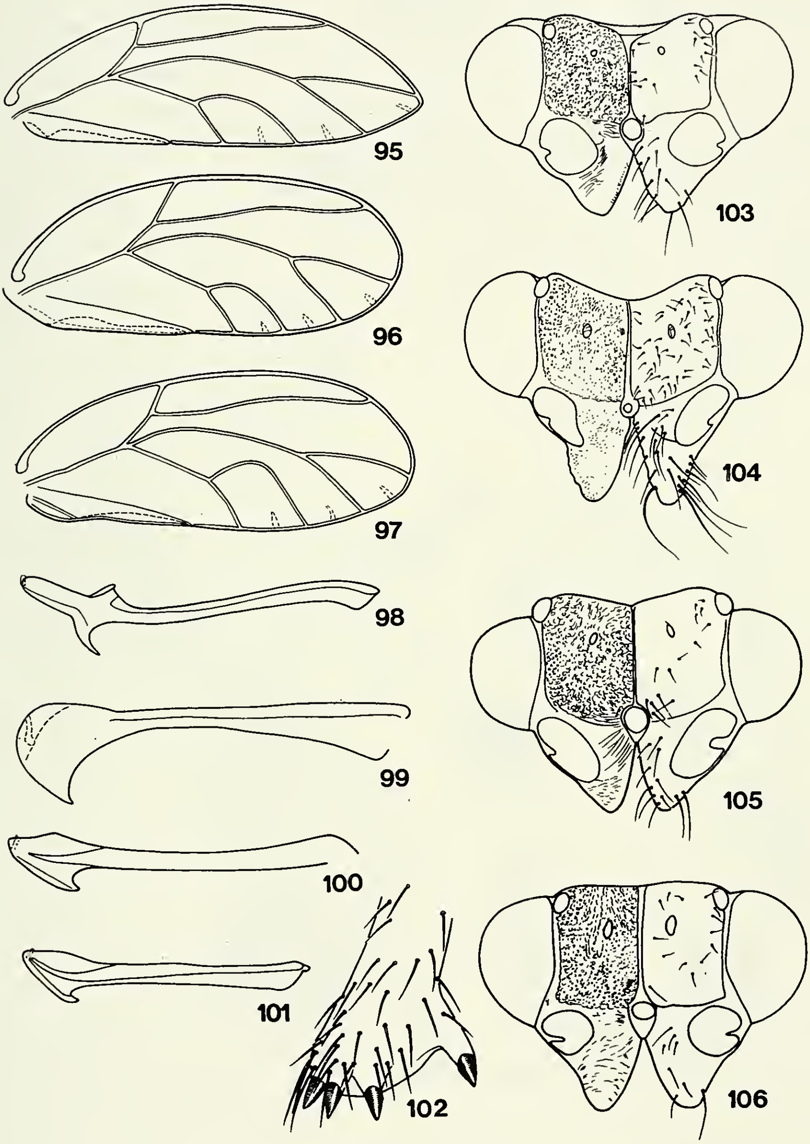
FIGS 75-85

Spanioneura spp.; 75, 77, 78, 80, 82, 84, 85, *S. persica*; 76, 79, 81, 83, *S. turkiana*. 75, 76, Forewing; 77, 79, head, dorsal view; 78, antennal segment 10; 80, 81, inner surface of male paramere; 82, 83, distal portion of aedeagus; 84, male terminalia, in profile; 85, female terminalia, in profile.



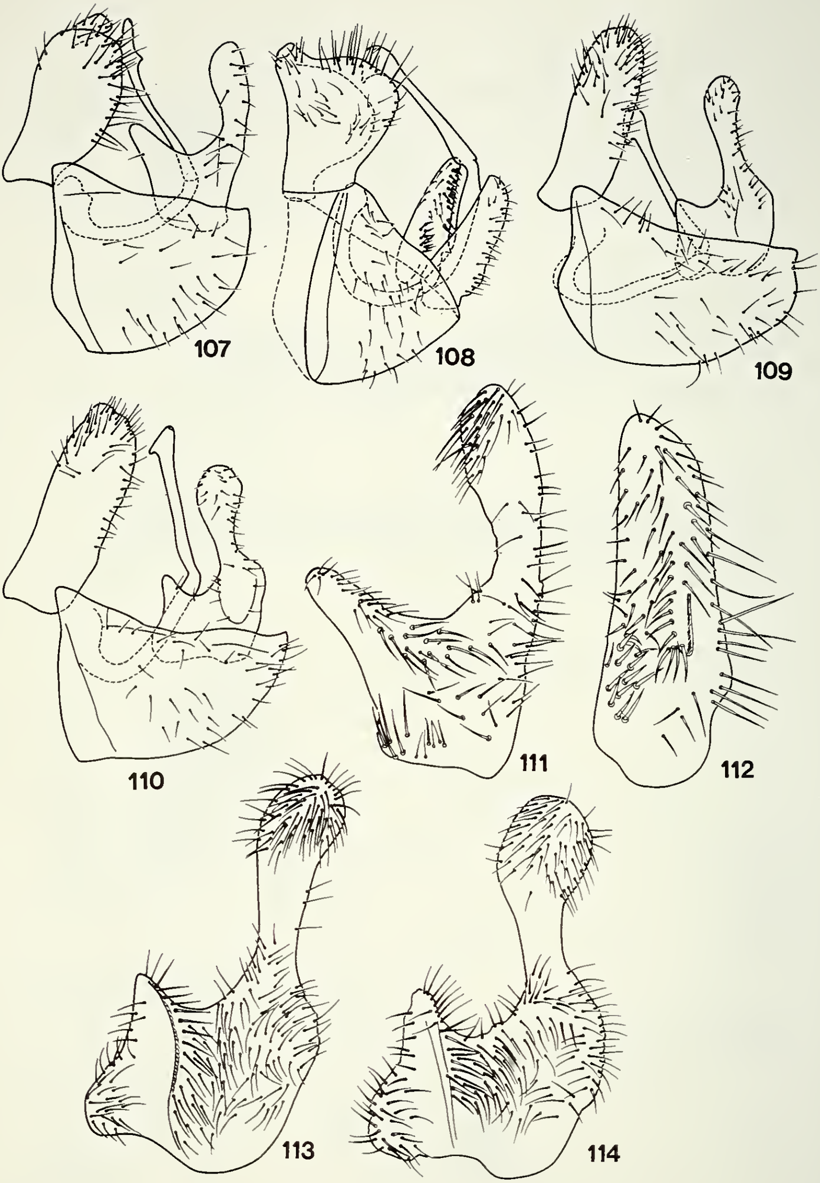
FIGS 86-94

Homotoma spp.; 86-88, 90-94, *H. caroliquarti*; 89, *H. ficus*. 86, Forewing; 87, head, dorsal view; 88, 89, antenna; 90, inner surface of posterior lobe of male proctiger; 91, distal portion of aedeagus; 92, male terminalia, in profile; 93, inner surface of male paramere; 94, female terminalia, in profile.



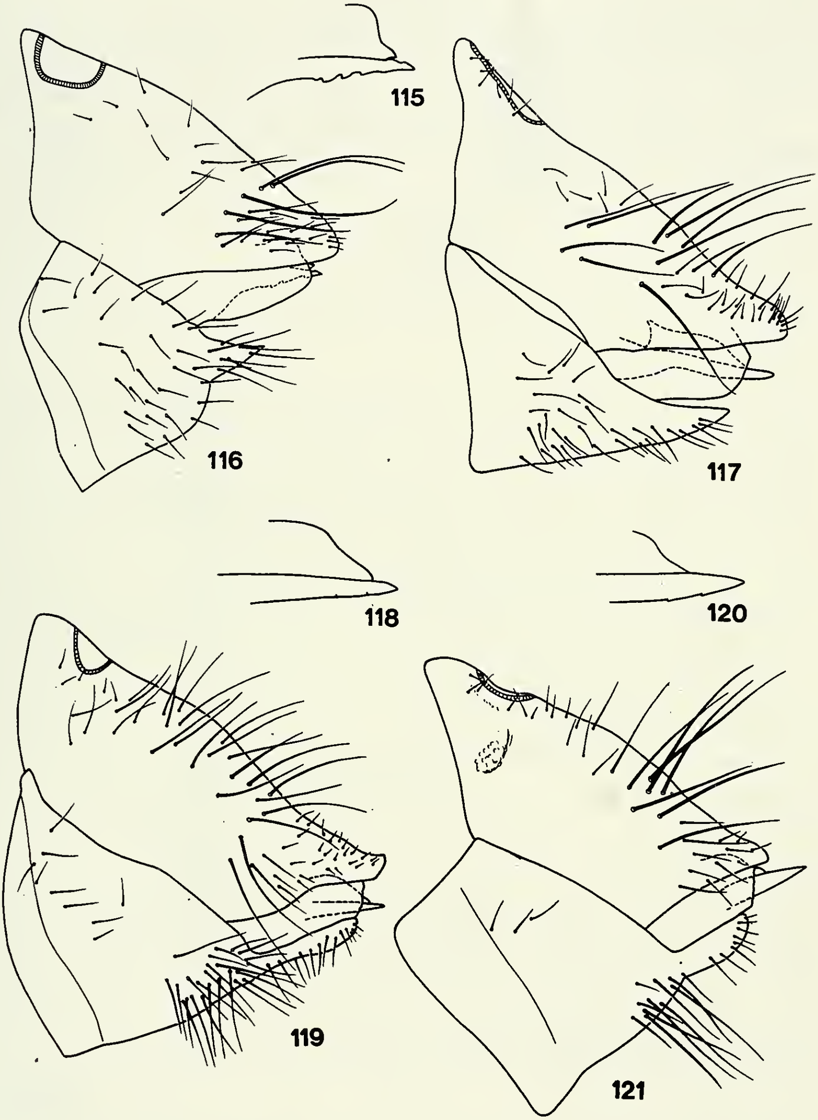
FIGS 95-106

Egeirotrioza spp.; 95, 98, 102, 103, *E. corporosa*; 96, 100, 105, *E. gemina*; 97, 101, 106, *E. justa*; 99, 104, *E. gardneri*. 95-97, Forewing; 98-101, distal portion of aedeagus; 102, apex of metatibia; 103-106, head, dorsal view.



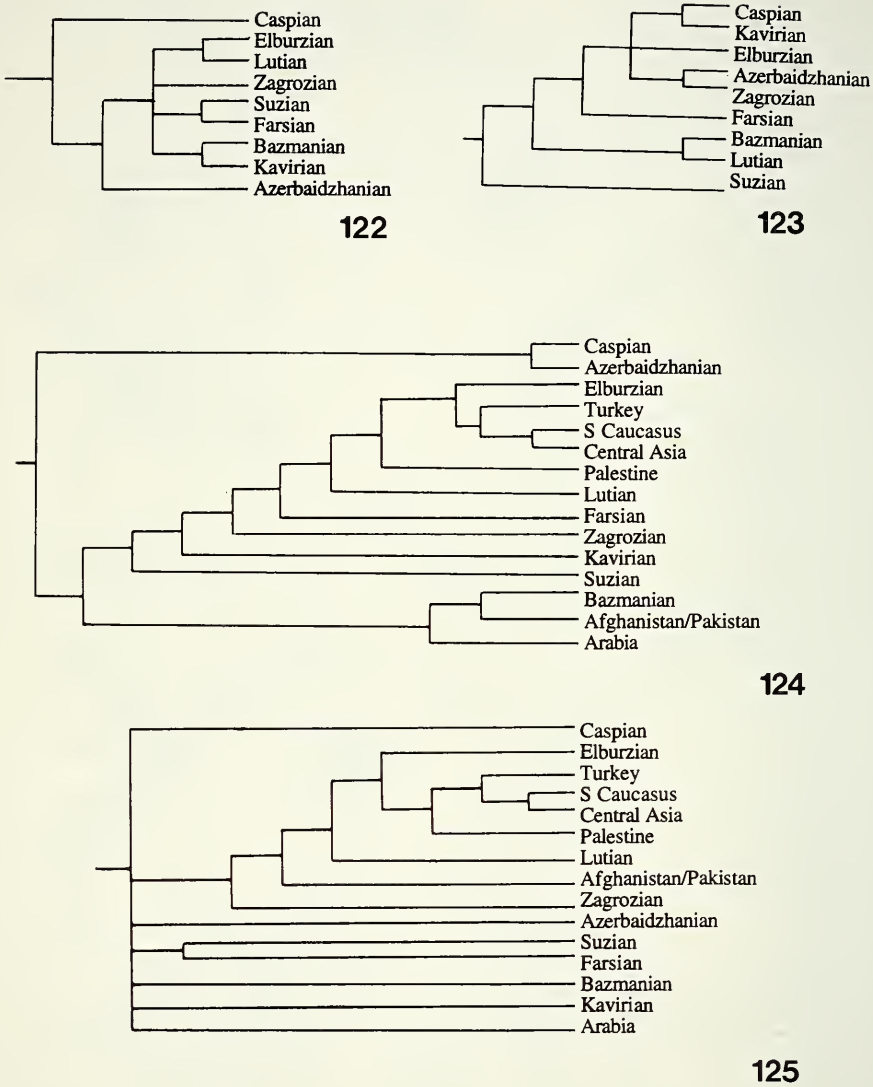
Figs 107-114

Egeirotrioza spp.; 107, 111, *E. corporosa*; 108, 112, *E. gardneri*: 109, 113, *E. gemina*; 110, 114, *E. justa*. 107-110, Male terminalia, in profile; 111-114, inner surface of male paramere.



FIGS 115-121

Egeirotrioza spp.; 115, 116, *E. corporosa*; 117, *E. gardneri*; 118, 119, *E. gemina*; 120, 121, *E. justa*. 115, 118, 120, valvulae 1 and 2; 116, 117, 119, 121, female terminalia, in profile.



FIGS 122-125

Cladograms for 9 areas of endemism in Iran and 6 regions outside Iran (see text for details); 122, analysis 1: all psyllid taxa from Iran; 123, mammal distributions in Iran according to MISONNE (1960) and NOWAK (1991); 124, analysis 2: psyllid taxa from Iran with their occurrences inside and outside Iran; 125, analysis 3: all psyllid taxa from the Middle East.

REFERENCES

ANONYMOUS 1956. Gazetteer. Iran. Official standard names approved by the U. S. Board on geographic names. Office of Geography, Department of Interior, Washington, D. C., 578 pp.

BAEVA, V. G. 1970. O dvuch novych vidach psillid roda *Craspedolepta* Enderl. (Homoptera, Psylloidea) iz Tadzhikistana. *Dokl. Akad. Nauk tadzhik. SSR*, 13: 64-67.

BAEVA, V. G. 1978. New species of jumping plant lice (Homoptera, Psylloidea) from Middle Asia. *Zool. Zh.*, 57: 32-45. (In Russian).

BAEVA, V. G. & A. A. ALEKSEEV. 1991. Psyllids of the genus *Brachystetha* (Homoptera, Psylloidea). *Zool. Zh.*, 70: 143-148. (In Russian).

BASTOW WILSON, J. 1991. A comparison of biogeographic models: migration, vicariance and panbiogeography. *Global Ecol. Biogeogr. Letters*, 1: 84-87.

BECKER, A. 1864. Naturhistorische Mittheilungen. *Bull. Soc. imp. Naturalistes, Moscou*, 37: 477-493.

BERGEVIN, E. de. 1926. Description d'une nouvelle espèce de *Trioza* (Hémiptère Psyllidae) produisant une galle sur *Populus euphratica* Oliv. var. *Bonnetiana* Dod. dans le Sud orano-marocain. *Bull. Soc. hist. nat. Afr. N.*, 17: 149-153.

BOSELLI, F. B. 1931. Studii sugli Psyllidi (Homoptera: Psyllidae o Chermidae) X. Instituzione di un nuovo genere e descrizione de *Egeirotrioza ceardi* (De Bergevin) *euphratica* n. var., Triozina galligena su *Populus euphratica* in Mesopotamia. *Boll. Lab. Zool. gen. agr. Fac. agr. Portici*, 24: 267-278.

BURCKHARDT, D. 1985. The mediterranean species of *Diaphorina* Loew (Homoptera, Psylloidea). *Phytophaga, Palermo*, 2 (1984): 1-30.

BURCKHARDT, D. 1986a. Sternorrhyncha: Suborder Psyllodea of Saudi Arabia (Part 2). *Fauna of Saudi Arabia*, 7 (1985): 141-159.

BURCKHARDT, D. 1986b. Redescription of *Trioza sahlbergi* Šulc with comments on the genus *Heterotrioza* (Hem.-Hom., Psyllidae). *Entomologists's mon. Mag.*, 122: 121-126.

BURCKHARDT, D. 1987. Jumping plant lice (Homoptera: Psylloidea) of the temperate neotropical region. Part 1: Psyllidae (subfamilies Aphalarinae, Rhinocolinae and Aphalaroidinae). *Zool. J. Linn. Soc.*, 89: 299-392.

BURCKHARDT, D. & J. HALPERIN. 1992. Additions to the psyllid fauna of Israel (Homoptera: Psylloidea). *Israel J. Ent.*, 25-26: 41-50.

BURCKHARDT, D. & I. D. HODKINSON. 1986. A revision of the west Palaearctic pear psyllids (Hemiptera: Psylloidea). *Bull. ent. Res.*, 76: 119-132.

BURCKHARDT, D. & P. LAUTERER. 1989. Systematics and biology of the Rhinocolinae (Homoptera: Psylloidea). *J. nat. Hist.*, 23: 643-712.

BURCKHARDT, D. & A. ÖNUÇAR. 1993. A review of Turkish jumping plant lice (Homoptera, Psylloidea). *Revue suisse Zool.*, 100: 547-574.

CRACRAFT, J. 1991. Patterns of diversification within continental biotas: hierarchical congruence among areas of endemism of Australian vertebrates. *Aust. Syst. Bot.*, 4: 211-227.

CRAW, R. 1988. Panbiogeography: method and synthesis in biogeography, pp. 405-435. In: Analytical biogeography (A.A. Myers & P.S. Giller, eds.). *Chapman & Hall, London*, 578 pp.

CRAW, R. 1989. Quantitative panbiogeography: introduction to methods. *N. Z. J. Zool.*, 16: 485-494.

DAVATCHI, G. A. 1958. Etude biologique de la faune des *Pistacia* sauvages et cultivés. *Revue Path. vég. Ent. agric. Fr.*, 37: 1-166.

GEGECHKORI, A. M. 1973. A new species of Psyllidae (Homoptera, Psylloidea) from Georgia. *Soobshch. Akad. Nauk gruz. SSR*, 69: 181-184. (In Russian).

GEGECHKORI, A. M. 1977. New jumping plant lice (Homoptera, Psylloidea) from Transcaucasia and Iran. *Zool. Zh.*, 56: 789-793. (In Russian).

GEGECHKORI, A. M. 1981. New genus and species of Psylloidea (Homoptera) from Transcaucasus and Jugoslavia. *Zool. Zh.*, 60: 695-703. (In Russian).

GEGECHKORI, A., M. & M. M. LOGINOVA. 1990. Psillidy SSSR. *Akad. Nauk Gruz., Tbilisi*, 164 pp.

HALPERIN, J., I. D. HODKINSON, L. M. RUSSELL & M. J. BERLINGER. 1982. A contribution to the knowledge of the psyllids of Israel (Homoptera: Psylloidea). *Israel J. Ent.*, 16: 27-44.

HEDGE, I. C. & F. YALTIRIK. 1982. *Quercus* L., pp. 659-682. In: Flora of Turkey and the East Aegean Islands, 7 (P. H. Davis, ed.). University Press, Edinburgh, XX, 947 pp.

HESLOP-HARRISON, G. 1946. A contribution to our knowledge of the distribution of certain Palaearctic Psyllidae (Hem.). *Entomologist's mon. Mag.*, 82: 36-37.

HESLOP-HARRISON, G. 1949. The subfamily Liviinae Löw, of the homopterous family Psyllidae. - Part 2: (a) subfamily diagnosis; (b) an outline of the genera and species of the Liviinae; (c) the biology of *Livia juncorum* Latr. and a description of two new British varieties; (d) three new species of the Liviinae. *Ann. mag. nat. hist.*, ser. 12, vol. 2: 241-270.

HOBERLANDT, L. 1974. Results of the Czechoslovak-Iranian Entomological expedition to Iran 1970. No. 1: Introduction. *Acta ent. Mus. natn. Pragae*, suppl. 6: 9-20.

HOBERLANDT, L. 1981. Results of the Czechoslovak-Iranian Entomological expeditions to Iran. Introduction to the second expedition 1973. *Acta ent. Mus. natn. Pragae*, 40: 5-32.

HOBERLANDT, L. 1983. Results of the Czechoslovak-Iranian Entomological expeditions to Iran. Introduction to the third expedition 1977. *Acta ent. Mus. natn. Pragae*, 41: 5-24.

HODKINSON, I. D. 1981. Status and taxonomy of the *Trioza (Bactericera) nigricornis* Förster complex (Hemiptera: Triozidae). *Bull. ent. Res.*, 71: 671-679.

HODKINSON, I. D. 1984. The taxonomy, distribution and host plant range of the pear feeding psyllids (Homoptera: Psylloidea), 32-44. In: Lutte intégrée contre les psylles du poirier, Toulouse, 27.-29.ix.1983 (Atger, P. *et al.*, eds). *Bull. SROP, WPRS Bull.*, 1984/vii/5, 388 pp.

HODKINSON, I. D. 1986. The psyllids (Homoptera: Psylloidea) of the Oriental Zoogeographical Region: an annotated check-list. *J. nat. Hist.*, 20: 299-357.

HODKINSON, I. D. 1989. Jumping plant lice (psyllids) and significant aspects of two recent introductions into South America and the Pacific. *Pl. Prot. Bull. F.A.O.*, 37: 180-181.

HODKINSON, I. D. & D. HOLLIS. 1987. The legume-feeding psyllids (Homoptera) of the west Palaearctic Region. *Bull. Br. Mus. nat. Hist. (Ent.)*, 56: 1-86.

HODKINSON, I. D. & I. M. WHITE. 1979. Psylloidea (Homoptera). *Handbk Ident. Br. Insects*, 2 (5a), 98 pp.

HOLLIS, D. & P. S. BROOMFIELD. 1989. *Ficus*-feeding psyllids (Homoptera), with special reference to the Homotomidae. *Bull. Br. Mus. nat. Hist. (Ent.)*, 58: 131-183.

HOUARD, C. 1922. Les zoocécidies des plantes d'Afrique, d'Asie et d'Océanie, 1. *Librairie scientifique Jules Hermann, Paris*, 496 pp.

HUMPHRIES, C. J. 1992. Cladistic biogeography, pp. 137-159. In: Cladistics, a practical course in systematics (P. L. Forey, C. J. Humphries, I. J. Kitching, R. W. Scotland, D. J. Siebert, & D. M. Williams, eds.). *The Systematics Association publ.*, 10: 191 pp.

HUMPHRIES, C. J. & L. PARENTI. 1986. Cladistic biogeography. *Clarendon Press, Oxford*, x + 98 pp.

KLIMASZEWSKI, S. M. 1973. The jumping plant lice or psyllids (Homoptera, Psylloidea) of the Palaearctic. An annotated check-list. *Annls zool., Warsz.*, 30: 155-286.

KLIMASZEWSKI, S. M. & N. LODOS. 1977. New informations about jumping plant lice of Turkey (Homoptera: Psylloidea). *Ege Üniversitesi Ziraat Fakültesi Dergisi*, 14: 1-9.

LAING, F. 1930. Some records of Indo-Malayan Psyllidae. *Indian Forest Rec.*, 14: 166-175.

LAUTERER, P. 1982. New data on the occurrence, bionomics and taxonomy of some Czechoslovakian Psylloidea (Homoptera). *Čas. moravsk. Mus. Brně (Sci. nat.)*, 67: 133-162.

LAUTERER, P. & B. ŠRÁMKOVÁ, 1983. The psyllid *Heterotrioza chenopodii* (Reuter) (Homoptera, Triozidae), a new potential pest of beet plants. *Proc. IX Czechoslovak plant protection conference in Brno, 30th Aug. - 1st Sept. 1983*: 163-164.

LAY, D. M. 1967. A study of the mammals of Iran resulting from the Street Expedition of 1962-63. *Fieldiana, Zool.*, 54: 282 pp.

LOGINOVA, M. M. 1962. List of leaf-hoppers (Homoptera, Psylloidea) of the Leningrad region. *Trudy zool. Inst. Leningr.*, 31: 33-45. (In Russian).

LOGINOVA, M. M. 1963. Listobloshki roda *Psyllopsis* Löw (Homoptera, Psylloidea). *Acta entom. Mus. natn. Pragae*, 35: 183-196.

LOGINOVA, M. M. 1968. New data on the fauna and biology of the Caucasian Psylloidea (Homoptera). *Trudy vses. ent. Obshch.*, 52: 275-328. (In Russian).

LOGINOVA, M. M. 1972a. On the fauna of Psylloidea (Homoptera) from Morocco. *Commentat. biol.*, 47, 37 pp.

LOGINOVA M. M. 1972b. The psyllids (Psylloidea, Homoptera) from the Mongolian People's Republic. *Nasekom. Mongol.*, 1: 261-324. (In Russian).

LOGINOVA, M. M. 1974. Jumping plant lice of the tribe Stigmaphalarini Vondr. (Psylloidea, Aphalaridae) from arid regions of Palaearctic. *Ent. Obozr.*, 53: 150-170. (In Russian).

LOGINOVA, M. M. 1975a. A revision of the genus *Camarotoscena* Haupt (Psylloidea, Aphalaridae). *Ent. Obozr.*, 54: 43-61. (In Russian).

LOGINOVA, M. M. 1975b. Representatives of the genus *Psylla* (Homoptera, Psylloidea) developing on *Rhamnus* and *Cerasus*. *Zool. Zh.*, 54: 701-711. (In Russian).

LOGINOVA, M. M. 1976. Psyllids of the genus *Egeirotrioza* (Homoptera, Triozidae). *Zool. Zh.*, 55: 1318-1327.

LOGINOVA, M. M. 1978a. Novye vidy psillid (Homoptera, Psylloidea). *Trudy zool. Inst., Leningr.*, 61: 30-123.

LOGINOVA, M. M. 1978b. Review of the genus *Caillardia* Bergevin (Homoptera, Aphalaridae) with descriptions of new species. *Trudy zool. Inst., Leningr.*, 71: 6-22. (In Russian).

LOGINOVA, M. M. & V. G. Baeva. 1972. Review of psyllids of the genus *Psylla* Geoffr. (Homoptera, Psylloidea), connected with *Glycyrrhiza* species. *Trudy vses. ent. Obshch.*, 55: 4-13. (In Russian).

LOGINOVA-DUDYKINA, M. M. & V. J. PARFENTIEV. 1958. Leafhoppers (Homoptera, Psylloidea) injurious to *Populus diversifolia* and *P. pruinosa* in the vicinity of the Lake Balkhash, Kazakstan. *Ent. Obozr.*, 37: 88-104. (In Russian).

MATHUR, R. N. 1975. Psyllidae of the Indian subcontinent, *Indian Council of Agricultural Research, New Delhi*, 429 pp.

MISONNE, X. 1960. Analyse zoogéographique des mammifères de l'Iran. *Mém. Inst. r. Sci. nat. Belg.*, ser. 2, 59, 157 pp.

MOBAYEN, S. & V. TREGUBOV. 1970. Carte de la végétation naturelle de l'Iran 1:600,000. - Guide pour la carte de la végétation naturelle de l'Iran. *Fac. Forêts et Paturages, Tehran, Bull.* 14/ UNDP/FAO 92, UNDP/FAO IRA 7 14: 1-20.

NAEEM, A. & E. BEHDAD. 1988. The biology of "gaz psyllid" in Iran. *Entomologie phytopath. appl.*, 55: 29-30, 111-121.

NELSON, G. & N. PLATNICK. 1981. Systematics and biogeography, cladistics and vicariance, *Columbia University Press, New York*, xi + 567 pp.

NERONOV, V. M. 1976. A zoogeographical analysis of the rodent fauna of Iran. *Byull. Mosk. Obshch. Ispyt. Prir.*, Otd. Biol., 81: 32-47. (In Russian).

NOWAK, R. M. 1991. Walker's mammals of the world, (5th ed.) *the John Hopkins University Press, Baltimore and London*, 2 vols, 1629 pp.

PARSA, A. 1978. Flora of Iran, 1, *Ministry of Science and education, Tehran*, 506 pp.

PETROV, M. P. 1955. Iran. Physical-geographical outline, *Moscow*. (In Russian).

RADJABI, C. & N. D. BEHECHTI. 1975. Bio-ecological studies and control of *Psylla pyriaola* [sic!] Foerster (Hom. Psyllidae) in Esfahan. *Entomologie Phytopath. appl.*, 39: 4, 39-53.

RECHINGER, F. 1963 ff. Flora Iranica. Flora des iranischen Hochlands und der umrahmenden Gebirge: Persien, Afghanistan, Teile von West-Pakistan, Nord-Iraq, Azerbaijan, Turkmenistan, *Vienna*.

ROSEN, B. R. 1985. Long-term geographical controls on regional diversity. *The Open University Geolog. Soc. J.*, 6: 25-30.

ROSEN, B. R. 1988. From fossils to earth history: applied historical biogeography. In: Analytical biogeography (A. A. Myers, & P. S. Giller, eds). *Chapman & Hall, London*: 578 pp.

RÜBSAAMEN, E. H. 1902. Mittheilung über die von Herrn J. Bornmüller im Oriente gesammelten Zoocecidien. *Zool. Jb*, 16: 243-336.

SAMY, O. 1973. Psyllids of Egypt. *Bull. Soc. ent. Egypte*, 56: 437-480.

TAKHTAJAN, A. 1986. Floristic regions of the world, *University of California Press*, 522 pp.

SWOFFORD, D. 1989. PAUP, Phylogenetic Analysis Using Parsimony, *Illinois Natural History Survey, Champain IL.*

WHITE, I. M. & I. D. HODKINSON. 1982. Psylloidea (Homoptera). *Handbk Ident. Br. Insects*, 2 (5b), 50 pp.

WHITE, I. M. & I. D. HODKINSON. 1985. Nymphal taxonomy and systematics of the Psylloidea. *Bull. Br. Mus. nat. Hist. (Ent.)*, 50: 153-301.

ZOHARY, M. 1963. On the geobotanical structure of Iran. *Bull. Res. Coun. Israel*, 11D suppl: 1-113, 1 map.

ZOHARY, M. 1973. Geobotanical Foundations of the Midlle East, *Gustav Fischer Verlag, Stuttgart*, 739 pp.

APPENDIX 1.

Host plant list of Iranian psyllids.

Agonoscena bimaculata Mathur	*Pistacia khinjuk, P. mutica* (Anacardiaceae)
Agonoscena pegani Loginova	*Peganum harmala* (Zygophyllaceae)
Agonoscena pistaciae Burckhardt & Lauterer	*Pistacia atlantica, P. mutica, P. palaestina, P. terebinthus, P. vera* (Anacardiaceae)
Aphalara loginovae sp. n.	unknown
Aphalara polygoni Förster	*Polygonum tomentosum, P. amphibium, P. hydropiper, P. lapathifolium, P. persicariae* (Polygonaceae)
Bactericera albiventris (Förster)	*Salix* spp. (Salicaceae)
Bactericera ligulariae (Loginova)	*Ligularia thomsonii* (Asteraceae)
Bactericera nigricornis (Förster)	polyphagous
Bactericera perrisii Puton	*Artemisia* spp. (Asteraceae)
Bactericera striola (Flor)	*Salix* spp. (Salicaceae)
Bactericera tremblayi (Wagner)	*Allium* spp. (Liliaceae), possibly polyphagous
Bactericera trigonica Hodkinson	probably *Daucus carota* (Apiaceae)
Brachystetha loginovae Baeva & Alexeev	*Zygophyllum* sp., *Halimiphyllum* sp. (Zygophyllaceae)
Cacopsylla bidens (Šulc)	*Pyrus communis, P. pyraster, P. syriaca* (Rosaceae)
Cacopsylla crataegi (Schrank)	*Crataegus* spp. (Rosaceae)
Cacopsylla incerta (Loginova)	*Rhamnus* spp. (Rhamnaceae)

Cacopsylla iranica sp. n.	unknown
Cacopsylla notata (Flor)	*Pyrus communis, P. amygdaliformis, P. elaeagnifolia* (Rosaceae)
Cacopsylla permixta Burckhardt & Hodkinson	*Pyrus communis, P. elaeagnifolia, P. salicifolia* (Rosaceae)
Cacopsylla pruni (Scopoli)	*Prunus* spp. (Rosaceae)
Cacopsylla pyri (Linnaeus)	*Pyrus communis, P. elaeagnifolia* (Rosaceae)
Cacopsylla pyricola (Förster)	*Pyrus communis, P. pyraster* (Rosaceae)
Cacopsylla pyrisuga (Förster)	*Pyrus communis, P. amygdaliformis, P. salicifolia* (Rosaceae)
Cacopsylla saliceti (Förster)	*Salix* spp. (Salicaceae)
Cacopsylla suturalis (Horvath)	*Rhamnus* spp. (Rhamnaceae)
Caillardia accola Loginova	*Haloxylon persicum* (Chenopodiaceae)
Caillardia azurea Loginova	*Haloxylon aphyllum, H. persicum* (Chenopodiaceae)
Caillardia dilatata Loginova	*Hammada elegans, H. salicornia, H.* sp. (Chenopodiaceae)
Caillardia inedita Loginova	*Haloxylon aphyllum, H. persicum* (Chenopodiaceae)
Caillardia robusta Loginova	*Haloxylon persicum, H. annodendron* (Chenopodiaceae)
Camarotoscena fulgidipennis Loginova	*Populus* ? *pyramidalis* (Salicaceae)
Camarotoscena hoberlandti (Vondráček)	*Populus* spp. (Salicaceae)
Camarotoscena unicolor Loginova	*Populus diversifolia, P. pruinosa* (Salicaceae)
Colposcenia agnata sp. n.	unknown
Colposcenia aliena (Löw)	*Tamarix* spp. (Tamaricaceae)
Colposcenia cavillosa sp. n.	unknown
Colposcenia elegans (Bergevin)	*Tamarix* sp. (Tamaricaceae)
Colposcenia kiritshenkoi Loginova	*Tamarix smyrnensis, T. ramosissima* (Tamaricaceae)
Colposcenia paula sp. n.	unknown
Colposcenia vicina Loginova	*Tamarix hispida, T. ramosissima* (Tamaricaceae)
Craspedolepta bulgarica Klimaszewski	*Achillea* spp. (Asteraceae)
Craspedolepta convexa Baeva	*Artemisia glandulifera, A. kochiiformis* (Asteraceae)
Craspedolepta pontica Dobreanu & Manolache	*Achillea* spp. (Asteraceae)
Craspedolepta remaudierei sp. n.	possibly *Artemisia cina* (Asteraceae)
Craspedolepta tadzhikistanica Baeva	*Artemisia baldschuanica* (Asteraceae)
Crastina myricariae Loginova	*Myricaria bracteata* (Tamaricaceae)
Crastina tamaricina Loginova	*Tamarix ramosissima, T. smyrnensis* (Tamaricaceae)
Cyamophila astragalicola (Gegechkori)	*Astragalus* sp. (Fabaceae)
Cyamophila coluteae (Baeva)	*Colutea* spp. (Fabaceae)
Cyamophila glycyrrhizae (Becker)	*Glycyrrhiza glabra, G. uralensis* (Fabaceae)
Cyamophila oshanini (Loginova)	*Halimodendron halodendron* (Fabaceae)
Diaphorina aegyptiaca Puton	*Cordia* spp. (Ehretiaceae)
Diaphorina chobauti Puton	*Convolvulus* spp. (Convolvulaceae)
Diaphorina enormis Loginova	unknown
Diaphorina luteola Loginova	unknown
Diaphorina lycii Loginova	*Lycium* spp. (Solanaceae)
Diaphorina tamaricis Loginova	*Tamarix* sp. (Tamaricaceae)
Diaphorina zygophylli Loginova	*Zygophyllum* spp., *Halimiphyllum* spp. (Zygophyllaceae)
Euphyllura straminea Loginova	*Olea europaea* (Oleaceae)

Eremopsylloides amirabilis Loginova	*Calligonum* sp. (Chenopodiaceae)
Egeirotrioza ceardi (Bergevin)	*Populus pruinosa, P. diversifolia* (Salicaceae)
Egeirotrioza corporosa sp. n.	possibly *Populus diversifolia* (Salicaceae)
Egeirotrioza gemina sp. n.	unknown
Egeirotrioza justa sp. n.	*Populus diversifolia* (Salicaceae)
Homotoma caroliquarti sp. n.	possibly *Ficus* sp., *F. carica* (Moraceae)
Homotoma ficus (Linnaeus)	*Ficus carica* (Moraceae)
Livia juncorum (Latreille)	*Juncus* spp. (Juncaceae)
Megagonoscena viridis (Baeva)	*Pistacia mutica, P. palaestina, P. terebinthus, P. vera* (Anacardiaceae)
Pachypsylloides errator Loginova	*Calligonum caput-medusae, C. arborescens* (Chenopodiaceae)
Paratrioza lycii Loginova	*Lycium ruthenicum* (Solanaceae)
Paratrioza petiolata Loginova	*Lycium depressum* (Solanaceae)
Psyllopsis fraxini (Linnaeus)	*Fraxinus* spp. (Oleaceae)
Psyllopsis machinosus Loginova	*Fraxinus* spp. (Oleaceae)
Psyllopsis repens Loginova	*Fraxinus oxycarpa* (Oleaceae)
Psyllopsis securicola Loginova	*Fraxinus oxycarpa* (Oleaceae)
Rhodochlanis bicolor (Scott)	*Petrosimonia* spp., *Salicornia* spp., *Salsola* spp., *Suaeda* spp. (Chenopodiaceae)
Spanioneura persica sp. n.	unknown
Trioza berbericola Loginova	*Berberis vulgaris, B. orientalis, B. iberica* (Berberidaceae)
Trioza chenopodii Reuter	*Atriplex* spp., *Beta* sp., *Chenopodium* spp., *Halimione* sp., *Spinacia* sp. (Chenopodiaceae)
Trioza dichroa Scott	*Atriplex tatarica* (Chenopodiaceae)
Trioza elaeagni Scott	*Elaeagnus angustifolia* (Elaeagnaceae)
Trioza eurotiae Loginova	*Eurotia ceratoides* (Chenopodiaceae)
Trioza galii Förster	*Galium* spp. (Rubiaceae)
Trioza magnisetosa Loginova	*Elaeagnus angustifolia* (Elaeagnaceae)
Trioza neglecta Loginova	*Elaeagnus angustifolia* (Elaeagnaceae)
Trioza remota Förster	deciduous *Quercus* spp. (Fagaceae)
Trioza rumicis Löw	*Rumex scutatus, R. alpestris* (Polygonaceae)
Trioza scottii Löw	*Berberis* spp. (Berberidaceae)
Trioza urticae (Linnaeus)	*Urtica* spp. (Urticaceae)

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Etude de la morphologie des écailles de la cuticule des jarres primaires des renards polaires adultes - *Alopex lagopus* (Linné, 1758) à l'aide du microscope électronique à balayage

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Morphology of cuticular cells of guard hairs of the adult polar fox - *Alopex lagopus* (Linné, 1758) in the scanning electron microscope (SEM). - The shape and arrangement of cuticular cells of guard hairs of adult *A. lagopus* are described with SEM photografs. Theoretical aspects are considered and auxiliary criteria for specific determination are provided. This method may be useful for estimation of fur quality of the polar fox.

Key-words: Morphology - Guard hairs - Fur - *Alopex lagopus*.

INTRODUCTION

Cette étude a pour cadre principal la recherche de problèmes liés aux poils défectueux trouvés dans la fourrure des renards polaires *Alopex lagopus* qui pourrait dévaloriser la qualité de la fourrure. L'étude au microscope électronique à balayage (MEB) de la morphologie des écailles de la cuticule des poils du renard polaire *A. lagopus* nous a permis de trouver de nouveaux caractères taxonomiques. Cette méthode inédite et les résultats obtenus permettraient d'évaluer l'influence des conditions d'élevage sur la qualité de la fourrure; il est en effet prévu de comparer les poils d'animaux maintenus dans des conditions particulières d'alimentation.

Dans la littérature, de nombreux auteurs ont décrit les formes et la structure des écailles de la cuticule des jarres primaires de plusieurs espèces de mammifères, ceci dans le cadre de travaux généraux, p. e.: LAMBERT & BALTHAZARD (1910), HAUSMAN (1920), LOMULLER (1924), LOCHTE (1930), WILDMAN (1954), APPLEYARD (1960), ADORJAN & KOLENOSKY (1969), BRUNNER & COMAN (1974), FALIU *et al.* (1980), DEBROT *et al.* (1982), TEERINK (1991).

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LAMBERT & BALTHAZARD (1910) distinguent *Alopex lagopus* de *Vulpes vulpes* par la longueur, la cuticule écailleuse et la structure médullaire de leurs poils. JULLIEN (1930), décrit entre autres la structure écailleuse de la cuticule d'*Alopex lagopus*, sans toutefois trouver des critères distinctifs avec *Vulpes vulpes*. DZIURDZIK (1973), dans son manuel d'identification des poils des mammifères de Pologne présente la structure écailleuse de la cuticule des poils de *Alopex lagopus*.

En 1985, VANĚK a étudié la structure écailleuse de la cuticule des poils de *Alopex lagopus*. Cet auteur a évalué la forme et l'épaisseur de ces écailles cuticulaires considérant d'une part la longueur des poils, la période de prélèvement, le renouvellement du pelage, le sexe et d'autre part, la localisation du prélèvement. En 1986, KARASKOVA publie une étude analogue chez les spécimens juvéniles de *Alopex lagopus*. Cet auteur s'attache également à une analyse visuelle du procédé de croissance des jarres, du duvet, ainsi que du développement corporel des jeunes. La même année, GALATIK (1986) fait une description détaillée de la forme, de la surface et de la bordure des écailles de la cuticule des poils de seize espèces, montrant ainsi les variabilités des caractères décrits, lui permettant de définir la qualité de la fourrure; sa terminologie proposée nous semble par ailleurs trop complexe.

MATÉRIEL ET MÉTHODE

Pour cette étude, les poils ont été prélevés au mois de septembre 1986 sur les parties dorsale, latérale et ventrale de quelques spécimens adultes (dont ceux d'un mâle ont été utilisés pour les clichés) provenant d'une ferme d'élevage privée, située à proximité de Brno, République Tchèque. Les conditions de détention des spécimens ont été les suivantes: un seul spécimen par cage dont les dimensions sont de 120x100x80 cm, et fabriquée avec du matériel anticorrosif. Ces cages sont protégées par un appentis ouvert, ce qui a permis aux animaux de vivre pendant toutes les saisons aux conditions climatiques extérieures. Les animaux sont nourris une fois par jour avec 800 g d'aliments composés d'une part de 55% d'albumine animale (10% de musculature et 45% de déchets d'abattoirs); 25% de blé finement moulu; 10% de lait, caillebotte et œufs; 7% de légumes, fruits; 3% de vitamines et de substances minérales.

Compte tenu du fait que le pelage est composé de trois formes principales de poils, à savoir: les jarres primaires, secondaires et les poils laineux, seuls les jarres primaires sont pris en considération dans ce travail. Pour le traitement des poils, nous renvoyons le lecteur aux travaux de KELLER (1978, 1980, 1981, 1984). L'analyse des poils a été faite à l'aide du microscope électronique à balayage au Muséum d'histoire naturelle de Genève. Les clichés ont été réalisés par le Dr J. Wüest que nous remercions très vivement ici. Cinq sections des poils ont été retenues pour l'analyse de la morphologie des écailles de la cuticule: la racine, la base et le milieu de la tige, la partie subapicale et la pointe. Pour définir les différents types d'écailles observés tout au long du fuseau cortical des jarres primaires, nous avons utilisé en partie la nomenclature de HAUSMAN (1920).

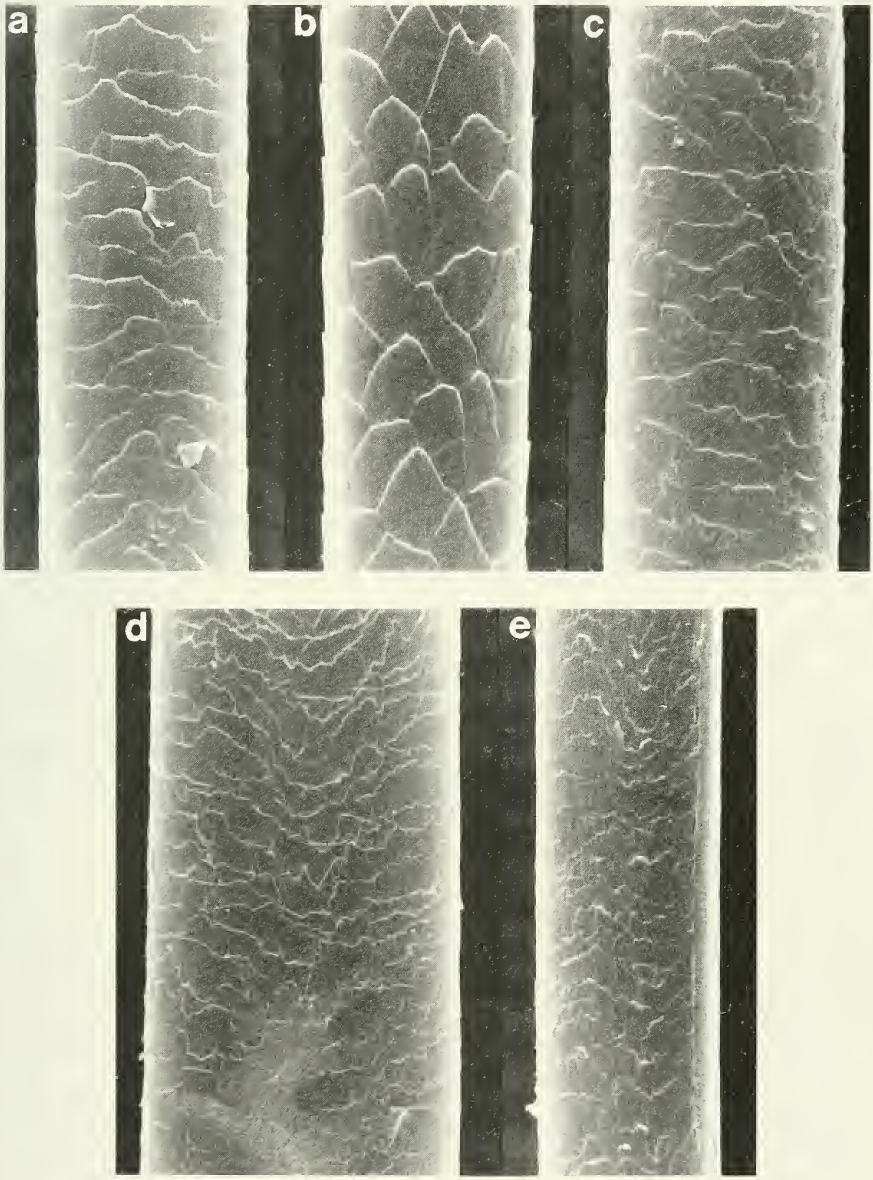

Fig. 1

a: racine de la tige des jarres primaires dorsaux, et latéraux; **b:** base de la tige des jarres primaires dorsaux et latéraux; **c:** milieu de la tige des jarres ventraux; **d:** partie subapicale des jarres primaires dorsaux; **e:** partie subapicale des jarres primaires latéraux et ventraux.

RÉSULTATS

Au niveau de la racine des jarres primaires prélevés sur les parties dorsale, latérale et ventrale du spécimen, nous avons observé des écailles cuticulaires en forme de peigne, avec un bord apical légèrement relevé et ondulé irrégulièrement (Fig. 1a). Sur la base de la tige des jarres dorsaux et latéraux, les écailles observées sont parfois très aiguës sur leur sommet (Fig. 1b), alors qu'au même endroit sur les jarres ventraux on observe le même type d'écaillure qu'au niveau de la racine. Sur la partie centrale de la tige des jarres dorsaux, la forme des écailles est identique à celle rencontrée aux autres endroits de la tige des jarres dorsaux et latéraux. Les écailles de la partie centrale de la tige des jarres ventraux ont la même forme que celle observée sur la racine (Fig. 1c). Au niveau de la partie subapicale des jarres dorsaux, les écailles de la cuticule sont de par leur disposition et leur aspect général, très semblables à celles observées au milieu de la tige (Fig. 1a). Au même endroit, sur les jarres des parties latérale et ventrale, ces écailles deviennent étroites et onduleuses à bord denticulé plus ou moins crénelé (Fig. 1d). Les jarres dorsaux montrent sur leur pointe, des écailles cuticulaires très similaires dans leur forme et leur structure à celles de la partie subapicale des jarres latéraux et ventraux. La pointe des jarres latéraux et ventraux montrent une structure écailleuse de la cuticule onduleuse à bord très peu denticulé ou parfois plutôt lisse (Fig. 1e).

RÉSUMÉ

La description de la forme et de la disposition tout au long du fuseau cortical des écailles de la cuticule des jarres primaires d'un spécimen adulte de renard arctique, *Alopex lagopus* observées au microscope électronique à balayage est d'un grand intérêt. Cette étude a permis aux auteurs d'obtenir des connaissances plus détaillées, donnant des critères auxiliaires très précieux pour la détermination de l'espèce.

BIBLIOGRAPHIE

ADORJAN, A. S. & G. B. KOLENOSKY. 1969. A manual for the identification of hairs of selected Ontario mammals. Dept. Lands and Forest, Ontario, *Res. Report (Wildlife)* No 90, 64 pp.

APPLEYARD, H. M. 1960. Guide to the identification of animal fibres. *Leeds, Wool Industrie Research Association*, viii + 124 pp.

BRUNNER, H. & B. COMAN. 1974. The Identification of mammalian hair. *Inkata press, Melbourne*, vii-ix, 176 pp.

DEBROT, S., G. FIVAZ, C. MERMOD & J.-M. WEBER. 1982. Atlas des poils de mammifères d'Europe. *Institut de Zoologie de l'Université de Neuchâtel*, 208 pp.

DZIURDZIK, B. 1973. Key to the identification of hairs of mammals from Poland. *Acta zool. cracov.*, 18(4): 73-92.

FALIU, L., Y. LIGNEREUX & J. BARRAT 1980. Identification des poils de quelques mammifères pyrénéens. *Donana-Acta Vertebrata*, 1 (2): 125-212.

GALATIK, A. 1986. Histologicka stavba srsti z pohledu kvality kožešin. *Zbornikpred. konf. "Persp. modern. chovu koz. zv." Nitra, 4-5 Sept.*, 219 pp.

HAUSMANN, L. A. 1920. Structural characteristics of the hair of mammals. *Am. Nat.*, 54 (635): 496-523.

JULLIEN, A. 1930. Recherche sur les caractères histologiques de la tige des poils chez les mammifères carnivores et ruminants. *Bull. Histol. appl. Physiol. Path.*, 7: 169-192.

KARASKOVA, D. 1986. Rust a vyvoj srsti mladat pescu polarnich - *Alopex lagopus* (Linné, 1758). *Dipl. prace AF VSZ Brno.*, 51 pp.

KELLER, A. 1978. Détermination des mammifères de la Suisse par leur pelage: I. Talpidae et Soricidae. *Revue suisse Zool.*, 85 (4): 758-761.

KELLER, A. 1980. Détermination des mammifères de la Suisse par leur pelage: II. Diagnose des familles. III. Lagomorpha, Rodentia (partim). *Revue suisse Zool.*, 87 (3): 781-796.

KELLER, A. 1981. Détermination des mammifères de la Suisse par leur pelage: V. Carnivora, VI. Artiodaytyla. *Revue suisse Zool.*, 88:3.

KELLER, A. 1984. Etude de la structure fine des jeunes dorsaux de quelques Canidés sauvages et domestiques du genre *Canis* (Mammalia: Canidae). *Revue suisse Zool.*, 91 (4): 973-992.

LAMBERT, M. & V. BALTHAZARD 1910. Les poils de l'homme et des animaux. *Ed. Steinheil, Paris.*

LOMULLER, L. 1924. Reconnaissance métholodique à l'aide du microscope, des poils d'un certain nombre de mammifères. Essai de leur classification. *Bull. Sci. pharmac.*, 31 (10): 497-506 et 567-581.

LOCHTE, TH. 1938. Atlas der menschlichen und tierischen Haare. *Leipzig, Verlag Dr. Paul Schops*, 303 pp.

TEERIUK, B. J. 1991. Hair of West European Mammals. *Cambridge University Press*, 224 pp.

VANĚK, M. 1985. Morfologie pourchouych strukture chlupu (pesí kű) pescú polárnich - *Alopex lagopus* (Linné, 1758) v REM. *Závěr. zpráva VÚ AF VSZ Brno*, 27 pp.

WILDMAN, A. B. 1954. The microscopy of animal textile fibres. *Wool Indust. Research Assoc., Leeds,* 209 pp.

REVUE SUISSE DE ZOOLOGIE, 100 (4) : 905-906; décembre 1993

Deux nouveaux Ceratocanthidae (Coleoptera) de Sumatra du Muséum de Genève

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Two new Ceratocanthidae (Coleoptera) from Sumatra of the Natural History Museum Geneva. - Two new species, *Madrasostes agostii* and *M. clypealis* are described from Sumatra. Both may be readily distinguished by external characters.

Key-words: Coleoptera - Ceratocanthidae - Taxonomy - Sumatra.

Les récoltes de MM. I. Löbl, D. Agosti et D. Burckhardt à Sumatra en 1989 ont fourni un nombre important de nouvelles espèces de Cératocanthides du genre *Madrasostes*. Nous décrivons ci-dessous deux de ces espèces conservées au Muséum d'Histoire Naturelle de Genève.

Madrasostes agostii nov. sp.

Holotype: SUMATRA, Aceh, Mont Leuser Nat. Park, Ketambe, 800 m., 28.XI.1989 (Löbl, Agosti et Burckhardt).

Paratype: un exemplaire de même provenance et date de capture au Muséum d'Histoire Naturelle de Paris.

Long. (déroulé): 6,5 mm. - Corps ovalaire, assez large, convexe, noir luisant, téguments non chagrinés sur la face dorsale.

Clypéus très transverse, anguleux au milieu, aux côtés faiblement convexes en dehors et rebord finement crénelé; surface à quatre rides transverses fines. Front et vertex à points progressivement plus forts de l'avant vers l'arrière, un peu serrés; certains points confluents en lignes longitudinales courtes sur les côtés en dedans des yeux.

Pronotum très transverse, à angles antérieurs tronqués et angle externe de la troncature marqué et suivi en arrière d'une assez faible sinuosité; rebord antérieur entier; base à fort rebord entier et légèrement bisinué. Ponctuation forte, serrée, assez régulière, à points ocellés, parfois un peu interrompus et vaguement en fer à cheval.

Ecusson à rides transverses, incomplètes, plus ou moins arquées.

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Elytres sans reliefs, carènes ou tubercules; une très fine strie suturale sur la moitié postérieure et la trace de deux très fines et courtes stries discales. Sculpture formée de points en fer à cheval, moyens, peu serrés, assez réguliers, mêlés de points très fins et épars; dans la région basale des élytres, les points sont unis en courtes stries transverses arquées, ouvertes vers l'arrière.

L'espèce est reconnaissable, dans le genre *Madrasostes*, par la sculpture des élytres, à points réguliers, peu serrés, sans reliefs et avec une faible strie suturale et la trace de deux strioles discales, ainsi que par la forme des côtés du pronotum.

Madrasostes clypealis nov. sp.

Holotype: SUMATRA, Aceh, Mont Leuser Nat. Park, Ketambe, 800 m., 28.VI.1989 (Löbl, Agosti et Burckhardt).

Trois paratypes de même provenance et date de capture, Muséum de Genève et Muséum National d'Histoire Naturelle de Paris.

Long. (déroulé): 3,5 mm. - Corps relativement étroit, allongé, très convexe, noir luisant. Téguments de la face dorsale non chagrinés.

Tête transverse. Clypéus saillant au milieu en avant en un court lobe transverse nettement bidenté sur les côtés; côtés crénelés, élargis vers l'arrière en ligne presque droite, légèrement sinueuse jusqu'aux angles externes des joues qui sont aigus; bord postérieur des joues faiblement concave. Clypéus avec des points transverses le long du bord antérieur, puis quelques (4 ou 5) stries transverses, fines, écartées, sinueuses et incomplètes. Front et vertex à assez gros points écartés, un peu confluents en stries sur les côtés vers l'avant.

Pronotum très transverse, à rebord antérieur entier et fort; côtés et base non rebordés; angles antérieurs obtusément tronqués; côtés en courbe régulière et forte, sans sinuosité après les angles antérieurs. Ponctuation très forte et serrée sur les côtés du disque, moins forte et moins serrée sur le reste de la surface, mais toujours assez forte.

Ecusson avec quelques fines et grandes impressions arquées ouvertes en arrière.

Elytres ovalaires, un peu déprimés sur le disque en dehors de la suture, sans tubercules, stries ni carènes. Ponctuation très forte, dense, disposée en lignes longitudinales assez régulières et serrées mais ne formant pas des stries ponctuées. Pubescence courte, pâle, dressée, éparse.

Tibias antérieurs parallèles, à deux fortes dents marginales externes arrondies, précédées, vers la base de quelques dents marginales écartées et fortement arrondies.

Tibias postérieurs en triangle large, les tarses un peu plus courts que la troncature apicale.

L'espèce est reconnaissable à sa sculpture thoracique et élytrale; chez un individu, le clypéus est simplement anguleux en avant, mais les trois autres montrent un clypéus nettement lobé et bidenté en avant, caractère unique, jusqu'ici dans le genre *Madrasostes*.

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Trends in phytoplanktonic and zoobenthic communities after the decrease of phosphorus concentrations in Lake Joux

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Trends in phytoplanktonic and zoobenthic communities after the decrease of phosphorus concentrations in Lake Joux. – The eutrophic Lake Joux (Jura Mts., Switzerland) has been continuously colonized from 1980 to 1992 by dense populations of *Oscillatoria rubescens*, even after phosphorus concentrations began to decrease in 1986. At a depth of 25 m, biomass and abundance of chironomid larvae decreased between 1985 and 1992 whereas abundance of *Chaoborus* larvae increased. In addition, abundance of *Tubifex tubifex* increased in tubificid communities relatively to that of *Limnodrilus hoffmeisteri*. These trends are indicative of a deterioration of oxygen conditions in the profundal. They suggest that benthic communities will not recover from eutrophication as long as planktonic communities are dominated by *Oscillatoria*.

Key-words: Benthos - Bloom - Cyanobacteria - Eutrophication - Oligochaeta.

INTRODUCTION

In Lake Joux (Switzerland, Vaud, Jura Mts., alt. 1008 m), blooms of *Oscillatoria rubescens* DC were recorded for the first time in 1972 (Bosset 1981). Since 1980, this species dominated the phytoplankton in terms of biomass. Its expansion was facilitated by the increase of total phosphorus concentrations from 25 $mg \cdot m^{-3}$ in 1980 to 45 $mg \cdot m^{-3}$ in 1985 (Vioget 1991). Accordingly, Lake Joux was classified as eutrophic in 1982 (De Heer 1984); and, at the summer end, the profundal was anoxic below 15 m down to 30 m, the maximum depth. As a consequence, the profundal was colonized only by zoobenthic species adapted to the extreme conditions of eutrophic lakes (Lang & Lang 1986).

However, phosphorus concentrations began to decrease in 1986 from the maximal of 45 $mg \cdot m^{-3}$ in 1985 down to 25 $mg \cdot m^{-3}$ in 1990 (Vioget 1991). In the present study, we examine the effects of this reversal of eutrophication on phytoplanktonic and zoobenthic communities. And we ask two related questions: 1. Is there any downward trend in the abundance of *Oscillatoria*? 2. Is there any changes in zoobenthos which are indicative of improved conditions in the profundal?

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These two questions are related because benthic communities respond directly to organic sedimentation derived from phytoplankton (Lang & Hutter 1981), especially if the sedimented matter consist mainly of *Oscillatoria* threads (Hutter & Lang 1981). Hence, it is probable that zoobenthic communities will not recover from eutrophication as long as planktonic communities are dominated by *Oscillatoria*.

STATIONS AND METHODS

Phytoplankton was sampled from 1980 to 1992 at one site located in front of Pont village. Samples were collected every two weeks, from April to December, by lowering vertically a weighted tube from the surface to a depth of 10 m. Algae, present in this integrated sample, were identified and counted under an inverted microscope. Dimensions of algae were used to compute their volume which was converted into biomass (wet weight).

Zoobenthos was sampled from the same site as phytoplankton, but at a depth of 25 m. From 1985 to 1992, ten 16 cm^2 cores were collected by a diver in April, June, and October of each year. The sediment collected in each core was sieved (mesh size aperture: 0.2 mm) and the retained material was preserved in 5% formalin. Tubificid worms, chironomid and *Chaoborus* larvae were counted and weighed after removing excess water with blotting paper.

The Cox and Stuart test for trend (Conover 1971, p. 170) was used to detect downward trends in median abundance of *Oscillatoria* between years (Fig. 1). Years were divided into two groups of six years each: 1980/85 and 1987/92, the middle year, 1986, was omitted. Then, the years which occupied the same position in each group were paired to compute the T statistic. To detect trends in zoobenthic data (Tab. 1), the Spearman rank correlation was computed by pairing mean abundance or biomass of zoobenthos with the time at which the measurements were taken (Conover 1971, p. 251).

RESULTS

Phytoplankton

Oscillatoria rubescens DC and/or *O. agardhii* Gom. (identified by M.E. Meffert, Plön, BRD) were present in each of the 283 samples collected in Lake Joux between 1980 and 1992. In most cases, these two species formed the main part of the phytoplanktonic biomass.

Figure 1 showed that median biomass of *Oscillatoria* per year decreased from 1980 to 1983, increased from 1983 to 1988, and decreased from 1988 to 1992. However, these graphical trends were not confirmed by statistical analysis which indicated no significant downward trend if the 1980/85 years were compared with the 1987/92 years (Cox and Stuart test for trend, T=5, n=6, p=0.984, see Stations and methods).

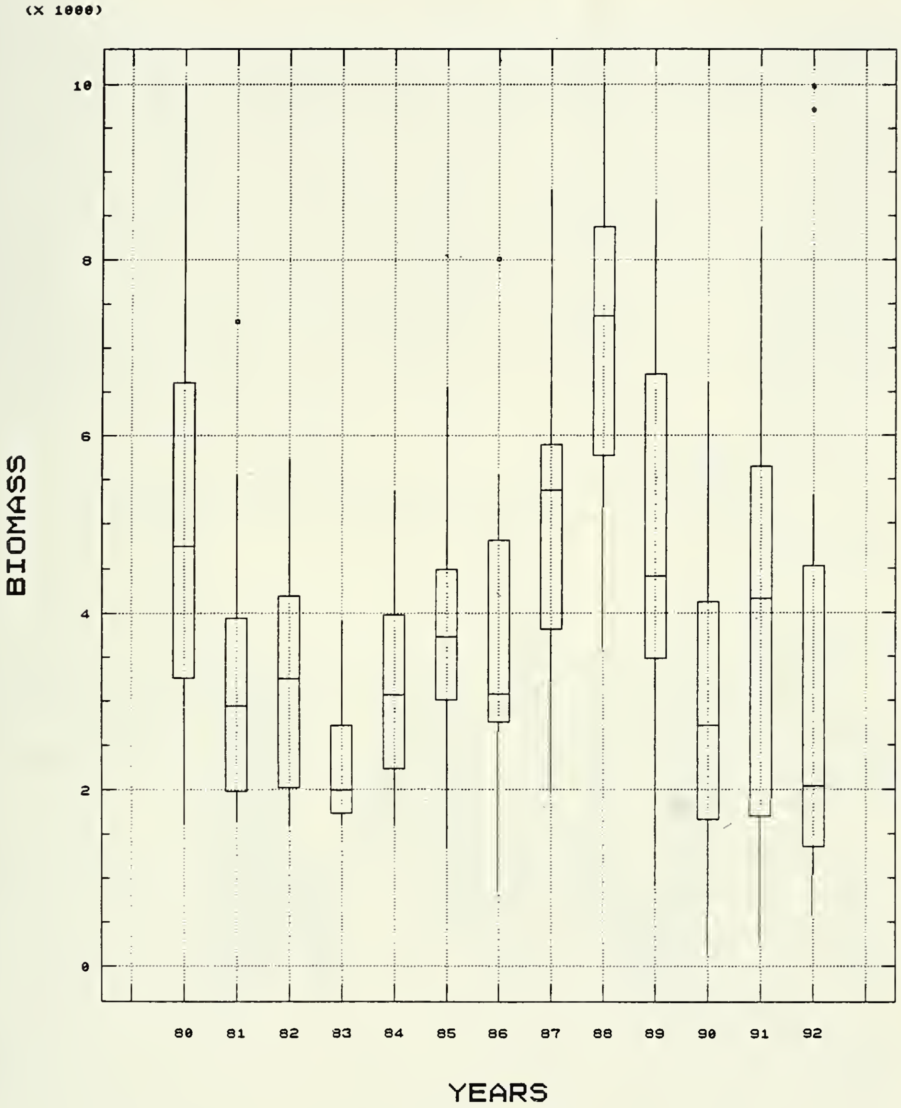

FIG. 1

Variations of median biomass (mg·m^{-3}) of *Oscillatoria* per year from 1980 to 1992 in Lake Joux. The central box covers the middle 50% of the values, bars extend to the extreme, outliers are shown as single dots.

TABLE 1

Mean biomass (B) and abundance (A) of zoobenthic taxa in Lake Joux: comparison between the 1985/88 years and the 1989/92 years, based on 120 cores in each set. The 1985/92 trend is assessed with the Spearman rank coefficient (see Stations and methods, n=24).

			Trend	Mean			
	Taxa	Unit	r_s (probability)	1985/88	1989/92	Test	Probability
B	All	mg ·16cm^{-2}	–0.31 (0.135)	90.3	76.2	Mann-Whitney	0.004
	Tubificids		0.06 (0.761)	43.2	42.7		0.736
	Chironomids		–0.64 (0.002)	39.9	15.1		0.039
	Chaoborus		0.34 (0.122)	7.1	18.4		0.298
A	Tubificids	no ·16 cm^{-2}	0.11 (0.593)	67.2	69.3		0.308
	Chironomids		–0.73 (0.000)	4.6	1.5	Median	0.000
	(if present)		–	4.7	2.4		0.000
	Chaoborus		0.05 (0.825)	1.8	4.1		0.142
	(if present)		–	3.3	6.8		0.000
	Limnodrilus hoffmeisteri (%)		–	76.2	36.4	Chi^2	0.000*
	Tubifex tubifex (%)		–	23.8	63.6		

* Based respectively on 143 worms collected in 1985 and on 55 worms collected in 1992.
– not computed.

ZOOBENTHOS

Zoobenthic taxa, present in Lake Joux at a depth of 25 m (Tab. 1), were ranked according to their increasing resistance to severe anoxia: chironomid larvae, tubificid worms (*Limnodrilus hoffmeisteri*, then *Tubifex tubifex*), and *Chaoborus* larvae (BRINKHURST 1974). This rating was used to assess the significance of trends recorded between 1985 and 1992.

Biomass of *Oscillatoria* did not decrease between 1980 and 1992: therefore, we can assume that the less resistant zoobenthic taxa (chironomids) will decrease whereas the most resistant taxa (*Chaoborus*) will increase. Indeed, chironomid larvae decreased whereas *Chaoborus* larvae increased (Tab. 1, Fig. 2). In addition, abundance of *Tubifex tubifex* increased in tubificid communities relatively to that of *Limnodrilus hoffmeisteri*.

The downward trend for total biomass was not significant (Tab. 1), because of the increasing contribution of *Chaoborus* (Fig. 2). Indeed, the downward trend became significant (r_s=-0.45, n=23, p=0.031) if the sample collected in June 1992 was eliminated. In this sample, *Chaoborus* contributed heavily (68%) to total biomass. Biomass of tubificids pooled with that of chironomids decreased significantly between 1985 and 1992 (r_s=-0.64, n=24, p=0.001). In other words, zoobenthic taxa which, contrary to *Chaoborus*, were unable to migrate every day into the oxic layers, were especially affected by anoxia.

All these trends were indicative of a deterioration of oxygen conditions in the profundal. Indeed, low oxygen concentrations persisted longer in 1992 than in 1991 (Ph. Vioget, pers. com.), but a detailed analysis of the oxygen trend in the profundal was not available.

DISCUSSION

In Lake Joux (Switzerland), the abundance of *Oscillatoria rubescens* presented no significant downward trend between 1980 and 1992 (Fig. 1), even after phosphorus concentrations began to decrease in 1986 (VIOGET 1991). As in Lake Joux, dense populations of *Oscillatoria* persist in other lakes after the decline of phosphorus (STEINBERG & HARTMANN 1988). According to data reviewed by these authors, Lake Joux presents some of the characteristics which facilitate the persistence of *Oscillatoria*. Firstly, the lake is relatively shallow (mean depth: 20 m): therefore, *Oscillatoria* can easily recolonize the water column from the sediment. Secondly, the lake freezes during three months each winter: therefore *Oscillatoria*, which is able to maintain dense populations under the ice, is abundant enough in the early spring to shade and thus to outcompete the other species. But, whatever are the reasons why *Oscillatoria* persists (see LANG & LANG 1986), this persistence affects zoobenthos.

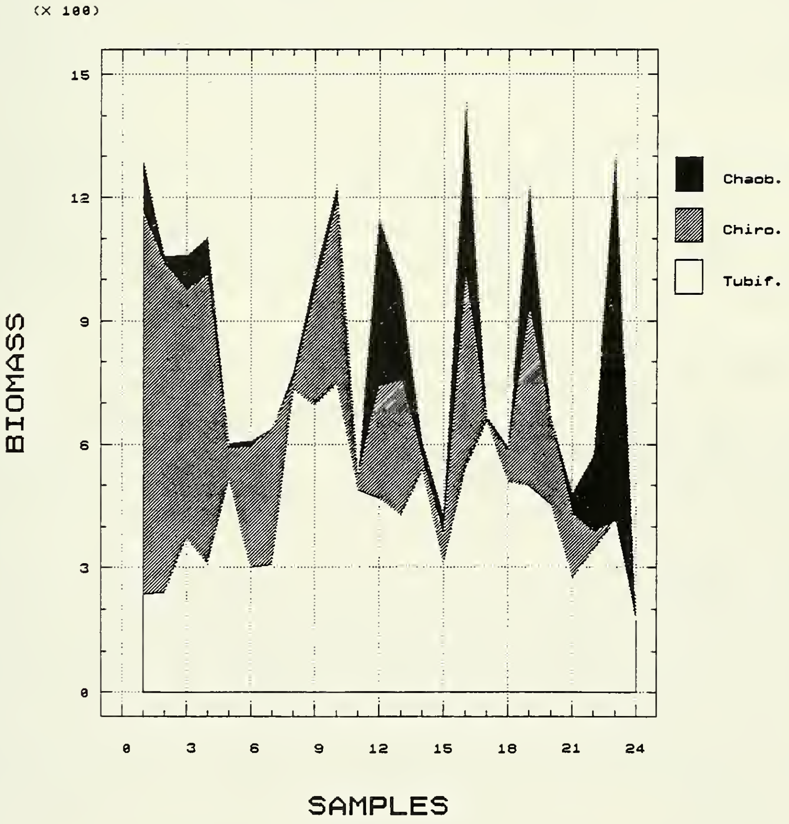

FIG. 2

Variations of cumulated biomass (mg ·160 cm^{-2}) of *Chaoborus* (Chaob.), chironomids (Chiro.), and tubificids (Tubif.) from 1985 (samples 1 - 3) to 1992 (samples 22 - 24) in Lake Joux.

Zoobenthos is affected directly by the variations of organic sedimentation derived from phytoplankton (LANG & HUTTER 1981). Zoobenthos responds initially to the amount of organic sedimentation, but also to its composition (HUTTER & LANG 1981). Organic sedimentation is high in Lake Joux (240 g $C \cdot m^{-2} \cdot yr^{-1}$) and *Oscillatoria* is very abundant in the sedimented matter (LANG & LANG 1986). Oxygen uptake by the sediment is very high if the sedimented matter consists mainly of *Oscillatoria* threads (HUTTER & LANG 1981). Therefore the persistence of *Oscillatoria* prevents the increase of oxygen concentrations in the profundal.

As a consequence, zoobenthos of Lake Joux consists, at least in the profundal, only of tolerant species adapted to the severe anoxia of eutrophic lakes (LANG & LANG 1986). At a depth of 25 m, the trends in zoobenthic abundance, recorded between 1985 and 1992 (Tab. 1, Fig. 2), are the same as those associated with the decrease of oxygen concentrations in eutrophic lakes (BRINKHURST 1974). In 1992, the most resistant taxa, i.e. *Chaoborus* and *Tubifex tubifex*, become dominant in zoobenthos as in the deepest area of the very eutrophic Lake Bret (Lang, unpublished data). All these trends suggest that zoobenthos will not recover from eutrophication as long as phytoplankton is dominated by *Oscillatoria*.

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REFERENCES

BOSSET, E. 1981. Evolution de l'état sanitaire du lac de Joux de 1953/57 à 1978/79. *Bulletin de l'A.R.P.E.A.* 108: 11-44 and 109: 41-64.

BRINKHURST, R.O. 1974. The benthos of lakes. *The Macmillan Press Ltd. London and Basingstoke*, 190 pp.

CONOVER, W.J. 1971. Practical nonparametric statistics. *John Wiley & Sons Inc. New York. London*, 462 pp.

DE HEER, J. 1984. Etude de l'environnement de la Vallée de Joux. Rapport de synthèse. *Institut du génie de l'environnement, Ecole polytechnique fédérale, Lausanne.*

HUTTER, P. & C. LANG. 1981. Sedimentary inputs and oxygen uptake by the sediment in Lake Geneva (Switzerland). *Schweiz. Z. Hydrol.* 43: 253-264.

LANG, B. & C. LANG. 1986. Coregonid fish: key predator in a eutrophic lake? *Arch. Hydrobiol. Beih.* 22: 363-372.

LANG, C. & P. HUTTER. 1981. Structure, diversity and stability of two oligochaete communities according to sedimentary inputs in Lake Geneva (Switzerland). *Schweiz. Z. Hydrol.* 43: 265-276.

STEINBERGER, C.E. & H. HARTMANN. 1988. Planktonic bloom-forming Cyanobacteria and the eutrophication of lakes and rivers. *Freshwater Biology* 20: 279-287.

VIOGET, Ph. 1991. Qualité du lac de Joux. *Rapport du service des eaux et de la protection de l'environnement.* CH-1066 Epalinges, Suisse.

REVUE SUISSE DE ZOOLOGIE, 100 (4) : 913-919; décembre 1993

Nouvelle espèce d'isopode terrestre des Açores: *Armadillidium amicorum* n. sp. (Isopoda, Oniscidea, Armadillidiidae)

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A new species of terrestrial isopod from Azores: *Armadillidium amicorum* **n. sp. (Isopoda, Oniscidea, Armadillidiidae).** - *Armadillidium amicorum* n. sp. is described. It was collected on a lava flow in the north of the Sant Miguel Island and it is closely related to the mediterranean *Armadillidium album* (Dollfus, 1887).

Key-words: Taxonomy - Azores Islands - Oniscidea - *Armadillidium* - New species.

INTRODUCTION

La connaissance de la faune des isopodes de l'archipel des Açores n'a pas encore atteint des niveaux pouvant être considérés comme acceptables.

Les travaux de VANDEL (1957, 1968) sont ceux qui ont apporté la plus grande partie des connaissances actuelles sur les isopodes terrestres de cet archipel. Néanmoins, quelques données disséminées étaient connues à partir des travaux de DOLLFUS (1889) et des référencs indirectes faites par SOIKA (1954) et VANDEL (1960, 1962).

Comme l'indique VANDEL (1968), la plupart des espèces connues des Açores sont d'origine Atlantico-Européenne ou Méditerranéenne, exception faite d'une espèce d'origine américaine, *Trichorhina tomentosa* (Budde-Lund, 1893), et d'une autre qui est considérée comme endémique, *Chaetophiloscia guerneri* (Dollfus, 1887). Mais comme le relève VANDEL (1968) l'identité taxonomique de cette dernière espèce n'est pas claire. Seule l'étude d'un matériel plus important pourra préciser son statut. Ce nombre réduit d'endémiques ou leur absence aux Açores, contraste avec la grande quantité de ces espèces se trouvant dans les archipels voisins de Madère (VANDEL, 1960) et des îles Canaries (RODRIGUEZ & VICENTE, 1992).

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On connaît cinq espèces de la famille des Armadillidiidae aux Açores, vraisemblablement toutes importées: *Eluma purpurascens* (Budde-Lund, 1879), *Armadillidium granulatum* (Brandt, 1883), *Armadillidium assimile* (Budde-Lund, 1879), *Armadillidium album* (Dollfus, 1887) et *Armadillidium vulgare* (Latreille, 1804). Etant donné l'influence européenne chez les isopodes terrestres des Açores, ce nombre important d'*Armadillidium* n'a rien d'étrange, car c'est un genre très diversifié dans la région méditerranéenne où le nombre d'espèces est très élevé (Vandel, 1962; Schmalfuss, 1981, 1982, 1984; Taiti & Ferrara, 1980).

La présence d'*Armadillidium amicorum* n. sp. confirme la richesse de cette famille dans les Açores, et rend évidente la nécessité de nouvelles recherches plus exhaustives dans un environnement géographique où la faune des isopodes est mal connue.

Armadillidium amicorum n. sp.

Holotype: 1 ♂, 5.4 x 2.6 mm, Misterio de Rabo de Peixe, San Miguel, Açores, 28-8-1989; Pedro Oromí & Philip Ashmole leg.

Paratype: 23 ♂♂, 107 ♀♀ (11 ovigères), Misterio de Rabo de Peixe, San Miguel, Açores, 28-8-1989; Pedro Oromí & Philip Ashmole leg.

Dépôt de matériel: Holotype, 20 ♂♂, 104 ♀♀ paratypes, Laboratoire de Zoologie de l'Université Autonome de Barcelone (C.Z.U.A.B.). 1?, 1♀ paratypes, Muséum d'Histoire naturelle Genève; 2 ♂♂, 2 ♀♀, Staatliches Museum für Naturkunde à Stuttgart.

Caractères somatiques: La taille moyenne des mâles est de 5 x 2,3 mm, alors que celle des femelles est de 5,3 x 2,5 mm.

Ils sont de couleur marron foncé avec quelques taches claires à l'extrémité des épimères du péréion. Quelques individus, principalement les mâles, sont de couleur marron violacé. Tous les péréiopodes sont pigmentés.

Les yeux sont formés de 10 ommatidies.

Les individus sont capables de se rouler en boule pendant la volvation.

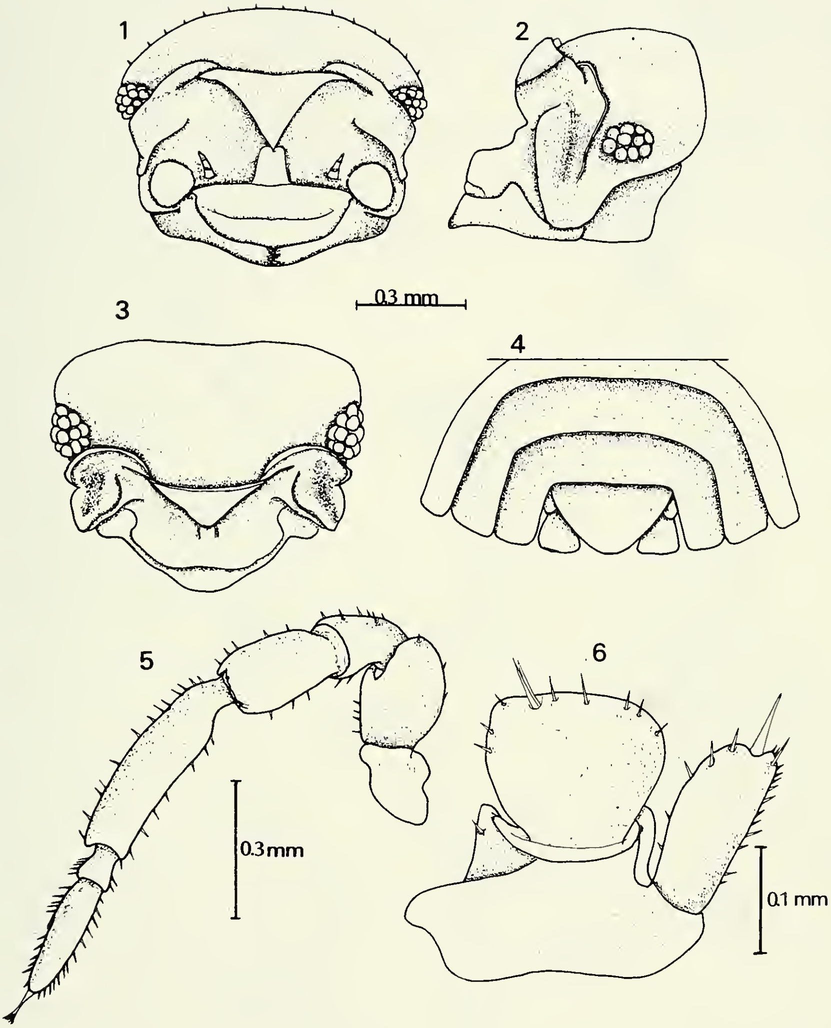
Des granulations lisses, à peine perceptibles, apparaissent sur le tegument, et tous les péréionites portent de grandes soies; les tergites présentent des soies érigées (absentes chez les autres espèces du genre à l'exception d'*A. album*).

L'écusson frontal est triangulaire et bien marqué, il ressort vers l'avant et son bord dorsal est incliné vers l'arrière suivant le niveau du vertex. L'arête dorsale de l'écusson est légèrement concave et s'efface avant d'atteindre la base des yeux. La ligne post-scutellaire est large et très développée. Les lobes antennaires sont très arrondis, les sillons antennaires étroits, longs et profonds (Figs 1, 2 et 3).

Les bords latéraux du premier épimère sont légèrement orientés vers le haut et leur angle posterolateral est plus large que chez *Armadillidium album*, finissant en pointe dirigée vers l'arrière (Figs 13 et 14).

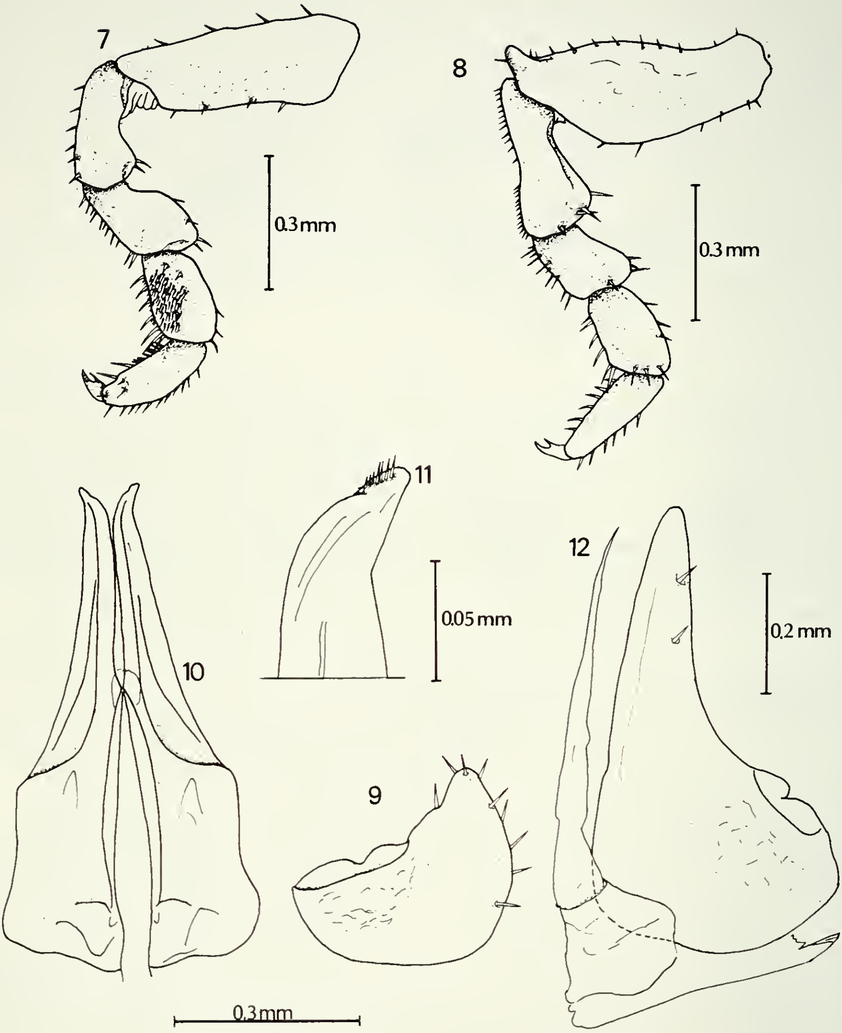
Le bord postérieur du telson est arrondi ou légèrement rectangulaire (Fig. 4).

Appendices: Les antennes sont courtes et ne dépassent pas le bord postérieur du premier péréionite. Le premier article du flagelle de l'antenne est deux fois plus court que le second (Fig. 5).



FIGS 1-6

Armadillidium amicorum n. sp. 1. Vue frontale du céphalon. 2. Vue latérale de céphalon. 3. Vue dorsale du céphalon. 4. Telson et pléon. 5. Antenne gauche. 6. Uropodes.



FIGS 7-12

Armadillidium amicorum n. sp. 7. Premier péréiopode du mâle. 8. Septième péréiopode du mâle. 9. Exopodite de la première paire de pléopodes du mâle. 10. Endopodite de la première paire de pléopodes du mâle. 11. Pointe de l'endopodite de la première paire de pléopodes du mâle. 12. Deuxième pléopode du mâle.

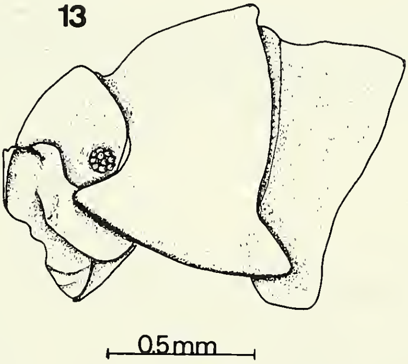
Caractères sexuels mâles: Les méros et les carpos de tous les péréiopodes du mâle sont munis de brosses plus nombreuses que les femelles. Ces différences s'accentuent sur les trois premiers péréiopodes (Fig. 7).

Sur le septième péréiopode du mâle, l'arête dorsale de l'ischion décrit une courbe très concave et possède de fines soies. Le basis, sur son angle dorso-distal, présente une apophyse saillante très prononcée, orientée perpendiculairement à l'axe de l'appendice (Fig. 8).

Les exopodites de la première paire de pléopodes ont un lobe postéro-interne court portant des soies dures. La ligne marginale, à la hauteur du champ trachéen, est légèrement incurvée. (Fig. 9).

Les pointes postérieures des endopodites du premier pléopode sont divergentes et possèdent une rangée de soies (Figs 10 et 11).

13



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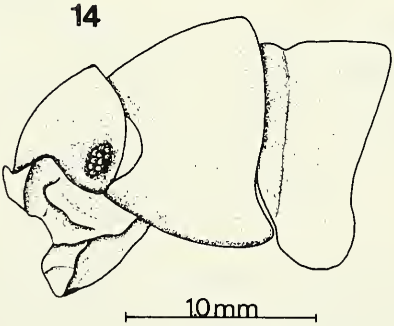

Figs 13-14

13. Vue latérale d'*Armadillidium amicorum* n. sp.; 14. Vue latérale d'*Armadillidium album*.

L'exopodite du second pléopode présente une pointe postéro-interne large, et la ligne marginale, à la hauteur du champ trachéen, apparaît elle aussi incurvée (Fig. 12).

L'endopodite est de la même longueur que l'exopodite. Il est mince et se termine en pointe très fine.

AFFINITÉS

Cette espèce est certainement proche de l'*Armadillidium album* (Dollfus, 1887), avec laquelle elle partage un grand nombre de caractéristiques. Ces dernières sont liées à l'ornementation du tegument, aux modifications sexuelles des péréiopodes, spécialement le septième, à la configuration de l'exopodite du premier pléopode du mâle, à la forme du telson et des uropodes. Les différences qui apparaissent concernent principalement la configuration céphalique. Chez l'*Armadillidium amicorum* n. sp. la ligne frontale s'efface avant d'atteindre la hauteur des yeux. Au contraire, chez l'*A. album*, la ligne frontale dépasse les yeux. L'écusson frontal de la nouvelle espèce est orienté dans le sens du vertex, alors que chez l'*A. album* il se situe dans une direction quasi perpendiculaire au vertex. De plus, le bord latéral du premier épimère d'*A. amicorum* est un peu plus dirigé vers le haut et forme une pointe bien développée à l'angle posterolateral.

CARTE 1

Situation de la localité type.

Amadillidium anicorum n. sp. se différencie également d'*A. album* par sa taille moyenne plus petite (5,2 x 2,4 mm contre 6-7 mm) ainsi que par sa forte pigmentation alors que chez *A. album* seuls quelques individus peuvent être légèrement pigmentés.

Dérivation nominale: Dédié à mes amis: Ramón, Elvira, Pep, Nuri, Gloria et Rodo.

HABITAT ET DISTRIBUTION

Armadillidium amicorum n. sp. a été récolté dans une coulée de lave située à 10 m au-dessus du niveau de la mer sur la côte nord de l'île de San Miguel. Malgré la proximité de la mer, la localité typique ne peut être considérée comme un habitat halophyle (Carte 1).

REMERCIEMENTS

Cette espèce a été récoltée par le Dr. Pedro Oromí de l'Université de La Laguna et le Dr. Philip Ashmole de l'Université d'Edimbourg, dans le cadre d'une étude réalisée dans les tubes de lave et sur des coulées volcaniques de l'Archipel des Açores au cours des années 1987 et 1989, financée par la National Geographic Society. Nous les remercions sincèrement de nous avoir confié l'étude de ce matériel.

RÉSUMÉ

Description d'une nouvelle espèce appartenant à la famille des Armadillidiidae provenant des Açores, trouvée dans une coulée de lave au Nord de l'île de Sant Miguel: *Armadillidium amicorum* n. sp. Il s'agit d'une espèce endémique étroitement apparentée à l'*Armadillidium album.*

BIBLIOGRAPHIE

DOLLFUS, A. 1889. Liste préliminaire des Isopodes extramarins recueillisaux Açores pendant les campagnes de l'Hirondelle (1887-1888) par M. Jules de Guerne. *Bull. Soc. Zool. Fr.*, 14: 125-132.

RODRIGUEZ, R. & C. VICENTE. 1992. *Porcellio eserensis* sp. n. of Terrestrial Isopod from tre Canary Islands (Isopoda: Oniscidea: Porcellionidae). *Bocagiana*, 162: 1-7.

SOIKA, A. 1954. Ecologia, Sistematica, Biogeografia ed Evoluzione del *Tylos latreillei* auct. (Isop. Tylidae). *Bol. Mus. civ. Stor. nat. Venezia*, 7: 63-83.

SCHMALFUSS, H. 1981. Die Landisopoden (Oniscoidea) Griechenlands 2. Beitrag: Gattung *Armadillidium*, Teil I (Armadillidiidae). *Spixiana*, 4: 275-289.

SCHMALFUSS, H. 1982. Die Landisopoden (Oniscoidea) Griechenlands 3. Beitrag: Gattung *Armadillidium*, Teil II (Armadillidiidae). *Spixiana*, 5: 217-230.

SCHMALFUSS, H. 1984. Die Landisopoden (Oniscidea) Griechenlands. 6. Beitrag: Gattung *Armadillidium*, Teil III (Armadillidiidae). *Sber. österr. Akad. Wiss., math-nat. Kl.*, Abt. I, 193: 289-301.

TAITI, S. & F. FERRARA. 1980. Nuovi Studi sugli Isopodi Terrestri dell'Arcipelago Toscano. *Redia*, 63: 249-300, 17 fig. 1 tab.

VANDEL, A. 1957. Les Isopodes terrestres des Açores. *Mém. Mus. natn. Hist. nat. Paris*, ser. A. Zool., 8: 249-264.

VANDEL, A. 1960. Les Isopodes terrestres de l'Archipel Madérien. *Mém. Mus. natn. Hist. nat. Paris*, Sér. A. Zool. 22: 1-155.

VANDEL, A. 1962. Isopodes Terrestres (deuxième partie). *Faune de France*, 66. Ed. Paul Lechevalier, Paris, 513 pp.

VANDEL, A. 1968. The Terrestrial Isopoda of the Azores. *Bol. Mus. Munic. Funchal*, 22(98): 5-29.

REVUE SUISSE DE ZOOLOGIE, 100 (4) : 921-927; décembre 1993

Notes sur les Psélaphides néotropicaux (Coleoptera).
8 - Le genre *Metopias* Gory de la tribu des Metopiasini

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Notes on Neotropical Pselaphidae (Coleoptera). 8 - The genus *Metopias* Gory of the tribe Metopiasini. – The genus *Metopias* is redefined. The type species is redescribed and 3 new species from South America are described and figured.

Key-words: Coleoptera - Pselaphidae - *Metopias* - Taxonomy - South America.

INTRODUCTION

Le genre *Metopias* a été créé par Gory (1832) pour une espèce nouvelle, *curculionoides*. SCHAUFUSS (1872) a ajouté *elongatus* de l'Amazone; puis SHARP (1887) a décrit *elegans* de Panama, enfin RAFFRAY (1904) y a placé *carinipes* de Bolivie. Ces trois dernières ne sont pas conspécifiques avec *Metopias curculionoides*. Par contre, j'y ai adjoint trois espèces nouvelles: *cordiformis*, *goryi* et *surinamensis*, toutes provenant de l'Amérique du Sud.

Les espèces de *Metopias* présentent toujours les caractères suivants:

- Antennes avec les articles 2, 3 et 4 de longueurs décroissantes; article 3 un peu plus petit que le 2, article 4 nettement plus petit que le 3 (figs 5 et 7); les articles 3 et 4 ensemble sont plus longs que l'article 2.
- Taille grande: 3,5 à 3,6 mm.
- Edéage très grand: 0,54 à 0,85 mm.

En outre: le tégument est brillant et tout le corps est recouvert d'une pilosité, plus ou moins longue et dense. La pilosité de l'antenne est longue, dirigée vers l'apex. Il y a deux petites fossettes basales sur chaque élytre. Les angles huméraux sont arrondis mais bien marqués. Les hanches I et II sont contiguës; les hanches III sont séparées d'une fois et demie leur diamètre.

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Les individus de ce genre paraissent rares et isolés.

Les dessins des mêmes parties de chaque espèce sont à la même échelle. Seuls les segments abdominaux apparents sont observés. Le matériel étudié est déposé dans les institutions suivantes: Muséum d'histoire naturelle de Genève (MHNG), Muséum national d'histoire naturelle, Paris (MNHN) et Field Museum of Natural History, Chicago (FMNH).

Metopias curculionoides Gory

Tête (Fig. 1) avec un gros bourrelet central à l'arrière. Tégument finement et irrégulièrement granuleux-ponctué. Pilosité dense et très longue sur toute la tête. Antenne (Figs 5 et 6) a tégument granuleux. Dessous de la tête avec une échancrure longitudinale profonde partant du bord basal.

Pronotum bien plus large que long, cordiforme partagé longitudinalement par un sillon. Au tiers postérieur, un sillon transversal s'étend sur toute la largeur. Tégument comme celui de la tête. Pilosité dense et longue, mais plus courte que celle de la tête et des antennes.

Elytres réunis aussi longs que larges; un sillon longe la suture sur toute sa longueur; un autre sillon part du milieu de la base et s'efface à mi-longueur de l'élytre. Tégument assez densément et irrégulièrement ponctué. Pilosité dense, assez longue comme celle du pronotum.

Métasternum bombé à tégument lisse, très finement et irrégulièrement ponctué.

Abdomen. Tergites avec, de chaque côté avant le replat, un fort sillon longitudinal. Bord apical des tergites et des sternites avec une frange de soies dirigées en arrière, un peu plus dense latéralement. Tégument finement et irrégulièrement ponctué, granuleux-ponctué sur les replats latéraux. Pilosité dense et assez longue comme celle du pronotum et des élytres. Extrémité ventréale de l'abdomen: Fig. 11.

Pattes à tégument finement ponctué. Pilosité assez dense, longue et fine, couchée en direction de l'extrémité.

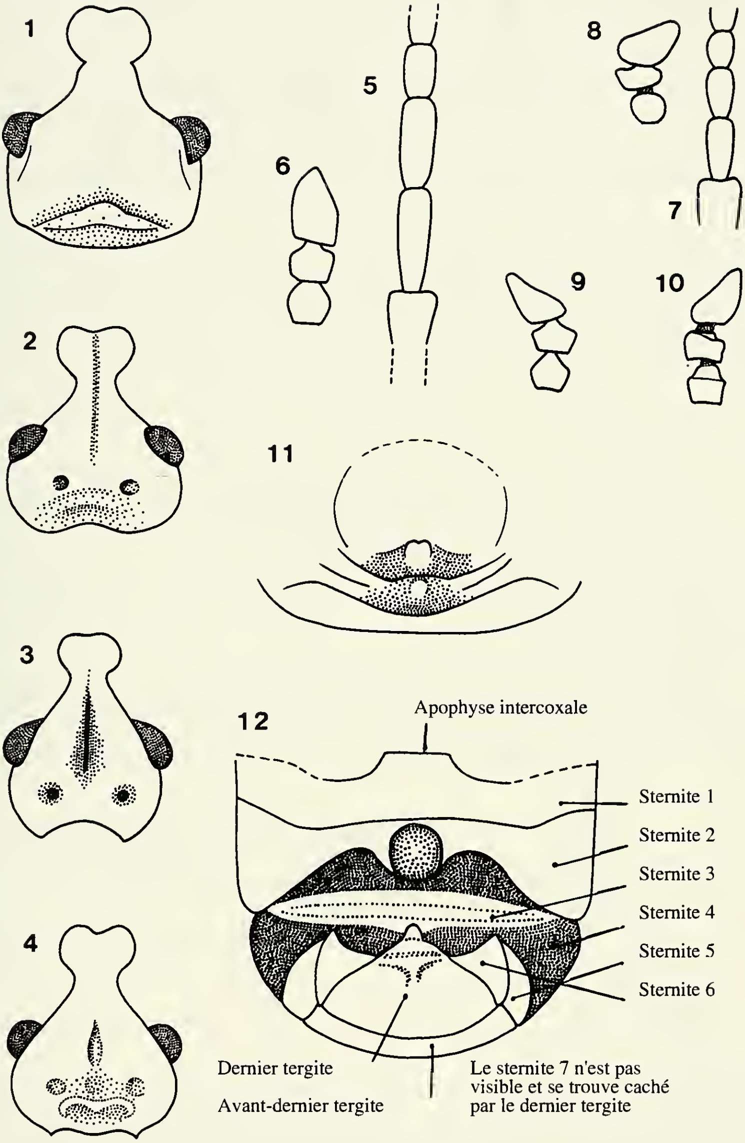
Longueur de la ♀: 3,6 mm env.

Matériel examiné: ♀, *lectotype* par présente désignation: Cayenne, Guyane française. L'étiquette porte comme indications: Metopias Gory / curculionoides Gory / Mag. zool. 1832, 42 / Cayenne. Coll. Raffray (MNHN).

Metopias cordiformis n. sp.

Tête (Fig. 2) avec un bourrelet central à l'arrière. Tégument très finement et irrégulièrement ponctué-granuleux, plus fortement sur le bourrelet et l'arrière de la tête. Pilosité assez dense, longue et fine, un peu plus serrée sur les côtés. Massue antennaire fortement asymétrique (Fig. 9). Dessous de la tête avec une courte échancrure triangulaire partant du milieu du bord basal. Pilosité du dessous de la tête assez longue et très fine, plus dense sur les côtés.

Pronotum bien plus large que long, cordiforme, avec une dépression transversale sur toute sa largeur au tiers postérieur. Tégument ponctué-granuleux, plus fortement par



FIGS 1-12

Dessus de la tête: 1. *Metopias curculionoides* Gory; 2. *M. cordiformis* n. sp.; 3. *M. goryi* n. sp.; 4. *M. surinamensis* n. sp. Antenne, articles 1 à 5: 5. *M. curculionoides* Gory; 7. *M. goryi* n. sp. Antenne, massue: 6. *M. curculionoides* Gory; 8. *M. goryi* n. sp.; 9. *M. cordiformis* n. sp.; 10. *M. surinamensis* n. sp. Dessous de l'extrémité de l'abdomen; 11. *M. curculionoides* Gory ♀; 12. *M. surinamensis* n. sp. ♂.

place. Pilosité dense, assez longue, plus serrée sur la moitié antérieure et surtout sur les côtés.

Elytres réunis un peu plus larges que longs, leur plus grande largeur au quart postérieur. Un sillon longe la suture, un autre également longitudinal part du milieu de la base et s'efface aux deux tiers de l'élytre. Tégument très finement ponctué-granuleux. Pilosité comme celle du pronotum, plus dense sur les côtés et à l'arrière.

Métasternum à pilosité fine longue et assez dense, dirigée en éventail ouvert vers l'arrière.

Abdomen. Tergites avec, de chaque côté avant le replat, un sillon longitudinal bien marqué, assez profond, surtout sur le premier tergite apparent; le replat latéral de celui-ci est creusé, en avant, d'une profonde fossette lisse. 7ème sternite divisé en deux, avec sur chaque partie, à l'apex, une petite apophyse dirigée vers l'extérieur (fig. 13). Pilosité assez dense, couchée, dirigée obliquement en arrière.

Pattes à tégument très finement ponctué-granuleux. Pilosité très dense, fine et couchée, assez courte et dirigée vers l'extrémité des pattes.

Longueur: ♂, 3,50 mm. env.

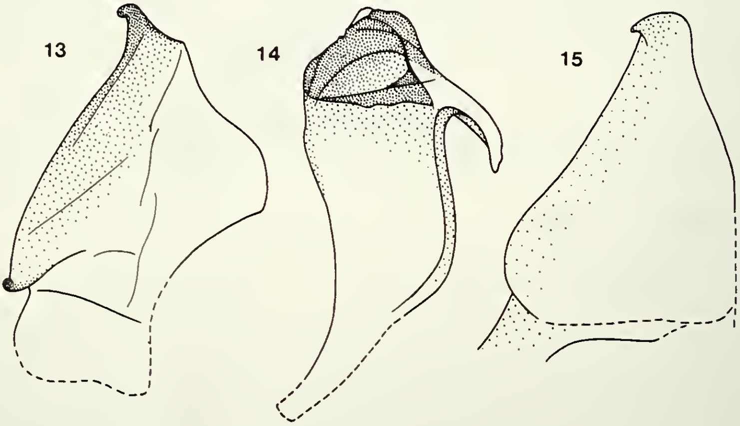
Edéage: Figs 16 et 17; longueur 0,64 à 0,70 mm.

♂, *holotype*: Mont Grand-Matoury, île de Cayenne, Guyane française (leg. J. Orousset) (MHNG). Paratype: 1♂, même provenance (MHNG).

Le nom *cordiformis*, référence à la forme du thorax.

Metopias goryi n. sp.

Tête (Fig. 3). Tégument très finement ponctué. Pilosité très fine et dense, surtout sur l'arrière et les côtés. Antenne (Figs 7 et 8) à tégument assez fortement granuleux,



Figs 13-15

7ème sternite: 13. *Metopias cordiformis* n. sp.; 14. *M. goryi* n. sp.; 15. *M. surinamensis* n. sp.

surtout le scape, plus faiblement dans le milieu du funicule; massue fortement asymétrique. Dessous de la tête à pilosité longue, assez dense et très fine. Bord basal du dessous de la tête avec une échancrure longitudinale profonde.

Pronotum un peu plus long que large avec deux grosses bosses en avant séparées longitudinalement, au milieu, par un sillon très profond; celui-ci est coupé, au tiers postérieur, par un sillon transversal occupant toute la largeur du thorax. De chaque côté du thorax, sur la moitié antérieure, une bosse latérale séparée de la bosse centrale par une dépression longitudinale. Tégument finement ponctué, un peu granuleux dans les creux. Pilosité dense et longue, comme celle de la tête, un peu plus éparse en arrière.

Elytres réunis plus larges que longs, leur plus grande largeur au tiers postérieur. Un fin sillon longe la suture sur toute sa longueur; une dépression longitudinale bien marquée part du tiers huméral de la base et s'efface vers le milieu de la longueur de l'élytre. Tégument finement ponctué. Pilosité dense, plus longue et un peu plus épaisse que celle du pronotum.

Métasternum à pilosité longue et dense, dirigée vers l'arrière. Une profonde dépression occupe toute la partie médiane; elle est garnie, sur sa moitié antérieure, d'une série transversale serrée de 4 ou 5 peignes formés de poils assez courts, larges et serrés; le premier et le dernier peigne sont argentés, ceux du milieu sont dorés.

Abdomen. Tergite avec, de chaque côté avant le replat, un sillon longitudinal bien marqué, recourbé vers le centre à la base. Le replat latéral du premier tergite apparent est creusé, en avant, d'une grande et profonde fossette lisse. Le 7ème sternite est divisé en deux, avec à l'apex, un crochet sur chaque partie du côté interne (Fig. 14). Pilosité assez dense, dirigée obliquement en arrière, plus courte et plus fine que celle du thorax et des élytres.

Pattes à tégument finement ponctué granuleux. Pilosité dense, assez longue et fine, dirigée vers l'extrémité.

Longueur de l'unique exemplaire ♂: 3,50 mm env.

Edéage: Fig. 18; longueur 0,85 mm.

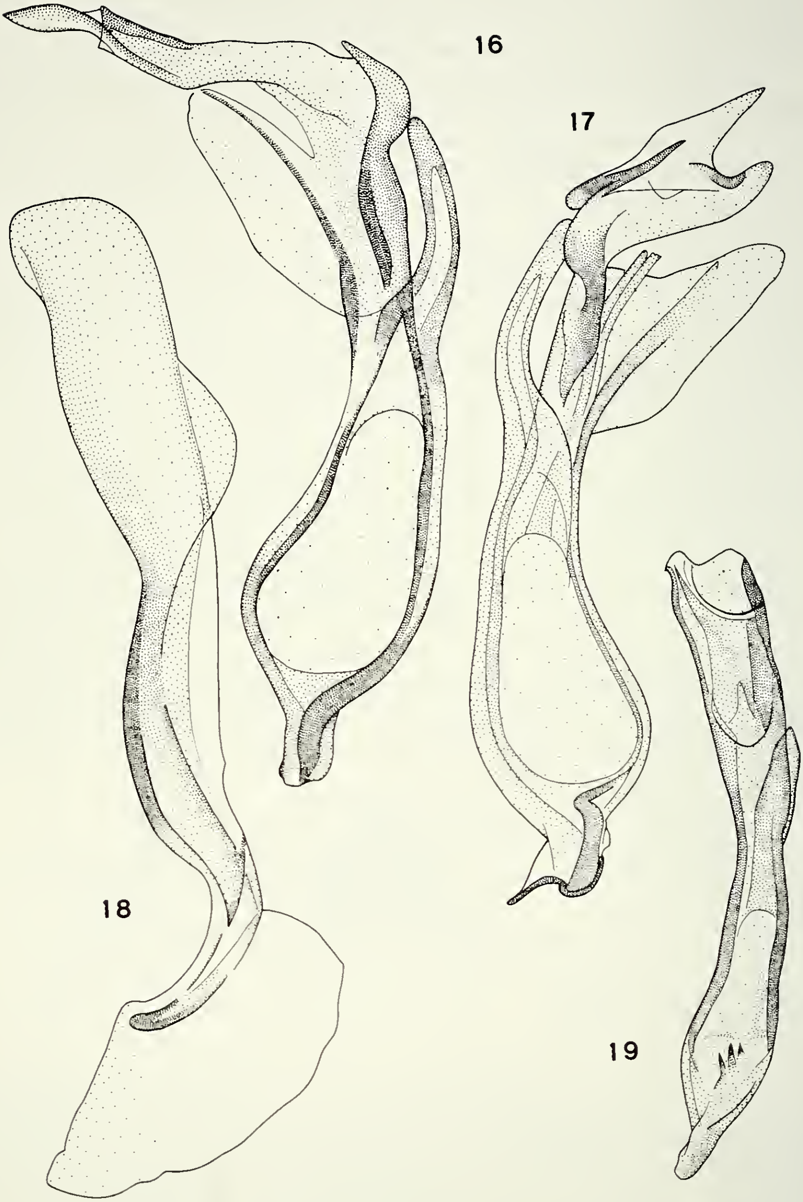
♂, *holotype*: Mont Grand-Matoury, île de Cayenne, Guyane française (leg. J. Crousset) (MHNG).

Espèce dédiée à Hyppolype Louis Gory qui a décrit le genre.

Metopias surinamensis n. sp.

Tête (Fig. 4) avec un fort bourrelet en ovale transversal à l'arrière. Tégument finement et irrégulièrement ponctué, granuleux sur le bourrelet et l'arrière de la tête. Massue antennaire asymétrique; (Fig. 10) antenne à tégument assez densément granuleux-ponctué. Dessous de la tête avec une large et courte échancrure triangulaire partant du bord basal. Pilosité du dessous de la tête longue, assez forte et dense.

Pronotum plus large que long, assez rectangulaire avec la base convexe. Les deux tiers avant forment un relief tabulaire partagé longitudinalement, au milieu, par une dépression plus profonde en avant; ce relief est bordé, à l'arirère, d'un large sillon transversal plus profond au centre; la base du pronotum forme un bourrelet arrondi.



FIGS 16-19

Edéages: 16. *Metopias cordiformis* n. sp.; 17. idem! autre aspect; 18. *M. goryi* n. sp.; 19. *M. surinamensis* n. sp.

Tégument ponctué-granuleux, plus lisse dans le sillon transversal. Pilosité fine et longue, plus dense et un peu plus courte sur les côtés.

Elytres réunis aussi longs que larges. Tégument finement et irrégulièrement ponctué, granuleux par places. Pilosité fine et assez dense, plus courte que celle du pronotum.

Metasternum à pilosité très fine, longue et peu dense, dirigée en éventail s'ouvrant vers les côtés et l'arrière.

Abdomen. Tergites avec, de chaque côté avant le replat, un sillon longitudinal bien marqué. Le replat latéral du premier tergite apparent est orné à la base d'une dépression lisse. Chaque tergite est bordé, latéralement et en arrière, d'une frange dense et épaisse de longs poils recourbés. Pilosité générale assez longue, très fine et peu dense. Tégument très finement et irrégulièrement ponctué, granuleux par place. Dessous de l'abdomen (Fig. 12); 7ème sternite (Fig. 15).

Pattes à tégument finement ponctué-granuleux. Pilosité dense, couchée, assez longue, dirigée obliquement vers l'extrémité.

Longueur de l'unique exemplaire ♂: 3,60 mm. env.

Edéage: Fig. 19; longueur 0,54 mm.

♂, *holotype*: Surinam, distr. Marovijne, Anapaitae, village Lawa R. (leg. B. Malkin) (FMNH).

BIBLIOGRAPHIE

GORY, H. L. 1832. Description du genre *Metopias*. *Magasin de Zoologie*, 2: 2 pp. non numérotées, planche 42.

RAFFRAY, A. 1904. Genera et catalogue des Psélaphides. *Annls Soc. ent. Fr.*, 1-400.

SCHAUFUSS, L. W. 1872. Beschreibung einiger Pselaphiden. *Numquam Otiosus*, 2: 259-279.

SHARP, D. 1887. Fam. Pselaphidae, pp. 1-46. *In:* Biologia Central; - Americans Insecta Coleoptera, 2 (I). *Taylor & Francis, London.*

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Taxonomy and stridulation of the Gomphocerinae and Truxalinae of Thailand (Orthoptera, Acrididae)

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Taxonomy and stridulation of the *Gomphocerinae* **and** *Truxalinae* **of Thailand** (*Orthoptera, Acrididae*). – Four species of Gomphocerinae and one of Truxalinae are recorded from Thailand: *Dhimbana castanea* sp.n., *Paragonista hyalina* Ingrisch, 1989, *Dnopherula (A.) taeniatus* (Bolívar, 1902), *Dnopherula (A.) svenhedini* (Sjöstedt, 1933) and *Truxalis siamensis* Dirsh, 1950. The female of *P. hyalina* is described for the first time; *T. siamensis* is redescribed; the high morphological variability of both *Dnopherula* species is demonstrated. For all 5 species, stridulation is described for the first time.

Key-words: Orthoptera - Acrididae - Thailand - Taxonomy - Stridulation.

INTRODUCTION

Grasshoppers of the subfamilies Gomphocerinae and Truxalinae (used here in the sense of Dirsh 1961, 1975 and Uvarov 1966) are scarcely represented in the fauna of Indochina. Previous records from Thailand comprise only three species: *Aulacobothrus luteipes* (Walker, 1871) (Roffey 1979), placed in *Dnopherula* by Jago (1971), *Paragonista hyalina* Ingrisch, 1989 and *Truxalis siamensis* Dirsh, 1950. However, recent studies showed that the first consists in reality of two species, *D. luteipes* with a restricted distribution in India and *D. taeniatus* (Bolívar, 1902) which is widespread in the Oriental region (Ingrisch in press). Both were erronously synonymised by Uvarov (1921). *P. hyalina* has been known in the male sex only, and *T. siamensis* from the female type and a pair of doubtful origin.

Sporadic excursions from 1985 - 1993 showed that four Gomphocerinae and one Truxalinae species occur in Thailand. Apart from the species mentioned above,

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Dnopherula svenhedini (Sjöstedt, 1933), the previously unknown female of *P. hyalina* and an undescribed species of the Indian genus *Dhimbana* Henry, 1940 were recently collected. Moreover, it proved that *T. siamensis* was insufficiently described by DIRSH (1950).

In Gomphocerinae and Truxalinae, the variation of the individuals within a species or even within a local population is usually high, the differences between closely related species low. Thus, differenciation of the species on morphological characters is often difficult, and even the genital structures are rather uniform between and within genera (DIRSH 1956). In those subfamilies, separation of the species is mainly based on behavioural characteristics.

Gomphocerinae and Truxalinae are characterised by the possession of stridulatory pegs on the inner surface of the postfemur which are rubbed against the radial vein of the tegmen during sound production. The songs differ between species and are a powerful tool in the recognation of the species. Our knowledge of the stridulation of the Gomphocerinae and Truxalinae of the Oriental region, however, is only at the very beginning.

The aim of the present paper is to update the systematics of all species of Gomphocerinae and Truxalinae hithertho found in Thailand. Emphasis is laid on presenting the great intra-population variability of some morphological characters previously thought to be of taxonomic value and on introducing stridulation as a new character for the separation of the Oriental Gomphocerinae.

METHODS

Morphological studies and measurements were done with a WILD M5 stereo microscope using an ocular micrometer; for drawings a camera lucida was used with the same stereo microscope. Apart from standards the following measurements were taken:

Head: width of fastigium between the front margins of the compound eyes and including the lateral carinulae; eye length: the longest diagonal diameter in lateral view; length of suborbital furrow; length of fastigium in lateral view from the tip of the head to the front margin of the compound eye. Pronotum: length along the median carina; length of prozona along the median carina from the front margin to the principal sulcus. Tegmen: apical field, from the point where the subcosta meets the costa to the tip of tegmen (sometimes difficult to evaluate in the ♀ and thus not always measured). Mesosternum: width of mesosternal interspace and width of mesosternal lobes, both at halfway the length of the interspace.

The terminology of the phallic complex used is as in DIRSH (1956).

Recording of stridulation: In the field, recording was done with a portable cassette recorder (SONY WM3) and a UNIVERSUM microphone on CrO_2-tape cassettes; resulting frequency range 0.05 - 15 kHz. In the studio, stridulation was recorded with a cassette recorder (KENWOOD KX 880 HX) and an AKG D202 mikrophone with the low frequency range (< 100 Hz) switched off on pure metal tape cassettes. The resulting frequency range was 0.1 - 20 kHz. During studio recording, the grasshoppers were kept in wooden cages with gauze walls. A 60-Watt-bulb provided ligth and radiation heat.

Oscillographs were produced by an Oscillomink (Fa. Siemens) after rerecording on an UHER Report M4200 tape recorder.

For the description of songs the following terminology is used: syllable, one complete down and up movement of the hind legs; echeme, first order assemblage of syllables; verse (= echeme sequence in RAGGE 1987, RAGGE & REYNOLDS 1988), first order assemblage of echemes.

Most material was personally collected during excursions in 1985 - 1993. Unless otherwise stated, the material is in my collection.

SYSTEMATIC PART

KEY TO THE SPECIES OF GOMPHOCERINAE AND TRUXALINAE OF THAILAND

1 Postfemur with a row of stridulatory pegs (and/or bristles) on internal surface. 2
– Postfemur without stridulatory pegs on internal surface. . . . . . other subfamilies
2 Head strongly elongate with eyes near the apex (fig. 25); distance eyes - pronotum more than twice the longest diameter of one eye. Truxalinae: . . . . *Truxalis siamensis* Dirsh, 1950
– Head not so extremely elongate, if strongly reclinate (figs 21-22) then the distance eyes - pronotum not more than the longest diameter of one eye. . . . . Gomphocerinae 3
3 Head strongly reclinate, distinctly conical, with a shallow triangular impression at the front margin of the compound eye (figs 21-22). 4
– Head slightly reclinate to bulbous, with rectangular foveolae (figs 23-24). . . . 5
4 Fastigium verticis in front of the eyes 0.7 - 0.9 x the longest diameter of one eye; antennae inserted in front of lateral ocelli (fig. 3); vertex with a strong median carina (figs 1-2). Tegmen shorter than abdomen. Brown with a dorso-medial and on each side with a ventro-lateral white band (figs 1-2, 21-22). . . . . *Dhimbana castanea* n.sp.
– Fastigium verticis in front of the eyes 0.6 - 0.7 x the longest diameter of one eye; antennae inserted between the anterior margins of the lateral ocelli (fig. 6); vertex with a faint median carinula (figs 4-5). Tegmen longer than abdomen. Coloration different, without a dorso-medial white band. . . . . *Paragonista hyalina* Ingrisch, 1989
5 ♀ stout. Antennae slender, in ♂ surpassing base of postfemur. Sulcus often slightly behind the middle of pronotum (figs 7-11) (but sometimes in or slightly before the middle), index prozona : metazona = 0.93 -1.22 (mean = 1.06). Tegmen indistinctly mottled, with small spots in medial area, in ♂ with costal area wider, apical area rather narrow, and cubital field slightly widened (figs 45-47). Posttibia with ventral interno-apical spur only slightly longer than dorsal spur (fig. 26). *Dnopherula (Aulacobothrus) taeniatus* (Bolívar, 1902)

– ♀ slender. Antennae stronger, in ♂ not reaching base of postfemur. Sulcus slightly before or in the middle of pronotum (figs 12-15), index prozona : metazona = 0.84 - 1.00 (mean = 0.94). Tegmen distinctly mottled, with large spots in medial area, in ♂ with costal area less widened, apical area broad, and cubital field not widened (figs. 49-50). Posttibia with ventral interno-apical spur much longer than dorsal spur (fig. 27). . . . . *Dnopherula (Aulacobothrus) svenhedini* (Sjöstedt, 1933)

DESCRIPTION OF SPECIES AND STRIDULATION

Dhimbana castanea n.sp. (Figs 1-3, 21-24, 29, 30, 36, 52-53, 56-58, 64)

Holotype, ♂: Thailand, Chiang Mai province, W Chiang Mai, near Huei Kaeo waterfall at the foothills of Doi Suthep, 26.IV.1988 lg. Ingrisch (Muséum d'Histoire naturelle de Genève).

Paratypes: 1 ♀, Thailand, Chiang Mai, Huei Kaeo 12.IV.1985; 1 ♂, 1 ♀ (allotype), do. 26.IV.1988; 2 ♂, 3 ♀, do. 3.V.1988; 2 ♂, 1 ♀, do. 10.IX.1989; 1 ♂, do. 3.X.1991; 1 ♂, 4 ♀, do. 4.-7.VIII.1992 (allotype ♀, Muséum d'Histoire naturelle de Genève; 2 ♂, 2 ♀, Department of Agriculture Bankhen, Bangkok; rest in my collection).

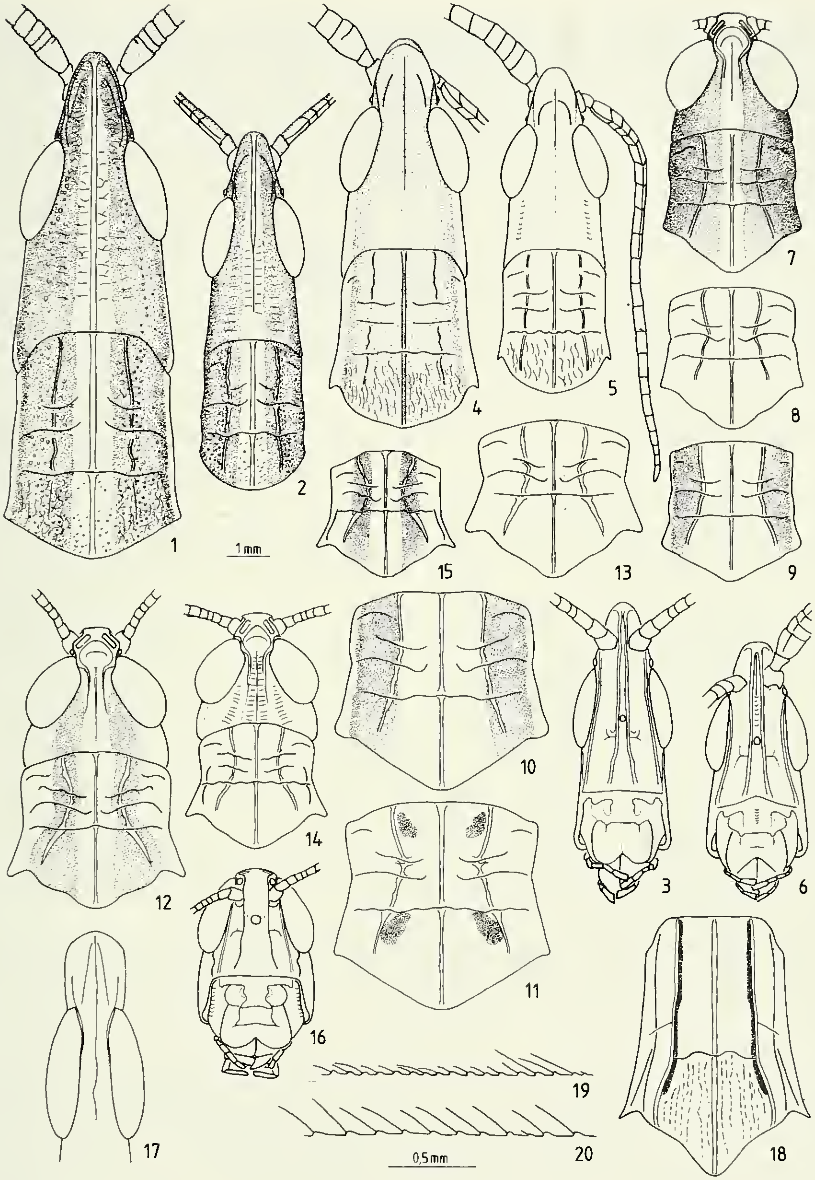
Other material: 1 ♀, Prachuap Khiri Kan province, Hua Hin, hill near golf course, 26.VII.1992; 2 ♂, 2 ♀, do. 1.IV.1993.

Habitat: Open grassy spots in a mixed rock-savanna-teak forest habitat.

Description. Head (figs 1-2, 21-22) elongate, conical, longer than pronotum; fastigium verticis dinstinctly projecting in front of the eyes, with a median carina which is distinct in front of the eyes, gradually fading behind. A shallow triangular impression in front of dorso-anterior margin of compound eye; a faint additional carinula below lateral ocellus. Frontal carinae subparallel above, diverging below median ocellus (fig. 3). Vertex with transverse rugosities and longitudinal rows of punctures. Antennae longer than head and pronotum together, in male surpassing base of posterior femur; segments 3 - 8 or 9 (♂) respectively 3 - 12 or 13 (♀) in cross-section triangular and dorsally expanded in an apically decreasing manner, remaining segments subcylindrical.

Pronotum (figs 1-2, 21-22) cylindrical, rugosely punctured, more densely in metazona; median carina distinct, interupted by principal sulcus only, lateral carinae faint, with indication of additional carinulae bordering the median pale band; first sulcus lateral, second sulcus indicated at lateral carinae only, third sulcus on paranota and disc, interrupted on the latter, fourth (= principal) sulcus faint on paranota, distinct on disc. Tegmen surpassing apex of streched postfemur but leaving abdominal apex uncovered; venation as in figs 52-53. Hind wings reaching apex of folded tegmen.

Prosternum without distinct tubercle. Sternal plate (figs 36, 37) finely stippeled; mesosternal lobes 1.5-2.4 x broader than mesosternal interspace, interspace 1.4-2.3 x longer than wide; metasternal lobes contiguous. Tympanum ovoid, 1.3 - 1.9 x longer than broad, operculate in dorso-posterior half. Postfemur slender, not reaching apex of elongate abdomen, interior area with a row of 90 - 115 (♂) or 84 - 117 (♀) stridulatory pegs; genicular lobes rounded. Posttibia with dorso-external apical spine lacking.



FIGS 1-20.

1-3. *Dhimbana castanea* n.sp. (paratypes): 1. head and pronotum of ♀ in dorsal view; 2. do. of ♂; 3. head of ♂ in frontal view; 4-6. *Paragonista hyalina* Ingrisch: 4. head and pronotum of ♀ in dorsal view; 5. do. of ♂; 6. head of ♂ in frontal view; 7-11. *Dnopherula taeniatus* (Bolívar) from Huei Kaeo: 7. head and pronotum of ♂ in dorsal view; 8-9. pronotum of other ♂♂; 10-11. pronotum of ♀♀; 12-16. *Dnopherula svenhedini* (Sjöstedt): 12. head and pronotum of ♀ in dorsal view; 13. pronotum of another ♀; 14. head and pronotum of ♂ in dorsal view; 15. pronotum of another ♂; 16. head of male in frontal view; 17-20. *Truxalis siamensis* Dirsh ♂ from Huei Kaeo: 17. fastigium and eyes in dorsal view; 18. pronotum; 19-20. sector of stridulatory file on internal side of postfemur: 19. from end of basal third of postfemur, 20. from middle of postfemur.

♂: Tenth tergite continuous. Supra anal plate (fig. 30) elongate-triangular, apex rounded, with a median furrow bordered by rounded carinae and with diagonal, baso-external folds. Cerci long-conical, simple. Subgenital plate (fig. 29) elongate, conical, with a strong dorso-medial carina. Epiphallus (figs 57, 58) bridge-shaped; anchorae large, apex subobtuse or obtuse; outer lophi much larger than inner lophi, somewhat curved. Cingulum (fig. 56) with zygoma, rami and apodemes; apodemes rather short, rami almost completely thin-membranous and translucent. Basal and apical penis valves connected by a curved, unbroken flexure.

♀: Supra anal plate semi-ovoid with sloping sides, a transverse sulcus, and a medio-longitudinal furrow in or somewhat beyond basal half. Cerci short. Ovipositor short, simple, only slightly extending beyond apices of supra anal plate and paraproctes. Subgenital plate oblong, apex from obtuse-angular to almost semicircular with a small triangular expansion in the middle.

Coloration. Antennae, head, pronotum und tegmen dark chocolate brown, a dorso-medial whitish band running from fastigium to apex of tegmen, a lateral whitish band from base of antennae to base of postfemur; frons and ventral margin of pleurae medium to light brown; hidden tergits and underside of body yellowish brown or testaceous. Antennae with white tips. Anterior and medial legs and postfemur yellow, green or light brown; hind knees more or less darkened; posttibia yellowish brown with an indistinct teint of blue. Variation: the general colour can be light brown instead of dark brown; the dorso-medial white band and the postfemur and posttibia can be infumated to a varying degree.

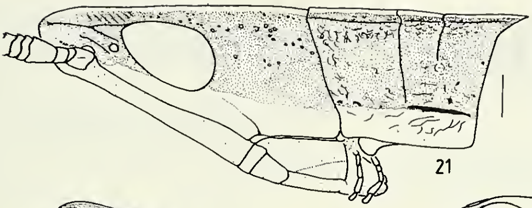
Measurements (length in mm): body ♂ 24 - 27, ♀ 30 - 36; fastigium (in front of eyes) ♂ 1.4 - 1.7, ♀ 1.8 - 2.2; antenna ♂ 12.0 - 14.0, ♀ 10.5 - 13.0; pronotum ♂ 3.4 - 3.8, ♀ 4.5 - 5.5; tegmen ♂ 14.5 - 17.0, ♀ 17.5 - 21.0; postfemur ♂ 9.5 - 10.5, ♀ 11 - 14.

Indices: Width of fastigium : eye length ♂ 0.52 - 0.58, ♀ 0.54 - 0.69; eye length : length of suborbital furrow ♂ 1.40 - 1.79, ♀ 1.33 - 1.65; length of prozona : length of pronotum ♂ 0.60 - 0.63, ♀ 0.61 - 0.67.

Stridulation (fig. 64). The calling song consists of a single verse, and can be described as "tsick tick tick tick tick ....". Verse durations of (4 -) 10 - 20 s

FIGS 21-44.

21-24. head and pronotum in lateral view of 21. *Dhimbana castanea* n.sp. (paratype) ♀, 22. do. ♂, 23. *Dnopherula svenhedini* ♀, 24. do. ♂; 25. head of *Truxalis siamensis* Dirsh ♂ from Huei Kaeo in lateral view; 26-27. spurs at internal apex of posterior tibia of ♂ of 26. *Dnopherula taeniatus* (Bolívar); 27. *Dnopherula svenhedini* (Sjöstedt); 28-29. apex of abdomen of ♂ in lateral view of 28. *Dnopherula svenhedini* (Sjöstedt), 29. *Dhimbana castanea* n.sp.; 30-35. apex of abdomen in dorsal view of 30. *Dhimbana castanea* n.sp. ♂, 31. *Paragonista hyalina* Ingrisch ♂, 32. *Dnopherula svenhedini* (Sjöstedt) ♂, 33-34. *Dnopherula taeniatus* (Bolívar) two different ♂♂, 35. *Dnopherula svenhedini* (Sjöstedt) ♀; 36-41. meso- and metasternum of 36. *Dhimbana castanea* n.sp. ♀, 37. do. ♂, 38. *Dnopherula taeniatus* (Bolívar) ♂, 39. Dnopherula svenhedini (Sjöstedt) ♂, 40. do. ♀, 41. *Truxalis siamensis* Dirsh from Huei Kaeo ♂; 42-44. apex of subgenital plate of ♀ and ovipositor in ventral view of 42. *Dnopherula taeniatus* (Bolívar); 43-44. *Dnopherula svenhedini* (Sjöstedt). Scale = 1 mm (corresponding figures are always at the same scale). Abbreviations: 10t. tenth tergite, C cercus, OV ovipositor, PA paraproct, SA supra anal plate, SG subgenital plate.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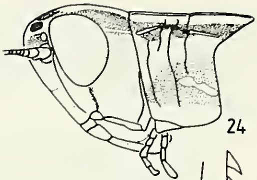
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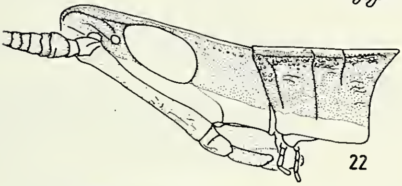
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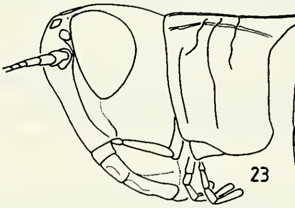
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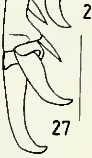
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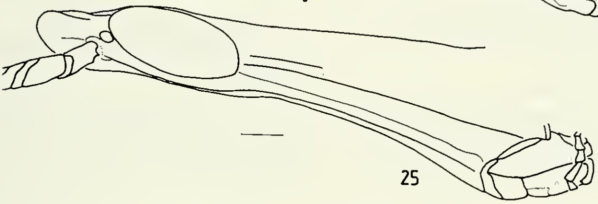
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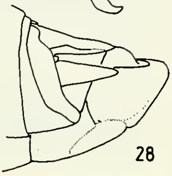
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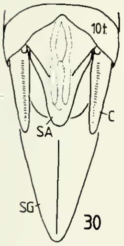

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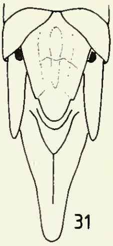
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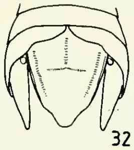
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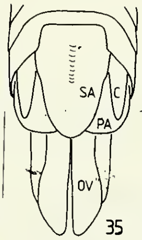

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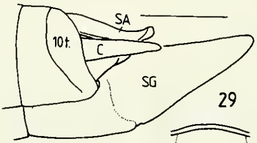

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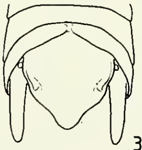
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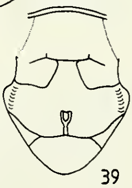
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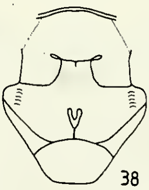
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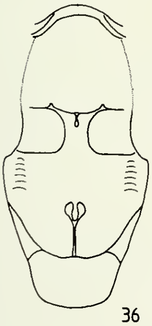
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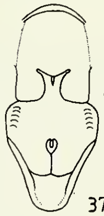
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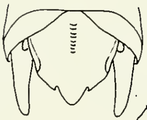
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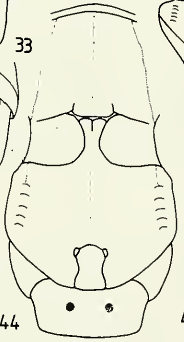
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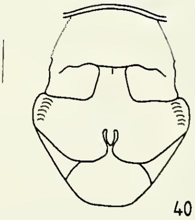
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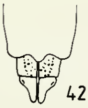
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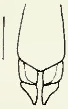
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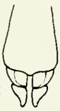
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have been recorded. Stridulation starts with a separate tsick-sound which is followed, after a pause of less than a second, by a prolonged echeme of uniform syllables. The syllables are double-pulses with the first pulse somewhat less loud than the second. They are repeated at a rate of about 6.5 per second (at 23°C + radiation heat). In the field, the males preferably used the pauses of a cicada choros to perform their songs.

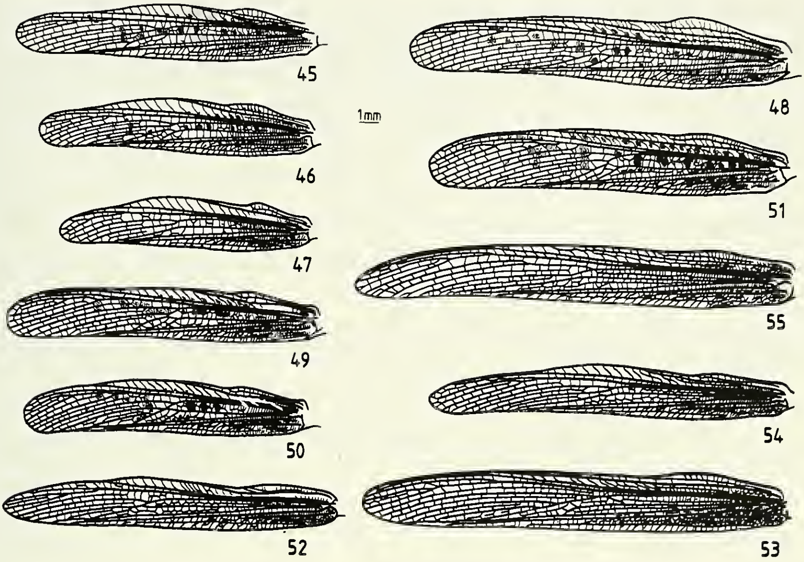
Discussion. The name of the new species refers to the beautiful chocolate-brown coloration with white and green ornaments. *D. castanea* can be recognised by the peculiar shape of the body: face strongly reclinate, antennae ensiform, abdomen longer than tegmen or postfemur, and by the striking brown-white coloration. The genus *Dhimbana* HENRY, 1940, is not included in the revision of the Gomphocerinae by JAGO (1971); but according to an earlier paper it belongs to the *Mesopses* group (JAGO 1969). Two species have previously been placed in the genus, the type species *D. dawsoni* HENRY, 1940, and *D. indica* (UVAROV, 1932), the latter was originally described in *Brachycrotaphus* and is refered to as *Dhimbana* in UVAROV, 1943. Both species are strongly brachypterous. The new species differs from the above by much longer tegmina and hind wings. It can fly. Otherwise it is similar to *D. dawsoni*. Apart from the wing condition, it differs in having shorter antennae (at otherwise equal size of head and body), a shorter subgenital plate in the male, and in the ovipositor extending beyond the supra anal plate and the paraproctes in the female.

Paragonista hyalina Ingrisch, 1989 (Figs 4-6, 31, 54, 55, 59, 65)

Material studied: 2 ♂ (holotype + paratype), Thailand, Chiang Mai province, Huei Kaeo 12.IV.1985 (holotype in the Zoologische Staatssammlung; Munich); 1 ♂, 2 ♀, do. 30.IX.1985; 1 ♂ (paratype), do. 23.I.1987; 2 ♀, do. 26.IV.1988; 2 ♂, 3 ♀, do. 3.IV.1988; 1 ♂, do. 10.IX.1989; 1 ♂, do. 23.X.1990; 1 ♀, 7.VIII.1992.

Description. Antennae (fig. 5) distinctly (♂) or faintly (♀) longer than head and pronotum together, ensiform, 3rd to 7th 9th (♂) respectively 3rd to 8th 12th (♀) articles widened, remaining articles subcylindrical. Face strongly reclinate. Frontal ridge prominent, in lateral view subconcave, projecting between antennae, sulcate, widening below median ocellus (fig. 6). Lateral fascial carinae curved. Fastigium verticis (figs 4, 5) projecting in front of eyes; vertex with a faint median carinula.

Pronotum (figs 4, 5) with median carina distinct, cut by the principal sulcus only, lateral carinae weak, substraight, cut by sulci 2-4; disc with posterior margin rounded or almost obtuse-angulate. Paranota longer than high. Prosternum slightly bulging. Mesosternal lobes with internal margin convex, 1.2-2.3 x wider than interspace; mesosternal interspace 1.2-2.1 x longer than wide; metasternal lobes contiguous. Tegmen (figs 54, 55) slender, reaching or surpassing middle of streched hind tibia: costal and cubital areas slightly widened in ♂. Tympanum 1.6-2.3 x longer than wide. Legs rather short. Postfemur slender, internal area with a row of 134-188 (♂) or 126-165 (♀) stridulatory pegs; ventral genicular lobes rounded. Posttibia with external apical spine lacking: internal spurs of almost equal length.



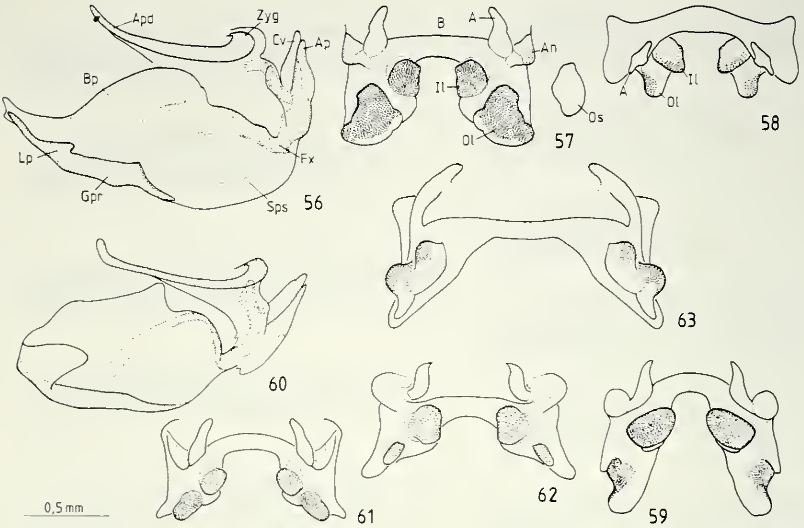
FIGS 45-55

Left tegmen of 45-47. *Dnopherula taeniatus* (Bolívar) ♂ (45, 46. Huei Kaeo, 47. Erawan); 48. do. ♀ (Huei Kaeo); 49-50. *Dnopherula svenhedini* (Sjöstedt); 51. do. ♀; 52. *Dhimbana castanea* n.sp. ♂ (paratype); 53. do. ♀; 54. *Paragonista hyalina* Ingrisch ♂; 55. do. ♀.

♂: Tenth tergite divided. Supra anal plate (fig. 31) triangular with a mediolongitudinal groove and indication of a transverse step; subapically constricted and sometimes faintly incised; apex rounded. Subgenital plate elongate, apex subpointed. Epiphallus (fig. 59) bridge-shaped; anchorae flexed, in lateral view pointed; outer lophi prolonged with a small lateral bulge, inner lophi rounded-trapezoid. Cingulum with zygoma, rami and apodemes; apodemes upcurved; rami thin-membranous in ventral half; basal and apical penis valves connected by a sharply curved, unbroken flexure.

♀: Supra anal plate long-triangular with sides almost rectangularly sloping; dorsal surface subflat or grooved, with indication of a transverse sulcus. Ovipositor short. Subgenital plate elongate, in apical quarter with indication of lateral carinae between the flat central part and the upcurved lateral areas; apical margin (of disc) subtruncate or lateral corners faintly projecting, with a triangular medial projection.

Coloration. Legs and lateral sides of head, pronotum, pleurae and tegmen in front of subcosta green or yellowish-brown; dorsum of head, pronotum (including dorsal area of paranota), tegmen behind subcosta, face between lateral fascial carinae, and sternal plate varying from medium brown to black; in some ♀ also the anterior area of the tegmen infumate. Hind wings transparent or more or less infumate. Antennae brown with white tips. Hind tibiae darkened towards apex.



FIGS 56-63

56-58. *Dhimbana castanea* n.sp. (holotype), 56. endo- and ectophallus in lateral view, 57. epiphallus in dorsal view, 58. do. in cranial view; 59. *Paragonista hyalina* Ingrisch, epiphallus; 60-61. *Dnopherula svenhedini* (Sjöstedt), 60. endo- and ectophallus, 61. epiphallus; 62. *Dnopherula taeniatus* (Bolívar) from Huei Kaeo, epiphallus; 63. *Truxalis siamensis* Dirsh from Huei Kaeo. Abbreviations: A anchorae, An anterior projections, Ap apical valves of penis, Apd apodemes, B bridge, Bp basal valves of penis, Cv Valves of cingulum, Fx flexure, Gpr gonopore processes, Il inner lophi, Lp lateral plates of basal valves of penis, Ol outer lophi, Os oval sclerites (only drawn on one side), Pp posterior projection, Sps spermatophor sac, Zyg zygoma.

Measurements (length in mm): body ♂ 22 - 25, ♀26-33; fastigium (in front of eyes) ♂ 1.3 - 1.5, ♀ 1.5 - 1.7; antenna ♂ 10 - 12, ♀ 9.5 - 11; pronotum ♂ 3.0 - 3.7, ♀ 4.1 - 4.8; tegmen ♂ 16 - 18.5, ♀ 20.5 - 22.5; postfemur ♂ 9 - 10.5, ♀ 11 - 13.

Indices: Width of fastigium : eye length ♂ 0.47 - 0.55, ♀ 0.51 - 0.55; eye length : length of suborbital furrow ♂ 1.83 - 2.13, ♀ 1.73 - 2.00; length of prozona : length of pronotum ♂ 0.56 - 0.60, ♀ 0.57 - 0.59.

Stridulation (fig. 65). The calling song, a prolonged verse, can be desribed as a "rhrhrhrhrhrh...rt". It lasts between 5 and 10 s (at 25°C plus radiation heat) and comprises about 90 - 170 succeeding echemes. The intensity of the echemes increases at the beginning of the verse. In the laboratory, an isolated male sang up to two times in one minute. But usually the repetition rate is much lower and the song is rarely heard in the field.

Discussion. As the preceding species, *P. hyalina* belongs to the *Mesopses* group (JAGO 1969). The female was hitherto unknown. It differs from the only other species of the genus *P. infumata* C.Willemse, 1932, by the shape of the frons in lateral view which is slightly concave in *P. hyalina*, straight in *P. infumata*, and a much higher number of stridulatory pegs (126 - 165 in *P. hyalina*, about 100 in *P.*

infumata). The differences in the male sex are already outlined in INGRISCH (1989). In contrast to the original description, the coloration of the hind wings in both sexes can vary from completely hyalinous to strongly infumate. *P. hyalina* lives in the same habitat as *D. castanea.*

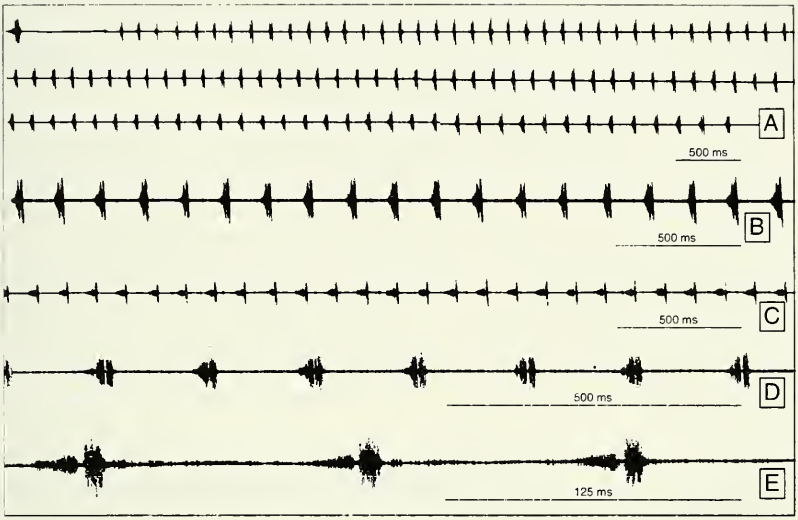


FIG. 64

Calling song of *Dhimbana castanea* n.sp. A. Studio-record of a complete song at 23°C plus radiation heat from a 60 W-bulb; B. Section of A; C. field-record at Huei Kaeo in sunshine after rain (no temperature recorded); D. Section of B; E. Section of C.

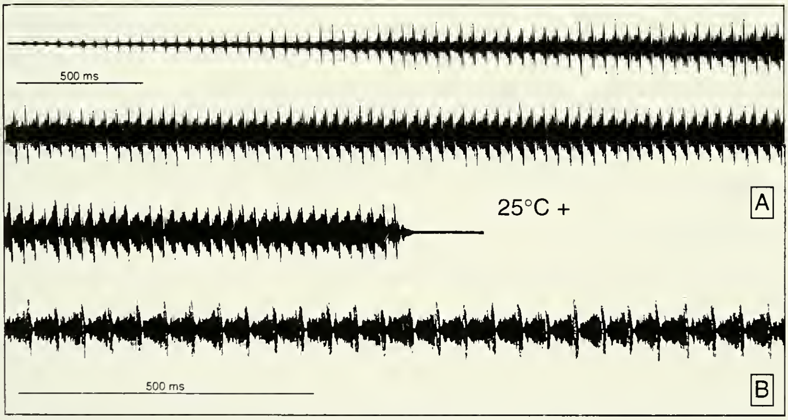


FIG. 65

Calling song of *Paragonista hyalina*. Studio-record of a male from Huei Kaeo at 25°C plus radiation heat from a 60 W-bulb. A. Complete verse; B. Section.

Dnopherula (Aulacobothrus) taeniatus (Bolívar, 1902) (Figs 7-11, 26, 33, 34, 38, 42, 45-48, 62, 66)

Material studied: 1 ♂ (lectotype), India, Kodaikanal ?, (Museo Nacional de Ciencias Naturales, Madrid, Spain). Thailand: 2 ♂, 2 ♀, Chiang Mai province, Huei Kaeo, 12.IV.1985; 2 ♂, 1 ♀, do. 30.IX.1985; 3 ♂, 4 ♀, do. 23.I.1987; 3 ♂, 4 ♀, do. 26.IV.1988; 3 ♂, 4 ♀, do. 3.V.1988; 5 ♂, 1 ♀, do. 10,IX.1989; 1 ♂, do. 23.X.1990; 4 ♂, 7 ♀, do. 23.X.1990 ex larvae; 1 ♂, 6 ♀, do. 23.X.1990 ex ovo; 1 ♂, 3.X.1991; 1 ♂, 1 ♀, do. 8.VIII.1992; 4 ♂, 4 ♀, Sukothai province, ancient town, 12.V.1988; 6 ♂, 2 ♀, Kanchanaburi province, near Pha That Cave, 2.VI.1988; 2 ♂, 2 ♀, Chon Buri province, Pattaya, 4.IV.1985; 2 ♂, Petchaburi province, Khao Wang, 7.II.1987; 4 ♂, 3 ♀, Prachuap Khiri Kan province, Hua Hin, 26.VII.1992.

Description. Antennae slightly flattened in circa basal third, longer than head and pronotum together and slightly surpassing base of postfemur. Frontal ridge with subparallel sides. Fastigial foveolae oblong. Pronotum (figs 7-11) with lateral carinae variable: straight or slightly diverging before second sulcus, sometimes irregular or absent between second and third sulcus, diverging posteriorly behind third sulcus. Tegmen (figs 45-47, 48) variable in length and in width of apical area, costal and cubital fields widened in ♂. Mesosternal interspace (fig. 38) varying from almost as wide to almost only half as wide as mesosternal lobes; metasternal lobes contiguous (♂) or narrowly separate (♀). Tympanum 1.4 - 2.1 x longer than wide. Postfemur moderatly stout; with a row of (70 -) 94 - 126 (♂) or 75 - 121 (♀) stridulatory pegs on internal surface (variation in the Huei Kaeo population ♂ 70 - 126, ♀ 75 - 113). Posttibiae with external apical spine lacking; ventral interno-apical spur moderately longer than dorsal.

♂. Tenth tergite divided, varying from separate to subcontiguous (figs 33, 34). Supra anal plate weapon-shaped; lateral margins upcurved in circa basal half, constricted subapically with constriction either concavely rounded (fig. 33) or incised, in the latter case with a small tooth at the base of the constriction (fig. 34); apex rounded. Epiphallus (fig. 62) bridge-shaped, ancorae with apex acute, inner lophi larger than outer. Penis valves flexured.

♀. Ovipositor short, simple. Subgenital plate with sinuate apex (fig. 42).

Coloration. Grey or different shades of brown. Four colour variants: (1) uniform throughout, irregularly mottled; (2) dark with a narrow, pale, dorso-medial stripe; (3) dorsal parts of head, pronotum and tegmen of pale colour, head and paranota with a dorso-lateral dark band; (4) quadrimaculate: irregularly mottled, disc of pronotum with a dark spot at each corner. Hind knees darkened; posttibia reddish, yellowish at base.

Measurements (length in mm): body ♂ 12 - 19 (15 - 19), ♀ 19 - 30; pronotum ♂ 2.5 - 3.8 (3.0 - 3.8), ♀ 3.9 - 5.1; tegmen ♂ 10 - 15 (12 - 15), ♀ 14 - 21; postfemur ♂ 7.5 - 11.5 (9.0 - 11.5), ♀ 11.0 - 16.0. The values in brackets are those of the Huei Kaeo population (♂ only); in ♀, the full range of measurements occurs in this population.

Indices (the full range of variation can be found within the Huei Kaeo population): Width of fastigium : eye length ♂ 0.34 - 0.47, ♀ 0.43 - 0.50; eye length : length of suborbital furrow ♂ 2.36 - 3.30, ♀ 2.00 - 2.64; length of prozona : length of pronotum ♂ 0.49 - 0.55, ♀ 0.48 - 0.54; length of apical field of tegmen : length of tegmen ♂ 0.21 - 0.32, ♀ 0.22 - 0.34.

Stridulation (fig. 66). Stridulation can be described as a "tr drhrhrhr....hrhhh" (using a guttural "r"). The calling song starts with a single tick sound which is immediatly followed by a sequence of up to 24 echemes. Within an echeme, the intensity increases from the start. The syllable structure of the echemes is not very clear on the oscillograms due to fast leg movement, but there is always a louder pulse at the end of an echeme, lacking only in the last echeme. The number of echemes per verse is somewhat variable. In the studio and in the field, isolated males produced between 9 and 24 echemes per verse. There is a tendency towards a reduction in the number of echemes per verse, if a male has acoustical contact with other males. In the typical rivalry song, the number of single pulses at the beginning of the verse can be increased and the number of echemes is usually reduced to 3 or 5 per verse. Intermediate songs between the rivalry and the calling song were also recorded. No differences in stridulation were observed between males with straight or with somewhat angular lateral carinae in the prozona of the pronotum, nor between males with different length of the apical area of the tegmen. Slight variations in song duration at similar ambient temperature as shown in fig. 66 are due to differences in the distance of the singing male from the heat source, a 60 Watt bulb.

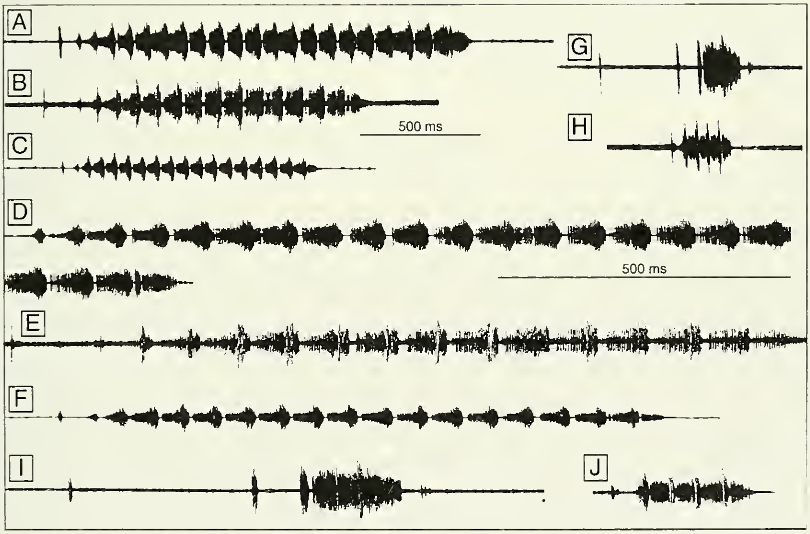


FIG. 66

Stridulation of three males of *Aulacobothrus taeniatus* from Huei Kaeo (studio records). A - F. Calling songs; G - J. Rivalry songs; A, D. male with diverging lateral carinae of prozona in pronotum; B, E, male with straight lateral carinae in prozona of pronotum; C, F. male (ex ovo) with diverging lateral carinae in prozona of pronotum; G, I. male with diverging lateral carinae responding to song of male with diverging lateral carinae; H, J. male with straight lateral carinae responding to song of male with diverging lateral carinae. Records at 25°C plus radiation from a 60 W-bulb (G, I at 23°C).

Discussion. The genus *Aulacobothrus* BOLIVAR, 1902 was reduced to subgeneric rank in the genus *Dnopherula* KARSCH, 1896 by JAGO (1971); *Aulacobothrus* contains most of the Asiatic, *Dnopherula* s.str. mainly African members of the genus.

D. taeniatus BOLIVAR, 1902 has been confused with *D. luteipes* (WALKER, 1871) since UVAROV (1921). However, wing venation of the types of both taxa differ so strikingly that they cannot be regarded as belonging to the same species. The relative size of the head, the position of the principal sulcus of the pronotum and the apex of the female subgenital plate are further diagnostic characters separating both species. A more detailed account of the differences will be given elsewhere (INGRISCH, in press). *D. luteipes* has a rather local distribution in India, while *D. taeniatus* is widespread in India and Indochina.

D. taeniatus is a highly variable species. A fact already emphasized by UVAROV (1929: as *D. luteipes*). The variation is most striking with regard to the course of the lateral carinae of the pronotum, the size and venation of the tegmen (especially the width of the medial and cubital fields and the length of the apical area), coloration, and the shape of the supra anal plate of the male. As all the different forms can occur within the same population, for example in the mixed forest-savanna near the Huei Kaeo waterfall outside Chiang Mai, as they all produce the same songs, and as the males of different forms respond to each other with rivalry songs, there is no doubt that they are conspecific.

Dnopherula (Aulacobothrus) svenhedini (SJÖSTEDT, 1933) (Figs 12-16, 23, 24, 27-29, 32, 35, 39, 40, 43, 44, 49, 50, 60, 61, 67)

Material studied: 1 ♂ (holotype), China, NE Szechuan, lg. Hummel (Naturhistoriska Riksmuseet, Stockholm). 10 ♂, 10 ♀, Thailand, Loei province, Phu Kradung, 28.V.1988; 4 ♀, do., 8.III.1948, lg. Chainarang (Lot 1430, Department of Agriculture Bangkok).

Description. Antennae longer than (♂) or as long as (♀) head and pronotum together, segments compressed in basal, subcylindrical in apical half. Foveolae visible from above, longer than broad, shallow (figs 12, 14). Disc of pronotum (figs 12-15) with a prominent median carina cut by the principal sulcus only. Lateral carinae cut by sulci 2 - 4, from substraight to distinctly diverging anteriorly in front of the 2nd sulcus, distinctly diverging posteriorly behind the 3rd sulcus. Tegmen slightly surpassing apex of stretched postfemur; rather wide until apex, venation as in figs 49-51. Mesosternal interspace (figs 39-40) narrower than mesosternal lobes, slightly or distinctly deviating posteriorly; metasternal lobes subcontiguous. Tympanum 1.4 - 1.6 times longer than wide. Postfemur moderately stout, inner side with a row of 77 - 112 (♂) or 73 - 104 (♀) stridulatory pegs; genicular lobes rounded. Posttibia with 10 dorso-external (apical spine lacking) and 12 - 13 dorso-internal (including apical spine) spines.

♂. Tenth tergite divided. Supra anal plate (fig. 32) ovoid-triangular, lateral margins upcurved in basal half, with indications of a basal medial furrow and a transverse sulcus, apex unmodified. Cerci conical. Subgenital plate short (fig. 28).

Epiphallus (fig. 61) bridge-shaped, ancorae with apex rounded, inner and outer lophi almost equal in size. Cingulum (fig. 60) with zygoma, rami and apodemes; apodemes rather short, rami thin-membranous in ventral half and apically connected with a thin membrane covering bases of cingular valves and apical penis valves. Basal and apical penis valves connected by a sharply curved, unbroken flexure.

♀. Supra anal plate lingulate (fig. 35). Cerci conical. Ovipositor short, simple. Apex of subgenital plate blunt-triangular with margins straight or slightly concave and tip rounded.

Coloration. Brownish-grey, mottled with darker spots; dorsal side usually darker than face, lower part of genae, ventral margin of pronotum and underside, or reddish brown. Three colour variants were collected: (1) dorsal side dark with a narrow pale, medial band on head, pronotum and tegmen; (2) dorsal surface completely pale and with broad dark, dorso-lateral bands; (3) uniformely and indistinctly mottled. Tegmen translucent with brown spots, especially in the medial area; hind wings transparent, apex infumate. Postfemur on dorso-external area with a more or less distinct dark brown spot before the middle followed or not by a brown stroke, ventro-external carina with dark dots, internal and ventro-internal areas red, yellowish towards apex; a pregenicular ring yellowish brown, hind knees more or less infumate. Posttibia with basal third yellowish-brown, apical two thirds and tarsi reddish.

Measurements (length in mm): body ♂ 16 - 18, ♀ 20 - 22; pronotum ♂ 2.9 - 3.2, ♀ 3.5 - 3.9; tegmen ♂ 13.5 - 15.0, ♀ 16.5 - 18.0; postfemur ♂ 9.5 - 11.0, ♀ 12.0 - 13.5.

Indices: Width of fastigium : eye length ♂ 0.35 - 0.39, ♀ 0.38 - 0.44; eye length : length of suborbital furrow ♂ 2.44 - 2.95, ♀ 2.13 - 2.50; length of prozona : length of pronotum ♂ 0.47 - 0.50, ♀ 0.46 - 0.49; length of apical field of tegmen : length of tegmen ♂ 0.26 - 0.32, ♀ 0.27 - 0.33.

Stridulation (fig. 67). Only a few field observations were possible during some minutes of sunshine in otherwise cloudy weather. Two different types of songs were heard. Usually the males produced rather quiet and short verses of about 1 s, consisting of a single echeme of about 14 - 20 pulses (fig. 67, A first row and D). The resulting sound can be described as a "drrrrr". Once, this short song was immediately followed by a long song of alternating quiet and loud echemes (fig. 67 A). The sound can be described as a "rr(ou)h drre rr(ou)h drre ....". This song lasted for 11 s and comprised 15 loud and 17 quiet echemes (starting with one and ending with two quiet echemes). Both types were of about equal duration. The loud echemes started with a haplo-syllable (one-pulse-syllable) which was followed by 4 - 6 diplo-syllables (two-pulse syllables); the pattern of the quiet syllables is less clear.

Discussion. This species was previously only known from China. In Thailand, a single locality is known, the plateau of Phu Kradung at about NN + 1500 m. The habitat is a mixed grassland-shrub savanna with scattered pine trees on poor soil as indicated by the occurance of many pitcher plants and *Drosera*. Most grasshoppers were found sitting on sandy roads.

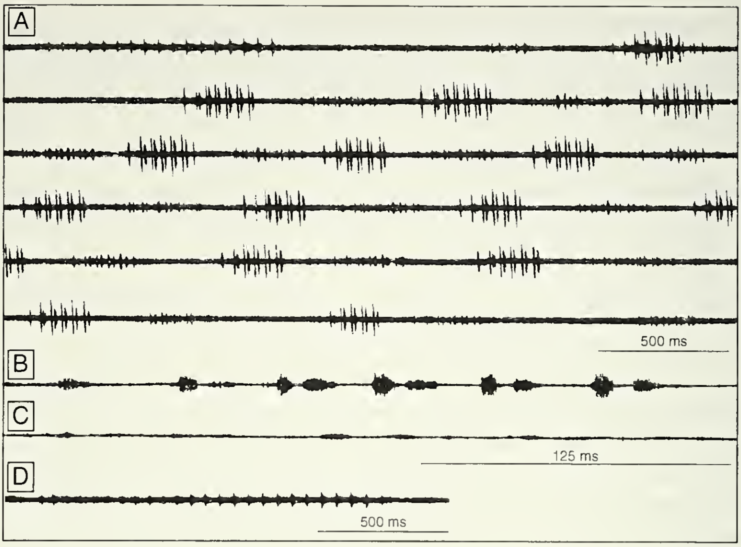


FIG. 67

Field record of the calling song of *Dnopherula svenhedini* (Sjöstedt) at Phu Kradung in sunshine (temperature above 20°C, not measured exactly). A. Short song followed by a long song; B. one loud echeme of the long song; C. one quiet echeme of the long song; D. separate short song.

Truxalis siamensis Dirsh, 1950 (Figs 17-20, 25, 41, 63, 68)

Material studied: 1 ♂, 1 ♀ (topotypes), Prachuap Khiri Kan province, Hua Hin, hill near golf course, 26.VII.1992 ex larvae; 1 ♂, 1 ♀, do. 1.IV.1993; 2 ♂, Chiang Mai province, Huei Kaeo, 3.V.1988; 1 ♂, 2 larvae (♂ + ♀ last instars), do. 23.X.1990 ex larvae; 1 ♀, do. 4.IV.1993; 1 ♂, Loei province, Phu Kradung, 26.VIII.1975, lg. G. Minet (Naturhistorisches Museum Basel).

Description. Antennae with segments 3 to 8 or 9 (♂) respectively 3 to 11 (♀) compressed and moderately widened. Fastigium (fig. 17, 25) extenting 1.7 - 2.0 mm (♂) or 2.3 - 2.7 mm (♀) in front of front margin of eyes, parallel sided, apex rounded-angulate. Pronotum (fig. 18) circa parallel-sided in prozona, faintly (♂) or distinctly (♀) saddle-shaped in metazona; lateral carinae substraight (♂) or slightly sinuate (♀) in prozona, more or less diverging in metazona; principal sulcus from slightly before to slightly behind middle of pronotal length (index prozona : pronotum = 0.48 - 0.54); posterior margin triangular, apex rounded, sides straight or faintly concave. Tegmen 8.3 - 10.3 x (♂) or 9.5 - 10.6 x (♀) longer than broad. Mesosternal lobes 2.8 - 3.5 times wider than mesosternal interspace at the smallest point. Tympanum 1.6 - 2.2 x longer than broad.

Interior side of postfemur with a row of 130 - 163 bristles (♂ + ♀) almost over the whole length of the femur, all pointing apico-internally (figs 19, 20). At both sides some bristles are largely spaced and sit on very tiny pegs or rise directly from the surface of the femur, towards the center of the row they sit on pegs of gradually increasing size. The pegs are most dense at the end of the basal third of the postfemur. Obviously this part is mainly used for stridulation, as the bristles are short, i.e. used and partly broken.

♂: Tenth tergite divided-contiguous. Supra anal plate lingulate, almost semicircular, with a medio-longitudinal groove and a transverse sulcus in about middle of length, both usually very faint, apex rounded. Cerci conical, apex obtuse. Subgenital plate with a long basal and short apical part, apex sub-pointed. Epiphallus bridge-shaped (fig. 63), ancorae with apex rounded, inner lophi slightly larger than outer lophi. Cingulum with zygoma, rami and apodemes; zygoma prolonged with a curvature on each of its apico-lateral corners; rami thin-membranous throughout; basal and apical penis valves connected by a curved, unbroken flexure.

Coloration. Different shades of brown with green ornaments. Narrow apical part of antennae white. Genae with a white stripe below compound eyes. Tegmen of type 4 in DIRSH (1950), with a white and a black stripe in cubital area, the latter more or less serrated at anterior margin. Hind wings red.

Measurements (length in mm): body ♂ 37 - 46, ♀ 61 - 65; antennae ♂ 14.5 - 17.5, ♀ 20 - 22; pronotum ♂ 6.0 - 6.4, ♀ 9.6 - 10.1; tegmen ♂ 30 - 37, ♀ 52; postfemur ♂ 23 - 28, ♀ 34 - 37.

Stridulation (fig. 68). The songs of one male from each, Hua Hin (locus typicus) and Huei Kaeo, were recorded. Stridulation is rather scarce. The male from Hua Hin stridulated at intervals of between 1 and 5 minutes when the singing activity was high. Sometimes two successive verses were produced at an interval of 10 - 30 s. Both males were often silent for hours or even during the whole day.

In both males, the speed of the calling song was rather variable even at the same ambient tempterature. It obviously depended on the distance of the male from the 60-Watt bulb which was a source of radiation heat. It lasted from about 1.3 to 2.5 s (n = 18) in the ♂ from Huei Kaeo and from 1.6 to 2.1 s (n = 22) in the ♂ from Hua Hin. The sound can be described as "dr dr dr ...". The calling song is a single verse wich consists of 6 - 14 echemes (6 - 14 in the ♂ from Huei Kaeo, 11 - 14 in the ♂ from Hua Hin). One echeme usually contains 3 or 4 syllables, but the number may be lower at the start or the end of a verse. In the ♂ from Huei Kaeo four-syllabic echemes (106 of 186) and in the ♂ from Hua Hin three-syllabic echemes (175 of 278) prevailed. The duration of an echeme varied between 134 and 313 ms in the ♂ from Huei Kaeo and between 125 and 177 ms in the ♂ from Hua Hin.

Discussion. The species was originally described after a female (the type) from Hua Hin and a pair of uncertain origin. According to the description and figures in DIRSH (1950), the principal sulcus of the pronotum should be located in or slightly before the middle of the pronotum. Recently, LIANG (1989) described a new species, *T. guangzhouensis*, from southern China. The differences were said to be (1) the sulcus lying behind the middle of the pronotum and (2) some faint differences in the very tip of the male subgenital plate. The specimens from northern Thailand agree more with the description given by LIANG (1989) than with the description in DIRSH (1950), as the prozona of the pronotum is 1.05 - 1.2 x longer than the metazona. The apex of the male subgenital plate of one male from Huei Kaeo agrees with the figure in Dirsh (1950), that of a second male from the same locality with the figure in Liang (1989). In specimens from the type locality in Hua Hin, the index prozona : metazona varies from 0.9 - 1.1. In contrast to the description in Dirsh (1950), the prozona can thus be either longer or shorter than the metazona. In the living male, the subgenital plate is even more pointed than in the figure 116 in Dirsh (1950).

As the stridulation of the males from Hua Hin and Huei Kaeo is identical, both populations must be regarded as conspecific. The variation of *T. siamensis* is thus much larger than previously supposed. The status of *T. guangzhouensis* should be re-examined.

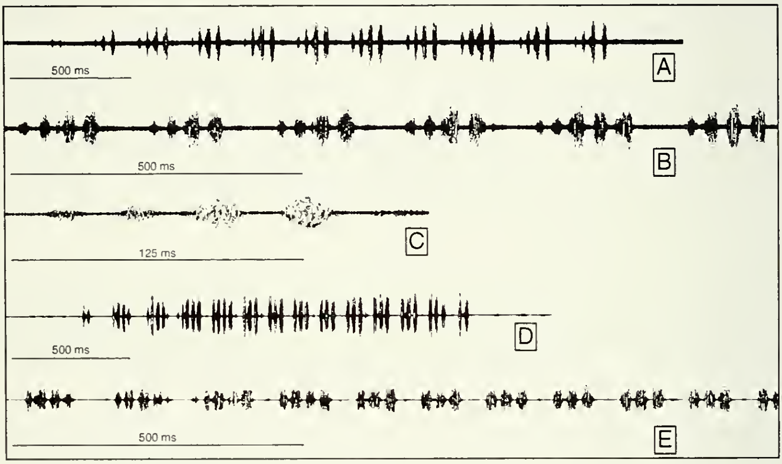


Fig. 68

Studio record of the calling song of *Truxalis siamensis* Dirsh at 25°C plus radiation heat from a 60 W-bulb. A - C. male from Huei Kaeo sitting remote from the 60 W-bulb; D - E. male from Hua Hin sitting close to the 60 W-bulb. A, D. complete verse; B, E. section; C. single echeme.

T. siamensis has one generation per year. Larval development is prolonged and lasts from the middle of the rainy season to the end of the dry season (July - April). Adults appear at the end of the dry and the beginning of the rainy season, mainly in April and May.

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The oscillograms were done at the Zoological Institut Erlangen; I am grateful to Prof. Dr. O. von Helversen and Dr. K.-G. Heller (Erlangen) for providing room and equipment. Thanks go also to Dr. K. Tschudi-Rein (Zurich) for helpful criticism on the style of the manuscript.

REFERENCES

BOLÍVAR, I. 1902. Les Orthotères de St. Joseph's College à Trichinopoly (Sud de l'Inde), 3e Partie. Annls Soc. Ent. Fr. 70 (1901): 580- 635, pl. 9.

DIRSH, V.M. 1950. Revision of the group *Truxales* (Orthoptera, Acrididae). *Eos, Madrid,* tom. extr.: 119-247.

DIRSH, V.M. 1956. The phallic complex in Acridoidea (Orthoptera) in relation to taxonomy. *Trans. R. ent. Soc. Lond.* 108: 223-356, pl.1-66.

DIRSH, V.M. 1961. A preliminary revision of the families and subfamilies of Acridoidea (Orthoptera, Insecta). *Bull. Br. Mus. nat. Hist. (Ent.)* 10 (1961): 351-463.

DIRSH, V.M. 1975. Classification of the Acridomorphoid Insects. E.W.Classey, Faringdon/ Oxon 1975, 171 pp.

HENRY, G.M. 1940. New and little known South Indian Acrididae (Orthopt.). *Trans. R. ent. Soc. Lond.* 90: 497-540.

INGRISCH, S. 1989. Records, descriptions, and revisionary studies of Acrididae from Thailand and adjacent regions (Orthoptera, Acridoidea). *Spixiana* 11: 205-242.

INGRISCH, S. in press. A review of the Oriental species of *Dnopherula* (Orthoptera, Acrididae). *Ent. scand.*

JAGO, N.D. 1969. A revision of the systematics and taxonomy of certain North American Gomphocerine grasshoppers (Gomphocerinae, Acrididae, Orthoptera). *Proc. Acad. nat. Sci. Philad.* 121: 230-344.

JAGO, N.D. 1971. A review of the Gomphocerine of the world with a key to the genera (Orthoptera, Acrididae). *Proc. Acad. nat. Sci. Philad.* 123: 205- 343.

KARSCH, F. 1896. Neue Orthopteren aus dem tropischen Afrika. *Stett. Ent. Z.* 57: 242-359.

LIANG, GEQIU 1989. Two new species of grasshoppers from China (Orthoptera: Acridoidea: Acrididae). *Acta Sci. Nat. Univ. Sunyatseni* 28: 68-72.

RAGGE, D.R. 1987. The songs of the western European grasshoppers of the genus *Stenobothrus* in relation to their taxonomy (Orthoptera, Acrididae). *Bull. Br. Mus. nat. Hist. (Ent.)* 55: 393-424.

RAGGE, D.R. & W.J. REYNOLDS, 1988. The songs and taxonomy of the grasshoppers of the *Chorthippus biguttulus* group in the Iberian Peninsula (Orthoptera: Acrididae). *J. nat. Hist.* 22: 897-929.

ROFFEY, J. 1979. Locusts and grasshoppers of economic importance in Thailand. *Anti-Locust Memoir* 14: 1-200.

SJÖSTEDT, Y. 1933. Schwedisch-chinesische wissenschaftliche Expedition nach den nordwestlichen Provinzen Chinas, unter Leitung von Dr. Sven Hedin und Prof. Sü Pingchang. Insekten. Einleitung und Orthoptera 1. Acrididae. *Arkiv Zool.* 25 A: 1-34, pl.1-12.

UVAROV, B.P. 1921. Records and descriptions of Indian Acrididae (Orthoptera). *Ann. Mag. nat. Hist.* (9) 7: 480-509.

UVAROV, B.P. 1929. Acrididen (Orthoptera) aus Süd-Indien. *Revue suisse Zool.* 36: 533-563.

UVAROV, B.P. 1932. A revision of the genus *Brachycrotaphus* Krauss (Orthoptera, Acrididae). *Soc. ent. France, Livre du Centenaire*: 285-300.

UVAROV, B.P. 1943. A revision of the group *Mesopsis* (Orthoptera, Acrididae). *Eos. Madrid.* 19: 69-78.

UVAROV, B.P. 1966. Grasshoppers and Locusts I. *Cambridge*, 481 pp.

WALKER, F. 1871. Supplement to the Catalogue of Dermaptera Saltatoria. *London*, 116 pp.

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Campodeidae de Sumatra et de Singapour (Diplura)

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Campodeidae from Sumatra and Singapore (Diplura). - Seventy-one campodeids collected by B. Hauser and C. Lienhard in Sumatra (63) and in Singapore (8), together with 4 specimens from Bali (P. Strinati and V. Aellen leg.) and 8 specimens from Nepal (P. Beron and St. Andrew leg.) belong to the pantropical genus *Lepidocampa*. Three species and four subspecies are recognized, one species (*heteroclita*) and one subspecies (*nepalensis*) being undescribed up to now. *L. heteroclita* is most interesting for it shares characters with the two subgenus *Lepidocampa* s. str. and *Paracampa*. Accordingly, the definition of *Lepidocampa* s. str. is emended.

Key-words: Campodeidae - Sumatra - Singapore - Taxonomy - New taxa.

Les 71 Campodéidés récoltés par B. Hauser (B. H.) et C. Lienhard (C. L.) au cours de leur campagne à Sumatra (63 spécimens) et à Singapour (8 spécimens), du 5 au 27 novembre 1985, appartiennent sans exception au genre *Lepidocampa*. Nous y ajoutons 4 spécimens d'une grotte de Bali et 8 spécimens du Népal, récoltés respectivement par P. Strinati et V. Aellen, et par P. Beron et St. Andrew, appartenant eux aussi à *Lepidocampa*. A l'exception des 8 spécimens du Népal, propriété du Muséum national d'Histoire naturelle de Sofia, tous les matériaux sont déposés au Muséum d'Histoire naturelle de Genève. La mise au propre de l'illustration est due au talent de Madame Elisabeth Seraoui que nous remercions très vivement.

Jusqu'à présent, ce genre comprenait deux groupes d'espèces très distincts, auxquels j'ai donné valeur de sous-genres (CONDÉ 1954: 619), suivi en cela par PACLT (1957: 50-51). *Lepidocampa* s. str. est un complexe pantropical dont les représentants possèdent une paire de macrochètes médiaux antérieurs méso- et métanotaux, et un macrochète fémoral dorsal. *Paracampa*, limité à l'Afrique orientale, Madagascar, l'Inde, Bornéo et la Chine, est dépourvu des phanères mentionnés ci-dessus.

Manuscrit accepté le 13.04.1992.

La découverte à Sumatra d'une espèce ne pouvant être rangée dans l'un ou l'autre des deux sous-genres établis doit conduire, soit à la création d'un troisième sous-genre, soit à une définition élargie de l'un de ceux qui existent déjà. La seconde éventualité me semble préférable, en choisissant d'émender le sous-genre nominal qui est déjà le plus diversifié et dont la nouvelle espèce semble le plus proche. La clé ci-dessous résume les combinaisons de caractères retenues.

1. Pas de macrochètes médiaux antérieurs (*ma*) aux méso- et métanotum, ni de macrochète tergal au fémur III; tous les articles des cerques avec de courts phanères glabres; 14 à 23 articles antennaires; urosternite I de la ♀ sans champ glandulaire .... subgen. *Paracampa*
– Les macrochètes absents en 1 sont représentés par une catégorie au moins; tous les articles des cerques avec de longs phanères barbelés ou glabres; 16 à 46 articles antennaires; urosternite I de la ♀ avec parfois un champ glandulaire .... subgen. *Lepidocampa* s. str. emend. 2
2. Des *ma* au mésonotum; urosternite I de la ♀ sans champ glandulaire (sauf *giffardii*) .... complexes *weberi*, *zeteki*
– Pas de *ma* au mésonotum; urosternite I de la ♀ avec un champ glandulaire .... *heteroclita* n. sp.

1. Complexe de **Lepidocampa weberi** Oudemans

Parmi les variables utilisées par SILVESTRI (1933) pour définir les sous-espèces, figure la longueur relative des macrochètes médiaux antérieurs des tergites thoraciques II et III. Pour l'évaluer avec précision, j'ai déjà proposé d'utiliser le rapport *ma*/ε, *ma* étant la longueur moyenne des phanères et ε la distance entre leurs embases; on peut y ajouter le rapport *ma*/δ, δ étant la distance entre l'embase du macrochète et celle du sensille sétiforme postérieur correspondant. Ces mensurations sont faciles à prendre sur un spécimen bien monté et intact, mais très fréquemment les macrochètes *ma* sont arrachés ou brisés, lors de la capture ou des manipulations ultérieures, ce qui nous prive d'un élément discriminatif d'importance. Le rapport *ma*/ε peut être biaisé par la présence de plis longitudinaux dans la région centrale du tergite ou par un défaut de planéité du tergite dans la préparation.

1° **Lepidocampa (L.) weberi** Oudemans, f. typ. sensu Silvestri, 1931.

SINGAPOUR. Sum - 85/8. Bukit Timah Nature Reserve. Taban Valley, croisement des sentiers South View Path et Kruing Path, env. 110 m, 6.XI.1985, leg. B.H. : 2 ♂, 4 ♀, 2 l.

Antennes de 30 - 32 articles chez les 3 individus à 15 soies *C* (2 ♂, 1 ♀), de 27 - 28 chez les 2 ♀ à 5 et 7 soies *C*, de 23 chez la ♀ à 2 soies *C* et de 20 chez les 2 larves. Les *ma* sont présents, au moins unilatéralement, sur le mésonotum de 7 des 8 spécimens. *ma*/ε = (0,68) 0,75 - 0,93 ($\bar{X}$= 0,81); *ma*/ε = 0,91 - 0,97 ($\bar{X}$ = 0,94). Ces rapports, mesurés sur la fig. XX, agrandie 3 fois, du travail de SILVESTRI (1931) sont respectivement 0,81 et 1,16.

2. **Lepidocampa (L.) weberi borneensis** Silvestri, 1933.

SUMATRA. Sum - 85/56 (Sumatera Barat), région Payakumbuh, environs de la grotte "Ngalau Lintau", près de la localité Lintau Buo, 200 m, 24.XI.1985, leg. B. H. : 3 ♀ - Sum - 85/57: comme 85/56, sauf leg. C. L. : 1 ♂, 4 ♀.

Antennes de 22 - 24 articles chez les 6 femelles à 13 - 16 soies *C*, de 20 chez le ♂ à 11 soies *C* et la ♀ à 6 soies *C*. Les *ma* sont présents chez les 8 spécimens. ma/ϵ = 0,55 - 0,76 ($\bar{X}$ = 0,63); ma/δ = 0,58 - 0,77 ($\bar{X}$ = 0,65); les macrochètes des cerques (4 spécimens) sont presque tous glabres. En mesurant les rapports des macrochètes mésonotaux sur la figure originale de SILVESTRI (1933, fig. IV), agrandie comme précédemment, ma/ϵ = 0,72 et ma/δ = 0,58, valeurs comprises dans les limites de la variation de nos spécimens de Sumatra. Seules les antennes des types sont un peu plus longues (24 - 30 articles), comme chez les deux ♀ de Bornéo (25-27) que nous avons déterminées précédemment (CONDÉ 1990).

Nous rapportons encore à cette forme une femelle ovigère (14 soies *C*) à antennes brisées, un mâle juvénile (9 soies *C*), une femelle juvénile et une larve (0 soies *C*) récoltés dans la grotte Goa Karang Boma, Uluwatu, Bali, par P. Strinati et V. Aellen, le 7.II.88. Ils se tenaient sur le guano pulvérulent de la Chauve-Souris *Hipposideros diadema nobilis*. Antennes de 19 articles chez la larve, de 22 chez les juvéniles; ma/ϵ = 0,66-0,74 (0,92 chez la larve); ma/δ = 0,79-0,80 (0,92 chez la larve).

3° **Lepidocampa (L.) weberi lawrencei** Bareth & Condé, 1972.

SUMATRA. Sum-85/47 (Sumatera Utara: Deli Serdang), forêt de *Pinus merkusii*, près de la route de Brastagi à Sibolangit, 1400 m, prélèvement de sol sous *Pinus merkusii*, 19.XI.1985, leg. B. H. (B): 1 ♂.

Spécimen en mauvais état (antennes brisées, *ma* II arrachés, pas de cerques), présentant 11 soies *C* glabres; des phanères glandulaires au sternite I.

4° **Lepidocampa (L.) weberi nepalensis** n. ssp.

(*Lepidocampa* (*L.*) *weberi* Oudemans, 1890; ?ssp. CONDÉ, 1958)

SUMATRA. Sum-85/11 (Sumatera Utara: Simalungun), sur la route en provenance de Pematangsiantar, 18 km avant Parpat, lieu-dit "Ainuli", forêt dans la chaîne montagneuse Bukit Parasat, station "Holzweg Nr. 2 du Dr Diehl", prélèvement de sol, 980 m, 8.XI.1985, leg. B. H. (B): 1 ♂. - Sum-85/33 (Sumatera Utara: Deli Serdang), Réserve naturelle de Tinggi Raja, près de Negridolok, dans la région de Tebingtinggi, forêt primaire, prélèvement de sol dans les angles formés par les contreforts d'un très grand arbre, 420 m, 15.XI.1985, leg. B. H. (B): 8 ♂, 3 ♀, 1 juv. ? sexe, 1 l. - Sum-85/36 (Sumatera Utara: Deli Serdang), Réserve naturelle de Sipispis, dans la région de Dolokmerawan, 2 km à l'intérieur, 430 m, 17.XI.1985, leg. B. H. : 1 ♂. - Sum-85/67. Comme Sum-85/11, sauf: près des pièges Barber, 27.XI.1985, leg. C. L.: 1 ♂.

NÉPAL. Langtang, alt. 3500-3600 m, 17-IX-84, P. Beron et St. Andrew leg.: 1 ♂. - Pokhara-Jomosom trek, Tadapani to Ghorepani Pass, alt. 2000-2800 m, 18-X-84, P. Beron leg.: 4 ♂, 3 ♀.

L'examen de spécimens du Népal, du Sikkim et du Manipur State, récoltés entre 1220 et 2135 m, et appartenant aux collections du British Museum (Natural History) (CONDÉ 1958: 192) avait révélé que les soies de la papille génitale des 6 mâles

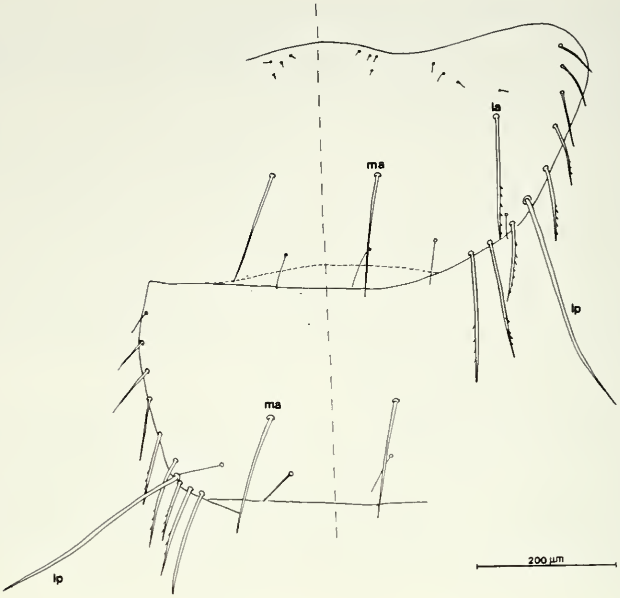

Fig. 1

Lepidocampa (L.) weberi nepalensis n. ssp., mâle holotype: moitié droite du mésonotum et moitié gauche du métanotum. *la*: macrochète latéral antérieur; *l*p: macrochète latéral postérieur; *ma*: macrochète médial antérieur.

disponibles, à l'exception de celles qui forment une rosette autour du gonopore, étaient barbelées ou au moins fourchues. Les longs *ma* mésonotaux (*ma*/ϵ = 0,87 - 1,26; *ma*/δ = 1,28 - 2,17) rapprochaient les deux sexes de la ssp. *ceylonica* Silvestri, 1933.

Les matériaux du Népal, rassemblés par H. Janetschek entre 2700 et 4800 m (Condé, in Condé & Jacquemin-Nguyen Duy 1968: 6), ne comprenaient que des femelles et un immature pourvus eux aussi de *ma* bien développés (*ma*/ϵ = 1 - 1,34).

En revanche, une série de 30 individus du Népal, communiquée par P. N. Lawrence (British Museum, Natural History) à C. Bareth et étudiée par ce dernier (inédit), renferme 7 mâles qui tous ont les phanères de la papille génitale barbelés. Les femelles et les immatures ont en commun avec les mâles de longs *ma* mésonotaux (ma/ϵ = 1 - 1,44; *ma*/δ = 1,50 - 1,80).

La découverte à Sumatra, de spécimens identiques à ceux de la région himalayenne, m'incite à nommer cette forme dont les mâles sont immédiatement reconnaissables, les femelles, au contraire, se confondant avec celles de *L.* (*L.*) *w. ceylonica*, en raison de la grande longueur relative de leurs *ma* mésonotaux.

Holotype: mâle de 3,25 mm de Pokhara-Jomosom trek, à 17 soies *C*, 9 poils glandulaires g_2 et 16 phanères à la rosette du gonopore.

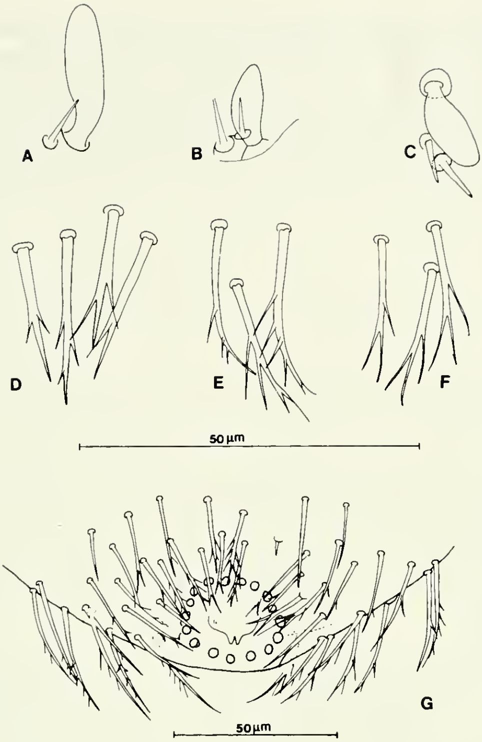

FIG. 2

Lepidocampa (*L.*) *weberi nepalensis* n. ssp. Mâle holotype (n° 6): *A*. Sensille du IIIe article de l'antenne gauche (vu par transparence); *B*. Sensille du palpe maxillaire droit; *C*. Sensille du palpe labial droit; *E*. Phanères de la portion latérale de la papille génitale. - Mâle de Langtang: *D*. Phanères de la portion médiane de la papille génitale. - Mâles de la même station que l'holotype: *F*. Phanères de la portion médiane de la papille génitale (mâle n° 7); *G*. Papille génitale (mâle n° 4), les phanères de la rosette ne sont représentés que par leur embase pour ne pas surcharger le dessin.

Paratypes: mâles de 3,03 et 2,23 mm (Sum-85/36, 85/67) à 14 et 15 soies *C*.

Tête. Les antennes ont au moins 17 articles (larves et juvéniles de 0 à 8 soies *C*) et au plus 28-29 (paratype Sum-85/36 et ♀ de Pokhara à 24 soies *C*); les antennes de 19 à 27 articles appartiennent à des individus ayant 0 à 20 soies *C*. Ces nombres sont sensiblement inférieurs à ceux des types de la ssp. *ceylonica* (33 - 36 pour 14 - 16 *C*; 18 chez une larve). La sensille du IIIe article est volumineux (20 µm), un peu renflé et rectiligne.

Thorax. Les *ma* mésonotaux sont en moyenne un peu plus longs que leur écartement (ma/ϵ: $\bar{X}$ = 1,18; extrêmes = 0,85-1,42) et leur apex dépasse l'embase du sensille sétiforme marginal correspondant (*ma*/δ: $\bar{X}$ = 1,49; extrêmes = 1-2,17). C'est le mâle de Langtang qui présente, pour les deux rapports, le nombre extrême inférieur; l'holotype est voisin des moyennes (1,12 et 1,39); les paratypes s'en éloignent pour *ma*/ϵ (0,94 et 0,96), mais l'un au moins en est proche pour *ma*/δ (1,42 et 1,12). L'ensemble est néanmoins assez cohérent, compte tenu des distances entre les populations étudiées, du petit nombre d'individus mesurables (19) et de l'imprécision de certaines mesures (cf. ci-dessus); l'âge et le sexe n'entrent pas en ligne de compte.

Abdomen. Le sternite I du mâle le plus jeune (0 *C*, 4 poils en rosette) est dépourvu de phanères glandulaires. Ceux-ci (g_1) sont présents au stade 5 *C* (8 poils en rosette) au nombre d'une quarantaine chez un spécimen du Sikkim (CONDÉ 1958: 193), mais un individu de Sumatra (Sum-85/33) à 6 soies *C* n'en possède encore que 3 + 3. Les phanères g_2, disposés sur un rang, sont présents à partir de 9 soies *C*, chez certains spécimens au moins (1 sur 3 au Népal: $0g_2/46g_1$, 0/82, 12/70); à 10 soies *C*: 25/80, 37/144; à 12 soies *C*: 35 ± 140; l'holotype à 17 soies *C* a seulement 9/ ± 60 et un individu à 20 soies *C*, de la même population, porte 40-50 g_2 et plus de 100 g_1. Il existe donc une large variation d'un individu à l'autre.

Sternite VIII avec 0 ou 1 *C* chez les larves, 0 à 21 chez les mâles, 0 à 24 chez les femelles. Les soies *C* des mâles sont toutes longuement barbelées, les mieux fournies évoquant un arbuscule.

Poils en rosette autour du gonopore mâle de 4 à 18, en relation approximative avec le nombre des soies *C* (4 et 17 pour 0 et 20 *C*). Chez les 29 mâles disponibles (Népal: 13, Sikkim: 4, Manipur, Sumatra: 11), les soies de revêtement de la papille génitale sont barbelées ou au moins fourchues pour les plus grêles; celles qui forment le premier verticille autour de la rosette peuvent évoquer un arbuscule.

Aucun cerque n'est complet; les plus longs appartiennent au paratype de 3,03 mm et sont égaux aux 2/3 environ de la longueur du corps (2,02 et 2,04 mm), formés d'une base et de 10 articles dont les moyennes de longueurs sont les suivantes: 111; 24,5; 23, 24,5, 28,5, 30,5, 32, 35,5, 36,5, 39, 39,5. Les macrochètes de la base et des premiers articles sont longs, complètement glabres ou faiblement barbelés.

5° **Lepidocampa (L.) weberi** Oudemans, 1890, s. lat.

SUMATRA. Sum-85/11: 3 ♀ (avec *L.w. nepalensis*, cf. ci-dessus). - Sum-85/33: 1 l. (avec *L. w. nepalensis*, cf. ci-dessus) - Sum-85/45 (Sumatera Utara: Deli Serdang), forêt de *Pinus merkussii* près de la route de Brastagi à Sibolangit, 1400 m. 19.XI.1985, leg. B. H.: 1 ♀. - Sum - 85/47: 1 ♀ (avec *L. w. laurenci*, cf. ci-dessus). - Sum - 85/49: 1 l. (avec *Lepidocampa* sp., cf. ci-dessous).

Il s'agit d'individus en mauvais état (épilés), ne pouvant être déterminés avec certitude. Il est possible que les femelles de la localité 85/11 appartiennent à *nepalensis*.

6° **Lepidocampa (L.)** sp.

SUMATRA. Sum - 85/49 (Sumatera Utara: Langkat). Réserve naturelle de Bukit Lawang, près de Bohorok, forêt primaire le long de la rivière, 180 m, prélèvement de sol dans les angles formés par les contreforts d'un grand arbre, 20.XI.1985, leg. B. H. (B): 2 l.

Ces 2 individus à 0 et 2 soies *C*, sans antennes, sont remarquables par le sensille du palpe labial qui est volumineux, dilaté en massue et courbé vers l'extérieur. Le seul *ma* II qui subsiste (gauche de la larve à 2 *C*) est fortement barbelé sur ses 3/4 distaux. Un peu plus court que son écartement ($ma/\epsilon = 0,87$), son apex dépasse de plus de moitié l'embase du sensille sétiforme ($ma/\delta = 2,21$). Ces deux caractères opposent formellement ces spécimens aux *L.* (*L.*) *angulata* avec lesquels ils cohabitent.

7° **Lepidocampa (L.) angulata** Condé, 1990 stat. nov.

(*Lepidocampa* (*L.*) *weberi* ssp. *angulata* Condé, 1990)

Sumatra. Sum - 85/30 (Sumatera Utara: Simalungun), sur la route en provenance de Pematangsiantar, 18 km avant Prapat, lieu-dit “Ainuli”, forêt dans la chaîne montagneuse Bukit Parasat, derrière la station “Holzweg Nr. 2 du Dr Diehl”, forêt primaire autour de l'école forestière, 1000 m, prélèvement de sol dans les angles formés par les contreforts de grands arbres, 14.XI.1985, leg. B H. (B): 7 ♀, 7 l. - Sum - 85/33: 1 ♂ (avec *L. w. nepalensis*, cf. ci-dessus). - Sum - 85/38 (Sumatera Utara: Deli Sedang), Sibolangit, sur la route de Medan à Brastagi, Jardin botanique, 530 m, 18.XI.1985, leg. B. H.: 1 l. - Sum - 85/39, comme 85/38, sauf prélèvement de sol dans les angles formés par les contreforts de grands arbres, 520 m,, 18.XI.1985, leg. B. H. (B): 1 ♂, 1 ♀, 1 l. - Sum - 85/47: 2 ♀, 2 l., 1 l. I en mue (avec *L. w. lawrencei*, cf. ci-dessus). - Sum - 85/49: 1 ♂, 2 ♀ (avec *Lepidocampa* sp., cf. ci-dessus).

Cette forme a été décrite de Bornéo (Sabah), d'après 181 individus; l'examen des spécimens de Sumatra confirme sa validité. Comme elle est déterminable sans équivoque à tous les stades, nous lui accordons ici le rang spécifique.

Les antennes des larves (17 - 19 articles) et des individus sexués (20 -25 articles) sont dans les limites de la variation (16 - 26). 4 ♀ ont 16 soies *C* et un ♂ 17 (max. 15 chez 2 ♀ à Bornéo). Très peu de *ma* mésonotaux étaient présents: $ma/\epsilon = 0,65$ et $ma/\delta = 1,03$ chez une femelle; $ma/\epsilon = 1,02$ et $ma/\delta = 1,40$ chez une larve; les mêmes rapports, mesurés sous l'exuvie de la larve I, sont 0,92 et 1,80, cette dernière valeur paraissant exceptionnelle.

II. **Lepidocampa (L.) heteroclita** n. sp.

Sumatra. Sum - 85/52 (Sumatera Barat), Lake Maninjau, bord du lac au sud de la localité Maninjau, 400 m, 23.XI.1985, leg. C. L.: 1 ♀ (holotype). - Sum - 85/61 (Sumatera Barat), route en provenance de Bukittinggi, 3,5 km avant Maninjau (près du virage no 12), 580 m, 25.XI.1985, leg. C. L.: 1 ♂ (paratype).

Longueurs. Corps: 2,30 (paratype) et 2,75 mm (holotype); cerques incomplets (1,63; 1,77 mm).

Tête. Les deux antennes intactes (holotype et paratype) ont 25 articles, l'antenne droite de l'holotype étant un régénérat de 23 articles. Sensille du IIIe article postérotergal (entre *b* et *c*), subcylindrique, plus grêle que celui des palpes, mais sensiblement de même longueur (10,5 - 11 µm). L'organe cupuliforme de l'article apical est petit, occupant 1/8 à 1/9 environ de la longueur de l'article, et renfermant 4 sensilles simples (collerette unique).

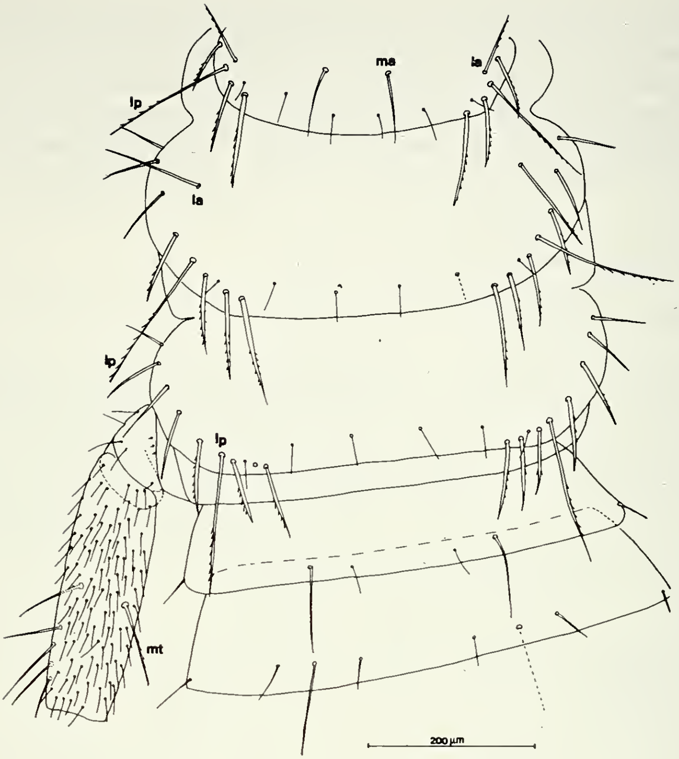

FIG. 3

Lepidocampa (*L.*) *heteroclita* n. sp. Femelle holotype: tergites thoraciques, trochanter et fémur de la patte métathoracique gauche, et urotergites I à III. *la*: macrochète latéral antérieur; *l*p: macrochète latéral postérieur; *ma*: macrochète médial antérieur; *mt*: macrochète tergal du fémur III.

Thorax. Méso- et métanotum sans macrochètes médiaux antérieur (*ma*), comme chez les représentants du sous-genre *Paracampa*. Les phanères du pronotum, comme ceux du méso- et du métanotum, sont longs et grêles; en I, *ma*/*la* = 1,13, *lp*/*ma* = 1,80; en II, *lp*/*la* = 1,45; *lp* II/*lp* III = 1,04. Les barbules sont minuscules et à peine écartées de la tige. Soies marginales beaucoup plus épaisses que les macrochètes et plus distinctement barbelées.

Le macrochète tergal du fémur III est très différencié, quoique les barbules portées par sa moitié distale soient discrètes et à peine écartées de la tige. Il est égal à un peu plus du 1/3 du bord tergal (t/M = 2,75 - 2,85) et inséré vers le milieu de ce dernier (t/eM = 1,92 - 1,98). Un macrochète vers le milieu du bord sternal du tibia. Griffes et processus télotarsaux comme chez les autres espèces du genre *Lepidocampa*.

Abdomen. *Holotype*. Tergites II à VII avec une paire de macrochètes postérieurs ($post_1$), un peu plus de 2 fois plus courts que leur écartement de II à VI

($post_1/\epsilon$ = 0,46) et 2 fois plus courts en VII ($post_1/\epsilon$ = 0,51). Tergites V à VII avec 2 + 2 macrochètes en plus ($post_{3,4}$), l'intermédiaire ($post_3$) étant le plus long ($\bar{X}$ = 80), le latéral ($post_4$) le plus court (X = 58), surtout en V, et le submédian ($post_1$) de longueur intermédiaire (X = 63). Une paire de sensilles sétiformes entre les $post_1$ en II, une seconde paire à l'extérieur des mêmes macrochètes en III et IV, une troisième paire latérale (près de $post_4$) de V à VII. Une seule paire de soies marginales postérieures tout à fait latérale de II à IV, et 3 paires alternant avec les macrochètes de V à VII. Tergite VIII avec 4 + 4 macrochètes. Valvule supra-anale avec 2 longues soies sagittales subapicales.

Paratype. De taille un peu inférieure à celle de l'holotype, ses phanères sont en valeur absolue légèrement plus courts ($\bar{X}$ = 55,5 au lieu de 59,5 pour les $post_1$); par rapport à leur écartement, les $post_1$ sont, au contraire, un peu plus longs ($post_1/\epsilon$ = 0,49 de II à VI; 0,54 en VII).

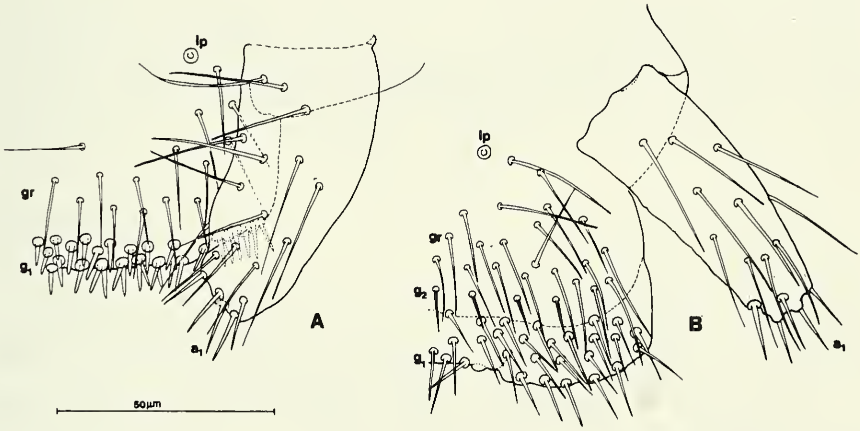

FIG. 4

Lepidocampa (*L.*) *heteroclita* n. sp. Portion gauche du premier urosternite: *A*. Femelle holotype; *B*. Mâle paratype. a_1: phanères glandulaires de l'appendice; g_1, g_2: phanères glandulaires de la marge postérieure de la plaque médiane; *gr*: phanères grêles; *lp*: macrochète latéral postérieur.

Sternite I avec 6 + 6 macrochètes.

Femelle. La marge postérieure de la plaque médiane est légèrement concave et ses angles latéraux sont saillants par rapport à l'insertion de l'appendice qui ne les dépasse que de son tiers apical. Un champ de phanères glandulaires tous semblables (g_1), disposés sur 2 rangs ou sur 3 dans les régions latérales, occupe toute la marge; j'ai compté environ 125 de ces phanères. Immédiatement en avant, un rang, parfois dédoublé, de poils grêles (*gr*), au nombre d'une cinquantaine. Les appendices sont subcylindriques, légèrement atténués vers l'apex qui ne porte que 5 poils glandulaires a_1.

Mâle. Les angles latéraux sont plus saillants, et l'apex de l'appendice ne les atteint pas tout à fait. Le champ de phanères glandulaires est plus large et comprend des poils g_1, plus longs et minces que ceux de la femelle, disposés sur 3 ou 4 rangs, et des poils g_2, espacés les uns des autres, formant une rangée unique un peu en avant des g_1. Des poils grêles (*gr*) sur 2 ou 3 rangs occupent l'espace compris entre la ligne joignant les macrochètes les plus postérieurs (latéral et médial postérieurs) et le champ glandulaire. Sur la moitié gauche du sternite, sauf une petite portion submédiane cachée par le télotarse III droit replié, j'ai compté 47 poils grêles, 19 g_2 et 72 g_1, soit un équipement total de 276 phanères au moins, au lieu de 175 environ chez la femelle. Les appendices, plus étroits et plus grêles que ceux de la femelle, n'ont, comme ceux de cette dernière, que 5 phanères glandulaires apicaux.

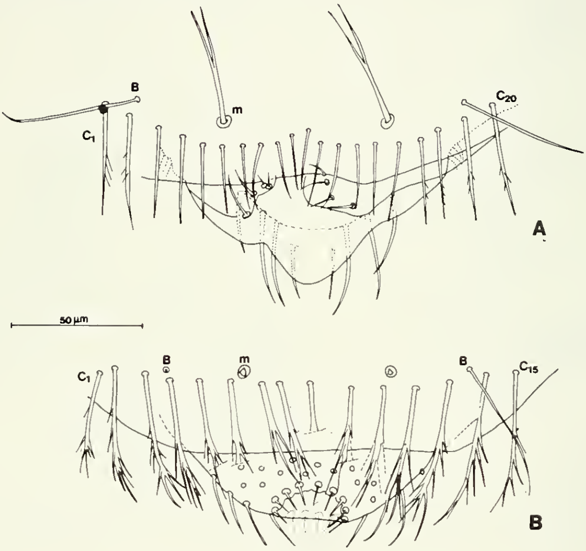

FIG. 5

Lepidocampa (*L.*) *heteroclita* n. sp. Marge postérieure du huitième urosternite et papille génitale: *A*. Femelle holotype; *B*. Mâle paratype. *B*: sensille sétiforme; C_1-C_{20}: phanères de la marge postérieure du sternite; *m*: macrochète ou son embase. La plupart des soies banales de la papille génitale mâle ne sont représentées que par leur embase pour ne pas surcharger le dessin.

Sternite VIII présentant un dimorphisme sexuel.

Femelle. 20 soies *C* de longueurs croissantes du centre vers les bords du sternite (X = 28,70 µm), glabres, sauf les plus externes. Sensilles *B* entre les éléments de la paire la plus latérale, mais beaucoup plus près de la soie *C* la plus proche du plan sagittal. Papille génitale avec 4 + 4 poils courts sur les volets et 4 + 4 phanères beaucoup plus longs et robustes sur le tubercule médian. Macrochètes longuement fourchus.

Mâle. 15 soies *C*, longuement barbelées, les externes plus développées, comme chez la femelle, mais toutes considérablement plus longues ($\bar{X}$ = 51,85 µm) quelques-unes brisées. Sensilles *B* insérés à gauche entre les phanères de l'avant-dernière paire latérale et à droite entre ceux de la 3e paire latérale. Papille génitale avec une rosette de 13 phanères; tous les phanères sont glabres. Macrochètes arrachés.

Cerques incomplets. Le droit de l'holotype comporte une base, subdivisé en deux, et 11 articles, tous revêtus de longs macrochètes glabres, des soies courtes formant un verticille vers l'apex de certains articles. Les longueurs relatives sont les suivantes: base = 49 (34 + 15); 16 - 18 - 19 - 19 - 23 - 25 - 40 - 34 - 41 - 40 - 40 = 364 (1,63 mm).

Le droit du paratype comporte une base indivise et 13 articles, les longueurs relatives étant les suivantes: base = 43; 15 - 16 -17 - 19 -18 - 17 - 24 - 36 - 36 - 38 - 37 - 38 - 40 = 394 (1,77 mm).

Discussion. Les caractères essentiels de cette curieuse espèce ont été indiqués dans la clé de détermination. Au mélange de caractères attribués jusqu'ici à *Lepidocampa* s. str. (macrochète dorsal du fémur) d'une part, et au sous-genre *Paracampa* (pas de macrochètes médiaux antérieurs au méso- et au métanotum) d'autre part, il faut ajouter la présence, chez la femelle, d'un champ glandulaire (g_1) au sternite I, précédé d'une rangée de poils grêles (*gr*). Cette disposition est identique à celle que présentent les femelles matures de *L.* (*L.*) *giffardii* Silvestri, 1931, les mâles de cette espèce ayant en plus, comme ici, des poils glandulaires plus minces (g_2), (CONDÉ 1954[1]).

BIBLIOGRAPHIE

CONDÉ, B. 1954. Campodéidés de Madagascar et de l'Ile de la Réunion. *Mém. Inst. sci. Madagascar*, sér. E, 4: 617-637.

CONDÉ, B. 1958. British Museum Nepal Expedition 1954,. Protoures et Diploures Campodéidés. *Proc. R. Ent. Soc. London* (B), 27 (11-12): 189-193.

CONDÉ, B. 1990. Diploures Campodéidés de Bornéo. *Revue suisse Zool.* 97 (2): 465-475.

CONDÉ, B. & M. JACQUEMIN-NGUYEN DUY. 1968. Diplopodes Pénicillates et Diploures Campodéidés. *Khumbu Himal*, 3 (1): 4-8. Innsbruck-München, Universitätsverlag Wagner.

PACLT, J. 1957. *Genera Insectorum*, P. Wytsman, Crainhem, 212E: 123 pp.

SILVESTRI, F. 1931. Campodeidae (Insecta Thysanura) dell'Estremo Oriente. *Boll. Lab. Zool. gen. agr. Portici* 25: 286-320.

SILVESTRI, F. 1933. First contribution to the knowledge of the Indo-Malayan *Campodeidae* (*Thysanura Entotropha*). *Rec. ind. Mus.* 35 (4): 379-392.

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[1] Dans cette note, p. 622, à la 4e ligne du 4e paragraphe, il convient de lire «chez les femelles âgées» au lieu de «chez les ♂ âgés». De même, à la 4e ligne du 5e paragraphe, il faut lire «les 2 femelles» et non «les 2 ♂».

Revue suisse de Zoologie, 100 (4) : 961-969; décembre 1993

Révision de quelques espèces de Diplopodes décrites par Faës, Rothenbühler et Verhoeff. I. *Trimerophorella*, *Janetschekella* (Chordeumatida) et *Polydesmus alticola* (Polydesmida)

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Revision of some Diplopoda species described by Faës, Rothenbühler and Verhoeff: I. *Trimerophorella*, *Janetschekella* **(Chordeumatida) and** *Polydesmus alticola* **(Polydesmida).** - The morphological analysis of type-material, of specimens rediscovered at the type-localities and of other comparative material from the Swiss Alps, allowed a revision of the following taxa in the genera *Trimerophorella* (Neoatractosomatidae), *Janetschekella* (Craspedosomatidae) and *Polydesmus* (Polydesmidae): *Trimerophorella rhaeticum* (Rothenbühler, 1901) nov. comb. (from *Trimerophoron*), *T. ornatum* (Faës, 1902) nov. comb. (from *Craspedosoma*), *Janetschekella valesiaca* (Faës, 1902) nov. comb. (from *Atractosoma*). Newly synonymized are *T. nivicomes* Verhoeff, 1902 and *T. glaciei* Verhoeff, 1912, each with *T. rhaeticum*, *Janetschekella nivalis* Schubart, 1954 with *J. valesiaca* and *Polydesmus alticola* Verhoeff, 1894 with *P. helveticus* Verhoeff, 1894.

Key-words: Diplopoda - *Trimerophorella* - *Janetschekella* - *Polydesmus* – Revision.

INTRODUCTION

Lors des recherches faunistiques effectuées en Suisse par Verhoeff (1894, 1912), Faës (1902) en Valais et Rothenbühler (1901,1902) dans les Grisons, ces auteurs ont décrit un certain nombre de nouvelles espèces et sous-espèces en provenance des Alpes qui ont retenu notre attention lors de l'établissement d'un premier bilan de la faune suisse (Pedroli-Christen, 1992) soit parce qu'il était difficile de les situer dans la systématique actuellement en vigueur, soit du fait de leur ressemblance avec d'autres espèces décrites plus tardivement.

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Un examen attentif de cet ancien matériel, partiellement retrouvé, des descriptions et dessins publiés à l'époque, de notre propre matériel ainsi que du matériel de MEYER (1983), nous amène à proposer plusieurs synonymies. Par ailleurs, les résultats concernant le genre *Trimerophorella* amènent à discuter le statut de certains taxons à la lumière d'une systématique moderne évolutive. Chacun des groupes d'espèces traités sera abordé séparément. Précisons que des problèmes similaires ont été rencontrés pour d'autres genres, dont une révision sera publiée ultérieurement.

MATÉRIEL ET MÉTHODE

La difficulté de retrouver le matériel de collection ancien, notamment celui de Faës nous a amenée à revisiter avec un certain succès toutes les stations types des espèces que ce dernier a décrites. Par ailleurs les nombreuses autres excursions faites dans les Alpes dans le cadre de l'Atlas suisse des Diplopodes (PEDROLI-CHRISTEN, 1993), nous ont permis de rassembler un matériel de comparaison. Pour le genre *Trimerophorella*, huit nouvelles stations ont été recensées en Suisse (Tableau 1), pour le genre *Janetschekella* une et aucune pour *Polydesmus alticola*.

Ce matériel a été comparé pour identification avec les figures et descriptions des auteurs, mais aussi avec les collections suivantes: (Abréviations PM: préparation microscopique; A: en alcool)

A) Taxa en rapport avec *Trimerophorella*

Collection Verhoeff: Staatssammlung München
Trimerophorella nivicomes, Bernina (PM); *Trimerophorella nivicomes*, Ötztaler Alpen (PM) (type ?); *Trimerophorella nivicomes*, Alp Grüm (A; 1♀); *Trimerophorella nivicomes engadina*, Muottas Muraigle (PM; A; fragments) (type ?); *Trimerophorella glaciei*, Engadine (2x) (PM; A fragments) (type).

Collection Faës: Musée zoologique, Lausanne
Craspedosoma ornatum, Chanrion (A: No 88: fragment arrière) (type).

Collection Carl: Musée zoologique, Lausanne (déterminé selon toute vraisemblance par Rothenbühler). *Trimerophoron rhaeticum* Piz Soër, Schuls (Engadine, GR)(A: 1♂, 3♀ et 4 larves).

Collection Meyer: Zoologisches Institut, Innsbruck. *Trimerophorella nivicomes*, Ötztaler Alpen (A); *Trimerophorella paradisia*, Gran Paradiso (A) (type).

B) Taxa en rapport avec *Janetschekella*

Collection Faës: Musée zoologique, Lausanne
Atractosoma valesiacum (A: No 84: fragment arrière, 1 ♀) (type).

C) *Polydesmus alticola*

Collection Verhoeff: Staatssammlung de München
Polydesmus alticola, Gemmijoch (A Etk.Nr.287: 2♀)

Trimerophorella

Ce taxon comprend plusieurs espèces nominales, toutes semblables dans leur morphologie externe. La révision du genre amène à considérer les taxons suivants et à proposer diverses synonymies:

Trimerophorella rhaeticum (Rothenbühler, 1901) Figs 1-4

Trimerophoron rhaeticum Rothenbühler, 1901; Rothenbühler, 1902.
Trimerophoron /?Trimerophorella rhaeticum; Verhoeff, 1912.
Trimerophorella nivicomes Verhoeff, 1902; Bigler, 1929; Verhoeff, 1934; Meyer, 1983; Kurnik, 1988.
Trimerophorella glaciei Verhoeff, 1912; Verhoeff, 1934.
Trimerophorella nivicomes engadina Verhoeff, 1912.
Trimerophorella nivicomes muscorum Verhoeff, 1914.

Trimerophorella ornatum (Faës, 1902) Figs 5-8

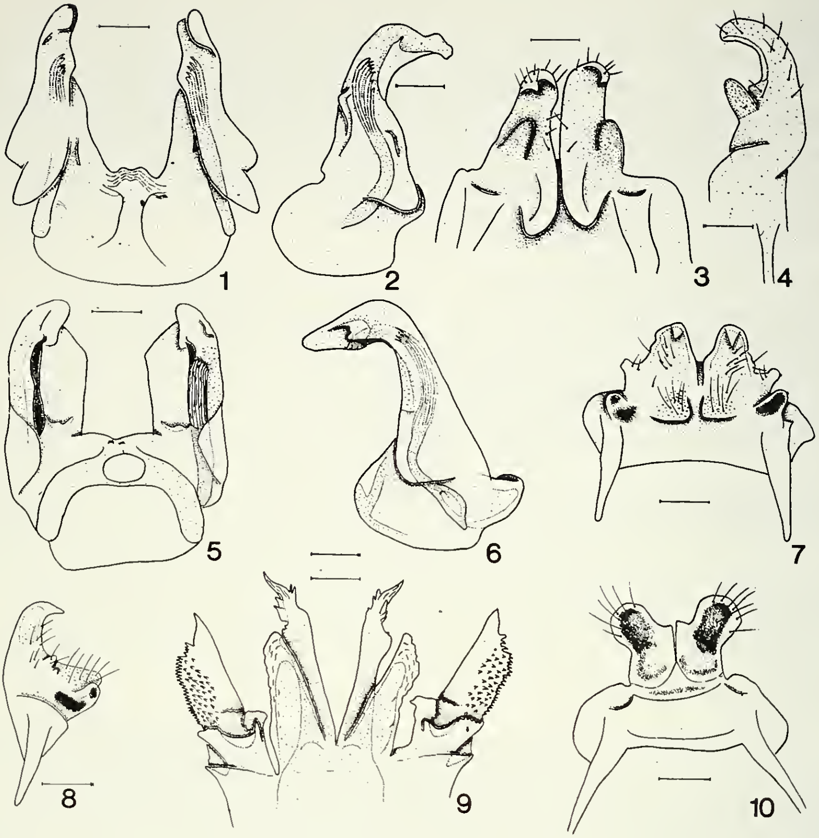
Craspedosoma ornatum Faës, 1902.

Trimerophorella paradisia Meyer, 1983

HISTORIQUE ET CHOROLOGIE

Verhoeff (1894) signale page 291 sans donner de description, ni de dessin, la présence de deux individus (le sexe n'est pas précisé) identifié comme *Craspedosoma oribates* Latzel au Riffelsee près de Zermatt à 2800m (ces individus n'ont pas été retrouvés). Rothenbühler (1901) décrit succinctement (pages 367-368), *Trimerophoron rhaeticum* sur des échantillons en provenance de l'Alp Scaradra (Val Luzzone (TI) 2200 m, juillet 1900) et de Scalettapass (2500m) près de Davos (GR) qui n'ont pas été retrouvés; il signale que Carl l'a retrouvée en Engadine (Val Triazza 1850-2200 m et Alp Champatsch, 2200-2700 m). Il précise que la description sera mieux détaillée dans une publication future, qui n'a malheureusement jamais vu le jour. Rothenbühler (1902) analyse le matériel récolté par Carl en Engadine et cite (p. 553-554) la présence de cette espèce à Muchetta entre 2400 m et 2600 m, dans le Val Plazbi entre 2100 m-2400 m, au Flüelapass et au Piz Soër près de Schuls à 2900m (ces derniers individus sont déposés dans la coll. Carl à Lausanne).

Faës (1902) décrit *Craspedosoma ornatum* (pages 90-91, fig. 38-40) en provenance de la cabane de Chanrion, 2200 m, le 23 septembre (type déposé coll. Faës, Lausanne). Verhoeff (1902) décrit *Trimerophorella nivicomes* en provenance des Oetztaler Alpen, Autriche. Verhoeff (1912), décrit *Trimerophorella nivicomes engadina* en provenance du Muottas Muraigle (Engadine, GR) 2500 m, le 27 juillet 1910 et *Trimerophorella glaciei* de la Bernina, Engadine, (GR) 1910 m, le 26 juillet 1910 (types coll. Verhoeff, Munich). De plus il émet l'idée que *Trimerophoron rhaeticum* Rothenbühler appartient plutôt au genre *Trimerophorella*. Verhoeff



Figs 1-10

1-4: *Trimerophorella rhaetica* (Rothenbühler, 1901), mâle de Piz Soër, Schuls (Engadine, CH), 2800m; coll Carl/ Musée Lausanne (échelle 0,1mm): 1, gonopodes antérieures en vue caudale - 2, cheirite en vue latérale - 3, gonopodes postérieures, vue orale - 4, gonopodes postérieures en vue latérale. 5-8: *Trimerophorella ornata* (Faës, 1902), mâle de Riffelberg, Zermatt (VS, CH), 8.9.1990, coll. Pedroli, Neuchâtel (échelle 0,1mm): - 5, gonopodes antérieures en vue caudale - 6, cheirite en vue latérale - 7, gonopodes postérieures, vue orale - 8, gonopodes postérieures en vue latérale. 9-10: *Janetschekella valesiaca* (Faës, 1902), mâle de Mauvoisin, Chanrion (VS, CH), 2.9.1990, coll. Pedroli, Neuchâtel (échelle 0,1mm): - 9. gonopodes antérieures en vue caudale. - 10. gonopodes postérieures, vue orale. (Dessins: Jörg Spelda).

(1914) établit une clé des espèces du genre *Trimerophorella* et décrit une nouvelle sous-espèce *T. n. muscorum* en provenance des Ferwallgruppe (type coll. Verhoeff, München). Bigler (1929) émet des doutes quant à la validité des sous-espèces *engadina* et *muscorum* ainsi que de l'espèce *glaciei* et ceci sur la base de ses propres récoltes en provenance de 8 stations en Engadine, qu'il attribue à *Trimerophorella nivicomes* Verhoeff. Meyer (1983) décrit une nouvelle espèce, *Trimerophorella* paradisia, en provenance du Massif du Gran Paradiso, 2900 m (1 ♂ et 3 ♀, type coll. Meyer, Innsbruck). KURNIK (1988) décrit les caractères des femelles de *T. nivicomes* (Obergurgl, Tyrol) et *T. paradisia* (Gran Paradiso).

Les données inédites (données personnelles ainsi que matériel légué par Dr K. Thaler, Innsbruck, en provenance de Ramosch, où il avait entrepris une campagne de piègeage dans divers sites en 1970, /1971 et en 1981/1982) sont les suivantes:

TABLEAU 1

STATIONS	année	adultes	♀	♂
rhaeticum				
Airolo, Capanna Cadlimo	1987	1	1	
Bernina, Val Lagune	1989	2	1	1
Camp, Val da, Viola	1989	1	1	
Gueglia, Pass dal (Julier)	1989	5	1	4
S. Bernardino, col	1989	7	2	5
Ramosch* (plusieurs sites)	1970-1982	19	8	11
* Matériel récolté par Dr Thaler et déterminé par nous-même				
ornatum				
Zermatt, Gornergrat	1989	2	1	1
Zermatt, Riffelberg	1989	4	4	
Zermatt, Riffelberg	1990	13	8	5

MORPHOLOGIE COMPARÉE DES GONOPODES

a) DES TAXA *glaciei*, *nivicomes*, *nivicomes engadina* ET *nivicomes muscorum*

Ces taxa sont tous morphologiquement extrêmement proches. Les trois premiers ont été récoltés en Engadine. La comparaison entre le matériel de collection et le matériel personnel montre que, comme le relève déjà Bigler, les différences observées par Verhoeff dans la structure des gonopodes antérieurs et postérieurs relèvent, d'une part de variations individuelles non négligeables surtout pour les gonopodes arrières; d'autre part d'artefacts dus à l'écrasement des pièces lors de préparation de lames microscopiques ainsi qu'aux différents angles de vues des objets, tels les télopodites antérieurs par exemple, pouvant induire des erreurs d'interprétations. Ainsi sur la base de nos observations, il est permis d'établir sans ambiguïté la conspécificité de *glaciei* et *nivicomes*. La division de l'espèce *nivicomes* en sous-espèces, *engadina* et *muscorum* n'est à notre avis pas justifiée.

b) DES TAXA *nivicomes* ET *rhaeticum*

Nous avons sans aucune hésitation identifié les individus étiquetés *T. rhaeticum* en provenance du Piz Soër, Engadine (station signalée par ROTHENBÜHLER (1902) et déposé dans la collection Carl à Lausanne) (Fig. 1-4) comme identiques à *T.*

nivicomes de Verhoeff (coll. Verhoeff, München), de BIGLER (1929, p. 21-22), de MEYER (1983, Fig. 8-10) et de notre propre matériel. Ces deux taxa doivent donc être considérées comme conspécifiques.

c) DES TAXA *ornatum* ET *oribates*

Le type de *T. ornatum*, un seul individu, est déposé au musée de Lausanne, mais il ne possède malheureusement plus les gonopodes pour pouvoir établir une détermination. Par ailleurs les trois excursions faites dans la région de Chanrion (localité type) n'ont pas permis de le retrouver. Toutefois la description, même succincte et le dessin relativement grossier de FAËS (1902, Fig. 38-40) sont suffisamment explicites pour pouvoir attribuer ce taxon au genre *Trimerophorella*. A la recherche dans l'unique station connue en Suisse de *Craspedosoma oribates* Latzel (citée par VERHOEFF (1894) entre le Riffelberg et le Gornergrat près de Zermatt) le taxon *Trimerophorella* a pu être mis en évidence, mais aucun individu ressemblant à *oribates* (Latzel). STRASSER (1965) dit: "Wegen ihrer grossen habituellen Ähnlichkeit ist [*T. nivicomes*] bereits wiederholt mit *H. oribates* verwechselt worden....". Ailleurs STRASSER (1965) écrit: "Es kann kaum ein Zweifel daran bestehen, dass auch die Nachweise [von *H. oribates*] von Obergurgel, Zermatt, Stilfserjoch sich auf diese Form '*T. nivicomes*' beziehen". Selon MEYER (1973) qui limite la distribution géographique de *H. oribates* à la partie nord-est du Tyrol, ce dernier taxon semble souvent être confondu avec d'autres. Par ailleurs Verhoeff ne reprend nulle part dans ses travaux ultérieurs concernant la faune Suisse cette observation. La présence de *oribates* en Suisse doit donc être considérée comme très douteuse et il est fort probable que Verhoeff se soit trouvé en présence d'un *Trimerophorella*, genre encore inconnu à l'époque. Les *Trimerophorella* que nous avons récoltés au Riffelberg montrent une structure gonopodiale (Fig. 5-8) se rapprochant fortement des dessins concernant *ornatum* (FAËS, 1902, Fig. 38-40).

d) DES TAXA *ornatum*, *rhaeticum* ET *paradisia*

Le taxon *ornatum* prend une place intermédiaire autant géographiquement que dans sa structure gonopodiale (Fig. 5-8). En effet, si les télopodites antérieures ressemblent beaucoup à *rhaeticum*, les gonopodes postérieures se rapprochent plus de *paradisia*, les gonocoxites étant cependant arrondi et non pointu comme pour *paradisia* (voire MEYER, 1983, Fig. 3 et 4). Si la nécessité de séparer ces trois taxa s'avère justifié du point de vue morphologique, il se pose cependant la question de savoir quel statut leur attribuer.

RÉPARTITION GÉOGRAPHIQUE

La présence de *ornatum* a jeté un pont entre les deux territoires alpins connus jusqu'à présent, à l'est, les Alpes d'Ötztal, Silvretta, Engadine et les Alpes tessinoises (voir également la carte de distribution de JANETSCHEK, 1956), région colonisée par *rhaeticum*, et à l'ouest, le massif du Gran Paradiso colonisé par *paradisia*. A l'exception des observations près de Ramosch, en Engadine à 1100 m, toutes les stations se situent à l'étage alpin voir même nival.

DISCUSSION

A chacun de ces trois taxa un rang spécifique a été attribué par leurs auteurs, en accord avec une systématique restée très typologique en myriapodologie. On peut cependant se poser la question, si l'on n'est pas plutôt en présence, comme cela a pu être observé pour *Rhymogona* (SCHOLL & PEDROLI-CHRISTEN, 1992) d'une espèce polytypique développant un cline à travers les Alpes, des Alpes tyroliennes aux Alpes Graies, la position intermédiaire prise par *ornatum*, autant du point de vue morphologique que du point de vue géographique, renforçant cette idée. Il faudrait alors pour être en accord avec la définition de l'espèce selon MAYR (1967) considérer ces taxa comme sous-espèces. Une meilleure connaissance de ce genre apportera une réponse à notre hypothèse.

Janetschekella

Ce taxon comprend deux espèces nominales, semblables dans leur morphologie externe. La révision du genre entreprise, amène à la proposition de les considérer comme conspécifiques.

Janetschekella valesiaca (Faës, 1902) Fig. 9-10

Atractosoma valesiacum FAËS, 1902.
Janetschekella nivalis SCHUBART, 1954.

HISTORIQUE ET CHOROLOGIE

FAËS (1902) décrit et illustre page 84-86, Fig. 24-26 *Atractosoma valesiacum* (1♂, 2♀♀), en provenance de la cabane Chanrion, Mauvoisin (VS) 2500 m, 22 septembre et de la La Fouly (VS) 1600m, 31 juillet. SCHUBART (1954) décrit et illustre en détail page. 352-358, Fig. 1-5 un nouveau genre comprenant une nouvelle espèce *Janetschekella nivalis* en provenance du massif de l'Oisans en France entre 1960 et 3450 m. STRASSER (1978) signale dans la faune du Piémont 1♂ et 1♀ de *J. nivalis*, en provenance du Colle di Finestrelle, 1500 m. GEOFFROY (1981) signale plusieurs récoltes de *J. nivalis* en provenance du Parc des Ecrins en France. Nos récoltes proviennent de Chanrion (Mauvoisin, VS), 17 août 1989, 2♂♂; 2.9.1990, 6♂♂, 2

♀♀, 2 larves VIII; Vieux Lac d'Emosson, (VS) 15.9.1991, 7♂♂, 7♀♀, 2 larves VIII. A la Fouly nous n'avons pas retrouvé l'espèce.

MORPHOLOGIE COMPARÉE DES GONOPODES

La comparaison entre la structure gonopodiale très typique des individus que nous avons récoltés dans la localité-type (Fig. 9, 10) et les figures des gonopodes faites par FAËS (1902, Fig. 18-23) et surtout celles très détaillées de SCHUBART (1954, Figs 1-5) ne laisse aucun doute quant à la conspécificité des taxa *nivalis* et *valesiacum*, ce dernier ayant été décrit en premier. Il se substitue donc comme espèce type au genre *Janetschekella*. Le genre *Atractosoma* a en effet aujourd'hui un sens beaucoup plus restrictif qu'à l'époque de Faës.

Polydesmus helveticus Verhoeff, 1894

Polydesmus helveticus VERHOEFF, 1894.
Polydesmus alticola VERHOEFF, 1894. **Syn. n.**

Parmi les taxa qui n'ont été signalés qu'une seul fois par Verhoeff et qui n'ont plus été retrouvés par la suite par d'autres chercheurs se trouve *Polydesmus alticola* en provenance du Gemmijoch, Leukerbad (VS, CH). La description succincte de VERHOEFF (1894, page 286) est basée sur une femelle et deux larves et se situe très près de *P. subinteger* ou de *P. helveticus*. Les exemplaires de Verhoeff en provenance du Gemmijoch (Staatssammlung München), doivent être, selon les critères utilisés pour les femelles par DEMANGE (1968), ainsi que par comparaison avec notre matériel personnel en provenance de la même localité, rattachés à *P. helveticus* Verhoeff, 1894 décrit sur la base d'un mâle. Il est probable que le manque de matériel de comparaison à l'époque soit à la base de cette erreur d'appréciation de Verhoeff. Nous proposons donc la synonymie des deux taxa.

REMERCIEMENTS

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BIBLIOGRAPHIE

BIGLER, W. 1929. Die Diplopodenfauna des schweizerischen Nationalparks. *Ergeb. wiss. Unters. Schweiz. Nationalpark* 5: 1-87.

DEMANGE, J.-M. 1968. Etudes des femelles appartenant aux genres *Polydesmus* et *Brachydesmus* pour servir a une faune des myriapodes de France. *Bull. soc. hist. nat. Toulouse*, 104: 276-305.

FAËS, H. 1902. Myriapodes du Valais. *Rev. suisse Zool.* 10: 31-164.

GEOFFROY, J.-J. 1981. Les myriapodes du Parc National des Ecrins. *Trav. Sci. Parc natn. Ecrins* 1:97-123.

JANETSCHEK, H. 1956. Das Problem der inneralpinen Eiszeitüberdauerung durch Tiere. *Österr. Zool. Z.* 6: 421-506.

KURNIK, I. 1988. Zur Taxonomie ostalpiner Chordeumatida: Vulvenmorphologie und Identifikation der Weibchen. *Zool. Jb. Syst.* 115: 229-302.

MAYR, E. 1967. Artbegriff und Evolution (dtsch. Übersetzung von Animal, Species and Evolution). *Hamburg, Berlin.* 617 pp.

MEYER, E. 1973. Über die Diplopoden Nordtirols und Vorarlbergs (Kritische Artenliste, mit biologischen Daten aus der Literatur). *Magisterarbeit Innsbruck*, 102 pp.

MEYER, E. 1983. *Trimerophorella paradisia* n.sp., ein nivaler Diplopode aus dem Gran Paradiso-Nationalpark (Grajische Alpen, Italien) (Diplopoda: Chordeumatida: Neoatractosomatidae). *Ber. nat.-med. Ver. Innsbruck* 70: 99-104.

PEDROLI-CHRISTEN, A. 1992. Les Diplopodes de Suisse: Un premier bilan. *Ber. nat.-med. Verein Innsbruck*, Suppl. 10, XII: 401-409.

PEDROLI-CHRISTEN, A. & A. SCHOLL 1990. Ecological and genetic studies on parapatric *Rhymogona silvatica* (Roth.) and *R. cervina* (Verh.)(Diplopoda: Craspedosomatidae) with special reference to hybrid populations in a zone of contact. *Rev. suisse Zool.* 97: 349-359.

PEDROLI-CHRISTEN, A. 1993. Faunistique des mille-pattes de Suisse (Diplopoda). Faunistik der Tausendfüssler der Schweiz (Diplopoda). *Doc. Faun. Hel.* 14, 164 + LXIII pp.

ROTHENBÜHLER, H. 1901. Myriapoden Graubündens. *Rev. suisse Zool.* 9: 357-377.

ROTHENBÜHLER, H. 1902. Myriapoden des bündnerischen Rheingebietes II. *Rev. suisse Zool.* 10: 549-561.

SCHOLL, A. & A. PEDROLI-CHRISTEN. 1992. The genus *Rhymogona* (Diplopoda: Craspedosomatidae) a ring species? - Enzyme electrophoretic data. (Abstract). *Rev. suisse Zool.* 99: 733-734.

SCHUBART, O. 1954. Über einige von Professor H. Janetschek in der hochalpin-nivalen Region der Dauphiné gesammelte Diplopoden. *Österr. Zool. Z.* 3: 350-365.

STRASSER, C. 1965. Über Diplopoden aus Kärnten und anderen Ostalpenländern. *Carinthia II*, 75/155: 127-142.

STRASSER, C. 1965. Über österreichische Attemsiiden. *Ann. naturhistor. Mus. Wien* 68: 553-583.

STRASSER, C. 1978. Diplopodi del Piemonte. *Boll. mus. civ. st. nat. Verona* 5: 141-173.

VERHOEFF, K.W. 1894. Beiträge zur Diplopodenfauna der Schweiz. *Berl. entom. Zeitschrift* 39: 281-296.

VERHOEFF, K.W. 1902. Über Diplopoden. 1. Aufs.: Formen aus Tirol, Italien und Cypern. *Arch. f. Naturgesch.* 68: 175-198.

VERHOEFF, K.W. 1912. Zur Kenntnis der Neoatractosomiden. *Zool. Anz.* 39: 320-336.

VERHOEFF, K.W. 1914. Zur Kenntnis einiger alpiner Chilognathen. *Zool. Anz.* 45: 219-238.

Revue suisse de Zoologie, 100 (4) : 971-992; décembre 1993

Pseudoskorpione (Arachnida: Pseudoscorpiones) von Inseln des Mittelmeers und des Atlantiks (Balearen, Kanarische Inseln, Madeira, Ascension), mit vorwiegend subterraner Lebensweise

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Pseudoscorpions (Arachnida: Pseudoscorpiones) from islands of the Mediterranean Sea (Balearic Is.) and the Atlantic Ocean (Canary Is., Madeira, Ascension), inhabiting mainly subterranean biotops. - Two new species of the genus *Chthonius* (*Ephippiochthonius*) (Chthoniidae) are described from Cabrera (Balearic Is.), three species of the genus *Chthonius* (*Ephippiochthonius*), three species of the genus *Microcreagrina* (Syarinidae) and one species of the genus *Rhacochelifer* (Cheliferidae) from the Canary Is. (Tenerife, Gomera, La Palma), one species of *Microcreagrina* from Madeira and one species of the genus *Apocheiridium* (Cheiridiidae) from Ascension Is. are described and figured. Their affinities are discussed, an identification key is proposed for the five species of the genus *Microcreagrina*.

Key-words: Pseudoscorpiones - Arachnida - Balearic ls. - Atlantic Islands - Taxonomy.

EINLEITUNG

In den letzten Jahren waren mir von mehreren Kollegen kleine, interessante Aufsammlungen von verschiedenen Inseln des Atlantiks und des Mittelmeers zur Bearbeitung zugesandt worden, wobei besonders die systematische Erforschung der ober- und unterirdischen Fauna der Insel Cabrera durch Dr. J.A. Alcover und G. Pons (Mallorca) und die reichen Aufsammlungen aus dem "MSS" ("milieu souterrain superficiel") der Kanarischen Inseln zu erwähnen sind, die der intensiven Tätigkeit Dr. P. Oromis (Universität von La Laguna) und seiner Mitarbeiter zu verdanken sind (Oromi *et al.* 1986; Medina & Oromi 1990). Drei neue *Chthonius*-Arten und besonders die vier neuen Arten der bislang monotypischen Gattung *Microcreagrina*

Manuskript angenommen am 06.08.1993.

(nach Revision aller in der Sammlung Genf aufbewahrten Exemplare) stellen die überraschenden Resultate dieser Studie dar. Der auslösende Faktor für die Ueberprüfung der Gattung *Microcreagrina* stellte eine kleine Serie dieser Gattung aus einer Höhle der Insel Tenerife dar, die mir Dr. W. Schawaller (Mus. Stuttgart) übersandt hatte. Die Diversität der vulkanischen Grotten und des MSS des Kanarischen Archipels war durch die Beschreibung hochadaptierter Höhlenpseudoskorpione bereits angedeutet worden (MAHNERT 1986, 1989) und wird durch die neuen Ergebnisse eindeutig unterstrichen. Während ihrer gemeinsamen Sammelreise gelang den Genfer Kollegen Dr. B. Hauser und Dr. Ch. Lienhard der Fund einer neuen borkenbewohnenden *Rhacochelifer*-Art auf der Insel Tenerife, ein wertvoller Einzelfund gelang Prof. Dr. N. P. Ashmole (Edinburgh) mit der neuen *Apocheiridium*-Art in einer Grotte der Insel Ascension. Allen Kollegen sei für ihr Vertrauen und besonders für ihre Geduld gedankt und auch für die Grosszügigkeit, mir Typen- und Belegexemplare für die Sammlung des Genfer Museums überlassen zu haben.

VERWENDETE INSTITUTSABKÜRZUNGEN

DZUL	Departamento de Zoologia de la Universidad de La Laguna, Tenerife, Spanien
MHNG	Muséum d'histoire naturelle, Genf, Schweiz
MNCM	Museu de la naturalesa de les Illes Baleares, Mallorca,Spanien
SMNS	Staatliches Museum für Naturkunde, Stuttgart, Deutschland

A. Balearen: Cabrera

Chthonius (Ephippiochthonius) cabreriensis n.sp. (Fig. 1-4)

Untersuchtes Material: Cabrera, Conillera, lg. G.Pons, 4.IV.1991: 1♂ (Holotypus)(MHNG).

Beschreibung: Normal sklerotisierte Tiere; Carapax retikuliert, so lang wie breit (0,31mm/0,29mm), kaudal kaum verengt, 4 kleine Augen, Vorderaugen gewölbt, um ihren Durchmesser vom Vorderrand entfernt, Hinteraugen flach; Chätotaxie: 4 + je 1 präokulares Börstchen /6/4/2/4 (Lateralborsten abgefallen, nach Areolendurchmesser jedoch kürzer): 20. Tergitbeborstung: I-IV 4, V-IX 6,X 4, XI 6 (2 submediale Tastborsten); Lobus der Pedipalpencoxa spitz, 2 Borsten, Pedipalpencoxa 3, I 4 + 3 apikale Randbörstchen, II 4 + 5 Coxaldornen, III 5 + 4 Coxaldornen, IV 6, Intercoxaltuberkel 2; Genitaloperkel 9 Borsten (4 mediale Randborsten), Genitalöffnung schmal V-förmig, mit je 6 Randborsten, Sternit IV 10 + je 3 , IV 9 + je 1 Suprastigmalborste, V 8, VI-IX 6, X 7 (2 submediale Tastborsten), Analkonus 2+2.

Chelicere mit 6 Stammborsten und einer akzessorischen Borste, fester Finger mit 7 Zähnen, beweglicher Finger mit 5 distal grösseren Zähnen, ohne isolierten subdistalen Zahn; Spinnhöcker flach und undeutlich, Serrula externa mit ca. 17 Lamellen, Flagellum 11 Borsten.

Pedipalpen: Femur 5,0x länger als breit (0,34mm/0,07mm) und 2,41x länger als Tibia, diese 1,8x länger als breit (0,14/0,08), Hand 1,9x länger als hoch

(0,21/0,11), Finger 1,44x länger als Hand (L. 0,30mm), Schere 4,6x länger als hoch (0,51/0,11); fester Finger mit 16 distal kleineren, aufrechten, deutlich getrennt stehenden Zähnen, beweglicher Finger mit 7 spitzen und anschliessend mit 5 verrundeten Rudimenten bis Tasthaar *sb*. Trichobothrium *sb* weit proximal, an *b* genähert, Sensillum etwas proximal von *sb*; *ist* ca. auf gleicher Höhe mit *esb*. Dorsalkontur der Palpenhand mit deutlicher Stufe, ein breiter flacher Höcker distal von *ib*/*isb*.

Laufbein I: Basifemur 4,0x länger als breit (0,19/0,05) und 2,1x länger als Telofemur, dieses 2,1x länger als breit (0,09/0,04), Tibia 3,0x 0,11/0,035), Tarsus 7,7x länger als breit (0,21/0,03) und 2,0x länger als Tibia; Laufbein IV: Femur 2,1x (0,31/0,15), Tibia 3,5x (0,19/0,06), Basitarsus 2,8x (0,12/0,04), TS der Tastborste = 0,42, Telotarsus 7,0x länger als breit (0,19/0,06) und 1,62x länger als Basitarsus.

Diskussion: Die neue Art ist durch das Fehlen eines isolierten subdistalen Zahn auf dem beweglichen Chelicerenfinger, dem Besitz von 4 Borsten am Carapax-Hinterrand und das Vorhandensein eines kleinen, aber deutlichen Höckers auf der Dorsalseite distal der Trichobothrien *ib*/*isb* gekennzeichnet. Sie unterscheidet sich von den (geographisch nahen) Arten *ponsi* n.sp. (siehe dort), *balearicus* Mahnert, *bellesi* Mahnert, *hispanus* Beier und *catalonicus* Beier durch deutlich geringere Palpenmasse; *C. cabreriensis* n.sp. scheint mit *C. vachoni* Heurtault (Frankreich, Gironde) nahe verwandt zu sein, unterscheidet sich jedoch von dieser Art durch das Fehlen eines Spinnhöckers beim Männchen, durch den Besitz von 4 Augen (gegen 2 bei *vachoni*) und durch schlankere Palpenschere.

Im letzten veröffentlichten Bestimmungsschlüssel der Arten der Untergattung *Ephippiochthonius* (Callaini 1984) ist *C. cabreriensis* n.sp. im Punkt 16 neben *C. nidicola* Mahnert einzufügen. Von dieser Art (aus Maulwurfsnester bei Genf, Schweiz) unterscheidet sich *cabreriensis* n.sp. durch das Fehlen eines Spinnhöckers beim Männchen und einige Palpendimensionen.

Chthonius (Ephippiochthonius) ponsi n.sp. (Fig. 5-7)

Untersuchtes Material: Cabrera, Avenc des Frare, 12.I.1991, lg. J.A. Alcover et G.Pons: 1♂ (Holotypus; MNCM), 2♂ 1♀ 3 Tritonymphen (Paratypen; MNCM) (2♂ MHNG).

Beschreibung: Carapax und Pedipalpen braun gefärbt; Carapax kaudal kaum verengt, Oberfläche fein schuppig skulpturiert; Vorderrand fast gerade, in der Mitte gezähnelt, mit 4 Augen, Vorderaugen gross, um ca. ihren Durchmesser vom Vorderrand entfernt, Hinteraugen gross, mit flacher Linse; Beborstung: 4+0-1 Mikrochäte beiderseits/6/4/2/2: 18. Tergitbeborstung: I-IV 4, V-IX 6 (IX mit 2 sublateralen Tastborsten), X4, XI 6 (2 sublaterale Tastborsten); Lobus der Pedipalpencoxen spitz, 2 Borsten (1♂ links mit 0 Borsten), Pedipalpencoxa 3, Coxa I 3 + (2)3 Randborsten, II 4+7-8 Coxaldornen, III 5+4-5, IV 6, Intercoxaltuberkel 2 Borsten; Genitaloperkel des Männchens 10 (4 mediale Randborsten), des Weibchens 10 (4 Diskalborsten), männlicher Genitalspalt kelchförmig, mit 8-11 Randborsten; Sternit III 10 (Männchen) bzw.9 (Weibchen) + je 3 Suprastigmalborsten, IV 7-9+ je 1-2

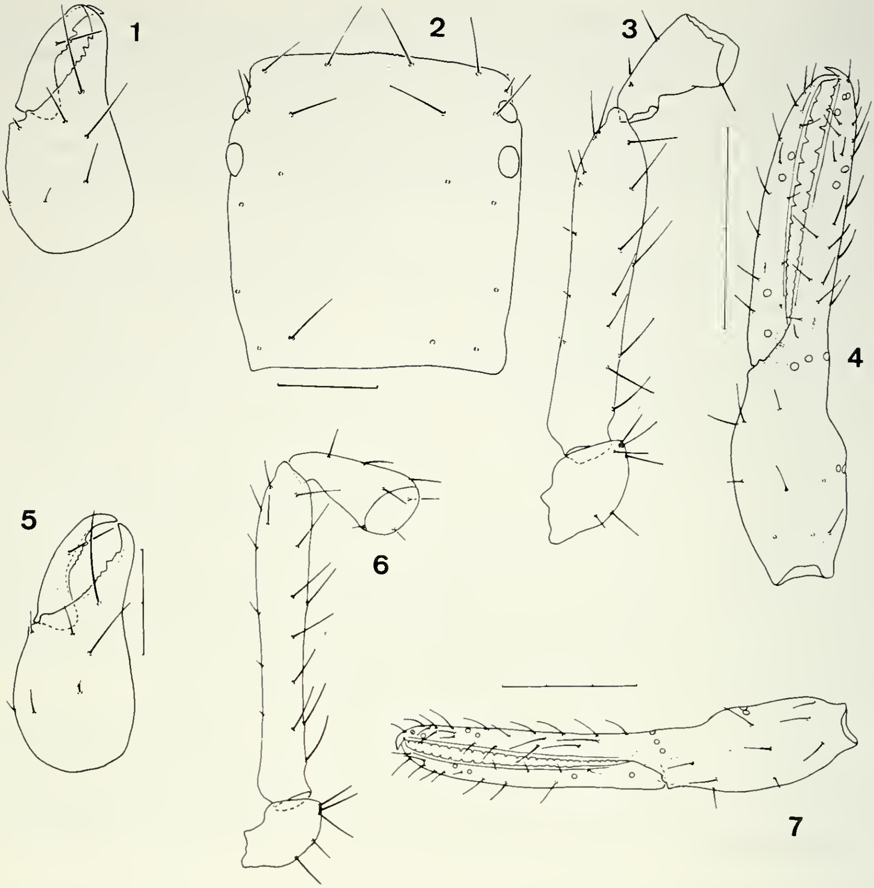

FIG.1-7

Fig.1-4 *Chthonius (E.) cabreriensis* n.sp.:1: Chelicere; 2: Carapax; 3-4: Pedipalpe; Fig. 5-7 *Chthonius (E.) ponsi* n.sp.: 5: Chelicere; 6-7: Pedipalpe; Masstabeinheit 0,1mm.

Suprastigmalborsten, V7-8, VI-IX 6, X 7 (2 submediale Tastborsten), Analkonus je 2 Borsten.

Chelicerenstamm schuppig skulpturiert, 6+1 akzessorische Borste, fester Finger mit 9-10, beweglicher mit 6-8 distal grösseren Zähnen, isolierter subdistaler Zahn fehlt, Spinnhöcker beim Männchen fehlend, beim Weibchen deutlich höckerförmig; Flagellum typisch, Serrula externa 14-16 Lamellen.

Pedipalpen: Trochanter 1,7-1,8x länger als breit, Femur 6.2-6,6x länger als breit und 2,53-2,57x (♀: 2,37x) länger als Tibia, diese 1,8-2,1x, Hand 2,2-2,3x (♀:2,1x), Schere 5,4-5,5x (♀:4,9x) länger als hoch, Finger 1,40-1,45x länger als Hand; Dorsalkontur der Hand mit deutlicher Stufe, distal von *ib*/*isb* mit breitem

Höcker, Apodem des beweglichen Finger deutlich entwickelt; fester Finger mit 22-26 aufrechten, spitzen, getrennt stehenden Zähnen, ein lateraler Distalzahn, beweglicher Finger mit 8-9 spitzen Zähnen und 9-10 undeutlichen verrundeten Rudimenten (bis *sb* reichend), Sensillum ca. bei *sb* liegend; Trichobothrium *ist* distal von *esb*, *eb-esb-ist* in gerader Schräglinie stehend.

Laufbein I: Basifemur 5,7-6,1x (♀: 5,5x) länger als breit und 2,03-2,13x länger als Telofemur, dieses 2,93-3,43x, Tibia 4,7-5,3x, Tarsus 10,3-10,8x (♀: 11,8x) länger als breit und 1,60-1,70x länger als Tibia. Bein IV: Femur 2,2-2,3x (♀: 2,5x) länger als breit, Tibia 3,8-4,1x (♀: 4,5x), Basitarsus 2,8-3,1x (♀: 2,6x), TS der Tastborste 0,40-0,41, Telotarsus 10,2-11,9x (♀: 12,4x) länger als breit und 1,89-1,95x länger als Basitarsus, TS der Tastborste 0,31-0,33.

Körpermasse in mm (Weibchen in Klammern): Carapax 0,51-0,52/0,49-0,51 (0,53/0,52); Palpen: Femur 0,73-0,76/0,11-0,12 (0,80/0,12), Tibia 0,29-0,30/0,14-0,16 (0,31/0,15), Hand 0,41-0,43/0,18-0,19 (0,43/0,21), Finger-L. 0,58-0,60 (0,61), Scheren-L.0,99-1,00 (1,02): Laufbein I: Basifemur 0,40-0,42/0,06-0,07), Telofemur 0,19-0,20/0,06-0,07, Tibia 0,24-0,26/0,05, Tarsus 0,41/0,03-0,04; Laufbein IV: Femur 0,60-0,63/0,24-0,28, Tibia 0,39-0,41/0,09-0,10, Basitarsus 0,21-0,22/0,07-0,08.

Tritonymphe: Chaetotaxie des Carapax und der Tergite wie bei Adulti; Chelicere mit 5 Grossborsten; Pedipalpen: Femur 5,2x (0,50/0,10), Beborstung: 3-5-2-4, Tibia 1,8x (0,22/0,13), Hand 2,1x (0,30/0,15), Finger 1,34x länger als Hand, Schere 4,9x , Finger-L. 0,41mm, Scheren-L. 0,70mm. Bezahnung der Palpenfinger wie bei Adulti, Trichobothrien *isb* und *sb* fehlen.

Diskussion: *Chthonius ponsi* n.sp. weist zahlreiche gemeinsame Merkmale mit *C. balearicus* Mahnert auf (Fehlen eines isolierten subdistalen Zahns auf dem beweglichen Chelicerenfinger, 2 Carapax-Hinterrand-Borsten), sie unterscheidet sich jedoch davon durch den Besitz von 4 Augen, durch etwas plumpere Palpenproportionen und geringere Palpenlänge (Scheren-L. max. 1,02mm gegen min. 1,09mm). Wahrscheinlich stellen *ponsi* n.sp. und *balearicus* Mahnert zwei von *gibbus* Beier abstammende, zu unterschiedlichen Zeiten in Höhlen eingewanderte Arten dar.

B. Kanarische Inseln

Chthonius (Ephippiochthonius) rimicola n.sp. (Fig. 8-12, Tabelle 1)

Untersuchtes Material: Hierro, Tinor, MSS (H-F3-39), 5.VII.1987: 1♀ (Holotypus; DZUL); Hierro, Jinama, MSS (H-F3-37), 5.VII.1987: 3♂, 9♀; Hierro, Jinama, MSS (H-F3-38), 5.VII.1987: 1♀; Hierro, Las Montanetas, MSS (H-F3-33), 18.VIII.1987: 2♀; Tenerife, La Montaneta, MSS (T-G5-190), 25.VI.1986: 1♀ (DZUL, MHNG); Tenerife, Bailadero, MSS-VII, 8.IX.1989: 1♀; Tenerife, Mte. del Agua, MSS-M, 25.IX.1989: 1♀; La Palma, Garafia, MSS-11, 2.V.1989, alle lg.A.L.Medina: 1♀; La Palma, kleine Höhle bei Barlovento, ca. 500m, VIII.1984, lg.J.Wunderlich: 1♀; La Palma, Cueva del Belmaco, près de La Sabina et Belmaco, route de Santa Cruz à Fuencaliente, 360m, 11.V.1993, lg.B.Hauser: 2♂1♀ (MHNG) (Paratypen).

Beschreibung: Normal sklerotisierte Tiere; Carapax so breit wie lang oder etwas breiter als lang, kaudal kaum verengt, Vorderrand medial fast gerade und gezähnelt, 4 grosse Augen, Vorderaugen um ca. ihren Durchmesser vom Vorderrand entfernt, Hinteraugen ganz flach, etwas kleiner und um ihren Durchmesser von Vorderaugen; Beborstung: 4+meist 2(1-3) Mikrochaeten/6/4/2/4 (Lateralborsten kurz) (nur bei 2 Weibchen aus Jinama fehlte jeweils links die kurze Lateralborste), Länge der medialen Vorderrandborste 0,08-0,10mm, Länge der medialen Hinterrandborsten ca.0,09mm. Tergitbeborstung:I-IV 4, V-IX 6, X 4, XI 6 (2 submediale Tastborsten); Lobus der Pedipalpencoxa 2 Borsten, Pedipalpencoxa 3, Coxa I 3+3 Randbörstchen (beim Holotypus fehlend), II 4+5-10 Coxaldornen, III 5+3-5 Coxaldornen, IV 6, Intercoxaltuberkel 2 Borsten; Genitaloperkel des Männchens 10 Borsten (4 Randborsten), der des Weibchens 9-10, männlicher Genitalspalt kelchförmig, mit meist 7 (6-8) Randborsten, Sternit III meist 10 (9-12) Randborsten+ je 3 Suprstigmalborsten, IV meist 8 (6-9)+ je1-2 Suprastigmalborsten, V meist 8 (8-10), VI-IX 6, X 7 (2 submediale Tastborsten), Analkonus mit 2 Borsten.

Chelicere mit 6 Stammborsten und 2 akzessorischen Börstchen, fester Finger mit ca. 6 , beweglicher Finger mit ca. 5 distal grösseren Zähnen, ein isolierter subdistaler Zahn vorhanden; Spinnhöcker des Männchens flach, der des Weibchens deutlich gewölbt; Flagellum 11 Borsten (gattungstypisch), Serrula externa ca. 14 Lamellen.

Pedipalpen: Femur des Männchens 5,4-5,7x (Weibchen:5,2-5,4x) länger als breit und 2,33-2,49x länger als Tibia, Chätotaxie: 3-6-2-5, Tibia1,8-2,1x (♀:1,7-1,9x), Hand 2,0-2,1x (♀:1,8-1,9x) länger als hoch, Dorsalkontur mit deutlicher Stufe, ein breiter flacher Höcker distal von *ib*/*isb*; Finger 1,4-1,5x (♀:1,3-1,4x) länger als Hand, Schere 4,8-5,3x (♀:4,2-4,7x) länger als hoch. Fester Finger mit 17-22 spitzen, getrennten Zähnen (distaler Lateralzahn vorhanden), beweglicher Finger mit 6-9 spitzen, getrennten Zähnen und anschliessend mit 8-11 verrundeten, z.T. undeutlichen Rudimenten bis proximal von *sb* (meist zwei).

Laufbein I: Basifemur 4,2-4,8x länger als breit und 1,86-1,98x länger als Telofemur, dieses 2,5-2,9x länger als breit, Tibia 3,5-3,9x, Tarsus 7,8-9,0x; Bein IV: Femur 2,2-2,5x, Tibia 3,8-4,1x, Basitarsus 2,6-3,0x, TS der Tastborste 0,32-0,39, Telotarsus 8,2-9,8x länger als breit und 1,70-1,94x länger als Basitarsus.

Diskussion: Die neue Art ist nahe verwandt mit *machadoi canariensis* Beier (Form der Palpenhand, Bezahnung der Palpenfinger, Vorhandensein eines isolierten Zahns auf dem beweglichen Chelicerenfinger), unterscheidet sich jedoch von ihr durch das konstante Auftreten von 4 Carapax-Hinterrandborsten, durch das Fehlen eines Epistoms (bei *canariensis* ist der Carapax-Vorderrand medial verrundet vorgezogen) und etwas plumpere Palpenschere.

Chthonius (Ephippiochthonius) dubius n.sp. (Fig. 13-16, Tabelle 1)

Untersuchtes Material: Tenerife, Cueva de San Marcos, 10.IX.1992, lg. P. Strinati: 1♀ (Holotypus) (MHNG).

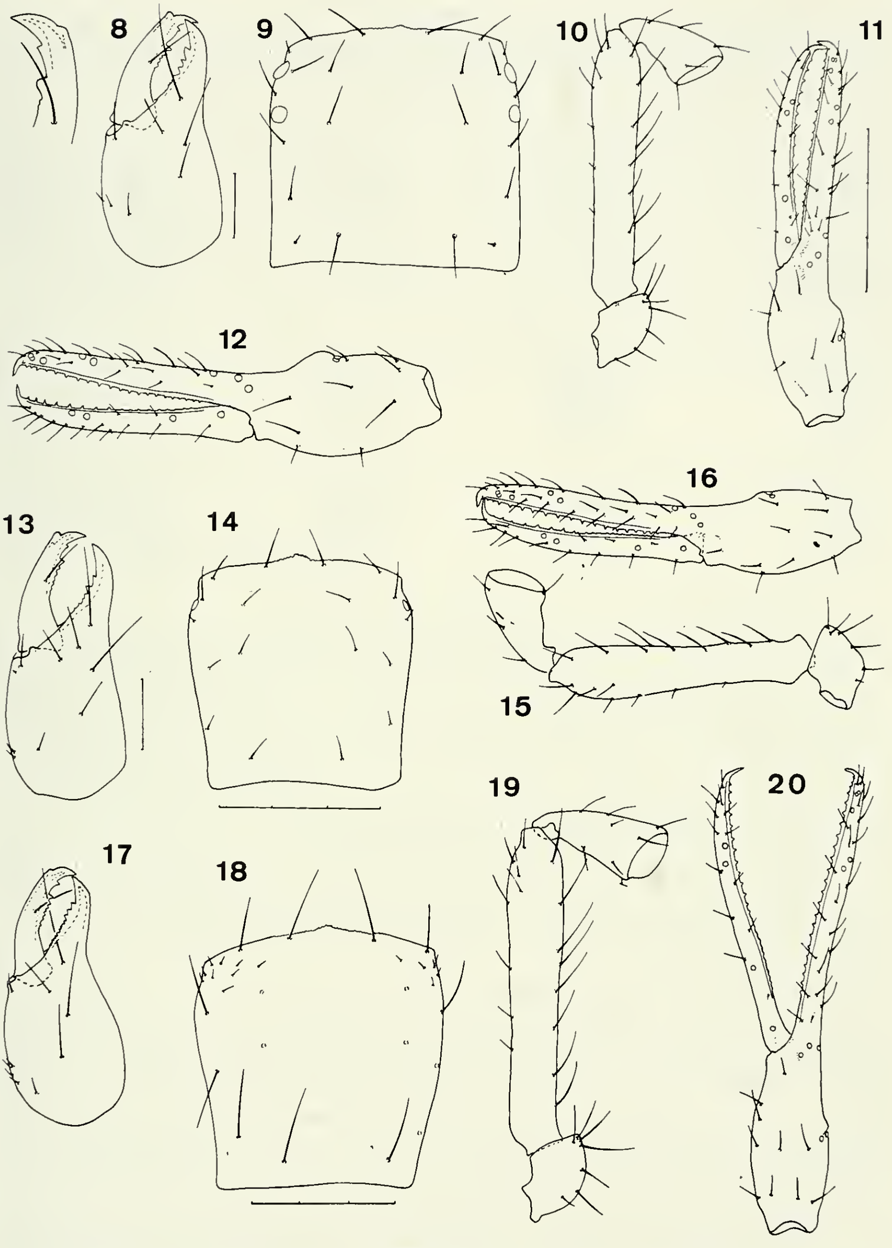

FIG.8-20

Fig. 8-12 *Chthonius (E.) rimicola* n.sp.: 8: Chelicere des Weibchens, Distalende des beweglichen Chelicerenfingers des Männchens, 9: Carapax (Weibchen), 10-11: Pedipalpe (Männchen), 12: Palpenschere (Weibchen); Fig.13-16 *Chthonius (E.) dubius* n.sp., 13: Chelicere, 14: Carapax, 15-16: Pedipalpe; Fig.17-20 *Chthonius (E.) setosus* n.sp., 17: Chelicere, 18: Carapax; 19-20: Pedipalpe; Masstabeinheit 0,1mm.

TABELLE 1

Körpermasse in mm der Arten *Chthonius (E.) setosus* n.sp., *dubius* n.sp. und *rimicola* n.sp.

	setosus n.sp.	*dubius* n.sp.	*rimicola* n.sp.
Carapax	0,55/0,51	0,42/0,42	0,36-0,45/0,36-0,46
Palpen:Femur	0,77/0,13	0,49/0,10	0,47-0,56/0,08-0,11
Tibia	0,31/0,14	0,21/0,11	0,18-0,23/0,14-0,10
Hand	0,41/0,18	0,29/0,15	0,28-0,34/0,13-0,19
Finger-L.	0,69	0,42	0,40-0,46
Scheren-L.	1,08	0,69	0,65-0,77
Bein I			
Basifemur	0,41/0,07	0,27/0,06	0,26-0,31/0,06-0,07
Telofemur	0,20/0,06	0,13/0,05	0,14-0,16/0,05-0,07
Tibia	0,22/0,05	0,15/0,04	0,15-0,18/0,04-0,05
Tarsus	0,45/0,04	0,27/0,04	0,29-0,34/0,03-0,04
Bein IV:Femur	0,59/0,23	0,40/0,18	0,42-0,50/0,18-0,22
Tibia	0,40/0,09	0,27/0,07	0,28-0,34/0,07-0,09
Basitarsus	0,22/0,07	0,15/0,06	0,15-0,19/0,06-0,07
Telotarsus	0,43/0,04	0,24/0,03	0,28-0,33/0,03-0,04

Beschreibung: Schwach sklerotisiert; Carapax so lang wie breit, mit deutlichem, verrundeten und gezähnten Epistom, Vorderaugen klein und undeutlich, mehr als um ihren Durchmesser vom Vorderrand entfernt, Hinteraugen kleine undeutliche Flecken; Beborstung: 4 (Mikrochäten fehlen)/6/4 /2 /2: 18, Borsten z.T. verkürzt (Länge der medialen Vorderrandborsten 0,07mm, die der Hinterrandborsten 0,056mm). Tergit- und Sternitchätotaxie: wie *rimicola* n.sp.; Coxalchätotaxie wie *rimicola* n.sp.,II 13-14 Coxaldornen, III 6-7 Coxaldornen.

Chelicere: links mit 7, rechts mit 6 Grossborsten, 1-2 akzessorische Börstchen, fester Finger mit 8 Zähnen, beweglicher Finger mit 7 und einem isolierten subdistalen Zahn, Spinnhöcker tuberkelförmig; Serrula externa ca. 14 Lamellen, Flagellum typisch.

Pedipalpen: Trochanter 1,7x länger als breit, Femur 5,1x länger als breit (Beborstung: 3-6-3-5) und 2,30x länger als Tibia, diese 2,0x, Hand 1,9x, Finger 1,45x länger als Hand, Schere 5,1x ; Dorsalkontur der Hand mit kleinem Höcker distal von *ib*/*isb*, die Stufe knapp distal dieser Tasthaare; fester Finger mit 17 spitzen, getrennt stehenden Zähnen, beweglicher Finger mit 9 spitzen Zähnen und 12 flachen, verrundeten Rudimenten (bis proximal von *sb* reichend, die Zahnlamelle leicht erhöht); Trichobothrium *ist* deutlich distal von *esb*.

Laufbein I: Basifemur 4,8x länger als breit und 2,09x länger als Telofemur, dieses 2,6x, Tibia 3,5x, Tarsus 7,6x länger als breit und 1,75x länger als Tibia; Bein IV: Femur 2,2x, Tibia 3,8x, Basitarsus 2,7x, TS der Tastborste 0,40, Telotarsus 7,4x länger als breit und 1,63x länger als Basitarsus, TS der Tastborste 0,29.

Diskussion: Durch den Besitz eines deutlichen (wenn auch etwas flacheren) Höckers in der Dorsalkontur der Palpenhand, den Besitz eines isolierten subdistalen Zahns und anhand der Bezahnung des beweglichen Palpenfingers der *machadoi*-Gruppe angehörend; sie nimmt jedoch eine Zwischenstellung zwischen *machadoi canariensis* Beier und *rimicola* n.sp. ein. Mit *machadoi* teilt sie die Carapax-Beborstung (2 Borsten am Hinterrand), die etwas schlankere Palpenhand (wegen etwas längerer Palpenfinger), die kleinen Vorderaugen und das etwas deutlichere Epistom, mit *rimicola* hat sie folgende Merkmale gemeinsam: Trichobothrium *ist* deutlich distal von *esb*, Bezahnung des beweglichen Palpenfingers (zahlreichere verrundete Rudimente bis proximal von *sb*). Von beiden Arten unterscheidet sie sich durch etwas plumpere Tarsenglieder, die verkürzten Carapaxborsten (besonders in Okular- und Subbasalreihe) und die Femurbeborstung (3 distale Dorsalborsten). Von *setosus* n.sp. unterscheidet sie sich durch den Besitz von (undeutlichen) Augen, die Carapax-Beborstung und zahlreiche morphometrische Merkmale.

Chthonius (Ephippiochthonius) setosus n.sp. (Fig. 17-20, Tabelle 1)

Untersuchtes Material: Tenerife, Pedro Alvarez, MSS-Anaga-1 (T-C13-7), 3.VII.1988, lg. A.L.Medina: 1 ♀ (Holotype: MHNG).

Beschreibung: Schwach sklerotisierte, hell gelblichbraun gefärbte Art. Carapax breitschuppig skulpturiert, die Spitzen der Schuppen zähnchenartig, medial retikuliert; etwas länger als breit, kaudal verengt; augenlos; Vorderrand mit breitem, deutlichen, gezähnten Epistom, Chätotaxie: 4/4+15(!) Mikrochäten/4/2/2:16. Tergit- und Sternitbeborstung: wie *rimicola* n.sp.; Coxalchätotaxie: wie *rimicola* n.sp., II 6 Coxaldornen, III 4 Coxaldornen.

Chelicerenstamm deutlich schuppig, mit 6 Borsten und 4 akzessorischen Börstchen, fester Finger mit 11, beweglicher Finger mit 9 distal grösseren Zähnen, isolierter subdistaler Zahn vorhanden; Spinnhöcker klein, höckerförmig, Serrula externa 15 Lamellen, Flagellum typisch.

Pedipalpen: Femur 5,9x länger als breit und 2,44x länger als Tibia, diese 2,2x, Hand 2,3x länger als hoch, Finger 1,69x länger als Hand, Schere 6,0x länger als hoch; dorsale Kontur der Hand mit kleiner Stufe, die durch einen kleinen, aber deutlichen Höcker distal von *ib*/*isb* verstärkt wird; fester Finger mit 22 spitzen, getrennten Zähnen und 1 distalen Lateralzahn, beweglicher Finger mit 13 spitzen Zähnen und anschliessend mit 12 flachen, engstehenden Rudimenten (bis proximal von *sb*, bis zum Sensillum); Trichobothrium ist undeutlich proximal von *esb*.

Laufbein I: Basifemur 5,5x länger als breit und 2,01x länger als Telofemur, dieses 3,2x, Tibia 4,4x, Tarsus 10,1x länger als breit und 2,02x länger als Tibia; Bein IV: Femur 2,6x, Tibia 4,6x, Basitarsus 3,3x, TS der Tastborste = 0,37, Telotarsus 11,2x länger als breit und 1,94x länger als Basitarsus, TS der Tastborste 0,31.

Diskussion: Der kleine, deutliche Höcker distal der Trichobothrien *ib*/*isb*, das Vorhandensein eines Epistoms am Carapax-Vorderrande und eines isolierten subdistalen Zahns auf dem beweglichen Cheliceren-Finger sowie die Chätotaxie des Carapax und die Bezahnung der Palpenfinger kennzeichnen diese neue Art als Mitglied der *machadoi*-Gruppe. Die schlanken Palpen- und Beinproportionen und -masse, die vollständige Reduktion der Augen und besonders die zahlreichen zusätzlichen Mikrochäten in der okularen Borstenreihe des Carapax charakterisieren *setosus* n.sp. eindeutig.

Anpassungwege an das subterrane Milieu: Wahrscheinlich stellen *rimicola* n.sp., *dubius* n.sp. und *setosus* n.sp. von der *machadoi-Gruppe* abstammende, in das subterrane Milieu eingewanderte Arten dar, deren Anpassung jedoch zwei verschiedene Wege folgte.

a) *C. setosus* n.sp., die wohl höchst spezialisierte Art, behielt die für *machadoi* typische Trichobothrienstellung (*ist* auf gleicher Höhe wie *esb*, die Linie *eb-esb-ist* daher deutlich geknickt), die bei *machadoi canariensis* schon bestehende Tendenz zu erhöhter Borstenzahl (besonders Mikroborsten) auf Carapax und Chelicerenstamm wird noch verstärkt: auf dem Carapax 4-8 Mikrochäten (vorwiegend subokular inserierend) bei *canariensis*, 15 (lateral konzentrierte) Mikroborsten bei *setosus* n.sp., 3-5 akzessorische Börstchen auf dem Chelicerenstamm bei beiden Arten. Die Dorsalkontur zeigt bei beiden Arten einen kleinen deutlichen Tuberkel distal von *ib*/*isb*, bei *setosus* n.sp. wird dieser, durch die Streckung der Hand und die Verringerung der Dorsalstufe, noch deutlicher.

b) Beim Artenpaar *dubius* n.sp. und *rimicola* n.sp. steht das Tasthaar *ist* deutlich distal von *esb*, die Verbindungslinie zwischen *eb-esb-ist* ist daher gerade; die Stufe der Dorsalkontur ist deutlicher und beginnt etwas weiter distal von *ib*/*isb*, der Höcker erscheint breiter. Die Zahl der Mikrochäten auf dem Carapax und dem Chelicerenstamm wird nicht erhöht, im Gegenteil, sie unterliegt anscheinend einer Reduktion.

Allerdings lässt das Auftreten von 4 Borsten am Hinterrand des Carapax auch vermuten, dass *rimicola* n.sp. vielleicht doch aus einer anderen Artengruppe stammen könnte, was auch durch das Fehlen eines deutlich ausgebildeten Epistoms am Carapax-Vorderrand angedeutet wird (allerdings ist dieses Merkmal auch bei einigen *m.canariensis*-Exemplaren teilweise schwach ausgebildet).

Microcreagrina gomerae n.sp. (Fig. 21-25, Tabelle 2,3)

Untersuchtes Material: Gomera, El Cedro, MSS, 6.IX.1987 (G-C4-37), lg. A.L. Medina: 1♂ (Holotypus) (DZUL).

Beschreibung: Normal sklerotisiert; Carapax 1,25x länger als breit (0,54mm/0,43mm), mit basaler, leicht geschwungener Querfurche, kleines dreieckiges Epistom vorhanden, augenlos, mit zahlreichen Fensterflecken; 26 Borsten (4/6/6/4/6); Tergitbeborstung: I 8, II 11, III-IX 10 (laterale Borste submarginal), X 8, XI 7 (2 laterale und submediale Tastborsten); Lobus der Pedipalpencoxa 2 Borsten, Pedipalpencoxa 8-9, Coxa I/II 5-6, III 4, IV 5; Genitaloperkel mit 9 Borsten (3 mediale Randborsten), Genitalkammer beiderseits mit je 3 Borsten, Sternit III 10+je 2, IV12+ je 2 Suprastigmalborsten, folgende 14/15/14/13/11/11 (Lateralborsten z.T. submarginal), XI 4 (2 Tastborsten); Analkonus dorsal und ventral je 1 Borstenpaar.

Chelicere mit 6 Stammborsten, fester Finger fein gezähnelt (ca. 17 kleine Zähne), beweglicher Finger 8 spitze aufrechte Zähne, Galea lang, glatt, leicht gebogen, Serrula exterior ca. 22, S. interior 18 Lamellen, Flagellum 4, einseitig kurz gesägt).

Pedipalpen: Trochanter mit 2 kleinen Höckern, Femur medial schütter flach granuliert, Tibia glatt, Hand medial deutlich granuliert, lateral chagriniert. Trichobothrium *t* etwas verkürzt, sonst nicht modifiziert, unterhalb von *isb* 5 Kolbenhaare, ein porenartiges Sensillum distal von *sb*.

Laufbeine: Subterminalborste apikal breit gegabelt und gezähnt, Klauen glatt und etwas länger als die ungeteilten Arolien.

Diskussion: *Microcreagrina gomerae* n.sp. steht in Palpendimensionen und -proportionen *hispanica* (Ell.) am nächsten, ist aber von dieser durch schlankere Palpen (Femur 3,5x bzw. höchstens 3,28x, Tibia 2,35x bzw. max. 2,26x, längeren Tibiastiel: Keule 1,66x bzw. mind.2,05x länger als Stiel) und schlankere Laufbeine abgrenzbar. Die Beinproportionen bei *hispanica* (Exemplare aus dem Libanon und Mallorca) sind die folgenden:

Bein I: Basifemur 1,88-1,91x, Telofemur 1,58-1,77x, Tibia 3,17-3,65x, Basitarsus 1,71-2,20x, Telotarsus 3,92-4,92x. Bein IV: Femur 2,53-2,69x, Tibia 3,72-4,08x, Basitarsus 1,72-1,88x, Telotarsus 3,66-4,21x. Die zwei nachstehend neu beschriebenen Arten von den Kanarischen Inseln sind von *gomerae* n.sp. anhand bedeutenderer Dimensionen, schlankerer Palpen und grösserer Zahnzahl auf den Palpenfingern zu unterscheiden.

Von MEDINA & OROMI (1990) wurde diese Art als *Microcreagrina* cf. *hispanica* erwähnt.

Microcreagrina subterranea n.sp. (Fig. 26-30, Tabelle 2,3)

Untersuchtes Material: Tenerife, 3km S Icod, Cueva Felipe Reventon, 24.2.1988, lg. Trautner, Geigenmüller, Löderbusch & Bense: 1♀ (Holotypus; SMNS 3240), 2♂ 4♀ 1 Tritonymphe (SMNS 3240, MHNG); gleicher Fundort, 2.I.21984, lg. I.Izquierdo (FP-95): 1♂; Tenerife, Mte.Silos, Pista Bco. Picon, in Falle in 20cm Bodentiefe, 16.I.1986, lg. A.Aguiar: 2♂ 4♀ + 1 Fragment; Gomera, Epina, MSS-8, 26.XII.1988, lg. A. Medina: 1♂ (Paratypen) (DZUL, MHNG)

Beschreibung: Normal sklerotisierte Tiere; Carapax 1,2-1,4x länger als breit (0,58-0,74mm/0,46-0,56mm); Chätotaxie: 4/8-10 (je 1-2 subokulare Borsten)/6/4/7-8; 2 undeutliche Augen, Epistom deutlich, klein-dreieckig; Chätotaxie der Sternite, der Palpencoxen und der Sternite (mit geringfügigsten Abweichungen) wie bei *cavicola* n.sp..

Cheliceren: wie *cavicola* n.sp., Serrula exterior 23-25 Lamellen.

Pedipalpen und Beine I,IV : Proportionen und Masse: siehe Tabelle 2,3; sonst vergleichbar *cavicola* n.sp.

Diskussion: Diese neue Art nimmt eine Zwischenstellung zwischen *gomerae* n.sp. und *cavicola* n.sp. ein, scheint aber näher *cavicola* zu stehen. Mit dieser teilt sie die schlanken Palpen, ist jedoch grösser, besitzt schlankere Laufbeine und weist eine höhere Zahnzahl auf den Palpenfingern auf.

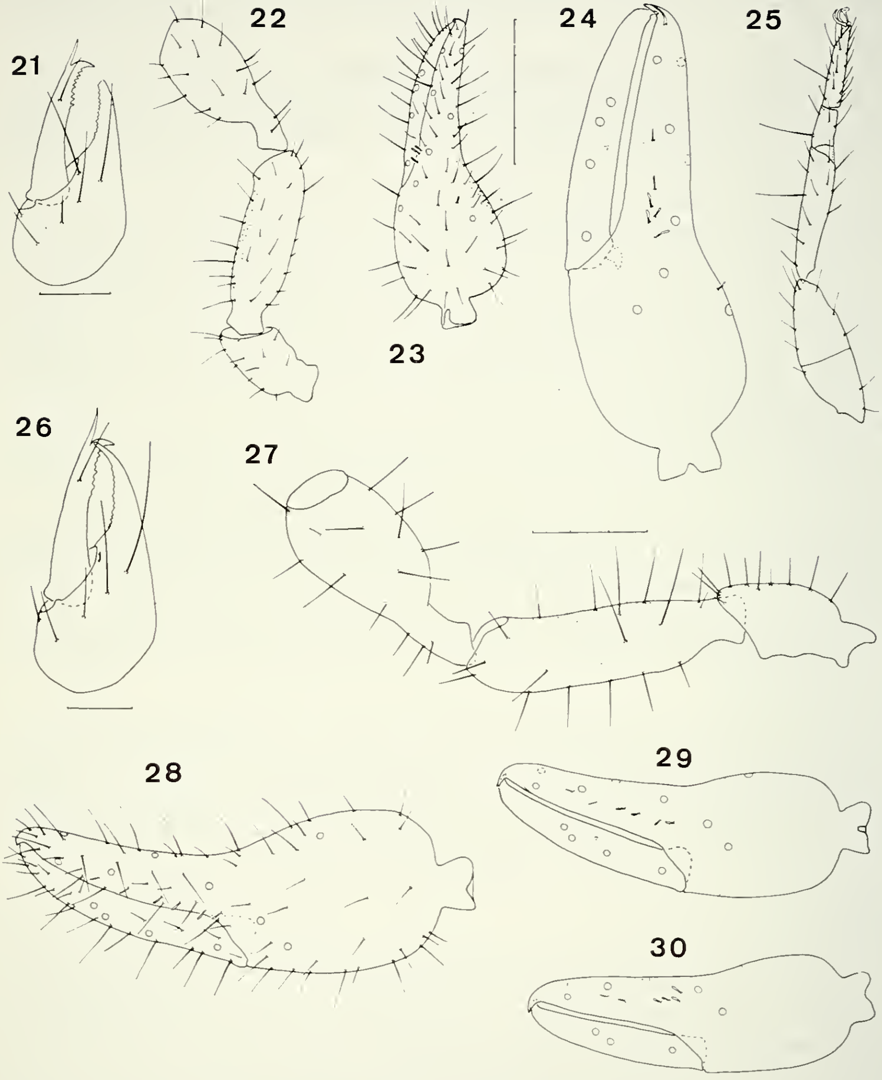

FIG. 21-30

Fig. 21-25 *Microcreagrina gomerae* n.sp., 21: Chelicere, 22: Pedipalpenfemur und -tibia (links), 23: Palpenschere (rechts), 24: Trichobothrienstellung, 25: Laufbein IV; Fig. 26-30 *Microcreagrina subterranea* n.sp., 26: Chelicere, 27-30: Pedipalpe und Trichobothrienstellung; Masstabeinheit 0,1mm.

Tabelle 2

Körperproportionen von *Microcreagrina hispanica* (Ell.), *gomerae* n.sp., *subterranea* n.sp. und *cavicola* n.sp.

	hispanica (Ell.)	*gomerae* n.sp.	*subterranea* n.sp.	*cavicola* n.sp.
Palpen:Femur	2,60-3,28x	3,49x	3,72-3,86x	3,70-3,94x
Tibia	1,85-2,26x	2,35x	2,32-2,58x	2,37-2,59x
Ti-Keule/Stiel	2,05-2,39x	1,66x	1,91-2,25x	1,79-2,05x
Hand+Stiel	1,29-1,56x	1,41x	1,38-1,65x	1,31-1,46x
Hand/Finger	1,12-1,14x	1,15x	1,04-1,21x	1,11-1,13x
Schere+Stiel	2,59-2,86x	2,88x	2,88-3,31x	2,75-3,04x
Zähne f./b.F.	39-51/39-54	50/46	52-57/51-61	68/65-70
Bein I:				
Basifemur	1,88-1,91x	2,34x	2,45-2,71x	2,71-2,90x
Telofemur	1,58-1,77x	2,34x	2,25-2,71x	2,75-2,99x
Tibia	3,17-3,65x	4,94x	4,74-5,80x	6,12-6,29x
Basitarsus	1,71-2,20x	2,21x	2,10-2,73x	2,64-2,90x
Telotarsus	3,92-4,92x	5,09x	5,02-6,28x	6,61-7,52x
Telo-/Basit.	1,87-2,05	2,04	1,82-2,09	1,89-2,14
Bein IV.Femur	2,53-2,69x	2,81x	2,83-3,25x	3,40-3,47x
Tibia	3,72-4,08x	4,85x	5,07-5,84x	6,87-7,19x
Basitarsus	1,72-1,88x	1,78x	1,88-2,15x	2,21-2,39x
Telotarsus	3,66-4,21x	4,58x	4,80-5,82x	5,87-6,29x
Telo-/Basit.	1,82-1,86	2,06	1,84-2,08	1,88-1,95x
TS tib.TB	0,63-0,66	?	0,56-0,66	0,63-0,68

Tabelle 3

Körpermasse in mm von *Microcreagrina gomerae* n.sp., *subterranea* n.sp. und *cavicola* n.sp. von den Kanarischen Inseln.

	gomerae n.sp.	*subterranea* n.sp.	*cavicola* n.sp.
Palpen:Femur	0,51/0,15	0,56-0,72/0,15-0,19	0,72-0,85/0,19-0,23
Tibia	0,46/0,20	0,50-0,64/0,20-0,27	0,65-0,76/0,28-0,30
Stiel-Länge	0,14	0,15-0,21	0,21-0,26
Hand+Stiel	0,41/0,30	0,47-0,60/0,30-0,41	0,59-0,70/0,44-0,48
Finger-L.	0,48	0,52-0,65	0,71-0,79
Scheren-L.	0,85	0,94-1,18	1,24-1,42
Bein I:			
Basifemur	0,24/0,10	0,27-0,34/0,10-0,14	0,35-0,40/0,13-0,14
Telofemur	0,20/0,08	0,22-0,27/0,09-0,11	0,31-0,33/0,11-0,12
Tibia	0,26/0,05	0,30-0,39/0,05-0,07	0,42-0,47/0,07-0,08
Basitarsus	0,10/0,05	0,11-0,14/0,04-0,06	0,16-0,18/0,06
Telotarsus	0,21/0,04	0,21-0,27/0,04-0,05	0,31-0,34/0,04-0,05
Bein IV:Femur	0,44/0,16	0,47-0,59/0,15-0,19	0,65-0,71/0,19-0,21
Tibia	0,38/0,08	0,43-0,55/0,08-0,10	0,62-0,71/0,09-0,10
Basitarsus	0,12/0,06	0,12-0,16/0,06-0,08	0,17-0,19/0,07-0,09
Telotarsus	0,24/0,05	0,26-0,32/0,05-0,06	0,34-0,37/0,06

Microcreagrina cavicola n.sp. (Fig. 31-33, Tabelle 2,3)

Untersuchtes Material: Insel La Palma, Tacande de Arriba, Cueva Tacande (P-TA-4), 9.VII.1986, lg. I. Izquierdo: 1♂ (Holotypus, DZUL), 1♀ (Paratypus); Teneguia, Cueva El Raton (P-RA-4), 12.VII.1986, lg. J.L. Martin: 1♀ (Paratypus) (2♀ MHNG).

Beschreibung: schwach sklerotisiert, Carapax und Pedipalpen gelblich braun, Tergite gelblich; Beborstung: 4/10 (je 2 subokulare Börstchen)/6/4/8; Tergit I 7-9, II-IX meist 11 (10-14; Lateralborsten submarginal), X 8-10 (4 Tastborsten), XI 7-9 (4 Tastborsten); Genitaloperkel des Männchens 12 Borsten (6 Rand- und 6 Diskalborsten), der des Weibchens 6-7 mediale Diskalborsten, Sternit III 6-8+ je 3, IV 12-13+je 3 Suprastigmalborsten, V-IX meist (12-)14-15 Borsten (Lateralborsten submarginal), X 10-11 (4 Tastborsten), XI 3-4 (2 Tastborsten).

Chelicere: Serrula exterior 26-29 Lamellen.

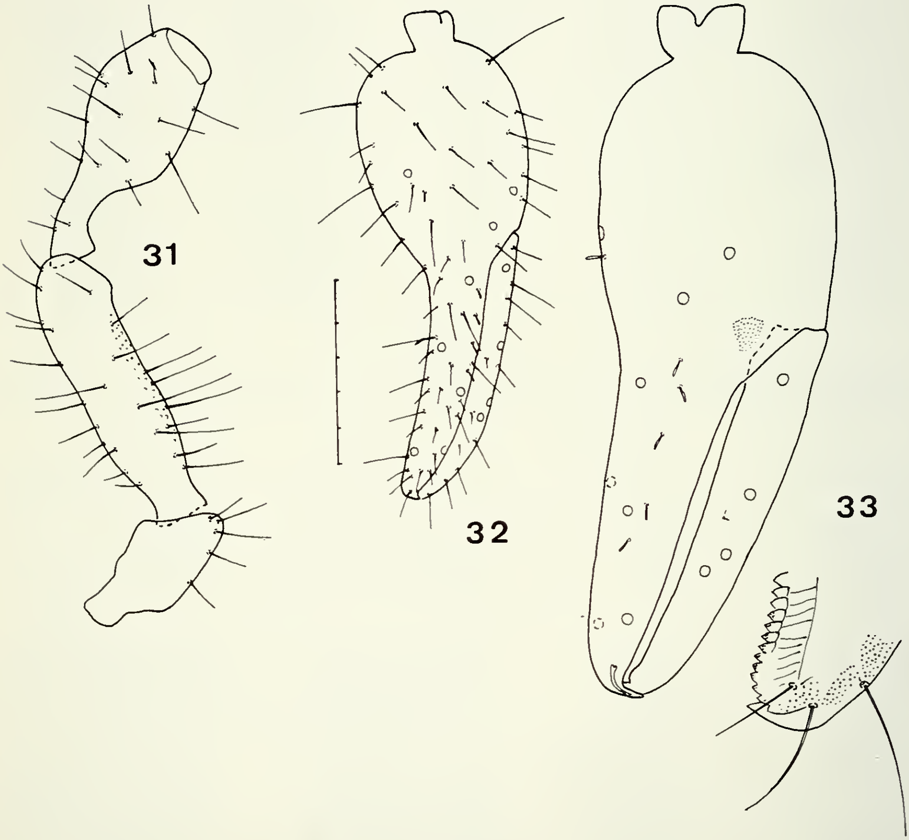

FIG. 31-33

Microcreagrina cavicola n.sp., 31-32: Pedipalpe (Holotypus), 33: Trichobothrienstellung (Weibchen, Paratypus) mit vergrösserter Distalbezahnung des beweglichen Palpenfingers; Masstabeinheit 0,1mm.

Pedipalpen: Trochanter mit flachem Höcker, Femur medial fein und schütter granuliert, leicht keulenförmig, basal kaum geschultert, Tibia glatt, Hand distal fein und flach granuliert.

In den übrigen Merkmalen mit *gomerae* n.sp. übereinstimmend.

Rhacochelifer gracilimanus n.sp. (Fig. 34-39)

Fundort: Tenerife, Bosque de La Esperanza, oberhalb La Esperanza, 1040m, unter Borke von *Pinus canariensis*, 9.V.1993, lg.B. Hauser: 1♂ (Holotypus) 2 Tritonymphen (Paratypen) (MHNG).

Beschreibung: Palpen, Carapax und Tergite schwärzlich braun; Carapax- und Tergithinterecken ohne jede Verdickung oder dornartige Modifikation; Carapax deutlich breiter als lang ((1,05mm/1,17mm), gegen Hinterrand regelmässig verbreitert, dicht granuliert, Granula regelmässig, beide Querfurchen am Grunde granuliert und deutlich, die subbasale dem Hinterrand näher gelegen als der medialen Furche, Borsten zart, spitz; 2 deutliche, gewölbte Augen; Beborstung: 4 (etwas derber und leicht gezähnt)-10 (glatt, spitz); Halbtergite I-III 5-6 Hinterrandborsten, IV-X meist 4 Hinterrand-, je 1 laterale und mediale Randborste und 1 mediale Diskalborste, alle Borsten in hellen, kontrastrierten Areolen inseriert, Tergite deutlich, aber schmal geteilt (XI unvollständig) und klein pflastersteinartig skulpturiert (auch XI), dieses mit 13 Borsten (2 mediale Diskal- und 2 sublaterale Tastborsten). Lobus der Pedipalpencoxen mit 3 Randborsten (mediale kurz) und 2 Diskalborsten, granuliert, Pedipalpencoxa ca.11 Borsten, Coxa I/II 8, III 17, IV ca.54, ohne Hintereck-Dorn und mit Atrium und langen Coxalsäcken (ca. 3/4 der Coxallänge einnehmend); Genitaloperkel mit ca.36 langen, gezähnten und gebogenen Borsten, Halbsternit III 6/7 Borsten, Suprastigmalborsten fehlen, IV 4+1 Suprastigmalborste, V-X 5-6 Hinterrandborsten, ab IX eine laterale Randborste, X mit 1 submedialen Tastborste, Sternit XI 14 (2 submediale Tastborsten, Lateralborsten verlängert).

Chelicere mit 5 Stammborsten (2 basale apikal mit einem Zähnchen), fester Finger mit 3 geneigten Zähnen und 2 apikalen Granula, beweglicher Finger mit kleinem zahnförmigen Subapikallobus und 3 Marginalzähnchen, Galea relativ kurz und dick, mit 5 apikalen Krallenästchen, Serrula externa 20 Lamellen, Flagellum 3 Borsten (distale gezähnt: 2 abgebrochen).

Pedipalpen: Trochanter mit deutlichem Dorsalhöcker, wie Femur und Tibia dicht granuliert, Femur aus Stielchen schräg verdickt, dann gleich dick verbleibend, 3,6x länger als breit (1,17mm/0,33mm), Tibia 2,8x (1,05/0,38), Keule 3,06x länger als Stiel, Hand dicht und fein granuliert, fast parallelseitig, 2,6x länger als breit (1,18/0,45) und 1,50x länger als die deutlich gekurvten Finger (Länge 0,79mm), Schere mit Stiel 4,1x, ohne Stiel 3,9x (Länge 1,86mm/1,75mm); fester Finger mit 43, beweglicher Finger mit 46 Zähnen (einige basale ohne Spitze); Trichobothrien: mit Ausnahme von *et* alle Trichobothrien des festen Fingers basal gelegen, *st* des beweglichen Fingers näher *sb* als *t*; fester Finger mit einer Serie von kleinen Sinnesborsten, beweglicher Finger mit 2 Sinnesborsten distal von *t*; nodus ramosus etwas distal von *t* bzw. in gleicher Höhe im festen Finger.

Laufbein I: alle Beinglieder granuliert, Borsten glatt, dorsal kürzer als ventral; Basifemur 2,1x länger als breit (0,41/0,19), Telofemur 3,1x länger als breit (0,56/0,18) und 1,36x länger als Basifemur, Tibia 3,0x (0,47/0,16), Tarsus 3,2x (0,40/0,12), Dorsalkontur undeutlich konkav, Ventralkontur konvex, Vordereck stumpfwinklig, Klauen schlank, leicht asymmetrisch, Aussenklaue apikal hakenförmig gebogen; Bein IV: granuliert, Femur 3,3x (1,03/0,31), Tibia 4,2x (0,74/0,17), Tarsus 3,9x (0,46/0,12), ohne Tastborste; Subterminalborste gezähnt, Klauen glatt, länger als die ungeteilten Arolien.

Diskussion: Nur wenige Arten der Gattung *Rhacochelifer* weisen schlanke Pedipalpen (Femur wenigsten 3,5x länger als breit) auf; innerhalb dieser (vorwiegend im westlichen Mediterrangebiet und in Nordafrika) verbreiteten Gruppe nimmt *gracilimanus* n.sp. eine Sonderstellung ein: seine Körpergrösse (Femur-L. 1,17mm), das Fehlen gröberer Granula auf dem Palpenfemur und seine schlanke Palpenhand und -schere charakterisieren die Art sofort (die grösste bislang bekannte *Rhacochelifer*-Art weist eine Femurlänge von 0,93mm im männlichen Geschlecht auf). *Rhacochelifer chopardi* Vachon, *tenuimanus* Heurtault und *corcyrensis procerus* Mahnert weisen darüber hinaus keine Diskalborsten auf den Halbtergiten auf, *R. andreinii* Beier ist ebenfalls kleiner (Femur-L. 0,93mm) und besitzt gröbere Granula auf dem Femur, die Palpenschere ist deutlich plumper (3,0x länger als breit), *R. tibestiensis* Heurtault weist zwar einen ähnlichen Vordertarsus (Männchen) auf, ist jedoch auch kleiner, mit plumperer Palpenschere (3,3x).

Das Fehlen von modifizierten Carapax- und Tergithinterecken schliesst eine Zugehörigkeit zur Gattung *Pseudorhacochelifer* aus, ebenso spricht das Fehlen einer Tastborste auf Tarsus IV gegen die Zuordnung zur Gattung *Lophochernes* (zu der anscheinend *mayeti* Simon aus Tunesien zu stellen ist).

Die vegetationsgebundene (corticole) Pseudoskorpion-Fauna der Kanarischen Inseln (Chernetidae, Cheliferidae, Withiidae) ist anscheinend noch ungenügend bekannt; *Rhacochelifer* cf. *spiniger* (MAHNERT 1980) ist sicherlich nicht zu dieser neuen Art zu stellen und gehört wahrscheinlich einer noch unbeschriebenen Art an, die Einzelfunde von *Canarichelifer teneriffae* Beier, *Pseudorhacochelifer schurmanni* Beier, *Rhacochelifer spiniger* Mahnert und *Rh. pinicola* (Nonidez) (BEIER 1965, 1975; MAHNERT 1978, 1980) unterstreichen die Lücken, die in unserer Kenntnis dieser besonderen Fauna noch bestehen.

C. Madeira

Microcreagrina madeirensis n.sp. (Fig. 40-42)

Untersuchtes Material: Ponta de S. Lourenço, "grassland south of Pedra Branchas, under stones", 20.XI.1980, lg. H.Enghoff & O.Martin: 1 ♀ (Holotypus; MHNG).

Beschreibung: Stark sklerotisierte Art; Carapax 1,2x länger als breit (0,73mm/0,60mm), wie *M. hispanica* (Ell.); Chaetotaxie des Carapax, der Tergite, der Coxen und der Sternite wie *hispanica* (mit geringfügigsten Abweichungen).

Chelicere wie *hispanica*; Serrula exterior 27 Lamellen (*hispanica* 21-22).

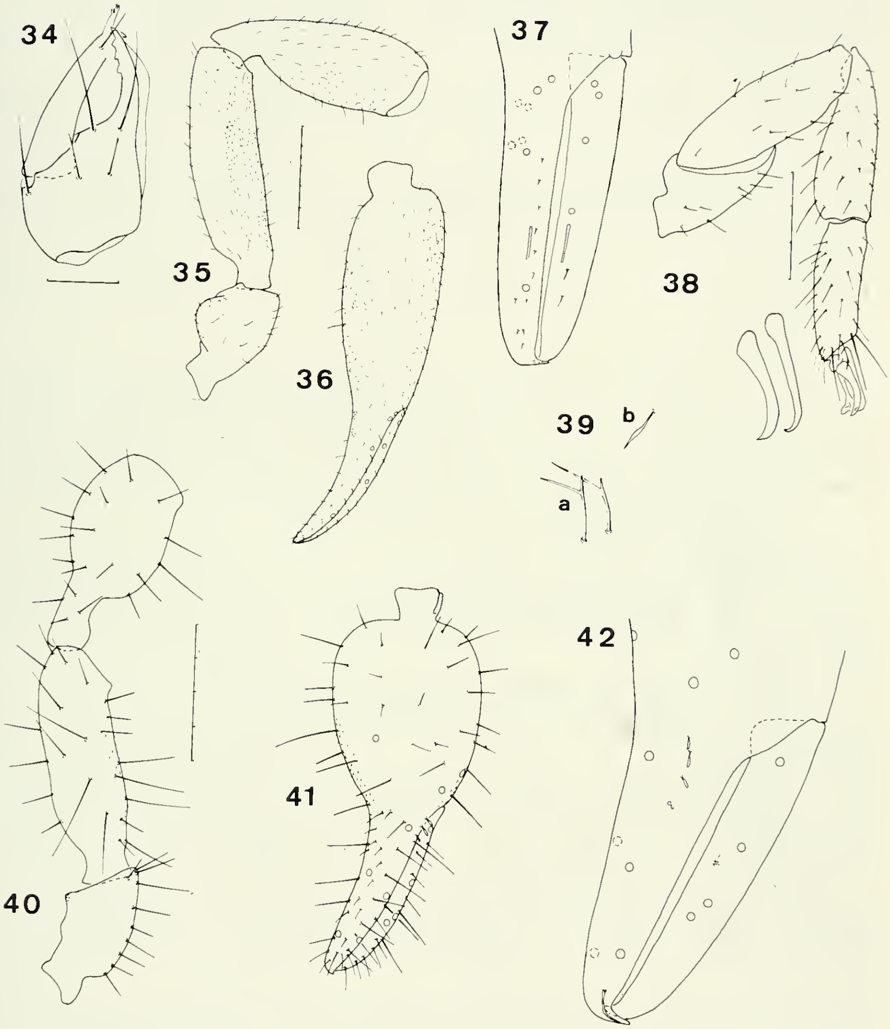

FIG. 34-42

Fig.34-39 *Rhacochelifer gracilimanus* n.sp. (Holotypus), 34: Chelicere, 35-37: Pedipalpe und Trichobothrienstellung, 38: Laufbein I, 39: Borsten des Genitaloperkels (a) und der Genitalkammer (b); Fig. 40-42 *Microcreagrina madeirensis* n.sp., Pedipalpe und Trichobothrienstellung; Masstabeinheit 0,1mm.

Pedipalpen: Trochanter mit flachem Höcker, ventraler Hinterrand leicht höckerförmig und granuliert, flacher Ventralhöcker, 2,1x länger als breit (0,43mm /0,21mm), Femur 3,3x (0,71/0,21), medial fein und schütter granuliert, Tibia 2,2x länger als breit (0,62/0,29), Keule 2,2x, glatt, Hand mit Stiel 1,5x länger als breit und 1,04x länger als Finger, mediodistal fein und dicht granuliert, Schere mit Stiel 2,7x länger als breit (1,17/0,43), Finger-L. 0,61mm; fester Finger mit 51, beweglicher Finger mit 50 Zähnen (die des beweglichen Fingers in den basalen 2/3 verrundet).

Bein I: Basifemur 2,5x länger als breit (0,33/0,13) und 1,29x länger als Telofemur, dieses 2,5x länger als breit (0,26/0,10), Tibia 5,4x (0,37/0,07). Basitarsus 2,4x (0,12/0,05), Telotarsus 5,3x länger als breit (0,26/0,05) und 2,11x länger als Basitarsus; Bein IV: Femur 2,9x (0,61/0,21), Tibia 5,3x (0,55/0,10), TS der Tastborste 0,56, Basitarsus 1,8x (0,15/0,08), TS der Tastborste 0,19, Telotarsus 4,1x (0,29/0,07) länger als breit und 1,91x länger als Basitarsus; Subterminalborste, Klauen und Arolien typisch.

Diskussion: Die Art von Madeira ist direkt verwandt mit *hispanica* (Ell.), mit der sie die plumpen Pedipalpen und den kurzen Palpentibiastiel teilt, sie unterscheidet sich jedoch durch bedeutendere Grösse und schlankere Beinglieder (besonders Tibia der Laufbeine). Dieses Exemplar war von mir ursprünglich als *M. hispanica* bestimmt worden und gemeinsam mit anderen Exemplaren von PIEPER (1991) von diesem Archipel erstmals gemeldet worden.

Evolution innerhalb der Gattung *Microcreagrina*: Bislang war nur eine Art, *hispanica* Ell., innerhalb der Gattung *Microcreagrina* bekannt, die im Mittelmeerraum weit verbreitet schien (MAHNERT 1976). Die Entdeckung verschiedener Taxa aus meist subterranen Lebensräumen auf atlantischen Inseln erlaubt, einige Ueberlegungen über die möglichen Mechanismen der Adaptation.

- *Anpassung an die endogäische Lebensweise: hispanica* Ell. und *madeirensis* werden normalerweise unter Steinen oder im Gesiebe von Bestandesabfall gefunden. Beide Arten zeichnen sich durch plumpe Pedipalpen aus, der Stiel der Pedipalpentibia ist kurz, verglichen zur Keulenlänge, die Zahnzahl der Palpenfinger ist (unabhängig von der Länge) relativ gering. Die Proportionen der Pedipalpen könnte vielleicht vom Vorkommen auf Inseln abhängig sein (die Exemplare des Kanarischen Inseln scheinen etwas grösser zu sein als Festlandtiere), was auch *madeirensis* n.sp. zu beweisen scheint, dagegen sprechen die Palpendimensionen der Exemplare von den Balearischen Inseln, die genau denen der Festlandtiere entsprechen. Im Vergleich zu *hispanica* Ell. von den Kanarischen Inseln zeigt *madeirensis* n.sp. von Madeira folgende abweichende Tendenzen: bei gleichbleibenden Palpenproportionen wächst die Körpergrösse, die Zahnzahl der Palpenfinger bleibt gleich, die Beinglieder werden jedoch bei *madeirensis* schlanker, was besonders die Tibia betrifft. Die Erhöhung der Lamellenzahl der Serrula exterior scheint, unabhängig der Lebensweise, von der Länge des Chelicerenfingers beeinflusst werden.
- *Anpassung an das subterrane Leben:* wie bei endogäischen Arten verbleibt die Chätotaxie der abdominalen Segmente fast unberührt von jeglicher Anpassung, die des Carapax scheint in der Erhöhung der subokularen Borsten eine gewisse Tendez zu zeigen. Die Pedipalpen werden deutlich schlanker (auch bei geringer Körpergrösse:

gomerae n.sp.), wobei sich besonders der Stiel der Palpentibia verlängert; die Zahnzahl der Palpenfinger erhöht sich (vielleicht nicht proportionell mit der Fingerlänge); die Beinglieder werden schlanker, wobei besonders die Tibia betroffen scheint.

Ausgehend von *gomerae* n.sp. (die wohl nächst den endogäischen Verwandten stehend), kann vermutet werden, dass die Anpassung an das subterrane Leben eingeleitet wird durch folgende Phänomene:

- schlankere Palpenproportionen
- schlankere Beinglieder (besonders Tibia)
- grössere Palpendimensionen
- erhöhte Zahnzahl der Palpenfinger (z.T. bedingt durch Fingerlänge?)
- leichte Erhöhung der Borstenzahl (bes. auf Carapax)

BESTIMMUNGSSCHLÜSSEL DER *Microcreagrina*-ARTEN

1 Arten mit plumpen Pedipalpen, Femur höchstens 3,5x länger als breit, 39-51 Zähne auf festem Palpenfinger. 2

1* Arten mit schlankeren Pedipalpen, Femur mindestens 3,7x länger als breit, 52-68 Zähne auf festem Palpenfinger. 4

2 Beine schlank, Tibia des Laufbeins I mind.4,9x , Tibia des Laufbeins IV mind.4,8x länger als breit. 3

2* Beine plumper, Tibia des Laufbeins I max.3,7x, die des Laufbeins IV 4,1x länger als breit. .... *hispanica* (Ell.)

3 Etwas kleinere Art mit etwas schlankeren Pedipalpen, Femur 3,5x (L. 0,51mm), Tibia 2,35x (L. 0,46mm) länger als breit, Tibiakeule 1,7x länger als Stiel. Gomera. .... *gomerae* n.sp.

3* Etwas grössere Art mit etwas plumperen Pedipalpen, Femur 3,3x (L. 0,71mm), Tibia 2,2x (L. 0,62mm) länger als breit, Tibiakeule 2,2x länger als Stiel. Madeira. .... *madeirensis* n.sp.

4 Femur des Laufbeins IV mind. 3,4x länger als breit, mehr als 60 Zähne auf festem Palpenfinger, Palpen etwas länger: Femur mind. 0,72mm, Scheren-L. mind. 1,24mm. La Palma. .... *cavicola* n.sp.

4* Femur des Laufbeins IV max. 3,25x länger als breit, max. 57 Zähne auf festem Palpenfinger, Palpen etwas kürzer: Femur max. 0,72mm, Scheren-L. max. 1,18mm. Tenerife, Gomera. .... *subterranea* n.sp.

Chthonius (C.) ischnocheles (Hermann)

Untersuchtes Material: Machico, Höhle "Furnas do Cavalum", 160m, 21.XI.1992, lg. B.Hauser (MHNG).

Eine weit verbreitete Art, die von Madeira bereits mehrmals gemeldet wurde (PIEPER 1981), aber aus dieser Höhle noch nicht bekannt war.

D. Ascension

Apocheiridium cavicola n.sp. (Fig. 43-47)

Untersuchtes Material: Ascension Is., Ravin Cave, 200m (UTM ES 694 192), Fallenfang, lg. N.P.Ashmole, 25.-30. III. 1990: 1 ♂ (MHNG).

Fundort: "This cave is near the top of the northwest wall of a deep raine down from the Grazing Valley, just east of Spoon Crater. There is a short (ca.25 m) lava tunnel with a dead end at the bottom, where the floor is dusty. Erosion of the cliff has made several small entrances in the SE side of the cave, giving deep threshold (not completely dark) conditions. No bird guano is visible anywhere on this slope" (N.P.Ashmole, in litt.).

Beschreibung: Carapax nur undeutlich länger als breit, glatt, nur seitlich mit wenigen undeutlichen Granula, mit deutlicher, leicht geschwungener medianer Querfurche, Borsten lang und glatt; zwei kleine, hochgewölbte Augen, 4 Borsten am Vorder- und 10 Borsten am Hinterrand (insgesamt ca.56), Metazona ohne zentrale Vertiefung. Tergite I-XI von oben sichtbar, I-X z.T schmal und undeutlich geteilt, fein lederartig gerunzelt; Beborstung der Halbtergite: 6/7-5/7-5/6-6/7-7/8-7/8-8/9-7/8-7/8-6/7 (Halbtergite VII-X mit einer lateral submarginalen Randborste), Tergit XI mit 7 Borsten, alle Borsten lang und glatt. Lobus der Pedipalpencoxen mit 3 Randborsten (interne klein), Pedipalpencoxa 9/10 Borsten, Coxa I 4, II 5, III 6, IV median verschmolzen, 6/7 Borsten; Genitaloperkel mit 6 Randborsten und 1 Diskalborste, Genitalöffnung mit beiderseits 1 Eingangsbörstchen, keine Suprastigmalbörstchen, Halbtergite mit meist 6 bis 7 Hinterrandborsten, VII-X mit je einer submarginalen Lateralborste, Sternit XI mit 8 Borsten, Analkonus 2+2 Borsten.

Chelicerenstamm mit 4 Borsten (die basale mit einem Seitenzahn), fester Finger mit Lamina, 3 geneigte Zähnchen, beweglicher Finger mit grobem zahnförmigen Subapikallobus; Serrula externa 9 Lamellen, Flagellum 3 Borsten (erste breit segelförmig und gezähnt, übrige glatt), Galea kurz und dreispitzig.

Pedipalpen glatt: Femur 6,7x länger als breit, basal undeutlich geschultert, Tibia 4,6x, Hand mit Stiel 2,0x, Finger 1,23x länger als Hand mit Stiel, Schere mit Stiel 4,45x, ohne Stiel 4,2x länger als breit, Schere mit Stiel 7,2x länger als Tibia-Breite; fester Finger mit 37 Zähnen, beweglicher Finger mit 31 Zähnen (die basalen Drittel zahnlos), fester Finger mit 7, beweglicher Finger mit 1 Tasthaar(en). Position des nodus ramosus und Länge des Giftkanals nicht beobachtet. Borsten der Pedipalpen gebogen, mit einem Aussenzähnchen im basalen Drittel.

Laufbein I: Trennaht zwischen Basi- und Telofemur deutlich, Femur 5,9x länger als breit, Tibia 5,9x, Tarsus 6,9x länger als breit; Laufbein IV: Trennaht zwischen Basi- und Telofemur deutlich, Femur 7,4x, Tibia 7,4x, Tarsus 7,8x länger als breit; Klauen einfach, Arolien ungeteilt, so lang wie Klauen.

Körpermasse in mm: Carapax 0,34/0,32; Palpen: Femur 0,38/0,06, Tibia 0,31/0,07, Hand mit Stiel 0,22/0,11, Stiel-L. 0,03, Finger-L. 0,28, Scheren-L. mit Stiel 0,49; Laufbein I: Femur 0,24/0,04, Tibia 0,16/0,03, Tarsus 0,16/0,02; Laufbein IV: Femur 0,28/0,04, Tibia 0,21/0,03, Tarsus 0,20/0,03.

Diskussion: Die verwandtschaftlichen Beziehungen dieser neuen Art sind derzeit nicht klärbar, nach den herkömmlichen taxonomischen Merkmalen unterscheidet sie sich sofort durch die stark reduzierte Granulierung der Pedipalpen, des Carapax und der Tergite sowohl durch die schlanken Palpen- und Beingliedern von allen beschriebenen Arten. Die Anpassung an das Höhlenleben (siehe angeführte

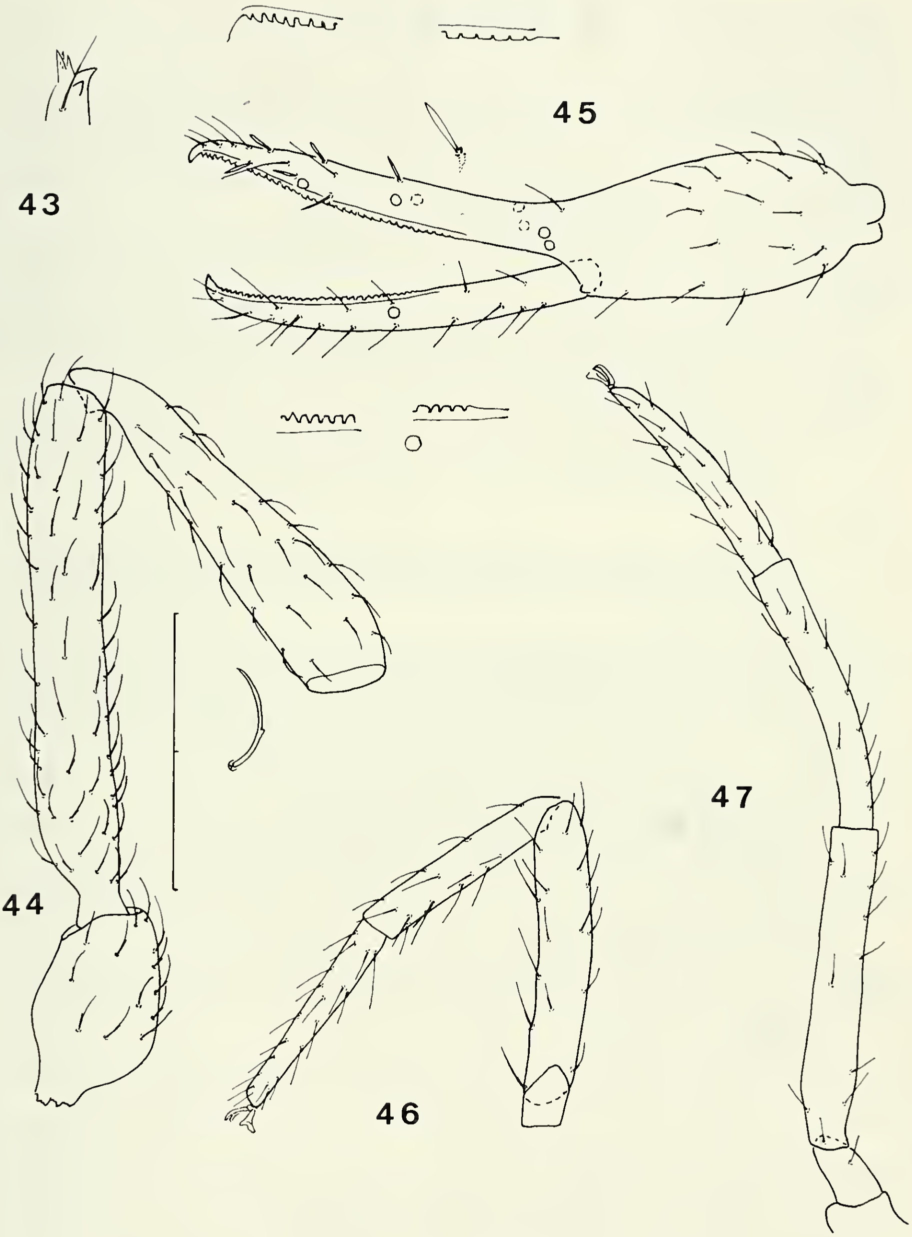

FIG.43-47

Apocheiridium cavicola n.sp., 43: Galea; 44-45: Pedipalpe (Vestituralborste, Bezahnung und Sinnesborste vergrössert), 46: Laufbein I, 47: Laufbein IV; Masstabeinheit 0,1mm.

Merkmale, zusätzlich zur reduzierten Sklerotisierung) wurden bereits von MUCHMORE (1992) für *Apocheiridium reddelli* (Texas, Devil`s Sinkhole, Texas) erwähnt; von dieser Art unterscheidet sich *cavicola* n.sp. aber durch die absoluten und relativen Palpendimensionen und die weniger distal gerückte Stellung des Tasthaars *est.* Erstaunlicherweise zeigt, wie *reddelli* Muchmore (und auch die ebenfalls in Höhlen gefundene Art *Cheirdium reyesi* Muchmore, 1992), *cavicola* n.sp. ebenfalls eine deutliche Gliederung in Basi- und Telofemur der Laufbeine.

Die Grosszahl der Arten dieser Gattung lebt unter Borke verschiedenster Baumarten, mehrere wurden jedoch phoretisch auf Vögeln gefunden (*Apocheiridium rossicum* Redikortzev; *A. pelagicum* Red.: in Fischernetzen gefunden, wahrscheinlich von Vögeln transportiert: REDIKORTZEV 1938; *A. minutissimum* Beier: beschrieben aus Vogelnestern aus Malaya: BEIER 1964). Die Besiedlung der Insel Ascension kann ebenfalls auf diesem Weg erfolgt sein.

Von Ascension war bislang nur eine Pseudoskorpion-Art bekannt geworden, *Withius ascensionis* (BEIER 1960).

LITERATUR

BEIER, M. 1960. Pseudoscorpione von der Insel Ascension. *Ann.Mag.nat.Hist.*, ser.13, 3: 594-598.

BEIER, M. 1964. Some further nidicolous Chelonethi (Pseudoscorpionidea) from Malaya. *Pacific Ins.* 6(2): 312-313.

BEIER, M. 1965. Ueber Pseudoskorpione von den Kanaren. *Annln naturhist. Mus.Wien* 68: 375-381.

BEIER, M. 1975. Die Pseudoskorpione der macaronesischen Inseln. *Vieraea* 5 (1-32): 23-32.

CALLAINI, G. 1984. Osservazioni su alcune specie di *Chthonius* del sottogenere *Ephippiochthonius* Beier (Arachnida, Pseudoscorpionida, Chthoniidae). Notulae chernetologicae XVII. *Annali Mus.civ.Stor.nat "Giacomo Doria"* 85: 125-159.

HEURTAULT, J. 1971. Pseudoscorpions de la région du Tibesti (Sahara méridional). IV. Cheliferidae. *Bull.Mus.natn.Hist.nat.Paris*, 2e série, 42(4):685-707 (1970).

MAHNERT, V. 1976. Zur Kenntnis der Gattungen *Acanthocreagris* und *Roncocreagris* (Arachnida, Pseudoscorpiones, Neobisiidae). *Revue suisse Zool.* 83 (1): 193-214.

MAHNERT, V. 1978. Zwei neue *Rhacochelifer*-Arten aus dem westlichen Mediterrangebiet und Wiederbeschreibung von *Chelifer heterometrus* L. Koch. *C.r.Séances Soc. phys. hist. nat. Genève*, n.s., 12 (1): 14-24.

MAHNERT, V. 1980. Pseudoscorpions from the Canary Islands. *Ent.scand.* 11: 259-264.

MAHNERT, V. 1986. Une nouvelle espèce du genre *Tyrannochthonius* Chamb. des îles Canaries, avec remarques sur les genres *Apolpiolum* Beier et *Calocheirus* Chamberlin (Arachnida, Pseudoscorpiones). *Mém.Soc.r. belge Ent.* 33: 143-153.

MAHNERT, V. 1989. Les pseudoscorpions (Arachnida) des grottes des Iles Canaries, avec description de deux espèces nouvelles du genre *Paraliochthonius* Beier. *Mém. Biospéol.* 16: 41-46.

MEDINA, A.L., P. OROMI 1990. First data on the superficial underground compartment in La Gomera (Canary Islands). *Mém. Biospéol.* 17: 87-91.

MUCHMORE, W.B. 1992. Cavernicolous pseudoscorpions from Texas and New Mexico (Arachnida: Pseudoscorpionida). *Texas Mem. Mus., Speleol. Monogr.* 3: 127-153.

OROMI, P., A.L. MEDINA & M. TEJEDOR 1986. On the existence of a superficial underground compartment in the Canary Islands. *Act. 9 Congr. Int. Speleol., Barcelona*, 2: 147-151.

PIEPER, H. 1981. Die Pseudoskorpione von Madeira und Nachbarinseln. *Bocagiana* 60: 1-7.

PIEPER, H. 1991. New records of pseudoscorpions from the Madeiran Islands. *Bol. Mus.Mun. Funchal* 42 (225): 217-221 (1990).

REDIKORTZEV, V. 1938. Les Pseudoscorpions de l'Indochine française recueillis par M.C. Dawydoff. *Mém. Mus. natn.hist.nat.Paris*, n.s., 10(2): 69-116.

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