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No. 81

May, 1965

RESOURCE MANAGEMENT REPORT

ONTARIO

DEPARTMENT OF LANDS AND FORESTS

Hon. A. Kelso Roberts, Q.C.
Minister

F. A. MacDougall
Deputy Minister

(These Reports are for Intra-Departmental Information and Not for Publication)

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WILDLIFE STATUS REPORTS

by
A. B. Stephenson
Biologist, Research Branch, Maple

Abstract

Questionnaires completed by Fish and Wildlife personnel pertaining to the status of 13 mammalian species for the period 1954-55 to 1963-64 have been analysed. Graphs illustrating the 10 year trends in relative abundance and maps showing the 1963-64 population statuses are presented. These data indicate population trends and provide a basis for prediction of future population changes. They illustrate changes brought about by range extension, predation, disease and other factors, many of which are still unknown.

Introduction

Since 1954 the Fish and Wildlife Branch has been conducting an annual enquiry to determine the population status of several animals for which information was not available from other sources. Information on the relative abundance of each of the 13 mammalian species collected during the past 10 years is summarized in this report along with their 1963-64 status by District.*

The use of annual questionnaires to ascertain the status of Ontario wildlife populations had its beginning in 1924 when the National Parks Branch in Ottawa started a two year snowshoe hare enquiry (Elton, 1933). There was a lapse of five years before the Bureau of Animal Populations in Oxford continued these questionnaires for the National Parks Branch. This organization collected data from 1931-32 to 1947-48 when the enquiry was discontinued (Elton, op. cit.; Chitty, 1950). In 1932 the Royal Ontario Museum of Zoology initiated a much broader questionnaire which included a diversity of birds and mammals. They continued their records until 1953-54 when they discontinued the enquiry in view of the increased interests in wildlife populations by provincial governments. At that time the Ontario Department of Lands and Forests initiated its own questionnaire pertaining to the status of a few species of particular interest to wildlife management.

* A series of 13 maps accompanied the original article which is on file in the Fish and Wildlife Library, Maple.

Status Reports

A mimeographed questionnaire, as shown in Fig. 1, has been distributed to all Fish and Wildlife field personnel at the end of each fiscal year. The reporter indicated the occurrence of a species and the trend in the population by checking the appropriate columns. This technique assumed that each individual was familiar with the local status of the various populations and could give a subjective opinion of the current status relative to that of the previous year. In a few cases no comment was reported on the status of a population. This was taken into account when calculating the percentage of returns indicating occurrences and trends.

Table I shows the number of reports received from each District for 1963-64 and an average for the 10 year period. No reports were obtained for 1956-57. Only the percentage of reports indicating abundance was used in illustrating the population trends from 1954 (Graphs 1-13) since this criterion reflected any relative changes which took place.

Table I. Number of Wildlife Status Reports

District	Average No. of Annual Reports	No. of Reports in 1963-64
Lake Erie	14.1	16
Lake Huron	13.9	13
Lake Simcoe	11.4	12
Lindsay	10.2	10
Tweed	10.4	13
Kemptville	9.6	11
Pembroke	6.2	5
Parry Sound	10.5	15
North Bay	9.9	10
Sudbury	6.9	7
Sault Ste. Marie	7.0	7
Chapleau	4.4	5
Gogama	3.6	4
White River	5.7	5
Swastika	6.7	9
Kapuskasing	4.9	7
Cochrane	6.8	9
Geraldton	5.0	5
Port Arthur	4.2	5
Fort Frances	4.4	8
Kenora	4.7	6
Sioux Lookout	4.9	5
Total	154.8	187

Wildlife Status

Snowshoe Rabbit

This species exhibits noticeable fluctuations in numbers and consequently has been a subject of investigation for a number of years. Its periodic peaks of abundance have been well documented since 1785, initially from the Hudson's Bay Company fur returns and during the past four decades by special status enquiries. In Ontario, snowshoe rabbits attained peak abundance in 1923-24, 1933-34, 1942-43, 1951-52 and 1959-60. Questionnaire reports do not indicate the magnitude of these peaks but from general accounts of their status, it appears that they were most numerous during the early 30's and relatively lower during their peak in the early 40's. The population reached a low level in 1946-47 but for some unknown reason they did not increase to a major provincial peak in the early 50's. Their numbers fluctuated at a relatively low level during this period although local areas did experience a fair abundance of hares. Following the next population low in 1954-55 their numbers increased to a provincial peak in 1959-60 (Graph I). Subsequently the population declined although the reports for 1963-64 indicated that snowshoe hares were common in most Districts (Map I).

Peak populations may not be attained in all areas at the same time. Indeed, there are many local populations which are separated by only a few miles which will be out of phase with each other. During the most recent cycle peak populations were first attained in the south and central portions of the Province and gradually progressed to the western Districts where they were most abundant one year later in 1960-61.

From the history of fluctuations in snowshoe hare numbers it appears that they are currently at a low population level, and that their numbers will increase to a provincial peak between 1968 and 1970.

European Hare

This species was introduced into southern Ontario in 1912 when a few individuals escaped from captivity in the Brantford area. Their population spread up to 1952 is well documented by Reynolds (1955). Since that time the European or brown hare (commonly called jack rabbit) has continued to extend its range throughout the southern agricultural areas, especially into eastern Ontario. Presently they are found in the southwestern portions of Grenville County with the occasional specimen being taken in the south of Lanark and Carleton Counties.

In southwestern Ontario their numbers were relatively low between 1955 and 1957 (Graph 2). During the next three years they exhibited a continuous increase which was also evident throughout the rest of their range. What effect predation had on this increase is unknown but it was during this period that foxes were drastically reduced in numbers by rabies which was spreading eastward throughout southern Ontario.

Since 1960-61 the European hare has been relatively common and even abundant in some local areas, although the 1963-64 reports indicated a general decrease in abundance (Map 2).

Cottontail Rabbit

This species, which is confined to the agricultural regions of southern Ontario, was relatively stable in numbers from 1954 through to 1960-61 (Graph 3). During this period over 25 per cent of the reports indicated that rabbits were abundant, especially in southwestern Ontario. In 1961 and 1962, there appeared to be a sharp increase in their numbers with nearly 50 per cent of the reports indicating an abundance. This was followed by a decrease in 1963-64 although they were still reported to be relatively common except in the Kemptville District.

Black Squirrel

This species is commonly found throughout southern Ontario where it attains its highest densities in the agricultural areas. The northern limit of its range extends into Pembroke District and throughout most of Parry Sound District to Lake Panache in the Sudbury District. It is also found in the urban areas of North Bay and Sudbury. In 1961, four individuals were introduced to Cockburn Island in the Sudbury District. Occasionally a few individuals have been reported in the western portion of Fort Frances District. These are a northern extension of the Minnesota population of black squirrels.

Reports showed a peak population in 1955-56 with a gradual decline to 1960-61 (Graph 4). The reports for the next three years indicated a relatively common, but stable population with the exception of Tweed District where there was an increasing population in 1963-64 (Map 4).

Red Squirrel

This species is found throughout the Province and during the last 10 years has exhibited two years of peak abundance; 1957-58 and 1961-62 (Graph 5). It has seldom been reported as scarce except in the Lake Erie District. The 1963-64 reports indicated that red squirrels were relatively common with little to no change in their population status (Map 5).

Chipmunks

The chipmunk population has been relatively stable over the past 10 years with minor fluctuations in abundance (Graph 6). All Districts reported no change in the population trend in 1963-64. However, both Port Arthur and White River Districts reported chipmunks relatively abundant in 1963-64 and Lake Erie and Lake Simcoe Districts reported them relatively scarce (Map 6).

Woodchuck

Although this species is found throughout the Province it attains its highest numbers in southern Ontario, especially in the agricultural areas. The status of the woodchuck population was relatively stable between 1954 and 1961 but in 1962 there was a noticeable increase in their numbers (Graph 7). The reports for 1963-64 indicated that they were relatively abundant and still increasing in some Districts in southern Ontario (Map 7). This change was not evident in northern and western Ontario where the population is relatively low and stable.

Porcupine

This species was most abundant in 1954 and 1962 although it has never been abundant in northern Ontario (Graph 8). There are only a few local areas where the porcupine has become fairly numerous; mainly in Parry Sound District and the northern portions of Lindsay and Tweed Districts. In the Parry Sound District porcupines have been reported abundant every year since 1954.

The 1963-64 reports indicate that there is no change in the population status following the slight increase in 1962 (Map 8).

Skunk

This species has been common to abundant in southern and south-central Ontario for the past 10 years (Graph 9). It has also been relatively common in the Districts of Fort Frances, Kenora and Port Arthur. Although the skunk has decreased in relative abundance during this 10 year period it is still considered common in all areas except northern Ontario where it is relatively scarce. The 1963-64 reports indicated no change in this status (Map 9).

Raccoon

The major population of raccoons is found throughout southern Ontario although they are extending their range northward in the North Bay, Sudbury and Sault Ste. Marie Districts. Occasionally a few are reported from Gogama and other northerly Districts where they are usually found near railroads. There is a minor population in western Ontario where their numbers have remained relatively scarce.

Raccoons were most abundant between 1954 and 1957 (Graph 10). They decreased in 1958 when rabies was prevalent in southern Ontario and have remained at a relatively stable level through to 1963-64 (Map 10).

Red Fox

The red fox exhibited a similar trend in abundance to the raccoon except that it decreased to a much lower level in 1958 following the relatively abundant level between 1954 and 1957 (Graph 11). This marked reduction in population took place largely in southern Ontario probably as the result of rabies. In the rest of the Province foxes remained relatively stable during this period.

The 1963-64 reports indicated that foxes were still scarce in a large portion of southern Ontario but they were generally increasing in numbers (Map 11). Throughout central and northern Ontario they were relatively common and increasing in several Districts. In Fort Frances and Port Arthur foxes were reported to be relatively abundant with little indication of any decrease in numbers.

Black Bear

This species showed a general increase in abundance from 1954 to a peak population in 1957-58 (Graph 12). The reports indicated a sharp drop in 1958, although they remained relatively common through to 1963-64. The northern and western Districts showed an increasing population in 1962-63 and this was continuing in a few of these Districts in 1963-64 (Map 12). The remainder of the Districts reported no change in the population trend in 1963-64.

Bobcat

According to Peterson and Downing (1952) the bobcat is found in three discrete areas of the Province; southern Ontario, Sault Ste. Marie and western Ontario. The recent status reports, however, indicate that the Sault Ste. Marie and western populations

are now contiguous in the White River District. There is still, however, no indication that the southern Ontario population is linked with the Sault Ste. Marie population.

Bobcats have been relatively scarce in Ontario since 1954 but in 1962 they showed signs of increasing, especially in the western portions of their range (Graph 13). The 1963-64 reports indicated a continued increase in bobcats although they are still only relatively common in the centres of their ranges (Map 13).

Conclusions

Field personnel can provide a good general assessment of the status of wildlife populations from one year to the next. The changes which take place in different animal populations may not, however, be equally conspicuous. For example, the behavioural characteristics of the snowshoe hare and their great fluctuations in numbers are readily apparent while the chipmunk is not as conspicuous and probably does not have as large a change in numbers from one year to the next.

Since the reports are based on subjective information they do not permit comparison of abundance or scarcity from one area to another: abundance in one area, especially toward the limits of a species range may be considered to be scarce in the centre of its range. This does not, however, preclude comparisons from one year to the next providing the area in question remains the same.

Trends in populations are independent of relative abundance hence an increase or decrease in one area can be compared with that in another area.

The reports have their value in indicating general trends from which predictions can be made. These trends may be the result of inherent properties of the population, as in the case of snowshoe hares; range extension and possibly the reduction of predators, in the case of European hares; and disease, in the case of foxes and raccoons.

Status reports are also useful in indicating range extensions, as were reported for the European hare, black squirrel, raccoon and bobcat.

References

Chitty, Helen. 1950. The Snowshoe Rabbit Enquiry 1946-48. J. Animal Ecol. 19(1):15-20.

Elton, C. 1933. The Canadian Snowshoe Rabbit Enquiry 1931-32. Can. Field-Nat. 47(4):63-69; 47(5):84-86.

Peterson, R. L. and S. C. Downing. 1952. Notes on the Bobcats (*Lynx rufus*) of Eastern North America With Description of a New Race. Contribution of the Roy. Ont. Mus. Zool. and Pael. No. 33:1-23.

Reynolds, J. K. 1955. Distribution and Populations of the European Hare in Southern Ontario. Can. Field-Nat. 69(1):14-20.

Figure I

Fish and Wildlife Branch

WILDLIFE STATUS REPORT

Name.........................Address..............................

District.....................April 1, 196... to March 31, 196.....

Description of area covered in this report.........................

....

	Absent	Present	Decrease	Same	Increase	Number Seen During the Year.
Horned Owl						
Snowy Owl						
Goshawk						

Comments...

....

	Absent	Present	Scarce	Common	Abundant	Decrease	Same	Increase
Snowshoe Rabbit								
Cottontail								
European Hare								
Woodchuck								
Red Squirrel								
Black " (Grey)								
Chipmunk								
Black Bear								
Raccoon								
Skunk								
Red Fox								
Bobcat								
Porcupine								

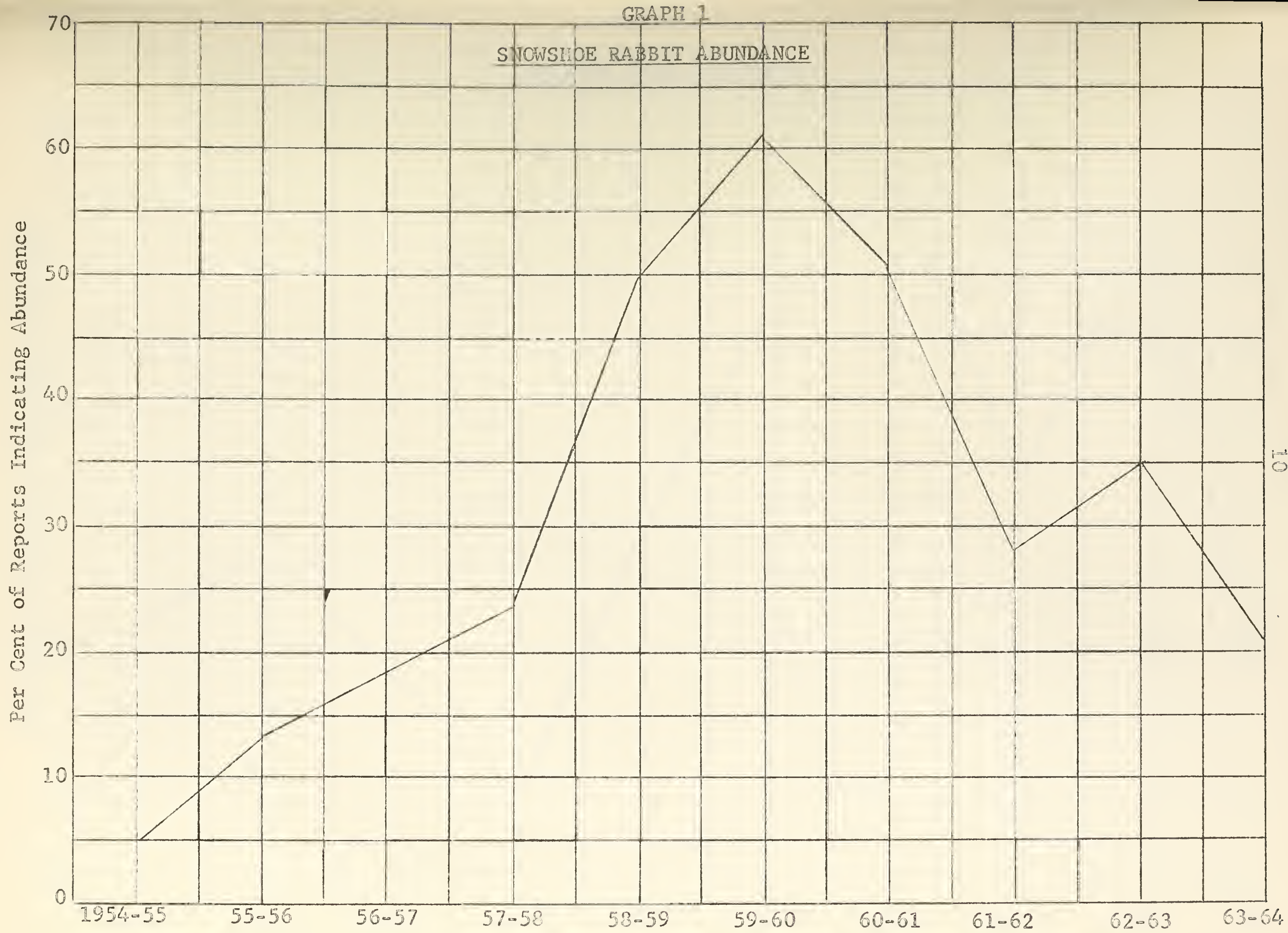
Comments...

....

Indicate if Scarce, Common or Abundant and if Decreased, Same or Increased during the past 12 months.

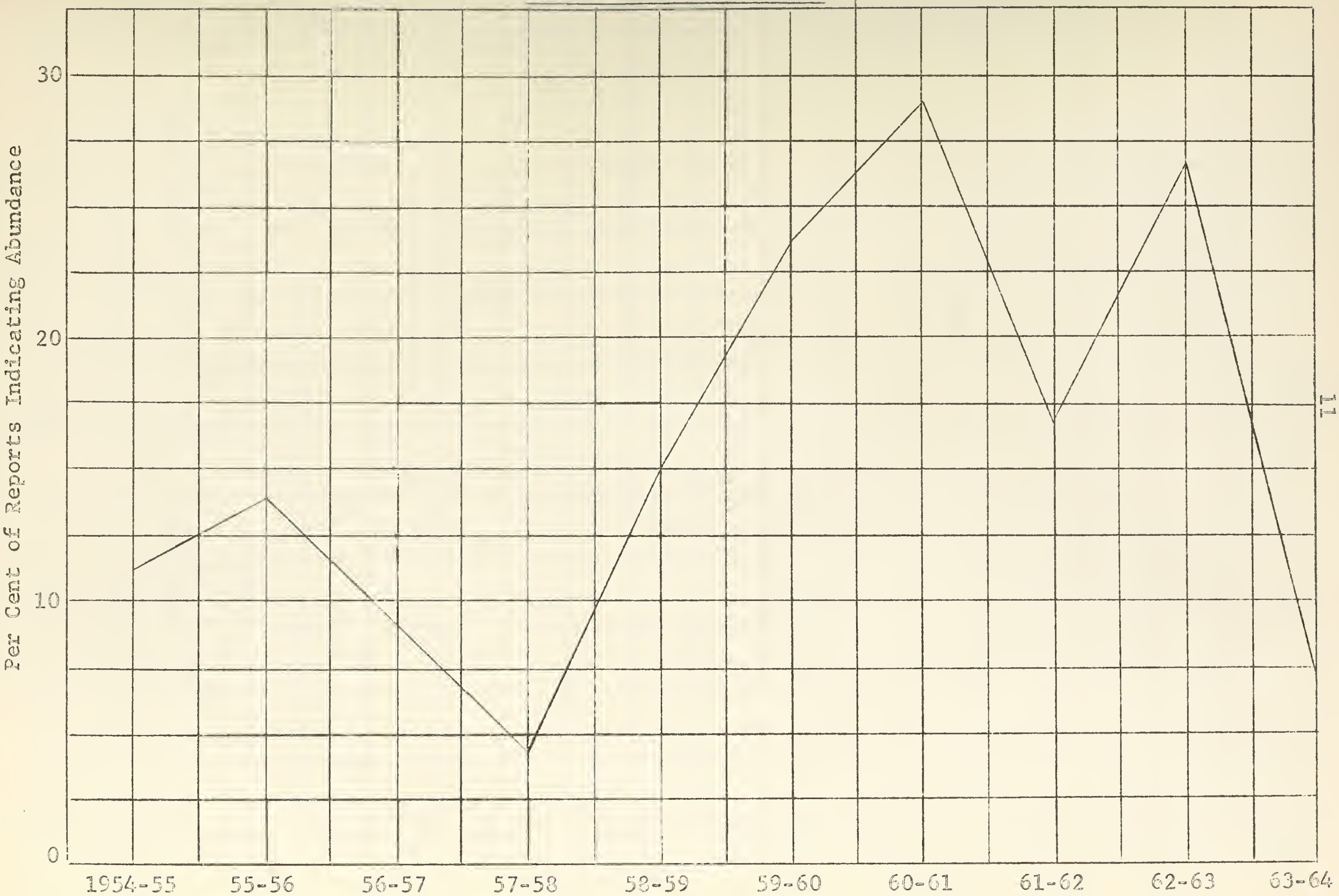
GRAPH 1

SNOWSHOE RABBIT ABUNDANCE

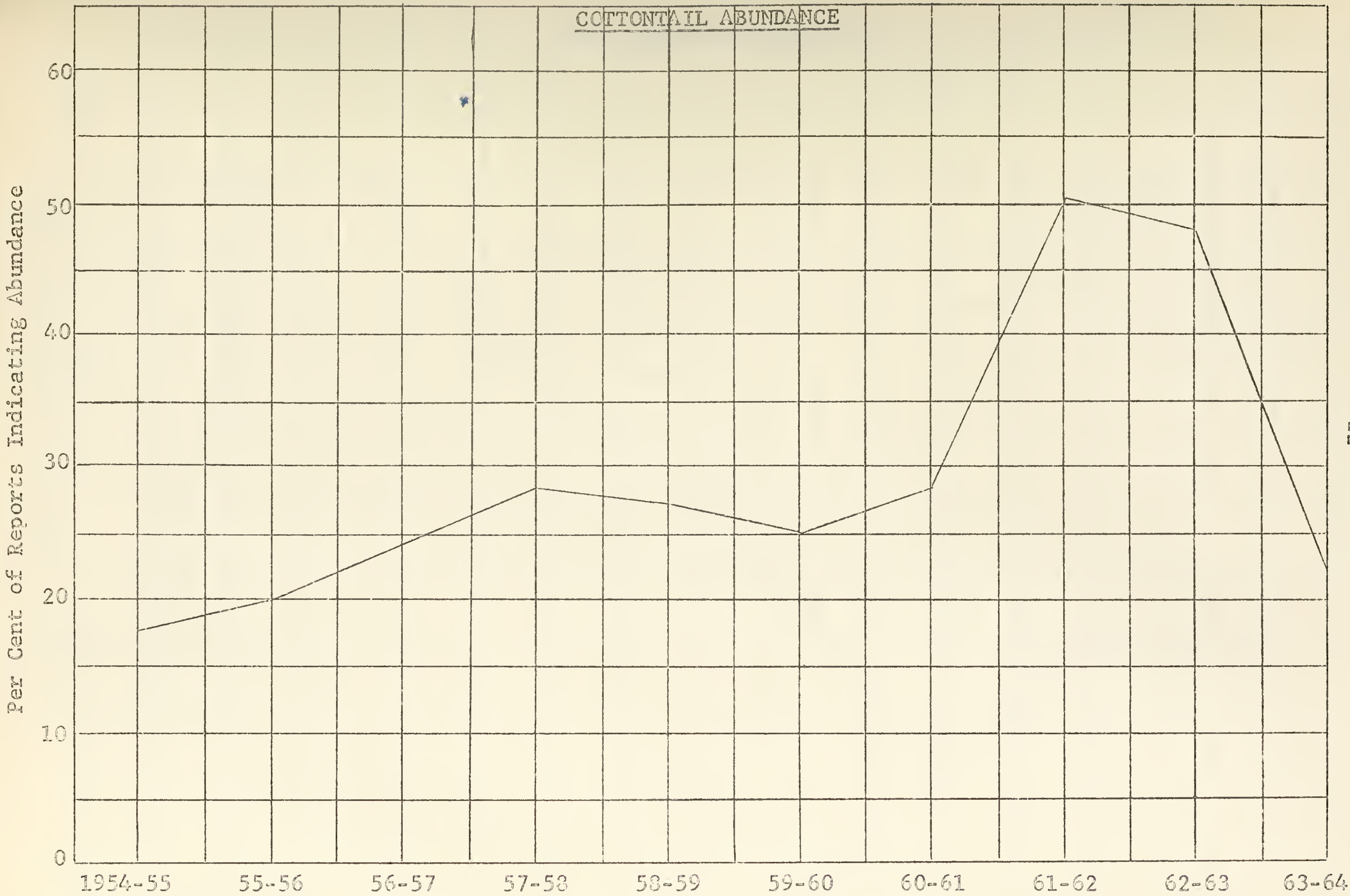


GRAPH 2

EUROPEAN HARE ABUNDANCE

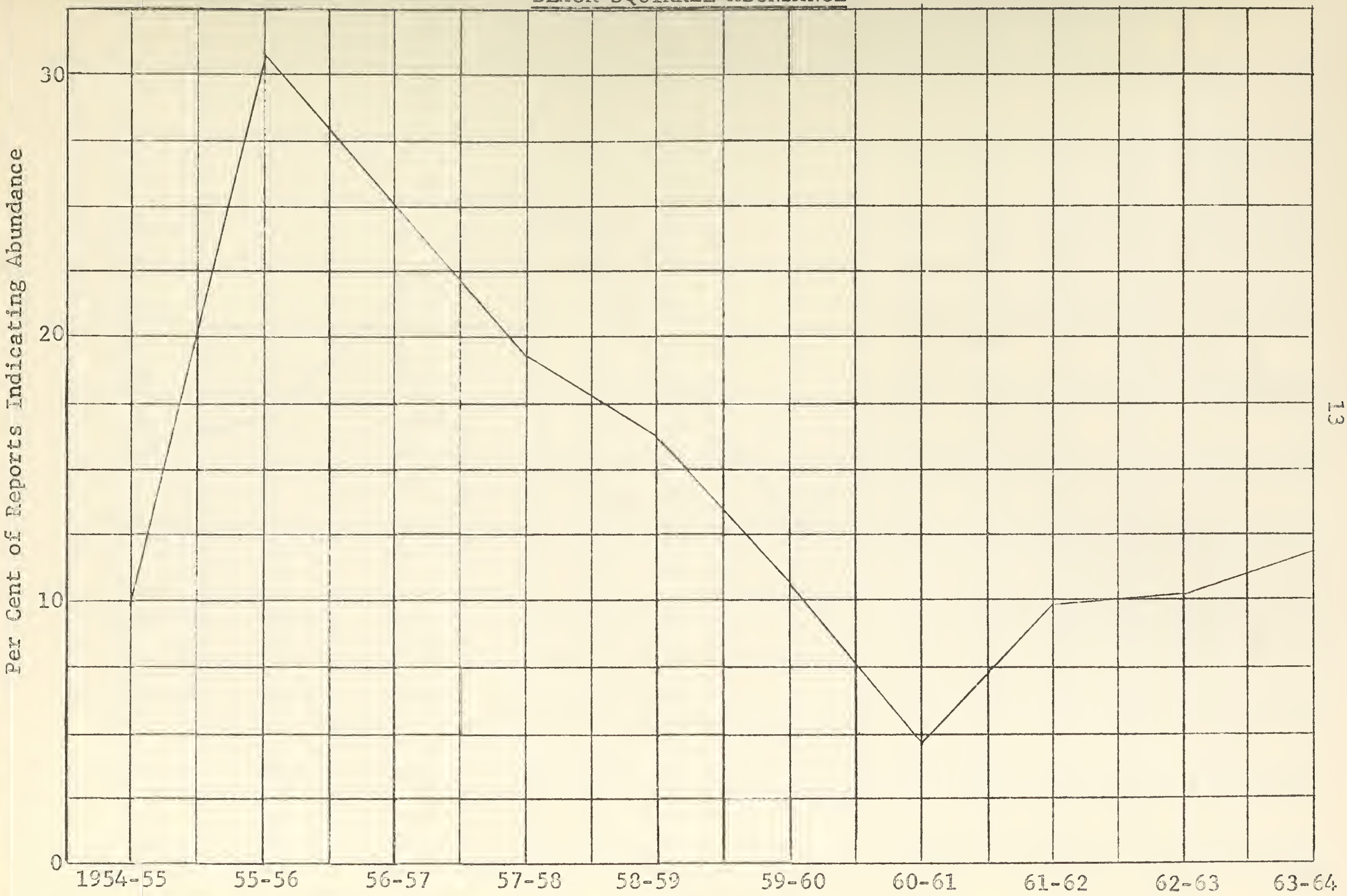


GRAPH 3


COTTONTAIL ABUNDANCE
Per Cent of Reports Indicating Abundance
60
50
40
30
20
10
0
1954-55
55-56
56-57
57-58
58-59
59-60
60-61
61-62
62-63
63-64

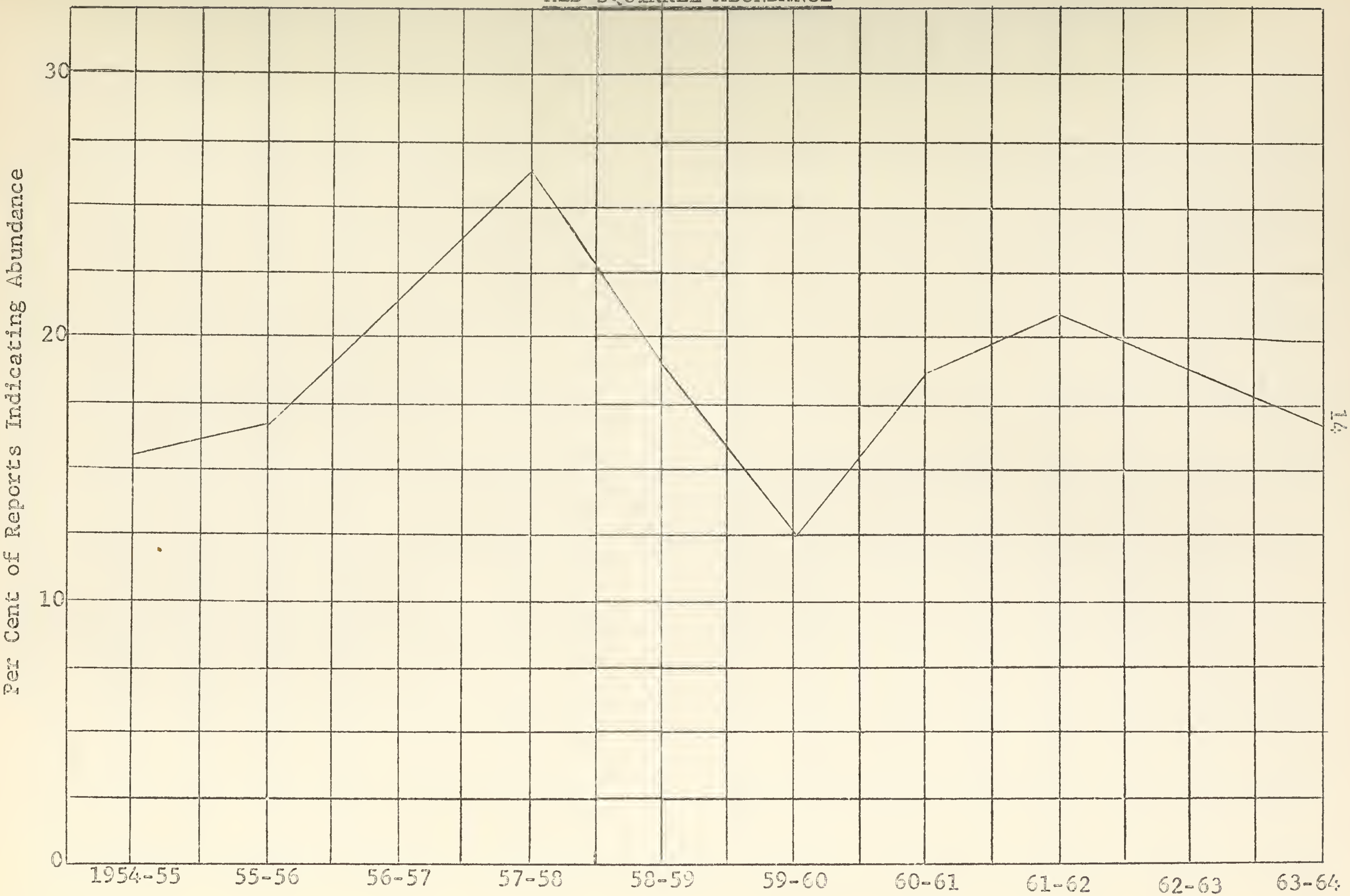
GRAPH 4

BLACK SQUIRREL ABUNDANCE



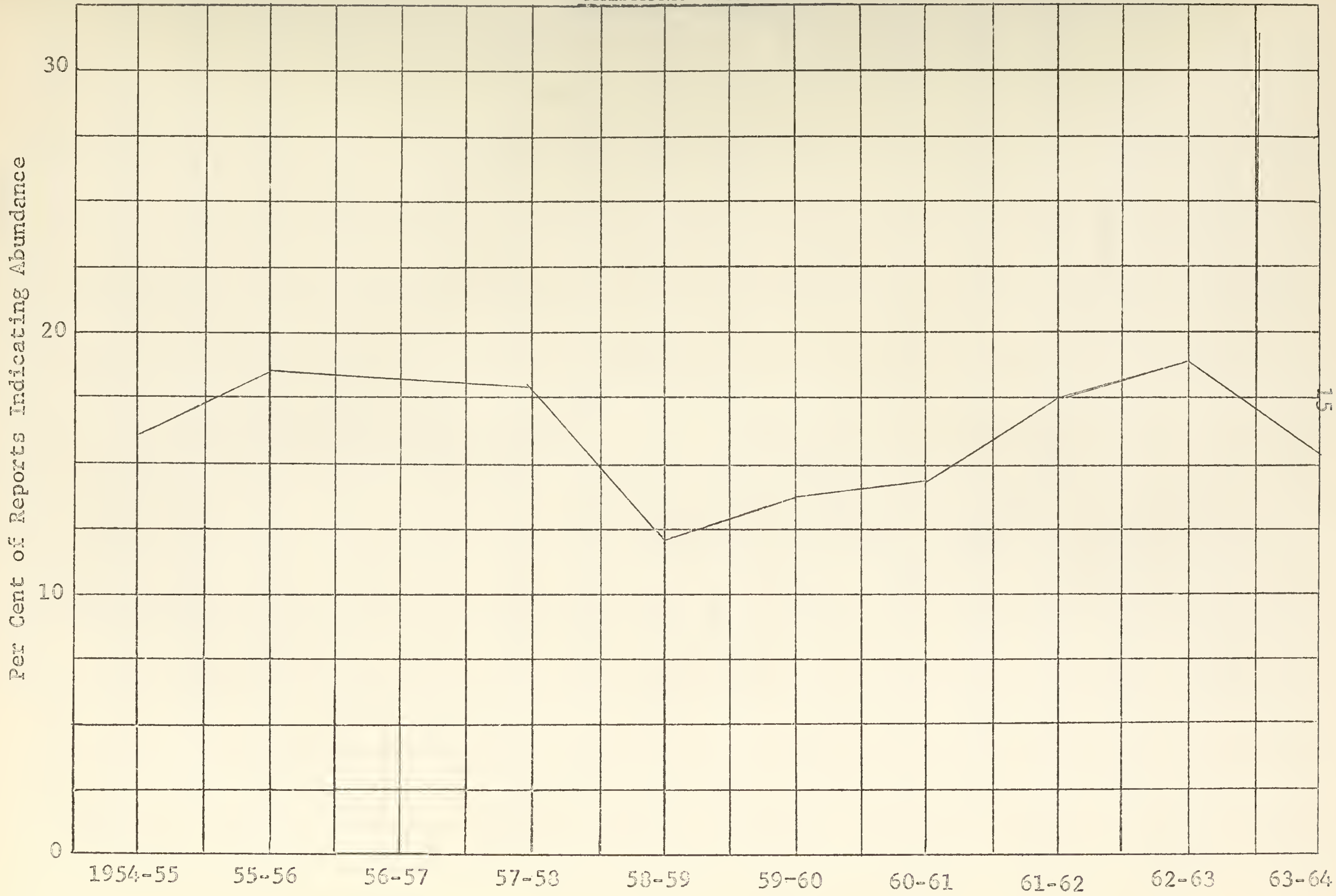
GRAPH 5

RED SQUIRREL ABUNDANCE

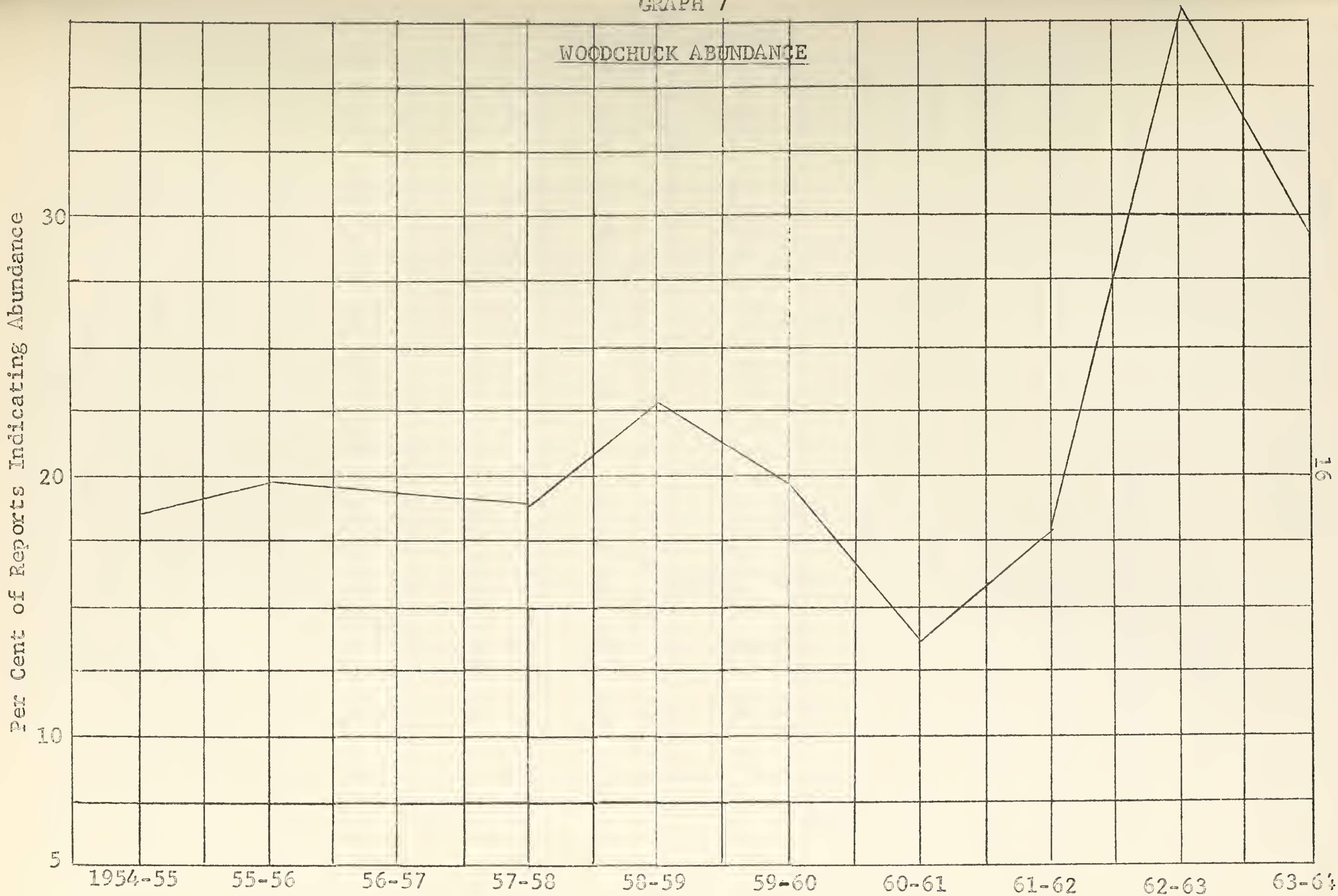


GRAPH 6

CHIPMUNK ABUNDANCE

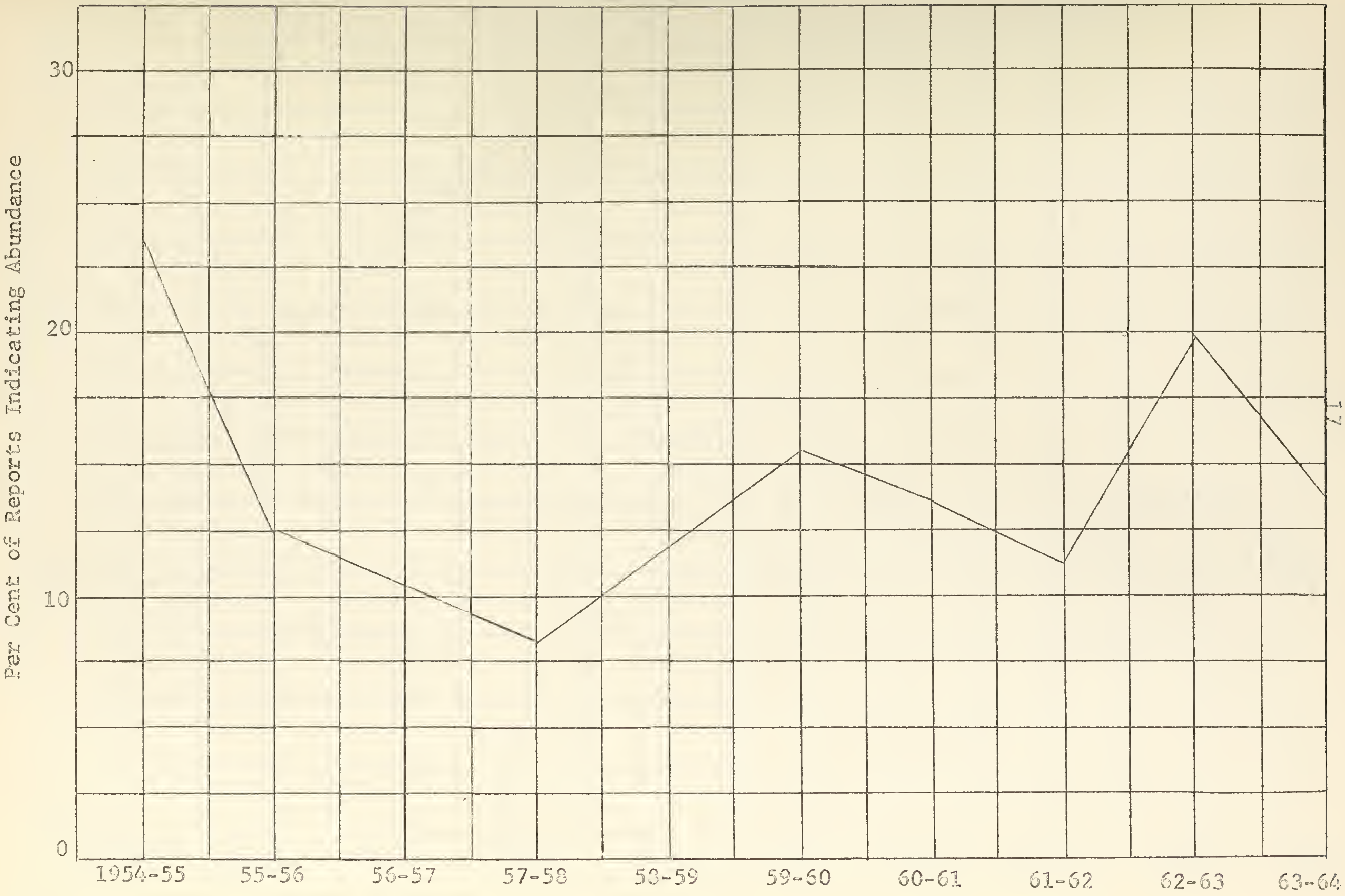


GRAPH 7


WOODCHUCK ABUNDANCE
Per Cent of Reports Indicating Abundance
30
20
10
5
1954-55
55-56
56-57
57-58
58-59
59-60
60-61
61-62
62-63
63-64

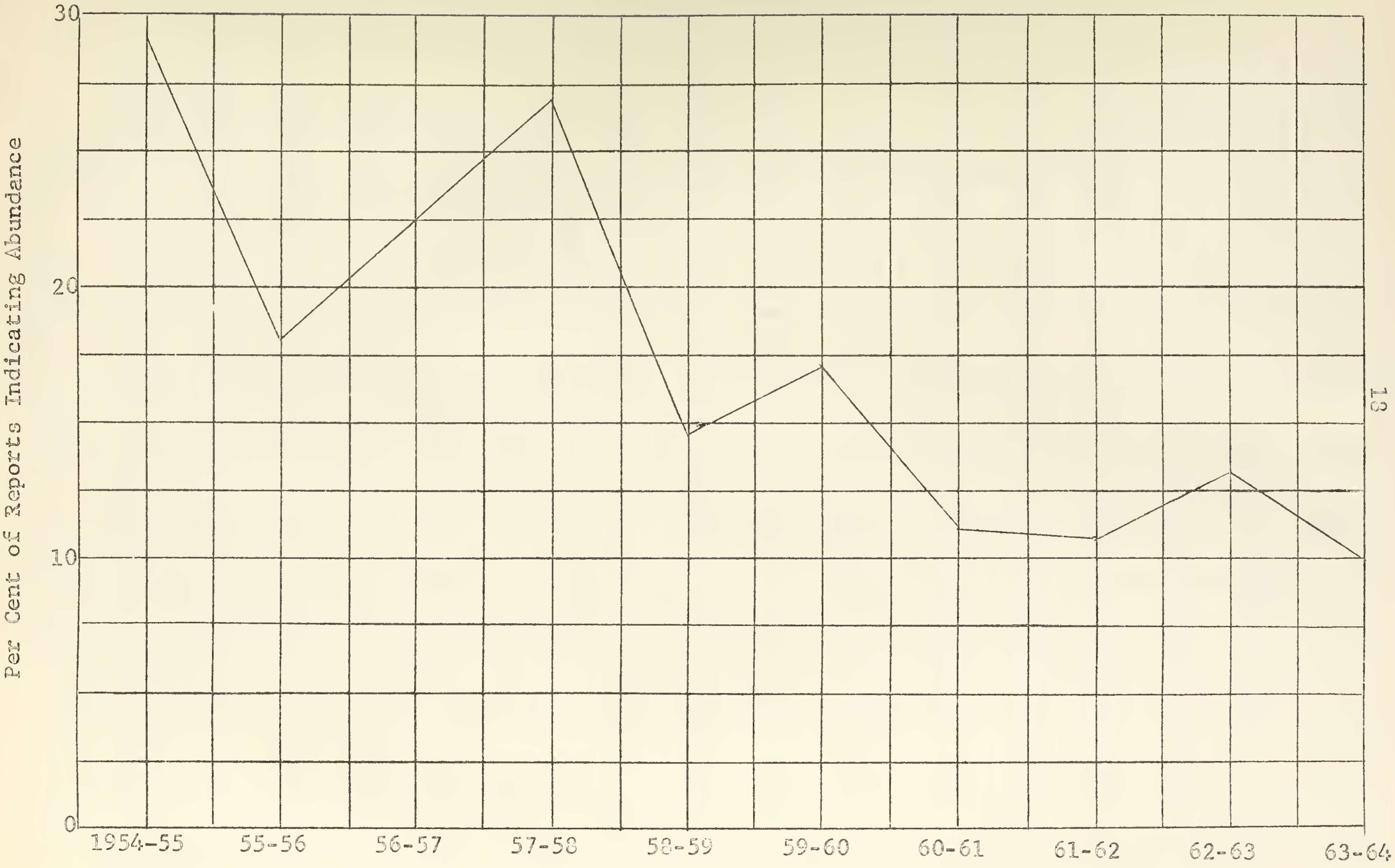
GRAPH 8

PORCUPINE ABUNDANCE



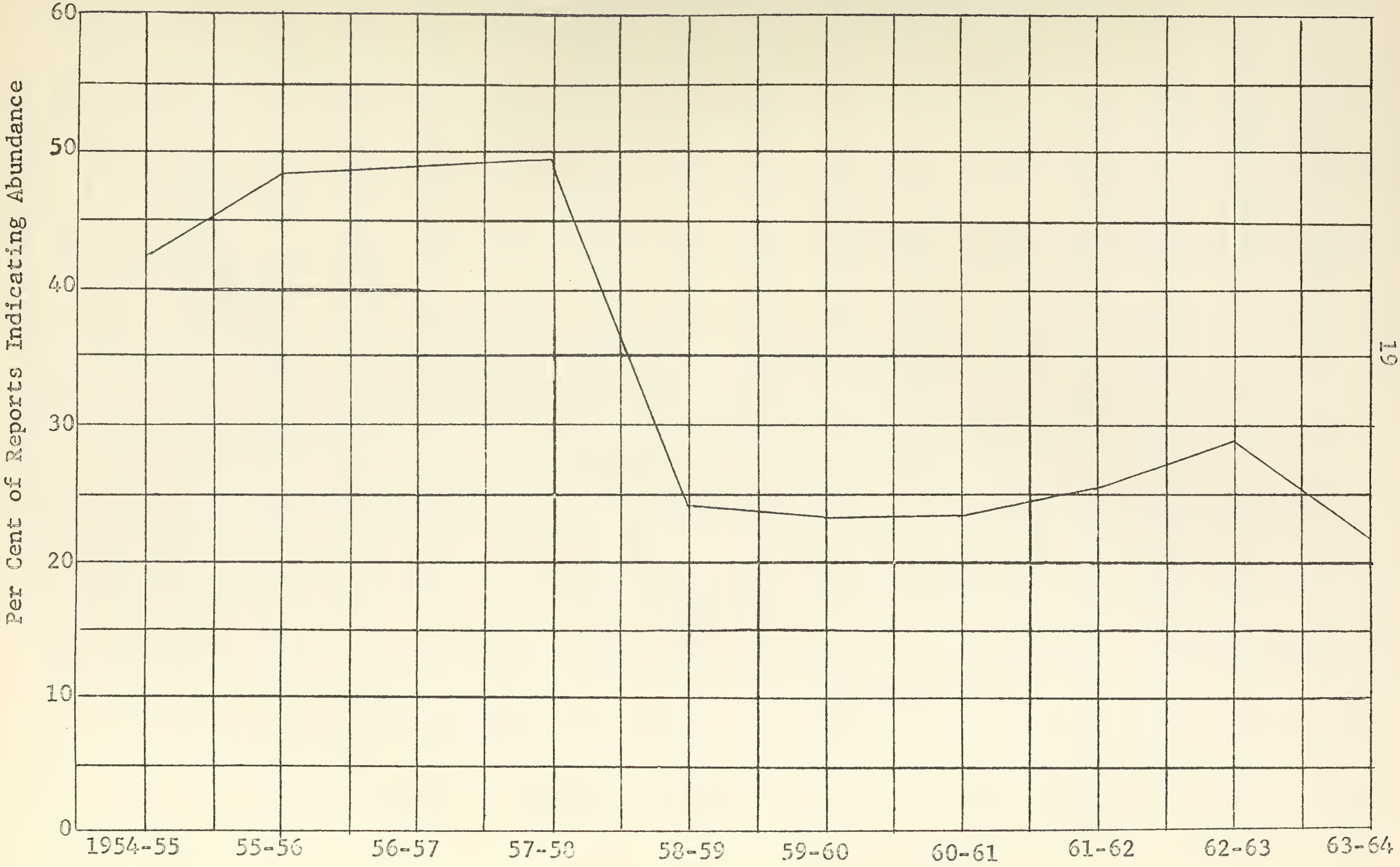
GRAPH 9

SKUNK ABUNDANCE

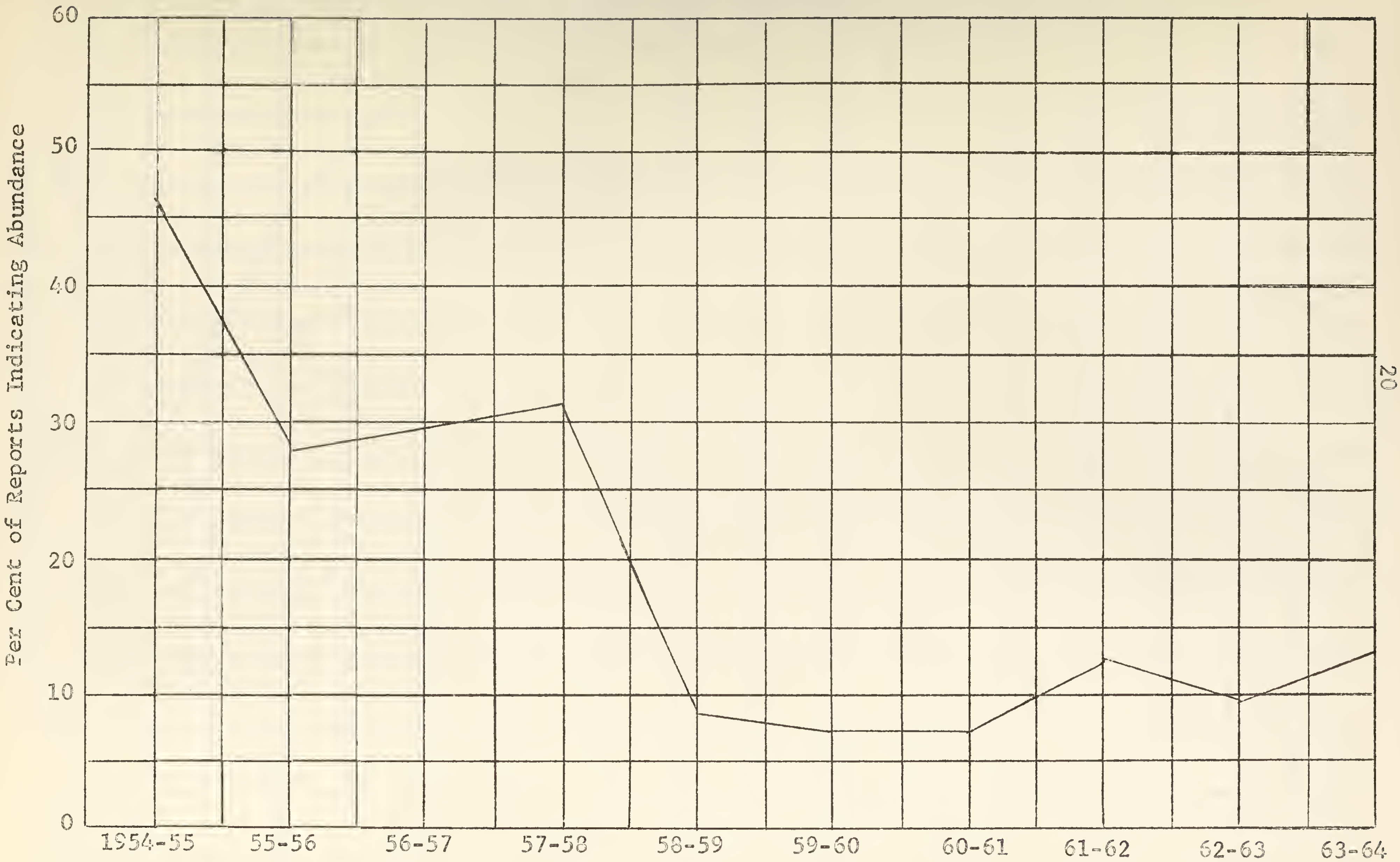


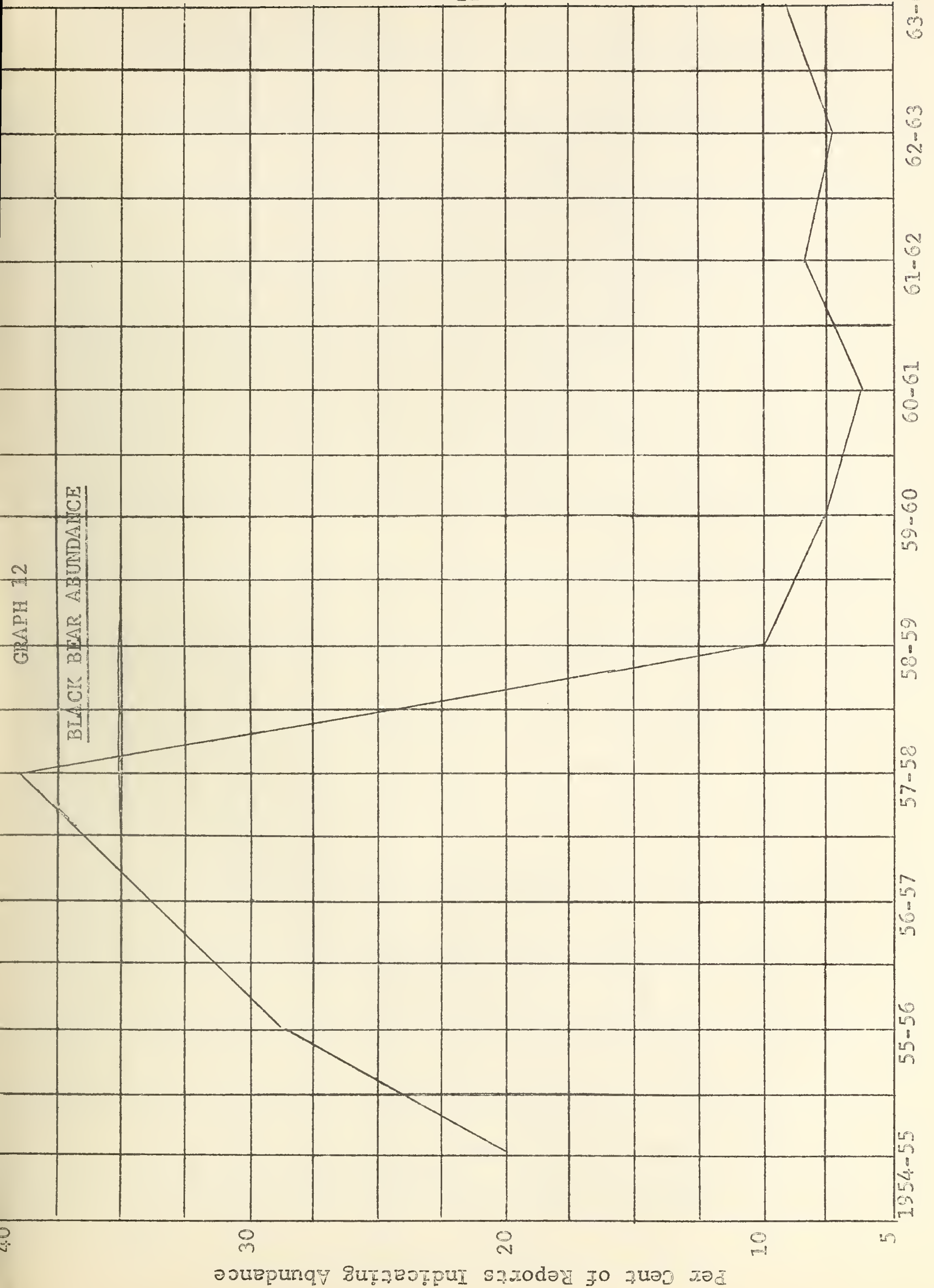
GRAPH 10

RACCOON ABUNDANCE



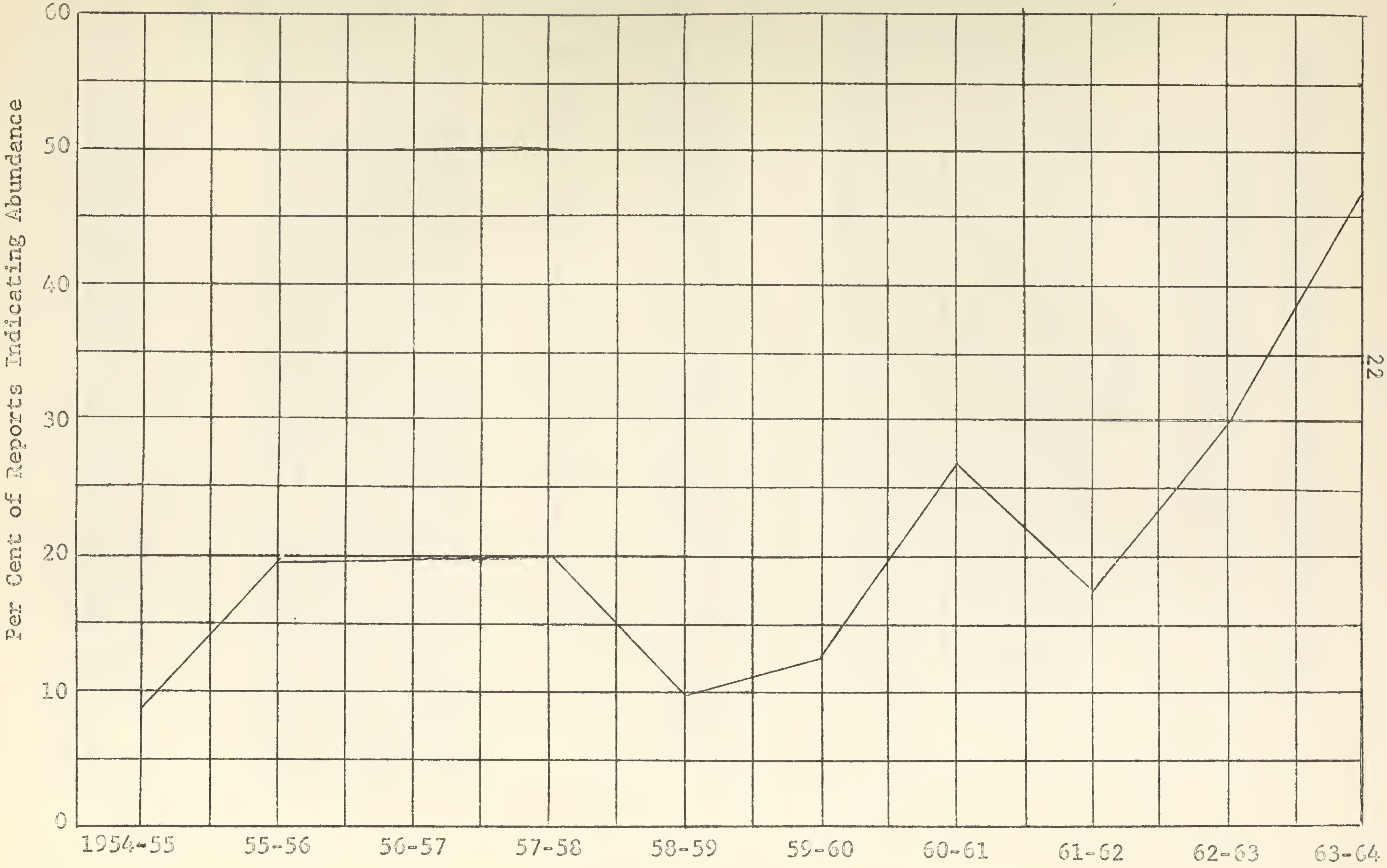
RED FOX ABUNDANCE




GRAPH 12
BLACK BEAR ABUNDANCE
Per Cent of Reports Indicating Abundance
40
30
20
10
5
1954-55
55-56
56-57
57-58
58-59
59-60
60-61
61-62
62-63
63-64

GRAPH 13

BOBCAT ABUNDANCE



MOOSE TAGGING IN THE WHITE RIVER DISTRICT, 1964

by
S. B. Woodside and D. J. Rice
Conservation Officers

Abstract

A new method of moose tagging employing a rubber collar set on an automatic snare-type release was investigated. Owing to the limited nature of this season's work (only 12 collars released) no definite conclusions could be drawn. Temperature was found to be a limiting factor to this method as below 42°F the rubber collar lost its elasticity. It is concluded that the economy of this method over present techniques of moose tagging warrants further study into its possibilities.

Purpose

To determine animal movement in direction and distance, during a recorded period of time, with thought to establishing movement patterns.

Method

A rubber collar set on a snare-type release.

Forward

This project has so far been limited to time spared from the normal enforcement and management duties of two conservation officers, and materials picked up at random within the District. The only material expense was the purchase of 150 feet of "SIMATCO RUBBER TUBING" from the Fisher Scientific Company of Montreal at a cost of $30.00. The idea for this method of tagging was obtained from a newspaper article describing similar project being carried out by Mr. Pierre Des Meules, of the Quebec Department of Tourism, Fish and Game.

Procedure

It is first necessary to find locations where moose are consistantly using definite trail to water or feeding areas. Since this project was to be carried out in conjunction with our normal enforcement and management duties, we chose only those locations

which could be visited with little deviation from our regular patrol routes. These trails were rather easy to locate during the months of June and July, but became quite obscure and little-used by mid-August. The best set locations always occurred within 10 to 30 feet of the water. Beyond this point, the main trail invariably fanned out into numerous secondary trails. The ideal site for erecting the collar release mechanism is between two trees located approximately 46 to 50 inches apart, on opposite sides of the trail. The larger the trees, the less work involved. It was noted that trees under 8 inches DBH were susceptible to considerable sway in a heavy wind and this resulted in the mechanism being tripped, the collar being released and often landing far enough away from the set to require a lengthy search in locating it.

If trees under 8 inches DBH must be used, they should be wired firmly together about 8 to 10 feet from the ground and wired back to a heavier tree on either side of the trail. In some cases, only one tree could be found in a suitable location. Here, it was necessary to plant a post on the opposite side of the trail and wire it firmly in place as outlined above. In one instance, the trail was in a cleared area where no trees were available. In this case, two Jackpine trees about 6 inches DBH were cut, planted whole on either side of the trail and wired firmly in place. This set was successful in obtaining six releases.

On completion of each set, it is important that it be left as natural looking as possible. This often requires considerable camouflage. Small spruce or balsam (7 to 10 feet high) wired to the set trees, proved quite effective.

Equipment

1 - axe
1 - hand saw
1 - pr. pliers (with cutter)
1 - long handle shovel
1 - hammer
1 - 8 foot step-ladder
1 - 8 inch rat-tail wood rasp
1 - steel pocket tape

Material

For one set.

2 steel rods - 5/16" x 70"
4 "I" bolts - 1-1/2" eye - 6" shank
50 feet (approx.) haywire - gauge
1 pc. hardwood dowel - 48" x 1/2" - stained dark brown or dark green

1 pc. hardwood dowel - 4" x 3/8"
1 roll black "electric tape" (Plastic)
1 pc. "Simatco Rubber Tube" - 38" x 5/16" Bore
1/16" walls
18 inches plastic coated "twist-tie" wire
1 identification tag.

Collar Construction

See Figure 2.

Cut a piece of "Simatco Rubber Tubing" to a length of 38". Insert a piece of hardwood dowel (4" x 3/8") into one end of the tubing for a distance of 2 inches. Bend the tubing in a circle and insert the remainder of the dowel into the open end and force it on until both ends of the tubing meet. Bind this joint firmly with the plastic coated "Twist-tie" wire leaving length of about 6 inches protruding. Wrap the joint firmly with plastic electrical tape.

Identification Tag

Bright yellow "Dymo Embossing Tape" was used for the identification tags. The required information (tag number and Return to Lands and Forests - White River) was printed on two separate lengths of tape and these were glued back to back. This offered double strength to the tape. A small hole punched in one end of the tape allowed for its attachment to the twist-tie wire protruding from the joint of the collar.

Collar Release Construction

See figure 2.

Take a 70 inch length of 5/16" steel rod. Measure 4 inches from either end and bend it 90°. From this bend measure 12 inches and bend it 90°. Measure 4 inches and bend 180°. Measure 4 inches and bend 90°. Measure 42 inches and bend 90°. The rod should now appear as in figure 2. Two such rods are required for each set. The eyelets were made from the broken coil springs off "Conibear" beaver traps. Cut the shank to about 6 inches and sharpen to a point on the grindstone. Four eyelets are needed for each set.

Making the Set

See figure 1.

When the desired trees have been located as previously described, measure from the ground, 30 inches up the side of one of the trees. Drive an eyelet into the tree at this point. Before

driving the eyelet securely, decide what position it must be in so that when the set is complete, the "trip-stick" and collar will sit at close to a right angle to the trail. Place one of the steel rods against the side of the tree with the inside arm (the double-one) resting on top of the secured eyelet. Drive a second eyelet into the tree at the inside angle of the top arm on the rod. Place the rod into the eyelets (top first, bottom last) and repeat the process on the opposite tree, checking to see that the two bottom eyelets are level with each other. Make sure the rods turn freely in the eyelets. With the rods turned so the arms point parallel to the moose trail, place one end of the 1/2" hardwood dowel against the side of the bottom arm of the rod and measure the distance to the same point on the opposite rod. Cut the dowel to this length (which should be close to 42 inches) and file a shallow groove in each end. This groove should only be deep enough to allow the dowel to set firmly between the two steel rods.

It requires two men to set the release. The first man holds the wooden dowel in place between the bottom arms of the rods as close to the ends as possible. This man should kneel at the side of the release opposite to the ends of the rod arms. The second man stands on the side of the release facing the ends of the rod arms. He stretches the collar first over the two top arms, then down under the second set of arms, making sure that the tension of the rubber is close to equal on all four sides. The first man cautiously releases his grasp on the dowling and the set is made. Note: At no time should you allow any part of your body to come in line with the stretch of the collar while placing it on the release. The tension on this rubber is great enough to cause considerable pain and possible injury should it accidentally slip and strike you.

Before leaving the set, take a spruce bow and sweep out all tracks on the trail in the immediate vicinity of the set. This serves a three-fold purpose; 1. When returning to check the set, the fresh tracks may indicate as to whether it was a moose, other animal, or a human who released the collar; 2. If there are no tracks present, the collar was likely wind-tripped; 3. Tracks may show that a moose approached the set and for some reason (likely poor camouflage) had by-passed it.

Conclusions

Temperature was found to be a controlling factor in this project in that at any temperature below 42°F the rubber had lost all of its elasticity and when the set was released, the collar simply fell to the ground in the form of a 42 inch square.

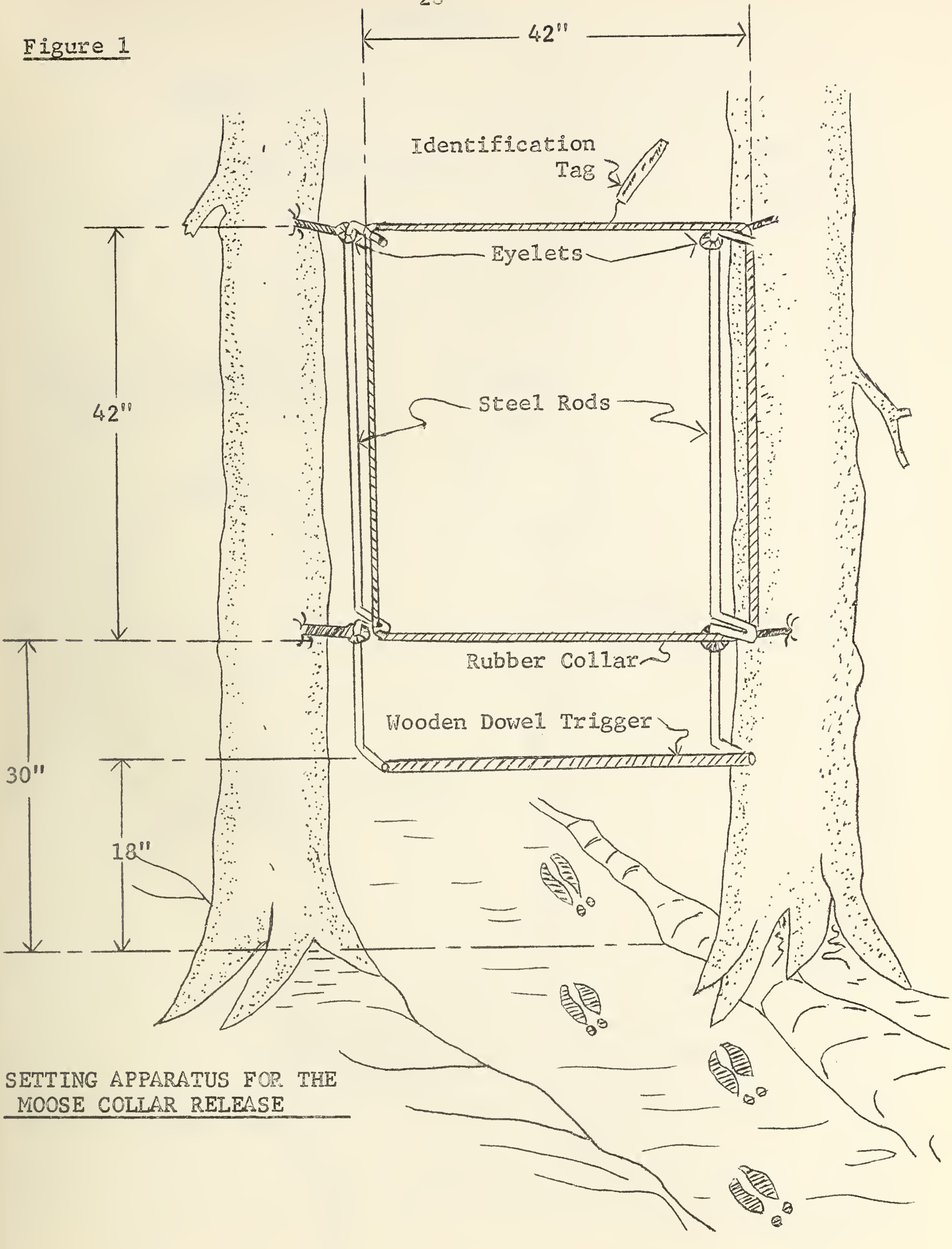
Due to the very limited nature of the project this year, it is rather difficult to draw many concrete and proven conclusions. From three different set locations we released a total of twelve collars during the period from June 8th to July 15th. To date, with the bulk of the hunting season over, we have had no returns. Observations were made of collared moose as late as August 28th by the writer and the public. The collars appeared to fit the animals quite comfortably, at least at the times of observation. The lack of returns could be attributed to possibly three factors; 1. An insufficient number of animals were collared; 2. The collars have become snagged and torn off the animals; 3. The collared animals have moved from the release sites to areas inaccessible to the hunters.

However, it is felt that the economy of this method over present techniques of moose tagging definitely warrants a much more intensive study into its use. This will be conducted in the spring of 1965.

Acknowledgment

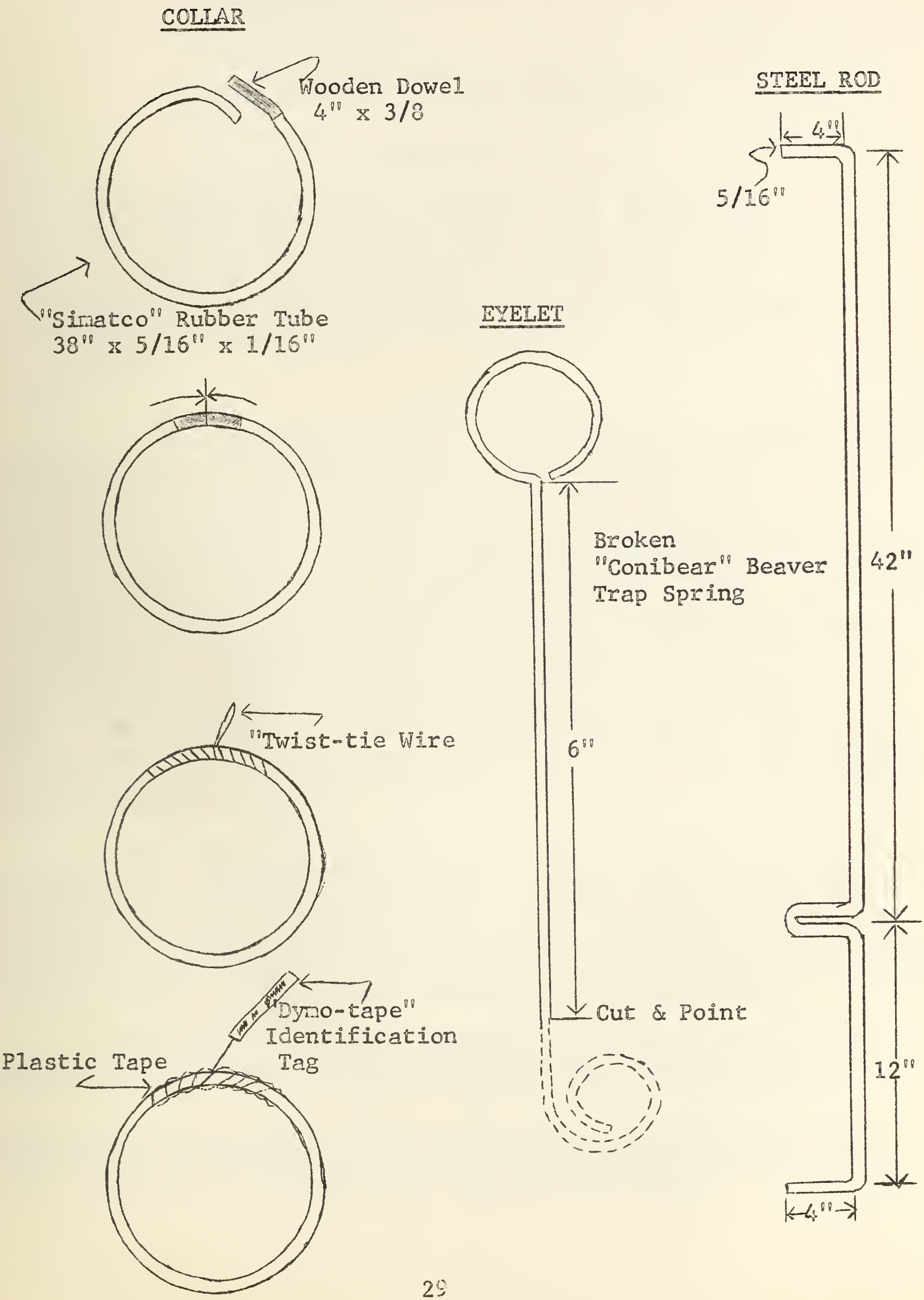
Mr. Pierre Des Meules, Director, Terrestial Game Division, Department of Tourism and Game, Quebec: Mr. Des Meules was very co-operative in providing complete information of his collar release apparatus. Although we have modified the mechanism to a certain extent, the basic principle is identical.

Figure 1



SETTING APPARATUS FOR THE MOOSE COLLAR RELEASE

Figure 2


COLLAR
Wooden Dowel
4" x 3/8
"Simatco" Rubber Tube
38" x 5/16" x 1/16"
"Twist-tie Wire
"Dymo-tape"
Identification
Tag
Plastic Tape
EYELET
Broken
"Conibear" Beaver
Trap Spring
6"
Cut & Point
STEEL ROD
4"
5/16"
42"
12"
4"

PESTICIDES AND WATER QUALITY*

by
C. F. Schenk, Biologist
Ontario Water Resources Commission

Abstract

The contribution made by pesticides in increasing food production is recognized. On the other hand, the writer points out the combined effect on water resources of synthetic pesticides, detergents and industrial wastes. The paper discusses at some length the role of pesticides as a destructive component in water.

A tremendous acceleration of technological development has characterized America's pest control industry within the last two decades and, more specifically, there has been an entire re-orientation of emphasis to the production of organic pesticide chemicals, as opposed to previous emphasis on inorganic compounds such as arsenicals and salts of copper, zinc and sodium. Throughout the United States and Canada during this post-war period, the insecticide DDT and the herbicide 2,4-D have maintained dominant positions with respect to production, although the use of some of the newer chlorinated hydrocarbon insecticides such as dieldrin, aldrin and lindane has increased dramatically in the last few years. The total value of pesticides manufactured in the United States increased from just over $75 million in 1939 to $300 million in 1961 (1) and it is anticipated that this figure will more than double itself by 1975 (2).

The substantial contribution that pesticides have made in increasing the production of food, feed and fibre to meet the challenge of increasing human populations, in reducing spoilage and improving the quality of produce, and in effecting spectacular reductions in the severity and incidence of vector-borne communicable diseases, cannot be denied and should not be de-emphasized.

However, accelerated technical and industrial progress of all kinds is producing an increasingly complicated array of

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unnatural forces at work in nature, which if left to proceed without appropriate checks and balances, would soon lead to a deterioration of our natural surroundings. One important aspect of this broader problem is the combined effect on our water resources of discharges of sanitary and industrial wastes, and the use of a large number of synthetic pesticides, detergents and other compounds which are reaching our waters from homes, farms and forested areas. The focal point of this presentation is to be the role of pesticides as a destructive component in water. I hope that I can objectively demonstrate that, while it is my firm belief that the search for effective pesticides that will be more specific as control agents should proceed unstinted, that progress along this line must be counter-balanced by equivalent emphasis in other directions. I am thinking of the development of refined methods of analyses to detect these compounds in water, the accumulation of data on residue levels in waters throughout the province and the promotion of studies related to the side-effects of the use of pesticides.

How Pesticides Reach Our Waters

Agricultural insecticides and herbicides applied to vegetation or soil are subject to both biologic breakdown and processes of chemical alteration, the degree of change varying with different types of chemicals. The chlorinated hydrocarbons are extremely resistant to breakdown and indeed a generalized figure that has been established for the rate of loss of aldrin in soil indicates only a partial reduction of about 29 per cent of the applied rate over a six-year period. (Westlake and San Antonio in Dugan et al, 1963) (1).

Pesticides may be transported to watercourses following periods of heavy rainfall. Stable compounds such as DDT and dieldrin are particularly hazardous in water since levels can increase over prolonged periods. On the other hand, these same chemicals tend to remain tightly bound to soil particles and this minimizes somewhat the hazard of surface and ground water pollution. Much depends on the timing of the application. The more volatile compounds may drift into streams or lakes during aerial and ground applications and this possibility is sometimes aggravated by carelessness on the part of persons applying the pesticides. Cleanup of spraying equipment in watercourses is often another source of contamination, for which there seems to be little excuse. Additionally, some pesticides are purposely added to water to control aquatic vegetation, algae, undesirable species of fish, aquatic insects, snails and leeches. Here in Ontario,

the addition of aquatic pesticides to water is regulated by a permit system administered by the Ontario Water Resources Commission, to forestall any detrimental effects that might result from such practices.

Effects on Water Quality

There is little doubt that the use of pesticides is the most important of the several agricultural practices that affect water quality. The hazards associated with the presence of pesticides in water that have been quite well demonstrated by actual pest control operations and by laboratory studies are as follows:

1. Toxicity to fish and aquatic invertebrate life upon which fish feed.

2. The effect of accumulated pesticides on the reproductive capacity of female fish and the hatching success of fish eggs.

3. The tainting of fish flesh, making them unfit to eat.

4. The creation of adverse tastes and odours in municipal water supplies.

Fish are extremely sensitive to pesticidal compounds, more so than birds and mammals, as a general rule. They are especially susceptible to the chlorinated hydrocarbon pesticides. Endrin is the most toxic chemical to fish that is known to man, causing mortality at a concentration of less than 1 ppb in laboratory tests (i.e., 1 pound of endrin to 100 million gallons of water) (3). Laboratory studies have shown DDT to be toxic at a concentration of approximately 16 ppb (3). The organic phosphorus insecticides, such as malathion and parathion, together with the herbicidal compounds, are considerably less toxic than the chlorinated hydrocarbons, generally at concentrations expressed in parts per million rather than parts per billion. The toxicity of DDT to aquatic insects and other invertebrate life has been well established by studies in Maine, Montana and New Brunswick, following applications of DDT for control of forest insects (4)(5)(6).

It is necessary to cite only a few examples where pest control operations have decimated fish populations and have affected municipal water supplies, to emphasize the potential dangers that exist.

In August, 1950, extensive fish kills resulted in 15 streams of the Tennessee River Valley of Alabama, following the use of organic insecticides in this area for the first time to control boll weevil in cotton. Toxaphene was reported to be the principal insecticide involved and the contamination of the streams was associated with excessive runoff caused by above-average rainfall and too frequent applications of the insecticide (7). Another example of a heavy fish kill was that experienced within a 2,000-acre salt marsh in Florida where dieldrin was applied at a rate of one pound per acre to eliminate sand fly larvae. It was estimated that 20 to 30 tons of fish were killed as a result of the treatment (8). Studies in New Brunswick showed that populations of young salmon and brook trout were drastically affected by aerial applications of DDT for control of spruce budworm (9).

One of the most highly publicized fish kills in the history of the United States developed on the lower Mississippi River in the fall of 1963, following sporadic and less serious mortalities as far back as 1960. A tangled sequence of investigations, consultations and hearings involving government and the chemical industry centered around whether or not pesticide residues in agricultural runoff or discharges from chemical processing plants, or a combination of both, were responsible for the deaths of several millions of fish. Though pesticides were definitely implicated, the question of the source of contamination does not yet appear to be satisfactorily resolved and further studies are currently in progress. One extremely worthwhile outcome of the controversy has been the tremendous impetus given to the development of specialized analytical procedures to detect the presence of minute quantities of pesticides in water. The final conclusions with respect to this situation on the lower Mississippi are being anxiously awaited.

Closer to home, we have been fortunate in Ontario that large-scale fish kills related to pest control operations have never materialized. However, there have been several significant fish kills in the province which have been attributed to carelessness in the use of these compounds. Cleanups of potato spraying equipment in the Nottawasaga River near Alliston in 1963 destroyed several hundreds of fish, including brown trout and rainbow trout. In a canal southeast of Leamington in July of 1962, fish were hauled away by the truckload following the use of aldrin for control of grubs in a radish crop and an application of DDT for control of mosquitoes and flies on the other side of the canal about the same time. In this case, it was reported that the spray bar on the water side was not shut off when the strip in the radish field adjacent to the canal was treated with aldrin.

The accumulation of DDT by lake trout and the subsequent effect on the survival of young fish at the Lake George fish hatchery was proven beyond doubt by a comprehensive study undertaken in New York State between 1958 and 1962. Survival of hatched eggs collected throughout the watershed and retained at the hatchery was completely lacking or negligible over a period of several years. This mortality was caused by the extensive use of DDT, mostly for black fly and mosquito control in the area surrounding the watershed (10). Another study in New York State has demonstrated the ability of fish to concentrate DDT in their tissues, particularly in their internal body fat and reproductive organs (11).

With respect to production of tastes and odours, studies undertaken at the laboratory of the Ontario Water Resources Commission have demonstrated the ability of 2,4-D and other herbicides to cause tastes and odours in water at low concentrations (12). Toxaphene can be detected in water at an extremely low level of a few parts per billion and other insecticides are offensive to a lesser degree. One of the most famous incidents related to the production of tastes and odours in water occurred at Montebello, California, in 1945. A small plant began to manufacture 2,4-D and discharged its waste water into the local sewage system. The sewage plant, in turn, discharged its treated effluent to the Rio Hondo River. Within 17 days following the commencement of operations at the manufacturing plant, tastes and odours developed in shallow wells downstream and it was reported that lawns and shrubs were killed when the well waters were used for irrigation. These wells remained contaminated for a period of three years (13). The possible contamination of waters used as sources of municipal water supplies necessitates a cautious approach where aquatic herbicides or fish poisons are used to control nuisance populations. Furthermore, persons using such chemicals should be aware that claims for damages might arise should their activities interfere with the use of water for irrigation or other rightful purposes by adjacent or downstream riparian landowners.

Although this is an impressive resume of problems associated with the use of pesticides, it is to be admitted that, in the main, problems have been sporadic and generally localized when compared with the total utilization of pest control compounds throughout the entire U.S. and Canada. The widespread use of herbicides and insecticides has not resulted in concentration levels in surface waters used for public water supplies that can be considered to present any immediate hazard to human life. Nonetheless, studies undertaken by the U.S. Public Health Service

have revealed the presence of detectable residues of DDT in several of the major watersheds of the United States and, of more interest to us, in Lake St. Clair and the Detroit River. Concentrations measured by the technique employed were in the range of 1 to 20 ppb (14). Pesticides are getting into our waters and we do not understand all of the implications of their presence.

In drawing to a close, the fact that much is still to be learned about the possible effects to man of long-term exposure to low concentrations of the more toxic pesticides, together with the ability of fish and possibly other forms of aquatic life to concentrate these compounds to their own detriment, point up the need for an accelerated programme to accumulate data concerning pesticide residue levels in water. The best means of providing an expansion of essential analytical services is currently being given careful consideration by the Ontario Water Resources Commission and rapid progress to this end is anticipated. Plans have been laid for this year to collect several species of fish from selected waters throughout the province to determine whether fish contain residues of DDT and possibly dieldrin. Since fish tend to concentrate these materials, it is felt that this study will provide a useful means of determining whether surface waters are being contaminated to a significant degree. Additionally, a single watershed draining an agricultural area receiving repeated heavy applications of pesticide compounds is to receive special attention, in order to determine what residue levels are present in the watercourse and whether fish populations are being detrimentally affected.

In conclusion, may I re-iterate my realization of the need for high standards of agricultural production and I hope that continuing research will provide effective and specifically toxic pesticides to make this a certain accomplishment. All too often, this whole matter is presented as a choice - between high standards of agricultural production and uncontaminated waters, or on a broader scale, an uncontaminated environment. There really is no choice to be made, for we need both! A spirit of co-operation is required on the part of all parties concerned to see that both are maintained.

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PHEASANT HARVEST REPORT

LAKE SIMCOE DISTRICT - 1964

by
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Abstract

A total of 5,518 township hunting licences consisting of 2,047 resident and 3,471 non-resident were sold in the thirteen regulated townships, up to and including November 7, the close of the pheasant season. This is a decrease in total licences purchased by hunters of 10.6% from the previous year. Nine thousand, four hundred pheasants, 4,750 day-olds, 4,000 poults, and 650 adults were distributed to the regulated townships, excluding Markham, E. Whitby, Toronto and Albion townships. A field check of 1,795 hunters during the open season produced a harvest figure of 964 pheasants, for a hunter success of .53 of a bird per hunter checked, an increase of 15.1% over 1963. Time to kill a bird took 6.4 man-hours, a decrease in time from 1963 of about one hour. In Markham township where no pheasants were released this year an average of .85 of a bird per hunter was obtained during the opening day and .61 of a bird for the entire season.

Open Seasons

October 21 - November 7 - Counties of Dufferin, Peel and York. The townships of Adjala, Essa, Tosorontio, Innisfil, Tecumseth and West Gwillimbury in Simcoe County and the townships of Pickering, Reach, Scott, Uxbridge, Whitby and East Whitby in the County of Ontario.

October 3 - November 30 - Remainder of the District.

Statistics

Although the hunting of pheasants was open throughout the entire District, this report covers only nine regulated townships in the District. The remaining regulated townships, Adjala, Tecumseth, West Gwillimbury in Simcoe County, the township of East Gwillimbury in York County and the townships of Toronto and Albion in Peel County

either produced little pheasant hunting or closed their township to hunting during the pheasant season. The remainder of the District that is northward is well outside normal pheasant habitat and no figures are available.

	Opening Day	Entire Season
No. of Parties Checked in Field	251	712
No. of Parties Using Dogs	141	427
No. of Hunters Checked in Field	670	1,795
No. of Man-hours Hunted	1,941	6,182
No. of Cocks Bagged	251	578
No. of Hens Bagged	175	386
Total Pheasants Bagged	425	964
Per Hunter Cock	.37	.32
Per Hunter Hen	.26	.22
Per Hunter Total	.63	.54
Man-hours hunted to Bag a Pheasant	4.6	6.4
Cock Pheasants Seen but not Shot	431	935
Hen Pheasants Seen but not Shot	381	778
Sex Ratio c/h Shot	1.4-1	1.5-1
Sex Ratio c/h Seen not Shot	1.1-1	1.2-1

See Table I for complete coverage by townships

Distribution

A total of 11,000 pheasants made up of 5,700 day-olds, 4,500 poults and 800 adults were received in the District for distribution. As usual day-olds were raised to poult size by townships, Game Commissions and interested sportsmen before release. In the case of Whitchurch township 426 adult birds carried over the winter by the Whitchurch Game Commission were released in early spring, at a ratio of one cock for every five or six hens. In Pickering township, 1,400 day-olds and poults were received by the Game Commission, of this number 974 were released just prior and during the open season and an additional 68 are being wintered over for further experimentation. A loss of some 25.6 per cent here was attributed to the lack of space to raise a healthy well-feathered bird. See Table 2 for complete distribution figures.

Costs of Raising Chicks by Townships

Whitchurch Township	426 birds released = $675. or $1.55 per bird released (winter carry-over)
Pickering Township	1,400 birds (974 released) = $1,805.15 or $1.76 per bird released (Put and Take Project)
King Township	700 birds received = $691. or 99¢ per bird received (shown only for comparison sake)

Licences

A total of 5,518 township licences were sold up to the close of the pheasant season, November 7. This figure is made up from 2,047 resident licences, a decrease of 26.6 per cent from 1963 and 3,471 non-resident licences, a decrease of 8.9 per cent from 1963. Although the new township licence which was placed on sale for the first time this year made additional work for the issuers, no complaints were received from the townships. In regard to the Township Back Patch a numbered patch issued with the licence and to be worn by the hunter, only praise was received. See Table 3 for complete coverage by Townships.

Weather

Unlike the previous year's opening day, when temperatures were above normal, this year's opening presented the hunter with a cool drizzling rain which turned to snow by mid-afternoon. The remainder of the season was a mixture of cool, overcast and sunny warm weather which was, in most cases, excellent for both dog and hunter.

Harvest

Hunter success, bird in the bag and hours to kill a bird all show a nice increase towards better pheasant hunting this year. Although our figures are taken from one township less than the previous year, our hunter success of bird per hunter is up 15.1 per cent and the time to kill a pheasant has decreased by one hour, figuratively shown as .53 bird per hunter and 6.4 man-hours to kill a bird. See Table 1.

Comparison with 1962 and 1963 figures

	1962	1963	1964
No. of Townships reporting	9	10	9
No. of Hunters reporting	1,455	2,097	1,795
No. of Parties Using Dogs	263	457	427
No. of Pheasants reported shot	672	942	964
No. of Pheasants reported seen (not shot)	1,679	1,403	1,713
Hunter Success	.46	.45	.54
Man-hours to kill a bird	7.4	7.5	6.4
Distribution of birds to Regulated Twp.	15,550	15,000	9,400

Remarks

In comparison with 1963 hunter success figures which are shown above as comparable with 1962, this year's hunter success figures for the regulated townships were upwards. In dealing with some of the townships individually, however, we find some interesting harvest figures which might tend to change our thinking as to the proper types of yearly introduction or if such introduction in some townships is needed at all. Three types of planting were in operation this year, spring, summer, and fall, and in two townships where introduction has been carried out yearly in the past, no plantings were made this year. (A Special Pheasant Report is being prepared on these different types of plantings).

Discussion

In this report, and owing to the different procedures of re-stocking in some townships this year's harvest results have been erratic. Summarized very briefly they indicate to us seven things. First, spring plantings of hen pheasants in the Township of Whitchurch in the hope of producing more natural hatched birds, failed. This, we feel, was due to some extent to poor survival of the bird shortly after release, a poor hatch, cause unknown, and poor reproduction from 1963 plantings. Second, poor harvest of pheasants planted in the township of Pickering just prior and during the open season could be attributed to the release, in some cases, of an underweight, poorly-feathered bird brought about from the conditions under which they had been raised; inclement pheasant hunting weather during the opening day and insufficient publicity as to release spots. Third, the very poor harvest in the township of E. Whitby where in previous years a good number of birds have been released and this year none, is mainly due to lack of reproduction and release of birds, plus the publicity given by the township that no birds were to be released. Four, the much improved harvest over previous years in the township of Markham where, like E. Whitby, no birds were released this year, is difficult to explain. From checking hunters over the years in this township, one factor appears to stand out and it could be one of the main reasons that much of this year's harvest came from the southwest corner above No.7 highway which has many acres of grassy and legume fields. In previous years the best hunting came from the north-central areas, where many corn, grain field and low lands are to be found. Five, in the township of King where in past years this township was normally known for its rabbit hunting and where pheasant hunters have been difficult to locate this year enjoyed exceptionally good pheasant hunting. Although the number of licences issued has changed little in the past three years, planting of pheasants during August and September this year increased some 31 per cent over the 1962-63 figures. These, with little hunter competition and well-feathered birds released, are some factors which, we feel, account for the

near doubling of hunter success from the previous year. Six, as in previous years, those regulated townships such as E. Gwillimbury, West Gwillimbury, Tecumseth and Adjala which are very marginal pheasant lands produced little or no hunting. Seven, the continuation under improved supervision of the raising and releasing of adult pheasants during the open season should be furthered, plus improved supervision and more encouragement given to those townships raising and releasing poults.

Acknowledgments

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1964

PHEASANTS HUNTING STATISTICS

LAKE SIMCOE DISTRICT

TABLE 1

	Whitby		E. Whitby		Pickering		Markham		Whitchurch		King	
	Open Day	Entire Season	Open Day	Entire Season	Open Day	Entire Season	Open Day	Entire Season	Open Day	Entire Season	Open Day	Entire Season
No. of Parties	37	67	6	26	64	220	51	142	52	121	17	37
Parties Using Dogs	20	41	6	20	40	132	34	106	22	59	8	21
No. of Hunters	97	175	25	47	154	530	147	384	155	318	36	82
Total Hunter-Hours	228	515	43	266	481	2,103	411	1,187	441	1,066	128	298
Cocks Bagged	25	58	1	2	84	207	82	141	9	33	19	39
Hens Bagged	16	29	1	1	66	133	43	95	13	25	14	28
Total Bagged	41	87	2	3	150	340	125	236	22	58	33	67
Per Hunter Cock	.26	.33	.04	.04	.55	.39	.56	.36	.06	.10	.53	.48
Per Hunter Hen	.16	.17	.04	.02	.43	.25	.29	.25	.08	.08	.39	.34
Per Hunter Total	.42	.50	.08	.06	.98	.64	.85	.61	.14	.18	.92	.82
Hrs. to bag a bird	5.6	5.9	21.5	88.7	3.2	6.2	3.3	5.0	20.5	18.0	3.9	4.4
Cocks Seen (not shot)	57	116	2	3	81	291	185	320	18	61	31	59
Hens Seen (not shot)	44	81			45	214	189	297	30	56	33	56
Total Seen (not shot)	101	197	2	3	126	505	374	617	48	117	64	115
Sex ratio c/h shot	1.6-1	1.9-1	1-1	2-1	1.3-1	1.6-1	1.9-1	1.4-1	1-1.4	1.3-1	1.4-1	1.4-1
Sex ratio c/h seen	1.3-1	1.4-1			1.8-1	1.4-1	1-1.0	1.1-1	1-1.7	1.1-1	1-1.1	1-1

1964

TABLE I Continued

PHEASANT HUNTING STATISTICS, LAKE SIMCOE DISTRICT

	Caledon		Chinguacousy		Toronto Gore		District Total	
	Open Day	Entire Season	Open Day	Entire Season	Open Day	Entire Season	Open Day	Entire Season
No. of Parties	14	62	4	27	6	10	251	712
Parties Using Dogs	5	31	2	12	4	5	141	427
No. of Hunters	27	150	12	79	17	30	670	1,795
Total Hunter-Hours	82	421	83	266	44	66	1,941	6,182
Cocks Bagged	15	58	13	37	3	3	251	578
Hens Bagged	10	44	6	25	5	6	175	386
Total Bagged	25	102	19	62	8	9	425	964
Per Hunter Cock	.56	.39	1.08	.47	.18	.10	.37	.32
Per Hunter Hen	.37	.29	.50	.31	.29	.20	.26	.21
Per Hunter Total	.93	.68	1.58	.78	.47	.30	.63	.54
Hours to Bag a bird	3.3	4.1	4.4	4.3	5.5	7.3	4.6	6.4
Cocks seen (not shot)	30	49	27	36		431	431	935
Hens seen (not shot)	13	36	27	38			381	778
Total seen (not shot)	43	85	54	74			812	1,713
Sex Ratio c/h shot	1.5-1	1.3-1	2.1-1	1.5-1	1.1-7		1.4-1	1.5-1
Sex Ratio c/h seen	1.3-1	1.4-1	1-1	1-1			1.1-1	1.2-1

TABLE 2

PHEASANT DISTRIBUTION - 1964

LAKE SIMCOE DISTRICT

Township	Day Olds	Poults	Stock	Total
Whitby	1,000	800	100	1,900
Pickering	1,100	300		1,400
King	700	1,000	200	1,900
E. Gwillimbury	500	300	100	900
Caledon	200	500	75	775
Chingaucousy	700	500	75	1,275
Toronto Gore		200	50	250
Tecumseth	550	300	50	900
W. Gwillimbury		100		100
Tosorontio			50	50
N. Gwillimbury, Georgina			100	100
Orillia G & F	200			200
Orangeville School	150			150
Stayner Rod & Gun	600	200		800
Tiny Marsh		200		200
Little Lake		100		100
TOTALS:	5,700	4,500	800	11,000

TABLE 3

REGULATED TOWNSHIP HUNTING LICENCES
SOLD UP TO AND INCLUDING NOV. 7
LAKE SIMCOE DISTRICT 1964

Township	Resident	Non-Resident	Total
Whitby	289	300	589
E. Whitby	45	88	133
Pickering	410	415	825
Markham	320	347	667
Whitchurch	170	600	770
King	320	200	520
E. Gwillimbury	159	222	381
Toronto Gore	22	100	122
Chingaucousy	151	239	390
Caledon	35	210	245
Adjala	24	200	224
Tecumseth	36	300	336
W. Gwillimbury	66	250	316
TOTAL:	2,047	3,471	5,518

REPORT ON THE USE OF FOUR INCH MESH IN HARVESTING THE WALLEYE (*Stizostedion vitreum*) OF MAKOOP LAKE WITH RECOMMENDATIONS OF THE USE OF THIS MESH SIZE IN THE PATRICIAS

by
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Abstract

An investigation was begun on a Precambrian Shield lake to study the effects of a reduction in mesh size from 4-1/2 inch to 4 inch extension measure. An analysis of a representative sample of 537 walleyes captured in the 4 inch commercial nets showed that approximately fifty per cent of the catch is ten years old and younger. The average age of the sample is 10.8 years. The growth of walleyes from Makoop Lake is very similar to the average growth of walleyes of nine Patricia lakes and to the walleyes of the Red Lakes, Minnesota. A length-weight equation is presented for a representative sample of 100 walleyes from Makoop Lake. An analysis of maturity data indicates that male walleyes from this lake probably mature at age VII followed by females a year later. An analysis of a segment of a catch curve for this walleye population indicates an annual mortality rate of twenty-eight per cent. When this information is used in conjunction with the relative growth rate, the age at maximum biomass occurs at 5.8 years. The large difference between the age at maximum biomass and the average age of the sample collected from 4 inch mesh indicates that the 4-1/2 inch mesh currently in use in Makoop Lake is inefficient in harvesting the walleye. Recommendations on the use of 4 inch mesh in the Patricias is presented.

Introduction

Lewis (1964) recommended that a study be inaugurated on the effects of a reduction in mesh size from 4-1/2 inch to 4 inch (extension measure) on the whitefish and walleye populations in Patricia lakes. In this report Lewis used catch per unit effort data to show that the 4-1/2 inch mesh currently in use is very inefficient in harvesting the slow growing populations in this

section of the province. He suggested that the use 4-1/2 inch mesh "...may be one factor in preventing a greater and more efficient harvest of walleye (Stizostedion vitreum) and whitefish (Coregonus clupeaformis)".

The use of catch per unit effort is not satisfactory by itself to justify a reduction in mesh size unless this information has been collected on an unfished population. Where a population has been previously fished by a given mesh size, the effect of such exploitation is to remove the larger fish which are expected to be old and which are generally slower growing. The end result is a younger population in which the average size of fish is too small for efficient capture by the gear in use, and a subsequent reduction in the catch per unit of effort. This chain of events is especially true where only the oldest and largest fish in the population are harvested. With further reductions in mesh size the effects of recruitment and growth become more important and modify the situation described above.

Lewis apparently recognized the limitations to which catch per unit effort data are subject, and recommended a study on the population dynamics of the two species in at least one Patricia lake. This proposed study was to specifically examine the case for or against a reduction in mesh size. In accordance with this recommendation the present study was begun on Makoop Lake by this author with the assistance of Mr. E. A. Driver.

Makoop Lake is situated at Long. 90° 50', Lat. 52° 25', approximately 205 air miles north of Sioux Lookout on the Precambrian Shield. A limited amount of physical, chemical and morphometric data is available in a report by Monk and Lessard (1963).

Makoop Lake was selected for this type of study since Monk and Lessard had found that the walleye captured in the 4 and 4-1/2 inch mesh nets were rather old and that the catch per unit of effort for these mesh sizes was low relative to the smaller mesh sizes. They found that the greatest catch per unit of effort occurred in the 2-1/2 inch mesh. (Figure I) These authors recommended that 4 inch mesh would afford a better return to the commercial fishermen. That the potential yield of this lake was not being realized was apparent on examination of the production records in comparison with the potential fish production calculated using Ryder's (1964) morphoedaphic index. Using this method a potential fish production of approximately 4.5 pounds per acre, or a yield of 123,000 pounds for the entire lake was calculated. Although a quota of 45,000 pounds was set for this lake, the effort required to harvest this poundage of fish made the venture unprofitable. This quota was removed only once in three years of fishing (1959), and was almost entirely composed of whitefish (18,100 lbs.). During the winter of 1962 intensive netting with 10,000 yards of 4-1/2 inch mesh net daily for 14 days yielded only 340 pounds of walleye (Pers. comm. - C. St. Paul). The general attitude was that the lake has been "fished out".

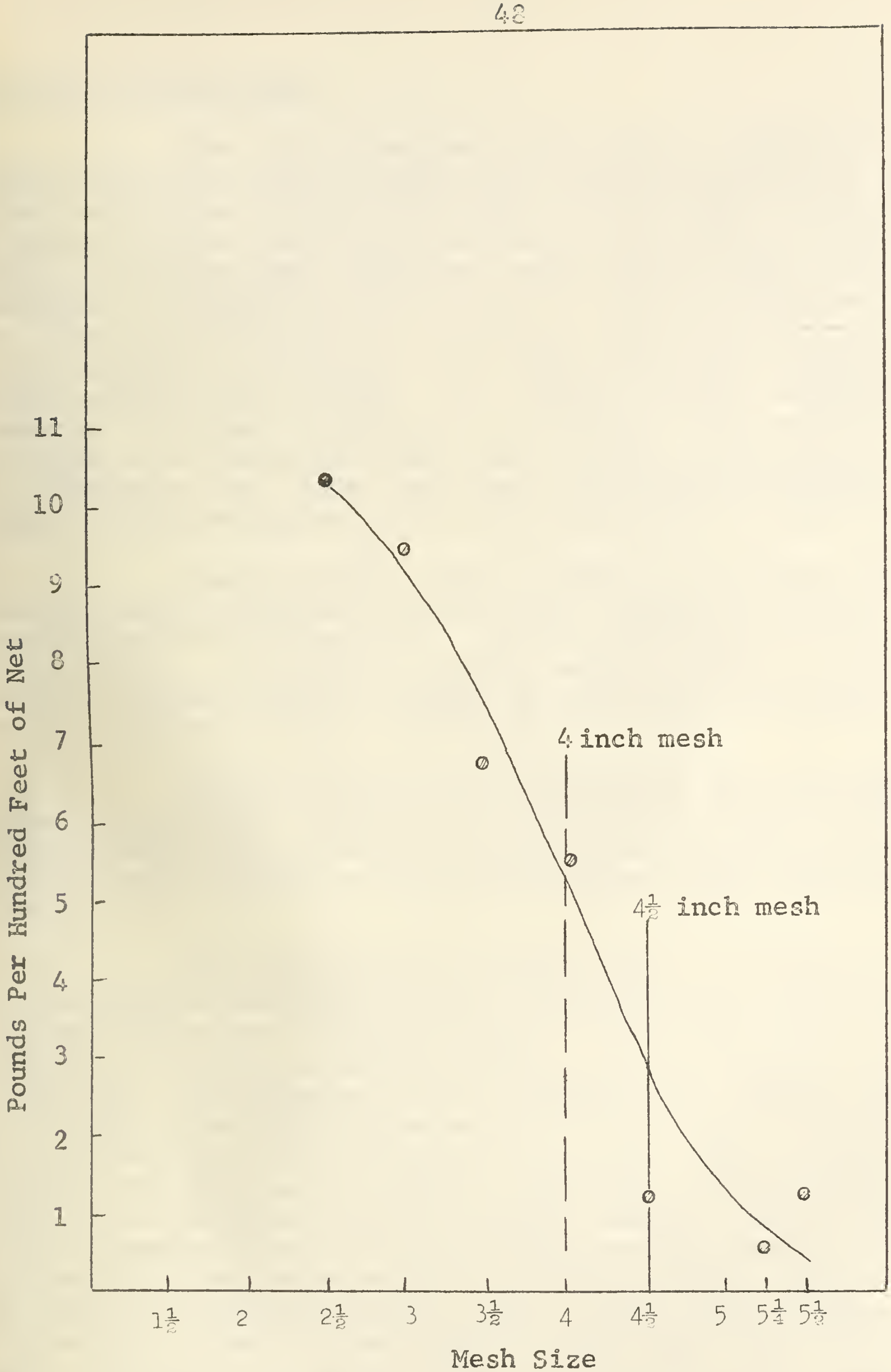


Figure I - Catch of walleyes per hundred feet of net for ten mesh sizes from 1-1/2 to 5-1/2 inch. Data calculated from Monk and Lessard.

Methods and Materials

The main objective in the work at Makoop Lake was to representatively sample walleye and whitefish caught by the 4 inch mesh nets in use for the first time in this lake. In order that a representative sample was collected the fishermen were asked to bring all walleye and whitefish caught back to camp for examination. Excellent co-operation was received. When the fishermen were checked on the lake while they were removing their catch from the nets, no small walleyes or whitefish were being discarded although some very small walleyes were caught. As a further check, locations where unwanted fish were discarded were examined. No walleyes were found, although a few whitefish which were probably culls were present. It is, therefore, felt that the sample of walleyes reported in this paper is representative of the catch harvested by the 4 inch mesh.

Scale samples, total lengths, sex and the state of maturity were collected on each fish. A total of 633 walleyes were sampled for this information. Total weights were collected on 100 walleyes. In addition weights were collected on samples of dressed (without heads) walleyes to determine the average dressed weight harvested by the 4 inch mesh.

Scale samples were removed from the area below the anterior insertion of the soft dorsal fin below the lateral line. Total lengths were recorded to the nearest one-tenth of an inch. Weights were recorded to the nearest ounce using a balance type scale.

The determination of the state of maturity is difficult in the walleye especially if the fish have been collected early in the growing season. Although mature females are fairly simple to identify by the noticeable presence of eggs retained from previous spawnings, the immature fish are difficult to separate from those fish which have only spawned once or twice, and in which the presence of retained spawn is not readily apparent. Where maturing eggs are visible the fish must be mature, but these are very difficult to find in the early part of the growing season. For the same reason the incidence of mature walleyes that were not going to spawn the following spring could not be evaluated; probably samples collected in August or September would clear up these difficulties. Since the samples of walleye reported in this paper were collected in the early part of the growing season, many walleyes just reaching maturity were undoubtedly recorded as immature. The values reported for the percentage of immature fish are, therefore, probably too high. Since maturing eggs were difficult to find, the incidence of mature walleyes that were not going to spawn the following spring could not be evaluated.

At Sioux Lookout, the scale samples were arranged in an ascending order of length and the information on the scale sample envelopes was recorded on previously prepared forms. Scale impressions were made on cellulose acetate slides, and the impressions were read using a Leitz Trichinoscope following the method described in Appendix A of Lewis et al (1964).

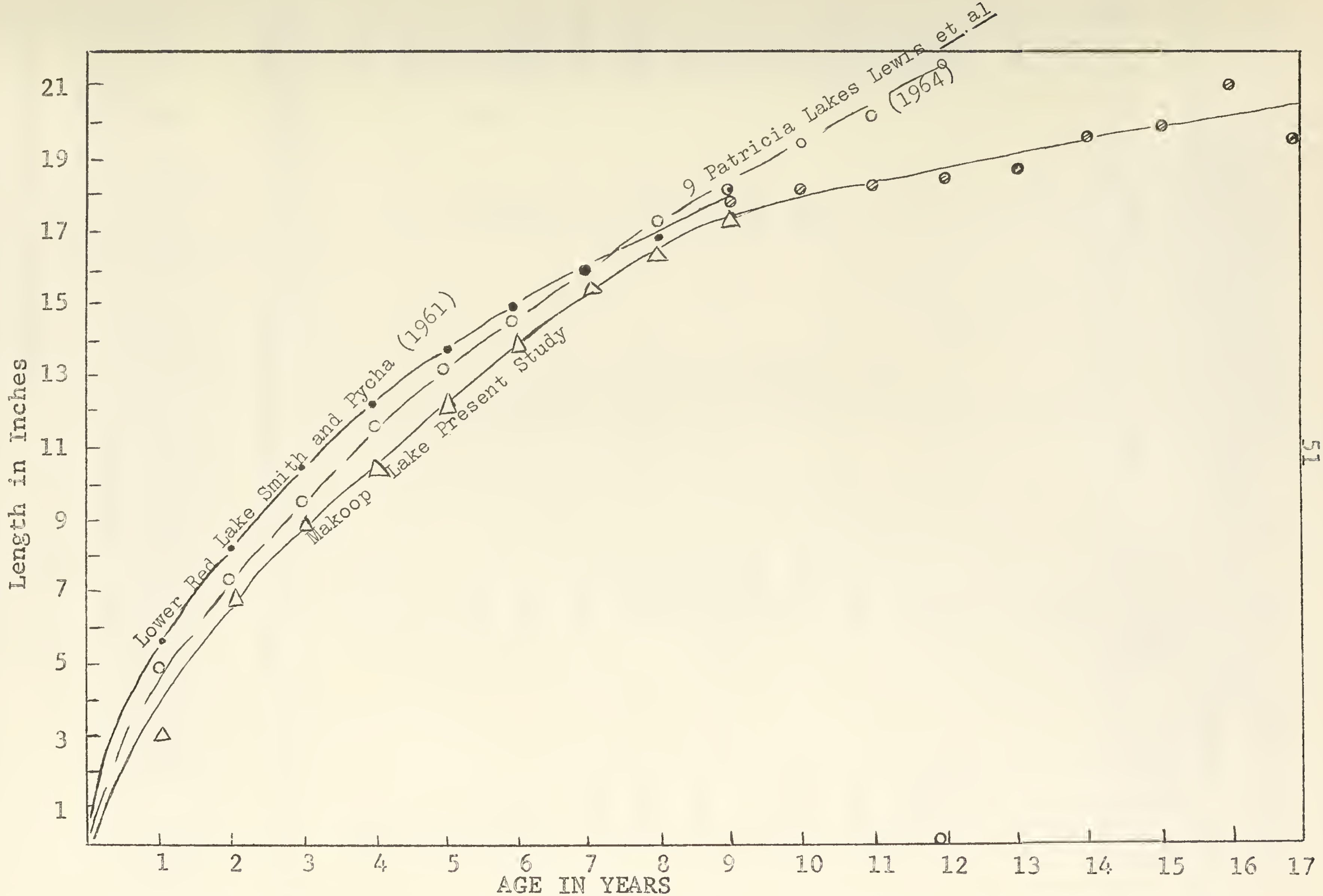
Results

Age and Growth

Table 1 shows the percentage composition of walleyes caught in the 4 inch mesh at Makoop Lake in 1964, and the cumulative percentages at each age. The sample is predominantly composed of old fish. Approximately fifty per cent of the sample was ten years old and younger with age groups IX and X accounting for forty-four per cent of the entire sample. Approximately ninety-eight per cent of the sample was older than six years. The average age of the entire sample was 10.8 years.

The growth of the walleye in Makoop Lake is presented in Figure II. Triangles represent back-calculated values on a sample of age group IX walleyes collected in 1964. Circles represent the average lengths of each age group of walleyes collected in 1964. This growth curve is very similar in the older age groups to the curve presented by Monk and Lessard (opus cit.), but shows a faster growth rate in the younger age groups. When the original scales were examined it was found that the locations of the first annulus and in some cases the last were probably misinterpreted. Thus the ages were one year less than the ages designated by this author. When a correction was applied to their growth curve and the two curves compared they were almost identical.

Differential growth between the sexes is general after the age at maturity has been reached. In this study the females grew faster than the males (plots not shown), but both sexes were combined in calculating the growth rate from age groups IX to X represented in Figure II. Since the females greatly outnumbered the males (80 females to 20 males) this section of the curve more closely represents the growth of the females than the combined growth which should be lower.



<u>Figure II</u> - The growth of the walleye of Makoop Lake, 1964, in comparison to the growth of walleyes from nine Patricia Lakes (Lewis et al 1964) and from Lower Red Lake, Minnesota (Smith & Pycha, 1961.).

Table I - Percentage composition of the catch of 537 walleyes from 4 inch mesh at Makoop Lake in 1964

Age Group	Number	Percentage	Cumulative Percentage	Cumulative Percentage
IV	2	.37	.37	99.95
V	2	.37	.74	99.58
VI	1	.18	.92	99.21
VII	4	.75	1.67	99.03
VIII	24	4.47	6.14	98.28
IX	120	22.34	28.48	93.81
X	119	22.16	50.64	71.47
XI	81	15.08	65.72	49.31
XII	72	13.40	79.12	34.23
XIII	61	11.35	90.47	20.83
XIV	30	5.58	96.05	9.48
XV	16	2.97	99.02	3.90
XVI	4	.75	99.77	.93
XVII	1	.18	99.95	.18

Average age - 10.8 years.

The average growth of walleyes from nine Patricia lakes (Lewis et al, 1964), and from the Red Lake of Minnesota (Smith and Pycha, 1961) are presented for comparative purposes. The similarities of the curves is apparent, and will be discussed in other sections.

Length-weight Relationship

The length-weight relationship for the walleyes of Makoop Lake can be expressed by the regression equation: $Y = 2.8930X - 2.1701$ where Y is the log of the weight in ounces and

X is the log of the total length in inches (Figure III). In order to avoid the tedious work involved by using observations on 100 fish, the average weight of fish in ounces was calculated for each one-tenth inch interval and the regression analysis was calculated using forty-one observations. The method of regression analysis is presented by Snedecor (1956). A summary of the computations is presented in Appendix A.

Maturity

Table II shows the percentage of mature and immature walleyes of both sexes caught in the 4 inch mesh at Makoop Lake. It is quite apparent that this size of mesh captures a predominance of mature fish, at least when first used in a lake. With removal of greater proportion of the older year classes the percentage of immature fish will probably increase slightly.

Table II - The percentage of mature and immature walleye of both sexes sampled from the 4 inch mesh used in Makoop Lake in 1964.

	Males	Number	Females	Number
Mature	97.8	132	90.3	446
Immature	2.2	3	9.7	48
Totals	100%	135	100%	494

The data are not sufficient to accurately determine when the walleye of this lake first become mature, but are presented in Table III to serve as a rough indication.

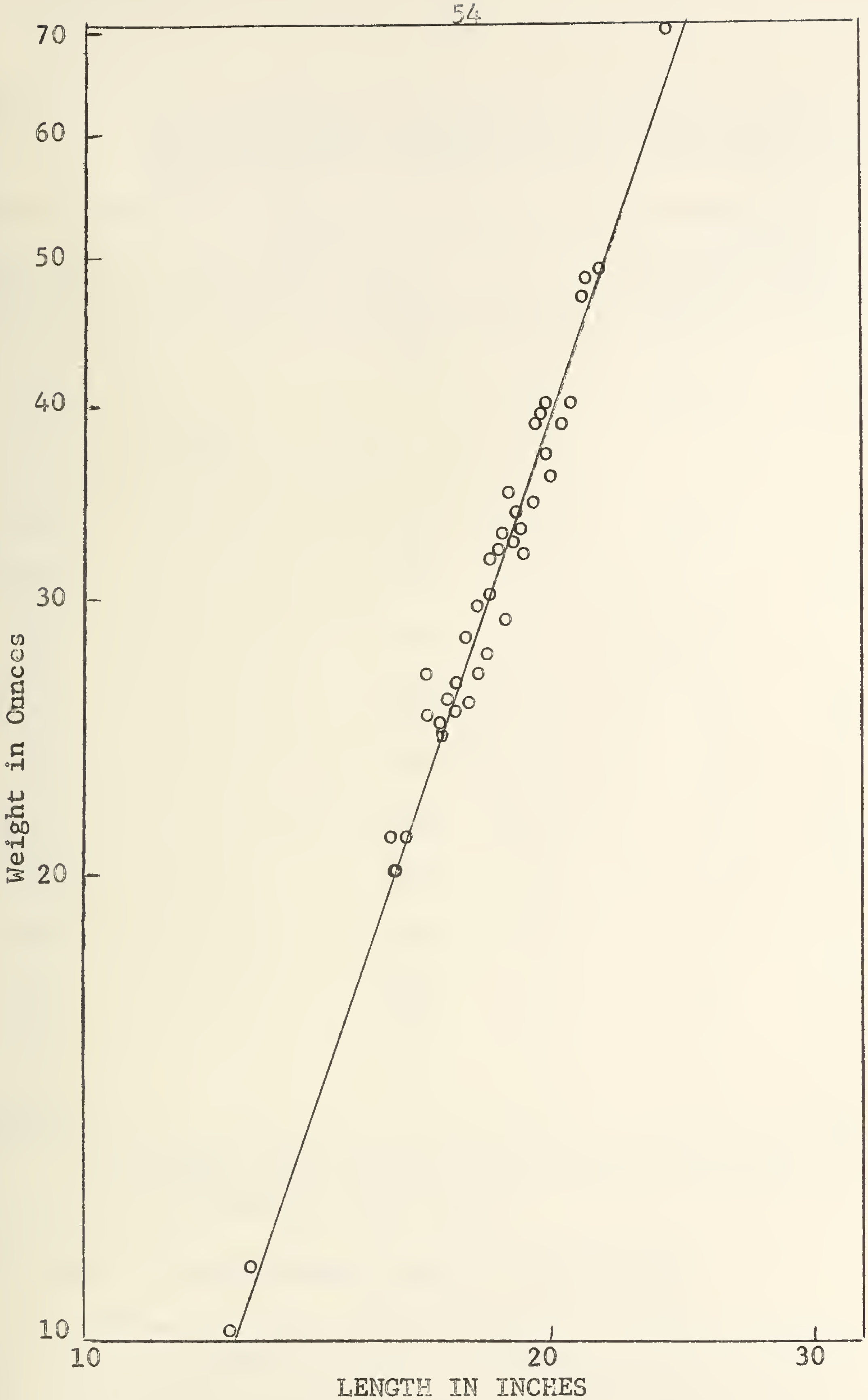


Figure III - The length-weight relationship of Makoop Lake walleye.
The regression equation is presented in the text.

Table III - The percentage of mature and immature walleye for each age group caught in the 4 inch mesh at Makoop Lake, 1964.

	Males			Females		
Age Group	Immature	Mature	No.	Immature	Mature	No.
IV	0	100	1	100	0	1
V	-	-	0	100	0	2
VI	100	0	1	-	-	0
VII	33	67	3	100	0	2
VIII	0	100	7	41	59	17
IX	0	100	17	13	87	102
X	0	100	19	10	90	102
XI	0	100	23	2	98	59
XII	0	100	20	0	100	52
XIII	0	100	22	0	100	38
XIV	0	100	3	0	100	27
XV	0	100	2	0	100	12
XVI	0	100	1	0	100	4
XVII	-	-	0	0	100	1

Probably male walleyes become mature for the first time at age VII and females at age VIII.

Catch Curve of the Walleye Catch in Makoop Lake

When the log of the frequencies of the age groups in a representative sample of fish is plotted against the age of those fish, the resulting curve is called a catch curve (Ricker, 1948). The catch curve for Makoop Lake walleye is presented in Figure IV. When such a curve is straight in the right-hand limb constant survival rate is indicated. Nonlinearity in this section of the curve may have several causes when the population being considered has previously been fished, but in a relatively unfished population

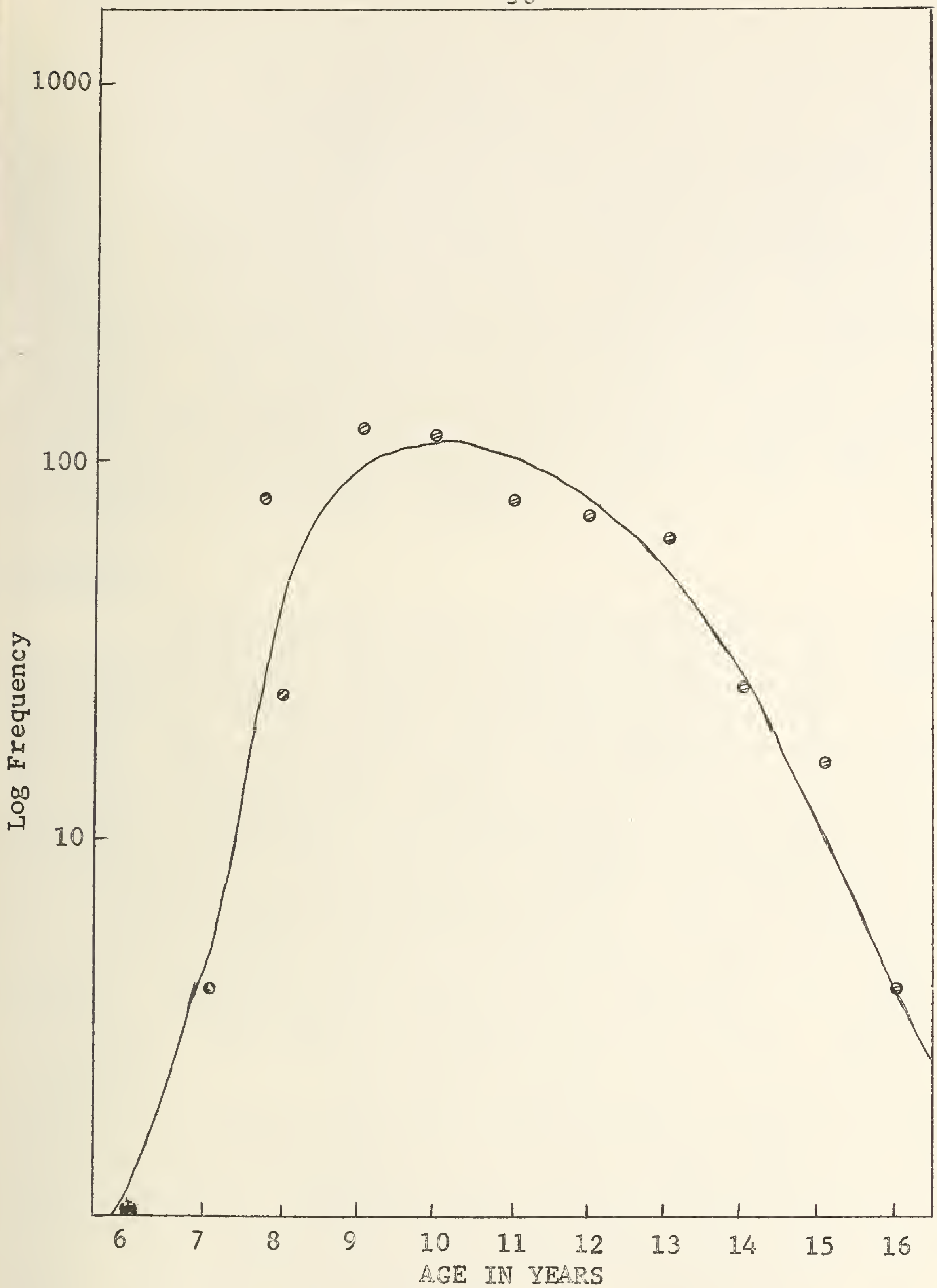


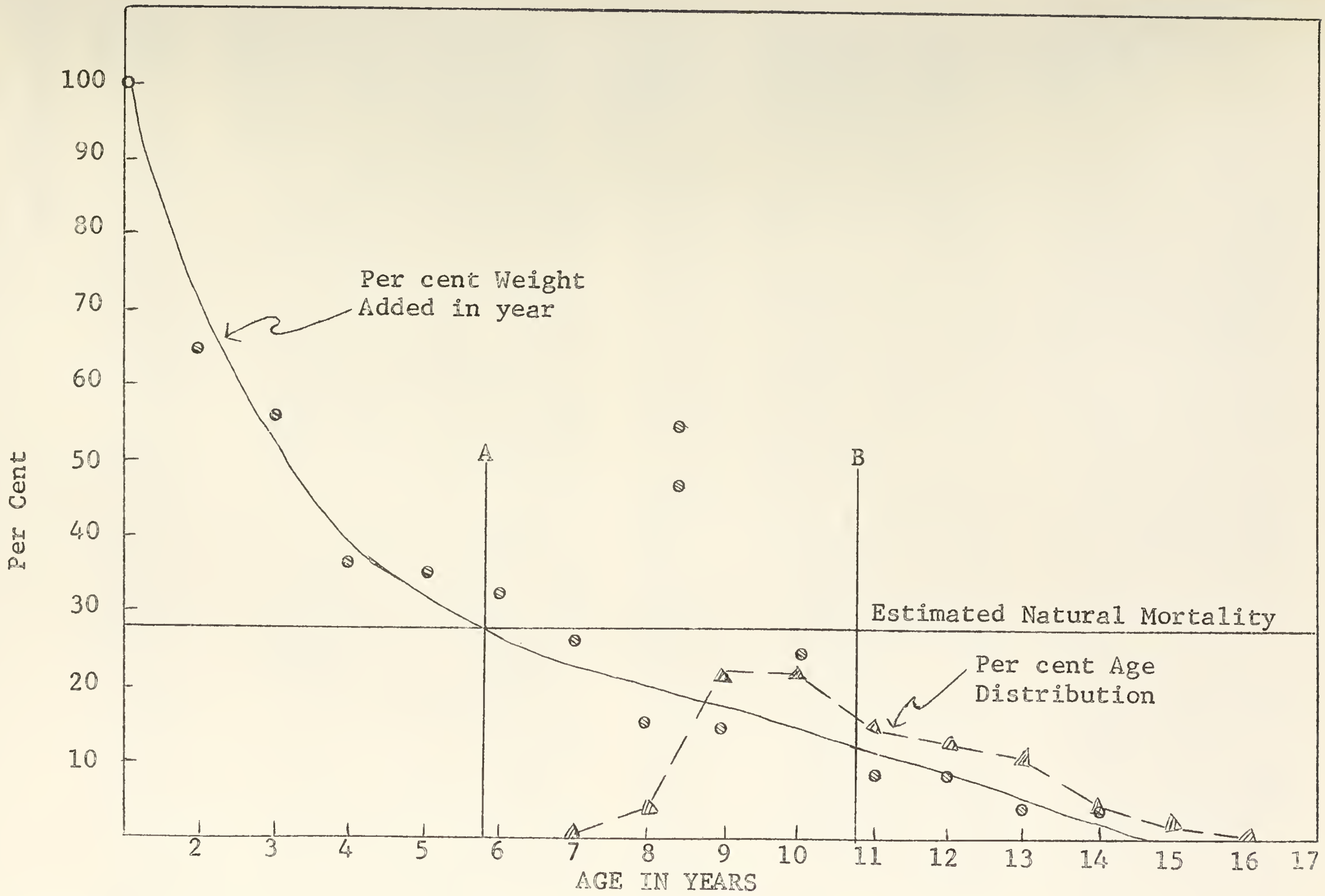
Figure IV - Catch curve of Makoop Lake walleyes samples from 4" nesh nets, 1964.

such as Makoop Lake, the convexity is probably caused by two factors:

1. An increase in natural mortality with age, and: 2. The effects of previous fishing effort on the older age groups when 4-1/2 inch mesh was used. The straightness of part of this curve under the situation of a relatively unexploited fishery should give some indication of the annual survival rate between the ages of such a section of the catch curve. This section has been assumed to be between age groups ten and fifteen, inclusive. Using the method described by Robson and Chapman (1961) in analyzing a segment of a catch curve, an annual survival rate of 72 per cent was calculated. The computations are presented in Appendix B. The mortality rate, which in this case would be the natural mortality rate, is the complement of the survival rate and was found to be 28 per cent. It is assumed that this mortality rate is constant and applies to age XV and younger.

Discussion

If the relative rate of growth in weight of a species is known in addition to the rate of natural mortality, the minimum size at which maximum biomass occurs can be calculated. This information is presented for the walleye of Makoop Lake in Figure V. The descending curved line represents the increase in weight added each year relative to the weight at the beginning of the year expressed as a percentage. This information was obtained by determining the average lengths at the end of each year from Figure II and calculating the weights corresponding to these average lengths by the regression equation represented in Figure III. A curve showing the growth rate in terms of weight would be just as satisfactory. Next the difference between the weights of successive age groups was determined and the percentage change in weight in relation to the weight at the beginning of the year was calculated. This method is presented by Fry (1964). The method of estimating the rate of natural mortality has been presented previously. The age at which the curve of the relative growth rate intersects the line representing the rate of natural mortality is the point where the mass of weight added each year equals the mass of weight removed each year through the factors of natural mortality. Maximum biomass of the species occurs at this point, and is represented by the vertical line A in Figure V (5.8 years). The vertical line B represents the average age of the fish samples from the 4 inch mesh nets used on Makoop Lake in 1964 (10.8 years). The broken line with the solid triangles is the percentage age distribution of a sample of the catch, and is presented to show the contributions of each year class relative to the estimated point of maximum biomass and the average age of the sample.



<u>Figure V</u> - Relationship of the relative growth rates and the estimated natural mortality, of walleye of Makoop Lake, 1964. The percentage age distribution of walleye sampled from the 4 inch mesh is presented for convenience (closed triangles).

No average age for the sample of fish caught in the 4-1/2 inch mesh nets was ever obtained, but this value must be greater than the average age of the fish caught in the 4 inch nets. Even so, the difference between the average age of fish caught in the 4 inch nets and the age at maximum biomass is startling and indicates that with the use of 4-1/2 inch nets, the lake was being grossly underfished. The fish which were passing through the 4-1/2 inch mesh nets were simply dying through the factors of natural mortality.

With continued use of 4 inch mesh nets in Makoop Lake, it can be expected that the average age of the sample will decrease slightly, but will not become less than the average age at maximum biomass simply because this size of mesh is too inefficient in capturing the size of fish at this age. In making this statement it is realized that with increased exploitation the characteristics of growth and mortality of the walleye in this lake will change, but the extent of this change should not invalidate this statement.

The average dressed weight of 303 walleyes (dressed without heads) was 1.28 lbs. The average round weight of 100 walleyes was 1.88 lbs. These weights are suitable for government and commerce.

Theoretically, when the effects of future exploitation with 4 inch nets are more fully known, it may be found that the use of 3-1/2 inch nets will more fully realize the potential of this lake, having due regard for the requirements of government and commerce for a desirable size of fish. This mesh size has been used in the Red Lakes of Minnesota for many years with no damage to the fishery (Smith and Pycha, 1961). Since the growth rates of walleyes from Makoop Lake and the Red Lakes are very similar, Figure II, especially in the older year classes, the use of 3-1/2 inch mesh should be investigated in the future. No specific recommendations for the immediate use of this size of mesh are given here.

Since the growth rate of walleyes from Makoop Lake is very similar to the average growth of nine Patricia lakes, it can be safely argued that 4 inch mesh nets can be used in this area.

Recommendations

1. That 4 inch mesh nets be used for existing Patricia Indian fisheries after a fishery investigation has been conducted for the harvest of walleye and whitefish in lakes where lake trout are not present.

2. That adequate representative samples of walleye and whitefish be collected by standard gill net sets and the data analyzed before licenses for 4 inch mesh nets are issued for any lake, providing that this restriction would be removed when adequate information is available to justify the use of this mesh size in Patricia lakes in general.

3. That an intensive tagging programme be conducted on at least one, preferably two, Patricia lakes (Makoop and/or Sachigo if feasible) to more accurately determine the natural mortality rate. The use of trap nets capable of capturing the younger year classes is recommended.

4. That detailed analysis be conducted on the data collected at Sachigo Lake in 1964 from the commercial fishery and experimental netting. This recommendation is especially important since Sachigo is the only lake in which representative samples have been collected by standard gill net sets before 4 inch mesh nets were used for the first time. Much valuable information has been collected from this lake.

5. That follow-up procedures be conducted on the changes in the age, sex, and size composition of the commercial catch of 4 inch mesh nets, especially in Sachigo and Makoop Lakes.

6. That long-term studies be inaugurated on the feasibility of using 3-1/2 inch mesh nets in the future. Caution in making recommendations on the extensive use of this mesh size is recommended.

Acknowledgments

I wish to personally thank Mr. C. E. Perrie, Fish and Wildlife Supervisor, for permitting me to undertake this interesting study, and for advice on the problems I encountered. For assistance in the field I am indebted to Mr. E. A. Driver and Mr. T. Beardy. For information on the past history of Makoop Lake I wish to thank Messrs. C. St. Paul, C. Milko, C.Monk and J. Lessard. For critically reading the manuscript my thanks are expressed to Mr. A. E. Armstrong. Finally, my thanks to Mr. H. Speight, pilot of Otter ODV for the transportation and suggestions.

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APPENDIX A

Computations of the length - weight regression equation for walleyes sampled from the 4 inch mesh used in Makoop Lake in 1964.

$SX = 51.6873$	$SY = 60.5625$	$SXY = 76.65775517$
$\bar{x} = 1.2607$	$\bar{y} = 1.4771$	$C.F. = 76.34907576$
$SX^2 = 65.26714693$	$SY^2 = 90.37177603$	$Sxy = .30867941$
$C.F. = 65.16041417$	$C.F. = 89.45893673$	
$Sx^2 = .10673276$	$Sy^2 = .91283930$	

$$N = 41$$

$$b = Sxy/Sx^2 = .30868/.1067 = 2.8930$$

$$Y = 2.8930X - 2.1701$$

APPENDIX B

Analysis of a segment of the catch curve presented in Figure IV using the method of Robson and Chapman (1961)

Age	Coded Age	Number in Catch
10	0	119
11	1	81
12	2	72
13	3	61
14	4	30
15	5	16
	Total	379

$$\bar{X} = \frac{Tk}{n} = \frac{81 - 2(72) - 3(61) - 4(30) - 5(16)}{379} = \frac{608}{379} = 1.604$$

Using the above author's Table 3 (page 187) for K = 5, the survival rate is .72.