FLAT-TAILED HORNED LIZARD STATUS REPORT

SEPTEMBER 1993

BY

GAVIN R. WRIGHT

BUREAU OF LAND MANAGEMENT

EL CENTRO, CA.

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Acknowledgements

Student Conservation Association (SCA) volunteers Valli Parthasarathy, Mark Massar and Renee Kolbezen provided most of the field work in 1993, Kevin Zippel and Paula Miller provided it in 1992. SCAs Greg Edgar and Kevin Kennedy did the field work in 1991. BLM biologist Gavin Wright participated with the SCAs in data collection from 1991 to 1993. SCAs Jim Westerhold and Charise Hedlund helped BLM biologist Jim Watkins in 1990. Marty Perez volunteered in 1989, Yvette Matthews in 1986 and Lila Borge and Allison McCall in 1985.

The names of the other 3 SCAs who volunteered in the 1980s have been lost. Likewise, others who collected flat-tail data presented in this report may not be acknowledged because their names were not recorded on the data sheets. I regret that these people cannot be acknowledged.

Lillian Olech (BLM) was the primary data collector from 1984 to 1986. Kim Nicol (California Department of Fish and Game) and Lillian Olech were the primary data collectors from 1987 to 1989.

Anza-Borrego Desert State Park and the California Department of Fish and Game collected the data in the greater Ocotillo Wells area in 1979, 1986, 1988 and 1989 and participated in surveys with the BLM in 1979, 1981 and 1987 - 1989. In addition, the following people have performed surveys over the years:

Ken Asplund	Jim Rorabaugh	Todd Esque	Mark Roddy
Booher	Mark Jorgenson	Eugene Stewart	Robert Klinger
Bill Berry	Paul Jorgenson	Eric Nelson	Russell Duncan
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Bill Clark	Yvette Matthews	Herbert Hill	Nancy Foley
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Jeff Lovich, Bill Boarman, Hal Avery and Larry Foreman provided statistical assistance. BLM rangers Kurt Toovey and Ray Polo completed inventory of the East Mesa Area of Critical Environmental Concern (ACEC). Ron Salz loaded the flat-tailed horned lizard (FTHL) scat data from dbase4 to the geographic information system (GIS), so that a scat map could be produced. Bob Bower, Ron Salz, Rose Shepard, Rose Lucero and Jim Scrivner helped with printing copies of the scat map. Jim Watkins, Tom Zale and Ben Koski of the El Centro Resource Area also provided helpful comments on the manuscript.

ABSTRACT

Flat-tailed horned lizard (Phrynosoma mcallii) (FTHL) scat counts in Imperial County, California were analyzed from 1979 to 1993 with the Spearman Rank Correlation Coefficient. Relative abundance of FTHL scat showed a significant ($p <= 0.05$) downward trend in the Yuha Desert. Relative abundance of scat in West Mesa and East Mesa did not exhibit a statistically significant trend. The reason for the Yuha decline is uncertain.

The relative abundance of scat in the Yuha Desert was significantly greater in 1993 than in 1991.

The relative abundance of FTHL scat along route Y1955 in the Yuha desert did not show a significant trend in the 5 years following its closure in 1984. The relative abundance of FTHL scat along route Y1851 (an open route) in the Yuha desert did not show a significant trend during the same period. A reanalysis of Klinger's data from the Algodones Dunes found significantly more FTHL scat in the Open area than in the Limited area. No significant difference in the number of FTHL scat was found between the Closed area and the Open area or between the Closed area and the Limited Area. No significant difference in the relative abundance of FTHL scat was found between areas of heavy OHV use and no OHV use. These 2 studies contrast with Olech's work at West Mesa in 1985 which found a negative relationship between OHV tracks and FTHL scat.

The validity of these results in reflecting FTHL population trends or differences between areas relies on the assumption that the relative abundance of scat is correlated with the relative abundance of FTHLs. Chi-square analysis revealed a significant positive association between FTHL scat relative abundance classes and FTHL sightings. Analysis of variance showed a significant correlation between scat per hour and FTHL sightings, but regression analysis showed scat per hour to be a poor predictor of the actual number of FTHL sightings. These results suggest that scat per hour may be a rough indicator of FTHL relative abundance. The Yuma Bureau of Land Management (BLM) office is initiating a study to determine what relationship exists between scat relative abundance and FTHL relative abundance.

Three year-round scat monitoring transects showed that peak scat abundance lasted from mid-July to mid-October in West Mesa and the Yuha Desert while it lasted from early May to early-August in East Mesa. These data should guide FTHL surveying times each year, as well as supplementing monitoring data.

All known FTHL data collected from 1978 to 1993 in California were entered into a DBASE4 file. The mean scat per hour for each section from 1979 - 1992 was entered into a Geographic Information System (GIS) and a scat relative abundance map was produced to aid decision making and to complement the FTHL habitat category map.

Continued protection of the East Mesa ACEC, continued conservation of category 1 and 2 habitats and keeping OHV use at current levels are suggested as a means of managing habitat so as to prevent the need for listing. The BLM should initiate expanded OHV impacts studies in the Yuha Desert and West Mesa and should continue to incorporate the latest research findings into its monitoring. The total area impacted by sand and gravel operations should be quantified with a global positioning system.

145 sections were inventoried for FTHLs in 1993. FTHLs or their scat were found on 112 (77.24%) sections.

INTRODUCTION

The flat-tailed horned lizard (FTHL) is a small ant-eating igaunid lizard that occurs from southeastern California to extreme southwestern Arizona and northern Baja California and Sonora. Much of its original habitat has been lost to agriculture, cities, freeways, canals and other man-made impacts. Most of the remaining habitat is on Bureau of Land Management (BLM) lands in Arizona and California, in Anza-Borrego Desert State Park and in Mexico. Because of this historic habitat loss, the FTHL is of concern to the BLM. In response to this concern, BLM designated the FTHL a sensitive species in 1980.

Since that time, the FTHL has become a category 1 candidate for listing under the Endangered Species Act. A listing package has been prepared by the U.S. Fish and Wildlife Service (USFWS). The preparation of the listing package is in part a response to a legal settlement with the U.S. Fish and Wildlife Service, in which it was agreed to decide whether to propose the species for listing by September 1996 (DOI 1992). The BLM's current policy is to manage lands with candidate species (categories 1 and 2) in a manner that will not contribute to the need to list the species as threatened or endangered (BLM 1988). Implementation of this policy requires the BLM to monitor populations of the FTHL.

The foundation for this monitoring was laid in 1978 when the BLM contracted with the University of California at Los Angeles to examine the status of the FTHL in various parts of Imperial and Riverside Counties (Turner *et al* 1978). This survey identified 4 high density areas: Ocotillo Wells, East Mesa, West Mesa and Yuha Desert. BLM monitors populations in East Mesa, West Mesa and the Yuha Desert; Anza Borrego Desert State Park (ABDSP) monitors populations in the Ocotillo Wells area. Monitoring data is intended to assist managers in the decision making process. Monitoring or inventory has occurred in every year since 1978, except 1980, 1982 and 1983. Not all areas have been monitored in all years due to man-power restrictions. This report summarizes and interprets all BLM California FTHL monitoring and inventory data collected from 1978 to 1993.

METHODS

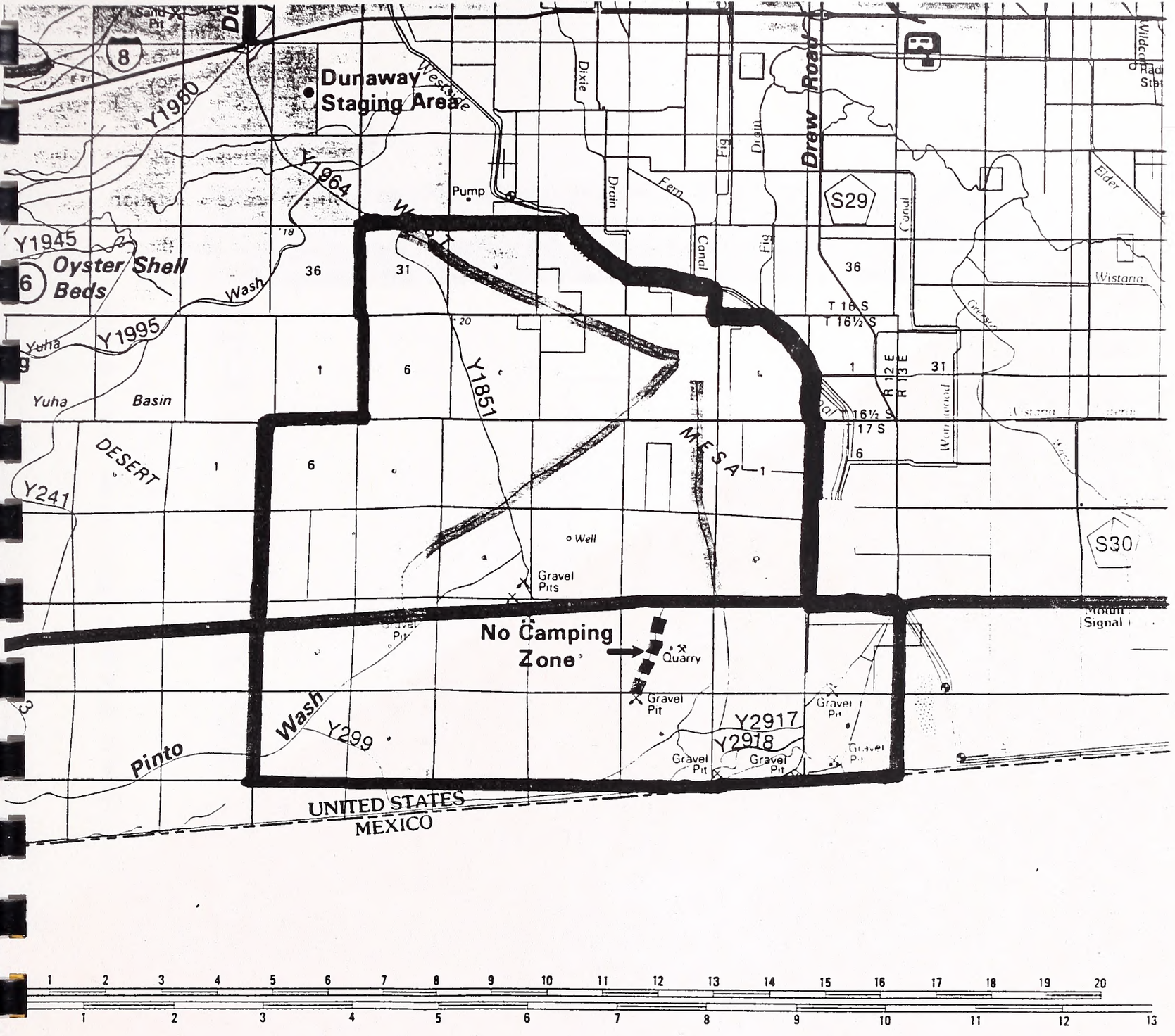
INVENTORY AND MONITORING SURVEYS

FTHL populations are monitored by counting the number of scat seen per hour on 2.5 mile triangular transects. Transects are walked in about 1 hour, depending on terrain, observer condition, number of scat seen and weather conditions. Each transect is begun 0.1 miles from a section corner marker and occurs entirely within a section. FTHLs seen on transects are also counted, although they are rarely seen due to the cryptic coloration and generally motionless status of the FTHL when threatened. The transect width is 50".

FTHL scat counts from 1979 to 1993 were analyzed from three areas within West Mesa, East Mesa and the Yuha Desert (Figures 1,2,3). Transects outside these three areas were excluded from the analysis, as were years in which samples were not taken randomly or systematically. The counts were standardized to scat counted per observer per hour. Most transects were 2.5-mile long triangles located within 1 section. Some transects in the Yuha and East Mesa before 1991 were linear or in irregular shapes. Sections in which transects were performed were selected at random, except in 1979, 1981 and 1986 in the Yuha and 1986 in East Mesa. In 1979 a large systematic sample of the Yuha was taken. In 1981, transects were done to assess the impact of the construction of the La Rosita Powerline, but effectively blanketed the area surveyed in 1979. In 1986 many of the 1979 transects were repeated. If more than one scat count was done in a section in a given year, then those counts were averaged first before being averaged with the all the counts in an area for that year. The average scat per hour for each of the three areas for each year was calculated. This average was used in the Spearman Test (Ullman).

MAPPING SCAT DATA

A scat relative abundance map was produced with the Geographic Information System (GIS) MOSS (Figure 4). All data from 1979 to 1992 (except that collected by Anza-Borrego after 1986) were averaged to produce an average scat per hour. The sections were then classified according the high, medium, low and poor criteria of Olech (1990), except that sections with FTHL sightings were not classified as "high" but rather according to their scat per hour. The following are the relative abundance categories for scat: poor: < 1 per hour, low: 1 to < 5 per hour, medium: 5 to < = 9 scat per hour, high: > 9 scat per hour.



ROUTE SIGNS

AREA SIGNS

Figure 3. Yuha Desert Flat-tailed Horned Lizard (*Phyrnosoma mcallii*) Sampling Area. Imperial County, CA.

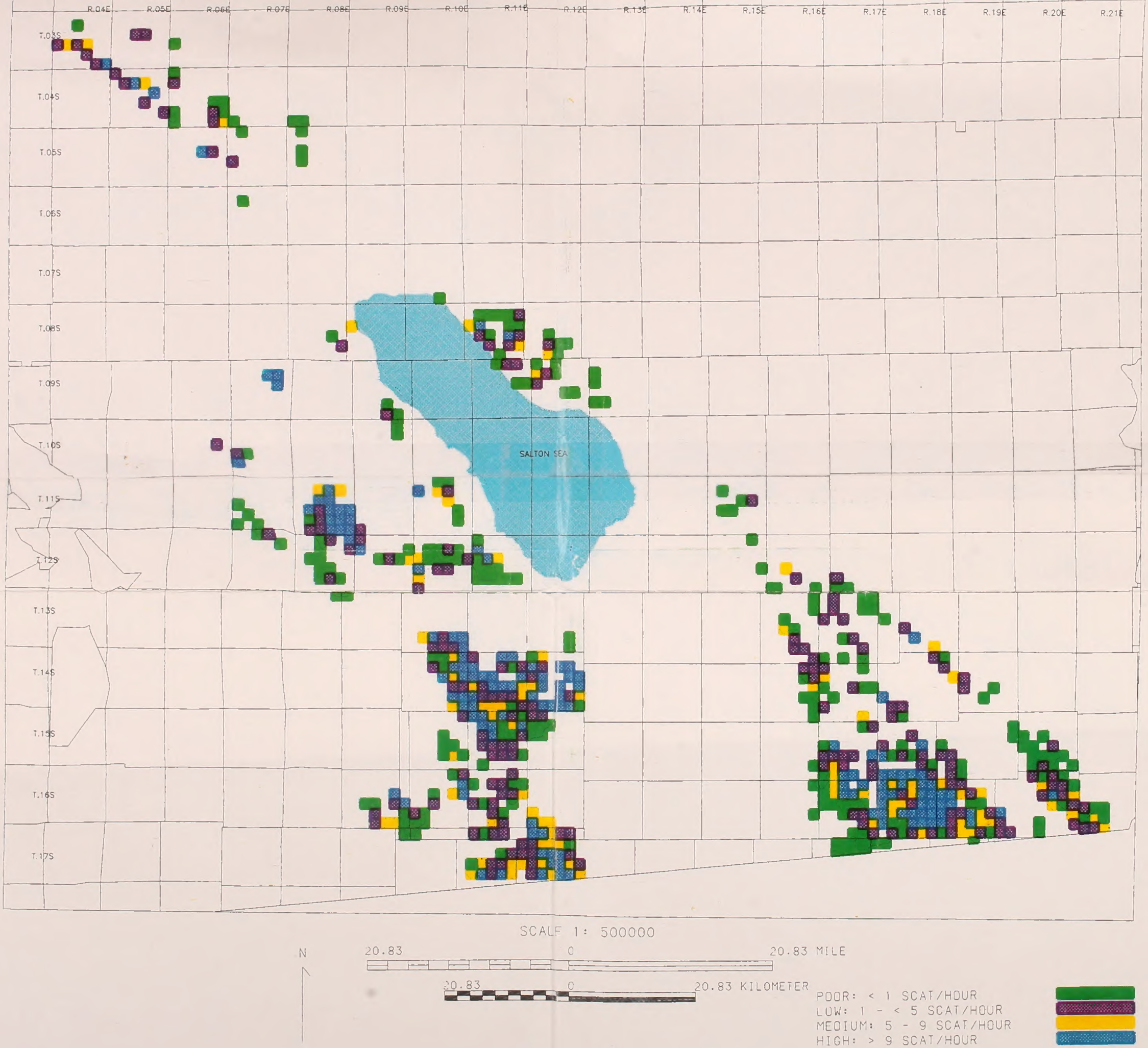
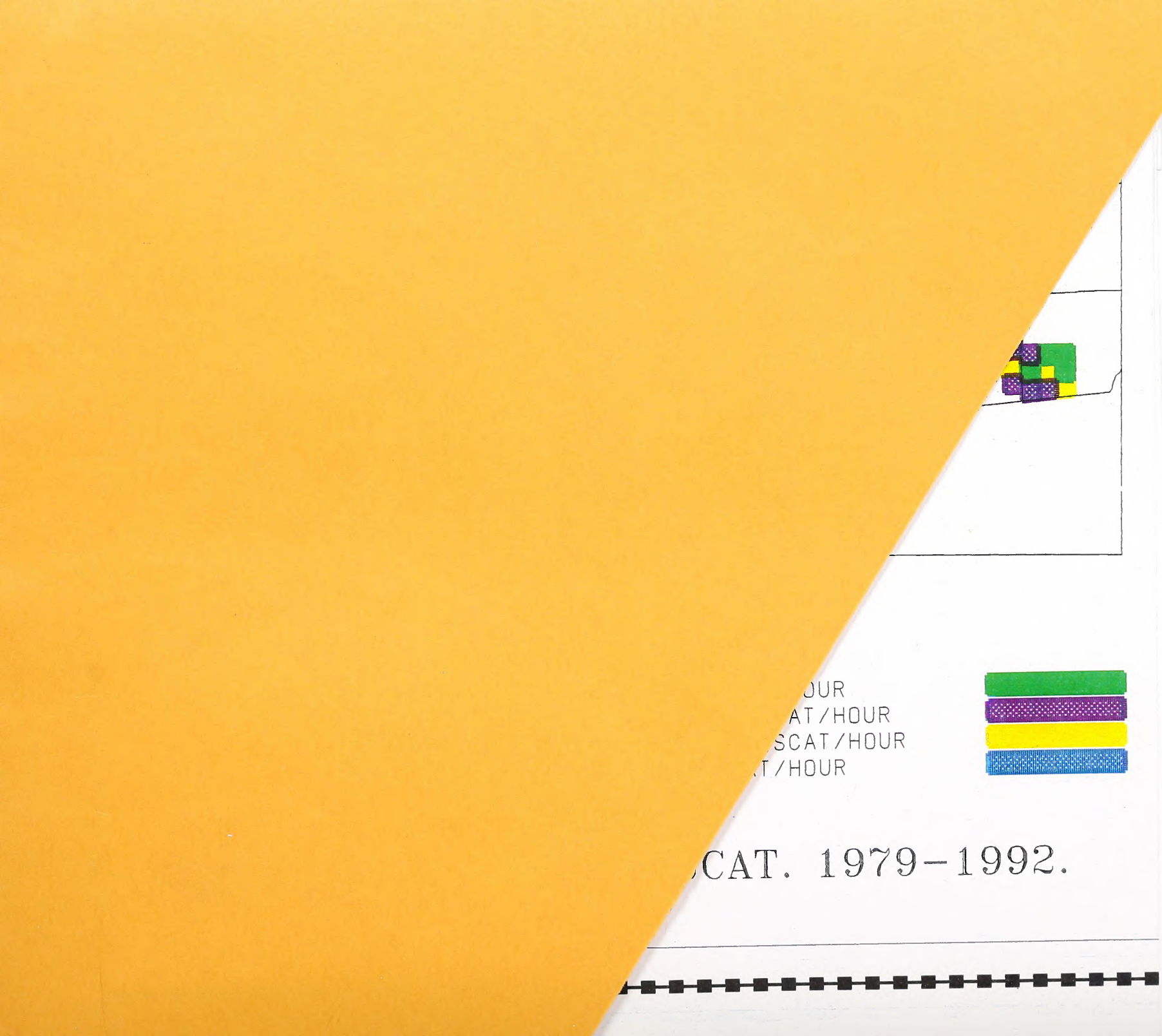


FIGURE 4. MEAN RELATIVE ABUNDANCE OF FLAT-TAILED HORNED LIZARD SCAT. 1979-1992.



UR
AT/HOUR
SCAT/HOUR
T/HOUR

CAT. 1979–1992.

STATISTICAL TESTS

Because the data were strongly skewed to the left (Figure 5), nonparametric statistics were used except for the regression analysis. Count data, such as the number of scat per hour, generally fail to meet the normalcy assumption of parametric statistics (Zar 1984). For this reason, the trends in scat per hour were analyzed with the Spearman Rank Order Correlation Coefficient (Ullman), a non-parametric test. Prior to performing regression and analysis of variance, data were transformed with the square root of x + 3/8 procedure recommended by Zar (1984) for data that is highly skewed to the left. The chi-square test (Sokal and Rohlf 1981) assessed the degree of association between scat per hour categories and FTHL sightings.

OFF-HIGHWAY VEHICLE RACING ASSESSMENT

In November of 1984, route Y1955 was closed to all vehicle traffic, while route Y1851 was left open to vehicle traffic (Figure 6). Prior to the closure both routes had been race routes and open to casual use. Monitoring transects were set up along both routes (figure 6a) to assess the impact of the closure on the relative abundance of FTHL scat. Since, the two routes are close to each other and are similar in other respects (high scat density, similar level of impacts, etc), route Y1851 served as a control to route Y1955. The main difference between transects along the two routes is that Y1955 no longer had legal vehicle use, while route Y1851 still had legal vehicle use. Illegal use may have occurred along route Y1955. No data on the level of casual OHV use is available for the period from 1985 - 1989.

A separate Spearman test was performed on the average scat per hour for the transects along the closed and open route. Transects not performed in all years from 1985 to 1989 were excluded from the trend analysis.

CASUAL OFF-HIGHWAY VEHICLE IMPACTS AT THE ALGODONES DUNES

The data collected by Klinger, *et al* (1990) from the Algodones Dunes were reanalyzed using the Vehicle-use classifications and the non-parametric Mann-Whitney U-test and Kruskall-Wallis tests (Sokal and Rohlf 1981). Vehicle-use classifications for reanalysis were obtained from Desert Access Guides # 20 - 22 (Salton Sea, Imperial Valley South and Midway Well).

The transects in the Klinger report were classified according to the BLM multiple-use class system, as required by contract. Since the Klinger study had

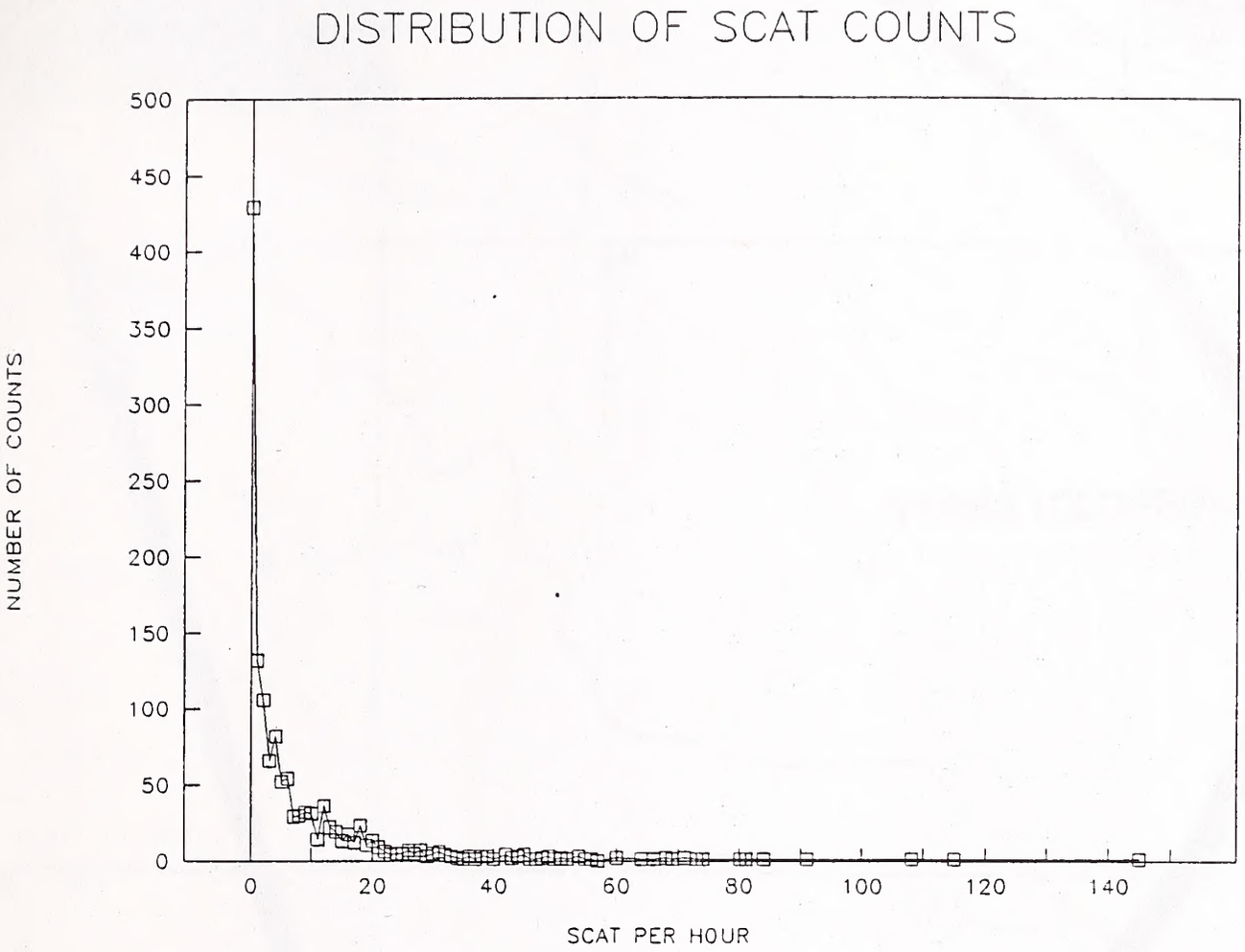


Figure 5. Frequency Distribution of Flat-tailed Horned Lizard (*Phyrnosoma mcallii*) Scat per Hour Counts in San Diego, Imperial and Riverside Counties, California. 1979 - 1992.

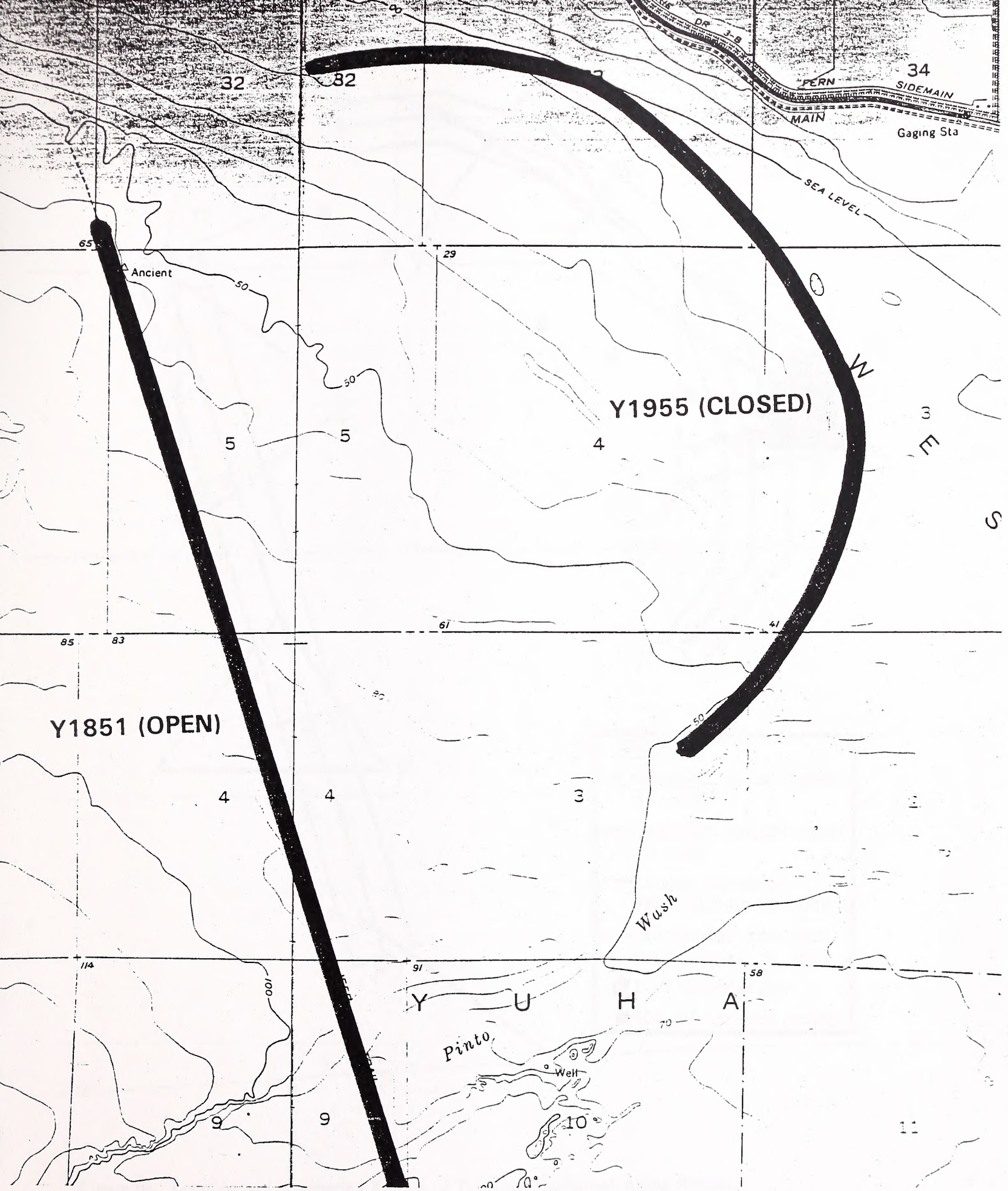


Figure 6. Location of Routes of Travel (Dirt Roads) Monitored for Relative Abundance of Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Scat. Y1851 Open to Vehicle Traffic. Y1955 Closed to Vehicle Traffic. Yuha Desert, Imperial County, CA. Yuha Basin and Mt. Signal 7.5' USGS Quads. T. 16S, T. 16.5S and 17S. R. 12E.

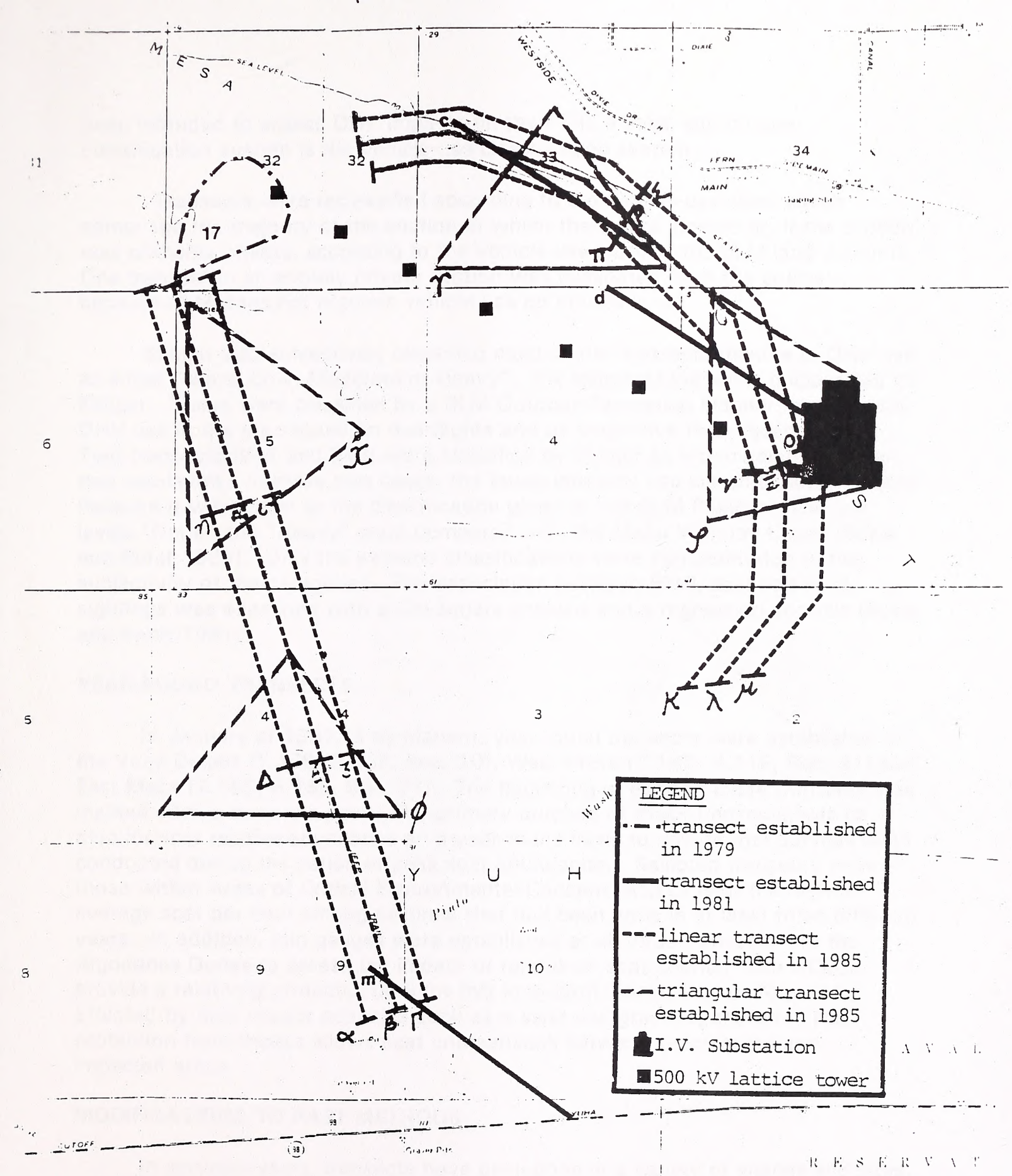


Figure 6a. Location and Numbering System of Transects Performed Along Routes Y1851 and Y1955. Yuha Desert, Imperial County, CA. Yuha Basin 7.5' and Mt. Signal 7.5' USGS Quad. T. 16S, 16.5S, 17S and R. 12E and 13E.

been intended to assess OHV impacts on the FTHL a more appropriate classification system is the vehicle-use classification system.

Transects were reclassified according to the vehicle-use class which comprised the majority of the section in which they were located or, if the section was primarily private, according to the vehicle-use class of the BLM land within it. One transect in an entirely private section was eliminated from the analysis, because BLM does not regulate vehicle use on private land.

Klinger also subjectively classified most of the transects relative to OHV use as either "None, Low, Moderate or Heavy". Six transects were left unclassified by Klinger. These were classified by a BLM Outdoor Recreation Planner familiar with OHV use in the area based on overflights and on subjective field observations. Two transects (941 and 943) were classified by Klinger as intermediate between two use-levels. In these two cases, the lower intensity use classification was used because it was closer to the classification given by the BLM Planner. The use levels "None" and "Heavy" were compared with the Mann-Whitney U-test (Sokal and Rohlf 1981). Only the extreme classifications were compared due to the subjectivity of the categories. The association between FTHL scat and FTHL sightings was examined with a Chi-square analysis and a regression analysis (Sokal and Rohlf 1981).

YEAR-ROUND TRANSECTS

In January of 1992, 3 permanent, year-round transects were established in the Yuha Desert (T.17S, R.12E, Sec. 10), West Mesa (T.14S, R.11E, Sec. 21) and East Mesa (T.16S, R.18E, Sec. 21). The beginning of each of these transects was marked with a carsonite post. The primary purpose of these transects was to monitor scat relative abundance on a year-round basis to ensure that surveys were conducted during the period of peak scat abundance. Selected transects were those within Areas of Critical Environmental Concern (ACEC) with the highest average scat per hour among sections that had been done in at least three different years. In addition, rain gauges were established at all three transects and the Algodones Dunes to assess the impact of rainfall on scat counts. The ACECs provide a relatively protected area for this long-term monitoring, unlikely to be affected by high impact activities such as a sand and gravel operation. This protection from impact allows scat comparisons between unimpacted and impacted areas.

MODIFICATIONS TO PAST METHODS

In previous years, transects have been done in a variety of shapes and sizes, particularly in the Yuha Desert. Effective in 1991, transects were only in the 2.5-mile triangular form described by Olech (1990). Exceptions will continue to be

made for sections truncated by freeways, canals or other barriers to FTHL movement, such as occurs along the East and West Highline Canals. In these cases, designer triangular transects will be run within the truncated area. Length and angles of the designer transect will be flexible, dependent on the size and shape of the truncated area.

The long, linear 1.0-mile transects in the Yuha Desert were all designated with a unique label (Figure 7). The standard 2.5-mile transects in the Yuha were given the prefix "Y", followed by the lower number originally used for the irregularly shaped transects in the same sections (Figure 8). The small triangular shaped transects in East Mesa E1 and E2 have been replaced by the standard 2.5-mile transect in these sections were labeled as E1a and E2a. The linear transects in East Mesa E4, E5 and E6 will no longer be done. The standard triangular transects that will be done in these sections will be labeled as E4a, E5a and E6a (figure 9).

In 1992, two or three repetitions were done by different observers for each monitoring transect to dampen the effect of season and observer acuity on scat counts. Prior to this time monitoring transects had usually only been done once. The repetitions were averaged to produce an average scat per hour for each monitoring section.

All known data collected in California from 1978 to 1993 were entered into a Dbase4 file named "Lizards" stored on the hard disk at the resources work station adjacent to printer 1682. The operation of this database is explained in Appendix 1. This database is now updated as data is collected. It is intended to hold all FTHL data collected in California.

In the summer of 1993, 145 sections were inventoried for FTHL scat throughout the El Centro Resource Area. The Yuha Desert was monitored for long-term trends. 12 sections were selected by a randomized systematic sample. Each section was walked 3 times about 1 month apart. The results were compared to the last survey in 1991 using the Mann-Whitney U-test (Sokal and Rohlf 1981).

Figure 7. Linear Yuha Desert Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Transects. Imperial County, CA. Plaster City 7.5' USGS Quad. T. 15S, T. 16S, R. 11E, R12E. Transect ID is Circled. Transects are 1 Mile Long and Run from Dot (•) to Dot (•). Date of Transect Shown as Month/Day/Year. Results Shown as Scat per Observer Hour/# of Flat-tails. Initials are Observers. JCR = Jim C. Rorabaugh, CH = Charise Hedlund, JDW = Jim D. Westerhold.

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Figure 7 (continued). Linear Yuha Desert Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Transects. Imperial County, CA. Mt. Signal 7.5' USGS Quad. T. 17S, R. 12E, R. 13E. Transect ID is Circled. Transects are 1 Mile Long and Run from Dot (•) to Dot (•). Date of Transect Shown as Month/Day/Year. Results Shown as Scat per Observer Hour/# of Flat-tails. Initials are Observers. JCR = Jim C. Rorabaugh, CH = Charise Hedlund, JDW = Jim D. Westerhold. LAO = Lillian A. Olech. YM = Yvette Matthews.

Flat-ta

Figure 7 (continued). Linear Yuha Desert Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Transects. Imperial County, CA. Mt. Signal 7.5' USGS Quad. T. 17S, R. 12E, R. 13E. Transect ID is Circled. Transects are 1 Mile Long and Run from Dot ( ) to Dot ( ). Date of Transect Shown as Month/Day/Year. Results Shown as Scat per Observer Hour/# of Flat-tails. Initials are Observers. JCR = Jim C. Rorabaugh, CH = Charise Hedlund, JDW = Jim D. Westerhold. LAO = Lillian A. Olech. YM = Yvette Matthews.

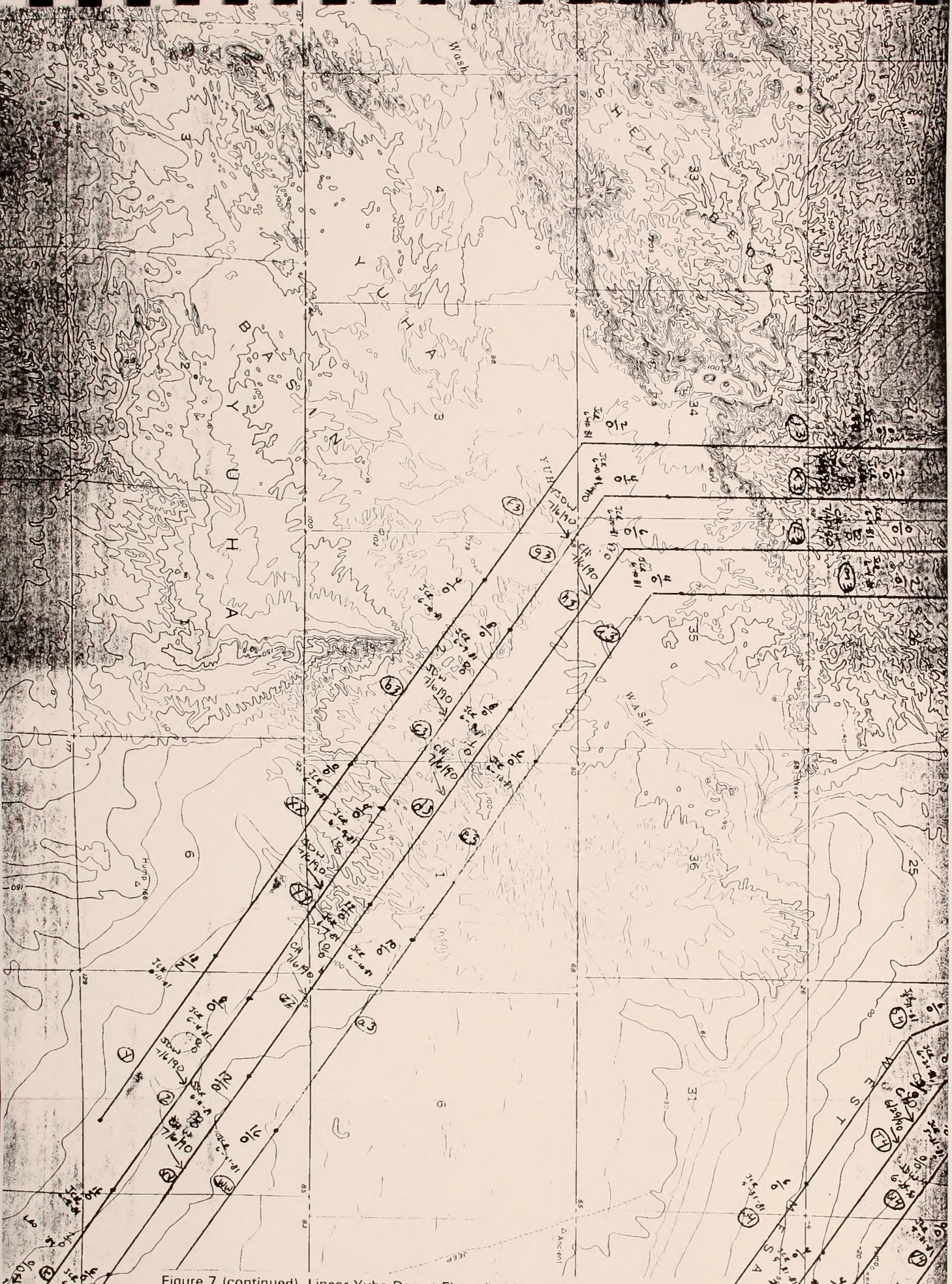


Figure 7 (continued). Linear Yuha Desert Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Transects. Imperial County, CA. Yuha Basin 7.5' USGS Quad. T. 16S, T. 16.5S, T. 17S, R. 11E, R12E. Transect ID is Circled. Transects are 1 Mile Long and Run from Dot (•) to Dot (•). Date of Transect Shown as Month/Day/Year. Results Shown as Scat per Observer Hour/# of Flat-tails. Initials are Observers. JCR = Jim C. Rorabaugh, CH = Charise Hedlund, JDW = Jim D. Westerhold. LAO = Lillian A. Olech.

RESULTS

MONITORING SURVEYS

Average scat per hour in West Mesa (figure 10) fluctuated widely, peaking in 1985 and bottoming out in 1990. Average scat per hour in the Yuha dropped by an order of magnitude from the 1985 survey to the 1991 survey, rising sharply in 1993 (figure 11). The number of FTHL sightings per 10 hours of observer effort roughly followed the trends in scat per hour (Figure 11a). Scat per hour in East Mesa remained relatively flat from 1979 to 1989, dropping in 1991 and shooting up to its highest level ever in 1992 (Figure 12). The patterns in East and West Mesa were not statistically significant, while the pattern in the Yuha was significant. The relative abundance of scat in the Yuha Desert increased significantly from 1991 to 1993 (Figures 13 and 13a).

OFF-HIGHWAY VEHICLE RACING ASSESSMENT

Scat per hour along an open route and a closed route in the Yuha Desert did not show a significant trend up or down (Figures 14 and 15). A visit to the routes in April of 1993 found signs of heavy use (recent extensive tracks, devegetation) along the open route and signs of only very light use along the closed route. The closed route is returning to its natural state, the open route remains heavily used. The zone of impact (measured by pacing) along the open route is 50 meters across at its widest, with most impacts restricted to a 25-meter wide corridor.

YEAR-ROUND TRANSECTS

Three year-round scat monitoring transects showed that peak scat abundance lasted from mid-July to mid-October in West Mesa and the Yuha Desert while it lasted from early May to mid-October in East Mesa (Figures 16 - 18).

CASUAL OFF-HIGHWAY VEHICLE IMPACTS AT THE ALGODONES DUNES

The transects in the Limited area at the Algodones Dunes had significantly less scat than those in the Open area. Those transects in the Closed area did not vary significantly in their number of scat per hour from those in either the Limited area or the Open area. The percentage of transects with scat in the Open and Closed areas was nearly identical while the number with scat in the Limited area was substantially less. The Kruskall-Wallis test showed that scat per hour varied significantly with use-classification but not with level of use (Figures 19 - 25).

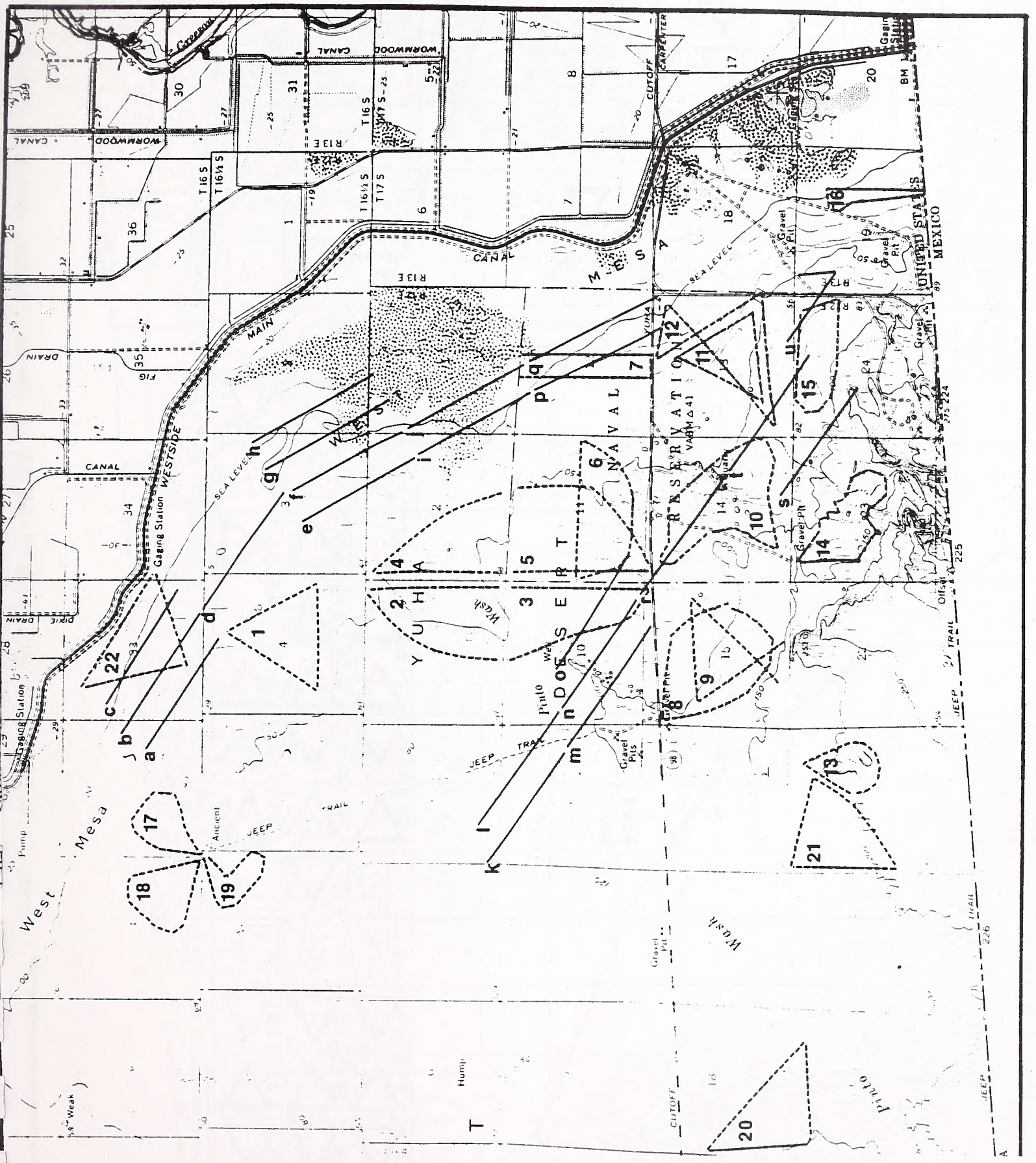


Figure 8. Old Yuha Transects Replaced by Standard 2.5 Mile Long Transects in 1991. New Transect Identification Numbers are the Old Transect Numbers with a "Y" in front of the Number. For Example, Transect "5" Has Been Replaced by "Y5". In Sections where More than One Irregularly Shaped Transect Was Done, the Lower Number with the Prefix "Y" Comprises the New Transect ID. Transects with Letter IDs Were Replaced by a Transect ID Comprised of a "Y" plus a Number. Yuha Desert, Imperial County, CA. Coyote Wells and Heber 15' Quads. T. 16S, 16.5S, 17S and R. 12E, 13E.

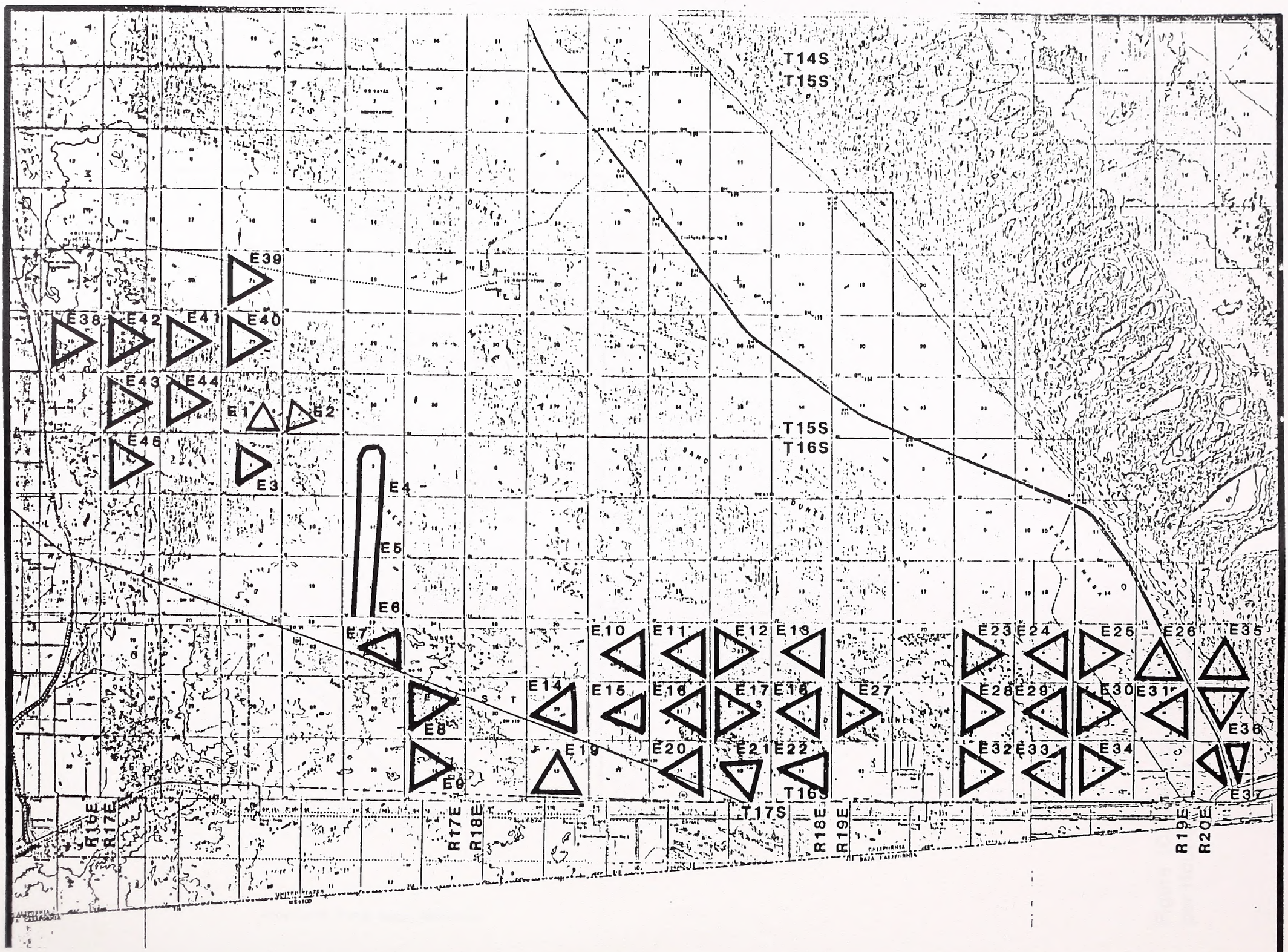


Figure 9. East Mesa Transect Locations. E1, E2, E4 - E6 Replaced by Standard 2.5 Mile Transects E1a, E2a, E4a, E5a, E6a in 1991. East Mesa, Imperial County, CA. Glamis and Midway Well 15'

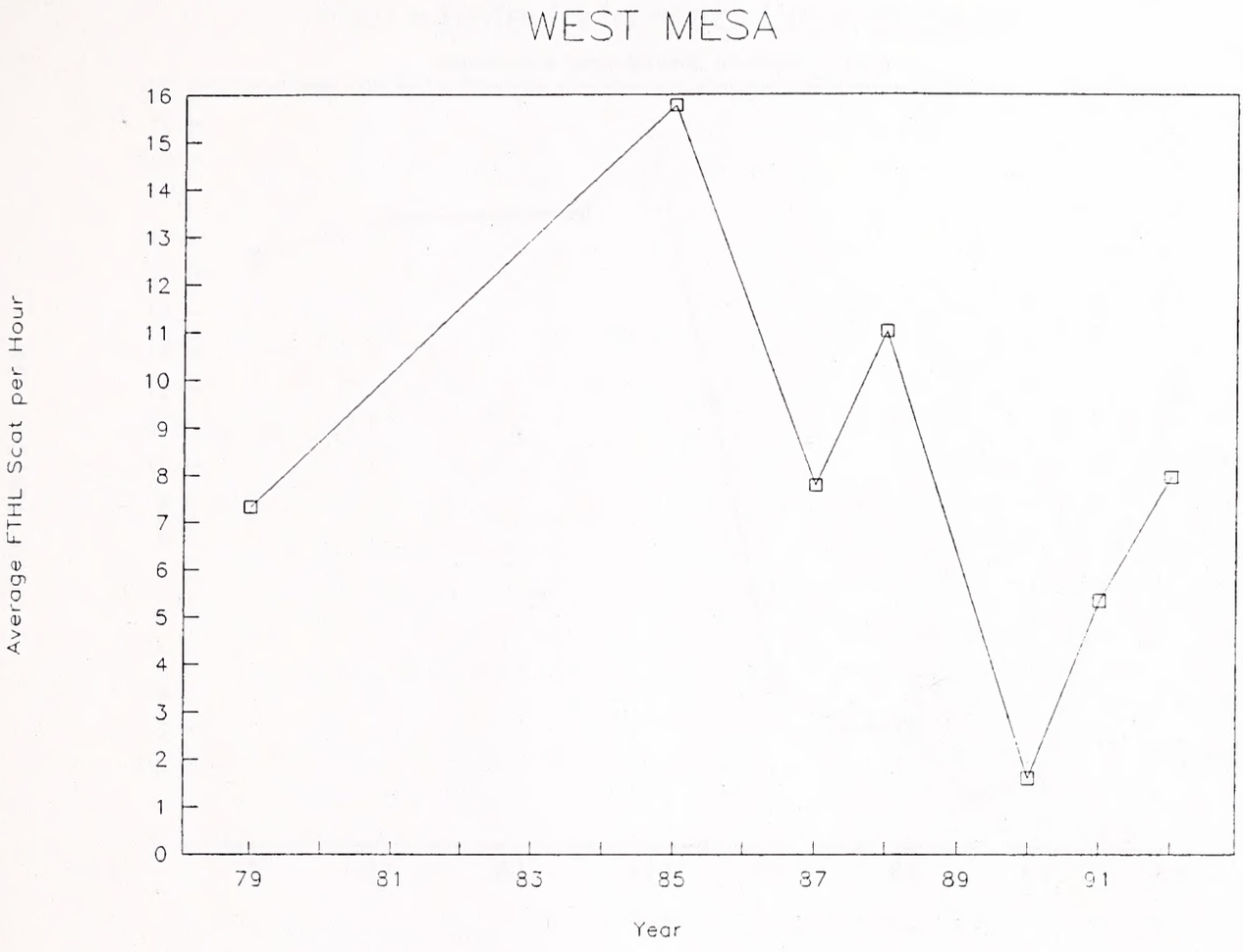


Figure 10. Average Flat-tailed Horned Lizard (*Phyrnosoma mcallii*) Scat Detected per Hour at West Mesa, Imperial County, CA. 1979 - 1992.

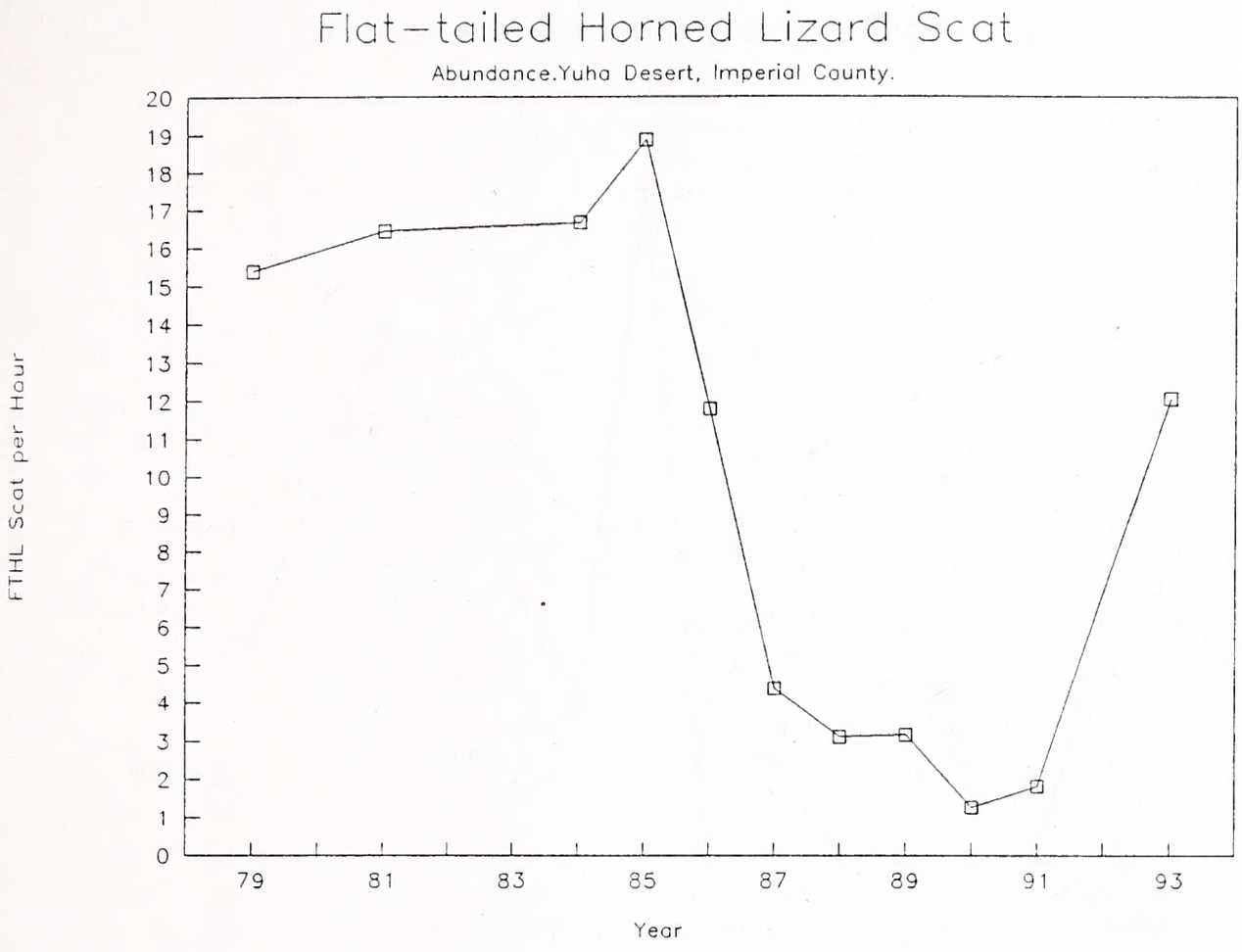


Figure 11. Average Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Scat Detected per Hour in Yuha Desert, Imperial County. 1979 - 1993.

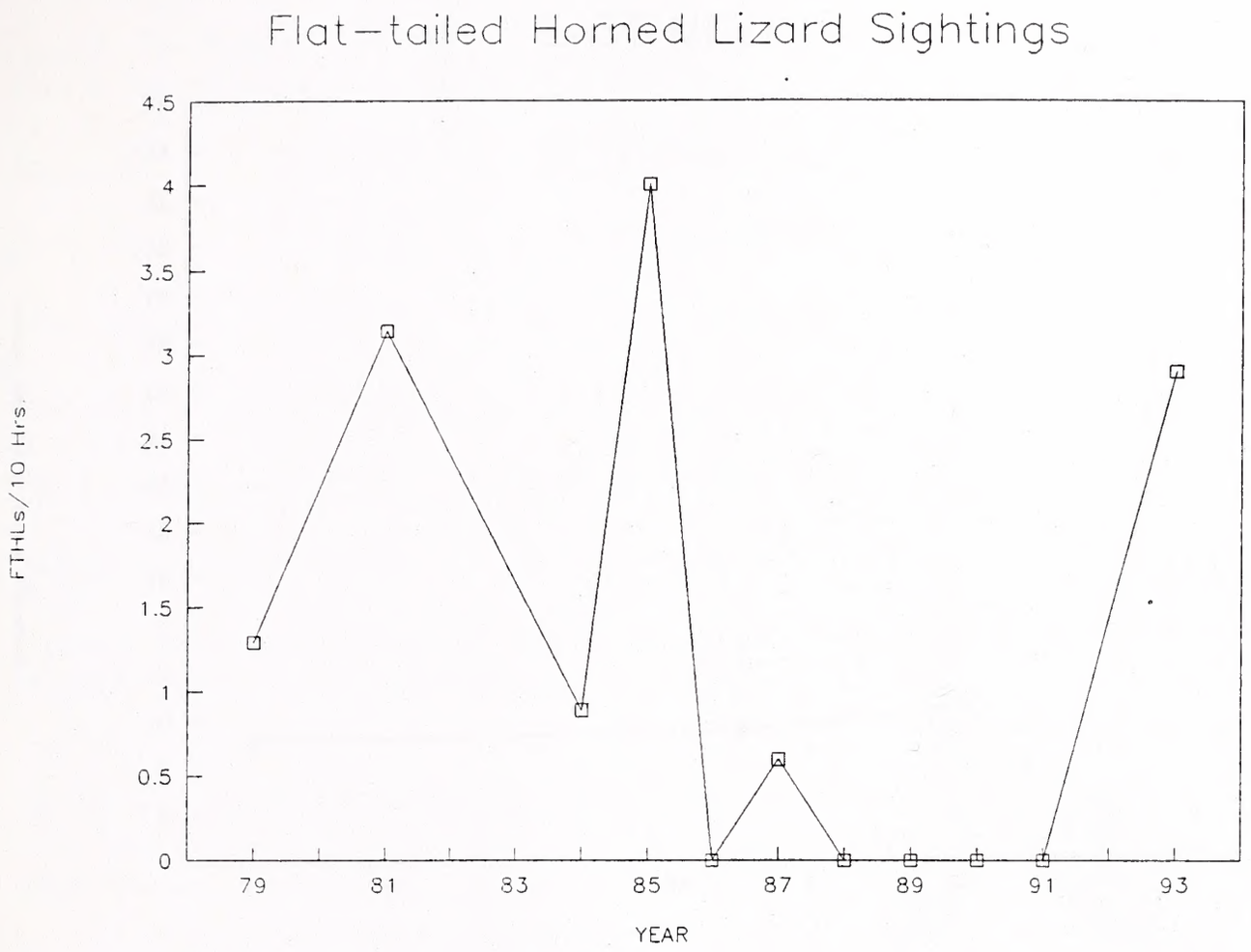


Figure 11a. Flat-tailed Horned Lizards (*Phrynosoma mcallii*) Detected per 10 Hours in the Yuha Desert, Imperial County, CA. 1979 - 1993.

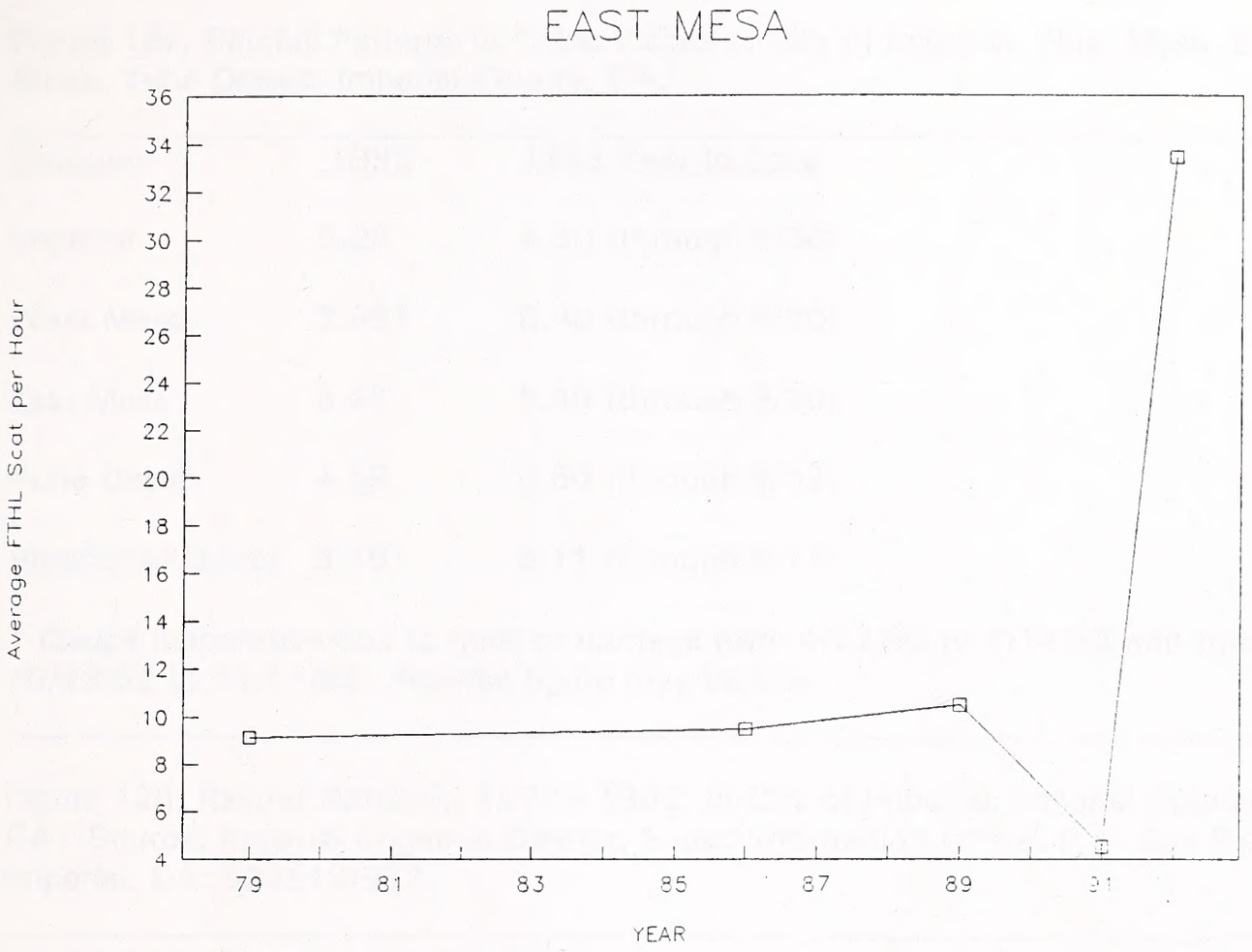


Figure 12. Average Flat-tailed Horned Lizard (*Phyrnosoma mcallii*) Scat Detected per Hour on East Mesa, Imperial County, CA. 1979 - 1992.

Figure 12a. Rainfall Patterns in Cubic Inches in City of Imperial, West Mesa, East Mesa, Yuha Desert. Imperial County, CA.

Location	1992	1993 Year-to-Date
Imperial	5.25	4.50 (through 8/30)
West Mesa	3.99*	0.40 (through 8/30)
East Mesa	6.42	5.40 (through 9/20)
Yuha Desert	4.08	0.60 (through 9/02)
Algodones Dunes	3.19	6.11 (through 9/17)

* Gauge inoperative due to theft or damage from 4/22/92 to 5/14/92 and from 10/28/92 to 11/11/92. Rainfall figure may be low.

Figure 12b. Rainfall Patterns, 1977 - 1992, in City of Imperial, Imperial County, CA. Source: Imperial Irrigation District. Public Information Office. P.O. Box 937. Imperial, CA. 92251-0937.

Year	Cubic Inches
1977	5.21
1978	4.37
1979	2.35
1980	4.35
1981	2.52
1982	4.84
1983	5.72
1984	3.43
1985	3.74
1986	3.73
1987	2.58
1988	1.32
1989	0.75
1990	1.46
1991	4.57
1992	5.25

Figure 13. Spearman Rank Order Correlation Coefficient for Flat-tailed Horned Lizard *(Phrynosoma mcallii)* Scat Relative Abundance for Three Areas of Imperial County, CA. n = Number of Years Data Collected, r-rho = Spearman Statistic, p = Probability (2-tailed) of No Trend. *Significant at $p <= 0.05$. 1979 to 1992.

Area	n	r-rho	p
West Mesa	7	0.536	> 0.10
Yuha Desert	11	0.700	< 0.05*
East Mesa	5	0.050	> 0.10

Figure 13a. Mann-Whitney U-test Comparison of Relative Abundance of Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Scat between 1991 and 1993 in the Yuha Desert, Imperial County, CA.

Year	n	mean	stan. dev.	max	min
1991	17	1.82	1.92	6.00	0
1993	12	12.36	9.28	26.49	1.53

U-Statistic = 195, critical value (n_1 = 17, n_2 = 12, p = 0.001) = 170.

Figure 13b. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) (FTHL) Monitoring Results from the Yuha Desert, Spring and Summer 1993. Results Shown as Scat per Observer-Hour/# FTHL Seen. Yuha Basin and Mt. Signal Quads, Imperial County, CA.

Legal Desc	First Count	month /day	Second Count	month /day	Third Count	month /day	Mean/ Total FTHL
16S, 12E, S32	19.00/ 0	4/19	8.31/1	7/6	5.26/0	8/6	10.86/ 1
16.5S, 12E,S2	1.11/0	6/7	1.09/1	7/6	2.40/0	8/5	1.53/1
16.5S, 12E,S5	12.41/ 0	4/19	32.73/ 1	7/6	12.86/ 0	8/6	19.33/ 1
17S, 12E,S2	6.00/0	6/7	4.62/0	7/6	9.31/0	8/5	6.64/0
17S, 12E,S5	25.09/ 0	4/19	14.33/ 0	7/6	4.53/0	8/4	14.65/ 0
17S, 12E,S9	24.76/ 0	5/5	12.22/ 1	7/6	42.50/ 0	8/4	26.49/ 1
17S,12 E,S12	6.67/0	4/5	3.53/0	6/22	6.67/0	8/5	5.62/0
17S,12 E,S15	13.58/ 0	4/5	12.45/ 0	6/22	4.92/0	8/4	10.32/ 0
17S,12 E,S18	13.68/ 0	5/5	10.71/ 1	7/7	12.79/ 1	8/6	12.39/ 2
17S,12 E,S20	31.34/ 1	6/7	6.77/0	7/7	9.15/0	8/6	15.75/ 1
17S,12 E,S23	12.00/ 0	4/20	4.00/0	7/7	4.70/2	8/6	6.90/2
17S,13 E,S18	20.43/ 0	4/5	13.92/ 0	6/14	7.50/1	8/6	13.95/ 1
Mean/ Total	15.36/ 1		10.68/ 5		11.04/ 4		12.36/ 10

Figure 14. Spearman Rank Order Correlation Coefficient for Flat-tailed Horned Lizard *(Phrynosoma mcallii)* Scat Relative Abundance adjacent to 2 routes, One Closed, One Open in the Yuha Desert. n = Number of Years Data Collected, r-rho = Spearman Statistic, p = Probability of No Trend (2-tailed). 1985 to 1989.

Area	n	r-rho	p
Closed	5	0.70	> 0.10
Open	5	0.90	> 0.10

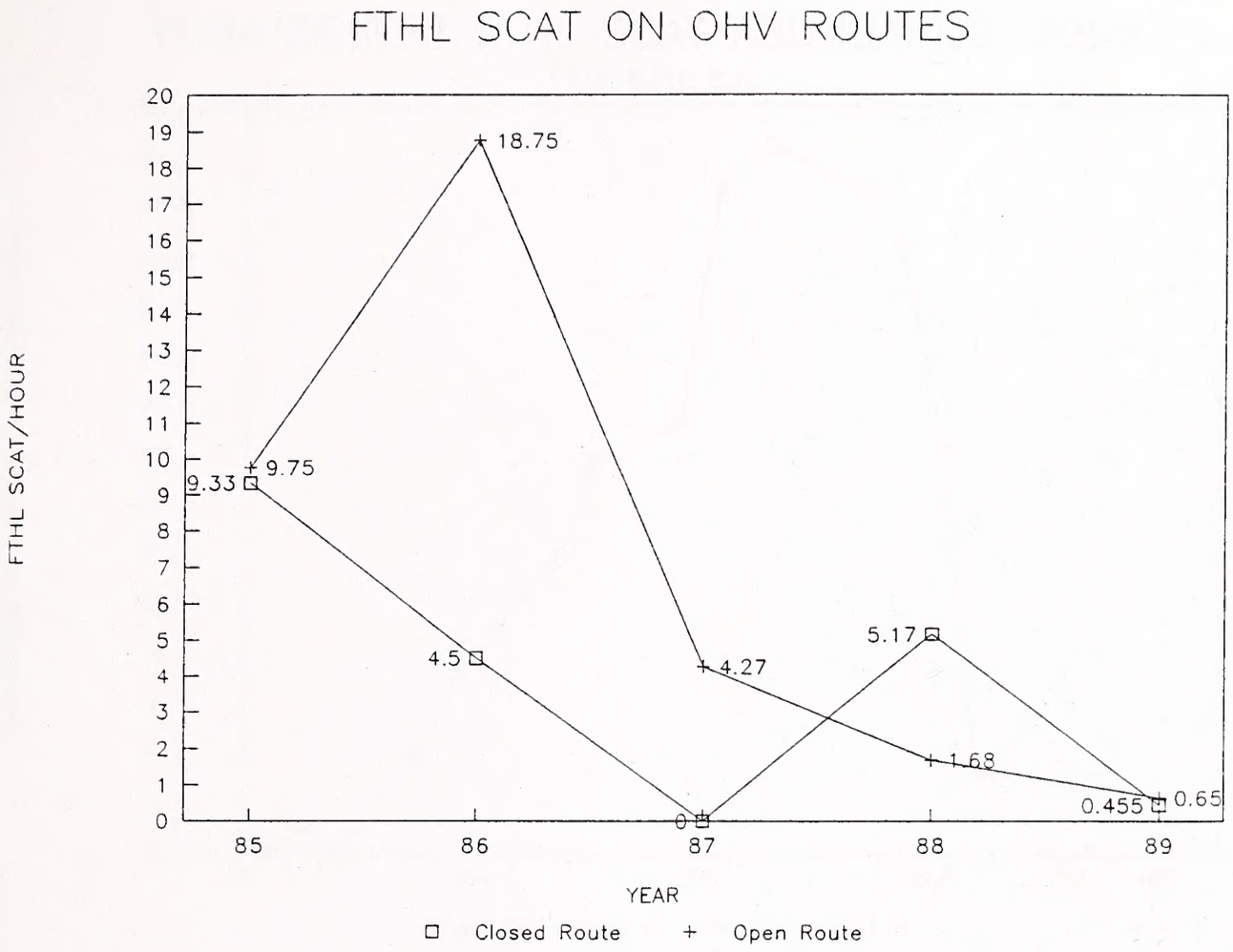


Figure 15. Average Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Scat Detected per Observer-hour along an Open and a Closed Off-highway Vehicle Route in the Yuha Desert, Imperial County, CA. 1985 - 1989.

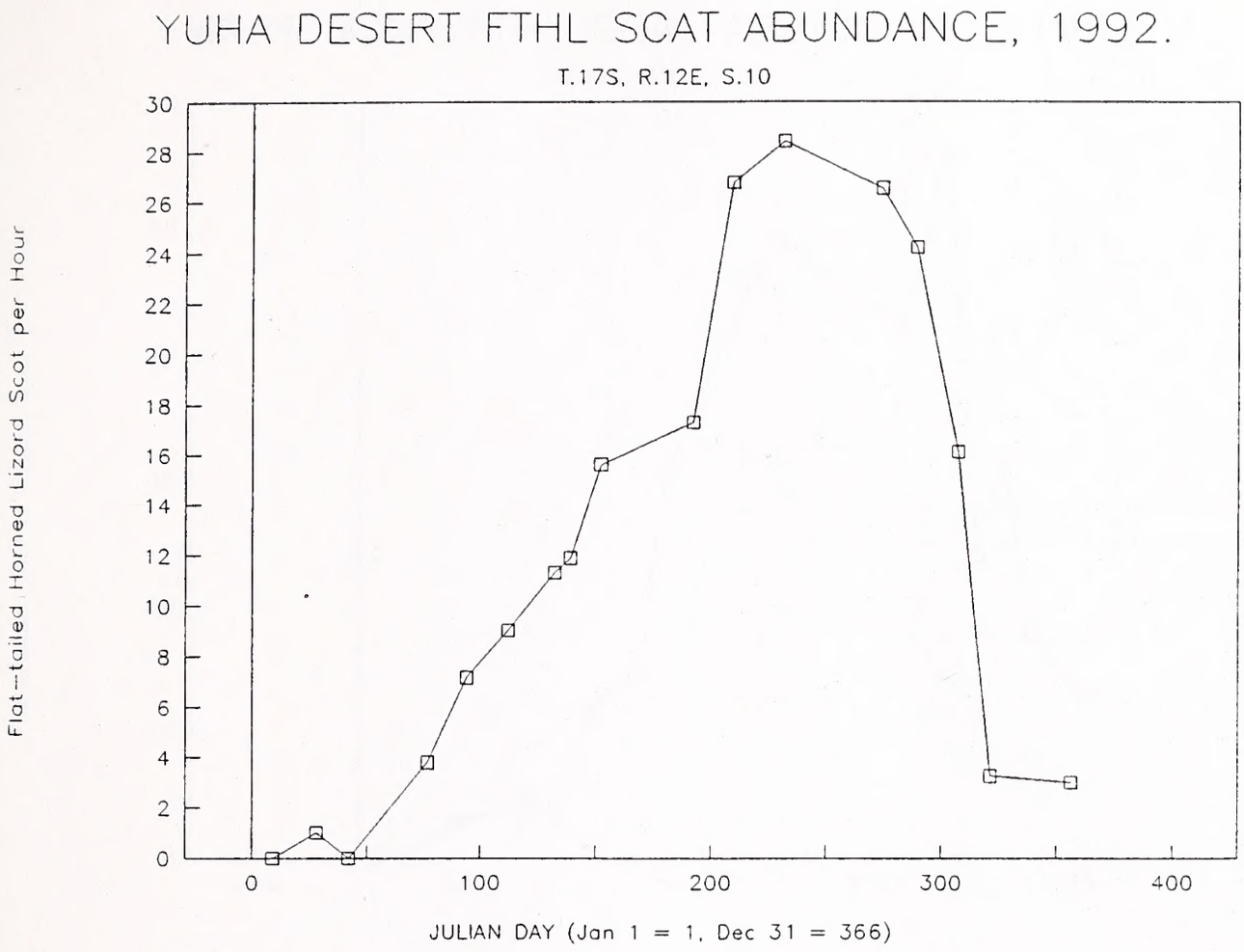


Figure 16. Pattern in Flat-tailed Horned Lizard (FTHL) (*Phrynosoma mcallii*) Scat per Hour on the Same Transect in the Yuha Desert. Imperial County, CA.

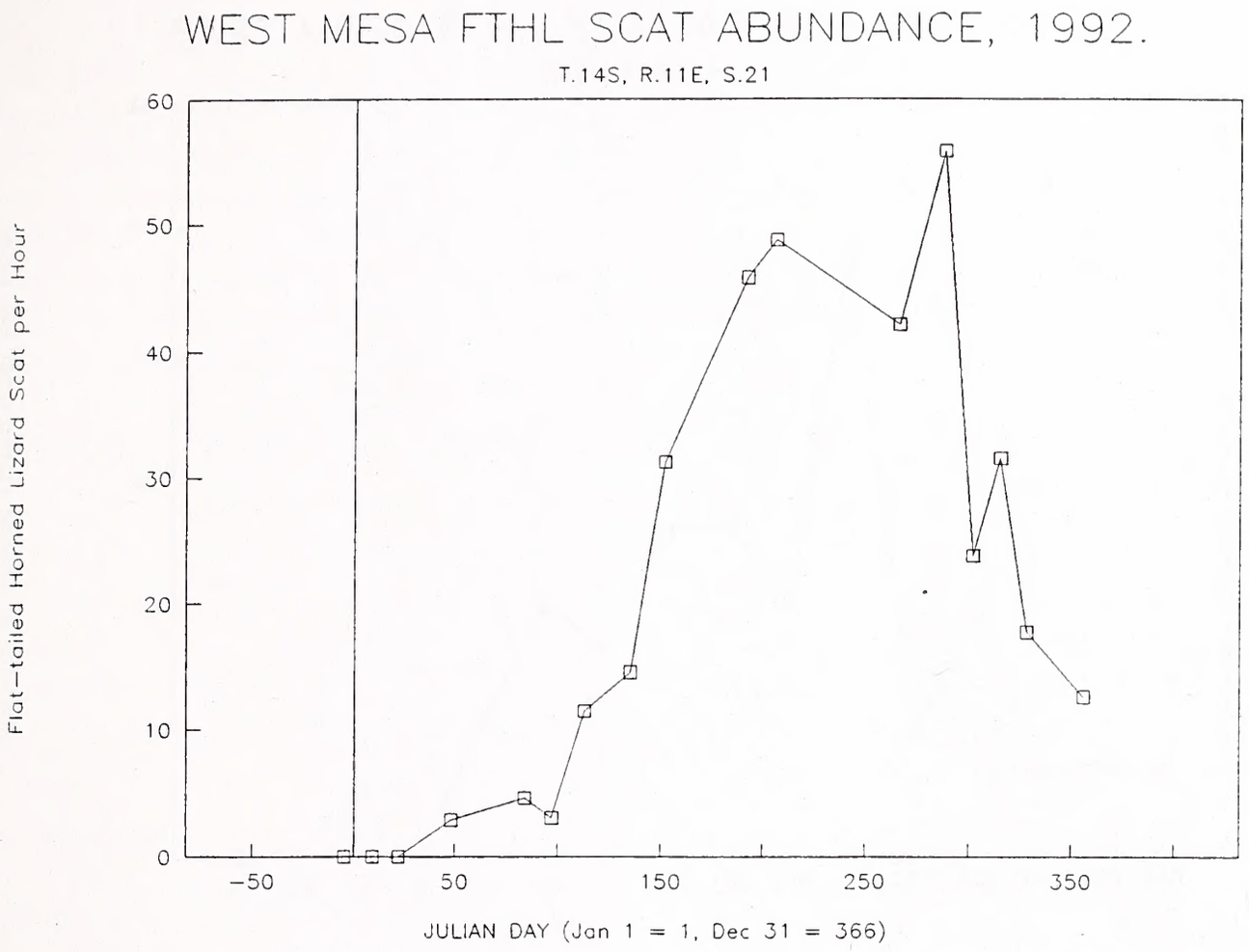


Figure 17. Pattern in Flat-tailed Horned Lizard (FTHL) (*Phrynosoma mcallii*) Scat per Hour on the Same Transect on West Mesa. Imperial County, CA.

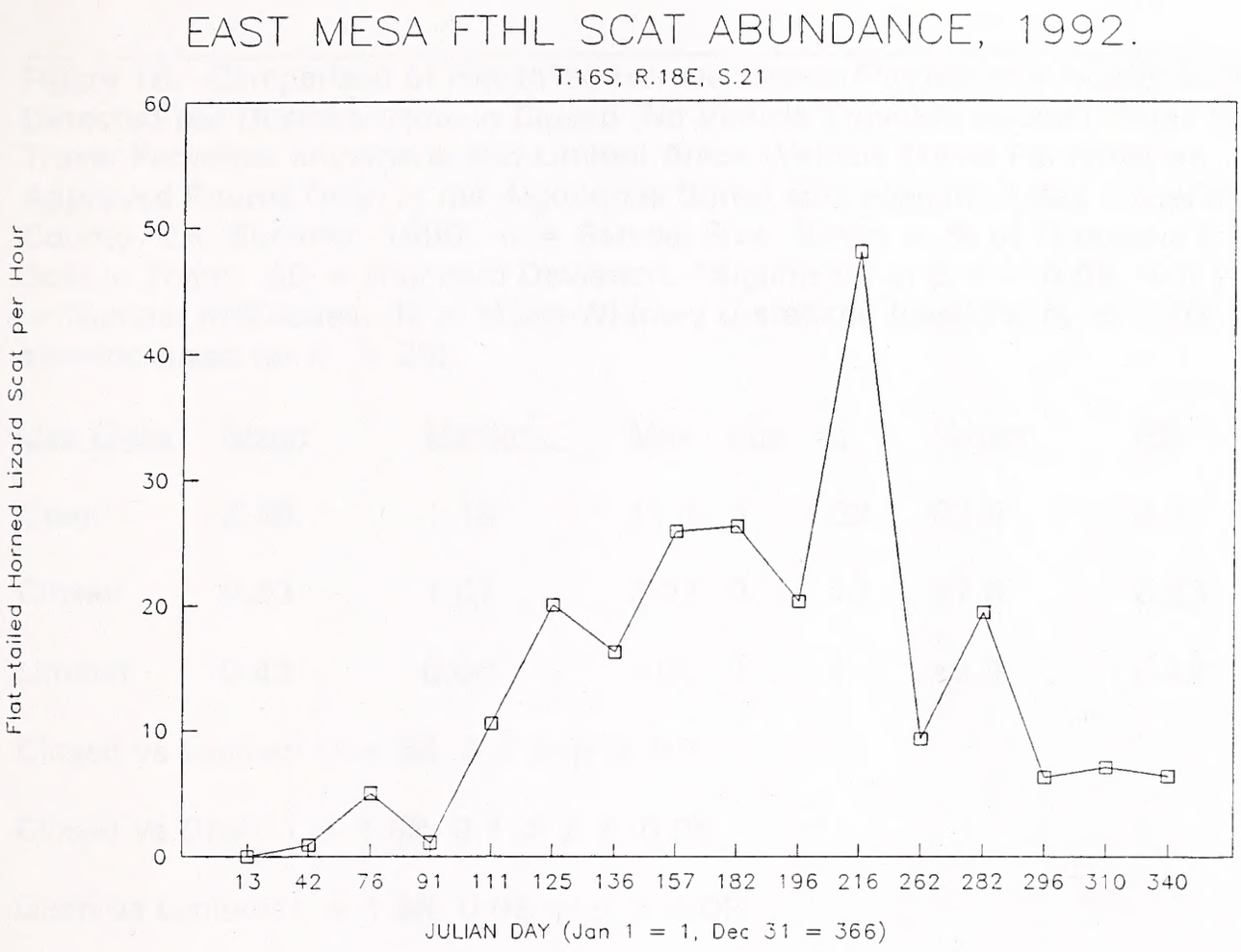


Figure 18. Pattern in Flat-tailed Horned Lizard (FTHL) (*Phrynosoma mcallii*) Scat per Hour on the Same Transect on East Mesa. Imperial County, CA.

Figure 19. Comparison of Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Scat Detected per Observer-Hour in Closed (No Vehicle Travel Permitted), Open (Vehicle Travel Permitted anywhere) and Limited Areas (Vehicle Travel Permitted on Approved Routes Only) in the Algodones Dunes and adjacent Areas. Imperial County, CA. Summer, 1990. n = Sample Size. %tran = % of Transects that Had Scat in Them. SD = Standard Deviation. *Significant at $p <= 0.05$, two-tailed. a = Number of Classes. U = Mann-Whitney U-statistic (used for $n_1 <= 20$), t = t statistic (used for $n_1 > 20$).

Use Class	Mean	Median	Max	Min	n	%tran	SD
Open	2.46	1.18	11.2	0	32	62.5	3.11
Closed	0.83	1.07	2.07	0	13	61.5	0.73
Limited	0.43	0.00	1.00	0	7	42.9	0.49

Closed vs Limited: $U = 66$, $0.2 > p > 0.1$.

Closed vs Open: $t = 1.88$, $0.1 > p > 0.05$.

Open vs Limited: $t = 1.98$, $0.05 > p > 0.02$.*

Kruskall-Wallis: $H = 175.775$, $a = 3$, $p < 0.001$.*

Figure 20. Comparison of Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Scat Detected per Observer-Hour along Transects with Varying Levels of OHV use in the Algodones Dunes and adjacent Areas. Imperial County, CA. Summer, 1990. n = Sample Size. %tran = % of Transects that Had Scat in Them. SD = Standard Deviation.

OHV use	Mean	Median	Max	Min	n	%tran	SD
None	2.31	1.18	10.34	0	11	81.82	2.78
Low	1.80	1.03	7.00	0	15	60.00	2.19
Moderate	2.11	1.09	11.19	0	17	47.00	3.37
Heavy	0.79	1.05	3.00	0	11	54.55	0.88

None vs Heavy: $U = 88$, $0.1 > p > 0.05$.

Figure 21. Correct Vehicle-Use Classifications and locations for Transects in Table 1 of Klinger, et al (1990). C = Closed, O = Open, L = Limited, P = Private. Algodones Dunes, June 1990. Corrected Classifications are Italicized. OHV Use Levels: N = None, L = Low, M = Moderate, H = Heavy. Use Levels with a "/" Indicates Use Intermediate between 2 Levels. *Use Level Pick by BLM in 1993 based on overflights.

Transect	Class	Township	Range	Section	Scat/Hour	OHV Use
901	C	12S	17E	30	1.07	N
902	C	12S	17E	31	0.00	L
903	C	12S	17E	32	1.03	L
904	C	13S	17E	5	1.18	N
905	C	13S	17E	2	1.11	L
906	C	13S	17E	1	0.00	L
907	C	13S	17E	9	2.06	N
908	C	13S	17.5E	11	0.00	N
909	C	13S	17.5E	13	2.00	N
910	C	13S	18E	19	2.14	N
911	*O*	*13S*	*18E*	*29*	*10.34*	*N*
912	C	13S	17E	22	1.13	N
913	O	14S	18E	3	1.15	H
914	O	14S	18E	11	1.09	M
915	O	14S	18E	13	6.43	L
916	O	14S	18E	19	2.14	L
917	C	13S	17E	26	1.15	N
918	C	13S	17E	35	0.00	N
919	O	14S	18E	19	4.29	N
920	O	14S	18E	29	4.44	M
921	O	14S	18E	32	1.18	M
922	O	15S	18E	10	1.18	H
923	O	15S	18E	14	9.47	M
924	O	15S	18E	23	3.00	H
925	O	15S	19E	19	3.16	M
926	O	15S	18E	25	0.00	M
927	O	15S	19E	29	2.11	M
928	O	15S	19E	33	0.00	L
929	*O*	*15S*	*19E*	*12*	*0.00*	*M*
930	*O*	*15S*	*19E*	*13*	*0.00*	*M*
931	*O*	*15S*	*20E*	*18*	*0.00*	*M*
932	*O*	*15S*	*20E*	*19*	*0.00*	*M**
933	*O*	*15S*	*20E*	*20*	*0.00*	*L*
934	*O*	*15S*	*20E*	*29*	*0.00*	*M*
935	*O*	*15S*	*20E*	*32*	*0.00*	*M*
936	*O*	*16S*	*20E*	*5*	*1.11*	*M*
937	L	16S	19E	14	0.00	H
938	*O*	*15S*	*20E*	*33*	*1.13*	*H**

Figure 21. (continued).

Transect	Class	Township	Range	Section	Scat/Hour	OHV Use
939	O	15S	20E	34	1.13	H*
940	O	16S	20E	4	0.00	M
941	O	16S	20E	3	0.00	M
942	O	16S	20E	9	7.00	L
943	O	16S	20E	10	4.07	L
944	O	16S	20E	16	3.10	L
945	O	16S	20E	15	11.19	M
946	O	16S	20E	23	1.15	L
947	O	16S	20E	26	0.00	H*
948	*O*	*16S*	*20E*	*25*	*0.00*	*L**
949	*L*	*16S*	*20E*	*36*	*1.00*	*L**
950	L	16S	19E	23	0.00	H
951	L	16S	19E	24	1.05	H
952	L	16S	19E	25	0.00	H
953	*P*	*16S*	*19E*	*36*	*0.00*	*H*

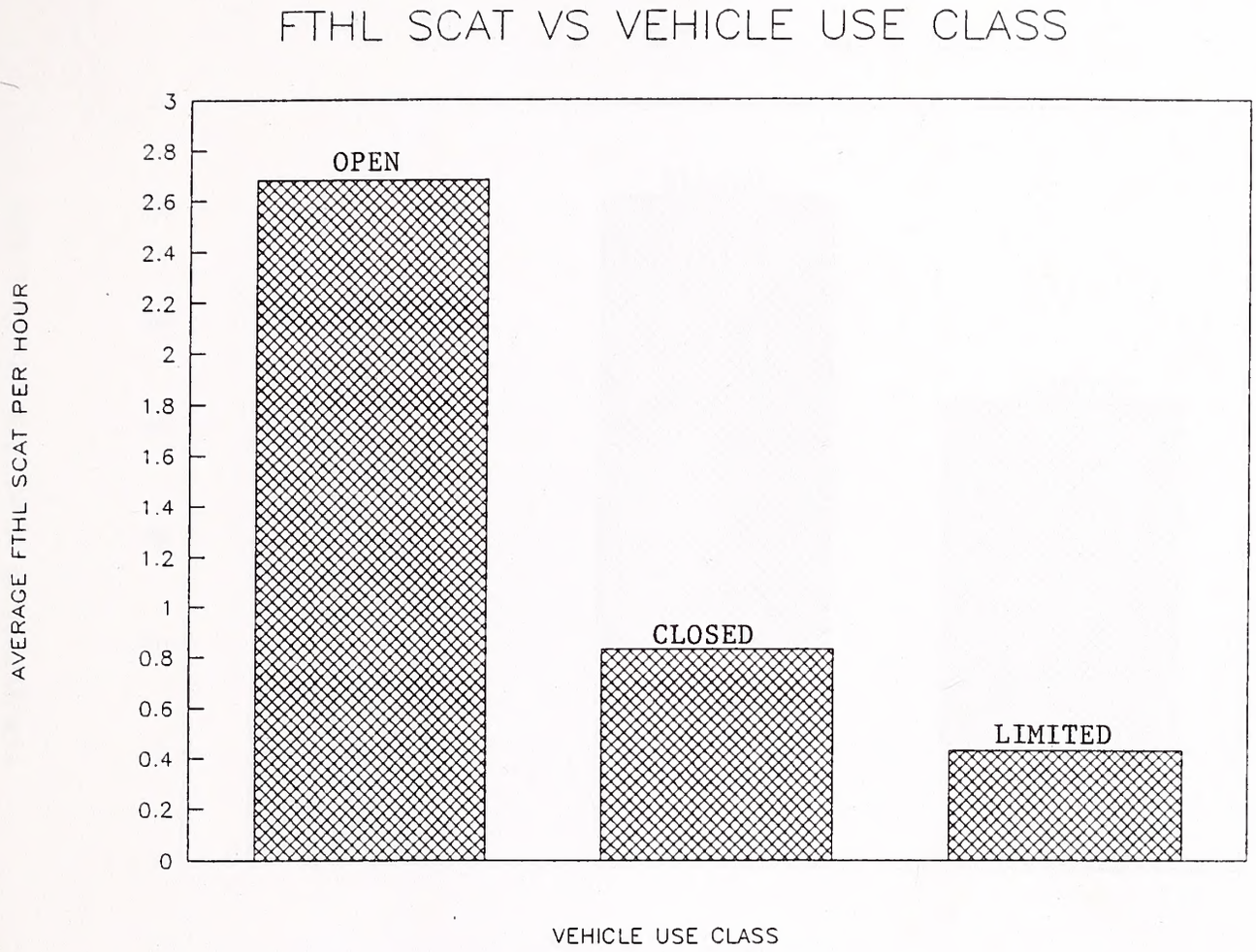


Figure 22. Average Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Scat Detected per Observer-Hour in Closed, Open and Limited Vehicle-Use Areas. Algodones Sand Dunes, Imperial County, CA. Summer 1990.

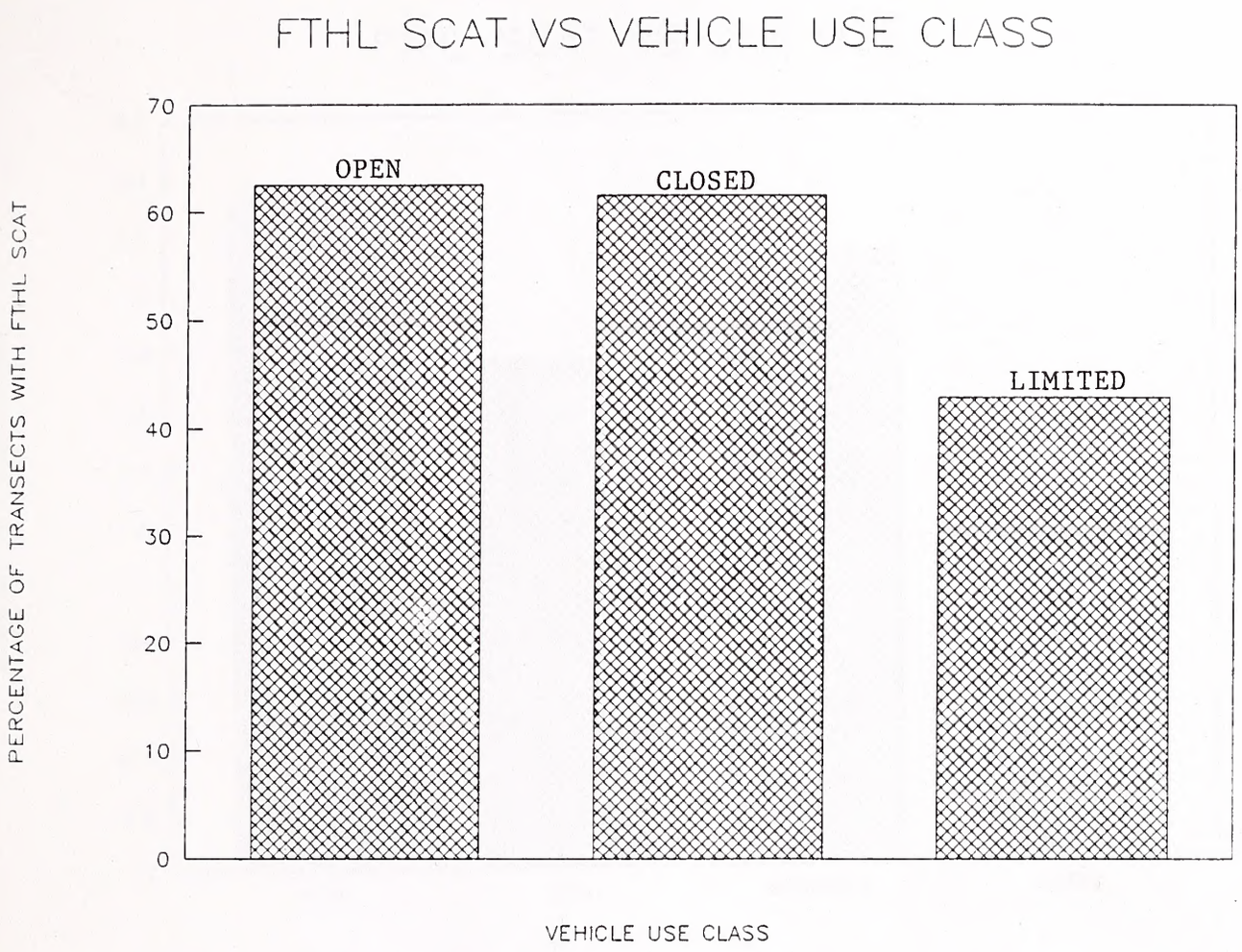


Figure 23. Percentage of Transects with Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Scat in Closed, Open and Limited Vehicle-Use Areas. Algodones Sand Dunes, Imperial County, CA. Summer 1990.

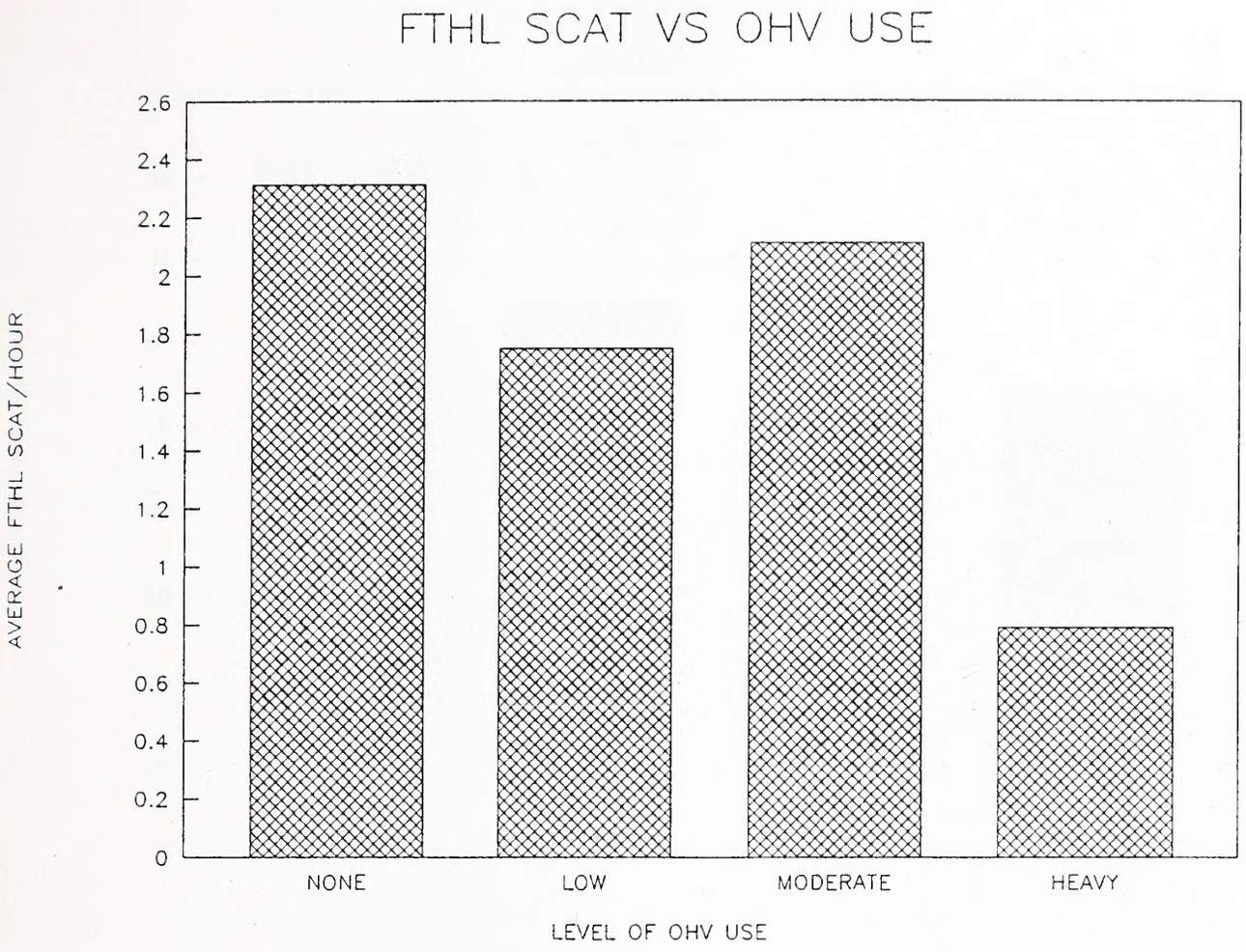


Figure 24. Average Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Scat Detected per Observer-Hour along Transects with Varying Levels of OHV Use. Algodones Sand Dunes, Imperial County, CA. Summer 1990.

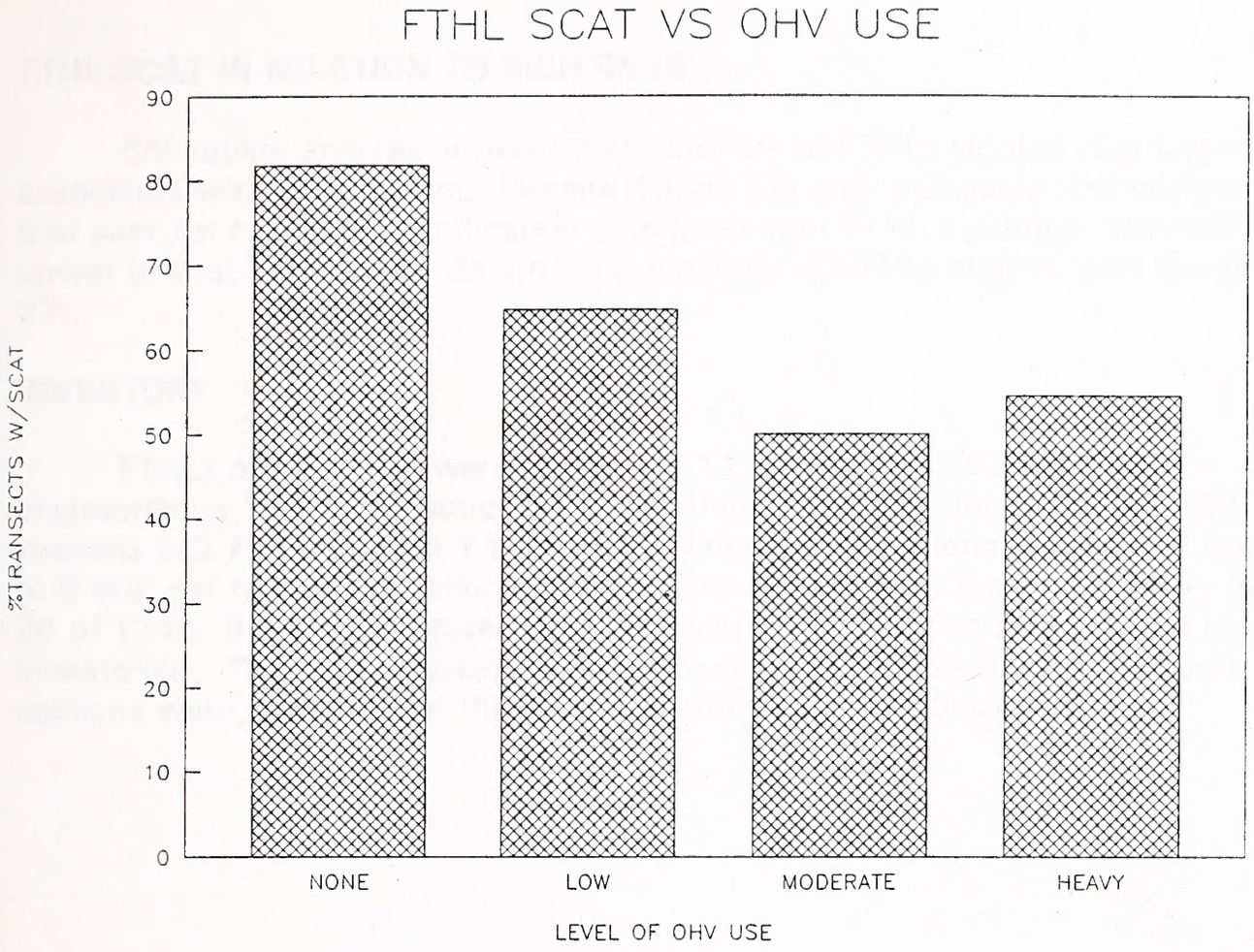


Figure 25. Percentage of Transects with Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Scat in Areas of Varying OHV Use. Algodones Sand Dunes, Imperial County, CA. Summer 1990.

FTHL SCAT IN RELATION TO SIGHTINGS

Chi-square analysis showed that numbers of FTHLs sighted was significantly associated with scat per hour classes (Figure 26) and regression analysis showed that scat per hour was significantly correlated with FTHL sightings. Predictive power of scat per hour for determining numbers of FTHLs sighted was low (Figure 27).

INVENTORY

FTHLs or their scat were found on 112 of 145 (77.24%) sections inventoried in 1993. 46 sections had less than 1 scat per hour (31.7%). 59 sections (40.7%) had from 1 to 5 scat per hour. 14 sections (9.7%) had from 5 to 9 scat per hour. 27 sections (18.6%) had greater than 9 scat per hour. Section 28 of T14S, R10E was accidently inventoried twice. It is counted as one section inventoried. The other sections were all inventoried just once. An additional 141 sections were identified for the 1994 inventory (figures 28 and 29).

Figure 26. Chi-square Analysis of Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Sightings in Relation to Scat per Hour Classes. 1978 - 1993. Imperial County, CA. f = Actual Frequency of Sightings. f = Expected number of Sightings if No Association between Scat per Hour and Frequency of Sightings. df = Degrees of Freedom.

Scat/Hour	#Tran	Actual #FTHLs(f)	Expected #FTHLs(*f*)	f/*f*	$(f-f)^2/f$
< 1	457	11	33.38	0.33	15.00
1 - < 5	395	28	28.85	0.97	0.25
5 - 9	185	17	13.51	1.26	0.42
> 9	373	47	27.25	1.72	14.31
Totals	1410	103	102.99	-	29.99

Chi-square value = 29.99, critical value (p = 0.001) = 16.266, df = 3.

Figure 27. Regression Analysis and Analysis of Variance of Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Sightings in Relation to Scat per Hour Classes. 1978 - 1979. Imperial County, CA.

Regression

Number of Lizards Sighted = 0.068 + Scat per Hr (0.012)

N = 1410, Multiple R = 0.137, R^2 = 0.019, Adjusted Multiple R^2 = 0.018. Standard Error of Estimate = 0.150.

Variable	Coefficient	Std. Error	Std. Coeff.	Tolerance	T	p(2-tail)
Constant	0.680	0.007	0.000	-	103.176	0.000
Scat per Hr	0.012	0.002	0.137	1.000	4.831	0.000

Analysis of Variance

Source	Sum of Squares	df	Mean-Square	F-ratio	p
Regression	0.608	1	0.608	26.882	0.000
Residual	31.870	1408	0.023	-	-

Table 28. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Inventory Results, Summer 1993. Imperial County, CA. Scat/hour: number of Flat-tail Scat Sighted per Observer-Hour.

Township	Range	Section	Scat/hour	Number Flat-tail
12S	09E	24	3.05	0
12S	10E	12	0.00	0
12S	10E	20	7.06	0
12S	10E	23	0.00	0
12S	10E	24,N1/2	1.86	0
12S	10E	24,S1/2	3.60	0
12S	10E	26	0.00	0
12S	10E	27	0.00	0
12S	10E	28	0.00	0
12S	10E	29	1.78	0
12S	10E	34	6.79	0
13S	11E	02	4.76	0
13S	11E	10	0.00	0
13S	11E	11	1.00	0
13S	11E	12	2.90	0
13S	11E	13	8.00	0
13S	11E	14	9.43	0
13S	11E	15	4.29	1
13S	11E	16	3.00	0
13S	11E	17	18.20	0
13S	11E	20	6.36	0
13S	11E	21	6.10	0
13S	11E	22	26.96	1
13S	11E	23	22.11	0
13S	11E	24	13.00	0
13S	11E	32	21.00	1
13S	11E	33	27.69	0
13S	12E	05	0.00	0
13S	12E	06	0.00	0
13S	12E	07	3.58	0
13S	12E	08	0.88	0
13S	12E	17	3.33	0
13S	12E	18	0.00	0
13S	12E	19	7.87	0
13S	12E	20	5.63	0
13S	12E	21	0.00	0
13S	12E	22	0.00	0
13S	12E	27	2.03	0

Table 28. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Inventory Results, Summer 1993. Imperial County, CA.

Township	Range	Section	Scat/hour	Number Flat-tail
13S	12E	28	4.00	0
13S	12E	33	27.00	0
13S	12E	34	7.27	0
13S	16E	34	1.46	0
13S	16E	35	0.00	0
13S	17.5E	25	0.00	0
13S	17.5E	26,27	9.00	0
13S	17.5E	34,35	0.83	0
13S	17.5E	36	0.00	0
13S	17E	25	7.50	0
13S	18E	31	0.00	0
14S	10E	21	3.30	1
14S	10E	22	5.71	0
14S	10E	27	18.46	0
14S	10E	28	8.42	0
14S	10E	28	14.52	0
14S	10E	29	3.93	0
14S	10E	32	28.00	1
14S	10E	34	9.64	1
14S	11E	04	60.90	3
14S	11E	05	27.46	0
14S	12E	03	4.76	0
14S	12E	04	27.46	0
14S	16E	14	2.00	0
14S	16E	26	5.00	1
14S	16E	35	0.00	0
14S	17E	01	11.08	0
14S	17E	27	0.00	0
14S	17E	28	4.36	0
14S	17E	33	1.97	0
14S	17E	36	8.24	0
14S	18E	07	0.92	0
14S	18E	08	0.00	0
14S	18E	16	0.91	0
14S	18E	18	2.93	0
14S	18E	20	1.00	0
14S	18E	21	1.15	0

Table 28. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Inventory Results, Summer 1993. Imperial County, CA.

Township	Range	Section	Scat/hour	Number Flat-tail
14S	18E	31	2.00	0
14S	18E	41	1.00	0
15S	11E	31	0.00	0
15S	11E	33	0.82	0
15S	11E	34	2.90	0
15S	16E	01	4.23	0
15S	16E	02	1.94	0
15S	16E	11	0.00	0
15S	16E	12	1.40	0
15S	16E	13	0.95	0
15S	16E	14	1.09	0
15S	16E	23	4.62	0
15S	16E	24	0.00	0
15S	17E	05	0.00	0
15S	17E	06	2.77	0
15S	17E	07	1.15	0
15S	17E	08	4.07	0
15S	17E	11	9.41	0
15S	17E	12	3.00	0
15S	17E	13	4.14	0
15S	17E	14	1.90	1
15S	17E	23	0.00	0
15S	17E	26	15.65	0
15S	17E	35	50.00	0
15S	17E	36	4.58	1
15S	18E	05	0.00	0
15S	18E	06	0.97	0
15S	18E	07	3.30	0
15S	18E	08	0.00	0
16S	11E	01	1.96	0
16S	11E	03	3.81	0
16S	11E	04	0.90	0
16S	11E	05	1.85	0
16S	11E	06	1.00	0
16S	11E	17	1.71	0
16S	11E	18	1.71	0
16S	11E	22	0.00	0

Table 28. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Inventory Results, Summer 1993. Imperial County, CA.

Township	Range	Section	Scat/hour	Number Flat-tail
16S	11E	24	3.05	0
16S	11E	25	0.92	0
16S	11E	26	0.00	0
16S	11E	29	1.90	0
16S	11E	30	4.14	0
16S	11E	31	2.95	0
16S	11E	35	2.57	1
16S	16E	12	0.00	0
16S	16E	13	0.81	0
16S	17E	01	36.19	0
16S	17E	12	53.26	0
16S	17E	13	44.12	0
16S	17E	19	1.76	0
16S	17E	20	0.00	0
16S	17E	29	0.91	0
16S	17E	30	0.00	0
16S	17E	31	1.25	0
16S	17E	32	0.00	0
17S	11E	01	10.65	0
17S	11E	02	13.93	0
17S	11E	03	2.22	0
17S	11E	06	1.94	1
17S	11E	07	0.00	0
17S	11E	10	0.00	0
17S	11E	18	1.11	0
17S	11E	19	1.71	0
17S	11E	25	11.00	1
17S	11E	26	3.81	0
17S	11E	27	1.02	0
17S	11E	28	2.00	0
17S	11E	29	9.00	0
17S	11E	30	0.00	0
17S	12E	19	29.00	0
17S	12E	30	9.60	1

Table 28. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Inventory Results, Summer 1993. Imperial County, CA.

Number of Sections surveyed: 145
Average Scat/hour: 6.24
Median Scat/hour: 1.96.
Maximum Scat/hour: 60.90.
Minimum Scat/hour: 0.00.
Number of Flat-tails Sighted: 17.
Number of Sections with FTHLs: 15 (10.20%).
Number of Sections with Scat or FTHLs: 112 (77.24%).

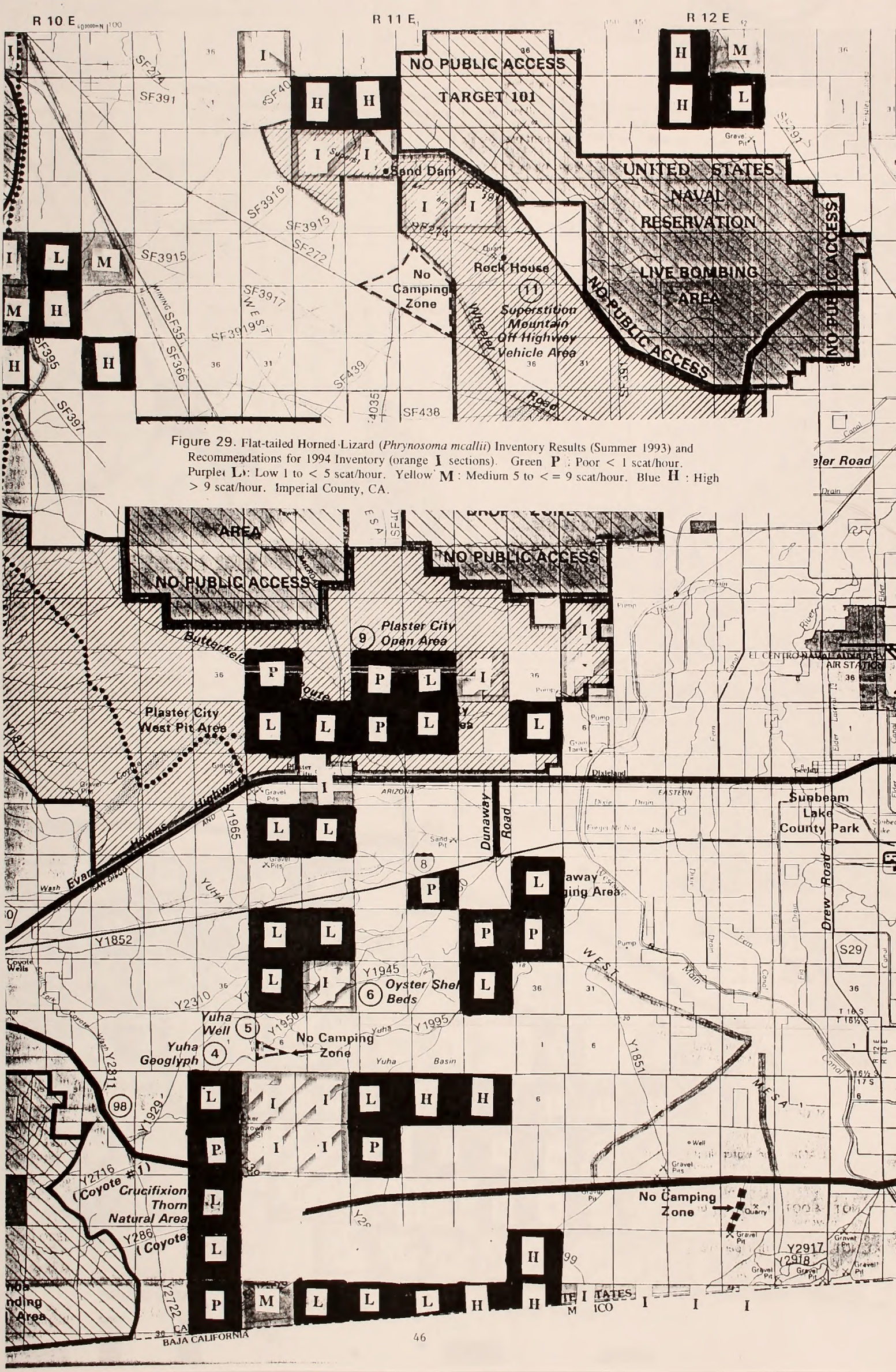
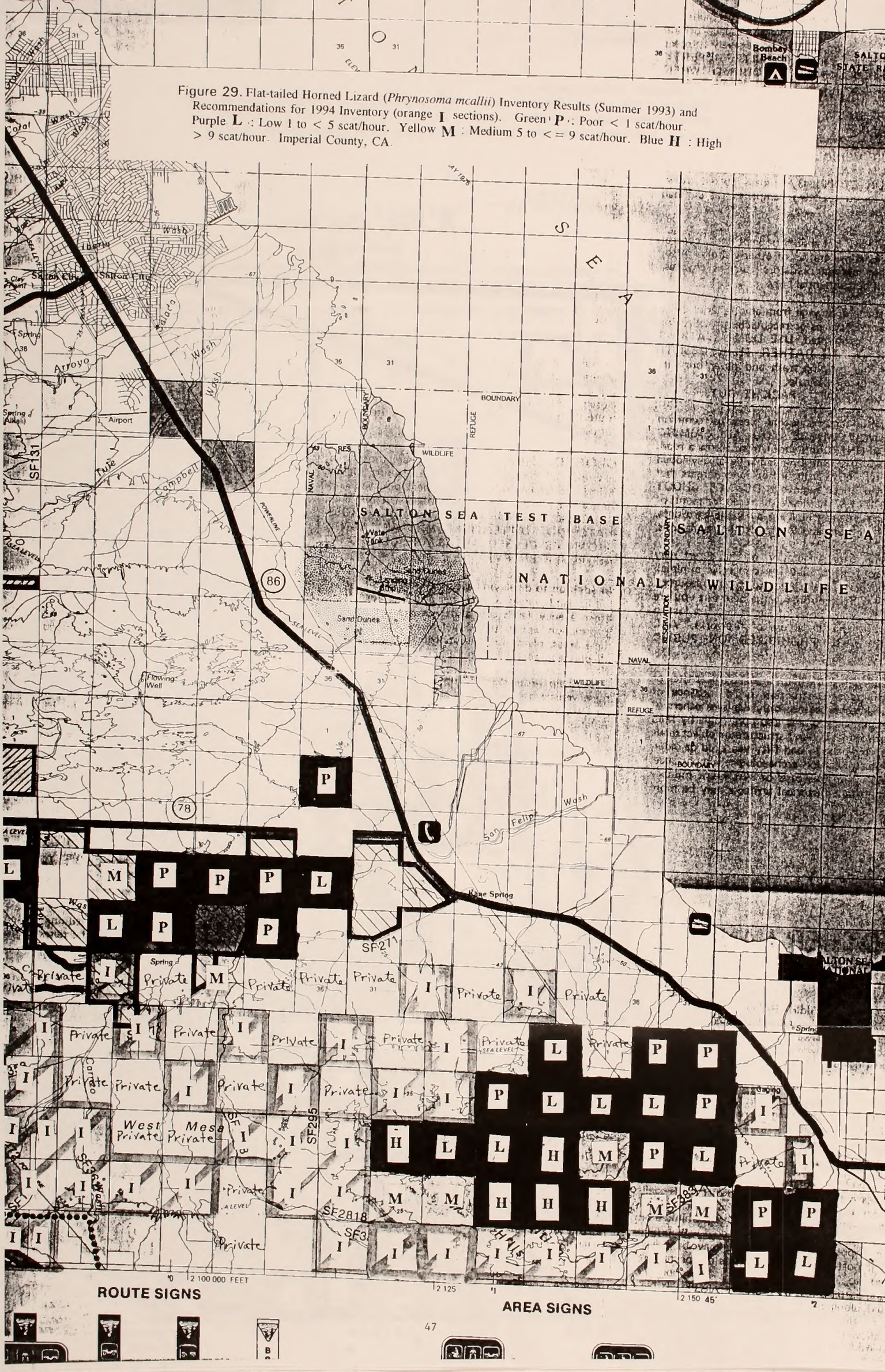


Figure 29. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Inventory Results (Summer 1993) and Recommendations for 1994 Inventory (orange I sections). Green P : Poor < 1 scat/hour. Purple L: Low 1 to < 5 scat/hour. Yellow M : Medium 5 to < = 9 scat/hour. Blue H : High > 9 scat/hour. Imperial County, CA.



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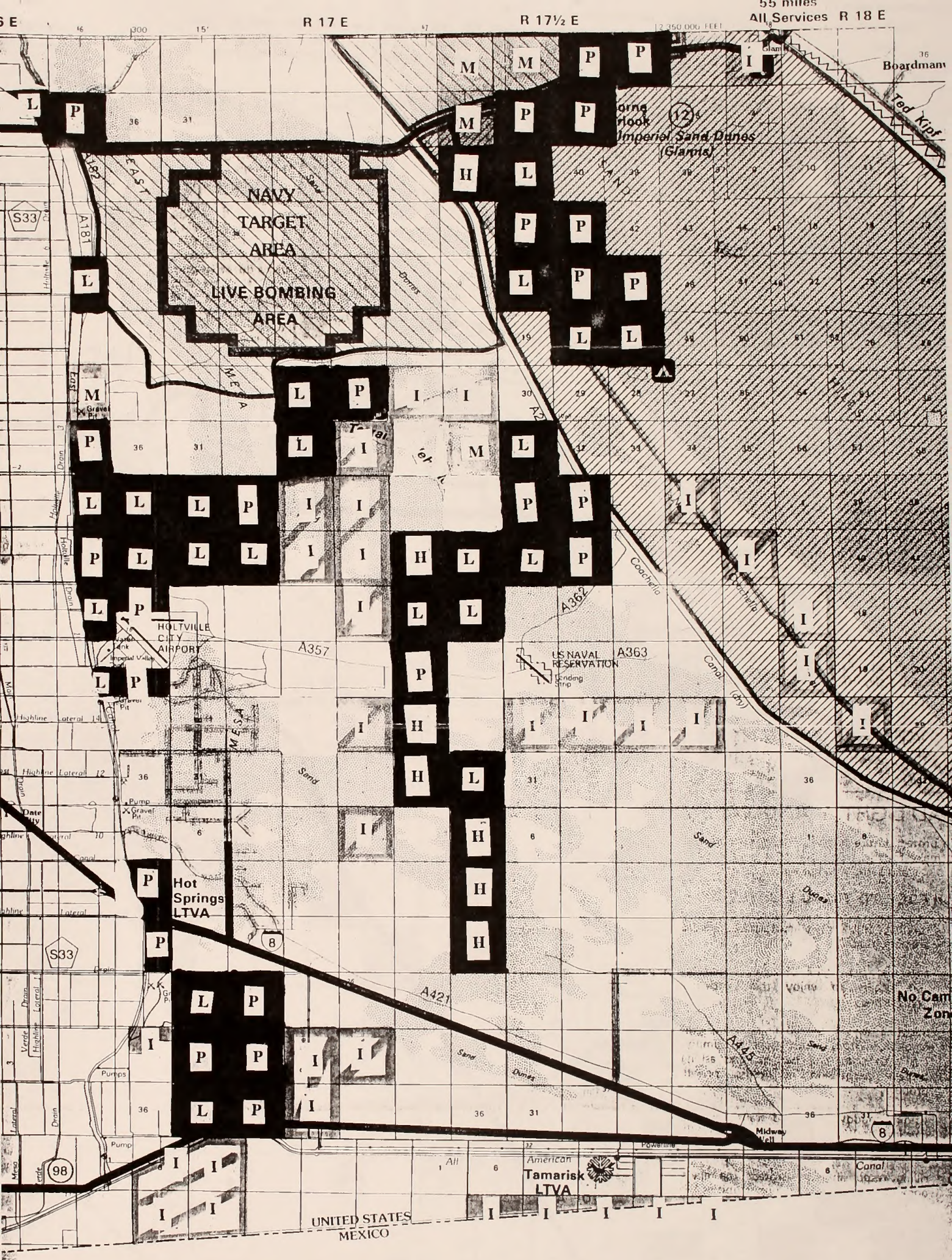

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CONVERSION TABLE

Meters	Feet
1	3.2808
2	6.5617

NOTE:

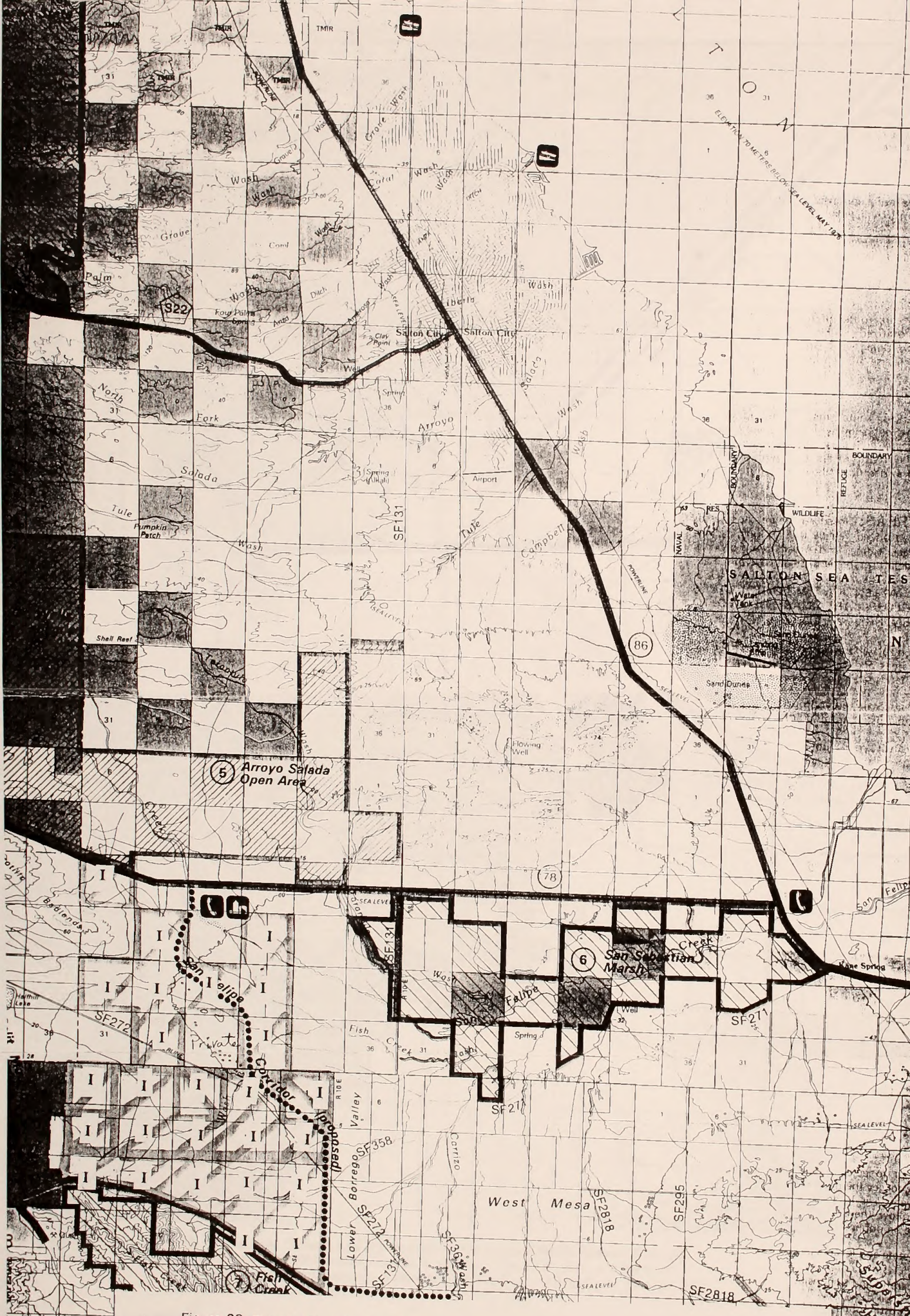

Figure 29. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Inventory Results (Summer 1993) and Recommendations for 1994 Inventory (orange **I** sections). Green **P**: Poor < 1 scat/hour. Purple **L** : Low 1 to < 5 scat/hour. Yellow **M**: Medium 5 to < = 9 scat/hour. Blue **H** : High > 9 scat/hour. Imperial County, CA.

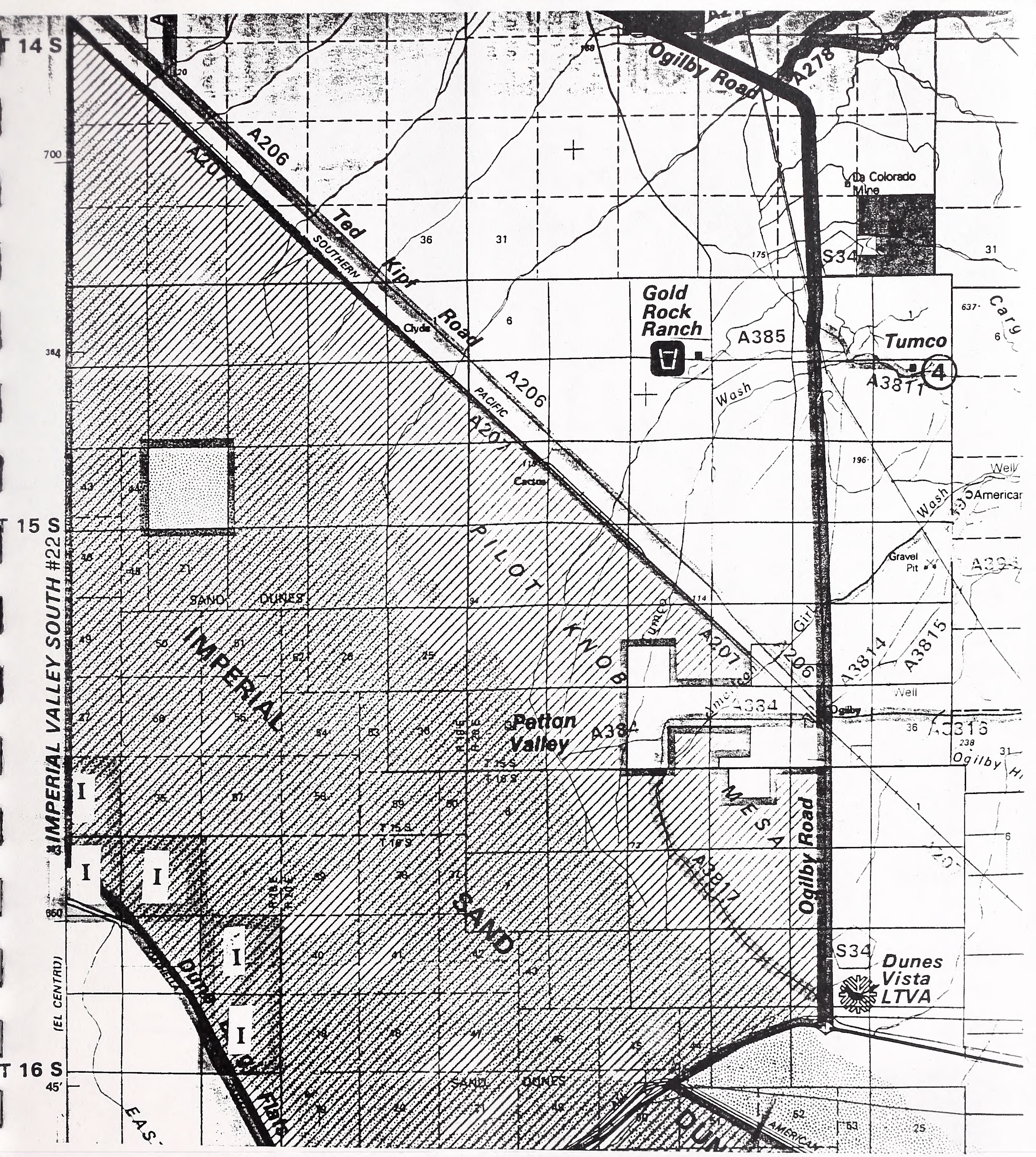

Figure 29. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Inventory Results (Summer 1993) and Recommendations for 1994 Inventory (orange **I** sections). Green **P** : Poor < 1 scat/hour. Purple **L** : Low 1 to < 5 scat/hour. Yellow **M** : Medium 5 to < = 9 scat/hour. Blue **H** : High > 9 scat/hour. Imperial County, CA.

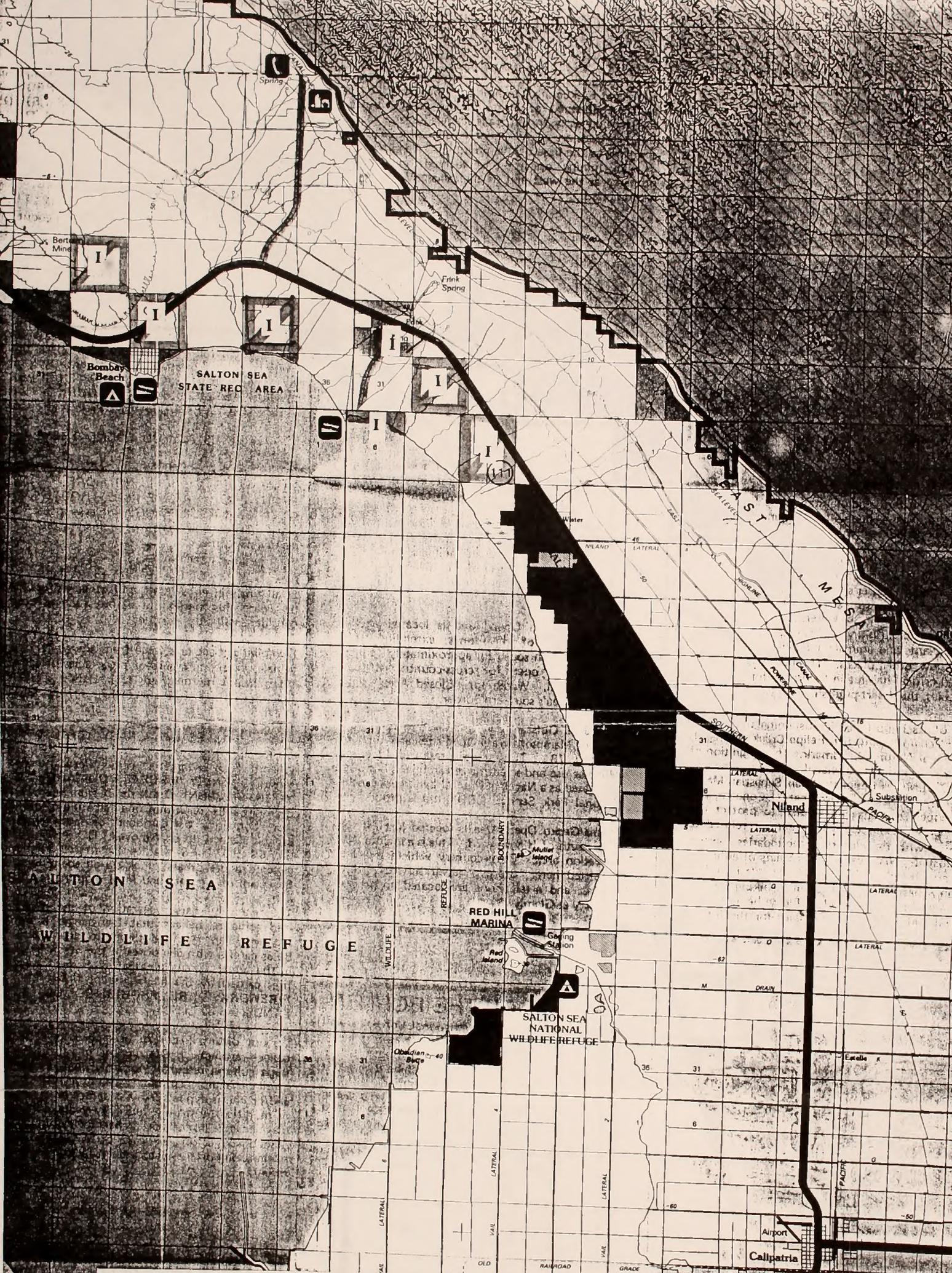

Figure 29. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Inventory Results (Summer 1993) and Recommendations for 1994 Inventory (orange **I** sections). Green **P**: Poor < 1 scat/hour. Purple **L**: Low 1 to < 5 scat/hour. Yellow **M** Medium 5 to <= 9 scat/hour. Blue **H**: High > 9 scat/hour. Imperial County, CA.

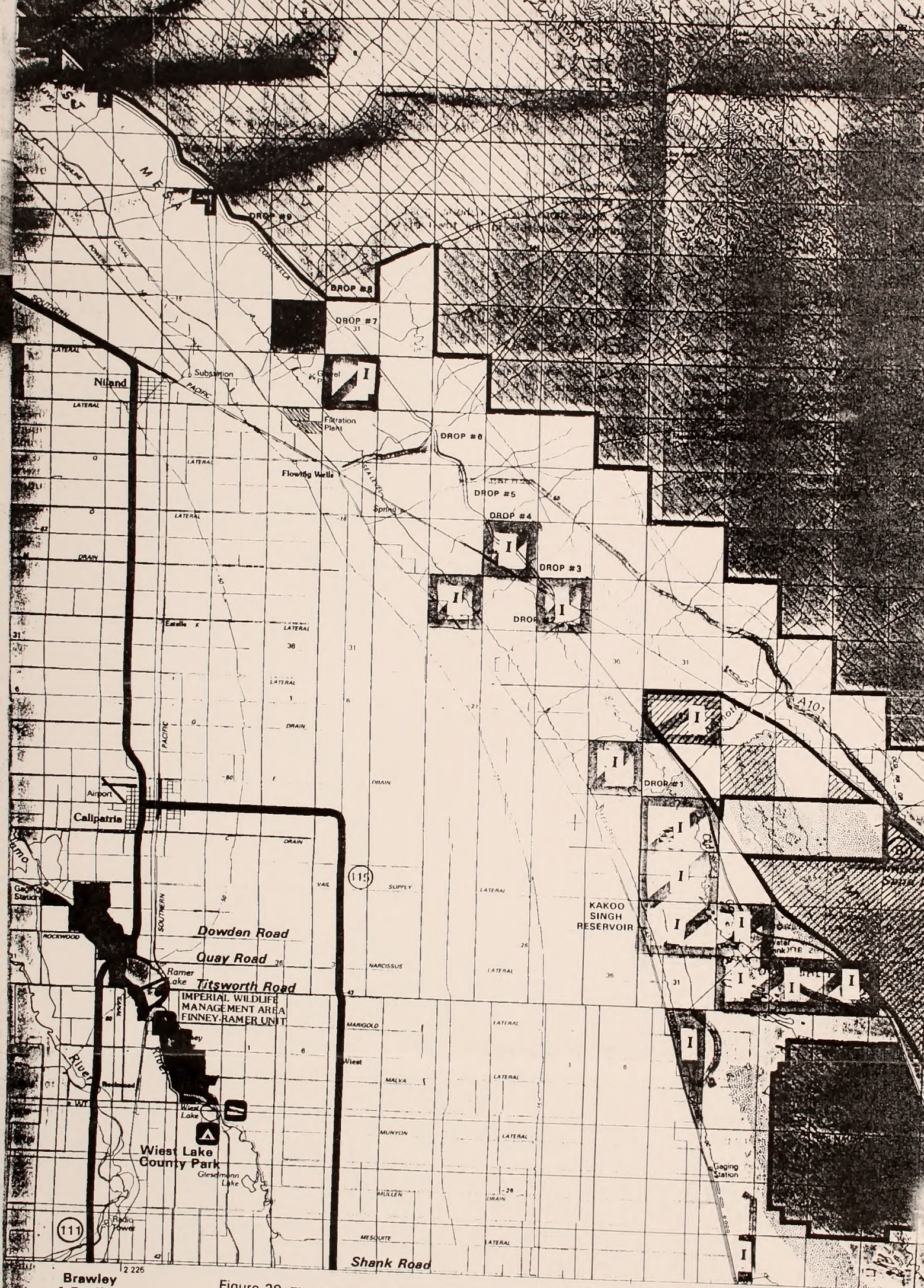

Figure 29. Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Inventory Results (Summer 1993) and Recommendations for 1994 Inventory (orange **I** sections). Green **P**: Poor < 1 scat/hour. Purple **L**: Low 1 to < 5 scat/hour. Yellow **M**: Medium 5 to < = 9 scat/hour. Blue **H**: High > 9 scat/hour. Imperial County, CA.

DISCUSSION

The relative abundance of scat declined in the Yuha while no statistically significant trend was found in the other two areas from 1979 to 1993 (figures 10 - 12). There are a number of possible explanations for the FTHL decline in the Yuha: drought, OHVs, pesticide spraying, powerline construction, highway maintenance, Border Patrol enforcement activities, sand and gravel extraction or an unidentified impact. A combination of these factors may also have resulted in the decline.

The Yuha scat decline corresponds roughly to the period of lower than average rainfall in the City of Imperial from 1987 to 1990 (figures 11 and 12c). Average yearly rainfall has been 2.92 inches since 1914 (Imperial Irrigation District 1992). Unfortunately, no data are available from the Yuha Desert on rainfall prior to January of 1992. Desert rainfall is so patchy and variable (figure 12b) that rainfall in Imperial is not a reliable indicator of rainfall in the Yuha. So it is not possible to draw correlations between Yuha rainfall and the scat decline. However, following the 4.08 inches recorded in the Yuha Desert in 1992, scat counts increased significantly from 1991, reaching the level from the 1986 surveys. Also, the number of FTHL sightings per 10 hours of effort was the highest since 1985. This increase in sightings followed 4 years of surveys in the Yuhas during which no FTHLs were sighted. Although drought may have been its cause, the Yuha scat decline cannot be statistically linked to drought. The collection of rain data in the Yuha in future years will allow BLM to assess the impact of rain on scat abundance.

OHVs impact the Yuha Desert in substantial numbers. The bureau has conducted 3 studies of this impact on FTHLs. The study by Olech (1985) from 1985 to 1989 to assess the impact of a route closure on FTHL scat showed no effect from the closing of route Y1955 to vehicle traffic. The scat counts along the closed route showed no significant trend up or down following closure. Similarly, scat counts along a nearby open route showed no significant trend. An inspection of both routes in April of 1993 showed little recent use of the closed route and extensive use of the open route. Apparently, the route closure is being respected by the OHV community. This result does not support the closing of routes to benefit the FTHL. However, this study did not measure OHV use during the period of the study. It assumed that OHV use along the closed route ceased and that the use along the open route continued. However, no reliable casual OHV use data for these two routes exists for the period from 1985 - 1989. BLM rangers state that violations of route designations are frequent and that some open routes receive light use. For this reason, this study really only compares FTHL scat to the administrative designation of "open" or "closed".

The reanalysis of Klinger's data from the Algodones dunes shows no negative relationship between the Open area designation and FTHL scat or between the estimated level of OHV use and FTHL scat. Figures 23 and 25 are probably the most valid because they rely only on the presence or absence of scat. Figures 22 and 24 incorporate the implicit assumption that scat per hour and number of FTHLs are closely related, which, as stated earlier, is an unverified assumption. Additionally, absence of OHV impact data for the winter of 1989 - 1990, the peak use period prior to the study, make determining the actual impact of OHVs on FTHLs from this study difficult. The subjective classification criteria of "none, low, moderate or heavy" is inexact and hard to repeat. However, these data do not support the notion that closing the Open area would help the FTHL or that OHV use is detrimental to the FTHL.

When Olech indirectly measured OHV use in 1985 she found a strong negative relationship ($p < 0.001$) between the presence of OHV tracks and the presence of scat (BLM 1986). This study contrasts with the Klinger study and the Yuha route closure study. Only the 1986 study actually quantified OHV use in relation to FTHL scat, so its results are probably the most reliable. The other two studies never quantified OHV use and so are less reliable indicators of OHV impacts on FTHLs.

Highway maintenance occurs along state highway 98. This work happens within an established right-of-way. A similar situation exists with respect to the La Rosita Powerline, constructed in 1984, along with its associated substation. Some FTHL habitat was permanently lost to this project. A dirt road for maintenance parallels the powerline. Prior to the construction of the powerline, long linear transects (figure 7) were established to assess its impact. These transects could be repeated to compare before and after construction FTHL scat abundance.

Along the eastern side of the Yuha Desert tamarisk (*Tamarix* spp.) is spreading into FTHL habitat from the seepage of the West Highline Canal. This is particularly true 1 mile east of the San Felipe powerline substation in T.16.5S, R.12E, Sec. 2, but it may be occurring in other areas along the western side of the Westside Main Canal. Tamarisk probably eliminates FTHL habitat. The extent of such elimination needs to be quantified. Tamarisk invasion has also occurred in the central portion of the Yuha, where the main decline in scat counts has occurred. Whether any relationship exists between this invasion and drops in FTHL scats has yet to be determined.

Agricultural spraying also occurs on the adjacent agricultural areas, as well as on BLM desert lands for beet leaf hopper control. This spraying has been occurring for many years. In 1991, the California Department of Agriculture and BLM showed that ant populations quickly recovered after spraying of malathion for leaf hopper control (BLM 1991). Since this spraying is sporadic and localized, it is

probably of less potential significance than the regular spraying of adjacent fields associated with agricultural fields. During such spraying a certain amount of pesticide or herbicide drift may occur from the wind, landing on FTHL habitat. The effect of such drift should be assessed.

The amount and extent of Border Patrol activity in the Yuha and its associated disturbance has not been quantified and its effect on the FTHL has not been assessed. Mortality of FTHLs probably occurs from Border Patrol vehicles, yet it may be difficult for Patrol agents to carry out there duties without occasionally running over a FTHL, since FTHLs are not easy to see. It may not be possible to alleviate this impact without seriously compromising the enforcement of immigration and smuggling laws. Still the effect on the FTHL needs assessment.

Currently, two sand and gravel operation are extracting material from the Yuha Desert. One on a 60 acre site in the vicinity of Pinto Wash near its junction with highway 98 and a second on 140 acres at the base of Mt. Signal (T17S, R12E, Sec. 24, SW1/4). How much of these two acerages has actually been impacted is unknown but both of these operations are impacting FTHL habitat.

Sand and gravel operations, although intense in nature, are highly localized. They could not account for the drop seen throughout the Yuha in scat abundance. The other 2 areas of sand and gravel impacts on FTHLs are southeast of the dry lake bed in West Mesa and along the East Highline Canal adjacent to East Mesa.

Sand and gravel eliminates FTHL habitat, probably rendering it unusable for 10 - 20 years. For this reason, as sand and gravel contracts come up for renewal, BLM charges compensation. Since June of 1992, when the BLM began collecting FTHL compensation, $9,439.34 has been for 29.3 acres of FTHL habitat eliminated by sand and gravel operations. 3.3 acres of this acreage was medium relative abundance habitat, the remaining acreage was all low relative abundance habitat. All this acerage was located along the East Highline Canal. 26 acres of it was in old sand and gravel areas (areas worked in the 1950s and 1960s) that FTHLs were recolonizing. The 3.3 acres was a previously undisturbed area adjacent to an active pit area. In general, the higher compensation that must be paid for entering an undisturbed medium or high relative abundance area, has detered sand and gravel operators from entering such areas. The amount of FTHL habitat lost and being lost to sand and gravel operations needs to be quantified to more accurately assess its impact on the species.

The positive relationship btween scat per hour and FTHL sightings (figures 26 and 27) is encouraging but inconclusive because FTHL sightings are a poor index of FTHL numbers. This is due to the high sensitivity of FTHLs to changes in soil temperature. Such changes in soil temperature dramatically affect activity and

observability. Scat per hour needs to be compared to an accurate population estimate made by mark recapture or diminishing capture methods.

CONCLUSIONS

Based on the available data, the cause of the Yuha scat decline cannot be positively determined. In subsequent years if rainfall stays up, so should scat counts. If scat counts decline despite adequate rainfall (> 2.92"), then other impacts may be causing the decline. One such impact will be addressed in a Yuha OHV impacts study. This study should include study of casual recreational use, races and border patrol activities.

Due to the relatively small area they affect, it is unlikely that the la Rosita Powerline, sand and gravel operations, tamarisk invasion or highway maintenance constitute a significant threat to the FTHL in the Yuha. However, pesticide spraying, due to its potential to affect reproduction and to spread on air currents, could cause widespread impacts. This possible pesticide impact should be studied.

The scat count method may give a rough idea of FTHL relative abundance, however regression shows that its ability to predict FTHL numbers is low. Until a better method of assessing trends is developed, this method should be continued. Knowledge from new studies on survey methods should continue to be incorporated into the methodology to keep it up to date. Yuma BLM with the assistance of the Marine Corps is initiating a study to provide helpful information in this regard.

Recommendations

When monitoring use the following methodology:

1) Monitor the 1 area which hasn't been done in the longest time. Use other FTHL time for inventory. In 1994, monitor East Mesa. In 1995, monitor West Mesa. In 1996, monitor the Yuha. If manpower allows, monitor 2 or 3 areas per year. This may become possible as inventory needs decline.

2) Select a randomized systematic sample of 12 sections from the area to be monitored, as follows:

   a) Number each section in the sampling area consecutively.

   b) Pick 1 of the sections randomly using a random numbers generator or random numbers table.

3) Monitor scat in this section and every 3rd section after it (for the Yuha), in every 10th section after it (for West Mesa) and in every 5th section after it (for East Mesa).

4) Perform 3 transect repetitions in each of the 12 sections in the area selected during the peak of scat abundance. This peak is generally from mid-May to mid-September. Allow 3 weeks between repetitions to dampen fluctuations in scat abundance to fluctuations in FTHL activity. If available, use a different observer for each repetition to dampen the effect of observer acuity on scat counts.

5) Use the average of these three repetitions for statistical analyses.

6) Update the methodology yearly based on the latest research.

7) Monitor rainfall at the 3 permanent transects and the Algodones Dunes after rainstorms and during scat counts. Count scat monthly at each transect. Assess the relationship between scat counts and rainfall, if any.

8) Keep the FTHL data-base updated. Produce a yearly monitoring and inventory report.

This sampling design will prevent clumping of the transects which could bias the data collected from such a small sample. It also ensures that each section has an equal chance of being selected.

For example, if East Mesa is to be monitored number all sections and partial sections from 1 to 66. Then randomly select a number from 1 to 66. If the number was 15, monitor the following sections: 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 4.

Some partial sections are in the sampling area. These are created by the division of sections by canals and freeways. Include these in the sample, using "designer" transects (customized triangular transects) to fit into the truncated sections. Attach 7.5 minute maps showing the "designer" transect to the FTHL data sheet.

Long-term survival of the FTHL depends on protecting its habitat. To ensure that this occurs, the East Mesa ACEC should continue to be protected for the FTHL. This area is the least impacted of any of the FTHL's habitat and also has the highest average scat counts. Although the scat counts may not indicate relative abundance, they are the best data available and thus the only means of making this choice.

The abandoned farm within the ACEC (T16S, R18E, Sec. 16) should be purchased with FTHL compensation funds, as should private lands between Ocotillo Wells and West Mesa. T16S, R19E, Sec. 16 is an active citrus farm and so would not be an acceptable purchase. Private lands north of West Mesa would probably link the West Mesa and Ocotillo Wells populations. This linkage would prevent the genetic isolation of the two populations.

The amount and source of annual habitat loss from all sources needs to be quantified with the Global Positioning System (GPS) and a Geographic Information System (GIS). Habitat losses in category 1 and 2 habitats should continue to be minimized.

Of all the impacts discussed, the one most meriting study is OHVs because they impact the widest area. Any OHV study must quantify OHV use directly and attempt to relate it to actual FTHL numbers. Current data on the impact of OHVs on the FTHL are mixed. Two studies showed no negative effect (Klinger 1986 and the Yuha route closure report), one shows a negative effect (BLM 1986). However, the study showing a negative effect is more rigorous and had a much higher degree of statistical significance ($p < 0.001$) than the other 2 studies. That being the case, expanding OHV use would be a poor idea. However, closing OHV areas is also not justified by the current database.

OHV use should be maintained at current levels while undertaking OHV impacts studies of greater scope than before. These studies must measure all impacts directly rather than using administrative designations (such as "closed" or "open"), which may not correspond to the situation on the ground. Race course monitoring should also be implemented at permanent points to ensure that devegetion does not increase over current levels from races.

Areas degraded from illegal use of OHVs should be rehabilitated. This would involve signing, raking burms flat, scarifying soil and scattering native seed prior to winter rains on illegal routes. This rehabilitation would lower OHV use of illegal routes, hopefully reducing incidental take of FTHLs.

The above steps, taken now would manage habitat so as to preclude the need for listing, a BLM objective. They might also prevent the need for more costly solutions in the future.

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Appendix 1.

FLAT TAILED HORNED LIZARD DATA BASE USER GUIDE

by

Paula Miller

ACCESSING DATA BASE 4:

select Data Base 4 from the menu;
select the lizards file;
type "D" to display data;
type "F10";
type "A" to add records;
enter the information according to the following guide;
If additional memos need to be recorded, type "control" and "home" simultaneously.

EXITING DATA BASE 4:

If memos were added, type "F10" and move cursor till "save and exit" is displayed;
type "S";
If no memos were added, type "F10" and move cursor till "quit" is displayed;
type "Q";
type "F10" again;
type "E" to exit to Dot prompt
type "quit";

ADDING DATA:

Once DB4 is accessed and the data is displayed on your screen, type the "control" key and the "page down" key simultaneously to move the cursor to the next available entry slot.

Column 1: asks for date of subject; enter date: month/day/year;

Column 2: enter the complete name of the quadrangle map- except for the state, and specify minutes;

Column 3: enter the township, specify South with a capital "S";

Column 4: enter the range, specify East with a capital "E";

Column 5: enter the section number. Some of the older transects transcended into more than one section number and crossed range boundaries. All of the involved sections and ranges must be noted, listing them respectively.

Column 6: enter the scat per hour. Calculated a #scat x 60/total time.

Column 7: Sampling Area. YR for year-round transects, Y for Yuha monitoring, W for West Mesa Monitoring, E for East Mesa monitoring. RO for route open (Y1955), RC for route closed (Y1851). These are the transects with greek letters established to study effects of route closure. Monitoring areas are those in figs. 1 -3, excluding data collected in a non-random or non-systematic fashion. Don't enter anything for inventory or project specific work.

Column 8: enter the names or initials of all the observers;

Column 9: enter the transect identification number designating the management area with a capitalized letter preceding the number.

Column 10: enter the military time the transect was begun; a zero in this column means the time was unknown.

Column 11: enter the military time the transect was completed; a zero in this column means the time was unknown.

Column 12: enter the number of total walking minutes. This number is not to include break time or lizard observation time- only walking. A zero means the total time was unknown - it was assumed to be 60 or 30 minutes depending on the size of the transect walked.

Column 13: enter the total number of lizards seen while walking the transect; any lizards spotted while walking to transect or outside of transect boundary should be noted in the comment section, not in this column.

Column 14: specify number of adult males seen;

Column 15: specify number of adult females seen;

Column 16: specify number of immmatures seen;

Column 17: enter the number of unclassified lizards seen; those which the observer was unable to determine sex.

Column 18: enter the number of scat observed;

Column 19: specify if the lizard(s) was reproductively active (gravid, swollen base of tail for males, copulating, or any other activity or feature you think means the lizard is, was or soon will be mating). "T" designating yes,"F" designating no.

Column 20-24: These four columns ask for a code designating types of usage the observer noted in the section. This is a four letter code in all capitalized letters. The codes are to be listed in order of intensity with column 19 having the code for the use most often observed. If there is only one use observed, then list it in column 19. Obtain the codes from the list provided:

OHVC-Off Highway Vehicle casual
OHVR-Off Highway Vehicle Racing
DRRD-Dirt Road
PVRD-Paved Road
PWLN-Power Line
PHLN-Phone Line
GETH-Geothermal
BMRG-Bombing Range
HIMT-Highway Maintenance
RESD-Residential
COMM-Commercial
SAGR-Sand and Gravel
AGRC-Agriculture
PIPE-Piping
MINE-Mining
RKQY-Rock Quarry
CANL-Canal

Column 25: This column asks for the management area the transect's section occurs in. This is a four letter code in all capitals. The management area can be determined by locating the township, range and section number on a Desert Access Guide. Compare this information against the Area of Critical Environmental Concern maps. If the section is within an ACEC boundary, list it according to the corresponding ACEC code. Otherwise, list it according to what the DAG classifies it as. If a section overlaps more than one management area then use all the appropriate codes. List the code for the management area covering the most territory first and then the others in decreasing order. If a section is in an ACEC and also private or partially private, however, use the corresponding ACEC code as well as the private code, placing the private code first. Obtain the codes from the list provided:

NAVY-Navy
PRIV-Private
ADCA-Algadones Dunes Closed Area
ADOA-Algadones Dunes Open Area
SMOA-Superstition Mountain Open Area
PSCA-Palm Spring Closed Area
PSLA-Palm Spring Limited Area
PCOA-Plaster City Open Area
EMLA-East Mesa Limited Area
EMAC-East Mesa ACEC
WMAC-West Mesa ACEC
WMLA-West Mesa Limited Area
ASOA-Arroyo Salada Open Area
YHAC-Yuha ACEC
YHLA-Yuha Limited Area

NGLA-Niland-Glamis Limited Area
PKLA-Pilot Knob Limited Area
SSLA-Salton Sea Limited Area
SSSRA-Salton Sea State Recreation Area
JONA-Jacumba Outstanding Natural Area
OWSVRA-Ocotillo Wells State Vehicular Recreation Area
ABDSP-Anza Borrego State Desert Park
CVFTLP-Coachella Valley Fringe-Toed Lizard Preserve
SSMCA-San Sebastion Marsh Closed Area
SSMLA-San Sebastion Marsh Limited Area
STAT-State Lands
ACIR-Agua Caliente Indian Reservation
TMIR-Torres Martinez Indian Reservation

The comments section, which can be reached by typing "control" and "home" simultaneously, is for a more detailed description of any relevant information. Such as: lizard measurements, wildlife observations, notable weather or habitat conditions, and break times.

FLAT TAILED HORNED LIZARD DATA BASE USER GUIDE

by

Paula Miller

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select the lizards file;
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ADDING DATA:

Once DB4 is accessed and the data is displayed on your screen, type the "control" key and the "page down" key simultaneously to move the cursor to the next available entry slot.

Column 1: asks for date of subject; enter date: month/day/year;

Column 2: enter the complete name of the quadrangle map - except for the state, and specify minutes. If more than 1 topo is covered by the transect enter the names of the topos separated by a "/".

Column 3: enter the township, specify South with a capital "S";

Column 4: enter the range, specify East with a capital "E";

Column 5: enter the section number. Some of the older transects entered more than one section and sometimes crossed township boundaries. In these cases sections surveyed are separated by a comma ",". In cases where township boundaries were crossed, a semicolon ";" separates the different townships and ranges. A semicolon also separates those sections that are in different townships from one another.

Column 6: enter the scat per hour. Calculated a #scat x 60/total time. Do not count scat that were 5.5 mm or less in diameter.

Column 7: enter the names or initials of all the observers;

Column 8: enter the transect identification number designating the management area with a capitalized letter preceding the number.

Column 9: enter the military time the transect was begun;
a zero in this column means the time was unknown.

Column 10: enter the military time the transect was completed;
a zero in this column means the time was unknown.

Column 11: enter the number of total walking minutes. This number is not to include break time or lizard handling time- only walking.

Column 12: enter the total number of lizards seen while walking the transect; any lizards spotted while walking to transect or outside of transect boundary should be noted in the comment section, not in this column.

Column 13: specify number of adult males seen;

Column 14: specify number of adult females seen;

Column 15: specify number of immmatures seen;

Column 16: enter the number of unclassified lizards seen; those which the observer was unable to determine sex.

Column 17: enter the number of scat whose diameter was greater than 5.5mm observed;

Column 18: specify if the lizard(s) was reproductively active
(pregnant, swollen base of tail for males, juveniles, copulating, or any other activity or feature you think means the lizard is, was or soon will be mating). "N" designating yes,"Y" designating no.

Column 19-23: These four columns ask for a code designating types of impacts the observer saw in the section. This is a four letter code in all capitalized letters. The codes are to be listed in order of intensity with column 19 having the code for the use most often observed. If there is only one use observed, then list it in column 19. Obtain the codes from the list provided:

OHVC-Off Highway Vehicle casual
OHVR-Off Highway Vehicle Racing
DRRD-Dirt Road
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BMRG-Bombing Range Imparts
HIMT-Highway Maintenance
RESD-Residential
COMM-Commercial
SAGR-Sand and Gravel
AGRC-Agriculture
PIPE-Piping
MINE-Mining
RKQY-Rock Quarry
CANL-Canal
OTHR-Other (specify)

Don't use for Navy lands without bombing impacts

Column 24: This column asks for the management area the transect's section occurs in. This is a four or five letter code in all capitals. The management area can be determined by locating the township, range and section number on a Desert Access Guide. Compare this information against the Area of Critical Environmental Concern maps. If the section is an ACEC boundary, list it according to the corresponding ACEC code. Otherwise, list it according to what the DAG classifies it as. If a section overlaps more than one management area then use all the appropriate codes with a slash "/" separating different codes. List the code for the management area covering the most territory first and then the others in decreasing order. If a section is entirely private, list the codes for the land classes it is adjacent to after the code "PRIV". For example: PRIV/SMOA/WMLA. This would designate as section that is private and adjacent to the Superstition Mtn. Open area and the West Mesa Limited Area. Obtain the codes from the list provided:

ACIR-Agua Caliente Indian Reservation
NAVY-Navy: NAVY103 (target 103), NAVYL (East Mesa Live), NAVYP (Parachute), NAVY101.
PRIV-Private
ADCA-Algadones Dunes Closed Area
ADOA-Algadones Dunes Open Area
SMOA-Superstition Mountain Open Area
PSCA-Palm Spring Closed Area
PSLA-Palm Spring Limited Area
PCOA-Plaster City Open Area
EMLA-East Mesa Limited Area
EMAC-East Mesa ACEC
WMAC-West Mesa ACEC
WMLA-West Mesa Limited Area
ASOA-Arroyo Salada Open Area
YHAC-Yuha ACEC
YHLA-Yuha Limited Area
NGLA-Niland-Glamis Limited Area
PKLA-Pilot Knob Limited Area
SSLA-Salton Sea Limited Area
SSSRA-Salton Sea State Recreation Area
JONA-Jacumba Outstanding Natural Area
OWSVRA-Ocotillo Wells State Vehicular Recreation Area
ABDSP-Anza Borrego State Desert Park
CVFTLP-Coachella Valley Fringe-Toed Lizard Preserve
SSAC-San Sebastian ACEC
SSMLA-San Sebastian Marsh Limited Area
STAT-State
TMIR-Torres Martinez Indian Reservation
SHLA-Superstition Hills Limited Area
SSTB-Salton Sea Test Base

The comments section, which can be reached by typing "control" and "home" simultaneously, is for a more detailed description of any relevant information. Such as: lizard measurements, wildlife observations, notable weather or habitat conditions, and break times.