Status of the Flat-tailed Horned Lizard (*Phrynosoma mcallii*) on Bureau of Land Management Administered Land in California

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ABSTRACT

The status of the flat-tailed horned lizard (Phrynosoma mcallii) on Bureau of Land Management (BLM) administered lands in California was examined through the performance of extensive inventories in the Yuha, East Mesa, and Superstition Mountain optimal habitats. Surveys in the Yuha and East Mesa primarily consisted of repeating earlier inventories which allowed a determination of trend in the species' relative abundance. Superstition Mountain surveys were project related, and chiefly consisted of work performed in previously unsurveyed habitat.

Although P. mcallii remains well represented in the three areas studied, declines in its relative abundance were observed in portions of both the Yuha and East Mesa. Much of this decrease appears to be due to ORV use and camping impacts. Pesticide use and transmission line-related activities may also have had an effect. This, in conjunction with recorded declines in non-BLM administered optimal habitat in Ocotillo Wells/Benson Dry Lake, is significant since it means that decreases have occurred in three of four identified optimal habitat areas.

INTRODUCTION

The flat-tailed horned lizard (Phrynosoma mcallii) inhabits desert areas of southern Riverside, eastern San Diego, and Imperial Counties in California; southwestern Arizona; and adjacent regions of northwestern Sonora and northeastern Baja California Norte, Mexico (Rado, n.d.; Turner and Medica, 1982) (Figure 1[1/]). The species occupies one of the smallest geographic ranges of any species of Phrynosoma (Funk,1981 in Mayhew and Carlson, 1986) and often occurs at apparently low densities in areas where it occurs (Turner and Medica, 1982).

The lizard's normally low density and observed declines in some portions of the range, coupled with the loss of large acreages of habitat due to greater use and development of desert areas, led to increased concern about the status of the species. Stewart and U.C. Berkeley's Museum of Vertebrate Zoology staff expressed such concern, as did the Riverside County Planning Commission. In response the U.S. Fish and Wildlife Service designated P. mcallii as a category 2 candidate for Federal listing under the Endangered Species Act. Taxa included in category 2 include those

> for which information now in possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available to support proposed rules....Further biological research and field study may be needed to ascertain the status of taxa in this category... (USDI, FWS, 1985).

The Bureau of Land Management supported investigations of the status of P. mcallii in California between 1978 and 1980. The aim of these studies was to define the species' local distribution and relative abundance, and to correlate these with habitat attributes, as well as to investigate population structure, mobility, and food habits. This work is summarized in Turner and Medica (1982). In addition, Rado (n.d.) analyzed factors such as agricultural development, mineral exploration and development, and intensive recreational use which actually or potentially could contribute to habitat loss in California. BLM

1/ All Figures are located in Appendix A.

has further recognized the declining status of P. mcallii by including it in the group of Sensitive Species listed in the California Desert Conservation Area Plan (USDI, BLM, 1980). Identification criteria for sensitive species include:

a. plants and animals under status review or considered as candidates for listing by the FWS;

b. plants and animals proposed for Federal listing by the FWS;

c. plants and animals whose numbers are declining so rapidly that Federal listing may become necessary;

d. plants and animals with typically small and widely dispersed populations; and

e. plants and animals inhabiting ecological refugia or other specialized or unique habitats (USDI, BLM, 1982a).

The goal of BLM's sensitive species management is "to manage the public lands so as to prevent deterioration of sensitive species' habitat thereby precluding the need for State or Federal listing of those species" (USDI, BLM, 1982b).

The precarious status of P. mcallii has also been recognized by the states of Arizona and California. The Arizona Game and Fish Commission has designated P. mcallii as a Group 3 species. This category includes

> Species or subspecies whose continued presence in Arizona could be in jeopardy in the foreseeable future. Serious threats to the occupied habitats have been identified and populations (a)have declined or (b)are limited to few individuals in few localities (Arizona Game and Fish Commission, 1982, in Johnson and Spicer, 1985).

Although not legally binding this designation results in consideration by state and Federal agencies during resource management planning. Arizona and California have also prohibited collection of the species except by permit (Arizona Game and Fish Regulation, Title 17, R12-4-443, Commission Order 43; and California Administrative Code 40.10, Title 14).

One result of the BLM sponsored investigations was the delineation of four primary areas in which P. mcallii was well represented: north of Ocotillo Wells and Benson Dry Lake (T.11S., R.8E.), South of Superstition Mountain (T.14S., Rs.10-11E.), the Yuha Basin (Ts.16-17S., R.12E.), and

East Mesa (Ts.15-16S., Rs.17-20E. - especially T.16S., Rs.19-20E.) (Turner and Medica, 1982) (Figure 2). The Ocotillo Wells/Benson Dry Lake crucial habitat is managed by the California Department of Parks and Recreation. The Superstition Mountain habitat is currently withdrawn by the Bureau of Reclamation and leased to the U.S. Navy; it is likely that Reclamation will relinquish its withdrawal, in which case administration of this habitat will devolve to BLM. The Yuha Basin and East Mesa habitats are also currently withdrawn by Reclamation, but are managed by BLM under a Memorandum of Understanding.

BLM's Desert Plan designated two special management areas in the Yuha and an additional two areas in East Mesa in which management of P. mcallii and its habitat was to be a priority consideration (USDI, BLM, 1980) (Figure 3). Management plans have been prepared for the Yuha Basin Area of Critical Environmental Concern (ACEC) and Yuha Desert Wildlife Habitat Area (WHA) (USDI, BLM, 1981, 1983b, 1985) and the Southern East Mesa ACEC and East Mesa WHA (USDI, BLM, 1982c, 1983a). A crucial element in all five plans was the need to monitor the status of lizard in each management area, both to be able to determine the effectiveness of management actions and to revise management if such actions prove ineffective. Such evaluation is also useful to agencies such as the U.S. Fish and Wildlife Service and the California Department of Fish and Game, which as already discussed have expressed varying degrees of concern about the species' status.

Starting in 1984 BLM has carried out intensive monitoring of the Yuha and East Mesa crucial habitat areas. BLM has also performed extensive inventory in previously unsurveyed, potential optimal P. mcallii habitat. The purpose of the present study is to present the results of monitoring studies in the Yuha and East Mesa, as well as the results of inventories of previously unsurveyed portions of the Yuha, East Mesa, and Superstition Mountain potential optimal habitats, in order to assess the species' current status on BLM- and potential BLM-administered land in California. Updated survey results in the Yuha and East Mesa habitats are also compared to earlier inventories in order to indicate the trend of P. mcallii populations in these areas.

METHODS

Pre-field Phase

Updated status and trend were determined for the Yuha and East Mesa habitats chiefly by repeating previously established transects. Supplementary transects performed in previously unsurveyed areas were also used to determine status in these areas. Status surveys in the Superstition Mountain habitat

relied primarily on new transects in previously unsurveyed areas, in addition to existing inventories. This was because field work in this area was performed in relation to potential land use allocations in a given project area, and also because of the limited field season.

In order to determine the trend of flat-tailed horned lizard populations in the Yuha and East Mesa, it was necessary to repeat transects which had been performed previously. The previous transect route, work hours of effort, time of year, and number of observers also had to be known accurately, in order for the transects to be repeated as closely as possible. Two groups of transects fulfilled these needs: those performed in 1979 as part of a general investigation of lizard occurrence and abundance (Turner et al., 1980), and those performed in 1981 in conjunction with the environmental assessment for the La Rosita 230 kV transmission line project (WESTEC, 1981). Priority was given to repeating transects in known high value habitat. Previously established transect routes were copied onto 7.5 minute USGS topographic maps.

Supplementary inventories of the Yuha and East Mesa habitats, and large-scale inventories in the Superstition Mountain habitat, were established by marking transect routes on 7.5 minute USGS topographic maps. Pertinent routes of travel shown on internal BLM work maps were also marked on all maps. These maps were used to locate transects in the field. New transects consisted of one 2.5 mile long triangular belt transect per square mile surveyed; this has become the standard survey method in California.

The routes of 83 transects chosen for repetition, as well as the 52 new transects, are shown on Figures 4-6.

Field Phase

Transects established in 1979 and 1981 in the Yuha were repeated between June 1 and July 1, 1984. These were supplemented with transects established and performed on June 25-26 and July 17, 1986. Yuha surveys began following sunrise (approximately 0600 hours) and ended by approximately 1030 hours daily.

Transects established in 1979 in East Mesa were re-inventoried between May 16 and June 23, 1986. These were supplemented by transects established and performed on May 9-10, 1985 and July 21, 1986. East Mesa surveys occurred between approximately 0700 and 1115 hours.

Transects established in the Superstition Mountain area were performed between June 4 and July 9, 1985. Superstition Mountain surveys were conducted between approximately 0700 and 1030 hours.

A Precise Sportach^{R} digital walking tachometer and Silva^{R} compass were used to aid in the accurate repetition or performance of all transects.

Information recorded on field forms included date, time the transect was begun and ended, observer(s), USGS quad, and legal description of the transect location. The number of scats and/or horned lizards observed was also recorded.

Analysis Phase

Data analysis first consisted of standardizing the number of scats observed/hour effort and horned lizards observed/hour effort for each transect. This was necessary because varying amounts of effort had been expended on many of the transects.

The Wilcoxon Signed-Ranks Test (Armour et al., 1983) was used to test the significance of differences in numbers of scats observed/hour effort/transect between 1979/1981 and 1984 (for the Yuha) or between 1979 and 1986 (for East Mesa). Tests were performed using a dBASE III computer program developed by Peter Ertman, Resources Branch Chief, BLM, El Centro.

The Wilcoxon Signed-Ranks Test was also used to analyze differences in the number of horned lizards seen/hour effort/transect in 1979 vs. 1984. There were too few observations to allow statistical analysis of 1981 vs. 1984 data or 1979 vs. 1986 data.

In addition Modified Abundance Indexes (modified from Turner and Medica, 1982) were calculated for 1984, 1985, and 1986 surveys in which more than four sections had been examined per Township. The modified method of calculation used scats and lizards observed/hour effort, rather than total scats and lizards observed, in order to more accurately standardize observations. This index gives an idea of the relative abundance of P. mcallii in each Township and was used originally to delineate areas in which the species was well represented. In addition, separate Modified Abundance Indexes were calculated for 1979 transects which had been selected for repetition in 1984 and 1986, as well as for data from the 1984 and 1986 resurveys. As in Turner and Medica (1982) Yuha data for Ts.16 and 16.5S. were combined. These Indexes were then compared using the Wilcoxon Signed-Ranks Test to determine whether significant changes had occurred between 1979 and 1984/1986. Categories of relative abundance were defined as in Turner and Medica (1982).

RESULTS

Yuha Desert Habitat

Table 1[1/] summarizes the results of 43 transects performed in 1979/1981 and repeated in 1984 in the Yuha Desert.

When analyzed using the Wilcoxon Signed-Ranks Test, the overall transect by transect data in Table 1 do not indicate significant differences in scats observed/hour effort between 1979 and 1984 ($T+ = 111$, $T- = 142$, $T_{.05} = 75$) or 1981 and 1984 ($T+ = 86$, $T- = 122$, $T_{.05} = 60$). Differences in 1979 vs. 1984 data south of State Highway 98 are also not significantly different ($T+ = 47$, $T- = 19$, $T_{.05} = 14$), although increases generally occurred in this portion of the study area in 1984. The sample size for 1981 vs. 1984 transects south of Highway 98 is too small to permit this type of analysis, although increases also occurred in these transect results in 1984.

However, differences (i.e., decreases) in both 1979 vs. 1984 and 1981 vs. 1984 data from individual transects north of Highway 98 are significantly different ($T+ = 11$, $T- = 55$, $T_{.05} = 14$; and $T+ = 31.5$,, $T- = 104.5$, $T_{.05} = 36$, respectively).

When evaluated by the Wilcoxon Signed-Ranks Test, the number of horned lizards observed/hour effort/transect in 1979 vs. 1984 was not significantly different ($T+ = 19.5$, $T- = 8.5$, $T_{.05} = 4$). Data for 1981 vs. 1984 included too few observations to allow statistical analysis.

The trend in scats observed/hour effort/transect between 1979/1981 and 1984 is portrayed in Figure 7. Figure 7 reiterates the trend of somewhat increased scat counts south of Highway 98 and significantly decreased scat counts north of Highway 98.

Table 2 presents the results of four new transects established in 1986 in previously unsurveyed habitat in the Yuha.

Figure 8 illustrates P. mcallii relative abundance based on the latest survey information available, for the Yuha study area.

East Mesa Habitat

Table 3 summarizes the results of 37 transects performed in 1979 and repeated in 1986 in East Mesa.

1/ All Tables are located in Appendix B.

When analyzed using the Wilcoxon Signed-Ranks Test, the overall transect by transect data in Table 3 show a significant difference (i.e., decrease) in scats observed/hour effort between 1979 and 1986 ($T+ = 186.5$, $T- = 408.5$, $T_{.05} = 201$). A more detailed analysis indicates that a significant decrease in scat counts has occurred on transects in T.16S., R.19E. plus T.16S., R.20E.[1/] ($T+ = 6$, $T- = 99$, $T_{.05} = 26$). Results from transects in T.15S., R.17E. plus T.16S., R.17E.[1/]; and T.16S., R.18E. were not significantly different between 1979 and 1986 ($T+ = 15.5$, $T- = 20.5$, $T_{.05} = 6$; and $T+ = 46.5$, $T- = 31.5$, $T_{.05} = 17$, respectively).

The trend in scats observed/hour effort/transect between 1979 and 1986 is shown in Figure 9. This reflects the trend of significant decreases in the southeastern portion of East Mesa.

Table 4 presents the results of eight new transects established in East Mesa in 1985 and 1986.

Figure 10 presents P. mcallii relative abundance based on the most recent survey information, for the East Mesa study area.

Superstition Mountain Habitat

Three transects established in this area in 1979 were repeated as part of the 1985 large-scale inventory. These results are presented in Table 5. This sample size is too small to allow analysis of population trend.

The results of 40 new surveys established in 1985 in the Superstition Mountain habitat area are presented in Table 6.

Figure 11 portrays P. mcallii relative abundance based on the latest survey data available, for the Superstition Mountain study area.

Abundance Indexes

Figure 12 illustrates the results of Modified Abundance Indexes calculated for 1984 and 1986 Yuha, 1985 and 1986 East Mesa, and 1985 Superstition Mountain surveys for Townships in which more than four transects were performed.

1/ Data from the two adjacent legal subdivisions were combined since the sample sizes in T.15S., R.17E., and T.16S., R.20E., were too small to allow individual analysis.

Table 7 shows Modified Abundance Indexes calculated for 1984 Yuha and 1986 East Mesa monitoring studies and their corresponding 1979 baseline surveys. These Indexes are not statistically different when analyzed using the Wilcoxon Signed-Ranks Test ($T+ = 6$, $T- = 9$, $T_{.05} = 1$). They do, however, show localized declines in category of relative abundance as defined in Turner and Medica (1982). T.16S., R.17E. declined from category 3 (Index of 8-14) to category 2 (Index of 3-7). T.16S., R.19E. also declined from category 3 to category 2. Other categories remained stable.

SUMMARY

Yuha Desert Habitat

The Yuha Desert study area continues to contain significant high density optimal habitat, based on the results of resurveys and new surveys. The overall value of this habitat remains high when analyzed using the Modified Abundance Index. However, the relative abundance of P. mcallii in areas monitored north of Highway 98 appears to be decreasing.

Taken alone, the study-area-wide transect by transect analysis for 1979 vs. 1984, and 1981 vs. 1984, data seem to indicate a stable trend in horned lizard relative abundance. However, when analyzed geographically by occurrence north of Highway 98 only, or south of Highway 98 only, a different trend becomes apparent. Transect by transect analysis of the former indicates significant decreases in scats observed/hour effort, both in 1979 vs. 1984 and 1981 vs. 1984. This decrease is probably masked in the study area-wide analysis by increases south of Highway 98, although the latter are not statistically significant on a transect by transect basis. Thus P. mcallii remains well represented in portions of the Yuha. The trend in its relative abundance is stable south of Highway 98, but is decreasing significantly north of Highway 98.

Because of the paucity of sightings, analysis of lizards observed/hour effort is not really productive in giving an indication of population trend.

East Mesa Habitat

East Mesa continues to contain some localized areas of high density optimal habitat. However, significant, probably permanent decreases have occurred in the southeast portion of the study area.

A study-area-wide transect by transect analysis seems to indicate a significant decrease in overall P. mcallii relative abundance. This has occurred primarily in T.16S., Rs.19 and 20 E. Decreases are also scattered throughout the other portions of the study area (see Figure 9), but are not statistically significant in these areas. When analyzed using Modified Abundance Indexes, P. mcallii again remains well represented in portions of the study area. However its status is poor in what was formerly the best East Mesa habitat, and the trend is decreasing in at least this key area in southeast East Mesa.

Again, the low number of P. mcallii sightings decreases the value of analyzing lizards observed/hour effort in order to indicate population trend.

Superstition Mountain Habitat

This habitat contains large areas of high density optimal habitat. Only three transects established in 1979 were repeated during 1985 field work, so a statistically valid assessment of population trend in this area is not possible. However, the status of P. mcallii in this habitat appears very good.

Modified Abundance Indexes also show P. mcallii to be well represented in the Superstition Mountain habitat.

DISCUSSION

Although P. mcallii remains well represented in the three areas examined, the species' relative abundance appears to be decreasing in large portions of the Yuha and East Mesa habitats. Although this is based on a single year's monitoring in these habitat areas, it is certainly a cause for concern and calls for additional, systematic monitoring efforts. It is also necessary to determine the causes of decreased relative abundance in order to attempt to correct them.

In the Yuha, why area significant decreases in P. mcallii relative abundance occurring north of Highway 98? While the 1984 study results cannot definitively answer the question, they can begin to answer it and also can define future study needs. Non-approved ORV use appears to be a factor in transects showing decreases in scats counted, as discussed (Olech, 1984; USDI, BLM, 1986). Although not statistically testable, racing and transmission line-related activities may be a factor. All transects subject to racing, and 80% of transects subject to transmission line-related activities, occurred north of Highway 98. In addition, 10 months before the 1984 study and before the construction of the La Rosita 230 kV line, several horned lizards and scats were observed in areas currently showing no lizards and

extremely low scat counts. Attempts should be made to better assess these impacts. As a result of the 1984 monitoring surveys, BLM has restricted ORV use in the Yuha (USDI, BLM, 1985). Unfortunately non-approved cross-country travel continues, especially by the U.S. Border Patrol as they intercept undocumented workers.

In East Mesa, camping and ORV use are at least partly responsible for significant decreases in relative abundance in the southeast portion of the study area. Large areas of T.16S., Rs.19 and 20E. have been heavily impacted. These losses may be permanent since the substrate is now heavily compacted, and vegetation is severely reduced or absent. Decreases in less impacted areas are more difficult to account for.

Weather and localized natural cyclic fluctuations cannot be totally discounted. Heavy rainfall in 1983 appears to have allowed increases in relative abundance of reptiles desert-wide. This probably explains the increases observed during the 1984 Yuha study south of Highway 98, and should also have resulted in increases north of Highway 98 unless other factors (as described) were involved. Natural population fluctuations should have resulted in random localized increases or decreases, rather than the more generalized trends observed, but cannot be ignored as a possible factor.

An additional factor which may affect flat-tailed horned lizard distribution is pesticide overspray from agricultural fields near, within, or adjacent to the study areas. This type of activity, if it occurs, has probably occurred for years. Therefore, effects should have been apparent and reflected in earlier survey results. Also, past, cursory observations showed only short-term impacts from Malathion to the lizards' prey species, which would tend to discount this factor. Perhaps a change in the type of chemical or frequency of spraying could account for the sudden reductions observed in 1984 and 1986. The validity of this possible explanation cannot be determined. However, it would be useful to attempt to learn whether overspray is occurring presently, and also whether pesticides truely impact the lizard or its prey species. Such studies are called for in management plans, but have not yet been funded.

The time of year in which the surveys were performed in another possible factor influencing the comparability of survey results. Original 1979 Yuha transects were done between April 19 and June 1, while 1981 transects were performed between May 27 and June 11. The 1984 Yuha resurvey began on June 1 and ended on July 1. The 1979 East Mesa surveys occurred between April 29 and July 11. The 1986 monitoring surveys were performed between May 16 and June 23. Turner and Medica (1982) indicate that season of survey influenced investigator's success in observing horned lizards and scats in 1979; middle to late May was found to be most productive. However, they did not feel that season was a significant

factor in widespread geographic variations they observed. Seasonal cycles probably do influence observer success, but climatic variations should influence the cycles' relative occurrence over time. The fact that the 1984 Yuha study observed increases in scat counts in large blocks of habitat tends to reduce the likelihood that significant decreases in other areas were due to the time of year. Transect performance within sampling locations (north and south of Highway 98) was interspersed with regard to time of year, wind conditions, and temperature, yet trends north of Highway 98 remained down, and south of Highway 98 remained generally up.

Following the 1984 Yuha surveys two standard calibration transects (which remained stable in 1979 and 1984) were used to determine the appropriate field season. Once the stable level of scats observed/hour effort was reached, 1985 and 1986 surveys were begun. This, in conjunction with obvious ORV impacts, would reduce the likelihood that season of surveys is a factor in the decreases observed in East Mesa.

Finally, experimental error could be a factor. Personnel performing the 1984 and 1986 surveys were different from those in earlier investigations. Transect routes walked in 1984 and 1986 may have been slightly different than earlier routes. These factors would pertain study-area-wide, however, and should therefore result in constant, area-wide differences, rather than for the differing trends observed in the Yuha south vs. north of Highway 98, or in East Mesa in T.16S., Rs.19 and 20E.

Turner and Medica (1982) concluded that "whereas P. mcallii still exists comfortably in parts of its original geographic range, it is rapidly disappearing in others." These investigators also identified four areas in which the species was well represented. The present study has found statistically significant decreases in sizeable areas of the Yuha and East Mesa habitats. Of the BLM managed or future BLM managed habitats only Superstition Mountain appears to continue substantially intact; extensive monitoring has not taken place here and is necessary to determine whether the trend of P. mcallii relative abundance in the Superstition Mountain area remains stable.

Observed decreases in portions of the Yuha and East Mesa are of special concern when considered in conjunction with recent surveys in the Ocotillo Wells/Benson Dry Lake habitat managed by the Anza-Borrego Desert State Park. Much of this habitat is within the Ocotillo Wells State Vehicular Recreation Area, and has been called the "most remarkable" of the four favorable areas (Turner and Medica, 1982). According to Mayhew and Carlson (1986):

> Transects were conducted in the Ocotillo Wells State Vehicular Recreation area in 1986 (Jorgensen,

per comm.) to be compared with the 1979 work (Turner et al., 1980, 1982 [sic]). Turner indicated this area to be the highest in abundance of all areas checked for the FTHL. The 1986 results of six sections showed that scat counts were only 15% of what was found in 1979. Using the criteria designated at Superstition Mountain (USDI BLM, 1986), in 1979 there were 4 high density, 1 medium density and 1 low density while 1986 shows 2 high density and 4 low density sections. Five sections done in 1979 were not repeated in 1986. The five sections, all with high densities in 1979, are interspersed with those searched in 1986 and are also in the high ORV use area. Eight other sections, not previously sampled, were surveyed for FTHL in 1986. Of those eight, one had a high density, one medium density, 3 low density and 3 no lizards or scat were found. Although weather conditions cannot be eliminated as a cause of the decrease, three sections surveyed for the first time in 1986, east and northeast of Borrego Springs near Clark Valley and approximately seven to eight miles from the vehicle recreation area, all had high density counts. These two areas are close enough together to suggest that weather is possibly not a factor. Destruction of habitat and reduction of prey species could be a factor as the count of vehicles on high use days ranges from 900 to over 2000 during the peak period which is from November thru April (McClary, per. comm.).

Again more extensive monitoring in Ocotillo Wells/Benson Dry Lake is necessary.

Appendix A
Figures

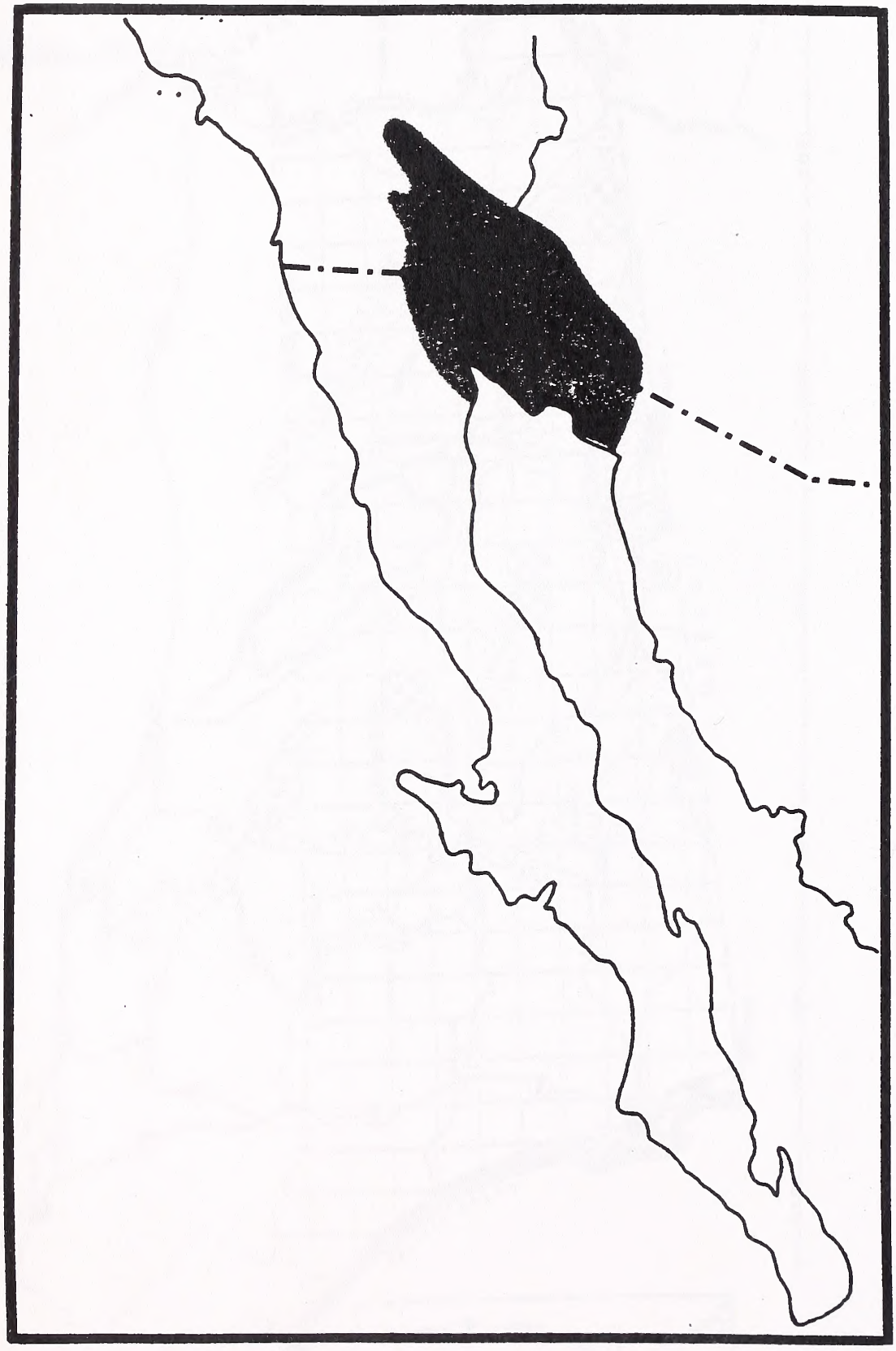


Figure 1. Flat-tailed Horned Lizard (Phrynosoma mcallii) distribution (after Stebbins, 1966).

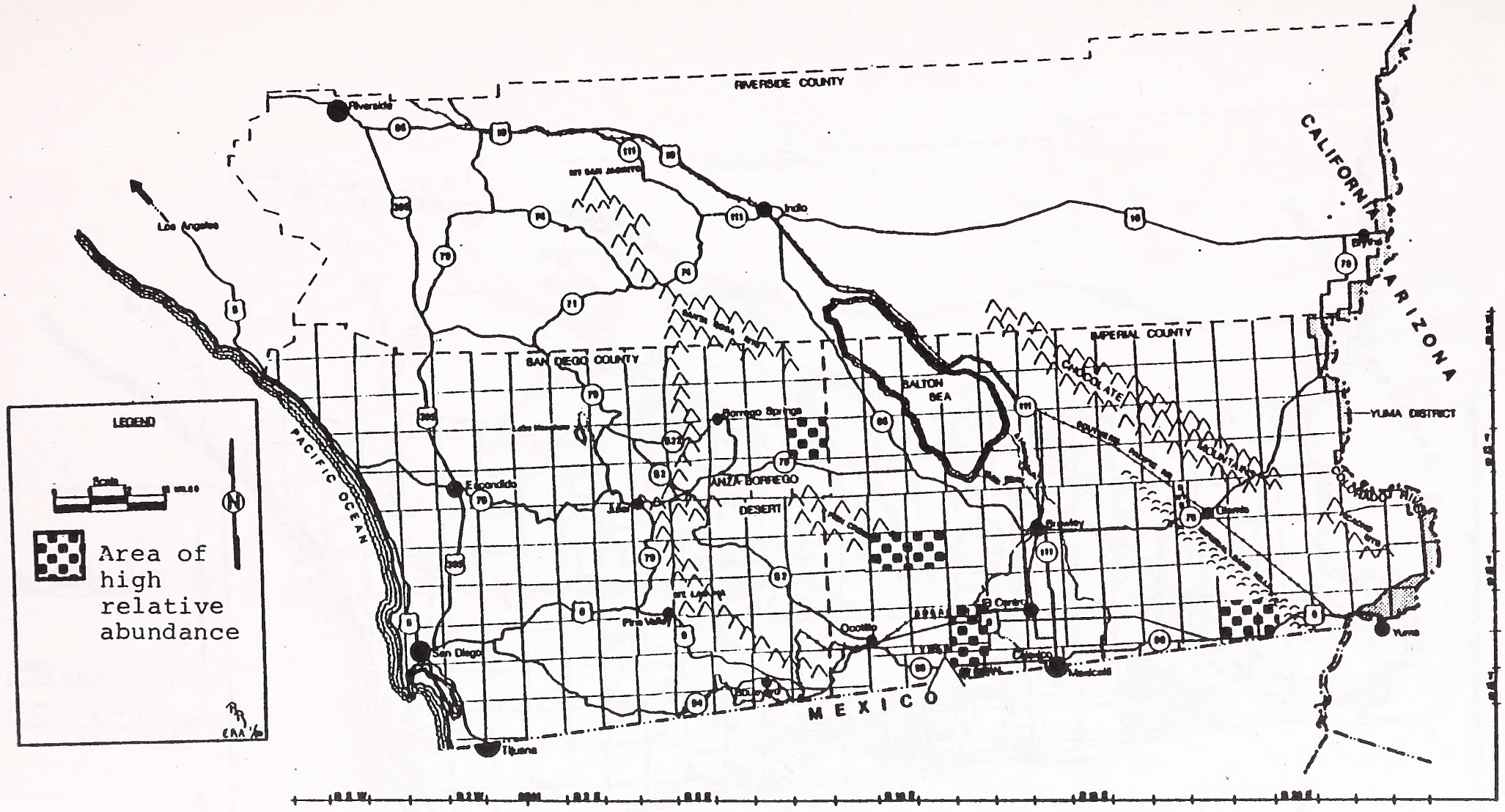


Figure 2. Primary areas of high P. mcallii relative abundance (adapted from Turner and Medica, 1982).

REGIONAL LOCATION MAP

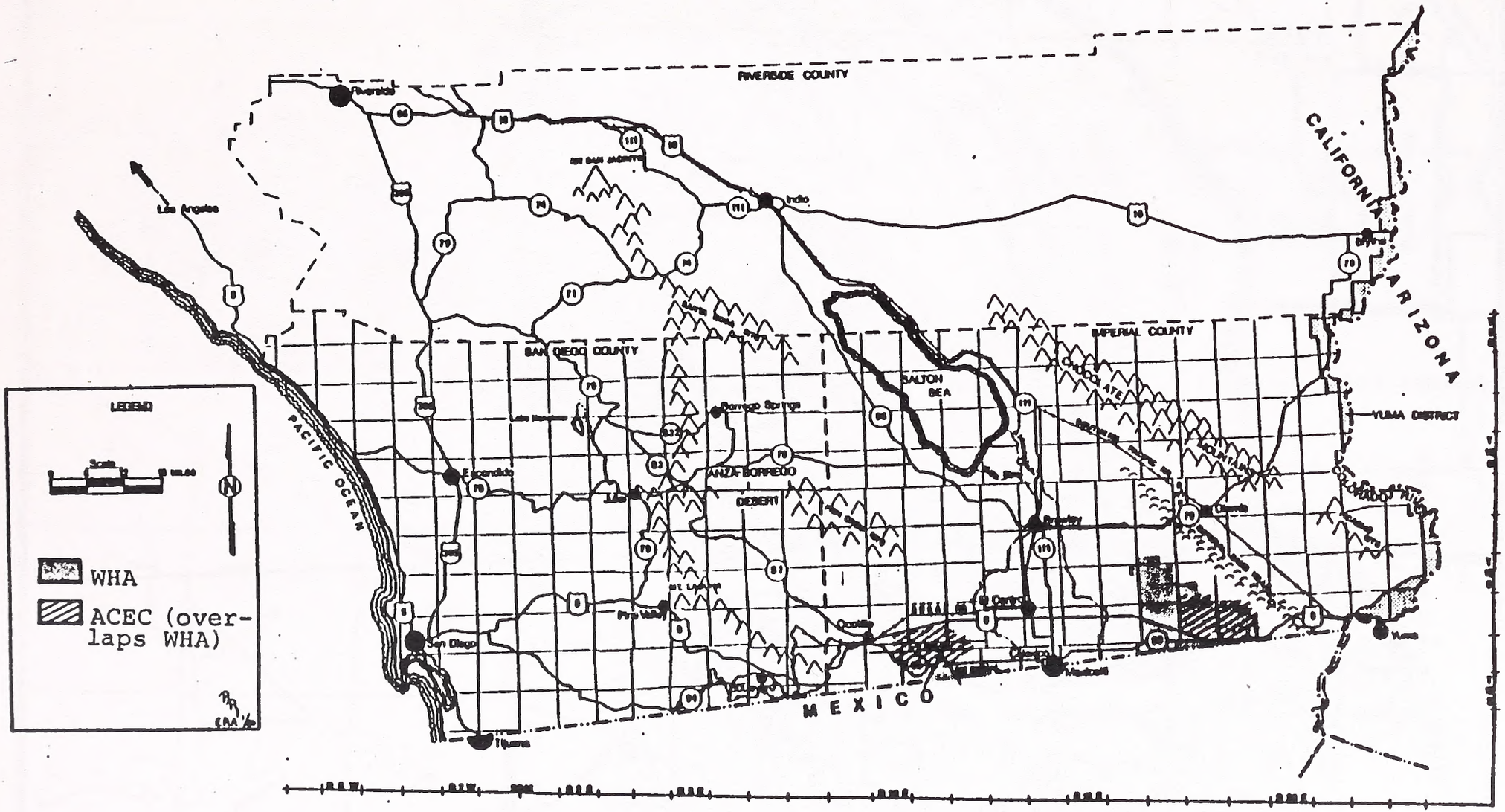


Figure 3. Location of East Mesa Wildlife Habitat Area (WHA) and Southern East Mesa Area of Critical Environmental Concern (ACEC), and Yuha Desert WHA and Yuha Basin ACEC.

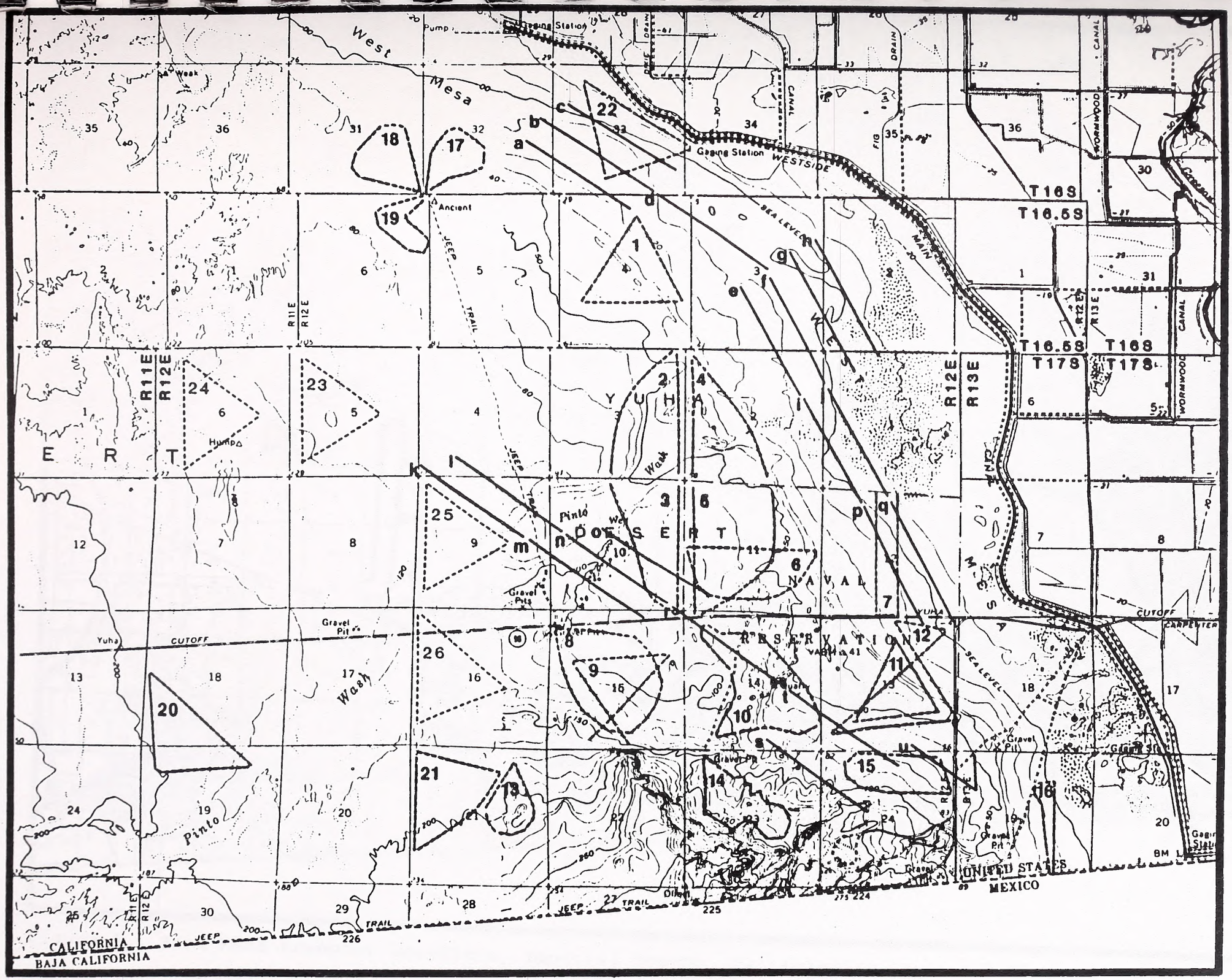


Figure 4. Yuha Desert transect locations, Imperial County, California.

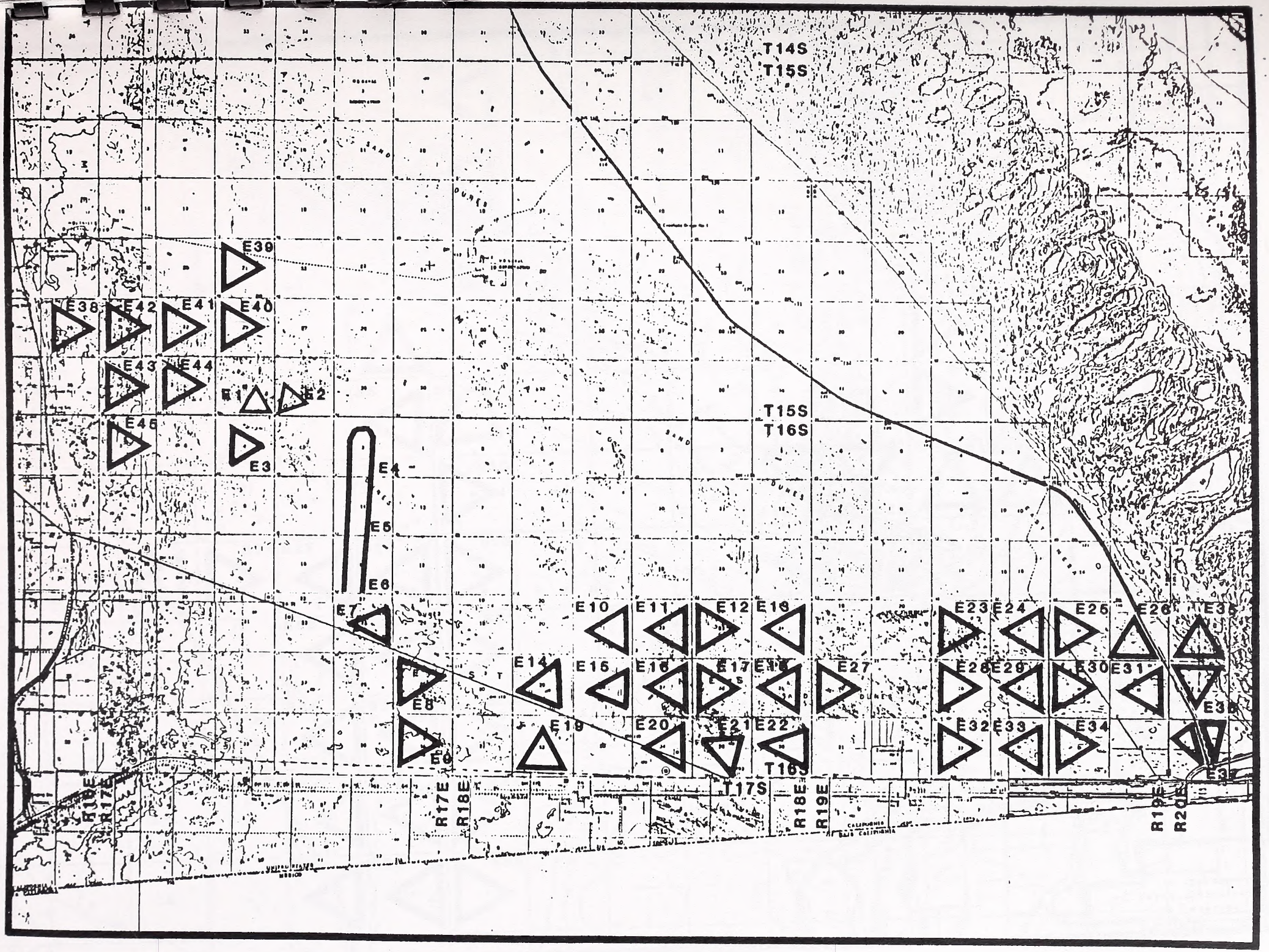


Figure 5. East Mesa transect locations, Imperial County, California.

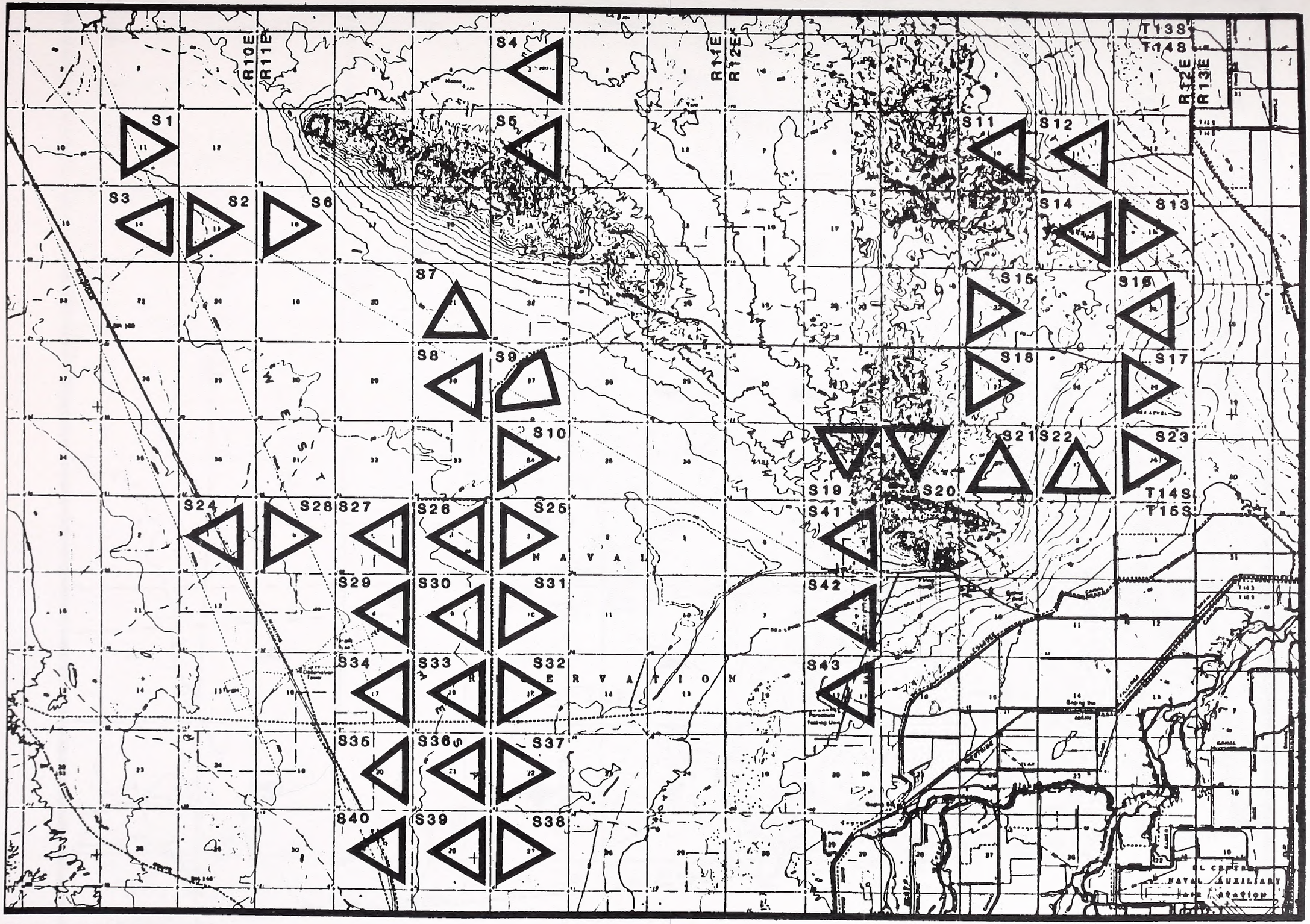
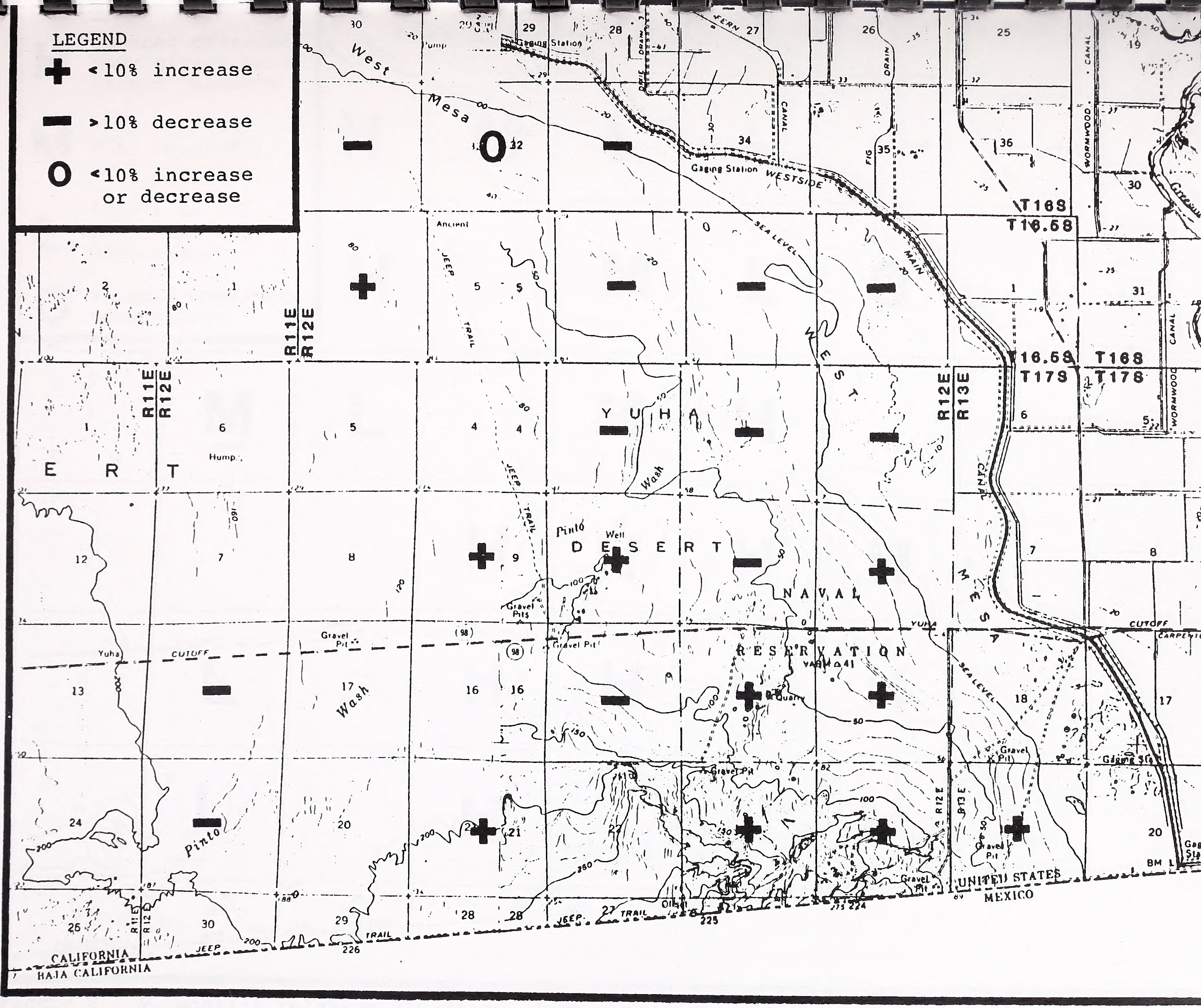


Figure 6. Superstition Mountain transect locations, Imperial County, California.



LEGEND
<10% increase
>10% decrease
<10% increase or decrease
West Mesa
Y U H A
D E S E R T
N A V A L
R E S E R V A T I O N
W E S T
M E S A
E R T
T16S
T16.5S
T17S
R11E
R12E
R13E
Gaging Station
WESTSIDE
MAIN
CANAL
SEA LEVEL
WORMWOOD
CUTOFF
FIG
FERN
DRAIN
JEEP TRAIL
Ancient
Hump
Pinto
Well
Wash
Gravel Pit
Gravel Pits
Quarry
Yuha
UNITED STATES
MEXICO
CALIFORNIA
BAJA CALIFORNIA

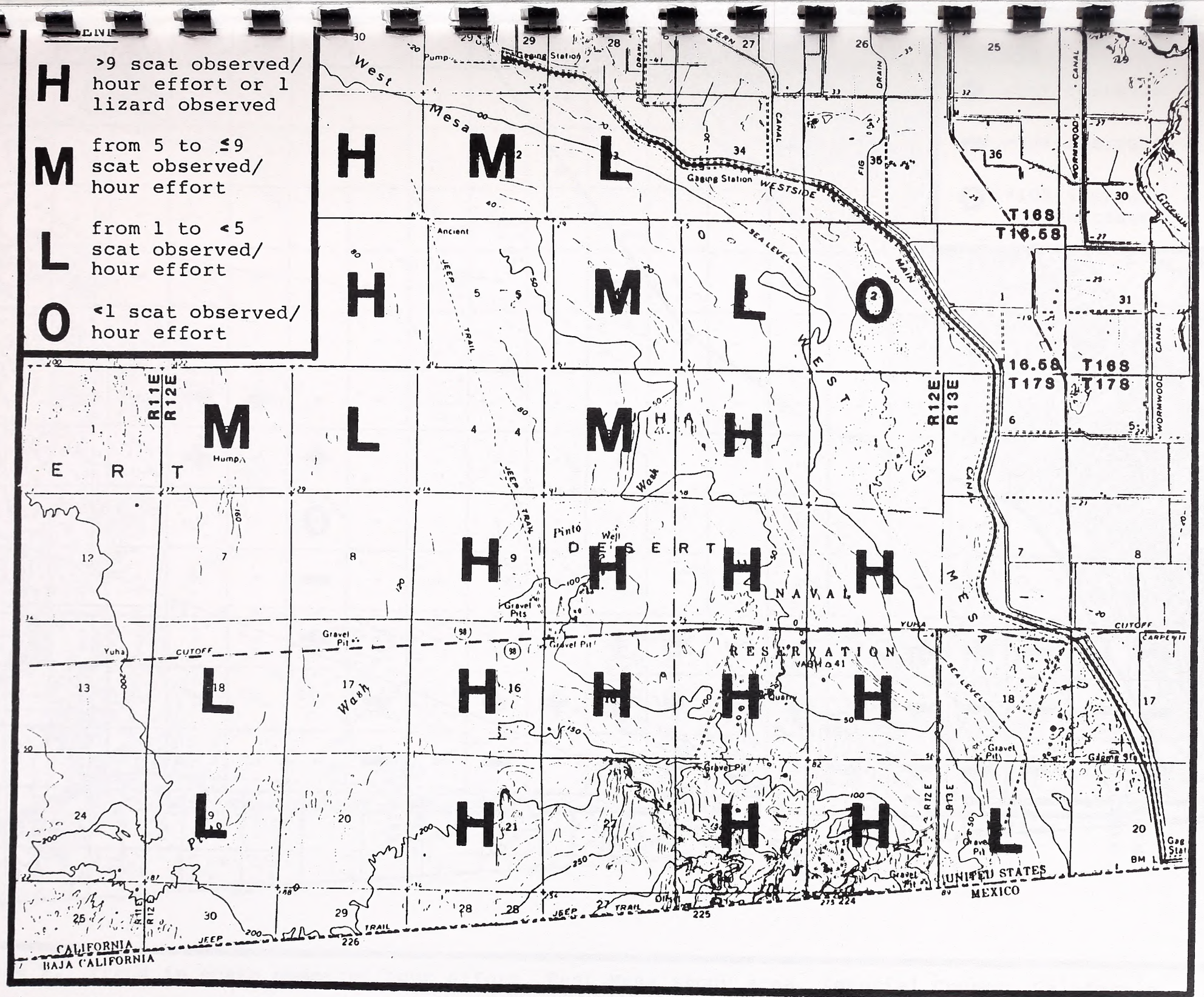


Figure 8. P. mcallii relative abundance, Yuha study area, Imperial County, California.

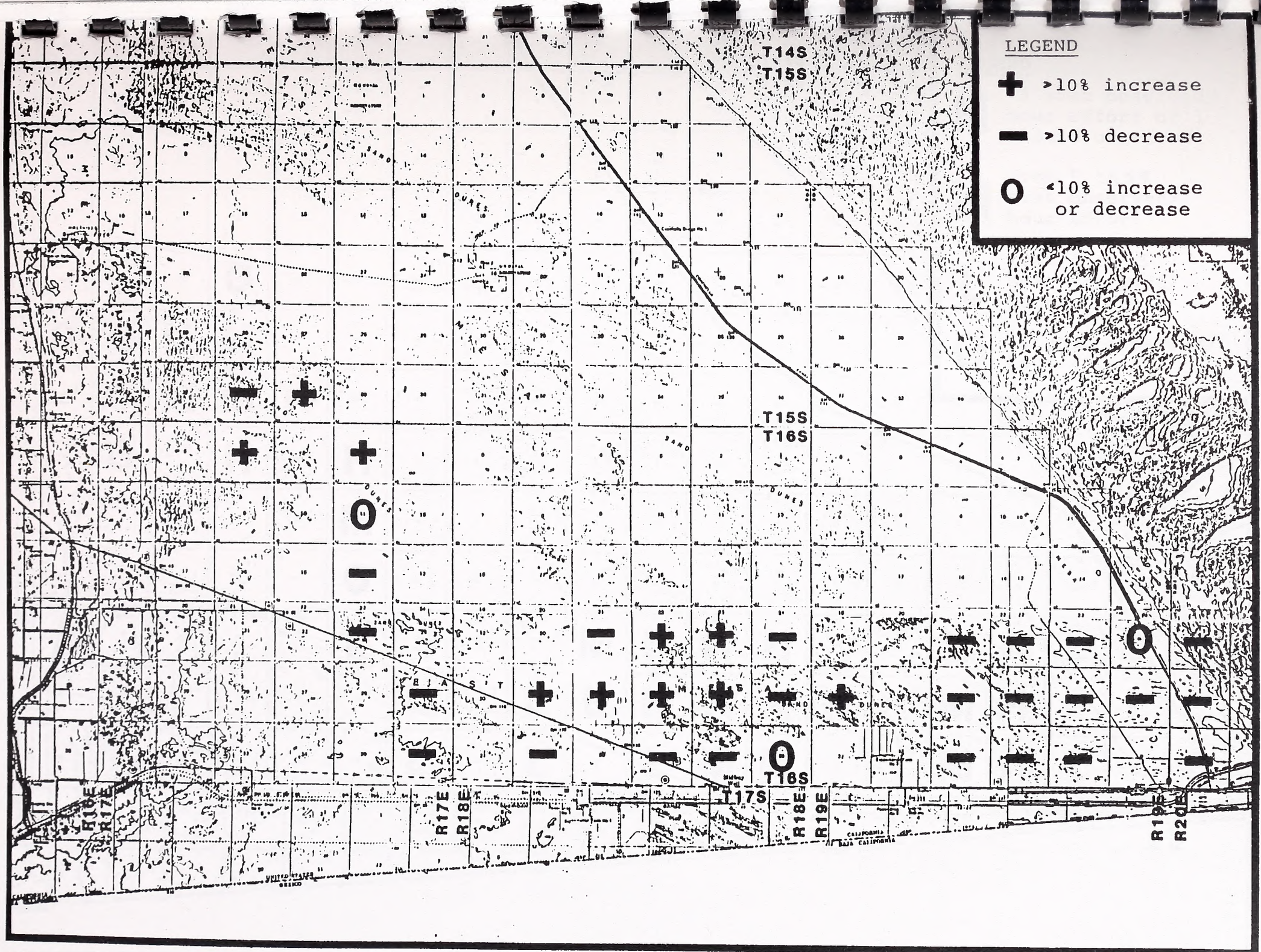


Figure 9. Trend in scats observed/hour effort, East Mesa study area, Imperial County, California.

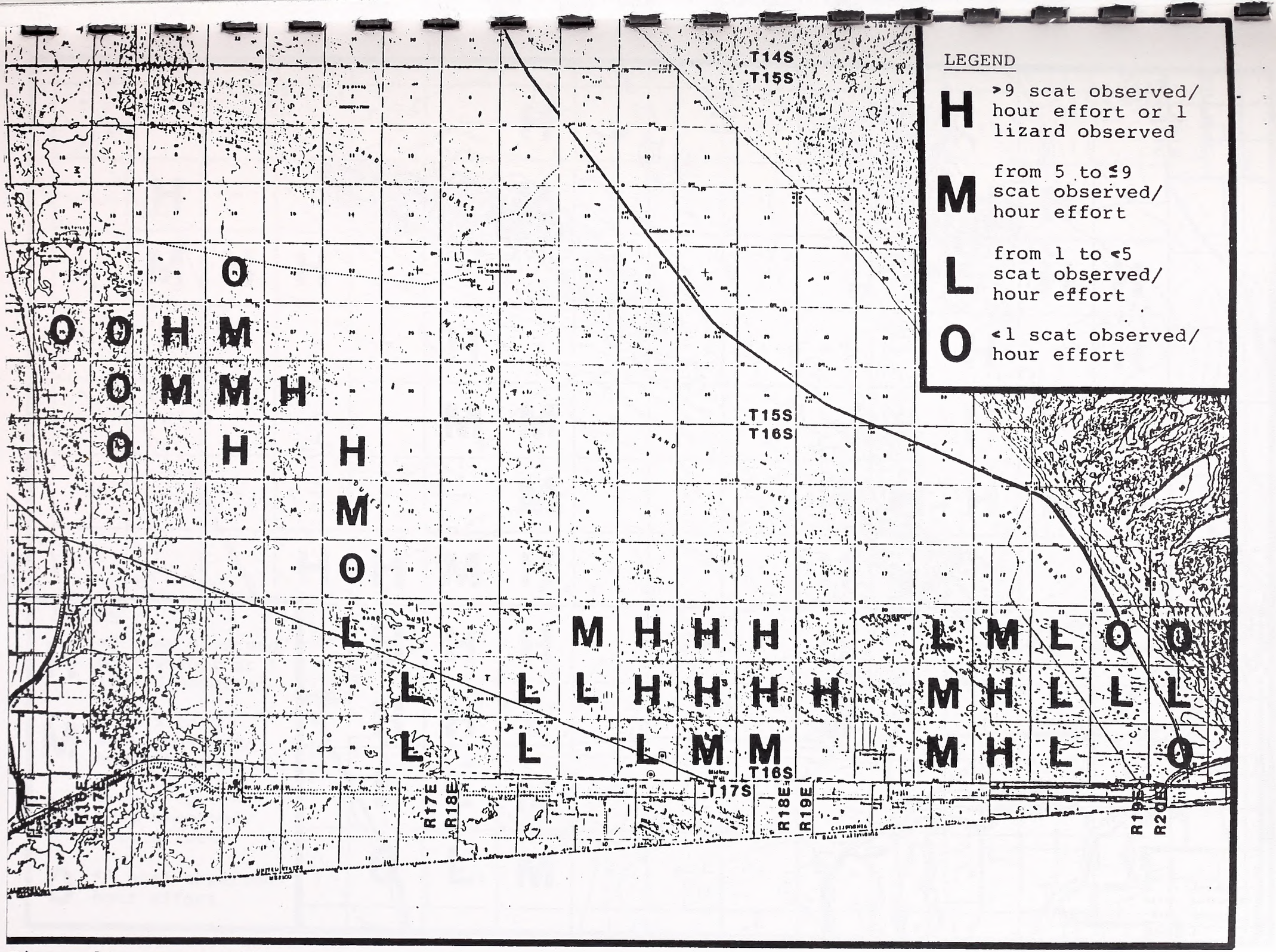


Figure 10. P. mcallii relative abundance, East Mesa study area, Imperial County, California.

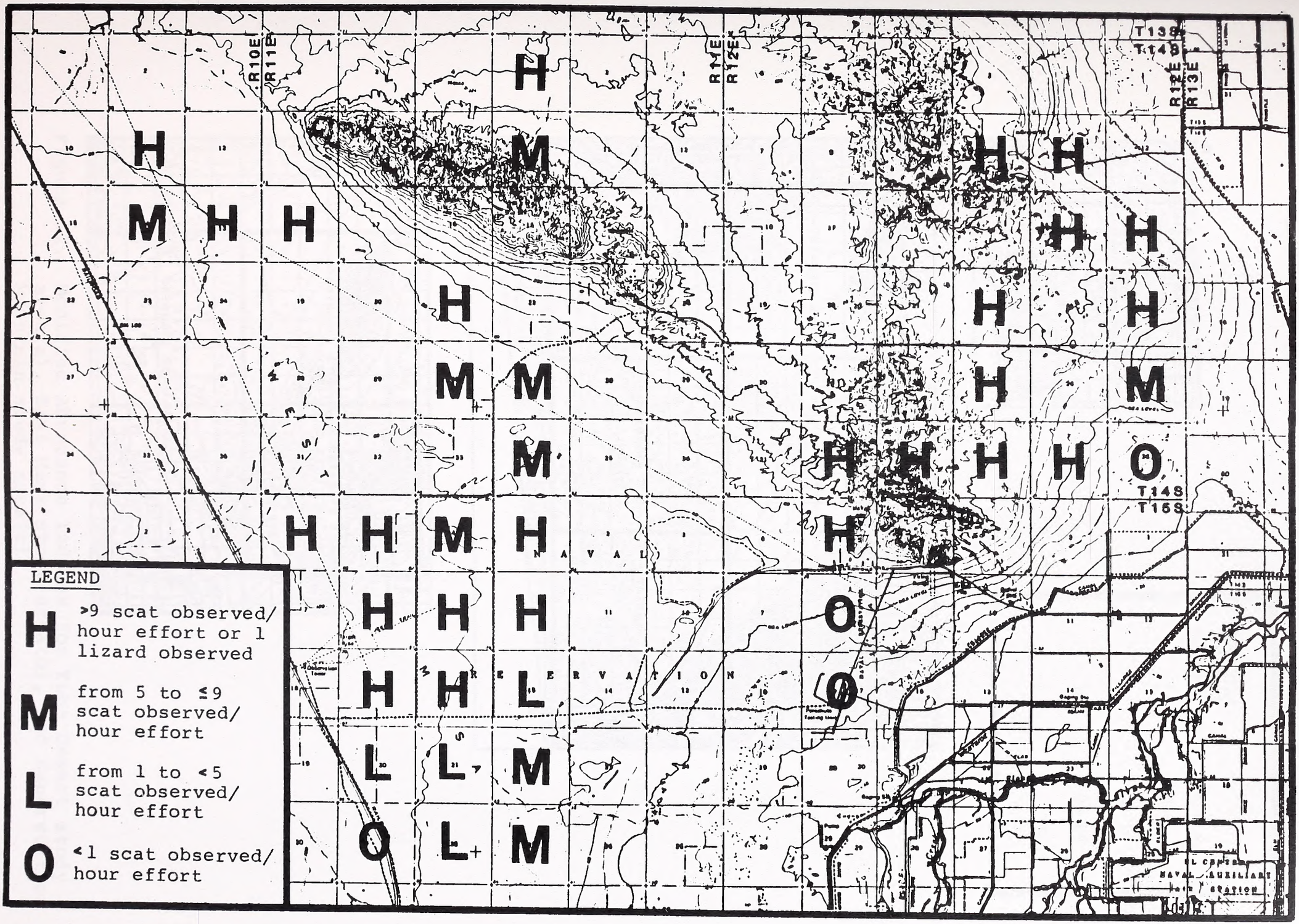


Figure 11. P. mcallii relative abundance, Superstition Mountain study area, Imperial County, California.

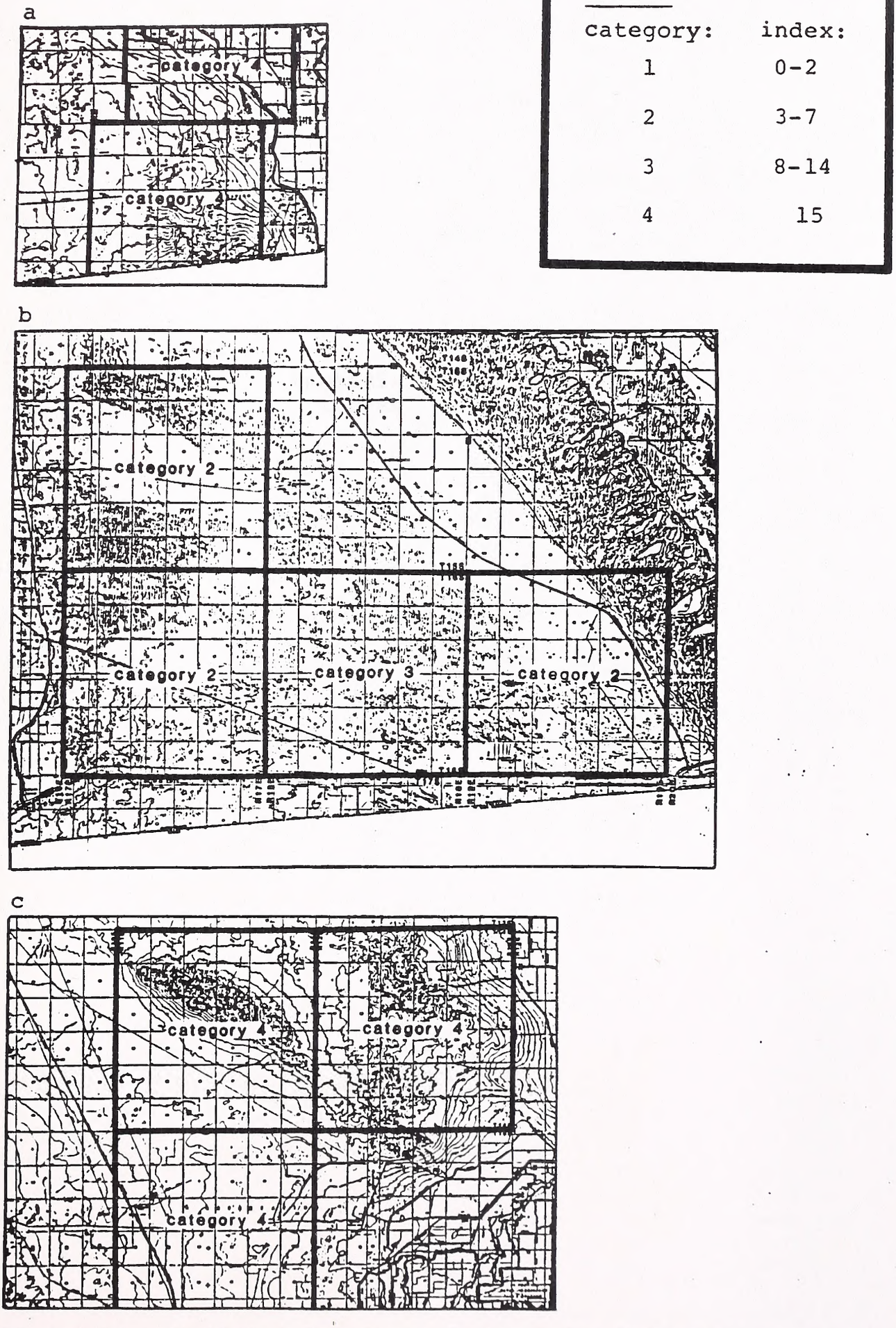


Figure 12. Modified Abundance Indexes for Yuha Desert study area(a), East Mesa study area(b), and Superstition Mountain study area(c).

Appendix B
Tables

Table 1. Yuha Desert transect monitoring results.

Transect	Scats observed/hour effort 1979/1981[1/]	Scats observed/hour effort 1984	Lizards observed/hour effort 1979/1981	Lizards observed/hour effort 1984
1	13.00	8.00	0.00	0.00
2	12.00	8.00	0.00	0.00
3	54.00	19.00	0.00	0.00
4	18.00	11.00	0.00	1.00
5	41.00	30.00	0.00	0.00
6	31.25	8.50	0.50	0.00
7	3.25	5.25	0.00	0.25
8	7.50	9.50	0.00	0.00
9	17.00	9.00	0.00	0.00
10	3.75	26.00	0.25	0.00
11	3.75	7.25	0.00	0.50
12	4.50	9.00	0.00	0.00
13	7.00	17.67	0.00	0.00
14	9.00	69.00	0.00	0.00
15	27.25	29.75	0.00	0.00
16	9.00	1.50	0.00	0.00
17	7.00	8.00	0.00	0.00
18	42.00	13.00	0.00	1.00
19	10.00	29.00	0.00	0.00
20	20.00	1.75	0.25	0.00
21	21.00	89.00	0.00	0.00
22	8.00	3.00	0.00	0.00
a	68.00	0.00	0.00	0.00
b	68.00	6.00	0.00	0.00
c	44.00	0.00	0.00	0.00
d	28.00	2.00	0.00	0.00
e	22.00	14.00	0.00	0.00
f	28.00	0.00	2.00	0.00
g	4.00	2.00	0.00	0.00
h	18.00	0.00	0.00	0.00
i	10.00	8.00	0.00	0.00
j	6.00	2.00	0.00	0.00
k	8.00	2.00	0.00	0.00
l	3.00	30.00	0.00	0.00
m	46.00	46.00	0.00	0.00
n	32.00	22.00	0.00	0.00
o	22.00	72.00	2.00	0.00
p	16.00	10.00	0.00	0.00
q	0.00	8.00	0.00	0.00
r	8.00	18.00	0.00	0.00
s	12.00	42.00	0.00	0.00
t	34.00	52.00	0.00	0.00
u	6.00	34.00	0.00	0.00

1/ Transects denoted by numbers were established and performed originally in 1979. Transects denoted by letter were established and performed originally in 1981.

Table 2. New transect results, Yuha Desert habitat.

Transect	Scats observed/ hour effort	Lizards observed/ hour effort
23	4.00	0.00
24	5.00	0.00
25	20.00	0.00
26	11.00	0.00

Table 3. East Mesa transect monitoring results.

Transect	Scats observed/hour effort 1979	Scats observed/hour effort 1986	Lizards observed/hour effort 1979	Lizards observed/hour effort 1986
E1	13.00	5.33	0.00	0.00
E2	9.00	21.00	1.00	0.00
E3	6.66	13.00	0.00	0.00
E4	11.00	14.00	0.00	0.00
E5	8.00	8.00	0.00	0.00
E6	1.00	0.50	0.00	0.00
E7	5.00	4.00	1.00	0.00
E8	6.00	3.00	0.00	0.00
E9	15.00	1.00	0.00	0.00
E10	15.00	9.00	0.00	0.00
E11	10.00	24.00	0.00	0.00
E12	12.00	31.00	0.00	0.00
E13	15.00	13.00	0.00	0.00
E14	0.00	1.00	0.00	0.00
E15	0.00	2.00	0.00	0.00
E16	3.00	19.00	0.00	0.00
E17	3.00	18.00	0.00	0.00
E18	25.00	17.00	0.00	0.00
E19	3.00	1.00	0.00	0.00
E20	5.00	3.00	0.00	0.00
E21	9.00	6.00	0.00	0.00
E22	7.00	7.00	0.00	0.00
E23	7.00	2.00	0.00	0.00
E24	33.00	5.00	0.00	0.00
E25	27.00	3.00	0.00	0.00
E26	0.00	0.00	1.00	0.00
E27	7.00	15.33	1.00	0.00
E28	9.00	5.38	0.00	0.00
E29	17.00	13.00	0.00	0.00
E30	33.00	2.00	0.00	0.00
E31	14.00	1.00	0.00	0.00
E32	12.00	5.50	0.00	0.00
E33	28.00	10.00	0.00	0.00
E34	6.00	4.00	0.00	0.00
E35	21.00	0.00	0.00	0.00
E36	10.00	1.00	0.00	0.00
E37	14.00	0.00	0.00	0.00

Table 4. New transect results, East Mesa habitat.

Transect	Scats observed/ hour effort	Lizards observed/ hour effort	Year
E38	0.00	0.00	1985
E39	0.00	0.00	1986
E40	6.00	0.00	1986
E41	13.00	0.00	1985
E42	0.00	0.00	1985
E43	0.00	0.00	1985
E44	5.00	0.00	1985
E45	0.00	0.00	1985

Table 5. Superstition Mountain transect monitoring results.

	Scats observed/hour effort		Lizards observed/hour effort	
Transect	1979	1985	1979	1984
S7	2.00	73.00	0.00	0.00
S8	1.00	6.00	0.00	0.00
S10	20.00	5.00	0.00	0.00

Table 6. New survey results, Superstition Mountain habitat.

Transect	Scats observed/ hour effort	Lizards observed/ hour effort
S1	11.00	0.00
S2	16.00	0.00
S3	8.00	0.00
S4	18.00	0.00
S5	9.00	0.00
S6	29.00	0.00
S9	7.00	0.00
S11	14.00	0.00
S12	18.00	0.00
S13	16.30	0.00
S14	18.70	0.33
S15	45.00	0.50
S16	21.00	0.00
S17	9.00	0.00
S18	38.00	0.00
S19	15.00	0.00
S20	20.00	0.00
S21	15.00	0.00
S22	9.50	0.00
S23	0.00	0.00
S24	4.50	0.00
S25	27.00	0.00
S26	6.00	0.00
S27	24.00	0.00
S28	11.00	0.00
S29	15.00	0.00
S30	42.00	0.00
S31	40.50	0.00
S32	1.50	0.00
S33	31.00	0.00
S34	2.00	1.00
S35	2.00	0.00
S36	2.00	0.00
S37	6.50	0.00
S38	8.00	0.00
S39	4.00	0.00
S40	0.00	0.00
S41	14.00	0.00
S42	0.00	0.00
S43	0.00	0.00

Table 7. Modified Abundance Indexes for selected transects originated in 1979 and repeated in 1984/1986.

Habitat Area	Township	Range	Modified Abundance Index 1979	1984	1986
Yuha Desert	16 + 16.5S.	12E.	16.00	22.20	----
	17S.	12E.	19.95	26.39	----
East Mesa	16S.	17E.	14.67	----	6.21
	16S.	18E.	8.23	----	11.62
	16S.	19E.	24.42	----	5.60

Appendix C
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