DATE: 26 May 1977

TO: Robert G. Personius, Refuge Manager
San Francisco Bay National Wildlife Refuge Complex

FROM: Howard S. Shellhammer
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SUBJECT: Interim report - Studies on Reithrodontomys raviventris raviventris in the Alviso area (Permit #15550-76-4)

This report covers the period from July 28, 1976 to May 4, 1977 and includes both my Fall and more intensive Spring trapping periods.

INTRODUCTION

My objectives have been to learn more about the distribution and population biology of salt marsh harvest mice Reithrodontomys raviventris in the Alviso sector of the San Francisco Bay National Wildlife Refuge. More specifically I wished to ascertain whether these animals move between marshes since Zetterquist (1976) suggested they do not. A third objective developed because of climatic conditions and that was to note the population levels of these mice during the second year of an extreme drought.

MATERIALS AND METHODS

Large Sherman and Sherman "style" live traps, stuffed with cotton, sunflower seeds and birdseed, were placed in the marshes at 10 meter intervals. Trap lines were left out for one or two nights and were checked in the late afternoon, as well as morning when left out for periods of two nights. Most salt marsh harvest mice were tagged with numbered, metal ear tags, measured and weighed, and released at their points of capture. Trap lines were used in most areas as the suitable portions of most marshes were so narrow as to preclude the use of any type of grid.

Preliminary trapping to locate populations of mice was carried out in the Alviso marshes from September 1 to October 11, 1976. Spring trapping, from February 15 to May 4, 1977, can be divided into two phases: (1) Triangular Marsh studies, and (2) various trapping activities in the Alviso area and Coyote Hills Regional Park.

AREAS TRAPPED

See Figures 1 and 2 for the location and relationship of these areas to one another.

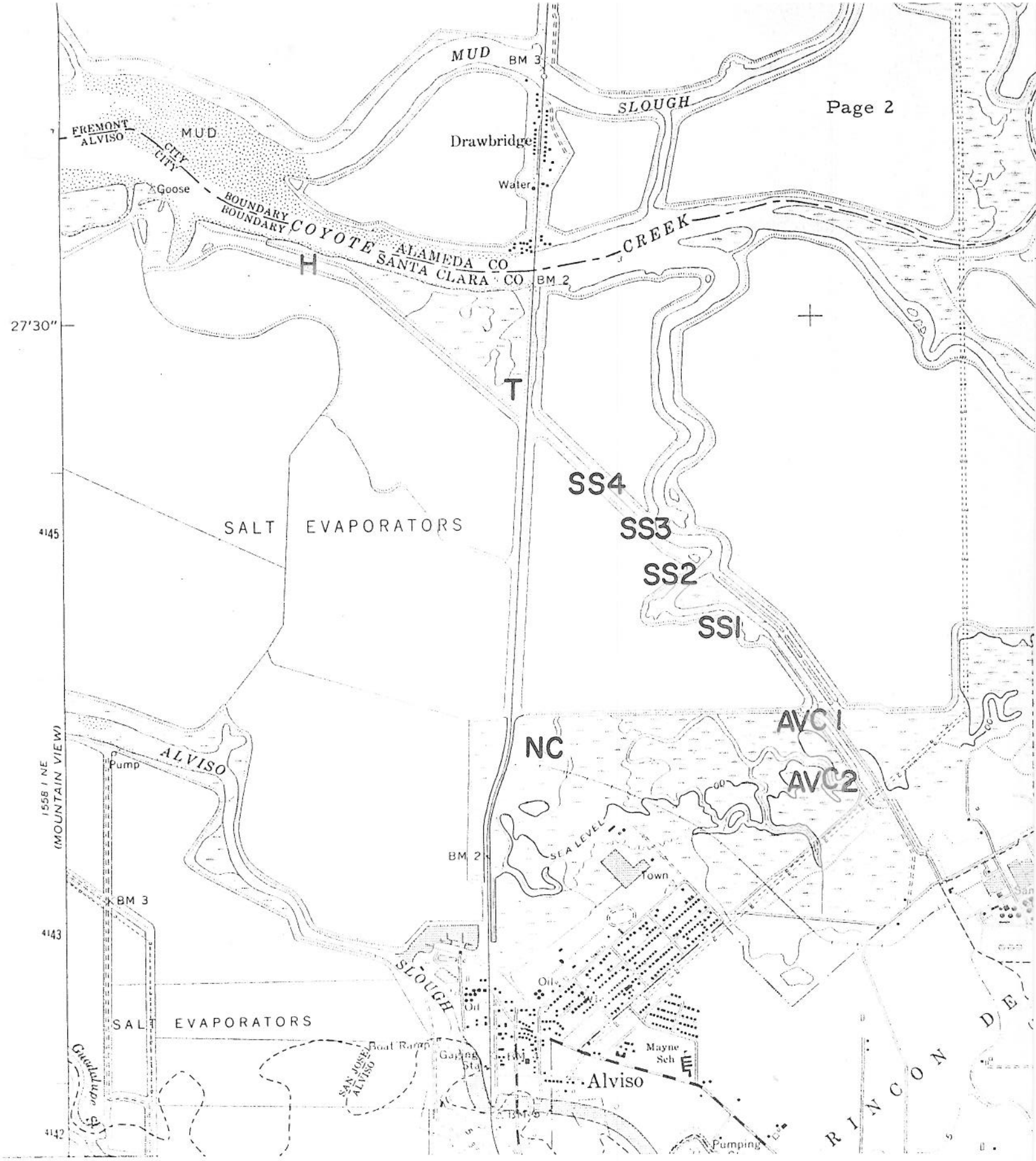

Figure 1. Alviso area trapping sites

T = Triangular Marsh - intersection area
H = trap line between T and "Goose"
SS = Slough side
AVC = Alviso Visitor's Center area
NC = New Chicago Marsh

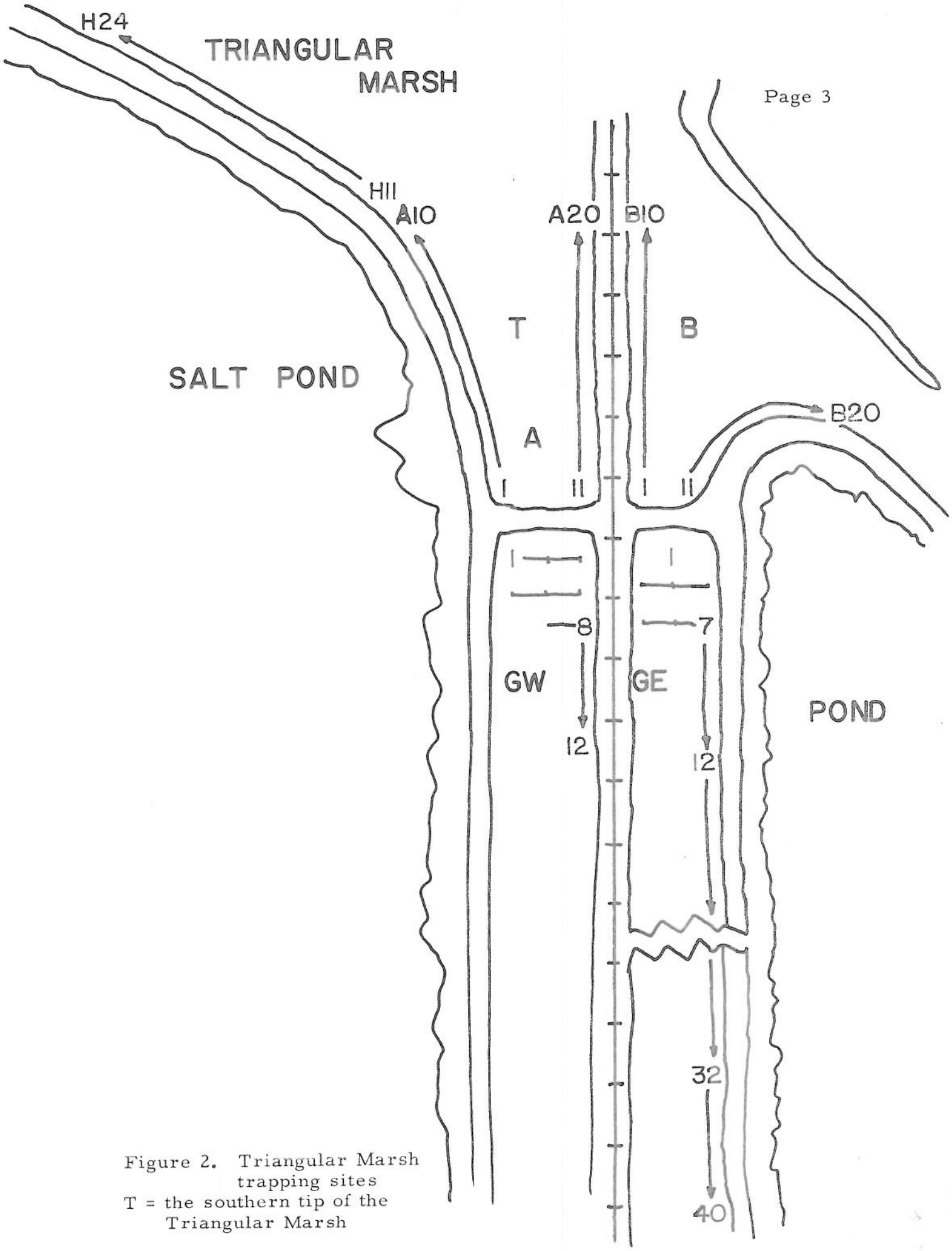

Figure 2. Triangular Marsh trapping sites
T = the southern tip of the Triangular Marsh

(T) Triangular Marsh: The trapping area included the marshes on the four sides of the intersection of the Southern Pacific Railroad tracks and the dike road crossing it approximately 700 meters south of Bench Mark 2 at the southern end of the railroad bridge over Coyote Creek (See Figures 1 and 2). The northwestern portion is the Triangular Marsh (so named by Rice, 1974, and myself). It is an area of great subsidence and has been changing floristically over the last four years. Today only the berm of the levee road supports the plant association utilized consistently by salt marsh harvest mice - Salicornia virginica, Atriplex semibaccata, Frankenia grandifolia and Atriplex patula. Rice (1974) found no salt marsh harvest mice in the flood plain 20 or more meters from the road during what I now assume to be intermediate population levels of the mice. In most areas along the edge of Triangular Marsh the cord grass zone (Spartina foliosa) is but 5 to 10 meters from the road. This plant is adapted to the maximum inundation of any plant species in the marsh and is avoided by harvest mice (Wondolleck, et al, 1977).

The strips of marsh southwest and southeast of the intersection were "marginal" areas lacking tidal flow and having reduced cover. These areas contained some vernal ponds and numerous patches of bare ground.

(H) Strip of marsh from Triangular Marsh 2,000 meters northwest from intersection noted above. Suitable berm vegetation narrows from 10-15 meters near the Triangular Marsh trapping area to 5 meters or less 1,500 meters out. Trapping area ends in the slightly more extensive marsh area near the name "Goose" on Figure 1.

(NC) New Chicago Marsh: Northwestern corner of that non-tidal marsh. Moderately good cover of Salicornia virginica in northwestern corner but the percent cover of this species decreases rapidly to the east and south where grasses and, in this year, dry to near barren spots are common.

(SS) Slough side: Vegetation along slough that runs from the Alviso visitor's center site northwest to Coyote Creek.

SS1. Narrow band along strip berm of Lepidium latifolium, conium maculatum, and Atriplex patula. Quickly falls off into rushes.

SS2. Boarder bands of the three species listed above are located around tidal and non-tidal ponds near where Artesian Slough connects with the slough used by San Jose as a sewer out fall.

SS3. Same three species, primarily, along gradual berm. Lepidium in masses 10-15 meters deep.

SS4. This is really an extension of the northeastern portion of Triangular Marsh. Northwestern part of this strip has a good cover of Salicornia but this becomes thinner and mixed with Atriplex patula, Lepidium latifolium, Distichlis spicata and grasses towards the southeastern end.

(AVC) Alviso Visitor's Center area: Very marginal areas of scant Salicornia cover usually found near standing water in old tidal channels. Much of the area is devoid of vegetation, especially in this dry year.

AVC1. Just north of the raised fill I call the Alviso Visitor's Center area.

AVC2. The narrow strips of Salicornia along the upper ends of the old, cut off tidal sloughs 100 meters southwest of the AVC. Most of the surrounding ground is bare with vegetation restricted to patches along creek and depressions.

Coyote Hills: I am including some data on a series of trappings in the North Marsh of Coyote Hills Regional Park for matters of comparison. Zetterquist (1976) used an area very close to this site as one of her "marginal" marshes. It includes the grass covered berm of the levee of the Coyote Hills Creek and Flood Control Channel and the non-tidal Salicornia marsh south of it and is 900 meters north of the visitor's center at Coyote Hills Regional Park near Newark.

RESULTS

No salt marsh harvest mice were captured during the Fall trapping period in the 2,000 meter stretch of marsh from, and including, the Triangular Marsh to the point on Figure 1 labelled "Goose", or in the New Chicago Marsh (Table 1).

Repeated trapping (976 trap nights) of the Triangular Marsh area during the Spring yielded 38 Reithrodontomys raviventris raviventris and 2 Reityrodontomys megalotis. The figures on Table I will exceed 38 R. r. raviventris as they do not include recaptures. Sixteen of the 38 raviventris individuals were captured more than once but none over three times. The average distance moved between trappings for six females was 15.4 meters and ten males was 13.1 meters. Most animals moved 10 meters betweem trappings and several were captured at the same site. The western harvest mice were captured once each at B1 and GE6 in Salicornia (Figure 2.)

No raviventris individuals in the Triangular Marsh moved between marshes nor moved farther than 60 meters between captures. Only one

TABLE 1. Trapping results in the Alviso area

Date	Area	Traps	Rr. r.	R. m.	Microtus	Mus	Peromyscus
9/1	T	80			3	2	
9/9	H	100				8	
9/14	H	100			2	6	
9/21	H	100			4	4	
10/7	NC	80		1			
2/16	T	100	2		2	6	
2/17	T	100	3		5	6	
3/2	T	80	5	2	11	3	
3/3	T	80	5		21	5	
3/9	T	108	8		25	11	1
3/10	T	108	2		28	8	3
3/22	T	100	11		24	3	3
3/23	T	100	10		30	4	3
4/14	T	100	13		17	2	1
4/15	T	100	6		26	5	2
4/21	AVC1	10			1		
	SS1	20				2	1
	SS3	40				4	1
4/26	SS4	60				3	
	SS2	20				5	
	AVC2	20				2	
5/4	NC	100	2				

animals moved more than 20 meters between captures and he moved 30 and 60 meters. Movement between the areas A and B or GW and GE or visa versa (See Figure 2) required travel over 10+ meters of bare ground and railroad bed and under the tracks. Movement between the areas A and GW or B and GE or visa versa required travel over an open space of approximately 10 meters of flat, clay road bed.

Thirty six of the 38 mice in the Triangular Marsh area were checked for venreal coloration. Fifty percent were in the darkest venter category of Fisler (1965), i.e. Class 7, 30.6% in Class 6, 13.9% in Class 5 and 3% (one animal) in each of Classes 4 and 3. This percentages compare closely with those of Fisler (op. cit.) although the 26 animals from the population he sampled inthe late 1950's had more Class 7 animals, less Class 6 and Classes 1 and 2 were present.

Two raviventris individuals were captured in the New Chicago Marsh in May and were taken in the thickest and deepest Salicornia. None were taken at any sites along Artesian Slough, although to the number of trap nights was relatively small. Those Mus and Peromyscus were captured in Salicornia or hemlock in most cases only four of the 21 animals (all Mus) captured in these areas were taken in Lepidium and in the place where this species is most extensive (SS2 on Figure 1).

Trapping of the North Marsh at Coyote Hills Regional Park in November, February, Marsh and April yielded 16 western harvest mice, R. raviventris 5 of which were captured twice. All of these animals were unmistakedly megalotis individuals.

DISCUSSION

These data add support to the contention of Zetterquist (1976) that salt marsh harvest mice do not move between marshes, even from marginal to more optimal ones. Fisler (1965) demonstrated that raviventris animals are restricted by cover but that they will swim (and assumedly cross open spaces) when they are threatened by high tides.

The animals in the Triangular Marsh had small average distances moved between captures, especially when compared with either the populations studied by Rice (1974) and Zetterquist (1976). Rice found Av. D. (average distance moved between captures) of 71.7 meters for males and 35.0 for females while Zetterquist found 32.0 meters and 25.3 respectively. I found Av. D. of 13.1 meters and 15.4 meters. The greatest Av. D. in my study was 60 meters versus 110 meters in Zetterquist's and 300 meters in that of Rice. Zetterquist's data was pooled from a number of marginal habitats in the Alviso and Coyote Hills area while Rice studied the Triangular Marsh (A and H on Figure 2) plus the strip of marsh northwest to "Goose" on Figure 1.

Rice (op. cit.) estimated she had 95 salt marsh harvest mice within the area of her 2,000 meter trap line from June-October, 1973 with most of them in the first 1100 meters (the end involving the present study). It is hard to compare her population with mine. I found 20 mice in the first 240 meters of the area Rice trapped in 1973. My best guess is that she did not get more than 14 animals in the same area. It would appear that I had a larger population than hers however, I cannot be sure as my data is for Spring and that of Rice is for Summer and Fall. The larger Av. D. she reported might indicate a seasonal change, the result of a greater average number of captures or a higher density of animals. In any case we do not know if the higher Av. D. she reported resulted in movements between marshes as she only studied the one contiguous area. Hence, while it is still possible that these mice move between marshes under the stress of high densities, it seems likely they do not do so if moderate to low population densities and when potentially stressed by severe climatic conditions.

Turning to other parts of the Alviso area. The New Chicago Marsh has a small population of R. raviventris in its northwest corner. Zetterquist (1976) found raviventris individuals approximately 500 meters east of that corner as well as 500 meters southeast and at two sites between the Southern Pacific tracks and the Leslie Salt road to the west and southwest. Neither she or I found any raviventris west or south of the Alviso Visitor's Center site. Those areas appear to lack sufficient cover of Salicornia.

The slough side habitats along Artesian Slough, especially those areas of Lepidium latifolium, appear to be devoid of raviventris individuals. My guess is that they would be missing even in a year of average rainfall.

The effect of climate on salt marsh harvest mice remains as confusing as ever. Trapping at Coyote Hills suggests the extended drought might be deliterrous to them. Zetterquist (1976) trapped an area in the North Marsh at Coyote Hills just west of my trapping area, but similar to it, in the summer of 1975 which followed a wetter year than the present. She captured 8 R. raviventris and 23 R. magalotis individuals in 270 trap nights while I trapped 16 megalotis in 290 trap nights. I can only guess at what has caused the apparent disappearance of raviventris animals from the area especially when this dry year has not had as major an effect on them in the Triangular Marsh.

MANAGEMENT SUGGESTIONS

1. I urge you to plan to increase the quality and area of marshes useable by salt marsh harvest mice in the Alviso sector of the Refuge. Most of its tidal marshes are narrow, interrupted strips undergoing vegetation change brought about by subsidence. The vegetation along Artesian Slough and in at least half (the eastern part) of the New

Chicago Marsh is unlikely to support raviventris animals. These animals prefer marshes with thick cover, especially of Salicornia (Wondolleck, et al, 1976), and the total average of marshes of this type in the sector is decreasing.

2. Make the marshes in all sectors larger by joining those marshes near to one another with corridors of appropriate vegetation. This would require plantings in some cases and moderate physical alterations (trench, pipe and fill over new small bridges, etc.) in others. I believe these actions would be of direct benefit to the populations of salt marsh harvest mice in refuge on the basis of the data collected thus far. While the mice potentially may move between marshes when their numbers are very high, I expect such movements to rare knowing what I do of the biology and behavior of this form.

3. The New Chicago Marsh, especially the eastern sixty plus percent needs to be up-graded vegetationally. At present the nearest populations of harvest mice appear to be more than a mile away.

4. The salt marsh harvest mice within the various sectors of the refuge merit continued study. The studies of Rice, Zetterquist and myself have added much new information of this subspecies - information vital to their successful management.

CONTINUING STUDIES

I wish to continue to study the salt marsh harvest mice in various parts of the refuge for the next year or more. I plan to check the population in the Triangular Marsh complex throughout the year. I plan to retrap the area H (Figure 2) with the help of my mammalogy (Zoology 173) students this Fall. We need to monitor some of the marshes until we get another high population in one or more of them to see if heightened densities stimulate any emigrations. How many years this will take is unknown. I wish to continue to sample various marshes throughout the refuge to help us build a better idea of their actual distribution in its marshes.

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