Chapter 2

ENDANGERED SPECIES AND DEVELOPMENT: THE SALT MARSH HARVEST MOUSE

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Introduction

Who cares about a mouse? The seemingly unimportant plight of one small mouse in the San Francisco Bay Area is but a reflection of a growing global crisis. The rapid increase in extinction rates and the ensuing decline of biological diversity is a serious threat worldwide. The case of the salt marsh harvest mouse (Reithrodontomys raviventris) is an example of these problems on a much smaller and more familiar scale. This study focuses specifically upon the mouse and its status in non-tidal wetlands in southern San Francisco Bay.

The salt marsh harvest mouse (SMHM) is a Bay Area endemic species uniquely adapted to the saline environments found in brackish and salt marshes. These rapidly disappearing tidal wetlands, which are one of the richest and most productive environments in the world, have been reduced in the San Francisco Bay estuary by an estimated 95 percent since the California Gold Rush (Atwater et al., 1979). This reduction of the SMHM's historic habitat, primarily through landfill, hydraulic mining (which had the most effect in San Pablo Bay), diking, and a shift in salt balance (resulting from input of freshwater from sewage treatment plants), is the principal reason for the species' endangered status (USFWS, 1984). Further development of the wetland areas is the primary threat to the mouse's survival. There are indications that non-tidal habitats, such as those behind diked levees, may be increasingly important to the SMHM as the tidal wetlands are developed (Botti et al., 1986; Zetterquist, 1977). Despite the protection which the endangered status gives the SMHM, it is rapidly declining as a species due to destruction of its habitat.

The focus of this project is to determine how well this endangered species is being protected in the South Bay, particularly in the non-tidal wetlands which are most immediately threatened by development. This project quantitatively examines the known and inferred mouse habitat, as well as habitat losses, in the non-tidal leveed marshes along the margins of southern San Francisco Bay. A comparison of known acreages of SMHM habitat and lost habitat is used to estimate the degree of protection of the mouse and its chances for survival in the South Bay.

Related Studies

Fisler's general monograph (1965) on the harvest mouse species (R. megalotis, R.r. halicoetes, and R.r. raviventris) provides an overview of the lifestyles, habitats, morphology, and biology of these mice. Shellhammer and others (1982) have reported on trapping surveys with regard to the

optimal habitat of the SMHM. Zetterquist (1977) has studied the mouse in marginal habitats such as diked salt marshes. Olson (1982) conducted a study of the status of the SMHM and habitat suitability in the Emeryville Crescent marsh at the east approach to the Bay Bridge. The USFWS Recovery Plan (1984) provides general information about the mouse and its current status, as well as a recovery plan and management techniques to ensure its survival.

Methodology

The area studied consists of non-tidal leveed marshes of the South Bay below the Bay Bridge. A total of 52 sites was studied (Figure 1, Appendix I). Forty-one sites are found in Alameda County, seven in Santa Clara County, and four in San Mateo County. These marshes were chosen as the areas where the threat of development is the most immediate.

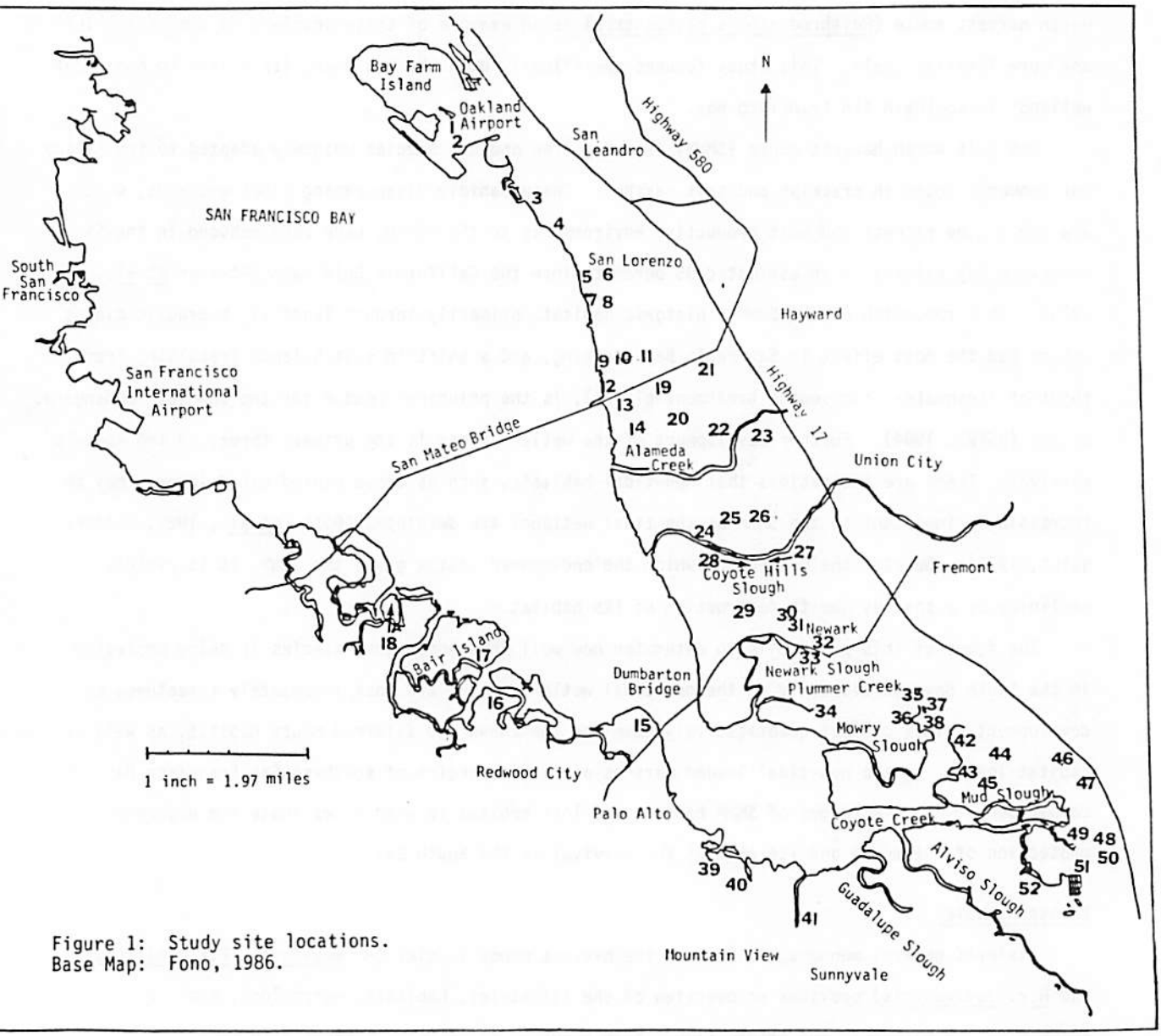

Figure 1: Study site locations.
Base Map: Fono, 1986.

Areas of known and potential habitat were mapped onto USGS 7.5 topographic maps. Data on "known habitat," defined as the areas where the mouse has been trapped, were obtained from Sorenson (1986, pers. comm.), trapping surveys by Harvey and Stanley Associates (1985-1986), the Union City 511 Area EIR (Union City General Plan Amendment, 1986), and unpublished surveys by Jennings and WESCO. Areas of potential mouse habitat were identified by Sorenson (1986, pers. comm.) and Kelly (1987, pers. comm.).

Information regarding loss of known and likely habitat was provided by Sorenson (1986, pers. comm.). Areas of "lost habitat" are ones which have been developed or altered in some way, such as by grazing or disking.

Acreages were determined with a planimeter; three readings were taken per area and then averaged to determine a final value. Additional information on potential habitat was compiled from National Wetland Inventory (NWI) maps based on information obtained within the past five years. Where NWI areas coincided with previous data, the values were averaged.

There is a lack of accuracy in the data resulting from the rough outlining of habitat locations on the base maps and the ensuing inaccuracies in planimetering these locations. However, the data do give an educated overall picture of the SMHM's status in the southern San Francisco Bay as indicated by habitat.

Detailed maps of each site are on file with the Environmental Sciences program, University of California, Berkeley, and Paul Kelly, State Department of Fish and Game, Sacramento.

Background

The SMHM, which is listed as a single endangered species, is actually two separate subspecies: the southern R.r. raviventris in Corte Madera, Richmond, and southern San Francisco Bay, and the northern R.r. halicoetes in San Pablo and Suisun Bays (USFWS, 1984). Fisler (1965) speculates that as sea level rose in San Francisco Bay, the SMHM became isolated both geographically and genetically from its predecessor, the western harvest mouse (R. megalotis). Further isolation of raviventris and halicoetes led to morphological and adaptive variations. The adaptive variations correlate with the preferred habitats; halicoetes occupies brackish marshes, whereas raviventris prefers salt in its diet and occupies salt marshes. The SMHM's endemism to the Bay Area and not to other California embayments is a result of actual spatial isolation which did not exist to the same degree in other bays (Fisler, 1965).

As the SMHM became isolated from R. megalotis, it adapted to the saline environment found in the marshes. Thus, the mouse is unique; only two other rodents, both desert species, are adapted to such conditions (Fisler, 1965). The SMHM cannot drink sea water regularly, but prefers the salinity of its food and water to be both high and relatively stable (Fisler, 1965; Zetterquist, 1977).

The primary habitat is composed of moderate-to-dense vegetative cover (in response to the SMHM's partially diurnal habits) with an escape habitat of adjacent grasslands during extremely high winter tides (Fisler, 1965). The optimal habitat consists of 100 percent vegetative cover; at least 60 percent of this cover must be pickleweed (Salicornia pacifica) which is 30-50 cm tall (Shellhammer et al., 1982). In the optimal habitat, pickleweed is complexly interwoven with other species such as alkali heath (Frankenia grandifolia), fat hen (Atriplex patula), salt grass (Distichlis spicata), and Olney bulrush (Scirpus olney) (Zetterquist, 1977 Shellhammer et al., 1982). In a typical salt marsh, the pickleweed zone begins at six to ten feet above mean sea level (Fisler, 1965). Zetterquist (1977) also found the SMHM in marginal, hypersaline, diked areas with similar vegetative components as the tidal marshes. In summary, dense, complex stands of pickleweed and other halophytes adjacent to high marsh zones of peripheral halophytes are important components of the SMHM habitat.

The SMHM's lifestyle is characterized by the mouse's placid temperament (Fisler, 1965). The fairly torpid mouse must rely on dense cover rather than quickness to escape predators. It is so dependent upon cover that open areas or roads 10 meters wide provide barriers to movement (USFWS, 1984). Thus, preservation of contiguous habitat may be important to avoid genetic isolation. The diurnal habits of the mouse add to its need for dense cover to avoid exposure to predators, including snakes, herons and egrets. During the extremely high winter tides, the SMHM may be forced to swim, which it does quite well, floating placidly on the surface until it can find shelter (Fisler, 1965).

The breeding season of the mouse extends from March to November, yet it has a low breeding potential (USFWS, 1984). This is due to the small litter size (approximately 3.72 young) and the small number of litters produced per year. The northern subspecies may produce only one litter per year. More information is needed about the southern subspecies (Fisler, 1965; USFWS, 1984). The SMHM does not burrow and often does not build a nest.

The habitat destruction which is the primary threat to the SMHM's survival results from (1) destruction of the marshes; (2) diking and fragmentation of the marshes; (3) widespread loss of the high marsh zone due to land filling; (4) land subsidence due to groundwater pumping; and (5) changes in vegetation from variations in salinity (USFWS, 1984). Habitats which otherwise appear to be optimal, may be affected by these activities so that they are rendered unlivable. The mouse is then forced to utilize the more marginal wetlands for its habitat (Botti et al., 1986; Zetterquist, 1977). It is the effect of development upon salinity, vegetation, and the existence of peripheral zones which affects the mouse's presence. The ensuing geographic and genetic isolation of SMHM populations may result in limited gene pools, random genetic drift, and interbreeding, which will be deleterious to the species' adaptive evolution and survival (Zetterquist, 1977).

Data

The areas of potential, known, and lost mouse habitat are found in Table 1 and Figure 1. A total of 840 acres of potential habitat, 2280.4 acres of known habitat, and 3292.6 acres of lost habitat was

identified. The potential and known habitat acreages combined are approximately equal to the total lost habitat. The amount of potential habitat is approximately one-third of the known habitat. The largest areas of potential and known habitat occur in the Redwood Shores area (site 18) and the New Chicago marsh (site 52), whereas the area of greatest habitat loss is in a landfill expansion area (site 44). The Lincoln property is the site of the smallest acreage of potential habitat (site 23), and the smallest known and lost habitats are found in site 50 and the Mt. Eden Creek area (site 14), respectively.

The areas of known and potential mouse habitat are generally small and widely separated. There are very few areas of mouse habitat of any type, on the west side of the South Bay.

Discussion

It is clear that the SMHM habitat losses have been significant in comparison to the totals of known and inferred habitat, and that these losses are likely to continue in the future. These data indicate that perhaps half of the mouse's known and potential habitat has already been lost. Therefore, the amount of potential habitat may be a significant factor in the SMHM's survival, as the threat of development is more immediate in the marginal wetlands than in the tidal wetlands. Another factor to consider is the wide separation of habitat areas, which may lead to interbreeding or limited gene pools. Other limitations, such as rising sea level, may have a grave impact upon the mouse's chances for survival.

However, decisions such as the Palila decision in Hawaii may benefit endangered species such as the mouse. In this November 1986 decision, a judge ruled that "harm" to an endangered species may include degradation of habitat which prevents the recovery of the species as a whole (Sherwood, 1986). In the future, a similar ruling may be extended to areas such as the San Francisco Bay, and the critical SMHM habitat may be protected.

Conclusion

The future for the SMHM in southern San Francisco Bay, particularly in the non-tidal wetlands, is dependent upon habitat availability. Based upon trends in development of the wetland areas, the mouse's degree of protection as an endangered species is not very high.

Long-term management in seasonal wetlands consists of marsh acquisition and restoration, as well as the creation of a "buffer zone" along the upland edge or marginal habitat which appears to be increasingly important in the maintenance of the mouse species. Obviously, protecting potential habitat is a key factor, but one which is probably not realistic at this point in time without adequate trapping data to verify the mouse's presence. In areas of potential mouse habitat, it would make more sense to assume the mouse's presence, as opposed to the current system where its absence is assumed and must be proved otherwise. In addition, so much wetland area has been lost and altered already, that it should be a priority to preserve the remaining wetlands not only for the mouse's sake, but

for other wildlife and for the wetlands as a valuable resource.

Short-term management goals include more studies on the biology of the SMHM, its populations, and its habitat preferences and limitations (especially in regard to seasonal wetlands), in order to substantiate any long-term management guidelines.

Perhaps too much fuss is being made about the mouse--developers probably would be happier without it, and the general public would never even notice its disappearance. After all, a mouse isn't a very significant or impressive creature. Then again, neither is a snail darter, the San Francisco garter snake, or the three-toed salamander, yet people fought to save them. The same must be done for the mouse--not only for its value as a species, but as a symbol of the struggle to save the wetlands. Preserving the salt marsh harvest mouse's habitat is imperative before the mouse quietly becomes another extinction statistic and a valuable resource is lost.

Appendix I: Locations and area of potential, known, and lost SMHM habitat in the South Bay (in acres).

SITE[a]	POTENTIAL	KNOWN	LOSS
SAN LEANDRO QUADRANGLE			
1. Oakland Airport			50.8
2. Oakland Airport	116.7		
3. Citation Homes area			263.3
4. Citation Homes		200	
5. Marathon property		164.6	
6. Marathon property			117.7
7. unnamed	55		
8. unnamed	36		
9. unnamed	39.8		
10. SMHM preserve		27	
11. unnamed		47	
REDWOOD PT. QUADRANGLE			
12. unnamed	21.8		
13. Baumberg Tract			130
14. Mt. Eden Creek		83	1
15. Mosley property	36		
16. Ideal Cement site		48	
17. Bair Island	119.8		
18. Redwood Shores	123.4		
NEWARK QUADRANGLE			
19. Baumberg Tract			630
20. Mt. Eden Creek		27.6	
21. Old Meadow Duck Club		18.2	
22. Old Perry Duck Club		11.4	
23. Lincoln property	17.1		
24. 511 area		307.7	
25. 511 area	51.7		
26. 511 area		52.2	
27. unnamed		7.1	
28. Patterson Slough			69.6
29. EBPRD		10.9	
30. Leslie Salt		14.7	
31. Leslie Salt		13.1	
32. Mayhews Landing		45	
33. unnamed			92.5
34. unnamed	42.7		
35. Whistling Wings Duck Club		40.9	
36. Whistling Wings Duck Club	42.7		
37. Peery Arilaga			84.9
MT. VIEW QUADRANGLE			
38. Peery Arilaga			94.9
39. ITT property	45.7		
40. Mayfield Slough		478.2	
41. Lockheed/Navy property	20.5		
MILPITAS QUADRANGLE			
42. unnamed			52.7
43. Landfill expansion			84
44. Landfill expansion			1621.2
45. unnamed		28	
46. unnamed		11	
47. unnamed	29.8		
48. SMHM preserve		20	
49. King and Lyons property		81.1	
50. unnamed		.36	
51. unnamed	41.3		
52. New Chicago marsh		535.2	
TOTAL:	840	2280.4	3292.6

[a] Site names are informal. They are based upon identifying characteristics such as ownership, geographic location, etc.

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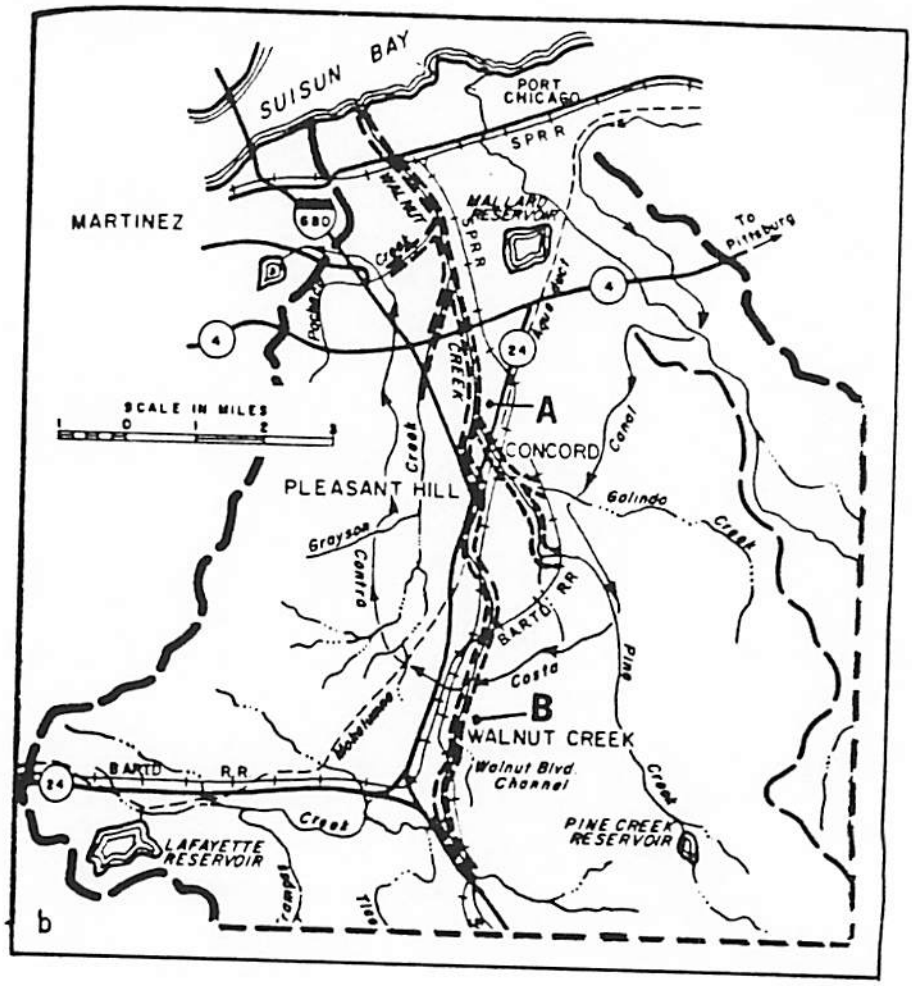

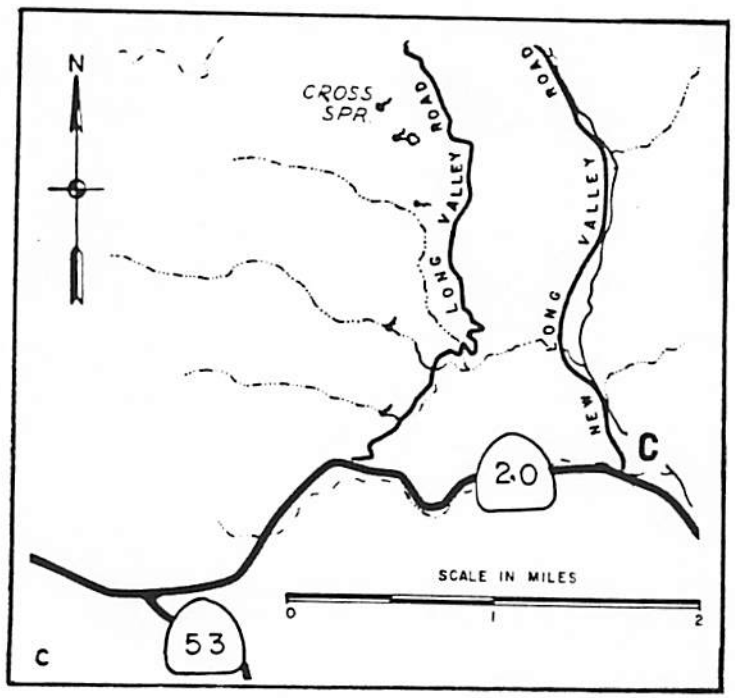

Figure 1. Locations of study areas.

a. Locations of the Walnut Creek Basin and Lake County.

b. Locations in Concord(A) and Walnut Creek(B). Double dashed lines indicate channel modification. Source: U.S. Army Corps of Engineers Environmental Impact Statement: Walnut Creek Project.

c. Location in Lake County. Source: Recreation Marketing, Inc., Concord, California.