THE SALT MARSH HARVEST MOUSE (REITHRODONTOMYS RAVIVENTRIS) AND THE MONTEZUMA POWER PLANT SITE[1]

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ABSTRACT.

Salt marsh harvest mice (*Reithrodontomys raviventris haliceotes*) were discovered on the proposed Montezuma fossil fuel power plant site at Collinsville, California. Three trapping periods in summer and fall, 1978 revealed densities of 2.7 to 37.1 animals/hectare in marshes dominated by pickleweed (*Salicornia virginica*). The riparian placement of the power plant orginally and informally proposed by the utility, Pacific Gas and Electric Company, would result in the destruction of 22.7 ha of wetlands including harvest mouse habitat. Mitigation studies indicate more marsh can be created and enhanced than will be destroyed although such mitigation is based on management for a single species. The questions of the mouse and wetland habitats are but two of a number of environmental issues associated with the plant, especially with a potential riparian placement. In November, 1978, governmental resource agencies went on record as favoring a non-riparian placement of the plant. Such is the situation at the beginning of the second phase of the Notice of Intention hearing on this plant site.

The salt marsh harvest mouse (*Reithrodontomys raviventris halicoetes*) is an endangered species endemic to the salt marshes of San Francisco, San Pablo and Suisun Bays of California. The easternmost portion of its range has been considered to be the Collinsville area where one individual was trapped in the late 1950's (Fisler 1965). The Collinsville or (Montezuma) area is the proposed site for a large coal-fired power plant to be built and operated by Pacific Gas and Electric Company. This paper is a summary of the studies of the mouse onsite.

The Montezuma power plant site is one of four sites proposed by the utility in 1977, the other three sites being in the northern Sacramento Valley. The Notice of Intention (NOI) study (Pacific Gas and Electric Co. 1977) reported the findings of Jones and Stokes (1975) and did not reveal the presence of any salt marsh harvest mice. Their study was necessarily general in that they had to sample all the habitats onsite. They censused during years when the marshes onsite were evidently smaller and more marginal in nature. The marshes on the site were sampled in 1978 as part of the Application for Certification (AFC) study by Envirodyne Engineers (also referred to in this paper as Biosystems Analysis) and 15 mice were trapped. This discovery came during the first pahse of the NOI hearings and led to two more trappings and associated botanical studies.

The 4.5 km^2 power plant site is located in Solano County on the north side of the Sacramento and San Joaquin Rivers. Hills rise to 79 m behind a riparian band averaging about 0.5 km in width. The riparian area is diked; much of it filled with spoils from the river. It varies from approximately -3 below to +8 ft. above mean sea level (MSL) and the lower areas throughout the riparian area are covered with marshes dominated by pickleweed (*Salicornia virginica*). Higher areas are covered with annual grasses, especially

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[1]This paper is based upon work done for Envirodyne Engineers and later for Biosystems Analysis, Inc. of San Jose, California under contract to the Pacific Gas and Electric Company.

wild oats (*Avena barbata*), ripgut brome (*Bromus rigidus*), rye grass (*Lolium multiflorum*) and wheat grass (*Agropyron parishii*) while salt grass (*Distichlis spicata*) is found in small depressions. The western end of the riparian band (called the Collinsville and Tower marshes in this study, Fig. 1) was covered with various-sized *Salicornia* marshes separated by annual valley grassland. The middle area was the highest portion of the band and contained a small, vernal alkaline marsh (the Resort Club marsh) dominated by salt grass and alkali heath (*Frankenia grandifolia*) plus some pickleweed. The eastern end of the band was a long seasonal alkali marsh partially surrounded by *Salicornia* marshes. The former was dominated by tules (*Scirpus acutus*), alkali bulrush (*S. robustus*) and cattail (*Typha angustifolia*); the latter by pickleweed, fat hen (*Atriplex patula*) and several other salt-tolerant species. This marsh (the Duck Club marsh) was flooded seasonally and managed as a duck club. The other marshes received their moisture from runoff and possibly from a high water table during the winter.

The riparian area is of great interest to both Pacific Gas and Electric Company (PGandE) and the various governmental resource agencies. A riparian placement of the power plant (removing 20-30 ha of wetlands) may be the most cost-effective alternative for the utility due to the existence of riparian water rights. The wetlands have the greatest wildlife value and hence, a considerable amount of the controversy about the site concerns the riparian areas.

METHODS

The riparian area was trapped three times (July 17-20, 1978, August 28-September 1, 1978 and October 16-20 and 23-27, 1978). Rat-sized sherman traps were used in lines or grids and set 7 to 10 m apart. They were stocked with crushed English walnut meats, sunflower seeds, bird seed and bedding. Harvest mice alone were tagged with numbered fingerling tags. All small mammals were released except the very numerous house mice (*Mus musculus*) which were removed from the areas during the two later trapping sequences. Criteria used to identify salt marsh harvest mice and to separate them from western harvest mice (*Reithrodontomys megalotis*) included the diameter of tail at 20 mm from rump, shape of the tip of the tail, ventral color of the tail, tail bicolor or not and head:tail ratio (Fisler 1965, Zetterquist 1977).

Optimal marshes were trapped first to ascertain whether the mouse was present (Figure 1). These included the Tower Marsh (Area A, 49 traps), Duck Club West (B, 80), Duck Club East (C, 40) and levee edge of grasses, willow (*Salix* spp.) and blackberry (*Rubus vitifolius*), i.e. Marshall Cut (D, 40). Each area was trapped for three nights.

The second trapping was accompanied by stratified random vegetation sampling (Envirodyne Engineers 1978). Areas A, B and C were trapped again plus the Collinsville Marsh (E) for the first time (Figure 1). Areas A, B and E were trapped in grids of 75 traps (3 X 25) for four nights while C was trapped with 99 traps (3 X 33) for four nights. Twenty, randomly-selected, 1 m^2 quadrates were sampled in each trapping grid for species composition, percent cover for each species, frequency of occurrence of each species, and height class of each species of plants.

The third and final trapping and associated studies were part of a report on potential mitigation (Biosystems Analysis 1979). Area E was trapped for 600 trap nights (75 traps X 8 nights) as a control in an optimal area while four marginal marshes and upland areas each were trapped for 300 trap nights. Five transects were run across the riparian band with 10 m^2 releves run every 33 m (100 ft.) with all species estimated with the cover-abundance scale of Braun-Blanquet (Mueller-Dombois and Ellenburg 1974). Areas covered by wetlands, *Salicornia*, and optimal areas of *Salicornia* were determined. These area determinations and tradeoffs associated with them were compared to a wildlife habitat evaluation done on the site by Jones and Stokes (1978) using the Habitat Evaluation Procedures (HEP) developed by the United States Fish and Wildlife Service (1976). Three mitigation areas (I, II, III) were established. Area I includes the Collinsville Marsh (Areas E, F), II surrounds the Resort Marsh (Area H) and III includes the Duck Club Marsh (Areas B, C, I). Soil analyses and plant growth studies were carried out but are not reported in this paper.

RESULTS

Salt marsh harvest mice were captured in the three appropriate marshes trapped in the first series (July 17-20), i.e. those with dense cover of pickleweed and associated salt-tolerant species. One western harvest mouse was captrued in the Marshall Cut lines along with numerous house mice. House mice were the most numerous species captured - 103 of 132 total animals compared with 15 salt marsh harvest mice and two western harvest mice.

Salt marsh harvest mice were captured in all four areas (A, B, C, E) in the second series (Aug. 28-Sept. 1) in densities of from 2.7 to 37.1/ha. Thirty-two animals were captured out of 348 total animals along with 281 house mice and four western harvest mice. There were considerable differences in species diversity, cover values and height characteristics as measured with layer diagram among the four pickleweed marshes sampled. There were, however, no significant correlations between densities of mice and various aspects of the vegetation in the four areas.

The third and final trapping yielded 17 salt marsh harvest mice, of which 10 were found in the control area for this series, Area E, the Collinsville Marsh. One salt marsh harvest mouse was captured in Area F to the north of the Collinsville Marsh. This extremely marginal area was approximately 25% *Salicornia* and 75% bare ground. Two animals were captured in Area G in the portion covered with *Salicornia* as a dominant species while two western harvest mice were captured in annual valley grassland. A similar situation was found in Area H (Resort Marsh) where four salt marsh and three western harvest mice were found. Area I in the Duck Club Marsh yielded only house mice in an area covered by *Distichlis* and weedy vegetation.

The areas presently covered by *Salicornia* plus potential areas of marsh development are tabulated on Table 1. The riparian placement of the power plant will remove 22.7 ha of wetlands including 9.7 ha of *Salicornia* marsh, 2.7 ha of which is considered optimal vegetation. This constitutes a loss of 24.3% of the optimal and 40% of the total *Salicornia* marshes on the site. Potentially 28.8 ha of ruderal and marginal marshlands can be converted into *Salicornia* marshes for a net gain of approximately 19.1 ha (235%). While not all of the added wetland can be developed into optimal *Salicornia* marsh, I estimate a 1.5 to 2.0 fold increase in such vegetation. Hence Biosystems Analysis' mitigation potential plan (1979) shows a considerable gain in salt marsh harvest mouse habitat. The HEP study by Jones and Stokes (1978) indicated that additional marsh development would be needed as enhancement of the marginal *Salicornia* now present would not compensate for the losses incurred with the riparian placement of the plant.

In summary it appears that onsite mitigation for salt marsh harvest mice is possible and could result in more habitat and hence potentially more mice after mitigation. A non-riparian placement of the plant, allowing for the retention and enhancement of the wetlands to be lost under the riparian placement, would yield even more optimum habitat.

DISCUSSION

The discovery of an endangered species on this potential powerplant site complicated an already complex situation. It is but one of the environmental problems involved with the siting of a large coal-fired power plant. Other problems include air quality, entrainment of aquatic organisms, rare and endangered plants, economic and sociological impacts, and the first industrial development in the area of the Suisun Marshes, to name some of those most discussed. Even so, there has been evidence that the California Energy Commission favors this site as the other three sites have problems associated with them and are much farther away from the users of the energy to be produced, i.e. from the San Francisco Bay Region.

Another complicating factor was the fact that Congress was considering the renewal of the Endangered Species Act during late 1978. The case of the snail darter produced a strong reaction to the act resulting in the possibility of crippling changes in endangered species legislation. The salt marsh harvest mouse at this site was not a snail darter nor did I wish it to be considered one.

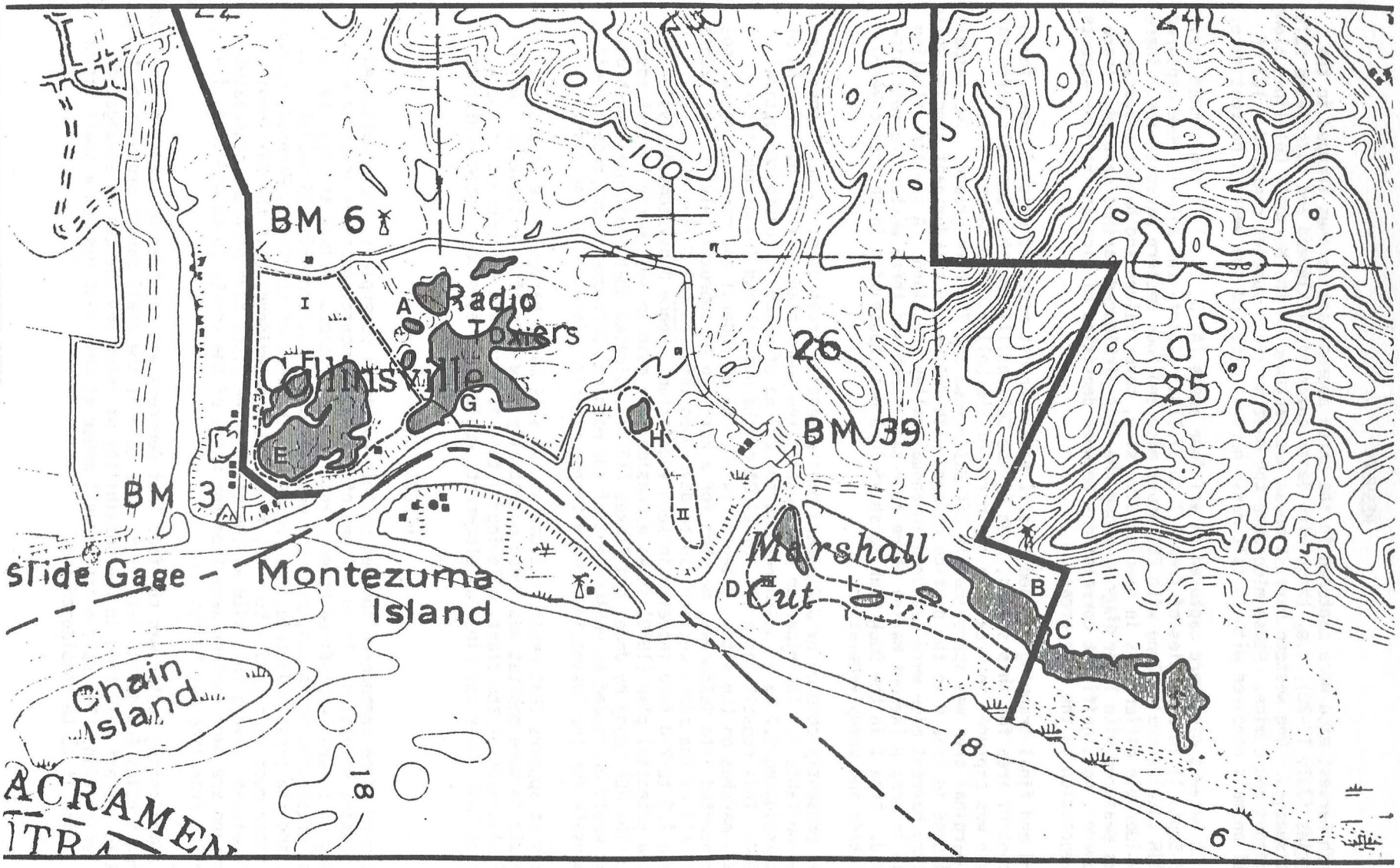

FIGURE 1. Collinsville powerplant site, showing areas of *Salicornia* marshes (shaded), trapping sites (letters, A-I), proposed mitigation areas (I, II, III and dashed lines) and the area of wetlands destroyed using a riparian placement (between mitigation areas I and II and the road, edge indicated by dotted and dashed line).

TABLE 1. Present and potential salt marshes on the Montezuma power plant site in hectares.

	Present optimal *Salicornia* excluding plant area.	Present total *Salicornia* excluding plant area.	Potential new *Salicornia* marsh in mitigation areas.	Wetland lost, with riparian placement of plant (including *Salicornia* marsh).
Riparian plant site				22.7 (9.7)[a]
Mitigation Area I	5.1	8.6	16	
Mitigation Area II	---	0.5	4	
Mitigation Area III	3.3	5.1	8.8	
Totals	8.4	14.2	28.8	22.7 (9.7)[a]

[a]Includes 2.7 ha of optimal *Salicornia* marsh.

The population of salt marsh harvest mice at the Montezuma site are at the eastern edge of the range of the subspecies. It is under less threat than the southern subspecies (*R. r. raviventris*) and the best habitat left for it is in the Suisun marshes to the northwest of Collinsville. I could not honestly say that manipulation of the mouse onsite would endanger either it, or the subspecies in general, so I recommended that Pacific Gas and Electric mitigate for the plant's impact on the mouse.

Onsite mitigation was preferred initially by Pacific Gas and Electric so the major thrust of our studies was to ascertain whether or not mitigation could be provided with a riparian placement of the plant. Such mitigation is possible. We now know the general distribution of the mouse and its habitat onsite. The mouse is restricted to dense salt marsh vegetation dominated by *Salicornia* as we expected. It appears to me that more marsh can be produced by development and enhancement than the total now present including the loss of approximately 23 ha of wetlands to the plant site. Long term monitoring of the marshes would be necessary as part of any mitigation plan. Such a plan, however, involves managing the area for a single species.

The riparian area on the Montezuma site has many other wildlife values, some of which would be decreased by favoring pickleweed marshes, a plant little used by water fowl. The maintenance of greater plant diversity will necessarily reduce the amount of habitat useable by salt marsh harvest mice.

The value of wetlands in general is high and appears to be one of the principal reasons for the official stand of both the United States Fish and Wildlife Service and the California Department of Fish and Game. Both groups went on record in November, 1978, favoring a non-riparian placement of the plant - one destroying no marsh.

This is the situation as the second series of NOI hearings are about to begin. The position of the utility has not been formally stated while resource agencies appear to be firmly in favor of a non-riparian placement. What role the mouse will play in future decisions concerning the Montezuma plant is not known. There are certainly many factors

in addition to the mouse considered critical by the utility, governmental agencies and environmental groups. Only time will tell, but perhaps not, as in any process as complicated as this one the forces which produce the final result are seldom clear.

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