Chapter 2

VEGETATION OF THE HOFFMAN MARSH BEFORE THE RESTORATION PROJECT OF 1984

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Introduction

With an increase in automobiles in the Bay Area, our highways must be expanded, often at the expense of open land. To make a stretch of highway 17 in the East Bay more effective by widening it, Caltrans is going to take a portion of natural mud flats in Albany. By law, land that is taken must be compensated for by some means. As legal compensation or "mitigation" Caltrans has planned to revive an unhealthy portion of a nearby salt marsh.

The Hoffman Marsh in Richmond (see map, p. viii) is the location for the mitigation. A dike that supports a sewer line has cut off tidal flow to the southern portion of the marsh, which has had many adverse effects on the natural flora. To revive the marsh, Caltrans planned to enlarge the culverts through the dike in an attempt to bring normal tidal flow to the unhealthy section. Caltrans also planned to enlarge the existing channels.

My study is a base-line survey of the vegetation before the rehabilitation project. With my work others will later be able to determine if Caltrans has fulfilled its obligation to restore normal tidal flow and consequently, to restore the natural flora. It is my hope that through a follow-up survey the merits of the mitigation process can be evaluated and future mitigation cases can be guided by those assessments.

Background

The Hoffman Marsh study site is located on the shore of San Francisco Bay (see map on p. viii). Nestled between the city of Richmond to the north and Albany to the south, the marsh, for the most part, has thrived.

The present-day Hoffman Marsh is not in the same condition as it was 130 years ago (Turner, 1982). In the 1850's the marsh was more extensive than it is today. A large portion extended inland along the southern margin. Another sizable portion extended westward towards the present-day Point Isabel. Although more than half the original marsh of the 1850's has been lost, a small new portion has since formed and constitutes approximately the northwestern half of today's marsh (Turner, 1982). According to my calculations based on a map by Turner (1982, Figure 1), the new addition to the Hoffman Marsh equals approximately 10 acres or .04 km^2.

The changes in the Hoffman Marsh are the results of man's direct and indirect intervention in the natural ecosystem. The direct intervention has come from both filling in the shoreline and construction of marinas and piers. In an effort to provide more land for growth, filling in of the marsh began around 1912 (Turner, 1982). The indirect intervention originated miles away in the Sierra Nevada. From 1853 to 1884 gold miners using hydraulic mining methods sent tons of silt and sediment to the bay. This increase in fine sediments, which tend to deposit on the edges of the bay, produced shallow waters, the first step towards formation of new marsh land. New marsh formed since 1850 in San Francisco Bay comprises approximately 75 square kilometers (Atwater, 1979).

Past Work

In 1973 the URS Research Company prepared an environmental impact analysis for the widening of highways 17 and 80 along the Richmond-Albany shoreline. The URS study examined both plant and animal life in the Albany mud flats, as well as in Hoffman Marsh. This study is the only source of previous data with which I can compare and build upon. The URS vegetation survey covered the entire Hoffman Marsh, whereas my study focuses on the southern diked portion. The URS study used a 10 cm square quadrat at every other 10 cm distance, for a total area (from two transects) of 2.5 square meters. My quadrat size was also 10 cm square, but differed in a few respects. The specifics of my quadrat are explained below. One other difference was the direction of the transects. Whereas the URS transects ran perpendicular to highway 17, mine paralleled 17.

Even though the URS study was done twelve years ago, the species they found are still present today and in essentially the same relative abundance. They found the dominant species to be Salicornia virginica (common pickleweed) and Spartina foliosa (Pacific cordgrass) in the healthy portion of the marsh. The URS study made a special note that the southern part, my study site, did not support Spartina foliosa.

Approach and Methodology

Three transects were made to determine species present and relative abundance of each, measured by relative frequency and percent coverage. Two of the transects (A-1 and B) were taken October 26 before any reconstruction work had been done. Both transects (A-1 to A-1', B to B' on Figure 1) began approximately half a meter north of a channel that parallels the dike and ran southward towards the Central Avenue offramp (Figure 1). The third transect, A-2 (A-2 to A-2', Figure 1) was made March 3, after the channels had been deepened and widened. Although transect A-2 was along the same line as transect A-1, it covered only about a third as much area. The area surveyed in this transect was reduced since the channel spoils were not at that time supporting any vegetation. A string was pulled tightly across the study site to align the transects, which were placed in locations that had a wide variety of plant life due to variation in elevation and water flow. By incorporating a range of flora, I hope to cover all possible changes that can result from increased circulation.

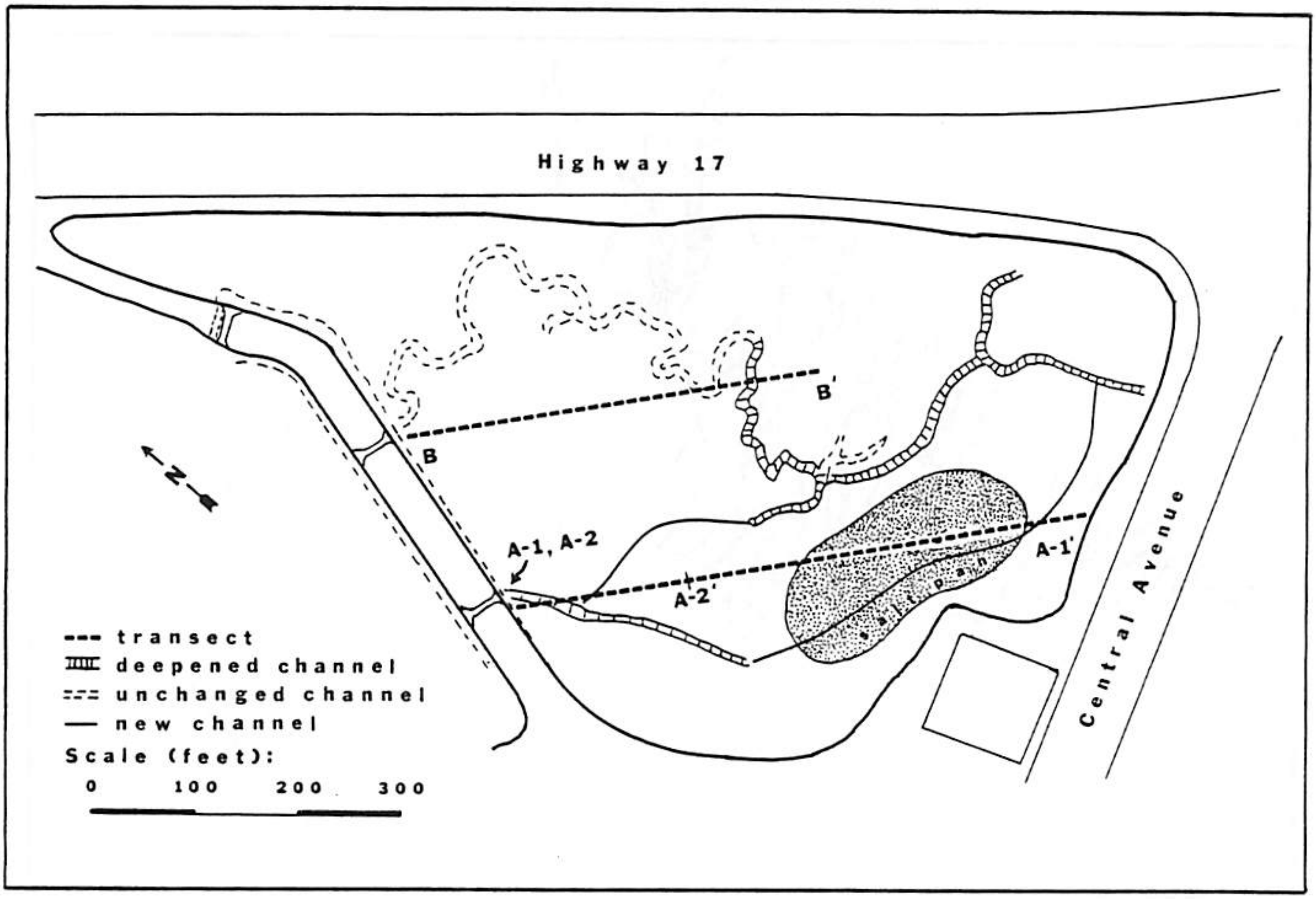

Figure 1. Study Site Showing Location of Transects. Stipled Area Is Salt Pan.
Source: Adapted from URS (1973) and Siegel (this report).

A 0.25 m^2 quadrat, or grid, subdivided into 25 100 cm^2 sections, was placed on alternating sides of the string at one-meter intervals. Five of the 100 cm^2 quadrats were surveyed at each location. Which five quadrats were used was determined by following a random sample list which I made before going into the field.

Salicornia virginica posed a problem in counting the actual number of individuals to determine the species density. Salicornia virginica has a prostrate rooting system (Figure 2) that made counting individuals very difficult. The number counted in my first set of transects was stems and not roots. This incorrect individual count would not have given a true picture as to species density. It was for this reason that I opted for two other indicators that give a good idea of vegetation present, frequency and percent coverage.

Total frequency for all species is calculated by dividing the number of quadrats in which any species occurs by the total number of quadrats taken. Relative frequency, the frequency that I am reporting, is determined by dividing frequency of a specific species by the total frequency. This relative frequency

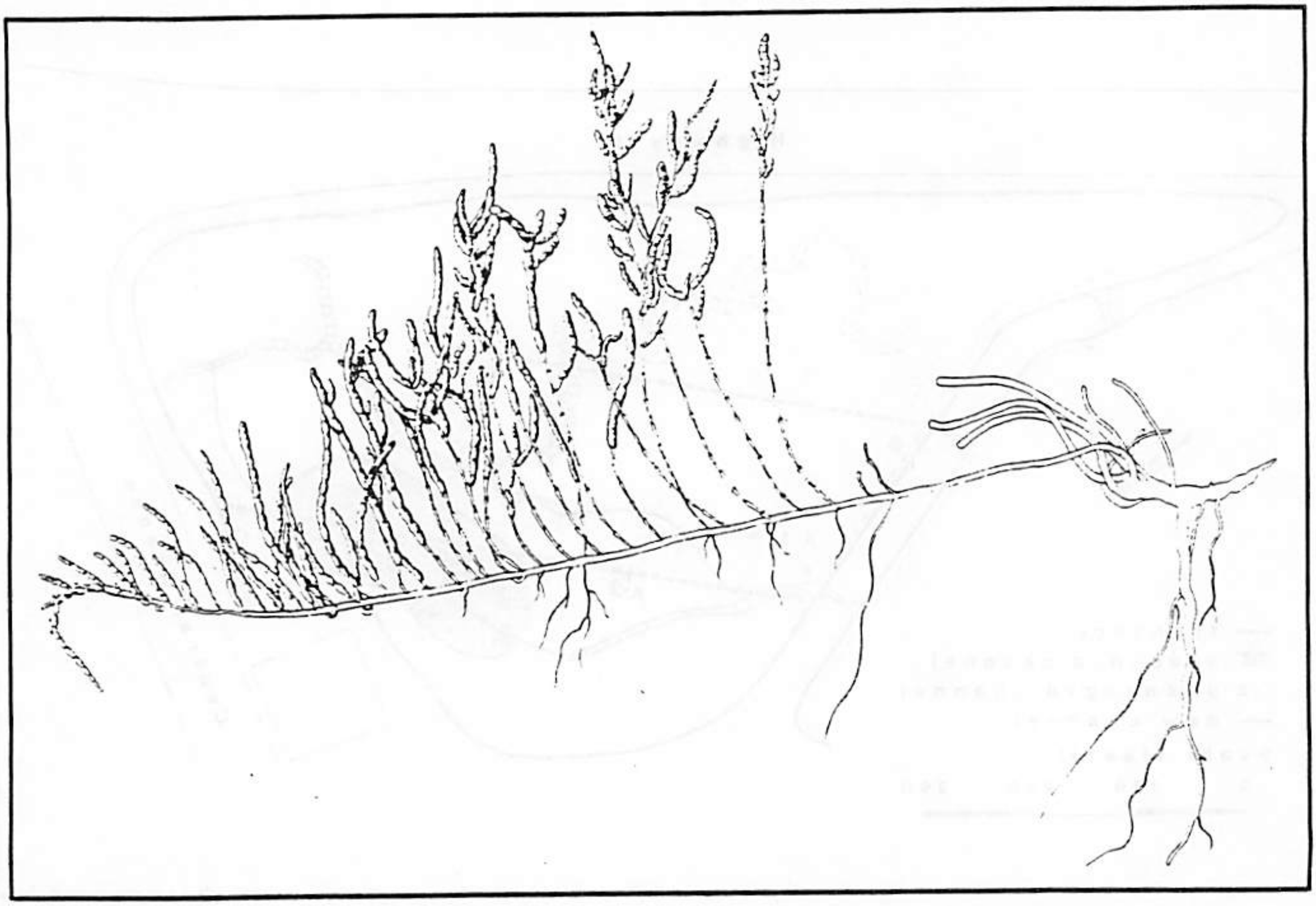

Figure 2. Salicornia virginica.
Source: Correll and Correll, 1972.

gives a good idea of a particular species' frequency in relation to the other species present, whereas absolute frequency for a species includes areas without vegetation. Percent coverage was also calculated in relative terms and requires similar mathematical manipulations.

Results

The Hoffman Marsh is nearly completely dominated by Salicornia virginica. Spartina foliosa is non-existent in the study site, but flourishes in the lower expanses of the healthy main marsh. Before the construction was done, a large vegetation-free pond was present in the southwest portion of the study site. In October the study site had taken on a strong rust-red color, whereas the healthy portion, the main marsh, retained the in-bloom green. The observations that Salicornia virginica is overwhelmingly the dominant species and that Spartina foliosa is absent in the study site are supported and reinforced by the quantitative data from the transects.

Results from the first two surveys (transects A-1 and B) show that Salicornia virginica is the dominant species, both in frequency and in percent coverage (Table 1). Distichlis spicata (saltgrass)

TRANSECT	SPECIES	FREQUENCY (%)	COVERAGE (%)
A-1 (Oct 26, 1984)	Salicornia virginica	83	92
	Distichlis spicata	8.5	4
B (Oct 26, 1984)	Salicornia virginica	87	95
	Distichlis spicata	10	4
A-2 (Mar 3, 1985)	Salicornia virginica	86	92
	Grindelia humilis	14	8

Table 1. Frequency and Percent Coverage of Dominant Species.

is the next most dominant. Other species occurring in much smaller numbers, and therefore not listed in Table 1, include Grindelia humilis (marsh gumplant), Frankenia grandifolia (alkali heath), Jaumea carnosa (Jaumea), Cuscuta salina (salt marsh dodder), Cotula coronopifolia (brass-buttons), Raphinus sativa (wild radish), and Limonium californicum (marsh rosemary).

Transect A-2 also showed Salicornia virginica to be the major species, with a frequency of 86% and a coverage of 92%. Grindelia humilis covered the second largest area and was the second most frequent species. A large portion of Transect A-2 and approximately three-to-four acres of the marsh had been churned up into a soil-pickleweed mixture by the heavy equipment used to enlarge the channels. The spoils from the channels were dumped along the western border of the study site, covering any surviving pickleweed. This area seems to be drying a great deal, as large cracks are forming in mud spoils.

The ranges of the two dominant species (Salicornia and Distichlis) are distinct and have their own characteristics (Figure 3). Salicornia grows in a wide range, from Mean High Water (MHW) to elevations at Extreme High Water (EHW). Salicornia not only grows as high as Grindelia, which is an upland species, but is also found to line the higher elevations along the channels. The Salicornia intermixes with ice plant at the outside upper edges of the marsh. Distichlis is found only at upper elevation areas.

The growth pattern of both the dominant species seems to be very similar. Both seem to grow in patches. Salicornia has an intertwined mat-type growth; Distichlis does not grow in such a tight mat. Distichlis tends to grow in clumps or bunches.

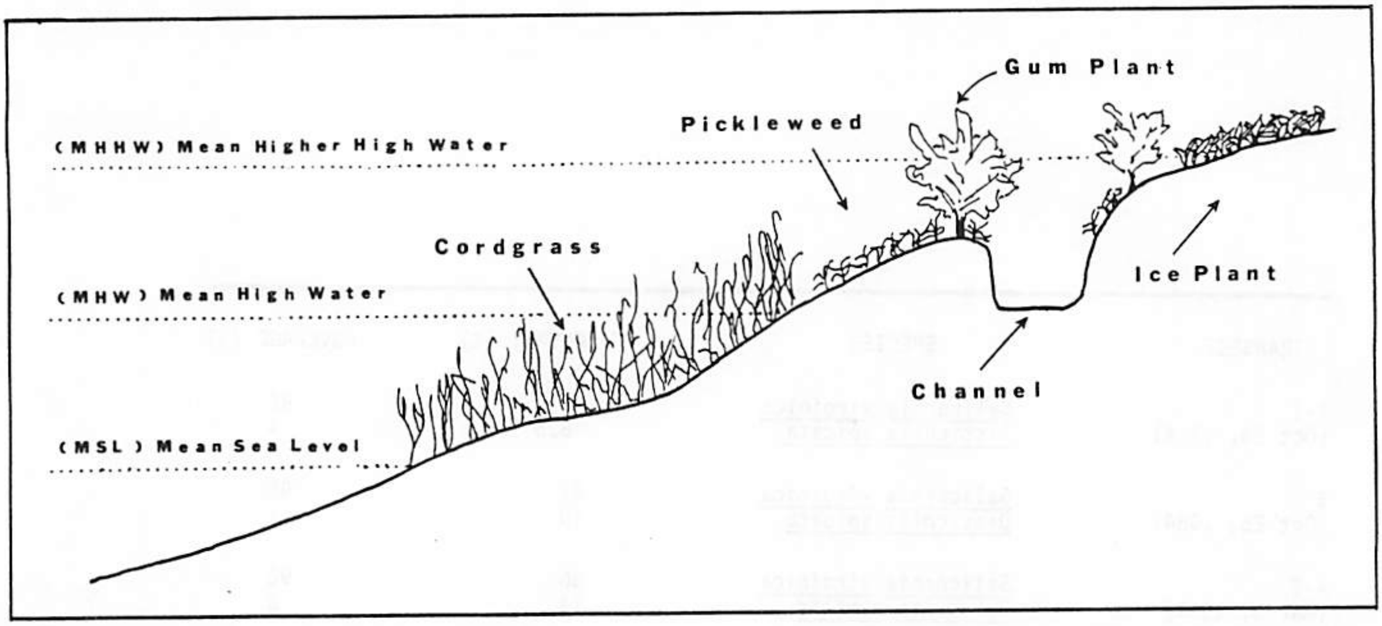

Figure 3. Plant Distribution at Study Site.

Discussion

The natural evolution of marine wetlands is a slow, complex process that is influenced by many factors, such as tidal flow, water salinity, rainfall, sedimentation, soil composition and interspecific competition (Josselyn, 1983). The natural process follows the sedimentation that occurs at the upper limits of the tidal extremes. The greatest sedimentation occurs in the back channels and on the marsh surface itself where vegetation further slows water velocity (Josselyn, 1983). As more and more sedimentation occurs, the land level rises and supports higher elevation vegetation. The study site, which supports a large number of upland species, is physically much older than the main marsh.

Sediment salinity, along with tidal flow and elevation, play an important role in the determination of vegetation present in a marsh. Areas that receive improper tidal drainage, such as the diked study site, retain more salt, which controls the particular vegetation present. Sediment salinity increases with elevation due to longer periods of exposure and evaporation. Measurements of sediment salinities in marshes can vary depending on elevation and tidal flow in the marsh (Josselyn, 1983). Salicornia is a succulent that can tolerate the higher salt concentrations that are normally present above the MHW.

The color change that was observed in late October tells a great deal. Pickleweed is a succulent perennial that can store a certain amount of salt before the stems begin to slough off. Normally pickleweed builds up salt content during the summer months when tides are generally low. In the late fall and winter the pickleweed sloughs off. This process is accompanied by the loss of chlorophyll (green) pigment and the development of anthocyanin (red) pigment (Josselyn, 1983). The fact that the entire study site was turning red weeks sooner than the main marsh shows that the study site was not receiving proper tidal flow, and for this reason the growing season for the pickleweed was reduced considerably.

The values for relative frequency and relative coverage give an excellent idea of what is present in the study site. The values that I obtained were very close to those the URS study reported in 1973. This high correlation between results could indicate two things. First, it could mean that the study site is a stable environment that will not undergo any further change. In my opinion, a better explanation would be that 12 years is not necessarily an adequate period of time to allow a drastic change in vegetation.

Of the three transects, only A-2 should be examined more closely. This transect was originally designed to permit a comparison to be made with A-1. Since transect A-2 contained only the very high portion of transect A-1, a biased picture results. Transect A-2 showed a Grindelia humilis frequency of 14% and a coverage of 8%. These numbers do not reflect the true picture and should not be compared to transect A-1.

The zonation patterns that I observed were very unusual for a salt marsh. I found upland species that would normally be along the high edges of marsh lining the channels running in the middle of the study site. Although this is very abnormal for a healthy marsh, Josselyn (1983) reports that deposition of the heavier particles along the top edge of the channel forms a natural levee. My hypothesis is that with the poor tidal drainage, the sediments that would have been swept away from the top edge of the channel are instead allowed to settle. Cordgrass, which normally grows along and in the channels of a healthy marsh, are not present in the study site. This was not surprising, as the study site appears to be roughly a foot higher in elevation than the main marsh. This elevation difference was very evident during high tides that completely covered the healthy portion of the marsh, whereas the study site was still above the water by several feet.

The construction of the rehabilitation has not moved smoothly towards the goals set prior to the project. The major change scheduled, the enlarging of two culverts under the dike to allow more tidal flow, has still not been done. The work that has been done, the widening of the channels, appears to have been more of a setback rather than a means to facilitate rehabilitation. Although it appears that some of the construction was attempted in a way as to do the least damage to the marsh (i.e., digging out two channels from the same location), considerable change and damage has taken place. This change will limit drastically the wetlands productivity of the Hoffman Marsh unless the spoils are removed by the time of the winter rains of 1985-86.

The project will be deemed a success only if the study site is restored to a healthy natural condition, much like the condition that exists in the main marsh. The appearance of Spartina foliosa, a low elevation species, would be one indication of normal marsh conditions, as would the disappearance of Grindelia humilis and Distichlis spicata, both upland species. The appearance and disappearance of these species respectively would indicate a reduction of elevation and/or an increase in tidal flow.

The seasons for the study site will also be lengthened as regular tidal flushing would reduce the high salt concentrations that are presently affecting the study site vegetation and causing early seasonal changes.

Conclusion

Although productive changes take time, deleterious and drastic measures usually produce quick and obvious visual changes. The present state of the study site, with nearly half covered with channel spoils, is not supporting any marsh vegetation. This unacceptable condition is proof that Caltrans has taken steps, but those steps have not been planned well. In a genuine and sincere effort to preserve and restore the marsh, the spoils should never have been dumped on the existing marsh, but should have been hauled away. What I find most astounding is the fact that the condition of the present marsh is being ignored, and Caltrans is not being held responsible.

Under ideal restoration circumstances, changes produced by restoration work similar to that done in the Hoffman Marsh, would be controlled by the natural cycle of perennial plants and by the slow processes of nature. This slow process usually will not produce immediate visual changes in the vegetation patterns. It is for this reason that follow-up studies must be done in the coming years to determine the success of the restoration project. It is my hope that the findings of the future studies will show the true merit of such projects.

In my mind, the present system of mitigation can use a few reforms. To enforce and add strength to the present process, the Bay Conservation and Development Commission should take a more active role in the planning of the restoration. In the case of the Hoffman Marsh, a more active role would have meant studying the conditions of the existing clay sewer pipe and exploring all possible alternatives, and finally implementing those most feasible. The appointment of a wetlands restoration director would give a much-needed central guidance and supervision to the present restoration projects. This director could oversee the restoration from the very start and could keep a tight check on the work. With a director of restoration in charge Caltrans would have been able to complete the restoration efficiently and properly on their initial attempt.

The success of the Hoffman marsh restoration project will directly reflect the effectiveness of the San Francisco Bay Area mitigation process. More careful planning and better supervision are needed to see that projects are carried out completely as proposed.

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