Chapter 7

THE SOUTH RICHMOND MARSHES: AN ECOLOGICAL ANALYSIS

Mark Oddi

Introduction

Along the south Richmond shoreline immediately north of Pt. Isabel and extending towards Richmond's Inner Harbor Basin, a serene salt marsh community exists (FIGURE 1). Hardly noticed by motorists on Hoffman Boulevard just east of the marsh, it manages to survive amid chemical and heavy industries, rail-served industrial parks, and flagrant acts of vandalism.

Wildlife is abundant; migratory and resident birds are the most obvious marsh users, but small mammals are also well represented. Stands of cord grass and pickleweed, the floral bulwarks of a salt marsh community, form the base of a food chain

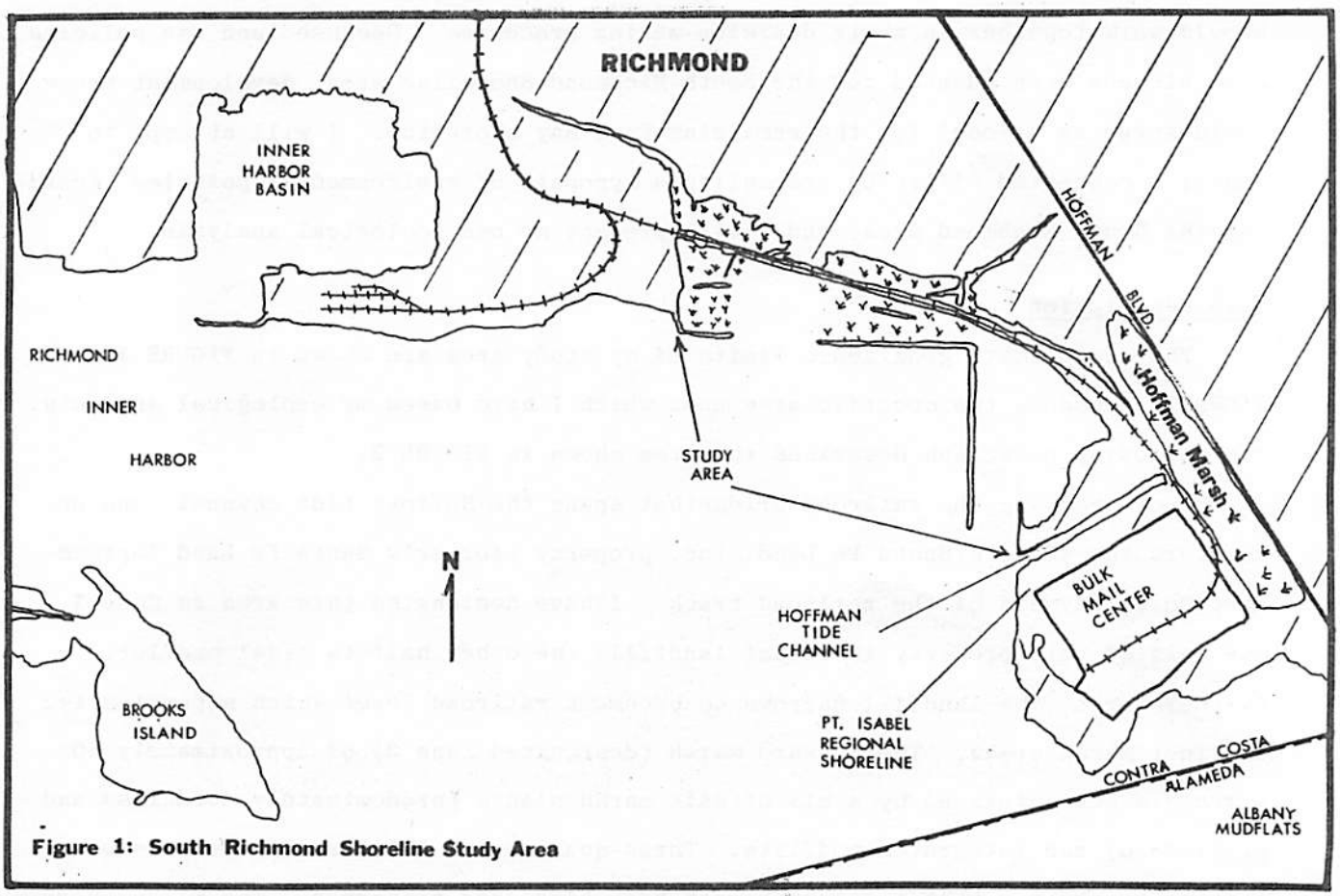

Figure 1: South Richmond Shoreline Study Area

upon which the diverse fauna have come to rely.

Extending south of Pt. Isabel and reaching to the Bay Bridge Toll Plaza, the East Bay shoreline exhibits partially developed, peninsular landfills with intermittent salt marshes and mudflats. The California Coastal Conservancy was chosen to provide guidance in implementing various park proposals for the remainder of the undeveloped landfill along the shoreline. For various political and economic reasons the Conservancy chose as its northern jurisdictional limit the Hoffman tide channel (FIGURE 1), including the Hoffman Marsh (Peter Brand, 1982, pers. comm.). The wetlands north of this boundary come under the policies of the South Richmond Shoreline Special Area Plan (South Richmond Shoreline, 1977).

The entire East Bay shoreline, however, encompasses a dynamic biotic community which does not recognize political or otherwise temporal delineations of its habitat. It is important to realize that development in one area can impact wildlife along the entire shoreline, due to the mobility of birds and certain other animals.

I feel that the various agencies involved in the two areas, namely those guided by the Coastal Conservancy and those guided by the South Richmond Special Area Plan, should work together in their decision-making processes. Because land use policies have already been adopted for the South Richmond Shoreline Area, development there could serve as a model for the remaining East Bay shoreline. I will attempt to foster a concerted effort by presenting a synopsis of environmental policies regarding the South Richmond Area, and I will present my own ecological analysis.

Site Description

The approximate geographic limits of my study area are shown in FIGURE 1. FIGURE 2 presents the specific area upon which I have based my ecological analysis. The following paragraph describes the area shown in FIGURE 2.

Upon crossing the railroad bridgethat spans the Hoffman tide channel, one encounters the 45 acre Santa Fe Land, Inc. property (formerly Santa Fe Land Improvement Co.), bayward of the railroad track. I have designated this area as Zone 1. One half of this property is vacant landfill; the other half is tidal mudflat. Farther north, the landfill narrows to become a railroad levee which separates two distinct marsh areas. The bayward marsh (designated Zone 2) of approximately 50 acres, is characterized by a mix of salt marsh plants (predominately cordgrass and pickleweed) and integrated mudflats. Three-quarters of this marsh is enclosed by a stone breakwater that is popular with both birds and fishermen. The marsh shoreward of the railroad levee (designated Zone 3) encompasses approximately 40 acres.

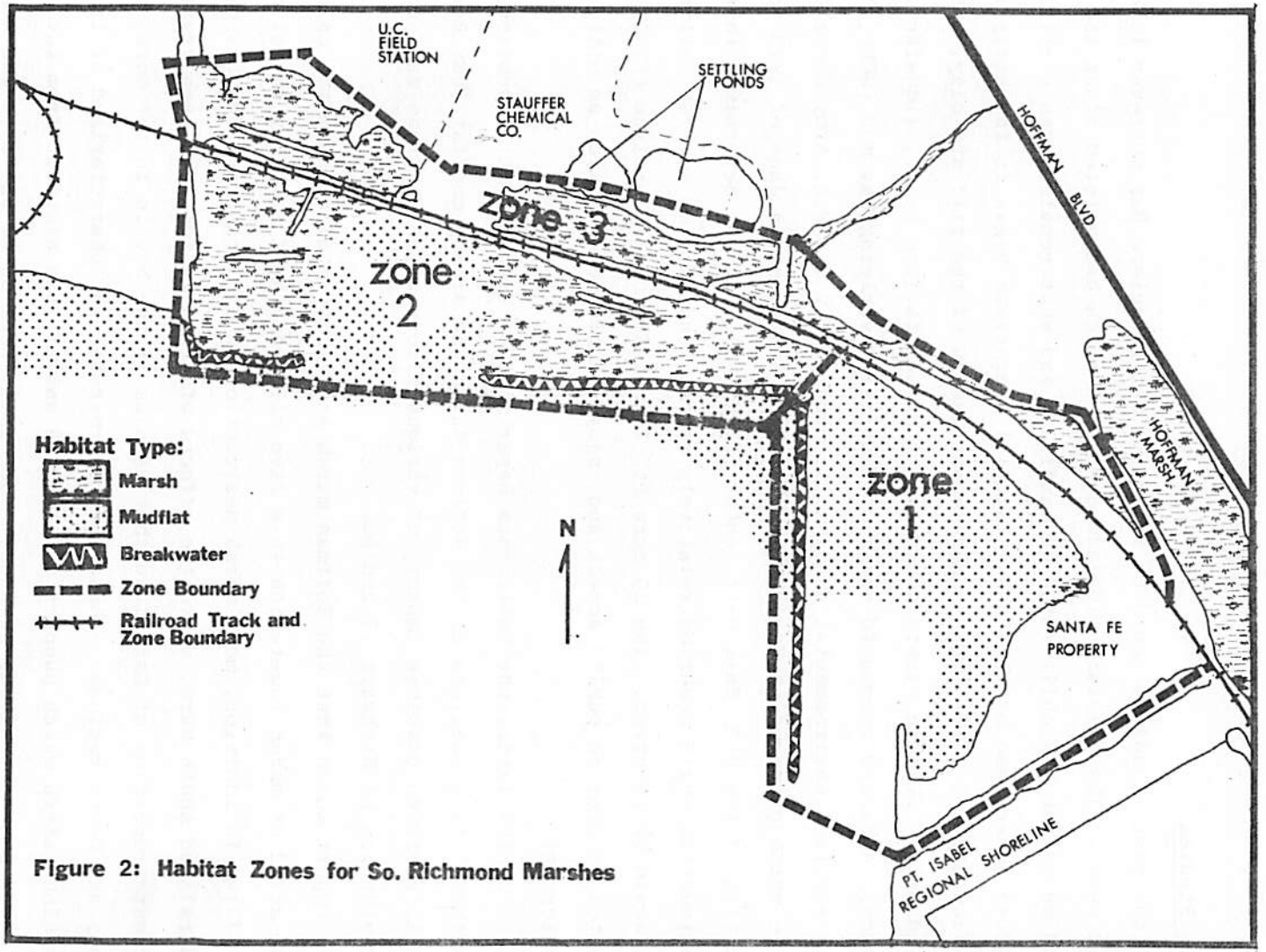

Figure 2: Habitat Zones for So. Richmond Marshes

FIGURE 2. Habitat Zones of the South Richmond Marshes.
Source: South Richmond Shoreline Special Area Plan, 1977.

There are actually two distinct marshes here, each draining into the bayward marsh through a separate breach in the levee. They are of poorer quality than the bayward marsh because of their removal from direct tidal action by the levee. The upland area immediately surrounding the marshes is a mix of grassy vacant lots, and both heavy and light industry.

Previous Studies

In the past, landfill could be placed in San Francisco Bay wherever it made economic sense. The pristine tideland ecosystem which had existed along the South Richmond shoreline was obliterated by landfill, and what remained was partitioned by railroad levees and breakwaters. Landfill operations began in the early 1900's and continued until 1969. The primary constituents of the fill are clay, sand and compacted silt. Seismic events could induce ground failure (e.g., liquefaction and subsidence), a hazard common to man-made landfills overlying bay mud (BCDC, 1977).

The earliest environmental analysis is provided by the U.S. Army Corps of Engineers which prepared an Environmental Impact Statement in June of 1973 for the construction of the U.S. Bulk Mail Center (FIGURE 1). It was determined that because all construction would occur on relatively recent landfill, no adverse environmental impacts would be incurred. The 20 acre Pt. Isabel Regional Shoreline (FIGURE 1) was created to provide public access and enjoyment of the shoreline as mitigation for development.

Three months later, the California Department of Transportation published the first authoritative analysis of the Hoffman marsh and Albany mudflat (URS Research, 1973). It reviewed possible impacts of various alternatives Caltrans was proposing for the widening of Highways 17 and 80.

The report notes that the Hoffman marsh and Albany mudflat form the only existing stand of marsh vegetation in a five mile length of East Bay shoreline (URS, 1973). In addition, most marsh destruction in San Francisco Bay has been in the central and south bays, where the effects of urbanization have been greatest. The largest proportion of marshland that remains in the bay is in the more rural north bay and Delta regions. These northern marshes are characterized by fresh and brackish waters which support a plant and animal life distinct from the more saline south and central bay marshes. Therefore, because of the area and habitat-type imbalance, the marshes in the south and central bays become biologically very important because so little of them remains (URS, 1973). This is a critical point to consider in any instance involving mitigation on an acre-for-acre basis.

The URS study also found that species diversity and biomass of benthic invertebrates are higher near the borders of mudflats than areas farther from shore (URS, 1973). This could have implications for shorebird health and welfare if visitor use of the shoreline became heavy.

In 1980, Caltrans completed its own EIS (Caltrans, 1980) for the widening of Highway 17. In the marsh vicinity, a proposal now termed "D_1 modified," has been adopted. This proposal will claim 1.3 acres of wetland, of which 0.8 acres is low-grade residual marsh (Caltrans, 1980). Planned mitigation calls for the rejuvenation of 7.5 acres of the southern Hoffman marsh. A levee now isolating this portion of the marsh would be breached to provide better tidal circulation. Appropriate landscaping along the highway is also planned, utilizing native shrubs and trees (Caltrans, 1980). There may be no impacts on high quality marshes in the area if a new I-180/80 interchange site north of Central Avenue is found (Caltrans, 1980). Other mitigation measures under consideration include dredging of the existing marsh network to improve tidal circulation and breaching of railroad levees to create islands which would provide secure nesting sites for marsh wildlife (Caltrans, 1980, p. 138, Plate 39-2).

Although the Hoffman marsh is within the range of four endangered species, the report concluded that no deleterious effects would occur by implementation of the D_1 modified proposal. If all mitigation measures are adopted, overall habitat quality would probably be improved (Caltrans, 1980).

The San Francisco Bay Conservation and Development Commission (BCDC) acted as lead agency in drafting a final environmental impact report in conjunction with the Special Area Plan for the South Richmond Shoreline; both were adopted in 1977. The EIR resolved conflicts between the Richmond General Plan and the BCDC Bay Plan. The Special Area Plan recognizes that the marshes and tidelands provide significant wildlife habitat for many species of animals, particularly birds. In addition, Brooks Island (FIGURE 1) provides a valuable habitat for native flora. Upland areas are zoned industrial; the University of California Field Station, Stauffer Chemical Company and the U.S. Bulk Mail Center are the primary users (BCDC EIR, 1977).

The BCDC EIR indicates that storm drainage presents a particularly hazardous problem. The shoreline waters of South Richmond contain pollutants such as heavy metals (e.g., lead and mercury), corrosives, chemicals, oil, and other petroleum products. The discharge problem has been compounded by the deteriorating and abandoned drains within the shoreline area (BCDC EIR, 1977).

Land use policies adopted in the Special Area Plan include: (1) the protection of marshes, mudflats, tidelands and open water to the maximum extent feasible, (2) encouragement of public access along the bay shoreline during the course of future development, and (3) retention of the existing Santa Fe landfill (FIGURE 2) as a preservation area (open space recreation, limited access) until the proper permits are issued for development (South Richmond Shoreline, 1977).

The Santa Fe Plan

Santa Fe originated the fill project before the Bay Plan was adopted and is exempt (due to a grandfather clause) from the need to obtain BCDC approval; but only if the project remains the same and is completed "in a timely manner" (BCDC EIR, 1977). Twenty acres of the 45 acre tideland property had been filled by 1969 when filling operations terminated.

An application to resume filling of the remaining 25 acres of tideland was submitted to the U.S. Army Corps of Engineers in February of 1977. Six hundred thousand cubic yards of imported material would have been used as fill to create a rail-served industrial park (Santa Fe permit applications).

Public response to this proposal was considerable. The Resources Agency of California noted that as of 1977, the mudflats surrounding the proposed fill area contained a minimum of 30,000 Japanese littleneck clams and a minimum of 20,000 softshell clams. The softer mudflats offshore also contained high populations of marine worms and small clams. Adult striped bass, starry flounder, and other sport fishes frequent this area to feed on juvenile fishes, bay shrimp and other marine organisms. Fishing success in the area is subsequently high (Goodson, 1977).

The California Department of Fish and Game, the U.S. Fish and Wildlife Service, and others opposed the fill for its potential destruction of wildlife habitat. The State Lands Division also stated that the proposed project occupies sold unreclaimed lots, and a serious doubt remained concerning the ownership of the lands by Santa Fe (Goodson, 1977).

The request for a permit was denied by the Corps on December 1, 1977. Their findings stated that the total public interest would not be served by the implementation of this project (Adsit, 1977). It is unknown at this time what future plans Santa Fe has concerning this property.

Methods

In making my own analysis of the South Richmond Shoreline (FIGURE 2), I selected several days at random each week to observe and census wildlife. Lists are compiled

for both plants and animals from a total of 14 days observation which began 3/12/82 and ended 4/25/82. I spent an additional 6 days during the month of May collecting plant specimens as they came into flower.

I divided the site into 3 zones as outlined in FIGURE 2 and as described previously under site description. The birds are classified according to habitat, seasonality and maximum abundance during the census period. The other animals are classified only as to occurrence. The flora are grouped into indigenous marsh species and those species particular to landfill or upland areas. All floral identifications are based on Munz and Keck (1968).

Stephen F. Bailey of the Museum of Vertebrate Zoology provided invaluable assistance in annotating the bird list. The staff of the Jepson Herbarium also gave helpful assistance with plant specimens.

Results

Only the most prominent fauna and flora will be discussed, but TABLES 1 and 2 give a complete list of the birds and flowering plants, respectively.

Zone 1

The 20 acre Santa Fe landfill, despite its recent origin, supports a rich mixture of native and exotic shrubs, ornamentals and weeds. The shoreline is too precipitous for most salt marsk plants, although one area, approximately 200 square meters in extent, supports a miniature salt marsh community (FIGURE 2).

Pickleweed, Salicornia virginica, dominates the lower tidal zones with salt grass, Distichlus spicata var. stolonifera, occupying the higher peripheral margins. Growing throughout are sea lavender, Limonium californicum, jaumea, Jaumea carnosa, brass buttons, Cotula cornopiflora, and fat hen, Atriplex spp. The marsh appears to be expanding out onto the mudflat. Gumplant, Grindelia humilis, typically found in the transitional zone between salt marsh and upland, is quite abundant along the shoreline and occurs sporadically inland. Small growths of pickleweed and salt grass are also found scattered along the shore.

The most striking vegetational feature of the upland is the dark green coyote bush, Baccharis pilularis consanguinea, that rises up to 2.5 meters above the rumpled landscape. A few large specimens of the native arroyo willow, Salix lasiolepsis, grow at the southwest corner of the landfill. The broom, Cytisus canariensis, grows interspersed between the ubiquitous coyote bush. These individuals are generally found along the shoreline and parallel to the railroad track.

Species+	A[1]		B	C
Common Loon	2	(3-20)	W	W
Horned Grebe	1	(4-3)	W	W
(Eared Grebe)	-		W	W
Western Grebe	3	(4-14)	W	W
Pied-billed Grebe	2	(3-19)	W	W
(Brown Pelican)	-		S	W,B
Double-crested Cormorant	1	(3-28)	R	W,B
Brandt's Cormorant	1	(4-25)	W	W
Great Blue Heron	1	(3-17)	R	S,M,U
Great Egret	6	(3-21)	R	S,M,U
Snowy Egret	11	(3-17)	R	S,M,U
Black-crowned Night Heron	1	(4-25)	R	S,M,U
Mallard	12	(4-25)	R	S
Pintail	5	(3-21)	W	W
Canvasback	12	(3-19)	W	W
Greater Scaup	70*	(4-14)	W	W
Lesser Scaup				
Bufflehead	2	(4-1)	W	W
Common Goldeneye	2	(3-17)	W	W
Surf Scoter	20	(3-19)	W	W
White-winged Scoter	1	(3-20)	W	W
Black Turnstone	3	(3-14)	W	M
Ruddy Duck	40	(3-19)	W	W
White-tailed Kite	2	(4-3)	R?	U,S
Red-tailed Hawk	2	(4-7)	R	U
Marsh Hawk	2	(3-19)	W?	S,U
American Kestrel	1	(4-7)	R?	U
American Coot	25	(3-20)	W or R	W,M,S
American Avocet	14	(3-17)	W or R	M
Semipalmated Plover			W	M,B
Killdeer	≈700*	(4-14)	R	M,U,B
Black-bellied Plover			W	M,B
Marbled Godwit	8	(3-19)	W	S,M
Whimbrel	6	(4-25)	M or W	S,M
Long-billed Curlew	8	(3-20)	W	S,M
(Greater Yellowlegs)	-		W or M	S,M
Willet	200	(3-19)	W	S,M
Short-billed Dowitcher	43	(4-14)	W	M
(Long-billed Dowitcher)	-		W	M,S
(Red Knot)	-		W	M
(Sanderling)	-		W	M

Species	A		B	C
(Western Sandpiper)	-		W	M
(Least Sandpiper)	-		W	M
Dunlin	67	(3-19)	W	M
(Glaucous-winged Gull)			W	M,B
Western Gull			R	M,B
Herring Gull			W	M,B
(Thayer's Gull)			W	M,B
California Gull	≈ 200*	(4-14)	W or R	M,B
Ring-billed Gull			W	M,B,W
(Mew Gull)			W	M,B,W
(Bonaparte's Gull)			W or M	M,B,W
Forster's Tern	31	(3-21)	R	W,M
Caspian Tern	7	(4-25)	S	W,M
Rock Dove	3	(3-21)	R	U
Mourning Dove	18	(4-7)	R	U
(Barn Owl)	-		R	U
(Great Horned Owl)	-		R	U
(Burrowing Owl)	-		R	U
(Short-eared Owl)	-		W	U
White-throated Swift	1	(3-28)	S	U,S
Anna's Hummingbird	1	(4-3)	R	U
Belted Kingfisher	1	(3-19)	W or R?	W
Common Flicker	2	(3-20)	R or W	U
(Say's Phoebe)	-		W	U
Barn Swallow	12	(4-25)	S	S,U
(Cliff Swallow)	-		S	U
Common Crow	8	(3-20)	R	U,M
Bushtit	14	(3-28)	R	U
Northern Mockingbird	2	(3-21)	R	U
(Water Pipit)	-		M or R	U,S
Yellow-rumped Warbler	1	(3-20)	W	U
Starling	5	(3-28)	R	U,S
Western Meadowlark	3	(3-17)	R?	U
Red-winged Blackbird	31	(4-25)	R	U,S
Brewer's Blackbird	7	(4-3)	R	U
House Finch	20	(4-3)	R	U
American Goldfinch	12	(4-3)	S or R	U
(Savannah Sparrow)	-		W	U
White-crowned Sparrow	9	(3-19)	W	U
Song Sparrow	30	(4-1)	R	U,S
Brown-headed Cowbird	1	(4-25)	R	U

[1]Notes:
Column A-Maximum Daily Count and Date.
Column B-Occurrence during year;W=winter, S=summer, M=migrant only, R=resident.
Column C-Habitat where sp. is typically found; W=water(swimming), B=breakwater, S=marsh, M=mudflat(standing), U=upland
+This is a complete list of species observed, plus a select group of species in parentheses that were not observed, but are expected to occur here. Annotated by Stephen F. Bailey.
*Scaups, Plovers, and Gulls are grouped here because specific identification in winter plumage requires expert knowledge.

Table 1. Birds of the South Richmond Marshes.

Species+	Common Name	Zones in Which it Was Found
*Spartina foliosa	Cord grass	2,3
*Salicornia virginica	Pickleweed	1,2,3
*Salicornia subterminalis	Pickleweed	2,3
*Distichlis spicata var. stolonifera	Salt grass	1,2,3
*Limonium californicum	Sea lavender	1,2,3
*Grindelia humilis	Gum plant	1,2,3
*Jaumea carnosa	Jaumea	1,2,3
*Cotula cornopifolia	Brass buttons	1,2,3
*Atriplex sp.	Fat hen	1,2,3
*Frankenia grandifolia		2
*Cuscuta salina	Dodder	1,2,3
*Spergularia macrotheca	Sand spurrey	1,2
*Spergularia marina	Sand spurrey	1,2
*Triglochin concinna	Arrow grass	1,2,3
*Parapholis incurva	Sickle grass	1,2
Scrophularia californica	Figwort	1,2,3
Rumex crispus	Curly dock	1,2,3
Rumex occidentalis	Western dock	1,2,3
Foeniculum vulgare	Sweet fennel	1,2,3
Kentranthus ruber	Red valerian	1,3
Dipsacus sativus	Fullers teasel	3
Brassica nigra	Black mustard	1,2,3
Brassica campestris	Field mustard	1,2,3
Raphanus sativa	Wild radish	1,2,3
Lobularia maritima	Sweet alyssum	1
Plantago lanceolata	English plantain	1,2,3
Lupinus arboreus	Lupine	2,3
Lupinus bicolor ssp. pipersmithii	Lupine	1
Lupinus succulentus	Lupine	1
Vicia sativa	Spring vetch	1,3
Medicago polymorpha	Bur clover	1,2,3
Lathyrus latifolius	Everlasting pea	1
Acacia decurrens	Acacia	1
Cytisus canariensis	Broom	1,3
Convolvulus arvensis	Bindweed	3
Sisyrinchium arvensis	Blue-eyed grass	3
Avena fatua	Wild oat	1,2,3
Bromus rubens	Foxtail chess	1,2,3
Phalaris aquatica	Harding grass	3
Geranium dissectum	Cranesbill	1,3
Ambrosia chamissonis	Ragweed	1,2,3
Baccharis pilularis ssp. consanguinea	Coyote bush	1,2,3
Cirsium vulgare	Bull thistle	1,2,3
Picris echioides	Ox tongue	1,2,3
Senecio vulgaris	Common groundsel	1,2,3
Silybum marianum	Milk thistle	1,2,3
Sonchus oleraceus	Sow thistle	1,2,3
Anagallis arvensis	Scarlet pimpernel	1
Phacelia californica		3
Malva nicaeensis	Mallow	1
Eschscholzia californica	California poppy	1,2,3
Mesembryanthemum chilense	Sea-fig	1,2,3
Mesembryanthemum edule	Hottentot-fig	1,2,3
Salix lasiolepsis	Arroyo willow	1,3

+Due to time limitations this list neglects many species but represents those species that best characterize the South Richmond marshes.
*Indicates species is typically associated with salt marsh communities.

Table 2. Flowering Plants of the South Richmond Marshes.

The remaining plants, occupying approximately 80 percent of the landfill, consist of grasses and weeds common to disturbed vacant lots. Wild oats, Avena fatua, foxtail chess, Bromus rubens, and the native grass Festuca megalura grow throughout. The bull thistle, Cirsium vulgare, with its fierce spines, is common in dense patches and is a favorite food of finches (Martin, 1972). This troublesome plant has a great capacity for dispersion with its wind-blown seeds. Other common inhabitants include sweet fennel, Foeniculum vulgare, iceplant, Mesembryanthemum edule, wild radish, Raphanus sativa, and English plantain, Plantago lanceolata.

Animals

The embayment formed by the breakwater and the Santa Fe landfill affords good protection for swimming birds, which dive for small fish during high tides. Lesser and greater scaups, ruddy ducks, and American coots are the most common inhabitants here. I observed up to 800 shorebirds resting on the leeward side of the breakwater while waiting for the tide to recede, when feeding typically commences. Plovers, willets, gulls, and sandpipers are very common in winter. These species would arrive in large flocks on an ebb tide and feed on the invertebrates inhabiting the mudflat. Bird numbers were generally highest on calm, sunny days; windy conditions created waves which hampered feeding activity. I counted an average of approximately 500 shorebirds each day of the 14 days of observation. Bird use climbed above 1000 on two occasions.

The song sparrow and mourning dove are the most common and obvious inhabitants of the uplands. These birds usually breed in the urban environment and come here to feed on the abundant vegetation (Stephen F. Bailey, 1982, pers. comm.). Other common upland species include the common bushtit and Brewer's blackbird. Although several species of raptors occur quite frequently in Zones 2 and 3, only the small American kestrel was regular in its hunting activities in Zone 1. An occasional marsh hawk or red-tailed hawk would briefly soar overhead in search of small mammals and birds.

Both the California jack rabbit and California ground squirrel have established local populations. I observed an average of 3 individuals of each species on each census day. The squirrels inhabit mainly the shoreline riprap and any exposed rock heap which provide safe refuge from hawks. Other mammals suspected to exist here include the pocket gopher, California meadow vole, European rat and the domestic cat and dog (URS Research, 1973).

Zone 2

Zone 2 is comprised of two distinct areas of marsh vegetation with a central mudflat. Cordgrass, Spartina foliosa, and pickleweed grow in healthy profusion behind two separate breakwaters where the marsh presumably gained its foothold and presently protects the marsh from winter storms. On the last day of observation, April 25, I counted 16 persons fishing from the smaller, westernmost breakwater. Striped bass had just then begun to enter the bay to spawn.

Cordgrass and pickleweed are about equal in abundance here, an unusual situation along the East Bay shoreline because pickleweed is typically the dominant competitor. Two species of pickleweed are found: Salicornia virginica and S. subterminalis. S. subterminalis generally grows in the transition zone between Spartina foliosa and S. virginica.

In addition to those marsh plants found in Zone 1, Zone 2 species include brass buttons and marsh dodder, Cuscuta salina. Zone 2, like Zone 1, lacks the transitional plant stage between marsh and upland. Coyote bush, figwort (Scrophularia californica), gum plant and wild oats commonly occupy the riprap railroad levee which abuts the marsh proper.

The central mudflat supports a shorebird population similar to that in Zone 1, although approximately one-half the number. But shorebirds frequently shuttle back and forth between the two mudflats during low tides and the relative number of shorebirds that each contains can change considerably. Zone 2 supports a larger variety of dabbling and diving ducks. These birds feed in the tide channels that course through the marshes. Mallard, American coot, surf scoter, and canvasback along with the great and snowy egrets often feed here. The California ground squirrel, skunk, and a raccoon (dead) were the only mammals observed in Zone 2.

Zone 3

Zone 3 is composed of two marshes separated by landfill. The marsh flora found here suffers from poor tidal exchange and circulation. Each marsh has a freshwater inlet from inland sources and each receives tidal water from a breach in the railroad levee. Brackish conditions prevail where the freshwater meets the marsh. Cattails (Typha latifolia), bullrushes, and brass buttons grow along the perimeter of the marsh where these conditions exist. Extensive stands of low quality cordgrass and saltgrass, apparently in good health, grow in the central marsh. The saltgrass is well adapted to the low water circulation and related high salinity soils.

Shorebirds are infrequently found here. Egrets, willets, and killdeers are casual visitors. Mallard, bufflehead, and common goldeneye also occasionally visit the two main tide channels. The belted kingfisher is the only water bird I found in Zone 3 that did not occur elsewhere. It hunts for fish by hovering above the tide channels, swiftly diving into the water when prey is sighted.

Upland bird species are relatively abundant. The presence of several species of raptors distinguishes this area from all other marshes along the East Bay shoreline. The red-tailed hawk, marsh hawk, white-tailed kite and American kestrel frequently patrolled the grassy uplands. A large stand of mature eucalyptus trees on the University property adjacent to the marsh is the current roost for all of these birds. The marsh hawk is the most frequent visitor to the salt marsh; the other predatory birds hunt predominately on the surrounding upland areas, although I did observe the kite make one kill among the pickleweed. Other upland bird species that are common here include the common crow, red-winged blackbird and barn swallow.

Zone 3 contains all mammals that were reported for Zones 1 and 2. In addition, I believe the endangered Salt Marsh Harvest Mouse (SMHM) could exist in the marsh adjacent to the University Field Station. I discovered several mice nests among the shoreline debris and one mouse was sighted but not confirmed as a SMHM. A central, narrow island could offer refuge for these mice from excessive high tides. Dave Olsen's paper considers the SMHM in greater detail.

Discussion

Life in the South Richmond Marsh, like that in all other marshes around San Francisco Bay, revolves around the semi-diurnal tides, with shorebirds generally feeding on the ebb tide. As the tide begins tis ebb flow, bird species sequentially replace one another as different benthic prey species become available (Stephen F. Bailey, 1982, pers. comm.). The number of bird species feeding on a given mudflat at a given time belies the actual number of species that use the mudflat in question. Because species will feed at different times in relation to one another and in specific locales depending on their morphological adaptations, competition is reduced (Stephen F. Bailey, 1982, pers. comm.).

A notable feature of these marshes is the variety of habitat available. Birds frequently fly from one area to another to exploit the varying food resources as they are uncovered by the tides. For example, during the stages of high tide, willets would feed among the thick growth of pickleweed in the Hoffman Marsh. As

the tide receded, groups of willets would proceed to the outboard marshes and feed along the cordgrass/mudflat edge which had been previously flooded.

The benefit to shorebirds of having a variety of habitats available, in this case several distinct mudflats and marshes, is that prey populations can be locally high in one area and shorebirds can concentrate feeding there. Prey diversity composition may also vary among habitats and support a more diverse bird population. The important point here is that wildlife populations can best be served by maintaining as many diverse habitats as possible.

Hazards to the Marsh

There are several present and future areas of concern regarding the marshes in South Richmond. Presently, illegal debris dumping occurs quire regularly. Besides offending one's sense of sight and smell, it destroys marsh flora. Vehicles have access to the Santa Fe landfill via the railroad bridge that spans the Hoffman Marsh tide channel. Trucks, and especially motorcycles, frighten wildlife and damage vegetation. There are no signs posted barring vehicles from access. This tends to imply that access is permitted by default.

Shooters with .22 caliber rifles, air rifles, and bows and arrows also frequent the marshes. On one particular day I had to duck down to avoid rifle bullets whistling over my head. This is an obvious threat to public safety, not to mention the animals that are caught in a hunter's sights. The Richmond municipal code bans all shooting and the hunting of wildlife in this area, but enforcement of the law is minimal due to the isolated nature of the marshes.

Future concerns include an increase of public usage. I estimate that 10 people per day visited the marshes during my observation period. On several occasions no one was sighted. The City of Richmond has plans for changing this sparse visitor use by allowing construction of high density residential units adjacent to the northwest border of the marsh (Marshal Walker, 1982, pers. comm.). Plans call for an interpretive center and the possible removal of the railroad track to allow for a pedestrian trial to be built upon the levee, with the marsh becoming a park. In addition, the Richmond Special Area Plan states that the large, 90 degree breakwater (FIGURE 2) offers good potential for a public fishing site (South Richmond Shoreline, 1977). This breakwater is now accessible to humans only at low tide, and then only with difficulty because of the soft mud. The interpretive center and pathway are a positive step toward park development, but I feel that public fishing should be confined to the smaller, western breakwater. Since large

numbers of wintering shorebirds use the larger breakwater for resting, human access should not be allowed.

Conclusion

In terms of shorebird use, the South Richmond marshes are surpassed only by the Emeryville Crescent and Albany Mudflat along the East Bay shoreline. In terms of salt marsh acreage, only the Emeryville Crescent is superior. For these reasons alone, the South Richmond marshes must figure prominently in an integrated East Bay Shoreline Park plan.

All things considered, the South Richmond marshes are on fairly stable ground, ecologically speaking. The Special Area Plan recognizes the area's potential for park development and the East Bay Regional Park District would provide the means for doing so. Brooks Island already enjoys the protection afforded by the Park District but has not yet been opened to the public.

Under the Park District's management, vehicles would not longer have access, thus preventing debris dumping, off-road vehicles and motorcycles. The presence of park personnel and information centers would benefit the public and effectively discourage hunters from harassing wildlife (Nelson, 1982, pers. comm.).

I would like to close and sum up my feelings about "development" in general by quoting from the late ecologist, Aldo Leopold. In his book, A Sand County Almanac, Leopold writes, "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold, 1949, p. 224).

REFERENCES CITED

Adsit, John M., Dec. 1, 1977. U.S. Army Corps of Engineers, San Francisco District, Findings of Fact concerning proposed fill by Santa Fe Land Improvement Co. (#11585-47).

Bailey, Stephen F., Senior Ornithologist, Golden Gate Audubon Society; Museum of Vertebrate Zoology, pers. comm., 1982.

California Department of Transportation, 1980. Final Environmental Impact Statement, Hoffman Corridor, Volume 1: San Francisco, California, 204 pp.

Goodson, L. Frank, Aug. 10, 1977. Letter from the Resources Agency of California to the Army Corps of Engineers, San Francisco District, concerning Public Notice No. 11585-47.

Leopold, Aldo, 1949. A Sand County Almanac: New York, Oxford University Press, 226 pp.

Martin, Alexander C., 1972. Weeds: New York, Golden Press, 160 pp.

REFERENCES CITED

(continued)

Munz, P.A., and D.D. Keck, 1959. A California Flora: Berkeley, California, University of California Press, 1681 pp.

Nelson, Christian, Chief of Parks and Information, East Bay Regional Park District, pers. comm., 1982.

Paul, W.L., Feb. 28, 1977. Santa Fe Land Improvement Co.'s fill permit application to the Army Corps of Engineers, San Francisco District, number 11585-47.

San Francisco Bay Conservation and Development Commission and the City of Richmond, 1977. Final Environmental Impact Report on the Special Area Plan for the South Richmond Marshes: Richmond, California, 108 pp.

South Richmond Shoreline Special Area Plan Citizens Advisory Committee, 1977. South Richmond Shoreline Special Area Plan: Richmond, California, 114 pp.

URS Research Co., 1973. Marine Environmental Impact Analysis, Widening Highways 17 and 80 Along Shoreline of Richmond, California: California Department of Transportation, 150 pp.

Walker, Marshal, Urban Planner, City of Richmond, pers. comm., 1982.