



Biological Foundations of the San Francisco Bay Joint Venture

US COASTAL SURVEY, 1857

Transforming the Landscape

Before the mid-1800s, the San Francisco Bay was **B**ringed by roughly 190,000 acres of tidal marshes, 50,000 acres of tidal flats, 85,000 acres of seasonal wetlands and associated uplands (including vernal pools), and over 69,000 acres of riparian habitat, as illustrated in **Figure 2-1**, (Historical View of San Francisco Bay, circa 1770–1820). The San Francisco Bay and its adjoining watersheds was one of the richest and most diverse estuaries on the West Coast; it supported populations of fish and wildlife that today seem unimaginable. Early reports of the Bay Area describe vast expanses of wetlands inhabited by millions of waterfowl, schools of salmon so dense that they choked the mile-wide Carquinez Strait, and plentiful numbers of grizzly bears and other big game animals.

Since the late 1800s, the growth of the human population has effected traumatic changes to the natural landscape of the Bay Area. Large tracts of tidal marshes have been filled for urban development or federal and state projects, or diked for salt production or agriculture. Today, only 40,000 acres of tidal marsh remain, as shown in **Figure 2-2**, (Modern View of San Francisco Bay, circa 1998). Much of what remains has been degraded, and less than three percent of original wetland acreage is in relatively pristine condition (*State of the Estuary Report 1992–1997*). Development pressures have

destroyed or significantly altered over 80 percent of the tidal marshes and 40 percent of the mudflats that once rimmed two-thirds of the Bay's shores. During this same period, riparian areas, seasonal wetlands, vernal pools, native grasslands, and coastal scrub have all suffered similar, if not greater, losses due to development pressures.

The destruction or alteration of wetlands is not limited to the forces of urbanization. Pollution, sedimentation, and water diversion have degraded the health of the surviving wetlands. Historic influences such as hydraulic mining also play a role, and their impacts can be persistent over time. The Gold Rush-era mining of the mid-1800s sent enormous sediment loads into the Bay, causing changes in habitat type and location, particularly of mudflats in the North Bay. What remains of the Bay ecosystem is further stressed and modified by the impacts of freshwater diversions for urban uses around the Bay, and agricultural and urban uses in the Central Valley and southern California. Up to 70 percent of the freshwater flows that would naturally enter the Bay through the San Joaquin and Sacramento River Systems is now diverted. This has increased the net salinity of the Bay with a consequent alteration of the plant and animal species residing in many wetland communities. Local land uses have played direct and indirect roles in damaging wetlands: the footprint of new buildings still displaces them; sediment loads and erosion caused by development degrade them. Stormwaters contaminated by auto-

Figure 2-1
Historical View of San Francisco Bay (circa 1770–1820)

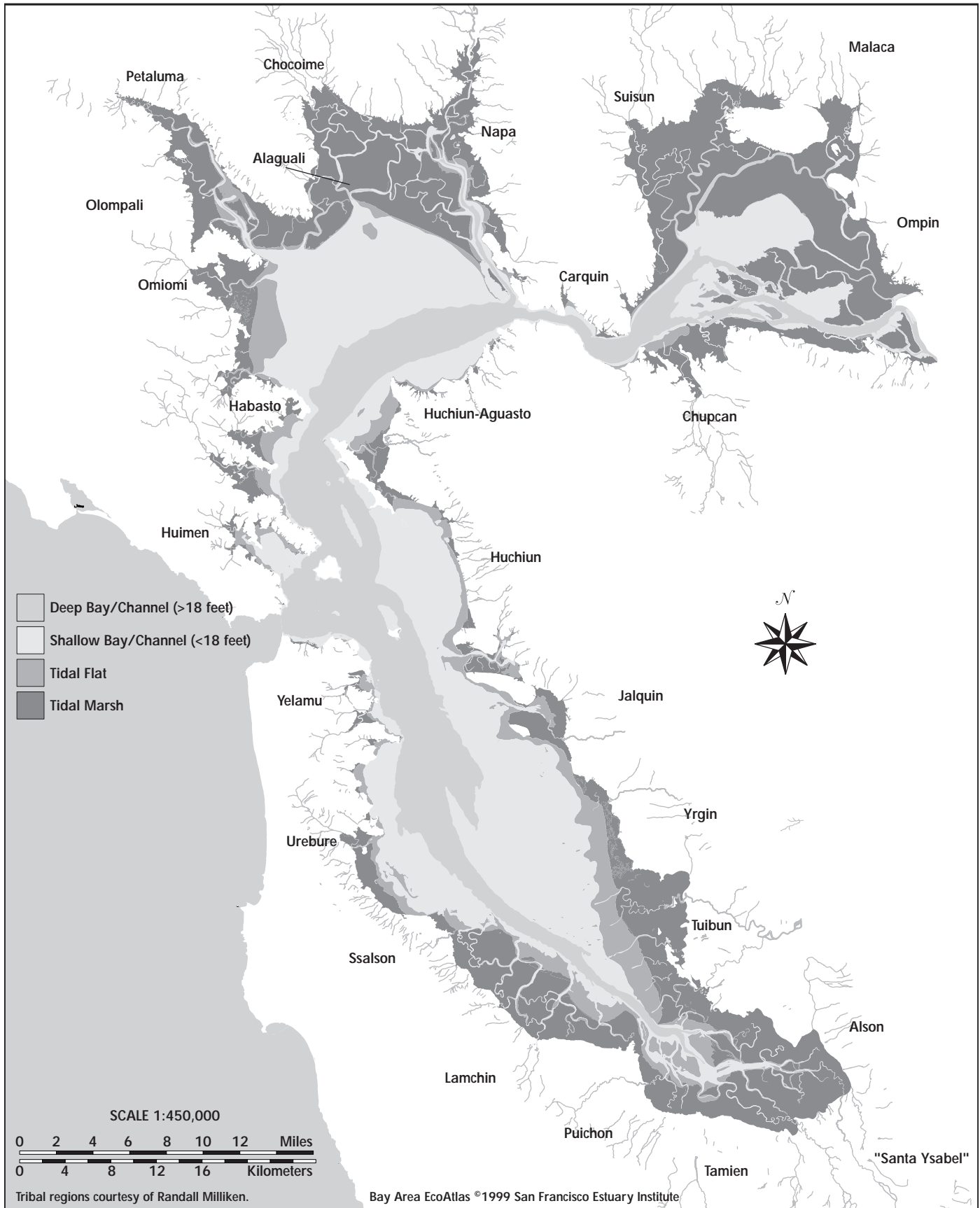
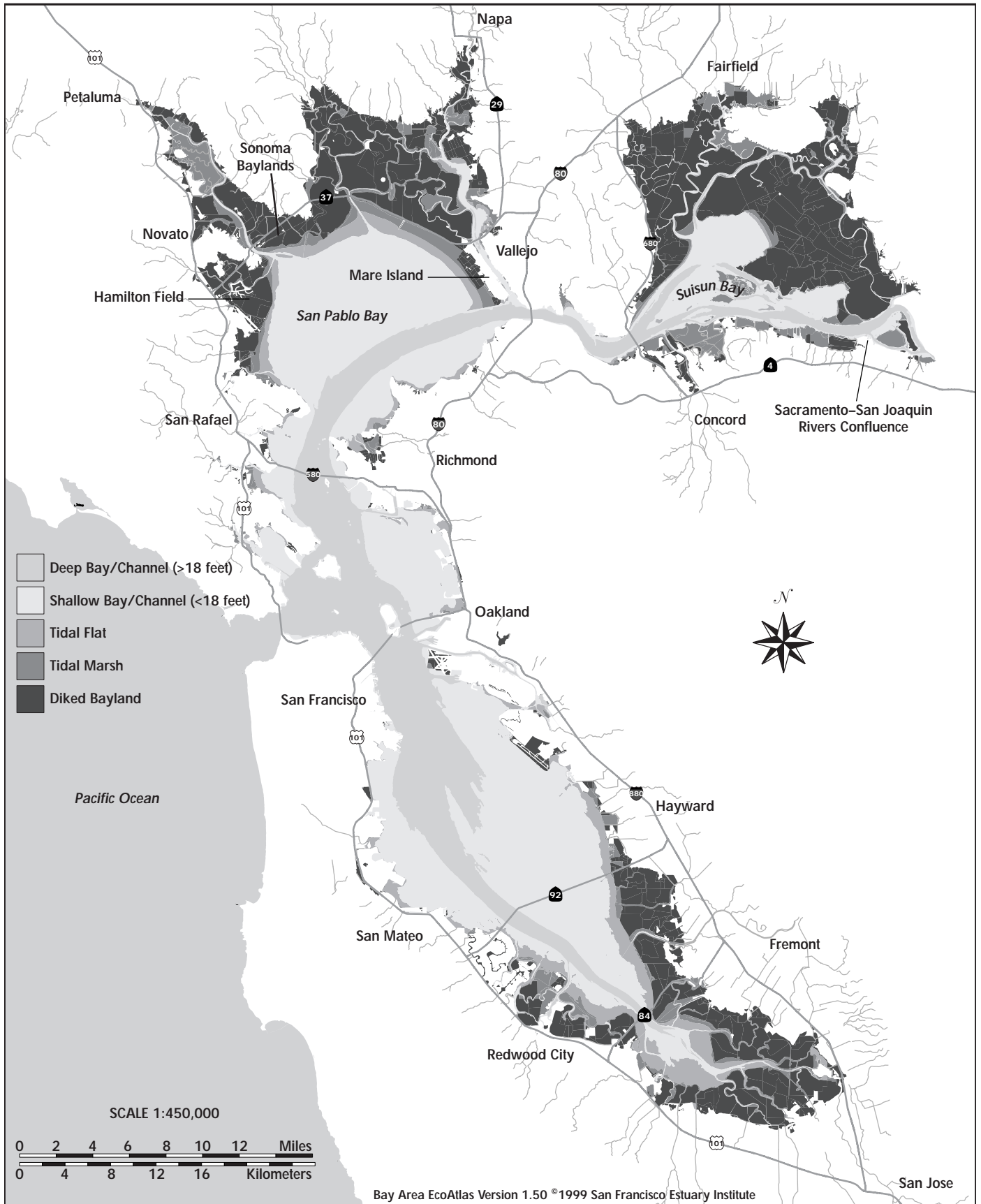


Figure 2-2
Modern View of San Francisco Bay (circa 1998)



motive metals, pesticides from lawns, and high bacterial counts continue to stress wetlands and pollute the Bay.

Such drastic impacts to the Bay's wetland ecosystem have put fish and wildlife populations, as well as the ecological health of the Bay, at risk. Most of the threatened and endangered species, and almost all of the commercial and recreational fish species in San Francisco Bay depend on wetland and riparian habitat. Numerous adult and juvenile fish species that are dependent on tidal marshes, such as Chinook salmon and delta smelt, have declined dramatically due to the loss of habitat. The loss of a once-thriving fishing industry has also severely impacted the economies of numerous Bay cities.

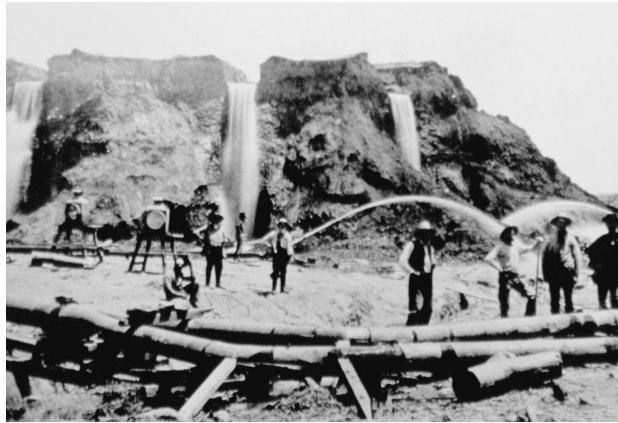
Wetland losses and degradation would have been even more severe were it not for state and federal regulations, active public and nonprofit acquisition programs, and increased public awareness. The protection and enhancement of wetlands and riparian corridors has been given a tremendous boost with the growth of watershed planning efforts that bring diverse stakeholders together. Approximately 16,300 acres of wetlands were permanently protected in the Bay region between 1992 and 1999. In addition, about 9,040 acres of degraded or former wetland were restored and enhanced during this period of time. (CCMP Workbook, 1996; SFBJV, 1999) While these figures are encouraging, much of the reported acreage is submerged tideland and represents a fraction of the potential. There is a tremendous amount of protection, restoration, and enhancement work remaining for wetlands, riparian areas, and associated uplands.

The establishment of the SFBJV was hastened by the growing realization among all parties that immediate action is needed. The costs of acquiring



Dredging channels and levees have dramatically altered the face of the Estuary and armored its margins.

COURTESY OF BANCROFT LIBRARY, UC BERKELEY



Hydraulic mining in the Sierra foothills during the Gold Rush sent vast amounts of sediment downstream and into San Francisco Bay.
COURTESY OF BANCROFT LIBRARY, UC BERKELEY

and restoring the remaining wetlands of San Francisco Bay have skyrocketed over the past decade, and are likely to continue to climb. Restoration work, which often meant only breaching a dike, now may cost from \$4,000 to \$20,000 per acre, given the need for extensive grading, planting, new dike construction, or temporary irrigation.

Wildlife of San Francisco Bay

Waterfowl Use of the San Francisco Bay Area

The San Francisco Bay Area is one of the most important coastal wintering and migrational areas for Pacific Flyway waterfowl populations. Significant numbers of the Pacific Flyway scaup (70%), scoter (60%), canvasback (42%), and bufflehead (38%) were located in the San Francisco Bay/Delta. According to 1998 California Fish and Wildlife surveys, San Francisco Bay held the majority of California's 1999 wintering scaup (85%), scoter (89%), and canvasback (70%) populations. More than 56 percent of the State's 1999 wintering diving ducks were located in the San Francisco Bay proper, which includes the salt ponds and wetlands adjacent to the North and South Bays. Although the San Francisco Bay is most recognized for its importance to diving ducks, large numbers of dabbling ducks like pintail (23,500) and wigeon (14,000) were observed during the 1999 mid-winter waterfowl survey. For a more detailed analysis of winter waterfowl surveys for the San Francisco Bay Area, see **Appendix F**.

Regionally, the greatest variation observed in waterfowl numbers between years and seasons



The San Francisco Bay is a key wintering and stopover area along the Pacific Flyway.

US FISH AND WILDLIFE SERVICE

was in Suisun Bay, followed by the North Bay and North Bay salt pond regions. Waterfowl use was most consistent in the Central and South Bays, with some variation in the South Bay salt pond region. The greater range of waterfowl use of the

North Bay may be due to the variability of salinity and the presence of wetlands in the adjacent delta. San Pablo Bay and Suisun Bay are greatly influenced by outflows from the Sacramento and San Joaquin Rivers.



Canvasbacks take flight on Suisun Marsh.

CENTRAL VALLEY HABITAT JOINT VENTURE, 1995

Waterfowl production in the San Francisco Bay Area is typically limited to small numbers of mallards, gadwalls, northern pintails, cinnamon teals, and ruddy ducks. Tidal marshes, diked wetlands, and seasonal wetlands are the primary habitats of nesting waterfowl. In addition, Canada geese have nested in the area in recent years.

The San Francisco Bay is of particular importance to the future of canvasback and other diving duck populations of the Pacific Flyway. San Francisco Bay wetlands can—if protected, restored, and enhanced—play a significant role in meeting NAWMP's overall objective of providing diverse habitats and spreading waterfowl populations over large geographical areas.

Other Important Species in the San Francisco Bay Area

Wetlands and adjoining uplands in the San Francisco Bay Area provide habitat critical to the survival of almost 50 endangered and threatened species (26 animal and 22 plant species) protected by the federal or State Endangered Species Acts. See **Table 2-1** for a complete list of federal and state protected species found in and around the Estuary.

In addition to state and federally listed species, the Bay Area is home to 16 fish and wildlife species and 13 plant species associated with wetlands that are candidate or proposed candidate species for federal endangered or threatened status. Of the fish and wildlife species, 15 of 16 candidates are associated

with wetlands. Enhancement and restoration of wetlands throughout the region will benefit the populations of most of these species.

The number of special-status species resident in or using Bay wetlands demonstrates the crucial importance of these areas, their level of degradation, and the overwhelming need to hasten restoration efforts.

Shorebirds. Shorebirds are among the most conspicuous wildlife of the North and South bays. Thirty-eight species of wintering and migratory shorebirds were found in the

Bay between 1988 and 1995 on surveys performed by the Point Reyes Bird Observatory (PRBO). Total numbers of shorebirds on these surveys ranged from 340,000–396,000 in the fall, 281,000–343,000 in the winter, to 589,000–838,000 in the spring. Approximately two-thirds of the migrating and wintering shorebirds occurred in the South Bay.

According to the United States Shorebird Conservation Plan, San Francisco Bay is used by higher proportions of wintering and migrating shorebirds within the U.S. Pacific coast wetland system than any other coastal wetland. Depending on the season, San Francisco Bay accounted for the following percentages of shorebirds in the wetlands of the contiguous U.S. Pacific Coast on the PRBO surveys: black-bellied plover, 55–62%; semipalmated plover, 40–52%; black-necked stilt, 58–90%;



Black-necked stilts are among the many shorebirds that winter in the San Francisco Bay Estuary.

MARK RAUZON

Table 2-1

Threatened and Endangered Species of the San Francisco Bay Estuary

Plant and animal species listed under the Federal and/or State Endangered Species Acts

| Species (T=Threatened, E=Endangered) | Scientific Name |
|---|---|
| Mammals | |
| Salt marsh harvest mouse (E) | <i>Reithrodontomys raviventris</i> |
| Steller sea lion (T) | <i>Eumetopias jubatus</i> |
| Birds | |
| Tule greater white-fronted goose (T) | <i>Anser albifrons gambelli</i> |
| California brown pelican (E) | <i>Pelecanus occidentalis</i> |
| Western snowy plover (T) | <i>Charadrius alexandrinus nivosus</i> |
| California clapper rail (E) | <i>Rallus longirostris obsoletus</i> |
| California black rail (T) | <i>Laterallus jamaicensis corturniculus</i> |
| California least tern (E) | <i>Sterna antillarum browni</i> |
| Aleutian Canada goose (T) | <i>Branta canadensis leucopareia</i> |
| Amphibians and Reptiles | |
| San Francisco garter snake (E) | <i>Thamnophis sirtalis tetrataenia</i> |
| Giant garter snake (T) | <i>Thamnophis gigas</i> |
| California red-legged frog (T) | <i>Rana aurora draytonii</i> |
| Fish | |
| Chinook salmon (E) | <i>Oncorhynchus tshawytscha</i> |
| Coho salmon (T) | <i>Oncorhynchus kisutch</i> |
| Steelhead (E) | <i>Oncorhynchus mykiss</i> |
| Sacramento splittail (T) | <i>Pogonichthys macrolepidotus</i> |
| Tidewater goby (E) | <i>Eucyclogobius newberryi</i> |
| Delta smelt (T) | <i>Hypomesus transpacificus</i> |
| Invertebrates | |
| Behren's silverspot butterfly (E) | <i>Speyeria zerene behrensii</i> |
| California freshwater shrimp (E) | <i>Syncaris pacifica</i> |
| Conservancy fairy shrimp (E) | <i>Branchinecta conservatio</i> |
| Myrtle's silverspot butterfly (E) | <i>Speyeria zerene myrtleae</i> |
| Callippe silverspot butterfly (E) | <i>Speyeria callippe callippe</i> |
| Delta green ground beetle (T) | <i>Elaphrus viridis</i> |
| Valley elderberry longhorn beetle (T) | <i>Desmocerus californicus dimorphus</i> |
| Vernal pool fairy shrimp (T) | <i>Branchinecta lynchi</i> |
| Vernal pool tadpole shrimp (E) | <i>Lepidurus packardi</i> |
| Plants | |
| Suisun thistle (E) | <i>Cirsium hydrophilum hydrophilum</i> |
| Soft bird's-beak (E) | <i>Cordylanthus mollis mollis</i> |
| Kenwood Marsh checkermallow (E) | <i>Sidalcea oregana valida</i> |

Source: Baylands Habitat Goals, (1999); Life on the Edge, (1995)

American avocet, 86–96%; greater yellowlegs, 26–41%; willet, 57–69%; long-billed curlew, 45–65%; marbled godwit, 46–68%; red knot, 39–76%; western sandpiper, 54–68%; least sandpiper, 39–73%; dunlin, 24–38%; and dowitcher, 49–72%.

Tidal flats, salt ponds, diked seasonal wetlands, grazed uplands and, to a limited extent, salt marshes are the chief habitats of shorebirds at the San Francisco Bay. Species making the heaviest use

of tidal flats include black-bellied plover, willet, long-billed curlew, marbled godwit, western sandpiper, least sandpiper, dunlin, and short-billed dowitcher. Species making heaviest use of salt ponds include snowy plover, black-necked stilt, American avocet, northern phalarope, and Wilson's phalarope. Black oystercatchers nest on the rocky shores of some islands in the Bay. Snowy plover, federally listed as a threatened species, killdeer, black-necked stilt, and



Least bittern

SAN FRANCISCO BAY JOINT VENTURE

American avocet nest in the salt ponds. Killdeer, black-necked stilt, and American avocet also nest in the managed diked marshes of Suisun Bay.

Because of the great shorebird numbers, the Western Hemisphere Shorebird Reserve Network has classified San Francisco Bay as a site of “Hemispheric Importance” for shorebirds—the highest possible ranking.

Marsh Birds, Gulls, and Terns. The San Francisco Bay Estuary provides nesting habitat for a variety of marsh birds including snowy egret, great egret, black-crowned night heron, great blue heron, and California clapper rail. In 1990, it was estimated that 350 pairs of great egrets were breeding in the San Francisco Bay, along with 160 breeding pairs of great blue herons.

California clapper rails, a Federally listed species currently found only in San Francisco Bay, are among the most inconspicuous wildlife of the North and South bays, but are a good indicator of the health of Bay wetlands. Clapper rails occur primarily in emergent salt and brackish tidal marshlands having intricate networks of slough channels, and vegetation dominated by pickleweed and Pacific cordgrass. The total population size is currently estimated at around 1,200. Clapper rails were formerly more numerous and ranged more widely.

Numerous human-related factors over the past 150 years have caused their decline. These include hunting in the late 1800s and, more recently, predation by non-native predators and habitat loss. Presently, California clapper rail populations are restricted to fragmented marshes that are small in size, and lack a significant transition zone to terrestrial habitat that would buffer them from nearby urban and industrial development. Habitat goals calling for the restoration of significant amounts of tidal salt marsh habitat in the Bay would immediately and directly benefit clapper rails by allowing movement of individuals between isolated populations and recolonization of unutilized habitat.

An extensive variety of other “colonial nesting birds” are common in the San Francisco Bay Estuary. These include western gull, California gull, Forster’s tern, Caspian tern, and double-crested cormorant.

Raptors. Marshes, tidal flats, and grasslands provide excellent feeding habitat for the northern harrier and other raptors. Other wetland-associated raptors include merlin, peregrine falcon, red-tailed hawk, short-eared owl, black-shouldered kite, and burrowing owl. The bald eagle is rare, but it nests near reservoirs and lakes, and preys on waterfowl and coots. Loss of habitat is an enormous threat to raptors in the Bay Area.

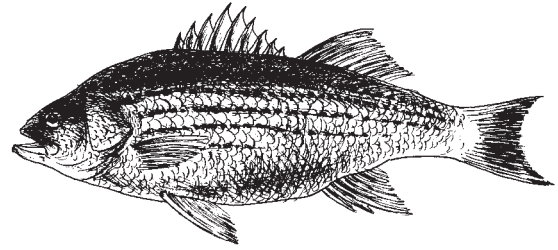
Other Marine Birds. Open waters, large lakes, and salt ponds provide habitat for loons, pelicans, and grebes. Grebes found in the study area are the pied-billed grebe, eared grebe, horned grebe, Clark’s grebe, and western grebe. Large open-water habitats of the Estuary such as bays, lagoons, salt ponds, and diked habitats are fall and winter habitats for California brown and the American white pelicans.

Migratory Songbirds. Over 50 species of songbirds make use of the remnant riparian zones around the Bay. Among them are flycatchers, sparrows, thrushes, woodpeckers, warblers, vireos, and swallows. Salt, brackish, and freshwater marshes house the salt marsh yellowthroat. Song sparrows utilize tidal salt and brackish marshes, and the tricolored blackbird is a resident of freshwater wetlands. These birds are also affected by habitat loss; the number of tricolored blackbirds has diminished by 89 percent since the 1930s, and only 6,000 pairs of Suisun song sparrow remain in the Bay Area.

Mammals. The most abundant marine mammal associated with wetlands and deepwater habitats of the Estuary is the harbor seal. This species uses tidal salt marshes and mudflats for breeding and hauling out, and deepwater habitats for foraging. The sea lion is another important marine mammal of the San Francisco Bay, while elephant seals and humpback whales are significant species of the San Francisco/San Mateo coast. Tidal marshes provide habitat for the Suisun shrew, salt marsh wandering shrew, and salt marsh harvest mouse.

Amphibians and Reptiles. Inhabiting Delta channels, small rivers, creeks, lakes, ponds, and seasonal wetlands are a wide variety of amphibians and reptiles. Several federally and/or state listed species are among them, including the California tiger salamander and the California red-legged frog. Among listed reptiles dependent on riparian habitat is the San Francisco garter snake; other riparian residents include the striped racer and the western pond turtle.

Fish and Shellfish. Wetlands and deep waters of the study areas provide important habitat for a wide variety of fish and shellfish. Salt marshes and shallow water areas provide habitat for larval, juvenile, and adult fishes and shellfish including shiner perch, top smelt, staghorn sculpin, striped bass, and bay shrimp. Intertidal and sub-tidal areas of the North Bay serve as important spawning areas for Pacific herring. Important commercial and sport fishes that utilize deepwater habitats



Striped bass

LEE ADAIR

include northern anchovy, starry flounder, striped bass, king salmon, sturgeon, steelhead, and American shad.

Benefits of Wetland Restoration and Enhancement

Wetlands and riparian areas in the Bay Area are important oases of life set against the backdrop of the arid west. However, the value of wetlands and riparian habitats extends beyond the animal and plant communities they support. And while these are profoundly important, as the prior chapter suggests, there are a myriad of other supportive functions that magnify their significance. These complementary values underscore the rationale and need for protecting and restoring wetlands. Riparian and wetland habitats play key roles in maintaining both a healthy ecosystem and an economically vibrant region. Among these vital “ecological services” are their capacity to absorb or buffer floodwaters, cleanse pollutants from runoff, reduce sediment loads in runoff, recharge overdrawn groundwater supplies, and contribute to a community’s identity and recreational amenities. Wetlands offer a broad range of non-biological benefits that include:

- **Reduced flood damage.** Wetlands can not only serve as biofilters but can also slow down and soak up water that runs off the land. This capacity can lower the volume of floodwaters and diminish flood heights, thereby reducing shoreline and stream bank erosion. Preserving natural wetlands can reduce or eliminate the need for expensive flood control structures.
- **Economic values—Food and related industries.** The vast majority of our nation’s fishing and shellfishing industries harvest wetland-dependent species. This catch is valued at \$15 billion a

Dungeness crab (*Cancer magister*)

JOHN INASE

year. The economic benefits of wetlands also extend to other forms of commercial harvesting—in the case of the South Bay, shell mining. The South Bay formerly had one of the nation's most productive oyster beds, its harvest serving much of the West Coast.

- **Water quality enhancement.** Wetlands can help improve water quality by filtering nutrients, organic particles, and sediment carried by runoff. Many chemicals—fertilizers, human and household wastes, toxic compounds—are tied to sediments that can be trapped in wetlands. Plants and biological processes in wetlands break down and convert these pollutants into less harmful substances.
- **Increased groundwater availability.** Wetlands can absorb water during and after rainfall. Some of this precipitation percolates into the groundwater supply. Hence, wetlands often do the vital job of recharging groundwater by passively “banking” water for use at a later date.
- **Recreation.** Wetlands also contribute to the economy through recreational activities such as fishing, hunting, and bird watching. It is estimated that the annual economic value of wetlands statewide in California is between \$6.3 and \$22.9 billion



Family fishing at Marin Headlands

DON COPPOCK

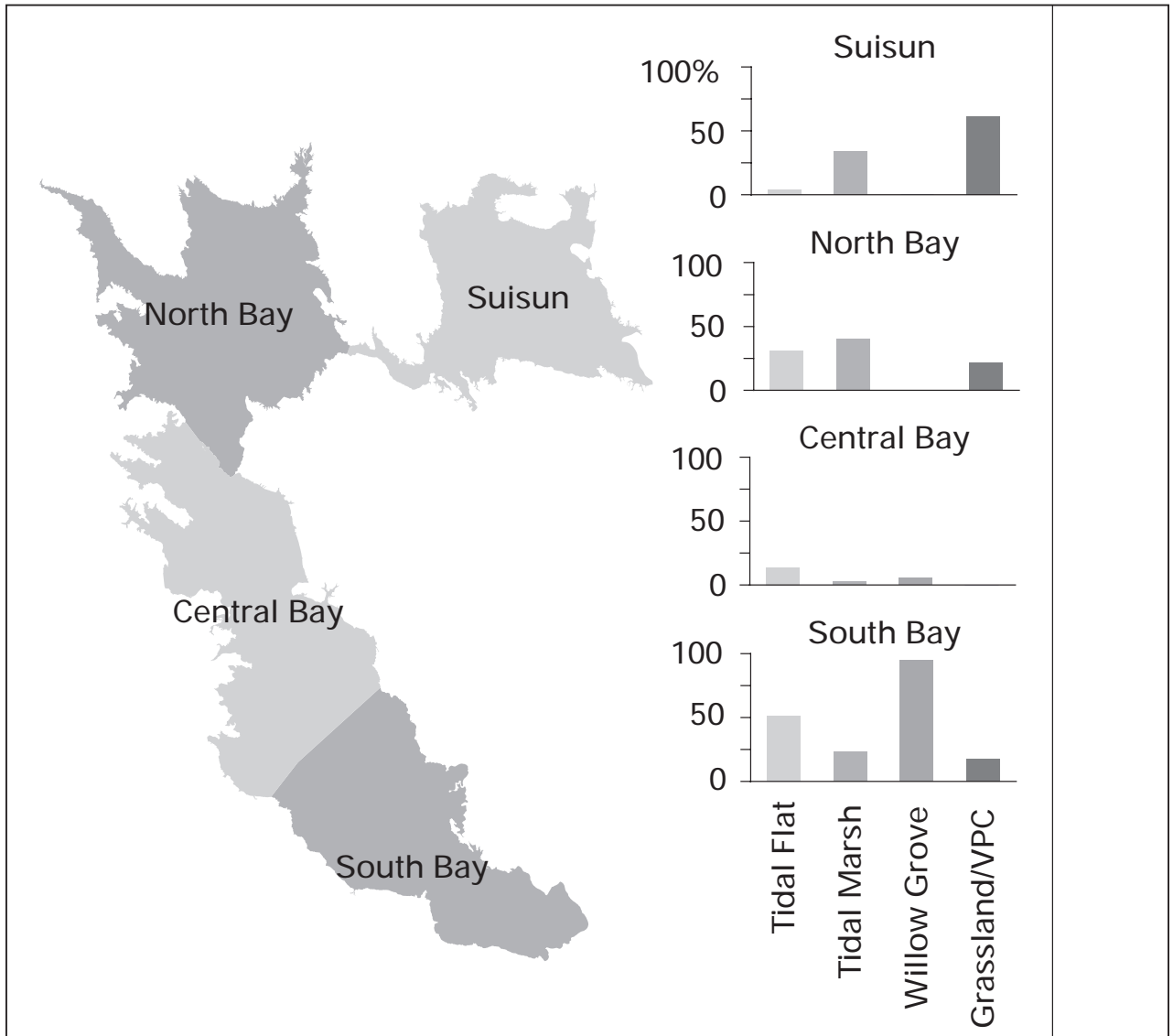
(*Habitat Goals*, page 31). The 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation reported that 3.1 million adult Americans hunt migratory birds including geese, ducks, doves, and other game birds. Nationwide it is estimated that hunters spend about \$1.3 billion on travel, equipment, and other associated expenses.

- **Aesthetic and scenic values.** The natural beauty and solitude of wetland areas provide opportunities for bird watching, wildlife photography, painting, hiking, and simply relaxing while appreciating the wonders of nature. Wetlands are a vital part of lives, providing a peaceful place to reflect while offering respite from everyday stresses.
- **Education and research.** Tidal, coastal, and inland wetlands of the Bay Area provide educational opportunities for nature observation and scientific study.
- **Historic and archaeological values.** Some wetlands are of archaeological interest. In the San Francisco Bay region Indian settlements were often located in coastal and inland wetlands, especially at the mouths of creeks. Estuaries were rich sources of fish and shellfish.
- **Community identity and vitality.** The presence of wetlands in a city or town strengthens its sense of identity and place. Wetlands and creeks help to give positive and vivid definition to a community, offering tangible indicators of the “quality of life” values that are increasingly important to the residents of a growing metropolis, yet are degraded by the homogenizing effects of urban sprawl. Likewise, they help define the urban edges by providing physical separators between towns. Collectively, they confer a natural character and presence within an urban area. Wetlands are essential to the identity and vitality of the Bay region and its continued desirability as a place to live and work.
- **Estuary support.** Wetlands provide important nutrients to near-shore waters from decomposing vegetation, which provides support for coastal food webs.

Subregional Characteristics

As previously described, the SFBJV has divided its geographic scope into five subregions: Suisun, North

Figure 2-3
Habitat Types by Subregion



Source: Bay Area EcoAtlas Modern View ©1999 SFEI

Bay, Central Bay, South Bay, and the San Francisco/San Mateo Coast (Figure 1-1). These subregions coincide with those used by the Habitat Goals Project, with a few exceptions. The fifth subregion is the San Francisco/San Mateo Coast.

The subregions vary greatly in their habitat composition. In general, the North Bay and Suisun Subregions have the greatest areas of tidal marshes and moist grasslands/vernal pools, together possessing more than 70 percent of the region's habitats of these types. The South Bay contains the overwhelming majority of riparian willow groves, and about 50 percent of the mudflats. **Figure 2-3** summarizes the subregional distribution of the estuary's major habitat types.

The following section provides a geographic and ecological overview of each of these five subregions, focusing on characteristics and status of their habitats.

North Bay Subregion

The North Bay subregion consists of the submerged lands, wetlands, and uplands of San Pablo Bay. It is bounded to the east by the Carquinez Strait, which connects it to the Suisun subregion just upstream. Downstream it abuts the Central Bay subregion at Point San Pedro. The boundary climbs to the ridgeline of the East Bay hills and follows the ridgeline of

the watersheds draining north to the Carquinez Strait (a line roughly parallel to and north of Highway 24). Its major watercourses include the Napa River, Sonoma Creek, Petaluma River, Novato Creek, and Gallinas Creek. This subregion includes all of Solano County, and portions of Marin, Sonoma, Napa, and Contra Costa Counties.

Historically, this subregion was characterized by broad expanses of shallow bays and brackish tidal marshes that received substantial amounts of runoff from many local streams draining narrow valleys between ridges of low hills. Major creeks and rivers also ran to the Bay and still do. These include the Petaluma and Napa Rivers in Sonoma and Napa counties, Green Valley Creek in Solano County, and Walnut, Wildcat, and San Pablo creeks in Contra Costa County. The uplands and the relatively flat lands near the Bay often have a high clay content, providing soils suitable for grasslands and oak savannas.

There have been significant changes to the landscape of the North Bay, as elsewhere in the Bay Area. Most of the tidal marsh that once ringed the North Bay has been converted to farmlands or salt ponds. The riparian habitat and water quality of creeks have been degraded by many decades of grazing and woodcutting, but many riparian restoration projects are under way to reduce erosion and enhance habitat values within a farming context. Restoration of major floodplains, such as that of the Napa River, is an emerging hallmark of this region, with even larger projects contemplated in the future. The Bay margins of Marin present significant opportunities to restore diked baylands to tidal

action. There are several thousand acres of potential salt marsh restoration among the “Marin Baylands.” The former Hamilton Airfield is presently being restored to marshlands. This scale of renewing wetlands within a metropolitan context is unprecedented. Other Marin Baylands also present unique conservation opportunities—particularly as component sites in the expansion of the San Pablo Bay National Wildlife Refuge. The Fish and Wildlife Service is moving forward on plans for this proposed expansion.

Suisun Subregion

The Suisun subregion is located in Solano and Contra Costa counties and extends from near Chippis Island on the Sacramento River downstream to the Carquinez Bridge. Suisun Marsh is on the north side of the Sacramento River. It is important to note that below the 10-foot contour the marsh is part of the Central Valley Habitat Joint Venture’s geographic scope. The Contra Costa shoreline is on the south side. Its major watercourses include the Sacramento River, and Green Valley, Solano, and Walnut Creeks.

On the Solano side, there are still vernal pools and moist grasslands on the fringes of Suisun Marsh, particularly to the east and north. A prominent remnant of this seasonal wetland complex is the Jepson Prairie Reserve, east of Fairfield in Solano County.

On the Contra Costa side, brackish tidal marshes along the shoreline extend into the lower reaches of the major tributaries. These marshes are particularly extensive in the Walnut Creek watershed, which also supports some remnant riparian forest in its tributaries.

Comparing historical to present conditions in this subregion, deep bay and shallow bay habitats have declined from about 41,000 acres to about 34,000 acres. Much of this change is due to sediment deposits from Sierra Nevada mining in the mid-19th century. Some of the deeper areas have become shallow bay, and some of the shallow areas have become tidal flats. Tidal marsh has



A Petaluma River bank is the graveyard of a grain scow that plied the waters in the 19th century.

JOHN STEERE



A managed marsh meets a riparian willow grove in the South Bay.

JOSH COLLINS

also declined significantly in this area. Much of the loss came from tidal marsh being converted to managed marsh to provide habitat for wintering waterfowl. These marshes also provide habitat for shorebirds and other wetland-associated wildlife. The majority of privately-owned managed marshes in the area are used for duck hunting in the fall and winter. Private landowners have taken the lead in assuring the protection of the Suisun Marsh.

Adjacent to the baylands, farming and other activities have affected most of the moist grassland habitat and about one-third of grasslands with vernal pools. Farming and stream channelization have greatly reduced the area of riparian vegetation and willow groves.

On the Contra Costa shoreline, most of the tidal marshes have been diked, initially for farming. Some have been filled for industrial uses such as oil refining and power generation. Riparian vegetation has been stripped from many of the streams. This is most apparent in the heavily urbanized Walnut Creek/San Ramon watershed, where many miles of stream channel have been straightened, widened, and lined with concrete.

Central Bay Subregion

The Central Bay subregion includes submerged lands, wetlands, uplands, and the main body of San Francisco Bay. It extends along the west shore from Point San Pedro to Coyote Point, and along the east

shore from Point San Pablo to the San Leandro Marina. It follows the northern edge of the creeks (Crow Creek, Alamo Creek, etc.) that drain the interior of Contra Costa and Alameda Counties south to Alameda Creek. This region includes portions of San Francisco, Marin, Contra Costa, Alameda, and San Mateo Counties.

Historically, steep watersheds draining into broad alluvial fans characterized this region. At their bayside margins, there were small pockets of tidal marshland, sandy beaches, and natural lagoons, all fed by relatively small drainages, with similarly scaled areas of tidal flats and tidal marshes. The near-

Bay habitats in this sub-region reflect the proximity of the ocean more than the other subregions, with strong marine influence showing in the subtidal and intertidal plant and animal communities. Historically there were few prairies, as there is less flat land between the old marsh line and the hills, but there were relatively more moist grasslands than in other subregions. The hills, being of mixed geologic origin and receiving coastal fog, were formerly dominated by oak woodlands with occasional stands of redwood.

Today, this subregion is one of the most urbanized, with three-quarters of its baylands filled. Tidal



Many Central Bay wetlands have been filled by industrial, commercial, or residential development. PORT OF OAKLAND



25,000 acres of Cargill Salt Ponds rim the South Bay; 19,000 acres are now available for sale to federal and State agencies.

BOB WALKER

marsh acreage has been reduced by over 90 percent, and tidal flat acreage by 70 percent. Large areas of interior open space are protected, e.g. the watershed lands of the San Francisco Water Department and East Bay Municipal Utility District, and the parklands of the East Bay Regional Park District. However, most of the flatland areas of this subregion have been significantly modified. Restoration has occurred on a variety of fronts, but has generally had to adapt to the highly urban influences. Unusual restoration projects have been accomplished, including the “daylighting” (opening) of several culverted streams, and restoration of old sewage sludge ponds into marshes.

South Bay Subregion

The South Bay subregion includes the submerged lands, wetlands, and uplands from the southern edges of the Central Bay subregion south to the limits of the watersheds feeding the Bay. It abuts the Central Bay subregion on the west shore at Coyote Point and on the east shore at the San Leandro Marina. It gets less rainfall than the other subregions, and has few major streams; the largest include Alameda, Coyote, San Francisquito, San Mateo, and Stevens Creeks. This region includes all of Santa Clara County and portions of Alameda and San Mateo Counties.

Historically, this subregion was characterized by broad bands of mudflats and tidal marshes on either side of the Bay. Between the tidal creeks were many salt marsh ponds or pans. Near the mouth of San Leandro Creek on the East Bay shoreline was a complex of large natural salt ponds, named Crystal Salt Pond on historical maps. This feature was apparently formed by a beach ridge or swash bar, and was a precursor of the subregion’s man-made salt ponds. Along the periphery of the baylands were wet grasslands, and a large area with vernal pools lay near Warm Springs.

Evaporation exceeds precipitation in the South Bay by a two to one ratio, producing less freshwater runoff and much drier conditions than in the other subregions.

The geology of the South Bay also includes more sand and gravel deposits than the other subregions, resulting in broad alluvial valleys, once dominated by giant sycamores and other riparian vegetation. The uplands were dominated by shrubs or, at higher elevations, woodlands.

This subregion still contains broad valleys with flats adjacent to the Bay, but many have been converted to non-habitat uses. Silicon Valley and urbanization have supplanted the orchards that once covered many of the valleys. Nearly all the moist grasslands are gone and much of the riparian vegetation has been removed. Tidal marshes were too saline for agriculture, so they were converted to salt ponds. Sewage treatment facilities, landfills, residential and industrial uses also reduced the area of natural baylands habitats. Restoration projects of many types are taking place in this subregion, from tidal marshes to riparian woodlands. Watershed planning initiatives have been particularly active in this subregion.

San Francisco/San Mateo Coast Subregion

The San Francisco/San Mateo Coast subregion includes the western side of San Francisco and San Mateo Counties, from the submerged and intertidal lands of the Pacific Ocean to the crest of the coastal

range. This subregion has similarities to the Central Bay, in that it is characterized by short, steep watersheds that lead to pockets of tidal marsh with strong marine influences. However, the Pacific coast is distinguished by its beauty, prominent rural qualities, and variety of plant communities and wetlands. Tidal and seasonal wetlands on the coast tend to be smaller in scale than those of the Baylands; they are frequently less than an acre in size. This subregion is a study in dramatic contrasts, with the heavily developed coastal area of San Francisco giving way to the rural and relatively wild segments of coastline in San Mateo County. While coastal

wetlands are small, the variable topography of the coastline and the scattering of offshore rocks has led to a complex mosaic of marine habitats in the intertidal zones. Streams lined with willow thickets form into lagoons; these are generally behind beaches that fan out along the margins where the creeks enter the ocean. Inland from the bluffs that characterize the majority of the San Mateo coast, are coastal terraces that are primarily in intensive agriculture, while the adjacent slopes of the coastal range are clad in evergreen and mixed hardwood forests.

This portion of the Joint Venture's regional scope retains many intact habitats. Over 75 percent



An urban wetlands quilt: South Bay salt ponds, looking North toward Bair Island

BRADY AERIAL PHOTOGRAPHY

of the land remains wooded—from the redwood and Douglas fir forests found in many of the seaward watersheds, to the hardwoods along the small, but well vegetated streams, to the pocket marshes near the coast, to the patches of coastal scrub communities near the bluffs and creeks. Restoration work has been occurring in some of the watersheds and stream channels. However, grazing and farming practices have been causing excessive sedimentation in the coastal streams, impairing their fisheries capacity, particularly for salmon, causing siltation even in several coastal lagoons and marshes that have been protected in state parks.

Categorizing Wetland Habitats in San Francisco Bay

The habitat categories developed by the SFBJV are based largely on the extensive and historical ecological research for the Estuary that was completed by the San Francisco Bay Area Wetlands Ecosystem Goals Project (Goals Project.) Contributors to this project, led by researchers at the San Francisco Estuary Institute (SFEI), with participating scientists from many disciplines, institutions, and agencies, developed a comprehensive set of habitat categories for the Bay and its environs. These were mapped as habitat types in the Goals Project. They include 14 cat-



Cowell Ranch Beach along the San Mateo Coast DON COPPOCK

egories of wetlands—tidal flats, tidal marshes and muted tidal marshes, beaches, lagoons, salt ponds, agricultural baylands, diked/managed wetlands, moist grasslands, grassland/vernal pool complexes, creeks, perennial ponds, and riparian forests and willow groves. See Appendix D for descriptions of each of these habitat types. The SFBJV has refined these categories into 10 “tracked habitats,” which refers to specific groupings of habitat types whose conditions will be periodically monitored. Figure 3-1 in the following chapter shows how the Goals Project classifications translate into the tracked habitats of the SFBJV.

The pattern of habitat simplification over time is indicative of how much wetlands in the Bay Area have been altered by human activity. The human modification of the Baylands (the area once exposed to daily tidal action) that began during the mid-1800s with diking tidal areas to create agricultural lands, salt ponds, managed marshes, and uplands has drastically changed the mix of habitats in the region. It has created a curious patchwork of man-made habitats that do provide some biological value, but lack the diversity found in the complex mosaics of their natural predecessors.