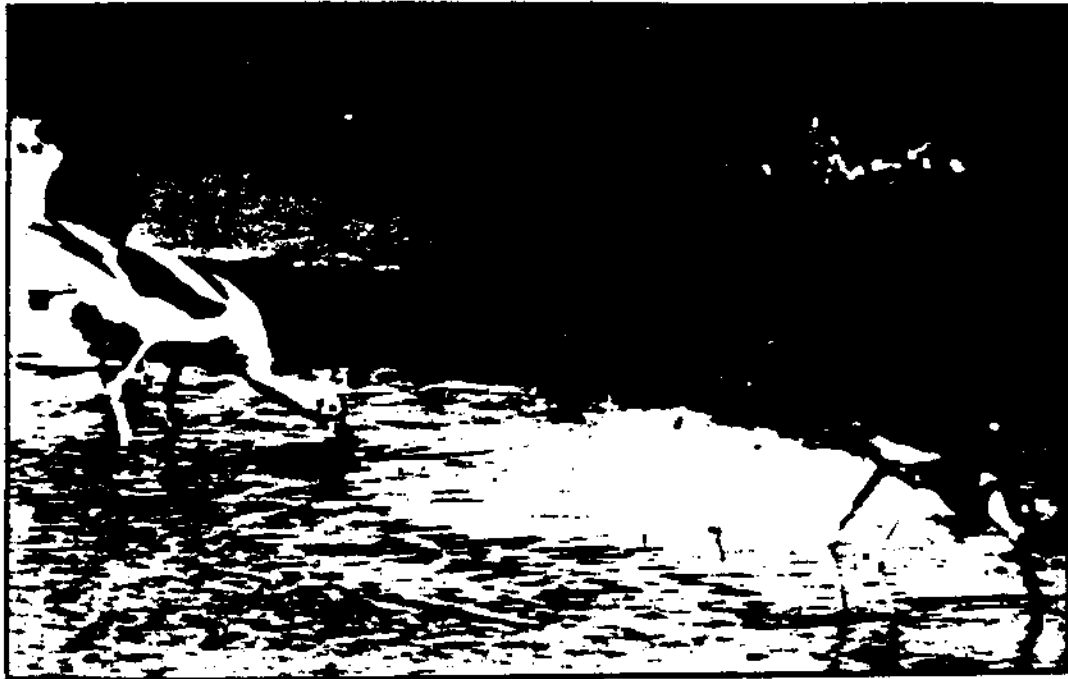


under the legal catch size (6-1/2 inches) to be present in Estero de San Antonio. Investigators are trying to identify crab nursery areas and determine their importance to Bay Area Dungeness crab populations which are at present lower than historical levels. Preliminary data indicate that bays and estuaries, particularly San Pablo and northern San Francisco bays, provide nursery area for a high proportion of those Dungeness crabs now taken in the commercial crab catch in the Gulf of the Farallones.

Although Dungeness crabs spawn in the ocean, a portion of the hatch finds its way into estuaries. Newly-spawned crab eggs are attached to the swimmerets of the abdominal segment of the adult female, forming a sponge-like mass. Egg-bearing females are found within varying ocean depths, including the surf zone. The peak hatching months in California waters are December and January; during some early life history stage, young forms of Dungeness crab are carried by currents into bays and estuaries where they find favorable nursery habitat.

Although the amount of crab nursery area provided by the esteros is relatively small, it may make an important local contribution when the entrance sand bars are open to exchange juvenile crabs with the ocean. Maintenance of the esteros' mouths in an open condition from May through June and, if water conditions become stagnant, in October and November would maximize the esteros' contribution as crab nursery area. After November, rain flows usually keep the entrances open in normal rainfall years.

Prolonged closure of the esteros creates stagnant water, reduced depths, and crowding. Mortality becomes high because of unsuitable substrate, poor water quality, cannibalism, and predation. This situation occurred in 1976, a dry year. During that summer, Dungeness crabs were most abundant in Estero de San Antonio where crab ring nets fished for 15- to 20-minute periods produced 80 to 100 young crabs. No growth was evident in four months of sampling and



Estero Americano wetlands habitats provide feeding and resting sites for migrating and resident waterfowl and shorebirds. (Calif. Dept. of Fish & Game photo)



Department of Fish and Game investigations indicate the importance of Estero Americano wetlands as nursery grounds for the commercial Dungeness crab. (Calif. Dept. of Fish & Game photo)

abundance and distribution declined steadily over the time period. In addition to benefiting Dungeness crab production, keeping the entrances open could be expected to maintain an improved environment for other marine invertebrates and fishes, including starry flounders and striped bass.

Mollusks and Others

The bay mussel, *Mytilus edulis*, occurs in Estero de San Antonio more commonly on eel grass than on other submerged substrates. Common littleneck clams and sand clams are found in the sandy mud near the mouth of Estero de San Antonio. The soft-shell clam has been collected in both esteros. Hydroid coelenterates, ribbon worms, nematodes, and annelid worms occur on or in the bottom substrate or in eel grass beds in the esteros, and bay and hermit crabs are also common inhabitants.



Two large rocks near the usual mouth of Estero de San Antonio exhibit the remnants of the rocky shore community which is common immediately to both sides of the Estero mouth on the ocean side. One inhabitant of these rocks, the common sea star *Pisaster ochraceus*, was observed from March through July, 1976, to withstand extreme changes in water temperature and salinity (Studley, 1976).

INSECTS

While precise information about the insect fauna is not available, species inhabiting Estero Americano and Estero de San Antonio are expected to be similar to those found nearby. Insect collections (Appendix J) have been made by a local entomologist in estuarine portions of Walker Creek and Tomales Bay (Peterson, 1976), as well as extensively along the coast (Peterson, 1972-1976).

Throughout the esteros, from the marine mouth areas to the fresher water, upper areas which become Americano and Stemple creeks, one of the dominant insect groups of true flies are the midges.

Nearshore fish feed on the larval and pupal stages of these diatomivore flies (*Paraclunio* spp) which are also important in the diets of waterfowl in some areas. Early stages of other midges are common in the diet of fish found in fresher water areas of the esteros.

Throughout all regions where organic ooze and diatomaceous or other algal materials accumulate, the often-numerous shore flies are found. Many of the larval forms live in the upper layers of mud, providing food for probers like the shorebirds (Page and Stenzel, 1975). The long-legged flies are ubiquitous predators, with species of *Aphrosylus* feeding along the seashore, and species of *Hydrophorus* hunting prey in the upper estuaries. Small dung flies scavenge over the entire area.

Insect populations of the esteros may be adversely affected by human-induced alterations of the habitat, such as pollution of the water with livestock wastes, as well as livestock trampling and grazing of streamside vegetation and substrate, where many insects pupate or live as larvae.

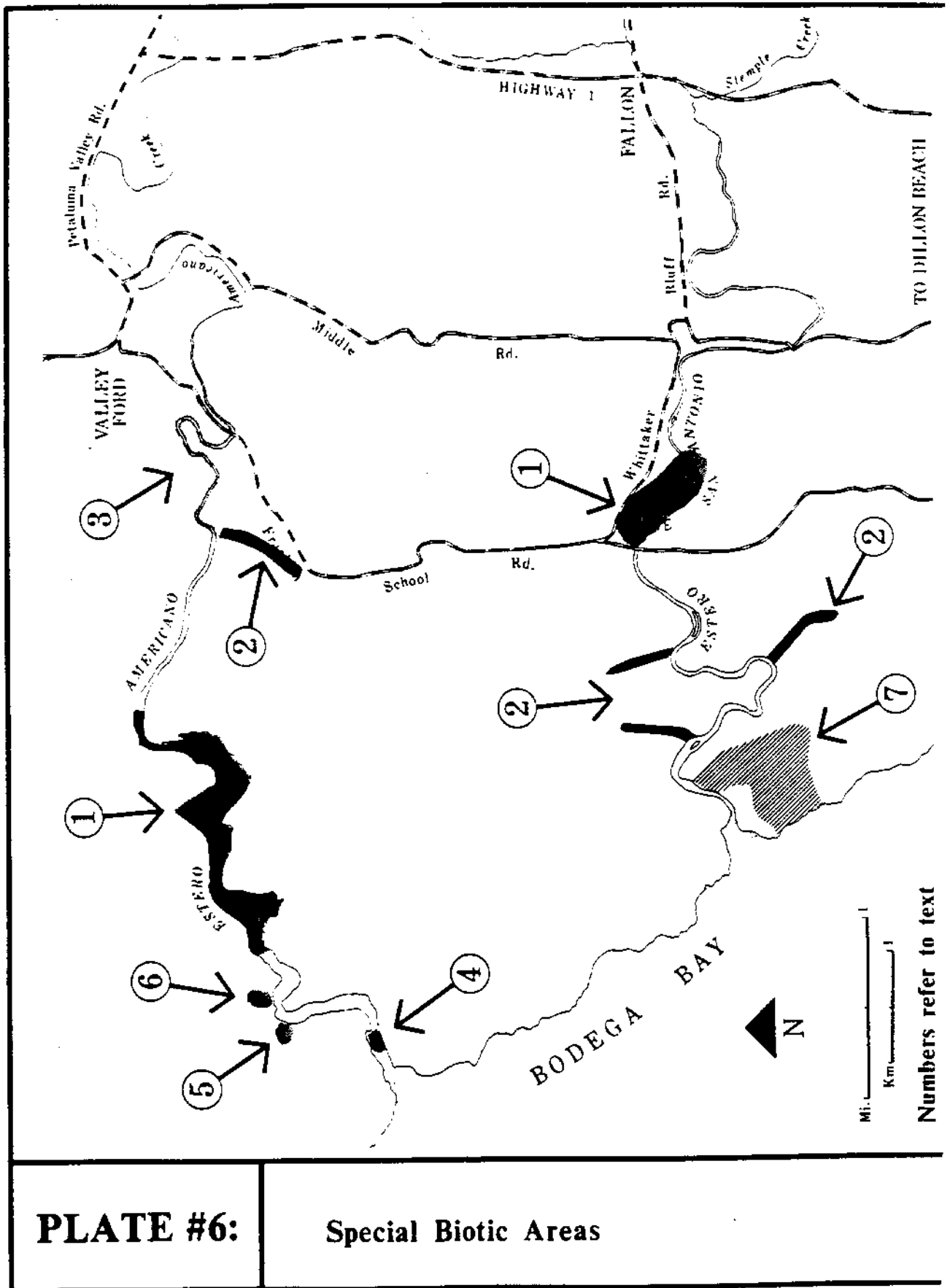
Insect populations of California's coastal wetlands require further study in order to fully understand the biotic communities of estuaries and their interrelationships.

SPECIAL BIOTIC AREAS

The Esteros Americano and de San Antonio watersheds include a number of smaller areas or biotic communities which are distinguished by unusual vegetation of high wildlife value (Plate 6). While some of these features are unique to one estero or the other, several are shared by both. Numbers throughout this discussion refer to areas located on Plate 6.

Features Found at Both Esteros

Upland hillsides surrounding the mouth of both esteros and bordering the esteros to a point roughly one mile inland provide a combination of varied, relatively undisturbed habitat types. This



interspersed of coastal prairie, coastal scrub, riparian ravines and seeps, coastal strand, and grassland creates areas with high habitat value for many species of wildlife. In addition, restricted public access has left these areas relatively undisturbed, further enhancing their attractiveness to wildlife.

On the coastal and estuarine bluffs of both esteros are locally common populations of rock cress (*Arabis blepharophylla*), an endemic wildflower classified as rare by the California Native Plant Society (1974). Other plants of phytogeographic significance are found in the vicinity of the esteros. These plants are uncommon elsewhere in the region; some of them approach their southernmost distribution at the esteros. Some examples include western choke-cherry (*Prunus virginiana* var. *demissa*) and Douglas hawthorne (*Crataegus douglasii*) in the bay groves, two sedges (*Carex pansa* and *C. tracyi athrostachys*) and cursed buttercup (*Ranunculus sceleratus*) in the brackish marshes, and local varieties of lupine (*Lupinus densiflorus* var. *crinitus*) and bindweed (*Convolvulus occidentalis* var. *Saxicola*) in the grasslands and along coastal bluffs.

Areas of open brackish water, marshland, and mudflats that receive extensive use by resident, migratory and wintering waterfowl, wading birds, and shorebirds are prominent features of both esteros. During highwater and the winter migratory period, the full area outlined as biotic area #1 on the Esteros de San Antonio and Americano species area map (Plate 6) is used by visiting species; a correspondingly smaller area is used during the drier summer months, primarily by shorebirds.

Freshwater features common to both esteros create valuable wildlife habitat by supplying drinking water and well-developed vegetation, which is used by animals as cover, nesting sites, hunting areas, and so on. Established riparian vegetation along drainage ravines provides habitat for such species as the Cooper's hawk.

A good example is located at Estero Americano (#2); more numerous examples occur along Estero de San Antonio. Freshwater seeps provide a similar habitat enhancement, numerous example of which are located at Estero Americano.

The scientific, aesthetic, and even potentially economic value of vernal pools has been well-documented (Jain, 1976). Unusual environmental conditions associated with these seasonally wet pools has resulted in the evolution of highly specialized plant species, such as Howell's bentgrass *Alopecurus howelli*, a plant identified in a vernal pool (near #2). Although not mapped, vernal pools are likely to occur throughout the grasslands surrounding both esteros.

Three species of animals that are listed as rare and endangered by both federal and state agencies (Federal Register, 1976; Cal. Dept. Fish and Game, 1976) are known to occur in the vicinity of the esteros. Brown pelicans (*Pelecanus occidentalis californicus*) feed and rest in the open water areas of both esteros during late summer, fall, and early winter. Bald eagles (*Haliaeetus leucocephalus leucocephalus*) have been known to occur along the coast in the vicinity of the esteros, especially during migration.

Features Found at Estero Americano

Certain features unique to the area are found only along Estero Americano. Along the upper reaches of Estero Americano, a freshwater marsh (#3) provides wildlife habitat that is particularly valuable in this general setting of dry uplands and largely saline or brackish water. During dry years the freshwater marsh is confined to small areas on either side of the estuary, but develops during wet years to the extent shown on the map. This spot is particularly attractive to many species of birds, mammals, reptiles, and amphibians; in addition to the habitat attributes usually associated with freshwater marshes, the old bay groves that flank the marsh and extend to Valley Ford-Estero Lane increase the diver-

sity of available cover, nesting sites, roosting places, and food sources. Proximity to the freshwater marsh correspondingly enhances the habitat value of the bay groves. Bitter cherry (*Prunus emarginata*), a plant found only sparingly in the area, grows in the bay groves along Estero Americano.

In the channel of the estero, roughly one-quarter mile upstream from the mouth, is a bed of eel grass (*Zostera marina*) (#4). Eel grass provides a substrate for life stages of many invertebrates, including amphipods, annelids, coelenterates, and gastropods. It functions as valuable spawning habitat and a place for the attachment of eggs of the Pacific herring (*Clupea harengus*). This associated fauna, as well as the eel grass itself, provides a rich food source for many other vertebrate and invertebrate species.

Within the coastal scrub along Estero Americano (#5), occur small, isolated patches of a plant association unique in this region: scraggly, bare-branched Douglas fir, growing with blue blossom (*Ceanothus thyrsiflorus*), salal (*Gaultheria shallon*), and huckleberry (*Vaccinium ovatum*). This association is typical of a more heavily forested environment and may represent a remnant of a plant community or successional stage that once grew more extensively in this area. A plant listed as rare by the California Native Plant Society (1974), (*Dichondra donnelliana*), is located on the north side of Estero Americano, about one mile inland from the marsh (#6).

Features Found at Estero de San Antonio

On the south side of Estero de San Antonio, extending inland from the coast for roughly three-quarters of a mile (#7), is an extensive patch of coastal prairie. Although a few patches occur along Estero Americano, this plant community is most well-developed here. In other places, human activities like grazing or development have converted coastal prairie into coastal scrub or grassland, making this remaining area one of particular value and

interest. Several native plant species that are uncommon or that reach the southernmost limit of their distribution in this area are locally common in the coastal prairie. These include native perennial grasses (*Festuca californica*, *Calamagrostis nutkaensis*, and *Deschampsia caespitosa*) and gentian (*Gentiana oregana*).

Numerous unmapped freshwater seeps occur along the hillsides of Estero de San Antonio. Along with the numerous riparian ravines mentioned above, these moist areas increase vegetational diversity and biomass and provide valuable wildlife habitat in the dry upland areas. Seep thistle (*Cirsium breweri*), known from only one other spot in the county, occurs in the seep areas along this estero.

LAND AND NATURAL RESOURCE USE

LAND OWNERSHIP AND USE

The State of California, acting through the State Lands Commission, is the owner of all tide and submerged lands in Estero de San Antonio and Estero Americano. Lands adjacent to these two esteros are privately owned; as a result, there is free public access to the water only from the public roads crossing the esteros and from the Pacific Ocean.

Agriculture continues, from its historic beginnings, as the primary use of the lands surrounding the esteros. Dairying and sheep and cattle grazing are at present the major agricultural industries in the area. In addition to these major agricultural uses, some farms in the area raise turkeys. Past agricultural land uses have included row crops of corn, beets, potatoes, onions, oats, and hay. Some small areas of these crops continue today, but the primary agriculture use now is grazing. Estero Americano was reportedly a navigable body of water in the late 1880's and was used for shipping potatoes to market.

LAND USE PLANNING AND REGULATIONS

Coastal Planning

The Sonoma and Marin county governments have direct responsibility for land use planning in the estero area. However, the local programs developed for this area by the two jurisdictions are subject to review and approval by the North Central Coast Regional Coastal Commission.

County General Plans require evaluation to determine the degree of modification they will need in order to comply with provisions of the California Coastal Act of 1976. The Act extends the jurisdictional boundary of the California Coastal Commission in

the area of the esteros (Plate 2) to include the watersheds of both waterways in the coastal zone. Under the Act each local government must prepare a program for that portion of the coastal zone within its jurisdiction. Until the local governments have prepared their coastal programs, they have relinquished their final authority to issue permits or give approval to development proposals in the coastal zone. Completion of the Marin County coastal program is expected in 1977 and the Sonoma County program, in 1978.

County Planning

The Marin County General Plan designates Esteros Americano and de San Antonio as "conservation zones", however, specific plans for implementation of this concept do not presently exist. The lands surrounding the esteros in Marin County have been designated as "agricultural". In Sonoma County (north of Estero Americano) the lands also are designated for agricultural use, except for the communities of Valley Ford and Bloomfield. The proposed Sonoma County General Plan designates these areas as rural communities and allows residential and commercial land use in the towns and their immediate environs.

Permitting Agencies and Districts

While the aforementioned local and regional agencies are responsible for land use planning and land use decisions in the esteros, there are other public agencies which have permit powers in the estero area.

The U.S. Army Corps of Engineers has jurisdiction over all navigable waterways, their tributaries, and adjacent wetlands. In the esteros, the Corps has jurisdiction up to the Mean Higher High Water line (MHHW). Any development, dredging, filling, or diking in this area of jurisdiction requires a permit from the Corps of Engineers.

The North Coast Regional Water Quality Control Board has permit issuing authority over any waste discharge on to land or water in the esteros. Their current program of water quality monitoring and setting of discharge requirements is aimed at producing water quality in the esteros which will comply with state and federal regulations.

State Lands Division has direct control over the lands and waterways to which they claim title. In the esteros their jurisdiction includes all tide and submerged lands.

GENERAL RESOURCE USE

Present use of the biological resources of Esteros Americano and de San Antonio is primarily by local private landowners. There also is some limited use of the esteros by others for recreational, educational, and scientific purposes. Limited commercial fishing takes place at the mouth of the esteros and along the coastline between them when surf and topsmelt are harvested with A-frame nets by day and night. Hunting is not prohibited in the esteros but is not reported as a predominant use. Primarily due to the lack of public access to the esteros by either road or boat launching areas, most use by persons other than local landowners has been restricted to personnel of public agencies or students of educational institutions. These access restrictions are also responsible for the somewhat natural state which still exists in the esteros.

Recreational Use

Because of the lack of public access, recreational use of the esteros has been primarily limited to local residents. Access is available to local residents by private roads and boats.

In the past, sport fishing for striped bass, starry flounder, and steelhead and silver salmon was common by local residents. A decrease in the bass fishing over the last five years has been

noticed by local residents. Steelhead fishing by local residents has also declined in the esteros. Rainbow trout are present in some impoundments in tributaries to upper Estero de San Antonio. Some small impoundments on tributaries to upper Estero de San Antonio have been privately stocked periodically with largemouth bass, green sunfish and bluegill. California Department of Fish and Game has not carried out a stocking program in either estero or their tributaries.

Local residents hunt waterfowl, deer, and quail in the esteros and surrounding uplands. Hunting pressure has reportedly declined in recent years.

Nature Study

Use of the esteros by individuals or groups for nature study, such as birdwatching, also has been limited to local residents and, with prior approval, to scientific or educational groups. The waterfowl and shorebird habitats of the esteros provide areas and subjects appropriate to such non-appropriative uses by limited numbers of interested persons.

Educational/Scientific Study

The tidal wetlands of the California coast provide unique and valuable educational opportunities to those studying our natural resources. Recent public agency plans and programs for the California coastal resources attempt to assure the preservation of these areas for future benefit. The Coordinating Council for Higher Education has emphasized the need for knowledge and understanding of the physical and biological conditions governing these wetland areas, in order to adequately plan for their future management (Rechnitzer, 1970).

The esteros have been the subject of past preliminary studies on fish, marine invertebrates, and algal populations, as well as chemical and physical parameters. The value of these unique

estuarine communities is increased by their proximity to the San Francisco Bay Area educational institutions offering degrees in the marine sciences. These include Sonoma State College, the University of California at Berkeley (Bodega Marine Laboratory), University of the Pacific Marine Station, and Santa Rosa Junior College. Scientific and educational use of the esteros has been limited by the lack of access to them except on private roads or through private lands.

Recent scientific surveys of the esteros have been initiated by California Department of Fish and Game and Regional Water Quality Control Board personnel. Continued data collection on the water quality of the areas will provide basic information on the effectiveness of programs designed to collect agricultural wastes and reduce runoff of agricultural wastewater. This program has been put into effect in order to meet federal and state water quality requirements.

PROBLEMS AND USE CONFLICTS

The location of estuaries between land and ocean not only makes them unique and productive communities but also gives them attractive qualities for many uses by human societies. In California, these uses have increased to the degradation and in some cases elimination of the estuarine biological community itself. The wetlands associated with the interface between land and the ocean in California have been reduced by 70 percent since 1900.

EXISTING ZONING AND PLANNED LAND USE

Existing zoning in some areas of the esteros watersheds is not consistent with the respective general plan land use designations of those areas. The land which lies immediately south of the mouth of Estero de San Antonio is zoned A-2, designating a minimum requirement of two acres for every home in the zoning district (Plate 7). However, the Marin County General Plan designates this area as "conservation zone" and "agricultural-rural open space". This zoning classification and planned land use discrepancy is even more significant since Marin County has already rezoned the rest of the area A-60 (one unit per 60 acres) in order to bring the area's zoning into conformance with the adopted General Plan. The A-2 zone south of Estero de San Antonio includes the Oceana Marin subdivision and the undeveloped lands lying north of the existing residential development and extending to the Estero. These lands are expected to be brought into conformity with the countywide plan in the future.

Approximately two-thirds of the estero watershed area in Sonoma County is zoned Agricultural Preserve (AE) (Plate 7). Under this zoning designation, parcels are restricted to a minimum of 200 acres. Parcels in this area are each under annually renewable contracts with Sonoma County to keep the land in agricultural use. The remaining third of the watershed in Sonoma County is zoned A-2 (one residence

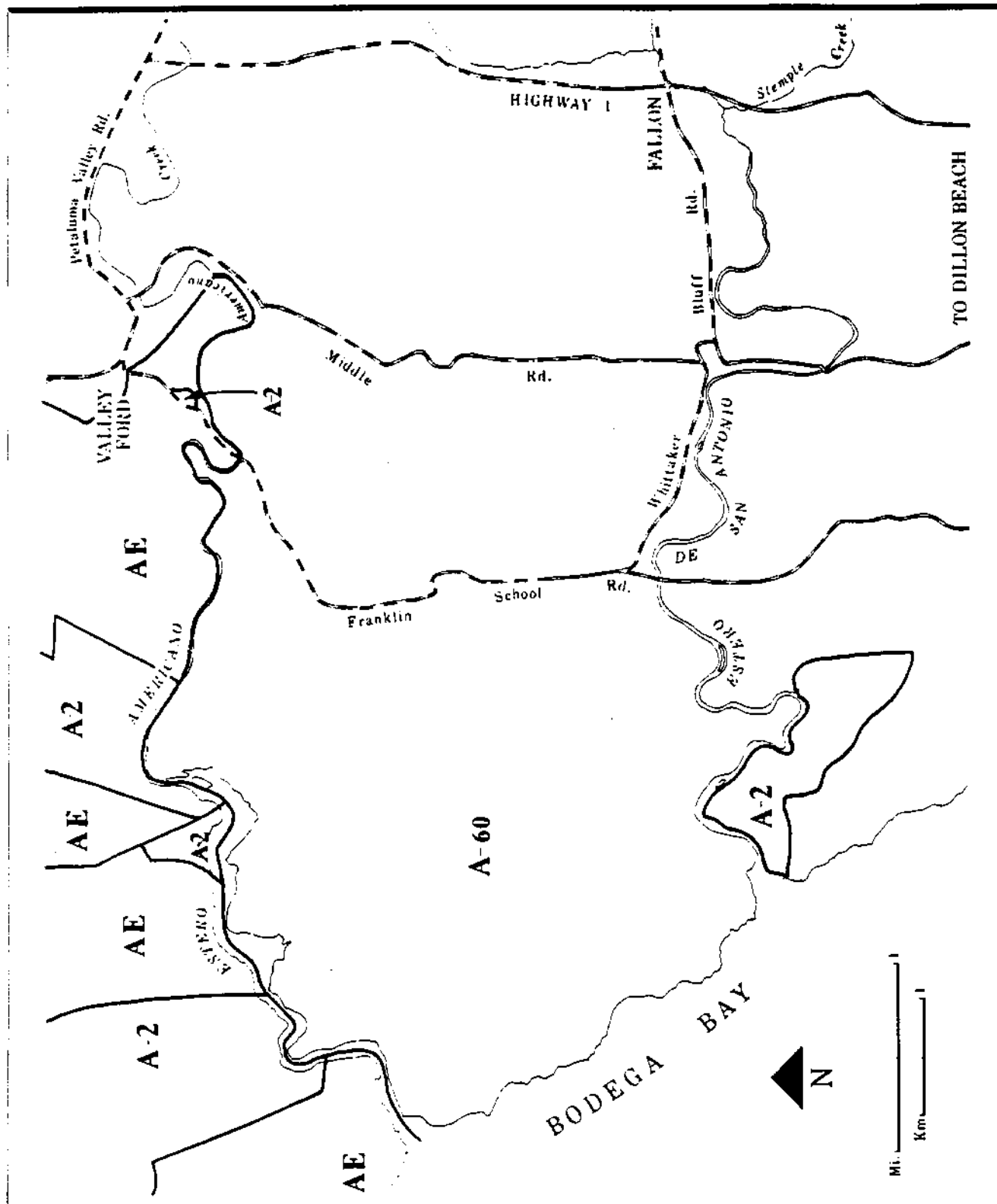


PLATE #7:

Esteros Americano & De San Antonio Zoning

per two acre parcel). Adjoining lands to the north, outside the esteros watershed, which are zoned P-C (planned commercial) are the site of Bodega Harbour Development. Designation by the proposed Sonoma County General Plan of these lands for agricultural use is not consistent with their existing A-2 zoning.

A local coastal program for Marin County coastal lands will probably be adopted in 1977. Zoning designations consistent with that program may then be expected. A Sonoma County coastal program is not anticipated until 1978; however until that time the North Central Region Coastal Commission has adopted a policy of restricting any further urban expansion in the Bodega Bay area. This policy position is obviously not as protective of the esteros as would be zoning designations reflecting agricultural use.

URBAN DEVELOPMENT

In the last decade, the demand for second and retirement homes in California has brought subdivision pressure on agricultural lands in Marin and Sonoma counties. Surrounding lands north and south of the esteros watersheds contain large residential subdivisions. Just south of Estero de San Antonio, adjacent to the community of Dillon Beach, is Oceana Marin, a private residential subdivision; and to the north of Estero Americano lies Bodega Bay and its associated residential and second-home developments, including the Bodega Harbour subdivision.

Oceana Marin is a single-family home development designed for families retired from the work force, or families seeking a second home. The subdivision plan contains 262 lots, 15% of which had been built on by April 1977. No further subdivision is included in existing plans. "Overall Conditions for Oceana Marin" were adopted by the North Central Coast Regional Commission on September 20, 1973, and revised on March 21, 1974. These conditions place design geologic restraints on the future development of lots in the Oceana Marin Subdivision. Additional conditions require a public pedestrian

easeement to the beach at the end of Kailua Way in the subdivision. A policy also has been adopted for establishment of a public pedestrian trail dedicated to the County of Marin along the coastal bluffs. As proposed, this pedestrian access would extend from Kailua Way in Oceana Marin north to the Beach at Estero de San Antonio. This proposed pedestrian trail would provide limited access to the beach and mouth of Estero de San Antonio. Public use of this trail and the beach is expected to be high seasonally.

All development proposals must first be approved by the Bodega Bay Preserve Design Committee, Oceana Marin homeowners' association, which has established a set of development criteria including: soils and geology, siting, drainage, design motif, materials, colors and landscaping. Because of past severe problems with landslides, slumping, and erosion, the Coastal Commission requires site-specific foundation recommendations for development plans as well as a program of geologic maintenance for common or open space lands.

Intensive urban development has begun to take place on Bodega Bay north of the Estero Americano. A proposed 41-lot subdivision of the Bloomfield Ranch on Americano Creek was denied by Sonoma County in 1973. The most recent subdivision in the area is the Bodega Harbour Development, a 725 lot subdivision, which is located just north of the Estero Americano's watershed. Lands located between the Bodega Harbour Development and Estero Americano's watershed may be subject to future urban expansion pressures.

Pressures for development of this land are sure to increase in the future. Local landowners indicate that use of the land for agricultural production or grazing is becoming less and less profitable with the rising costs of property taxes and shortages of water. The economic feasibility of continuing agricultural use cannot be assured without state or local tax programs, and/or legislation. This urban residential use of land will have a longer lasting adverse impact on the environment than traditional agricultural use of the land.

Increased water quality problems, noise, and other disturbances from human intrusion would detrimentally affect the natural flora and fauna.

WATER QUALITY

Esteros Americano and de San Antonio are in the Regional Water Quality Control Board - North Coast Region - Basin 1B. A Water Quality Control Plan for this basin was adopted July, 1975. Beneficial uses for the Bodega Bay subbasin include: agricultural supply, industrial service supply, commercial and naval shipping, water contact recreation, non-contact water recreation, ocean commercial and sport fishing, cold freshwater habitat, preservation of areas of special biological significance, wildlife habitat, marine habitat, fish migration, fish spawning, and shellfish harvesting.

The major problem jeopardizing the implementation of these beneficial uses for the esteros is agricultural wastewater management. Sampling in Estero de San Antonio has shown a dramatic increase in the biological oxygen demand (BOD), nitrogen, phosphates, and total dissolved solids of the water after the first winter rains in the area, due to livestock wastes being carried into the stream by surface runoff. Discharge permits have been issued to the dairy operators in this area to prevent continued degradation of Stemple Creek and the Estero de San Antonio. Water quality data from both esteros indicate higher pollution levels in Estero de San Antonio than in Estero Americano during runoff periods. This is probably due to a less intensive agricultural use of the upstream watershed of Americano.

The North Coast Region Water Quality Control Board has adopted resolutions that all dairies in the region will be required to be in full compliance with all provisions of the "Minimum Guidelines for the Protection of Water Quality from Animal Wastes" at the earliest practicable date but not later than September 1, 1978. The regional board is currently conducting a survey of status of compliance with these guidelines and estimates that 75 percent of the

dairies are in some stage of action of compliance varying from beginning plans to total compliance with the regulations. The Sonoma and Marin county dairy waste committees will be requested to provide periodic progress reports in developing facilities to meet the guidelines. This program is being enacted to enforce the Water Pollution Control Act of 1972 which prohibits discharge of wastes to surface water without a federal permit. The State has the authority to administer this permitting program in California.

In Marin County all dairies have been surveyed by an engineer for the U.S. Soil Conservation Service. He has formulated plans and costs for each dairy to comply with new requirements. This service was provided free to all dairies and the same program has just begun for Sonoma County dairies. The Marin County Dairy Wastes Pollution Control Program funds salaries for the engineers of this program in Marin and will reimburse dairy owners for costs of dairy pollution control devices at a rate of 25% of total capital costs, payable in five equal annual installments. These payments to dairies in fiscal year 1975-1976 approximated \$25,000. Sonoma County does not currently have such a funding program.

Anti-pollution facilities include holding ponds, spray irrigation systems for summer disposal of collected run-off waters, and loafing or "free stall" barns. These barns have been shown to increase winter milk production as well as decrease run-off water problems.

Given enforcement of the current water anti-pollution program as set by the Regional Water Quality Control Board, it seems safe to assume that the existing water quality problem which mars both esteros will be solved by late 1978.



Trampled pickleweed marsh, increased sedimentation, and agricultural runoff waters are problems associated with agricultural land use immediately adjacent to the Esteros. (Calif. Dept. of Fish & Game photo by Tom Studley)



Closer to Stemple Creek, Estero De San Antonio changes character, and the alluvial plains provide farmhouse sites. (Calif. Dept. of Fish & Game photo by Tom Studley)

SEDIMENTATION

Coastal lands in the Bodega Bay-Tomales Bay area have a long history of sedimentation problems. The combination in the esteros watersheds of past potato farming practices, overgrazing, and moderately erodible Steinbeck-Los Osos soils has resulted in an extensive loss of open water. In the late 19th century, Estero Americano was reportedly a navigable waterway used for shipping potatoes.

More recent erosion problems have been caused by the cattle and sheep which graze on the watershed lands and trample the pickleweed of the seasonal brackish marsh. Grazing cattle also cave in the banks of the esteros and tributary streams; thus adding to siltation of the channel. Examples of this are more prominent in the upper flood plain reaches of both esteros. Livestock grazing in the estero watersheds should be at "moderate" levels whenever possible.

Residential development south of Estero de San Antonio, in the Oceana Marin subdivision, has resulted in extreme landslides, slumping and erosional problems in that area. These past problems and the deep gullies in the dirt roads leading to the mouth of Estero de San Antonio are indicative of the potential sedimentation hazards of the area. Development plans for all Bodega Bay areas should include data concerning their impacts on erosion and sedimentation processes. Changes in these processes in areas as far away as the coastal town of Bodega Bay and Doran Spit can ultimately affect the esteros by changing offshore sediment loads which form the seasonal sand bars.

Coastal Commission conditions on future development of lots in Oceana Marin, south of Estero de San Antonio, require site specific foundation recommendations by a soils engineer. When possible geologic problems are indicated, an in-depth professional report is required to demonstrate the ability of the parcel to be developed without causing a significant change such as landslide, erosion, or cliff retreat.

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PERSONS CONTACTED

The following representatives of organizations and agencies contributed assistance, advice, and data included in this report:

Arnold, John. Emeritus Professor of Biology. Sonoma State College.

Brittsan, Don. Marin County Farm Bureau.

Brown, Charles W. Chairman, Department of Life Sciences, Santa Rosa Junior College.

Eto, Larry. Sonoma County Public Works Department - Road Maintenance.

Holloway, Gary. Senior Planner, North Coast Regional Coastal Commission.

Kjeldsen, Chris K. Professor of Biology. Sonoma State College.

Ohlson, Kathleen. Marin County Planning Department.

Pottee, Alleen. Marin County Administrator's Office, Administrative Analyst.

Reitermann, Laura. North Coast Regional Coastal Commission.

Robinson, Skip. Bureau of Land Management.

Rugg, Mike. California Department of Fish and Game.

Salisbury, Dennis. Regional Water Quality Control Board--North Coast Region.

Sample, Sally. Seasonal aid, California Department of Fish and Game.

Stocking, Ken. Sonoma State College.

Studley, Tom. Seasonal aid, California Department of Fish and Game.

Thompson, Rockford.

Thomsen, Craig. Seasonal aid, California Department of Fish and Game.

Trout, James F. State Lands Commission.

REPORT PREPARATION

The following persons have been responsible for preparation of sections of this report for MADRONE ASSOCIATES, Environmental Consultants.

MADRONE ASSOCIATES

Principal-in-Charge

Rembert B. Kingsley

Consultants

Cecilia B. Bridges - Project Director and Editor; Habitats; Wildlife Ecology; Resource Use; Problems and Conflicts; Line drawings

Carol Handin - Clerical

Gay Kagy - Clerical

Judy Kingsley - Data collection

Daniel Lewis - Graphics

David Mayfield - Habitats; Data collection

Carolyn McKecknie - Habitats

Ray Petersen - Insects

Diane Renshaw - Habitats; Wildlife Ecology; Editing

John Roberto - Land Use and Planning; Climate

Tom Studley - Wildlife Ecology

Nancy Wise - History

HARDING-LAWSON ASSOCIATES

Frank Kresse - Geology

STORM ENGINEERING

David Storm - Drainage

* Observed only in Estero de San Antonio.
 ** Observed only in Estero Americano.
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APPENDIX A

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VEGETATION--(ESTEROS AMERICANO and de SAN ANTONIO

| Scientific Name | Common Name | Coastal Scrub | Coastal Prairie | Annual Grassland | Estuarine & Coastal Rocky Bluffs, Outcrops | Vernal Pool | Fresh Water Marshes, Ponds (border) & Seeps | Seasonal Brackish Marsh | Intermittent Streams | Coastal Strand | Bay Groves | Wetlands | Estuary |
|-------------------------------|---------------------|---------------|-----------------|------------------|--|-------------|---|-------------------------|----------------------|----------------|------------|----------|---------|
| NATIVE GRASSES (Cont.) | | | | | | | | | | | | | |
| <i>Stipa pulchra</i> | Needlegrass | | X | X | | | | | | | | | |
| INTRODUCED GRASSES | | | | | | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Halgrass | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | European beachgrass | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Wild oats | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Quaking grass | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Ripgut | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Soft chess | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Dogtail | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Orchard grass | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Fescue | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Velvet grass | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Wild barley | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Farmers foxtail | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Italian ryegrass | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Perennial ryegrass | | | X | X | | | | | | | | |
| <i>Aeluropus laticarpus</i> | Sickle grass | | | X | X | | | | | | | | |

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| Scientific Name | Common Name | Coastal Scrub | Coastal Prairie | Annual Grassland | Estuarine & Coastal Rocky Bluffs, Outcrops | Vernal Pool | Fresh Water Marshes, Ponds (border) & Seeps | Seasonal Brackish Marsh | Intermittent Streams | Coastal Strand | Bay Groves | Wetlands | Estuary |
|--|-----------------|---------------|-----------------|------------------|--|-------------|---|-------------------------|----------------------|----------------|------------|----------|---------|
| INTRODUCED GRASSES (Cont.) | | | | | | | | | | | | | |
| <i>Poa annua</i> | Bluegrass | | | X | | | | | X | | | | |
| <i>Polypogon interruptus</i> | | | | | | | | | X | | | | |
| <i>Polypogon monspeliensis</i> | Rabbitfootgrass | | | | | | | | X | | | | |
| CYPERACEAE (SEDGES) | | | | | | | | | | | | | |
| <i>Carex alirostachya</i> | | | | | | | | | | | | | |
| <i>Carex barbarae</i> | | | | | | | | | | | | | |
| <i>Carex bolanderi</i> * | | | | | | | | | | | | | |
| <i>Carex obnupta</i> | | | | | | | | | | | | | |
| <i>Carex pinna</i> ** | | | | | | | | | | | | | |
| <i>Carex tracyi</i> ** | | | | | | | | | | | | | |
| <i>Carex tumicola</i> | | | | | | | | | | | | | |
| <i>Eleocharis macrostachya</i> | | | | | | | | | | | | | |
| <i>Scirpus acutus</i> | Spike rush | | | | | | | | | | | | |
| <i>Scirpus americanus</i> | Common tule | | | | | | | | | | | | |
| <i>Scirpus americanus</i> var. <i>californicus</i> | Three square | | | | | | | | | | | | |
| <i>Scirpus kottlensis</i> | | | | | | | | | | | | | |
| <i>Scirpus microcarpus</i> | | | | | | | | | | | | | |
| <i>Scirpus maritimus</i> ** | | | | | | | | | | | | | |

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VEGETATION--ESTEROS AMERICANO and de SAN ANTONIO

| Scientific Name | Common Name | Coastal Scrub | Coastal Prairie | Annual Grassland | Estuarine & Coastal Rocky Bluffs, Outcrops | Vernal Pool | Fresh Water Marshes, Ponds (border) & Seeps | Seasonal Brackish Marsh | Intermittent Streams | Coastal Strand | Bay Groves | Wetlands | Estuary |
|---|-----------------------|---------------|-----------------|------------------|--|-------------|---|-------------------------|----------------------|----------------|------------|----------|---------|
| JUNCACEAE (RUSHES) | | | | | | | | | | | | | |
| <i>Juncus balticus</i> | Baltic rush | | | | | | | | | | | | |
| <i>Juncus bolanderi</i> | Bolander's rush | | | | | | | | | | | | |
| <i>Juncus bufonius</i> | Toad rush | | | | | | | | | | | | |
| <i>Juncus effusus</i> var. <i>brunneus</i> | | | | | | | | | | | | | |
| <i>Juncus effusus</i> var. <i>pacificus</i> | | | | | | | | | | | | | |
| <i>Juncus leeseurii</i> | | | | | | | | | | | | | |
| <i>Juncus patens</i> | | | | | | | | | | | | | |
| FERNS AND ALLIES | | | | | | | | | | | | | |
| <i>Asolla filiculoides</i> | Water fern | | | | | | | | | | | | |
| <i>Adiantum jordanii</i> | California maidenhair | | | | | | | | | | | | |
| <i>Athyrium filix-femina</i> | Common lady fern | | | | | | | | | | | | |
| <i>Dryopteris arguta</i> | Coastal wood fern | | | | | | | | | | | | |
| <i>Equisetum arvense</i> | Horsetail | | | | | | | | | | | | |
| <i>Equisetum hyemale</i> var. <i>robustum</i> | Giant scouring rush | | | | | | | | | | | | |
| <i>Equisetum</i> sp. | Horsetails | | | | | | | | | | | | |
| <i>Pellaea andromedaefolia</i> * | Coffee fern | | | | | | | | | | | | |
| <i>Pityrogramma triangularis</i> * | Goldback fern | | | | | | | | | | | | |
| <i>Polypodium californicum</i> * | Licorice fern | | | | | | | | | | | | |

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| Scientific Name | Common Name | Coastal Scrub | Coastal Prairie | Annual Grassland | Estuarine & Coastal Rocky Bluffs, Outcrops | Vernal Pool | Fresh Water Marshes, Ponds (border) & Seeps | Seasonal Brackish Marsh | Intermittent Streams Drainage Ravines | Coastal Strand | Bay Groves | Wetlands | Estuary |
|---|----------------------|---------------|-----------------|------------------|--|-------------|---|-------------------------|---------------------------------------|----------------|------------|----------|---------|
| FERNS AND ALLIES (Cont.) | | | | | | | | | | | | | |
| <i>Polystichum minutum</i> | Shield fern | X | X | | | | | | | | | | |
| <i>Pteridium aquilinum</i> var. <i>pubescens</i> | Western bracken | X | X | X | | | | | X | | X | | |
| <i>Woodwardia fimbriata</i> | Western chain fern | | | | | | X | | | | | | |
| NATIVE HERBS | | | | | | | | | | | | | |
| <i>Abronia latifolia</i> * | Sand verbena | | | | | | | | | | | | |
| <i>Acaena californica</i> | California acaena | | X | X | | | | | | | | | |
| <i>Achillea borealis</i> var. <i>californica</i> | Yarrow | X | X | X | X | | | | | | | | |
| <i>Agoseris apargioides</i> var. <i>eastwoodiae</i> | Seaside dandelion | | | | X | | | | | | | | |
| <i>Alisma triviale</i> ** | Water plantain | | | | | | X | | | | | | |
| <i>Allium</i> spp. | Wild onion | | X | | X | | | | | | | | |
| <i>Allocaarya bracteata</i> | Bracted allocarya | X | | | | | | | | | | | |
| <i>Ammannia spectabilis</i> | Coast fiddleneck | | | X | | | | | | | | | |
| <i>Anaphalis margaritacea</i> | Pearly everlasting | X | X | | | | | | | | | | |
| <i>Angelica hendersonii</i> * | Henderson's angelica | | | | X | | | | | | | | |
| <i>Arabis blanchardii</i> * R-E | Rock cress | | | | X | | | | | | | | |
| <i>Artemisia maritima</i> var. <i>californica</i> | Sea thrift | | X | | X | | | | | | | | |

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VEGETATION--ESTEROS AMERICANO and de SAN ANTONIO

| Scientific Name | Common Name | Coastal Scrub | Coastal Prairie | Annual Grassland | Estuarine & Coastal Rocky Bluffs, Outcrops | Vernal Pool | Fresh Water Marshes, Ponds (border) & Seeps | Seasonal Brackish Marsh | Intermittent Streams | Coastal Strand | Bay Groves | Wetlands | Estuary |
|--|-----------------------|---------------|-----------------|------------------|--|-------------|---|-------------------------|----------------------|----------------|------------|----------|---------|
| NATIVE HERBS (Cont.) | | | | | | | | | | | | | |
| <i>Artemisia douglasiana</i> | Mugwort | X | | | | | | | | | | | |
| <i>Aster chilensis</i> | Aster | X | | | | | | | | | | | |
| <i>Atriplex patula</i> var. <i>hastata</i> | Fat hen | | X | | | | | | | | | | |
| <i>Baccharis pilularis</i> | Prostrate coyote bush | | | | | | | | | | | | |
| <i>Bouleria tiniana</i> * | Bowlesia | | | | | | | | | | | | |
| <i>Brodiaea hyacinthina</i> ** | White brodiaea | | | | | | | | | | | | |
| <i>Brodiaea laxa</i> | Trileleia | | | | | | | | | | | | |
| <i>Brodiaea pulchella</i> | Common brodiaea | | | | | | | | | | | | |
| <i>Brodiaea terrestris</i> | Dwarf brodiaea | | | | | | | | | | | | |
| <i>Calandrinia ciliata</i> var. <i>menziesii</i> | Red maid | | | | | | | | | | | | |
| <i>Calochortus tolmiei</i> ** | Pussy-ears | | | | | | | | | | | | |
| <i>Calystegia purpurata</i> ssp. <i>auriculata</i> | Morning glory | | | | | | | | | | | | |
| <i>Calystegia soldanella</i> * | Beach morning glory | | | | | | | | | | | | |
| <i>Comarostaphylis divaricata</i> | Dune sun cup | | | | | | | | | | | | |
| <i>Comarostaphylis ovata</i> | Sun cup | | | | | | | | | | | | |
| <i>Cardiandra romosissima</i> * | Paintbrush | | | | | | | | | | | | |
| <i>Castilleja latifolia</i> | Paintbrush | | | | | | | | | | | | |
| <i>Castilleja latifolia</i> var. <i>wrightii</i> | Paintbrush | | | | | | | | | | | | |

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| Scientific Name | Common Name | Coastal Scrub | Coastal Prairie | Annual Grassland | Estuarine & Coastal Rocky Bluffs, Outcrops | Vernal Pool | Fresh Water Marshes, Ponds (border) & Seeps | Seasonal Brackish Marsh | Intermittent Streams | Coastal Strand | Bay Groves | Wetlands | Estuary |
|---|----------------------|---------------|-----------------|------------------|--|-------------|---|-------------------------|----------------------|----------------|------------|----------|---------|
| NATIVE HERBS (Cont.) | | | | | | | | | | | | | |
| <i>Cenchrus ciliaris</i> | Native chickweed | | | | | | | | | | | | |
| <i>Chlorogalum pomeridianum</i> | Soap plant | | | | | | | | | | | | |
| <i>Chrysopsis villosa</i> | | | | | | | | | | | | | |
| <i>Cicuta</i> sp. ** | Water hemlock | | | | | | | | | | | | |
| <i>Cirsium breweri</i> var. <i>urangelii</i> * | Seep thistle | | | | | | | | | | | | |
| <i>Cirsium coulteri</i> | Cobweb thistle | | | | | | | | | | | | |
| <i>Cirsium quercetorum</i> | Brownie thistle | | | | | | | | | | | | |
| <i>Clarkia amoena</i> | Farewell-to-spring | | | | | | | | | | | | |
| <i>Clarkia gracilis</i> * | | | | | | | | | | | | | |
| <i>Collinsia bartolaeifolia</i> * | Chinese houses | | | | | | | | | | | | |
| <i>Cratogeomys californica</i> | | | | | | | | | | | | | |
| <i>Cryptantha leucantha</i> * | Coast cryptantha | | | | | | | | | | | | |
| <i>Cryptantha torreyana</i> ** | Torrey's cryptantha | | | | | | | | | | | | |
| <i>Cucurbit edulis</i> * | Salt marsh dodder | | | | | | | | | | | | |
| <i>Dalmanella decorum</i> var. <i>decorum</i> * | Blue larkspur | | | | | | | | | | | | |
| <i>Dalmanella nudicaule</i> | Red larkspur | | | | | | | | | | | | |
| <i>Dontaria californica</i> | Milk-maids | | | | | | | | | | | | |
| <i>Dichondra domelliana</i> ** R-E | California dichondra | | | | | | | | | | | | |
| <i>Rubroanthem hendersonii</i> | Shooting star | | | | | | | | | | | | |
| <i>Ruellia brittanica</i> * | Live-forever | | | | | | | | | | | | |

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VEGETATION--ESTEROS AMERICANO and de SAN ANTONIO

| Scientific Name | Common Name | Coastal Scrub | Coastal Prairie | Annual Grassland | Estuarine & Coastal Rocky Bluffs, Outcrops | Vernal Pool | Fresh Water Marshes, Ponds (border) & Seeps | Seasonal Brackish Marsh | Intermittent Streams Drainage Ravines | Coastal Strand | Bay Groves | Wetlands | Estuary |
|--|-------------------|---------------|-----------------|------------------|--|-------------|---|-------------------------|---------------------------------------|----------------|------------|----------|---------|
| NATIVE HERBS (Cont.) | | | | | | | | | | | | | |
| <i>Epilobium watsonii</i> var. <i>franciscanum</i> | Willow-herb | | | | | | | | | | | | |
| <i>Eriogon glaucus</i> * | Seaside daisy | | | | | | | | | | | | |
| <i>Eriophyllum lanatum</i> var. <i>arabizoides</i> | Golden yarrow | | | | | | | | | | | | |
| <i>Eryngium armatum</i> | Coyote thistle | | | | | | | | | | | | |
| <i>Echecholaia californica</i> | California poppy | | | | | | | | | | | | |
| <i>Fragaria</i> sp. | Strawberry | | | | | | | | | | | | |
| <i>Frankenia grandifolia</i> | Frankenia | | | | | | | | | | | | |
| <i>Frankenia chumieae</i> | Silver beach weed | | | | | | | | | | | | |
| <i>Frankenia chumieae</i> var. <i>bipinnatisecta</i> | | | | | | | | | | | | | |
| <i>Galium californicum</i> | Bedstraw | | | | | | | | | | | | |
| <i>Galium nuttallii</i> | | | | | | | | | | | | | |
| <i>Gaultheria shallon</i> ** | | | | | | | | | | | | | |
| <i>Gentiana oreana</i> | Sala | | | | | | | | | | | | |
| <i>Gilia capitata</i> | Gentian | | | | | | | | | | | | |
| <i>Gratiola californica</i> | Globe gilia | | | | | | | | | | | | |
| <i>Gratiola californica</i> | Cudweed | | | | | | | | | | | | |
| <i>Gratiola californica</i> | Cudweed | | | | | | | | | | | | |
| <i>Gratiola californica</i> | Cudweed | | | | | | | | | | | | |

* Observed only in Estero de San Antonio.

** Observed only in Estero Americano.

VEGETATION--ESTEROS AMERICANOS and de SAN ANTONIO

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| Scientific Name | Common Name | Coastal Scrub | Coastal Prairie | Annual Grassland | Estuarine & Coastal Rocky Bluffs, Outcrops | Vernal Pool | Fresh Water Marshes, Ponds (border) & Seeps | Seasonal Brackish Marsh | Intermittent Streams | Coastal Strand | Bay Groves | Wetlands | Estuary |
|---|-----------------|---------------|-----------------|------------------|--|-------------|---|-------------------------|----------------------|----------------|------------|----------|---------|
| NATIVE HERBS (Cont.) | | | | | | | | | | | | | |
| <i>Glycyrrhiza purpurea</i> | Cudweed | X | | | | | | | | | | | |
| <i>Grindelia rubricaulis</i> | Gum plant | | X | X | | | | | | | | | |
| <i>Helianthus puberulus</i> | Sneeze weed | | X | X | | | | | | | | | |
| <i>Heliotropium curassavicum</i> var. <i>oculatum</i> | Heliotrope | | | | | | | | | | | | |
| <i>Hemizonia congesta</i> | White tarweed | | X | X | | | | | | | | | |
| <i>Hemizonia multiflora</i> | Coast tarweed | | | X | | | | | | | | | |
| <i>Hesperomida tenella</i> ** | Cow parsnip | | | | | | | | | | | | |
| <i>Heuchera pinnatifida</i> | | | | | | | | | | | | | |
| <i>Hydrocotyle renunculaeoides</i> ** | Marsh pennywort | | | | | | | | | | | | |
| <i>Iris douglasiana</i> | Coast iris | | X | X | | | | | | | | | |
| <i>Jaumea carnosa</i> | Jaumea | | | | | | | | | | | | |
| <i>Lathenia rhynchosoma</i> | Gold fields | | | X | | | | | | | | | |
| <i>Lathenia platyrrhiza</i> ** | Marsh lathenia | | | X | | | | | | | | | |
| <i>Lathenia macrantha</i> | | | | | | | | | | | | | |
| <i>Lathenia macrantha</i> var. <i>chalamphila</i> * | | | | | | | | | | | | | |
| <i>Lathyrus ventricosa</i> var. <i>puberulus</i> | Hillside pea | X | | | | | | | | | | | |

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** Observed only in Estero Americano.