STATE OF CALIFORNIA

NATIONAL ESTUARY PROGRAM

THE NOMINATION OF MORRO BAY

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1991

OFFICE OF ENVIRONMENTAL PROTECTION
STATE WATER RESOURCES CONTROL BOARD

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OFFICE OF ENVIRONMENTAL PROTECTION
AND THE
STATE WATER RESOURCES CONTROL BOARD

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NATIONAL ESTUARY PROGRAM

THE NOMINATION OF MORRO BAY

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MORRO BAY

Governor's Nomination for the National Estuary Program
Under Section 320 of the Clean Water Act

By the powers conferred on us by the Governor of California and under Section 320(a)(1) of the Clean Water Act, we hereby nominate Morro Bay, San Luis Obispo County, California, for the National Estuary Program.

We recognize the need for a management conference on Morro Bay to better define the environmental concerns in the system; to address the extent, complexity and sources of pollutants; and to develop and implement a comprehensive conservation and management plan for action to protect and improve the Bay's condition. We further recognize that the State of California and the Environmental Protection Agency will share the responsibility for management decisions and resources regarding priority issues in the Bay.

In signing this nomination, we commit to the seven purposes of management conferences as outlined in the Clean Water Act [Section 320(b)] and, when the management conference is convened, the management conference will: assess trends in water quality, natural resources and uses; determine the cause of environmental change through data collection, characterization and analysis; evaluate point and nonpoint loadings and relate them to observed changes; write a comprehensive conservation and management plan which includes recommendations for priority actions; coordinate implementation of the comprehensive plan with Federal, State and local agencies; provide monitoring to assess the effectiveness of the implementation actions; and review Federal financial assistance program and Federal development projects for consistency.

We also agree to the statutory requirements for management conference membership [Section 320(c)] and that the State of California will participate in that Conference. Further, the statutory requirement for matching funds [Section 320(g)(3)] will be fulfilled by local funding. The Federal and local funds will be used to complete the characterization of priority problems and development of the comprehensive conservation and management plan.

W. Don Maughan
W. Don Maughan
Chairman
State Water Resources Control Board

Date: 5/30/91

James M. Strock
James M. Strock
Secretary for Environmental Protection
Office of Environmental Protection

Date: 5/30/91

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EXECUTIVE SUMMARY

Section 320 of the Clean Water Act established the National Estuary Program to address two situations concerning the nation's estuarine habitats: improvement of water quality and maintenance of water quality. Management conferences have been convened in a number of estuaries where there is a need to plan for the improvement of an already polluted situation. Morro Bay is relatively unpolluted and falls into EPA's second category. While the estuary is no longer truly pristine, it is less disturbed by human activities, and most of the pollution problems associated with other California estuaries have not yet occurred. However, the bay is filling with sediment at an unnatural and accelerating rate, and unless this problem is addressed soon, the life of the bay is threatened.

There are many known and potential threats to this nationally significant estuary. The State of California requests that the Environmental Protection Agency (EPA) Administrator convene a Management Conference for Morro Bay to define its complex biological, geographical and political relationships and to develop and implement a resource management strategy protecting and enhancing water quality, shellfish, fish and wildlife, and recreational values.

The estuary at Morro Bay contains the most significant wetland system on California's central coast. It serves a critical environmental function on the Pacific Coast as well as to international interests, in that it supports many species of migratory birds protected by International treaties and provides a protected harbor for off-shore marine fisheries.

The convening of a management conference for Morro Bay will be important for the future of the many species found there, especially the very large number of State and federally-listed endangered and threatened plants and animals which reside in or near the Bay or depend on Morro Bay for an important part of their life cycle. In addition to these identified species of concern, Morro Bay's geographic location results in an unique environment where southern species mix with northern species. This physical and biological assemblage is important in supporting many species at the edge of their range. Information learned about these species and attendant management strategies, will be critical to their continued survival, and should be directly applicable in other areas of their range.

The Bureau of Land Management and U.S. Fish and Wildlife Service have highlighted the lack of estuarine data from the central coast and the importance of this information to national planning.

> "Data on estuarine species inhabiting smaller estuaries and estuaries remote from university and/or marine labs (in particular, central California from Monterey to Point Conception) are scant. Biological and physical processes and interactions are poorly understood for major California estuaries and unknown for the smaller estuaries. The lack of such information severely limits the ability to assess potential effects on estuaries of human activities such as those associated with offshore oil and gas development" (Stokes and Jones, 1981).

The California State Legislature in Senate Resolution No. 176, declared in 1966 that the preservation of Morro Bay's fish, wildlife, recreational and aesthetic resources was of great importance to the people of California and recognized the need for a comprehensive management plan. This concern was reaffirmed on June 29, 1990 when the Legislature enacted Assembly Concurrent Resolution 118, which "affirms the importance and value of Morro Bay, its estuary, and its environs to the people of California...and supports the nomination of Morro Bay as a National Estuary as provided in federal law, to be administered by the EPA."

The process of convening a management conference for Morro Bay, and the subsequent development and implementation of a comprehensive conservation and management plan will be very different than that applied to the much more complex estuaries already in the program. The process developed here will be a valuable model for the large number of similar small estuaries nationwide.

A significant need exists for convening a management conference for Morro Bay. Local, state and federal agencies already support this goal. The state is prepared to strongly support this effort. Funding of at least 25 percent of the program will be provided by local sources to support the conference.

The State of California anticipates the rapid and successful completion of a comprehensive conservation and management plan for Morro Bay. There is broad support and an existing informal structure for a management conference. Acceptance into the National Estuary Program will allow this structure to coalesce and provide the formal relationships necessary to manage the bay in a comprehensive and integrated manner.

In conclusion, the State of California strongly supports the commissioning of a management conference for Morro Bay. We request that the EPA Administrator accept this nomination and direct his staff to take all measures to get this needed effort underway.

NATIONAL ESTUARY PROGRAM

THE NOMINATION OF MORRO BAY

INTRODUCTION

The National Estuary Program (NEP) became part of the Federal Water Pollution Control Act (Clean Water Act or CWA) with the enactment of the Water Quality Act of 1987 (PL 100-4).

The State of California submits this nomination of Morro Bay, San Luis Obispo County, California in accordance with Section 320(a)(1) of the Clean Water Act. The nomination was prepared using the final guidance for the contents of a governor's nomination (Environmental Protection Agency, 1988). The information which follows substantiates the national significance of Morro Bay, the need for convening a management conference and the likelihood of conference success.

The State of California is committed to participating in a Morro Bay management conference. The required 25 percent [Section 320(g)(3)] match will be provided by local in-kind funds. The State of California is also committed to the seven statutory purposes of the management conference [Section 320(b)]. The project will be guided by the management conference and will, first, assess trends in bay water quality, natural resources and uses; determine causes of environmental change through an assessment of data collection, characterization and analysis; evaluate point and nonpoint pollutant loads and relate them to the observed changes. Second, the project will prepare and the management conference will approve a comprehensive conservation and management plan which will include recommendations for priority actions; develop plans to coordinate the comprehensive plan with Federal, State and local agencies and organizations; provide monitoring to assess the effectiveness of the implementation actions; and review Federal financial assistance programs and Federal development projects for consistency.

The State also pledges to meet the statutory requirements of the management conference membership. Following the establishment of a Morro Bay NEP Policy Committee, a broad range of individuals from the public, local governments, local universities, user groups, environmental groups, State and Federal resource protection agencies, and federal, State and local regulatory agencies will be assembled from the present Task Force to form the various necessary committee structure. Committees formed will be a Public Advisory Committee, and a Technical Advisory Committee, with a number of technical subcommittees.

At the beginning of each section of the nomination the important questions are answered in summary form. After the questions, a more detailed explanation of topics required by the EPA guidance are discussed.

NATIONAL SIGNIFICANCE OF MORRO BAY

Morro Bay is significant on the national level because it is characteristic of many estuaries that face environmental and institutional problems. This portion of the nomination addresses the factors which demonstrate the bay to be a significant resource in need of a special program to preserve the bay's resources and prevent further degradation.

Questions

- **How can the lessons learned from this bay be applied to other coastal areas within the state or to other states? What problems, causes of those problems, and/or biogeographic area is represented by this estuary that is not already addressed by existing programs in the NEP?**

  Morro Bay is a relatively pristine estuary threatened by development pressure and changing land use. It is an example of the many small and medium sized estuaries on the Pacific Coast and around the nation that face similar threats. Sedimentation and habitat loss, including deepwater, lagoon, littoral and wetland habitat have already occurred. Shellfish harvesting has been restricted due to bacterial contamination. The development of technical solutions and institutional arrangements to prevent further pollution could save the natural resources of Morro Bay and serve as a model for saving resources elsewhere.

- **Why is the estuary important to the nation?**

  Morro Bay is the only major estuary in California south of San Francisco that has not been significantly altered by human activities. A large number of federally-listed endangered and threatened plant and animal species reside or occur in the watershed or rely on the estuary for a significant part of their life cycles. The estuary serves a critical environmental function for a number of migratory bird species of the Pacific Flyway. International treaties protect these species and their habitat. The estuary serves as an important breeding and nursing area for a number of species important to the commercial and recreational fisheries industry.

- **What is the geographic scope of Morro Bay?**

  The proposed study area is the watershed of Morro Bay and the Bay itself seaward to the breakwaters at the harbor mouth (Figure 1). The 48,000 acre (75 square miles) Morro Bay watershed lies entirely within San Luis Obispo County.

Opportunity for Application of Results to Other Estuary Programs

Morro Bay offers the National Estuary Program (NEP) an opportunity for a successful program to prevent the degradation of a relatively pristine estuary. Both its relatively small size and relatively simple political and institutional setting make it a site where significant results can be achieved within five years. The relatively pristine environment of Morro Bay offers the NEP an opportunity to address the protection and enhancement of estuaries. Many existing Management Conferences focus on impaired conditions and strategies for improvement. One problem not addressed through existing Management Conferences is threats to currently pristine environments. A Management Conference at Morro Bay could lead the way in providing protective management strategies which can be mirrored by the many threatened small estuaries across the nation.

Morro Bay's location, in juxtaposition with two of the National Oceanographic and Atmospheric Administration's (NOAA's) programs, the Elkhorn Slough Estuarine Research Reserve and the Monterey Bay Marine Sanctuary, has much to offer. A Management Conference for Morro Bay will complement these by implementing research findings and providing these programs much needed watershed management techniques.

Morro Bay's Importance to the Nation - (Living Resources)

Migratory Birds/Wetlands

Each year, millions of waterfowl and shorebirds migrate between their Canadian and Alaskan arctic and Great Plains breeding areas and their wintering areas along the coasts of southern North America, Central America, and South America. The international nature and importance of these populations have been recognized and have been protected and managed through international treaties since 1918. These migrations occur along chains of wetlands, known as "flyways," which provide migratory resting and feeding stops and overwintering areas.

Morro Bay's position makes it an important component of the Pacific Flyway's coastal wetlands. At the beginning of the century, there were 28 estuaries of significant size between Morro Bay and Ensenada, Mexico. Since that time 15 estuaries have been modified slightly or moderately, 10 have been altered drastically, and three have been destroyed (Bureau of Sport Fisheries and Wildlife, 1972). By 1975, Morro Bay was identified as one of the top 10 priority wetlands in California by the U.S. Bureau of Sport Fisheries and Wildlife and by the State Department of Fish and Game (California Coastal Plan, 1975).

In California, approximately 90 percent of all wetlands (Dennis et al., 1984) and 70 percent of the coastal wetlands (Speth, 1979) have been destroyed by draining, dredging, or filling. Although in recent years destruction of wetlands has abated, it has not ceased. Additionally, new threats have been identified, such as accumulation of toxins from agricultural, industrial and urban runoff, and increasing freshwater diversions.

The estuary, together with adjacent inshore ocean waters and upland freshwater locations, annually hosts approximately 25 species of migrant and overwintering waterfowl. According to the records of the Morro Coast Audubon Society's Christmas Bird Count, held annually since 1961, the most abundant wintering waterfowl have been American widgeon,* lesser scaup, brant, and northern pintail. Significant numbers of ruddy duck, surf scoter, bufflehead, and green-winged teal also overwinter at Morro Bay.

In addition to waterfowl, Morro Bay is an important migratory stop and wintering area for shorebirds (avocets, stilts, plovers, sandpipers, and phalaropes). Up to 24 species have been identified during the annual Audubon Christmas counts, and an additional 10 species have been recorded during migratory stopovers on the estuary.

In 1988, Point Reyes Bird Observatory (PRBO) began a project to determine the status and prospects for shorebirds in wetlands of the Pacific Flyway. Among the goals of the project are to obtain a measure of shorebird use of each major wetland of the Flyway, to identify long-term trends in shorebird abundance, to document the threats to population stability, and to promote conservation of wetland habitat.

Census of shorebirds on Morro Bay estuary are being conducted as a part of PRBO's Pacific Flyway Project. Results of these censuses have shown interesting and important differences between Morro Bay and most other northern and central California wetlands. At Morro Bay, willets and marbled godwits make up a substantially larger percentage of the total population than at most other sites. Also, least sandpipers greatly outnumber western sandpipers at Morro Bay, whereas the converse is true for most other coastal wetlands. The significance of these differences is not well understood, and further research is needed.

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*Scientific names were not used in order to make the nomination more readable to the non-scientist.

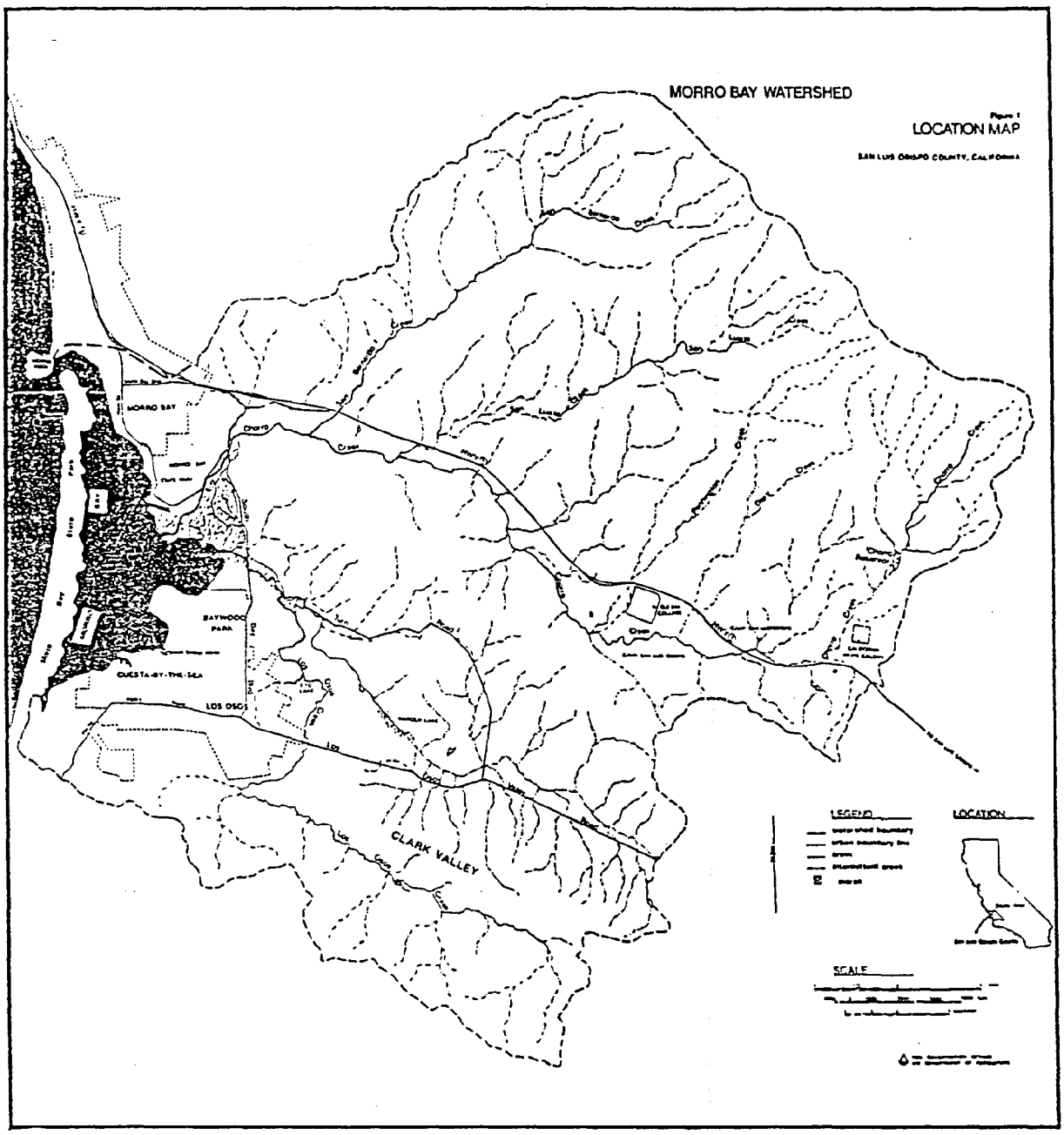


Figure 1. Morro Bay Study Area

Source: USDA/SCS 1989. Erosion and Sediment Study, Morro Bay Watershed. Coastal San Luis Resource Conservation District and California Coastal Conservancy.

Western Hemisphere Shorebird Reserve Network is an international coalition of organizations committed to shorebird conservation through international recognition of important sites. Significance is recognized at two levels, Hemispheric Sites and Regional Sites. Regional Sites are those holding over 20,000 shorebirds or over 5 percent of any species' population over a year. Morro Bay is likely to qualify as a Regional Site (Stenzel et al., 1989).

Nursery Functions of the Estuary -- Riparian Habitats

Chorro and Los Osos creeks provide the primary freshwater input to the estuary. These creeks support an assemblage of native fish which include steelhead rainbow trout, three-spined stickleback, prickly sculpin, and tidewater goby. The creeks support dense riparian vegetation, which serve as transportation corridors and habitat for numerous species of birds and wildlife. Sensitive species such as redlegged frogs and southwestern pond turtles can be found inhabiting these areas.

The creeks provide spawning and nursery habitat for steelhead, an important recreational species on the Pacific coast. California state policy (California Fish and Game Code, 1988) recognizes steelhead as a valuable resource with strict environmental requirements and a limited range. It also recognizes that California's steelhead resources are largely dependent upon the quality and quantity of habitat available to them. The Chorro Creek watershed supports one of the southernmost remaining runs of steelhead on the Pacific coast. Steelhead are especially dependent upon low salinity estuarine environments and freshwater habitats. The Morro Bay estuary provides the transition environment critical to the juvenile phase of this fishery. Because of damage and threats to their restricted habitat, state policy requires that emphasis shall be placed on management programs to inventory, protect, and restore or improve the habitat of natural steelhead stocks (California Fish and Game Code, 1988). Recent research has identified estuary and lagoon environments as optimum nursery areas for juvenile steelhead with growth rates and densities of fish much higher than in freshwater areas (Smith, 1987).

The Federal Fishery Conservation and Management Act of 1976 and Fish and Wildlife Coordination Act also emphasize the importance of maintaining anadromous fishery resources and habitats. Section 404(b)(1) of the Clean Water Act (450 CFR Part 230) specifically identifies riffle and pool habitat "complexes" as special aquatic sites of concern. These areas provide primary feeding, spawning and rearing habitat for steelhead and other fish. Siltation is regarded as a source of fill under Section 404, and is particularly detrimental to riffle and pool habitat. The Clean Water Act specifically recognizes the need to regulate the discharge of fill in and adjacent to riparian habitats, wetlands and streams. Additionally, President Bush has instituted a national policy of "no net loss of wetlands." This wetland policy could affect the estuarine environment of Morro Bay itself, as well as to the upland riparian vegetation throughout the watershed.

Nursery Functions of the Estuary -- Estuarine and Marine Systems

Estuaries play a vital role in the reproductive and early life histories of numerous species of fish and invertebrates which form the basis of many recreational and commercial fisheries. Estuaries provide a level of protection and productivity found nowhere else. Of the more than 70 fish species listed as occurring in Morro Bay (Gerdes et al., 1974; Nakamura, 1986), 30 species are economically important, and most of the others are ecologically important forage species. There is a growing concern that environmental problems, such as sedimentation and water quality degradation, have substantially reduced the estuary's productive capabilities.

An example of this may be represented by the status of California halibut in Morro Bay. This fish is one of central and southern California's most popular recreational and commercial species. Recent work conducted by researchers in southern California (Kramer and Hunter, 1987) has shown that the majority of juvenile halibut spend their first year in the shallow waters of estuaries and enclosed bays. This research has lead to speculation that the sharp decline of halibut in southern California since the 1930's is directly related to loss of estuarine habitat. The same thing may be happening in Morro Bay. California Fish and Game biologists have attempted on several occasions in 1988 to collect juvenile halibut in Morro Bay, but have yet to find a halibut younger than two years of age (L. Laurent, pers. comm.). This may indicate that the fisheries are not being sustained by estuarine nursery production and may be jeopardized. The combined recreational and commercial value to the local area of this one fishery alone, averages approximately $500,000 annually.

Endangered and Threatened Species

San Luis Obispo County's rich biotic diversity is partially the result of its geographic location within the climatic transition zone between northern and southern California. A high number of threatened and endangered species are dependent upon the diverse habitats of the estuary and watershed for their survival and recovery. Although many of the rare species occur in publicly-owned, environmentally sensitive areas, there is concern that increased human encroachment and further loss of habitat due to development will result in more species being listed, especially plant species (California Native Plant Society [CNPS], undated). Federal Candidate 1 and 2 species are included in Table 1.

The stabilized dunes support the coastal dune scrub which is the habitat of the banded dune snail and the Morro Bay kangaroo rat, both of which are listed as endangered by international, Federal and State agencies. Both species have been reduced by loss of habitat due to development and competition or predation with introduced species (other snail species and house cats, respectively). The Morro Bay kangaroo rat requires open, sandy areas rather than mature scrub which occurs in the absence of periodic fires. Recovery efforts for this species include the establishment of the Morro Dunes Ecological Reserve, habitat rehabilitation activities and a captive breeding program for eventual reintroduction.

The bay and ocean beaches are the preferred hunting and resting areas for the California brown pelicans which are primarily May to February visitors, with a small year-round population of immature non-breeders. Pesticide pollution once reduced this species' reproductive success but the population seems to be recovering.

The reproductive success of the American peregrine falcon in Morro Bay has been reduced to dangerously low levels. Some detrimental factors, still present in the ecosystem, are impacting new adult falcons here. The pair of peregrine falcons at Morro Rock requires monitoring and manipulation to produce young. Morro Rock Ecological Reserve, which provides nesting sanctuary, is the most famous natural nesting site for peregrine falcons on the Pacific coast. The coastal strand and wetlands in and around the bay offer prime foraging habitat for wintering falcons and for the resident pair.

The snowy plover, a federal candidate, utilizes the sandspit and sandy ocean beaches around Morro Bay to nest and forage. Populations of this shore bird are declining due to predation (Hutchinson et al., 1987) and human activity.

The southern sea otter has only recently become a familiar sight inside the bay as the population is expanding. Morro Bay is close to the present southern limit of the sea otter's range.

Table 1. Federal and State Listed Threatened and Endangered Species in Morro Bay Estuary and Watershed

Common Name	Scientific Name	Status
Banded Dune Snail	Helminthoglypta walkeriana	1
California Brackishwater Snail	Tyronia imitator	2
*Morro Blue	Plebejus icarioides moroensis	2
Monarch Butterfly	Danaus plexippus	INT
Tidewater Goby	Eucyclogobious newberryi	2
Black Legless Lizard	Anniella pulchra nigra	2
California Brown Pelican	Pelecanus occidentalis californicus	FE, CE, CP
Golden Eagle	Aquila chrysaetos	CP
American Peregrine Falcon	Falco peregrinus anatum	FE, CE, CP
California Black Rail	Laterallus jamaicensis coturniculus	2, CT, CP
California Clapper Rail	Rallus longirostris occidentalis	FE, CE, CP
Snowy Plover	Charadrius alexandrinus	2
Western Yellow-billed Cuckoo	Coccyzus americanus occidentalis	2, CT
. . . . .	. . . . .	. . . . .
Morro Bay Kangaroo Rat	Dipodomys heermanni morroensis	INT, FE, CE, CP
Southern Sea Otter	Enhydra lutris nereis	FT, CP
. . . . .	. . . . .	. . . . .
Beach Spectacle Pod	Dithyrea maritima	2
Arroyo De La Cruz Manzanita	Arctostaphylos cruzensis	2
Morro Manzanita	Arctostaphylos morroensis	1
Indian Knob Mountain Balm	Eriodictyon altissimum	1
Pt. Reyes Birds's-Beak	Cordylanthus maritimus palustris	2
Salt Marsh Bird's-Beak	Cordylanthus maritimus maritimus	FE, CE
Jones Layta	Layia jonesii	2

Status codes: INT = IUCNN "Red Book" CE = California, Endangered 1 = Federal Candidate, sufficient evidence to list
FE = Federal, Endangered CE = California, Threatened
FT = Federal, Threatened CP = California, Fully Protected 2= Federal Candidate, may warrent listing
* listed in California DPR, 1987

The salinity requirement of the California brackish water snail (32 parts per thousand [ppt]) indicates that it occurs near the freshwater inflows. Patchy but abundant populations of this Federal Candidate 2 species are found near Los Osos Creek.

The coastal brackish marsh, near the mouths of Chorro and Los Osos Creeks is the habitat of the tidewater goby. This small fish is vulnerable to human disturbance because of its restricted habitat requirements, short lifespan and limited movement of the isolated populations.

The upland reaches of the watershed, extending to the volcanic peaks which separate the two watersheds, is habitat for the golden eagle, a state-protected raptor that is a year-round resident here. Large hunting territories are required by this species, so only a few pairs should be expected in a watershed dominated by cattle grazing and intensive vegetable farming.

The monarch butterfly is not in danger of extinction as a species, but the North American populations are very vulnerable due to their overwintering strategy of congregating in large flocks along the coast. The conservation of monarch butterfly overwintering sites (such as those around Morro Bay) have been designated as a top priority of the International Union for the Conservation of Nature and Natural Resources. The monarch butterfly is protected internationally by the Convention on the Conservation of Migratory Species of Wild Animals (Nagano and Lane, 1985).

Riparian willow thickets along creeks in the Morro Bay watershed are nesting and foraging habitat and suspected nesting habitat for the threatened western yellow-billed cuckoo. There have been no recent records of nesting cuckoos in the Morro Bay area.

Arroyo de la Cruz manzanita grows in the uplands near Hollister Peak and southeast of Los Osos Creek, on south facing slopes of the bluffs near Los Osos mesa. Jones' layia (a member of the sunflower family) grows in the Chorro Valley and on Black Hill. Both species have Federal Candidate 2 status.

Morro manzanita and the Indian Knob mountain balm grow in the coastal sage chaparral of north and west facing slopes of old dunes. The beach spectacle pod occurs on the Morro Bay Sandspit on stabilized, younger coastal dunes where the black legless lizard is also found. The morro blue butterfly is found in the Los Osos Oaks Reserve, a community of dwarf coastal live oaks, coastal sage scrub, and riparian vegetation.

The coastal salt marsh, in the shallowest parts of the bay, characterized by pickleweed and jaumea is home to the very rare California black rail and the California clapper rail. Only small remnant populations exist in a few of California's estuaries. The California clapper rail has not been reported in Morro Bay in recent years. Black rail populations here are very low, probably due to habitat losses and discontinuous areas of remaining habitat.

Salt marsh bird's-beak, a Federally and State endangered plant, and the Pt. Reyes bird's-beak exist in the upper marsh zone where sedimentation, alterations in shallow groundwater flows, and foot traffic pose a threat. Sweet Springs preserve will help to protect a population of salt marsh bird's-beak.

Geographic Scope of the Estuary

The Morro Bay study area will include the Morro Bay watershed seaward to a line connecting the breakwaters at the harbor mouth (Figure 1). Morro Bay estuary extends from its connection with the open ocean at the extreme northern end up into the freshwater portions of Chorro and Los Osos creeks. Morro Bay meets the statutory

definition of an estuary. Chorro Creek and its tributaries have traditionally supported steelhead runs to their upper reaches. These migrations continue today but are threatened by dams, water diversions, sedimentation and loss of riparian habitat. Estero Bay, the marine system seaward of Morro Bay, is not within the study area but has several facilities and hydrologic systems that interact with Morro Bay. These are mentioned in this document and will be fully addressed in the comprehensive conservation and management plan. The Morro Bay watershed lies entirely within San Luis Obispo County, California, with the city of Morro Bay and the County being the only local jurisdictions.

The Morro Bay Estuary lies at the western end of two coastal valleys (Figure 1). The valleys have been developed by erosion of broadly folded sedimentary rocks, especially of the highly erosive Franciscan Formation. The western ends of the valleys, which are oriented nearly east-west, are drained by Chorro Creek and Los Osos Creek. The valleys empty into the most easterly portion of the estuary, with Chorro Creek terminating in a marsh delta within the tidelands, and Los Osos Creek ending in a tidal estuary.

Morro Bay itself has developed as a result of the gradual inundation of the seaward ends of the two valleys by the rising post-Ice Age ocean, and therefore is a young geologic feature of less than 15,000 years in age. The rising sea also eroded coastal sands, and a barrier beach developed in front of the rising, eastward migrating beach system. The barrier beach, now known as the Morro Bay Sandspit, extends along the western edge of the estuary. Dunes migrate across the sand spit, which is about four miles long and about one-quarter of a mile in width. The spit is connected to the mainland only at its southern end, has no roads or off-road vehicle trails, and therefore has high value as animal and plant habitat. The entire sandspit-estuary complex lies at the center of the broader Estero Bay, that extends from Point Buchon in the south to Cayucos Point in the north.

Estero Bay is a closed littoral cell, from which beach sand apparently does not escape. Large areas of older sand dunes cover much of the shoreline in the southern parts of Morro Bay. At the extreme northern end of the Bay, a channel runs between the end of the sand spit and the old volcanic plug of Morro Rock out to the ocean. The estuary extends southward from the entrance between the City of Morro Bay on the east and the sand spit on the west. The northern portion of the estuary is about one-quarter of a mile wide. It is dominated by a dredged channel which is the main mooring area for vessels. About one mile south, the estuary widens to the east to a width of about three-quarters of a mile. Tidal dispersion has constructed two marshy islands in the middle of the estuary in this area. The southern portion of this part of the estuary is flanked to the east by Morro Bay State Park, where a generally natural shoreline has been preserved, including a major heron rookery.

The bay widens to a maximum width of just over 1.5 miles at the tidal marsh and delta of Chorro Creek and the marsh of Los Osos Creek. This is the site of the greatest tideland loss to sedimentation. The delta and associated saltmarsh presently comprise about 400 acres. This area represents an increase of 200 acres since 1884 (Haltiner, 1988). The northwestern edge of the Chorro Creek delta has been dredged into a marina, and the Corps of Engineers maintains a dredged channel from near this point to the ocean. Tidal channels south of this point are not dredged.

The bay extends south of the Los Osos Creek mouth for 1.75 miles. Baywood Point closes the width of the bay to three-quarters of a mile. South of the Point, the bay opens again to a mile in width. At the extreme southern end, a southwest trending shoreline narrows the bay to a tidal channel at Shark Inlet, hard against the sand spit.

The southern portion of the bay is dominated by tidal mud flats of very fine sediment. Sedimentation on these flats threatens the estuarine environment of the bay. The tidal channels contain water at low tide, and provide food for the dense bird populations. The flats are ringed by a narrow zone of saltwater marsh, and above that lies a patchy

freshwater marsh that is supplied by effluent groundwater. Fairly large patches of pickleweed-dominated marsh occur on the edge of the sand spit, around Shark Inlet, at Cuesta-by-the-Sea, at Sweet Springs in Los Osos, and north and west of the Elfin forest.

NEED FOR A MANAGEMENT CONFERENCE FOR MORRO BAY

Significant, unresolved land use planning issues are causing environmental problems in and around the bay. These problems include habitat loss, declining fishery resources, poor water quality and reduction of the volume of the bay due to sedimentation. The difficulty in effectively addressing these problems is compounded by the overlapping and sometimes conflicting governmental responsibilities in the Morro Bay watershed. The combination of environmental and institutional issues can be best addressed by the formal convening of a management conference which will lead to development and eventual implementation of a comprehensive conservation and management plan.

Questions

- **What is the importance of the estuary at Morro Bay on a local or regional scale?**

  The 2,300 acres that comprise Morro Bay contain the most significant wetland system on the central coast. The estuary also serves an important nursery function for many species of fish and invertebrates, including steelhead and halibut. Morro Bay is unique in its retention of much of its ecological integrity in a coastline that is increasingly overdeveloped. Beyond these resource values, the bay offers residents and visitors outstanding scenic, aesthetic, scientific and recreational values. It supports important commercial fishing, mariculture operations and a thriving tourist industry.

- **What are the major environmental problems facing the estuary?**

  Erosion in the watershed and sedimentation in the estuary are the greatest threats to Morro Bay. The scientific community is in agreement that if sediment deposition in the estuary continues at the present rate, the health, and indeed the very life of the estuary is in severe jeopardy. Under normal conditions, an estuary and lagoon such as Morro Bay, could have a life measured in the thousands of years (USDA/SCS, 1989a). However, if there is no abatement of sediment deliveries to the estuary, its life expectancy is likely limited to some 300 years (Haltiner, 1988), with parts of the southern section of the bay disappearing much sooner. The economic and environmental impact of the death of the estuary would be severe.

  In addition, development pressures in this region of the Central California coast are great. Increasing population density and changing land use threaten water quality and wildlife habitat. Urban runoff, discharge of sewage, and contamination by pathogens and toxic substances are all potential problems for Morro Bay, as for most estuaries. High coliform concentrations have been found in the Bay resulting in the restriction of shellfish harvesting from time to time (Department of Health Services, 1985). For the most part these potential problems are not adequately understood. With proper planning and monitoring, the impacts of development on Morro Bay can be understood and solutions developed before the estuary becomes severely impaired.

- **What are the institutional arrangements for the watershed and how are they working?**

  There are several city, County, State and Federal agencies with varied responsibilities in the watershed. While there are on-going efforts to pull these together, there is no single agency or management program to coordinate or to formalize this effort.

- **What is known about cause/effect relationships and how do you propose to better identify the causes of environmental problems?**

  Recent studies have demonstrated that human activity and land use in the watershed are related to sedimentation and loss of habitat in the bay, including estuarine waters, which serve an important nursery function, and riparian habitats. Inadequate waste treatment is known to periodically cause poor water quality. By focusing interest on specific questions (such as freshwater in-flows, waste treatment, species of concern, etc.), we will be able to avoid a crisis in Morro Bay and act to prevent pollution and enhance the Bay.

Economic Importance

The Morro Bay estuary has tremendous value for not only local residents, but also for the entire state, and the nation. The estuary is used extensively on a year-round basis by both residents and visitors from all over the country. The small city of Morro Bay, as well as several of the adjacent communities, derive much of their economic livelihood from the estuary and the people that use it. Beaches, parks and wildlife sanctuaries; sport and recreational fishing facilities and related businesses; marinas and harbors; the extensive development of tourist uses, including restaurants, retail shops, and numerous motels; other bay-dependent commercial and industrial uses; scientific and educational research; and governmental services all bring income to the community. These uses depend upon long-term protection of the bay's scenic quality, wildlife resources and good water quality.

Recreational Uses

Beaches, Parks, and Wildlife Sanctuaries

Morro Bay and Montana de Oro State Parks represent the second largest land use acreage next to agriculture in the watershed. State and city parks and beaches in the area include over 2250 acres within the city limits of Morro Bay. Morro Bay State Park, one of the oldest state parks, provides diverse recreational amenities including a golf course, a developed marina, a natural history museum, wetlands and open water, and a large intensively used campground with 130 campsites. This park is used year-round by 500,000 visitors from throughout the state and nation who come to enjoy Morro Bay's pristine and scenic natural setting.

The south and west shores of Morro Bay are bordered by Montana de Oro State Park. The westerly shore of the bay is formed by a sand dune complex that is one of the principle dune systems within the State of California. The extreme north portion of the estuary is bounded by Morro Rock and the Morro Strand State Beach, again under the supervision and management of the State Department of Parks and Recreation. Morro Rock is a spectacular 587-foot high volcanic plug, and the largest such feature on the entire California coastline. The rock itself is a significant visitor destination point and landmark that contributes to the unusual and spectacular setting for which the estuary is known.

Wildlife resources also bring visitors to the area. The bay lands under the city's jurisdiction have been designated as a bird sanctuary, and portions of the state park systems are set aside as environmentally sensitive wildlife and plant habitats. The federally-listed rare and endangered peregrine falcon nests on Morro Rock. Due to the accessibility and proximity of a variety of habitats, the area is a popular destination point for bird watchers, botanists, nature photographers and duck hunters.

Sport and Recreational Fishing

Several commercial "party boats" sail from Morro Bay on a year-round basis. These boats operate from private wharfs within the city limits, fishing along the coast as well as within the bay. Their owners also operate fishing equipment supply outlets. Along with other recreational fishing pursuits, sport fishing is an important part of the local economy. These boats collectively generate between $1 million and $1.5 million per year in gross revenues and employ 65-70 employees during the summer and 30-35 employees during winter months.

For the saltwater angler, year-round opportunities provide catches of lingcod, many rockfish species, and cabezon, along with seasonal catches of king salmon (February to November), albacore (September to November), and halibut (July to December). The combined recreational and commercial value to the area of local halibut averages $500,000 yearly.

Although clams are not nearly as prevalent as they once were, Morro Bay still maintains a variety of clams: gaper, Washington, littleneck and geoducks. Rock and dungeness crabs can also be found here seasonally by the resourceful fisherman, and ghost shrimp are harvested from the mudflats.

Marinas and Harbors

The central coastline of California from Monterey to Morro Bay represents one of the longest unprotected shorelines on the Pacific Coast. Morro Bay estuary is the location of a large year-round and all weather commercial and recreational boating harbor. The nearest such harbors are Monterey Bay, over 100 nautical miles to the north, and Santa Barbara, 100 miles to the south. Because Morro Bay provides the only location within many miles to gain year-round boating access to the Pacific Ocean, it provides a critical resource to the commercial fishing and recreational boating industries.

There is an extensive complex of private and public berthing facilities consisting both of docks and piers and fixed moorings within Morro Bay. The City Harbor Department manages approximately 450 berths or moorings. In addition, the state park marina at Morro Bay State Park provides recreational berthing for another 100 or more vessels. Piers or platforms extending from street ends into the bay are available for recreational fishing. There continues to be demand for berthing beyond the available supply. The city of Morro Bay is considering a private proposal to construct a 65-slip recreational boat marina in an area of potentially sensitive wetlands resources.

The rock revetment along the north shore of Morro Bay estuary is used extensively by sport fishermen and scuba divers. In the southern end of Morro Bay, many private homes have small docks or beaches from which small recreational craft are launched. A small dredged marina is located at Cuesta-by-the-Sea. In addition, several small beaches within the bay are sites for launching of small craft, including power boats, sailboats, canoes, kayaks, rafts, sailboards, and jet skis.

Tourism

Morro Bay, as one of the few relatively intact natural estuaries on the Pacific Coast, attracts an average of 4000 tourists daily, or 1.5 million annually to its environs. In fact, Morro Bay's economy is dominated by tourism and visitor-serving businesses, generating 37 percent of all jobs in the city and one-third of the city's general fund revenues. The motel industry contributes the majority of the City's tourism-generated revenues. There are 930 motel rooms (42 motels) in the city of Morro Bay, representing 37 percent of all motel rooms on the north coast of San Luis Obispo County from Los Osos to San Simeon. Bed taxes were $845,000 in Fiscal Year 1988-1989. Several million tourists annually travel north and south on Highway One passing through the city of Morro Bay. Consequently, in addition to tourist and recreational visitation destined specifically for the bay, thousands of persons each year use the bay as they journey on Highway One. A primary attraction for this high level of tourism is the estuary and the scenic waterfront and surrounding watershed. The health of the estuary has been identified as critically important to the long-term tourist and economic life of the city.

Commercial/Industrial Uses

Commercial Fisheries

As the area's only year-round all-weather port, Morro Bay has long been important as a commercial fishing center. Indeed, the city of Morro Bay takes its very origins from the commercial fishing industry and is widely identified as a fishing community. Commercial fishing remains one of the area's chief economic activities. Fishing activities include hook and line fishing for rockfish, albacore and salmon, trawlers, gillnetters and trap fishermen. A recent economic study prepared by the city of Morro Bay indicated that commercial fishing and related support activities contributed significantly to the city's overall operating income.

Shipping

The Morro Bay harbor provides tugboats and support personnel for several off-shore oil transfer terminals in Estero Bay. These terminals include fuel delivery for the large Pacific, Gas and Electric (PG&E) steam generating plant at Morro Bay, on-loading facilities for crude oil from Chevron's tank farms at the north end of Estero Bay, and off-loading of jet fuel for Lemoore Naval Air Station, located in the San Joaquin Valley. Morro Bay is the only harbor in the area capable of providing this service.

Oil and Gas Development

Morro Bay serves as the home port for an active off-shore construction company that primarily serves the Outer Continental Shelf (OCS) oil industry. This business docks several ocean tugs in Morro Bay and a large construction barge. Future development of OCS lands in the region could potentially result in dramatic increases in related work in Morro Bay.

Industrial Water Supply/Energy

The mouth of Morro Bay is the site of one of the major steam electric generating plants on the Pacific Coast. Owned by the PG&E, the thermal plant at Morro Bay draws water directly from the estuary to cool its boilers. Heated water is discharged to the ocean just north of the estuary. The PG&E facility is the single largest industrial employer in Morro Bay and is a mainstay of the local economy, employing 130 people.

Educational and Scientific Research

There is increasing interest in the Morro Bay estuary as a site for educational and scientific research. The estuary contains large tracts of intertidal and marsh area and the area's ready accessibility provides an ideal location for both educational and scientific work. The Bay Foundation of Morro Bay (a spin-off of Morro Bay Task Force activities) is a private, non-profit, organization conducting research on the bay. A private foundation is currently pursuing plans to develop a research station on the shores of Morro Bay within the city limits. This facility would be open to the public, would provide a research function for studying the Bay's resources and have educational classrooms for use by area schools. The presence of Cal Poly University, San Luis Obispo, and their recently formed Coastal Resources Institute, underlines the importance of marine research and education at Morro Bay.

Several other universities schedule regular field trips to Morro Bay, many students from the Central Valley come to the Kern County Environmental education camp, and the Morro Bay Natural History Museum serves 10,000 students, and a total of 79,000 visitors annually.

Mariculture

Morro Bay is the site of several mariculture operations, and this young industry is growing. Central and southerly portions of the estuary are used for oyster growing. Presently, 742 acres of mudflats are leased for oyster and mussel growing. This enterprise is regulated by the State Department of Fish and Game. The shellfish harvested from these beds are sold to local markets and restaurants, as well as being shipped to other regions.

Two companies are currently involved in abalone production in Morro Bay. One facility is aimed primarily at research and seed development, using seawater pumped from the bay and recirculated through their facility, while the other is developing large grow-out facilities on property leased from the PG&E plant. Because of the size of this latter facility, it is expected to contribute important economic benefits to the local area. The available sites on the shores of Morro Bay where clean seawater can be extracted and then returned provide an ideal operating environment for these activities. Maintenance of high water quality in the estuary is vital to ongoing mariculture operations.

Living Resources

Virtually every remaining coastal wetland is unique in its combination of wildlife resources and natural attractions (California Department of Fish and Game, 1972). The uniqueness of the biotic resources and the scenic attraction of Morro Bay and its wetlands are enhanced by its relative natural state and geographic location. As the "most significant wetland system in the central coast" (Arnold, 1987) of California, it is of vital importance to a great variety of migratory and resident species, including many rare and endangered species.

Just as the combination of scenic quality, access to diverse recreational opportunities and a wide selection of visitor services act to attract human visitors and residents, it is the proximity and diversity of interconnected ecosystems (nearshore reefs, sandy beaches, dunes, bay, mudflat, riparian, upland and Morro habitats) which make Morro Bay and watershed a vital wildlife habitat. Such diverse resources (Table 2) in a small area produce an unusual richness of species diversity and high population numbers for some species, especially during winter months. The high percentage of publicly-owned lands in and adjacent to the bay help to maintain the integrity of many environmentally sensitive areas, including habitats of rare species, but other factors outside these lands continue to threaten that integrity.

The many habitats of Morro Bay can be largely differentiated by their exposure to salt water and characterized by their dominant plant species. Scientists generally delineate three estuarine zones: marine, that area continually under water; littoral, that area subject to tidal influence; and maritime, that area between the upper edge of the littoral zone and the upland vegetation (Gerdes et al., 1974).

The nearshore and pelagic marine area outside the bay is important to note because the quality of that environment and the numbers and types of species affect the fish, bird and marine mammal populations which use the bay. Fifty-eight important fish species (Figure 2) were listed in the area by California Fish and Game (Blunt, 1980). More than 15 species of fish are known to spawn in the bay (Fierstine, et al., 1973). The presence of both rocky and sandy bottom habitats off-shore increases the species diversity within the bay.

The zonation of estuary vegetation (Figure 3) reveals areas of bare mud. Mud flats are rich in organic matter and provide habitat for large numbers of invertebrate species such as crabs, clams, snails and worms. These areas are favored by harbor seals, shorebirds, bird watchers, and shellfishermen. Eelgrass is a very valuable resource as a primary food source for wintering brant and is important for many other species in the bay. Eelgrass currently covers 723 acres (Josselyn et al., 1989) within the marine and lower littoral zones of the bay.

The freshwater discharged from the Los Osos and Chorro Creeks into the estuary transports nutrients that serve as an important food source for the whole bay complex. Additionally, this freshwater prevents the bay's salinity from exceeding the tolerance level of many estuarine species.

Riparian thickets of arroyo willow, blackberry and poison oak occur around Los Osos and Chorro Creeks. This riparian area is important for bird nesting. Some exotic species, most notably German ivy, have invaded riparian and freshwater wetlands.

The maritime zone borders almost all of the bay except the developed harbor. It is composed of grassland or coastal scrub. Sea blite, statice, salt-wort, and annual saltbush. Shrubs on the dunes are dominated by silvery lupine, mock heather, and coyotebrush, while sand verbena, beach primrose, live-forever, and sea rocket, colonize the dunes. Several dune plants are listed by the California Plant Society as plants of special concern. Maritime habitats furnish important escape, nesting and resting cover for many estuarine birds and mammals (Gerdes et al., 1974), most notably the rare Morro Bay kangaroo rat.

Upland vegetation around the Los Osos area is primarily coastal sage (black sage, bush lupine, buckwheat and deer weed) interspersed with residential areas and some oak woodlands. The soil conditions produce twisted coastal live oak such as in Los Osos Oaks Reserve or "Elfin Forests" of stunted, wind-pruned trees on ancient dunes near the bay. Grass lands of non-native species are grazed in the watershed; however, a few native grasslands (Stipa) are still found in the watershed area on park land (California Natural Diversity Data Base, 1988). Chaparral (California sage, black sage, and manzanita) and oak woodland are found on the Morros in the upper watershed. These undisturbed areas are valuable habitat for some rare manzanita species and many species of special concern to California Fish and Game, such as golden eagles and peregrine falcon.

Agricultural land in the watershed is a mix of irrigated and dry farm croplands in the low lands and grazing on the hilly and lower mountainous areas. It is the complex interaction of these marine, estuarine and upland plant communities that provide feeding, resting and nursery areas for thousands of migratory birds as well as fish and marine mammals. Migratory birds use Morro Bay as a site to feed and rest during fall and spring migration or as wintering habitat. The U. S. Fish and Wildlife Service Migratory Bird List contains 44 coastal, pelagic and shoreline species; 30 waterfowl species; and 200 upland migratory bird species.

Table 2. Habitat Distributions of the Morro Bay Watershed

Ocean Front	4 miles
Marine	
Harbor Entrance & Natural Channels	6+ miles
Littoral	
Open Water at High Tide	2,300 acres
Mud Flats	1,450 acres
Eelgrass	723 acres
Saltmarsh Pickleweed	472 acres
Oyster Leases	742 acres
Maritime	
Sandspit and Dunes	735 acres
Riparian & Upland	
Riparian Woodlands within the State Park	82 acres
Willow Thicket within the State Park	27 acres
Total Watershed	48,000 acres
Total Wetlands	2,500 acres

* The habitat descriptions are not mutually exclusive, therefore areas can't be added to arrive at the totals.

The abundance and diversity of bird species alone is a good indication of the quality and quantity of food and resting habitat around the bay. Audubon Society's Christmas counts record Morro Bay as consistently among the top 15 spots out of 963 sites nationwide for diversity of winter bird species, with around 200 species and over 50,000 individual birds censused in a single day in December (Persons, pers. comm.). The Morro Bay area is considered to be one of the most important stop-over points on the Pacific Flyway in the central and south coast (Arnold, 1987).

In winter, shorebirds are more abundant than any other group of birds with marbled godwits, willets and sandpipers being most numerous. Waterfowl are second in abundance in Morro Bay during their annual migration: brant, a goose hunted in the bay, is most numerous, followed by pintail, green-wing teal, scaup and widgeon. Wading birds, such as great blue herons, black-crowned night herons and egrets use the area year-round. A heron rookery, active since 1948, is on Fairbanks Point in Morro Bay State Park (Gerdes et al., 1974).

More than 70 fish species (including one candidate for endangered species status, the tidewater goby) have been collected in the bay (Fierstine, Kline and Garman, 1973). The role of the estuary as a fish nursery is significant to the coastal sport and commercial fishery. The bay is also an important migration route and nursery for steelhead trout which utilize the tributary streams.

Invertebrate populations are large and diverse (Figure 2). Shellfish are important in the bay where 19 species can be collected. The most common species are Washington, gaper and geoduck clams.

Areas of Biological Importance

Environmentally sensitive habitat areas within the Coastal Zone warrant specific protection under the California Coastal Act if they meet these criteria: 1) unique, rare or fragile community; 2) rare and endangered species habitat; 3) specialized wildlife habitat vital to a species survival; 4) outstanding representative natural community with an unusual variety of plant or animal species; or 5) areas with outstanding educational values to be protected for scientific research and education uses (Morro Bay City Coastal Land Use Plan, 1982). The area contains a large number of environmentally sensitive habitat areas.

Table 3 lists areas of special biological importance which have been identified or are recommended by various agencies for special protection (e.g., San Luis Obispo County, Local Coastal Plan). Category numbers in Table 3 refer to the criteria listed in the previous paragraph. Unique, fragile or rare community types are represented in many public lands such as Morro Bay Sandspit, Los Osos Oaks, and Elfin Forest. Rare and endangered species are protected at Morro Rock, Morro Dunes and Sweet Springs. Specialized wildlife habitat is preserved at the Heron Rookery, Chorro Creek Steelhead Trout protected area, and a number of Monarch Butterfly roosts which are not already protected (Nagano and Lane, 1985). Outstanding representatives of natural communities are included within the diverse habitats of Morro Bay State Park, Black Hill and the Sandspit. Areas of educational value are Morro Bay State Park including the heron rookery and Los Osos Oaks State Reserve. All of these areas are visited regularly by school groups and the public.

Areas recommended for future protection include more Elfin Forest land adjoining the recently acquired 51 acres. Warden and Eto Lakes were listed for preservation as important freshwater marsh habitat by the California Coastal Commission in 1975. Natural preserve status has been suggested for the Sandspit (CPR, 1988).

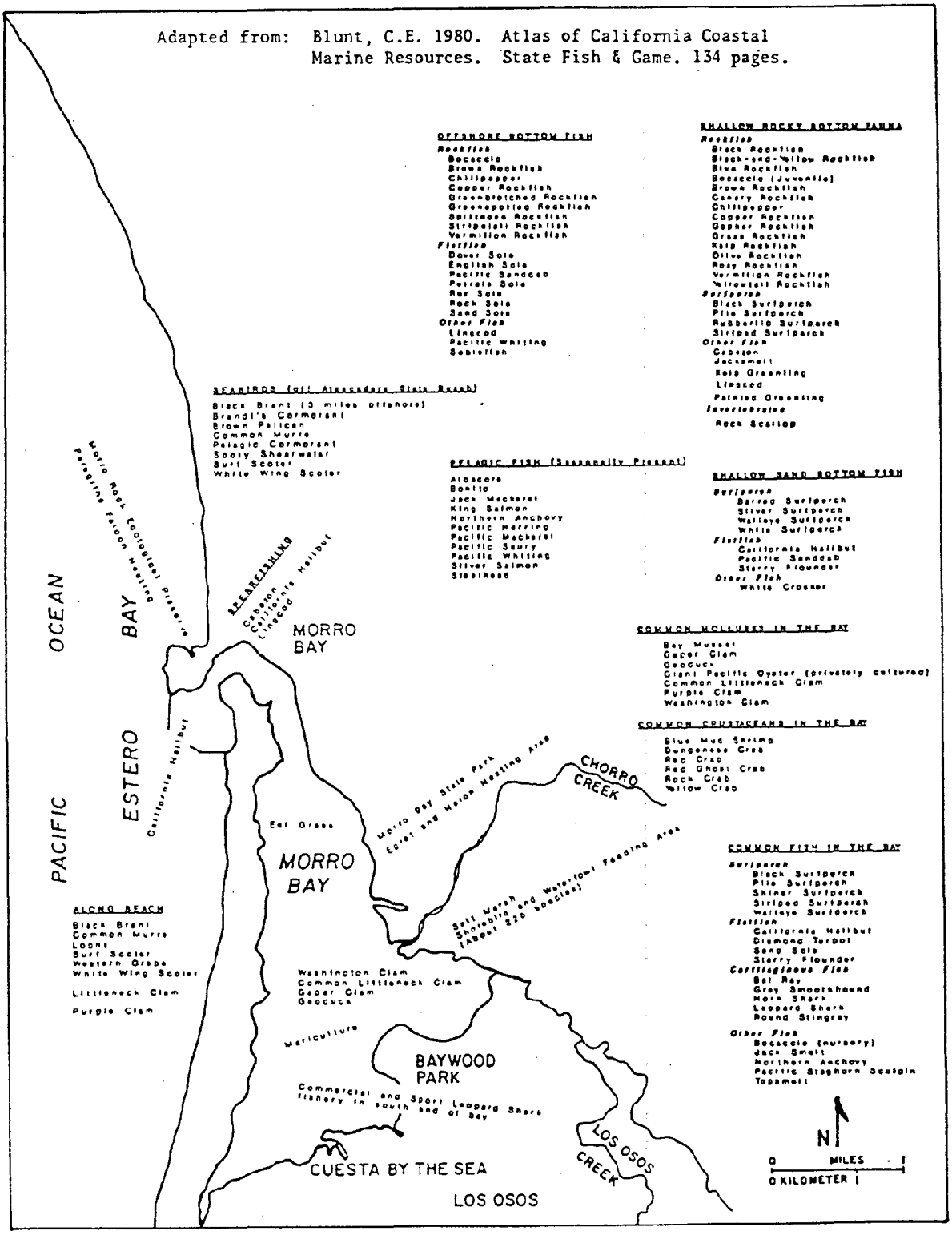


Figure 2. Marine Resources of Morro Bay

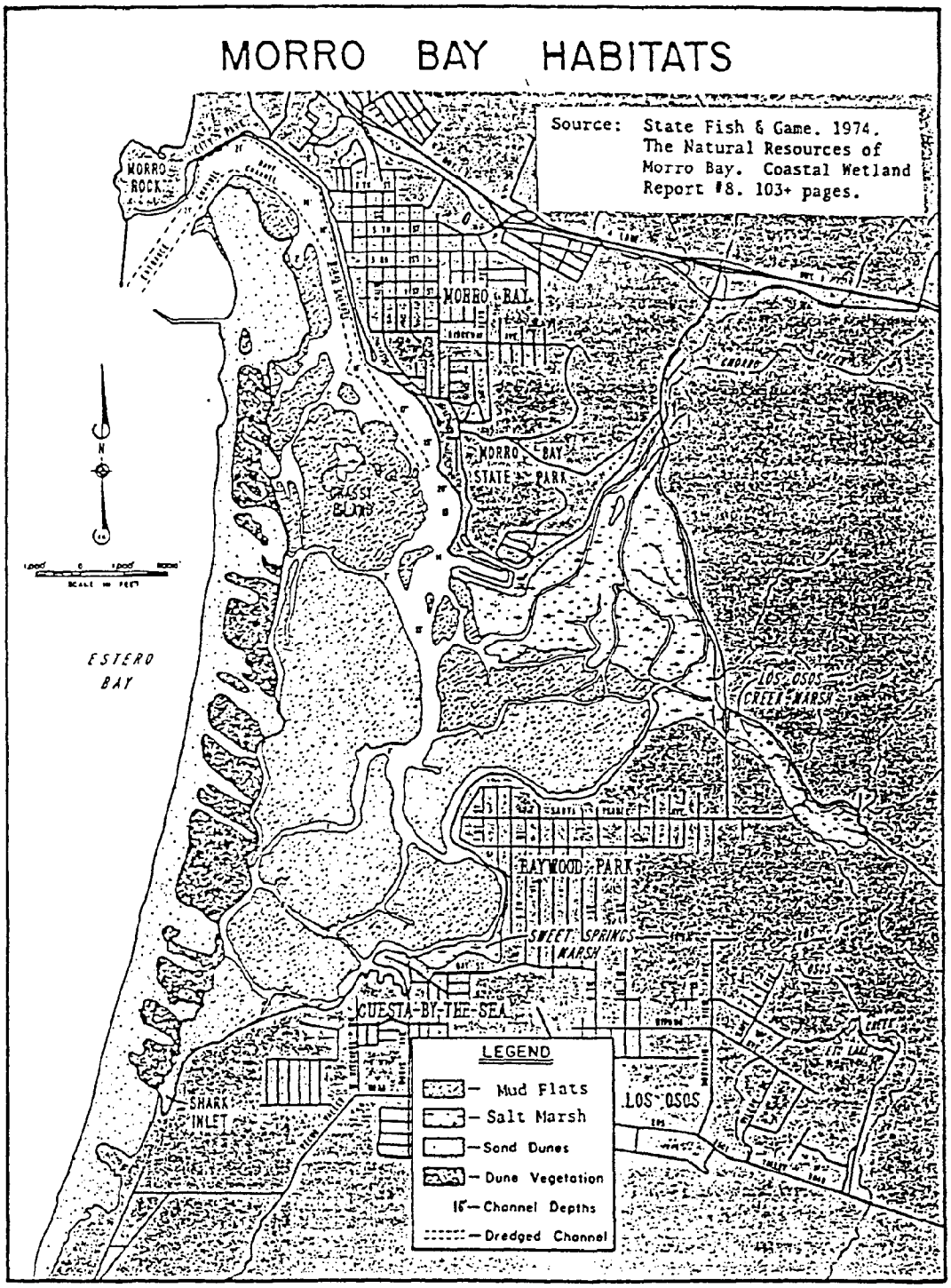


Figure 3. Morro Bay Habitats

Regionally Important Rare and Endangered Species

The California Department of Fish and Game (DFG) (Natural Diversity Database, 1986) refers to "Special Animals" which are inventoried because they are officially listed or they are candidates for listing by State or Federal government. The animal may be recognized as a sensitive species in California by the USFWS, U.S. Forest Service or the Bureau of Land Management, or recognized as a species of special concern by DFG. Taxa which are declining, biologically rare or very restricted, or those associated with a habitat in decline in California, (such as wetlands or riparian) are also so designated. A listing of "Special Animals" is found in Table 4 which includes some already listed in "Threatened and Endangered Species" (refer to Table 1).

Those species in decline due to alteration or loss of habitat in the estuary are the California black rail and snowy plover. The shy, secretive black rail is protected by California threatened status but its population and distribution in Morro Bay is virtually unknown. Projects potentially impacting the habitat (e.g., Twin Bridges replacement, Los Osos wastewater treatment system) continue to be approved despite lack of knowledge about this species. The narrow habitat requirements of the black rail suggest that less than 10 percent of the 575 acres of salt marsh is suitable rail breeding habitat (Evens et al., 1986).

The snowy plover's required nesting area is on the sandy beach which is heavily impacted by recreational use. Birds have been concentrating their nests in less optimal portions of the beach. Predation is a big factor in high mortality rates. In 1989, only one-third of the nests were successful at hatching at least one egg.

Brant winter only in San Diego Bay, Morro Bay and northern estuaries. It is a population in decline in California and is dependent upon eelgrass (Gerdes et al., 1974). Seventy-six percent of the brant wintering on the southern California coast occur in Morro Bay (Josselyn et al., 1989). Numbers have dropped from 11,000 to a low of 1,000.

Herons and egrets are numerous in Morro Bay but the heron rookery, used continuously since 1948, in Morro Bay State Park has been declining as a nesting spot in recent years.

Anadramous fish, such as the steelhead trout migrate from coastal streams to the ocean and back to the same stream to spawn. The Chorro and Los Osos Creeks are spawning streams. Water diversion projects, drought and siltation upstream are reducing the viability of local steelhead populations.

Endangered plant species (Table 1) were identified by the California Native Plant Society (CNPS) in terms of limited distribution and rarity. Some of those species which are of concern (but are without state or federal status) are found on the dunes (dune dandelion, dune mint, Blochman's leafy daisy, coastal gumplant, and sand almond (CPR, 1988)). Also being considered for protection is seepweed which has the same narrow range and scattered populations as salt marsh bird's beak. Pecho manzanita is limited in distribution and is on the CNPS watch list.

Marine Mammals

The Morro Bay estuary provides shelter or habitat for at least four species of fur-bearing marine mammals found along the California coast: harbor seals, California sea lions, elephant seals, and sea otters. Of these four species, harbor seals and sea otters are the most reliant on a healthy estuarine environment for their existence. While sea lions and, less frequently, elephant seals visit the estuary and probably feed in and around it, they usually only use the bay for hauling-out in times of stress (injury, illness, low offshore

Table 3. Areas of Special Biological Importance

Area	Jurisdiction	Category
Black Hill Natural Area	State Parks & Recreation	2,4
Elfin Forest (Otto Property)	State Parks & Recreation	1
Heron Rookery - Natural Preserve	State Parks & Recreation	3,5
Los Osos Oaks State Reserve	State Parks & Recreation	1,5
Los Osos Creek Mouth	State Lands Commission	2,5
Morro Bay Sand Spit - Natural Reserve	State Parks & Recreation	1,4
Morro Bay State Park	State Parks & Recreation	3,4,5
Morro Dunes Ecological Reserve	State Fish & Game	2
Morro Rock State Reserve	State Parks & Recreation	2
Morros	Private	1
Sweet Springs Marsh	Morro Coast Audubon Society	1,2
Wardon & Eto Lakes	Private	1
Monarch Butterfly wintering areas	Private	3
Chorro Creek	State Fish & Game	3

Category: 1=unique, rare or fragile community
2=rare or endangered species habitat
3=specialized wildlife habitat vital to a species survival
4=outstanding representative natural community with an unusual variety of plant or animal species
5=areas with outstanding educational values to be protected for scientific research and educational uses

Table 4. Special Animals Found in the Morro Bay Area

Species	Status	Habitat
Banded Dune Snail Helminthoglypta walkeriana	1	MT
Calif. Brackishwater Snail, Tyronia imitator	2	L
Monarch Butterfly, Danaus plexippus	0	U
Morro Blue, Plebjus icarioides moroensis	2	U
Tidewater Goby Eucycloglobius newberryi	CSC,2	L
Redlegged Frog, Rana aurora draytonia	CSC,2	R
Western Pond Turtle, Clemmys marmorata	CSC,2	R
Black Legless Lizard, Anniella pulchra nigra	CSC,2	MT
Western Grebe, Aechmophorus occidentalis	0	M
American White Pelican, Pelecanus erythrorhyncos	CSC	M
California Brown Pelican, Pelecanus occidentalis californicus	CE,CP,FE	M
Double-crested Cormorant, Phalacrocorax auritus	CSC	M
Great Blue Heron, Ardea herodias	0	L,MT
Great Egret Casmerodius albus	0	L,MT
Snowy Egret, Egretta thula	0	L,MT
Black-crowned Night Heron, Nycticorax nycticorax	0	L.MT
Cooper's Hawk, Accipter cooperii	CSC	R,V
Sharp-shinned Hawk, Accipter striatus	CSC	R,V
Golden Eagle, Aquila chrysaetos	CP,CSC	U
Northern Harrier, Circus cyaneus	CSC	U
Black-shouldered Kite, Elanus caerulea	CP	U
Merlin, Falco columbarius	CSC	MT
Prairie Falcon, Falco mexicanus	CSC	U
American Peregrine Falcon, Falco peregrinus anatum	CE,CP,FE	MT
California Black Rail, Laterallus jamaicensis coturniculus	CT, CP,2	L
Snowy Plover, Charadrius alexandrinus	CSC,2	L
California Gull, Larus californicus	CSC	M
Caspian Tern, Sterna caspia	0	M
Elegant Tern, Sterna elegans	CSC	M
Marbled Murrelet, Brachyramphus marmoratus	CSC	P
Rhinoceros Auklet, Cerorhinca monocerata	CSC	P
Western Yellow-billed Cuckoo, Coccyzus americanus occidentalis	CT,2	R
Short-eared Owl, Asio flammeus	CSC	U
Burrowing Owl, Athene cunicularia	CSC	U
Calif. Black-tailed Gnatcatcher, Polioptila melanura californica	CSC,2	R
Morro Bay Kangaroo Rat, Dipodomys heermanni morroensis	CE,CP,FE	MT,U
Southern Sea Otter, Enhydra lutris nereis	CP,FT	M
American Badger, Taxidea taxus	CSC	U
Steelhead Trout, Oncorhynchus mykiss	LC	R
Brant, Branta bernicla nigricans	LC	M,L
Harbor Seal, Phoca vitulina	LC	M

Status: 0 = Special animal; 1 = Federal Candidate 1; 2 = Federal Candidate 2; CP= California Protected; CT= California Threatened; CE= California Endangered; CSC= California Species of Special Concern; FE= Federally Endangered; FT= Federally Threatened; LC= Local Concern

Habitat: P = Pelagic; L = Littoral; R = Riparian; M = Marine; MT = Maritime; U = Uplands

food stocks). Accordingly, this section will focus on harbor seals and sea otters. Also, while cetaceans (whales, dolphins, porpoises) have been sighted within the bay, they are even less common than sea lions and elephant seals and are not included in this discussion.

Harbor Seals

The local office of the California Department of Fish and Game has made periodic counts and observations of harbor seals in Morro Bay, (Laurent, pers. comm.). They have identified at least three major haul-out areas on the mudflats in the southern bay. It is unusual not to observe harbor seals on one or more of the areas during low-tide periods, but the highest numbers and frequency of harbor seal sightings occur during the late spring pupping period. Over 50 harbor seals, mostly mothers and pups, have been counted at one time in the major haul-out area of the estuary. Because of the safety provided to harbor seals by the deeper channels which create mudflat "islands," and possibly because fish are easily available as forage to the seals, the estuary is an important habitat for this species.

Sea Otters

The sea otter in California is a "threatened" species under the U.S. Endangered Species Act of 1973 and a "depleted" species under the U.S. Marine Mammal Protection Act of 1972. Sea otters in California currently range from northern Santa Cruz County to northern Santa Barbara County and number about 2000 individuals. The Estero Bay area was re-occupied by sea otters from the north in about 1972, but they did not enter Morro Bay in appreciable numbers until about 1982. Populations vary seasonally, with 20-60 sea otters in Morro Bay, principally during the winter (Figure 4). About 99 percent of the sightings in the bay are of males. While in Morro Bay, it is estimated that the sea otters spend about 62 percent of their daylight hours resting, 21 percent feeding, 8 percent grooming, 5 percent interacting socially, and 4 percent swimming. Over 90 percent of their diet while in the bay is composed of clams, mainly gaper and Washington clams. During the summer, it is known that several of the Morro Bay sea otters establish breeding territories north of Estero Bay; one individual moved nearly 70 km north of Morro Bay to Point San Martin. It is essential that the features that support the sea otters (especially their prey) be protected because Morro Bay is important habitat for sea otters.

Environmental Problems and Cause/Effect Relationships

Morro Bay is a relatively pristine estuary threatened by development pressures and changing land uses. There are several sources of pollutants which are known and others are likely but presently undocumented. To date, most of these sources have been identified as non-point sources of pollution. Point sources likely exist, but only limited documentation is available presently (State Water Resources Control Board, 1988). The following discussion identifies some of the known and suspected problems.

Habitat Loss

While to the untrained eye, there are few visible signs of erosion and sediment problems in the watershed, this is the major identified threat to the estuary. Few gullies are visible from public roads. Agricultural practices and rainfall patterns do not always present visible evidence of sheet and rill erosion on most cropland. The rates of erosion, with the exception of road and streambank erosion, are usually too small to be perceived and may not be excessive for many individual sites. It is,however, the cumulative effect from all 43,000 acres in the watershed which impact the bay (USDA/SCS, 1989b). Impacts are documented in reduction of open water (Figure 5) and of the major loss in tidal prism (Figure 6). The estuary has lost 25-30 percent of its volume in the past 100 years, with 35-40 percent of the deeper portions (Haltiner, 1988).

The rate of sediment delivery to Morro Bay from the watershed has increased since 1700. This increase is probably due to: 1) changes in land use resulting in more sediment becoming available for movement into the bay, and 2) depositional areas for sediment on the valley floor no longer being available due to increased creek depth or levee development. The rate of sediment delivery to Morro Bay has been approximately 45,000 cubic yards per year between 1890 and 1935, approximately 37,000 cubic yards per year between 1935 and 1986 (Haltiner, 1988). These estimates are from the comparison of four bathymetric surveys since the 1890's. Table 5 demonstrates the net loss of area in all shallow water areas of the bay since 1884.

An erosion and sediment study in the Morro Bay watershed (USDA/SCS, 1989a) identified sources of sediment to the bay. This sediment begins either as sheet and rill erosion or as erosion from gullies, roadbanks, and streambanks. All of this sediment does not immediately reach the bay. The present rate of sediment production is estimated to be 50 percent greater than during the 1700's. The estimated quantity of sediment delivered to Morro Bay is currently 45,500 tons per year (USDA/SCS, 1989a). This is an average value: in reality, pulses of sediment are delivered by large storm events.

Another study showed that, between the turn of the century and 1965, the pickleweed delta of the marsh increased in size by over 50 percent (Figure 5), again due to sedimentation from upstream sources (Gerdes et al., 1974). This same delta appears to be making another "push" into the estuary on the bordering mudflats, which have apparently reached the critical level for pickleweed invasion (Laurent, DFG, pers. comm, 1989). These studies and observations demonstrate that the estuarine habitat is disappearing at a quick pace, measurable in decades rather than centuries or millennia.

The increase in sediment delivery to Morro Bay from natural and man-affected sources has increased the rate of change from estuarine to upland habitat (Figure 5). Should present conditions continue, the presence of open water in the non-dredged areas of Morro Bay is estimated to end in 300 years (Haltiner, 1988). Parts of the back bay have disappeared in recent generations and this process continues at a rapid rate.

Seasonal runoff of freshwater produces measurable turbidity in mid-estuary zones (eelgrass), the time duration of which is significantly longer than is the case in a simple flow system like a mature river (Phillips, 1984). Extensive land cultivation leading to siltation and the associated increase in turbidity leads to decreased eelgrass growth. Desiccation through increased sediment accumulation has been given as the major factor limiting the upper intertidal distribution of eelgrass. If eelgrass declines enough, increased erosion of bottom sediments could occur, diminishing the potential for eelgrass recovery. There appears to be no species succession in the eelgrass stage of the ecosystem. Eelgrass is the initial colonizer as well as the climax stage of development (Phillips, 1984).

The ability of eelgrass to exert a major influence on estuaries is due in large part to its rapid growth and high net productivity. Eelgrass stabilizes sediments in two ways. Leaves slow and retard current flow, reducing water velocity near the sediment/water interface which promotes the sedimentation of particles and inhibits the resuspension of organic and inorganic material. Secondly, rhizomes and roots form an interlocking matrix which bonds sediment and retards erosion. The disappearance of eelgrass from an area leads to increased sediment grain size, water chemistry changes and increased circulation patterns and turbidity as well as significant changes in species composition, which in turn leads to an expansion of the salt marsh.

The salt marsh, while increasing in area, does so at the expense of the eelgrass beds and deep water zones. Once established, salt marsh plant populations may persist or decline depending on environmental conditions. With increased sedimentation, freshwater influence increases over tidal cycles and saltwater marsh vascular plants become dominated by lower-salinity tolerant species. Overall productivity will be greatly reduced in the estuary as this zone expands (USDA/SCS, 1989b).

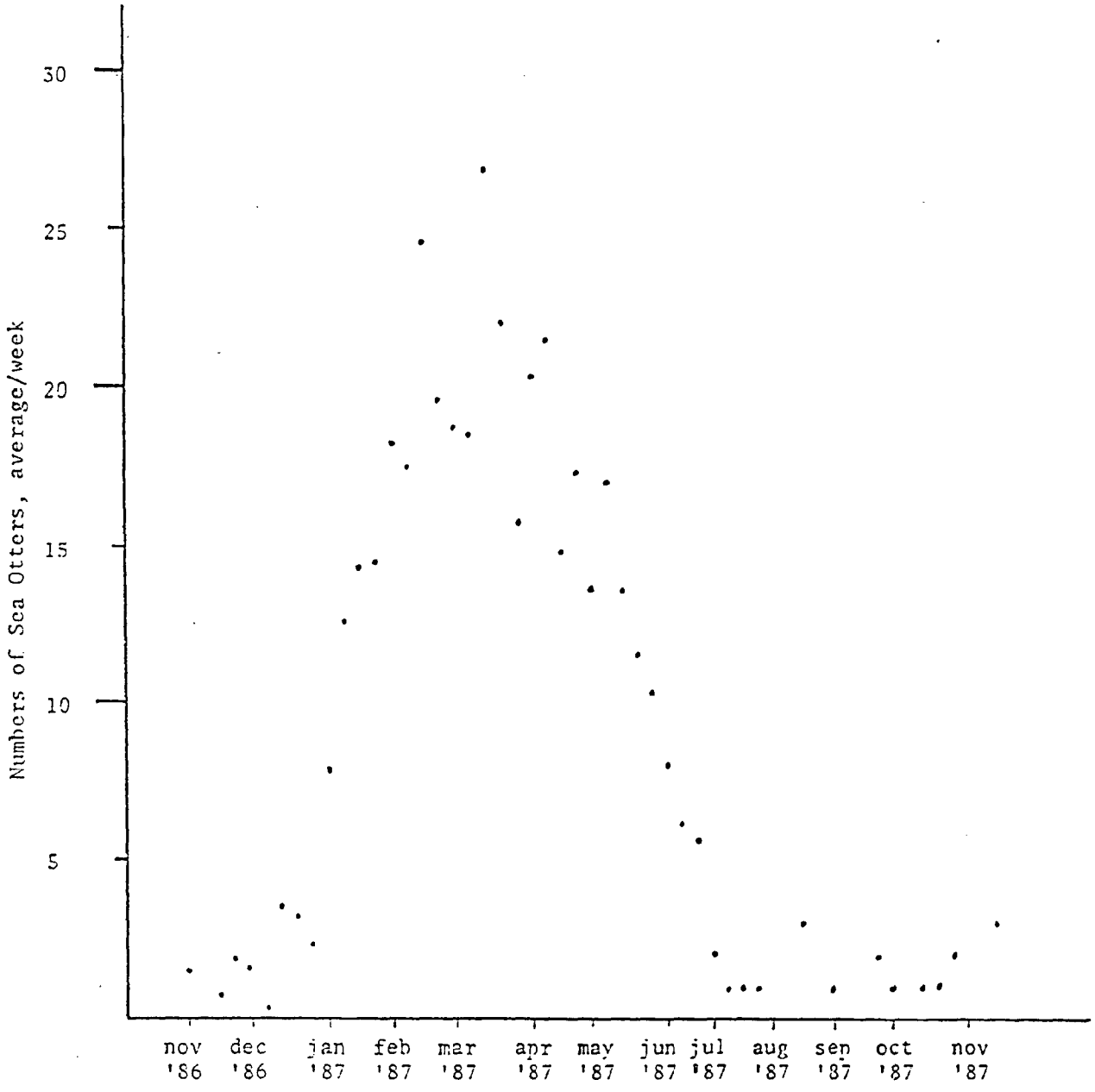
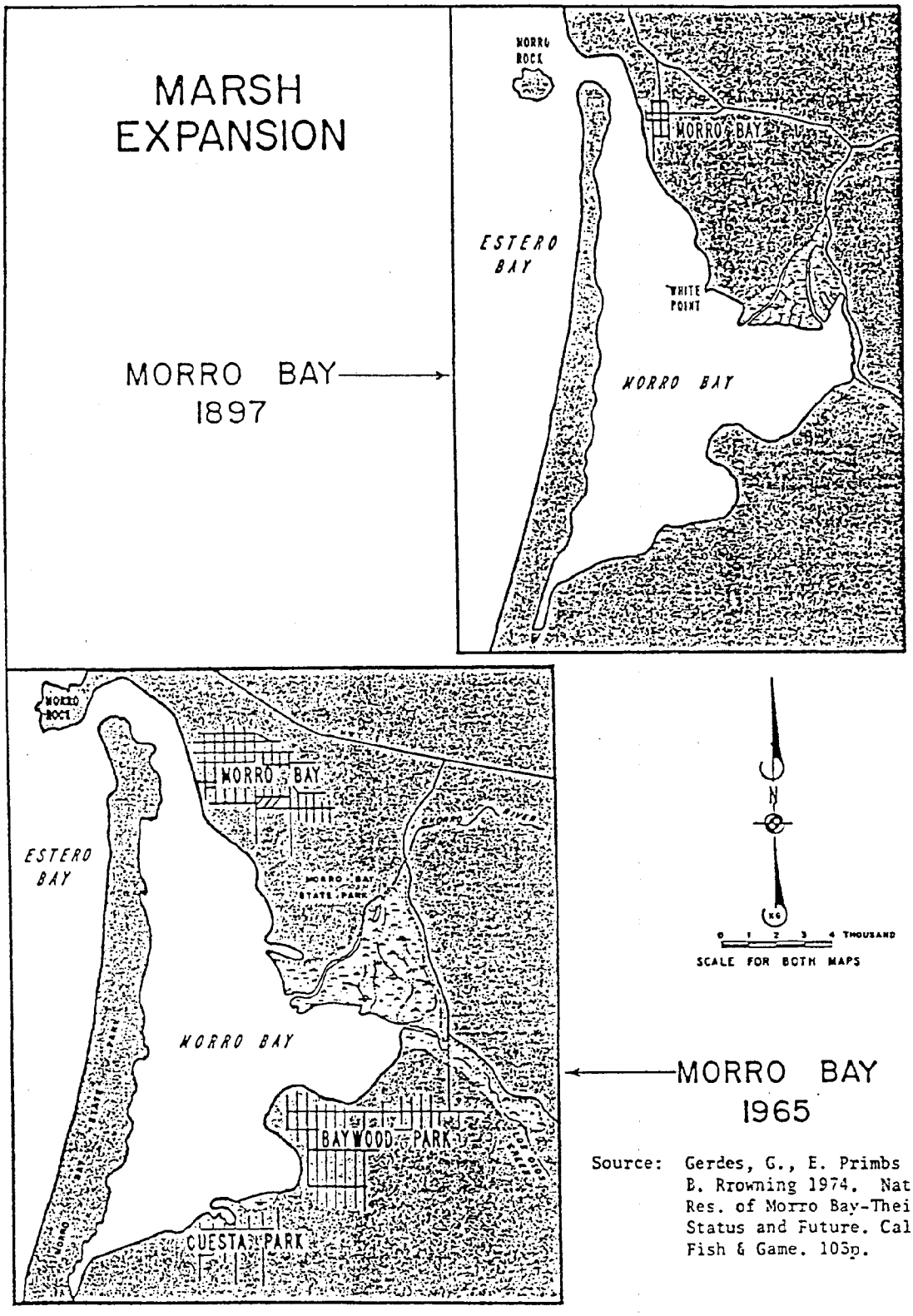


Figure 4. Weekly Mean Sea Otter Counts, Morro Bay, 1987-1988



Source: Gerdes, G., E. Primbs & B. Rrowning 1974. Nat. Res. of Morro Bay-Their Status and Future. Cal. Fish & Game. 105p.

Figure 5. Marsh Expansion, 1897-1965

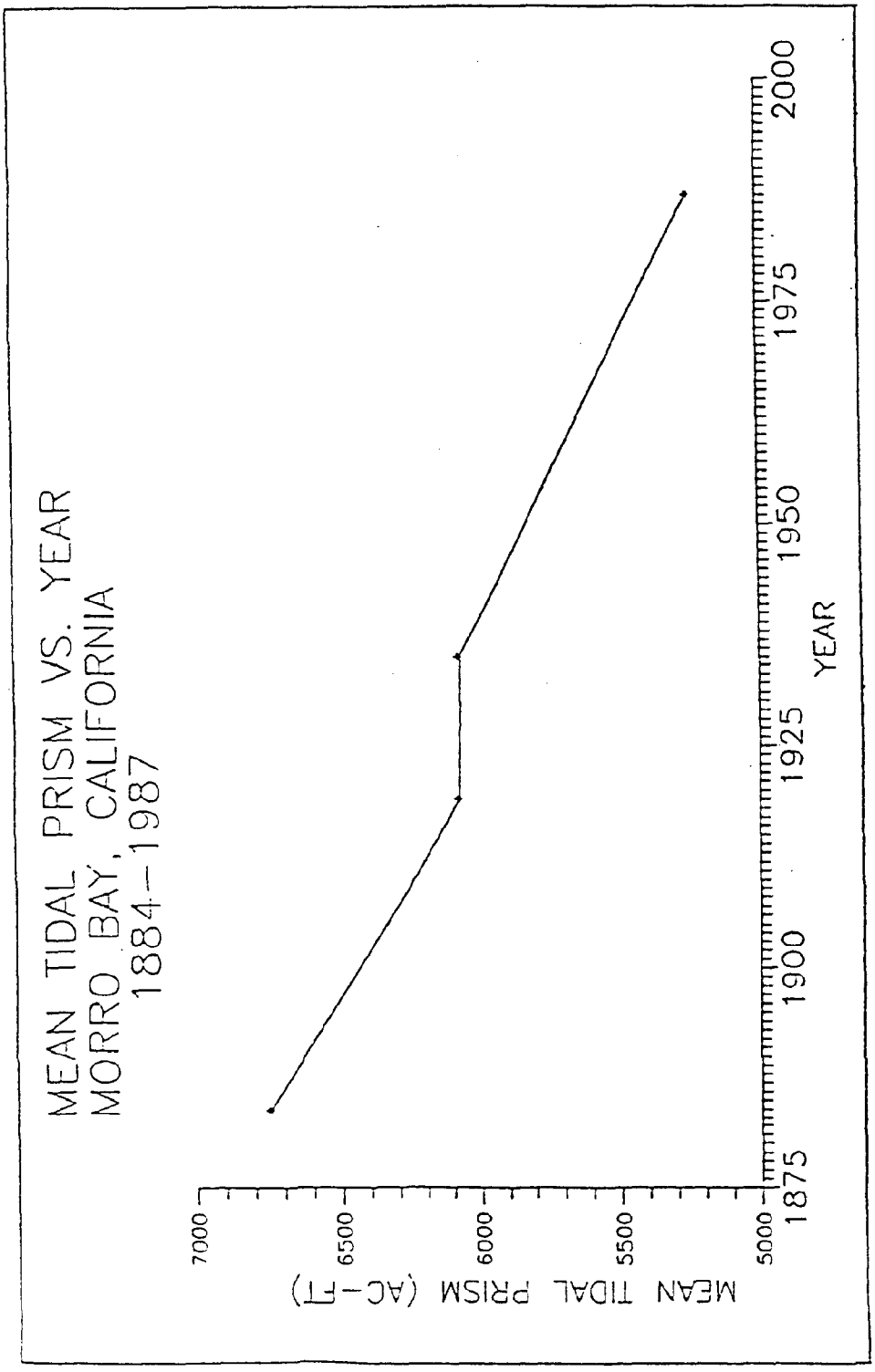


Figure 6. Mean Tidal Prism vs. Year, Morro Bay, CA 1887-1987

Source: Haltiner, J. Sedimentation processes in Morro Bay, California. Philip Williams and Associates, San Francisco. 94+ pages.

Table 5. Depth to Area Data for Morro Bay, 1887-1987

DATE	+2.0	+1.0	+0.0	-1.0	-2.0	-3.0	-4.0	-5.0
1884	2240	NA	1985	1697	1255	955	592	255
1919	2155	NA	1743	1455	1047	780	350	249
1935	2158	2001	1733	1423	907	673	267	221
1987	1891	1805	1521	1155	629	361	315	287
Net Change (acres)	-349	NA	-464	-542	-626	-594	-277	+32

Source: Josselyn, M., M. Martindale & J. Callaway. 1989. Biological Resources of Morro Bay as Impacted by Watershed Development in Los Osos and Chorro Creek Watersheds. State Coastal Conservancy. 35+pages.

The "Morro Bay Watershed Enhancement Plan" (USDA/SCS, 1989b) identifies and discusses proposed land treatment and structural measures to reduce sediment deposition as well as their relative economic feasibility and local acceptability. Selected measures were assessed on the basis of their cost-effectiveness and technical adequacy in reducing sediment yield. Eight groups of measures were evaluated. These included measures for roads, brush land, gully control, riparian management, rangeland, small pastures, conservation cropping, and urban areas. Sediment control structures were also evaluated. Funding to implement the Phase I recommendations in the Watershed Enhancement Plan has been approved by the California Coastal Conservancy and the EPA and the project got underway during August 1990.

Nutrients

The sediment from agricultural land contains significant amounts of nitrogen and phosphorus as well as organic matter. As sediment enters the estuary from agricultural sources, some nutrient additions are inevitable. Previous studies (Soil and Water Conservation Society, 1985) in other watersheds are available; however, no published data are available for agricultural nutrient additions to the Morro Bay estuary. The effects on the estuary as a result of nutrient additions include increased vegetative growth that can periodically reduce the oxygen content of water. The reduced oxygen contents can adversely affect the growth and reproductive abilities of aerobic/aquatic organisms. The problems may increase as grazing lands are converted to higher intensity agriculture, and in sections of the watershed, to horse operations and residential parcels. The chaparral on the upper elevation grazing land is prone to periodic wild fire, yielding higher nitrate and sediment loadings to the estuary. There has been a proposal to convert some portion of the Chorro Creek watershed into a regional sanitary landfill.

Nutrient-containing organic matter from roadsides and lawns will seasonally runoff into the estuary during high rainfall events (Department of Health Services, 1985). The major contributing areas are the city of Morro Bay and the margin of Los Osos, including Baywood Park and Cuesta-by-the-Sea. Additionally, fertilizer nutrients applied to landscape vegetation may either runoff with sediment or leach into groundwater. Nitrate contamination of groundwater in Los Osos has been linked to septic tank effluent and fertilizer (Brown and Caldwell, 1984). Some of this contaminated groundwater may seep into the estuary via freshwater springs. The pattern of this pollution will change when sewers are eventually installed in the Los Osos area.

In recent years, biologists have noted a significant change in algae populations within the estuary. Mats of Enteromorpha have covered mudflats, potentially choking out the mud dwelling invertebrate populations. Excessive algae growth is usually attributed to high nutrient loadings.

Bacteria

The presence of bacterial contamination in the estuary has threatened shellfish operations. The bay's tidal exchanges, with an estimated 2.2 billion gallons entering the bay on an average tidal cycle, supply nutrients and remove contaminants to aid the oyster growing process. However, the oysters have been frequently contaminated by bacteria so that harvesting has been restricted (Department of Health Services, 1985).

Along the city bayfront, high coliform counts were found both in summer and winter near locations discharging significant amounts of contaminated water. In the back bay, summer sampling revealed intermittent peaks of coliform contamination with consistently higher counts at drainageways by Broderson and Pecho Roads. Winter sampling results confirmed

this trend and showed high results at other South Bay stations, especially near Baywood Park pier (Anthony et al., 1988).

Some have suggested this problem started in 1983 when the Morro Bay-Cayucos Wastewater Treatment Plant (WWTP) began discharging unchlorinated wastewater to the ocean via an extended outfall stretching 4060 feet offshore just north of the estuary entrance (Department of Health Services, 1985). There was a major spill of untreated sewage into Chorro Creek on September 23, 1990 at Camp San Luis. Sewage spills from the California Men's Colony Wastewater Treatment Plant in the Chorro Creek watershed could contaminate estuary waters (Department of Health Services, 1985).

Heavy Metal and Toxic Hydrocarbons

The Los Osos Landfill in the Los Osos Creek watershed was, until early 1988, the waste dump for residential wastes, toxic materials including motor oil, pesticide containers, lubricants, and other domestic pollutants. Recent studies (Engineering Science, 1987) show low level hydrocarbon contamination in two wells adjacent to the landfill.

The initial round of quarterly sampling of the shallow groundwater aquifer showed only trace amounts (60 ppb) of landfill generated constituents, most notably vinyl chloride, PCE, and DCE. These low concentrations were anticipated due to the absence of liquid wastes in the site and the dry climate. These trace concentrations of organic constituents are attributed to decomposing plastics and common solvents associated with the residential waste stream (Engineering Science, 1988). It is possible that contaminated sediment which eroded from the landfill has entered Morro Bay in the past. For example, during major storms in 1983, portions of the buried trash were exposed and eroded by a tributary of Los Osos Creek. Monitoring of water continues in the estuary (State Water Resources Control Board, 1988). No conclusions have been made, but the following are clear:

1. Morro Bay's overall water quality is unknown, but some very limited mussel data is available as an indicator of the bay's quality (with respect to metals and organics).

2. No mussel samples exceeded United States Food and Drug Administration action levels, National Academy of Sciences guidelines, or median international standards.

3. Higher than expected concentrations occurred once for cadmium and mercury in mussels.

4. Higher than expected concentrations occurred once for lindane, chlorbenside, and phosphorothoic acid in mussels.

These data indicate that a potential for problems exists in Morro Bay. Efforts are needed to prevent one-time occurrences of toxic concentrations becoming chronic problems.

In addition, diesel fuel, gasoline, motor oil, and boat paint residues are added to estuary sediment by small spills from boats entering and moored in Morro Bay. A boatworks area along the estuary shore has been shown to be a source of heavy metal and toxic organics contamination in the past (State Water Resources Control Board, 1988).

Urban Runoff

Morro Bay estuary receives significant amounts of storm runoff from the streets of the city of Morro Bay, and from streets in and around Los Osos. The chemistry of this runoff is complex, but would include significant amounts of oil and grease from automobiles, lead residuals from gasoline, small amounts of heavy metals derived from engine crankcases,

pesticides and fertilizer, and nutrients from street waste. Several studies (Benner, 1985; Thompson et al., 1975) have been conducted in large metropolitan areas like San Francisco and Chesapeake Bay region,to document this problem. Street waste would include soils, vegetation such as leaves and lawn clippings, fine pellets from the breakdown of styrofoam containers, nutrients and biological hazards associated with animal feces, and crankcase oils disposed illegally into storm drains. The amount of pollutant discharge into the estuary would depend on the accumulation time between runoff events, and rainfall amounts. The effect on the estuary would depend on the state of the tide at the time of discharge, with the greatest impact being during the flood tide.

Other nonpoint pollution sources are live-aboard boaters, boat painting and cleaning, and fuel docks. The ultimate fate of pollutants is uncertain. Some would bond to the clay minerals suspended in the waters of the estuary, and would ultimately be deposited on the floor of the estuary, where they would interact with the benthic ecosystems. Some would remain in suspension, possibly entering the food chain, and others might float as trash, accumulating on shorelines. The ultimate destination of toxics in the food chain would have implications to the survivability of the brown pelican, peregrine falcon, and sea otter which use the estuary waters.

Point source pollution of Morro Bay has, in the past, been attributed to accidental lift station failures, fish cleaning operations, dredge operations, and the Morro Bay Aquarium. The level of coliform bacteria in the estuary has been sufficiently high to prevent the sale of oysters grown in the estuary.

Much of the water flowing down Chorro Creek in the summer months is effluent from the California Men's Colony treatment plant, which at times has violated clean water standards.

Risk from Oil Development and Spills

The President's Task Force on Offshore Oil Drilling reported on September 21, 1989 that the chances of a coastal oil spill in the next 30 years for Southern California were 99.5 percent and for Northern California were 96 percent. Four major marine terminals lie just north of the estuary, served by offshore tanker moorings. Small spills have taken place in the past. In addition, there may be increased oil activity in the Santa Maria Basin. Thus there could be a serious spill. The protection available for the estuary is presently inadequate due to a lack of full coordination, immediately available equipment and weather and sea conditions which often do not allow control.

Loss of Freshwater Flows

The Morro Bay watershed is the source of drinking water for the communities of Los Osos (population about 16,000), the California Men's Colony (population about 6-8,000), and the city of Morro Bay (population about 10,000). The Los Osos area utilizes a deep sedimentary basin that extends below the dunes of the southeast side of the estuary, and beneath the central and southern portions of the tidelands. Sea water intrusion of these sub-estuary aquifers has occurred in the past, and may increase if population continues to rise and water use is not managed properly (Yates and Wiese, 1988). California Men's Colony draws water from Chorro Reservoir in the upper reaches of Chorro Creek. This can be supplemented when necessary by imported water. The city of Morro Bay draws on a well field on the lower portion of Chorro Creek, adjacent to the tidal wetlands in an area where there is also significant use by agriculture.

At present, groundwater recharge of aquifers comes from the same sources that bring freshwater to the estuary, and increases in groundwater diversion directly affect the flow of creeks, the number of flow days, and wildlife and botanic values associated with a fresh water supply. Freshwater flows from the two main creeks (a third was diverted from the

bay in the 1940's) entering the bay have been reduced, and at times completely interrupted, through a combination of agricultural and urban uses.

Effluent from septic tanks recharges the upper portion of the sand dunes in Los Osos, and much of this water probably returns to the estuary through springs. The amount of flow of these springs controls the boundary and vitality of fresh and brackish water ecosystems surrounding the estuary, and these may be affected as changes in effluent disposal are implemented in Los Osos. Such changes are being mandated by the Basin Plan of the Regional Water Quality Control Board, which will require an end to septic tank effluent disposal in Los Osos, and the diversion of effluent to a central treatment plant and disposal site. Such changes may have a profound affect on the estuary's ecosystems.

Streams flowing into Chorro Creek may be subjected to appropriation and diversion by the city of Morro Bay, at points above their present point of well extraction. Environmental studies are currently under way, and the diversion will be subject to State Department of Water Resources hearings and rulings.

The lagoon habitats at the mouths of the creeks have also been heavily impacted by water diversion and siltation. Coastal brackish marsh, a sensitive habitat present at the mouths of the creeks, is being rapidly lost due to silt accretion (California Natural Diversity Database, 1988). Most of the lower watersheds have dried out entirely during the past several drought summers. The tidewater goby, a candidate for listing on the Federal Endangered Species List, is a brackish water species that for the past several years has not been documented in either creek mouth. If this species still inhabits the estuary, its numbers have been greatly reduced as a result of habitat degradation by water diversion and siltation.

The increase of imported water into the watershed, and subsequent disposal of treated effluent into the estuary, may also impact the estuary relative to water quality and fresh water budget.

Unfortunately, there have been no definitive studies to examine the impact on Morro Bay's estuarine communities by deprivation of freshwater. At this point, we can only turn to studies conducted elsewhere to speculate that biological productivity has been significantly reduced in the Morro Bay estuary. The result of lowered productivity will have impacted not only the abundance and diversity of the estuary's invertebrate and fish communities, but also the marine mammals and thousands of resident and migratory birds which rely on them for food sources. The question of the importance of freshwater influences is the subject of a preliminary study, funded by The Bay Foundation of Morro Bay (The Morro Group, 1990). More work will be needed, however, before we truly begin to understand the ecological and economic consequences of freshwater loss to the estuary.

Institutional Arrangements

There are no unique laws or regulations applicable in the Morro Bay watershed. The many local, state and federal environmental laws, regulations and policies apply in the Morro Bay watershed as they do across the nation. The water quality, water use, land use and environmental protection laws are diverse and complex. Review, monitoring and enforcement of many environmental regulations is lax or lacking in the watershed.

The need for enhanced protection is critical as the Morro Bay watershed lies within the fastest growing area of the Pacific Coast and is presently experiencing greatest pressure from land uses. The pristine nature of this area actually works against the watershed. Due to the crisis orientation in governmental organizations, Morro Bay is often at the bottom of priority lists. The need, at this time, is mainly for protection and enhancement. This good condition of Morro Bay could easily reverse (and may be already) to a condition that needs extensive clean-up. This would, of course, be a much more expensive and time-consuming situation for all responsible agencies as well as being a terrible environmental loss.

A baseline understanding of Morro Bay is almost totally lacking. There is a need to understand what is happening in the watershed so that the monitoring and enforcement activities of the various State and Federal clean water and environmental protection laws can be properly conducted. The weaknesses in the current monitoring effort in Morro Bay area lie in lack of coordinated planning, determination of need, and in interpretation of results, with appropriate feedback to the planning and regulatory process. Routine monitoring results are less frequently subjected to thorough evaluation, partly due to resource limitations within responsible agencies.

The developing relationships among the agencies through the existing Morro Bay Task Force has "broken the ground." Once formalized within the management conference structure, these relationships will help to assure a speedy resolution of these problems.

Convening of a Morro Bay Management Conference will be an effective tool to promote the necessary planning, identification of problems, and development of appropriate coordinated monitoring and enforcement. The process developed here will aid in the protection and enhancement of Morro Bay's many unique and significant values.

LIKELIHOOD FOR SUCCESS OF THE MORRO BAY MANAGEMENT CONFERENCE

Many of the environmental problems faced by Morro Bay are still potential problems which can be solved through proper planning and a pollution prevention strategy. This enhances the potential for success of the management conference since, in general, preventative measures are more successful and economical in preserving resources than are remedial measures. A management conference for Morro Bay will be successful because the State of California, many local agencies, environmental groups, members of the State and Federal legislature, and, most importantly, the public are committed to protecting and enhancing the bay's resources and beneficial uses. The management conference is needed to coordinate the research, data collection and other efforts which have already been undertaken in Morro Bay and to create a comprehensive conservation and management plan (CCMP) for mitigating the varied problems. The Morro Bay Management Conference will provide a demonstration program for use in the many small estuaries across the nation, whether in the NEP or not.

Questions

- **What are state and local governments, and public and private institutions already doing for Morro Bay?**

  The Morro Bay Task Force, composed of some 50 agencies and interest groups, is working to understand the complexities of the interactions influencing the bay and is working towards united goals and identification of research needs for the watershed. Friends of the Estuary, a local non-profit group, coordinated the development of this nomination. State and Federal agencies regulate water quality in Morro Bay. The California Coastal Conservancy has funded Phase I of a Watershed Enhancement Plan prepared by the Soil Conservation Service to reduce sedimentation in the estuary.

- **What goals and objectives do you propose to set for the estuary and how do you propose to met them?**

  The Task Force has adopted the coordinated goal of "the long term preservation, conservation and enhancement of the Morro Bay and associated wetlands, nearshore and watershed environments for all occupants and users, whether human, other

animal or plant." This goal is further defined and objectives identified, with the expectation that they will be accomplished through formalizing the task force effort in a National Estuary Program management conference.

- **Who will participate in the management conference and how will it be organized?**

  The management conference will include all the entities that use, regulate, study, or make decisions concerning Morro Bay, including State and Federal-elected officials, local officials, regulatory agencies, resource agencies, dischargers, environmental groups, and scientific researchers. The management conference will be organized into a Sponsoring Agency Committee, a Policy Committee composed of decision makers from all these groups, Technical and Public Advisory Groups, and a number of subcommittees.

- **Is there public and political will, as well as financial capability, to support implementation of the CCMP?**

  There is tremendous public support for Task Force efforts to convene a management conference and to implement a management plan, as illustrated by broad participation in the Task Force and the growth of environmental groups directly concerned with Morro Bay. Local, State and Federal elected representatives have expressed support for the nomination. The agencies presently active in the Task Force are supporting this effort financially. These in-kind funds will provide the required 25 percent match of federal funding for participation in the National Estuary Program.

Pollution Control History

The State Water Resources Control Board (State Board) and the Central Coast Regional Water Quality Control Board (Regional Board) have the primary responsibilities for implementing the Clean Water Act (CWA) and State water quality mandates in the central coast area. The State and EPA have formed an effective partnership in carrying out CWA-mandated programs. In addition, the State has worked and continues to work productively with other federal, State, and local entities on ocean related topics and on issues directly related to the Morro Bay area.

Water quality programs in California are based upon Federal mandate and State statutes. California's Porter-Cologne Water Quality Control Act and related Water Code sections define the structure, programs and enforcement powers of the State Board and the Regional Boards. In combination with the CWA and its recent amendments, these laws form the basis for a comprehensive approach to the overall protection of the bay and estuarine waters.

Traditional Federal Programs

At the federal level, pollution-control efforts culminated in the 1972 passage of a complete revision of the Water Pollution Control Act (Clean Water Act or CWA). The Act required states or the U.S. Environmental Protection Agency (EPA) to set standards for surface water quality, mandate sewage treatment effluent and receiving water limits, regulate wastewater discharges, and implement waste discharger monitoring systems. The State of California has assumed the responsibility for implementing the Clean Water Act in California, including issuing discharge permits, operating the grants program and setting water quality standards.

The Clean Water Act and California's Porter-Cologne Water Quality Control Act (Porter-Cologne) requires Water Quality Control Plans (Basin Plans) which are adopted by each Regional Board for each of the state's nine regions. Basin plans identify beneficial uses for each water body in the region, establish water quality objectives, and

implementation programs. Basin Plans are reviewed at least once every three years and are revised as needed to reflect changes in public priorities or in state or federal programs.

The Clean Water Act was amended in 1987 to include a new Section 319 entitled "Nonpoint Source Management Programs." Section 319 requires the states to develop Assessment Reports and Management Programs describing the states' nonpoint source problems and set forth a program to address the problems. The State Board's November, 1988, Nonpoint Source Assessment Report and Nonpoint Source Management Plan responds to this requirement. Section 319 authorizes federal grants to the states to support implementation of the Management Programs.

New Federal and State Activities

The State of California is developing a State Clean Water Strategy (CWS). The CWS is a process to provide an efficient means to address water quality issues throughout California. The CWS will link State and Regional Board programs together in directing actions on individual water bodies. In directing these actions, the CWS relies on the statewide Water Quality Assessment to provide the technical information necessary for management decisions. The CWS pulls together this technical information and recommended actions into a plan to direct staff and resources towards the highest priority water quality issues.

The Water Quality Assessment (WQA) provides a catalog of the water bodies in the state organized by region and by water body type (Rivers and Streams, Lakes and Reservoirs, Ground Water, Bays and Estuaries, etc.). Information on water quality conditions is provided for each water body. The condition of these water bodies is described as "good," "intermediate," or "impaired," and the nature and source of threats or impairments to beneficial uses are described.

A WQA is prepared by each region, and the regional WQAs are compiled into a statewide WQA by the State Board. The statewide WQA can then be used to satisfy several federal reporting requirements including the Section 305(b) Biennial Water Quality Assessment report on the conditions in California's waters, and updates to several federally mandated lists of water bodies that are impaired or warrant concern due to point and/or nonpoint sources. (See 40 CFR 131.11, and Sections 303(d), 304(l), 314 and 319 of the CWA.)

The CWS goes beyond the basic assessment of the water quality. The CWS will be used to review current actions and identify additional measures which may be necessary to protect water quality. It will also be used to review the costs of these measures and identify which water quality programs must work in concert to accomplish the goals.

Morro Bay has been classified in the WQA as being impaired due to sedimentation from nonpoint sources and shellfish bacteria contamination. Morro Bay is on both the CWA Section 304(l) list and Section 319 list for the above reasons.

There is a need to coordinate several CWA activities with the proposed estuary program. Coordination needs are discussed below:

- Toxic Control Strategies - To date, most water quality data does not reveal problems from toxics (an exception is toxic metals in sediments at one boatworks sampled). However, very little water-column toxics data is available. Agency coordination is necessary to collect appropriate data and determine future needs. Land use controls may be necessary to assure protection from toxics.

- Nonpoint Source Pollution - The State Water Resources Control Board's Nonpoint Source Management Plan (November, 1988), indicates the need for stronger links between the local, state, and federal agencies which have powers to manage nonpoint sources. The State Board and Regional Boards will seek agreements with these agencies to implement best management practices. The Nonpoint Source Management Plan also identifies potential funding sources.

To implement the Nonpoint Source Management Program and solve existing nonpoint source problems, cooperation will be necessary among several agencies. A management conference can facilitate the necessary cooperation by bringing together the concerned parties. For example, to solve sediment problems, cooperation will be necessary among several agencies (San Luis Obispo County, California Coastal Commission, California Coastal Conservancy, United States Department of Agriculture, County Agriculture Commission, EPA, California Fish and Game, and California Regional Water Quality Control Board, to name a few).

o State Revolving Fund - State Revolving Funds can provide funds to implement point and nonpoint source projects. The Regional Water Quality Control Board sets the priority on projects into potential fundable categories. The State Water Resources Control Board approves a final fundable list.

The Management Committee should make recommendations for loan projects to the Regional Board.

State Water Quality Programs

The statewide program for water quality control is administered regionally within a framework of statewide coordination and policy. The State Board and the six coastal Regional Boards are the primary agencies responsible for regulating water quality in bay and estuarine waters.

For Morro Bay, the Central Coast Regional Water Quality Control Board (Regional Board) is the primary agency responsible for implementing state water quality laws, plans and regulations. The Regional Board has a basin plan, issues waste discharge requirements, takes enforcement action against violators, and monitors water quality.

The State Board has adopted a statewide policy for California bay and estuarine waters which applies to Morro Bay -- the Water Quality Control Policy for the Enclosed Bays and Estuaries of California (Policy) (State Water Resources Control Board, 1974). It was adopted specifically to provide water quality principles and guidelines for bays and estuaries to prevent degradation and protect beneficial uses in enclosed bays and estuaries.

Decisions by the Regional Boards must be consistent with the Policy. The policy lists principles of management that include an objective of phasing out all discharges (exclusive of cooling waters) as soon as practicable. The following types of discharges are prohibited:

1. New dischargers (other than those that would enhance the receiving waters);

2. Untreated waste and waste products;

3. Refuse;

4. Consequential effects of mining, construction, agriculture, and timber harvesting;

5. Materials of petroleum origin;

6. Radiological, chemical, or high-level radioactive waste; or,

7. Discharge or by-pass of untreated waste.

The State Board is currently developing a Water Quality Control Plan for the Enclosed Bays and Estuaries of California (Enclosed Bays and Estuaries Plan). The Enclosed Bays and Estuaries Plan will establish beneficial uses and numerical water quality objectives for toxic pollutants for bays and estuaries. The Plan is scheduled for adoption in January, 1991.

The State Mussel Watch (SMW) program is the State Board's long-term marine water quality monitoring program. The SMW measures concentrations of pollutants in mussels as a means of monitoring for the presence of toxic substances in marine and estuarine waters. The report, "California State Mussel Watch, Ten Year Data Summary, 1977-1987," (State Water Resources Control Board, 1988) indicates that four stations in Morro Bay have been monitored in different years. Unfortunately, the data are too limited to describe trends or fully characterize the Bay.

The Department of Health Services (DHS) has the responsibility for determining whether a public health risk is associated with eating shellfish from a location in California. DHS may declare an area closed for shellfish harvesting if shellfish are unsafe or unfit for human consumption (Health and Safety Code, Chapter 10, Section 28502). There have been periodic instances when shellfish harvesting in Morro Bay has been halted due to bacterial contamination. At these times, joint efforts have been made by the Central Coast Regional Board and DHS to determine the bacteria source. DHS, in cooperation with Regional Board staff, is currently performing a "Sources of Bacteria Contamination Investigation" for Morro Bay. The study involves collecting shellfish samples from different locations. Periodic water quality samples are taken to determine the bacteria contamination origin. Progress has been made by both agencies in identifying and regulating some additional bacterial dischargers. However, occasional shellfish contamination still occurs. Joint efforts are being made to control point source discharges, private lift-station failures, and live-aboard boat discharges. The establishment of a Management Conference will facilitate necessary controls.

Local Programs

There are no specific local efforts to prevent pollution. The Morro Bay Task Force, as described earlier has been the means of information exchange to aid in understanding pollution control responsibilities.

Management Conference Goals, Objectives and Action Plans

While the specific goals of the Management Conference will be established after it is convened, the Morro Bay Task Force has already addressed this question and developed common goals and objectives in April, 1989.

The overall aim of the Morro Bay Task Force is the long-term preservation, conservation and enhancement of the Morro Bay and associated wetlands, nearshore, and watershed environments for all occupants and users, whether human, other animal or plant. This broad objective is further defined by four primary goals:

1. Achieve effective, coordinated management of the bay and watershed.

2. Develop a comprehensive understanding of the environmental and public health values related to the bay and watershed and how these values interact with social and economic factors.

3. Develop a Comprehensive Conservation and Management Plan to restore and maintain the chemical, physical and biological integrity of the bay and watershed, including restoration and maintenance of water quality, a balanced indigenous population of shellfish, fish and wildlife, and recreation activities in the bay and watershed and assure that desired uses of the bay and watershed are protected.

4. Assure long-term implementation of the comprehensive conservation and management plan.

Each of these primary goals involves a number of supporting tasks. Following goals identification, the task force has been identifying unanswered questions, i.e., research needs, towards the preparation of action plans.

Management Conference Organization and Participants

The Morro Bay Management Conference will be directed by the National Estuary Program Policy Committee (Figure 7). The present Task Force will be organized into a Public Advisory Committee and a Technical Advisory Committee. The NEP Policy Committee will be composed of decision makers representing city, County, State and Federal agencies to give guidance and direction to the working groups in the preparation of the comprehensive conservation and management plan. A number of technical subcommittees will address specific issues for review and incorporation into the comprehensive conservation management plan. Subcommittees will be established to address water quality, land use planning, endangered species, estuary enhancement practices, recreation, institutional relationships, education and demonstration projects. All of the present participants in the Morro Bay Task Force will be represented in the management conference. One of the primary benefits of acceptance in the program will be the formalizing of present relationships and the ability for agencies presently only peripherally involved to increase their commitment to their responsibilities in Morro Bay.

The Sponsoring Agency Committee (SAC) will have members from the Central Coast Regional Board, the State Board, the County of San Luis Obispo, and EPA. The SAC will advise on State, federal and local priorities and give general direction to the Policy Committee on funding and implementation of recommendations.

Public Support

One of the greatest assets of the Morro Bay estuary is the manner in which individuals, organizations and agencies have united to support the nomination of the Morro Bay estuary to the National Estuary Program. The citizens of the area have always been fiercely proud of the Morro Bay ecosystem, even to the point of being boastful about its unspoiled beauty, and its undisputed claim as the only remaining estuary in California, south of San Francisco, that has not been destroyed or severely altered by the hand of man.

The erosion and sediment studies of the Morro Bay watershed (Haltiner, 1988; USDA/SCS, 1989), financed by the California Coastal Conservancy, documented the alarming rate at which the bay is being filled with sediment, and the speed at which the estuary is being converted to upland habitat. These facts came as a shock to most people in the area. The realization that the estuary is threatened, generated a grass roots reaction. Individuals, organizations and agencies united to determine a course to follow that would result in, not only slowing the sedimentation processes, but also would provide for the long-term restoration and enhancement of the total ecosystem. After studying the various options, it was clear that the National Estuary Program was best suited to the long term needs of the Morro Bay estuary.

The public sector has willingly and enthusiastically accepted its role in all programs directed toward the acceptance of the Morro Bay estuary into EPA's National Estuary Program. The environmental interest groups were also quick to respond. They support such a goal, and all are willing and anxious to participate in the decision-making process that the Management Conference would oversee. Local groups demonstrating their desire to be a part of the process are as follows:

Organization	Membership
Morro Coast Audubon Society	700
Sierra Club, Santa Lucia Chapter	1800
Morro Coast Natural History Assn	700
Small Wilderness Society	300
California Native Plant Society	400
Friends of the Estuary at Morro Bay	2000

A number of new public interest groups have been formed, all working to enhance and extend the life of the estuary, and to establish a formal management system as offered by EPA's National Estuary Program. These are:

- Friends of the Estuary at Morro Bay. A non-profit advocacy group working to extend the life of the Morro Bay ecosystem through positive programs of enhancement, conservation and rehabilitation. Its immediate goal is to secure a comprehensive management plan for the estuary under the National Estuary Program. Accordingly, the Friends of the Estuary played an important role in the preparation of this nomination document (Friends of the Estuary, 1989).

  Although this group has been in existence only since early 1989, the membership has reached the 2000 mark. It is expected that this figure will grow to 3000 by the end of 1991. The organization holds regular public meetings. Interest in these meetings is very strong with attendance sometimes reaching to over one hundred. A quote from a Morro Bay Sun-Bulletin editorial (2/2/89) illustrates this point:

  > "One of the most heartening examples of enlightened public spiritedness we have seen in a long time is the interest being shown in Morro Bay estuary. More than 100 persons turned out for a January 10 meeting to establish a citizens' advocacy group to work to preserve the Morro Bay estuary. For this area that is a big crowd. Its size is a measure of the public interest in the wetlands, mudflats and harbor."

- The Bay Foundation of Morro Bay. A non-profit public benefit corporation, organized to study, conserve and enhance the bay, the estuary, and the watershed, through scientific, historic, ecological, agricultural, and other programs. This organization has already received grant money and is funding an investigation of fresh water influences in the estuary, and studies to determine shorebird populations in the bay.

- The Bay Foundation is ideally suited to contribute to the Management Conference concept and could easily become the fiscal-administration arm for needed research.

- Coastal Resources Institute (CRI). A research and educational organization being formed at California Polytechnic University at San Luis Obispo. The goal is to foster research on conservation and management of coastal resources. CRI could contribute to the Management Conference concept by providing a pool of dedicated academic scientists who are already committed to the need for an action plan for the management of the Morro Bay estuary.

Public support for an estuary program extends to the business community of the city of Morro Bay and Los Osos-Baywood Park. The media has also been supportive. The Morro Bay Sun-Bulletin, and the San Luis Obispo Telegram-Tribune have been generous in their coverage. Both newspapers have published numerous articles and editorials endorsing the need for a management conference. Editorials have encouraged and applauded the effort being made to reach that goal.

Morro Bay
National Estuary Program
Management Conference Structure

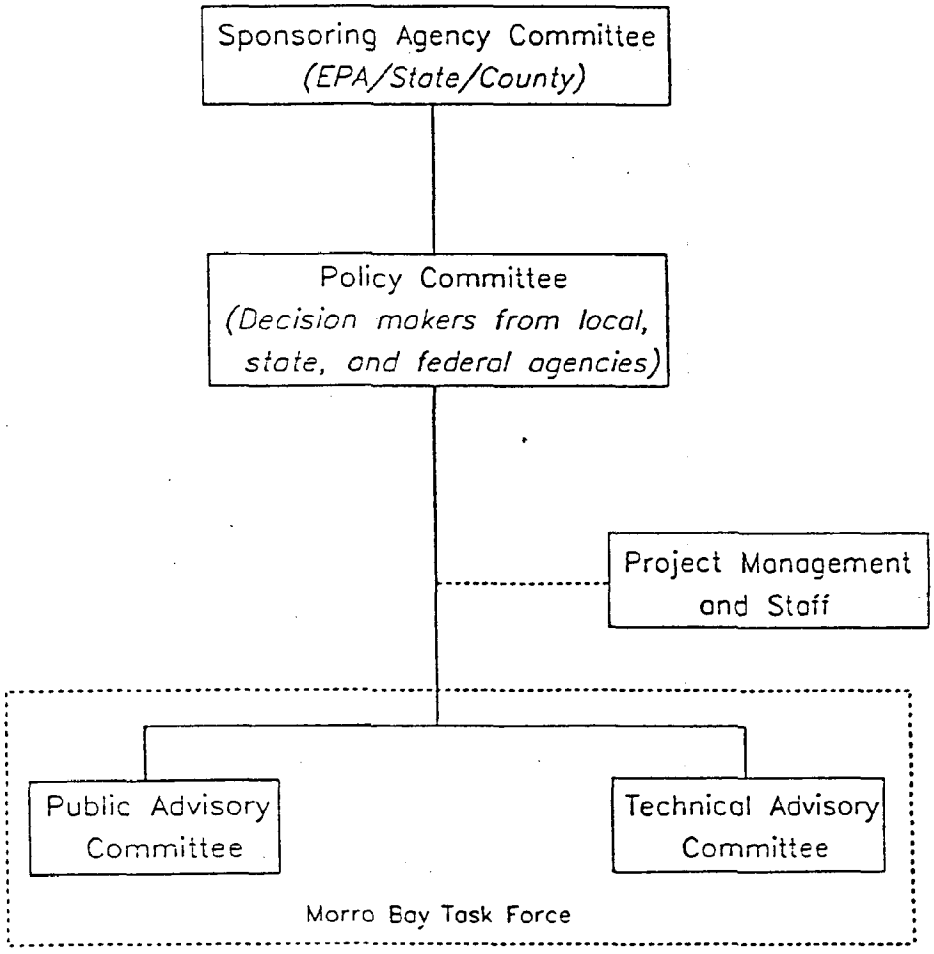


Figure 7. Management Conference Structure

The Morro Bay Watershed Enhancement Plan (USDA/SCS, 1989b), prepared for Coastal San Luis Resource Conservation District by the SCS details plans and recommendations for dealing with erosion in the watershed to reduce the excessive sedimentation that is reaching the estuary. This report was developed with full participation of all interested parties, including the landowners and residents in the study area. The success of this project demonstrates the willingness of the public to become involved, if the goal is to preserve, enhance and extend the life of the Morro Bay estuary. Phase I of this plan has just been funded by the California Coastal Conservancy for $410,000, with an additional $160,000 grant from the EPA.

Political Commitment

Political concern for the natural resources of the Morro Bay ecosystem was expressed in State Senate Resolution No. 176 (1966). This resolution recognized the importance of the Morro Bay estuary to the people of California as a unique wildlife habitat. It also noted that the area's scenic attractions were of great aesthetic importance to visitors and to residents. The resolution requested the Resources Agency to prepare a plan for the preservation of the natural resources therein.

In 1990, Assembly Concurrent Resolution (ACR) No. 118, introduced by Assemblyman Eric Seastrand and supported in the Senate by Kenneth Maddy, was enacted by the California Legislature on June 29, 1990. ACR 118 "affirms the importance and value of Morro Bay, its estuary, and its environs to the people of California...declares a long-range management plan should be developed to coordinate the efforts of government agencies and other groups...and supports the nomination of Morro Bay as a National Estuary, as provided in federal law, to be administered by the EPA."

The county of San Luis Obispo, and the city of Morro Bay are the two political entities, other than State and Federal agencies, that have jurisdiction in the area under consideration for nomination to the National Estuary Program. The total land and water area involved is 48,000 acres. Approximately 95 percent of this area is under the jurisdiction of the county, the remainder falling within the boundaries of the city of Morro Bay.

Both the county Board of Supervisors and the Council of the city of Morro Bay have endorsed the management conference concept, and are prepared to participate. Both governing bodies have urged the nomination of the Morro Bay estuary to the National Estuary Program.

William B. Coy, Supervisor, 2nd District, as Chairman of the Board of Supervisors, wrote on July 26, 1988:

> "We urge you (the Governor) to nominate Morro Bay to the Administrator of the U.S. Environmental Protection Agency for acceptance to the (National Estuary) Program...."

Dale Reddell, as Mayor of Morro Bay, expressed the wishes of the City Council on July 26, 1988:

> "We are encouraged by the prospect of Morro Bay's inclusion in the National Estuary Program, and sincerely hope that you (the Governor) can support our objective by nominating Morro Bay."

The late Assemblyman Eric Seastrand, Twenty-Ninth District, and Senator Kenneth L. Maddy have both demonstrated support for the nomination. Assemblyman Seastrand wrote on August 5, 1988, that:

> "There is tremendous community support for this designation (National Estuary Program) which would formalize the working relationship already underway between the various county, State, and Federal agencies, and private organizations...."

Senator Kenneth Maddy, in a letter to the Governor on August 12, 1988 stated:

> "I would like to add my support to the request of the city of Morro Bay, and the county of San Luis Obispo for your nomination of Morro Bay to the National Estuary Program."

Congressman Leon Panetta has supported the nomination process and has offered to help in any way possible. In a letter to the Governor on September 9, 1988 he expressed his support as follows:

> "Morro Bay is one of our State's most important natural resources. .... The variety of threats and the fragmented management have made it difficult to develop a comprehensive approach to addressing the needs of the Bay. The National Estuary Program appears to be ideally tailored to problems such as those facing Morro Bay."

It is apparent that the political will exists to convene an effective and productive Management Conference, and to carry such a process to a successful conclusion.

Financial Capability

Section 320 of the Clean Water Act requires the State to provide local matching funds for NEP projects in an amount equal to 25 percent of the total funds received for the project. It is estimated that the first year of this program will cost $400-$500,000. The State's share of this total will be provided through local funds for (1) city and county participation on the Task Force, (2) the continuing commitment of staff for the Morro Bay management conference, and (3) the development and implementation of the comprehensive conservation and management plan for Morro Bay. In addition to these local funds a small amount of in-kind State resources to participate in the Management Conference will count towards the State match.

Staff of at least 11 State agencies (the California Coastal Commission, California Coastal Conservancy, California Conservation Corps, Regional Water Quality Control Board, California Fish and Game, California Parks and Recreation Department, University of California, Co-operative Extension, Farm and Home Advisor, and the Sea Grant Program, State Lands Commission, State Department of Health Services, and Cal Poly State University) are already involved and committed to this process through their activities in the Morro Bay Task Force. Budget definitions will be changed to account for these activities under the NEP. Local agencies, expertise and commercial and environmental groups active in the Morro Bay Task Force are committing considerable support to management conference activities.

A number of specific part- and full-time positions will be defined, funded and filled in order to more clearly address the tasks. These might include:

1. Program Manager and Executive Secretary to the Policy Committee, responsible for planning, budgeting, coordination and operations.

2. Public Relations, responsible for liaison with the public, knowledgeable in governmental and regulatory affairs, and in relevant scientific issues.

3. Watershed/Land Use Planner, responsible for development of watershed plan, liaison with committee addressing this issue.

4. Estuarine Biologist, knowledgeable in freshwater, estuarine and marine biological resources, impacts and environmental modeling, responsible for development of estuary planning and liaison with committee addressing this issue.

5. Environmental/Pollution Control Specialist, knowledgeable in sediment and water quality issues, control technology treatment and economics, and liaison with the committee addressing this issue.

A financial strategy will be developed within two years of the convening of a management conference to pay for implementation of the comprehensive conservation and management plan.

FINDINGS

o **How can the lessons learned from this bay be applied to other coastal areas within the state or to other states? What problems, causes of those problems, and/or biogeographic area is represented by this estuary that is not already addressed by existing programs in the NEP?**

Morro Bay is a relatively pristine estuary threatened by development pressure and changing land use. It is an example of the many small and medium sized estuaries on the Pacific Coast and around the nation that face similar threats. Sedimentation and habitat loss, including deepwater, lagoon, littoral and wetland habitat have already occurred. Shellfish harvesting has been restricted due to bacterial contamination. The development of technical solutions and institutional arrangements to prevent further pollution could save the natural resources of Morro Bay and serve as a model for saving resources elsewhere.

o **Why is the estuary important to the nation?**

Morro Bay is the only major estuary in California south of San Francisco that has not been significantly altered by human activities. A large number of Federally-listed endangered and threatened plant and animal species reside or occur in the watershed or rely on the estuary for a significant part of their life cycles. The estuary serves a critical environmental function for a number of migratory bird species of the Pacific Flyway. International treaties protect these species and their habitat. The estuary serves as an important breeding and nursing area for a number of species important to the coastal commercial and recreational fisheries industry.

o **What is the geographic scope of Morro Bay?**

The proposed study area is the watershed of Morro Bay and the Bay itself seaward to the breakwaters at the harbor mouth (Figure 1). The 48,000 acre (75 square miles) Morro Bay watershed lies entirely within San Luis Obispo County.

o **What is the importance of the estuary at Morro Bay on a local or regional scale?**

The 2,300 acres that comprise Morro Bay contain the most significant wetland system on the central coast. The estuary also serves an important nursery function for many species of fish and invertebrates, including steelhead and halibut. Morro Bay is unique in its retention of much of its ecological integrity in a coastline that is increasingly overdeveloped. Beyond these resource values, the bay offers residents and visitors outstanding scenic, aesthetic, scientific and recreational values. It supports important commercial fishing, mariculture operations and a thriving tourist industry.

- **What are the major environmental problems facing the estuary?**

  Erosion in the watershed and sedimentation in the estuary are the greatest threats to Morro Bay. The scientific community is in agreement that if sediment deposition in the estuary continues at the present rate, the health, and indeed the very life of the estuary is in severe jeopardy. Under normal conditions, an estuary and lagoon such as Morro Bay, could have a life measured in the thousands of years (USDA/SCS, 1989a). However, if there is no abatement of sediment deliveries to the estuary, its life expectancy is likely limited to some 300 years (Haltiner, 1988), with parts of the southern section of the bay disappearing much sooner. The economic and environmental impact of the death of the estuary would be severe.

  In addition, development pressures in this region of the Central California coast are great. Increasing population density and changing land use threaten water quality and wildlife habitat. Urban runoff, discharge of sewage, and contamination by pathogens and toxic substances are all potential problems for Morro Bay, as for most estuaries. High coliform concentrations have been found in the Bay resulting in the restriction of shellfish harvesting from time to time (Department of Health Services, 1985). For the most part these potential problems are not adequately understood. With proper planning and monitoring, the impacts of development on Morro Bay can be understood and solutions developed before the estuary becomes severely impaired.

- **What are the institutional arrangements for the watershed and how are they working?**

  There are several city, County, State and Federal agencies with varied responsibilities in the watershed. While there are on-going efforts to pull these together, there is no single agency or management program to coordinate or to formalize this effort.

- **What is known about cause/effect relationships and how do you propose to better identify the causes of environmental problems?**

  Recent studies have demonstrated that human activity and land use in the watershed are related to sedimentation and loss of habitat in the bay, including estuarine waters, which serve an important nursery function and riparian habitats. Inadequate waste treatment is known to periodically cause poor water quality. By focusing interest on specific questions (such as freshwater in-flows, waste treatment, species of concern, etc.), we will be able to avoid a crisis in Morro Bay and act to prevent pollution and enhance the Bay.

- **What are State and local governments, and public and private institutions already doing for Morro Bay?**

  The Morro Bay Task Force, composed of some 50 agencies and interest groups, is working to understand the complexities of the interactions influencing the bay and is working towards united goals and identification of research needs for the watershed. Friends of the Estuary, a local non-profit group, coordinated the development of this nomination. State and Federal agencies regulate water quality in Morro Bay. The California Coastal Conservancy has funded Phase I of a Watershed Enhancement Plan prepared by the Soil Conservation Service to reduce sedimentation in the estuary.

- **What goals and objectives do you propose to set for the estuary and how do you propose to met them?**

  The Task Force has adopted the coordinated goal of "the long term preservation, conservation and enhancement of the Morro Bay and associated wetlands, nearshore

and watershed environments for all occupants and users, whether human, other animal or plant." This goal is further defined and objectives identified, with the expectation that they will be accomplished through formalizing the task force effort in a National Estuary Program management conference.

- **Who will participate in the management conference and how will it be organized?**

  The management conference will include all the entities that use, regulate, study, or make decisions concerning Morro Bay, including State and Federal elected officials, local officials, regulatory agencies, resource agencies, dischargers, environmental groups, and scientific researchers. The management conference will be organized into a Sponsoring Agency Committee, a Policy Committee composed of decision makers from all these groups, Technical and Public Advisory Groups, and a number of subcommittees.

- **Is there public and political will, as well as financial capability, to support implementation of the CCMP?**

  There is tremendous public support for Task Force efforts to convene a management conference and to implement a management plan, as illustrated by broad participation in the Task Force and the growth of environmental groups directly concerned with Morro Bay. Local, State and Federal elected representatives have expressed support for the nomination. The agencies presently active in the Task Force are supporting this effort financially. These in-kind funds will provide the required 25 percent match of federal funding for participation in the National Estuary Program.

CONCLUSIONS AND RECOMMENDATIONS

Morro Bay is significant both nationally and locally for its estuarine values, salt and freshwater wetlands, threatened and endangered species, sport and commercial fisheries, and many recreational uses. The bay has experienced tremendous pressures recently with changing land uses, increasing population density and the associated water use and pollution pressures.

The bay is impacted by identified pollution problems that are not being addressed completely by the current regulatory framework or pollution control efforts. Additionally, the public perceives the problems in the bay as serious, and are demanding that improvements be made in water quality and marine resources as well as in protection of public health. The management conference proposed for Morro Bay is an essential step toward addressing these problems.

The State of California, therefore, recommends that the Administrator of the Environmental Protection Agency convene a management conference for Morro Bay. The State recommends further that the conference be convened as soon as is practicable.

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