Land Vegetation

Following a modified scheme presented by Munz (1964), four major plant communities (Appendix 8) occur along the one-half mile wide belt bounding the Mugu-Latigo ASBS: coastal strand, coastal salt marsh, coastal sage scrub and riparian woodland. In addition, there are a number of areas where plant communities have been severely altered by land development.

Coastal strand vegetation is found along sandy beaches and sand dunes adjacent to the ASBS. In these communities the vegetation is often sparse, low or prostrate, and frequently contains succulents (Appendix 8). Coastal strand vegetation occurs along the Mugu Lagoon barrier beach, in scattered locales along La Jolla Beach, very sparsely between Sequit Point and Lechuza Point, along and above Zuma Beach and on the mesa area of Point Dume. Only in the Zuma Beach-Point Dume vicinity is this kind of vegetation well represented. Coastal strand vegetation is very susceptible to encroachment by man and the beach areas tend to be a preferred area for development. Thus, the coastal strand community is a relatively rare element along the ASBS.

A relatively rare but well represented community adjacent to the ASBS is the coastal salt marsh. The entire eastern fringe of Mugu Lagoon has a lush coastal salt marsh which is quite extensive (928 acres) and in a fairly natural state. The community associated with the marsh is discrete and quite distinct from all other vegetation types. It is dominated by pickleweed, Salicornia spp., and salt grass, Distichlis sp., but has numerous other members (Appendix 8). For a treatment of this community see MacDonald, 1976; Warme, 1971.

The most prevalent coastal plant community to one-half mile inland from the ASBS is the coastal sage scrub. This community dominates all the coast range slopes from the beach up to an elevation of about 3000 feet but is best developed below 500 feet. It grows primarily on coastal slopes of dry clay, gravel, or sandy or rocky soil. This plant community is made up primarily of open deciduous shrubs about one to five feet tall (Appendix 8). It also includes the giant Cereopsis which is

endemic to the nearshore bluffs in southern California. It is particularly abundant around Point Mugu and Point Dume.

Riparian woodland communities border most of the creek beds along the coastal drainages. This plant community is dominated by tall deciduous trees, especially the western sycamore. Several species of thick shrubs regularly occur beneath these trees. Some of these riparian habitats have been quite modified by man, but natural communities of this type are especially well represented in La Jolla, Big Sycamore and Zuma Canyons.

The upper parts of most of the Santa Monica Mountains are dominated by the chaparral community. However, this community does not occur within one-half mile of the ASBS.

Developed land bordering the ASBS is commonly landscaped with non-native, exotic vegetation which is carefully maintained. Much of the bluff between Little Sycamore Canyon and Latigo Point is landscaped. The western part of the Mugu Lagoon area has been substantially altered by the activities of the U.S. Navy.

Unique Components

The Mugu-Latigo ASBS was set aside not because of any single unique component or habitat, but because of the multiplicity of distinct habitats and organisms in a relatively healthy state which collectively make the area unique. An important aspect of this ASBS is its proximity to a major urban center thus providing access to the area for millions of people for scenic, recreational, and educational purposes each year. In addition, because the ASBS possesses a large reservoir of organisms which are breeding and recruiting, it could serve as the basis for recolonizing surrounding and more impacted habitats to the north and south.

It is difficult to single out specific organisms which are especially unique components. However, there are several ecologically dominant organisms which are so important to these communities that they warrant consideration here. These include the giant kelp, *Macrocystis pyrifera*, the surf grass, *Phyllospadix torreyi*, the sand dollar, *Dendraster*

excentricus, the sand tube worm, Phragmatopoma california, and the gray tube worm, Diopatra ornata. These species provide food, shelter, substrate, and increased heterogeneity, and they physically stabilize and change the habitat. The recreationally and commercially important species are the pismo clam, Tivela stultorum, the urchins, Strongylocentrotus spp., and the California halibut, Paralichthys californicus.

Giant kelp, Macrocystis pyrifera: Ecologically, these plants have a profound influence on the surrounding biological community. The extensive beds occur for a distance of about 9 miles along the ASBS (Figs. 19, 20) and largely dictate the kind of organisms which will be found under, around and shoreward of them. The continued health and preservation of these extensive beds are critical to maintaining the biota of the reefs in their highly diverse state. These beds are an important renewable resource and represent the only economically important kelp beds on the mainland Ventura and Los Angeles Counties (Fay, 1972). Macrocystis lives up to 7 years, and the major cause of mortality appears to be storm waves. Kelp is sensitive to heavy sedimentation, high turbidity, and higher water temperatures.

Surf grass, Phyllospadix torreyi: This is an abundant and ecologically dominant flowering plant of the shallow subtidal and lower intertidal. It occurs regularly on most of the shallow water rocks and reefs between Latigo Point and Point Mugu. Surf grass serves as an important nursery for juvenile fishes (Kikuchi and Peres, 1973) and for the local lobster (Serfling and Ford, 1975). Except in the case of the lobster, the overall importance of Phyllospadix as a nursery ground is still largely unexplored and should be examined further. Phyllospadix, which is long lived, contains a complex and unique community and aids in stablizing the rocks of the lower intertidal and shallow subtidal by anchoring them together. This grass also dampens the incoming surf and thereby decreases the erosive effect of the waves. Increased runoff into the shallow subtidal zone due to urbanization of land areas surrounding the ASBS may be detrimental to surf grass. The shallow area where this grass grows makes it susceptible to pollutants that float in on the water or flow in from the land or intertidal area. The biological importance of the surf grass Phyllospadix is not well known.

Sand dollar, Dendraster excentricus: The extensive sand dollar beds which occur on the nearshore sand bottoms within the ASBS represent the greatest species abundance and biomass of any single macroscopic species on the sand bottom (Figs. 21-23). An estimated 50 million sand dollars exist in the nearshore waters between Point Dume and Lechuza Point (a distance of 4 1/5 miles). Sand dollars live a long time (up to about 13 years, Timko, 1975) and form well-organized, structurally complex beds in the shallow subtidal region (15 to 45 feet depth). Their presence has important structuring effects on the community and also provides protection and perhaps a nursery habitat for a number of species. Their location just below the point where major onshore-offshore sand movement ceases may have important implications on sand transport. Clearly they represent an ecologically important and unique component of the nearshore sands. For further information see Merrill and Hobson, 1970; Timko, 1975, 1976; and Morin et al. (in prep).

Tube worms, Phragmatopoma californica and Diopatra ornata: Both the shallow water reef forming Phragmatopoma and the deeper water Diopatra occur in high densities over substantial areas of the bottom within the ASBS. They are clearly important in structuring their communities, but their biology is not well studied, although it is believed that loss of these species would greatly alter the environment and have a major effect on species diversity.

Pismo clam, Tivela stultorum: The pismo clams within the ASBS are important to the southern California recreational fishery. Their numbers are substantial, and they probably represent an ecological dominant in their shallow subtidal sand habitat. These are large clams (up to about

juveniles at any one time. Surveys (Figs. 21-23) showed that fairly dense pismo clam beds occur in the shallow subtidal zone (10 to 25 ft. depth) off Zuma Beach and more or less continuously from Big Sycamore Beach to Laguna Point (the western 1/4 of the ASBS). In general, these beds are somewhat patchy and the clams seem to move around quite a bit. As pismo clams most frequently are distributed within the region of maximum sand flux (Zone 1, in Figs. 18 and 19), their movements probably represent adjustments to the changing beach profiles. The following are survey estimates of the maximum pismo clam bed densities (in 10-25 ft. depths) at several locations within the ASBS:

Zuma Beach:	1-3/m^2
Four-tenths mile east of Big Sycamore Beach:	2-3/m^2
Big Sycamore Beach:	2/m^2
La Jolla Beach:	mostly 1/m^2, but up to 5/m^2
Four-tenths mile east of Pt. Mugu:	1-2/m^2
Pt. Mugu:	mostly 1/m^2, but up to 5/m^2
Mugu Lagoon Barrier Beach:	4-5/m^2 (high)
Mugu Canyon:	rare

In general these beds are 20 to 50 meters wide (Figs. 21-23). The subtidal clam population appears reasonably dense and probably fairly stable, although not nearly as dense as has been reported for Pismo Beach (Fitch, 1950, 1961). Useful sources of information on the pismo clam include: Coe and Fitch, 1950; Knaggs *et al*. 1976, 1977; Miller *et al*., 1975; Weymouth, 1923.

Other Recreationally and Commercially Important Species: The Mugu-Latigo ASBS is an area which has low but not inconsequential numbers of the abalone species (reds, *Haliotis rufescens*; pinks, *H. corrugata*; greens, *H. fulgens*; whites, *H. sorensoni*), lobsters, *Panulirus interruptus*, purple urchins, *Strongylocentrotus purpuratus*, and red urchins, *S. franciscanus*. None of these species are particularly abundant within the ASBS compared to other locations in the Southern California Bight and offshore islands. In fact, their numbers have been considerably reduced

important area for these species. Maintenance of habitat within the ASBS available for recolonization in the future is essential to assure continued recruitment and potential recovery of these species to their previous levels. In addition, this area can potentially act as a reservoir for recruitment into nearby areas in which populations have been depleted by fishing pressure, adjacent land development and/or deteriorating water quality.

The recruitment of several of these species is dependent upon the availability of suitable substrate or habitat. Abalone larvae preferentially settle on encrusting coralline algae, lobsters on surf grass, red urchins under adults, and halibut in shallow bays where the adults do not occur. The relatively large numbers of halibut present within the ASBS may be because of the health state of Mugu Lagoon where the juveniles are regularly found. Without the lagoon as a nursery, adult populations might not recruit well into the ASBS and the populations would therefore suffer. Therefore, having the lagoon associated with the ASBS adds a unique and vital component to the ASBS. These examples indicate that the success of a population may depend on a seemingly unrelated feature of the environment, which therefore also warrants special protection.

Several rare and endangered species forage in the ASBS and should be considered unique components. These include the brown pelican, *Pelecanus occidentalis*, the clapper rail, *Rallus longirostris*, and the California least tern, *Sterna albifrons browni*. One of the few remaining breeding sites of the least tern is in Mugu Lagoon, and special attention should be given to its protection.

LAND AND WATER USE DESCRIPTION

Marine Resource Harvesting

Commercial Fishing: The Mugu-Latigo ASBS contains portions of California Department of Fish and Game catch blocks 680, 681 and 682. Data over a 5-year period from these three blocks were analyzed for the commercial catches within and seaward of the ASBS (Table 14).

There are two major classes of organisms taken: 1) transient species which migrate into and out of the ASBS and 2) resident species which reside within the ASBS as adults. Four of the six most important species are transient and are usually caught outside the boundary of the ASBS (Table 14). These transient species enter the ASBS but most (except the halibut) are more consistently found in deeper water. Large schools of both Pacific mackerel and barracuda are observed in 40 feet of water off Zuma Beach. Market squid are netted over sandy areas within the ASBS when the schools come inshore to spawn from March to June. Resident species such as lobster, crab, sheephead and urchins are most often collected in or near rocky areas in the ASBS. Halibut, a summer fishery, and sole are taken over sandy bottoms. Sablefish are primarily a deep water species (>300 ft.) taken beyond the ASBS. The numerous rockfishes are taken most regularly over rocky areas, but many are also taken over deeper sands. White sea bass are captured in gill nets mostly off the western headlands. Other species which are only occasionally taken in the ASBS and do not appear in the table include the Pacific mackerel, *Scomber japonicus*, barracuda, *Sphyraena argentea*, and lingcod, *Ophiodon elongatus*. Abalone, *Haliotis* spp., have been harvested in the ASBS in the past but their numbers are too low to support a commercial fishery in this area at the present time.

The entire coast off the ASBS is presently closed to drag boat fishing within three miles of shore. Halibut trawl grounds are one mile from shore. Anchovies, which have also been seen in the ASBS, can be

Table 14 Commercial Average Yearly Fisheries' Catches between 1970 and 1975 within and beyond the Mugu-~~Latigo~~ ASBS. (Catch Blocks 680,681,682).

Organism	Resident (R) or Transient (T); Seasonal (S)	Amount (in lbs/year)
Market Squid (*Loligo opalescens*)	T-S	537,126
Pacific Bonito (*Sarda chiliensis*)	T-S	213,565
Northern Anchovy (*Engraulis mordax*)	T	93,598
Sea Urchins (*Strongylocentrotus* sp.)[1]	R	83,222*
Bluefin Tuna (*Thunnus thynnus*)	T	22,957
Rockfish (*Sebastes* sp.)[2]	R	12,427
Jack Mackerel (*Trachurus symmetricus*)	T	4,340
Market Crab (*Cancer* sp.)[3]	R	3,742
White Sea Bass (*Cynoscion nobilis*)	T	3,124
Swordfish (*Xiphias gladius*)	T	3,107
Halibut (*Paralichthys californicus*)	T	1,319
Lobster (*Panulirus interruptus*)	R	1,307
Shark (various species)[4]	T	961
Sole (*Citharichthys sordidus*)	R	261
Yellowtail (*Seriola dorsalis*)	T-S	151
Sheephead (*Pimelometopon pulchrum*)	R	85
Sablefish (*Anoplopoma fimbria*)	T	61

[1]Two species are taken: the purple urchin (*S. purpuratus*) and the red urchin (*S. franciscanus*).

[2]Numerous rockfish are lumped together and not distinguished in the catches.

[3]Includes three common species: the southern yellow crab (*C. anthonyi*), the red crab (*C. productus*), and the rock crab (*C. antennarius*).

[4]Species are not indicated.

*This is a three year average since the fishery only began in 1973.

taken anywhere south of Point Mugu for bait, but the major fishing occurs outside the ASBS. The area is open to gill netting. However, nets may not be used within 750 feet of the piers within the ASBS. Boats are not allowed closer than 300 yards from shore in Los Angeles County. Black abalone, Haliotis cracherodii, and pismo clams may not be taken for commercial purposes within the ASBS; all other species of abalone may be taken commercially.

Kelp Harvesting: The kelp beds and their use are discussed previously in this report. The ASBS includes all of Bed 17 and the western part of Bed 16, as designated by California Department of Fish and Game. Harvesting does occur within the area but the amount of kelp harvested is unavailable.

Sport Fishing: The Mugu-Latigo ASBS is an area of considerable sport fishing activity (Table 15). Sport fishing consists of shore fishing off the rocks and beaches, and fishing from private and party boats. SCUBA sport fishing effort for fishes, lobster, abalone, clams, and other shellfish is also substantial. The collecting of fish and shellfish at low tides is also a common practice.

Party boats: In 1976, 113 boat days were reported by the California Department of Fish and Game for blocks 600, 601 and 602. The catch per

unit effort was high (1.9 fish per hour). Annual average sport fishing

Table 15. Sport Fishing Average Yearly Catches [1] From Party Boats between 1971 and 1976 within and beyond the Mugu-Latigo ASBS.

Organism	No. of Fish
Rockfish (*Sebastes* sp.)	224,648
Bass (*Paralabrax* sp.)	25,016
Bonito (*Sarda chiliensis*)	4,454
Sablefish (*Anoplopoma fimbria*)	1,815
Flounder (various species)	1,521
Sculpin (*Scorpaena guttata*)	869
Lingcod (*Ophiodon elongatus*)	692
Pacific Mackerel (*Scomber japonicus*)	684
Halibut (*Paralichthys californicus*)	530
Jack Mackerel (*Trachurus symmetricus*)	489
White Croaker (*Genyonemus lineatus*)	217
Yellowtail (*Seriola dorsalis*)	215
Halfmoon (*Medialuna semicincta*)	209
Barracuda (*Sphyraena argentea*)	198
Cabezon (*Scorpaenichthys marmoratus*)	191
Sheephead (*Pimelometopon pulchrum*)	121
White Sea Bass (*Cynoscion nobilis*)	65
Jumbo Squid (*Dosidicus* sp.)	35

Occasionally caught are Salmon:(King, *Oncorhynchus tshawytscha* and Silver, *Oncorhynchus kisutch*) and Ocean Whitefish (*Caulolatilus princeps*).

1. Based on data from catch blocks 680, 681, 682.

Small boats: At Paradise Cove, boats up to 17 feet in length may be launched from the pier and are available for rent. Most of the boats launched from the pier heavily fish the local area east of Point Dume. California Department of Fish and Game monitors sport fishing activity at the Paradise Cove pier. Rockfish and white croaker are the largest groups of fishes caught while kelp bass are also taken in large numbers. The catch per unit launch effort during the Fish and Game sampling was 0.5 fish/hr (Wine and Hoban, 1976).

Shore fishing: A popular sport within the ASBS is surf fishing. This method of fishing occurs widely within the ASBS, especially west of Point Dume. The areas with the greatest surf fishing activity are Zuma [illegible]

the ASBS and are largest at Little Sycamore Canyon, Arroyo Sequit and San Nicholas Canyon. Rangers at Arroyo Sequit indicated that clamming pressure is heavy in the cobble field and results in extensive disturbance to the area. Some intertidal mussels and gooseneck barnacles are taken along the ASBS.

Limited fishing and clamming are done by Navy personnel between Laguna Point and the mouth of Mugu Lagoon. Because of the firing range, walking the beach and boating are limited off Mugu Lagoon.

Municipal and Industrial Activities

There are no municipalities within one mile of the ASBS; however, a substantial residential area exists at the eastern end on the Malibu bluff coast (Fig. 24). Houses are primarily located on the bluffs above the beach; however, between Latigo Point and Paradise Cove and between Trancas Canyon and 1/4 mile west of Little Sycamore Canyon, houses have been built on the beach. There are no major industrial activities within one mile of the ASBS. However, some of the U.S. Navy Pacific Missile Test Center property is within 1/2 mile of the area. This facility includes airfields and missile launching areas. Naval personnel are housed on the base which occupies 4,830 acres including Mugu Lagoon, and employs over 9,000 personnel. The Southern California Edison Company's Ormond Beach Generating Station is four miles west of the western boundary of the ASBS (Laguna Point). Deer Canyon has been proposed as a LNG site (LNG Tech. Rep. No. 23, 1977).

Agribusiness

On most of the land within 1/2 mile of the ASBS there is no agricultural production to any major degree. A few small horse ranches and kennels are scattered along the Malibu bluffs. Private gardening activities also occur from the County Line eastward in residential areas. Most land is occupied by residences and open space (Fig. 24).

The Calleguas Creek draining (Fig. 8), which is extensive, does contain considerable agricultural activity (Fig. 25, and see MacDonald, 1976). Most of this activity consists of cattle grazing on the steeper slopes and agricultural production in the alluvial plain region. The runoff from these lands drains into Mugu Lagoon and then into the ASBS near its western end.

Governmental Designated Open Space and Recreational Use

Five major beach areas are developed for recreational use along the [illegible] ASBS (Fig. 24, Table 16). Point Mugu State Park is located

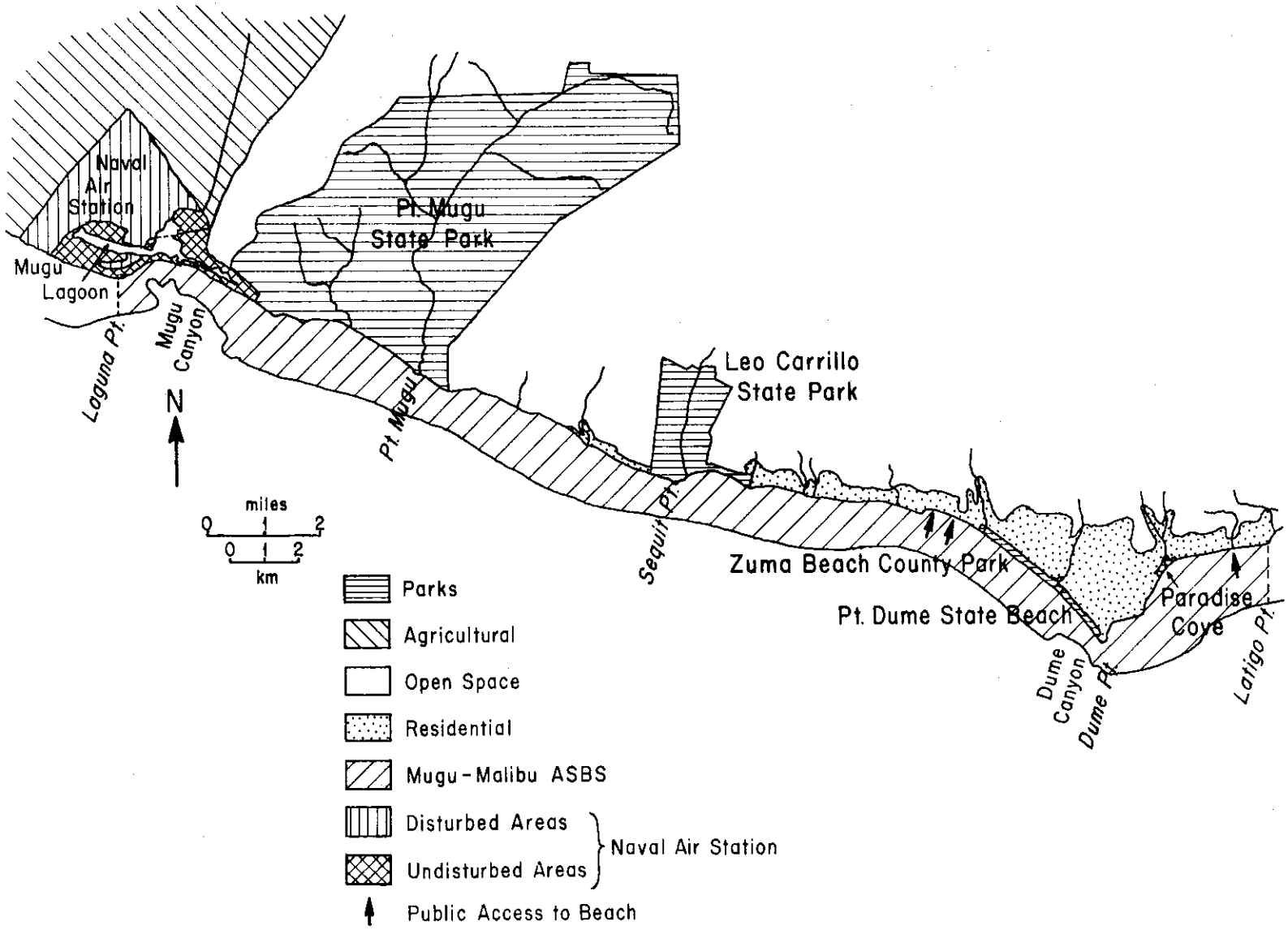


FIGURE 24

Land Usage along the Mugu-Latigo ASBS.

Table 16

Attendance Figures, Size and Facilities of Public Parks Adjacent to the Mugu-Latigo ASBS

	Point Mugu State Park	Leo Carrillo State Park	Zuma Beach County Park	Point Dume State Beach	Paradise Cove
Ocean Frontage Operator	3.8 miles State Parks	1.3 miles State Parks	1.8 miles Los Angeles County	1.2 miles Los Angeles County	0.5 miles Private
Parking	150 (+ highway)	300 (+ ca. 200 on highway)	1,986 (+ ca. 600 on highway)	376 (+ca. 360 on road)	350
Picnic Tables and Fire Pits	Yes	Yes	No	No	Yes
Camping	150 sites	190 sites	None	None	None
Showers	Cold	Cold	Cold	Cold	None
Concessions	None	Snack Bar	Snack Bar	None	Bait and Tackle Shop, Snack Bar, Restaurant
Fishing	From Shore: Rock + Sand	From Shore: Rock + Sand	From Shore: Sand	From Shore: Rock and Sand	From Shore and Pier, plus Two Party Boats, Skiff Rental, Boat Landing
Estimated Monthly Attendance	1976	1977	1977	1977	1977
January	12,356	21,100	181,000	30,750	
February	22,875	55,700	534,000	86,050	
March	23, 289	26,800	232,500	33,450	

Table 16 (Continued)

	Point Mugu State Park	Leo Carrillo State Park	Zuma Beach County Park	Point Dume State Beach	Paradise Cove
Estimated Monthly Attendance (Cont.)					
April	24,579	50,550	533,000	94,850	
May	50,898	35,750	480,000	64,650	
June	69,732	64,750	971,000	89,000	
July	88,265	128,200	1,685,000	127,400	
August	102,501	117,100	2,336,000	72,000	
September	43,790	81,600	1,064,500	1,126,500	
October	40,593	35,300	527,000	87,200	
November	26,030	30,150	218,000	123,500	
December	26,965	16,700	538,000	18,000	
Total	532,000	663,700	9,300,000	1,953,350	ca. 300,000
Daily Average	1,450	1,800	25,000	5,300	ca. 800

urban areas of Los Angeles and Ventura Counties continues to increase. Much of the ASBS (about 11 1/2 miles) is essentially open to the public (Fig. 24). Of this, about 6 1/2 to 7 miles receives extremely heavy use by sunbathers and swimmers during the summer months (Fig. 26). The approximately 9 1/2 miles of privately owned beach with restricted access has relatively light recreational use. The remaining 3 miles along the Mugu Lagoon barrier beach is essentially unused because of Naval restrictions. Relative public use of beach areas is shown in Figure 26.

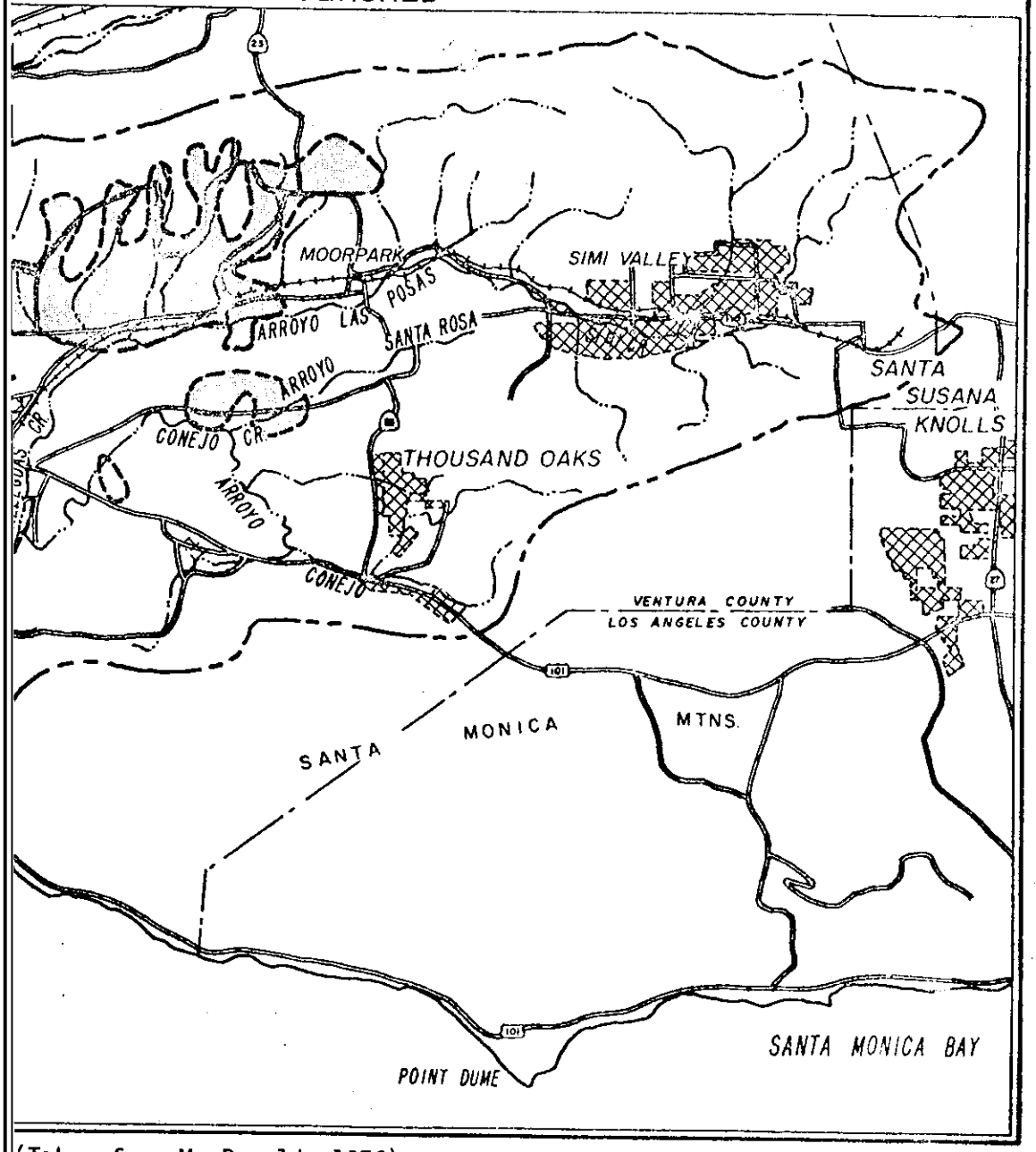
Except in the area immediately around Paradise Cove, boating activity is not heavy, probably due to the distance of the ASBS from any marinas.

Scientific Study Use

The Mugu-Latigo ASBS is an important scientific resource. There are four main categories of scientific use which occur here.

Education. Several intertidal areas are used by local schools and colleges for class field trips. The reefs at Paradise Cove and Leo Carrillo are used in particular for this purpose. Some subtidal biology classes take working field trips to the area. Leo Carrillo is a popular

RAL & URBAN LANDS
JAS CREEK WATERSHED



(Taken from MacDonald, 1976).

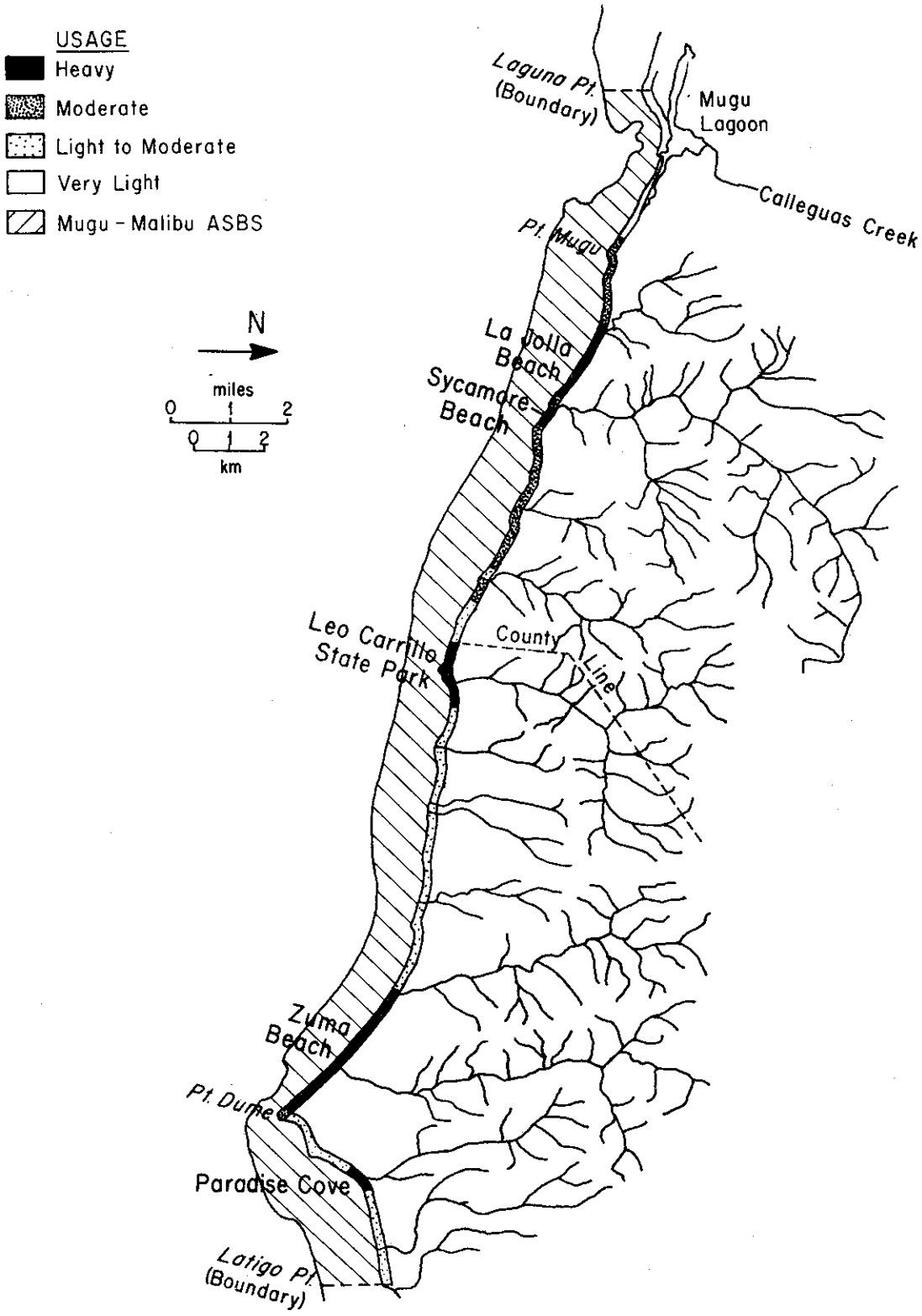


FIGURE 26

Relative Public Recreational Use of the Beaches along the Mugu-Latigo ASBS.

natural and without oil (Nicholson and Cimberg, 1971). The Bureau of Land Management, as part of its Southern California Baseline Study, has taken data on sandy and rocky intertidal and mussel communities within the ASBS (BLM 1978). The State Water Resources Control Board maintains a State Mussel Watch station at Point Mugu. If an adequate water quality level is maintained within the ASBS, the area will remain extremely valuable as a control site.

Basic Research. The ASBS has been the site for many studies seeking to document the biota of the region and the interactions of species with each other and their environment under conditions where human impact has been minimal. Some locations within the ASBS are well suited for this type of research.

Mugu Lagoon and the barrier beach are now being studied extensively by students and researchers from a number of universities and colleges. The relatively undisturbed conditions and restricted access make this an ideal location for studies of natural intertidal, shallow subtidal, salt marsh and open beach communities. Shore bird studies are possible because of the lack of human traffic in the barrier beach and lagoon areas.

It is difficult to provide a complete description of scientific research within the ASBS; often projects are of a short term nature, of uncertain extent, or involve infrequent sampling. Offshore sampling is done on a periodic basis by the Allan Hancock Foundation and the Southern California Coastal Water Research Project. Private industry also occasionally does survey work within the area.

Transportation Corridors

The major highway adjacent to the ASBS is Pacific Coast Highway, a variable width arterial highway which runs parallel to the coastline. About 7 1/2 miles of the highway is along the beach, and about 13 miles is a short distance inland, usually on the bluff with houses between the road and the ASBS. Pacific Coast Highway is the major access to the ASBS for residential and recreational traffic. In addition, Pacific

Coast Highway is an alternate route for the Ventura Freeway, so there is a fair amount of through traffic between the Ventura Freeway to the northwest and the Santa Monica Freeway to the south.

Traffic on Pacific Coast Highway is extremely heavy during the summer months east of Zuma Beach because of the heavy recreational use of that portion of the ASBS. Annual daily traffic averages in 1974 on Pacific Coast Highway were 20,000 at Dume Road, 12,000 at Decker Canyon Road and 8,300 at the County Line. As there is relatively little development west of the county line, the 8,300 vehicles per day can probably be considered representative of the through traffic volume in 1974.

Shipping lanes for tankers traveling between San Francisco and Los Angeles pass between the Channel Islands and the mainland. The northbound lane is 4 1/2 miles off Laguna Point and the southbound lane is 7 1/2 miles off Laguna Point. The estimated freighter traffic here in 1975 consisted of 2,130 northbound ships and 1,200 southbound ships. Average daily traffic was 9.1 ships per day. If the SOHIO facility is completed at Los Angeles Harbor, freighter traffic will increase to an estimated 26.6 ships per day between San Francisco and San Pedro, and consist in part of supertankers carrying oil from Alaska (SOHIO Draft EIR, 1977).

ACTUAL OR POTENTIAL POLLUTION THREATS

Point Sources

Municipal and Industrial Wastes: There are no municipalities within one-half mile of the shoreward boundary of the Mugu-Latigo ASBS. However, there are several communities which discharge secondary treated sewage into the Calleguas Creek drainage, which feeds into Mugu Lagoon. These include Thousand Oaks, Simi Valley, Moorpark, Camarillo and Newbury Park. The domestic and indistrial sewage from the Point Mugu Naval Air Station previously discharged directly into Mugu Lagoon. However, this secondary treated wastewater discharge was eliminated in late 1978.

The majority of the residences bordering the ASBS have individual septic tanks. Apartment complexes and condominiums have systems that provide secondary treatment; leach fields or spray irrigation are used to dispose of the effluent. The overall effect of the leach fields, some of which are on the beach, on the biota within the ASBS is not at all known. Some experts contend there is little or no effect, while others speculate that the effects might be quite significant. For instance, Dawson (1965) suggests a decrease in algal diversity at Malibu Point was due to leach field effluents.

The major municipal outfalls in the vicinity of the ASBS are those of Oxnard (5.3 miles away from the western ASBS boundary), Ventura (16 miles away from the western ASBS boundary), the Las Virgenes (about 5 miles from the eastern ASBS boundary via Malibu Creek), and the Los Angeles Hyperion outfall (about 20 miles from the eastern end of the ASBS). Total discharge volumes in 1976 were 353 million gallons per day (MGD) from Hyperion, 11.6 MGD from Oxnard. All of these discharges could potentially affect water quality in the ASBS, depending on local and oceanic currents. The Los Angeles and Las Virgenes effluents could be carried westward along the Malibu Coast to the Paradise Cove area. The typical southerly and easterly currents and swell are more likely

to deliver effluents from the north and west (Oxnard and Ventura) into the ASBS. The Oxnard effluent is discharged 1 mile offshore at a depth of 50 feet. These discharges do not have any obvious adverse impact on water quality in the ASBS; the effects, if any, are most likely chronic and subtle.

Occasionally high coliform counts have been recorded within and beyond the ASBS, especially in Mugu Lagoon. Their source is unknown, but likely candidates were: 1) wastewater discharges from Point Mugu Naval Air Station, 2) private leach fields which overflow or in other ways enter the ASBS (e.g. high tides, heavy rains, faulty fields, etc.), 3) from failures in the treatment plants which discharge into Calleguas Creek, or from Oxnard, Ventura, Las Virgenes or less likely Los Angeles, 4) livestock manure washed into the drainages by runoff, and 5) possibly waterfowl and shorebirds inhabiting Mugu Lagoon.

Cooling Water Effluents and Intakes: The Southern California Edison Company's Ormond Beach Generating Station has an intake and discharge pipe for its cooling water system 4.1 miles west of the ASBS. The intake pipe is 2000 feet from shore in 35 feet of water and the adjacent discharge pipe is about 1400 feet from shore in 30 feet of water. The cooling water system uses 475,000 gallons of seawater per minute and elevates the circulated water's temperature by as much as 30°F (16.6°C). The discharge rapidly disperses in the nearshore waters and has no observed impact on the ASBS. The constituents of the discharge which could have an impact on the ASBS are the chemicals used to control marine fouling growth (1,058 pounds of sodium hypochlorite per day)

The impact of the entrainment of marine organisms on the area's resources is not well understood; however, no adverse effects have been observed in the ASBS.

Dredging and Spoil Disposal: The only location adjacent to the Mugu-Latigo ASBS where dredging occurs is in Mugu Lagoon. The U.S. Navy has dredged the western part of the lagoon and their installation of missile sites has recently involved some earth removal and filling (Naval Undersea Center, 1977). In addition, spoil disposal operations from routine dredging at Port Hueneme may be associated with biological changes upcoast of the ASBS, but impacts within the area have not been reported.

A second point source impact that best fits under this heading is that of landslides. The region, especially between Point Mugu and Little Sycamore Canyon, but elsewhere too, is prone to slides because of the steepness of the adjacent land masses. This problem was particularly evident during the 1977-78 rainy season when the Pacific Coast Highway was repeatedly closed due to slides. The earth from the slide may naturally fall into the ocean or is sometimes pushed or dumped into the intertidal area during cleanup operations. The effect of this activity increases water turbidity but other effects are not known.

Radioactive Wastes: The Naval Air Station uses radioactive materials, but these are not dumped into the ASBS (R. Dow, pers. comm.). No other such sources are known to occur within the ASBS.

Ocean Dumping: No known ocean dumping occurs in or near the Mugu-Latigo ASBS except for the previously mentioned dredge spoil disposal to the north from Port Hueneme.

Vessel Discharge: Bilge wastes and other vessel discharges are generally quite minimal within the ASBS. There are very few party boats that regularly visit this area and only two are moored there. Their bilge pumping is minimal, but they discharge their sewage directly into the sea. Most of the other boats in the ASBS are small powerboats, sailboats and rented skiffs which produce relatively few discharges.

Non-Point Sources

Agricultural Wastes: Calleguas Creek is the only drainage into the ASBS which contains substantial agricultural activity (Fig. 25). The amount of runoff from this agricultural area is highly variable and depends primarily on rainfall. During the summer there is no natural water flow in Calleguas Creek; all of the summer flow comes from irrigation runoff and wastewater discharge. The principal pollutants from agricultural activities are coliform bacteria from manure, nutrients from manure and fertilizers, and chemical residues from pesticide use. The following data, taken from the Las Virgenes EIR (U.S. E.P.A., 1977), indicate the relatively low levels of chlorinated hydrocarbon emission rates from runoff in 1971-1972 for Calleguas Creek: flow volume = 3.4×10^6 m^3/yr; total DDT = 0.5 kg/yr; total PCB = 0.7 kg/yr; Dieldrin = 0.05 kg/yr; total chlorinated hydrocarbons = 1.3 kg/yr. In the past, the U.S. Navy used pesticides for mosquito abatement within the lagoon; this practice has been discontinued. For further information on Calleguas Creek see MacDonald (1976), and U.S. E.P.A. (1977).

Oil Spills and Seeps: There are no known oil or tar seeps within or near the ASBS. The closest known seeps are along Anacapa Island at least 16 miles away (Emery, 1960).

Oil spills could have an impact on the ASBS. To date there have been no major spills which have reached this region, but the ever increasing ship traffic in the nearby lanes, especially the increasing oil cargos, obviously increases the risk of such a spill.

Land Development: The population density of the area along the Malibu bluff coast is steadily increasing, thus causing an increase in several potential threats to water quality in the ASBS. These potential threats include sewage discharges, private use of pesticides and fertilizers, garbage, aerial borne pollutants, auto associated pollutants via highway runoff, and runoff due to urbanization and forest fires on adjacent lands.

Airborne pollutants probably have an impact on the biota of the ASBS. However, the extent of aerial fallout of pollutants into the sea

is not well documented. Limited data (SCCWRP, 1972) suggest significant amounts of airborne pollutants enter the offshore waters of southern California by both rainfall washout and dry fallouts, including lead, mercury and manganese. The amount of asbestos, hydrocarbons, and other metals contributed from airborne sources is not known but may be significant. Generally the air quality over the ASBS is relatively good compared with nearby urban centers but does not yet meet long-range EPA standards. The nighttime offshore breezes tend to move the polluted air seaward

SPECIAL WATER QUALITY REQUIREMENTS

Special water quality safeguards were mentioned under the section on Unique Components above. In addition to water quality control programs

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Keys to and descriptions of the marine algae of the California coast. Scientific names used in our report follow this recent reference.

Allan Hancock Foundation. 1959. Oceanographic Survey of the Continental Shelf Area of Southern California. State Water Pollution Control Board. Publ. No. 2 Q, Sacramento, Calif.

Data from two years of an oceanographic survey that included microbiology, benthic biology, bottom sediments, water characteristics, attached algae and climate. Some of the data, including sediment and water analysis and intertidal algae were collected in the Mugu-Malibu ASBS. Maps, descriptions of the areas surveyed, and species lists are included.

Allan Hancock Foundation. 1965. An Oceanographic and Biological Survey of the Southern California Mainland Shelf. Calif. State Water Quality Control Board, Publ. No. 27. Sacramento, Calif.

A five year study of the marine environmental phenomena relatable to the practice of waste discharge into coastal waters off southern California. Included are biological, geological, chemical and oceanographic data on the Southern California Bight. Especially relevant to the ASBS are the physical properties of the water and sediments and the intertidal algal study by Dawson.

Azmon, E. 1956. The Geology of the Point Mugu Quadrangle. Dept. Geol. UCLA Unpub. MA thesis, 36 pp.

There are three major formations in the quadrangle: Nicholas Canyon Formation (a calcareous sandstone), Point Mugu Formation (a black shale) and Little Sycamore Formation (an alternating shale and sandstone with large diabase sills and dike intrusions); all are Miocene in age. There are four major southwest trending faults in the quadrangle.

Bass, R. 1960. Geology of the Western Part of the Point Dume Quadrangle. Dept. of Geology UCLA, Unpub. MA thesis.

This area is divided into mountain and coastal blocks by the Malibu Coast Fault. The coastal block consists of the Trancas Formation (sedimentary breccias, dark arenites and lutites and intrusive igneous rock) and the Modelo Formation (siliceous shale with arkose interbedded). These Miocene aged formations are overlain by Pleistocene marine terrace deposits. Point Dume and Lechuza Point are probably part of a different formation, the San Onofre breccia.

Bureau of Land Management 1978. Southern California Baseline Study 1975/1976: draft integrated summary report. In press.

This document summarizes the baseline studies done for BLM in 1975 and 1976. Some of the data in this report were taken within the Mugu-Malibu ASBS; for example, kelp bed surveys, sandy intertidal, and benthic and water column studies. Trace metal concentrations in sand are reported for Point Mugu and Point Dume. These baseline studies and this summary report will provide important information on the ASBS as well as the entire Southern California Bight.

California Department of Parks and Recreation. Statistical report 1975-1976. State of Calif. Resources Agency.

California Department of Parks and Recreation 1977. The Santa Monica Mountains State Parks: Topanga State Park, Malibu Creek State Park, and Point Mugu State Park. Resource management plans, general development plans, and environmental impact reports. 204 pp.

This report contains a resource inventory and analysis for Point Mugu State Park which is adjacent to the ASBS. Figures show slope, structural geology, vegetation and paleontology of the park. Existing and planned projects are described and the impacts are evaluated. Existing shoreline projects are a ranger station and picnic area at Big Sycamore Beach and a campground and parking area at La Jolla Beach. Planned projects include 60 roadside camps between Point Mugu and La Jolla Beach and beach parking (100 cars) and a scenic overlook at Point Mugu.

Campbell, R.H., B.A. Blackerby, R.F. Yerkes, J.E. Schoellhamer, P.W. Birkeland, and C.M. Wentworth. 1970. Preliminary Geologic Map of the Point Dume Quadrangle, Los Angeles County, California. U.S. Geol. Survey open file map.

Cimberg, R.L., S. Mann and D. Straughan. 1973. A reinvestigation of Southern California rocky intertidal beaches three-and-one-half years after the 1969 Santa Barbara oil spill: a preliminary report. Proc. of Joint Conf. on Prevention and Control of Oil Spills. Mar. 13-15, 1973, Wash. D.C. 697-702.

This paper uses the data presented by Nicholson and Cimberg, 1971, and data collected in 1972 to compare ten rock intertidal beaches in southern California, one of which was Arroyo Sequit Beach within the ASBS. Arroyo Sequit is used as an "unoiled" beach and compared to "oiled" beaches using similarity analysis.

Coe, W.R. and J.E. Fitch. 1950. Population studies, local growth rates and reproduction of the Pismo clam (Tivela stultorum). J. Mar. Res. 9(3):188-210.

Davis, N. 1978. Studies of the Southern California Nearshore Sand Bottom Communities. Ph.D. diss. Univ. of Calif., San Diego.

A study of the sand bottom off La Jolla, California, concentrating mainly on feeding in the sand star Astropecten verrilli. A study on the effect of a rock reef on the surrounding sand subtidal community is included.

Dawson, E.Y. 1959. A Primary Report on the Benthic Marine Flora of Southern California. Pages 169-218 in:Oceanographic Survey of the Continental Shelf Area of Southern California. State Water Pollution Control Board, Publ. No. 20. Sacramento, Calif.

Seven of Dawson's intertidal sites were in the ASBS; descriptions of the sites and photographs are included along with species lists for each site. The areas surveyed include: Point Mugu, Bass Rock, Yerba Buena Road (Little Sycamore Canyon), Arroyo Sequit, Lechuza Point, Point Dume Bay and Latigo Shore Road. Of special value may be Dawson's collections and color photographs of his study sites which are on file at the Allan Handcock Foundation. He compares his data at Sunset Boulevard east of the ASBS to data taken by Gardner in 1912. None of the 22 species collected by Gardner were dominant in Dawson's transects. Dawson suggests that sewage solutes and drain fields in the beach sand may be responsible for this shift. Dawson also suggests that air pollution may damage algae, especially at low tide.

Dawson, E.Y. 1965. Intertidal Algae. In:an Oceanographic and Biological Survey of the Southern California Mainland Shelf. Calif. State Water Quality Control Board, Publ. No. 27. Sacramento, Calif. pp. 220-227, and appendix data pp. 351-438.

A summary of his intertidal algal studies done in 1956-1959. He makes the point that low algae diversity, less than 20 species, occurs on eight transects known to receive introductions of human wastes; Malibu and Rincon Point, with septic tanks and drain fields in the beach sand, are examples. Yerba Buena Road (Little Sycamore Canyon) had more species of algae (69) than any of his other transects. He discussed seasonal and other variations in algal diversity.

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de Violini, R. 1975. Climatic Summary for the Pacific Missile Test Center. Pac. Missile Test Center Tech. Publ. TP-75-25.

This publication includes a topographic description of the area around Point Mugu, aerial photograph of the base, and a general weather description for the area. A tabular climatic summary gives monthly analysis of temperature, precipitation, humidity and surface winds.

Egstrom, G.H. 1974. The Los Angeles County Underwater Resource Inventory. Univ. of Calif. Sea Grant Program. 284 pp.

This report provides a description and an evaluation of Los Angeles County Beaches for the recreational diver. Factors such as accessibility, public facilities, quality of beach and underwater environment are ranked on a

are used to describe the biota (e.g. kelp, urchin, starfish) so that the biological information is too vague to be useful. Rocky subtidal areas encountered on the transects are mapped.

Emerson, R.R. 1975. The Biology of a Population of Diopatra ornata at Santa Catalina Island, California. Ph.D. Diss., Univ. of So. Calif. 325pp.

A study of the reproductive biology, larval settling behaviour, and distribution of Diopatra.

Emery, K.O. 1960. The Sea Off Southern California. John Wiley and Sons, Inc. New York. 366pp.

This book provides a synthesis of oceanographic, geological and biological information for the Southern California Bight. Basic ideas and processes are discussed using southern Californian examples, some of which are in the ASBS. This book is an important reference for relating the ASBS to the rest of southern California, especially with regard to currents, sediments and submarine canyons.

Fay, R.M. 1972. An Evaluation of the Health of the Benthic Marine Biota of Ventura, Los Angeles, and Orange Counties. So. Calif. Assoc. Gov. 117pp.

Dr. Fay provides a description of the area which includes physical, economic, biological, and ecological considerations. The ASBS is contained within the area covered by this report and we found this to be an important reference because it is aimed at the marine environment. Dr. Fay makes an evaluation of the comparative biological health and found most of the area of the ASBS to be essentially in a natural state. Figures show the major coastal divisions and interpretive geology of the area.

Fitch, J.E. 1950. The Pismo Clam. Calif. Fish and Game 36(3):285-312.

Fitch, J.E. 1961. The Pismo Clam. Calif. Dept. of Fish and Game, Marine Resource Leaflet. 1:1-22.

Francis, L. 1973. Clone specific segregation in the sea anemone Anthopleura elegantissima. Biol. Bull. 144:64-72.

Grigg, R.W. 1970. Ecology and Population Dynamics of the Gorgonians Muricea californica and Muricea fruticosa. Ph.D. diss. Univ. of Calif., San Diego. 261pp.

A study on southern California gorgonians including information on recruitment.

Hendricks, T.J. 1977. Satellite Imagery Studies. So. Calif. Coastal Water Res. Project, Ann. Rept. 1977:75-78.

Discussion of surface currents and surface water temperatures in the Southern California Bight as determined by satellite imagery.

Hobson, E.S. and Chess, J.R. 1976. Trophic interactions among fishes and zooplankters nearshore at Santa Catalina Island, California. Fishery Bulletin 74:567-598.

An important and careful study of plankton feeding fishes in the nearshore

area. Availability of plankton, both during the day and night, was quantified. Feeding and activity of fish species was determined by direct observations using SCUBA and from stomach content data.

Hodder, D. and Mel, M. 1978. Kelp Survey of the Southern California Bight. Bureau of Land Management, Oct. 1977.

Aerial photography was used to map kelp beds and assess changes in aer al extent of the beds in southern California. In September 1975 they mapped 59 patches of kelp in Bed #17 and 13 patches in Bed #16. These patches ranged in size from 0.1 to 124 acres. Maps of the kelp beds in the area are included. They found that in general the area is stable but there are shifts in the locations of the beds, possibly due to burial and exposure of the rocky substrate. Los Coyotes, which is within the ASBS, was intensively

Kikuchi, T. and J.M. Pérès. 1973. Animal communities in the seagrass beds: a review. Internat. Seagrass Workshop, Leiden, Netherlands, 22-26 Oct. 1973.

A discussion of seagrass communities, mostly associated with Zostera

will become more important in the future. The importance of the lagoon as a nursery ground for fishes found in the ASBS, such as the California halibut and the diamond turbot, and as an area of scientific study is pointed out. Species lists of plants, invertebrates, fishes, birds and mammals of the lagoon and surrounding marsh are provided.

MacGinitie, G.E. and N.L. MacGinitie. 1969. A report on Mugu Lagoon. Tabulata 2:15-24.

Discussion of the biota of the lagoon including a species list.

McLean, J.H. 1969. Marine Shells of Southern California. L.A. Co. Mus. Nat. Hist., Sci. Ser. 24, Zool. No. 11.

Description of the common shells found in southern California. Range and sometimes habitat information are included.

Merrill, R.J. and E.S. Hobson. 1970. Field observations of Dendraster excentricus, a sand dollar of western North America. Amer. Midland Natur. 83:595-624.

Observations on Dendraster at Zuma Beach and La Jolla Beach are reported. A species list of animals associated with the sand dollar beds is also included.

Miller, D.J., J.E. Hardwick and W.A. Dahlstrom. 1975. Pismo clams and sea otters. Calif. Dept. of Fish and Game, Mar. Res. Tech. Rept. 31:1-49.

Miller, D.J. and R.N. Lea. 1972. Guide to the Coastal Marine Fishes of California. Calif. Fish Bulletin No. 157. Univ. of Calif., Div. of Agricultural Sci.

A description of California fish species and a key to the local fish families and species. Notes on distribution, depth and habitat are included.

Miller, M.B.F. 1977. Utility of trace fossils in paleoenvironmental interpretation: the distribution of biogenic structures in three modern and ancient nearshore environments. Ph.D. thesis, Univ. of Calif., Los Angeles, Calif. 373pp.

One of the modern sites in this study is Mugu Lagoon. This study provides information on the biota of the lagoon.

Morin, J.G., J. Kastendiek, A. Harrington and N. Davis. A subtidal sand community in space and time.

A study of the sand community at Zuma Beach including physical and biological information. The migration of the sand dollar Dendraster is discussed.

Munz, P.A. 1964. A California Flora. University of Calif. Press, Berkeley, Calif. 1681pp.

Naval Undersea Center. 1977. Draft Environmental Impact Statement "Ready Missile Test Facility" Military construction project p:875, Pacific Missile Test Center, Point Mugu, Calif.

A five acre area of the lagoon is being dredged and filled with sand.

Mitigating action will provide increased flow of seawater to the western arm of the lagoon.

Neushul, M. 1959. Studies on the growth and reproduction of the giant kelp, Macrocystis. Ph.D. thesis, Univ. of Calif., 134pp.

Neushul, M. and F.T. Haxo. 1963. Studies on the giant kelp, Macrocystis. I. Growth of young plants. Amer. J. Bot. 50:349-353.

Nicholson, N.L. and R.L. Cimberg. 1971. The Santa Barbara oil spills of 1969: a post spill survey of the rocky intertidal. In: Biological and oceanographic survey of the Santa Barbara oil spill 1969-1970. 1:325-400. Publ. Allan Handcock Foundation.

One of the transects in this study was at Arroyo Sequit beach within the ASBS. Species lists of algae from the rocky intertidal indicate a decrease in algal diversity since Dawson's transects in 1956 (78% reduction). The authors classify sand movement and fresh water input as heavy (in January 1970 the entire transect, except for one rock, was covered by sand). They speculate that large amounts of industrial effluents might be impacting this area. In Nov. 1956 Dawson found 41 algae spp., in Feb. 1958 he found 23 spp. In Dec. 1967 Neushul found 14 spp. This study reports 11 species in Nov. 1969 and 2 spp. in Feb. 1970. Information on intertidal invertebrates is also included but is of lesser value because many animals are not identified to species or even to genus. This paper provides documentation on massive intertidal sand movement at this beach. See also Thom and Widdowson, 1978.

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North, W.J. (ed.) 1971. Biology of Kelp Beds in Southern California. Nova Hedwigia. 600pp.

This publication, with chapters written by experts, provides information on many different aspects of Macrocystis. Physical factors effecting kelp, such as light penetration and surge, biological factors, such as grazers and fouling organisms and economic factors, such as kelp harvesting by man are discussed. In addition, organisms associated with kelp beds are well covered.

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Patterson, M.M. 1974. Intertidal macrobiology of selected sandy beaches in southern California. Univ. of So. Calif. Sea Grant USC-SG-9-74.

Intertidal transects on nine sand beaches in southern California were taken to assess the importance of substrate, slope and exposure to beach infaunal distribution. Two of the sites are in the ASBS: Zuma Beach and Little Dume Cove. Mean phi, sorting and slope ratio values are given for both beaches at six different times. Both beaches had a low species diversity; Emerita was found most commonly. Little Dume had a higher diversity which included mainly crustaceans and annelids.

Pequegnat, W.E. 1963. Population dynamics in a sublittoral epifauna. Pac. Sci. 17:424-430.

This study documents the changes that took place in a shallow reef off Corona del Mar when a Mytilus bed was replaced by the coralline algae Corallina chilensis. Total animal species increased while the total number of individuals decreased. Reasons for the mussel declinewere unknown.

Pequegnat, W.E. 1964. The epifauna of a California siltstone reef. Ecology 45:272-283.

Intensive sampling of a small (1,385 m^2) reef off Corona de Mar yielded three to four hundred species of macroscopic animals (inc. 22 fish species). On the basis of this study Pequegnat divided the reef into three zones with a fourth zone around the base. He suggests that the degree of water movement on the reef, which varies inversely with depth, determines the distribution of the major units of the epifauna through its effects on the availability of food of different types.

Pequegnat, W. 1968. Distribution of epifaunal biomass on a sublittoral rock reef. Pac. Sci. 22:37-40.

Peterson, C.H. 1972. Species diversity, disturbance and time in the bivalve communities of some California lagoons. Ph.D. thesis, University of California, Santa Barbara, California 230pp.

Pirie, D.M., M.J. Murphy and J.R. Edmisten. California nearshore surface currents. Unpub. Manuscript. U.S. Army Corps of Eng., San Francisco District.

A discussion of surface currents off the coast of California as determined by satellite remote sensing in 1972-74. Three California coastal seasons are described: Oceanic, July to November; Davidson, November to February when the northward flowing Davidson current is best developed; and Upwelling,

Feb. through July. They report that during the Davidson season "suspended sediments in Santa Monica Bay ring the bay with a 4 to 8 kilometer wide border. This band of sediment appears to be escaping the bay area around Point Dume."

Planning Consultants Research. Proposed incorporation of the city of Malibu, EIR. Prepared for LAFCO (Local Agency Formation Commission of Los Angeles County).

A comprehensive description of the Malibu area including the seaward portion of the ASBS to the county line. Information on geology, sysemicity, traffic on PCH, etc.

Ricketts, E.F., J. Calvin and J.W. Hedgpeth. 1968. Between Pacific Tides. Stanford Univ. Press, Stanford, Calif. 614pp.

Identification and natural history of marine animals along the Pacific coast. Discussion of habitat types and zonation in the intertidal.

Rosenthal, R.J., W.D. Clarke, and P.K. Dayton. 1976. Ecology and Natural History of a stand of giant kelp, Macrocystis pyrifera, off Del Mar, California. Fishery Bull. 72:670-684.

A six year study on the assemblage of plants and animals living within a

Shepard, F.P. 1950. Longshore current observations in southern California. U.S. Army Corps of Engineers Beach Erosion Board Tech. Memo No. 13. 54pp.

Shepard, F.P. and R.F. Dill. 1966. Submarine Canyons and Other Sea Valleys.

intertidal was found to have a sparse and patchy fauna with a greater abundance in the summer than in the winter. Studies on the subtidal, which consists of sand in this area, were done using SCUBA to make direct observations and collect sediment samples. Of 59 representative species 37 occurred frequently enough for statistical analysis. Fish were sampled using an otter trawl, fifteen species constituted 96% of the catch, surf perch, flatfish and anchovies predominated. Appendices (Vol. II.) includes species lists, quantitative data, diurnal variation, and comparison of pre- and post discharge data.

Stephenson, T.A. and A. Stephenson. 1972. Life Between Tidemarks on Rocky Shores. W.H. Freeman and Co., San Francisco.

Compares rocky intertidal communities throughout the world including La Jolla, Calif. and Pacific Grove, Calif.

Stimpson, J. 1973. The role of territory in the ecology of the intertidal limpet Lottia gigantea. Ecology 54:1020-1030.

Straughan, D. 1977. Intertidal study of the Southern California Bight. BLM AA550-CT6-40; SAI-77-917-LJ Vol. III.

Two stations in this study of sand beaches were in the ASBS, one at Point Mugu and one just west of Point Dume. These stations were sampled four times and data on beach profiles, moisture content, organic content and biota were collected. Air and water temperature and salinity were also recorded. Species diversity was very low at both sites along the transects (3 living species for Mugu, two for Dume). Emerita analoga and Excirolana chiltoni were found at both sites. Dr. Straughan also presents data on a site inside the mouth of Mugu Lagoon where species diversity was much higher and a number of unique organisms was found.

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They found young Strongylocentrotus franciscanus beneath the adults more often than elsewhere and conclude that the area beneath adult S. franciscanus provides an important nursery area for the young urchins. The authors point out that overharvesting of the adult urchins may decrease the recruitment of young. This relationship between the adults and young did not appear to exist in the purple S. purpuratus.

Thom, R.M. and Widdowson, T.B. 1978. A resurvey of E. Yale Dawson's 42 intertidal algal transects in the southern California mainland after 15 years. Bull. So. Calif. Acad. Sci. 77(1):1-13.

Dawson's original transects, seven of which are in the ASBS, were resurveyed in 1973-74. There were slight changes in the ASBS transects, three with more species, three with fewer and one, Point Mugu, having the same number. In general they found a shift toward more turf and crustose species and away from the massive species in southern California. Los Angeles County has the least floral changes.

Timko, P.L. 1975. High density aggregations in Dendraster excentricus (Eschscholtz): Analysis of strategies and benefits concerning growth, age structure, feeding, hydrodynamics and reproduction. Ph.D. thesis. Univ. of Calif., Los Angeles, Calif. 323pp.

This study provides information on many aspects of the biology of Dendraster, an important member of the sand community in the subtidal area of the ASBS. Much of the work, including stomach contents, age determinations, time of reproduction, etc. was done on sand dollars from Zuma Beach.

Timko, P.L. 1976. Sand Dollars as suspension feeders: a new description of feeding in Dendraster excentricus. Biol. Bull. 151:247-259.

Feeding activity and amount and quality of food in the guts of sand dollars collected at Zuma Beach is reported in this paper. Diet varied with season, with diatoms most abundant in summer and crustaceans most abundant in winter.

United States Environmental Protection Agency and Edaw, Inc. 1977. Draft EIS/EIR, Las Virgenes-Triunfo, Malibu-Topanga Area-Wide Facilities Plan.

A report with a massive data base on the Malibu area, including the Los Angeles County area shoreward of the ASBS to the county line. Included are 1) a detailed consideration of air quality in the region with seasonal maps of day/night breezes, 2) geology, including figures on slope, surface hydrology, ground water, and faults, 3) oceanography including surface circulation, circulation at 200 feet, water quality, salinity, temperature, etc., 4) Land use including maps showing jurisdictions, populational projections, open space, traffic, drain field suitability, fire hazard, fire frequency, land vegetation and more. The bibliography is divided by subject and cites many governmental reports. Biological information on the marine area is weak.

Vance, R.R. 1978. A mutualistic interaction between a sessile marine clam and its epibionts. Ecology (in press).

Ventura-Los Angeles Mountain and Coastal Study Commission: final report to the legislature. Marvin Braude, Chairman. 1972.

Report provides information on the Santa Monica Mountains area. A discussion of issues and recommendations affecting the ASBS include: 1) a recommendation for special protection for Paradise Cove, Point Dume and Mugu Lagoon because of the rich biota of these areas, acquisition of property along the shore and development of parking to provide more public beaches. State beaches and parks should be expanded, 2) Issues include the location of a yacht harbor or refuge in the area, 3) Pacific Coast Highway is inadequate at peak loads, and 4) there will be increased potential for flooding and erosion due to development in the area.

Warme, J.E. 1971. Paleoecological aspects of a modern coastal lagoon. Univ. of Calif. Publ. in Geo. Sci. 87:1-110.

Data on the geology and biota, especially the molluscan fauna, are presented in this study of Mugu Lagoon. There is also a discussion of sand movement on the barrier beach.

Weymouth, F.W. 1923. The life-history and growth of the pismo clam (Tivela stultorum Maue). Calif. Fish and Game Comm., Fish Bull. 7:1-120.

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Wine, V.L. 1977. Southern California independent sport fishing survey, quarterly report no. 8. Dept. of Fish and Game, Mar. Res. Adm. Rept. no 77-16.

Wine, V. and T. Hoban. 1976. Southern California independent sportfishing survey annual report, July 1, 1975 to June 30, 1976. Calif. Dept. of Fish and Game, Mar. Res. Adm. Rept. no. 76-14.

Word, J.Q., B.L. Myers and A.J. Mearns. 1977. Animals that are indicators of marine pollution. So. Calif. Coastal Water Research Project, Ann. Rept. 1977:199-206.

Study of indicator species in the Santa Monica Bay area; samples were taken at 60M depths.

Appendix 1. Organisms Found on Subtidal Rock in the Mugu-Latigo ASBS during the survey.

Key: S = Southern species
N = Northern species
1 = Rare or occasional
2 = Uncommon
3 = Fairly common
4 = Common
5 = Abundant
X = Abundance not determined

	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Canyon	Little Sycamore Canyon to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt. Dume to Paradise Cove	Latigo Pt. Reef
PLANTS							
CHLOROPHYTA (Green Algae)							
Cladophora columbiana						X	
Ulva lactuca (Sea Lettuce)		3					
PHAEOPHYTA (Brown Algae; Kelp)							
Cystoseira osmundacea (Bladder Kelp)			4	4		3	
Dictyopteris undulata	S				X		X
Dictyota binghamiae				3	X		
Dictyota flabellata					3		
Egregia menziesii (Feather-boa Kelp)		3	2	2		4	
Eisenia arborea (Southern Sea Palm)	S			4	X	3	
Laminaria farlowii			2		2	2	X
Macrocystis pyrifera (Giant Kelp)		2	3	4	4	3	3
Pachydictyon coriaceum				X	X		
Pterygophora californica (Northern Sea Palm)	N	1		3	X	5	
Zonaria farlowii	S					5	
RHODOPHYTA (Red Algae)							
Bossiella orbigniana (Erect Coralline)		3	X	5	X	3	X
Bossiella plumosa (Erect Coralline)							X
Botryocladia neuschulii			X		X		
Calliarthron cheilosporioides				X	X		

PLANTS (Continued)

RHODOPHYTA (Continued)

	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt. Dume to Paradise Cove	Latigo Pt. Reef
Calliarthron tuberculosum					X		
Corallina officinalis var. chilensis (Erect Coralline)			X	3	X	3	
Corallina pinnatifolia (Erect Coralline)				X			
Corallina sp. (Erect Coralline)						X	X
Cryptopleura violacea		X					
Gelidium purpurascens				X		X	
Gigartina canaliculata		X					
Gigartina corymbifera			4			4	
Gigartina exasperata		3	5	4			
Gigartina harveyana			X				
Gigartina papillata					X		
Gigartina spinosa		4	2				
Gigartina volans					X	3	
Gracilaria andersonii			X		X		
Gracilaria sjoestedii		5					
Iridaea cordata				X	X		
Iridaea heterocarpa			X	2		X	
Lithothamnium sp. or Lithophyllum sp. (Encrusting Coralline)			5	2	X	5	X
Lithothrix aspergillum (Encrusting Coralline)			X			X	
Melobesia mediocris (Encrusting Coralline on Phyllospadix)			X			X	
Pikea californica				X			
Polysiphonia acuminata		X					

PLANTS (Continued) RHODOPHYTA (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt. Dume to Paradise Cove	Latigo Pt. Reef
Prionitis cornea					X		
Prionitis lanceolata			X				
Pterocladia capillacea				4	X	3	
Rhodymenia californica			X	X			
Rhodymenia callophyllidoides			X	X	X	X	
Rhodymenia pacifica					X		
Rhodymenia rhizoides		X					
TRACHEOPHYTA							
Phyllospadix torreyi (Surf Grass)			2			5	
Zostera marina (Eel Grass)					X		
ANIMALS							
PORIFERA (Sponges)							
Demospongiae (Common Sponges)							
Anaata spongigartina (Red Sponge)			1	1			
Axinella mexicana (Hard Orange Sponge)			4	3	3		
Cliona celata (Yellow Boring Sponge)		2	1	2	3	2	
Dysidea amblia (Gray Sponge)			X	1	1		
Dysidea-like sponge				1	2		
Halichondria sp. (Crumb of Bread Sponge)			1	1	1		
Haliclona permollis (Purple Sponge)				X	X		
Hard Brown Sponge (sp?)			1	2			
Hymenamphiastra cyanocrypta (Cobalt Blue Sponge)			2	2	4		

ANIMALS (Continued) PORIFERA (Continued) Demospongiae (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt. Dume to Paradise Cove	Latigo Pt. Reef
Microciona sp. (Smooth Orange Sponge)			2	2	3		
Ophlitospongia pennata (Stellate Orange Sponge)			3	3	3		1
Spheciospongia confoederata (Liver Sponge)			X	1	2		
Tethya aurantia (Orange Puffball Sponge)			2	3	5	2	3
Tetilla arb (Gray Ball Sponge)			2		1		
Verongia aurea (Sulphur Sponge)	S		X		1		
CALCAREA (Calcareous Sponges)							
Leucandra (=Leuconia) heathi			1	2			
Leucetta losangelensis	S		1	2	1		
Leucilla (=Rhabdodermella) nuttingi (Urn Sponge)		3	1	2			
Leucosolenia sp. (Spaghetti Sponge)			X			1	1
CNIDARIA (Anemones, Corals, Hydroids, Jellyfish)							
HYDROZOA (Hydroids)							
Athecata							
Eudendrium ramosum			1	1	2		
Hydractinia sp.			X	2	1		3
Tubularia - kelp					3		
Tubularia sp. (Rock)		3	X	2	1		
Zanclea protecta				1			
Thecata							
Abietinaria sp.			1	2	2	1	
Aglaophenia sp. (Ostrich Plumed Hydroid)			X				

ANIMALS (Continued) CNIDARIA (Continued) HYDROZOA (Continued) Thecata (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt. Dume to Paradise Cove	Latigo Pt. Reef
Antennella avalonia	S			2			
Clytia sp.				X	X		
Eucopella everta			2	3	5	3	2
Obelia geniculata			4	4	5		3
Obelia sp. on (kelp)		5	X	4	5		1
Pasya? quadridentata					1		
Plumularia sp. - 1			3	4	5		5
Sertularella sp.			X		3		
Sertularia - 1		2	1	2	4	4	2
ANTHOZOA (Anemones, Corals, etc.)							
Hexacorallia							
Actinaria (Anemones)							
Anthopleura artemisia		1	1	1	2	2	2
Anthopleura elegantissima (Common Green Anemone)		3	2	4	3	4	2
Anthopleura xanthogrammica (Solitary Green Anemone)	N	2					
"Brown Tentacled Anemone" (Undescribed sp.)	S		1			2	1
Cactosoma arenaria			1	1			1
Epiactis prolifera (Proliferating Anemone)			3	3	3	3	3
Halcampid - rock					1		
Harenactis attenuata (Sand Anemone)					4		
Metridium exilis			1	1	1		
Sagartia catalinensis	S		X	1	3		1

ANIMALS (Continued) CNIDARIA (Continued) HEXACORALLIA (Continued) Actinaria (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Tealia lofotensis	N						1
Tealia sp.	S		1	1		1	
Zaolutus actius					1		1?
Corallimorpharia							
Corynactis californica (Strawberry Anemone)			4	5	5	3	3
Scleractinia (Corals)							
Astrangia lajollaensis			4	5	4	4	4
Balanophyllia elegans (Orange Coral)	N			1			
Paracyathus stearnsi (Goblet Coral)			1	4	2		1
Ceriantharia							
Pachycerianthus fimbriatus (Tube Anemone)			3	5	3	-	2
Octocorallia							
Pennatulacea (Sea Pens)							
Renilla kollikeri (Sea Pansy)	S	4			1	1	
Stylatula elongata (Sea Pen)		2					2
Gorgonacea (Gorgonian)							
Lophogorgia chilensis (Pink Gorgonian)	S		X	1	1		1
Muricea californica (Yellow and Rust Gorgonian)	S		3	4	2	2	5
Muricea fruticosa (White and Rust Gorgonian)	S		1	2	4	2	2
Stolonifera							
Clavularia sp.				1	1		

ANIMALS (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt. Dume to Paradise Cove	Latigo Pt. Reef
PLATYHELMINTHES (Flatworms)							
TURBELLARIA							
POLCLADIDA (Marine flatworms)							
Stylochus sp.				2			
Thysanozoon californicum (Furry Flatworm)	S				2		
Eurylepta aurantica (Orange Flatworm)						1	
NEMERTEA (Ribbon Worms)							
Cerebratulus californiensis					1		
SIPUNCULIDA (Peanut Worms)							
Phascolosoma agassizii				2	1	1	
ANNELIDA (Segmented Worms)							
POLYCHAETA (Marine Segmented Worms)							
Sedentary - Tube Dwellers							
Chaetopterus variopedatus (Parchment Worms)			1	2	2	-	3
Cirratulid			1			1	
Diopatra ornata (Gray Tube Worm)		3	4	5	5	5	5
Dodecaceria fewkesi?			2			4	
Eudistylia polymorpha (Feather Duster Worm)	N		2	3	3	3	2
Hydroides? pacificus	N		X	3	4		2
Laonice foliata? (Wind-mill Worm)				1			
Myxicola infundibulum					1		
Neoamphitrite robusta			1		2		

ANIMALS (Continued) ANNELIDA (Continued) POLYCHAETA (Continued) Sedentary (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt. Dume to Paradise Cove	Latigo Pt. Reef
Phragmatopoma californica (Honeycomb Sand Worm)		4	5	4	-	5	-
Sabellid - Gray			1	1			
Sabellid - Purple						1	
Sabellid - Sand		1	X	X			
Sabellid - Whitish			X		2		
Salmacina tribranchiata			1	2	4	X	
Serpulid - long				1			
Spiochaetopterus costarum			1	3	3		
Spionid				1			
Spirobranchus spinosus (Ice Cream Cone Worm)	S			2			
Spirorbis sp.			3	3	X	4	2
Terebellid - light tentacles			X	1			
Errentia - No Tubes							
Euphrosine aurantiaca (Caterpillar Worm)			1	1			
Lumbrinereid						1	
Nereid					X		
Ophiodromus pugettensis (Bat Star Worm)				X	X	X	X
Phyllodocid					X		
Polynoid - sp. (Scale Worm)					X		
Polynoid - rock			X	2	2		
Polynoid - like						X	
Syllid					X		

ANIMALS (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
ARTHROPODA							
CRUSTACEA							
Cirripedia (Barnacles)							
Balanus aquila (Giant Barnacle)	S		X	1	1		
Balanus tintinnabulum (Candy Cane Barnacle)		4	2	3	3	X	X
Balanus sp.			X	4		X	
Balanus trigonus?		4	X	4			
Pollicipes polymerus (Goose Neck Barnacle)		2					
Malacostrace							
Paracarida							
Isopoda							
Flabelliferan				X	4		
Amphipoda							
Gammaridea (Gammarids)			X	X	4	X	X
Caprellidea (Skeleton Shrimp)			X	X	X	X	X
Mysidacea (Opossum Shrimp)		2		4			
Eucarida							
Caridea (Shrimps)							
Alpheus californica (Pistol Shrimp)			4	2	4	3	3
Betaeus macginitieae (Purple Shrimp)			3	2	4	3	2
Crangon nigracauda? (Sand Shrimp)			1		1		

ANIMALS (Continued)
ARTHROPODA (Continued)
CRUSTACEA (Continued)
Malacostraca (Continued)
Eucarida (Continued)
Caridea (Continued)

	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Heptacarpus sp. (Brokenback Shrimp)			2	2	1		
Lysmata californica (Barber Pole Shrimp)	S		X	2	1		
Pandalus gurneyi (Coon-striped Shrimp)	N		X	1	1		
Palinura (Lobsters)							
Panulirus interruptus (Spiny Lobster)	S			1	-	X	
Anomura (Anomuran Crabs)							
Hapalogaster cavicauda (Furry Crab)	N			1	2		
Pachycheles rudis? (Lumpy Porcelain Crab)			2		2		
Paguristes ulreyi (Furry Hermit Crab)			1	2	5	3	
Pagurus sp. (Hermit Crab)		1	2	3	X	4	4
Petrolisthes cinctipes (Porcelain Crab)			X	2	2	2	3
Brachyura (True Crabs)							
Loxorhynchus grandis (Sheep Crab)		1	X	1		2	
Mimulus foliatus			1				
Paraxanthias taylori (Lumpy Crab)					3		
Pilumnus spinohirsutus (Furry Crab)			1		3		
Pugettia richii					1		
Scyra acutifrons			2	2	3		

ANIMALS (Continued) MOLLUSCA GASTROPODA (Snails and Slugs) Opisthobranchia Notaspidea	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt. Dume to Paradise Cove	Latigo Pt. Reef
Chelidonura inermis (Navanax)						1	
Anaspidea							
Aplysia californica (Sea Hare)			X	1	1	3	4
Nudibranchia (Nudibranchs)							
Doridacea (Dorid Nudibranchs)							
Acanthodoris lutea			X				1
Aegires albopunctatus				3			
Anisodoris nobilis (Sea Lemon)			2	2	2	X	2
Cadlina luteomarginata					1		
Conulaevia alba			1	1	1		
Corambe pacifica					2		
Diaulula sandigensis				1			
Doriopsilla albopunctata			2	2	1		1
Chromodoris porterae					1		
Laila cockerelli						1	
Polycera atra					1		
Rostanga pulchra			2		1		
Triopha carpenteri			X	1	1		
Eolidiacea (Eolid Nudibranchs)							
Aeolidea papillosa			1				
Eolid - orange (Undescribed Species)			1				
Eolid - long orange (Undescribed Species)					1		
Flabellinopsis iodinea (Iodine Nudibranch)			X	3	2	1	
Hermissenda crassicornis (Opalescent Nudibranch)				1	1	1	

MOLLUSCA (Continued) GASTROPODA (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Phidiana pugnax (Pugnacious Nudibranch)	S		X				
Prosobranchia (Snails)							
Archeogastropoda							
Acmaea mitra (Dunce-cap Limpet)	N			1			
Astraea undosa (Wavy Top Snail)				X			
Calliostoma annulatum	N		1	1	1		
Calliostoma gloriosum					1		
Calliostoma tricolor						1	1
Diodora arnoldi (Key Hold Limpet)			1				
Diodora aspera (Key Hold Limpet)				1			
Haliotis corrugata (Pink Abalone)	S		X			3	
Haliotis cracherodii (Black Abalone)					X		
Haliotis fulgens (Green Abalone)	S				X		
Haliotis rufescens (Red Abalone)			1	2	1	2	
Haliotis sorensoni (White Abalone)	S			1			
Megathura crenulata (Giant Key Hole Limpet)			2	4	2	1	1
Norrisia norrisi (Chestnut Top Shell)	S		X	2		1	
Mesogastropoda							
Crepidula perforans (Slipper Shell)				2	2		

MOLLUSCA (Continued) GASTROPODA (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Crepidula norrisarum (Slipper Shell)			X	2			
Crepipatella lingulata (Half Slipper)			2	4	2	3	2
Cypraea spadicea (Chestnut Cowry)	S		3	3	4	5	2
Erato columbella							1
Hipponix antiquatus (Hoof Shell)			1				
Lamellaria diegoensis?							1
Serpulorbis squamigerus (Worm Snail)	S		3	3	-	2	-
Neogastropoda							
Acanthina sp.						1	1
Amphissa versicolor			3	3	4	4	4
Conus californicus (California Cone)			2		1	3	2
Ceratostoma nuttallii			X	X			
Crassispira semiinflata	S					1	1
Kelletia kelletii (Kellets Whelk)	S		2	2	3	3	3
Maxwellia gemma	S				1	2	
Mitra idae (Idas Mitre)			1	1		1	
Mitrella carinata (Dove Snail)			4	4	5	5	5
Nassarius mendicus				2			
Oceanebra lurida			1		2	2	1
Olivella biplicata (Purple Olive Snail)		2	X			3	
Pteropurpura festiva	S					2	
Pteropurpura trialata	S			X			
Terebra pedroana		1				1	

ANIMALS (Continued) MOLLUSCA (Continued) POLYPLACOPHORA (Chitons)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Callistochiton sp.					1		
Chiton sp.			X	X			
BIVALVIA (Clams and Mussels)							
Chama pellucida (Jewell Box)			4	4	3	X	X
Chione sp.				X	1		
Chlamydoconcha orcutti	S				1		
Clinocardium nuttallii (Basket Cockle)	N				X	X	
Hiatella arctica (Nestling Clam)		2	X	2	2	2	
Hinnites multirugosus (Rock Scallop)			1	2	2	2	2
Kellia laperousii					1		
Lima hemphilli (File Clam)			2		1		
Lyonsia californica					1		
Mytilimeria nuttalli (Tunicate Clam)			1		2	2	
Penitella penita (Pholad - Purple)				1		5	1
Parapholas californica (Pholad - Gray)						5	
Pododesmus cepio (Jingle Clam)			2	4	3	2	X
Protothaca staminea (Rock Cockie)			X	X			
Saxidomus nuttalli (Washington Clam)			X		X	X	
Semele decisa	S		X	X	X		X
Tresus nuttallii (Horse Clam)					X		
CEPHALOPODA							
Octopus bimaculatus (Octopus)			1	1	1	1	-

ANIMALS (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
ECHINODERMATA							
STELLEROIDEA							
Asteroidea (Sea Stars)							
Astrometis sertulifera (Spiny Soft Star)	S		1	X			2
Astropecten armatus (Sand Star)	S				1	X	2
Astropecten verrilli (Deep Sand Star)		2			2		1
Dermasterias imbricata (Leather Star)	N		X	-	1	2	2
Henricia leviuscula (Blood Red Star)			X	2	1		
Orthasterias koehleri	N					1	
Patiria miniata (Bat Star)			3	4	3	5	2
Pisaster brevispinus (Pink Star)					1	1	
Pisaster giganteus (Knobby Blue Star)			4	4	4	3	4
Pisaster ochraceus (Ochre Star)		2	X	2		2	
Pycnopodia helianthoides (Sunflower Star)	N			1		1	
Ophiuroidea (Brittle Star)							
Amphiodia occidentalis?		4	X				
Amphipholis squamata			X			2	
Ophiactis savignyi						2	
Ophioderma panamense	S		X	1	3		
Ophioplocus esmarki			2	2	4	3	2
Ophiopsila californica	S			X	1		
Ophiopteris papillosa			2	3	4	5	2

ANIMALS (Continued)

ENCHINODERMATA (Continued)

	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Ophiothrix spiculata			3	4	4	4	4
ECHINOIDEA (urchins)							
Centrostephanus coronatus	S				1		
Dendraster excentricus (Sand Dollar)		5	X			3	
Lytechinus anamesus (Sand Urchin)				1		3	
Strongylocentrotus franciscanus (Red Urchin)			3	5	5	5	2
Strongylocentrotus purpuratus (Purple Urchin)			3	5	3	5	1
HOLOTHUROIDEA (Cucumbers)							
Cucumaria salma	S		1	2	-	2	
Cucumaria sp. - small orange			X	1	2	1	1
Cucumaria piperata	N		X				
Eupentacta quinquesemita	N			1			
Parastichopus parvimensis (Southern Sea Cucumber)	S		3	2	1	2	1
Lissothuria (=Thyonepsolus) nutriens	N		1				
Cucumaria piperata:	N		X				
BRYOZOA ("Moss Animals")							
CYCLOSTOMATA							
Crisia sp.			X	3	5	4	3
Diaperoecia californica			3	5	5	4	5
Lichenopora novae-zelandiae	S			X			
CHEILOSTOMATA							
Bugula californica			X	2	5	3	4

ANIMALS (Continued) BRYOZOA (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Bugula neritina			2	3	5		5
Antropora tincta	S		X		3		2
Celleporaria (=Holoporella) brunnea			3	3	4	3	
Hippodiplosia insculpta (Corn Flake Bryozoan)				1	5	3	3
Membranipora membranacea (Jack Frost Bryozoan)			3	4	5	3	5
Membranipora tuberculata		5	3	3	5	3	4
Parasmittina californica and Rhynchozoon rostratum (Pink Encrusting Bryozoan)			4	4	4	4	3
Phidolopora pacifica (Lace Bryozoan)			4	4	4	3	2
Scrupocellaria sp.				3			
Thalamoporella californica	S		3	1	4		3
Thalamoporella ? sp. orangish colored						2	3
ENTOPROCTA							
Barentsia sp.				1			
CHORDATA							
UROCHORDATA (Tunicates)							
Ascidiacea (Sea Squirts)							
Aplidium californicum			2	4		4	4
Aplidium sp. 1							4
Aplidium sp. 2			X	3	5		
Aplidium sp. 3					2		
Clavelina huntsmani (Pink Light Bulb Tunicate)			1	1			

ANIMALS (Continued) CHORDATA (Continued)	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Corella ? willmeriana					1	1	1
Didemnum sp. - 1		1					
Euherdmania claviformis (Sand Tunicate)			4	4	5	5	5
Metandrocarpa dura (Orange Tunicate)				-	1	3	3
Metandrocarpa taylori				-	1		
Polyclinum laxum (Sea Pork)				X		3	4
Pyura haustor			X	1	2	2	3
Pycnoclavella stanleyi (Orange Light Bulb Tunicates)			2	4	2		1
Styela montereyensis		3	X	3	3	3	4
Trididemnum opacum (White Tunicate)			3	4	4	3	4
Archidistoma psammion			2	3	4	4	
Didemnum sp. - 2			3	2	5		2
VERTEBRATA (Vertebrates)							
Chondrichthyes (Cartilagenous Fish)							
Sharks							
Cephaloscyllium ventriosum (Swell Shark)	S				1		
Heterodontus francisci (Horn Shark)	S			X			
Triakis semifasciata (Leopard Shark)				1			
Rays							
Torpedo californica (Pacific Electric Ray)				1			
Osteichthyes (Bony Fishes)							
Scorpaeniformes (Mail-cheeked Fishes)							

ANIMALS (Continued)

CHORDATA (Continued)

	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Rockfishes							
Scorpaena guttata (Scorpionfish or Sculpin)	S		1	2	2	2	3
Sebastes atrovirens (Kelp Rickfish)	N		2	2	4	2	2
Sebastes carnatus (Gopher Rockfish)	N		X	2	2		1
Sebastes caurinus (Copper Rockfish)	N		X	1	2		1
Sebastes chrysomelas (Black-and-Yellow Rockfish)	N		X	2	3		
Sebastes dallii (Calico Rockfish)	N		X	1			
Sebastes mystinus (Blue Rockfish)	N		X	2	1	X	
Sebastes paucispinis (Bocaccio)		2					
Sebastes rastrelliger (Grass Rockfish)			1	2	3	2	2
Sebastes serranoides (Olive Rockfish)		3	X	2	2	4	
Sebastes serriceps (Treefish)	S			1	2	X	
Greenlings							
Oxylebius pictus (Painted Greenling)			2	3	2	3	2
Hexagrammos decagrammus (Kelp Greenling)	N		1				
Cottids							
Scorpaenichthys marmoratus (Cabezon)			1	1	2	X	2
Leiocottus hirundo (Lavender Sculpin)	S					3	2
Other Cottids			1	X	2	1	
Perciformes (Higher "Perch-like" Fishes)							

ANIMALS (Continued)

CHORDATA (Continued)

	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Sea Basses							
Paralabrax clathratus (Kelp Bass)	S		3	3	1	3	4
Paralabrax nebulifer (Barred Sand Bass)	S		1			-	4
Croakers and Grunts							
Anisotremus davidsonii (Sargo)							1
Cheilotrema saturnum (Black Croaker)	S				1		
Roncador stearnsii (Spotfin Croaker)	S						3
Seriphus politus (Queenfish)		5	X				
Surfperches							
Amphistichus argenteus (Barred Surfperch)	S	1	X?				
Brachyistius frenatus (Kelp Surfperch)			X		-	3	4
Cymatogaster aggregata (Shiner Surfperch)		2					
Damalichthys vacca (Pile Surfperch)		3	3	3	2	2	3
Embiotoca jacksoni (Black Surfperch)	S	3	4	4	5	4	4
Embiotoca lateralis (Striped Surfperch)	N				1	X	
Hyperprosopon argenteum (Walleye Surfperch)		4	X		5	2	-
Hyperprosopon ellipticum (Silver Surfperch)		3					
Hypsurus caryi (Rainbow Surfperch)		3	4	4	4	3	-
Micrometrus minimus (Dwarf Surfperch)		2				3	
Phanerodon furcatus (White Surfperch)		3	1	1	4	3	4

ANIMALS (Continued)

CHORDATA (Continued)

	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Rhacochilus toxotes (Rubberlip Surfperch)		2	3	3	2	2	4
Damselfishes and Wrasses							
Chromis punctipinnis (Blacksmith)	S		4	4	3	4	4
Halichoeres semicinctus (Rock Wrasse)	S		X	1		2	1
Hypsypops rubicundus (Garibaldi)	S		2	3	1	1	1
Oxyjulis californica (Señorita)		2	4	4	4	4	4
Pimelometopon pulchrum (California Sheephead)	S		3	4	3	3	4
Blennies and Clinids							
Gibbonsia sp. (Kelp Fish)				2	1	2	
Heterostichus rostratus (Giant Kelp Fish)			X	2		2	2
Hypsoblennius sp. (Blenny)			1		1	2	1
Gobies							
Coryphopterus nicholsii (Blackeye Goby)			3	3	4	X	4
Lythrypnus zebra (Zebra Goby)	S			1			
Other Perciforms							
Girella nigricans (Opalege)	S	3	2	1	1		3
Medialuna californiensis (Halfmoon)			2	2	1	X	3
Pleuronectiformes (Flatfishes)							
Citharichthys stigmaeus (Speckled Sand Dab)		3	2		1	1	2
Paralichthys californicus (California Halibut)	S	3	1	1	1		
Pleuronichthys coenosus (C-O Turbot)		1		X	1		
Pleuronichthys decurrens (Curlfin Turbot)						1	

ANIMALS (Continued)

CHORDATA (Continued)

	Range	Pt. Mugu to Deer Canyon	Deer Canyon Reef to Little Sycamore Cyn.	Little Sycamore Cyn. to Sequit Pt.	Sequit Pt. to Lechuza Pt.	Pt Dume to Paradise Cove	Latigo Pt. Reef
Pleuronichthys ritteri (Spotted Turbot)		1				X	
Other Bony Fishes							
Gymnothorax mordax (California Moray)	S		1				
Engraulis mordax (Nothern Anchovy)					5		
Porichthys notatus (Plainfin Midshipman)			X	1	1		
Atherinids (Silversides - Includes Grunion)		3	3	3	X		4
Gobiesox sp. (Clingfish)				1			
Mammalia							
Phoca vitulina (Harbor Seal)					X		
Zalophus californica (Sea Lion)					X	X	
Eschrichtius robustus (Gray Whale)				X			

Appendix 2. Organisms encountered in subtidal reefs and sands within the ASBS previous to the start of the survey.

	Location*
PORIFERA (Sponges)	
Aplysilla glacialis (Pink Sponge)	IR
Plocamia sp. (Orange Sponge)	IR
CNIDARIA	
HYDROZOA (hydroids)	
Corymorpha palma (Solitary Hydroid)	NS
ANTHOZOA (Anemones and Corals)	
Tealia crassicornis (Anemone)	IR
Epizoanthus leptoderma ? (Zoanthid)	IR
Parazoanthus lucificum (on gorgonians, Parasitic Zoanthid)	IR
Coenocyathus bowersii (Pink Coral)	IR
PLATYHELMINTHES (Flatworms)	
Prostheceraeus bellostriatus (Black and White Flatworm)	IR
SIPUNCULIDA (Peanut worms)	
Themiste zostericola ?	IR (NS)
ANNELIDA (Segmented Worms)	
Cirriformia spirabrancha (Cirratulid)	IR
Arctonoe pulchra (Scale Worm on *Parastichopus*)	IR
Owenia collaris ? (Oweniid)	NS
ARTHROPODA	
DECAPODA (Crabs and Shrimps)	
Betaeus harfordi (Purple Shrimp in *Haliotis*)	I&FR

Appendix 2 (Continued)

ARTHROPODA (Continued) Location*

DECAPODA (Continued)

Appendix 2 (Continued)

	Location*
MOLLUSCA (Continued)	
GASTROPODA (Continued)	
Opisthobranchia (Continued)	
Antiopella barbarensis (Eolid Nudibranch)	IR
Precuthona divae (Eolid Nudibranch on *Hydractinia*)	I&FR
Prosobranchia (Snails)	
Astraea gibberosa (Northern Wavy Top)	IR
Calliostoma canaliculatum (Channeled Top Snail)	IR
Calliostoma gemmulatum (Gem Top Snail)	IR
Tegula aureotincta (Guilded Turban Snail)	I&FR
Epitoneum tinctum ? (Tinted Wentletrap)	IR
Opalia funiculata (Sculptured Wentletrap)	IR
Crepidula adunca (Hooked Slipper Snail)	IR
Trivia californiana (California Coffee Bean)	I&FR
Bursa californica (Frogmouth)	OS
Oceanebra poulsoni (Poulson's Rock Snail)	IR
POLYPLACOPHORA (Chitons)	
Callistochiton crassicostatus	IR
Lepidozona californiensis ?	IR
BIVALVIA (Clams and Mussels)	
Lithophaga plumula (Date Mussel)	I&FR
Ventricolaria fordii	IR
Platyodon cancellatus (Boring Clam)	FR

Appendix 2 (Continued)

	Location*
ECHINODERMATA	
Linckia columbiae (Variable Sea Star)	I&FR
Ophionereis eurybrachyplax (Brittle Star)	IR
CHORDATA	
UROCHORDATA	
Botrylloides sp. (Compound Tunicate)	IR
CEPHALOCHORDATA	
Branchiostoma sp. (Amphioxus)	NS
VERTEBRATA	
Mustelus californicus (Gray Smooth Hound)	IR
Squalus acanthias (Spiny Dogfish)	IR
Anisotremus davidsonii (Sargo)	I&FR
Ophiodon elongatus (Lingcod)	IR
Paralabrax maculatofasciatus (Spotted Sand Bass)	FR
Syngnathus californiensis ? (Kelp Pipefish)	IR
Eschrichtius robustus (Gray whale)	OS, NS, IR

*IR = indurated rock.
FR = friable rock.
NS = nearshore sands.
OS = offshore sands.

Appendix 3. Organisms Found on Subtidal Sand and Mud in the Mugu-Latigo ASBS during the survey.

Key: S = Southern species
N = Northern species
1 = Rare or occasional
2 = Uncommon
3 = Fairly common
4 = Common
5 = Abundant
X = Abundance not determined

	Range	Mugu Barrier Beach	La Jolla and Big Sycamore Beaches	Pt. Mugu to Little Sycamore Cyn.	Zuma Beach	Sand Between 60 and 100 Feet	Mugu and Dume Cyns.
PLANTS							
CHLOROPHYTA (Green Algae)							
Enteromorpha sp.			X				
Ulva angusta (Sea Lettuce)			1				
RHODOPHYTA (Red Algae)							
Gracilaria sjoestedii			X	5			
Neoagardhiella baileyi (String Red)			2	X			
ANIMALS							
CNIDARIA (Anemones, Corals, Hydroids, Jellyfish)							
HYDROZOA (Hydroids)							
Athecata							
Tubularia sp.						X	
Thecata							
Campanulinid		X	X		X		
Clytia bakeri		X	1	2	2		
Obelia sp.		X	2	3			
Plumularia 2 (Long) sp.						3	3
Plumularia 3 sp.					X	3	
Sertularia 2 (Long Nodes)							1
ANTHOZOA (Anemones, Corals, etc.)							
Hexacorallia							
Actinaria (Anemones)							
Zaolutus actius					X		5

ANIMALS (Continued) CNIDARIA (Continued) HYDROZOA (Continued) Hexacorallia Continued)	Range	Mugu Barrier Beach	La Jolla and Big Sycamore Beaches	Pt. Mugu to Little Sycamore Cyn.	Zuma Beach	Sand Between 60 and 100 Feet	Mugu and Dume Cyns.
Ceriantharia							
Pachycerianthus fimbriatus (Tube Anemone)						1	
Octocorallia							
Pennatulacea (Sea Pens)							
Renilla kollikeri (Sea Pansy)	S	5	4	4	5		4
Stylatula elongata (Sea Pen)		1	X	2	4	1	
Stylatula sp.						1	4
Virgularia sp.					1		1
PLATYHELMINTHES (Flatworms)							
TURBELLARIA							
Polycladida (Marine Flatworms)							
Flatworm - Thalamoporella-like						2	
ANNELIDA (Segmented Worms)							
POLYCHAETA (Marine Segmented Worms)							
Sedentary - Tube Dwellers							
Cirratulid			X				
Diopatra ornata (Gray Tube Worm)			3	3	4	3	5
Laonice foilata? (Wind-mill Worm)						4	1
Myxicola infundifulum							1
Pectinaria californiensis				X	X		X
Salmacina tribranchiata						X	
Spiochaetopterus costarum			X		X	2	

ANIMALS (Continued) ANNELIDA (Continued) POLYCHAETA (Continued) Sedentary (Continued)	Range	Mugu Barrier Beach	La Jolla and Big Sycamore Beaches	Pt. Mugu to Little Sycamore Cyn.	Zuma Beach	Sand Between 60 and 100 Feet	Mugu and Dume Cyns.
Terebellid - light tentacles						2	
Terebellid - black tentacles			X				1
ARTHROPODA							
CRUSTACEA							
Cirripedia (Barnacles)							
Balanus pacificus (Sand Barnacle)		X	3	3	3		
Balanus tintinnabulum (Candy Cane Barnacle)				4	X	X	
Balanus trigonus?				4			2
Scalpellum osseum (Deepwater Gooseneck Barnacle)						4	
Malacostraca							
Peracarida							
Amphipoda							
Gammaridea (Gammarids)				X	X	X	
Caprellidea (Skeleton Shrimp)					X		X
Mysideacea		X		2	X	5	X
Hoplocarida (Stomatopods)							
Hemisquilla stylifera (Mantis Shrimp)	S		X				
Eucarida							
Caridea (Shrimps)							
Crangon nigracauda? (Sand Shrimp)					2		1
Heptocarpus sp. (Brokenback Shrimp)		4			X		

ANIMALS (Continued)
ARTHROPODA (Continued)
CRUSTACEA (Continued)
Malacostraca (Continued)
Eucarida (Continued)
Anomura (Anomuran Crabs)

	Range	Mugu Barrier Beach	La Jolla and Big Sycamore Beaches	Pt. Mugu to Little Sycamore Cyn.	Zuma Beach	Sand Between 60 and 100 Feet	Mugu and Dume Cyns.
Blepharipoda occidentalis (Spiny Sand Crab)		X	X	X	X		
Emerita analoga (Sand Crab)		X	X		X		
Isocheles pilosus (Hermit Crab)				2	2		
Pagurus sp. (Hermit Crab)			3	1			
Pagurus sp. 2 (Hermit Crab)						X	2

ANIMALS (Continued) MOLLUSCA (Continued) GASTROPODA (Continued) Opisthobranchia (Continued) Nudibranchia (Continued) Eolidiacea (Eolid Nudibranchs)	Range	Mugu Barrier Beach	La Jolla and Big Sycamore Beaches	Pt. Mugu to Little Sycamore Cyn.	Zuma Beach	Sand Between 60 and 100 Feet	Mugu and Dume Cyns.
Coryphella trilineata			1				
Flabellinopsis iodinea (Iodine Nudibranch)							1
Hermissenda crassicornis (Opalescent Nudibranch)						1	
Arminacea							
Armina californica (Pansy Nudibranch)		2	3	3	3		
Dendronotacea							
Doto sp.						3	
Prosobranchia (Snails)							
Mesogastropoda							
Balcis rutila?			5	4	3	2	
Balcis micans?					X		
Polinices altus (Moon Snail)			X	1		4	1
Neogastropods							
Conus californicus (California Cone)							4
Kelletia kelletii (Kellet's Whelk)	S					1	1
Megasurcula carpenteriana						2	3
Megasurcula stearnsiana						1	2
Nassarius perpinquis			X	1			
Olivella biplicata (Purple Olive Snail)				2			
Olivella baetica						1	
Ophiodermella ophioderma				1			
Terebra pedroana	S			1		2	

ANIMALS (Continued) MOLLUSCA (Continued) BIVALVIA (Clams and Mussels)	Range	Mugu Barrier Beach	La Jolla and Big Sycamore Beaches	Pt. Mugu to Little Sycamore Cyn.	Zuma Beach	Sand Between 60 and 100 Feet	Mugu and Dume Cyns.
Clinocardium nuttallii					X		
Lyonsia californica					X	X	
Macoma secta (White Clam)			X		X		
Modiolus rectus?			1				
Panopea generosa (Geoduck)						X	1
Tagelus californianus (Razor Clam)						X	X
Tellina sp.					X	X	
Tivela stultorum (Pismo Clam)	S	5	4	4	4		1
Tachycardium quadragenarium (Giant Cockle)	S		X		X		
Tresus nuttallii (Horse Clam)					X	X?	2
CEPHALOPODA							
Loligo opalescens (Squid)					X	X	X
ENCHINODERMATA							
STELLEROIDEA							
Asteroidea (Sea Stars)							
Astropecten armatus (Sand Star)	S				3		
Astropecten verrilli (Deep Sand Star)			X	2		5	5
Luidia foliolata	S				5		5
Patiria miniata (Bat Star)					1	1	3
Pisaster brevispinus (Pink Star)		1	1		1		
Pisaster ochraceus (Ochre Star)			X	2			
Ophiuroidea (Brittle Star)							
Amphiodia occidentalis?			X	4		3	2

ANIMALS (Continued) ENCHINODERMATA ENCHINOIDEA (Urchins)	Range	Mugu Barrier Beach	La Jolla and Big Sycamore Beaches	Pt. Mugu to Little Sycamore Cyn.	Zuma Beach	Sand Between 60 and 100 Feet	Mugu and Dume Cyns.
Dendraster excentricus (Sand Dollar)		5	5	5	5		2
Dendraster laevis					X		
Lovenia cordiformis (Heart Urchin)							1
Lytechinus anamesus (Sand Urchin)						3	2
HOLOTHUROIDEA (Cucumber)							
Molpadia arenicola (Sweet Potato)			X	1	1		
BRYOZOA ("Moss Animals")							
CYCLOSTOMATA)							
Crisia sp.						X	4
CHEILOSTOMATA							
Celleporaria (=Holoporella) brunnea							1
Hippodiplosia insculpta (Corn Flake Bryozoan)							X
Thalamoporella californica						4	5
BRACHIOPODA (Lamp Shells)							
Glottidia albida	S				X	X	
CHORDATA							
UROCHORDATA (Tunicates)							
Ascidiacea (Sea Squirts)							
Styela montereyensis				3		1	

ANIMALS (Continued) CHRODATA (Continued) VERTEBRATA (Vertebrates) Chondrichthyes (Cartilagenous Fish)	Range	Mugu Barrier Beach	La Jolla and Big Sycamore Beaches	Pt. Mugu to Little Sycamore Cyn.	Zuma Beach	Sand Between 60 and 100 Feet	Mugu and Dume Cyns.
Sharks							
Squatina californica (Pacific Angel Shark)					X		
Triakis semifasciata (Leopard Shark)					X		
Rays							
Myliobatis californica			X		X	X	
Platyrhinoidis triseriata (Thornback)	S		X	1	3	1	1
Rhinobatos productus (Shovelnose Guitarfish)	S		X	1	X		
Torpedo californica (Pacific Electric Ray)			1		X		
Osteichthyes (Bony Fishes)							
Scorpaneniformes (Mail-cheeked Fishes)							
Rock Fishes							
Scorpaena guttata (Scorpionfish or Sculpin)	S				X		2
Sebastes dallii (Calico Rockfish)							1?
Cottids							
Leptocottus armatus (Staghorn Sculpin)	S	1			1		
Perciformes (Higher "Perch-like" Fishes)							
Sea Basses							
Paralabrax clathratus (Kelp Bass)	S				X		
Paralabrax nebulifer (Barred Sand Bass)	S		X				
Jacks and Tunas							
Sarda chilensis (Pacific Bonito)					X		
Trachurus symmetricus (Jack Mackerel)						X	

ANIMALS (Continued) CHORDATA (Continued) VERTEBRATA (Continued) Osteichthyes (Continued) Perciformes (Continued) Croakers and Grunts	Range	Mugu Barrier Beach	La Jolla and Big Sycamore Beaches	Pt. Mugu to Little Sycamore Cyn.	Zuma Beach	Sand Between 60 and 100 Feet	Mugu and Dume Cyns.
Menticirrhus undulatus (California Corbina)	S				X		
Roncador stearnsii (Spotfin Croaker)	S					1	
Surfperches							
Amphistichus argenteus (Barred Surfperch)	S			1	X		
Damalichthys vacca (Pile Surfperch)				3	X	X	X
Phanerodon furcatus (White Surfperch)				3	X	X	X
Damselfishes and Wrasses							
Oxyjulis californica (Senorita)				2			X
Blennies and Clinids							
Neoclinus blanchardi (Sarcastic Fringehead)					1		
Other Perciforms							
Sphyraena argentea (California Barracuda)					X		
Pleuronectiformes (Flatfishes)							
Citharichthys sordidus (Pacific Sanddab)						3	?
Citharichthys stigmaeus (Speckled Sanddab)		3	2	3	4	3	3
Hippoglossina stomata (Bigmouth Sole)				1	X	2	
Hypsopsetta guttulata (Diamond Turbot)		2		3	3		
Paralichthys californicus (California Halibut)	S	1	1	3	1		
Pleuronichthys coenosus (C-O Turbot)				1	3	X	2
Pleuronichthys decurrens (Curlfin Turbot)					X		
Pleuronichthys ritteri (Spotted Turbot)				1			
Pleuronichthys verticalis (Hornyhead Turbot)						1	1
Xystreurys liolepis (Fantail Sole)			X	1	X		1

ANIMALS (Continued)
CHORDATA (Continued)
VERTEBRATA (Continued)
Osteichthyes (Continued)
Other Bony Fish

	Range	Mugu Barrier Beach	La Jolla and Big Sycamore Beaches	Pt. Mugu to Little Sycamore Cyn.	Zuma Beach	Sand Between 60 and 100 Feet	Mugu and Dume Cyns.
Synodus lucioceps (California Lizardfish)	S	1		1	1	3	2
Engraulis mordax (Northern Anchovy)					X		
Porichthys notatus (Plainfin Midshipman)					X		
Porichthys myriaster (Specklefin Midshipman)					X		
Chilara taylori (Spotted Cusk Eel)					2		1
Atherinids (Silversides - Includes Grunion)				3	X		
Mola Mola (Common Mola or Ocean Sunfish)					X		
Mammalia							
Phoca vitulina (Harbor Seal)					X		
Zalophus californica (Sea Lion)					X		
Eschrichtius robustus (Gray Whale)					X		

Appendix 4. Macrofauna recorded within study site at Zuma Beach between 1970 and 1973 (Taken from Morin *et al.*, 1978).

Species	Percentage of Dives Seen[a] (daytime)	Zone[b]	Temporal Characteristics[c]	Position with Respect to Substrate[d]	Comments
CNIDARIA					
Hydrozoa					
Obelia longissima	F	II, III		A	usually on *Balanus Pacificus* or *Diopatra* tubes
O. dichotoma	F	II, III		A	same
Lovenella producta	F	II		A'	usually on dead Dendraster tests
Campanulina rugosa	F	II		A'	same
Clytia bakeri	F	I, II		A'	usually on live *Olivella biplicata* or *Tivela* shells
Aglaophenia sp.	7.4	III		A'	on *Diopatra* tubes
Plumularia sp.	4.1	III		A	same
Bougainvillia sp.	<1.0	III		A	same
Tubularia sp.	<1.0	III		A	same
Polyorchis penicillatus	4.7	III, II	W, Sp	P	medusae usually within 10 cm of bottom
Scyphozoa					
Pelagia panopyra	10.8	-	Sp, Su	P	throughout water column
Anthozoa					
Renilla kollikeri	100	I, II, III		S	
Stylatula elongata	96.6	III		S	
Virgularia sp.	<1.0	B, III		S	replaces *Stylatula* with depth
Harenactis attenuata	18.2	III, II		S'	
Zaolutus actius	10.8	III		S'	

Species	Percentage of Dives Seen[a] (daytime)	Zone[b]	Temporal Characteristics[c]	Position with Respect to Substrate[d]	Comments
Edwardsiella californica	4.7	III		S'	
Halcampa sp.	4.1	III, II		S	extends off substrate like Corymorpha, probably brought in on floating kelp
Epiactis prolifera	1.4	III	T	A	
ANNELIDA - Polychaeta					
Diopatra ornata	100	B, III, II		S	tubes extend several cm above sand
Cirratulidae	13.5	II, I, III		S'	
Sabellidae	5.4	III	F, W	S'	
Aphrodita sp.	1.4*	III		I	
Terebellidae	<1.0	III		S'	
ARTHROPODA -Crustacea					
Cirripedia					
Balanus pacificus	100	II, I		A	mostly on *Dendraster* but also other exposed hard substrates
Malacostraca - Decapoda					
Caridea					
Heptacarpus sp.	F(8.1)	II		E	common between sand dollars
Crangon nigricauda	2.7*	-	N	I (E)	
Palinura					
Panulirus interruptus	1.4	II	T	E	
Anomura					
Isocheles (=*Holopagurus*) *pilosus*	27.0	II, III		E	
Paguristes bakeri	4.1	III		E	
Pagurus ochotensis	4.1	III		E	

Species	Percentage of Dives Seen[a] (daytime)	Zone[b]	Temporal Characteristics[c]	Position with Respect to Substrate[d]	Comments
Blepharipoda occidentalis	3.4*	S, I	N	I (S')	
Emerita analoga	<1.0	S		S'	usually within the surf zone
Brachyura					
Cancer gracilis	37.2*	-	N	I (E)	
Heterocrypta occidentalis	33.8	III, II		E to S'	
Loxorhynchus grandis	33.1	II, III, I		E	most common in the sand dollar bed
Randallia ornata	25.7*	-	N	I (E)	
Cancer antennarius	15.5	-	W, Sp	E	
C. productus	10.1	-	W, Sp	E	
C. anthonyi	6.8	-	W, Sp	E	
Portunas xantusii	6.8*	-	N	I (E)	
Podochela hemphillii	1.4	III		E	
Talicpus nuttallii	1.4	III	T	E	
Mursia quadichandi	<1.0	B		E	
Pugettia richii	<1.0	II	T	E	
MOLLUSCA					
Pelecypoda (Bivalvia)					
Tivela stultorum	99.3	I		S'	usually only siphons show
Clinocardium nuttallii	10.1	II, III	Sp	S'	
Donax gouldii	4.7	S, I		S'	near surf zone
Gastropoda					
Armina californica	68.2	III, I, II		E to S	
Neverita (=*Polinices*) *altus*	45.9	III, II		S' to E	
Megasurcula carpenteriana	43.2	III, II		E	
Olivella biplicata	39.9	I		S'	

Species	Percentage of Dives Seen[a] (daytime)	Zone[b]	Temporal Characteristics[c]	Position with Respect to Substrate[d]	Comments
Balcis rutila	37.8	II, III	[Sp]	E or A	usually found ectoparasitic on *Dendraster*
B. micans	I*	III, II	N?	I to E	ectoparasitic on echinoderms or free living on sand
Polinices lewisii	16.9	III, II		E	
Terebra pedroana	16.2	III		E	
Nassarius fossatus	13.5	II, III		S' to E	
Ophiodermella ophioderma	10.8	III		E	
Rictaxis (=*Acteon*) *punctocaelatus*	8.1	III, II		S' to E	
Hermissenda crassicornis	6.8	III	Su, F	A or E	on *Diopatra* tubes with hydroids
Kelletia kelletii	7.4	III	T	E	
Olivella baetica	7.4*	III, II		S' to I	
Mitra idae	3.4	III	T	E	
Nassarius perpinquis	2.0*	III		I to S'	
Precuthona divae	2.7	III, II	T	A or E	on *Diopatra* tubes
Coryphella trilineata	1.4	III	T	A or E	same
C. cooperi	<1.0	III	T	A or E	same
Polycera atra	<1.0	III	T	A or E	same
Cancellaria cooperi	<1.0	B		E	
Epitoneum sp.	<1.0	III	N?	S' to E	
Tritonia exulans	<1.0	B		E	
Aplysia californica	<1.0	III	T	E	
Cephalopoda					
Octopus bimaculatus	1.4	II	T?	E	concealed in dead clam shells or cans
BRACHIOPODA					
Glothidia albida	1.4*	III		I	

Species	Percentage of Dives Seen[a] (daytime)	Zone[b]	Temporal Characteristics[c]	Position with Respect to Substrate[d]	Comments
ECHINODERMATA					
Echinoidea					
Dendraster excentricus	100	II, III, I		S or E	
D. laevis	3.4	III, B		S	
Lovenia cordiformis	<1.0	III		I	
Holothuroidea					
Molpadia arenicola	33.1*	II, III		I to S'	
Leptosynapta sp.	1.4*	III		I	
Ophiuroidea					
Amphiodia occidentalis	14.2*	III, II		S'	arms extend several cm above sand
Asteroidea					
Astropecten verrilli	98.6	B, III		E to I	
A. armatus (=*braziliensis*)	97.3	II, III		E to I	
Petalaster (=*Luidia*) *Foliolata*	31.1	III	W, Sp	E to I	
Pisaster brevispinus	29.7	II, III, I		E	
P. giganteus	29.1	II, III, I		E	
Patiria miniata	8.8	II, III	T	E	
Pisaster ochraceus	1.4	II	T	E	
CHORDATA - Vertebrata					
Chondrichthyes					
Platyrhinoides triseriata	15.5*	-	N	I (E)	
Myliobatis californica	10.1	-		E	
Torpedo californica	10.1	-		E to S	
Rhinobatis productus	2.7	-		E to S	
Squatina californica	2.0	-		E to S	

Species	Percentage of Dives Seen[a] (daytime)	Zone[b]	Temporal Characteristics[c]	Position with Respect to Substrate[d]	Comments
Urolophus halleri	1.4	I		E to S	
Triakis semifasciata	<1.0	-		E to P	
Cephaloscyllium ventriosum	<1.0	-		E to P	
Osteichthyes					
Citharichthys stigmaeus	100	-		E	
Pleuronichthys coenosus	42.3	-		E to S	
Hypsopsetta guttulata	31.8	-		E to S	
Paralichthys californicus	22.3	-	Su, F	E to S'	
Paralabrax clathratus	12.9	-		P	
Synodus lucioceps	8.8	III, II, I	Su	E	
Menticirrhus undulatus	8.1	S		P	near surf line
Phanerodon furcatus	7.4	-		P	
Hyperprosopon argenteum	6.8	S	N	P	near surf line by day, throughout by night
Rhacochilus vacca	4.7	-		P	
Xystreurys liolepis	2.0	B, III		E to S	
Amphistichus argenteus	1.4	S		P	near surf line
Leptocottus armatus	1.4*	-	N	I (E)	
Neoclinus blanchardi	1.4	-		E	usually concealed in shells or cans
Otophidium taylori	<1.0*	-	N	I (E)	
Scorpaena guttata	1.4*	-	N	I (E)	
Scorpaenichthys marmoratus	1.4	-	T	E	
Syngnathus sp.	1.4	-	T	E	
Hippoglossina stomata	<1.0	B, III		E to S	
Parophrys vetulus	<1.0	B, III		E to S	

Species	Percentage of Dives Seen[a] (daytime)	Zone[b]	Temporal Characteristics[c]	Position with Respect to Substrate[d]	Comments
Pleuronichthys ritteri	<1.0	B, III		E to S	
P. verticalis	<1.0	B, III		E to S	
Porichthys notatus	1.4*	B, III		S' to E	
P. myriaster	1.4*	B, III		S' to E	

[a] Percentages are taken from 148 dives:
F = Frequently encountered (50%) but often not noted in dive logs
* = Infaunal or barely exposed during the day so that the correct percentages are probably higher than indicated
I = Intermittently observed and usually not recorded in dive logs

[b] Zones where the species have been observed are listed in their order of greatest to least encounters:
S = Shoreward of Zone I on the transect
I = Zone I (0-50 m on the transect)
II = Zone II (50-100 m on the transect)
III = Zone III (100-210 m on the transect)
B = Beyond the transect to the seaward
- = Not clearly restricted; occurs in all zones (I-III)

[c] Seasonal Data: W = Winter months (January-March)
Sp = Spring months (April-June)
Su = Summer months (July-September)
F = Fall months (October-December)
T = Transient; most common in rock and kelp habitats
Day-Night Data: N = Nocturnally active

[d] A = Epifaunal and attached to a solid substrate
A' = Same, but solid substrate may be partially buried in sand
P = Pelagic; swimming; not normally resting
E = Epifaunal; resting on the substrate
S = Substrate associated by being mostly exposed but also partly buried or anchored in the sand
S' = Substrate associated but being mostly buried or anchored in the sand and with only a limited amount of the organism exposed
I = Infaunal; usually not exposed or visible from above the substrate
( ) = Position of the species at night in the nocturnally active forms

Appendix 5

Species Found on Hard Substrates Within the Intertidal in the Mugu-Latigo ASBS.

	Relative Abundance*	Zone†	Source and Notes‡
PLANTS			
CHLOROPHYTA (Green Algae)			
Blidingia minima	2	-	N&C
Chaetomorpha linum	1	4	D, N&C, M&H
Chaetomorpha spiralis	1	4	D
Cladophora columbiana	1	4	D
Cladophora graminea	2	4	D
Cladophora microcladioides	1	4	D
Cladophoropsis fasciculatus	1	-	D
Enteromorpha compressa	3	2	D
Enteromorpha spp.	1	-	D, N&C, M&H
Ulva angusta (Sea Lettuce)	1	2	D
Ulva californica (Sea Lettuce)	4	2	D, M&H
Ulva lactuca (Sea Lettuce)	1	2	D
Ulva lobata (Sea Lettuce)	1	3	D
Ulva taeniata (Sea Lettuce)	3	2	D
PHAEOPHYTA (Brown Algae and Kelp)			
Colpomenia sinuosa (Bubble Algae)	1	3	D
Cylindrocarpus rugosus	2	3	D
Cystoseira osmundacea (Bladder Kelp)	1	4	D
Dictyopteris undulata	1	4	D
Dictyota flabellata	2	3	D
Ectocarpus spp.	1	2	D, N&C
Egregia menziesii (Feather-boa Kelp)	5	4	D, N&C, M&H

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
PLANTS (Continued)			
PHAEOPHYTA (Continued)			
Eisenia arborea (Southern Sea Palm)	2	4	D, M&H
Endarachne binghamiae	1	3	D, N&C
Giffordia granulosa	1	4	D
Giffordia mitchellae	1	4	D
Halidrys dioica	2	4	D
Laminaria farlowii	1	4	D
Laminaria sinclarii	1	4	N&C
Macrocystis pyrifera (Giant Kelp)	1	4	D, N&C, M&H
Pachydictyon coriaceum	2	4	D
Pelvetia fastigata	2	3	D, M&H
Petalonia fascia	1	2-4	D
Ralfsia spp. (Tar Spot Algae)	2	1-2	D, N&C, M&H
Sargassum agardhianum	1	4	D
Scytosiphon lomentaria	1	4	D, N&C
Taonia lennebackeriae (Banded Algae)	3	4	D, N&C
Zonaria farlowii (Banded Algae)	1	4	D, M&H
RHODOPHYTA (Red Algae-Mostly Foliaceous)			
Ahnfeltia plicata	1	3-4	D, N&C
Amplisiphonia pacifica	1	4	D
Anisocladella pacifica	1	4	D
Bangia fuscopurpurea	1	2	D
Bossiella orbigniana (Articulated Coralline)	4	3-4	D, M&H
Centroceras clavatum	1	2	D
Ceramium eatonianum	1	2	D

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
PLANTS (Continued)			
RHODOPHYTA (Continued)			
Chondria decipiens	1	3-4	D
Chondria nidifica	1	4	D
Coeloseira compressa	1	4	D
Coeloseira parva	1	4	D
Corallina officinalis (Articulated Coralline)	3-4	3-4	D, N&C, M&H
Corallina vancouveriensis (Articulated Coralline)	3-4	4	D, N&C, M&H
Cryptopleura corallinara (on Corallina)	1	4	D
Cryptopleura crispa (on Red Algae)	1	4	D
Cryptopleura lobulifera	1	4	D
Cryptopleura violacea	1	4	D
Cryptopleura spp.	1	4	D
Endocladia muricata	3	2	D
Farlowia mollis	1	4	D
Gastroclonium coulteri	3	3-4	D, N&C
Gelidium coulteri	3	3	D, N&C, M&H
Gelidium purpurascens	1	4	D
Gelidium robustum	3	4	D, N&C
Gigartina canaliculata	4	3-4	D, N&C, M&H
Gigartina harveyana	1	4	D, N&C
Gigartina leptorhynchos	5	3-4	D, N&C, M&H
Gigartina papillata	2	4	D
Gigartina spinosa	2	4	D, N&C
Gigartina volans	1	4	D, N&C
Gloiosiphonia capillaris	1	4	D

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
PLANTS (Continued)			
RHODOPHYTA (Continued)			
Gracilaria andersonii	1	4	D
Gracilaria sjoestedtii (Stringy Red)	4	4	D, M&H
Gracilaria textorii	1	4	D
Gracilaria verrucosa	1	3-4	D
Grateloupia doryphora	1	4	D, N&C
Grateloupia prolongata	2	3-4	D
Gymnogongrus leptophyllus	1	4	D
Haliptylon gracilis	1	4	D
Herposiphonia verticillata (epiphytic)	1	4	D, N&C
Hildenbrandia spp. (Tar Spot Algae)	1	1-2	D, M&H
Hydrolithon decipiens (Coralline)	1	4	D
Iridaea cordata	1	4	D
Iridaea spp.	1	4	D, N&C
Jania crassa (Articulated Coralline)	1	4	D, N&C
Laurencia pacifica	2	4	D
Laurencia spectabilis	1	4	D
Laurencia splendens (epiphytic)	1	4	D
Lithothamnium spp. and/or Lithophyllum spp. (Encrusting Corallines)	4	3-4	D, N&C, M&H
Lithothrix aspergillum (Articulated Coralline)	1	3-4	D
Melobesia marginata (Encrusting Coralline of Laurencia)	1	4	D
Melobesia mediocris (Encrusting on Phyllospadix)	4	4	D, M&H
Microcladia coulteri (on Red Alga)	1	4	D, N&C
Nienburgia andersoniana	1	4	D
Nemalion helminthoides	2	2	D

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
PLANTS (Continued)			
RHODOPHYTA (Continued)			
Neoagardhiella baileyi (Stringy Red)	1	4	D
Ozophora clevelandii	1	4	D
Petrocelis franciscana	1	2-3	D
Phycodrys setchellii	1	4	D
Plocamium cartilagineum	1	4	D, N&C
Pogonophorella californica	1	4	D
Polysiphonia confusa	1	3	D
Polysiphonia hendryi (often epiphytic)	1	2-4	D
Polysiphonia scopulorum	1	3-4	D
Polysiphonia spp.	1	4	D, N&C
Porphyra lanceolata	1	2	D
Porphyra perforata	2	1-2	D, N&C
Prionitis cornea	1	4	D
Prionitis lanceolata	3	3-4	D, N&C, M&H
Prionitis lyalli	2	4	D
Pseudogloiophloea confusa	1	4	D
Pterocladia capillacea	1	3-4	D
Pterocladia media	2	2	D
Pterocladia spp.	2	4	D
Pterosiphonia baileyi	1	4	D
Pterosiphonia dendroidea	3-4	1	D, N&C
Rhodoglossum affine	3-4	3-4	D, N&C
Rhodoglossum californicum	1	4	D, N&C

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
PLANTS (Continued)			
RHODOPHYTA (Continued)			
Rhodymenia californica	1	4	D
Rhodymenia pacifica	2	4	D
Rhodymenia rhizoides	1	4	D
Rhodymenia spp.	1	4	D, N&C, M&H
Schizymenia pacifica	1	4	D
Smithora naiadum (on Phyllospadix)	2	4	D, M&H
Stenogramme interrupta	1	4	D
Tenarea dispar (Coralline epiphytic on Red Algae)	1	4	D
Tiffaniella snyderae	1	4	D, N&C
TRACHEOPHYTA			
Phyllospadix scouleri (Broad Surf Grass)	2	4	D
Phyllospadix torreyi (Narrow Surf Grass)	5	4	D, M&H
ANIMALS			
PROTOZOA			
Gromia oviformis	1	4	M&H
PORIFERA			
Cliona celata (Yellow Boring Sponge)	1	4	M&H
Halichondria ? sp. (Purple Sponge)	1	4	M&H
Hymeniacidon ungodon (Yellow Green Sponge)	2	4	M&H
Leucetta losangelensis (White Sponge)	1	4	M&H
Leucilla nuttingi (Urn Sponge)	1	4	M&H
Leucosolenia sp. (Spagetti Sponge)	1	4	M&H
Microciona ? sp. (Orange Sponge)	2	4	M&H

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
ANIMALS (Continued)			
CNIDARIA			
Hydrozoa (Hydroids)			
Eudendrium sp. (Pinkish Hydroid)	2	4	M&H
Obelia sp.	2	4	M&H
Plumularia sp.	1	4	M&H
Sertularella sp.	1	4	M&H
Sertularia sp. (Epiphyte on Phyllospadix)	2	4	M&H
Tubularia sp.	1	4	M&H
Anthozoa (Anemones and Corals)			
Anthopleura elegantissima (Aggregated Green Anemone)	5	3	N&C, M&H
Clavularia sp. (Creeping Octocoral)	1	4	M&H
Epiactis prolifera (Proliferating Anemone)	1	4	M&H
Sagartia catalinensis (Pinkish Anemone)	1	4	M&H
Scyphozoa			
Haliclystus sp. (Attached Jellyfish)	1	4	M&H
PLATYHELMINTHES (Flatworms)			
Eurylepta aurantiaca (Orange Flatworms)	1	4	M&H
Stylochus franciscanus (Spotted Flatworms)	1	4	M&H
Leptoplana ? sp. (Brown Flatworms)	2	3-4	M&H
NEMERTEA (Ribbon Worms)			
Amphiporus bimaculatus (White Nemertean)	1	4	M&H
Emplectonema gracile (Green Nemertean)	1	3-4	M&H
Paranemertes peregrina (Purple and Yellow Nemertean)	2	3-4	M&H
Tubulanus sexlineatus ? (Purple and White Nemertean)	1	4	M&H

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
ANIMALS (Continued)			
ANNELIDA (Segmented Worms)			
Arabella ? sp. (Arabellid, in Phyllospadix)	2	4	M&H
Diopatra ornata (Gray Tube Worm)	2	4	M&H
Dodecaceria sp.	2	4	M&H
Halosydna brevisetosa (Scale Worm)	2	3-4	M&H
Hydroides ? sp. (Calcareous Tube Worm)	2	4	N&C?, M&H
Nereis ? sp. (Nereid)	1	4	M&H
Ophiodromus pugettensis (Patria Worm)	1	4	M&H
Pareurythoe californica ? (Fire Worm)	1	4	M&H
Pharagmatopoma californica (Sand Tube Worm)	4	4	M&H
Platynereis bicanaliculata (Nereid)	1	4	M&H
Polynoidae-unid (Scale Worm)	1	4	M&H
Scoloplos ? sp. (Orbiniid)	1	4	M&H
Spirorbis sp. (Calcareous Tube Worm)	3	3-4	M&H
Syllidae-unid. (Syllid)	1	4	M&H
ARTHROPODA			
Pycnogonida (Sea Spiders)			
Pycnogonum stearnsi (Sea Spider)	1	4	M&H
Cirripedia (Barnacles)			
Balanus glandula (White Acorn Barnacle)	5	2	N&C, M&H
Balanus tintinnabulum (Candy Cane Barnacle)	2	4	M&H
Balanus trigonus ?	1	4	M&H
Chthamalus fissus (Acorn Barnacle)	4	1	N&C, M&H
Pollicipes polymerus (Gooseneck Barnacle)	4	3	N&C, M&H

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
ANIMALS (Continued)			
ARTHROPODA (Continued)			
Cirripedia (Continued)			
Tetraclita squamosa (Red Barnacle)	3	2	M&H
Copepoda (Copepods)			
Tigriopus californicus	2	1	M&H
Amphipoda (Amphipods)			
Gammarids-unid.	3	3-4	M&H
Caprella sp. (Skeleton Shrimp)	1	4	M&H
Isopoda (Isopods)			
Cirolana harfordi	1	3-4	M&H
Ligia occidentalis (Rock Slater)	3	1	M&H
Idotea sp.	1	4	M&H
Decapoda (Crabs and Shrimp)			
Alpheus dentipes (Pistol Shrimp)	2	4	M&H
Betaeus sp.	1	4	M&H
Cancer antennarius (Red Cancer Crab)	1	4	N&C?, M&H
Heptacarpus sp.-2 species (Broken Back Shrimp)	2	4	M&H
Lophopanopeus sp.	1	4	M&H
Pachycheles rudis ? (Porcelain Crab)	1	4	M&H
Pachygrapsus crassipes (Lined Shore Crab)	3	2	N&C, M&H
Pagurus samuelis (Hermit Crab)	4	3-4	N&C?, M&H
Pagurus hirsutiusculus ? (Hermit Crab)	1	4	M&H
Panulirus interruptus (Spiny Lobster)	1	4	M&H
Petrolisthes cinctipes (Porcelain Crab)	2	4	N&C, M&H
Pilumnus spinohirsutus (Spiny Crab)	1	4	M&H

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
ANIMALS (Continued)			
ARTHROPODA (Continued)			
Decapoda (Continued)			
Pugettia producta (Kelp Crab)	1	4	N&C, M&H
Scyra acutifrons (Masking Crab)	2	4	M&H
MOLLUSCA			
Gastropoda (Snails and Limpets)			
Acanthina spirata (Toothed Whelk)	3	3	N&C, M&H
Aeolidia papillosa (Tan Eolid Nudibranch)	1	4	M&H
Amphissa versicolor (Varigated Snail)	1	4	M&H
Aplysia california (Sea Hare)	1	4	M&H
Ceratostoma nuttalli (Nuttall's murex)	1	4	M&H
Chelidonura inermis (Navanax Slug)	1	4	M&H
Collisella conus (Small Rough Limpet)	2	2	M&H
Collisella digitalis (Fingered Limpet)	4	1	M&H
Collisella pelta ? (Shield Limpet)	2	3	M&H
Collisella scabra (Rough Limpet)	4	1	M&H
Collisella strigatella (Limpet)	2	2	M&H
Conus californicus (Cone Snail)	1	4	M&H
Crepidula adunca (Hooked Slipper Snail)	1	2-3	M&H
Crepidula onyx (Onyx Slipper Snail)	1	4	M&H

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
ANIMALS (Continued)			
MOLLUSCA (Continued)			
Gastropoda (Continued)			
Flabellinopsis iodinea (Iodine Eolid Nudibrandh)	1	4	N&C, M&H
Haliotis cracherodii (Black Abalone)	2	4	M&H
Hermissenda crassicornis (Opalescent Eolid Nudibranch)	1	4	M&H
Lacuna unifasciata (One-banded Periwinkle)	2	4	M&H
Lamellaria sp. (Tunicate Lamellarian)	1	4	N&C, M&H
Littorina planaxis (Eroded Periwinkle)	4	1	N&C, M&H
Lottia gigantea (Owl Limpet)	3	2	M&H
Maxwellia gemma (Gem murex)	1	4	M&H
Mitrella carinata (Dove Snail)	2-3	4	M&H
Notoacmea insessa (Egregia or Seaweed Limpet)	2-3	4	M&H
Notoacmea paleacea (Surf Grass Limpet)	2	4	M&H
Nucella emarginata (Dog Whelk)	3	3	M&H
Oceanebra sp. (Rock Snail)	1	3-4	M&H
Olivella biplicata (Purple Olive Snail)	3	4	M&H
Opalia funiculata (Sculptured Wentletrap)	1	4	M&H
Rictaxis (=Acteon) punctocaelatus (Barrel Snail)	1	4	M&H
Serpulorbis squamigerus (Worm Snail)	2	4	M&H
Tegula funebralis (Black Turban Snail)	3	2-3	N&C, M&H
Triopha maculata (Orange Clown Dorid)	1	4	M&H
Trivia californiana (California Coffee Bean)	1	4	M&H
Bivalvia (Mussels and Clams)			
Adula falcata (Falcate Date Mussel)	1	4	M&H

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
ANIMALS (Continued)			
MOLLUSCA (Continued)			
Bivalvia (Continued)			
Chama pellucida (Jewel Box Clam)	2	4	M&H
Diplodonta orbellus (Spherical Clam)	1	4	M&H
Hiatella arctica (Nestling Clam)	2	3-4	M&H
Lasaea subviridis (Minute Clam)	2	3	M&H
Lithophaga plumula (Date Mussel)	1	4	M&H
Mytilimeria nuttalli (Tunicate Clam)	1	4	M&H
Mytilus californianus (California Mussel)	5	3	N&C, M&H
Mytilus edulis (Bay Mussel)	1	3	M&H
Penitella penita (Flat-tipped Piddock or Boring Clam)	2-3	4	M&H
Petricola carditoides (Nestling Clam)	1	4	M&H
Platyodon cancellatus (Boring Clam)	1-2	4	M&H
Pododesmus cepio (Jingle Shell)	1	4	M&H
Prothaca staminea (Rock Cockle)	2	3-4	M&H
Pseudochama exogyra (Reversed Jewel Box)	2-3	4	M&H
Septifer bifurcatus (Ridged Mussel)	2	3	M&H
Polyplacophora (Chitons)			
Cyanoplax hartwegii	2	2	M&H
Mopalia muscosa (Mossy Chiton)	3	3	M&H
Mopalia porifera ?	1	4	M&H
Nuttalina fluxa	3-4	2	M&H
Stenoplax conspicua (Conspicuous Chiton)	1	4	M&H

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
ANIMALS (Continued)			
MOLLUSCA (Continued)			
Cephalopoda (Squids and Octopuses)			
Octopus bimaculatus (Two spotted Octopus)	1-2	4	M&H
ECHINODERMATA			
Echinoidea (Urchins)			
Strongylocentrotus franciscanus (Red Urchin)	1	4	M&H
Strongylocentrotus purpuratus (Purple Urchin)	2	4	M&H
Stelleroidea (Sea Stars and Brittle Stars)			
Astrometis sertulifera (Spiny Soft Star)	1	4	M&H
Ophiopteris papillosa (Brittle Star)	1	4	M&H
Ophiothrix spiculata (Red Banded Brittle Star)	2	4	M&H
Patiria miniata (Bat Star)	2	4	M&H
Pisaster giganteus (Knobby Blue Star)	1	4	M&H
Pisaster ochraceus (Ochre Star)	3	4	N&C, M&H
Pycnopodia helianthoides (Sun Star-Juvenile)	1	4	M&H
BRYOZOA (Bryozoans)			
Antropora tincta (Lumpy Bryozoan)	1	4	M&H
Bugula californica (Erect Bryozoan)	2	4	M&H
Crisia sp. (Thin Erect Bryozoan)	2	4	M&H
Filicrisia sp. (Thin Erect Bryozoan)	1	4	M&H
Membranipora membranacea (Jack Frost Bryozoan)	2	4	M&H
Membranipora tuberculata (Epiphytic Bryozoan)	2	4	M&H
Parasmittina and/or Rhynchozoan sp. (Pink Encrusting Bryozoan)	2	3-4	M&H
Thalamoporella californica (Erect Bryozoan)	1	4	M&H

Appendix 5 (Continued)

	Relative Abundance*	Zone†	Source and Notes‡
ANIMALS (Continued)			
CHORDATA			
Urochordata (Sea Squirts)			
Aplidium californicum (Whitish Compound)	2	4	M&H
Archidistoma psammion (Brown Compound)	1	4	M&H
Corella willmeriana (Green Solitary)	1	4	M&H
Euherdmania claviformis (Sand Club Tunicate)	2-3	4	M&H
Metandrocarpa dura (Orange Social Tunicate)	1	4	M&H
Pyura haustor (Pink Siphoned Solitary Tunicate)	1	4	M&H
Styela montereyensis (Stalked Solitary Tunicate)	1-2	4	M&H
Trididemnum opacum (White Compound Tunicate)	2-3	4	M&H

*Relative Abundance: 1 = Rare or Irregularly Encountered, 2 = Uncommon, 3 = Fairly Common, 4 = Common, 5 = Abundant.

†Zone: 1 = Uppermost Horizon, 2 = High intertidal, 3 = Middle Intertidal, 4 = Low Intertidal.

‡Source: D = Dawson, 1959, 1965; N&C = Nicholson and Cimberg, 1971; M&H = Morin and Harrington, this report.

Appendix 6

Species Found on or in Soft Substrates Within the Intertidal in the Mugu-Latigo ASBS.

	Relative Abundance*	Zone†	Sources‡
ANNELIDA			
Euzonus mucronata	1-2	2-3	P, M+H
Hemipodus borealis (Glycerid Worm)	1	3	P
Lumbrinereis zonata (Lumbrinereid Worm)	1	3-4	P
Nephtys californiensis (Nephtyid Worm)	1	4	P
Nerinides acuta (Spionid Worm)	1	3-4	P
ARTHROPODA			
AMPHIPODA			
Orchestoidea benedicti (Beach Hopper)	1	1	P
Orchestoidea californiana (Beach Hopper)	1	1	P, M+H
Orchestoidea columbiana (Beach Hopper)	1	1	P
Eohaustorius washingtonianus	1	4	P
ISOPODA			
Excirolana chiltoni	1-2	2-3	P, S
Tylos punctatus	1	1	P
DECAPODA			
Blepharipoda occidentalis (Spiny Sand Crab)	1	4	P
Emerita analoga (Sand Crab)	2-4	2-4	P,S, M+H
INSECTA			
Coleopteran	1	1	P
Insect Larvae	1	1	P
MOLLUSCA			
GASTROPODA			
Olivella biplicata (Purple Olive Snail)	1-4	4	M+H

Appendix 6 (Continued)

	Relative Abundance*	Zone†	Sources‡
MOLLUSCA (Continued)			
BIVALVIA			
Donax gouldii (Bean Clam)	1	4	M+H
Tivela stultorum (Pismo Clam)	1	4	M+H

*Relative Abundance: 1 = Rare or Irregularly Encountered, 2 = Uncommon, 3 = Fairly Common, 4 = Common, 5 = Abundant.

†Zone: 1 = Uppermost Horizon, 2 = High Intertidal, 3 = Middle Intertidal, 4 = Low Intertidal.

‡Source: P = Patterson, 1974; S = Straughan, 1977; M+H = Morin and Harrington, this report.

Appendix 7. Aquatic Birds Encountered Within or Near the Mugu-Latigo ASBS (Modified from U.S., E.P.A., 1977)

Common merganser	*Mergus merganser*
Pintail duck	*Anas acuta*
Cinnamon teal	*Anas cyanoptera*
Redhead	*Antheya americana*
Wood duck	*Aix sponsa*
Mallard	*Anas diazi*
Mudhen	*Fulica americana*
Common goldeneye	*Bucephala clangula*
White-winged scoter	*Melanitta deglandi*
Dipper	*Cinclus mexicanus*
Common teal	*Anas discors*
Brant	*Branta bernicle*
Western grebe	*Aechmophorus occidentalis*
Brown pelican	*Pelecanus occidentalis*
Black-footed albatross	*Diomedea nigripes*
Comorants	*Phalcrocorax* sp.
Green heron	*Butorides virescens*
Great blue heron	*Ardea herodias*
Yellow rail	*Coturnicops novebaracensis*
Virginia rail	*Rallus limicola*
Clapper rail	*Rallus longirostris*
Semipalmated plover	*Charadrius semipalmatus*
Snowey plover	*Charadrius alexandrinas*
Black-bellied plover	*Squatarola squatarola*

Appendix 7 (Continued)

Turnstones	*Arenaria interpres*
Surf bird	*Aphriza virgata*
Spotted sandpiper	*Tringa solitaria*
Yellow throat	*Geothlypis trichas*
Baird's sandpiper	*Erolia bairdii*
Least sandpiper	*Erolia minutilla*
Western sandpiper	*Ereunetes mauri*
American avocet	*Recurviorostros americana*
Dunlin	*Erola alpina*
Sanderling	*Crocethia alba*
Willet	*Catoptrophorus semipalmatus*
Wandering tattler	*Heteroscelus incanum*
Knot	*Calidris canutus*
Short-billed dowitcher	*Limrodromus griseus*
Curlews	*Numenius americanus*
Common murre	*Uria aalge*
Pigeon guillermot	*Cepphus columba*
Murrelets	*Endomychura hypoleuca*
Auklets	*Ptychoramphus aleutica*
Western gull	*Larus occidentalis*
Herring gull	*Larus argentatus*
California gull	*Larus californicus*
Laughing gull	*Larus atricilla*
Least tern	*Sterna albifrons*

Appendix 8. Common Plants within the Four Vegetation Types Encountered within One-Half Mile of the Mugu-Latigo ASBS.

I. Coastal Strand*

Franseria chamissonis (Coastal Strand Bursage)

Oenothera cheiranthifolia (Evening Primrose)

Abronia umbellata (Sand Verbena)

Atriplex semibaccata (Australian Salt Bush)

Mesembryanthemum nodiflorum (Ice Plant)

Mesembryanthemum crystallinum (Ice Plant)

Haplopappus ericoides (Heather Goldenbush)

Convolvulus soldanella (Beach Morning Glory)

II. Coastal Salt Marsh*

Salicornia virginica (Pickleweed)

Salicornia subterminalis (Pickleweed)

Suaeda californica (Sea Blite)

Distichlis spicata (Salt Grass)

Spartina leiantha (Cord Grass)

Frankenia grandifolia (Frankenia)

III. Coastal Sage Scrub*

Artemisia californica (California Sage Brush)

Salvia apiana (White Sage)

Salvia mellifera (Black Sage)

Salvia leucophylla (Purple Sage)

Eriogonum fasciculatum (California Buckwheat)

Rhus integrifolia (Lemonade Berry)

Appendix 8 (Continued)

III. Coastal Sage Scrub* (Continued)

Encelia californica (California Encelia)

Horkelia cuneata

Haplopappus squarrosus (Haplopappus)

[illegible]

Coriopsis gigantea (Giant Coriopsis)

IV. Riparian Woodland†

Platanus californica (Western Sycamore)

Salix lasiolepis (Arroyo Willow)

Salix laevigata (Black Willow)

Rhus diversiloba (Poison Oak)