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THE MARINE RESOURCES AND ENVIRONMENTAL ALTERNATIVES

for the

NATURAL RESOURCES MANAGEMENT PLAN

OF THE

GOLDEN GATE NATIONAL RECREATIONAL AREA

~~CONFIDENTIAL~~

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by

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Abstract

The admonition in this report is the preservation of the marine resources of the Golden Gate National Recreational Area - Pt. Reyes shoreline properties. Some areas can tolerate high intensity recreation whereas other fragile areas should be protected. Much of the GGNRA coastline presents dangerous cliff-erosion rock slides and hazardous wave conditions for beach walkers and bathers. A coastal walking trail, called the "Sunset Trail," from San Francisco to Pt. Reyes would enhance recreation for those hardy individuals. Interpretive centers are spaced for all to enjoy and learn of the the unique marine geology and biology of the area. Research to establish baseline data for populations of marine organisms should be promptly initiated to determine the direction of change in the marine use of the park's coastal environment.

Acknowledgements

The study for this report was structured and assisted by the many students who have accompanied me in my treks to the marine habitats throughout the past 17 years. In particular, the past summer of 1974, the following young people greatly assisted me in formulating the suggestive alternatives in this report; my appreciation is extended to Mark Carr, Craig Dahl, Maureen Fallon, Doris Kennedy, Keith Mastin, Woody Nackley, Hughes Ryan, Ron Schwarz, and Jim Scott.

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I. INTRODUCTION - PURPOSE

In October, 1972, a 34,000-acre land and water mass was created into the Golden Gate National Recreational Area, hereafter referred to as GGNRA in this report. In order to formulate a wise and feasible management policy for the use of this recreational area, it was necessary to define the little known nor understood natural resources of the area--floral, faunal, geological and marine. The major purpose of this report is to delineate the significant marine resources and also to suggest alternative management plans which would be compatible with the total environment.

II. METHOD OF STUDIES

The presentation of data information will be described on a locality-to-locality method, beginning at the northern section of the marine Pt. Reyes National Seashore Park to the shores of the GGNRA. For the most part, direct observation was the chief method of recording the dominant marine resources.

The information on Duxbury Reef, Bolinas Lagoon, and the Pt. Reyes National Seashore Park was gathered over a period of years, 1958 through 1973. Likewise, from 1958 through 1965, much marine data was collected and marine species photographed around the Marin headlands area to provide baseline information for comparison with future summer observations.

In the detailing of data for the GGNRA, the observation of the marine faunal and floral population dynamics was recorded by the College of Marin students and myself over a period of four weeks, July 15 to August 9, 1974. Lack of time prevented a detailed counting of organisms; the density was subjected to a judgment value of "uncommon, common, or abundant". For more precise quantitative studies in the future, opportunities and funds should be made available to enable competent scientists to gather continuing information on these marine resources of the GGNRA. All cost estimates in this

report are based on my previous experiences and should be updated to current levels.

III. PRESENTATION OF DATA AND INFORMATION, BY AREA

A. REVIEW OF THE PT. REYES NATIONAL PARK

Because the Pt. Reyes National Seashore Park is geographically adjacent to the GGNRA, I felt it important to include a brief review of the marine resources and the potential impact of this Pt. Reyes Park. My recommendations are summary statements of the most desirable choice, among many choices; any extensive discussion of these and other recommendations for this area can be explored in a future study report.

The Pt. Reyes National Seashore Park, with its outstanding granitic and shale coastal formations, contains a wealth of marine resources which cannot be found elsewhere along the entire California coast. The major resources are included in my report of 1971 (Chan, 1971) for this area.

<u>Recommendations</u>	<u>Potential Impact</u>
(Most desired choice)	
1. In cooperation with the California Department of Fish and Game, develop a management program for the red abalone, <i>Haliotis rufescens</i> . <u>Research:</u> Monitor the ecology of the abalone within the park; yearly cost would be about \$2,000 for surveys to be conducted quarterly. Research time of 3 years; \$6,000 total cost. Future projects to be evaluated.	If current fishing regulations are allowed, the abalone will continue to decrease in some areas of the park. Under proper management, the abalone species can flourish in the intertidal and subtidal waters.

2. In cooperation with the California Department of Fish and Game, develop a management program for the sea urchins, *Strongylocentrotus purpuratus* (purple) and *S. franciscanus* (red).

Research: A quarterly ecological survey would cost about \$2,000 annually. Research time of 3 years; \$6,000 total cost. Future projects to be evaluated.

3. Maintain closure of all shell fishing for the horseneck clam, *Tresus nuttallii*, and geoduck clam, *Panope generosa*, until populations can return to density feasible for fisheries.

Research: A yearly ecological census of these clam populations would cost about \$500. Total cost of \$1,500 for three-year survey.

4. Develop an environmental impact report on the oyster (*Crassostrea gigas*) industry of Drakes Estero.

Research: With the assistance of competent scientists, determine the needs of an EIR program and cost of such a project.

If left unchecked, the sea urchin populations will continue to multiply, devouring kelp which is also the food for the abalone. Management program will allow the urchin and abalone to exist together in a balanced state.

Populations of both clams are now low and prohibition of fishery is for the benefit of these species.

If left unchecked, the continued expansion of oyster racks in Drakes Estero may produce sedimentation and circulation patterns within these waters which can cause damage to marine life.

5. Allow the sea otter, *Enhydra lutris nereis*, to migrate and naturally inhabit the small kelp beds found off the Double Pt. to Sculpture Beach area (Chan, 1971).

Research: Develop baseline data on subtidal organisms in the area before the arrival of the otters; take post-survey of these transects. Cost to be about \$2,000 spread over a 5-year period of pre- and post-studies.

6. Continue the state and federal marine protection law which prohibits the removal or tampering of any marine invertebrates or vertebrates within park territories.

Research: Encourage scientific school groups to perform legitimate ecological population studies within the park boundaries, at no cost to the Park; vehicle entry should be permitted for these groups. Ordinary field trips by school groups on a student "show and tell" basis should be continued, but with no vehicle entry into protected areas. Park officials should maintain a

There are enough invertebrates (large beds of sea urchins) which could support a small population of these sea otters. This marine mammal would be an asset to the Park's marine resources.

Prolong the natural ecological life of these seashores; restore some species which have been nearly depleted by man, e.g., *Polinices* spp., the moon snail.

research information center where
all groups may be coordinated and
the information and data collated
for park references.

B. DUXBURY REEF AREA

Just south of the Pt. Reyes National Seashore boundaries are extensive intertidal reef flats which are called Palomarin Reefs, Bolinas Pt. Reefs, and the Agate Beach-Duxbury Reef complex, Figure 1.



Figure 1. The Duxbury Reef-Bolinas Pt. Complex south of the
Point Reyes National Seashore Park. (Aero Photos, Sausalito)

At minus tide exposures these vast reefs can be observed as among the largest and the most outstanding in diversity of marine life along the entire Pacific Coast. Scientists from the University of California and other major universities have always utilized Duxbury Reef as the finest example of marine shale organisms. My documentations on Duxbury Reef are listed in the cited references and these publications describe the unique marine resources of these beautiful reefs.

1. Summary of Major Marine Resources

- a. Easy and safe accessibility for the public to visit and observe outstanding tidepool organisms.
- b. Marine organisms which bore into the soft shale rocks--mostly molluscan bivalves, Pholadidae.
- c. Extensive mussel *Mytilus californianus* beds with a complex diversity of species associations which number into the hundreds.
- d. Rare and uncommon marine life found only on Duxbury Reef, e.g., the giant black turban snail (Stohler, 1964), *Tegula funebris*, which has a record height of 56 mm. Likewise, the acorn worm, *Saccoglossus* sp., found in the sandy channels, is uncommon among central California localities.
- e. The finest area in Northern California for observing Opisthobranchs (nudibranchs, sea slugs); a study of more than 60 species of this order has been logged here (Gosliner and Williams, 1970).
- f. The large exposed reefs have afforded marine algologists the opportunity to observe one of the widest variety of marine algae found in Northern California.
- g. The reef is a vital feeding ground for many species of marine birds and an important "hauling area" for the harbor seal.

This prized Duxbury Reef complex is thus sandwiched between the Pt. Reyes National Seashore Park to the north and the GGNRA to the south, encompassing about 1.2 miles of ocean fraontage. There is no question in most ecological discussions that this reef is one of the finest assets to any park system. The fact that this reef is a designated marine reserve under the California Department of Fish and Game Code (Smith and Johnson, 1971) speaks for its uniqueness among California's marine habitats.

2. Management Alternatives

Alternative #1

Continue the present jurisdiction: California Department of Fish and Game controlling the marine reserve, and the Marin County Parks and Recreation maintaining the Agate Beach Park with a part-time ranger assisting in answering questions about the reserve rules to the general public.

Potential Impact

The California Dept. of Fish and Game does not have the budgetary capacity to develop, patrol, and enforce the regulations of this marine reserve. The Marin County Parks and Recreation program of providing one part-time patrolman for the past two years is deemed inadequate. Continuation of this dual sponsorship will result thusly:

- (1) The marine life will continue to deteriorate under constant pressure to human visitation without proper interpretative programs.
- (2) The uniqueness of this large shale reef will go unnoticed by the visiting populations to the reef; they should be presented with an education program of the marine resources

of the reef. There are proponents of the viewpoint that if you don't advertise this reef, there will be less damage to marine life. My studies show that this philosophy is untenable. More and more persons hear by word of mouth that Duxbury Reef is a fine field trip experience and should be visited. The numbers of school group visitations is still increasing. Groups coming to this area are largely uninformed and cause explicit damage to marine life with hands, feet, and collecting habits despite the regulation prohibiting collecting.

(Cal Fish & Game, Section 70.4)

Current management, as it now exists, will cause certain parts of the reef, areas A and B, to slowly deteriorate in diversity of marine fauna.

Alternative #2

Expand the role of the Marin County Dept. of Parks and Recreation by employment of a full-time ranger at \$9,000/yr and construction of an

(1) An expanded educational program would enable visitors to wisely preserve the reef--enhancing the return of the diverse marine life to Area A of Duxbury Reef, (Chan, 1970).

interpretative center, 15' x 20', to house handout materials and show diorama displays on reef life. Initial cost of the building is about \$6,000. An additional room for presentation of audio-visual films would be about \$6,000. Including restroom facilities, initial capital cost would be about \$18,000, with annual cost for salaried ranger, equipment, supplies totaling another \$15,000.

Alternative #3

Deed the Duxbury Reef Complex to the GGNRA for management. Cost for the items outlined in Alternative #2 above would be handled by GGNRA. The overall cost could be reduced by moving surplus buildings from Ft. Baker to Duxbury Reef, providing buildings would blend in with the environment.

- (2) There would be additional visitors because of the educational program, raising vehicle traffic and maintenance cost to this reef area.
- (3) Road traffic would probably increase around the Bolinas Mesa headland areas.

- (1) Adding Duxbury Reef to the GGNRA would enhance the marine resources blending in Pt. Reyes National Park to the GGNRA. There are no large shale reefs of this magnitude under present Pt. Reyes-GGNRA boundaries.
- (2) National Park and GGNRA officials could rotate rangers and assistants to this reef for diversity in work conditions, thus promoting a freshness in interpretive work.

3. Duxbury Reef Summary

My main recommendation for the Duxbury Reef area is that this unique shale intertidal habitat have protection for its organisms. A California law presently protects these reef animals, but the deterioration of marine life continues from the uninformed visitors to the reef. My report (Chan, 1970) revealed that conservation education reduced by 45% the number of organisms collected by visitors on Duxbury Reef.

The mitigating alternatives seem to exist between:

- (a) Little or no advertisement nor education on the reef; hope that nature will reproduce itself enough to keep ahead of the onslaught of the present human invasion by public and school visitors at low tides.
- (b) Establish a strong program of conservation education by conditioning the reef visitor before he moves out onto the shale flats. Such a program would involve a full-time ranger with an adequate "interpretive center". Initial outlay of cost would be about \$18,000, depending upon the availability of surplus buildings appropriately blending in with the environment. An annual maintenance cost of \$15,000, which includes salary of a full-time ranger, would be adequate to maintain a good program. A 8% inflationary budget should be incorporated.

In the long run, over a period of 20 years, a permanent concrete facility where tidal waters can be pumped into a mock-up intertidal display might be a feasible method to educate visitors and keep them off the reef, thus preserving the habitat for marine life to flourish. Perhaps private funds might be sought to construct such facilities.

I favor the educational alternative because of my studies dealing with the effects of conservation teaching on the destructive behavior of reef visitors. If the California Fish and Game Department and the Marin County Department of Parks and Recreation do not have the financial resources to adequately initiate and maintain such a conservation program, then the administration of this reef should be deeded elsewhere.

If GGNRA has the foresight to value this reef as a viable asset, bridging the GGNRA to Pt. Reyes National Seashore Park, then perhaps these intertidal reefs should be administered by the federal authorities.

C. BOLINAS LAGOON

Like Duxbury Reef, Bolinas Lagoon, Figure 2, exists as a vital marine resource area between the Pt. Reyes National Seashore Park and the GGNRA. Unlike Duxbury Reef, however, Bolinas Lagoon has received much attention from a host of local and state organizations and is well on its way to becoming an Ecological Reserve area under the jurisdiction of the Marin County Parks and Recreation Department.

There is much literature on the marine resources of Bolinas Lagoon, all of which are conveniently summarized by Paul E. Giguere, "The Natural Resources of Bolinas Lagoon, Their Status and Future," California Department of Fish and Game publication. This report highlights the past and present ecological history of the lagoon and should be utilized as a resource book for lagoon guidance.

1. Summary of Major Marine Resources

- a. The primary resource of this triangular-shaped, 1400-acre lagoon, is its natural condition, the fact that this shallow-water marine habitat is still undeveloped, with the natural forces of its

estuarine ecology available for observation and study by man.

- b. The marine fauna, invertebrates and vertebrates, are highly diverse. In 1967 I described the major invertebrates which were found in the lagoon (Chan, 1967). Since that time, a host of other writers have contributed much knowledge to the information on the wide diversity of marine life which exists here. There is a large assortment of marine fishes which use the lagoon as a nursery ground (Giguere, 1970). In a 1965 California Department of Fish and Game census, 230 harbor seals were counted in this area, using the lagoon for a "hauling" and breeding ground (Smith, 1973).
- c. The shorebirds, waterfowl, and other water-associated birds of Bolinas Lagoon are well documented (Giguere, 1970). The lagoon resources are basically a vital part of the birds' life cycles. Egrets and great blue herons utilize the redwood trees of the nearby Audubon Canyon Ranch as nesting platforms. This Audubon rookery is a very important resource of this lagoon area.

2. Recommendation

The above are but a highlight of the magnificent marine resources which can be observed by man in Bolinas Lagoon. Certainly, man has encroached to the boundries of the lagoon, and has even used the lagoon for fishing, mainly clam fisheries, and boating recreation. The administration of man's activities in and around the lagoon so that this marine estuary maintains its natural ecological balance is one of high and important magnitude.

Therefore, my sole recommendation is that GGNRA planning be made in cooperation with and support of the "Bolinas Lagoon Plan" as outlined by the Marin County Department of Parks and Recreation, 1972.

This plan proposes to deal with the multiple problems of maintaining this lagoon as an ecological reserve and developing compatible scientific, recreational, and land-use concepts with this marine habitat.

The key considerations are that any proposed activities, such as small craft boating, clam fishing, sightseeing, etc., be compatible with the marine resources and that the ecological balance of the lagoon be sustained. The Marin County Parks and Recreation Department has established a technical advisory committee to safeguard the ecological reserve development of their Bolinas Lagoon Plan.

D. STINSON BEACH

The Stinson Beach ocean frontage, Figure 2, is nearly 1.5 miles (Smith, 1973) and this State Park facility is heavily used by the public. As many as 12,000 visitors may frequent the area on a busy summer day and, in recent years, the use of the park has been in excess of 500,000 visitor days per year. (Giguere, 1970).

The characteristics of the climate in this Stinson Beach area is Mediterranean in classification with warm-day summers and cool-rainy winters. The inflow of cool marine air in the summer produces a common fog condition which modifies temperatures throughout the months of June through September. Northwest winds and on-shore breezes are common throughout the year. The average range of rainfall is about 30-35 inches in the lowlands and about 50 inches in the highlands (Giguere, 1970).

The geology of Stinson Beach is characterized by its long low-profile sandy beach, with the majority of its sand coming from the erosion of nearby headlands. The profile of the beach is constantly being altered by the differences of summer and winter wave conditions. During summer's mild wave actions, sand is deposited on to the beach from offshore bars,

and during the strong winter storm waves, the beach sand is removed out to the offshore bars. At the Calle Del Sierra transect at Boyle's fence post, I have measured a difference of about 2 to 3 feet of sand depth over the past five years (Chan, 1972) in these summer-winter sand conditions.

The physical environment is the most important factor in determining the beach infauna, and it appears that over the years, the density and appearance of marine organisms at Stinson Beach are conditioned by the seasonal description of the beach profile from variations of wave intensities. Winter conditions generally provide a decrease in marine species and densities.

1. Summary of major marine resources

The major marine macrofauna which I have found over the years at Stinson Beach are: (Appendix 1)

Upper Beach: *Orchestoidea* spp., Beach shrimp

Middle Beach: *Emerita analoga*, Sand crab
Nephtys californiensis, Sand worm
Siliqua patula, Razor clam

Low Beach: *Emerita analoga*, Sand crab
Blepharipoda occidentalis, Spiny sand crab

Surf Zone: *Archaeomysis maculata*, Opossum shrimp
Crago sp., Bay shrimp

Offshore sand bars: *Dendras ter excentricus*, Sand dollar

The marine infauna at Stinson Beach varies considerably in species and densities. In certain winter years I have found very few organisms, and also, some summer days, such as on July 23, 1974, only *Emerita analoga* and *Archaeomysis maculata* were found on the Calle Del Sierra transect.

The populations of *Orchestoidea* spp. varies at the high beach

- b. Allow hunters to dig for marine razor clams on the beach.
- c. Allow fishermen to catch fin fish off the beach.
- d. Allow surfboard activities to continue.
- e. Allow "hang-gliders" from the south end of the beach.
- whenever such conditions are deemed dangerous to bathers.
- The pressure of hunters has probably contributed towards the disappearance of the razor clam, *S. patula*. All such permits to dig for clams should cease. Perhaps this clam can return naturally to the beach infauna.
- No general harm to the marine species from the fishing activities for perch, etc.
- No harm to marine resources, other than the danger of mixing swimmers with surf board congestion. Likewise, surf board sailing may be permissible where there is no congestion danger to bathers.
- The flying of hang-gliders from the south cliffs of the beach is a potential recreational activity. If allowed, this activity should be regulated:
- (1) determine area of cliff erosion from people-pressure. A great demand for automobile parking at the cliff areas and trails pressure may cause irreversible

erosion damage.

- (2) Demand the presentation of proper aerial certification before allowing hang-gliders to leap off the cliffs.
- (3) Regulate the landing site, post notices on the beach to inform the public that there is a potential danger of landing gliders striking beach walkers.

3. Summary for Stinson Beach

The use of Stinson Beach for bathers, walkers, mini-picnic activities and games, and fin-fishing seems to be highly desirable and compatible recreation.

The digging for razor clams should be prohibited. The absence of clams self-regulates the digging activities, but this clam should be allowed to return naturally to the beach environment. A selected area for transplanting this clam from Tomales Bay area could be undertaken as a scientific project. Such transplant and monitoring activities would cost about \$500 per year for a period of 5 years, a total of \$2,500. In five years, one could judge whether this clam has sufficient density to support a digging recreational activity. However, based on my previous experience, I feel that this clam could not succeed due to the environmental physical factors of significant sand movement, along with the high intensity use by beach walkers. The latter would constantly pick and dig up these shallow-boring (down to 20 cm.) mollusks.

The sport of hang-gliding from the south cliffs would provide a diverse recreational activity. The sport is dependent on proper wind conditions and a large landing spot on the beach, 100 yards or more. A small environmental impact report on this sport should be undertaken, with specific concerns over the auto-parking pressure on the shoulders of the highway, abuse of trails, licensing or certification of individuals desiring to jump off the cliffs, and the liability factors of accidents to participants and on-lookers from such a sport.

The establishment of a natural science interpretive center at Stinson Beach is a potential possibility to coordinate the activities along the rocky coast--see the next section on Rocky Point and the Slide Ranch.

E. ROCKY POINT

To the south of Stinson Beach is an exposed rocky coastline all the way down to the Golden Gate Bridge. The area is a magnificent display of Franciscan shale rock headlands interspersed with some small sandy beaches. Rocky Point is the first of the prominent headlands along this coast which will be discussed, Figure 3-(1).

1. The Environment

The Rocky Pt. headland is also known as Steep Ravine with the presence of 14 cabins which are leased by the California State Parks and Recreation Department. Geographically, the headland appears to be a large slump-off from some past geological occurrence. There is a narrow road leading down to the cabin area on the northwest side of the headland. The "steep ravine" area is located to the north section of the headland where a freshwater stream, Webb Creek, trickles down the mountain slope to a small pebbled beach. To the north of

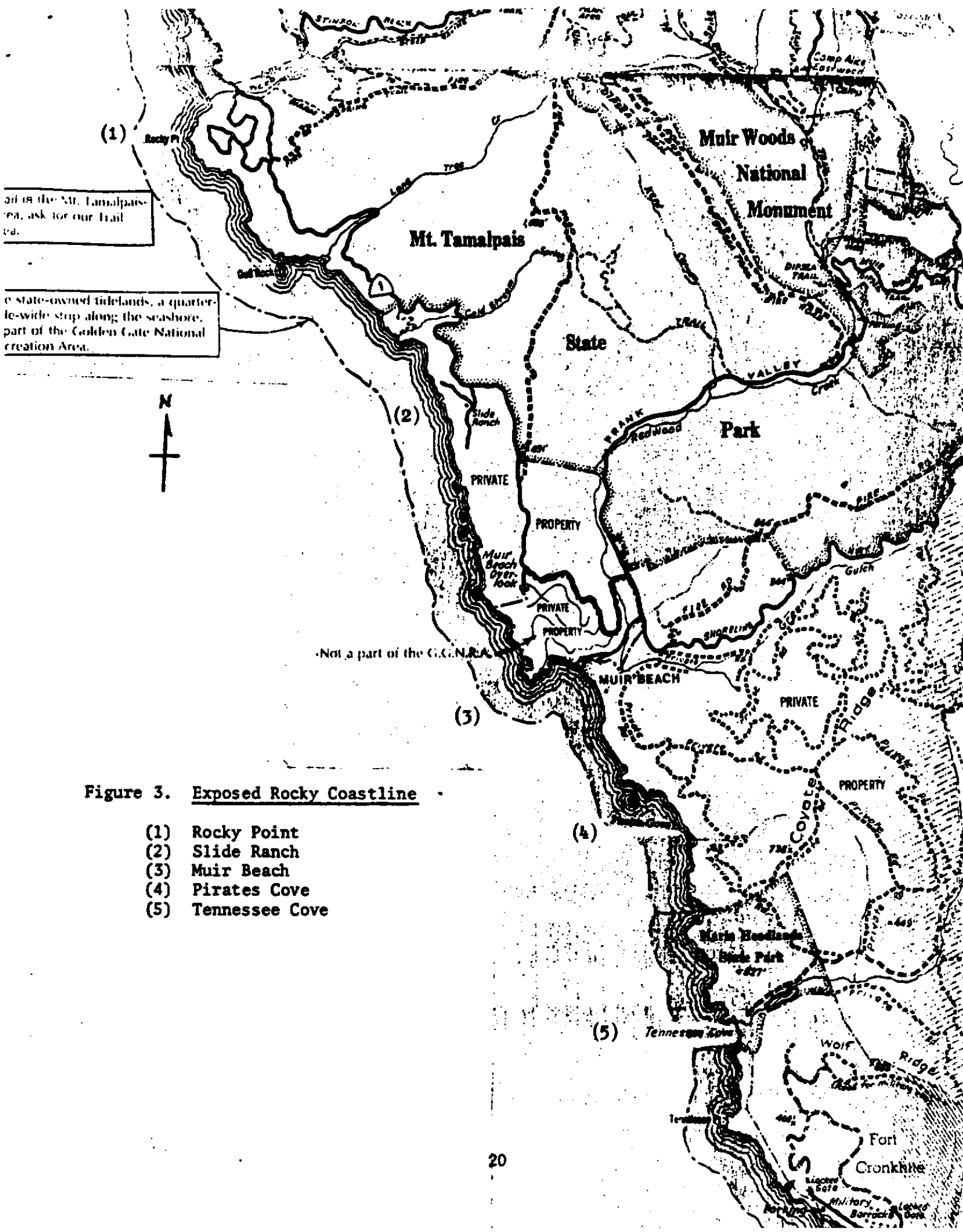


Figure 3. Exposed Rocky Coastline

- (1) Rocky Point
- (2) Slide Ranch
- (3) Muir Beach
- (4) Pirates Cove
- (5) Tennessee Cove

Pacific Ocean

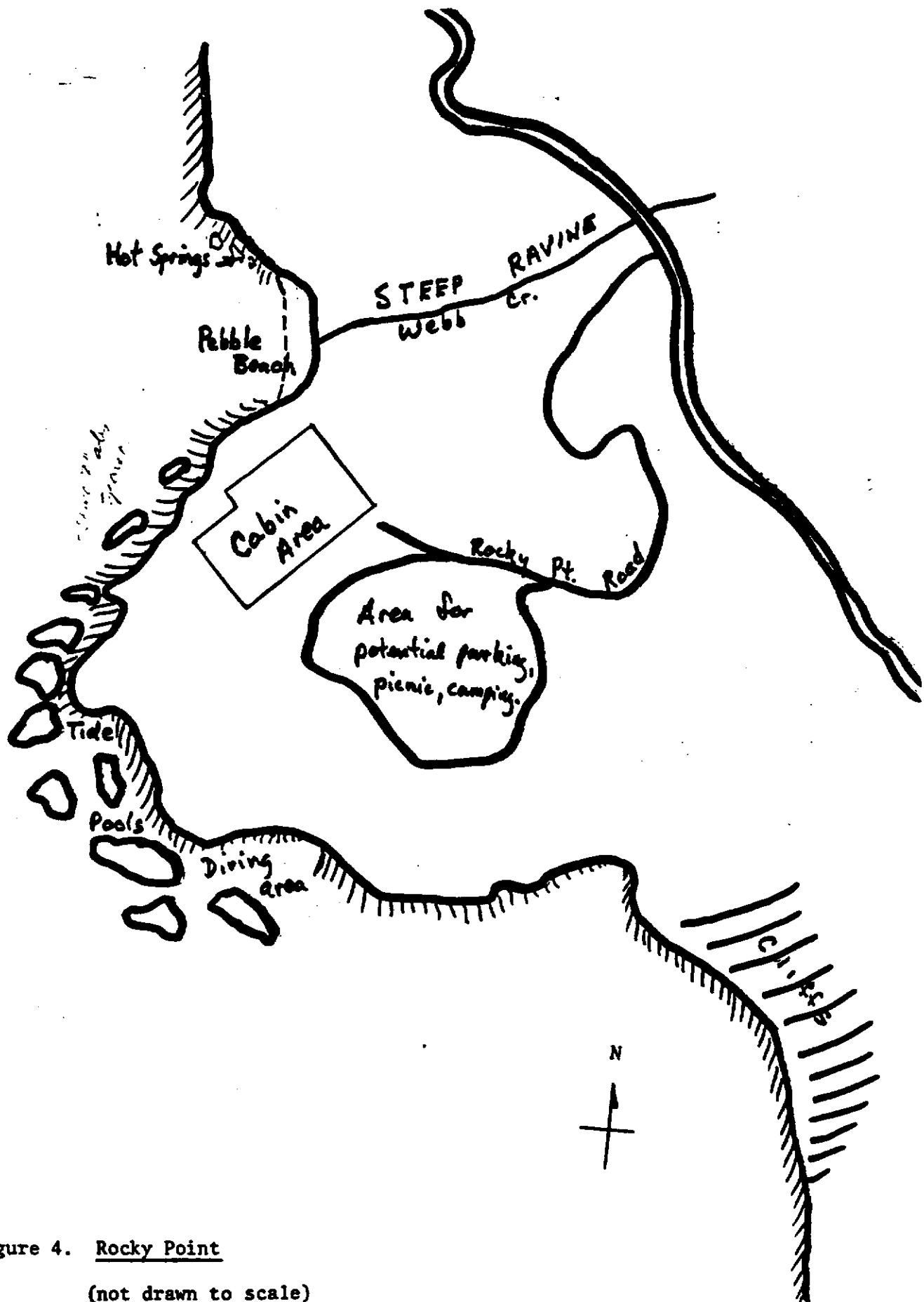


Figure 4. Rocky Point

(not drawn to scale)

this pebbled beach is a thermal hot spring which percolates up through the intertidal rocks. Marine life is very sparse in this hot spring area, Figure 4.

To the southwest of the cabin area, the Rocky Pt. headland protrudes into the ocean environment with a beautiful scenic arrangement of massive shale boulders. Behind these large rocks are fine tidepools displaying the typical open coast species (Appendix 2). In my diving investigations of the area, there were very few abalones, although water visibilities may be up to 10 feet during calm winter months. Generally, this headland is buffeted by strong northwest winds and waves. Finally, south of the Rocky Point headland is a very scenic view of sheer cliffs interfaced with the exposed rocky coast.

2. Summary of Major Marine Resources

- a. An exquisite rocky headland with many flat spaces for picnic and walking trails for viewing the scenic rocky coastline formations.
- b. A freshwater stream which flows down the north side of the point-"steep ravine". The flora in the area is quite outstanding.
- c. A unique thermal hot spring which bubbles up amongst the intertidal rocks at the north end of the "steep ravine", pebble beach.
- d. Fine tidepool areas for observation behind the headland's protective boulders.

3. Management Alternatives

Alternative #1

Potential Impact

Large Public Development--

The headland area is geologically

- a. Open this expansive headland to the public by enlarging

stable and could probably support development such as listed. The

and developing the existing road.

- b. Place a 100-car parking lot in the flat areas of the headland.
- c. Provide picnic and restroom facilities.
- d. Maintain the 14 cabins for public rentals or use as a camp facility for public groups; or develop a ranger interpretive center in the existing cabin facilities.
- e. Provide recreational activities such as sightseeing, picnicking, walking trails, sport diving for abalones, tours of thermal springs, freshwater creek and rock fishing, etc.

cost of development on such a scale would be high, up to \$120,000 for initial cost.

An environmental impact report must first precede such development, especially on the geological impact of roads, parking lots, and trail erosion.

The cost to maintain the 14 cabins up to proper living standards would be high. The cabins are not that sturdy and must have annual repairs. The septic tank system must be studied to view its impact on the marine biota.

High public use of this headland would probably decrease the marine life around the tidepools--as exemplified by the much visited area of Duxbury Reef, Agate Beach section. People pressure is detrimental to marine life despite prohibitive and protective laws (California Fish & Game regulation, Section 70.4). Abalones are

very scarce in this area, and open sport fishery would wipe out the population within the first year of this activity.

Alternative #2

Partial Development--

- a. Develop the road and provide a parking facility for 100 cars.
- b. Provide a mini-bus transportation to this area from an interpretive center at Stinson Beach.
- c. Demolish all but one or two cabins; use as an existing ranger interpretive center and rest room facilities for day use and overnight campers.
- d. Maintain trails for walking, sport diving (but not for abalones), rock fishing.

In general, initial cost for partial development would still be high, up to \$90,000. Environmental impact report should still be done for erosion studies.

Removing the cabins would save much cost in upkeep and septic tank maintenance.

People pressure will still diminish some marine invertebrates but provide tidepool and diving recreation for visual enjoyment. Posted signs warning divers of potential dangers from currents and waves should be placed at the headland areas.

Alternative #3

Limited development
to no development--

- a. No public roads; develop a trail system from Highway 1 to the headland area.

The lack of a public road would diminish the people pressure on erosion factors and preserve marine life from the overhandling by tidepool pickers.

- b. Provide restroom facilities for sightseers, hikers, pole fishermen. Maintain a service road.

- c. Demolish all cabins.

Removal of cabins would restore the original scenes of Rocky Pt.

- d. Provide trails, posted with signs warning of dangers from waves.

- e. Diving is permissible if individuals want to carry their gear down from Hwy 1.
- 1. No abalones fishery.

3. Summary of Rocky Pt.

My best recommendation for this area would be for partial development, alternative #2. The unique marine resources of a large headland with protective tidepools, hot springs, fresh water stream, and easy hiking trails would enable young and old to participate in this coastal recreational area. I would demolish all but a few cabins, and set up a small interpretive center to educate visitors on

the protection of the marine life, flowers, and the geological erosion from trails.

Providing a good road and public parking would enable all people to visit the area. Closing off the road into this headland would simply limit this locality for the young and eager hiker. This would be the only area of easy public access between Stinson Beach and Muir Beach. People will surely want to visit the scenic beauty of Rocky Point; closing off the entry road would simply add much burden to off-road parking at the junction of Highway 1.

Therefore, partial development of roads, parking lot, trails, and interpretive facility would be my idea of viable recreation on this Rocky Point headland.

A research project to assess the population of marine life from Rocky Pt. through Fort Cronkhite could be undertaken at a cost of \$1,000 per year for a 5-year evaluation study, total cost of \$5,000.

F. SLIDE RANCH AREA

The entire rocky coast area from Rocky Point south to Muir Beach should be left undeveloped and free from public pressure. Geologically, this area has steep cliffs and unstable serpentine rocks which could be subject to much erosion if developed for public roads. In between Rocky Point and Muir Beach is a sloping area of unstable serpentine rocks, called Slide Ranch, Figure 3-(2). The name itself implies that this area is a slump-off highly erosion-prone locality. An ecological report by Jackson and Mitchell, 1971, summarized the unstable geological nature of this Slide Ranch area.

The marine environment of the Slide Ranch area is a high-energy coastline subject to large wave actions from the Pacific northwest winds

and currents. There are large serpentine and graywacke boulders, some of which provide good protection for marine tidal pools. There are a few small sandy beaches in between the coastal rocky formations.

1. Summary of Major Marine Resources

The marine life on this Slide Ranch coast is one of the most abundant and finest among exposed outer coastlines along the central California shores. Along the exposed tidal rocks, there is a rich display of sponges, bryozoans, and tunicates along with a highly diverse marine invertebrate fauna (Appendix 3). The only other area of the central coast which can match this area in tunicate diversity are the rocky reefs found off the Pt. Reyes and Tomales Pt. headlands. The abundance and diversity of marine life is one of the finest resources of this coastal habitat. There is a small population of the red abalone, *Haliotis rufescens*, which is basically confined to crevices in the subtidal rocks. The water visibility here is very limited, perhaps up to six feet during favorable times of the year.

There is a Pacific Gas and Electric Company power facility on this property which requires a primitive service road for maintenance.

2. Management Alternatives

Potential Impact

Alternative #1

An organization, The Nature Conservancy, maintains the ranch house sites, allowing groups to use the small road and buildings to visit and study mammals, flora, and marine intertidal organisms.

The area is subject to much erosion and the maintenance of roads, buildings, parking lots in this area would be extremely costly, up to \$30,000 per year.

The slope of this area would cause much erosion and septic

GGNRA could continue, expand, and develop these buildings to cater to individuals and groups visiting this area.

tank drainage to the ocean, and may cause irreversible damage through siltation and pollution to its present diverse marine fauna and flora. Greater public use of this Slide Ranch area would cause environmental harm to the existing marine habitat.

Alternative #2

Limited development to no development.

- a. Remove the existing buildings and provide portable restroom facilities. Small maintenance road to service such accommodations will be needed.
- b. Prohibit the taking of abalones.
- c. Develop and maintain trails to the intertidal area. Close the area off to public automotive access.

In essence, return the Slide Ranch area to its natural environment. The property will not support high public use.

If abalone taking is permitted, the density of this animal would be diminished in this area. The poor visibility of the water could also protect this mollusk.

Trails for visitors can be maintained. Off the road parking at Highway 1 would enable visitors to hike down to the visit the Slide Ranch marine life, etc.

d. Hiker-camping site could be developed. Coast rock-pole fishing would be an acceptable recreation.

3. Summary of Slide Ranch Area

I strongly favor the limited or no development on Slide Ranch. Remove the buildings; place up some temporary restroom facilities and allow the area to be used only by hikers from Highway 1 or hikers traversing along the coast route. Camping for hikers would be permissible.

Those university and other school groups which wish to investigate the unique tunicate populations can hike down the trails as provided. No collecting should be allowed on any GGNRA shores. Legitimate research with state collecting permits are appropriate for all GGNRA property.

G. MUIR BEACH - PIRATES COVE AREA

The coastal habitat between Slide Ranch and Muir Beach is one of very steep terrain. The area is subjected to severe wave action from the Pacific northwest currents. The Muir Beach Overlook is a fine development for viewing recreation and should be maintained.

The area of Muir Beach itself is a highly used beach during the weekends. The sandy-shale composite beach is created from coastal wave actions which block off the estuarine marsh behind it. The major freshwater inflow comes from the Redwood and Green Gulch Creeks which come down from the Mt. Tamalpais watershed.

1. Summary of Major Marine Resources

The submarine life, as observed by scuba dives, at the base of the rocks just north of Muir Beach reveal a wide variety of

sponges, hydroids, bryozoans, and tunicates.

The marine life on the Muir Beach itself is similar to that of Stinson Beach (Appendix 1). Swimming in the surf zone is not recommended because of the steep beach profile. Large waves coming on to Muir Beach can often cause severe undertows which are dangerous to swimmers. In essence, Muir Beach is simply a sun-bathing area with picnic-type recreation.

To the south of Muir Beach, a reef walker would encounter massive graywacke and serpentine boulders which have tumbled down the steep cliffs of the area. The erosion and sliding of these cliffs make reef walking very hazardous. The marine life at Pirates Cove is pristine, typical of exposed coast organisms (Appendix 4).

At the North Pinnacle rock of Pirates Cove, a random square meter of marine life in zone 2 was sampled and the abundance of macro-marine life is evident in the sample counts:

20 *Hemigrapsus nudus*, purple shore crab

35 *Petrolisthes cinctipes*, porcelain crab

5 *Pachygrapsus crassipes*, purple shore crab

200+ *Collisella* spp., limpets

thousands+ *Balanus glandula* and *Chthamalus* spp., acorn barnacles

1 *Cancer antennarius*, red rock crab

90 *Tegula funebris*, black turban snail

8 *Anthopleura elegantissima*, aggregating sea anemone

Seaweeds: *Fucus* sp., *Prionities* sp., *Ralfsia* sp.,
Corallina sp., *Egregia* sp., and *Iridea* sp.

Since 1961 I have observed numerous pole fishermen use this South Muir rocky area and Pirates Cove area as sites to rock fish for perch, blennies, rock fish, and cabezons. Some of the fishermen use small rowboats launched from Muir Beach to fish the off-shore rocks with good success.

2. Management Alternatives

Potential Impact

a. Maintain the Muir Beach Outlook, provide a metal-etched map of north and south coastal view so visitors can relate of points of interest. Trails down the slopes of this area should be discouraged because of the dangers of rock slides.

Limiting access to the Muir Beach Overlook will decrease the erosion of other areas. Signs should be posted to warn visitors to "stay on the trail".

b. The proposed "Sunset Trail", coastal hiking trail, should be routed along the Highway 1 ridge before descending down to the Slide Ranch area, leading from Muir Beach to Tennessee Cove. Hiking along the intertidal zone from Muir Beach to Pirate's Cove should be discouraged because of the high danger of rock slides.

The proposed "Sunset Hiking Trail" should be clearly posted to prevent undue off-trail erosion. The coastal area between Muir Beach and Tennessee Cove is generally shrouded in fog. No adverse impact is foreseen with the trail covering the upper bluff area above the rugged intertidal rocks.

c. Maintain the present Muir Beach area as a sunbathing-recreational activity site.

Muir Beach will always be a populated beach for sunbathers. Signs should be posted, warn-

- d. There has been some demand to permit "hang-gliders" to leap off the cliff and use the beach as a landing site.
- e. The option to pole fish for blennies and other fish should be left optional. There are no abalones to sustain a fishery in this area.
- f. The area should be left completely undeveloped with just the Sunset Trail as the only development.

Allowing hang-gliders to land on such a small beach may cause injury to sunbathers. Hangliding should be prohibited here.

3. Summary of the Muir Beach - Pirate's Cove Area

The area between Slide Ranch and Pirate's Cove should be maintained as is, with no new development other than the Sunset Trail, a coastal hiking trail from Ft. Baker to Pt. Reyes. No adverse impact can be foreseen for this area with the development of a coastal hiking trail.

H. TENNESSEE COVE

Tennessee Cove is an erosion-cut canyon, Figure 3, through an excellent outcropping of Franciscan shale. The enclosed lagoon is basically freshwater; salinity (TDS) was measured as 2 ‰. The small beach is a steep profile beach indicating heavy wave action. The coarse beach sand is made of the multicolored grains of chert, serpentine, carnelian, etc. The rock formations of the cliffs are highly polished from the strong wave action and the varied colored strata enlightens the area into a massive

outdoor panorama. Fog is very common during summer months.

1. Highlights of outstanding marine environmental features

- a. The highly polished, multicolored strata cliffs will be a bonanza to geological students.
- b. The multicolored sand grains on the small beach. This beach has a steep profile with very strong waves. Swimming in the surf is extremely dangerous; the undertow is very pronounced throughout the year.
- c. A marine spectacle is seen in the highly polished living limpet shells of *Collisella digitalis*. Also hidden in the splash zone crevices and sea caves is the giant isopod, *Ligia occidentalis*. The polished limpet shells on *C. digitalis* are very unusual among coastal marine organisms. This area is the only spot in central California where these large limpets may be observed with such polished apical shells. This fact simply supports the contention that very strong waves buffet these limpets during high tidal periods. Again, this organisms stands as a warning to humans who walks along this beach, that all must keep a sharp eye on the large waves which crash in this cove.

Normally, the splash zone isopod, *L. occidentalis*, is about 1 inch in length and quite slender in width, about 3/8". Some of these isopods, tucked into the sea cave crevices, are nearly twice the normal length with some body widths measuring about 1 inch. Such large organisms are not common; since the population of this species is sparse, extra conservational attention is required toward protection of this organism. Other marine species are cited in Appendix 5.

2. Management Alternatives

Potential Impact

Alternative #1

Open the Tennessee Cove area to public vehicles and visitation. Allow people to visit beach, rocks, and military bunkers on the north slope of the cove. Post signs for no swimming and no collecting of marine organisms. It is dangerous for children to "run loose" on this steep beach; they can be swept away by unexpected waves.

An open invitation to the public would result in much erosion of the existing road, a high loss of life from persons swimming, a decrease of marine life--loss of limpets and sow bugs from collectors despite the signs and protective law, continual defacing of bunkers, and possibly geologists, professional and amateur, chipping the valuable strata formations. An open collecting of carnelian rocks would also deplete a valuable beach resource in time. The loss of geological and marine specimens would be an irreversible shortcoming.

Alternative #2

Close the cove to public vehicles. Individuals may hike through the area on the Sunset Trail, coastal hiking trail. Day-group visitation can be made by appointment and guided by park ranger. Fill in military bunkers on the north

Making the area simply a hiking area would reduce much erosion in this narrow canyon. Guided tours through the area would better insure safety of individuals approaching the beach and conservation of fauna and geological specimens. Establishing a rest stop here for

slope. Post signs warning of dangers of large breakers, no swimming. Signs should also be posted prohibiting removal of marine life and geological specimens. Signs should also warn of dangerous erosion slides when hikers approach the edges of high cliffs.

hikers on the Sunset Trail would enhance the trail-hike resources. Closing of military bunkers will prevent continual defacing of property.

Alternative #3

Complete closure of Tennessee Cove to public access.

This would prevent the public from viewing the unique geological formations of this area.

3. Summary of Tennessee Cove

The major marine aspects of Tennessee Cove are the geological rock formation of this narrow valley and the unique marine life as seen in the polished shells of limpets and the giant isopods in the sea cave crevices. The dangers of waves swallowing up swimmers and beach walkers are present throughout the year. With a careful watch on the beach breakers, individuals can safely visit this area, with signs posted "no swimming".

Limited access to Tennessee Cove seems to be my choice for this area. Hikers stopping here for rest will find the area of great beauty, especially if the unusual geological and marine features are pointed out in a hiking brochure. Guided tours in this area for groups and general public will reduce much erosion and removal of marine life and also prevent drowning accidents. A discreet sign blending in with

the environment could adequately point out the dangers and assets of this area to hiking visitors.

I. FORT CRONKHITE - FORT BARRY AREA

The outer fog-dominated coast headland area, encompassing the military facilities of Fort Cronkhite and Fort Barry, is certainly one of the outstanding scenic gems of the GGNRA, Figure 5.

1. Summary of Major Marine Resources

a. Fort Cronkhite - In Fort Cronkhite, the major marine resource is the adjacent Rodeo Lagoon and beach area.

(1) Rodeo Lagoon is cut off from the ocean by the buildup of sand and beach pebbles during summer months, but during severe winter storms, the lagoon has been open to the ocean. At the far western end of the lagoon where the sand bar separates the lagoon from the ocean, the salinity was measured as 14.5 parts per thousand in August of 1974. Obviously there is interstitial seepage and mixing of the saline ocean at this western fringe of the lagoon. Towards the last or back portions of the lagoon where the road bridge crosses the lagoon, salinities during this same August were 0 to 2 parts per thousand, or basically freshwater. Zooplankton, in particular the copepods and amphipods, were abundant at both ends of the lagoon. Once the raw sewage is cleared from the lagoon, a viable estuarine fishing recreation could be established.

(2) The Fort Cronkhite beach is the dominant marine geological form in this area. The beach is a steep profile beach, with large breakers crashing on the steep sloping beach, causing severe undertow conditions. Marine life on the beach is not abundant due to the high energy of wave actions. In August, 1974,



two students and I skindived the southern portions of this beach area and found the tidal and wave currents very strong. Even with swimming fins, we had trouble negotiating the inshore waters. Swimming and bathing in the area should be prohibited. The removal of any rocks and minerals from this beach should be prohibited. Basically, the beach could be used for sunbathing, picnicking, walking, and other play recreation. No hang-gliding should be allowed on this small beach area nor within the confines of this headland locality.

- (3) The Fort Cronkhite military installation naturally conforms the locality to a high intensity use area. The use of the military building for day camp use, for camping and inner city hostel for youths would seem feasible if renovative costs were not too high. An establishment of a central natural history interpretive center here would greatly enhance the educational potentials of this area and other GGNRA sections to the south.
- (4) The munition disposal site at the northwestern section of the coast should be renovated. The craters should be filled and hikers should be allowed in this area.

b. Fort Barry -

- (1) The Bird Island refuge, Figure 6, at the south end of Fort Cronkhite beach is the greatest of the marine resources of this entire marine headland area. In 1962 I photographed this Bird Island rock and since then, each year the guano cover has increased its spread over this rock. With the high concentration of guano, an accelerated erosion of nitrogen compounds added nutrients to the surrounding waters. A series of underwater dives in August,

1974, confirmed my hypothesis that the marine life would be exceedingly abundant in the benthic community. All the rock surfaces below the water line are covered with a thick layer of sponges, hydroids, bryozoans, and tunicates, such as I have not observed in other areas of Northern California. Large California sea mussels, *Mytilus californianus*, up to 7 inches in length abound in the intertidal zone. The surf grass, *Phyllospadix* sp. is a thick, lush growth, with leaves stretching up to 8 feet in length. The length of the surf grass is similar to my observations of the benthic community off the Baja-Pacific island of San Geronimo, a Mexican island covered with pelican-cormorant guano. The marine kelp algae, *Pterygophora californica*, is also giant size, with some stipes as long as seven feet. Other marine invertebrates, such as *Anthopoda* *anthogrammica*, the green anemone, and *Pisaster ochraceus*, the purple seastar, are of giant proportions. No abalones were observed in our repeated diving observations. Although other Pacific Coast areas may have one outstanding marine feature such as large starfish, the Bird Island marine invertebrate fauna and flora are my choice for combination of density and size (Appendix 6). Research into the reason for such anomalies may be very beneficial in discovering how man can utilize nutrients to accelerate and enhance growth rates of marine species. Again, a note of warning that skin and scuba diving be discouraged in this area, as strong currents were encountered throughout this Bird Island locality during the summer of 1974. Winter conditions would probably accelerate the dangers of this littoral environment for swimmers.

(2) Bird Island Saline Tidepool - On the northwest section of the Bird Island intertidal rocks, is a stepladder series of three tidepools which are located in the high splash zone area (Appendix 7). Nowhere else in my marine experience along the Pacific Coast have I observed such a phenomena. The uppermost of the tidepools, on July 31, 1974, was contaminated with fishermen's debris of cardboard, cigarettes, beer cans, newspapers, and plastic lids. At the same time, the waters of this splash zone tidepool, some 2.3 meters above the plus high tide zone 1 area, were colored red by the chili-pepper shrimp, *Tigriopus californicus*. Although this copepod is found in other Northern California splash zone areas, I have not observed such large sizes and density of this species anywhere else. Some were up to 3 mm. in length! Such giant copepods are not common and may thrive primarily in environments like the guano-influenced Bird Island habitat. Our recorded salinities reach a high of 118 ‰, some 3.5 times the average ocean salinity. During winter observations, the salinities and life in these three tidepools are greatly reduced.

Research Needs

One basic research problem should be performed around this Bird Island environment. The project should determine if accelerated guano deposits do increase size and density of the marine life of this area --the marine plants and invertebrates, especially the copepod *T. californicus*. Such a 5-year project would cost about \$5,000 per year or a total of \$25,000.

Trail accessibility to marine tidepools and organisms are not good because of the steep cliffs which outline the coast.

These physical factors, plus signs posted at the valley center citing prohibitive collecting laws, would sufficiently protect the marine life. Pole fishing off the rocks of the area will not environmentally damage the resources; brochures should remind fishermen to clean up their debris.

- (3) Point Bonita and cliff areas are other marine assets throughout the Fort Barry headland; scenic views in these areas can be enjoyed during fogless days which are not common in the summer. The hazards of eroding cliffs, poison oak, and flooding tides seem to be the greatest of the dangers in this area. A few of the military fortifications should be restored for public interest; otherwise, most of these should be sealed to prevent destruction by human hands. The lighthouse at Pt. Bonita should be off-limits to hikers; the cliffs in this area are very unstable. There is an orange-coated green algae, *Trentopholia* sp., growing on the upper cliff rocks; extra effort at conserving these plants should be made as they are endemic to our central California coastal marine rocks.

In summary then, the major resources of the Fort Cronkhite-Fort Barry area are:

Rodeo Lagoon--which could become a freshwater-estuarine fishing and swimming area when good sewage conditions prevail.

Fort Cronkhite Beach--an area for sunbathing, hiking, etc. No swimming or rock and mineral collecting should be permitted.

Bird Island--a sea stack area covered with guano, producing abnormal-sized marine invertebrates and plants.

Point Bonita cliff--military bunkers, scenic and historical sights.

2. Management Alternatives

Potential Impact

Alternative #1

High intensity use by the public, allowing public auto and transit busses to traverse the area. Set up a hostel for campers and inner-city dwellers. Set up an elaborate natural history interpretive center, a base for local and other GGNRA assets. Renovate some military bunkers for historical sites.

High cost factors of maintaining road systems, building renovations, and staffing. The interpretive center should be staffed with rangers who have expertise in the general areas of geology, marine, flora, etc. Complete renovation cost and maintenance of services would be well over \$500,000 for the first year. Public use of Fort Cronkhite roads would run the cost of road repair up considerably. Camper and trailer truck tires would eventually create large holes in the thin asphalt edges of the present roads.

Alternative #2

Partial development for public use. Restrict public vehicles to major roads within the Ft. Cronhite-Ft. Barry area. Develop hiking trails, ranger-guided tours. Set up small natural history interpretive center; i.e.,

Lower cost factors are involved with partial development. Dioramas in the existing interpretive center would cost about \$10,000 initially. Printed brochure outlining trails and marine resources would cost about \$400 initially. Maintain present corps of ranger -naturalists.

maintain the program along the present 1974 levels.

No collecting of any marine organisms and geological specimens throughout the area should be reinforced with discreet signs and brochures.

Alternative #3

Close off the total valley, the roads to public transportation. Develop a bus transit system with guided tours by ranger-naturalists.

Although this bus system would protect the environment, the high cost of bus and staffing could probably not be justified. The major recreation of this headland is sightseeing; this factor is basically controlled by the density of fog within this area.

Alternative #4

Destroy all but essential military buildings.

Restore the majority of the headlands to its natural terrain; reduce cost of building maintenance.

3. Summary of Fort Cronkhite-Fort Barry Area

Maintain present program levels for the next five years. Develop brochures outlining the major marine resources of the area, particularly the Bird Island area. Close most bunkers to prevent desecrative writings on bunker walls. Fill in munition craters on the north slopes and open the area to trail hiking via guide-brochures. Develop a five-year research program into the guano-nutrient study of the Bird Island area at total cost of \$25,000. The marine organisms are generally protected by the inaccessibility of the steep cliffs.

Within a 10-year program, concurrent with the 5-year research,

expand the interpretive center to include dioramas of all the area. Perhaps develop camping facilities for incoming vehicles, day camps, inner-city dwellers amidst some of the renovated military buildings. Most other military installations should be torn down to restore the headland area to its natural setting.

J. FORT BAKER - KIRBY COVE AREA

The steep cliff terrain from Pt. Diablo at the current Marin Headland State Park to the GGNRA boundry line within San Francisco Bay, the Yellow Bluff area, prevents much recreational development in this area, Figure 5.

1. Summary of Major Marine Resources

The small harbor facilities at Fort Baker cannot accommodate a large number of boats. The current boating activities seem compatible with the existing marine life (Appendix 8). The marine intertidal area is classified as a protected marine coastal chore, with species very losely related to exposed outer coast organisms. The only abundant marine organims which seem to have high densities are the starfishes, *Pisaster ochraceous* and *Patiria minima*. Some perch were observed amongst the pilings; thus, pole fishermen may be encouraged to use the large dock facilities on the east side of the harbor for this type of recreation.

At Kirby Cove, the swift Golden Gate channel currents have probably reduced the aggregating densities of marine intertidal organisms. Seastars were abundant on low tidal rocks. The giant isopod, *Ligia occidentalis*, was also observed here in the deep crevices at the east side of the upper sea cave formations. The size of this isopod was similar to those discovered at the south end of the Tennessee Cove beach; marine protection should insure the continuance of this species.

The road down to Kirby Cove would not tolerate open public use; thus, it seems feasible to list the area as a continuing group camp site, based on prior reservations. Soil erosion and slides will probably continue at both ends of Kirby Cove due to freshwater seepage and erosion by beach waves.

2. Management Alternatives

The potentials of developing Fort Baker into a GGNRA headquarters are attractive:

- | | |
|--|---|
| a. Set up a marine aquaria display museum at the east end of the barbor; some research could be carried on in cooperation with local universities. | Cost of converting such buildings to a marine aquaria-research facility would cost \$300,000 at the initial stage and at least \$30,000 annually for staff and operation of equipment. |
| b. Set up play areas for groups, set up hiking and bike trails. | |
| c. Maintain existing small craft harbor facilities. | Much organic debris was observed in the shallow portions of this harbor; this might indicate that flushing activities are not pronounced; i.e., incoming debris tends to be trapped in this harbor. Accelerated boating facilities may also create a basin trap for escaping oil and gas contaminants. Nutrient contaminants from waste water disposals on boats may cause eutrophication effects during summer months. |

3. Summary of Fort Baker - Kirby Cove area

Fort Baker is an area which could be attractively developed into a Golden Gate National Recreational Area Headquarters with open space play area, museum, day camp facilities, hiking and bicycle trails. Fishing from the docks and adjacent rocks should be permitted. The only hazard area is directly under the north side of the Golden Gate Bridge; repair of the large fence should be sufficient to keep hikers and fishermen out of the area. The harbor should be limited to small craft and the density of boats should not exceed present limits; otherwise an entrapment basin of debris may cause irreversible damage to marine life. A marine aquaria-museum could be developed at the harbor site.

Kirby Cove should be maintained as a group camp site based on prior reservations. The large marine isopod, *L. occidentalis*, should require extra protection at the east end of the cove.

K. ANGEL ISLAND

The most imposing island in San Francisco Bay is Angel Island, 740 acres, with Mt. Livermore rising in the center of the island to a commanding height of 781 feet. The only major addition to current programs here, presently under the jurisdiction of the California State Park system, might be the incorporation of marine life education, fauna and flora, into the present conducted tours, at some of the intertidal zones at various spots along the rocky shores.

1. Summary of Major Marine Resources

The marine community at Angel Island is classified as a protected bay marine environment. The marine life is closely related to the oceanic currents which come in through the Golden Gate (Appendices 9 and 10).

Another species list (Brown and Caldwell, 1971) also confirmed that many open coast organisms occupy these intertidal zones of Angel Island: more than 40 species of invertebrates and 37 species of marine algae. The only large and unusual density of marine organism found in July of 1974 was the isopod, *Idothea* sp., under rocks, at a average of 10 per square meter at Point Blunt. Raccoons and deer tracks abounded in most intertidal sands indicating a relationship between the upper terrestrial and marine fauna organisms.

The State Park of California seems to have the current recreational activities in compatibility with existing marine life. The general California Fish and Game law which protects all marine invertebrates seems to suffice for conserving the marine life at Angel Island, both for the short and long-term forecast.

The only adverse impact on the marine environment would be the erosion of sediments due to hiking trails placed too close to cliff areas.

Research activities should involve the biology of the entire island; that is, the relationships of upper terrestrial animals to the marine environment. No projects are cited here. Some local universities have staff professors who have done some research on Angel Island; these individuals should be consulted as to types of projects most feasible to the total island ecosystem.

L. ALCATRAZ

The administration of this former federal prison is under the auspices of the GGNRA. The island is currently open to public visitations.

1. Summary of Major Marine Resources

This large Franciscan shale island is certainly influenced by oceanic currents coming through the Golden Gate Bridge entrance;

thus, the highly diverse and abundant marine life is definitely related to the exposed outer-coast habitats (Appendix 9E). On the southwest side of the island, an intertidal reef can be visited at low tides; here Inase, Conklin, and Preston compiled most of their species list, 1974 (Appendix 11). Their list supports my observation of the ocean water influence of exposed coast.

Like Angel Island and other San Francisco Bay shorelines, during the months from December through April, the herring, *Clupea pallasii*, spawns eggs in the intertidal rocks here at the southwest reefs of Alcatraz, Inase, 1974. Inase also reported that marine seals sometimes haul themselves on to the island reef and beaches. The reef here is small and cannot tolerate many human visitors. I agree with Inase, 1974, that the general public should be kept off this reef and that only recognized educational or research groups be allowed to visit for investigations, such as population density studies.

Another potential research for Alcatraz is a physical oceanographic monitor station which records water salinity, temperatures, oxygen, nutrients, and currents. For studies of marine fauna and birds, and oceanographic collection data, the initial cost would be \$3,000 with additional \$500 annual cost thereafter. The monitoring should be absorbed as part of ranger-naturalist duties. Such studies may be incorporated into an expanded Alcatraz tour-guide package.

2. Management Alternatives

Potential Impact

Alternative #1

Retain present state of prison facilities and tours. Current program seems quite valid as a

Continuation of present budget requirements; no adverse impact to the marine environment.

sociological type of recreation.

Alternative #2

Retain the main cell block structure for tours and tear down all other surrounding buildings. An enlarged open space area will attract marine birds and possibly the California seal.

High cost to restore the island, but scenic and natural history of the island would be enhanced for tour visitors.

Alternative #3

Remove all human construction and restore the island as a bird-mammal sanctuary.

Removal of the prison would consequently eliminate prison educational tours, a human recreational need.

A bird-mammal sanctuary would probably enhance these populations in the San Francisco Bay.

3. Summary of Alcatraz

The present public tours of Alcatraz Prison seems to fill a large demand and serves a sociological, educational need. To tear down all human structures and return the island to the birds is a noble ecological endeavor, but would eliminate the visitation of man to an historical site. My evaluation of the best future management would be the retention of the main cell-block for tours and removal of all other surrounding structures. Such a project may attract the return of the birds. Perhaps in time, the accumulation of guano and its odors, plus the decrease in human visitation, may justify the eventual goal of returning the island to the birds.

M. FORT POINT TO FORT MASON AREA

This stretch of marine shores, Figure 6, encompasses the historical site of Ft. Point, Crissy Field, St. Francis Yacht Club Harbor, and Ft. Mason.

1. Summary of Major Marine Resources

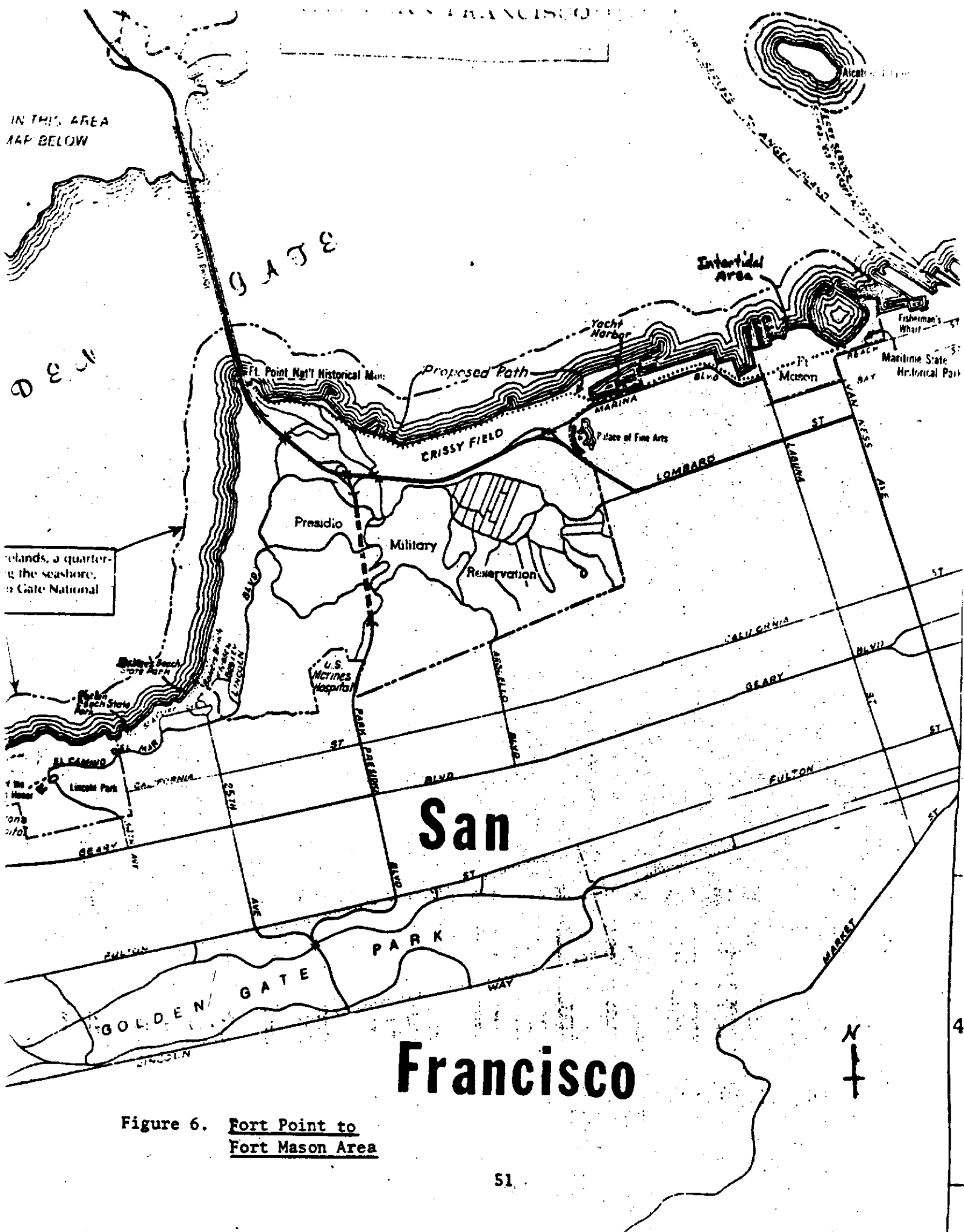
This historical Fort Point is one of GGNRA's most valuable assets. Along its northern seawall, for 100 meters, on August 5, 1974, my students and I counted 932 common starfish, *Pisaster ochraceous*. This count is indeed a high density for the area. Research of the marine ecology of the area should be encouraged; perhaps we can understand the reasons for the high population count. Likewise, on our other investigations all along the northern rocks of the Golden Gate channel, from Seal Rock to Fort Point, we encountered large numbers of starfish.

Many biology students and teachers study the marine life at the Ft. Point intertidal rocks. Robert Stetzer, for example, has recorded and pressed over 100 marine algal specimens at Ft. Point between the years 1969-1972. Nearly all his species are common to the outer exposed coast flora.

Basically, the marine life is abundant along this northern San Francisco shoreline (Appendix 12). I do not know the extent of damage the 1971 San Francisco oil spill may have caused to these marine species, but if the environment is similar to those in my Marin County studies, the major marine organisms have returned to normal densities.

The marine life on the intertidal rocks along the Crissy Field shores were the common marine invertebrates (Appendix 12C).

At the St. Francis Yacht Harbor docks, there is an abundance of diverse marine fauna and flora growing on the floating docks. On



August 6, 1974, I discovered the unusually large sea squirt, *Styela montareyensis*, on these rocks. Many marine biology students and teachers of the San Francisco School District utilize these docks as areas for the study of marine life.

A Galileo High School teacher, Sam Dederian, has used the natural intertidal rocks at Fort Mason, Figure 6, for a number of years to study the types of marine life along a rocky shore habitat.

Thus, the marine life in this metropolitan area continues to survive the oil spills from boats, sewage contaminants from outfalls, and predatory aspirations of marine biology students who collect specimens. Such marine life must continue to be nurtured as a viable asset to the GGNRA property.

2. Management Alternatives

- | | |
|---|--|
| a. Maintain current program of public visitation at Ft. Point. Continue to allow shore fishermen to use the seawall area for fishing; they may also use the rocks along Crissy Field. The beach area at Crissy Field is a potential sunbathing-picnic area. | No adverse impact from visitors in this area. Obviously, no dumping of sewage waste and garbage should be permitted in this area. Current sewage waste must be properly treated. |
| b. Expand hiking and bicycle trails in this area. | No adverse impact from additions of trails. |
| c. Build new breakwater system in the area. | No adverse impact; in time marine life will adapt to any breakwater rocks. |
| d. Convert part of Ft. Mason into vocational school. | Such a plan would not affect the marine life providing proper |

sewage disposal system is in operation.

- e. Develop the beginning of the proposed coastal hiking trail here at Ft. Mason, the "Sun-set Trail".

No adverse impact.

3. Summary for Fort Point to Fort Mason Area

The only adverse impact of this entire north shoreline would be the continual dumping of untreated sewage in the area. Such practices may produce eutrophication effects as well as contaminate the nearby water with pathogenic organisms.

The current level of human activities seems compatible with the marine environment. Future development of buildings and marinas will need further environmental impact reports.

N. BAKER'S BEACH TO SEAL ROCK

The area of Baker's Beach, Phelan's Beach State Park, Land's End, and Sutro Bath Rocks, Figures 6 and 7, suffers high soil erosion and contains sparse marine life.

1. Summary of Major Marine Resources

Except for the density of the common starfish, *Pisaster ochraceus*, on Mile Rock and Seal Rock, the near shore intertidal zone was not one of high marine life density. Perhaps the abundance of visitors over a period of time has removed a large majority of the macro marine specimens. These areas are used to a great extent by the people of San Francisco. The only logical present and future consideration is insuring that the hiking and bicycle trails are not supplanted by building developments. Future trails should not be situated close to the edges of cliffs, thus preventing sediment erosion which is detrimental to the

filter feeding marine life.

The area of the old Sutro's Baths should be completely razed and returned to natural conditions. The tunnels at Sutro Baths should be filled with rocks to prevent entrance. Signs should be posted at Sutro's Rocks to warn rock fishermen of the high danger of waves washing people off these rocky points. In fact, at the north section, where the Sutro caves are located, it should be forbidden to stand on these low ledges to fish. On flooding tides, it is common to see breakers crash over these low ledge areas.

Seal Rock should always be maintained as an area for viewing these mammals. The management of the Cliff House area could be deeded to public enterprise.

3. Summary of Fort Point to Fort Mason Area

The only course for present and future management of this entire northwest shoreline of San Francisco is to continue the open space plan and simply provide for hiking trails throughout the area. No adverse effects on the marine life can be foreseen with this management plan. Only the danger of fishermen being washed off Sutro's rocks seems to be the potential hazard.

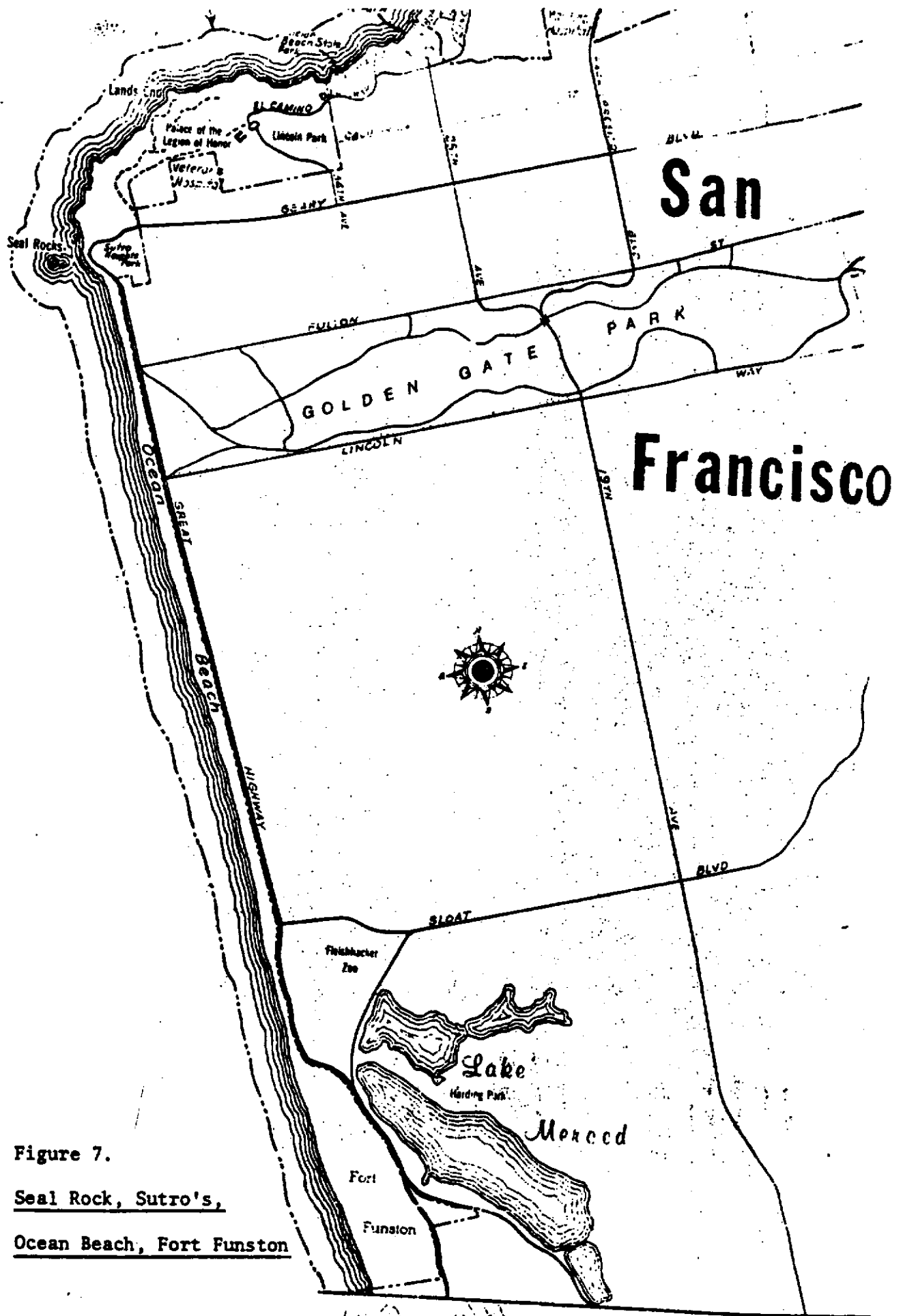


Figure 7.

Seal Rock, Sutro's,
Ocean Beach, Fort Funston

0. OCEAN BEACH AND FORT FUNSTON

Ocean Beach, with its long exposure of sand is certainly a prominent geological scene within GGNRA boundaries.

1. Major Marine Resources

My current studies reveal that the normal beach organisms can be detected on this beach (Appendix 12D).

2. Management Alternatives and Potential Impact

The current management plan of the beach should continue; that is, allow public use without development of any form. Ice plant covers help in some erosion retardation, but the movement of sand is a natural trend in this area. Obviously, no vehicles should be allowed in this area; vehicles would accelerate erosion effects.

The Fort Funston area should be opened as a historical site of military bunkers. The area should be left as open space. The only possible recreational addition would be to permit "hang-gliders" to leap off the bluff and land on the beach. The old Nike missile site could be used as a parking space for cars and gliders. The only adverse effect would be the erosion of cliff sediments down to the beach from the activity of glider take-offs. If this recreation is allowed here, GGNRA rules should clearly state that only "certified" or licensed individuals may use the site and that GGNRA has the right to rescind this activity if erosion effects are significantly accelerated beyond natural rates.

P. OTHER MARINE RESOURCES

1. Potential Impact of Two Major Activities

Two other major activities might be included in this paper as contributing an effect on the marine resources of the GGNRA.

a. Sight-seeing

The first is sight-seeing by visitors all along the San Francisco shoreline waterfront area to the expansive coastlines of Marin County. I have not seen the estimate of the number of people who traverse the areas along the Northern San Francisco shores which include the area of Fisherman's Wharf; the annual number of day visitors must run into the millions. Also, with the greater number of people taking Bay sightseeing and commuter ferries, the use of the water environment becomes very significant.

As for the Marin County environment, the California Department of Fish and Game stated that about 1.5 million people visit Pt. Reyes National Seashore Park annually, with projected estimates for 1980 to approach the 2.3 million visitor mark.

All such population projections must be taken into account when considering the impact of such visitation to the resources of the area. The greatest potential impact of such human encroachment on the marine environment is described below:

- (1) The erosion of the landscape, introducing sediments which may be harmful to the filter feeding marine organisms of the locality.
- (2) Even though the California Department of Fish and Game regulation (Section 70.4) protects all marine invertebrates, overzealous collecting and handling may eliminate uncommon species within the GGNRA-Pt. Reyes National Park boundaries. Such

species are listed in this paper.

- (3) The overfishing of game species--abalones, clams, etc.--may lead to the elimination of these select organisms from local waters. In both cases of general invertebrates and fish species, park officials must work cooperatively with the California Department of Fish and Game to insure that protective laws and enforcement will enable these organisms to continue to survive.
- (4) Overpopulation often leads to an overproduction of nutrients to such a level which may cause eutrophication processes detrimental to marine life. Sewage and septic tank outflows must have the necessary treatments to prevent such nutrient production levels.
- (5) Lastly, people pressure produces structural developments which can alter the habitats in such a way that the aesthetic values are no longer found in the once-natural setting.

b. Sport and commercial fishery enterprises

The second important marine utilization in and around the San Francisco area is the fish utilization by sport and commercial enterprises. Such fisheries do play a vital role in the planning and development of the GGNRA-Pt. Reyes park system.

- (1) Marin County. The major commercial ports are Tomales Bay, Point Reyes (Drakes Bay), and Sausalito. The major commercial species taken are flounder, Pacific herring, rockfish, salmon, albacore tuna, crab, and Pacific oyster. Albacore and salmon top the list in total pounds of catch per year (Smith, 1973).

In sport fishing from boats, wharfs, and shore, the

major species caught are salmon, lingcod, surfperch, steelhead, striped bass, cabezon, clams, rockfish, smelt, and abalone. The total net benefit from salmon caught in 1970 totaled \$222,000 and the California Department of Fish and Game predicts the growth of sport fishing to continue with all species (Smith, 1973).

(2) San Francisco Bay Area. The major commercial ports are San Francisco, Berkeley, Richmond and Alameda. The major commercial and sport fish species are basically the same as in Marin County. The total net benefit of salmon in 1970 from San Francisco's Bay ports complex of commercial sportfishing value is a total of \$894,000 and the value will reach over one million dollars by 1980 (Smith, 1973).

2. Potential Impact of Proposed Developments

The protection of the commercial and sportfishing resources of the Marin-San Francisco Bay ports must be considered in any proposed developments along our waterways. Special thought must be given to critical areas which form the nursery complex grounds for many of these fishes. For example:

a. Anadromous fish streams throughout the Bay Region must be preserved so that the historical runs of steelheads and salmon can continue. Streams with dams, diversions, siltation, road and subdivision construction, channelization, and backyard home repairs, can all downgrade these streams. Important streams in Marin County are: Papermill, Stemple, Mill Valley, Muir Woods, Corte Madera, Walker, Nicasio, and other small creeks which abound in the county. Destroying the anadromous runs in the creeks will cause irreversible damage to these fin fish.

- b. Maintaining the pristine nature of our wetland marshes throughout the San Francisco Bay Area must rank as top priority. The base of the food web which supports much of our fin fish nurseries is anchored in the rich fauna and flora relationships of these marshes. To fill in these wetlands, pollute the streams with eutrophivating nutrients or noxious chemicals, or dike these areas--any one or a combination of these activities will surely cause detrimental impact on these dependent marine fish species.
- c. Nearshore and offshore currents are vital towards the cyclical occurrence of fish life which crowd the surf zones of such beaches as San Francisco Ocean Beach, Stinson Beach, Bolinas Beach, and the Dillon Beach area. Moreover, the areas of marine waters surrounding the sport fishing docks at San Francisco, Sausalito, Fort Baker, Tiburon, etc., all are localities which depend on marine currents to bring in the sport fishes. Even though the exposed outer coast is a hardy marine environment, continual catastrophies such as the magnitudes of oil spills may produce irreversible damage to the marine food web and thus affect all such shoreline recreational fishing.

3. Major Recommendation

Federal Park officials should work closely with the San Francisco Bay Conservation and Development and with the North Central Coast Regional Commission to insure that streams, marshes, and shorelines receive protection from dredging and other potentially harmful development, and that water quality in all parts of the marine waters not be contaminated by harmful pollutants such as discharges from sewage and port facilities.

IV. CONCLUSIONS

The overall summary of the proposals and recommendations in my report may be condensed in the following statements:

1. The Pt. Reyes National Park. This seashore park has extremely valuable marine resources which need continual vigil. The marine land resources of shoreline, view points, trails, etc., are assumed to be under stable control to protect the environment. However, I do think that there is much information which is needed to guide park officials and advisory committees in making decisions involving the marine faunal resources of abalones, clams, oysters, otters, etc. Unless protective measures are incorporated soon, I feel such marine species will continue to deteriorate in certain localities, producing irreversible damage in a specific ecological niche. Research studies are sorely needed in this area to guide conservation recommendations.
2. Duxbury Reef and Bolinas Point Reef. These reefs are tremendous marine assets which sit in a transitional zone between Pt. Reyes and GGNRA boundaries. These areas seem to be in a state of reserve-limbo. The California Fish and Game Department has designated these areas as marine reserves, but the Department, in my observations, lacks the manpower and program to effectively protect the valuable and rare marine species on the reefs. The Marin County Parks and Recreation Department has jurisdiction at the Agate Beach area, but lacks the immediate monetary program to develop the conservation education program to insure the quality of the reef ecosystem. Perhaps national park officials may envision the value of annexing these reefs to its recreational park system. How long can the organisms on this reef last under the visitations of man?

3. Bolinas Lagoon. This lagoon has been given much attention and planning by the Marin County Parks and Recreation Department. Their Bolinas Plan has outlined some recommendations for utilizing this lagoon as an ecological reserve. I believe the guidance for this lagoon is sound and GGNRA should cooperate with the county in insuring the protection of this lagoon. The Audubon Canyon Ranch, adjacent to the lagoon is indeed a very valuable part of the total Bolinas Lagoon-Duxbury Reef ecosystem. Likewise, the research and educational programs of the College of Marin and the Pt. Reyes Bird Observatory should play a hand in wise management of these marine resources.
4. Stinson Beach. The current levels of recreational activities at Stinson Beach--sunbathing, etc.--are deemed essential and important to the many visitors to this beach. An interpretive center at the main beach parking lot would certainly enhance the educational opportunities of visitors.
5. Rocky Point. This headland area is a natural site for limited development, such as the construction of a satisfactory road down to a graded area for auto or bus parking. A small interpretive center here to guide people in wise choices among the tidepools should be implemented. The present wooden cabins are too unstable to house a continuous camping use, especially with the questionable sewage outflow onto the beach area. My recommendation is to tear these cabins down and restore the point to its natural contours. A house-camp system can be established at Fort Cronkhite or Fort Barry. Thus, this area can tolerate partial development to benefit all types of people--the young, the old, and even the handicapped, allowing them to tour this unique headland projection to observe the interactions of ocean meeting land.

6. Slide Ranch. This area is an unstable, highly erosion-prone marine habitat and basically unsuitable for extensive development. The tidal pool zones abound with marine tunicates and bryozoans. A "rest stop" station here for hikers along the coastal trail would seem to be the only logical and compatible recreational development. Abalones are very sparse along this coast and such fisheries should be prohibited. Pole fishing from the local rocks along this entire coast for cabezon, rockfish, and blennies would seem to be a viable recreation to encourage.
7. Muir Beach Area --south to Pirates' Cove. The sandy stretch of Muir Beach is designated as a steep profile beach subject to strong waves and undertows. Swimming at this beach is considered hazardous. The basic use of the beach presently as a picnic-sunbathing area seems compatible with current marine resources. South of Muir Beach, the marine coastal environment is very steep and the cliffs are extremely etched by continuous erosion. The marine habitat down to Pirates' Cove is classified as an exposed outer coast with large boulders of serpentine and graywacke. Tide pool life is quite pristine. Walking along these intertidal rocks is quite hazardous because of the dangers of rock slides from the steep cliffs. Sightseeing, pole fishing, and some tidepool excursions for the hardy marine visitors seem to be the only reasonable forms of potential recreation.
8. Tennessee Cove. The geological formations of this narrow valley are certainly a highlight of the marine assets here. There is great danger from giant waves washing up upon this small, narrow beach. Such forceful wave actions can be observed by the highly polished living limpet shells along the high tide rocks. The giant isopod of the splash zone

is another marine specimen rare to the GGNRA coast. Visitors here should be under cautious attention of park guides, as there is a high danger of individuals, especially small children, being trapped and pulled into the ocean by the large waves.

9. Fort Cronkhite - Fort Barry Area. Major marine resources are the Rodeo Lagoon, the unique pebbled beach, and Bird Island; other attractions are visitations of the military bunkers and the scenic walks along the coastline to view the Golden Gate - Pacific Ocean passage.

Bird Island is an area of high nutrient production and very diverse marine life below the intertidal waters. Some high splash zone pools possess some large unique copepods. This area needs research studies correlating nutrient production to density and diversity of marine populations.

The military facilities here seem to destine this locality to high intensity use. A major natural history interpretive center-museum would be most appropriate. Various types of recreation--fishing, tidepool education, bird watching, scenic viewing, etc.--provide highly diversified recreation.

10. Fort Baker - Kirby Cove Area. Kirby Cove should remain as a campsite locality with reservations required. The road down to the cove cannot tolerate everyday public use. Fort Baker seems to be an area of high intensity use--wharf and rock fishing, picnicking, etc. The boat harbor should be open to only a limited number of boats; the harbor appears to be an entrapment basin for much oceanic debris.
11. Angel Island and Alcatraz Island. The present recreational program by the State Park officials seems to be compatible with current marine resources. Research programs on upper terrestrial fauna and flora should

blend with the marine environment. Very little is known about the densities of deer, raccoons, and other mammals on the island.

Alcatraz Island should remain as a prison-tour facility with perhaps restoration of unused portions of the island as a natural habitat for birds. The small marine reef at the southern end of the island supports a very unique oceanic type of marine life.

12. San Francisco North Coastline and Ocean Beach Area. The present developments along the Fort Point, Fort Mason area seem to be compatible with current populations of marine organisms. The only detrimental potential which may cause problems in the area is untreated sewage waste water.

The area along Baker's Beach to Sutro-Cliff House area should be restored to natural contours and opened for hiking trails. The cliffs near the Sutro's headlands should be off-limits to shore fishermen because of the dangers of large waves. Seal Rock and its mammal population seem to be stable and a continuous attraction for visitors.

Ocean Beach remains as a large recreational area for bathers, beach walkers, fishermen. Fort Funston military installation could remain as a day-camp operation. Hang-gliders could profitably use the area for their activity, pending formal rules guiding their total activities.

In conclusion, the keynote word for this report is preservation of the existing marine resources along the entire Golden Gate National Recreational Area coastal shores. Any major call for development requires an examination of each coastal area and procedures to protect and incorporate only those recreational activities which are compatible with the geography and biology

of the area. Some areas can tolerate high intensity use, while others are fragile and need protection.

The only unifying recreation which I have recommended is a coastal hiking trail, the "Sunset Trail", which could begin in San Francisco's Fort Mason area and traverse all the way to the Pt. Reyes National Park. Rest stops with rest rooms and camping sites could be spread throughout these trail localities. A bus schedule to bring hikers back to their original take-off points could be set up to handle the return route. A brochure citing assets and shortcomings along the Sunset Trail would enhance the education of the hikers. Interpretive centers would also assist visitors along the high-intensity use areas of Fort Cronkhite, Rocky Point, Stinson Beach, and Pt. Reyes.

The most important research called for in this report is the establishment of baseline data documenting the present populations of marine organisms along the entire GGNRA - Pt. Reyes shores. Then when development over a period of time produces some changes in the local habitat, park officials and their advisory committees can ascertain the extent of change in both pro- and con- degrees within each marine locality. Without such baseline data, development and recreational activities would proceed as in a dark vacuum.

This report on the marine resources of the Golden Gate National Recreational Area boundaries is not to be considered as a final understanding of the present problems or of the potential impacts of alternative developments; it is a beginning meeting place where suggestions may be considered.

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Upper Beach

Orchestoidea californiana (Brandt, 1851)

Middle Beach

Emerita analoga (Stimpson, 1857)

Siliqua patula (Dixon, 1788)

Nepthys californiensis Hartman, 1938

Lower Beach

Blepharipoda accidentalis Randall, 1839

Cirolana harfordi (Lockington, 1877)

Emerita analoga (Stimpson, 1857)

Surf Zone

Archaeomysis maculata (Holmes)

Crago sp.

Offshore Sand Bar

Dendraster excentricus (Eschscholtz)

Marine Plants

Ulva spp.
Gigartina spp.
Cladophora spp.
Corallina spp.
Egrecia menziesii (Turner) Areschoug (abundant)
Phyllospadix sp.
Porphyra naiadum C.L. Anderson
Iridaea flaccidum Setchell and Gardner
Ralfsia pacifica Hollenberg
Laminaria andersonii Eaton
Fucus furatus C.A. Agardh
Pelvetia fastigata (J.G. Agardh) De Toni
Pelvetiopsis limitata (Setchell) Gardner
Lithothamnion spp.

Marine AnimalsSplash Zone

Ligia occidentalis Dana, 1853

Zone 1

Littorina spp.
Thais emarginata (Deshayes, 1839)
Collisella digitalis formerly Acmaea digitalis Eschscholtz, 1833
C. pelta formerly A. pelta Eschscholtz, 1833
C. limatula formerly A. limatula Carpenter, 1864
Balanus glandula Darwin, 1854
Littorina planaxis Philippi, 1847
L. scutulata Gould, 1849
Chthamalus dalli Pilsbry, 1916

Zone 2

Anthopleura elegantissima (Brandt, 1835)
Tegula funebris (Adams, 1854)
Hemigrapsus nudus (Dana, 1851)
Pachygrapsus crassipes Randall, 1839

Zone 3

Epiactis prolifera Verrill, 1869
Tegula brunnea (Philippi, 1848)
Mytilus californianus Conrad, 1837
Pollicipes polymerus formerly Mitella polymerus (Sowerby, 1833)
Mopalia spp.
Pisaster ochraceus (Brandt, 1857)
Petrolisthes cinctipes (Randall, 1839)

Appendix 2 (continued)

Zone 4

Anthopleura xanthogrammica (Brandt, 1835)

Bryozoa spp.

Leptasterias spp.

Pugettia producta

Pagurus spp.

Tunicata spp.

Sponge

Haliotis rufescens Swainson, 1822 (scarce)

Haliclona sp.

Aplysilla glacialis (Dybowski, 1880)

Amaroucium spp.

Clavelina huntsmani Van Name, 1931

Eudistoma spp.

Marine Plants

Ulva spp.
Gigartina spp.
Cladophora spp.
Corallina spp.
Egredia menziesii (Turner) Areschoug (common)
Phyllospadix sp.
Iridaea flaccidum Setchell and Gardner
Ralfsia pacifica Hollenberg (very abundant on rocks)
Laminaria andersonii Eaton
Fucus furatus C.A. Agardh
Pelvetia fastigata (J.G. Agardh) De Toni
Pelvetiopsis limitata (Setchell) Gardner
Lithothamnion spp.
Porphyra naiadum C.L. Anderson

Major AnimalsSplash Zone

Ligia occidentalis Dana, 1853

Zone 1

Collisella digitalis formerly Acmaea digitalis Eschscholtz, 1833
C. pelta formerly A. pelta Eschscholtz, 1833
C. limatula formerly A. limatula Carpenter, 1864
Balanus glandula Darwin, 1854
Littorina planaxis Philippi, 1847
L. scutulata Gould, 1849
Chthamalus dalli Pilsbry, 1916

Zone 2

Tegula funebris (Adams, 1854)
Mopalia spp.
Hemigrapsus nudus (Dana, 1851)
Pachygrapsus crassipes Randall, 1839

Zone 3

Anthopleura elegantissima (Brandt, 1835)
Tegula brunnea (Philippi, 1848)
Thais emarginata (Deshayes, 1839)
Mytilus californianus Conrad, 1837 (abundant)
Pollicipes polymerus formerly Mitella polymerus (Sowerby, 1833)
Lepas anatifera (Linnaeus, 1758): found on a washed up log.
Petrolisthes cinctipes (Randall, 1839)

Appendix 3 (continued)

Zone 4

Anthopleura xanthogrammica (Brandt, 1835)
Epiactis prolifera Verrill, 1869
Bryozoa spp.
Pycnogonum stearnsi Ives, 1892
Leptasterias spp.
Henricia leviuscula (Stimpson, 1857)
Pisaster ochraceus (Brandt, 1857) (abundant)
Pugettia producta (Randall, 1839)
Pagurus spp.
Triopha maculata MacFarland, 1905
Haliotis rufescens Swainson 1822 (scarce)
Aplysilla spp.
Halichondria sp.
Acarnus erithacus deLaub., 1927
Haliclona sp.
Eudistoma sp.
Polyclinum sp.
Amaroucium spp. (abundant)
Clavelina huntsmani Van Name, 1931
Cystodytes sp. (common)

APPENDIX 4. MAJOR SPECIES LIST FOR MUIR BEACH
TO PIRATES' COVE

July 24, 1974

Upper Beach

Orchestoidea californiana (Beandt, 1851)

Middle Beach

Emerita analoga (Stimpson, 1857)
Nephtys californiensis Hartman, 1938

Lower Beach

Blepharipoda occidentalis Randall, 1839
Archaeomysis maculata (Holmes)

Marine Plants

Endocladia muricata (Postels and Ruprecht) J.G. Agardh
Gigartina canaliculata Harvey
G. californica J.G. Agardh
Iridaea flaccidum Setchell and Gardner
Lithothamnion spp.
Porphyra naiadum C.L. Anderson
Ralfsia pacifica Hollenberg
Egregia menziesii (Turner) Areschoug
Alaria marginata Postels and Ruprecht
Nereocystis luetkeana (Mertens) Postels and Ruprecht
Phyllospadix sp.

Marine Animals

Splash Zone

Ligia occidentalis Dana 1853

Zone 1

Balanus glandula Darwin, 1854
B. cariosus (Pallas, 1788)
Chthamalus dalli Pilsbry, 1916
Littorina planaxis Philippi, 1847
Collisella spp. (common)

Zone 2

Tegula funebris (Adams, 1854)
Pachygrapsus crassipes Randall, 1839

Zone 3

Anthopleura elegantissima (Brandt, 1835)
Epiactis prolifera Verrill, 1869

Appendix 4 (continued)

Zone 3 (continued)

Hemigrapsus nudus (Dana, 1851)
Petrolisthes cinctipes (Randall, 1839)
Pisaster ochraceus (Brandt, 1835) (common)
Mytilus californianus Conrad 1837 (abundant)
Pollicipes polymerus (Sowerby, 1833)

Zone 4

Halichondria panicea (Pallas, 1766)
Cancer antennarius Stimpson, 1856
Pagurus samuelis (Stimpson, 1857)
P. hemphilli (Benedict, 1892)
Leptasterias spp.
Amaroncium spp.

Marine PlantsEnteromorpha sp.Ulva spp.Cladophora trichotoma (C.A. Agardh) KutzingGigartina spp.Egregia menziesii (Turner) AreschougFucus furcatus C.A. AgardhMarine AnimalsSplash ZoneLigia occidentalis Dana, 1853 (large size)Zone 1Balanus glandula Darwin, 1854Orchestoidea californiana (Brandt, 1851) (upper beach area)Collisella digitalis Eschschowltz, 1833 (common)Littorina scutulata Gould, 1849Chthamalus dalli Pilabry, 1916Zone 3Mytilus californianus Conrad, 1837Pollicipes polymerus (Sowerby, 1833)

July 31; August 1, 1974

Marine Plants

Ulva spp.
Cladophora trichotoma (C.A. Agardh) Kützing
Enteromorpha muricata (Postels and Ruprecht) J.G. Agardh
Gigartina spp.
Ralfsia pacifica Hollenberg
Eggregia menziesii (Turner) Areschoug
Fucus furcatus C.A. Agardh
Pelvetiopsis limitata (Setchell) Gardner
Prionitis lanceolata Harvey
Lithothamnion spp.
Porphyra spp.
Alaria marginata Postels and Ruprecht
Phyllospadix sp. (up to 8 ft. in length, see Appendix 7 for area)
Trentopholia sp. (on cliffs at Pt. Bonita)

Marine AnimalsSplash Zone

Tigriopus californicus (Baker, 1912)

Zone 1

Balanus glandula Darwin, 1854
Collisella digitalis Eschscholtz, 1833
Littorina scutulata Gould, 1849
Littorina planaxis (philippi, 1847)

Zone 2

Pachygrapsus crassipes Randall, 1839
Mopalia lignosa (Gould, 1846)
Tegula funebris (Adams, 1854)
Thais emarginata (Deshayes, 1839)

Zone 3

Anthopleura elegantissima (Brandt, 1835)
Pollicipes polymerus (Sowerby, 1833)
Hemigrapsus nudus (Dana, 1851)
Lepas anatifera (Linnaeus, 1758); found on a washed up log
Mytilus californianus Conrad, 1837 (large size, common at Bird Island)
Pisaster ochraceus (Brandt, 1835)

Zone 4

Sponges (abundant)
Hydroids (abundant)
Bugula spp. (common, Bird Island)
Membranipora spp. (common, Bird Island)

Appendix 6 (continued)

Zone 4 (continued)

Tricellaria sp.
Cucumaria spp. (common, Bird Island)
Clavelina huntsmani Van Name, 1931
Eudistoma spp.
Amaroucium spp. (Abundant)

RODEO LAGOON PLANKTON TOW

West End of Lagoon: Salinity = 14.5 ‰ August 1, 1974

Canthocamptus sp. (copepod)
Corophium sp. (amphipod)
Campylodiscus (diatom)
Ciliates
rod-shaped bacteria

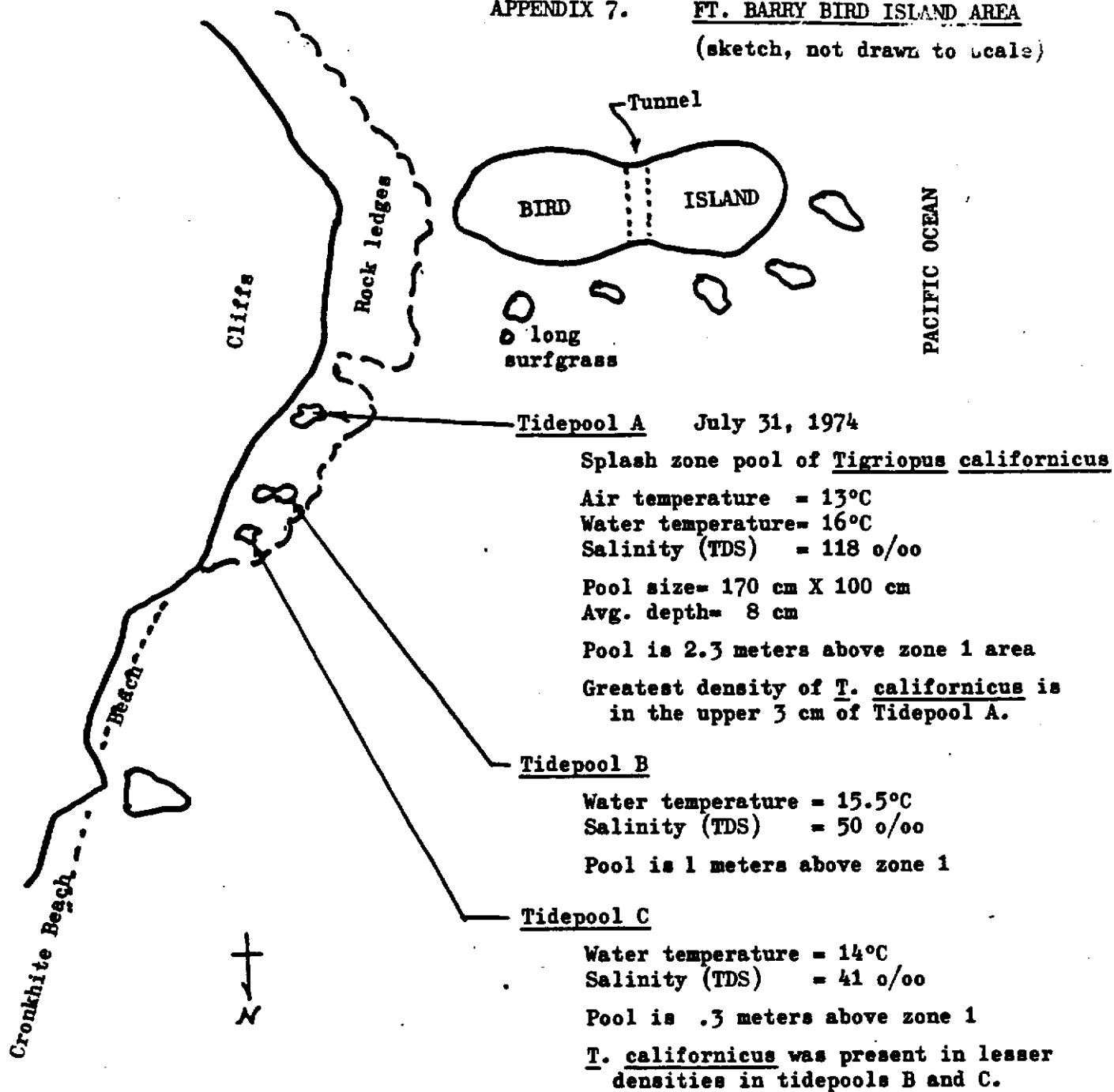
East End of Lagoon: Salinity = 0 to 2 ‰ August 1, 1974

Nauplius of copepods
Copepods of Canthocamptus
Ostracods: Linnocythere sp.
Hydractinia (water mite)
Nematoda worm
bacteria - rods

APPENDIX 7.

FT. BARRY BIRD ISLAND AREA

(sketch, not drawn to scale)



Marine Plants

Ulva spp.
Cladophora trichotoma (C.A. Agardh) Kutzing
Gigartina spp.
Egregia menziesii (Turner) Areschoug
Pelvetiopsis limitata (Setchell) Gardner
Porphyra spp.

Marine Animals

Splash Zone

Ligia occidentalis Dana, 1853 (large size at Kirby Cove)

Zone 1

Balanus spp.

Zone 2

Hemigrapsus nudus (Dana, 1851)

Zone 3

Pisaster ochraceous (Brandt, 1835)

Zone 4

Patiria minata (Brandt, 1835)

A. DOCK PILINGS AT AYALA COVEMarine Plants

Ulva spp.
Desmarestia spp.
Cystoseira osmundacea (Menzies) C.A. Agardh
Polyneura latissima (Harvey) Kylin
Zostera marina
Phyllospadix

Marine AnimalsZone 1

Balanus glandula Darwin, 1854
B. cariosus (Pallas, 1788)

Zone 3

Mytilus edulis Linnaeus, 1758

Zone 4

Obelia longissima (Pallas, 1766)

B. AYALA COVE INTERTIDAL ROCKSMarine Plants

Ulva spp.

Marine AnimalsZone 1

Balanus glandula Darwin, 1854
B. cariosus (Pallas, 1788)
Collisella limatula Carpenter, 1864

Zone 2

Pachygrapsus crassipes Randall, 1839
Thais canaliculata (Duclos, 1832)
Acanthina spirata (Blainville, 1832)

Zone 3

Nemerteans
Idothea spp.
Idothea (Pentidotea) resecata (Stimpson, 1839)
Amphipoda

Appendix 9 (continued)

(Ayala Cove Intertidal Rocks)

Zone 4

Cirolana harfordi (Lockington, 1877)

C. WEST GARRISON COVE INTERTIDAL ROCKS, EAST END

Marine Plants

Ulva spp.

Iriacea spp.

Porphyra spp.

Gigartina canaliculata Harvey

Ralfsia pacific Hollenberg

Egrecia menziesii (Turner) Areschoug

Fucus furcatus C.A. Agardh

Pelvetia fastigata (J.G. Agardh) De Toni

Pelvetiopsis limitata (Setchell) Gardner

Marine Animals

Splash Zone

Ligia occidentalis Dana, 1853

Zone 1

Balanus spp.

Balanus cariosus (Pallas, 1766)

Collisella limatula Carpenter, 1864

C. digitalis Eschscholtz, 1833

Littorina scutulata Gould, 1849

Zone 2

Pachygrapsus crassipes Randall, 1839

Hemigrapsus nudus (Dana, 1851)

Thais emarginata (Deshayes, 1839)

Tegula funebris (Adams, 1854)

Zone 3

Anthopleura elegantissima (Brandt, 1835)

Hemigrapsus oregonensis (Dana, 1851)

Petrolisthes cinctipes (Randall, 1839)

Thais lamellosa (Gmelin, 1792)

Zone 4

Halichondria panicea (Pallas, 1766)

Tapes semidecussata (Reeve, 1864)

Appendix 9 (continued)

D. PEARL'S BEACH INTERTIDAL ROCKS

Marine Animals

Upper Beach

Orchestoidea corniculata Stout, 1913

Zone 1

Balanus glandula Darwin, 1854

B. cariosus (Pallas, 1788)

Zone 3

Anthopleura elegantissima (Brandt, 1835)

Pollicipes polymerus (Sowerby, 1833)

Pisaster ochraceus (Brandt, 1835)

E. POINT BLUNT INTERTIDAL ROCKS

Marine Plants

Fucus furcatus C.A. Agardh

Endocladia muricata (Postels and Ruprecht) (J.G. Agardh)

Marine Animals

Zone 1

Balanus spp.

Collisella spp.

Zone 2

Hemigrapsus nudus (Dana, 1850)

Thais lamellosa (Gmelin, 1792)

Zone 3

Pagurus spp.

Amphipoda

Idothea (Pentidotea) spp. (very common under rocks)

Pisaster brevispinus (Stimpson, 1857); washed up on beach

Zone 4

Teredo navalis (Linnaeus, 1758); found on a washed-up log

Appendix 9 (continued)

F. ALCATRAZ

Major Marine Plants

Ulva spp.

Cladophora trichotoma (C.A. Agardh) Kützing

Enteromorpha compressa (Linnaeus) Greville

Endocladia muricata (Postels and Ruprecht) J.G. Agardh

Gigartina spp.

Ralfsia pacifica Hollenberg

Egregia menziesii (Turner) Areschoug (common)

Fucus furcatus C.A. Agardh

Pelvetiopsis limitata (Setchell) Gardner

Prionitis lanceolata Harvey

Marine Animals - see Appendix 11

APPENDIX 10.

Species List of the Fauna Found in the Point Blunt Survey Area

by Brown & Caldwell, 1971

Organism identification	Apr 27 1971	Dec 27 1971	Organism identification	Apr 27 1971	Dec 27 1971
PORIFERA			ARTHROPODA (cont'd)		
Unidentified sponges	x	x	<u>Pachygrapsus crassipes</u>	x	
COELENTERATA			<u>Pagettia gracilis</u>		x
Unidentified hydroids	x		<u>Pagurus brachydactylus</u>	x	x
<u>Sertularia</u> sp.	x	x	<u>Pycnogonida</u>	x	
<u>Anthopleura artemisia</u>	x	x	MOLLUSCA		
<u>Anthopleura elegantissima</u>		x	<u>Mopalia</u> sp.	x	
<u>Anthopleura xanthogrammica</u>	x	x	<u>Mytilus edulis</u>	x	x
<u>Clavularia</u> sp.	x		<u>Acmaea palta</u>	x	x
Unidentified anemone	x		<u>Acmaea personata</u>		x
NEMERTEA			<u>Acmaea scabra</u>	x	x
Unidentified ribbon worms	x	x	<u>Acmaea</u> sp.	x	x
ANNELIDA			Unidentified keyhole limpet	x	
<u>Nereis</u> sp.		x	<u>Littorina pinnaxia</u>	x	x
Unidentified bristle worms	x	x	<u>Acanthina punctulata</u>		x
ARTHROPODA			<u>Thais emarginata</u>	x	x
<u>Balanus glandula</u>	x	x	<u>Thais lamellosa</u>	x	x
<u>Balanus</u> sp.	x	x	<u>Thais</u> sp.		x
<u>Chthamalus dalli</u>	x	x	<u>Archidoriq montereyensis</u>	x	
<u>Idothea</u> sp.	x	x	BRYOZOA		
<u>Ligia</u> sp.	x		Unidentified bryozoans	x	x
Unidentified isopods	x	x	ECHINODERMATA		
Unidentified amphipods	x	x	<u>Pisaster brevispinus</u>	x	
<u>Spirontocaris</u> sp.	x		<u>Pisaster ochraceus</u>	x	x
<u>Cancer antennarius</u>	x		VERTEBRATA		
<u>Cancer productus</u>	x		<u>Perichthys notatus</u>	x	

Species List of the Flora from the Point Blunt Area

Organism identification	Apr 27 1971	Dec 27 1971	Organism identification	Apr 27 1971	Dec 27 1971
GREEN ALGAE			RED ALGAE (cont'd)		
<u>Blidingia minima</u>	x	x	<u>G. papillata</u>	x	x
<u>Spongomorpha coalita</u>	x		<u>Gracilaria sjostedtii</u>	x	x
<u>Ulva lobata</u>	x	x	<u>Gracilaria oryzoides</u>	x	x
<u>U. vexata</u>	x	x	<u>Gymnogongrus leptophyllus</u>	x	x
<u>Urospora penicilliformis</u>	x		<u>G. linearis</u>	x	x
BROWN ALGAE			<u>G. platyphyllus</u>	x	x
<u>Desmarestia herbacea</u>	x		<u>Iridaea flaccida</u>	x	x
<u>Egregia menziesii</u>	x	x	<u>I. heterocarpa</u>	x	x
<u>Fucus gardneri</u>	x	x	<u>Microcladia borealis</u>	x	x
<u>Laminaria sinclairii</u>	x	x	<u>Polysiphonia latissima</u>	x	x
<u>Pelvetiopsis limitata</u>	x	x	<u>Polysiphonia</u> spp.	x	x
<u>Petalonia fasciata</u>	x	x	<u>Porphyra perforata</u>	x	x
RED ALGAE			<u>Pterosiphonia dendroidea</u>	x	x
<u>Ahnfeltia gigartinoidea</u>	x	x	<u>P. bipinnata</u>	x	x
<u>Callithamnion pikeanum</u>	x	x	<u>Ptilota filicina</u>	x	x
<u>Ceramium eutoniamum</u>	x	x	<u>Rhodomela larix</u>	x	x
<u>Cryptopleura violacea</u>	x	x	<u>Pilea californica</u>	x	x
<u>Cryptosiphonia woodii</u>	x	x	<u>Monogramma californica</u>	x	x
<u>Gelidium</u> sp.	x	x	FLOWERING PLANT		
<u>Gigartina californica</u>	x	x	<u>Zostera marina</u>	x	x

APPENDIX 11. A PARTIAL SPECIES LIST FOR ALCATRAZ ISLAND

COMPILED BY

JOHN INASE, SARA CONKLIN AND LYNN PRESTON, 1974

	Organism	Ecology
Phylum Porifera - (Sponges)	unidentified yellow sponge	under rocks - zone 4
	unidentified pink sponge	under rocks - zone 4
Phylum Coelenterata		
Class Hydrozoa - (Hydroids)	<u>Abietinaria sp.</u>	attached to rocks zone 4
Class Anthozoa	Burrowing Anemone	in mud and on rocks
	<u>Anthopleura artemisia</u> (Pickering in Dana)	zone 2
	Giant Green Anemone	zone 3 and 4 -several
	<u>Anthopleura xanthogrammica</u> (Brandt)	specimens found on rocks and in tidepools
	Aggregating Anemone	on rocks and in tide-
	<u>Anthopleura elegantissima</u> (Brandt)	pools - zone 2 & 3
	Proliferating Anemone	on rocks- zone 4
	<u>Epiactis prolifera</u> (Verrill)	
	<u>Metridium senile</u> (Linnaeus)	these anemone were seen on the pier pilings at minus tides - zone 4
Phylum Platyhelminthes - (Flatworms)	<u>Notoplana sp.</u>	under rocks - zone 3
Phylum Annelida		
Class Polychaeta -	<u>Halosynda brevisetosa</u> (Kinberg)	crawling under rocks zones 3 & 4
	Clam worm	under rocks in mud
	<u>Nereis vexillosa</u> (Grube)	zones 3 & 4
Phylum Mollusca		
Class Amphineura - (Chitons)	<u>Cyanoplax dentiens</u> (Gould)	under rocks, crawling zones 3 & 4
	<u>Mopalia lignosa</u> (Gould)	"
	<u>Mopalia hindsii</u> (Reeve)	"

	Organism	Ecology
Phylum Mollusca		
Class Amphineura - (con't)	<u>Cyanoplax hartwegii</u> (Carpenter)	under rocks, crawling zone 3 & 4
Class Pelecypoda (Bivalves)	Bay Mussel <u>Mytilus edulis</u> (Linnaeus)	on & under rocks, most specimens under 1 inch zones 2 & 3
	California Sea Mussel <u>Mytilus californianus</u> (Conrad)	shell found on reef living specimen found on NNW side of island
	Flat Tipped Piddock <u>Penitella penita</u> (Conrad)	boring in sandstone rocks - zone 4
	Rock Entodesma <u>Entodesma saxicola</u> (Baird)	in sandstone rocks zone 3
	Thin Shelled Littleneck <u>Callithaca (Protothaca)</u> <u>tenerrima</u>	among algae and rocks zone 4
Class Gastropoda -	Angular Unicorn <u>Acanthina spirata</u> (Blainville)	on rocks - preying on barnacles - zones 2, 3 & 4
	Friiled Dogwinkle <u>Thais lamellosa</u> (Gmelin)	on rocks, eggs also seen on rocks - zones 2, 3 & 4
	Black Turban Snail <u>Tegula funebris</u> (Adams)	one specimen found among rocks - zone 2
	Checkered Periwinkle <u>Littorina scutulata</u> (Gould)	rocks and algae zones 1, 2 & 3
	Dove Shell <u>Mitrella carinata</u> (Hinds)	on and under rocks zones 2, 3 & 4
	<u>Notoacmea (Acmaea) persona</u> (Rathke)	on rocks - zone 2, 3 & 4
	<u>Notoacmea (Acmaea) scutum</u> (Rathke)	on rocks - zone 2 & 3
	Rough Limpet <u>Collisella (Acmaea) scabra</u> (Gould)	on rocks - zones 1 & 2

	Organism	Ecology
Phylum Mollusca		
Class Gastropoda - (cont)	Finger Limpet <u>Collisella (Acmaea)</u> <u>digitalis (Rathke)</u>	on rocks - zones 1 & 2
	Shield Limpet <u>Collisella (Acmaea) scutum</u> (Rathke)	on rocks zones 2 & 3
Nudibranchs (Sea Slugs)	<u>Laila cockerelli</u> (MacFarland)	in zone 2 tidepool
	<u>Hermisenda crassicornis</u> (Eschscholtz)	on algae- zone 3
	<u>Dendronotus sp.</u>	on specimen found in zone 3 tidepool
Phylum Arthropoda		
Superclass Crustacea		
Class Cirripedia -	White Buckshot Barnacle <u>Balanus glandula</u> (Darwin)	on rocks- zones 1, 2 & 3
	Goose Barnacle <u>Pollicipes polymerus</u> (Sowerby)	on rocks- zone 2
Class Malacostraca		
Subclass Pericarida		
Order Amphipoda	-Many Unidentified Amphipods Collected	on algae and rocks zones 2,3 & 4
Order Isopoda -	Rock Louse <u>Ligia occidentalis</u> (Dana)	among rocks of zone 1
	Flat Tailed Isopod <u>Idothea urotoma</u> (Stimpson)	under rocks and among algae- zone 2, 3 & 4
	<u>Ianiropsis kincaidi</u> <u>kincaidi</u> (Richardson)	among bushy bryozoan colonies and among algae zones 2 and 3
	<u>Gnorimosphaeroma oregonensis</u> (Dana)	under rocks and on algae zones 2,3 & 4

	Organism	Ecology
Phylum Arthropoda		
Superclass Crustacea		
Class Malacostraca		
Subclass Eucarida		
Order Decapoda		
Tribe Brachyura -	Spotted Commercial Crab <u>Cancer antennarius</u> (Stimpson)	among rocks zones 3 & 4
	Large Red Crab <u>Cancer productus</u> (Randall)	"
	Purple Shore Crab <u>Hemigrapsus nudus</u> (Dana)	very common all over reef, under rocks - most crabs found in zone 2 & 3
	Mud Flat Crab <u>Hemigrapsus oregonensis</u> (Dana)	under rocks, not as common as <u>H.</u> <u>nudus</u> - zones 2 & 3
	<u>Lophopanopeus leucomanus</u> <u>heathii</u> (Rathburn)	one specimen found among rocks of zone 4
	Lined Shore Crab <u>Pachygrapsus crassipes</u> (Randall)	Among rocks - zones 1 & 2
	Kelp Crab <u>Pugettia producta</u> (Randall)	among <u>Egregia</u> and rocks of zone 4
Tribe Anomura	Blue Banded Hermit Crab <u>Pagurus samuelis</u> (Stimpson)	zones 2,3 and 4 among and under rocks
	Big Clawed Porcelain Crab <u>Pachycheles rudis</u> (Stimpson)	under and on rocks zone 4
Phylum Ectoprocta (Bryozoans)		
Class Gymnolaemata		
Order Cheilostomata	<u>Scrupocellaria californica</u> Trask	under rocks zone 4
	<u>Bugula pugeti</u> (Robertson)	under and on rocks zone 4

	Organism	Ecology
Phylum Ectoprocta		
Class Gymnolaemata		
Order Cheilostomata	- <u>Bugula californica</u>	under and on rocks
(con't)	(Robertson)	zone 4
	<u>Cellepora (Hippothoa)</u>	on rocks and algae
	<u>hyalina</u> (Linmaeus)	zones 3 & 4

Phylum Echinodermata		
Class Ophiuroidea	- Brittle Starfish	
	<u>Ophionereis eurybrachyplax</u>	
	(Clark)	under rocks - two specimens collected from zone 4

- Class Asteroidea	Small Spined Starfish	
	<u>Plaster brevispinus</u>	on rocks - zones 3 & 4
	(Stimpson)	
	Ocher Starfish	
	<u>Plaster ochraceus</u>	very common on the reef - zones 2, 3 & 4
	(Brandt)	

Phylum Chordata		
Subphylum Urochordata		
(Tunicates or Sea Squirts)	Long Stalked Sea Squirt on rocks - zone 4	
	<u>Styela montereyensis</u>	
	(Dall)	

Subphylum Vertebrata		
Class Pisces	- Fluffy Sculpin	
(Fishes)	<u>Oligocottus synderi</u>	in tidepools- zones 2 & 3
	Northern Clingfish	
	<u>Gobiesox maeandricus</u>	clinging to rock zone 4
	California tonguefish	
	<u>Symphurus atricauda</u>	on kelp, stranded on reef - zone 4
	High Cockscorb	
	<u>Anoplarchus purpureus</u>	under rock - zone 4

Algae found on the reef includes Fucus, Egregia, Ulva, Iridea, Corallina, Polyneura, Enteromorpha, Gigartina and Porphyra.

Zones 1, 2, 3 and 4 refer to intertidal zonation of the area. The zones used are defined by Ricketts, Calvin and Hedgepeth in Between Pacific Tides (1968).

MAJOR SPECIES LIST FOR

APPENDIX 12. SAN FRANCISCO NORTHERN SHORES AND OCEAN BEACH

A. FORT POINT

August 5, 1974

Marine Plants

Ulva spp.
Endocladia muricata (Postels and Ruprecht) J.G. Agardh
Gigartina spp.
Egregia menziesii (Turner) Areschoug
Trentopholia sp. (on hill behind fort)

Marine Animals

Zone 1

Balanus glandula Darwin, 1854

Zone 2

Hemigrapsus nudus (Dana, 1851)
Pachygrapsus crassipes Randall, 1839

Zone 3

Anthopleura elegantissima (Brandt, 1835)
Pollicipes polymerus (Sowerby, 1833)
Mytilus californianus Conrad, 1837
Pisaster ochraceus (Brandt, 1835) (common)

B. ST. FRANCIS YACHT CLUB - FLOATING DOCKS

August 6, 1974

Marine Plants

Ulva spp.
Enteromorpha spp.

Marine Animals

Hydroid
Obelia longissima (Pallas, 1766)
Metridium senile (Linnaeus, 1767)
Caprellidae
Bugella neritina (Linnaeus, 1758)
Styela montereyensis (Dall, 1872)

C. ROCKY INTERTIDAL AT NORTHERN SHORES OF
CRISSEY FIELD, FORT MASON, BAKER'S BEACH, PHELAN'S BEACH, LAND'S END
AND SUTRO ROCKS

August 6-7, 1974

Marine Plants

Ulva spp.
Cladophora trichotoma (C.A. Agardh) Kutzine
Ralfsia pacifica Hollenberg

Appendix 12 (continued)

Egredia menziesii (Turner) Areschoug
Fucus furcatus C.A. Agardh
Pelvetiopsis limitata (Setchell) Gardner
Porphyra spp.

Marine Animals

Zone 1

Balanus glandula Darwin, 1854
B. cariosus (Pallas, 1788)
Chthamalus dalli Pilsbry, 1916
Collisella digitalis Eschscholtz, 1833
C. pelta Eschscholtz, 1833
C. testudinalis scutum Eschscholtz, 1833
Littorina scutulata Gould, 1849

Zone 2

Hemigrapsus nudus (Dana, 1851)
Pachygrapsus crassipes Randall, 1839
Thais emarginata (Deshayes, 1839) (common at Land's End reefs)

Zone 3

Pollicipes polymerus (Sowerby, 1833)
Mopalia hindsii (Reeve, 1847)
Mytilus californianus Conrad, 1837
Mopalia lignosa (Gould, 1849)
Limnoria quadrapentata Holthius, 1949; found in driftwood
Pisaster ochraceus (Brandt, 1835)

Zone 4

Hydroid
Bugula spp.
Pisaster brevispinus (Stimpson, 1857)

D. OCEAN BEACH

August 7, 1974

Upper Beach

Orchestoidea spp.

Lower Beach

Emerita analoga (Stimpson, 1857)
Archaeomysis maculata (Holmes)