## INTERTIDAL AND SHALLOW SUBTIDAL COMMUNITIES

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Almost all of the Project's biological work thus far has focused on the benthic organisms at depths of 20 to 200 meters: Creatures at these depths are most likely to reflect any effects of submarine wastewater discharges. But in recent years, there have been changes in the biological communities in shallower waters, such as the disappearance of the once widespread kelp beds off Palos Verdes, that may have complicated and far reaching results. These also merit our attention.

Early this year, we initiated a survey of intertidal and shallow subtidal communities (O to 20 m): Our initial goals were to verify other researchers' reports on these communities and to design a program to investigate the causes of observed changes. The program involved library research and field work as well as interviews with 25 scientists currently working on research in the intertidal and subtidal zones.

Our primary tool in field work on benthic communities in deeper waters is the otter trawl. But for this program, which involves work in rocky and shallow areas inaccessible to the trawl, we used divers and underwater television to make qualitative observations of the nature and condition of plants and animals. We worked in the Whites Point area and at several other points along the Palos Verdes Peninsula.

The numerous algal species and dense growth present in some rocky intertidal areas off Palos Verdes can be deceiving to the untrained eye: Our general observations in March, April, and May 1974 showed biological differences between the areas near the Whites Point outfalls and intertidal regions away from municipal wastewater discharge. For example, we found larger numbers of sea urchins, patchier covers of noncoralline algal species and fewer beds of the seagrass, *Phyllospadix* sp. near Whites Point. Other researchers have found the outfall area to contain faster growing, shorter lived algal species and individual plants that are unhealthy in appearance.

In the subtidal areas, where the giant kelp (*Macrocystis pyrifera*) used to exist, we found fewer species and numbers of algae than at areas away from the outfall and a community of large invertebrates consisting mainly of high numbers of the omnivorous bat starfish *Patiria miniata* and numerous gorgonian colonies. Several hypotheses have been proposed to explain these and other differences in the Whites Point shallow water communities, including natural environmental and biological variability, an overabundance of large, herbivorous organisms, toxic effects of substances in wastewater effluent or aerial fallout, increases in the amount of sediment in the water brought in by wastewaters or surface runoff from lands under development, and increased use of beaches and shallow waters by people, who affect the area by trampling and collecting organisms.

It is most likely that a combination of these influences, rather than any single condition, is at work in bringing about changes in the shallow water communities. For example, if either toxicity or overgrazing by herbivores alone were responsible for the decline in algal growth, we would expect all areas from 0 to 20 m to be equally affected since the water mixes in shallow depths through wave action and herbivores like sea urchins can live at these depths. But it is primarily the waters from 1O to 20 m that show fewer algal species in smaller abundances. Toxicity could be the problem if it is affecting the algae so that the plants have growth problems only in the lower light conditions of the 10 to 20 m zone. Or, at the lower light levels, algae such as the giant kelp may not be able to photosynthesize fast enough to replace tissue lost due to grazing.

We are now considering investigating several biological problems that we feel are particularly relevant to the general health of the shallow waters. These include:

- Turbidity in Subtidal Regions.

High amounts of particles in the water whether sewage material, silt from runoff, or plankton may be part of the reason for the sparse algal growth at depths below 10 m along the Palos Verdes shelf. The particles may reflect and block light needed for algal growth; in addition, settled particulate matter may "smother" algal fronds or cover the bottom areas where algae normally take hold. To understand the nature of this process near outfalls, we would first measure the amount and spectral quality of the light at depths of 3 to 15 m. Sediment collectors would be used in programs to determine the settling rate of the particulates and their origin.

- Abnormal Invertebrate Populations. In the past, scientists working off Whites Point have found the populations of several invertebrates to be abnormal or unhealthy in some respect. For example, Whites Point abalone were smaller and seemed to have a slower rate of growth than those off Catalina Island. Whites Point sea urchins had unusually short spines and showed evidence of infection. Studies of the growth, size classes, and nutritional state of these populations should be continued, in conjunction with studies of the same organisms in areas away from the outfalls.

- Absence of Sea Cucumbers. Sea cucumbers, which feed on settled detritus, tend to "process" bottom sediments in the way earthworms work on land soil. Sea cucumbers are found around the Hyperion and Orange County wastewater outfalls, but do not occur at similar depths near the Whites Point discharge. We feel the animals are absent because of the high content of metals and chlorinated hydrocarbons in the sediments off Whites Point or possibly because of the high volume of solids discharged there. Laboratory and field studies would be initiated to determine the exact constituents or combination of factors causing the problem.

- The Effects of Grazers. In the absence of drift kelp, large grazing herbivores (sea urchins, black abalone, etc.) scrape microalgae off of rocks and, in the process may consume small invertebrates and larval forms. Thus, these grazers, which are abundant off Whites Point, can cause significant changes in the bottom community structure. A study of the populations of these animals near and away from discharge sites where kelp

are found (Whites Point and Point Loma, for example) would be useful in understanding their effect.

- Community Development. We have very little information on the community structure in the Whites Point area before the outfall system was developed. Thus, it is not clear how or if it is different now. By installing artificial, "unpolluted" substrates in and away from the outfall area, we can encourage the development of new subtidal "fouling" communities and monitor the changes that occur as the substrate collects sediment debris from the outfall. A program will be initiated in September 1974, and the results will be reported in technical memoranda and in our quarterly progress report