DIRECTOR'S STATEMENT

In 1978, notable progress was made by our scientific staff toward understanding the ecology of the southern California shelf. In this year, we applied the techniques for navigation, sampling, analysis, and biological description that we had been developing in previous years to the practical problems of describing conditions in the sea off southern California.

Now we can report the completion of several important pieces of research that not only clarify the situation in our study area but may be helpful to other organizations with similar interests elsewhere along the coasts of the U.S. and the world. We had long been dissatisfied with the usual methods of reporting and analyzing bottom life. Results were given in such a complex form that even trained biologists found it difficult to communicate or to agree on the significance of findings. So we set out to develop simpler methods for defining and describing the quantity and quality of undersea life. Our intention was to apply the new methods to the southern California coastal shelf and present the results in chart form so that the effects of man, as contrasted with natural conditions, would be evident to all concerned.

This has now been done, at least for the bottom animals, along about 130 km of the shelf. We believe that two procedures described in this report--the Infaunal Index and the single-sample technique--will soon come into general use for monitoring because much less effort is required to produce an easily understandable result.

The previously used methods of assessing benthic communities are worth describing because they are responsible for many of the misunderstandings of the past. Marine biological research at universities has been largely concerned with discovering basic processes in the sea or in animals. Marine ecology is concerned with how animals live with each other and their environment.

Many professional ecologists believe that many ecosystems are constantly changing as a result of the climatic effects produced by the last ice age and by other widespread but more recent events. Much time is required to observe such changes. But municipal wastewater outfalls have presented scientists with a real-world experiment on a suitable scale for study. The food and nutrients issuing from an ocean outfall attract, repel, and change the marine biota in a time period short enough to study. Scientists therefore come to investigate this special situation as they would to study a new island or the effect of a tidal wave. Their primary concern is to understand what is happening and to make measurements that can be applied in some general way.

The outfall sediments are a good place to test techniques for distinguishing between marine and terrestrial sources of nitrogen and carbon. The waters near an outfall are of interest to those who are curious to learn if the addition of ammonia stimulates plankton growth. The metals issuing from outfalls in complexed form can be compared with the ionic forms of the same metals in upwelling water.

These are fascinating problems, and the scientists making the investigations usually have only a remote interest in marine pollution. They are less concerned with rights and wrongs than with facts relating to how the undersea world operates. Does a stable community mean many species and few individuals or visa versa? How do animal communities change in structure in response to a new food supply? University scientists trying to find the answers make an effort to cover all possibilities in their research. They examine every species, double-check themselves by repeating samples, and they use computers to make comparisons of dozens or hundreds of factors, many of which may turn out to be irrelevant. Those are the usual tools and approaches of scientific investigation. They are approaches this Project has also used in the past.

Unfortunately, the complicated and expensive methods that are suitable for university research are being applied in marine monitoring programs, where they are not entirely suitable. For example, it has become fashionable to use computers to make cluster analyses of marine samples (assemble groups of samples with similar characteristics), to construct dendrograms (compare samples from various locations), and to make ordination diagrams (relate clusters of stations to causative factors).

It has also been standard practice in marine surveys to list all species present in each sample. As any of over 4,500 species might be present, a highly trained taxonomist is required to make the identifications. Usually there are substantial numbers of a few animals and one apiece of the rare kinds. The result for each station is a species list of Latin names several pages long. No person or computer, to my knowledge, makes very effective use of such lists.

All of the above techniques are very inconvenient for those charged with monitoring and not very helpful to those who must interpret or only read the results. Moreover, obtaining the data required to make those lists and analyses is from 2 to 10 times as expensive as the methods we have developed.

In separate but interlocking studies, we have determined background or control conditions for the southern California shelf and made an intensive survey of the areas of greatest interest. Most importantly, we have been able to formulate a logic, based on a large amount of data, that can be used to identify those areas of the bottom that are polluted.

Let me try to explain the quandary that scientific ecologists find themselves in relative to the terminology used by the public and the press. Words such as pollution are seldom used by scientists unless a definition and explanation is given at the same time. This is because virtually everything that is considered to be a pollutant is already present in the ocean in large quantities; pollution means that a damaging excess of one or more pollutants is present. Thus, to decide if an area is polluted, the scientist must first define damage, and then he must have some way of measuring damage to humans, or marine life, or aesthetics.

We have chosen the life of the bottom as one of the most delicate and precise indicators of damage. There is no doubt that the bottom life has been changed greatly by man's waste discharges. In some of the areas that we have called "normal," the values for the three biological indicators we used--the number of species, the number of animals, and the weight of the animals--are equal to or greater than natural levels. In other areas, the number of species is somewhat lower, but the number and biomass of the animals is greatly increased. With 2 to 10 times more animals present (and these are perfectly acceptable animals), it is unreasonable to conclude that there has been damage, especially when this increased number of invertebrates attracts fish. This area is "changed." In still other areas, the number of species is about half normal, the number of individuals is about the same as normal, and only the weight (biomass) is above nor-mal. We have called this area "degraded"; many people will equate that with damage and, hence, pollution. On the grounds that two of the three principal biological indicators are below normal, we would not disagree. It happens that these degraded areas also have the highest levels of toxicants in the bottom muds. That is not entirely a coincidence, as these toxicants travel with the particulate organic materials the animals use as food, although we used feeding habits rather than toxicity to determine the boundary of the degraded area.

Some of these matters were discussed in the summary re-port of the Commission of the Coastal Water Research Project that was issued in June 1978. In that report, we presented our findings and tried to answer the questions most commonly raised by environmental groups. One result of that effort is that this year's annual report is later than usual. Additional delay was caused by the considerable time we spent assembling data on physical, chemical, and ecological mat-ters that could be used to respond to a long, complex EPA questionnaire commonly known as the "waiver requirements."

Also in 1978, in response to a request by the Los Angeles/Orange County Metropolitan Area Solids Management program, we predicted what would happen to the water, the bottom, and the animals off our shores if certain changes in wastewater treatment were made. These forecasts were published with my testimony before the Subcommittee on Water Resources of the Committee on Public Works and Transportation, U.S. House of Representatives, 25 May 1978. Some of the predictions of conditions that would exist 5 years or more after the implementation of changes (which included full secondary treatment) were as follows:

> "There will be no measurable change in plankton. The Infaunal Index of the bottom near discharges will slowly rise. There will be a great reduction in the number of invertebrates. The abundance of bottom fish will decrease, but some species now missing will return. The coliform count at nearshore sites will drop one to two orders of magnitude. Where DDT concentration in the sediments is now high, it will have fallen to 20 percent of that level by 1983 when the changes in treatment are assumed to become effective."

At that same hearing, I repeated some of my views about which possible pollutants require action and which materials do not make much difference under the present conditions of ocean discharge in southern California. Two classes of materials need continuing attention. The first are the highly toxic, man-made organic compounds such as DDT and PCB; it is plain that these should not be added to the ocean. They have already been reduced to very low levels by source control; efforts in that direction should continue. The second type of material requiring attention are the organic solids that are now released in such a form that 2 to 10 percent settle to the sea floor near the outfall. This material encourages growth of some sea animals, but an ex- cess of it may be damaging to these or other animals. The result is much the same as if food were dumped on land and allowed to rot. The food becomes a pollutant, not because it is intrinsically damaging, but because there is an excess at one location. If the same amounts of organic material issued from the outfall in a form that would not settle rapidly, there would be no build-up in a small area, and probably no area would be classified as degraded. The area of enhancement would be larger. In any event, excessive deposition of this material should not be permitted.

The remainder of the potential pollutants in municipal wastewaters that are often named are simply not problems in the ocean: No damaging effects are now caused by ammonia, pH changes, or bacteria, and there is no appreciable reduction of oxygen in the water in the discharge zones. After having reviewed tens of thousands of metal measurements in the water, the bottom, and the animals, I do not believe that metals are toxic in the forms and at the concentrations that are found in the ocean. Public response should be governed accordingly.

I hope the reader will find much of value and something of interest in this report.

WILLARD BASCOM
Project Director