DIRECTOR'S STATEMENT

This Project has been actively studying the ecology of the coastal waters of southern California for twelve years. In that time our scientific methods have become much more sophisticated, but our objective remains the same: We want to understand the effects of man on the sea off southern California, especially with respect to any changes caused by the disposal of a billion gallons a day of municipal wastewater.

Those who have followed our progress will recall that during the first few years of our existence the staff was largely occupied with reviewing the literature and assembling what was known from previous scientific studies and monitoring. Then, we began to take samples at sea and make our own careful chemical/biological measurements. We investigated inputs from streams, atmosphere and harbors; we devised improved methods of sampling; we began measuring subsurface water motions; and we worked to raise the taxonomic standards. Still later, our emphasis shifted to studies of unaffected areas in order to obtain more useful control data; to devising better methods of making comparisons between various areas; and to mapping life and contamination in the bottom. In recent years we have moved on to the higher level of technology illustrated by the scientific work described in this report.

In the same dozen years some of the problems changed, some of the laws and regulations changed, and the public perception of waste disposal in the sea changed. Scientists around the world worked to replace unsubstantiated opinions about environmental damage with facts and to understand "sources, sinks, and transport mechanisms."

The casual waste disposal practices of the 1960's that permitted large amounts of DDT and other contaminants to be discharged into the ocean were replaced in the 1970's by rigorous source control and improved treatment. The result was that although the volume of wastewater continued to increase, the amounts of contaminants steadily dropped. By the 1980's our coastal waters were in remarkably good condition. The once-decimated pelicans are back in force, kelp forests now grow where only a few years ago none existed, the incidence of fin erosion disease is down, there are more species of intertidal algae than ever before, and tiny crustaceans swarm around outfalls, thus, attracting some species of fish that were missing for several years. The recovery has been substantial, but environmental conditions are not yet as good as might be wished. There is room for further improvement.

This brings us to the present situation. Our prior work has produced what is probably a better assemblage of information about the coastal waters of southern California than is available anywhere else in the world. Be that as it may, fundamental problems in ecology that apply not just to southen California but to all the world remain to be solved. They are not specific to these outfalls, treatment practices, or locations. Everyone will benefit from progress towards their solution. One advantage we have over other marine environmental laboratories is a large data base and a specific knowledge of areas with a wide range of contamination levels.

Let me give some examples of the world-class problems that we are now attacking: which of the over 40,000 synthetic organic chemicals are likely to be a problem in the marine environment? How can numerical values be assigned to contamination levels or to assimilative capacity so that areas can be evaluated and compared? What is the relation between an excess of some contaminant in the body of an animal and toxic effects on that animal or on its predators? How many samples must be taken (with each type of equipment) to give a valid answer to various ecological questions? How does one mathematically model a proposed waste disposal site and obtain valid estimates of what its effects will be with each of the several kinds and qualities of discharge? How does one evaluate changes in the assemblage of animals living in an area where there is no evidence of damage or toxicity?

It has often been said that the quality of science at a laboratory can best be judged by the depth and sophistication of the problems it is working on. We will be happy to be judged by this standard.

We have already made so much progress in answering some of the questions above, that the results can be described as breakthroughs in understanding effects of contaminants in the sea. I shall give two examples. First, the troubling question of which synthetic organic chemicals are likely to cause toxicity in sea animals. The number of these compounds in existence is in the tens of thousands. However, our group has found that it is not difficult to eliminate most of them from consideration so that attention can be focused on the potentially dangerous ones that remain. Our method is to divide the octanol solubility, which is equivalent to body fat solubility, by actual toxicity. The result is the Toxic BioAccumulation Factor, a number that simultaneously takes into account the likelihood of bioaccumulation and the measured toxicity of each compound. When the hundreds of organic chemicals released into southern California waters are tested by these criteria, we find that only about seven have a high enough TBAF to be likely to cause problems. These are: DDT, DDD, DDE, PCB 1254, PCB 1242, PCP and HCB.

The second example is the establishment of a relationship between bioaccumulation and toxicity. When contaminants at very high concentrations are immediately available to animals there are often acute toxic effects. In the real world of the sea this rarely if ever happens; the question becomes: What is the result of a long period of exposure to low levels of contaminants? Dr. David Brown's past and present work on this has shown that even though the level of metals or organic metabolites may rise above normal levels in animal tissues there is rarely any toxic effect. The reason is that a detoxifying protein named metallothionein sequesters metal ions and prevents them from reaching the enzyme fraction which is a site of toxic action. A tripeptide named glutathione acts in a similar way to protect enzymes from the metabolites of DDT's, PCB's, etc. This is indeed a breakthrough in understanding how animals protect themselves from the low levels of contamination that exist in many places throughout the world.

In the last two years our staff members have presented many papers at scientific meetings and have published at least 20 pieces in professional journals. Some of us testify before senate and