

The establishment of water quality standards for estuarial waters also places great demands upon the marine biologist. Again, the information now available to the estuarine scientist is inadequate. For example, a recent water pollution control bibliography on nutrients lists only 8 out of 137 references applicable to the problems of eutrophication in the estuaries. Advanced research of the highest caliber must meet this inadequacy and, to fill the gap, the National Marine Water Quality Laboratory has been established in Rhode Island. Initially this laboratory is undertaking studies of the elusive factors which regulate the growth of food organisms in estuaries. As part of this effort, complementary studies are being undertaken at other Federal Water Pollution Control Administration laboratories located on the Yaquina Bay at Newport, Oregon.

The effects of many forms of pollution are difficult to evaluate. The spectacular results of an adult fish kill are easily understood and appreciated. But there are many biological disturbances which are just as catastrophic, but which are not so easily observed. Waste heat discharged to an estuary may destroy the food supply of waterfowl. Pesticides in trace quantities may slow the growth rate of oysters so that they may never reach marketable size. Thermal or low-oxygen-level barriers may prevent anadromous fish from reaching spawning grounds. Common industrial wastes, such as those from sulfite pulp mills, may interfere with the natural reproductive processes of both shellfish and fish (Figs. 31 and 32). Efforts of Federal Water Pollution Control Administration and the Bureau of Commercial Fisheries have been instrumental in the development of highly sensitive bioassay techniques which measure the responses of critical organisms to these adverse combinations of toxic materials.

Even man is not exempt from the hazards of waste discharge into estuaries. Some species of fish and shellfish have a demonstrated ability to concentrate bacteria or viruses from sewage—to concentrate insecticides by a factor of up to 70,000 and to concentrate industrial wastes to levels thousands of times greater than in the water itself.

Ultimately, the prevention of pollution and enhancement of water quality rests in the hands of the engineer-scientist who must design the treatment plants and water quality control methods which have both the capability and the reliability necessary for the protection of our marine resources. Scientists of the Department are in the forefront of this effort to develop new methods and to better apply old methods. Advanced research programs are making use of highly sophisticated laboratory and field projects to explore how nutrients can be best removed from municipal and industrial wastes. Such processes as ion exchange, electrodialysis, and reverse osmosis, processes on the very forefront of knowledge, are under investigation even now. Computers, electronic instrumentation, remote sensing devices—in short, the most advanced tools of science—are being brought to bear on the problem.

The role of the social scientist must also be recognized, for he may well have the task of interpreting and analyzing public opinion. It is vitally important that there be an adequate understanding of the economic and social values of the estuaries, and that these values be utilized in benefit-cost analysis. This need is being considered in comprehensive river basin studies and in pollution abatement research and studies to help better define these elements as a step toward better management of the Nation's resources are being developed.

In summary, the Nation appears to have recognized that the estuaries are a valuable national resource which must be preserved and managed for the public good. In many cases the control of pollution will be the key to the success of this effort. In turn, effective control of pollution requires the acquisition of a great deal of additional knowledge about the effects of thousands of different water quality factors on a complex biological system of plants and animals. Many of the programs of the Department of the Interior are oriented toward the generation of this information and its translation into effective means for protection and preservation of one of our great natural resources—the estuary.