

Environmental Change and the Northeast Pacific Ocean Fisheries: Introductory Remarks

MAURICE E. STANSBY

Effects upon the biota brought about by alterations in the environment induced by man are discussed in the series of papers in this issue of *Marine Fisheries Review*. Not included in these considerations are changes brought about by harvesting operations in the conduct of a fishery. Thus, depletions of resources from overfishing will not be considered.

The types of changes which are of chief interest here can be placed in three categories. The first of these relates to changes brought about by blocking of waterways, either by dams or by otherwise diverting water in rivers and streams. The second category includes changes which alter temperatures in waters inhabited by aquatic organisms. Water is utilized as a cooling agent in various industrial processes but will be in greater demand by the expanding thermal nuclear power plants. The third category includes operations which result in the transfer of harmful contaminants either through discharge as effluents or from fallout of air pollutants into waters containing aquatic life. This category includes such diverse pollutants as agricultural chemicals, petroleum oil, and municipal sewage effluents.

Whether or not any particular change in the environment from man's activities will have any serious harmful effect will depend, to a considerable extent, upon the species or on the condition of the particular aquatic organism in question. Some species of fish, for example, are exceedingly hardy and can withstand drastic environmental alterations, while others are very delicate and may be harmed when only slight environmental changes take place. Of even greater importance, however, is the stage in the life history of aquatic organisms when they are

exposed to altered environmental conditions. Fish at the larval stage, for example, are often exceedingly sensitive and may be killed or otherwise seriously affected at levels of environmental alteration that would go unnoticed by adults of the same species.

Another important factor in increasing sensitivity of aquatic organisms to potentially hazardous environmental change is the presence or absence of other stress conditions. Thus, fish in water of lower than optimum salinity may be seriously affected by other environmental changes, such as the presence of low levels of foreign contaminants that might not be apparent for an unstressed fish of the same species.

Even when, under some set of altered environmental conditions, a fish may be totally unaffected—even lacking any sublethal symptoms—there may be indirect effects if the particular altered environment should be lethal to the feed of the fish. Sometimes plankton, serving as an important source of food, may be much more sensitive to pollutants than some of the fish which feed upon them. Such indirect effects upon feed of aquatic organisms can have important adverse actions upon the organisms by depriving them of needed food supply.

Such problems of interference with the well-being of the organism have been important as factors in the determination of the thriving or depletion of fish populations in various geographical situations for many decades. It is only recently, however, that the serious nature of such potential harm has been fully realized. With a much fuller awareness of these hazards much more attention is being paid toward taking steps which will minimize harmful alterations in the environment.

It is now commonplace in the United



Stansby

Maurice E. Stansby is with the Northwest Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Blvd. East, Seattle, WA 98112.

States to reach decisions—upon whether to permit specified industrial or other operations—to require that an Environmental Impact Statement (EIS) be filed. Such statements often indicate that the potential for harm is so low as to be tolerable. These are written by experts, having knowledge which may enable them to accurately predict what effect the proposed action may have upon fish or other organisms in the biota.

An Environmental Impact Statement can be useful only if sufficient facts are available to the expert who prepares it to enable him to render a valid opinion. The realization of the potential hazards arising from alterations in the environment has come about so recently that there has been inadequate time for research to establish limits for potentially adverse effects. In many cases the facts needed are either not available at all or are so incomplete as to make the statement one that is based on guesswork as much as on sound knowledge. Much of the research to establish a basis for reaching decisions upon the hazards of man-made environmental changes is still at an early stage. A large part of the past research has exposed fish to levels of pollutants far in excess of what occurs in the natural environment. This procedure is often necessary in preliminary studies because the levels occurring under natural conditions are so low (parts per billion, even sometimes parts per trillion) that procedures have not yet been worked out for measuring such low levels. Yet, when preliminary investigations expose fish to levels of parts per million (perhaps thousands of times as much as occur under natural

environmental circumstances), there is no assurance that the harmful effects that may be found would be present at the lower levels.

With inadequate information upon which to prepare an EIS, the expert must nevertheless come up with some judgment. All too frequently, there is neither a precedent to indicate what harm has resulted in an analogous case nor any scientific data which can be used with confidence to predict what is likely to occur in a particular situation. In such an instance the expert(s) preparing the statement are likely to speculate on theoretical premises, even though no facts are available to support such a theory. Such judgments, based upon efforts to protect the biota when adequate facts are not available, frequently bias the situation to an extent that when the facts later become

available, it becomes evident that the precautionary protective measures adopted may have been too restrictive—perhaps unnecessary.

This situation demonstrates the need for two urgent steps. First, much more research is required to show the extent of damage to the biota caused under many different circumstances when environmental alteration occurs. In the second place, it must be realized that it is impossible at our present state of knowledge to adopt permanent regulatory measures or guidelines for protection of the biota against contaminants

in the environment and related alterations brought about by increased industrialization. Rather, we must look upon most measures adopted now as provisional, subject to modification to make them more or less restrictive as research facts accumulate.

The following papers prepared by staff members of Northwest Fisheries Center give detailed discussions of some of the man-made environmental changes which are having, or will in the future have, potentially adverse impact upon the fisheries in the northeastern Pacific Ocean.

MFR Paper 1217. From Marine Fisheries Review, Vol. 38, No. 11, November 1976. Copies of this paper, in limited numbers, are available from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Copies of Marine Fisheries Review are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for \$1.10 each.

MFR PAPER 1218

Pollution in the Northeast Pacific Ocean

NEVA L. KARRICK and EDWARD H. GRUGER, Jr.

Contamination of the northeast Pacific Ocean is generally thought to be below the level of serious pollution found in areas such as the North Atlantic Ocean and other oceans of the world. This does not mean that no problems exist or that this is an unusual area that has more self-purifying properties than other marine areas. Contamination does exist as evidenced by contaminated estuaries in various coastal areas and by the levels of chlorinated hydrocarbons, such as DDT and polychlorinated biphenyls, in the fat and blubber of marine mammals in the northeast Pacific. These animals obviously have been in contact with persistent contaminants, but whether this contact occurs on the high seas or in coastal waters is unknown.

The relative freedom of the north-

east Pacific Ocean from pollution has been an accident of geography and timing. The settlement and industrialization of the area was slower and occurred later than on other U.S. coasts and even now are concentrated in only a relatively small proportion of the coastline. The prevalence of on-shore winds and currents and the relatively narrow continental shelf with a sharp dropoff are also important factors. The shallow, cold Bering Sea will require special consideration when industrialization increases in the future. This lack of serious or recognized general pollution emphasizes the need to examine existing contaminants and the factors that may help to indicate if, when, and where problems may be developing. The information reviewed in this report includes research that is



Karrick

Gruger

Neva L. Karrick and Edward H. Gruger, Jr. are with the Northwest Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Blvd. East, Seattle, WA 98112.

generally applicable and not specific to any single geographic area.

Emphasis in this report on pollution is directed toward the use of coastal waters of northwestern North America as a receptacle for man's wastes from domestic, industrial, and agricultural activities, in addition to factors involved in evaluation of effects on the marine life. Attention also is given to the history of attempts to minimize the input from these sources, an evaluation of the success and limitations of these attempts, and a discussion of current actions.

Oregon, Washington, Alaska, and