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Report of the Committee on Oceanography: 'What Does It Mean to Commercial Fisheries?'

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THE FISHERMAN'S LOT is not an easy one. He enjoys no 40-hour week, no guaranteed comfortable working conditions, company life insurance or retirement benefits.

He works long, irregular hours, away from home, in all kinds of weather, and frequently on rough waters. While he is at sea, sleep is a luxury; working days of twelve to eighteen hours are not uncommon.

Fishermen of the north experience extreme cold that freezes their nets and blocks on deck so that they must be thawed with heated sea water. Sometimes their ships become dangerously unstable from frozen spray which must be chopped loose and thrown overboard.

Fishermen of the south sometimes suffer spoilage of their catch in hot weather before it can be delivered to market.

All fishermen suffer the vagaries of nature, of scarcity at one time, overplenty at another. Economic conditions act in various ways to alter prices. These factors add to the fisherman's problems by providing a fluctuating, undependable income.

We lack understanding of nature's effects upon fish abundance, and the effect of these changes upon all types of fishing, whether it be trawling for shrimp or groundfish or harvesting of coastal oysters and clams.

Oyster fishermen work hard to plant shell and seed, often to find that an unknown disease or a hurricane has spoiled the harvest.

Fishing is not now an efficient process. A trawl catch on the Grand Banks may contain five to ten thousand pounds of many types of fish. But our technology and markets allow the use of relatively few varieties. Consequently, a considerable amount of protein is washed back over the side after fishermen have expended labor to catch it.

When fish or shrimp are delivered ashore, they may not be acceptable for market because delays in fishing or weather may have allowed bacterial decay to spoil the catch. Desirable species of food fish often end up in a meal plant, for a fraction of their value had they been landed fresh from the sea.

Improvements in methods of catching and processing fish have been made in recent years, but, on the average, fisheries of the United States have declined in relation to other food-producing industries. Many segments of the United States fishing industry are facing difficulties which are causing them to shrink, to lose their former position of importance in the United States economy. In 1950 there were about fifty large trawlers fishing Georges Bank in the North

Atlantic Ocean. Now there are about thirty. Young men are not entering this industry. It is not attractive to them financially, and the work is hard. The fleet of tuna vessels working out of California ports is shrinking. As vessels become old they are not being replaced. The shrimp industry of the South Atlantic and Gulf Coasts is experiencing economic difficulties from imports and severe competition between fishermen for shrimp available on the fishing grounds.

How can research in oceanography help the fishing industry?

Assume that through oceanographic studies in the future we have complete knowledge of how fish react to combinations of various stimuli, and that we can apply this knowledge to catch fish from wide expanses of the ocean, either from the upper waters or the bottom.

For example, we know now that some fishes make noises and that some will react to sounds of various kinds. They might be attracted or repelled by sound vibrations of the right frequency and intensity.

Similarly, fish will respond to traces of chemicals, to visual barriers such as a curtain of air bubbles, or black dyes, or to light. Their movements can be controlled by electricity.

A fishery of the future, say on Georges Bank, might operate as follows:

An underwater craft, possibly powered by an atomic reactor, is used to scout a five-mile area to chart distributions and numbers of fish. The search for fish is made with the aid of underwater television, echo rangers and by direct visual observations. Next, four surface vessels, one mothership and three smaller ones, following directions from the undersea craft, approach from the edges of the area, towing sound vibrators which herd or drive fish towards the center of the circle.

Slowly, these vessels converge reducing the circle of sound until fish are concentrated within a radius of a half mile. One vessel is then detached from the others, which continue to hold the sound barrier, and an electric cable and chemical dispensing hose are placed around the group of fish. This will then be drawn in, concentrating them into a circle of a few hundred yards, using traces of chemical solutions and visual dyes to tighten the web of control.

Next an electric current pulls the school tight and raises it to large pumps where it is drawn aboard the mothership.

With suitable manipulation of the electric current the catch is sorted by size —perhaps even by species—as fish are pumped aboard. Those which are destined for filleting could be drawn aboard first, those for reduction to meal and oil later.

Next, conveyor belts carry the food fish through filleting machines, after which they are packaged and frozen or preserved by atomic radiation. The fish are processed in prime condition in less than an hour after being taken from the sea. This whole operation, resulting in the catch of all fish of the desired species and size in a five-mile area, has required about two hours.

Georges Bank, or a similar vast area of the sea, is fished with a few specialized vessels during ideal conditions of season and weather. Fishermen work in heated or air-conditioned compartments instead of handling fish in freezing weather or under the hot sun.

This highly efficient method of fishing, admittedly rather imaginative in terms of today's knowledge, can be achieved provided we learn enough about the sea and the fish in it. It presupposes that we know as much about animals in the sea as the farmer does about those on land. We must know: (1), how many fish of all kinds are in the sea, (2), how they are distributed, (3), what factors

control their abundance, (4), how they respond to various stimuli, (5), how they can be caught at the right time in their life to ensure maximum production and (6), how many to spare so that future production is assured. The last item is very important. For each species, we must know the maximum rate at which fish may be caught and still assure future production, for with such efficient methods of fishing it would be easy to reduce abundance quickly and endanger spawning stocks. Thus knowledge derived through oceanography can lead the way to wise fishing practices, better working conditions, and reduce production time and costs.

Besides revolutionizing our methods for harvesting the open sea, new research can lead to development of other ways of producing fishery products, for example, farming the edge of the sea, growing shrimp, crabs, oysters, clams and fish in ponds or portions of estuaries. Under such controlled conditions, more desirable products could be developed through selective breeding, predators could be controlled, the environment manipulated, and the animals fed on highly nutritive diets for rapid growth. Fish and shellfish could be grown to market size in a few months. The fishing industry might become known for "Beltsville" shrimp or Black Angus oysters as agriculture has become famous for certain strains of turkeys and cattle.

A realization of the need for the United States to gain more from the oceans, through increased resource production, improved transportation, better understanding of climate, and greater protection against military attack, led the National Academy of Sciences to examine the Nation's needs for oceanographic research. The Committee, organized in 1957, made a survey of the present status of the marine sciences in the United States. Its report, "Oceanography 1960-1970," (National Academy of Sciences—National Research Council 1959) contains recommendations which can strengthen marine sciences and, among other things, lead to greater development and utilization of ocean resources.

The Committee found that relative to other scientific endeavors progress in marine science has been slow. Research undertaken in the past has been done under difficult circumstances, handicapped by insufficient manpower, ships, and shore facilities. In the field of ocean resources, this has prevented an adequate understanding of the occurrence, behavior and potential harvest of fish and many other marine organisms. This lack of understanding is a serious barrier to their full economic development and utilization.

The Committee has, therefore, recommended that research on fishery resources be expanded over the next ten years. New information should be produced which will help fishermen improve methods of harvesting. Research on fish behavior, physiology, response to stimuli, and genetics of marine animals has been stressed. New knowledge gained about the oceans and its life can lead to new ways of fishing and of growing fish and shellfish even more startling than those described here.

Research and surveys have been recommended which will define potential yields of latent fisheries and reduce fishing costs by predicting times and places where fish concentrate. It may even be possible to modify the marine environment and thus improve fish survival and smooth-out abundance fluctuations.

It is easy to foresee that, in time, wide expanses of the open ocean and many coastal areas will be fished or farmed to increase our protein supply. Many species, not now utilized, will be brought to market. There will be need for radical changes in methods of fishing and in our concepts about use of products from the sea. The National Academy of Sciences has told scientists, Govern-

ment, and the fishing industry what must be done to accomplish this goal. The gains can be substantial but only after long-term, painstaking research, which should be started without delay if we are to compete with other countries or even maintain our present position among the fishing nations.

LITERATURE CITED

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The Effects of Pesticides on Sport Fisheries

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Abstract

Pesticides for agricultural use are being applied at such great rates in the United States that they must be considered as a major factor in the welfare of our fishery resources. It has so far been impossible for fishery research to keep up with the growing use and increased potency of these chemicals, but recent legislation directing the Secretary of the Interior to undertake comprehensive research on the effects of pesticides on fish and wildlife has dramatized the need for careful study. The insecticides pose the greatest threat to fish; of these, the chlorinated hydrocarbons are most dangerous because of chemical stability and slow detoxification. The Bureau of Sport Fisheries and Wildlife has organized a laboratory at Denver, Colorado, for research on the complex of fish, water, fish food, and pesticides, involving both biological and biochemical studies. The laboratory's program will include cooperative work with entomologists and chemical industry scientists to develop more specific and less toxic pesticides and improved methods of application.

THE MANAGEMENT of the inland sport fisheries has always had to consider the factors which tend to reduce fish populations. The effects of exploitation by fishermen, the survival of planted fish, and the improvement of the environment have been intensively studied, and progress has been made in maintenance of sport fish populations as a result of understanding these factors and applying improvements. Fishery science has made good progress in fresh water in providing fish for the creel, and in maintaining fish populations at safe levels. This has been possible because of long experience, long-term research, and hard work.

A relatively new threat has been added to the list of influences which adversely affect fish populations. Pesticides, including insecticides, weed killers, and other economic poisons, have come into such widespread use since World War II and have proven to be so poisonous to fish that they must now be ranked as a major factor in the welfare of sport fish in nature. Fishery biologists have been aware of the threat from pesticides for a long time; but it has been impossible to keep pace with the growing use of these toxicants in so many situations and in such widespread applications in the face of the augmented number of new agents, and with the increased potency of the newer insecticides.

Over 200 pesticides and more than 6,000 brand-named products are now marketed.