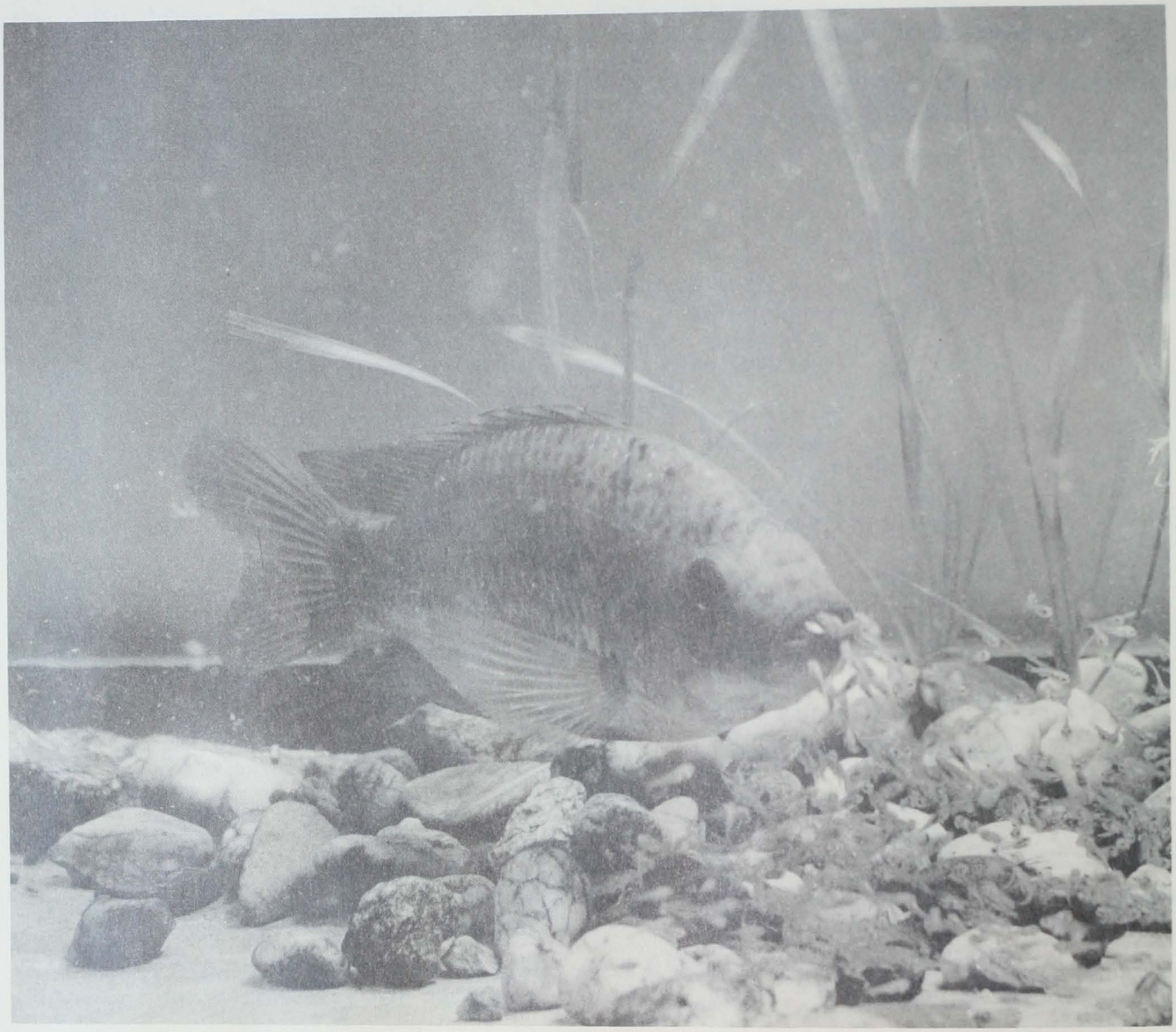


Tilapia fry seek shelter in their mother's mouth when frightened--here, by the photographer's flash. (FAO)

STRUGGLE TO CLOSE PROTEIN GAP REPORTED BY 60 NATIONS

Sixty members of the United Nations family ave responded to a questionnaire from the orld organization asking what they are doing ow and what they propose to do in the next years to improve and increase "the produc- ion and human consumption of protein." heir answers, reflecting the state of their conomic condition, prompted Secretary eneral Thant to warn about the "crippling rgency" of finding a solution to the problem.

The UN sent the questionnaire because it s studying a "possible reallocation of the esources" the agency itself is using to close he protein gap. It has compiled the answers n "The Protein Problem," along with state- nents by its own agencies: WHO, FAO, JNICEF, and the Protein Advisory Group PAG).

From the 60 answers, the report states, "it s clear that there is widespread support for n immediate emphasis on the use of con- entional sources of supply to meet protein eeds." There is general recognition that unconventional sources of protein will play n increasingly critical role."

For all nations, in all parts of the world, the heart of the matter is to ensure adequate onsumption of protein by the very young and y pregnant and lactating women."

THE PROBLEM IS NOW

The report rings an alarm: "The size, rgency, and rapid emergence of this problem nust be fully understood. About half the opulation of the developing world is under he age of twenty years and about a quarter s below the age of eight. Thus, the number f growing children is already very large, nd, irrespective of the effectiveness of pres- nt and future programmes to limit population growth, the young people already alive will hemselves soon become the parents of yet more children. The key to the protein prob- em is to have sufficient supplies of appropri- ate foods, that will be accepted and actually consumed, ready in time to feed the children who will inevitably be born within the next few years. Indeed, the remainder of this century is likely to be crucial for mankind."

And the report emphasizes: "No blueprint for the solution of the problem can be de- veloped by those unfamiliar with local prob- lems. Plans which have any chance of being applied can be made only by those on the spot and aware of all the circumstances. Plans which do not lead to appropriate action do not help to solve the protein problem."

UN GROUP'S RECOMMENDATIONS

The Protein Advisory Group (PAG) to the UN's FAO/WHO/UNICEF, commenting on the replies, stated: "Because the largest volume of protein must come from conventional animal plant and fishery sources, which are currently the most acceptable and desired foods, their production, preservation, and storage must receive primary emphasis."

Concerning fishery resources, PAG rec- ommended:

- "Improvement in the efficiency and broadening scope of both marine and inland fisheries, including fish farming. Investiga- tions in this area must include methods of distribution, preservation, and marketing."

- The development of fish protein concen- trate (FPC) and its uses in forms suited to local conditions. "Actual production should be encouraged in developing countries with substantial marine resources but only after preliminary trials have demonstrated that a wholesome product can be made from avail- able raw materials and will have practical food use."

- "Encourage the development of fisheries with particular reference to the creation of demand for fish and fish products and the development of economic preservation and distribution techniques."

FISH

Fish is one of the best sources of protein in quality and quantity. But it can contribute more to world protein supplies than it does

now. The factors contributing to this condition are inadequate fishing boats and gear, shortage of trained fishermen, difficulties in preserving fish, a highly perishable food, and dislike of fish in some countries.

The answers to the UN questionnaire report the worldwide efforts to improve marine and freshwater fisheries. These efforts seek to identify and assess new sources of fish; conserve fishery resources; promote development of commercial fisheries in order to catch, process, and distribute widely fish and fish products acceptable to the public.

The UN Report points out that a country eager to modernize its fishing industry needs many modern fishing vessels with refrigerating and freezing capacity, fishermen trained to use this equipment, and transport, storage, and marketing facilities. Even if funds exist to build and operate such facilities, it would take too long to produce food that could have "quick impact on the protein problem. The production of marine fish may have to be a long-term aim."

The following reports reveal the state of affairs in the reporting nations--and also illustrate that of many other nations:

ASIA

INDONESIA: The long-term aim was accepted by Indonesian scientists studying the protein problem. They decided that it would take more ships and facilities to improve sea fishing quickly enough than can be "pressed into service immediately." In the short run, effort should be concentrated on developing inland or brackish water fisheries. These are easier to improve with existing knowledge, and immediate costs are less.

PHILIPPINES: The government is concentrating on fish rather than on livestock in its efforts to increase protein sources because the country has great fisheries potential--and it is less expensive than developing livestock production. Its first planned activity is to increase the area of fish ponds, especially in brackish water.

Its other activities show how expensive it is to develop a marine-fishing industry. It needs more vessels, greater efficiency of present vessel equipment, a pier, dry-docking space, and marketing facilities and refrigerated warehouses to store catch. It plans to ask the aid of FAO experts now on the islands to locate regional fishing ports and harbors.

SINGAPORE: Its first aim is to increase fish-pond productivity. Also, it is carrying out schemes to improve marine fisheries. A fish-training institute is being set up at Changi with the help of the UN Development Program to train off-shore and deep-sea fishermen. A marine fisheries research department is being organized at Changi, sponsored by the South-East Asian Development Center, with help from several South-East Asian countries and Japan.

This department "will function to develop fishing grounds by experimental fishing; to research into fishing gears, equipment, fishing methods and handling of fish at sea; to investigate fisheries resources and fisheries oceanography; and to train research personnel. The department will be equipped with a modern research vessel."

At the Jurong Industrial Wharf, a modern, multimillion-dollar harbor complex is being built. The harbor itself is completed. Other shore-supporting facilities--ice plants, cold rooms, and processing installations--are being set up. A central fish-auction market is being built and subsidiary markets are planned for other places. Private enterprise is being encouraged to take part. A few joint fishing ventures involving more advanced fishing nations have begun, and negotiations for others are well advanced.

The Singapore Economic Development Board gives loans to finance large fishing enterprises. The Primary Production Department plans a loan scheme for small fishermen and cooperatives.

The UN Report explains that it has detailed Singapore's operations "to illustrate the complexity of developing fisheries, the need for international cooperation and cooperation between Governments and private industry and the expense involved."

SOUTH VIETNAM: It is being helped by the United Nations Development Program (UNDP) to study the fish potentialities of the continental shelf.

SOUTH KOREA: Between 1962 and 1966, "there was remarkable development of fisheries in the republic. The government plans to increase production at a 15% annual rate

during the Second Five-Year Economic Development (1967-1971).

LATIN AMERICA

The FAO/UNDP Regional Central American Fishery Development Project covers several countries, including El Salvador, Mexico, and Panama. It will go on for 5 years. Its immediate goals are to gather information about fish resources, including crustaceans, in the Atlantic through exploratory fishing and laboratory study. The aim is industrial production and marketing--and improvement of the professional competence of fishery researchers in the area.

VENEZUELA: A 1967 agreement with FAO and UNDP makes possible the country's most comprehensive program of fishery research and development.

MEXICO: The National Biological Research Institute "is investigating the area, size, structure, and potential of known fishing grounds" and is trying to find new ones. It aims to develop the fishing industry and make it more efficient.

PANAMA: It is administering an FAO project to promote the eating of herrings. These are abundant in coastal waters, can be sold much cheaper than other fish--and have never been caught in commercial quantities or marketed on a large scale because they were not in demand.

EL SALVADOR: The government gives credits and technical assistance to those with artificial ponds for fish farming. Lakes are stocked with high-yielding fish. The "flourishing shrimp fisheries" are worked by 73 vessels, but nearly 80% of the catch is exported; only 1.5% is used for domestic consumption. There is a project to promote fish consumption under the Regional Fisheries Development Project.

PERU: 98% of the marine fish landed is used by the fish-meal and fish-oil industries; the remainder is eaten. Many species of available fish are not eaten. Little is known about fishing the countless rivers, lakes, and lagoons. Trout is abundant in Lake Titicaca in the Andean region; and it is popular fresh and preserved. Three firms produce canned trout.

Several government programs seek to develop fishery resources. It is state policy to encourage fishing for food fish. Peru provides tax exemptions especially for fishermen's cooperatives. Fishery activities are given credit priorities. Training is provided to operate cooperatives. There is an educational plan to promote the eating of fish.

The major obstacles to developing fishing for human use are: traditional industry methods; lack of knowledge of Peru's fishery resources; few firms interested in fish for human use; and demand is limited by high prices caused by poor marketing system and poor display. The government hopes these will be overcome by the Sectoral Fishery Plan, an integral part of the 1967-1970 Economic and Social Development Plan.

A 1964 decree contained incentives to promote industrial production of cheap protein foods for people. The decree exempts machinery and raw materials. It offers tax incentives to stimulate investment. All projects must be approved by the Institute of Nutrition, Ministry of Health and Social Welfare. The food to be produced must contain 10-70% protein.

GUYANA: The Ministry of Agriculture long has tried to develop marine fisheries. It provides credit, duty-free concessions for gasoline, oil, and nets, large discounts on ice purchases--and landing facilities in cities and rural areas. The government supplies selected species of freshwater fish to farmers who want to develop fish ponds. The fish are raised in carefully designed ponds and provide protein food for the farmers.

AFRICA

The UN report states that "essentially similar reports come from Africa."

ETHIOPIA: "Although Ethiopia's inland waters and the coast of the Red Sea have good potentialities for fish exploitation, the insufficiency of modern fishing equipment and the lack of technical know-how have greatly retarded the possible development of fish economy in Ethiopia. Also the potentials in the rivers, lakes and the Red Sea coast have not been completely surveyed. Obstacles for the development of the fishing besides the lack of equipment and vessels are due to an

underdeveloped market and a lack of organizations to help the small fisherman. At present, the greater part of the fish caught comes from the Red Sea while inland waters are still unexploited and used only for small scale fishing for the local population or not at all in areas where fish is considered a low status food."

The government plans to overcome these obstacles. The nation's first fish-exploiting project will soon begin in an inland lake to benefit the domestic market.

TANZANIA: Reports great potential for freshwater and marine fisheries, "which so far remain virtually unexploited."

LIBERIA: It has begun a pilot project to produce carp aided by the Oxford Committee for Famine Relief of the U.K. A private corporation, Mesufish, distributes saltwater fish to nearly all major population centers. The source is the offshore waters of Liberia and west Africa. After processing and freezing, it is distributed to cold-storage centers--"from whence it moves into retail channels, largely operated by local marketers. The result of this private initiative has been to make fish protein available throughout the country at prices lower than have been realized previously."

NIGERIA: The Federal Government has invited experts to study the potential of the fish industry in order to increase the eating of fish protein.

MIDEAST

The UN Report states: "In Cyprus, Iraq, Jordan, Kuwait, Malta, and Turkey, activities essentially similar to those already described for other parts of the world are in progress or planned."

ISRAEL: Research has produced practical results in controlling brackish water and freshwater algae that produce toxins lethal to pond fish. The work is continuing at the Hebrew University-Hadassah Medical School and the Fish Breeding Research Laboratory.

EUROPE

The Report continues: "France, the Netherlands, Norway, and the United Kingdom as well as Canada report constant efforts to improve their own fisheries and catches, although during recent years the Swedish fishing industry has tended to stagnate, mainly due to competition from inexpensive foreign-caught fish."

UNITED KINGDOM: Government laboratories conduct much sea-fisheries research "to help the fishing industry to catch fish efficiently and economically and, in collaboration with scientists of other countries, to provide the scientific basis for conservation measures to protect the stocks and ensure rational exploitation of the resources." There is research to develop techniques to rear artificially in tanks plaice, sole, turbot, oysters, clams, and prawns. It is too early to say whether this fish farming can become an economic or competitive source of food.

Good progress is reported in rearing young fish to marketable size in sea-loch enclosures and in warm water discharged from generating stations. A pilot-scale plant has been built to develop methods to mass-produce shellfish. Research is starting on river management to increase production of salmon, sea trout, and brown trout. The National Environment Research Council is investigating possible use of krill and unexploited Antarctic fish stocks as new protein source.

FRANCE: Sea resources are developed by intensifying traditional fishing, improving fishing techniques and methods of preservation, developing new methods of exploitation, creating new resources, and utilizing better fish-protein resources. Research on hydrobiology of freshwater fish and other living organisms is being expanded.

Both France and the United Kingdom reported their aid to developing nations, "particularly in education and training, catching ability, processing and distribution, fish culture and research." France aids the Ivory Coast, Malagasy, and Senegal. Le Centre Technique Forestier Tropical operates a UNDP project to train fishery personnel and conduct research in fish culture in Cameroon, Congo (Brazzaville), Gabon, and the Central African Republic.

PROTEIN FROM UNCONVENTIONAL SOURCES

"If the protein problem is to be solved," says the UN Report, "use must be made of protein from new and unconventional as well as traditional sources; waste fish was at one

time widely used as a fertilizer; later on techniques were developed for preparing fish meal for use as animal feed, and more recently much effort has been devoted to refining methods of production so that now it is possible to produce a bland fish flour intended for human consumption which is usually called fish protein concentrate."

FISH PROTEIN CONCENTRATE (FPC)

Chile reported that it had "enthusiastically welcomed the offer made by FAO and UNICEF in 1956 to set up the first pilot plant in the world at Quintero to produce fish flour for human consumption." This followed laboratory tests with South African samples produced by refining products designed for feeding animals. Technical and administrative problems hampered progress, but finally Chile produced a fish flour. "Chilean and foreign research workers have pronounced it nontoxic, of high nutritive value, stable, easily digested and assimilated either directly or as a supplement to conventional foods and preparations."

Other countries followed Chile's example. And, in Chile since 1964, the government promoted and supported studies of ways to use the product. During the last 2 years, protein-rich mixtures have been developed and tested successfully on very young and school-age children. Trials are planned in rural communities, in cooperation with the food industry, to use the mixtures in the feeding programs of the National Health Service and the School Welfare Board. The estimated demand for these programs, compulsory by law, is much greater than the production capacity of even the most modern fish-flour plants in Chile. So the problem of putting the concentrates on the free market and keeping them from groups other than the children "is less acute than it is in other countries with different administrative and political structures and a different economic and social system."

The UN has surveyed possibility of commercial production in Chile and Brazil.

EL SALVADOR: A Panamanian Health Organization (PAHO) expert has advised the government that because the fishing industry is not being developed, the production of fish protein for human use is not likely in the near future.

PERU: Production is encouraged and research is under way: e.g., the use of stick-water in fish-meal factories.

URUGUAY: There is laboratory production of a powder made by drying a material produced by fermentation of ground fish with yeast and sugar. "This powder is hygienically prepared, stable, cheap and highly nutritious and has been tested successfully in feeding undernourished children." There are plans to produce the material in a pilot plant at the Fisheries Research Institute.

ETHIOPIA & SWEDEN: Together, they are trying to produce FPC for humans. In Massawa, on the Red Sea coast of northern Ethiopia, a modern fish-meal factory, originally a Bulgarian-Ethiopian venture, was built to produce fish meal for animal feeding. In Sweden, fish meal is used for animal feed, but production at the Ethiopian factory has stopped because of supply and marketing difficulties. Recently, the Ethiopian Ministry of Commerce and Industry asked Swedish private industry to study the possibility of using the existing fish-meal plant, vessels, and fish resources in the Massawa region to produce FPC. Possibly, the product might be used as an ingredient of supplementary mixtures for children or in feeding school children.

MOROCCO: The UN is helping Morocco redesign its FPC plant at Agadir and promote and market its products.

NIGERIA: A foreign company is studying the practicability of making FPC. It is afraid that the price may be too high for needy Nigerians.

TANZANIA & NETHERLANDS: An experimental factory to produce FPC has been built in Tanzania. The planners will try to manufacture a product people will accept. The Instituut voor Visserijprodukten T.N.O. of the Netherlands is helping. Tanzania reports the project hampered by lack of fishing gear. It has found that samples made from fresh-water fish appear to be more acceptable than those from marine fish. One aim is to set up several pilot plants on Lakes Tanganyika and Victoria to produce about 10,000 tons. This would require 80% of the present fish catch and might stimulate industry.

A second aim is to manufacture high-protein food supplements with FPC for children. "This will require market research, recipe development, studies on consumer acceptance and methods of publicity and an appropriate team of research workers." A third plan is to study possibility of making marine FPC.

SOUTH KOREA: The production of FPC from waste fish might help improve the fisherman's income and stimulate the poorly developed fishing industry. The Department of Fisheries Processing of the Pusan Fisheries College is investigating the experimental production of FPC. This work is financed by the Ministry of Science and Technology.

THAILAND: A.I.D. of the U.S. and the Oceanic Development Corporation have approached the Thai government about the possibility of producing FPC.

SOUTH VIETNAM: It is not now considering production because fresh fish are insufficient to meet demand. But it is aware of the possibility of adding FPC to bread and using it in supplementary foods for children.

PAKISTAN: FPC is not made, but the government is aware of its usefulness.

TURKEY: Experiments are in progress.

FPC: EUROPE

France, Norway, the United Kingdom, Sweden, and the Netherlands "have considered the subject but report no positive development." The Soviet Union is working to enrich bread with FPC and also "the preparation mixtures of this concentrate with plant products."

CANADA: Production and large-scale marketing of FPC are unlikely within the next 3 years. Likely to continue are small-scale production for nutritional evaluation. "Full commercial scale production is likely to develop three to five years hence."

The UN Report concludes the FPC section with the statement that, for developing countries now, the necessary technology would make FPC expensive compared to more conventional protein sources.

WHAT UN IS DOING ABOUT PROTEIN PROBLEM

FAO recognizes that if a country's staple food is cassava, sago, or plantains, this will provide little protein. An important part of FAO's plan to aid developing regions is to supplement such crops by fish or rice or maize, which can be grown locally and are better proteins. FAO also helps to increase production of grain legumes, including soya beans. "However, regions unaccustomed in the use of these good sources of protein must be educated in their processing and consumption."

FAO is working to improve the contribution of the world's marine and freshwater fisheries to world protein supply. Its activities include "identifying and assessing new sources of fish; conserving fishery resources; and promoting the development of commercial fisheries with the object of catching, processing and distributing fish and fish products in acceptable form as widely as possible throughout the world."

FAO is investigating the harmful effects of pollution on marine and freshwater fishery resources and fishing. It is studying the great manmade lakes and reservoirs, especially in Africa, so they can be managed for greatest production.

FAO is helping to avoid waste. It is helping governments to develop the food processing and distribution industries. Codes of practice for fish and fishery products, and for freezing fish, are being developed. These will help prevent losses during storage and distribution.

The Protein Advisory Group (PAG) has prepared tentative processing and quality guidelines for developing high-grade standardized protein products from oil-seeds and fish. Its membership has been expanded to include experts in many specialties.

Asks Fuller Report in 2 Years

Although the 60 governments provided voluminous material, PAG asks that "a more complete report be prepared in two years' time to allow for the development of country replies and their analysis."

UNITED STATES

4 SCIENTISTS WILL LIVE AT 50-FOOT OCEAN FLOOR 60 DAYS

Early this year, 4 U.S. scientists will live and work on the ocean floor off the Virgin Islands for 60 days. The major purposes of the operation, called TEKTITE I, are to help determine the kind of worthwhile marine research scientists can conduct when placed in the sea--and to see how the scientists behave under the stress of a strange setting. The latter information would be useful also to space scientists.

TEKTITE I is a combined operation of the U.S. Navy, NASA, Department of the Interior, and the General Electric Co., builder of the underwater habitat to be used by the scientists. ('Tektites' are small minerals that have survived a blazing journey through space to land on earth or in the ocean.)

The Habitat

The ocean-floor home of the scientists, a pressurized laboratory, is 2 vertical structures 18 feet high and 12 feet in diameter. These are connected by a 4-foot-diameter tunnel. Each structure has 2 living compartments, one atop the other. Food will be carried down in the habitat. A lifeline linking it to shore will supply water and the breathing mixture of oxygen and nitrogen. Power and communications will be provided by separate cables.

The Scientists

The 4 scientists, all from Interior Department, are: Richard A. Waller, Conrad Mahnken, John Van Derwalker, and H. E. Clifton. They will be in voice communication with colleagues on land. Throughout the operation, behavioral scientists and doctors will watch the aquanauts-scientists through closed-circuit TV.

SOME INTERIOR DEPARTMENT GOALS

The Department of the Interior is represented in TEKTITE I by BCF, the Bureau of Sport Fisheries and Wildlife, Geological Survey, and the National Park Service (NPS).

The scientists will study phytoplankton, the microscopic plants that drift in ocean currents and are food for larger animals in the ocean's food chain. Water samples containing plankton will be pumped to the habitat from different depths in order to measure the biological richness of the area.

The zooplankton, microscopic animals that feed on phytoplankton and are themselves eaten by fish, also will be studied. The emphasis will be on their relationships to other marine life and to the reef area. Such plankton studies usually are conducted from a rolling ship by lowering sampling devices. Direct observations from the ocean floor should be better.

How Productive Is Marine Life?

The scientists will use different methods to measure production of marine life in ocean and reef areas to compare the relative advantages of these methods. The conventional estimate of productivity is based on measurements of the oxygen produced and consumed in a certain period. During TEKTITE I, special equipment will be used to entrap organisms and then measure their oxygen production and absorption of radioactive carbon (C^{14}). These studies may enable scientists to standardize methods and reduce the present variations in estimates of organic production in ocean waters.

Study Marine Organism Behavior

Most marine organisms act in characteristic patterns when foraging, mating, and fleeing predators. Greater knowledge of these activities would lead to better understanding of the life history of certain species; and, if commercial species were involved, to development of the best gear to catch them.

Early in the operation, spiny lobsters (source of 'lobster tails'), reef and predator fishes, and some mollusks will be tagged with sonic transmitters. Then the movements and habits of these species will be monitored on a small, portable, sonar device. Even if an animal secretes itself in a coral burrow 4 miles away, the device will be able to detect the signals. The tagged animals will be followed day and night. When a lobster is found,

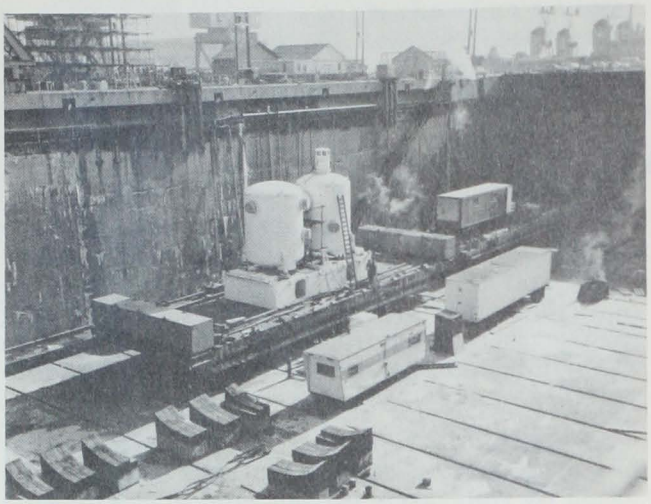


Fig. 1 - The TEKTITE I habitat undergoing systems tests in Philadelphia Naval Shipyard.

Fig. 3 - Interior view of quarters: bunks for the 4 aquanauts-scientists, entertainment console, and galley.

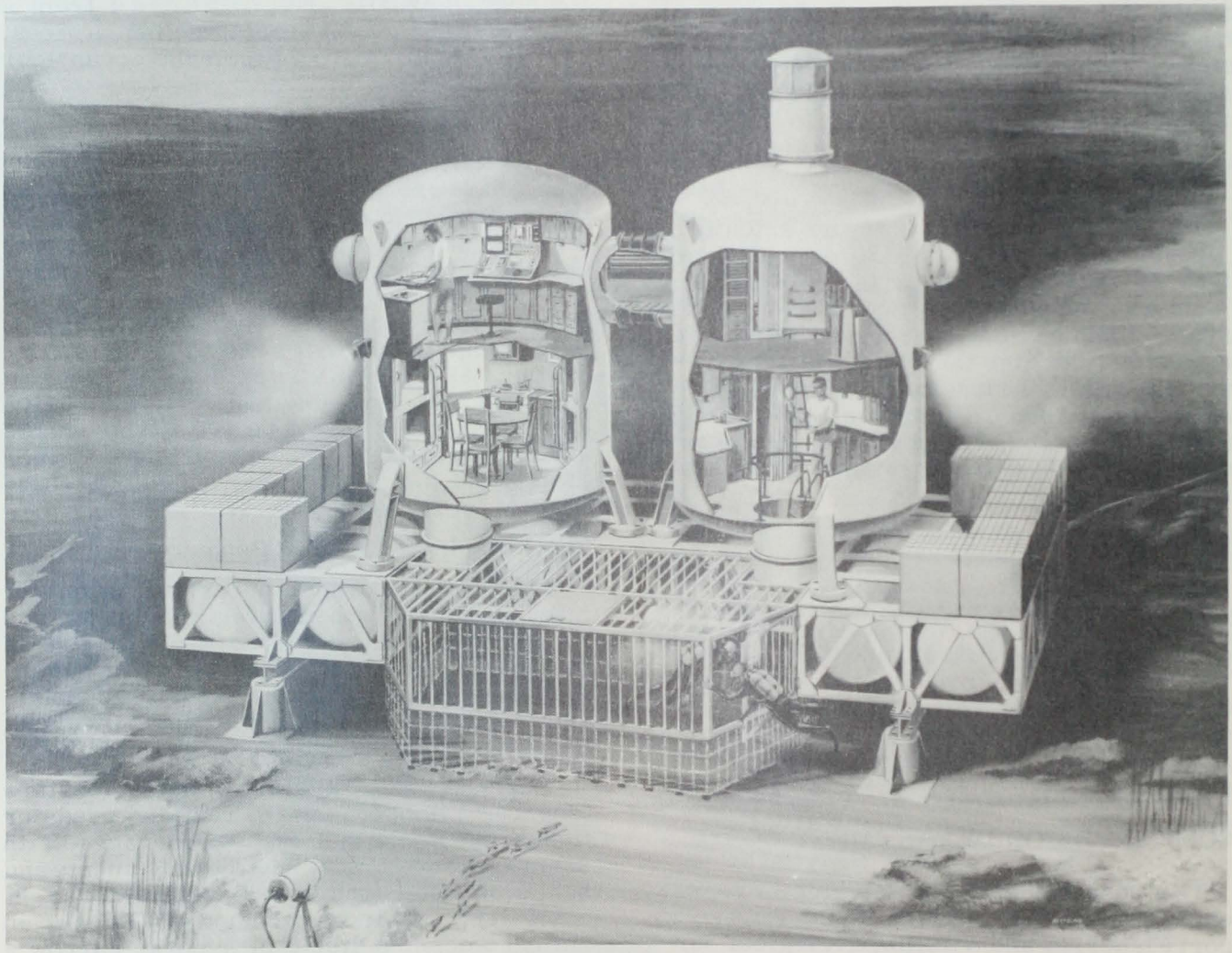


Fig. 2

the scientists will be able to determine its identity by a brand visible at night under ultraviolet light. When several representatives of a species are monitored, the scientists will accumulate information on "growth and survival, feeding habits, daily migrations, reproduction, responses to environmental changes," and other aspects of the species' life. Such observations are very difficult to make from the ocean surface.

Acoustical Studies

The increasing use of sonar in fishing makes it important to study its effectiveness in differentiating fish species--either by a characteristic signal return from one fish, or by signal recognition of swimming or schooling behavior of a group of fish. TEKTITE I will be an unique opportunity to identify sonar target species and correlate them with their acoustical "signatures."

TEKTITE SITE

The site of TEKTITE I is Beehive Cove in Greater Lameshur Bay, on the south shore of St. John Island in the Virgin Islands, about 900 miles southeast of Miami, Florida. The cove is in Virgin Islands National Park, administered by the National Park Service.

The water is very clear and warm, and tropical plant and animal life is abundant. The many coral reefs are home to vast reef-fish populations, spiny lobsters, and other marine life.

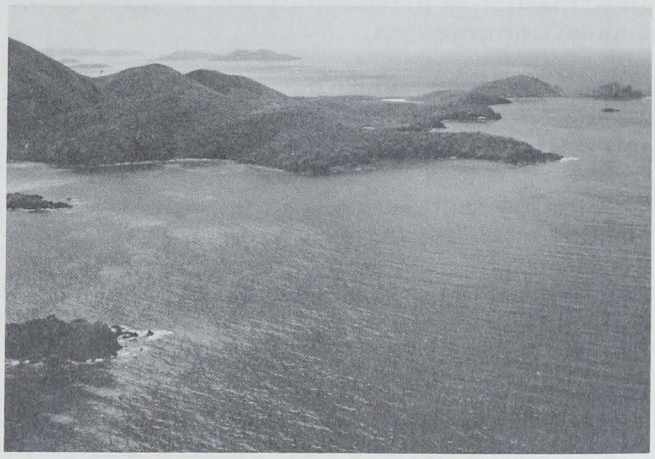


Fig. 4 - TEKTITE SITE. Aerial view of Greater Lameshur Bay off St. John Island in Virgin Islands National Park. (NPS: Fritz Henle)

First-Half 1968 Commercial Landings in Great Lakes Dropped

For the first 6 months of 1968, preliminary statistics from Michigan, Ohio, Pennsylvania, and Wisconsin show Great Lakes commercial landings of 32.3 million pounds; the figure for first-half 1967 was 41.3 million. This information is provided by the 8-state Great Lakes Commission.

BCF data showed 1967 landings for these states of about 78.5 million pounds--96% of the 8-state total for the lakes.

Ontario fishermen, who account for all of Canada's Great Lakes commercial catch, took nearly 20 million pounds in first-half 1968. It is a preliminary figure. The catch is 2.6 million pounds above the 1967 period.

1968 L. Michigan Catch

The first-half 1968 Lake Michigan catch by Michigan and Wisconsin commercial fishermen was 21 million pounds; it was 29.3 million in first-half 1967. The 1968 alewife catch was 12.5 million by the end of June.

Lake Erie

The 3 Lake Erie states reported first-half 1968 commercial landings of 7.8 million pounds, compared to the 1967 period's 8 million. Yellow perch landings, among the more valuable species, were 1.8 million pounds, 425,000 pounds more than in 1967. White-bass catch was 500,000 pounds, only half the 1967 figure.

Lake Superior

The Michigan-Wisconsin catch in Lake Superior was 1,958,000 pounds, nearly 200,000 pounds below the mid-1967 figure; the decline in lake herring was responsible for about half this loss. The catch of valuable lake trout, protected in Lake Superior, was over 113,000 pounds by June 30.

In Wisconsin, the 1968 catch quota of 75,000 pounds of lake trout was the same as in 1967. The quota is set to gain biological data necessary to follow the lake trout's recovery. In Michigan waters, the 1967 quota of 145,000 was raised to 330,000 pounds for 1968.

Lake Huron

Through June, the Lake Huron catch in the Michigan part was a little under 1.5 million pounds, a drop of 50,000 pounds from 1967. Landings of yellow perch and chubs, most important to Huron's commercial fishermen, declined more sharply. The perch catch of 365,000 was 30% below the mid-1967 figure. Chub landings dropped 40% to 86,000 pounds.

Ontario's Great Lakes Waters

In Ontario's Great Lakes waters, the important factor in a 1968 gain was the increase in Lake Erie landings: from 14.1 in 1967 to 16.4 million pounds. Smelt catch rose from 4.6 to 7.2 million pounds; it made up losses for some other species, among them yellow perch. The decline in Lake Erie's perch harvest from 8.2 to 7.6 million pounds may be attributed to new controls aimed at problem of oversupply. Provincial authorities report perch abundant in the lake, and expect fishermen to have no trouble catching second-half 1968 quota. For the other lakes, Ontario commercial landings rose in all areas except Lake Huron.

Lake Trout Releases Approach 30 Million

The young hatchery-reared lake trout released in 1968 in lakes Superior and Michigan exceeded 5 million for the third straight year. Records of the Great Lakes Fishery Commission show the number released in Lake Superior since 1958 has reached 22.6 million; for Lake Michigan, where plantings began in 1965, the total is 7.3 million.

In 1968, plantings of lake trout in Superior were 3,481,000 yearlings; a half-million of these went into Canadian waters. In U.S. waters, plantings were made in about 20 locations. These extended from Minnesota's North Shore to Whitefish Bay at the lake's east end.

Lake Michigan's 1968 plantings of 1,876,000 lake trout were made at 16 dispersed locations, including several in the lake's southernmost section. As reference, the U.S.-Canadian fishery agency used a system of fin-clip identifications for the young fish to show time and place of planting.

Haddock Recruitment on Georges Bank Continues to Fall

The joint cruises of BCF's 'Albatross IV' and the Soviet research vessel 'Blesk,' completed in fall 1968, provided useful information on survival of the 1968 spawning of Georges Bank haddock. Again, the abundance index of young-of-the-year was nearly zero. This makes the fifth consecutive very poor year-class, an unusual situation. It spells bad news for the haddock fishery for at least 1969 and 1970.

1963 Class Losing Dominance

The 1963 year class, which in recent years has been supporting the fishery, soon will lose its dominant position. The abundance of haddock has fluctuated widely. The 1963-year class was the largest in history. But, as it reached marketable size in 1965 and 1966, it was fished hard. The Georges Bank population is suffering from that overfishing. There is a real possibility now of depleting the spawning stock.

Browns Bank

The Browns Bank situation is similar. However, because of the slower growth rate there, the 1963 year class will remain in the population 2 years longer.

Halibut Fishing Effort Declines

In 1968, U.S. and Canadian halibut vessels made only 1,286 trips. In 1967, the figure was 1,750 trips; in 1966, 1,965. The 1967 decline resulted largely from strikes in Canada, the 1968 decline from low prices.

Total 1968 landings reached only 49 million of the 58-million-pound quota. Average production per trip rose slightly from 31,000 pounds in 1966, to 32,000 in 1967, and to 38,000 in 1968.

Good Outlook for N. California Crab Season

Northern California crab fishermen again can expect a good season, reports the California Department of Fish and Game. The 1968/69 landings are expected to be between 9.5 and 11 million pounds. This would be below the preceding year's outstanding catch of 12.2 million pounds--but well above the 10-year average of 7.3 million pounds.

The northern season, covering Fort Bragg to Crescent City, opened December 1 and will continue through July 15, 1969.

Crabs Better & Heavier

Marine biologists of the Department's Shellfish Investigations have been sampling the commercial catch since 1964. This season's predicted catch is based on samplings during the first 10 days.

The crabs appear in slightly better condition this season. The average size of legal crabs is substantially larger than last season's. The average weight of crabs in the commercial catch up to the end of 1968 was 2 pounds, compared with 1.8 pounds last season.

Tuna Fleet Grows

In mid-November 1968, the new tuna purse seiner 'Marietta' sailed on her maiden voyage. Her 65-ton carrying capacity brings the fleet's total, including that of small bait boats, to about 46,000 short tons.

The aggregate capacity of all fleets in the eastern Pacific tuna fishery is about 55,400 tons. In 1968, the U. S. added 6,000 tons and the other countries the same amount.

Trend to Continue

The growth of the tuna fleet is likely to continue. The vessels now being built, or in planning stage, will add an average of more than 6,000 tons a year to U.S. fleet for the next 3 years.

Other nations plan to expand and modernize their fleets. And some nations, not now fishing the eastern tropical Pacific, are thinking of participating.

Battelle Reports Vaccine Effective Against A Salmon Disease

Scientists of the Battelle Memorial Institute report that an oral vaccine has been successful in the laboratory in preventing C. columnaris disease. The disease has been killing many salmon and steelhead in the Columbia and other rivers. Several years ago, C. columnaris virtually destroyed a sockeye salmon run on a tributary of Canada's Fraser River system.

The oral vaccine, which can be mixed with fish foods, was developed by M. P. Fujihara in Battelle's Richland, Wash., laboratory, and has been used to protect juvenile salmon.

Years of Work Ahead

Fujihara said: "The oral vaccination of juvenile salmon against columnaris has been successful under controlled laboratory conditions. However, successful application of the oral vaccine to large scale production hatchery use will require several years of continued study. Identification and thorough knowledge of the disease is necessarily the first step in developing practical solutions." Fujihara, a biological scientist, and R. L. Tramel, a technician, have used the fish's ability to develop antibodies against the columnaris pathogen as a new method of surveying fish to determine disease exposure. This survey technique is said to be a sensitive, more effective, way to survey for C. columnaris.

Survey Technique

Juvenile salmon were examined during downstream migration from spawning grounds to the ocean. Adult salmon were examined during migration from the Columbia's mouth to tributary spawning grounds in Washington and British Columbia. Blood serum and other samples were taken from hundreds of coho, sockeye, and spring and summer runs of chinook (king) salmon. After the samples were taken, the adult salmon were returned live to the river and tributaries. Similar blood-serum samples were taken from individual yearling rainbow trout in the laboratory once a week for 6 months without harming them.

Field investigations have shown that about one-third the juvenile sockeye salmon sampled had been exposed to the disease during downstream migration and while entering the ocean. Antibody production was observed in about $2\frac{1}{2}\%$ of the adult sockeye sampled as they entered the Columbia's mouth.

Migration Hazards

"However," Fujihara noted, "both columnaris exposure and magnitude of antibody production increased during upstream migration until 70-100% exposure was observed on the spawning grounds." Some of the fish, on the upstream trip to spawning beds as far as 1,000 miles away, will be killed by "disease, exhaustion, predators, fishermen or barriers in the stream."

Studies have shown that population density and development of immune disease carrier fish (present in fish ladders) may be major source of disease exposure and infection during upstream migration.

Fujihara concluded: "This oral vaccine appears to be a practical and effective method for protecting young salmon against columnaris. If we could increase juvenile salmon immunity to columnaris to nearly 100 percent, more adults could make the return trip to their spawning grounds, or if we increase general survival by 10 percent, we could possibly double the number of adults which could return to the spawning grounds.

"Mixing this vaccine, and a vaccine against another salmon disease--furunculosis--into fish food may help control two of the main bacterial diseases of hatchery reared juvenile salmon. Columnaris vaccine incorporated into fish food could be extremely useful to State and Federal hatcheries which rear salmon."

Kodiak, Alaska, May Be No. 2 U.S. Fishing Port

Observers estimated in Nov. 1968 that the Port of Kodiak would have landings worth more than $15 million in 1968. The estimate was based on preliminary data compiled by the Kodiak office of Alaska's Department of Fish and Game. This would make Kodiak the second most important U.S. fishing port.

No. 3 in 1967

In 1967, San Pedro, Calif., was first with landings worth $29 million. New Bedford, Mass., was second with $16 million. Kodiak's $10 million placed it third.

Maryland Reports 1967 Was Record Year

The value of commercial fisheries products landed in 1967 was a record $16,912,898, reports Joseph H. Manning, Director, Maryland Department of Chesapeake Bay Affairs.

The value of manufactured fisheries products was estimated at more than $40,000,000.

Oysters led in landed values, 66% of total. Crabs were 14%; soft clams 9%; finfish 9%; hard clams and all other categories 1% each.

The Industry

About 9,000 fishermen--2/3 of them have no other employment--harvest Maryland's seafoods. About 6,500 boats and vessels harvest and transport the catch. The number of wholesale and manufacturing establishments has declined steadily: from 357 in 1957 to 285 in 1965. But the number of workers has remained "remarkably constant, never varying more than 209 from the mean of 4,355." The decrease in number of firms follows the general trend of consolidation in the food-processing industry. In the past 30 years, many small seafood processing plants were forced out because they were unable or unwilling to meet the costs of rising sanitation standards.

The seafood industry has recovered dramatically from the low point in 1963. Landings increased at a rate of $1.5 million a year.

Leads U.S. in Oysters

Maryland led the U.S. in oyster production during 1966 and 1967 "by a very substantial margin." Landed value of the 1967 harvest was $11,191,431, more than one-third the value of U.S. harvest.

Manning believes that Maryland's tidal waters are perhaps unmatched in the world as an environment for oyster growth. He warns, however, that the State's capacity to produce oysters is "not unlimited." The salinity range of Maryland's part of Chesapeake Bay is uninviting to starfish, one of the oyster's most effective predators; Maryland's tidal waters are troubled by boring snails only along the lower Eastern Shore. The oyster parasite 'Minchinia Nelsoni' (MSX) and 'Dermocystidium Marinum,' a marine fungus that probably kills more oysters in the U.S. than any other organism, are present in about one-third of State waters; they have caused many deaths. Occasionally, the Bay is hit by hurricanes. Storms like Hazel in 1954 do much damage. Throughout shellfish-producing waters, oysters must compete for space and food with many organisms. They are attacked by several predators. But the Maryland oyster has a much better chance to live to old age than oysters in most areas. The oyster's "normal" natural mortality rate is estimated at 10 to 15%.

State Help Since 1961

Since 1961, Maryland has invested annually about 1\frac{1}{3}$ million to restore productivity of the oyster resource. This had declined in almost a hundred years because of "overexploitation, neglect, and mismanagement."

This State effort has been based on (1) use for oyster cultch of centuries-old shell deposits buried in Chesapeake Bay, and (2) application of "farming" practices to management of the State's natural oyster bars.

Since 1961, 3 to 4 million bushels of dredged shells have been planted annually in the State's seed areas. Also, another 1 to 2 million bushels of dredged shells are planted to maintain "self-sustaining" natural oyster bars.

Manning projects a bright future for private oyster planters willing to invest in Maryland's efforts to remain the leading oyster-producing State. A 150% increase in production has not affected significantly the unit price received by public oystermen for their catch. It seems unlikely that oyster production in any other leading oyster State will increase during the next few years; in most, continuing decline is forecast.

Manning states: "We find no reason to believe that Maryland's private oyster fishery cannot undergo orderly developments without harm to the public fishery, and without abandonment of the time-honored concept that the natural oyster bars of the State are the common property of its citizens."

Coho Swim Over Willamette Falls in Record Numbers

Nearly 17,600 coho salmon, including 5,300 jacks, were counted over Willamette Falls in fall 1968. This doubled 1967's escapement and set a record, reported the Oregon Fish Commission.

Based on catch-to-escapement ratios, the record number over the Oregon City salmon barrier represented 36,000 more coho harvested by sport and commercial fishermen in 1968.

Of total escapement near the end of 1968, 94% chose the completed cul-de-sac part of the new fishway instead of the old, inadequate ladder. Early in the run, water levels were low and the coho chose the cul-de-sac because there was more attraction water. Later, as happened in previous years, water velocities over the old structure increased so passage became impossible. However, fish that used the cul-de-sac were not delayed. When the fishway is completed, no run will face the critical delays developing from extreme flows.

Increased Stocking

The 1968 record resulted from greater stocking efforts designed to develop the "tremendous natural potential of the Willamette system." From 1951-1960, the average annual juvenile coho release into the Willamette tributaries above the falls was less than 300,000. Since that period, juvenile coho releases rose to 6,500,000 a year.

Also, starting in 1964, the Fish Commission has transported and released around 7,000 adults each year into the Willamette system. The Oregon Game Commission and the U.S. Fish and Wildlife Service provided more trucks to help carry these surplus hatchery fish. These fish have become available only in recent years after the success of the Fish Commission's coho hatchery program.

The Commission notes the significance of coho returning to the Yamhill, South Santlam, Molalla, and the Mary's Rivers. In these rivers, coho runs never existed before the Commission's planting program.

Large Coho Runs Possible

Biologists estimate conservatively that the 1968 coho run in the Willamette can be tripled by natural production alone. The Fish Commission says that achievement of this potential depends on the fishway's completion. This is being paid for by Portland General Electric and the Bureau of Commercial Fisheries. Another factor is solving a serious downstream mortality problem at the falls' industrial complex that claims many young migrants.

The Fish Commission reported too that adult fall chinook counts, also double the 1967 count, had set a record.

DO YOU KNOW?

Lobster tag is not a game. BCF scientists think it is serious business. Recently, they "tagged" 2,000 lobsters off the coast of southern New England. They hope to learn more about the speed and extent of lobster movements, rate of growth, and the ages at which lobsters are most vulnerable to natural enemies other than man.

Harmless yellow plastic tags are attached to a lobster, and a reward is paid for each tag returned to BCF's Biological Laboratory at Boothbay Harbor, Maine. Although the tagging study has been underway only a short time, Bureau scientists have already learned that lobsters travel farther and faster than they had expected. One lobster covered 97 miles of ocean bottom in 27 days; another, an egg-bearing female, traveled 77 miles in 28 days.

--Catherine Criscione

U.S. FISHERMEN CATCH MANY TUNA OFF WEST AFRICA

The U.S. tuna catch off West Africa during the 1968 season was expected to total more than 10,000 tons of Atlantic yellowfin and skipjack. BCF reported that dockside value was expected to bring U.S. fishermen about $2.5 million.

Interest in the fishing grounds off West Africa was stimulated when 3 U.S. tuna boats, transferring operations from the Pacific to the eastern Atlantic during the second half of 1967, reported a catch of 1,500 tons.

In mid-June 1968, shortly after the yellowfin quota for the Pacific was reached, 8 tuna seiners, with carrying capacities of 450 to 1,000 tons, shifted to the eastern Atlantic. Fishing efficiency was increased by off-loading catches at Abidjan, Ivory Coast, and Tema, Ghana, for transshipment to the U.S. This enabled the seiners to return promptly to the tuna-rich Gulf of Guinea.

Assisted by R/V 'Undaunted'

Fishermen were assisted by BCF's research vessel Undaunted, which transmitted on-the-spot information about tuna school locations to the U.S. fleet. Undaunted is

assigned to BCF's Tropical Atlantic Biological Laboratory (TABL), Miami, Fla.

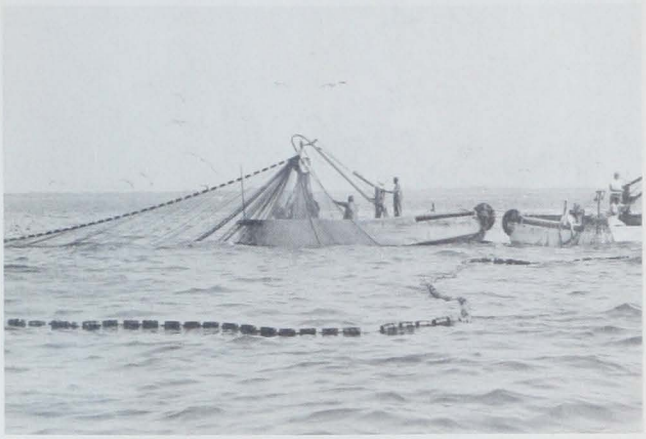
Much of TABL's program is devoted to gathering and interpreting fishery and oceanographic data on tuna in the tropical Atlantic. In cooperation with BCF's laboratory at La Jolla, Calif., U.S. fishing interests, and foreign scientists working in Africa, TABL personnel have compiled voluminous data on tuna stocks in the eastern Atlantic.

During 1968, TABL prepared "Tuna Purse Seining in West Africa, July-November," a guide for commercial fishermen planning to operate in the eastern Atlantic tuna fishery. It is a summary of information on tuna species, landings, fishing procedures, and favorable catch locations at specific times.

MENHADEN

In 1968, menhaden, which are converted into oil and fertilizer, or used as bait, made up nearly one-third of total U.S. landings of fish and shellfish.

The greatest catch increase occurred in the Gulf of Mexico. The Chesapeake and Middle Atlantic States followed.



Figs. 1 and 2 - Hauling in menhaden purse seine off North Carolina.

Fig. 3 - Flooding hold to unload menhaden catch.
(Photos: Bob Williams)

OCEANOGRAPHY

Scripps 'Washington' Is Studying Deep Ocean Off South America

The Scripps Institution of Oceanography's research vessel 'Thomas Washington' left San Diego, Calif., Dec. 9, 1968, on a 9-month biological, geophysical, and physical scientific exploration in the eastern Pacific Ocean. The first port of call of the 209-foot, 1,362-ton vessel was Antofogasta, Chile.

The 33,500-mile 'Piquero Expedition' will concentrate on the deep ocean off the west coast of South America, but it also will work on the continental shelf, according to Dr. Bruce A. Taft, cruise coordinator.

In Peru, piquero is the common name for the Peruvian Booby, the dominant bird of the Peru (Humboldt) Current. The bird's white head, neck, breast, and speckled back are distinctive.

Many Scientists Involved

During the Piquero's 9 legs, 130 scientists and technicians from the U.S. (including 16 Scripps graduate students), Chile, Peru, France, and the United Kingdom will conduct research.

Piquero is supported by the Office of Naval Research, Atomic Energy Commission, and the National Science Foundation.

Wide Study

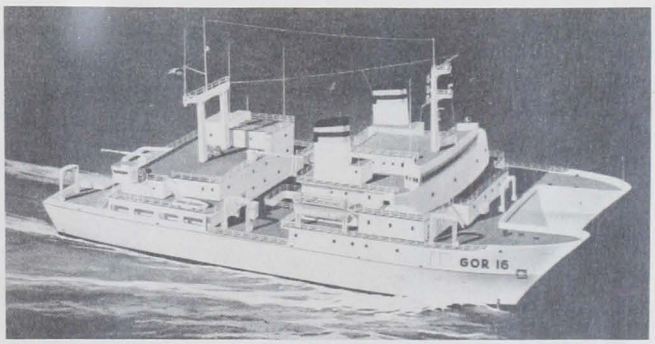
The investigations will include "an analysis of seawater samples for concentration of noble gases, such as xenon and helium, near the East Pacific Rise, a north-south underwater ridge on the eastern side of the Pacific; a major study of the physical oceanography of the Chile Current, including direct measurements of currents in the Drake Passage, between Cape Horn, Chile, and the Palmer Peninsula of Antarctica."

The scientists also will explore the relations among plankton, nutrient distribution, and currents west of Peru; a study of possible sea-floor spreading between the East Pacific Rise and the South American continent; and intensive study of animal and plant growth in upwelling water off Callao, Peru.

Between the Galapagos Islands and the mainland, the scientists will study the characteristics of the sharp boundary between the Peru Current's cold and salty waters and the warm and relatively fresh waters to the north. Also, they will study the circulation near the equator east and west of the Galapagos. The latter study will concentrate on determining the barrier effect of the Galapagos Islands on the flow of the subsurface Equatorial Undercurrent.

Navy Orders Unusual Oceanographic Ship

The U.S. Naval Ship Command System has awarded a $13.5-million contract to Todd Shipyards Corp.'s Seattle division to build the first of 9 oceanographic ships of a novel design.



Artist's conception of AGOR-16 Navy oceanographic research vessel (catamaran hull) being constructed for the U.S. Navy by Todd Shipyards Corporation, Seattle Division.

The prototype ship will become the Navy's first catamaran-style hull for oceanographic research. She will be 246 feet long, have a beam of 75 feet, displace 3,080 tons fully loaded, and travel at 15 knots. She will accommodate 25 scientists and a 44-man crew. Engineering work already has begun.

Foreign Fishing Off U.S. in November 1968

NORTHWEST ATLANTIC

92 Soviet, Polish, East and West German fishing and support vessels were sighted in early November; only 10 or 12 remained at month's end. The rapid decline may have been caused by 3 severe coastal storms in midmonth.

Soviet: Early in month, most vessels were 20 to 25 miles south of Martha's Vineyard; the rest were on Cultivator Shoals on Georges Bank. Moderate catches of herring were observed. After midmonth, there were only 5 to 7 vessels, scattered widely south from Block Island to Nantucket.

Polish: 19 vessels were sighted. 15 were south of Martha's Vineyard in early November; only 6 or 8 were left at month's end. Moderate catches of herring were observed.

East German: Early in month, 14 vessels were south of Martha's Vineyard; none was seen after mid-November.

West German: Some herring were observed on 17 vessels fishing along northern slopes of Georges Bank. None was sighted after midmonth.

MIDATLANTIC

Between 10 and 12 Soviet vessels were observed 45 to 55 miles southeast of Cape May, N.J., from November 10 to 22.

U.S. TERRITORIAL WATERS

On Nov. 13, during a fierce coastal storm with 100-mile-an-hour winds, some Polish vessels entered U.S. territorial waters without permission. About 10 inside 3-mile limit in Cape Cod Bay were not boarded because of hazardous sea conditions, but these were instructed to leave by sunset; 8 in territorial waters off Block Island and Martha's Vineyard were escorted outside 12-mile limit as winds diminished.

The Coast Guard boarded one vessel off Cape Cod and one off Block Island to advise that these vessels, and others, had failed to notify Coast Guard of entry into territorial waters. Both captains apologized. They said the storm had forced them to seek shelter. Neither had fished.

GULF OF MEXICO & SOUTH ATLANTIC

No sightings were reported.

OFF CALIFORNIA

In mid-November, 4 Soviet vessels were sighted around Channel Islands off Santa Barbara.

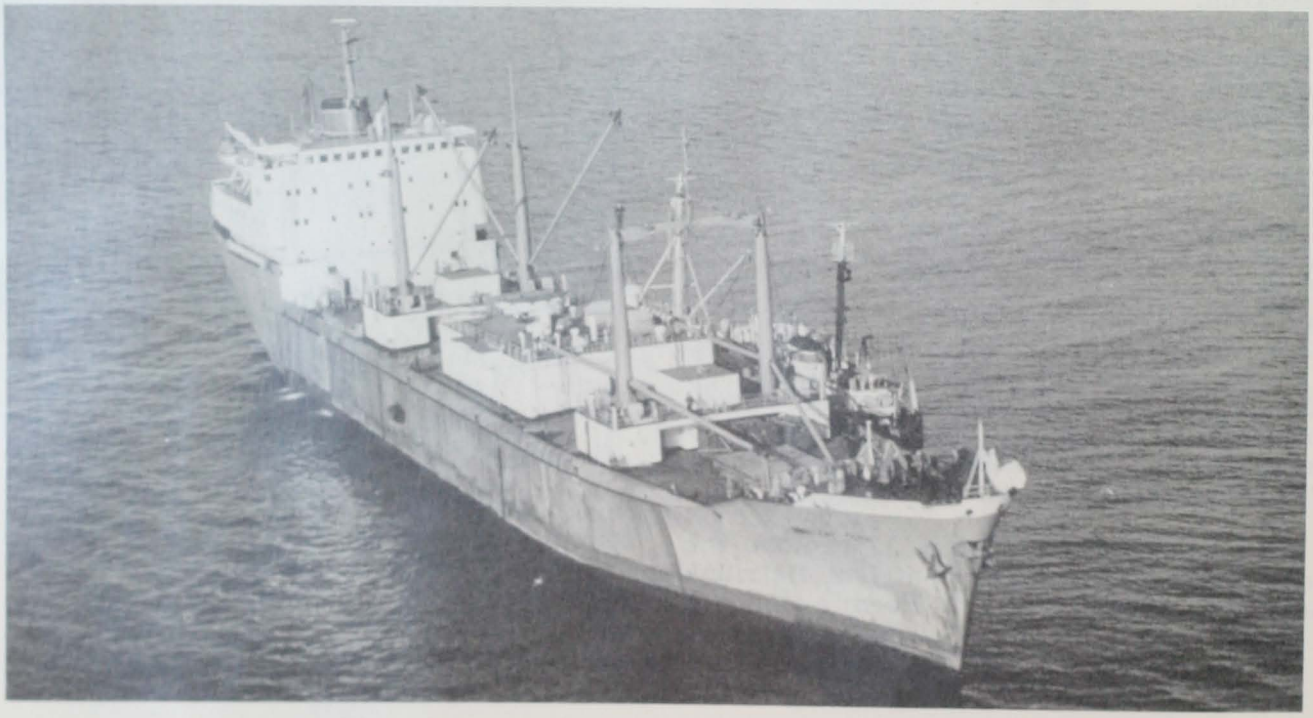


Fig. 1 - The refrigerated transport 'Saianskie Gory' off Anacapa Island in Santa Barbara Channel (northwest of Los Angeles, Calif.) on Nov. 18, 1968. The refrigerator, bought in Sweden in 1965, services vessels of Kamchatka Fisheries Adm.
(Putnam, Calif. State Fish and Game Comm.)

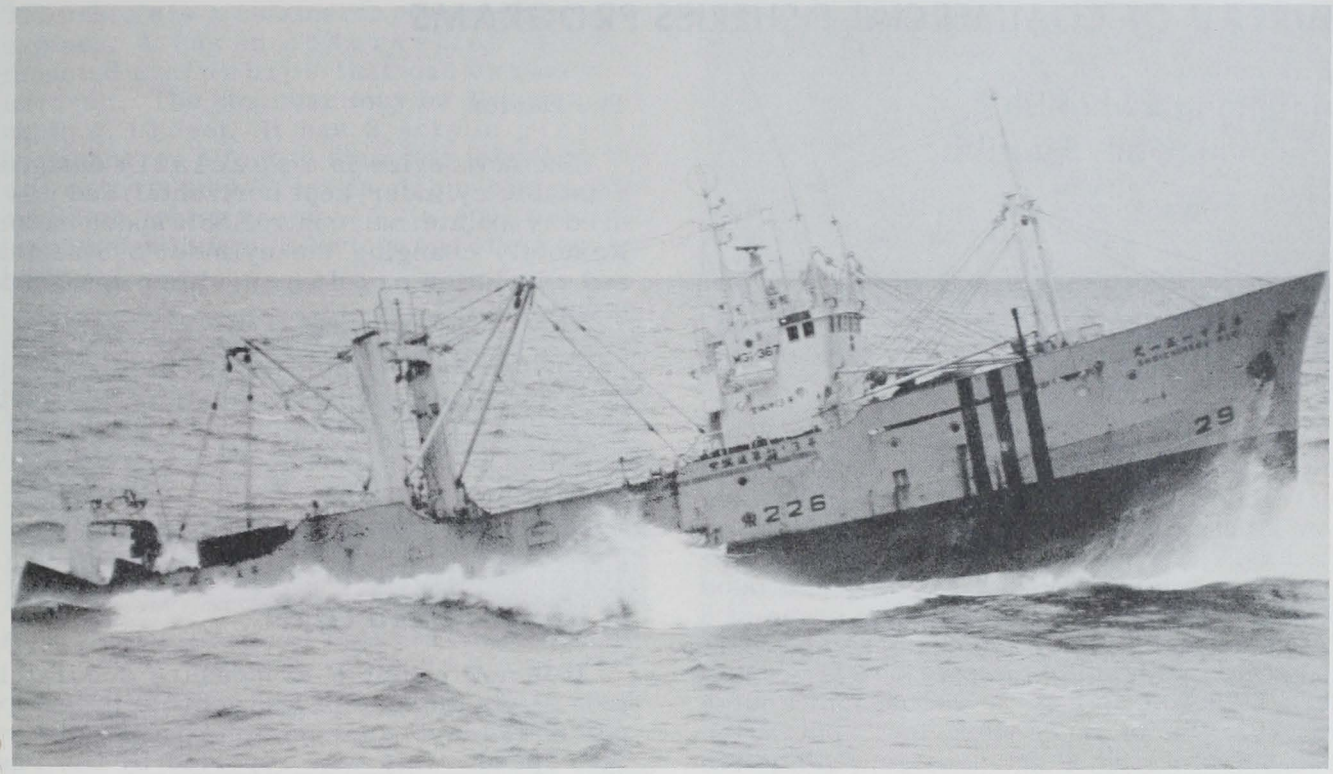


Fig. 2 - Japanese stern trawler underway in heavy swell in Bering Sea.

OFF WASHINGTON & OREGON

20 Soviet vessels, fishing rockfish and hake, were sighted off Oregon.

4 Japanese vessels were reported.

OFF ALASKA

Soviet: Around 30 to 34 vessels fished off Alaska in November 1968. About 16 to 19 fished ocean perch and other groundfish in the Gulf of Alaska; 3 continued ocean perch fishery along Aleutians.

11 medium trawlers--about half north of Fox Islands in eastern Aleutians, the other half along Continental Shelf edge in central Bering Sea--fished pollock, perch, gray cod, sablefish, and flatfish throughout month.

Japanese: About 40 vessels were sighted. In ocean perch fishery, 6 stern trawlers were in eastern Gulf, and 12-13 along Continental Shelf edge in eastern and central Bering Sea.

2 factoryships and 14 trawlers fished Alaska pollock and flatfish for fish-meal, oil, and minced-fish-meat fishery.

About 5 longliners caught sablefish in Gulf of Alaska.

BUREAU OF COMMERCIAL FISHERIES PROGRAMS

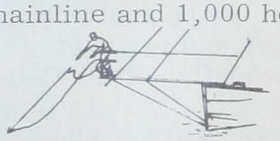
Longlining Swordfish Is Commercially Feasible

BCF's research vessel 'David Starr Jordan' returned to San Diego, Calif., on Nov. 23, 1968, with more than a ton of swordfish caught on a 9-day cruise off Baja California. The crew and scientists were joined by 3 commercial fishermen interested in longline fishing for broadbill swordfish.

Cruise Leader Susumu Kato of BCF Fishery-Oceanography Center, La Jolla, explained that the cruise's primary mission was to see how longline fishing, a successful method on the east coast but not used by California fishermen, compares with the traditional harpoon method. Five separate sets consisting of 6 miles of mainline with 400 hooks attached, and baited with squid or mackerel, caught zero to 9 fish per set. The broadbill catch was 20. Two of these were lost: one at the rail, the other by shark damage. Other fish landed included dolphin fish, species of shark, pelagic stingrays, and a turtle.

Fall-Winter Fishery

The cruise results indicate that the catch rate using longline gear is high enough to support a fishery during the late fall and winter when the harpoon fishery is over. Commercial fishing would require more hooks. If adopted, the methods developed by BCF should allow 4 or 5 men to handle daily 15 miles of mainline and 1,000 hooks.



New Device Controls Depth of Fishing Equipment

A depth-controller developed recently for BCF can regulate exactly the depth at which underwater fishing gear will be placed. The depth-controller was fashioned to provide quick, precise, remote control of midwater trawls and other towed gear. A patent was granted Mt. Auburn Research Associates, Inc., Cambridge, Mass. (Serial No. 3,404,655.)

The Device

The new device is a specially designed rotatable cylinder, kept horizontal, and powered by an internal, controllable speed motor. Remotely changing the cylinder's direction and revolution produces either upward or downward lift.

Underwater equipment and fishing gear can be put in place by the cylinders at the depth desired while in operating position.

Sonar Measures Size of Fish Schools in Upper Mixed Layer

It is now possible to measure accurately with sonar the size of fish schools in the upper mixed layers as a ship proceeds at normal speed. This was reported by Dr. Paul Smith, BCF La Jolla, leader of Cruise No. 30 of the 'David Starr Jordan' in the Channel Islands area in fall 1968.

In the past, fish schools at depth have been measured at ship's speed, but Cruise 30 offered the first opportunity to do it in the surface layer. Measurements were taken where high concentrations of anchovy schools had been found.

The Jordan's Sonar

The Jordan's sonar measures the width of fish schools using a receiver control that changes the gain level according to the loss of acoustic power with range in sea water. This control accounts for the divergence of sound waves and the weakening of the sound at each frequency.

Underwater Observation Vehicle Used to Study Fish

Dr. J.R. Hunter, BCF La Jolla, has checked out the underwater observation vehicle 'Sea-See' to see whether it can be used in field studies of the behavior of pelagic-fish schools.

The vehicle is a catamaran powered by diesel engines. It has an observation chamber mounted amidships that can be raised or lowered. The chamber may be lowered to a depth of 10 feet. It has 2 acrylic plastic hemispheres 6 feet in diameter joined by the entrance tube 3 feet in diameter. The chamber, which can seat 2, is equipped with underwater listening devices and other equipment.

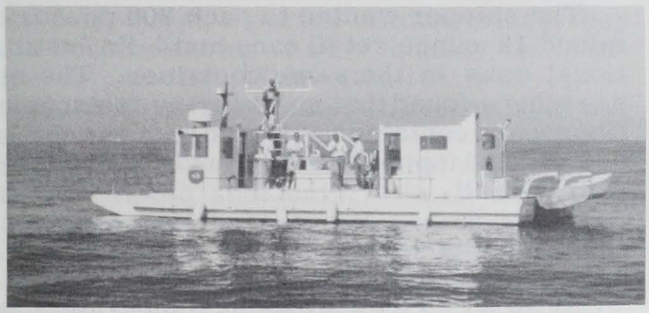


Fig. 1 - Sea-See searching for dolphins off California. Vehicle offers 'virtually unrestricted' view of marine mammals and fish.

Here, Sea-See is above water with viewing chamber submerged. The chamber is raised and lowered from central platform around which people are grouped. (Official photographs U.S. Navy)

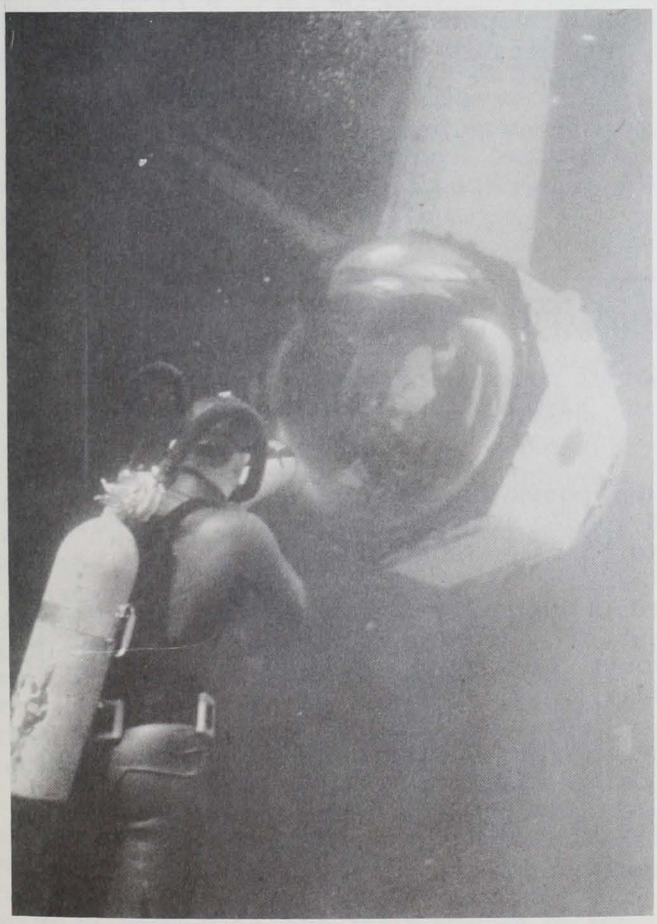


Fig. 2 - The octagonal underwater viewing chamber.

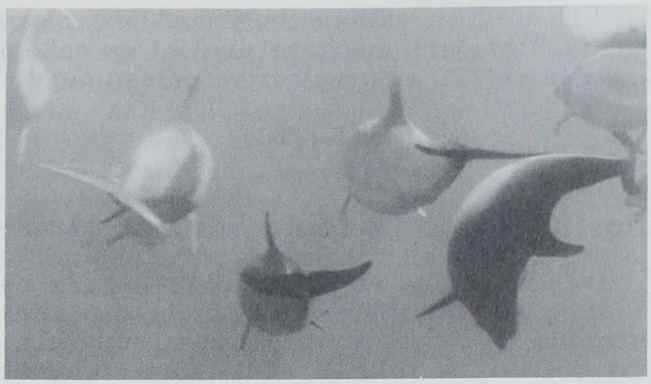


Fig. 3 - Dolphins photographed from observation capsule.

Jack Mackerel Schools Observed

The Sea-See made three 1-day trips near the Isthmus of Catalina Island. Jack mackerel schools were located on 2 of the 3. Underwater observations were made and photos taken of the schools. Some of the stereophotos taken during the day were good enough for making estimates of interfish distances; these will be compared with measurements made in the La Jolla lab.

Feeding

The schools of about 500 individuals (60-82 mm SL) remained at 5 to 25 feet. Fish fed through the day. Feeding frequencies ranged from 0 in a 1.17-min. interval to 29 feeding snaps in a 0.31-min. interval; the median frequency was 14 snaps per minute. Stomach contents of 4 feeding fish were taken and all were full. One stomach was examined. It contained 1,454 food items; 88% were copepods of 4 genera.

"This preliminary experiment demonstrated that feeding experiments incorporating behavioral observations can be conducted in the field on a pelagic marine fish."

Strobe Photos

Strobe photos were taken at night where schools had been observed during the day. The purpose was to determine if jack mackerel schools continued to school at night. Photos were taken at 1-minute intervals from 5:30-6 p.m. Jack mackerel schools were in many photos. The latest in the evening these schools were photographed was 5:57 p.m., about 8 minutes after end of nautical twilight. The sky was clear but moonless.

"These observations confirmed laboratory findings that jack mackerel are able to school near the surface on a clear moonless night."

Pascagoula Is Building Seawater Lab

BCF's Pascagoula (Miss.) Exploratory Fishing and Gear Research Base is constructing a closed-system seawater laboratory. It will contain an 18-foot-diameter circular pool, a 15-foot rectangular tank, smaller holding tanks, and many aquaria. A saltwater well will provide the water.

Lab's Function

The lab will be used to investigate the behavior of clupeid fishes in relation to fishing gear. The researchers will determine reactions, under controlled conditions, of potentially commercial fishes to artificial stimuli: light, electricity, barriers, and sound.

New Package Protects Oysters in Transit

BCF's Seattle (Wash.) Technological Laboratory cooperated with a major oyster cooperative and a container manufacturer to develop a package that will protect fresh oysters from temperature changes during transit.

The shipper wanted to pack 200 pounds of mixed 12-ounce retail cans and 4-lb. institutional cans in the same container. The researchers found that an ordinary telescoping fiberboard container--packed with prechilled oysters and topped with 12 pounds of dry ice--worked well.

Good Results

At an average ambient temperature of 75° F., the temperature of the product did not exceed 45° F. during a 24-hour period. The shipper reported "excellent results." Some shipments arrived at temperatures close to 32° F. Before the new packaging was used, shipments often arrived in poor condition because of excessively high temperatures.

DESTRUCTIVE MARINE ORGANISMS

Mollusks and crustaceans which attack soft rocks, sandstone, and wood are the most destructive of marine organisms. Some have been known to burrow through a lead submarine cable sheeting.

The Teredo (or shipworm), a mollusk that bores into wood for shelter and food, is the worst problem. It enters submerged wooden structures as a larva and grows rapidly to full size (4 to 10 inches long, $\frac{3}{16}$ to $\frac{1}{4}$ inch in diameter).

The Teredo long has been recognized as destructive. Few kinds of wood can withstand its attack. The heartwood of greenheart, a tropical tree, is the only timber that stands up reasonably well around the world. Teak is generally impervious to the Teredo, but is very susceptible in some areas.

There have been many schemes for exterminating the Teredo in infested wooden ships--the most effective is an occasional change of ports. Apparently, the Teredo can live only in water of more than 0.5 percent salt content, and at temperatures ranging between 30° F. and 100° F. The shipworm will die if an infested ship is in fresh water for several days, or beached during cold weather. ("Industrial Bulletin," Arthur D. Little, Inc.).

Fish Oil Research at Seattle Technology Laboratory

Fish oils represent only a small portion of the total U.S. fats and oils market, but they are a significant part of the industrial fishing industry. These oils have been items of commerce for many years. They have been sold on the basis of their general properties as low-priced substitutes for animal and vegetable fats. Over a period of many years, they have become known as a low-quality, inexpensive commodity. The situation still exists today. Before their domestic use in foods was prohibited in the 1930's, a considerable amount of fish oils was manufactured into margarine and shortening. Since then, they have been used as industrial products only. However, about 60 percent of the domestic production of fish oil is exported for manufacture into edible products.

As cheap synthetic and petrochemical compounds began to find their way into areas of industrial application once enjoyed by natural fats and oils, BCF started a research program in 1952 at the Technology Laboratory, Seattle, Wash., to develop new uses for fish oils. Studies of the chemical and physical properties of fish oils were emphasized. Considerable information regarding the characteristics of fish oils was gained. Many new derivatives of fish oils with a wide range of potential applications were prepared.

Research Scope Broadened

The objectives of the program were recently reviewed and the scope of research was broadened. The reason was the development within BCF of a process for manufacturing fish protein concentrate (FPC) that produces potentially high-quality oil as a byproduct. The fish oil research program now includes studies on methods of upgrading the quality of fish oil from FPC processes. The results indicate that the oil is superior in quality to commercial fish oil. The oil from FPC processes should be a good raw material for further refining to a food-grade product, or it can be used as a high-grade raw material for industrial purposes. Use of this oil in food depends on approval by the U.S. Food and Drug Administration.

Several variables that can determine the quality of the final product are being investigated. These include quality changes of the raw material under various holding conditions prior to extraction, and their effects on the final oil; solvent contact time and temperature during extraction; efficiency of solvents in separating the oil from the protein; and recovery of triglycerides free from other lipids and lipid-associated compounds that give rise to undesirable characteristics in fish oils. In studying these problems, the extraction process must not adversely affect the quality of the oil or the protein concentrate, and the economics of the process must be maintained. At the point where a satisfactory product is recovered from an FPC process that can be further refined to meet the requirements of an edible oil, studies on the oxidative stabilization of the oil will begin. This phase will be critically important if an edible-grade fish oil is to be utilized with the polyunsaturation intact.

Edible Fish Oil Uses

Undoubtedly the initial, and probably greatest, application of edible fish oil in the U.S. will be in the margarine and shortening industries. For these purposes, the oil will be hardened by partial hydrogenation. This will also increase the stability of the product toward oxidation. There are other areas where fish oil can be used by the food industry as liquid or solid fats. Also to be considered is the use of fatty derivatives of edible oils as industrial products and as food additives. Research is in progress to prepare surface-active agents that offer special functional properties when incorporated into food or industrial products. Samples of mixed mono- and diglycerides made from fish oils have been distributed to interested segments of the food industry for evaluation as emulsifiers in their products. If the evaluations show promising results, such compounds would enter into competition with similar compounds prepared from edible vegetable and animal fats. The market for this type of emulsifier in the U.S. amounted to 120 million pounds worth $30 million in 1965.

Future investigations will involve more research on fatty derivatives as food additives and industrial chemical intermediates, as well as evaluation of fish oil triglycerides as food fats. Other research subjects are the non-triglyceride lipids and lipid-associated materials that can be separated and recovered from fish oils. The investigations would focus on their potential in food, industrial, and pharmaceutical applications.

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