COMMERCIAL FISHERIES Review

VOL. 32, NO. 7 JULY 1970

COVER: The woman is a "gibber" in a Sitka, Alaska, processing plant. She extracts herring roe by hand. (BCF-Alaska photo: J. M. Olson)

See article page 45.

COMMERCIAL FISHERIES
Review

A comprehensive view of United States and foreign fishing industries--including catch, processing, marketing, research, and legislation--prepared by the Bureau of Commercial Fisheries.

Fishermen's Memorial
Gloucester, Mass.

Managing Editor: Edward Edelsberg

Production: Jean Zalevsky
Alma Greene
Jacqueline King

The Bureau of Commercial Fisheries and The Bureau of Sport Fisheries and Wildlife make up The Fish and Wildlife Service of The United States Department of the Interior.

Throughout this book, the initials BCF stand for the Bureau of Commercial Fisheries.

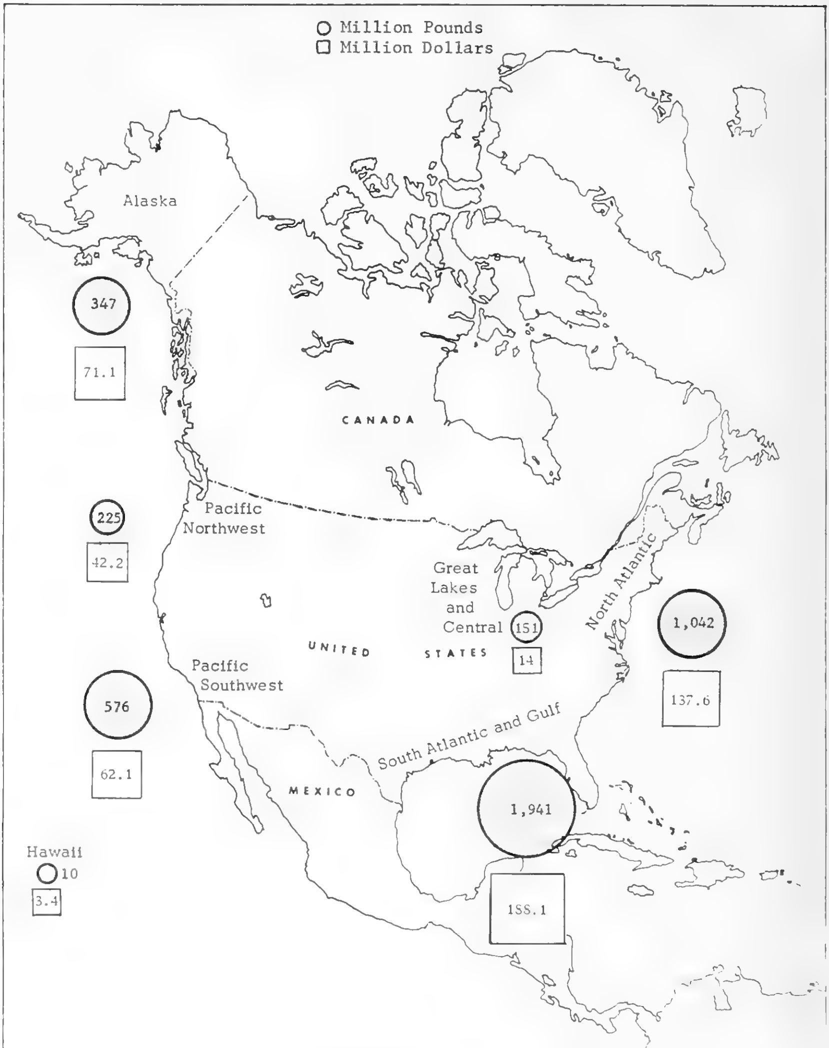
Address correspondence and requests to: Commercial Fisheries Review, 1801 North Moore Street, Room 200, Arlington, Va. 22209. Telephone: Area Code 703 - 557-4246.

Use of funds for printing this publication was approved by the Director, Bureau of the Budget, April 18, 1968.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Price 60 cents (single copy). Subscription Price: $7.00 a year; $2 additional for foreign mailing.

CONTENTS

VOLUME & VALUE OF CATCH BY REGIONS, 1969



(Source: 'Fisheries of the United States 1969')

NIXON PROPOSES NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

President Nixon sent to Congress on July 9 a plan to reorganize the Nation's oceanic and atmospheric research organizations into a single part of the Department of Commerce--the National Oceanic and Atmospheric Administration (NOAA).

At the same time, the President proposed consolidation of 8 antipollution agencies into one independent organization--the Environmental Protection Agency (EPA).

Both plans will go into effect after 60 consecutive days of Congress in session--if neither house disapproves them by majority vote.

NOAA would have 12,000 employes and a $270-million budget. Manpower and funds would be transferred from several agencies. (See page 3.)

PRESIDENT NIXON'S MESSAGE ON NOAA

The oceans and the atmosphere are interacting parts of the total environmental system upon which we depend not only for the quality of our lives, but for life itself.

We face immediate and compelling needs for better protection of life and property from natural hazards, and for a better understanding of the total environment--an understanding which will enable us more effectively to monitor and predict its actions, and ultimately, perhaps to exercise some degree of control over them.

We also face a compelling need for exploration and development leading to the intelligent use of our marine resources. The global oceans, which constitute nearly three-fourths of the surface of our planet, are today the least-understood, the least-developed, and the least-protected part of our earth. Food from the oceans will increasingly be a key element in the world's fight against hunger. The mineral resources of the ocean beds and of the oceans themselves, are being increasingly tapped to meet the growing world demand. We must understand the nature of these resources, and assure their development without either contaminating the marine environment or upsetting its balance.

Establishment of the National Oceanic and Atmospheric Administration--NOAA--within the Department of Commerce would enable us to approach these tasks in a coordinated way. By employing a unified approach to the problems of the oceans and atmosphere, we can increase our knowledge and expand our opportunities not only in those areas, but in the third major component of our environment, the solid earth, as well.

Scattered through various Federal departments and agencies, we already have the scientific, technological and administrative resources to make an effective, unified approach possible. What we need is to bring them together. Establishment of NOAA would do so.

By far the largest of the components being merged would be the Commerce Department's Environmental Science Services Administration (ESSA), with some 10,000 employes (70 percent of NOAA's total personnel strength) and estimated Fiscal 1970 expenditures of almost $200 million. Placing NOAA within the Department of Commerce therefore entails the least dislocation, while also placing it within a Department which has traditionally been a center for service activities in the scientific and technological area.

These are the principal functions of the programs and agencies to be combined:

The Environmental Science Services Administration (ESSA) comprises the following components:

-- The Weather Bureau (weather, marine, river and flood forecasting and warning).

-- The Coast and Geodetic Survey (earth and marine description, mapping and charting).

-- The Environmental Data Service (storage and retrieval of environmental data).

-- The National Environmental Satellite Center (observation of the global environment from earth-orbiting satellites).

-- The ESSA Research Laboratories (research on physical environmental problems).

ESSA's activities include observing and predicting the state of the oceans, the state of the lower and upper atmosphere, and the size and shape of the earth. It maintains the nation's warning systems for such natural hazards as hurricanes, tornadoes, floods, earthquakes and seismic sea waves. It provides information for national defense, agriculture, transportation and industry.

ESSA monitors atmospheric, oceanic and geophysical phenomena on a global basis, through an unparalleled complex of air, ocean, earth and space facilities. It also prepares aeronautical and marine maps and charts.

<u>Bureau of Commercial Fisheries and marine sport fish activities</u>. Those fishery activities of the Department of the Interior's U.S. Fish and Wildlife Service which are ocean related and those which are directed toward commercial fishing would be transferred. The Fish and Wildlife Service's Bureau of Commercial Fisheries has the dual function of strengthening the fishing industry and promoting conservation of fishery stocks. It conducts research on important marine species and on fundamental oceanography, and operates a fleet of oceanographic vessels and a number of laboratories. Most of its activities would be transferred. From the Fish and Wildlife Service's Bureau of Sport Fisheries and Wildlife, the marine sport fishing program would be transferred. This involves five supporting laboratories and three ships engaged in activities to enhance marine sport fishing opportunities.

<u>The Marine Minerals Technology Center</u> is concerned with the development of marine mining technology.

<u>Office of Sea Grant Programs</u>. The Sea Grant Program was authorized in 1966 to permit the Federal Government to assist the academic and industrial communities in developing marine resources and technology. It aims at strengthening education and training of marine specialists, supporting applied research in the recovery and use of marine resources, and developing extension and advisory services. The Office carries out these objectives by making grants to selected academic institutions.

<u>The U.S. Lake Survey</u> has two primary missions. It prepares and publishes navigation charts of the Great Lakes and tributary waters and conducts research on a variety of hydraulic and hydrologic phenomena of the Great Lakes' waters. Its activities are very similar to those conducted along the Atlantic and Pacific coasts by ESSA's Coast and Geodetic Survey.

<u>The National Oceanographic Data Center</u> is responsible for the collection and dissemination of oceanographic data accumulated by all Federal agencies.

<u>The National Oceanographic Instrumentation Center</u> provides a central Federal service for the calibration and testing of oceanographic instruments.

<u>The National Data Buoy Development Project</u> was established to determine the feasibility of deploying a system of automatic ocean buoys to obtain oceanic and atmospheric data.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

The following agencies will be brought into NOAA--which will be in the Department of Commerce--if Congress does not object to President Nixon's reorganization plan:

FROM DEPARTMENT OF THE INTERIOR

1. Bureau of Commercial Fisheries (BCF)

2. Marine sport fish activities of Bureau of Sport Fisheries and Wildlife (BSFW)

   BCF and BSFW now make up The Fish and Wildlife Service.

3. Marine Minerals Technology Center of the Bureau of Mines

FROM DEPARTMENT OF DEFENSE

1. Great Lakes Survey of the Army Corps of Engineers

2. National Oceanographic Data Center of the Navy Department

3. National Oceanographic Instrumentation Center of the Navy Department

FROM DEPARTMENT OF TRANSPORTATION

Data buoy development activities of the Coast Guard

FROM NATIONAL SCIENCE FOUNDATION

The program of grants to academic institutions for research in marine resources and technology.

ALREADY IN COMMERCE DEPARTMENT

The ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION (ESSA) remains in Commerce Department--but is shifted to NOAA.

Role of NOAA

Drawing these activities together into a single agency would make possible a balanced Federal program to improve our understanding of the resources of the sea, and permit their development and use while guarding against the sort of thoughtless exploitation that in the past laid waste to so many of our precious natural assets. It would make possible a consolidated program for achieving a more comprehensive understanding of oceanic and atmospheric phenomena, which so greatly affect our lives and activities. It would facilitate the cooperation between public and private interests that can best serve the interests of all.

I expect that NOAA would exercise leadership in developing a national oceanic and atmospheric program of research and development. It would coordinate its own scientific and technical resources with the technical and operational capabilities of other government agencies and private institutions. As important, NOAA would continue to provide those services to other agencies of government, industry and private individuals which have become essential to the efficient operation of our transportation systems, our agriculture and our national security. I expect it to maintain continuing and close liaison with the new Environmental Protection Agency and the Council on Environmental Quality as part of an effort to ensure that environmental questions are dealt with in their totality and that they benefit from the full range of the government's technical and human resources.

Authorities who have studied this matter, including the Commission on Marine Science, Engineering and Resources, strongly recommended the creation of a National Advisory Committee for the Oceans. I agree. Consequently, I will request, upon approval of the plan, that the Secretary of Commerce establish a National Advisory Committee for the Oceans and the Atmosphere to advise him on the progress of governmental and private programs in achieving the nation's oceanic and atmospheric objectives.

An On-Going Process

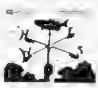
The reorganizations which I am here proposing afford both the Congress and the Executive Branch an opportunity to re-evaluate the adequacy of existing program authorities involved in these consolidations. As these two new organizations come into being, we may well find that supplementary legislation to perfect their authorities will be necessary. I look forward to working with the Congress on this task.

In formulating these reorganization plans, I have been greatly aided by the work of the President's Advisory Council on Executive Organization (the Ash Council), the Commission on Marine Science, Engineering and Resources (the Stratton Commission, appointed by President Johnson), my special task force on oceanography headed by Dr. James Wakelin, and by the information developed during both House and Senate hearings on proposed NOAA legislation.

Many of those who have advised me have proposed additional reorganizations, and it may well be that in the future I shall recommend further changes. For the present, however, I think the two reorganizations transmitted today represent a sound and significant beginning. I also think that in practical terms, in this sensitive and rapidly developing area, it is better to proceed a step at a time--and thus to be sure that we are not caught up in a form of organizational indigestion from trying to rearrange too much at once. As we see how these changes work out, we will gain a better understanding of what further changes--in addition to these--might be desirable.

Ultimately, our objective should be to insure that the nation's environmental and resource protection activities are so organized as to maximize both the effective coordination of all and the effective functioning of each.

The Congress, the Administration and the public all share a profound commitment to the rescue of our natural environment, and the preservation of the Earth as a place both habitable by and hospitable to man. With its acceptance of these reorganization plans, the Congress will help us fulfill the commitment.



BCF PROVIDES INFORMATION TO TROPICAL TUNA FLEET

Initial efforts toward extending BCF fishery advisory information to the tropical tuna fleet were completed during May, according to Dr. Michael Laurs, Group Leader, BCF La Jolla. Several San Diego-based purse seiners have sailed or are planning to sail to areas beyond the yellowfin regulatory area set up by the Inter-American Tropical Tuna Commission (IATTC). One group of 6 or 7 vessels plans to fish as far west as Truk and Palau.

For the most part, says BCF La Jolla, fishermen are unfamiliar with the oceanographic and fishing conditions they may expect to find outside the traditional fishing grounds in the eastern tropical Pacific. The American Tunaboat Association (ATA) asked BCF to provide information on oceanography, weather, and tuna resources that may help fishermen decide on areas most likely to have fish.

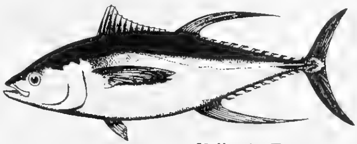
Dr. Laurs Prepares Synopsis

Dr. Laurs prepared a synopsis of what is known about tuna resources in the central and western tropical Pacific. It was based on records of exploratory cruises made mainly by BCF Hawaii and on Japanese catch data. "This information was included in a packet of data distributed to fishermen. The packet also included charts of sea-surface temperature, mixed layer depth, seabird and mammal sightings, information on weather, especially tropical storms, and sea conditions, and what weather advisory information is available over the marine radio bands for various regions in the central and western Pacific."

Also, arrangements were made with Tom Chase of Scripps Institution of Oceanography for BCF to print and distribute copies of unpublished bathymetric charts containing the most up-to-date and complete information.

Meet With Tunaboat Captains

On May 10, Dr. Laurs and R. Green of BCF and F. Miller of IATTC met with about 15 tunaboat captains and A. Felando of ATA to brief them and to present the information gathered. Also, Mr. Miller, under an IATTC contract with BCF, will provide special weather advisory information through ATA to the vessels as needed. XBT systems were installed and probes provided for two more vessels in the tropical tuna fleet. Each vessel has agreed to radio back synoptic BATHY reports and synoptic marine weather observations on a daily basis.



Yellowfin Tuna

ALBACORE TUNA CATCH OF 26-40 MILLION POUNDS PREDICTED

BCF La Jolla, Calif., estimates that 26 to 40 million pounds of albacore tuna will be landed in Oregon, Washington, and British Columbia this year. Between 11 and 15 million pounds will be landed in California. These estimates are based on current trends and historical analysis. "It would appear that the albacore fishery will be centered again this year in waters off the Pacific Northwest," says BCF La Jolla. This prediction is based on: warmer-than-average ocean temperatures in waters off the Pacific Northwest; position of 60° F isotherm offshore; and historical record of landings.

Albacore Prefer 60-66° F

The high correlation between the catch of albacore tuna and sea-surface temperature shows species seems to prefer temperatures in 60-66° F range. Historically, most albacore taken off California have been caught in waters 62-66° F; highest catches in 64° F.

Average sea-surface temperature in areas from which albacore were taken in July and August was about 62° F; for albacore caught in September, it was about 60° F. So reports Oregon State University. No commercial quantities of albacore were taken from waters off Pacific Northwest colder than 58° F, or warmer than 64.5° F.

Analysis of available information points strongly to an excellent start for the fishing season. A larger-than-normal percentage of the catch will be taken in northern regions. Present knowledge of arrival time of migrating population is inadequate; however, the probability of a northerly fishery suggest an early availability of fish in waters off Pacific Northwest.

1969 Landings

The Pacific west coast albacore landings in 1969 were 51 million pounds. This was somewhat higher than 1960-1968 average of 46 million pounds. The statistical variance in landings for 1960-1969 period is about 9 million pounds. According to 1960-1969 average, an estimation of 37-55 million pounds could be landed this year.

1970 Estimates

If Oregon, Washington, and British Columbia receive up to 75% of total west-coast landings, as in past 3 years, then California will receive 10-14 million pounds, and region to north 27 to 41 million pounds. If both regions receive 50% of total landings, then each will receive 18 to 28 million pounds. BCF La Jolla estimates 11 to 15 million pounds may be landed in California; 26-40 million pounds could be landed in Oregon, Washington, and British Columbia.

BCF La Jolla emphasizes that its projections of landings "are based on historical trends and our best estimates of the fishery. Without essential biological data for albacore we are in a difficult position to make meaningful long-term (seasonal) projections having the desired accuracy and substance." Recently, it began a study of albacore biology on a Pacific-wide basis. It hopes that in about a year this will provide "the ability to predict with greater confidence the abundance and size of the albacore population which enters the fishery along our coast each summer."

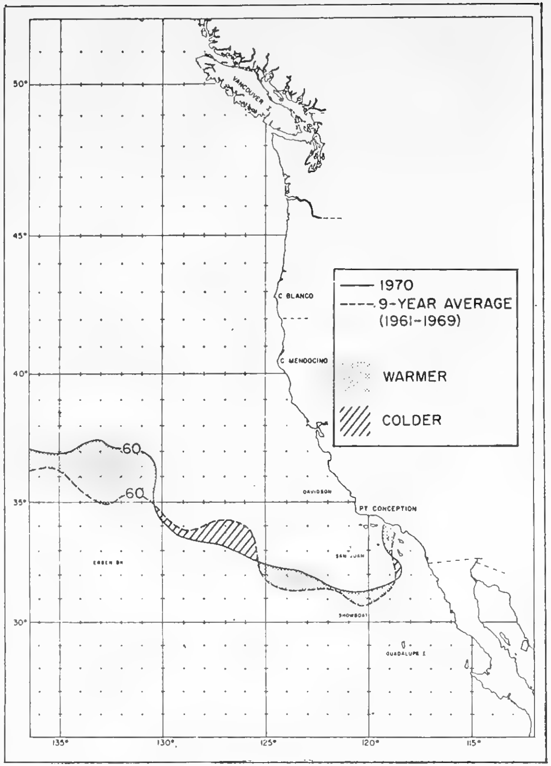


Fig. 1 - Relation of position of May 16-31, 1970, 60° F limiting isotherm to long-term average position for the same interval.

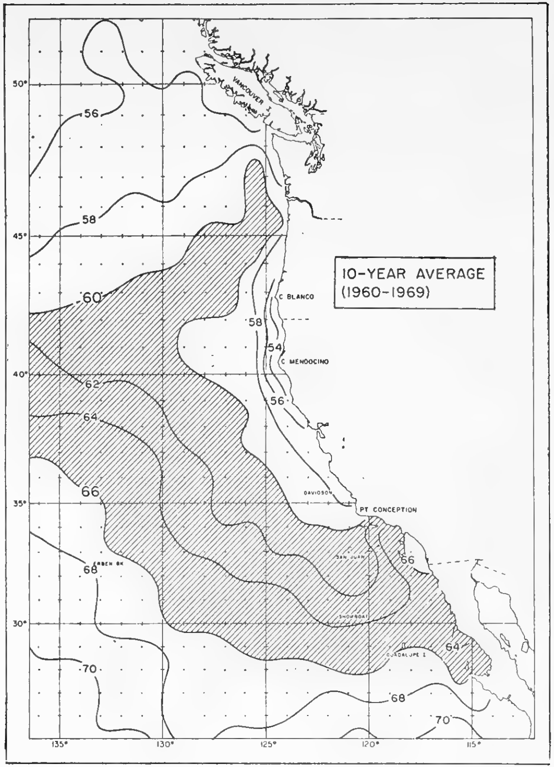


Fig. 2 - Average sea surface temperature fields for the July 1-15 interval. Shaded zone delineates region where most of the albacore would be available under these conditions.

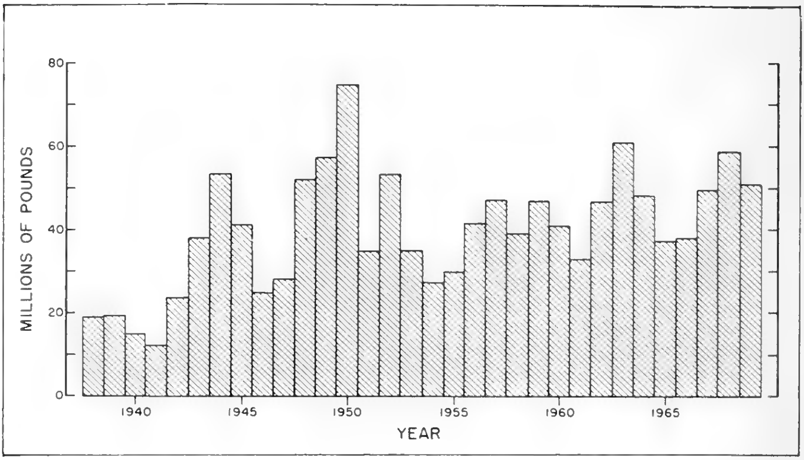


Fig. 3 - Total west coast (U.S. & Canada) landings of albacore tuna in millions of pounds, 1938-1969. Excluding 1938-1941, graph does not show significant trends in total landings. However, a decrease in year-to-year variability is evident in later years. Graph does not reveal effects of changes in fishing effort, availability, or fishing technology. In last few years, increase in effort and technology has not been matched by eauivalent increase in catch.

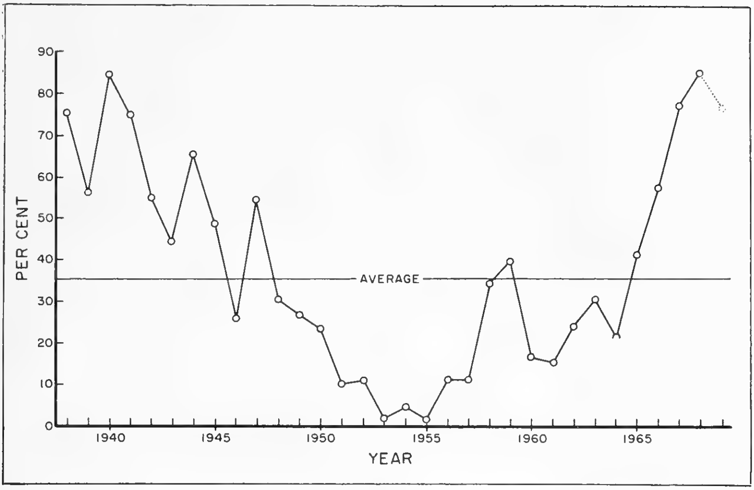
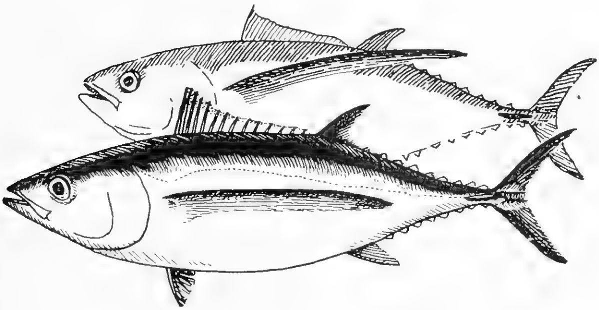


Fig. 4 - Percent of west coast albacore tuna catch taken north of San Francisco 1938-1969.



WINTER OYSTER SPAWNING TECHNIQUE DEVELOPED AT VIMS

Dr. John L. Dupuy of the Virginia Institute of Marine Science (VIMS) reported to the National Shellfisheries Association in Atlantic City, New Jersey, June 22-24, on his research to develop equipment and procedures for inducing oysters to spawn during winter.

Dr. Dupuy explained that spawning normally occurs in summer between June and September. "Any oysters can be used. Those in weak and watery condition as well as those in good condition can be fattened and brought to spawning condition within a month or less."

Production Essentials

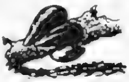
The essentials for producing young oysters are warm water and abundant food. Water tanks designed to distribute food equally to each oyster and to be cleaned easily contribute to success.

Adequate facilities for conditioning oysters to produce sperm and eggs were used at VIMS in February 1970. These permitted scientists to produce larvae during winter.

Water Temperature's Role

Scientists believe that oysters spawned, carried through larval development, and raised through young-oyster stage under controlled conditions are ready to be placed on growing grounds when water temperatures are high enough for them to feed actively. In this way, they may reach market size 18 months earlier than under natural reproducing and growing conditions.

Some scientists believe it may be possible to use waste heat from electric generating plants. Oysters would feed and grow all winter--shortening time required to market them.



POST-JUVENILE RED HAKE AND SEA SCALLOPS LIVE TOGETHER

A photo taken by biologists of BCF Woods Hole (Mass.) laboratory aboard the 'Albatross IV' shows a 12-inch red hake snuggled against a sea scallop in its natural habitat on the sea bottom. The photo was taken at a water depth of 210 feet on Georges Bank, 125 miles east of Cape Cod, Mass.

First Evidence

Biologists have known for many years that small red hake (post-larvae and early juvenile stages) normally live in the mantle cavity of sea scallops. The photo provides the first evidence that commensal relationships (organisms living in, with, or on another) continue beyond the stage when hake become too large to enter the mantle cavity.

Population Relationship?

The BCF biologists say that the commensal relationship between these 2 species undoubtedly has significant survival value to the hake. However, this question remains: Does abundance of red hake depend directly on abundance of sea scallop?

OFFSHORE LOBSTERS' GROWTH RATE GREATER THAN INSHORE'S

The recapture of 5100 offshore lobsters tagged by scientists of BCF Boothbay Harbor (Maine) has provided much information on the increase in size at molting and the frequency of molting.

Offshore lobsters 60 to 80 millimeters in carapace length increase in length by 16% (females) and 19% (males) at molting--compared to 12-13% for inshore lobsters. Offshore lobsters also molt more frequently.

STUDY TRANSPLANT OF NORTHERN ATLANTIC LOBSTER TO PACIFIC

The Northern Atlantic lobster may be harvested in the Pacific Northwest, if studies by Oregon State University (OSU) are successful. This was reported in June Commercial Fisheries Newsletter of University of Rhode Island (URI).

Capt. James McCauley, lobster trawlerman and URI professor of fisheries, has shipped adult berried females and adult males to OSU for study. These lobsters were trawled by 'Jerry and Jimmy' in offshore waters.

Offshore Lobsters for Oregon

Capt. McCauley believes that lobsters from offshore stock might be more adaptable to Oregon coast than inshore lobsters.

OSU workers are studying effect of water temperature on survival of larval stages. Oregon's relatively cold water does not provide ideal conditions for larval development. However, enough may survive to establish a population.

Canadian Experience

Dr. Ray Ghelardi, the Fisheries Research Board of Canada in Nanaimo, B.C., has been transplanting lobsters from Atlantic to British Columbia waters for years. Results were discouraging, but prospects now appear more encouraging. Lobsters hatched from eggs of Atlantic stock are in their third year and weigh over a pound.

DDT MAY INTERFERE WITH ADAPTABILITY OF TROUT

Scientists have become more concerned with once-unsuspected, subtle biological effects of environmental contaminants at sublethal levels. For example, water pollutants at legal levels were discovered by California researchers to cause dissipation of energy in flies and zooplankton--and interference with reproduction. This was reported in 'Science News' on May 9.

Canadian Trout Research

Two Canadian researchers discovered sublethal levels of DDT interfere with learning in brook trout. This may interfere with their adaptability.

Dr. J.M. Anderson and H.B. Prins, Fisheries Research Board of Canada in St. Andrews, N.B., exposed brook trout to 20 parts per million (ppm) of DDT for 24 hours. Then they subjected the fish to classical conditioning of the propeller-tail reflex.

A control group was conditioned in an average of 29 trials. Ten DDT-exposed fish could not be conditioned even after 100 trials; another 6 required an average of 76 trials.

NEW SHRIMP-SORTING TRAWL CATCHES CLEAN SHRIMP

BCF's 'John N. Cobb' returned recently to Seattle, Wash., after a shrimp-trawl development cruise. Comparative tows were made adjacent to commercial vessels with the latest model sorting trawl. This is about 25% smaller than other models.

The new trawl consistently caught 15-25% less shrimp than the commercial non-sorting trawls--but the catches were nearly free of fish and debris. Commercial catches often were contaminated with fish; this caused considerable loss of shrimp.

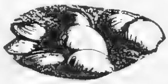
Cobb's Clean Shrimp

Once, the commercial trawler 'Jaka-B' caught 1,900 pounds of shrimp mixed with trash; the Cobb caught 1,500 pounds of clean shrimp. The Jaka-B Crew recovered only about 200 pounds of shrimp; all of Cobb's 1,500 pounds were high quality.

MACHINE DOES JOB ON MUSSEL THAT MUSCLE CAN'T DO CHEAPLY

A problem facing firms interested in developing a mussel industry is barnacles covering the mussel shell. These must be removed before sale. Removal by hand costs too much, so a mechanical method is needed.

Arne Einmo and Dr. Tim Joyner of the BCF Seattle Biological Laboratory ran a batch of mussels through an electric potato peeler. The barnacles were removed. The mussels emerged clean and ready for market. Operation time: about 55 seconds.



HATCHERIES ARE IMPROVING U. S. FISHING

Fish hatcheries have been used since the Civil War, but they did not become an effective tool to improve U.S. fishing until 1950. The chief difference was selective stocking. There were many stocking failures before 1950 because rearing and planting fish were inexact sciences.

'New Look' in Hatcheries

The "new look" of the 1950s and 1960s has come from evaluating species, their needs, and environmental conditions under which they would most likely survive. Other hatchery improvements are better diets, more research on control of diseases and parasites, better water in rearing ponds, and better brood stock to provide healthier fish.

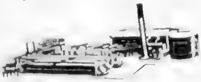
U.S. Facilities

"Today, managers of Federal facilities weigh environmental situations before attempting to stock fish," says Dr. Leslie L. Glasgow, Assistant Secretary of the Interior for Fish and Wildlife and Parks. "The idea is to plant fish where they will best thrive."

The 100 hatcheries operated by Interior's Bureau of Sport Fisheries and Wildlife (BSFW) are concerned largely with waters on Indian lands, national parks and forests, military reservations, and public reservoirs. Waters are stocked where native fish are not sport species, or where game species do not occur in sufficient numbers.

Warm- & Cold-Water Species

Warm-water and cold-water species--catfish to salmon--are raised in hatcheries, which benefit commercial and sport fishermen. Pacific salmon and steelhead trout from Northwestern facilities help maintain West Coast sport and commercial fisheries. A hatchery in Maine helps to reestablish runs of Atlantic salmon in streams along New England coast.



ANADROMOUS FISH CONSERVATION PROGRAM GETS MORE BENEFITS

The Nation's anadromous fishes--salmon and other species that ascend streams and rivers from the sea to spawn--are getting increased benefits from a 4-year extension, which began July 1, of the Anadromous Fish Conservation Act of 1965.

Congress has authorized appropriations up to $6 million for fiscal year 1971, $7.5 million for 1972, $8.5 million for 1973, and $10 million for 1974--a total of $32 million dollars, $7 million more than was provided over the past 4 years.

U.S. Share Up to 60%

Under the new program, the Federal share of project costs can be increased from 50% to a maximum of 60% when two or more States with a common interest in any basin enter into an agreement with Secretary of the Interior Walter J. Hickel.

The program is administered by both agencies of the Fish and Wildlife Service--the Bureau of Sport Fisheries and Wildlife, and the Bureau of Commercial Fisheries.

Commissioner's Statement

Commissioner for Fish and Wildlife, Charles H. Meacham, said: "Man has polluted the streams and estuaries, built impassible barriers, and generally damaged the environment of anadromous fish. Their abundance has been sharply reduced and some entire runs have been destroyed. Federal-State cooperation is helping to reduce losses, develop new runs, and increase existing stocks in some areas."

Great Lakes Species Included

The Anadromous Fish Conservation Act applies to anadromous species and to those Great Lakes fish that ascend streams to spawn. These include Atlantic salmon, 5 species of Pacific salmon, shad, striped bass, Dolly Varden, Arctic char, cutthroat trout, steelhead trout, sheefish, river herrings, and 3 species of sturgeon.

FPC IS AVAILABLE TO HOUSEWIVES

"Instant Protein," the first food-grade fish protein concentrate (FPC) to be approved by the U. S. Food and Drug Administration, is on the market.

The manufacturers, Alpine Geophysical Associates, say they are marketing it first in New York and New Jersey supermarkets, and then will expand into New England.

Instant Protein

The FPC is a light-colored powder in half-ounce envelopes, 8 in a package. Alpine says its product has only the faint aroma of fresh fish. When blended with foods, it does not add a fish flavor and fortifies them with animal protein at a small cost per serving.

Consumer testing showed that Instant Protein blends well with flour products--bread, cakes, rolls, and cookies--and with rice products. Mixed with these items at about 10% level, it produces virtually no change in basic cooking characteristics. With most of these products, only a slightly intensified color is noticeable.

Alpine says that the powder, added to a basic spaghetti sauce, can produce meat-type sauce stock that would provide about half of a person's daily need of animal protein for about 6 cents.

BCF TO PROMOTE U.S. FISHERY PRODUCTS AT WORLD FOOD FAIR

In cooperation with U. S. Department of Agriculture, BCF will return to Brussels, Belgium, this fall to introduce U. S. fishery products at the 2nd International Food Industry Fair, Sept. 2-7. It will be BCF's 25th participation in Western European food fairs.

U.S. Industry Invited

U. S. producers and processors of fishery products are invited to attend. Such firms are not required to send representatives because BCF personnel will coordinate activities. Floor space, adequate display cabinets, and interpreter services will be provided free.

For More Information

Information may be obtained from Office of International Trade Promotion, Bureau of Commercial Fisheries, 1801 N. Moore St., Room 401, Arlington, Va. 22209. Telephone: area code 703, 557-4731.

EDA AIDS FISHERIES IN HOMER, ALASKA

The Economic Development Administration has approved a $213,000 grant and a $123,000 loan to help develop port and fisheries facilities and to create 52 new jobs in the City of Homer, Kenai Peninsula, Alaska. Homer is providing $90,000 to complete the $426,000 project.

Port Improvements

The funds will be used to extend an existing 130-foot dock by 150 feet and add a pier for mooring seagoing vessels. The improvements will provide a port for the Coast Guard vessel 'Ironwood'. A 250-vessel fishing fleet depends on it for marine protection and ice breaking.

Allow Sea Shipments

The improvements also will allow shipment of seafood products by water instead of overland, and provide needed anchorage for oceangoing freighers and tankers (now these are diverted to other ports for berths).

ERRATA - CFR MAY 1970

1. Who put snap in snapper? It wasn't BCF Technological Laboratory in Seattle, Wash., as stated on p. 62. It was BCF Technological Laboratory in Pascagoula, Miss. The work was done by Harold C. Thompson and Mary H. Thompson.
2. "United Kingdom to Abandon Fathom Measurement," p. 50. One fathom equals 1.83 meters (not 0.914 a meter).

--Frank G. Morera

STUDY SALMON'S VULNERABILITY TO MIDWATER TRAWLING

BCF's largest research vessel, the 215-foot 'Miller Freeman', returned to Eureka, California, on May 9 after a 3-day cruise to investigate the vulnerability of salmon to midwater trawling (Cruise F70-2). The cruise was a response to growing concern over the impact midwater trawling in salmon-producing areas by Soviet and Japanese stern trawlers off U.S. could have on west-coast salmon stocks. Soviet experts have said often that they do not believe in harvesting salmon on the high seas; also, that salmon are taken rarely in their fishery for hake and rockfish off U.S.

Objectives

The cruise's primary objective was to determine vulnerability of chinook and silver salmon to Soviet-type midwater trawling tactics in 2 situations: when fishing specifically in salmon concentrations, and when fishing on hake schools in areas where salmon are concentrated.

Operations Area

The operation was conducted from Eureka because fishermen in recent years have reported Soviet vessels fishing in May off northern California where salmon were concentrated. Also, interviews with troll salmon fishermen on the day before departure (May 5) indicated salmon were concentrated in Eel Canyon area between Eureka and Cape Mendocino, about 15 miles off shore.

Silvers (cohos) were taken in "blue water" from surface to 10 fathoms. Chinooks were found from 8 to 20 fathoms in "brown water". Fishing was conducted in area north and south of Eel Canyon (approximately 40° 40' N.) from 8 to 20 miles off shore.

Vessel Description

The Miller Freeman is rigged as a stern trawler. She is powered by a 2,150-hp diesel engine driving a single controllable pitch propeller. She is smaller, but has slightly more horsepower, than the Soviet 'Mayakovskiy' stern trawlers (215 versus 270 feet), the dominant class of Soviet stern trawler off U.S. The Freeman was capable of as much or more towing power than Soviet trawlers. She was equipped with two resolution echo sounders, operating at 38 and 100 kHz, which were used for locating concentrations of organisms in midwater.

Gear

The two midwater trawls fished were the 'Cobb' 648 pelagic trawl and the Mark I Universal trawl. The 648 trawl was constructed of $2\frac{1}{2}$-inch mesh and had a fine mesh liner in the last 12 feet of cod end. The 648 trawl is symmetrical with 116-foot headrope, footrope and breastlines; it gives a design opening of about 68 feet square. It was towed with double bridles and spread with 7- by 12-foot V-doors weighing about 2,000 pounds each.

The Mark I Universal trawl, also constructed of $2\frac{1}{2}$-inch mesh, had a fine mesh liner in cod end. The headrope and footrope are both 121 feet long with breastlines of 63 feet. A 30- by 50-foot opening has been achieved when towed at around two knots. The Mark I was principal gear used in 1967 hake fishery; it has caught over 50 tons on several occasions. This trawl was rigged with three bridles and the V-doors mentioned previously.

Both trawls were towed with $\frac{5}{8}$-inch electromechanical cable. A pressure-sensitive, electrical, depth-telemetry system was used to determine trawl depth during fishing. Telemetry transmitters were positioned at each door. Also, on first tow a wireless netsonde was used to monitor trawl opening and presence of fish below, within, and above trawl. The echo-sounding side of this system operates at 200 kHz with information being telemetered back to vessel at 50 kHz. A receiving hydrophone was towed from port side and connected to a readout unit in pilot house.

Methods

Prior to midwater trawling, salmon trollers in Eureka area were interviewed to determine areas and depths of major salmon concentrations. During operation, trollers were contacted via marine radio to insure that Freeman operated in greatest salmon concentrations.

When in a reported salmon area, midwater trawling was conducted at depths salmon were caught by commercial troll fleet. Trawling also was conducted in scattering layers located with echo sounder. Over 3-day period, trawling was scheduled to cover all hours of day and night.

The fishing procedure was to set trawl at reduced power and allow the gear to settle to desired depth before applying towing power. Trawling speeds were varied from $2\frac{1}{2}$ to $5\frac{1}{2}$ knots. This corresponded to power settings of one-quarter to full power. Catches were enumerated. All salmon were identified, sexed, measured, and pertinent biological data collected. Also, a representative sample of hake was measured and examined.

RESULTS

18 hauls were made during 3 days. The trawl was fished 17 hours and towed 65 nautical miles. Depths of tows ranged from surface to 43 fathoms.

Only 17 salmon--all chinooks (Oncorhynchus tshawytscha)--weighing total of 41 pounds were captured; the best haul yielded 8 fish. The fish ranged from 13 to 29 inches and up to 8 pounds. Although schools of coho salmon (O. kisutch) were sighted in area prior to trials, none was seen or captured. On day Freeman caught the 17 salmon, the commercial troller 'Kristy' in same area caught 217 salmon, 117 legal size.

Besides salmon catches, most common catches were hake (Merluccius productus) and squid (Loligo opalescens). The salmon were feeding extensively on squid.

Gear Failures

Gear failures plagued cruise from very beginning. These resulted from large strains caused by trawling at high speeds.

Conclusions

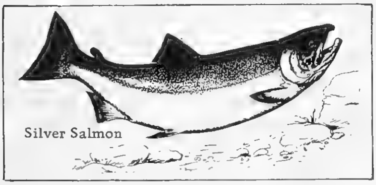
The results were inconclusive. Catches were disappointingly small. This may have been due to: fish not concentrated in areas or at depths where fishing was conducted; fish present in concentrations but avoided net; or, gear not fishing properly.

The salmon were not schooling well. Schools were not detected either visually or with fish-finding echo sounders. Trawls were not fished in scattering layers judged characteristic of hake; this could explain low catches of hake. Scattering layers fished were probably "feed" (plankton) because considerable numbers of euphausiids were enmeshed in trawl wings.

The 7- by 12-foot V-doors were too large for Mark I Universal trawl. Due to large door size, greater than normal spreading forces were exerted on net. This was apparent from large horizontal wire angles of trawl warps during fishing. Also, there was only minimal amount of chain on trawl wings. The combination of these two factors may have resulted in a reduced vertical opening, which could have affected catches.

It is difficult to trawl from Freeman at high speed with type of net used. Drag on net increases at about the square of the speed. This results very rapidly in large drag forces at high towing speeds. The use of larger meshes forward in the net would reduce drag. But it is still doubtful that speeds could be increased very much more than those obtained.

For further information contact: A.T. Pruter, Acting Base Director, Exploratory Fishing and Gear Research Base, 2725 Montlake Boulevard East, Seattle, Washington 98102 (Phone: 583-7729).


Silver Salmon


Chinook Salmon

U.S. AND POLAND SIGN FISHERIES AGREEMENT

The United States and Poland signed in Washington on June 13 an agreement on fisheries off the U.S. Middle Atlantic coast. The agreement extends and modifies an agreement originally concluded on June 12, 1969, in Warsaw, that protected scup, flounder, and hake--species important to U.S. sport and commercial fishermen. The latest agreement continues and expands protection for those species. It also broadens the protective measures to cover black sea bass, menhaden, and river herring. U.S. scientists agree that fishing of these resources should be limited.

Poland Will Refrain

Poland will not fish those species along Middle Atlantic coast and will avoid depleting them throughout the year.

Poland will continue to refrain from fishing during winter months in specified offshore area of Middle Atlantic--roughly between the 50-100 fathom zone, where bottom species concentrate early in the year. The effective period of this provision had been extended 15 days under the new agreement to apply from January 1 through April 15.

3 Loading Zones

In return, Polish fishermen will continue using, except during summer, 3 areas along mid-Atlantic coast within 9-mile contiguous fishing zone of the U.S. for unloading and transferring fish catches. One area is off Long Island. The second area is off New Jersey, south of Atlantic City. The third is off Virginia, north of Chesapeake Bay. No fishing by Polish vessels is allowed within U.S. contiguous fishing zone.

Port Entry

Each Government will continue to provide for entry of a certain number of fishing and supply ships into certain ports of the other country. In return for Polish cooperation in conserving species of special concern to U.S. fishermen, U.S. facilitation of entry by Polish fishing vessels into certain U.S. ports was broadened.

Fishery Research Cooperation

The Agreement provides for cooperation in fishery research designed to improve future conservation programs in the Middle Atlantic.

Provision is made for visits of fishery representatives and inspectors to each other's fishing vessels in the Middle Atlantic.

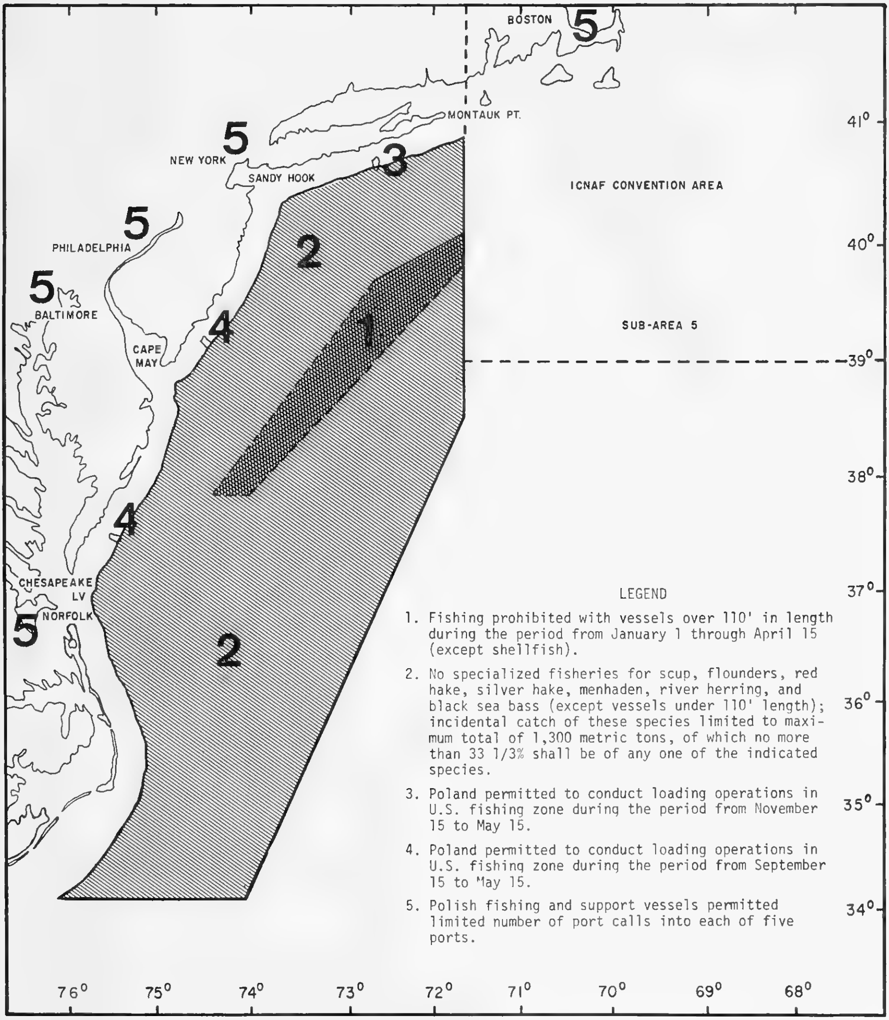
The Agreement will remain in force through September 30, 1971.

The Polish delegation was led by Vice-Minister Romuald Pietraszek, Ministry of Shipping.

The U.S. delegation was headed by Ambassador Donald L. McKernan, Special Assistant to the Secretary of State for Fisheries and Wildlife.

Both delegations contained fishing industry representatives and technical advisors.

U.S. - POLAND FISHERIES AGREEMENT
effective June 13, 1970



OCEANOGRAPHY

SEEK EVIDENCE THAT NORTH AMERICA & AFRICA ONCE WERE JOINED

ESSA oceanographers aboard the 'Discoverer' left Miami, Florida, on July 7 to probe the bottom of the North Atlantic between North America and Africa. They plan to obtain a continuous record of the ocean bottom and subbottom in a 3500-mile-long strip from Cape Hatteras, N.C., to Cap Blanc, Mauretania, in northwest Africa. They will return Sept. 17.

Electronic instruments will record the shape of rock strata, including layers miles beneath ocean floor, and their magnetic and gravity fields.

Were N. America & Africa Joined?

The geophysical information obtained on the 7000-mile trip will be applied to solving vital questions--for example, was North America once joined to Africa? Some prominent scientists believe the U.S. east coast and Africa's northwest coast were joined eons ago, with Cape Hatteras against Cape Blanc.

"The ESSA expedition will seek information about the growth and development of the Atlantic Ocean basin as the North American and African continents split and drifted apart to their present positions."

Continental Drift Theory

According to the continental drift theory, the earth once had one or two large land masses. These began to split 200 million years ago. The continents are drifting at about an inch a year in earth's mantle, the part of earth's interior that lies between molten core and crust. The drifting produced the separation of the supercontinent or supercontinents.

Discoverer's Track

The Discoverer will work along a 250-mile-wide path between Cape Hatteras and Cap Blanc. If the two capes once were joined, the evidence may be found in this strip of the ocean's floor.

The expedition will gather data on the nature of rock structures of deep sea bed. Such information is essential to understand how ocean floor was formed--and to assess geologic formations associated with mineral and oil deposits.

Geophysical information will be sought on active earthquake zones in North Atlantic Ocean basin, useful in understanding earthquakes. (See map page 19.)

RECOVER OLDEST SEDIMENTS SO FAR FROM ATLANTIC BOTTOM

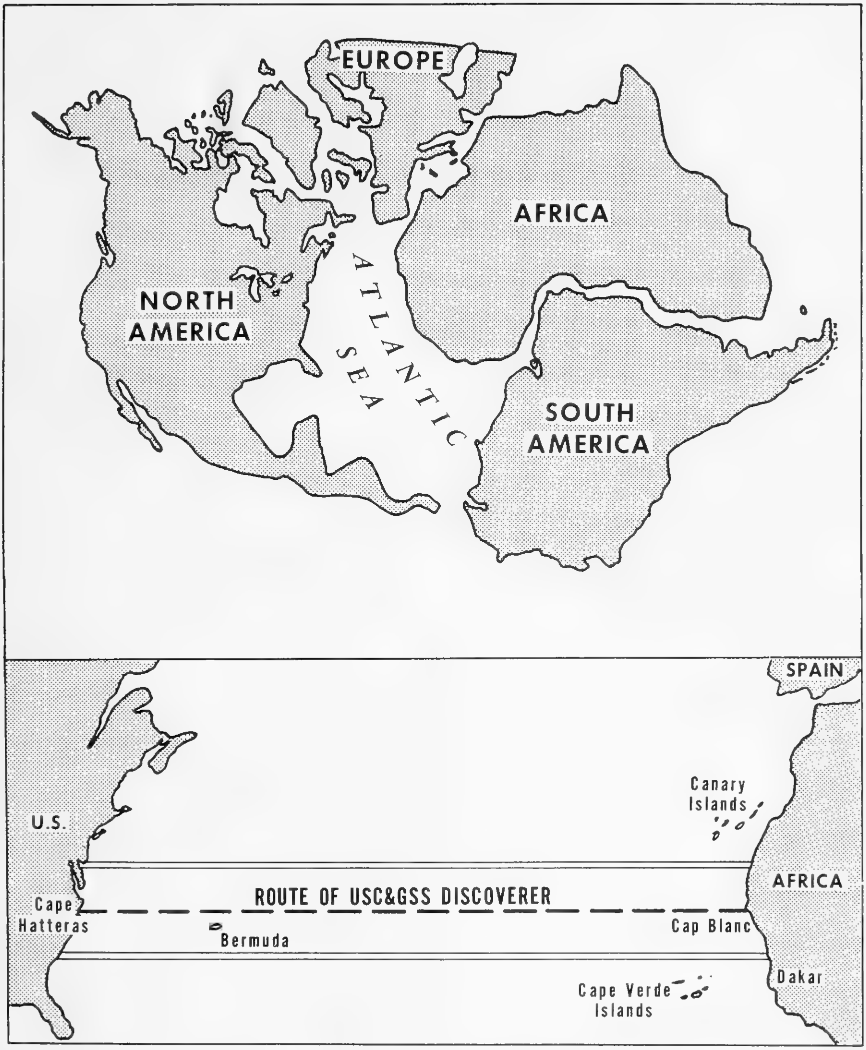
History of the very early development of the Atlantic Ocean has been probed by scientists aboard the 'Glomar Challenger' during Leg Eleven of the Deep Sea Drilling Project. Leg Eleven began in Miami, Fla., on April 8 and ended in Hoboken, N.J., June 1.

Reporting recovery of the oldest sediments yet obtained from the ocean bottom were John I. Ewing, of Columbia University's Lamont-Doherty Geological Observatory, and Dr. Charles D. Hollister, of Woods Hole Oceanographic Institution, cruise co-chief scientists.

The scientists described limestones that contain an abundance of shallow water fossils that lived 150-160 million years ago (Jurassic). This indicates that the early Atlantic Ocean was shallower than it is today. These limestones were deposited shortly after the ocean was formed--as North America separated from Europe and Africa. The separation of the continents occurred no earlier than the beginning of Jurassic time, about 180 million years ago, the scientists say.

Atlantic Widening

Since that time, the continents have been moving farther apart--increasing the size of the Atlantic Ocean. "New rock that comes from deep within the earth is forming the new Atlantic Ocean floor in the central part of the ocean." Compared with the earth's age (4.5 billion years), or the oldest dated rocks on the continent (3.5 billion years), the Atlantic is very young.



Top of drawing is interpretive sketch of North Atlantic Ocean as it may have existed some 200 million years ago after the continents surrounding it broke up and began to drift apart. Bottom drawing depicts the 250-mile-wide area across which Cape Hatteras and Cap Blanc may have drifted apart and the USC&GS Ship Discoverer's route as she seeks some of the answers to the age-old mystery. The ship will spend two months this summer probing the bottom of the sea between the two continents.

UNDERWATER POWER PLANTS STUDIED

Interior Secretary Walter J. Hickel announced on July 3 a grant to General Dynamics to study the feasibility of underwater power plants in the oceans as a means of supplying more electricity with less pollution.

He said: "We must immediately plan for the placement of generating plants so that the impact of waste heat discharge is beneficial rather than detrimental.

"I think bold, innovative ideas such as placing power plants beneath the oceans may possibly ensure the protection of the environment and at the same time allow a safe and orderly expansion of our power-producing capacity.

"Particular emphasis will be placed on identifying the possible effects that power plant waste heat and other wastes might have on the marine ecology of the area. Our Fish and Wildlife Service advises that an upwelling created by waste heat discharge can be beneficial if properly located. The concept is to make technology our servant, rather than our master."

Cold waters can absorb large quantities of waste heat from power plants more readily than can inland bodies of water.

The Project

General Dynamics will determine the feasibility of placing a 1000-megawatt, nuclear-powered generating station on the sea floor down to 250 feet. It could be placed as far as 25 miles from shore.

The study will examine several offshore sites for their geological, physical, and biological characteristics to determine suitability for submerged electrical generating stations. At least three sites will be evaluated: one in northerly waters, one in temperate, and a third in semitropical waters.

'RESEARCHER' WILL HAVE MOST ADVANCED ELECTRONIC DATA SYSTEM

The most advanced data-acquisition system will be installed on ESSA's oceanographic vessel 'Researcher'. She was scheduled for delivery in June to ESSA's Coast and Geodetic Survey. The ship will bring to 15 the number of hydrographic, ocean survey, wire drag, and tidal current survey ships operated by the Commerce Department agency.

The $1,000,000 data-acquisition system (DAS) is a major advance over DAS equipment installed in 1965 aboard the 'Oceanographer' and, in 1967, on her sister ship, the 'Discoverer'.

The heart of DAS is a computer with a capacity of 100,000 arithmetic calculations per second. The system is designed to collect and record scientific data. "When the ship is underway, it will sample (by means of shipboard and towed sensors), record and process geophysical, oceanographic, hydrographic, and meteorological data automatically and routinely."

The Vessel

The $10-million Researcher, christened in October 1968, can handle helicopters and small research submersibles. She is electronically equipped to probe the ocean's greatest depths.

The 2800-ton, air-conditioned vessel is 278 feet long. Her normal operating range is 13,000 nautical miles. She has 4000 square feet of enclosed laboratory space, and accommodations for 13 officers, crew of 54, and 18 men and women scientists.

The ship is a modified, slightly smaller version of the Coast Survey's largest vessels, the 303-foot, 3805-ton Oceanographer and Discoverer. She is the first of a new class of survey ships developed to meet present and future requirements.

She will conduct oceanographic surveys in the Atlantic and the Gulf of Mexico. Her home port will be Miami, Fla., site of ESSA's Atlantic Oceanographic and Meteorological Laboratories; initially, she will operate out of ESSA's Atlantic Marine Center in Norfolk, Va.

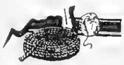
WORKSHOP ON MARINE WIRE ROPE

A 3-day workshop on the problems of a wire rope in the ocean and at the ocean-atmosphere interface will be held at The Catholic University of America in Washington, D.C., August 11-13. It is sponsored jointly by the National Oceanographic Instrumentation Center, the Office of Naval Research, the U.S. Navy Ship Systems Command, and the university.

The performance of wire rope is very important to oceanographers because their research instruments are complex and costly and frequently must be retrieved from depths greater than 10,000 feet.

Wire Rope Users

Fishery and off-shore mineral activities use wire rope extensively. So does the U.S. Navy in salvage operations. The "hard hat" diver who works on the bottom and the retrieval devices are got there by cable.



PUBLICATIONS

NEW FOLIO IN SERIAL ATLAS OF MARINE ENVIRONMENT

The American Geographical Society (AGS) has published Folio 19 of its Serial Atlas of the Marine Environment: "The Water Masses of the North Atlantic Ocean; A Volumetric Census of Temperature and Salinity," by W.R. Wright and L.W. Worthington, Woods Hole Oceanographic Institution (Mass.). It contains 8 pages of text and color plates. Price: $10. AGS is at Broadway & 156th St., New York, N.Y. 10032.

"This Folio is a tabulation of the volume of water in the North Atlantic Ocean by intervals of temperature and salinity, based principally on data from the International Geophysical Year. The intervals range from 2° C x 0.2‰ of salinity in the surface waters to 0.1° x 0.01‰ in the water colder than 2°, providing a fine-scale description against which future water mass changes can be discerned."

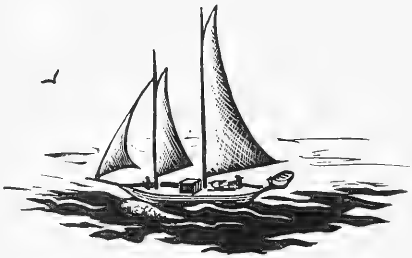
MEETINGS

1. The 23rd annual meeting of the Gulf and Caribbean Fisheries Institute will be held at the Inter-Continental Hotel, Curacao, Netherlands Antilles, Nov. 8-12, 1970.

   Of the 4 sessions, 2 will be devoted to topics of specific interest; 2 will emphasize current research.

2. The International Game Fish Conference will hold its 15th annual meeting, Nov. 13 and 14, immediately after Institute.

For information: Executive Secretary, Gulf and Caribbean Fisheries Institute, 10 Rickenbacker Causeway, Miami, Fla. 33149.



CRABBING MAY BE INEXPENSIVE SPORT

"Checked the price of crab meat lately?," asked the Texas Parks and Wildlife Department in June. The Department had--and suggested this cheaper way to obtain crab meat:

Unless your wallet makes a large, uncomfortable bulge in your hip pocket, a gander at the cost of picked meat will probably kill your craving for crab à la king.

But there is an alternative to plunking down hard cash for this saltwater delicacy--catch the crabs yourself.

True, hard cash is needed for equipment, but it doesn't take much money, and the equipment can be used again and again. And the money you spend gets some extra mileage by being spent for two things, recreation and food, instead of just for food.

Handlining for Crabs

The most common method of catching crabs is by handlining. A piece of meat tied to a strong string, a dip net, and a bucket or tow sack to keep the crabs in is all that is needed; a modest layout of cash indeed.

The meat is lowered into the water. When a crab tugs on it, the line is pulled upward slowly with the crab hanging on, and the net is used to dip out the crab.

Trotlining By Serious Crabbers

Trotlining is a method used by more serious crabbers. A line with several pieces of meat dangling from strings is tied between two poles. The bait is visited periodically, and the crabs are scooped up with a net.

Crab nets and wire crab pots (traps) are also used. The pots cost from $3 to $5 depending on size and construction, but the average crabber does not care to make this investment. Since the use of crab pots usually takes the sport out of crabbing, most crabbers stick to less sophisticated methods.

The Right Bait?

The right bait to use is a debatable question among crabbing enthusiasts. Some will swear by chicken necks and wings, while others prefer beef scraps. The availability of chicken in the home refrigerator and its ability to withstand several hours of crab fishing makes it a popular bait.

Blue Crabs Spawn in July

Spawning blue crabs fill the Gulf surf in July, and large numbers of people flock to the beaches to take advantage of this season. Sponge (egg-carrying females) and spent (spawned females) crabs are easy prey for dip nets. However, Texas law now prohibits the keeping of sponge crabs, easily recognized by the orange glob of eggs on their underside.

Sport Crabbing Valuable

A survey of the Galveston Bay fishery by Texas Parks and Wildlife Department biologists provided information to substantiate the popularity of sport crabbing and its impact on an area. Data gathered from the survey determined that sport crabbing contributes considerably to the area's economy.

Department personnel counted 41,000 crabbers and interviewed 887 from April through December of 1968.

Fifty stations, each selected for ease of public access, were established for the study. Bridges, ditches, bayous, piers, rock groins, jetties and beaches were checked for crabbers.

The survey showed that crabbing activity usually depends upon the weather, although people were observed crabbing throughout the year.

Women 38% of Crabbers

The fairer sex are ardent crabbers and made up 38% of those interviewed. Children under six years of age comprised 22% of the total. Also, sportsmen often combine crabbing with fishing. Of the 1,775 groups encountered, 15% did both. Generally, it appears that adults fished while their children went crabbing. This kept children nearby, and often the children provide the only seafood to take home.

Cost of Sport

The average cost of the sport was $.80 per person, or $3.00 per group.

FISHERY OCEANOGRAPHY--VII
ESTIMATION OF FLOW IN GULF OF ALASKA

Felix Favorite

Perhaps the most common immediate reaction to oceanographic studies by fishery groups is that the ocean is too large and that the extensive environmental studies required to direct fishery activities are too time consuming and expensive. After all, aren't you better off to cast your nets into the water and see if any fish are present than to use the time to make environmental observations and hypothesize the probability of catching fish. Of course, the answer to this question may be yes, especially if visual or electronic devices indicate the presence of fish. But in this manner one never answers the question why--why are the fish present; why are they here at this time; why are they so few or so abundant? How many fishermen spend the winter wondering why last summer's fishing was good or bad and if next year's will be worse or better? As soon as one begins to examine the causes of fluctuations in the sizes of catches, new problems demand attention. Information on reproduction and survival of the harvested stocks is required to estimate the numbers of fish in the sea. One must also know about the vagaries of the environment and the reaction of fish to its changes.

Much is said today about sea-surface temperatures as aids to fishing and the potential of satellites to monitor surface temperatures, but these data are in some respects very superficial. They are only indicative of a thin surface layer and are not necessarily indicative of the direction and intensity of ocean currents. It is these currents which disperse eggs and larvae of marine fishes into areas where conditions are favorable or unfavorable for survival, and transport passively drifting fishes from one area to another. Also, current boundaries appear to serve as guideposts to migrating fish, such as the Pacific salmon (genus Oncorhynchus).

Clues to Salmon Migrations

Frequently, unusual displacements of fish stocks occur. These are usually accompanied or foreshadowed by abnormal environmental conditions. Until satellite systems that monitor flow are devised, we must explore the methods presently available. We believed from the beginning of our studies that ocean currents and the inherent water properties of each current system provided some clue to migrations of salmon. Previous articles in this series showed that temperature and salinity distributions provide an indication of the southern limits of salmon distribution--but little information concerning their migration routes. These routes appear to be associated with the huge Subarctic gyres.

Geostrophic Flows

Usually, currents or water transport in these gyres are ascertained by the geostrophic method and are called geostrophic flows. Geostrophic velocities are proportional to the slope of the sea surface derived from observations, at two or more locations, of the vertical distribution of temperature and salinity above an arbitrarily selected reference level at which horizontal pressure gradients are believed to be negligible. The relation between the vertical distribution of mass (determined by distribution of temperature, salinity, and depth) and of flow is somewhat like the old query: which came first, the chicken or the egg? Does the flow result in the observed distribution of mass, or does the distribution of mass result in the flow? We will accept the fact that a slope indicates an imbalance of energy at the sea surface and consider how to ascertain this imbalance and its relation to flow.

Dr. Favorite is an Oceanographer with BCF's Biological Laboratory, 2725 Montlake Blvd. East, Seattle, Wash. 98102.

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Reprint No. 878

Above 4° C., water expands as the temperature rises. Thus, a column of warm water will stand higher above the common reference level than a column of cold water; a column of fresh water will stand higher than a column of salt water. As there is no way to ascertain a true reference level, an arbitrary depth is selected--usually where the least change of temperature and salinity with depth occurs. Although there are exceptions, a reference level of the order of 1,500 decibars is selected; this approximates a depth of 1,500 meters. By summing up effects of vertical structure of temperature and salinity on height of water column from this level at two or more locations, we are able to ascertain the topography of the sea surface relative to this level--and resulting geostrophic flow at sea surface relative to flow at this level. This is assumed to be zero and, in practically all cases, is insignificant compared to surface flow.

If you liken this topography to that of land, one might imagine intuitively that flow would be downslope. In the equilibrium state, the tendency for water particles to move downslope (pressure force) is assumed to be balanced by a centrifugal reaction (Coriolis force), and the resulting flow is normal, or at right angles to the slope. In the northern hemisphere, upslope is to the right of the flow as one looks downstream; the speed of, or transport of water in, the flow is related directly to steepness of slope. Thus, cyclonic (or counterclockwise) flow occurs around the topographic lows (the Gulf of Alaska gyre is an example); anticyclonic flow occurs around topographic highs. Using this technique, we have been able to ascertain geostrophic currents between fishing stations and the general circulation over large fishing areas. Of course, this method assumes unaccelerated, frictionless flow and is a gross simplification of actual flow conditions in the ocean. There is no need to pursue its limitations except to point out that distribution of temperature and salinity at depth are altered slowly, thus transient currents are not represented; furthermore, with even a number of ships, it is impossible to obtain synoptic observations over a large area.

Our early studies in the Subarctic Pacific Region provided some indication of geostrophic currents during summer; subsequent winter cruises provided an indication of currents during that period also. But we never have been able to obtain a continuous year-round picture of ocean currents or of salmon distribution that did not lack continuity in time or space and, therefore, was somewhat fragmentary. This prevented any successful attempts at forecasting environmental or fishery conditions.

Estimating Flow Over Wide Area

There is another method that permits one to obtain an estimate of flow over wide areas. Although it is difficult to integrate into a continuous record of flow, it provides valuable information independent of actual measurements of water properties. The flow in major ocean current systems is dependent upon the stress of the wind on the sea surface. Knowledge of this stress permits us to compute flow generally referred to as wind-stress transport. Although the exact coupling between surface winds and surface ocean currents is complicated and not well known, there are empirical considerations that permit us to obtain an estimate of flow in the open ocean. This is done in the following manner: the mean sea level pressure over the area concerned for a selected period is obtained from the weather records. The accompanying mean winds are derived from the spacing of the isobars, under accepted meteorological concepts, for surface wind stress at grid points. Knowledge of the curl (vector cross product) of the wind stress and the rate of variation of the Coriolis parameter along a meridian permits computation of the north/south transport across a unit length of latitude that would occur when steady-state conditions are reached. Using continuity concepts from grid point to grid point, commencing at the west coast of North America and proceeding westward, one is able to construct a circulation pattern that has been shown to approximate actual flows based upon the time-consuming and costly shipboard observations.

Gulf of Alaska Gyre

As indicated in Article V, we are particularly concerned about the effect of the Gulf of Alaska gyre on the distribution of salmon. If we ignore boundary conditions imposed by the coast, and investigate seasonal effects of mean monthly wind-stress transports in the Gulf of Alaska for the decade 1950-59, several interesting features are evident (fig. 1). There is an appreciably greater flow into and out of the Gulf of Alaska during winter than in summer. Although cyclonic winds (associated

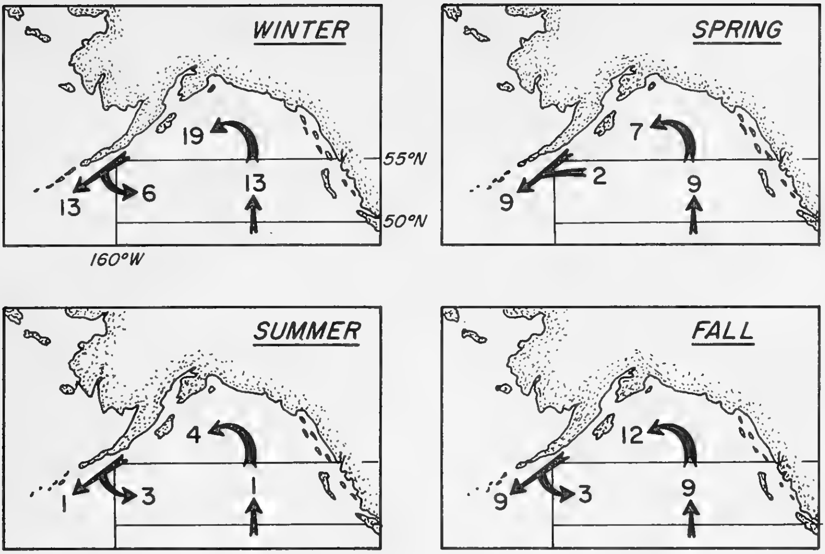


Fig. 1 - Mean seasonal flow (transport [X 10^6 m.^{3}/sec.]) into and out of the Gulf of Alaska, 1950-59.

with the low pressure system in the Gulf of Alaska each year during winter) should result in an intensification of flow, the differences appear large because there is little evidence of this intensification in the distributions of temperature and salinity. However, when one considers the monthly values of mean sea level for the same period at Yakutat (corrected for atmospheric pressure and precipitation effects)--an increase in sea level, indicating an increase in cyclonic flow, is found during winter.

There is no recirculation, or eastward flow, during spring. This is interesting because it is the season in which there is a predominant westward movement out of the Gulf of Alaska of sockeye salmon (O. nerka) bound for spawning streams in the eastern Bering Sea. Finally, northward flow across lat. 50° N. is at a minimum during summer, and most of the northward flow across lat. 55° N. is the result of water recirculating in the gyre. In addition to providing an indication of long-term seasonal or annual conditions, this method can be used to ascertain recent conditions--and provide enough insight to permit estimations or predictions of flow on a month-to-month basis.

Computations of geostrophic flow based upon shipboard observations of temperature and salinity, to 1,500-m. depth south of the Alaska Peninsula, indicated a westward transport of 11 x 10^6 m.^{3}/sec. in early March 1970. Data were required from numerous oceanographic stations parallel to the normal coastline because it was imperative to have observations at the high and low points of the topography of the sea surface to compute total flow. Computations of the mean wind-stress transport for February 1970 indicate an equivalent value for westward flow in this area (fig. 2). Furthermore, it is obvious that considerably more details of flow, particularly areas of possible divergence and convergence, are available from the wind-stress charts. Although this is, basically, a theoretical calculation, it is a method that permits insight into conditions in the ocean that cannot be obtained by a single ship or even by several. The technique requires no expenditure of research-vessel time, nor of a large staff to process data. At the end of each month, when the mean sea-level atmospheric pressure is available, the whole process is completed essentially by computer in minutes. It is through such techniques that we will be able to monitor and predict conditions in the

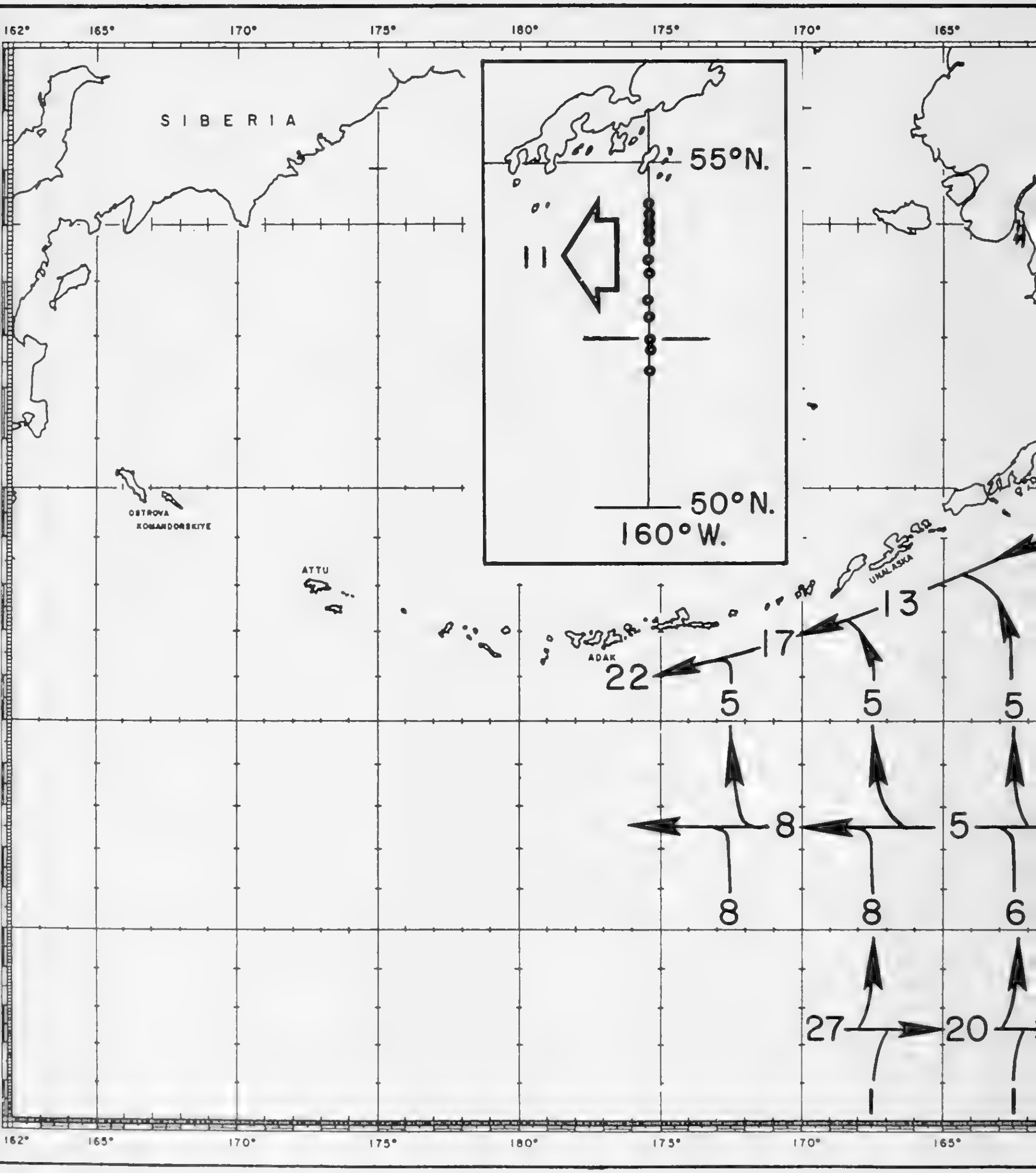
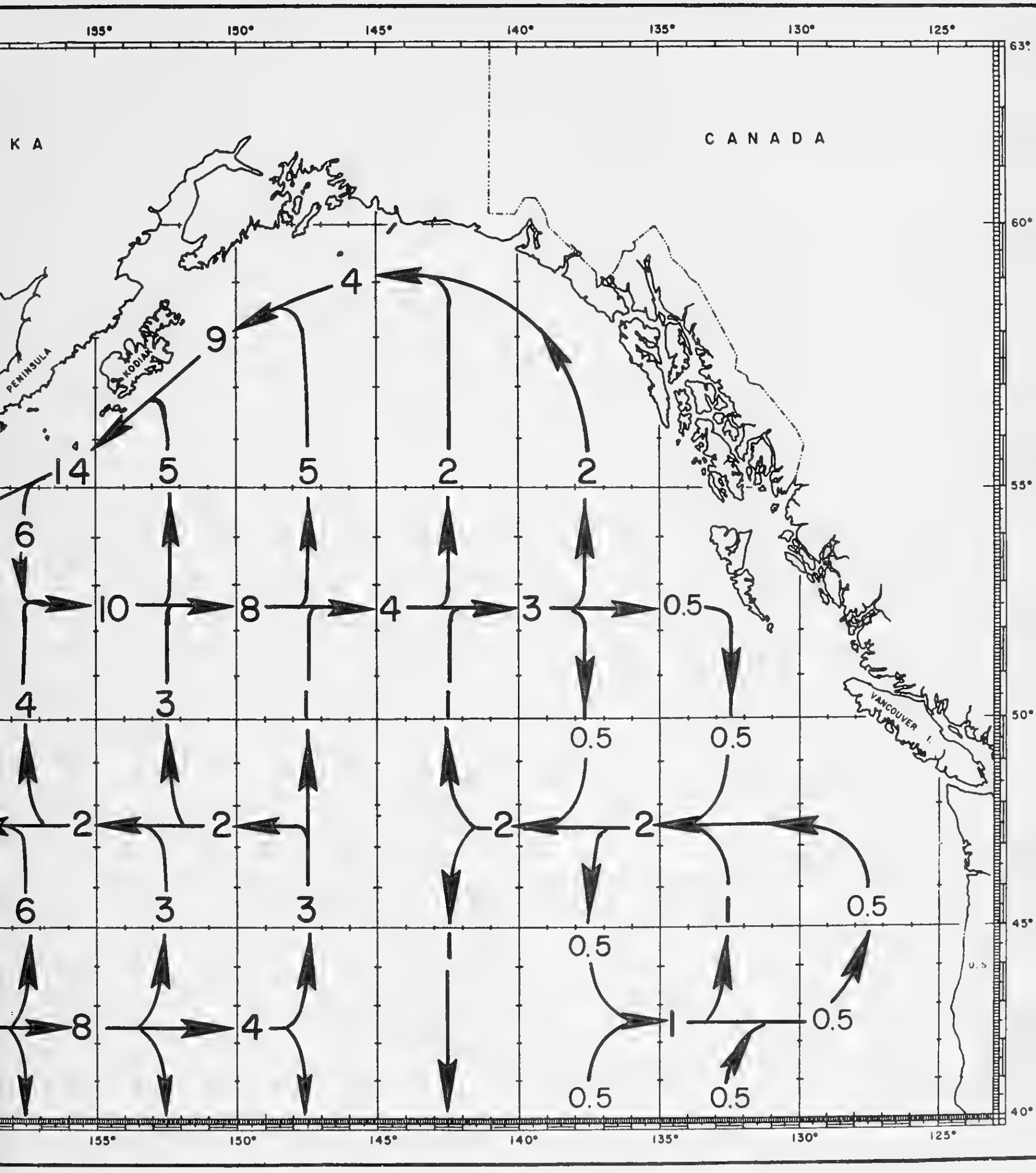


Fig. 2 - Flow (wind-stress transport [X 10^6 m.^{3}/sec.]) in the eastern North Pacific Ocean from oceanographic data obtained at indicated stations.



determined from records of sea level pressure, February 1970. Insert shows flow computed

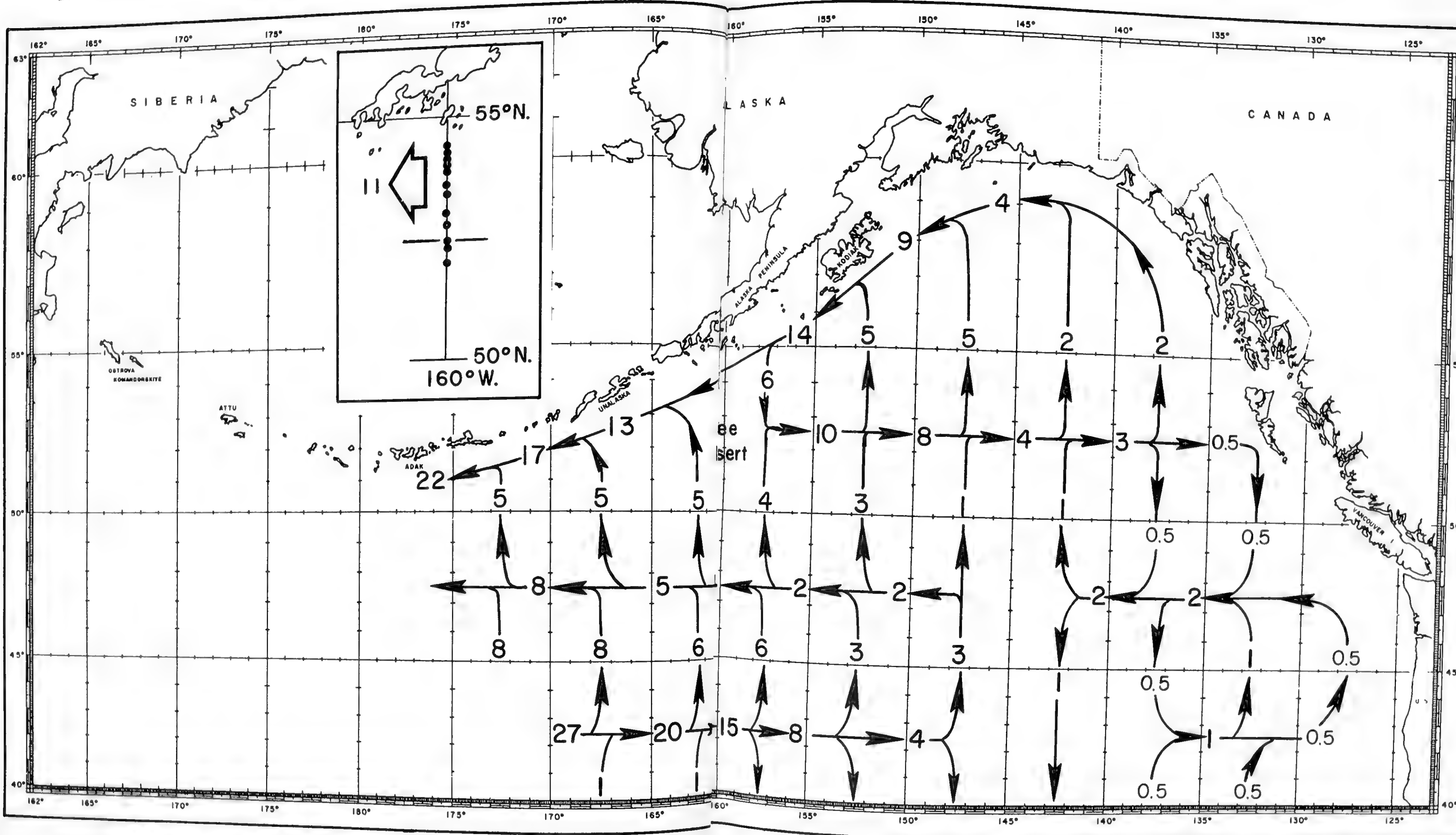


Fig. 2 - Flow (wind-stress transport [X 10^6 m.^{3}/sec.]) in the eastern North Pacific Ocean determined from records of sea level pressure, February 1970. Insert shows flow computed from oceanographic data obtained at indicated stations.

marine environment of the salmon. This information would be beneficial to other pelagic fisheries, such as tuna, hake, mackerel, herring, and saury. It would be invaluable for ascertaining drift of eggs and larvae of fish, shrimp, and other marine resources that have a planktonic stage in their life history.

Direct Measurement Necessary

Although we are using wind-stress transports to predict flow in the Subarctic Region, further supporting evidence is required to confirm our conclusions. This can only come through direct measurements. A vast system of moored current meter arrays would be expensive. An experimental array is presently in place in the North Pacific Ocean but, unfortunately, it is outside our region of interest. We proposed and developed a drifting telemetry buoy capable of being interrogated and positioned by satellites. Our plan for a north-south line of buoys, to be released off the Kurile Islands and tracked as they drifted eastward in surface waters influenced by variable wind stresses, was met with intense interest by fishing and oceanographic groups--not only in the United States, but in Canada and Japan. Perhaps the plan will become a reality in the future because, in addition to verifying the validity of wind-stress transports, it will provide answers to many problems concerning air-sea interaction--and information concerning weather approaching the west coast of the United States and Canada.

Money Needed for Ocean Study

This article is the last of this series, but there is a need for more. I have tried to point out that we know very little about the ocean environment. Most of the immediate benefits to be accrued by oceanographic studies, except for military, climatological, and geological applications, appear to be related to fisheries. Each week and each month, as we continue to explore and harvest oceans, new and exciting aspects of fisheries are revealed that require knowledge of environmental conditions. Yet, if we exclude the funds spent on monitoring and harvesting the fishery resources, only a small amount is being spent on studying the environment of the fish.

Some people believe that United States interest in oceanography is relatively new. While it is true that the large increase in oceanographic funds followed the International Geophysical Year 1957-58, extensive environmental studies were conducted by fishery oriented groups before 1957-58: from 1927 to 1929 by International Fisheries Commission in relation to life-history studies on halibut in Gulf of Alaska; from 1938 to 1941 over Bristol Bay shelf and southward of Alaska Peninsula and Aleutian Islands by U.S. Bureau of Fisheries in relation to distribution and movements of sockeye salmon returning to Bristol Bay streams; and from 1953 to present by the International North Pacific Fisheries Commission, which is concerned with oceanic distribution of numerous fish stocks. Sporadic cruises by independent oceanographic vessels notwithstanding, the major environmental investigations in the northern North Pacific Ocean have been conducted largely to answer fishery problems. Yet, today, the funds available for fishery oceanography are infinitesimal compared to those in other types of oceanographic investigations.

Considerably more emphasis must be placed on fishery oceanography--now and in the future--if we are to understand the effects of environmental conditions on the distribution and survival of living marine organisms so that we can provide guidelines for management and harvest, aid in protecting these resources from foreign exploitation, and counter the ever-increasing menace of pollution.

Oceanographic data and research summaries compiled and written by the Oceanographic Group at the BCF Seattle Biological Laboratory, as a result of investigations of the Pacific salmon, may be found in Annual Reports and Documents of the Commission dating from 1955. Much of the content of this and the other six articles on Fishery Oceanography have been derived from these reports and from the following papers by various members of the group:

BAKUN, A., and W. B. McALISTER
1969. Vertical circulation in the North Pacific Ocean, summer 1958. BCF Biol. Lab., Seattle, Wash., 22 p., 10 figs., 2 tables.

CALLAWAY, RICHARD J.
1963. Ocean conditions in the vicinity of the Aleutian Islands, summer 1957. Int. N. Pac. Fish. Comm., Bull. 11: 1-29.

DAY, DONALD S.
1970. Macrozooplankton and small nekton in the coastal waters off Vancouver Island (Canada) and Wash., spring and fall of 1963. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. (In press.).

DODIMEAD, A. J., F. FAVORITE, and T. HIRANO
1963. Salmon of the North Pacific Ocean. Part II. Review of oceanography of the Subarctic Pacific Region. Int. N. Pac. Fish. Comm., Bull. 13, 195 pp.

FAVORITE, FELIX
1961. Surface temperatures and salinity off the Washington and British Columbia coasts, Aug. 1958 and 1959. J. Fish. Res. Bd. Canada 18: 311-319.

1964. Drift bottle experiment in the northern North Pacific Ocean, 1962-64. J. Oceanogr. Soc. Japan 20(4): 6-13.

1967. The Alaskan Stream. Int. N. Pac. Fish. Comm., Bull. 21: 1-20.

1969. A summary of BCF investigations of the physical-chemical oceanic environment of Pacific salmon, 1955-68. BCF Biol. Lab., Seattle, Wash. 38 pp., 14 figs.

________, D. FISK, and W. J. INGRAHAM JR.
1965. First transponding oceanographic buoys in the Pacific. J. Fish. Res. Bd. Canada 22: 689-694.

________, B. A. MORSE, A. H. HASELWOOD, and R. A. PRESTON JR.
1964. North Pacific oceanography, Feb.-April, 1962. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish 477, 66 pp.

FISK, DONALD M.
1969. Recoveries in 1964-68 of drift bottles released from a merchant vessel, SS 'Java Mail' en route Seattle to Yokohama, Oct. 1964. BCF Biol. Lab., Seattle, Wash. 7 pp., 4 figs., 1 table.

INGRAHAM, W. JAMES JR.
1967. The geostrophic circulation and distribution of water properties off the coasts of Vancouver Island and Wash., spring and fall 1963. U.S. Fish Wildl. Serv., Fish. Bull. 66: 223-250.

________, and F. FAVORITE
1968. The Alaskan Stream south of Adak Island. Deep-Sea Res. 15: 493-496.

JOYNER, TIMOTHY
1964. The determination and distribution of particulate aluminum and iron in coastal waters of the Pacific Northwest. J. Mar. Res 22: 259-268.

LARRANCE, JERRY D.
1969. Primary production in the mid-Subarctic Pacific region, 1966-68. BCF Biol. Lab., Seattle, Wash. 45 pp.

McALISTER, W. BRUCE
1968. Buoy telemetry for environment prediction in fisheries research. Proc. Int. Telemetering Conf., Los Angeles, Calif., Oct. 8-11, 1968, Vol. 4: 650-657.

________, F. FAVORITE, and W. J. INGRAHAM JR.
1970. Influence of the Komandorskie Ridge on surface and deep circulation in the western North Pacific Ocean. Univ. Hawaii, Publ. Oceanogr. (In press.)

HURRICANE CAMILLE: A New Experience in Reclaiming Canned Seafood

E. Moret Smith

On August 17, 1969, hurricane Camille struck with unprecedented fury the coasts of Alabama, Louisiana, and Mississippi. She caused damage estimated at over one billion dollars. In Mississippi alone, 40,000 inhabitants suffered hardship, and about 35 miles of coastline were laid waste.

Most details concerning the storm and its effects have been documented on film and paper. It was a new experience in every respect. It is disconcerting to realize that neither the people nor the various governmental agencies were equipped to handle a disaster of such proportions. By using the Gulf Coast as a dramatic example, persons involved in a similar catastrophe in the future can profit from the experiences of those who cleaned up after Camille.

BCF personnel who were in Biloxi, Mississippi, the day after the storm, and who returned later to help clean up, observed the storm's effects on canned seafood products, and the results of efforts to recondition these products.

THE SCENE

For the most part, the seafood industry of Mississippi is grouped on the beach facing the Gulf of Mexico and would bear the brunt of any hurricane. This was the case in Biloxi the day Camille struck. Canneries and processing houses that were not blown away were later reduced to rubble, or swept into the sea by 18-foot tides. On August 18, the day after the storm, 200,000 cases of canned seafoods worth about two million dollars littered warehouses, beachfronts, or were intermingled with wreckage, debris, and silt. There was no consolation for those whose stocks remained on pallets in warehouses because these too suffered water and silt damage.

For days, there was little or no clean fresh water; in most instances, when it was restored, water pressure was inadequate to effectively start the cleanup. Because of the time required to rebuild damaged electric motors, those who had private water systems were only slightly better off. Labor was almost nonexistent as people tried to restore the basic needs of living. Most people were in shock; they did not recover for days. Everyone was staggered by the task of rehabilitating homes and businesses. The future was bleak. Trying to determine just where to begin rebuilding was a task--and this situation can be expected again.

THE NEED FOR A PLAN

Tools Needed: 1. Labor
2. Trucks
3. Warehouse

The only way to avoid a costly cleanup of canned stocks is to move them to a safe area before a destructive storm strikes. Except for relatively small quantities of merchandise, this would seldom be possible. Camille meandered over the Gulf for a week, but forecasters were unable to give a 24-hour advance notice on where she would strike. For this reason, only token quantities of merchandise were moved to safe areas.

Mr. Smith is a Fishery Marketing Specialist with the Bureau of Commercial Fisheries, 239 Frederick Street, Pascagoula, Mississippi 39567. At the request of Biloxi canners, he managed a 2-month can-cleaning operation.

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Reprint No. 879

Fig. 1 - Aerial view of "Cannery Row" Biloxi after hurricane Camille.

Fig. 2 - Some of 200,000 damaged cases of canned seafood in Biloxi.

Within each cannery, the decision about which to move--canned goods, machinery, or both--creates an additional demand on available trucking. To make the most of whatever advance notice is given, a company's plan for maximum evacuation should be developed well in advance of the storm. It should be put into action as soon as it is evident the storm will come close. Most hurricanes push tides of 12 to 15 feet. Canneries on high grounds would be safe from damaging tides, but there are few, if any, in the Gulf Coast area that are 15 feet above sea level. So it is reasonable to suggest that all canneries should have an evacuation plan.

It is difficult to determine what action should be taken after a storm until one has surveyed the damage to installations and stock. There are, however, certain basic steps that would be beneficial. These would require a plan not only for an individual canner, but for other canners and food brokers with large stocks of damaged canned goods.

The Biloxi cleanup was expedited by the finest type of cooperative action. Unfortunately, time was wasted conceiving and organizing it. Had there been a plan for united action prior to the storm, time would have been saved--the time during which cans deteriorated.

Salvage Canned Products

It is important to know that 75 percent or more of the canned goods can be reclaimed almost to original newness. For this reason, and because canned stocks represent needed collateral, I believe that all efforts should be directed to salvaging these canned products.

THE CLEANUP

Tools Needed: 1. Labor
2. Packing cases

After a storm, there may be some uncertainty about what to rebuild first. Assuming

Fig. 3 - Cleanup begins in Biloxi.

it is salvaging canned stocks, TIME becomes vitally important because, inevitably, in TIME canned goods will be worthless. In TIME, the action of saltwater and air will create rust that causes pinholes in a can, or the can will lose eye appeal from blotches in the tin plate. Cans should be reconditioned as fast as possible. Because labor will be short, this will not be easy. Therefore, it would be prudent to hire as much help as possible immediately after a storm.

If work cannot proceed because of the loss of a structure under which to work, the cans should be submerged in water. Steel will not rust as rapidly under water as when damp and exposed to air. In 1947, canned salmon in the 'S. S. Salmon' that sank in 135 feet of water was in good condition after $2\frac{1}{2}$ months; the cans were opened, the salmon removed, repacked, and processed in new cans.

Swimming pools could be used, or a pool constructed by building mud levees covered with plio-film sheets. Hosing the stock with water does not provide the same effect. In fact, hosing silt and salt deposits from the cans provides a perfect situation for rust to develop more rapidly.

It is probable that neither fresh water nor power would be available after a hurricane, but some measures can be taken toward salvaging canned goods. It is desirable to remove cans from wet packing cases, and labels from all cans. Residual chemicals in the paper combine with the dampness to set up an action that speeds rust formation. In Biloxi, cases that remained on pallets, but were saturated, remained wet in the center of the pallet for three months. Even if the cases and labels had dried, as some did on the outside, the rust formation was worse than on those that had been removed. The percentage of cans that were recovered from wet cases was considerably less than that of cans removed from such an environment. An added disadvantage was that production was hindered because more time was required to work from wet cases than from dry ones. The cases disintegrated when handled, spilling the cans; rust will develop more rapidly, especially along seams and at points where labels are attached to cans.

If utilities have not been restored, the cans should be repacked in dry or new packing cases and, later, treated more. For lack of cases, some canners in Biloxi stored cans in retort baskets. As a temporary measure this could be helpful, but in areas of high humidity, this is undesirable. Exposed cans will not be much better off than if left in wet cases. The recovery rate of cans held this way was less than those stored in dry cartons.

WHEN UTILITIES ARE RESTORED

Tools Needed:
1. Labor
2. Fresh water
3. Detergent
4. Scrubbing brushes
5. Steel wool or power buffer
6. Heat
7. Rust-preventive oil
8. New packing cases

Up to this point, everything accomplished was done as a temporary measure. Now cleaning should begin in earnest. Whether accomplished manually or mechanically, the objective is the same: to remove salt, dirt, silt, labels, and rust. It takes at least three weeks to arrange and obtain the services of a mechanical cleaner, so the following is directed at those who wish to clean their canned goods by hand.

A surprising amount of stock can be rejuvenated simply by scrubbing the cans in warm water and detergent. Several Biloxi canners depended entirely on this method for relatively small stocks of canned goods; if accomplished promptly, there is little reason to worry about later effects. Cans showing signs of light surface rust should be set aside for another group of workers to clean with steel wool. A power buffer filled with a fine wire or bronze brush will save much labor. Cans should then be immersed in water held at 180° F., and then dried. Normally, at this temperature, cans will dry without additional effort; if not, they should be passed through a wind tunnel or dried by compressed air.

For several reasons, no attempt was made to recondition unlacquered cans during the Biloxi cleanup. The high unit value of canned shrimp, oysters, and crabmeat made it imperative that these cans receive first consideration. These products were all packed in lacquered, rust-resistant cans. During the time needed for hand-cleaning lacquered cans, almost all unlacquered cans became hopelessly rusted. In Biloxi, only items of low unit cost were in unlacquered cans--fruit drinks and pet food. This should not be construed as reason not to clean items of low unit cost, because the mechanical cleaners that were used in Biloxi were designed for items of this type--beans, tomatoes, fruit cocktail, etc. Unlacquered cans and badly dented lacquered cans seem to rust at the same rate. Therefore, when cleaning up small stocks, do not separate the two--treat both equally.

On cans that have not been buffed, the lacquer will remain intact. The cans can be packed in new cases, held for at least two weeks, be inspected and defective cans pulled, and then marketed. In Biloxi, the U.S. Food and Drug Administration insisted that all cans not mechanically cleaned should be dipped in water containing 0.2 percent (200 parts per million) free chlorine. If this is necessary, it should be done after hand scrubbing, but prior to flushing cans in 180° F. water. While still warm, cans with all or part of the lacquer removed should be sprayed or dipped in a solution of one part mineral spirits and one part rust-preventive oil, be packed in new cases, and held for observation. A rust-preventive oil, available nationally, is sold in 52-gallon drums under the brand name "Oakite." This brand is mentioned for lack of other names. It does not prevent use of another product that could be superior.

Using only a mechanical lift truck as a labor saver, one Biloxi canner estimated that it cost $1.00 to clean a case of 24 307/113-type cans. Wages were fixed at the time at $1.60 per hour. This cost could be reduced by using a conveyor.

EXTREME CONDITIONS

Tools Needed:
1. Labor
2. Steam
3. Water
4. Chemicals
5. Mechanical cleaner
6. New packing cases

A mechanical cleaner and derusting machine should be used where there is a delay in organizing can-cleaning operations, or where the amount is so great that the race against the formation of rust is being lost. In Biloxi, where most canners had 25,000 or more cases to be cleaned, rust developed faster than hand cleaning could arrest it.

Where large stocks are being hand cleaned, at some point the percentage of cans lost will become so great that it will be unprofitable to continue operations. This should be expected if a mechanical cleaner is not available to speed the can cleanup. When this will become unprofitable is controlled by variables: how long cans have been stored prior to cleaning; how badly they are damaged or bent; what preconditioning they received. It will be the individual's determination where this condition will exist. He will take into consideration cost of producing the product, cost of cleaning, percentage of cans being recovered, and resale value.

The mechanical cleaner used in Biloxi cleaned and derusted cans at a rate of 1,000 to 2,000 cases of 24 cans on each machine per 10-hour shift. The wide variation in production was due to differences in can sizes, the extent they were bent, and degree rusted. Badly rusted cans required longer processing.

Except for one unit of the Warner assembly, cleaning consists of running cans between a series of rotating brushes; the cans are sprayed with water under high pressure, and dried. The exception is an electro-cleaning unit that derusts cans using high amperages, low voltages, and chemicals. The principle is the opposite of electroplating.

A layout of the Warner machine follows. These machines will process all sizes that roll on edge, from 307/113 through one-gallon No. 12 cans. Processing large quantities will lower unit cost. This is good reason why canners outside the seafood industry--vegetable canners and others--who may have damaged stocks should also be considered when the idea of obtaining a machine is discussed.

Mechanical Cleaning Superior

Cans mechanically cleaned are superior to those done by hand. They are restored to almost new. Rust is removed or deactivated. Because the caustics and solutions are held at relatively high temperatures (180° F.), the cans are sanitized. Because the process removes all U.S. lacquers, and possibly some foreign, the cans are fogged during the final stages of processing with a protective coating of rust-preventive oil. Thereafter, they may be packed in new cases and held for observation.

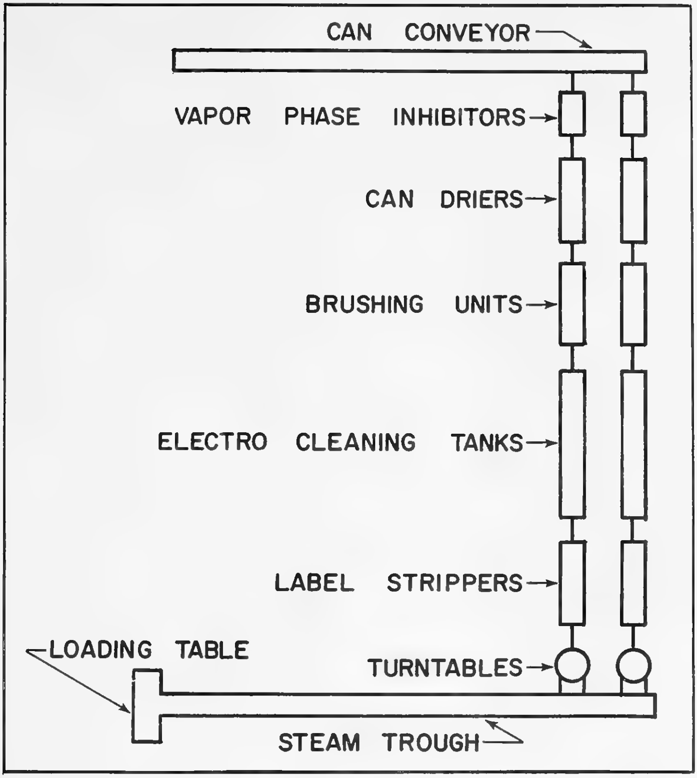


Fig. 4 - Layout of Lansing B. Warner machine.

2-Week Quarantine Period

It is imperative that ALL reconditioned cans be held at least two weeks (at 70-80° F.). During this time, defective cans will reveal themselves. After this quarantine period, each case should be inspected and "swells" removed because "swells" likely will become "leakers"--and the brine in which most seafoods are packed will spray other cans and cause them to rust rapidly.

Disadvantages of Mechanical Cleaner

There are some disadvantages or inconveniences in using a mechanical cleaner. Under most conditions, the machine will not be made available for quantities less than 20,000 cases, unless the user is insured by Lansing B. Warner, Inc. Based on fixed costs and cost of cleaning large quantities, it probably would be economically impractical for canner and machine owner to consider smaller quantities; but again this could vary where goods of high unit value are involved.

Arrangements to obtain a machine were made through Lansing B. Warner, Inc., 4210 Peterson Avenue, Chicago, Illinois 60646. Its representatives will wish to inspect damaged goods before confirming shipment, but this would protect the canner as much as the machine operators. Only then will one or more machines, stored in Greenwich, Ohio, be loaded on trucks and shipped. Assuming water and steam are available, a week is needed after the machine arrives to get it operable. This time-consuming procedure is frustrating when time is a prime factor. It emphasizes need to continue hand-cleaning operations while awaiting machine.

Hand Cleaning Canned Shrimp

In Biloxi, the canners focused on stocks of canned shrimp packed in traditional 307/113 cans. Most were hand cleaned before machine arrived. This was time well spent. The recovery rate on canned shrimp was more than 80 percent--in contrast to 50 percent or less for canned oysters in 211/300 cans, none hand cleaned. While the shape and surface area of the 211/300 can may have had some bearing on this difference, the evidence indicates that the big difference was that the shrimp was hand cleaned.

Assembly Is Bulky

Each unit of the entire assembly is bulky and considerable effort will be needed to move it into position manually. A unit will fit in an area 15 x 75 feet. A low retaining wall must be around it to contain the water used in cleaning. In Biloxi, two additional units were added. One was a 60-foot steambox at the head of the line to precondition cans and soften dirt and labels still on cans; the other, a conveyor supplied by a canner, was added at the end of the line to expedite inspection and sorting. The latter would be desirable under any circumstances. No additional space was needed when a second machine was added but, even so, an area 100 x 100 feet was needed. The U-shaped area enclosed by the assembled units was used for storing chemicals, holding stocks that had been cleaned, and those that were next in line for cleaning.

Assembly of the units is relatively uncomplicated and can be accomplished by four mechanically inclined men working under the supervision of a company technician. It would be advantageous, however, if one were a welder. Sixty hours were needed to assemble each machine in Biloxi; another 24 hours to get the units adjusted and the chemical portioned to achieve desired results. Most fittings required to customize the machine to a specific location can be obtained from a good hardware company. Operating under normal conditions, 1,000 pounds of chemicals are needed each 6 days. Although the chemicals are not unusual, they probably will have to be ordered from a fairly large city; delivery problems can develop.

2 Men Needed Nearby

After the units become operational, two mechanically competent men remained nearby at all times. One was the company technician, who had trained a helper supplied by the cannery to watch for conditions that would cause a unit to jam, add chemicals when needed, and watch for temperature variation and other conditions. With a machine processing cans at the rate of 60 to 80 per minute, it is important that a competent man be selected or production will be curtailed severely.

Company technicians state that cans do not require anything more than fogging with rust-preventive oil to stop rusting. This is not entirely true where humidity is high, buildings are not properly enclosed from the weather, and stocks will be stored longer than normal. Also, by handling and inspecting each can delivered from the machine, a small amount of protective oil is removed. It is recommended that cans be sprayed rather than fogged.

Another problem not completely resolved in Biloxi came while reconditioning cans with lithographed lids. These require special handling. To remove rust properly, the lithograph is disturbed and, to preserve the picturesque lid, some degree of rust will not be removed.

Foreign Cans More Difficult

The elimination of rust is dependent on first removing lacquer from the cans. The removal of lacquer from U.S. cans presents no problem, but removing it from foreign cans can be complicated and time consuming. Variations in tinplate and lacquer on foreign cans present problems because solutions normally used have no effect, or have adverse effects, on the materials in these cans.

In Biloxi, an attempt was made to clean about 3,500 cases of goods packed in cans from overseas, but the results were unsatisfactory. Without advance research to determine solutions and voltages necessary to produce a desirable finished product, attempts to derust cans from abroad in a Warner machine should be discouraged. It would be well even with U.S. cans. Because of the possibility of changes in the plate and lacquer, samples of cans to be cleaned should be analyzed by the machine operators to avoid last-minute disappointments.

With special equipment, lacquer can be replaced on reconditioned cans. It was considered at one point during the Biloxi cleanup, but was never attempted. The pros and cons are purely speculative.

Mechanical Cleaner in Action

When a mechanical cleaner is running, it will appear that losses are greater than they should be. The reason is that the machine reveals not only cans that are obviously defective--but also cans with hidden defects that will cause problems later. It is not unusual for a pinhole to be covered by rust that would be difficult to remove except through a machine's derusting action. Most cans will be 100 percent free of rust; however, an occasional can will have small amounts of rust, particularly in seams or around the lid. This should not be of great concern because any rust that is left has actually been lifted from the can and deactivated--another good reason for using a machine.

Community's Cooperative Spirit

The operation of the Warner machine in Biloxi was a cooperative venture sponsored by the American Shrimp Canners Association. Each canner was allowed to run 20 percent of his damaged inventory through the machine with lot determined by drawing straws. After each canner had his turn, the procedure was repeated. Initially, each canner was charged $1.30 for each case of 24 cans run through. This was determined by a counter at the end of the machine and would include defective cans discarded after passing the counter. This was recognized as a somewhat inflated cost. Each canner hoped to get a refund, but the refund was contingent upon shaving costs for materials, labor, and utilizing to best advantage the services of a BCF Marketing Specialist and 8 Technologists from the BCF Pascagoula Fisheries Station.

It is desirable to select persons who can perform best at every point of the operation. This is especially true at the beginning and end of the cleaning line. Those at the start can reduce costs by culling cans that are obviously defective, or those so badly bent that they would cause the machine to jam. Personnel who inspect cans coming from the machine are important. By eliminating a "leaker" or "swell" then, they will save all other good cans in a case that would be ruined by a "leaker" spraying brine later. The work performed by relatively unskilled workers in Biloxi cannot be discredited at this time by noting the greater percentage of defective cans in cases packed during the early weeks of the cleanup than later. This is evidence that more time should have been devoted to instructing loaders and packers on which cans should have been processed, and which packed.

Normally, only two women and one man will be needed at the starting point. A minimum of six women and one man will be needed to keep up with packing cans in cases and stacking products at the end of the line. However, the latter may vary. It will depend on the machine's production rate, number of defective cans that find their way through the machine, and the degree of sorting to be done. In Biloxi, sorting had to be done on 12 different products packed in the same type of can under 20 or more code numbers.

Other Machines

Machines suitable for salvaging purposes are described in a booklet published by the American Can Company: "Reconditioning of Flood and Fire Damaged Canned Goods."

Alternative

One alternative mentioned earlier would be to remove the product from damaged cans, repack it in new cans, and process it conventionally. If done, the cans would require some cleaning before the product could be removed and repacked. This alternative offers considerable promise if automatic can-opening equipment is available and if the product lends itself to reprocessing.

Another alternative deserves careful scrutiny. It is to sell damaged stock to a salvor. At the time of this report, no damaged canned goods in Biloxi were sold this way.

SUMMARY

Where large stocks are involved, a patented cleaner like the one used by Biloxi canners should be obtained with all haste, even though the stock is not rusted at the time the cans are first inspected. This feeling of the Biloxi canners is reflected by the number of cases of damaged goods returned to the market:

29,970	cases oysters in 211/300 cans
5,919	cases oysters and oyster stew in 311/300 cans
1,813	cases shrimp in 307/208 cans
54,162	cases shrimp and crabmeat in 307/113 cans

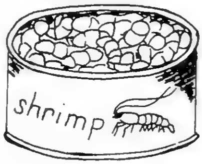
The initial cost of accomplishing this was \$1.30 per case; in the end, the cost through refunds was $47\frac{1}{16}$¢ per case. Of the \$123,239.90 collected to clean the cans, \$78,965 was refunded.

BEFORE A HURRICANE

1. Develop a tentative plan for evacuation.
2. Keep posted on weather developments.
3. Commandeer labor and transport to expedite evacuation.

AFTER HURRICANE

1. Survey extent of damage to structure and merchandise.
2. Provide dry working area.
3. Collect damaged canned goods.
4. Remove labels from water-damaged cans.
5. Repack cans in dry cases.
6. Ascertain extent of damaged goods held by other canners.
7. Consider procurement of mechanical cleaner that also could be used by other canners.
8. Emphasize manual cleanup of cans when utilities are restored.



JUBILANT SHRIMPERS RETURN TO SEA AFTER CAMILLE TRAGEDY

James T. Wooten

An ancient mariners' ritual, honored by time and deepened by calamity, was repeated here today as a long line of shrimp boats chugged past a Roman Catholic priest for the blessings of the church.

"Stretch forth to them thy right hand, O Lord," he intoned while dozens of colorfully decorated vessels plowed out into the Gulf of Mexico to begin again a vocation crippled since last August when a hurricane nearly obliterated this once prosperous coastline.

Camille, the storm that took 144 lives and destroyed nearly a billion dollars worth of property, left behind a legacy of death and destruction that, after 10 months, still haunts those who survived its wrath.

It played no favorites. Plush resort inns where affluent whites came to play were flattened along with the squalid shacks where Negroes lived on welfare--and the shrimpers, predominantly of Slavic and French-Canadian origins, were almost destroyed by the 200-mile-an-hour winds that struck here Aug. 17.

A New Day

Their boats were damaged, and factories that processed and distributed the shrimp were destroyed. But today, beneath a searing sun and a nearly cloudless sky, the men whose livelihoods have long been dependent on the abundance and popularity of the small pink crustaceans proudly steered their new or repaired boats out to sea with a bright promise of a new day.

"Come forth your servants with a calm voyage and a safe harbor," the Rev. Morgan Kavanaugh prayed as the shrimpers and their awkward ships moved past his makeshift chancel on the stern of a boat called 'The Elmer Williams'.

In white vestments, and assisted by another priest and several altar boys, he sprinkled holy water on the churning waters of the gulf and prayed that the masters and all hands aboard the high-masted ships would be recalled "again to the happiness of country and home."

A native of Ireland, Father Kavanaugh offered his blessing in a brogue reminiscent of Barry Fitzgerald's and Pat O'Brien's cinematic roles as clerics. And the fishing community of Biloxi, a historic port city 90 miles west of New Orleans, responded with the abandoned merriment of a Mardi Gras celebration.

Dancing and Beer

Their jubilance, expressed by dancing in the streets to the music of a Dixieland band and the consumption of gallons of beer on board the ships and on the white sand beaches, marked an end to 293 days of frustration and despair borne of the storm's havoc.

In Biloxi alone, a predominantly Catholic city of 50,000 population, 16 persons were killed, stately old mansions were leveled, prosperous businessmen wiped out, nationally famous restaurants razed, lush green golf courses scarred, and the factories that gave economic meaning to the lives of the shrimpers destroyed.

In one evening of terror, a city whose reputation was based on the carefree élan of tourists and vacationers was brought to its knees by the fury of nature.

Even today, the hurricane's power is still evident up and down the 200-mile coast from Pass Christian, the hardest hit of the Mississippi Coast communities, to Mobile, where fringes of the storm battered that city and its people.

Mr. Wooten is a reporter for The New York Times. His report from Biloxi, Miss., appeared on June 8.

In Pass Christian, skeletons of homes and motels stand along the beachfront highway. There are lonely mail boxes, perched on bent standards, empty and without accompanying houses.

Bricks and Steel and Boats

Piles of bricks and twisted steel dot the beach along with pleasure boats washed ashore by the winds and the floods. At nearby Gulfport, in the confines of the Mississippi state docks, a huge tanker still rests heavily on the land as wrecking crews with torches and cranes take her apart piece by piece for salvage.

Near Biloxi, two stone mastiffs stand guard against intruders over a slab of concrete that once was the foundation for an expensive house, and the giant, ageless oak trees that once formed a leafy tunnel for cars traveling along the beach are bent and twisted and bare.

There are hulks of cars and trucks rusting in the salt breezes from the Gulf--and there is, among some of those whose lives were disrupted by the winds, a certain bitterness toward the government agency that moved in to alleviate the suffering.

The State of Mississippi, for instance, only last month gave its final approval to a $10.5-million appropriation for coastal areas hit by the storm. Until then, only $500,000 had actually reached the disaster area.

The Federal Government, working through the Army Corps of Engineers, the Small Business Administration and other agencies, has, in the opinion of many residents, failed to keep the President's commitment to restore this area.

Red Tape Delays

At every level of the bureaucracy, there are red tape delays, structural impediments and official interference with the progress of renewal, local residents believe.

But all that was behind Biloxi today.

The ships' flags applauded in the breeze, their horns blasted with deafening enthusiasm, and the ruddy, hardy shrimpers laughed and swigged their beer and forgot about yesterday.

"The blessing of the fleet takes on an added importance and deeper meaning and significance because of the storm," Father Kavanaugh told those who attended an early mass today at St. Michael's, the church where he and his associate, the Rev. George Murphy, also an Irish native, spent the night of Camille clinging desperately to statues of the Virgin Mary and St. Joseph.

Those who heard him understood him. Their city had waited 10 months for a symbol of resurgence and the old tradition of the shrimp fleet blessing was enough.

"We cannot afford the luxury of self-pity," the priest said. "God in his goodness has seen fit to leave us here on this earth. You have your boats, your health and you have your families to support, so let's get on with the business of living with a deeper faith and trust in God."

SEASONAL AND GEOGRAPHIC CHARACTERISTICS OF FISHERY RESOURCES

California Current Region--III. Pacific Hake

David Kramer and Paul E. Smith

This third report of a series (Kramer and Smith, 1970a, b) describes the characteristics of the resource of the Pacific hake (Merluccius productus). It emphasizes predictions of the time and localities of adult spawning and suggests the potential for production of the resource.

The data of the California Cooperative Oceanic Fisheries Investigations (CalCOFI) for hake larvae (summarized for the decade 1951-60[1]) indicate that the major center of spawning (50 percent or greater occurrence of larvae taken in standard plankton tows) appear first in December in a small area just south of Point Conception (fig. 1). In January and February, the major centers extend from Point Conception to Magdelena Bay in a widening band, not delimited in their southernmost extent. In March and April, the last months of peak spawning in the CalCOFI pattern, the centers spread offshore and northward until they extend outside the survey pattern except off central Baja California.

The Pacific hake is variously distributed from the Gulf of California (Starks and Morris, 1907) to Alaska (Clemens and Wilby, 1961). A number of investigations of seasonal and annual distributions have led to the hypothesis that adult hake are migratory (Alverson and Larkins, 1969; Nelson and Larkins, 1970). These reports hypothesized that the fish migrate southward in late fall and winter to spawn from central California to southern Baja California--and migrate north in late spring, summer, and fall to concentrate chiefly in inshore waters from California to northwest Washington (fig. 2).

It is in the latter season, and in those locations, that the fisheries must limit themselves because, as stated by Nelson and Larkins (1970), attempts to locate spawning hake in commercial quantities usually have met with little success. They attributed this, for the most part, to insufficient knowledge of the behavior and dispersion of hake during spawning. They stated further that all present data indicate that, in winter and early spring, spawning adult hake were located beyond the continental shelf off California and Baja California. This fact was reflected particularly in the relative scarcity of hake landings in the California animal food fishery and the absence of hake from December to April in the Vancouver Island-Oregon region. The latter corroborates, in part, the hypothesis of migration cited above.

In November 1969, a meeting of fisheries specialists of the U.S. and the U.S.S.R. was held in Seattle, Washington, to discuss the status of fish stocks of mutual interest. Preliminary estimates of the size of the hake stocks were as follows:

1. U.S.S.R. estimate from hydroacoustic surveys for all hake in the area between 37° N. and 52° N.--1,200,000 metric tons.[2]

2. U.S. estimate from hydroacoustic surveys for all hake in the area between 44°40' N. and 49°12' N.--283,000 metric tons.[3]

The authors are Fishery Biologists, BCF Fishery-Oceanography Center, La Jolla, Calif.

[1] Organizations, area of investigation and treatment of the data were presented by Kramer and Smith (1970a).

[2] Verbal information only. Cited in the Report of the meeting of fisheries specialists of the United States of America and the Union of Soviet Socialist Republics concerning the status of fish stocks of mutual interest in the northeast Pacific Ocean, and on plans for joint and coordinated research of their biology, held in Seattle, November 17 to 22, 1969 (mimeo. report--copies available from BCF Biological Laboratory, Seattle, Wash. 98102).

[3] Smith, Paul E. 1969. Calculations of hake spawning biomass from egg and larva surveys, 1951-69. In Spawning Biomass of Pacific Hake, 1969 (Report on Cooperative USA/USSR Hake and Larva Surveys, 1969), compiled by Staff, Fishery-Oceanography Center, BCF, La Jolla, Calif., pp. 6-41 (mimeo. report).

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Reprint No. 880

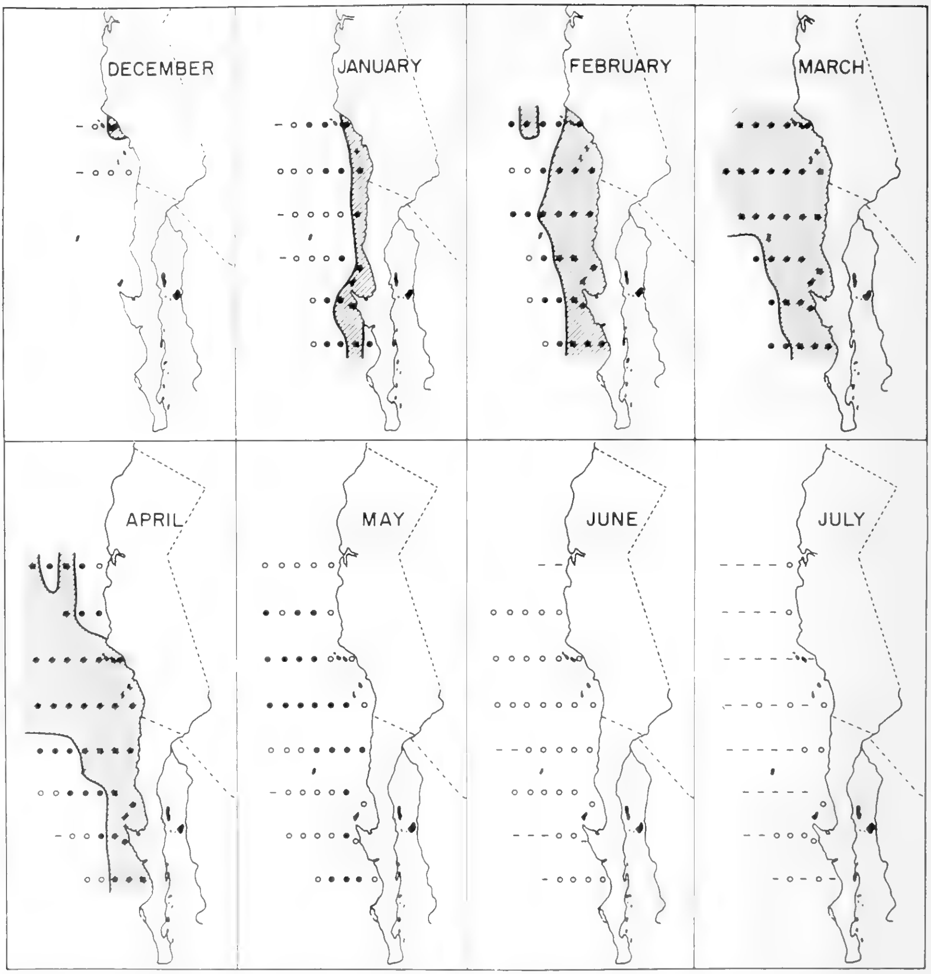


Fig. 1 - Percent occurrences of hake larvae, from summarized data for 1951-60, on the survey pattern of the California Cooperative Oceanic Fisheries Investigations (CalCOFI). Each line, circle or dot represents a pooled statistical area (see text footnote 2). (○) - equal to or less than 25 percent occurrence; (●) - greater than 25 percent occurrence; shaded area - greater than 50 percent occurrence; (-) - area occupied with no occurrences.

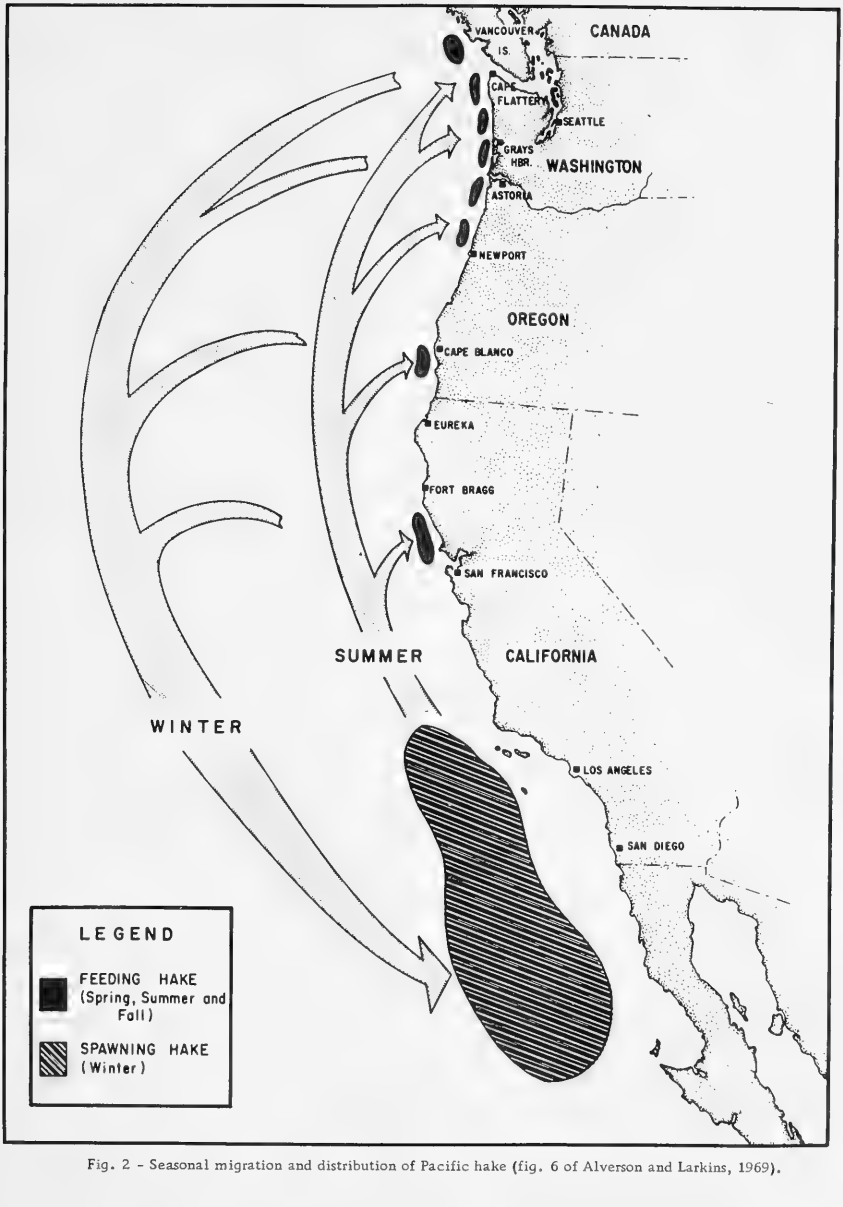


Fig. 2 - Seasonal migration and distribution of Pacific hake (fig. 6 of Alverson and Larkins, 1969).

3. U.S. estimate from egg and larvae surveys for adult hake over the entire range of species--2,630,000 metric tons.[4]

There is a possibility that another hake, M. angustimanus (or a southern stock of M. productus) may contribute some numbers of larvae to those collected in the southernmost extent of the range of M. productus. During a CalCOFI survey for adult spawning hake in January 1970, a number of small female hake with ripening eggs were collected in the latitude approximately that of Magdelena Bay and just north of it. These hake were maturing at sizes (126-202 mm.) much smaller than expected for M. productus, which matures at about 400-450 mm. On the basis of their maturity at such small sizes and certain meristic characters, it is believed that these are a separate stock or a different species--the meristics fit M. angustimanus better than they do M. productus. (Ginsburg described in 1954 eight specimens of angustimanus from Del Mar, California, to Panama.) It is also believed from their condition that this hake would probably spawn off Baja California about March or April. Ahlstrom and Counts (1955, p. 329) reported that careful examination of all hake eggs and larvae in their collections showed evidence of only one species, M. productus. They stated further that, from such evidence, angustimanus either does not spawn in the CalCOFI survey pattern or that its spawning take place at a deeper level than that sampled by the standard plankton haul.

[4] Nelson, Martin O. 1969. Abundance of adult hake off the Pacific northwest, 1969. Exploratory Fishing and Gear Research Base, BCF, Seattle, Wash., 13 pp. + 3 appendices (mimeo. report).

LITERATURE CITED

AHLSTROM, ELBERT H. and ROBERT C. COUNTS
1955. Eggs and larvae of the Pacific hake Merluccius productus. U.S. Fish Wildl. Serv., Fish. Bull. 99: 295-329.

ALVERSON, DAYTON L. and HERBERT A. LARKINS
1969. Status of knowledge of the Pacific hake resource. Calif. Coop. Oceanic Fish. Invest. Rept. 13: 24-31.

CLEMENS, W. A. and G. V. WILBY
1961. Fishes of the Pacific coast of Canada. Fish. Res. Bd. Can., Bull. 68, 2d ed., 443 pp.

GINSBURG, ISAAC
1954. Whitings on the coasts of the American continents. U.S. Fish Wildl. Serv., Fish. Bull. 96: 187-208.

KRAMER, DAVID and PAUL E. SMITH
1970a. Seasonal and geographic characteristics of fishery resources, California Current region--I. Jack mackerel. Commer. Fish. Rev., 32(5): 27-31. (Also Reprint No. 871.)

1970b. Seasonal and geographic characteristics of fishery resources, California Current region--II. Pacific saury. Commer. Fish. Rev., 32(6). (Also Reprint No. 876.)

NELSON, MARTIN O. and HERBERT A. LARKINS
1970. Distribution and biology of Pacific hake: A synopsis. U.S. Fish Wildl. Serv. Circ. 332:23-33.

STARKS, EDWIN CHAPIN and EARL LEONARD MORRIS
1907. The marine fishes of southern California. Univ. Calif. Publ. Zool. 3: 159-251.

HERRING ROE: Alaska's Fast-Growing Specialty Food Industry

Jerrold M. Olson

The use of Alaska herring as a commercial food product dates to the early days of the new Territory. Beginning in the late 1800s, herring salteries were built rapidly along Alaska's coast; by 1928, more than 70 were in operation. The annual production of salt-cured herring peaked in 1922 at 36 million pounds.

Because of poor market conditions in the 1930s, production declined from a high of 13.3 million pounds in 1933 to 3.4 million pounds in 1939. The decline continued during the next decade; by 1947, only 2 million pounds of salt-cured herring worth $280,000 were packed.

In 1950, when production had dropped to 264,000 pounds, valued at $42,000, the salted herring industry went out of existence.

Interest Reborn

Interest in Alaska herring as a food was revived in 1964 to meet the demand of a Japanese market for a new kind of specialty product--salt-cured herring roe. In that year, 23,000 pounds of roe were produced for export to Japan. The product sold for as high as $7 a pound on the Japanese retail market. In 1965, production increased fivefold. Nearly 200,000 pounds of roe worth over $300,000 were shipped to Japan. By 1968, almost 300,000 pounds of herring roe valued at more than $500,000 were produced in 7 Alaska processing plants.[1/] In that year, the wholesale value of this specialty food was 82 percent of the value of all Alaska herring products--although only 40 percent of the herring catch of 8.1 million pounds was used in the roe industry.

The steps used in processing herring roe for shipment to Japan are shown in figures 1 through 9.

Note: Herring roe production reportedly is "big" this season in the Kenai Peninsula area. About 1,500 tons of herring were caught in Kachemak Bay and Resurrection Bay; processors in Seward and Homer are swamped. Herring roe is being processed in Anchorage for the first time. Some of the larger plants are employing more than 90 employes in this presalmon-season venture. For Alaskans, this fishery has been increasingly profitable. In 1969, fishermen were making as much as $10,000 a vessel at prices of $40 a ton.

Fig. 1 - Herring used in roe processing are aged in an open-top tank for 5 to 7 days. Herring are being transferred from aging tank to containers for transfer to processing plant.

Mr. Olson is a Biological Technician with BCF Biological Laboratory, Auke Bay, Alaska 99801.

1/Richard C. Nelson. 1970. 1968 Alaska catch and production commercial fisheries statistics. Alaska Department of Fish and Game, Statistical Leaflet 17, 29 pp.

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Reprint No. 881

Fig. 2 - Herring roe is removed from the "aged" herring by first breaking the fish just behind the head, then using a squeeze-shake action to extract the roe from the carcass (woman on left). The ripeness of fish when caught is critical because seasonal maturity greatly influences both processing efficiency in removing roe and final quality of roe product. The amount of roe recovered from amount of herring landed is 8% to 10% by weight.

Fig. 3 - "Gibbers"--women who remove the herring roe--work on a piecemeal basis. In this Sitka, Alaska, processing plant, they earn $28 to $45 a day.

Fig. 4 - Basket of herring roe is put into a brine solution. During processing, roe is placed for 12 hours in each of three different brine solutions with a 3- to 6-hour drain period between each soak. The first two solutions have a salt content equivalent to sea water, the last a 100% solution of salt.

Fig. 5 - A Japanese technician looks on as worker carefully places basket of herring roe in final 100% brine solution. In background, herring roe in mesh baskets go through a 3- to 6-hour drain period.

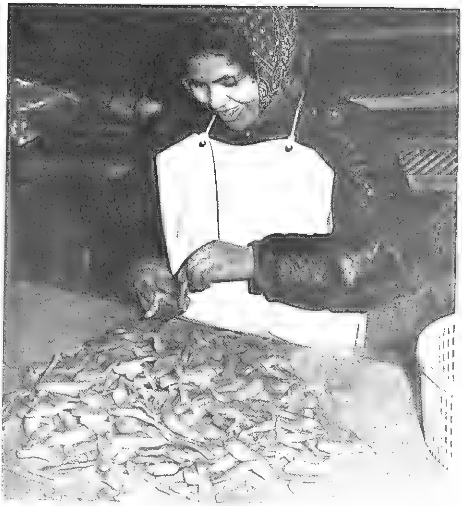


Fig. 6 - Broken and discolored skeins of herring roe are removed during final inspection.

Fig. 7 - Herring roe in baskets are weighed before they are packed in cartons.

Fig. 8 - Cured herring roe is packed in plastic-lined, heavy-duty cartons for shipment to Japan. Each carton holds 120 pounds of herring and 18 pounds of dry salt.

Fig. 9 - Herring roe, a delicacy in Japan, sometimes brings $7 a pound retail.

INTERNATIONAL

BREAKTHROUGH IN MIDWATER TRAWLING REPORTED AT FAO MEETING

Giant trawl nets half the size of a football field are being used successfully in the North Atlantic fisheries following the breakthrough in midwater-trawling in recent years.

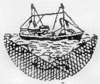
The nets are aimed at the fish through the use of echo sounders, sonar and netsonde. Now FAO is testing the effectiveness of the nets in other parts of the world and for different fish species as part of its fishery development projects in developing countries. The nets already have yielded impressive catches of hake and anchovy in demonstration fishing in Peru and Argentina.

Began in Early 1950s

Commercial midwater trawling dates to the early 1950s. A Danish netmaker invented the Atom trawl, a "pair trawl" towed by two boats. It proved effective for catching herring in the winter when the fish are sluggish. During the next 10 years, attempts at one-boat midwater trawling had limited success, except under particularly favorable conditions.

Giant Net at Low Speed

In those early experiments, attempts were made to tow a small trawl at high speeds, but active fish were difficult to overtake as they escaped around the edges of the net's mouth. A breakthrough came only about 4 years ago, when a different approach was tried: a giant net was towed at very low speed. These nets have a mouth area up to 20,000 sq. ft. They are now used successfully in the West German fishery for herring, cod, coalfish, and redfish in the North Atlantic. This was reported to FAO Technical Conference on Fish Finding, Purse Seining and Aimed Trawling, Reykjavik, Iceland, May 24-30.



ACTIVE TUNA FISHING IN SOUTHERN INDIAN OCEAN

For 5 years, the Japanese trading firm Toshoku, jointly with Daien Reizo, has been buying tuna off the Malagasy Republic's east coast. Supported by a strong export market, business reportedly has been good.

At first, 4 or 5 reefers (7,800 tons each) were used; 5,000 metric tons of tuna were purchased per year. In January 1969, Daien Reizo bought the 'Eijin Maru' (8,000 tons) from Taiyo Gyogyo. Since then, the vessel has been used as a floating cold storage. In 1969, 20,000 tons of tuna were bought.

60 Vessels Fishing

At present, about 60 vessels (Korea 30, Taiwan 20, Okinawa 5 or 6, and Japan 4 or 5) are fishing off east Africa year-round under 2-year contract with Toshoku: albacore off Malagasy, Capetown, and Durban; yellowfin off Monbasa and Colombo.

20,000 Tons in 1969

The 20,000-ton catch in 1969 is reportedly less than in 1968. Catches for 1970 are estimated at 25,000 tons. Since tuna export market is at its highest, forecast is good for purchase of tuna off east Africa and Malagasy.

Off Capetown & Durban

The albacore season off Capetown and Durban will continue until August. Each vessel will take a maximum of 2 to 3 tons per day during the 7- to 16-day fishing trip. It is reported that a catch of 2 tons per day for foreign vessels will pay.

The yellowfin season will begin in September.

Seller's Markets

Informed sources believe supply will not meet the demand because present exports are in a seller's market in U.S. and Italy. Export price is as high as US$680 a short ton for albacore to the U.S., and $640 a metric ton for yellowfin to Italy.

About 70% of tuna taken off eastern Africa and Malagasy is being exported through Toshoku to U.S. and Italy. Therefore, Toshoku appears well established. ('Minato Shumbun,' Apr. 7.)

JAPAN & INDONESIA EXTEND FISHERY AGREEMENT

The private fishery agreement between Japan and Indonesia was extended in Djakarta on May 21. It runs to July 26, 1972. The pact can be extended automatically for another year if requested by Japan and Okinawa.

Identical Provisions

The new agreement continues the old provisions: (1) Japanese and Okinawan tuna longline vessel owners, operating out of Ambon Island, will pay Indonesia an annual harbor fee according to vessel size: US$300 if under 70 gross tons; $390 if over 70 tons. (2) No more than 250 Japanese and 60 Okinawan vessels are permitted to operate annually. (3) Annual fish catches are not to exceed 15,000 metric tons for Japan, and 4,500 tons for Okinawa; their vessels are to operate in Banda and Ambon Island and other specified areas.

Speedy Settlement This Year

The speedy settlement is attributed to the agreement on extending monetary credit to Indonesia under Japan's economic assistance program. In 1967, Japan extended credit limit of $50 million; in 1968, $110 million; in 1969, $120 million.

This year, the Indonesians requested $140 million. Japanese agreed under condition that $5 million of it would be used to promote Indonesia's fisheries based on extension of bilateral fishery agreement. Then negotiations progressed rapidly. ('Suisan Tsushin', May 23.)

ICELAND AND SOVIET UNION SIGN TRADE AGREEMENT

The annual trade agreement between Iceland and the USSR was signed at the end of Jan. 1970. The value was US$8 million at prices slightly higher than before.

Iceland will export to the USSR 13,000 metric tons of frozen fish fillets--9,500 tons will be redfish (ocean perch) and saithe, and 500-1,000 tons Greenland halibut (turbot).

Export Totals

Iceland also will export 6,000 tons of whole frozen fish and 4,000 tons of frozen herring. Quantities are almost the same as in 1969, except for increase of 2,000 tons of whole frozen fish. ('Atlantica and Iceland Review', June 1970.)

CUBANS ATTEND PERU'S INTERNATIONAL FISHING FAIR

Cuban fishery officials headed by the director of the National Fishing Institute visited the International Fishing Fair in Lima, Peru, in early April 1970. They were interested primarily in studying Peruvian fish-meal processing techniques and new developments in plastic-hulled fishing vessels.

The Cubans conferred with Peru's Fisheries Minister, and visited El Callao port to watch unloading and processing of fish meal. They also fished for anchovies.

Cuba's Fish Meal Interest

The Cubans have become interested in fish meal only recently: their production in 1968 was 1,300 metric tons. In 1970, production goal is 20,000 tons; this parallels the rise in fishery catches.

The introduction of plastic-hulled vessels would be new to Cuba's shipbuilding industry.

Cuba's Efforts Praised

Peru's Fisheries Minister praised Cuban efforts to increase catch from annual 20,000 tons to 170,000 tons.

GOOD PINK-SALMON CATCHES IN N. PACIFIC

The catch of pink salmon by Japan and the Soviet Union was extremely good in 1969, the highest since 1964. It tends to support Japanese position that stocks have been recovering since 1964.

	Japan			U.S.S.R.		
Species	1967	1968	1969	1967	1968	1969
			(Metric tons)			
Sockeye	20,493	16,766	15,502	3,018	2,249	1,640
Chum	51,630	42,519	30,171	20,639	13,697	5,867
Pink	64,481	42,787	69,520	50,701	16,253	63,436
Other	4,904	7,039	11,127	4,523	3,992	4,525
TOTAL	141,508	109,111	126,320	78,881	36,191	75,468

JAPANESE EX-DETAINEES ON SAKHALIN IS. DESCRIBE SOVIET TREATMENT

Three Japanese fishermen were released recently from detention on Sakhalin Island for violating Soviet-claimed territorial waters (12 miles off Kuril Islands). They described conditions in work camps to the Liberal Democratic Party newspaper 'Jiyu Shimbun'.

Extremely cold weather and forced labor in quarries made life miserable for all, they said. They had to work outside in temperatures as low as -30° C. (-22° F.), often in snowstorms, until work quotas were filled. (Exceptions were persons with "medical certificates.") Particularly offensive to the Japanese was that the old fishermen were not excused. Lack of proper heating in rooms made sleep impossible; serious illness was prevalent.

Some Fishermen Seized Before

One fisherman said he and his vessel had been seized 3 times. Another detainee cited cases of Japanese fishermen seized 5, 8, and 13 times. In past 20 years, 11,000 fishermen and 1,300 vessels have been captured for fishing within 12 miles of some northern islands.

Seizure Costly

Cost of being seized is high in human and in economic terms. A new 30-ton coastal fishing vessel costs 20 million yen ($555,400); used vessels cost 4-5 million yen ($111,000-138,850). The Soviets have kept over one-third of all vessels seized. They sent those they did not want to North Korea.

Danger in Seizures

There is much danger in the actual seizure, the fishermen said. Soviet patrol boats fire flares directly at Japanese vessels to stop them.

The fishermen emphasized that, despite the dangers in fishing those waters, they will continue to do so because they consider the islands part of Japan. They felt their release under amnesty was political.

LARGE CAPELIN STOCKS REPORTED OFF LABRADOR AND NEWFOUNDLAND

Norwegian fishery scientists report large stocks of capelin off Labrador, Newfoundland, and in the Davis Strait. Research vessels have discovered the capelin widespread and available for a new commercial fishery for fish meal.

Factoryship May Be Sent

Norwegian vessels are not able to preserve catch adequately for transport to home plants. A new factoryship may be sent to produce fish meal on the grounds. Application has been filed for authority and funds to conduct such an operation, possibly this fall, with mothership and fleet. (U.S. Embassy, Copenhagen, June 12.)

JAPAN RATIFIES S.E. ATLANTIC FISHERY CONVENTION

On June 22, Japan became the first nation to ratify a convention for preserving resources of the South East Atlantic threatened by overfishing. The convention will become effective 30 days after formal acceptance by 4 states--provided their combined catch amounts to at least 700,000 metric tons.

7 Convention Signers

Japan was one of 7 signers of the Convention drawn up in Rome in October 1969 at a meeting of nations that fish off Africa's South West coast. Other signers were Cuba, the Federal Republic of Germany, Italy, Portugal, the Republic of South Africa, and Spain.

FAO called the October 1969 conference after experts found that the South East Atlantic was in danger of being overfished. Main catches there are hake and pilchard.

□□□□□□□□

SOVIET-JAPANESE FISHERY NEGOTIATIONS

The 14th annual meeting of USSR-Japanese Northwest Pacific Fisheries Commission, in Moscow, ended on April 30 after 59 days of negotiation. The two agreed on 1970 Pacific salmon catch quotas and on regulating Japanese herring fishery in Okhotsk and Bering Seas. The meeting overlapped crab negotiations.

Japan's Crab Catch Cut 10%

Japan's 1970 catch quota for all crab species was reduced 10% from 1969. However, sharpest reductions applied to areas off West Kamchatka, where king-crab quota was reduced 15.3% (from 216,000 cases in 1969) and off Cape Oliutorskii (West Bering Sea) where tanner-crab quota was cut 14.5% (from 13 million crabs in 1969). Tanner crab quota also was reduced 10.5% off East Sakhalin (from 19 million crabs in 1969).

Vessel Number Almost Unchanged

Number of Japanese vessels allowed to fish remains essentially unchanged: 4 king crab and 2 'Ibaragani' crab fleets will operate off West Kamchatka; 42 vessels in West Bering Sea (no more than 21 at one time); 6 vessels off East Sakhalin for blue crab and 39 vessels for tanner crab; 14 vessels in Nijoiwa area; and 37 vessels in "triangle area."

Soviets Set New Boundaries

Soviets established new fishing ground boundaries: northern limit of 'Ibaragani' crab fishing grounds off West Kamchatka at 56° N. (56.2° N. in 1969), and western limit of tanner crab fishing grounds off Cape Oliutorskii at 168° E.

Salmon

According to Japanese press, 1970 Japanese catch quota of 90,000 metric tons is lowest since Soviet-Japanese Fisheries Treaty in 1956; it is about 15% below 1969 (105,000 tons).

Fishing Zones for Japan

The Japanese agreed to 2 "no-fishing zones" off Southeast Kamchatka: in one, salmon fishing was banned between May 15 and June 19. Fishing season in zone A (N. of 45° N., where Japanese operate high-seas salmon fishery with motherships and catcher vessels) will end Aug. 10, as in 1969.

Soviet Salmon Catch

Japanese newspapers report Soviets have set their 1970 coastal salmon catch target at 40,000 tons. In 1969, it was 80,000; in 1968, 60,000. Soviets do not catch salmon on high seas. They have cut Japanese mothership catch from 54,000 tons in 1960 to 45,000 tons in 1970.

Soviet & Japanese Pacific Salmon Catches

	Japan		USSR	
	Quota	Catch	Plan	Catch
	(in metric tons)			
1970	90,000	n.a.	40,000	n.a.
1969	105,000	109,757	80,000	75,468
1968	93,000	92,012	60,000	36,191

Negotiations

Japanese salmon catch quota is set each year by negotiations of Soviet-Japanese Fisheries Commission. These usually begin in March and last until April, when Japanese coastal salmon fishery begins. The Japanese are forced to agree to Soviet terms or lose fishing time.

The fishery is divided by treaty into 2 zones: north of 45° N. (Zone A) and south of 45° N. (Zone B). Japanese salmon fishery in the latter is entirely coastal. Negotiations are purely a political exercise without scientific basis, except beginning of talks (usually first 2 weeks) when a joint scientific comittee discusses expected salmon run and tries to determine catch quota. In 1970, scientists were so divided on size of run, they were unable to submit joint report to Commission.

Artificial Salmon Breeding

Japan and USSR have agreed to confer about artificial salmon breeding. Prior to negotiations, Soviets proposed a joint artificial spawning and incubation project to increase salmon resources of North Pacific. According to Japanese, this was revival of a past proposal by them but ignored by Soviets. The project would involve suitable estuaries of Soviet rivers where salmon hatcheries could be built.

The Japanese Fisheries Agency is ready to cooperate fully with project and provide funds for hatcheries, materials, and equipment. Japan will proceed with studies of artificial salmon incubation in rivers of Soviet Far East.

Herring

Herring fishing was prohibited off Karagin Island (Bering Sea off North Kamchatka) and in Shelikhov Bay (Northwest Sea of Okhotsk) between May 1 and 15. Number of Japanese herring vessels in those 2 areas will be cut: off Karagin Island to 5 (98 in 1969), and in Shelikhov Bay to 3-5 (67 in 1969). Beginning in 1971, it was agreed to prohibit taking herring smaller than 22 centimeters in fishing grounds north of Hokkaido.

Agreement Is Compromise

The herring agreement is a compromise on original Soviet request to: (1) completely ban herring fishery off Karagin Island until resource is restored; (2) ban herring fishery off Kuril Islands, Hokkaido, and in entire Sea of Ikhotsk for 3 years beginning in 1970; and (3) close Shelikhov Bay herring fishery at specific periods.

Reportedly, Soviets in 1969 had closed Korfo-Karagin area (North Kamchatka) and Sea of Okhotsk to their herring fleets because of depleted herring resource. Since a further decrease in herring was recorded, they blamed Japanese, who rejected the accusation on grounds that: (1) there is not sufficient scientific evidence for Soviet claim of depleted herring stocks, and (2) Japanese herring fishery was conducted under terms of 1969 agreement. (Japanese press, U.S. Embassy, Tokyo, Apr. 8; TASS, Apr. 30.)

POLAND BUILDS TRAWLER FOR HIGH-SEAS RESEARCH PROJECT

Poland is building a computerized research trawler in the Gdansk shipyard for an FAO-aided fishery development project. The 300-ton vessel, scheduled for launching in October, is the major Polish contribution to the $13,395,000 project. FAO is providing the computer and other sophisticated navigational and fish-finding aids at a cost of US$1.2 million. The project, involves the exploitation and conservation of high-seas fishery resources in the tropical mid-Atlantic, and fishery training for developing countries.

The Vessel

The 294-foot, 2400-HP diesel-electric single-screw vessel will have computer and laboratory facilities, and accommodations for 45 crew members, 29 scientists, and 11 trainees. She will be able to use 5 types of trawls, including standard cod trawl, high-opening bottom trawl, deep-water and midwater trawls. She will carry two 36-foot work boats for purse seining, bottom set gillnetting, shrimp trawling, and for general use.

Fish-finding equipment will include survey sonar, search-light sonar, three scientific sounders, precision depth recorder, and echo integrators.

Computer and Lab

The computer will be interfaced with sophisticated navigational aids. It will be used for fishery research, making improved fishing charts, and for research on trawl gear and quick answers to problems of midwater trawling. Also, it will be used eventually for rapid processing of catch data from commercial vessels, and to develop understanding of problems in tactical control of high-seas fishing fleets.

The extensive laboratory facilities will include a hydro-acoustic cabin, located on bridge; hydrographic, benthic, and plankton working stations and laboratories; facilities for fishing-gear analysis and advanced fish studies, and for fish processing. A large fishmeal plant, 35-ton daily capacity of whole fish is being installed.

TO STUDY SOVIET & JAPANESE SALMON & HERRING CATCHES OFF B.C.

Canada's federal fisheries department plans to outfit a research vessel with special gear to study catches of Soviet and Japanese fleets off British Columbia. The C$1.8 million 'G. B. Reed' of Victoria will be equipped with gear for bottom fishing similar to Soviet gear. Her crew will try to establish whether the Soviets and Japanese are depleting salmon stocks.

Disagreement Over Fishing

The foreign fleets maintain they are only after bottomfish (hake and ocean perch); but the 33,000-member Pacific Trollers' Association says they also are landing salmon and herring, upon which salmon feed.

Despite department assurances, the Trollers' Association is far from convinced that the foreign dragger fleets are only catching salmon and herring incidentally.

Worst Year Since 1960

The fisheries director said the G. B. Reed's mission is to determine the size of this incidental catch in "another one of our steps to give the Canadian industry the best protection possible."

The Trollers' Association blames the foreign fleets at least in part for last year's poor salmon run. The total catch was 78,900,000 pounds worth C$27.6 million, only 45% of 1968 catch and the worst year since 1960.

NEW RAW-FISH SUPPLIES FOR MEAL SOUGHT OFF NEWFOUNDLAND

The need of Canada's Atlantic coast fish-meal industry for large quantities of alternatives to herring has resulted in a widespread search for capelin and sand launce. The federal Department of Fisheries and Forestry is exploring inshore and offshore waters south and east of Newfoundland for those species.

The growing importance of herring for human consumption necessitates finding large supplies of suitable substitutes as mainstay of Atlantic coast fish-meal industry.

Chartered Vessel

From early June through September, the chartered 100-foot midwater trawler 'Lady Anna,' out of Saulnierville, N.S., will survey the Burgeo, St. Pierre, and Grand Banks before moving north to Trinity, Bonavista, Notre Dame, Green and White Bays.

A midwater trawl will be used because it is more versatile and less vulnerable to damage over unknown grounds than conventional purse seine.

Herring Information Too

Although large stocks of capelin and sand launce are main objects, the survey also is expected to provide fishermen with information about size and location of herring stocks. (Canadian Dept. of Fisheries and Forestry, June 9.)

EUROPE

NORWAY

SAITHE SALES TO EAST EUROPE WILL SET RECORD

Norway's sales of deep-frozen saithe fillets to COMECON will total a record 20,000 metric tons in 1970. COMECON is the "Common Market" of Communist East Europe.

The Soviet Union is back as a big buyer. Her purchases had declined in the last few years. She will purchase 10,000 tons in 1970; the remaining 10,000 tons will go to other COMECON countries.

Norway's Saithe Sales

The large Soviet purchase is not affecting her purchases from other areas, mainly Iceland and Britain. Norway's increased sales to the Soviet Union are not expected to affect adversely sales to more stable markets, such as Czechoslovakia and Hungary. Deliveries to the U.S., Western Europe, and other markets are based on cod, haddock, and other white fish--not on saithe. The Norwegians would like to change this. ('Export Council of Norway')

Soviet Saithe Catches Drop

Soviet catches of saithe decreased from 33,800 metric tons in 1966 to 11,900 tons in 1968; this is most likely reason for increased purchases abroad.

* * *

SALMON CATCH DECLINED IN 1969

The 1969 salmon catch in Norwegian rivers and within the 12-mile fishing limit was 1,468 metric tons: 1,248 tons within the 12-mile limit and 220 tons in rivers. This compares with the 1968 catch of 1,593 tons: 1,318 tons in the sea and 275 tons in rivers. The river catch was down 55 tons from 1968.

Catch Tripled in Int'l Waters

Norway's Statistical Bureau estimates that Norwegian fishermen caught 440 tons of salmon in international water off the coast--more than triple the 1968 catch of 130 tons.

Off Greenland

Norwegian fishermen took an estimated 250 tons of salmon off Greenland in 1969 (135 tons in 1968). The estimated expressed catch value within 12-mile limit and in international waters was more than US$3 million; this excludes rivers. In 1968, it was about $2.95 million. River rental and fishing permits in 1969 totaled $53,000.

Sea Trout & Sea Char Included

The catch data may change somewhat--but not significantly. It is Norwegian practice to include with salmon catch data on sea trout and sea char. Weight is given in round fish, heads on and not gutted. (U.S. Embassy, Oslo, May 16.)

ICELAND

STRIKE SETTLEMENT RAISES FISH-PROCESSING COSTS

The strike by unskilled workers in Iceland was settled on June 18. The settlement provides for a general 15% base wage increase, and an 18.3% base wage increase for fish-processing workers.

Other union demands also were met. Estimates are that the settlement will cost most industries about 20% in increased expenses, but somewhat more in the fish-processing industry.

The new contract is scheduled to run 17 months, or until Oct. 1, 1971. (U.S. Embassy, Reykjavik, June 19.)

UNITED KINGDOM

SCOTLAND TO DELIVER 6 TRAWLERS TO S. AFRICA

An Aberdeen (Scotland) shipyard has delivered the M/S 'Protea' to Irvin & Johnson in Cape Town, S. Africa. The vessel is a prototype of 6 freezer trawlers: 3 will be built in Aberdeen, the others in Africa.

UNITED KINGDOM (Contd.):

Advanced Design

The vessel's advanced design includes a "bunker" to receive freshly caught fish to be cooled by salt water, and 12 conveyer belts to carry the fish to sorting stations and directly to the packing stations.

The vessel is 61 meters l.o.a. long, 12 meters wide, and speed $14\frac{1}{2}$ knots. The fish "bunker" is 18,000 cubic feet. (Reg. Fish Att., U.S. Embassy, Copenhagen, May 20.)

PORTUGAL

CANNED-FISH INDUSTRY OUTLOOK IS GLOOMY

Portugal's 1969 fish-canning season was unfavorable: there was a drop in fish landings at much higher exvessel prices than in 1968, an unfavorable year. The outlook this season is gloomy.

The mainstay is sardines. In 1967, landings along coast were 113,000 metric tons; in 1968, they dropped to about 78,000 tons; in 1969, to a little over 61,000 tons. Deliveries to canneries, always competing with demand for fresh sardines, decreased at same rate; prices rose. In 1969, landings were almost 17,000 tons below 1968.

Adverse Factors

These factors adversely affected the industry: decline of nearly 8,000 tons in pack, shift to packs other than canned sardines to make up for shortage of sardine packs, drop of about 13,000 tons in exports, loss or decline of some traditional export markets.

This Season's Prospects

The year began with temporary lifting of closed fishing season and duty-free import of fish and other seafood for canning. This season's fishing began April 1. Its effect on canned fish pack appears more promising. In Feb. and March, trawlers took advantage of suspension of closed season and caught reasonable quantities of sardine. In last days of March, sardine abundance was reported. If this prevails through 1970, the canned fish industry might face a better future. It would be able to resume contracts cancelled last year because of fish shortage. The early season was definitely encouraging, but the future, even short term, is unknown. ('Conservas de Peixe', Apr. 1970.)

USSR

FIRST AUTOMATED FISH HATCHERY SLATED FOR 1971

The Soviets are building an automated fish hatchery at Konakovskaia regional electric power station (Moscow region) that will be operational in early 1971. It will produce 400 metric tons of fish a year. This was reported by 'Izvestiia'.

Carp and trout will be fed by warm water from the power station. All operations will be automated, including catching fish of the right size and weight with special automatic device.

Small Staff

"Few" people will staff the hatchery, though staff size has not been specified.

This will be the first automated fish hatchery in the USSR.

* * *

SOVIET-NORTH KOREAN FISHERY RELATIONS

The "Protocol of the First Session of the joint Soviet-North Korean Fisheries Commission" was signed in Pyongyang on Mar. 10, 1970, reported TASS, the Soviet news agency, on that day. Soviet-North Korean cooperation in 1970-71 was discussed and "regulations" adopted.

Prepared in 1969

The groundwork for the Joint Commission was laid in Moscow in June 1969. Scientific and technical cooperation, including fisheries, was discussed. Apparently, the Soviets have had an agreement with North Korea since 1967. In 1967, the Soviet Minister of Fisheries went to Pyongyang for fishery negotiations after Communist China abrogated the

USSR (Contd.):

Northwest Pacific Fisheries Commission in 1964.

50 N. Korean Trainees

About 50 North Korean fishery trainees were in Vladivostok in 1968, and possibly in 1969; some, accompanied by Soviet instructors, went to the North Pacific aboard Soviet large stern factory trawlers.

Oceanographic Cooperation Rejected

In March-April 1970, the Soviet research vessel 'Vitiaz' cruised the Sea of Japan to study seabed sediments, detect manganese modules, iron, and other metals, perform seismic investigations, and test new oceanographic instruments.

On March 11, 'Pravda' had announced cruise as a joint effort of Soviet, Japanese, and North Korean scientists. However, at the last minute, the North Koreans refused to go along. They said their research group "had not been consulted" on oceanographic research with Japanese scholars. They added: "inclusion of the Japanese is contrary to the terms of the Soviet-North Korean Technical and Scientific Cooperation Agreement."

A group of North Korean oceanographers who were in the USSR at the time may have accepted the invitation to join--but the government vetoed it.

ROMANIA

ORGANIZES MARINE RESEARCH INSTITUTE

Romania has organized a Marine Research Institute in Constanta on the Black Sea--her first. It will include hydrography, physical and chemical oceanography, marine fisheries, pisciculture, marine and coastal biology, marine geology, and marine pollution. The Institute will cooperate with other marine-research agencies to assess research results and plan exploitation of the seas.

The Institute probably will coordinate all fishery research, including that for ICNAF.

Institute's Predecessor Agency

The new Institute may have developed from the Marine Fishery Research and Planning Station at Constanta, administered since 1961 by the Joint Scientific Council for the Coordination of Romanian Research in the Black Sea. The Council studies marine fish, culture of commercial species, plankton, and physics of the Black Sea.

The Station's Activities

In 1961, the Station had a small research vessel--the 'Marea Neagra,' displacement 100 tons, crew of 7. She was equipped with echo-sounder, bottom drag, bottom corer, bathometer, and fishing gear (seines, trawls, etc.).

The Station investigated phytoplankton distribution in cooperation with the Romanian Navy's Hydrographic Office, studied the ecology of Romania's rocky shores with Agigea Marine Station, and was involved in fishery forecasting with other Romanian fishery laboratories. It also used divers to study quantitative changes in benthos.

PERU

STATE COMPANY FOR MARKETING FISH MEAL & OIL IS OPERATIONAL

On May 25, Peru's State company, EPCHAP, undertook the marketing of all Peruvian fish meal and oil. EPCHAP is Empresa Pública de Comercialización de Harina de Pescado. According to its executive director, General R.D. Chumbianca, the objective is to eliminate speculation and middlemen, and to establish a stable price for fish meal. He hopes EPCHAP will cause a minimum of changes in the marketing system.

Current Situation

Gen. Dianderas emphasized that all contracts made by private companies (390,000 metric tons) will be filled. When EPCHAP took control of selling fish meal, stocks were 640,000 tons.

Despite current closed anchovy fishing season, these limited stocks will increase slightly for 2 reasons: some small plants that had not fulfilled their quotas during season have been allowed an additional 300,000 tons during closed season; also, the ports of Ilo and Mollendo are excluded from seasonal prohibition on fishing.

Speculation & Stable Prices

Gen. Dianderas said that, historically, extreme price changes in fish-meal market have been caused largely by speculation. He hopes to maintain a more stable price that will reflect "normal" supply and demand. Because demand for fish meal is growing steadily, while supply is static, there will be pressure to raise price.

He said, however, that fish meal was only a small part of protein market; attempts to maintain high price artificially through stockpiling would only drive meal users to substitutes.

Price will be kept at present level (US$200/metric ton c. & f. Europe) for time being--but no guide to price changes has been set.

Averaging Prices

Fish meal plant will hold products until shipment, and be paid for meal when sold. EPCHAP will withhold a still-to-be-determined percentage to (1) pay marketing costs, and (2) allow room for averaging prices at year end. In December, all prices will be averaged and firms paid net amount owed them by EPCHAP.

To guard against speculations, Gen. Dianderas said Peru's Commercial Attachés will check those who have received fish meal to see whether they actually use it (end users).

Large marketing firms already have agreed to supply EPCHAP with list of customers. He believes Socialist countries will steadily demand more fish meal in proportion to their growing consumption of poultry--but there will be no dramatic rise in consumption.

Wait-and-See Attitude

Local producers, Peruvian and U.S., have a "wait-and-see" attitude toward EPCHAP. Luis Banchero Rossi, president of National Fisheries Society and leading industry figure, favors government control. He said: "It will benefit the country if it is efficient."

Industry is interested most in the operation's efficiency. (U.S. Embassy, Lima, June 10.)

* * *

RECORD FISH-MEAL OUTPUT & HIGHER EXPORTS IN 1ST QUARTER 1970

In Jan.-Mar. 1970, Peru produced a record quarterly fish-meal output of 755,000 metric tons; this compared with only 583,000 tons for same quarter 1969. It exceeds 734,000-ton record of Oct.-Dec. 1967 and is 39% over previous quarter. The increase occurred despite a 4-week closed season in second-half February and first-half March.

Exports Up

Fish-meal exports in 3 months ending Mar. 31, 1970, were 611,600 tons, compared with 514,400 tons for same period 1969--and only 385,600 tons in Oct.-Dec. 1968.

Of total exports, 71% went to Europe, 18% to Western Hemisphere, and 11% to Asia. Exports to non-Western Hemisphere countries are about 82% of total, as in 1969. This is considerably above 67% of 1968, when U.S.

PERU (Contd.):

was the major single market. The chief factor in reduction of U.S. imports is relatively high price ratio of fish meal to soybean meal.

New Fishery Ministry

Peru established a Ministry of Fisheries on Feb. 1, 1970. Objectives are to regulate exports, study marine resources, and develop framework for edible fish industry--ports, ships, and refrigeration.

Prices continue relatively high despite improved catch. This may reflect uncertainty surrounding forward sales for export beyond government's arbitrary cutoff date of Sept. 30. On March 31, stocks of 440,000 tons, nearly equal to 450,000 tons of previous year, were substantially below large stocks of 1967 and 1968.

Anchovy Fishing Season Ends

Fishing since March 31 has been good. The anchovy fishing season was closed in mid-May; stocks probably exceeded 1969's reduced volume. At present rate of market uptake, supplies will dwindle sharply before beginning of 1970/71 fishing season in September.

Note: Earthquake damage early in June destroyed some stocks on hand and damaged plants. Amount of damage has not yet been reported.

URUGUAY

FISHING CONTRACT AWARDED TO SPANISH FIRM

Uruguay's fledgling fishing industry took an important step with award of contracts on May 8 for building and equipping a US$2.6-million fishing terminal. Action was taken by state-owned SOYP, which will operate terminal. Late 1971 is target date for completion of work.

Contract Won

Spain's Camer International's bid of US$1,448,000 won the machinery and installation contract. This beat rival offer of a Pennsylvania firm by about $400,000. In addition to refrigeration and related machinery, the Spanish firm will furnish 8 refrigerator trucks and 50 delivery vehicles at $480,000 more.

The Uruguayan company Tieger & Braselli received contract for civil works with bid of $680,000.

Sought Since 1914

Need for an adequate receiving and storage terminal for fish, sought since 1914, has become more pressing as a result of new regulations. These facilitate transfer of fish in Port of Montevideo from foreign fleets to foreign transport vessels, an arrangement that American, Chinese, and others now use.

Urgency for the new center also arises from recent legislation offering broad incentives to foreigners investing in fishing and fish processing within Uruguayan territory.

Local meat-packing plants are now serving as temporary storage until terminal is completed. (U.S. Embassy, Madrid, May 21.)

FRENCH GUIANA

FINES U.S. SHRIMP TRAWLERS FOR CUSTOMS VIOLATIONS

On June 5, the French customs office in Korou, French Guiana, took six U.S. flag shrimp trawlers into custody for violating French customs regulations. The vessels, owned by a firm in Georgetown, Guyana, and one in Cocoma, St. Laurent, French Guiana, were fined $800 (whether collectively or individually is not clear). The vessels apparently were bartering or otherwise trading supplies while in port. This is prohibited under French law without prior approval.

Advice to U.S. Trawlers

U.S. trawler owners should warn their captains against these practices inside 3 miles of French Guiana's territorial waters. (U.S. Consulate, Martinique, June 5.)

ASIA

JAPAN

FISHERY PRODUCTION DROP IN 1969 WAS FIRST IN 5 YEARS

Japan's 1969 fishery output was 8,610,000 metric tons, a slight drop from 8,670,000 tons, reports the Fisheries Agency.

It was the first drop since 1964 (including fish culture) from the preceding year.

Coastal Fishing Fell

Conspicuous in 1969 were declines in inshore (coastal) hauls and fish-culture yields to a 10-year low of 1,700,000 tons. The poor showing is expected to arouse demands for greater efforts to develop coastal fishing and pisciculture, these had rallied from 1,780,000 tons in 1964 to more than 2 million tons by 1968. Oyster production was among the notable losers.

Pelagic Fishing Much Responsible

Pelagic fishing hauls of 3,150,000 tons were much responsible for the decline because their annual gain was slowed to only 11% above 1968. They had been rising over 20% a year.

Deep-Sea Catches

All deep-sea fishery catches leveled off, except North Pacific trawling. The latter produced 369,000 tons--a 91% increase over 1968, chiefly in Alaska pollock. But fishery experts are not optimistic about prospects of Alaska pollock fishing because there are growing foreign conservationist moves to restrict catches.

Notable Offshore Declines

Among offshore catches, notable drops were in species in strong demand: saury pike (Pacific saury) 60% drop to 50,000 tons, cuttlefish 28% to 465,000, and tuna 7% to 383,000 tons. ('Japanese Economic Journal,' May 19.)

* * *

FISHERIES AGENCY PLANS LARGE DEVELOPMENT OF SKIPJACK TUNA

The Japanese Fisheries Agency plans to develop the skipjack tuna resource in line with its ocean development program. More marine fish are being used for animal protein--particularly medium- and high-priced fish. These are being subjected to heavy fishing pressure with indications of overfishing.

So the agency is turning its attention to the widely distributed, underexploited and underutilized skipjack resource. The agency has formed a group of industry members and government researchers to study production, distribution, sales, and even bait problems of skipjack fishing.

Group's First Meeting

The group's first meeting was held May 14 to study the plan worked out mainly by the agency. The agency hopes Japan's skipjack production can be doubled or tripled above present 200,000 metric tons a year.

Gear & Areas

The pole-and-line gear is considered more suitable than purse seine. The region off New Guinea and West Irian is believed suitable for development. A combination of poling and seining reportedly has been suggested whereby skipjack chummed by a bait boat would be surrounded by a purse seiner.

No Full-Scale Operations

Several exploratory skipjack cruises have been made to the southwestern Pacific, but none resulted in full-scale commercial operations. The joint Japanese-Australian Kyokuyo-Gollin Fishing Co. is skipjack fishing off West Irian with good results; it is averaging five tons of catch per day of operation. ('Shin Suisan Shumbun Sokuho,' May 15, 'Suisan Keizai Shimbun,' Apr. 29.)

* * *

BRISTOL BAY CRAB OPERATIONS REPORTED GOOD

The 1970 Japanese Bristol Bay crab fishing operations are producing good catches. Fishing was begun in February by the factoryship fleets led by 'Koyo Maru' and 'Keiko Maru'.

As of May 15, tanner crab catches by the two fleets were: 1,314 metric tons by Koyo Maru, and 1,815 tons by Keiko Maru, total of 3,129 tons. King crab production totaled 8,567 cases by Koyo Maru, and 5,785 cases by Keiko Maru.

JAPAN (Contd.):

Crab Resources Good

Favorable crab resources promise good season, particularly for tanner crabs. These are reported generally larger and more abundant than in 1969.

The factoryships are paying more attention to improving appearance and quality of frozen tanner crabs. There is a steady market for these in Japan to supplement king-crab production. Japan has been facing yearly king-crab cuts in negotiations with the U.S. and the U.S.S.R.

Prices Up

As of mid-May, Japanese domestic prices for frozen tanner crabs were US$889-916 a metric ton, compared with $694-833 in 1969. Prices are likely to continue steady because Japanese tanner crab quotas in western Bering Sea and Sakhalin Island were reduced in this year's meeting with the U.S.S.R.

Export prices for canned crabs have not yet been set. However, due to rising production costs, fishing restrictions and production cuts, Japanese packers will have to raise prices substantially above 1969.

Planned Exports

In 1970, the Japanese plan to export 150,000 cases of canned tanner crabs (180,000 cases in 1969), and an estimated 100,000 cases of canned king crabs (140,000 in 1969), although production outlook remains uncertain.

Sales to the U.S. and France are 60-70% of exports. ('Suisan Keizai Shimbun,' May 22.)

* * *

INDIAN OCEAN TUNA FISHERY UNDER WAY

In early April, about 30 South Korean, 20 Taiwanese, and 5-10 Japanese and Okinawan tuna longliners were fishing in the Indian Ocean off eastern Africa year round under contract to Japanese trading firm Toshoku.

Primarily, they were catching albacore off Madagascar, Cape Town, and Durban, where the season runs until about August, and yellowfin off Mombasa and Colombo, Ceylon. Albacore catches were averaging 2-3 tons a day per vessel.

Daien Reizo Venture

Toshoku, with Daien Reizo Cold Storage Co., operates five to six 7,800-8,000 gross-ton refrigerated carriers in that region. In recent years, the firm has been handling an average of 2,000 tons of Indian Ocean-caught tuna a year; this year, it anticipates a 25,000-ton catch.

April Prices

About 70% of tuna caught off east coast of Africa and Malagasy are exported to the U.S. and Italy through Toshoku. In early April, albacore were being exported to the U.S. at $680 a short ton, presumably c. and f. U.S. west coast price; yellowfin were bringing $640 a metric ton (presumably c.i.f. price) in Italy. ('Minato Shimbun,' Apr. 7.)

* * *

SALMON MOTHERSHIP FLEETS DEPART FOR NORTH PACIFIC

On May 15, 11 Japanese salmon motherships accompanied by 369 catcher vessels left Hokkaido for the North Pacific. The fleets headed straight for eastern sector of Area A (north of 45° N. latitude). They are seeking red salmon near Attu, Aleutian Islands. They began fishing around May 23.

Based on earlier sightings of Bristol Bay reds south of Aleutians by Fishery Agency's survey vessel, the fleets hope to meet a good run.

Good Fishing Forecast

The Kushiro Fishery Experimental Station in Hokkaido forecasts good fishing for reds and chums this year, particularly reds. The reds have been found distributed abundantly (4 fish to a "tan") in cold-water zone between 168° E.-170° E. longitudes.

The outlook for Asian pinks is not promising because 1970 is a poor cycle year. Oceanographic conditions indicate that the 1970 high-seas salmon fishery will be centered east of 160° E. longitude. ('Nihon Suisan Shimbun', May 18, 'Minato Shimbun', May 16.)

* * *

JAPAN (Contd.):

NORTH PACIFIC WHALING FLEETS SAIL

Three Japanese whaling fleets were scheduled to depart in early May for the 1970 North Pacific whaling season. They have been assigned a catch quota of 798.16 blue-whale units (BWUs) and 2,700 sperm whales, a 10% reduction from previous season. Planned production of processed products totals 75,000 metric tons of oil, frozen or salted meat, meal, and other products. ('Minato Shimbun,' Apr. 21.)

Name of Mothership	No. Catcher Vessels	Quotas Baleen	Sperm	Scheduled Departure and Return
		No. Whales (BWUs)		
'Nisshin Maru No. 3'	9	257	900	May 10-Aug. 27, 1970
'Tonan Maru No. 2'	9	257	900	May 8-Sept. 2
'Kyokuyo Maru No. 2'	8	284.16	900	May 2-Aug. 17

* * *

VESSELS DEPART FOR EASTERN PACIFIC TO EXPLORE SAURY

On April 22, Japan National Association of Saury Fishery decided to send two vessels on an exploratory cruise to eastern Pacific.

Names of vessels and departure dates are: 'Akebono Maru No. 17' (499-gross-ton trawler, 36 crew) June 16, and 'Habomai Maru No. 21' (299 gross-ton tuna vessel, 29 crew) June 30.

Time & Place

Areas of operation and period of survey are: (1) undeveloped areas near 165° E. long.--two months; and (2) east of 175° E. long. south of Aleutian Islands, Gulf of Alaska, and off west coast of North America--four months. Vessels may also survey northwestern Pacific.

50% Government Subsidized

The survey is subsidized 50% by government. Two government biologists, one assigned to each vessel, are accompanying the expedition.

Interest in Eastern Pacific

Many fishery firms are interested in sending vessels to eastern Pacific; in 1969, several Japanese trawlers made good saury catches off U.S. west coast. The Fisheries Agency has received inquiries from firms wishing to send around 40 vessels to eastern Pacific. About 20 vessels will be licensed this year.

Licensing Conditions

Licensing conditions established for 1970 are: (1) Area of operation--North Pacific Ocean east of 165° E. long., (2) Minimum number of licensed vessels necessary to carry out high-seas saury exploration plan. (Effect operations have on market price for saury taken by coastal fishery will be considered); (3) Catches will not be sold until three days after coastal saury fishing season opens for vessels over 40 gross tons. ('Nihon Suisan Shimbun,' Apr. 29; 'Minato Shimbun,' Apr. 28.)

* * *

SAURY VESSELS PLAN TO FISH NORTHEASTERN PACIFIC

Eight major Japanese fishery firms plan to operate about 20 saury vessels off west coast of North America in 1970. Three already have filed license applications with Fishery Agency.

The gear are "boke-ami" (stick-held dip nets), drift nets, and drag nets.

New Gear

One firm, Nihon Suisan, plans to use a new method (patent-pending) with a net described as a floating drag net. Details of its construction are unknown, but the gear is designed to fish even in stormy weather. ('Suisan Tsushin,' May 19.)

* * *

JAPAN (Contd.):

BOTTOMFISH CATCHES IN BERING SEA & GULF OF ALASKA ROSE IN 1969

The Japanese Fisheries Agency has reported that bottomfish catches by 12 mothership fleets in the Bering Sea and Gulf of Alaska during 1969 were 854,641.3 metric tons; 35 independent trawlers caught 360,506.4 metric tons. ('Suisan Tsushin,' March 28 & 30.)

* * *

RAISES 1970 HERRING IMPORT QUOTA FROM U.S. & CANADA

The Japanese Fisheries Agency has increased the 1970 herring import quota for the U.S. and Canada from 1,000 to 3,000 short tons. This is the first year Canada is included with the U.S. Alaska herring is preferred.

The quota from the U.S.S.R. remains 7,000 metric tons. (U.S. Embassy, Tokyo, May 28.)

* * *

WILL BUY MORE CUBAN SHRIMP

The Japanese Taiyo Fishing Co., in its second year of buying shrimp from Cuba, plans to increase purchases to 3,000 metric tons in 1970. In 1969, Taiyo contracted to import around 2,000 tons of shrimp and other species from Cuba.

The small Cuban shrimp consist of about 80% taken off the Guianas, and 20% in Gulf of Mexico.

Understanding With Cuba

Taiyo's purchases are based on agreement that the Japanese would provide materials and equipment worth US$8 million to help promote Cuba's fishing industry. Taiyo has drawn up a huge equipment export plan. It also is considering building a cold-storage plant in Cuba. ('Minato Shimbun,' May 20.)

* * *

CANNED TUNA EXPORTS ROSE IN 1969

Japanese canned tuna exports during business year 1969 (April 1969-March 1970) were about 6.68 million standard cases (7-oz. 48's). This was an increase almost 25% over 1968 exports, reports the Japan Tuna Packers Association. The increase was attributed primarily to the sharp gain in exports of canned tuna packed in oil. ('Suisan Tsushin,' May 21.)

* * *

MECHANICAL SKIPJACK TUNA POLE-AND-LINE GEAR TESTED

In mid-March 1970, Japanese mechanical pole-and-line skipjack tuna fishing gear, developed by Suzuki Tekkosho, was tested in southwest Pacific with impressive results.

The gear, aboard skipjack vessel 'Yusho Maru' (194 gross tons), accomplished three times the work of fishermen. It caught 160-200 skipjack per day of fishing. It worked particularly well in catching large (13-18 pound) fish.

Full Automation Sought

A specially designed, ship-rolling-control device prevented hooks from rising above the water and line from becoming entangled. The manufacturer hopes eventually to achieve a fully automated fishing operation by mechanizing bait chumming. The gear will be tested again off Japan during summer and winter skipjack and albacore seasons. ('Katsuomaguro Tsushim,' Apr. 22.)

* * *

LARGE STERN TRAWLER TO BE BUILT FOR NORTHWEST ATLANTIC FISHERY

In 1971, the Japanese fishery firm Nihon Suisan plans to build a 4,000-gross-ton stern trawler to fish in the northwest Atlantic Ocean. The vessel, to cost about US$4.17 million, will be equipped to process high-priced fish. It will not process "surimi" (minced meat used as ingredient for edible fish cakes).

Optimum Vessel Size

Use of such a large vessel in the northwest Atlantic, where smaller trawlers diverted from eastern Atlantic during off-season in west African trawl fishery have been operating, is certain to raise question in fishery circles as to optimum vessel size for that region. ('Shin Suisan Shimbun Sokuho,' May 2.)

* * *

JAPAN (Contd.):

FISHERIES AGENCY HAS NEW RESEARCH VESSEL

A 494-gross-ton research vessel has been completed for Japanese Fisheries Agency assigned to the Tokai Regional Fisheries Research Laboratory. The vessel, 'So-o Maru,' will conduct resource surveys primarily in the North Atlantic.

Geared for trawling and other fishing, she also is equipped to conduct oceanographic observations.

Main Specifications

Main specifications are: length 46 meters (150.9 feet), width 9.3 meters (30.5 feet), depth 4.5 meters (14.8 feet), maximum speed 14.3 knots, main propulsion two 800-hp. diesel engines. ('Nihon Suisan Shimbun,' Apr. 24.)

* * *

GUYANA-BASED SHRIMP FLEET TO BE DOUBLED

The 35-vessel Japanese shrimp-trawler fleet based at Georgetown, Guyana, will be increased to 80. The vessels are operated by the Japanese South America Northern Coast Trawl Fishery Development Co. The firm is scheduled to participate in a joint processing venture with British-owned Guyana Industry Holdings (G.I.H.) of Georgetown.

Other G.I.H.-contracted vessels reportedly planned to be increased in number are (figures in parens are present fleet size): U.S.-registered 45 (32), British-registered 14 (16), local Guyana-registered 20 (5).

Building Plans

Plant construction for joint venture was scheduled originally to start in June this year. However, construction was delayed several months due to proposed increase in capital investment. This was set originally at US$3 million; the Japanese were to put up $1 million.

Earlier reports indicated that a 1,000-ton cold storage with a 100-ton freezing capacity, and an ice plant with output of 34,500 tons a year, would be completed within one year. However, G.I.H. may build a 3,000-ton cold storage.

71 Trawlers in June

In early June, the Japanese shrimp fleet off the Guianas was 71 trawlers: 10 licensed for regular commercial fishing, and 61 to fish experimentally (1-year permit). ('Suisan Keizai Shimbun,' June 2.)

* * *

POLLOCK FISHING IN EASTERN BERING SEA IS POOR

Japanese trawler fishing in early June for Alaska pollock in eastern Bering Sea north of Unimak Island was poor. Six trawl fleets were fishing, led by factoryships 'Mineshima Maru' (21,000 gross tons), 'Gyokuei Maru' (10,357) 'Shikishima Maru' (10,144) 'Nisshin Maru No. 2'(27,035) 'Soyo Maru' (11,192) and 'Hoyo Maru' (14,111), plus 9 large independent stern trawlers.

Pollock Catches Halved

Since mid-May, their pollock catches have declined to half those of March-April. Also, the spawned-out fish are running smaller. They average 0.81-0.84 pound each, compared with 1.1-1.2 pounds in Feb.-April.

The fleets are encountering the same slackening of fishery they experienced last year about this time. It seems this condition is becoming a regular occurrence.

Some independent trawlers had moved temporarily to southern side of Aleutians in search of better fishing. They could make no catch, so they returned to eastern Bering Sea. ('Suisan Tsushin,' June 2.)

* * *

10,000-TON HERRING IMPORT QUOTA SET FOR 1970

On May 11, 1970, the Japanese Ministry of International Trade and Industry disclosed a 10,000-ton herring import quota for fiscal 1970 (April 1970-March 1971). This is a 25% increase over 1969's 8,000 tons.

In 1969, 6,787 tons were purchased from the Soviet Union, and 1,046 tons from Alaska.

JAPAN (Contd.):

The quota was increased because Canada has been added to supplying countries in 1970. The import allocation will be given to the Hokkaido Federation of Fisheries Cooperative Associations.

Prices Negotiated

Price negotiations for purchase of Soviet herring were concluded on May 7. The Japanese agreed to pay for 1970 deliveries at sea per metric ton: fresh US$143, salted $154, f.a.s. (free alongside ship) Okhotsk Sea; frozen $262, c. and f. Otaru or Wakkanai, Hokkaido.

Compared with 1969, prices are 14% higher for fresh fish, and about 20% for frozen fish. No salted herring was imported from the Soviet Union in 1969. ('Suisancho Nippo,' May 11 & 12.)

* * *

NEGOTIATES WITH S. KOREA TO IMPORT CANNED MACKEREL

A Japanese trading firm is negotiating to import canned mackerel from the South Korean Fisheries Public Corp. The Korean corporation reportedly is asking $7 a case (1-lb. talls, 48's). If a deal materializes, S. Korean packers can be expected to increase production of canned mackerel for export to Japan, which would become an important market.

Several years ago, S. Korea exported US$12,000 worth of canned mackerel to New Guinea, but the unprofitable trade was discontinued.

In Japan, imports of fresh, frozen, live, smoked, or dried mackerel are under quota restrictions--but canned is unrestricted. ('Nihon Suisan Shimbun,' May 29.)

* * *

BRISTOL BAY RED SALMON CATCH IN NORTH PACIFIC REPORTED GOOD

Eleven Japanese salmon mothership fleets fishing in the North Pacific reported good red salmon catches from around May 24-25 because the run of Bristol Bay reds was heavy, as predicted. In early June, they were fishing near the eastern boundary of Area A (north of 45° N. lat.), south of the Aleutian Islands.

The salmon were about 80% reds and 20% chums. Contrary to expectations, red salmon are small, about 3.9 pounds a fish. These compared with 4.6-4.8 pounds during previous good run of Bristol Bay reds in 1965. The chums, on the other hand, are averaging 4.8 pounds a fish.

Heavy Red-Salmon Run

Fishing in area south of Aleutians continues good until around June. The schools then begin migrating northward. The fleets either start moving toward north side of Aleutians, or proceed westward. The 1970 Bristol Bay red salmon run is the heaviest in recent years. And, as predicted, the reds are likely to make up a high percentage of Japanese high-seas salmon catch this year.

Situation in May

In Area B (south of 45° N. lat.), the fishing situation in late May was described by Kushiro Fisheries Experimental Station in Hokkaido: Most gill-net vessels that concentrated on reds east of 170° E. long. until mid-May returned home; in late May, no vessels were fishing in that area. In late May, concentrations of reds in Area B were becoming lighter; catch per "tan" was 1-2 fish. However, northward migration of reds is slower than usual this year. Pinks are distributed widely. Considering that 1970 is a poor cycle year for pinks, they are present in fairly heavy quantities. ('Suisan Tsushin,' June 1 & 9.)

日本

PHILIPPINES

FISH FARMING AIDED

For 7 months of the year, the Candaba area of the Philippines is flooded by seasonal rains that turn it into a huge marshland. It yields only one crop during the dry season: melons.

During their sweep along the lowlands, the floods, which reach 20 feet in places, carry millions of fish. These are trapped by farmers before waters recede. But the introduction of modern fish-culture and fingerling-rearing methods could greatly increase harvests and incomes.

Two FAO fishery biologists have carried out a pilot project to harness the flood waters to produce fish.

Work of FAO Biologists

The biologists have used fingerlings of various carp species imported from Taiwan in combination with local species. They have shown that marshlands can be farmed scientifically to produce unprecedented amounts of fish. They designed and built new ponds and supporting facilities in the Candaba area, including hatcheries to produce fingerlings for stocking the ponds. They trained extension workers and pond managers.

Government Plans

The Government plans, with FAO assistance, to develop almost 3,000 hectares of lowland in Candaba area into fish ponds at 17 sites to produce Chinese carp and suitable local species. The two-year project seeks development of a 60-hectare hatchery to produce stock fingerlings on continuing basis.

The pilot demonstration project is part of a general floodland fish-farming expansion program. It was approved by Philippines National Food and Agriculture Council in Feb. 1969 as a priority food-production project. It has been supported by UN Development Program and Australian Freedom from Hunger Campaign. (FAO, May 29.)

HONG KONG

FISHERIES ARE DECLINING

In 1969, Hong Kong's fishing fleet totaled 6,188 vessels, a decline of 626 vessels from 1968, and 3,292 from 1967, according to the 1970 Hong Kong yearbook. All categories of fishing craft decreased.

The 1969 fishing population of 45,000 was down over 30,000 from the previous two years.

More Shore Jobs

The downward trend is attributed to increasing shore jobs to which young fishermen are attracted. This is particularly true since the wages of land-based jobs have increased sharply in recent years.

The livelihood of fishermen is improving, however, due to active support and technical assistance by the Agriculture and Fisheries Office. ('Shin Suisan Shimbun Sokuho', May 15.)

SOUTH KOREA

1970 DEEP-SEA FISHING PLANS OUTLINED

In 1970, S. Korea plans to earn US$26 million in foreign currencies by catching (and exporting) 90,000 metric tons of fish with 229 deep-sea vessels. By the end of 1969, her 224 vessels had caught 80,000 tons with export value of $24,070,000.

Deep-sea fisheries account for 34% of annual exports of fishery products.

Rapid Growth

The rapid growth of S. Korea's deep-sea fisheries is due to: (1) Government support to private industry to purchase vessels; (2) Government assistance with medium-term loans to expand fishing; and (3) training experts.

The planned 1970 catch increase is 12.5% and for exports 4.2%. The greater part of 1969 catch came from Pacific, but highest export earnings were from Atlantic fisheries.

S. KOREA (Contd.):

Catch Targets

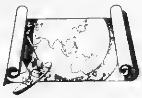
The Office of Fisheries raised catch targets for all high-seas areas except the Atlantic, which were cut two-thirds. Decline is due to: shortage of shore bases for S. Korean fishing fleets and logistics problems, general decline of fishery stocks, and declining fish prices at African bases.

To meet 1970 targets, Office of Fisheries plans to add six 2,000-ton vessels and 12 other vessels (size not specified) to high-seas fleet. Tuna bait will be provided domestically.

Government-owned Korea Marine Development Corp. (KMIDC) is S. Korea's largest high-seas fishing firm: 31,800-ton catch in 1969 and $10 million worth of fishery-product exports. This is about 41% of 1969 high-seas catch and exports.

Problems

Deep-sea fisheries are faced with following problems: (1) obtaining fishing rights off coasts where fleets fish (especially, off U.S., Canada, and Japan); (2) getting management of KMIDC out of red; (3) obtaining funds to build new vessels replacing old ones; and (4) devising appropriate measures against growing competition from Republic of China (Taiwan), which "may eat away fishing grounds and markets unless proper steps are taken." ('Taehan Ilbo').



THAILAND

DEMERSAL FISH STOCKS IN GULF OF THAILAND FALL 50%

Demersal fish stocks in Gulf of Thailand decreased more than 50% during 1961-1967. Decline will continue due to expansion of otter trawling (encouraged by Department of Fisheries since 1961) and increase in trawlers. The demersal fish catch is a large percentage of total marine fisheries catch.

Catch rates of demersal fish have decreased over 50% from 1961-1967, according to Department of Fisheries. Research vessel data show decline from about 300 kg. per hour of trawling in 1961 to 115 kg. in 1967. Catch rate of commercial vessels declined from about 17 crates (weight unknown) per hour of trawling in 1962 to 8 crates in 1966.

Over Maximum Sustainable Yield?

The maximum sustainable yield (MSY) of demersal fish is estimated at about 500,000 metric tons (about 6 tons per square kilometer). Catches increased from about 123,000 tons in 1961 to about 450,000 tons in 1966, when they came close to MSY. In 1967, Thailand's demersal fish catch in Gulf of Thailand (525,000 tons) exceeded estimated MSY.

Limit Vessels

The Government must now protect demersal fish stocks. The Demersal Fish Conservation Unit recommended limiting trawlers of specific sizes rather than total of all trawlers. ('Thai Fisheries Gazette')

SOUTH PACIFIC

AUSTRALIA

ECONOMIC STUDY OF NORTHERN SHRIMP FISHERIES ANNOUNCED

Australia's Department of Primary Industry will undertake during 1970 an economic investigation of the shrimp fisheries of northern Queenland and the Northern Territory.

The officers will interview members of fishing and shrimp-processing companies, industries servicing shrimp operations, and owners and skippers of trawlers and their accountants.

Joint ventures and Australian-owned operation will be considered.

Data for Economic Analysis

Information collected will serve government and the fishing industry. As results of research into northern shrimp become available, more detailed economic analysis will be possible.

This will help formulate policy for this important industry, including rational exploitation of the shrimp resourced. ('Australian Fisheries', Mar. 1970.)

AMERICAN SAMOA

TUNA PRICES ROSE IN JUNE 1970

Japanese tuna suppliers and U.S. packers in American Samoa increased prices US$20 a ton for albacore and $10 a ton for yellowfin deliveries in June 1970.

The new prices per short ton: frozen round albacore $530, frozen gilled-and-gutted yellowfin $420.

The Japanese had asked a $20-a-ton increase for albacore and yellowfin. ('Katsuomaguro Tsushin,' June 9.)

AFRICA

SOUTH AFRICA

SPINY-LOBSTER-TAIL EXPORTS TO U.S. ARE LOWEST IN DECADE

In 1969, there was a dramatic drop of 34% in shipment of cold-water spiny lobster tails to U.S. by South Africa. For first 10 months of 1969, shipments sagged to lowest level since trade was first reported in separate statistics by U.S. 10 years ago.

Shipments Down

The South African fall-off forms the most significant component in a general decline in shipments of cold-water spiny lobster to the U.S. Total imports from Australia, New Zealand, and South Africa fell 20% over the same period.

South Africa's share of U.S. market tumbled from 32% in 1968 to 22% in 1969. Australia's share, with a contribution down 15% in quantity, fell from 32 to 27%.

Brazil Large Supplier

Brazil's warm-water spiny lobster has been a major factor in supplying U.S. gourmet consumers. Imports by U.S. soared in 1969 to 173% above 1968. Brazil now ranks third, 4.5 million pounds behind Australia's 8.2 million pounds and South Africa's 6.5 million pounds, among main suppliers.

In 1969, warm-water tails were 37% of all lobster tails reaching U.S., compared with 23% in 1968. Total shipments in 1969 reached 30 million pounds; in 1968, these were 30.4 million pounds.

Higher Prices Main Reason

Substantially higher prices probably have been main reason for sales drop of spiny lobster tails to 27 to 28 million pounds in first 10 months of 1969; this compared with 30.2 million pounds in same period of 1968.

With sales dropping and inventories mounting, wholesale prices inevitably slumped by mid-1969. In New York City, the drop was from US$3.75 for 6-8-oz. cold water tails in June to $2.70 in Oct. Warm-water tails dropped from $2.68 to $2.13. ('South African Shipping News and Fishing Industry Review', Feb. 1970.)

BCF'S BIOLOGICAL LABORATORY, HONOLULU, HAWAII

The Bureau of Commercial Fisheries Biological Laboratory, Honolulu (P.O. Box 3830, telephone 946-2181) is located adjacent to the University of Hawaii in Honolulu's historic Manoa Valley. Established by Act of Congress in 1947, and known as the Pacific Oceanic Fishery Investigations in its early years, it has a staff of about 90 persons, of whom about 18 are professional scientists. It operates two research vessels. The larger is the 'Townsend Cromwell', 158 feet long, named after the late oceanographer who, while on the Laboratory staff, discovered the easterly flowing equatorial current that bears his name. The other vessel is the 'Charles H. Gilbert', 123 feet long, named after a renowned fishery expert of the early 20th century. Among the facilities of the Laboratory is a special library in oceanography and fisheries that is one of the best in the Pacific.

A scientific facility unique to the Laboratory is a group of fish-holding tanks located at Kewalo Basin, Honolulu, where the research vessels dock, in which living tunas can be held for experiments on their behavior and physiology. A series of pioneering studies on tuna behavior has been made there, and the facility attracts visiting investigators from the mainland and abroad whose research specialties require, or could benefit from experiments with living tunas.

The energies of the Laboratory in Honolulu are now focused on the harvesting by Americans of the now relatively unutilized skipjack tuna of the central Pacific Ocean. The skipjack tuna (Katsuwonus pelamis) is the mainstay of the small Hawaiian live bait tuna industry. As a first step toward a larger central Pacific harvest, the Laboratory is attempting to assist the Hawaiian industry to increase its present catch.

Bureau of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii.

(Continued next page.)

Skipjack tuna photographed from the 'Charles H. Gilbert.' During their feeding frenzy, a barred pattern appears on their flanks.

In pursuit of its aim of making the skipjack tuna resource available, the Laboratory is conducting basic studies in fishery biology, oceanography, and fish behavior. It is also pursuing investigations in applied science, attempting to better the operations of the Hawaiian tuna fleet by freeing it from its present dependence upon a small anchovy (Stolephorus purpureus), or nehu, as it is known locally, that is used for bait.

The Laboratory maintains cordial relations with the University of Hawaii--several of its scientists are members of the University's Affiliate Graduate Faculty. It also cooperates closely with the University's East-West Center, facilitating scientific interchange between America and Asia. It maintains ties with other research organizations in Hawaii, such as the Hawaii Division of Fish and Game and the Oceanic Institute.

Laboratory staff members represent the United States at meetings of such international bodies as the Indo-Pacific Fisheries Council, UNESCO's Cooperative Study of Kuroshio and Adjacent Regions, the International Indian Ocean Fishery Commission, and the South Pacific Commission.

One of the significant achievements of the Laboratory has been the use of immunogenetic techniques to show that the skipjack tuna of the Pacific Ocean can be separated into distinct groups. The results show one subpopulation in the western Pacific (Japan, Trust Territory), another in the eastern and central Pacific.

Another major achievement has been the preparation of an 'Oceanographic Atlas of the Pacific Ocean', a definitive volume, published by the University of Hawaii Press, in which half a century of oceanographic observations in the Pacific have been analyzed and presented in a form useful to oceanographers and fishery scientists.

The Laboratory welcomes visiting investigators and has been the site of original research by scientists from the mainland, Europe, and Asia. Space is limited, however, and arrangements with the Director must be made well in advance. (BCF Circular 306)

INDEX

Index continued page 72.

INDEX (CONTINUED)

U.S. GOVERNMENT PRINTING OFFICE : 1970

UNITED STATES DEPARTMENT OF THE INTERIOR

Walter J. Hickel, *Secretary*
Fred J. Russell, *Under Secretary*
Leslie L. Glasgow, *Assistant Secretary for Fish and Wildlife and Parks*

Charles H. Meacham, *Commissioner*, U.S. FISH AND WILDLIFE SERVICE
Philip M. Roedel, *Director*, BUREAU OF COMMERCIAL FISHERIES

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States -- now and in the future.

COMMERCIAL FISHERIES *Review*

VOL. 32, NOS. 8-9 AUGUST-SEPTEMBER 1970

COVER: View from BCF's 'Albatross IV' during survey cruise in Atlantic. (R. K. Brigham)

COMMERCIAL FISHERIES
Review

A comprehensive view of United States and foreign fishing industries--including catch, processing, marketing, research, and legislation--prepared by the Bureau of Commercial Fisheries.

Fishermen's Memorial
Gloucester, Mass.

Managing Editor: Edward Edelsberg

Production: Jean Zalevsky
Alma Greene
Jacqueline King

The Bureau of Commercial Fisheries and The Bureau of Sport Fisheries and Wildlife make up The Fish and Wildlife Service of The United States Department of the Interior.

Throughout this book, the initials BCF stand for the Bureau of Commercial Fisheries.

Address correspondence and requests to: Commercial Fisheries Review, 1801 North Moore Street, Room 200, Arlington, Va. 22209. Telephone: Area Code 703 - 557-4246.

Use of funds for printing this publication was approved by the Director, Bureau of the Budget, April 18, 1968.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Price 60 cents (single copy). Subscription Price: $7.00 a year; $2 additional for foreign mailing.

CONTENTS

ATLANTIC SALMON (R. K. Brigham)

ATLANTIC SALMON NEEDS INTERNATIONAL PROTECTION, DR. GLASGOW SAYS

Conservation of the Atlantic salmon depends significantly on international cooperation and careful management, believes Dr. Leslie L. Glasgow, Assistant Secretary of the Interior for Fish and Wildlife and Parks. He served this year as chief of U.S. delegation to annual meeting of International Commission for the Northwest Atlantic Fisheries.

ICNAF has recommended that its 15 member nations keep high-seas catches of salmon in Northwest Atlantic at 1969 level.

Salmon are hatched and spend their early life in freshwater coastal streams. Then they go to sea, where they migrate long distances before returning to native streams to spawn. The cycle is repeated.

Need for Controls Surfaces

The need for international controls became apparent in the mid-1960s, when high-seas fishing for salmon developed off Greenland. That island has no significant salmon-producing rivers. Many of the salmon caught off Greenland must have hatched elsewhere.

Dr. Glasgow said: "Fishing for salmon on the high-seas is contrary to principles of good conservation. It is essential to allow a certain number of salmon to escape to each spawning stream in order to maintain the resource. This can be done only if fishing operations are restricted to inshore waters and streams, where close supervision is possible."

ICNAF's Work

ICNAF coordinates high-seas conservation of fisheries in the Northwest Atlantic. Its members include the principal countries fishing there. It has sponsored studies that show some salmon caught off Greenland come from streams in Great Britain, Canada, and the U.S.

In 1969, ICNAF recommended a complete ban on salmon fishing in international waters; this proposal was not accepted by Denmark and West Germany. However, these countries agreed to catch limitation proposed for 1971. Denmark has the largest salmon fishing fleet off Greenland.

U.S. Position

"The freeze on 1971 catches is an interim measure and far from satisfactory," Dr. Glasgow has stated. "The United States approved this proposal only when it became clear that agreement could not be reached on more effective measures. Over the long term, stronger international controls will be necessary to serve the interests of good conservation. We shall do our utmost to this end."

HERRING AND MENHADEN APPROVED FOR FPC

The Food and Drug Administration (FDA) has approved the use of herring and menhaden in producing fish protein concentrate (FPC). FDA had examined data supplied by BCF before acting. Only hake and hakelike fishes had been approved before.

The value of recovered oil from herring and menhaden will reduce costs of producing FPC, a virtually odorless, tasteless light-tan powder made from whole fish. FPC contains over 75% animal protein and several nutritionally beneficial minerals.

Worldwide use of FPC could help provide a better-balanced diet for undernourished millions. It also offers profitable use of many unused fish off U.S. coasts.

Aberdeen FPC Plant

Assistant Secretary of the Interior Leslie Glasgow said August 25 that an experimental and demonstrational plant being built at Aberdeen, Washington, is scheduled for completion late this year. It is designed to process up to 50 tons of raw fish during a 24-hour day--and to produce up to 7.5 tons of high-quality FPC. The plant is intended to demonstrate the feasibility of manufacturing FPC by a BCF-developed extraction process using isopropyl alcohol. The plant also will provide a basis for design and construction of privately owned full-scale plants.

About 25¢ A Pound

Nutritionists estimate 750 million people suffer from a serious protein deficiency in their daily food--and their number is increasing daily. Commercial development of the BCF extraction process using hake is expected to provide a product costing about 25 cents a pound. This could compete easily with other available animal protein supplements on a protein-content basis. Tests have shown that less than half an ounce of FPC per day will produce a remarkable improvement in a protein-deficient diet.

LAND FIRST COMMERCIAL CATCH OF PELAGIC RED CRAB

The 'American Eagle' landed the first commercial load of pelagic red crabs in San Pedro, Calif., in July. The Starkist Food Co. bought the 1,700-pound catch.

BCF gear, a 16-foot otter trawl, and a 5' x 5' Blackburn neuston net were used to catch the crabs in international waters off southern Baja California. Rough seas permitted only 2 days of fishing during the 7-day trip. A BCF biologist was aboard.

Catching and Preparing Crabs

Both bottom and midwater trawls caught red crabs successfully. Samples were collected and prepared in several forms: whole, raw; ground, raw; and ground, cooked. The crabs were preserved in the spray-brine tank, or in a chest freezer.

The samples will be used by the BCF Technological Laboratory in Seattle, Wash., for analysis and experimental processing. According to lab director Dr. Maynard Steinberg, the most promising use of red crabs seems to be for pet food or animal feed.

110,000-TON QUOTA SET FOR CALIFORNIA ANCHOVY REDUCTION

An anchovy catch quota for reduction of 110,000 tons for the 1970-71 season--10,000 tons for Northern Permit Area and 100,000 tons for Southern--was approved on July 31 by the California Department of Fish and Game.

Fishermen are restricted from fishing for anchovy for reduction in designated zones ranging from 3 to 6 miles offshore.

The season opened August 1 for the northern area, and September 15 for the southern area. The fishery will be closed during February 1971. The season will end when the quotas have been attained, or on May 15, 1971.

U.S. FOOD SITUATION

"Food prices have increased much less rapidly in recent months than they did last fall and winter," reports the U.S. Department of Agriculture. In June 1970, food prices averaged 1.3% (seasonally adjusted annual rate) over March, and 3.3% over last December. This contrasted with gain of 5.7% for total Consumer Price Index. Much of the increase for food resulted from higher prices of food eaten outside the home. Retail-store prices of food rose a fraction.

Price Decline in Fall

"Food prices may show a small seasonal increase this summer," Agriculture Department states, "but they likely will decline more than seasonally this fall if the red meat supply, especially pork, increases as expected. Seasonally large supplies of fresh fruits, vegetables, and potatoes also will contribute to lower prices later this year." For 1970 as a whole, the total food price index may average about 5% above 1969. This will be due partly to large increases between fourth-quarter 1969 and first-quarter 1970.

Per-Capita Consumption Up

Per-capita consumption of food will increase this year. Contributing to rise will be expected increases in consumption of poultry, fish, fruit, potatoes, and sugar. Meat consumption also is expected to rise slightly. Less consumption of dairy products is in prospect.

Smaller % of Income For Food

Food expenditures increased 1% in second-quarter 1970, the smallest advance since late 1968. However, spending was still over 8% higher than in second-quarter 1969. For 1970, expenditures may total around \$113 billion; 1969's were \$105 billion. Disposable income probably will increase more than expenditures. This will lead to a decline from 16.7% in 1969 (revised) to 16.5% this year in proportion of income spent for food.

Food Prices

Between January and June 1970, retail food prices rose less than half as fast as prices for nonfood goods and services. There was a 1.5% increase for food compared with a 2.9% increase in prices of nonfood items. Prices of all consumer goods and services rose 2.6%. Since 1957-59, prices of all nonfood items have increased around 36%; total food prices have risen 32½%. Prices of food in stores rose 28%, and eating-place prices rose 55%.

The retail price index for all food averaged 7% higher during January-June 1970 than during same period 1969. Retail-store prices rose 6.7%, while prices of food eaten outside home went up nearly 8%.

SUPPLIES OF FISHERY PRODUCTS INCREASE

Supplies of edible fish during January-June 1970 rose an estimated 6% above first-half 1969. Supplies were lifted by a 14% rise in imports over a year ago, and an increase of about 4% in domestic catch.

Fish landings in the New England area for first 6 months of 1970 were a fraction below a year earlier. U.S. fishermen caught only about half the haddock of a year earlier. However, there were gains in flounder, ocean perch, pollock, and whiting.

Among the other major U.S. fisheries, shrimp "is well on its way" toward record production; catches are running 13% above last year. Pacific halibut landings probably will be a little below last year; tuna likely will be about the same.

Imports Much Above 1969

Imports of major edible fishery products are considerably above 1969. Imports of fillets are up 25%--led by sharp increases for cod, flounder, and haddock. The only sizable drop has been in ocean-perch fillets. Receipts of raw materials for fish sticks and portions have increased 15%. Imports of sardines are about 10% above 1969.

Imports of foreign lobsters have declined this year, but imports of shrimp are 17% above a year ago.

Inventories of frozen fish and shellfish are 11% higher than last year. Inventories of frozen fillets are up a third; stocks of cod and flounder fillets are substantially larger. Frozen haddock fillets are up slightly; stocks of ocean-perch fillets are down slightly.

Cold-storage holdings of shellfish are 11% above 1969 because of larger shrimp stocks. Most other shellfish are slightly below year-ago levels.

Strong Demand

Demand for fishery products was strong in first-half 1970. This continued 1968 and 1969 trends. Movement of most products is reported good. Fish prices are averaging 8 to 9% above a year ago.

Supplies Ample

Supplies of most fishery products will increase seasonally for the remainder of this summer. They are expected to be ample for trade needs. Price levels generally will continue higher than in 1969.

Large catches of Alaska salmon will ensure plentiful supplies of frozen and canned salmon for current marketing year. Supplies of most frozen fillets are higher than last year. Production of the popular fish sticks and fish portions is well above year-ago levels. Supplies of most shellfish will be adequate. Shrimp are expected to be plentiful for remainder of 1970.

CONSUMPTION OF SHELLFISH RISES 12% ABOVE 1969

From January-July, consumption of fresh and frozen shrimp, northern lobsters, spiny lobster tails, and sea scallops increased about 12% over a year earlier. These items made up 62% of all U. S. shellfish consumption in 1969.

Consumption of fresh and frozen shrimp has risen 15% in 1970; lobster tails have shown a moderate increase; sea scallops are a fraction ahead of last year; and northern lobster consumption is off a little.

SHRIMP-SEPARATOR TRAWLS TESTED IN GULF OF MEXICO

Tests of shrimp-separator trawls have been conducted in Gulf of Mexico by BCF's Pascagoula (Miss.) Exploratory Fishing and Gear Research Base. Two western-type, 70-ft., semiballoon shrimp trawls were modified into shrimp-separator trawls and tested on brown-shrimp grounds.

The horizontal panel trawl (modified Pascagoula design) was slightly more effective than vertical panel trawl (modified Seattle design) in channeling shrimp into the side or shrimp bags; but the former had a higher percentage of fish contamination.

The separating percentage for both trawls was below earlier trials with 40-ft. separator trawls. This is attributable partly to: (1) small fish encountered; (2) large horizontal opening of trawl, which permitted more shrimp to reach fish bag without contacting separator panel; (3) size of mesh in separator; and (4) basic design of western semiballoon trawl.

The Modified Designs

The modified designs, though less satisfactory at sorting shrimp, were much more efficient catchers of shrimp and fish than earlier models; they caught as much as standard trawls.

The accumulated data indicate strongly that radical design changes are required. Possibly, observations by SCUBA divers will be necessary before developing a commercially effective separator trawl for penaeid shrimp in the Gulf of Mexico.

EXCESS LAKE MICHIGAN SALMON WILL BE HARVESTED

An estimated 3 million pounds of salmon surplus to the needs of sport fishermen in fall 1970 will be taken from Lake Michigan streams for processing. The Michigan Department of Natural Resources has authorized the Blackport Packing Co. of Grand Rapids to do the job.

Terms of Contract

If the fish meet State and Federal food standards, they will be made available to qualified buyers in Michigan at a fair market price. Also, Blackport will process about 50,000 coho and chinook salmon for free distribution to Michigan's licensed salmon fishermen.

The 3 million pounds to be processed, and the free salmon, will be collected at 3 weirs operated by the Department of Natural Resources.

MAINE SARDINE COUNCIL SEEKS ANSWER TO HERRING SCARCITY

The Maine Sardine Council has made a grant for a study of the effect of environmental conditions on the habits, supply, and movement of herring along the Maine coast. The work will be done by The Research Institute Gulf of Maine (TRIGOM) and the Maine Medical Center.

Richard E. Reed, council executive secretary, said the most serious scarcity of fish in 10 years triggered the action.

Traditional runs of sardine-size fish have failed to appear. Maine's 21 sardine canneries have been operating at 20% or less of capacity since January. Reed said the condition existed over most of the Gulf of Maine because the Canadian industry was having the same problem.

Study Goals

Reed described the study goals: "We hope to find some clues that will permit our industry to anticipate the extent of fluctuations in herring supply that may be expected from year to year, determine the cause and then seek an effective plan for conservation and management of the fishery. New techniques and approaches developed by TRIGOM and the Medical Center will supplement extensive biological research that has been carried on by state and federal agencies for the past 25 years."

ESTIMATION OF FISH STOCKS BEING IMPROVED

Haddock stocks in the northwest Atlantic Ocean are under strong international regulations because of increased fishing and low recruitment. Regulation of the yellowtail flounder fishery because of increased fishing also has been proposed.

Characteristics of fishing fleets have been changing. Vessels previously used for standard measurements of fish are no longer fishing the same species.

Improved Estimates Needed

According to BCF's Biological Laboratory, Woods Hole, Mass., international regulations and changing fisheries have made acute the need to improve estimates of vital statistics. One statistic is relative abundance. Generally, it is expressed as landings per-unit-effort. Estimates of factors necessary to assess stocks depend upon estimates of abundance. The more precise this abundance estimate can be made, the higher the confidence that can be placed on the population factors.

Logbooks Issued

The standard method of obtaining fishing effort has been to interview the vessel's captain at dockside after a trip. However, this provides limited effort and discard information. To obtain more precise observations of effort and catch, on-board vessel logbooks are used. Segments of the haddock, yellowtail flounder, and ocean perch (redfish) fleets have been issued logbooks. Data from this sample will be the basis for evaluating the system. After necessary refinements are made, the logbooks will be put into general use.

SKIPJACK TUNA DISTRIBUTION IN PACIFIC MAY BE CHANGING

The results of a series of 5 oceanography-fishery cruises to the equatorial Pacific by BCF Honolulu suggest that skipjack tuna are increasing 500-1,000 miles southeast of Hawaii--while they are decreasing in Hawaiian area.

This could indicate a seasonal shift southward. BCF is investigating the subject thoroughly.

OREGON'S SHRIMP FISHERY REMAINS STRONG

Shrimp boats fishing off Oregon this year have landed 7.9 million pounds in Oregon's coastal ports through July, reports Jack Robinson, Fish Commission biologist in charge of monitoring the state's million-dollar-plus industry.

Landings should top 10 million pounds in 1970, says Robinson, the fourth highest on record. Although the high was 11 million pounds in 1968, the annual catch over the past 10 years has been a little over 4 million pounds. The fishery, which opened March 1, closes October 31.

Productive Areas

Coos Bay, with over 3 million pounds, is high port; landings at Newport are 1,067,000 pounds. Other productive areas for the cocktail-size shrimp include Astoria and Garibaldi.

Landings might have gone even higher, notes Robinson, except for poor market conditions in May, June, and July.

SIGNAL CRAYFISH FISHERY IS DEVELOPING IN PACIFIC NORTHWEST

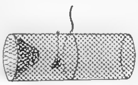
A fishery for signal crayfish, Pacifastacus leniusculus, is beginning to develop in the Pacific Northwest. This species apparently is similar to the European species. A shortage in Europe has fostered great demand in Scandinavia.

At the end of July, fishermen were getting about 40 cents a pound--but price has been as high as a dollar. Average size crayfish are 4 to 5 inches, 12 to 14 per pound.

Wide Distribution

Assessment of the resource has not begun, but indications are that species can be found in most lakes and streams in Northwest and in Northern California.

Cylindrical crayfish pots--2' by 10" diameter--have been built for testing.



SALT-WATER REARING OF SALMON IS TESTED

BCF Seattle Biological Laboratory staff are conducting experiments to determine the relation among water temperature, feed, and growth of salmon. They are using a system of screened pens and webbing enclosures supported by floating rafts attached to a pier.

First Trials Encouraging

Initial trials with coho salmon were very encouraging. In July 1969, 0.7-ounce fingerlings were placed in saltwater pens; by January 1970, they had grown to an average weight of 10 ounces. Conversion rate was 1.4 pounds of feed per pound of fish during late summer. This compares with conversion rate range of 1.2 to 1.5 pounds of feed per pound of fish under normal hatchery operations for cohos. During winter, the growth rate slowed, but the fish remained in excellent condition.

'KELEZ' STUDIES HIGH-SEAS RED SALMON POPULATION

BCF's 'George B. Kelez' has been indexing the red salmon population on the high seas south of the Aleutian Peninsula. Gillnet catches on August 15 and 16 were exceptionally high (445 red salmon on the 16th). Fish that have been at sea through one winter are designated .1 fish. The proportion of these fish is much higher than expected following this year's large run to Bristol Bay.

.1s are 80% of Reds

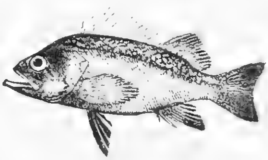
Eighty percent of the reds caught on the cruise have been .1s. The .2 reds (at sea through two winters) are not as abundant as usual following a large run; .1 fish are more abundant than usual.

The .3 fish usually move farther west than younger age groups--beyond abstention line at 175° W. longitude. This may mean that in 1971 there will be fewer North American fish exposed to the Japanese compared to other years following peak runs.

ROCKFISH SHOW STRONG HOMING INSTINCT

Tagged yellowtail rockfish from a submerged wreck north of Juneau, Alaska, have shown remarkable ability to return home. So far, 10 of 34 fish released at Auke Bay, 6 miles away, have returned; another quickly found its way across a channel one mile wide and 300 feet deep to return to the wreck.

The fish released from Auke Bay also had good "memory": they had been captive for 3 months before release.



CAMBRIDGE (MD.) WELCOMES ICELAND'S 'GODAFOSS' ON MAIDEN VOYAGE

On August 14, residents of Cambridge, Md., welcomed the Icelandic vessel Godafoss on her maiden voyage. The visit was significant to Cambridge: the vessel carried 3,000 tons of fish, the largest single load of fish to reach the port. Also, it marked the beginning of a biweekly service of 3 Iceland Steamship Co. vessels between Reykjavik and Cambridge

The Godafoss

The fully automated Godafoss is represented in Cambridge by Terminal Shipping Co. She features three 5-ton-capacity hydraulic deck cranes; two of the three can be operated together as a twin crane of 10-ton capacity.

The vessel has a cargo capacity of 150,000 cubic feet. Her holds are insulated to permit transportation of refrigerated and dry cargoes.

WILLIAM TERRY APPOINTED U.S. COMMISSIONER ON IATTC

On Aug. 13, the President appointed William M. Terry a U.S. Commissioner on the Inter-American Tropical Tuna Commission (IATTC). He succeeds J. Lawrence McHugh, who has resigned. Terry is Acting Deputy Director of BCF.

IATTC's Role

The Commission, created in 1950, conducts scientific investigation of tuna and bait fishes in the Eastern Pacific Ocean. It collects and interprets information necessary to maintain stocks of tuna and bait fishes at levels that will permit maximum sustained yields. Also, IATTC recommends to governments conservation measures indicated by its investigations.

MEETINGS

FISH EXPO '70 OPENS IN TAMPA, FLORIDA, OCT. 14

Fish Expo '70 will be held at the Curtis Hixon Convention Center on Hillsborough River in Tampa, Florida, Oct. 14-17.

Fish Expo originated in Boston, Mass., in 1967, and was held there again in 1968. Fish Expo '69 took place in Seattle, Washington, where gross sales from the exhibition floor reportedly were over $1,000,000.

Show Hours & Features

The show hours for the trade will be 12 noon to 6 p.m. From 10 a.m. to 12 noon, seminars will be conducted on the detection, catching, handling, processing, and marketing of fish; fishing vessels; and vessel subsidies.

Several otter trawl vessels built of wood, steel, fiber glass, aluminum, and cement will be displayed at the dock. These will give fishermen an opportunity to compare fishing vessels built of different materials. Exhibitors from the U.S., Canada, Mexico, Norway, England, Germany, France, Portugal, Denmark, and Japan will show latest fishing gear and equipment available to the commercial fishing industry.

BCF's Market News Service

The BCF exhibit will include a temporary Fisheries Market News Service office complete with teletype machine. On business days, information will be available on current fish and shellfish landings, receipts, prices, and market trends.

ATLANTIC & GULF GROUPS TO MEET

The annual meetings of the Atlantic States Marine Fisheries Commission and the Gulf States Marine Fisheries Commission will be held jointly at International Inn, Tampa, October 14-16.

TROUT FARMERS TO MEET IN CALIFORNIA, OCT. 28-30

The Eighteenth Annual Convention of the U.S. Trout Farmers Association will be held October 28, 29, and 30 at the Sacramento Inn, Sacramento, California. It is not limited to trout culturists.

The convention will feature a tour of hatching and rearing facilities on Oct. 29. Trout farm equipment will be demonstrated.

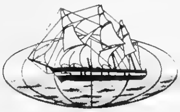
Highlights

Reports will discuss the use of ultraviolet in treatment of waters for control of diseases; the virus diseases and their control methods (IHN, IPN, whirling disease, and others). Engineering of hatcheries and fish farms, including practical systems of reusing water, also will be discussed.

For more information contact: Clay M. Robinson, U.S. Trout Farmers Assn., 67 West 9000 South, Sandy, Utah 84070.

GAME FISH MEETING CANCELLED

The Game Fish Research Conference of the International Oceanographic Foundation, scheduled for Curacao, Nov. 13-14, 1970, has been cancelled.



BCF CONTINUES WHALE RESEARCH PROGRAM

Although whales lost their economic importance years ago, they have not lost their popular appeal. To quiet rumors that Federal whale research would be curtailed, Dr. Leslie L. Glasgow, Assistant Secretary of the Interior for Fish and Wildlife and Parks, said BCF has never announced a reduction in funds or end of the program.

Has Scientists Closer To Whales

Dr. Glasgow stated: "In order to make better use of available funds, we are planning to relocate certain research activities, and to consolidate the scientific staff working with whales and other cetaceans. [Cetaceans are hairless, fish-like water mammals which include porpoises and dolphins, among other species.] Research on the gray whale population, which includes a yearly count of the whales as they migrate northward along the California coast, will continue. The program relocation would simply move the scientists closer to the whales they are studying."

CALIF. BANS COMMERCIAL FISHING OF PACIFIC MACKEREL FOR 2 YEARS

Gov. Reagan signed into law in August a bill banning the commercial fishing of Pacific mackerel for 2 years.

The bill was introduced to protect the dwindling Pacific mackerel resource from possible extinction.

A SIGN OF THE TIMES. The "ribbon" around neck of this dog fish was not won in competition. It is a plastic beer-can holder found on fish when it was removed from trawl net. (R. K. Brigham)

SALMON PLANT IN WILLAMETTE RIVER MAY BE LARGEST

The Oregon Fish Commission recently released into the Willamette River more than 10.5 million young fall chinook. It was another step in a 10-year program, which began in 1968, to develop the Willamette's potential for natural salmon production. It may have been the largest stocking effort of fed salmon ever undertaken within one state for that purpose.

Roy Sams, Commission project leader for Willamette Basin studies, said the young 3- to 4-inch fish are now well on their way to sea. They are destined to return as 3- and 4-year-old adults in 1972 and 1973.

Most unusual, the fish had not been reared in salmon hatcheries for all their juvenile freshwater cycle. Rather, they had been transferred from hatcheries to gravel borrow pits and a summer swimming pond at Cascades Gateway Park in Salem. Many more fish were reared in this way than could have been accommodated in existing hatchery facilities.

5% of Chinook Potential Utilized

Biologists believe that less than 5% of the fall chinook potential is being utilized--and that annual Pacific coast harvest of naturally produced Willamette River fall chinook could be multiplied.

The Commission believes this potential can be developed now because water-pollution control has been improved and many fish-passage problems corrected in the Willamette system. Oregon City's Willamette Falls, natural barrier to upstream migration, are main reason system is underutilized by fall chinook. This problem has been overcome as Fish Commission's $4 million Willamette Falls fishway nears completion. The funds were provided by Bureau of Commercial Fisheries and Portland General Electric.

Sams and others believe the quickest, most economical way to develop the natural spawning potential for fall chinook is to use inexpensive natural rearing ponds.

Pond Rearing Program

Sams said that this year over 12 million fall chinook, surplus to regular hatchery program needs, were available for the pond rearing program. "In early April, we stocked the four ponds at Salem, Stayton, and Aumsville with 2 to 5 million young weighing up to 600 to the pound. Then, for 8-10 weeks we fed them a commercially manufactured pellet diet at a cost of only $26,000." This is the largest part of the program's total cost.

During recent releases from the ponds, 85% of young chinook emigrated of their own choice, an excellent survival rate. The fish averaged about 100 to the pound.

The Commission hopes to increase the ponds' production level to 15 million a year for at least 8-10 years.

After the number of returning adults increases to the required level for adult spawning escapement, the pond rearing program could be discontinued. The run would perpetuate itself with little or no more expenditure. However, the ponds probably will be operated after developmental period because of their great value as production facilities.

LIGHTWEIGHT POTS ON LONGLINE EFFECTIVELY CATCH SABLEFISH

BCF's 'John N. Cobb' returned to Seattle on July 1 after a 12-day gear research cruise, in offshore waters off south-central Washington, during which technicians experimented with longline pot fishing for sablefish. They report: ". . .It is apparent that fishing lightweight pots on a longline is an effective method for taking sablefish."

Primary objective was to evaluate feasibility of fishing sablefish pots on longlines. Other objectives were to determine: optimum fishing distance between pots; suitable pot design for longline fishing; influence of soaking time on catch rates; and proper methods for handling pots and longlines aboard vessel.

GEAR AND METHODS

Pots and Longline Gear

Experimental pots of various designs and tunnel configurations were prepared to fish from longline gear. Most pots were constructed of 11-gauge, 2-by 4-inch, galvanized wire mesh and supported with $\frac{1}{2}$-inch mild steel rings and rungs. Most wire mesh pots were cylindrical, 6 to 10 feet long, 3 feet in diameter, with 8-inch tunnel openings and spring-tensioned triggers. Some pots had tunnel at one end; others had tunnels at each end. Several pots had experimental fyke tunnels. A few had 2 tunnels at one end to form double compartment. Five pots were rectangular, 40 by 30 inches by 8 feet, with tunnel at each end.

In addition to experimental wire mesh pots, 4 commercially designed and manufactured pots were evaluated. Two were plastic pots separated into halves and attached to webbed frame 40 inches square by 14 inches deep. These pots resembled a cloverleaf and had 4 openings. The remaining two pots were collapsible fyke-type nets with double tunnels at one end (two compartments) and completely webbed cod end.

The pots were fished from a 600-fathom longline (groundline) of $\frac{1}{2}$-inch, 6 by 19 galvanized wire cable. Stoppers formed by $\frac{1}{2}$-inch cable clamps were attached every 10 fathoms on groundline. One hundred fathoms at each end were free of stoppers.

Two Navy-type anchors, each 200 pounds, and 10 feet of anchor chain were used at each end of the groundline.

Buoylines, in 50-fathom coils, were $\frac{7}{8}$-inch, $\frac{3}{4}$-inch, and $\frac{5}{8}$-inch polypropylene and $\frac{1}{2}$-inch nylon. Two surface buoys, a pole marker, and a gill net light were used to mark each end of buoyline.

Setting and Hauling

Before setting gear, bottom was reconnoitered with echo sounder to determine depth and topography. Groundline was set from and hauled onto cable-towing winch drum from amidship on starboardside. An open-faced pursing block attached to a short boom extended outward and led groundline into winch. Groundline was transferred to and from anchor chain to a drum pendant using a short idler cable, flat links, and G-hooks. Pots were attached to groundline, when setting, with either a snap-on hook or $\frac{3}{8}$-inch shackle attached to gangion. The hauling operation was reverse of setting procedure, with exception that a hoist was used to lift pots aboard (see figures 1-6).

Area of Operation

Experimental fishing was conducted at two locations: 46°55' N.; 124°50' W. in 190-210 fathoms, and 46°49' N.; 124°54' W. in 175-200 fathoms. Three gear lifts were made at each.

RESULTS

Strong northwest winds offshore delayed operations, so only 6 sets were made. Catch results are summarized by pot type in table.

6 Experimental Sets Off Washington

Pot Type	No. Pot Hauls	Range of Catches Per Pot Lift Marketable Sablefish[1/] No.	Wt.
Cylindrical:			
2 tunnel, std.	20	0-42	0-231
1 tunnel, std.	20	1-25	5-137
1 tunnel, fyke	7	1-17	5-93
Double compartment	12	1-71	5-436
Rectangular	2	7-14	37-77
Cloverleaf, plastic, 4 tunnel	4	2-4	10-20
Fyke net, 4' x 12'	2	0	0
Total	67		

1/A marketable sablefish is longer than 17 inches from insertion of first dorsal fin to end of tail.

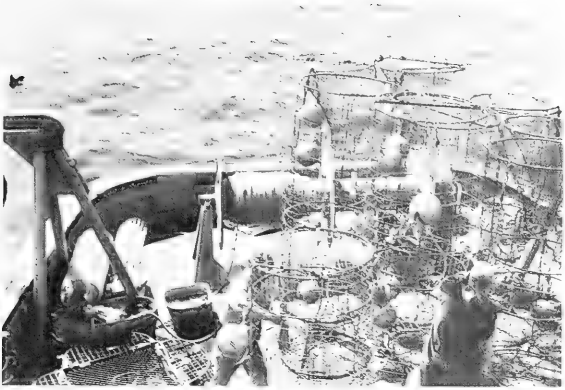


Fig. 1 - These pots on deck of John N. Cobb will be fished from a groundline.

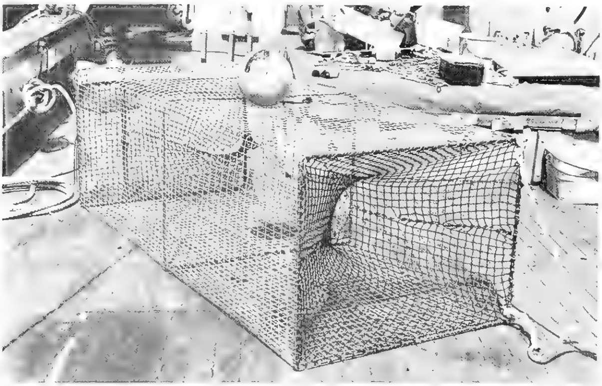


Fig. 2 - A rectangular pot built on deck.

Fig. 3 - Buoy line connected to anchor and groundline is wound on net reel.

Fig. 4 - Groundline and anchor are held with buoy line until connected to pendant with idler cable.

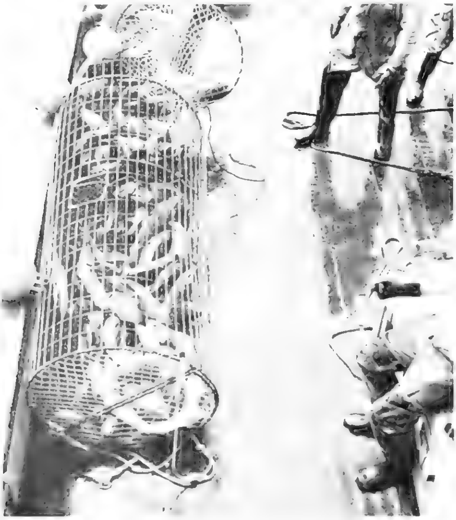


Fig. 6 - Largest fish catch made in double compartment pot--71 market-size sablefish; dressed weight of 436 pounds.

Fig. 5 - Pot coming out of water.

Soaking times ranged from 11 to 66 hours with best catches on longer soaks. Pots were spaced 10 to 30 fathoms apart on groundline--but no noticeable differences in catch rates could be detected due to pot spacing.

On first set, failure of snap-on hooks resulted in loss of 13 of 24 pots set. Later, all pots were fastened to groundline with $\frac{3}{8}$-inch shackles. No further losses occurred.

Fishing pots on longline was no problem. As expected, hauling time per pot was much better than experienced in past when fishing individually buoyed pots. The best record using longline gear was 18 pots hauled in 2 hours.

The BCF technicians concluded: "Although the lack of repetitive observations makes it difficult to make any conclusive statements regarding optimum soaking time, distance between pots or pot design, it is apparent that fishing lightweight pots on a longline is an effective method for taking sablefish.

"Averaging over the entire experiment, it appears that the double-compartmented pots outfished the other pots. The two largest catches, 240 and 436 pounds of marketable sablefish per lift, were made with this type of pot. The plastic cloverleaf-type and fyke net-type pots fished poorly or not at all."

For more information contact: A. T. Pruter, Acting Base Director, Exploratory Fishing and Gear Research Base, 2725 Montlake Blvd. East, Seattle, Washington 98102 (Phone: 583-7729).

LAKE ERIE: COMMON EFFORT CAN SAVE IT

The Nation's greatest freshwater resource, the Great Lakes, is seriously threatened. "Accelerated enrichment, unabated pollution, overexploitation, and introductions of exotic species, have all been guided--more often misguided--by man." Of all 5 Great Lakes, Lake Erie is most damaged and most threatened. This evaluation was part of a statement by BCF Ann Arbor, Mich., to the Lake Erie Enforcement Conference in Detroit, Mich., on June 3. It was delivered by Dr. Wilbur L. Hartman, Investigation Chief, Lower Great Lakes Program.

For over 100 years, Lake Erie has supported a commercial fishery. Even today, more than 50 million pounds of fishes are landed each year by U.S. and Canadian fishermen. This is comparable to levels of past half-century. In the last decade, the U.S. sport fishery has increased tremendously. These combined U.S. and Canadian fisheries in Lake Erie, nearly 70 million pounds, are worth nearly $5,000,000 today. When thousands of pleasure boats are included, capital investment in gear for these fisheries reaches hundreds of millions of dollars.

Shift to Cheaper Fishes

Unfortunately, the BCF Ann Arbor statement noted, "there has been a drastic shift in the commercial and sport harvest from high-value fishes to medium- and low-value fishes." The fisheries for lake trout, northern pike, blue pike, and sauger are memories. Sturgeon, whitefish, and ciscoes are nearly gone. Today, emphasis is on catching such medium-value fishes as yellow perch and white bass.

Many Changes in Lake Erie

Lake Erie is about 241 miles long; its maximum width is 57 miles.

Industrial, municipal, and agricultural pollution and enrichment have produced many changes in the living aquatic resources and environment: "massive nuisance and toxic algal blooms of Microcystis and Aphanizomenon, destruction of the valuable mayfly benthos in the western and central basins, a 20-fold increase in plankton, which is the diet staple for several nuisance and low-value fishes that have undergone population explosions in the last 15 years, increased levels of such pesticides as DDT and Dieldrin in fish flesh, dangerously high levels of mercury in many fishes, the destruction of spawning areas of some of our most valuable fishes, and disappearance of oxygen from the bottom waters of the central basin during the summer."

The statement warned: "Unless major action is taken immediately to remedy the deleterious activities of man, Lake Erie tomorrow will have very few walleyes, an unhealthy yellow perch population, increasingly larger populations of low-value fishes such as carp, goldfish, suckers, freshwater drum (sheepshead) and alewives. Without effective action, Lake Erie tomorrow will have increased fish kills, smothering algal blooms, greater bacterial contamination, and more extensive oxygen depletion. The quality of the water so desperately needed to supply a broad spectrum of users will continue to deteriorate."

Water Chemistry

About 40 billion gallons of untreated municipal sewage and many billion gallons more of partially treated sewage are dumped into Lake Erie each year. An estimated 137,000 pounds of phosphorous enter Lake Erie each day--72% from municipal waters. So nutrient levels have increased substantially.

Total dissolved solids have increased over 50 parts per million (ppm) during past 50 years. These increases alone have not directly killed fish, "yet they reflect the changes man has wrought, and have serious indirect effects. . . .The latest data on Lake Erie water chemistry shows no significant deacceleration of these rates of increase."

Organic Production

Generally warm water temperatures, increasing slightly over the years, are 2° F. warmer on average since 1920 due to climate changes. This and tremendous increases in nutrient levels have produced dramatic increases in organic production, particularly

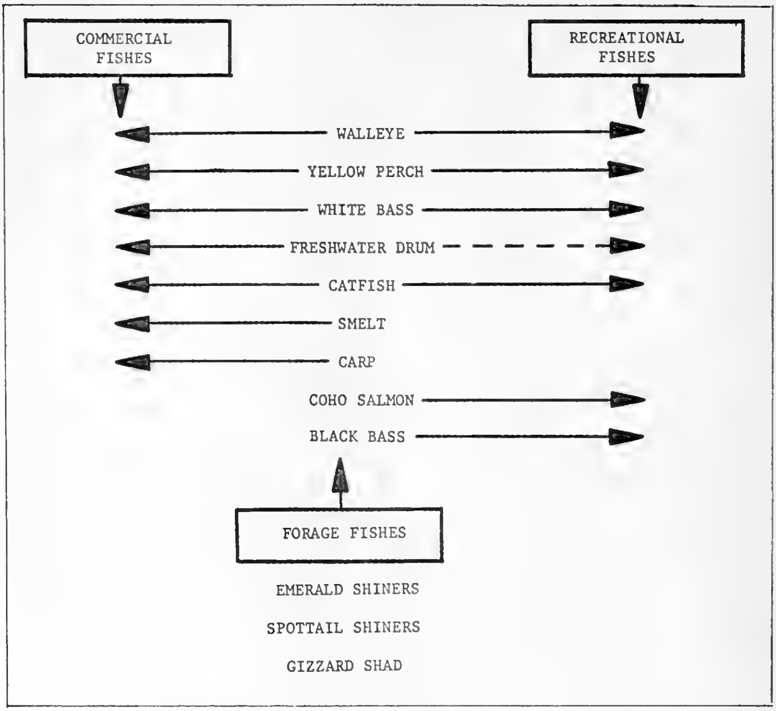


Fig. 1 - The fish resource of Lake Erie is a complex biological system involving predator fish-walleye; forage fish--emerald shiners; competitor fish--yellow perch and freshwater drum; parasitic fish--sea lamprey; and fish that seriously disturb the environment--carp.

at algal level. Over the past 50 years, plankton algae have increased 20-fold. The growths of filamentous algae, such as Cladophora, have boomed. These are a nuisance along Lake Erie's shores. Millions of tax dollars have been lost because property has been devalued.

The composition of the plankton algae has changed adversely. "The noxious blue-green algaes, Microcystis and Aphanizomenon, have recently become dominant summer species. In 1969, the late summer blooms of these forms in the western basin were unusually and unbelievably dense and widespread."

Oxygen Levels

Organic production directly affects oxygen regime in Lake Erie. The fallout of dead algae sinking through water column to bottom creates a tremendous biological-oxygen-demand (BOD) during decomposition. The greater the organic production, the greater the BOD.

Thermal Conditions

The waters of Lake Erie undergo considerable thermal change each season. During severe winters, 95% may be ice covered. Summer surface temperatures exceed 75° F. each year.

At present, Lake Erie is about 2° F. warmer than during early 1920s. Between 1925 and 1930, the greatest increase in mean annual air and water temperatures occurred.

The oxygen regime has been seriously degraded. During thermal stratification, the sediments and bottom waters become isolated

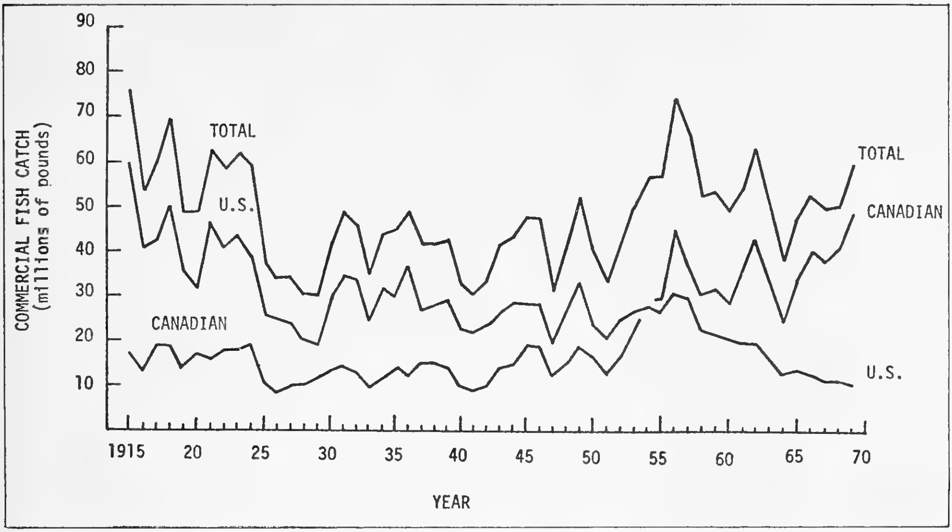


Fig. 2 - The commercial catch of Lake Erie fish has averaged 50 million pounds since 1915. Before 1954, U.S. fishermen landed most of the catch. Now Canadian fishermen reap the harvest and U.S. landings are at an all-time low.

from overlying surface waters. Oxygen lost in bottom waters cannot be replenished adequately until stratification breaks down and a mixing with oxygen-charged surface waters occurs.

Increased organic production and introduction of reduced, oxygen-demanding organic and inorganic materials have resulted in deterioration of oxygen levels in many areas of Lake Erie.

Bottom Organisms

Degradation of the oxygen regime has altered dramatically the populations of bottom organisms essential as food to certain valuable fish. Since 1953, this phenomenon has reduced mayfly larvae (Hexagenia) from 400 to 10 individuals per square meter and, in places, entirely eliminated them. It has "increased the numbers and distribution of sludge worms (oligochaetes) many-fold, reduced caddisfly larvae almost to the vanishing point, favored large increases in the populations of low oxygen tolerant forms of midges, reduced the non-tolerant forms, caused an increase in some species of fingernail clams, and generally reduced the numbers of all pollution-sensitive bottom organisms."

The original community of organisms was an essential part of the food chain important to desirable fish. Changes in this community have adversely affected these fish and, in turn, the economics of the fishing industry. The narrow stratum in the bottom of Lake Erie, with its low dissolved oxygen content, "is so polluted that the future status of the entire lake as a useful producer of fishery products is uncertain."

Thermal Effluents

Nuclear power plants on Lake Erie are proliferating. BCF is concerned with potential bad effects of heated discharges on fishes and associated aquatic resources for these reasons:

1) A uniform increase of temperature will increase metabolic activities of organisms and result in increasingly greater levels of organic production. This would increase rates of BOD and degradation of oxygen regime.

2) The highly valuable walleye in western Lake Erie have separate spawning sites on shallow reefs. The spawning areas are shallow, 2 to 10 feet. The spawning and incubation physiologies of walleyes are such that large

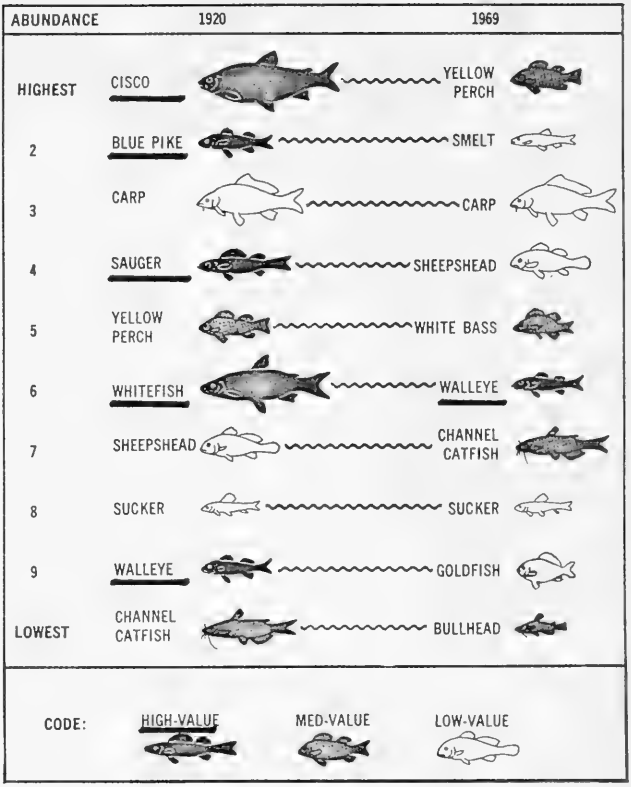


Fig. 3 - In 1920, the commercial catch from Lake Erie was dominated by five high-value fishes--cisco, blue pike, sugar, whitefish, and walleye. Now only the walleye is left, and it is in serious decline. The pressures of rapid environmental degradation and heavy exploitation have left us with a fishery resource composed only of medium and low-value fishes.

heated discharges would disrupt spawning severely and could destroy incubating eggs.

3) BCF data show that an increase in incubation temperatures from 10 to 15° C., for example, will decrease incubation period of walleyes from 20 to 10 days. Quite possibly, unnatural heating in areas where eggs are incubating would result in unnaturally earlier hatching when environment could be unsuitable to their survival. German scientists have demonstrated this for reduction of whitefish in Lake Constance, Switzerland.

There should be no significant additional thermal inputs into Lake Erie, especially into western basin, under possible consequences have been assessed.

Fishery Resources

Of all Great Lakes, Lake Erie has been most fertile and productive in pounds of fish. Nineteen species have been significant in the landings at some time. Annual combined U.S. and Canadian production, which has fluctuated little in the past 50 years, has averaged about 50 million pounds.

Lake Erie fish production, on a poundage basis, continues to maintain itself. However, catch value is declining, which reflects change from high-value to low-value species.

High-value fishes--whitefish, cisco, blue pike, sauger, sturgeon, and northern pike--have virtually disappeared. Walleye and yellow perch are the major remaining species of higher and medium value. These populations are declining and show signs of difficulty in perpetuating themselves.

Stocks of less valuable species--freshwater drum, carp, suckers, and goldfish--are still abundant. With few exceptions, they are greatly underexploited.

There is great concern over the instability of year-class success and the sharp decline for western basin populations of walleye and yellow perch, the two most important to commercial and sport fishermen. Not since 1965 has either species spawned successfully, despite a large spawning population available for each species that developed from the strong 1965 year-class.

Some people have felt for years that the decline and disappearance of so many valuable species from Lake Erie were due to overexploitation. "Actually, the combination of overexploitation, environmental degradation, nd the introduction (accidental or otherwise) of exotic fishes such as sea lamprey, carp, and goldfish have all contributed together in some measure over the years to cause changes in the abundance of our valuable species. Yet the decline of the walleye and yellow perch today must be attributed in larger part to extensive deterioration of the environment. In this sense, the populations are in double jeopardy."

Research during the 1969 walleye spawning season tends to support BCF contentions that the degraded environment is a primary factor influencing the abundance of certain species in Lake Erie.

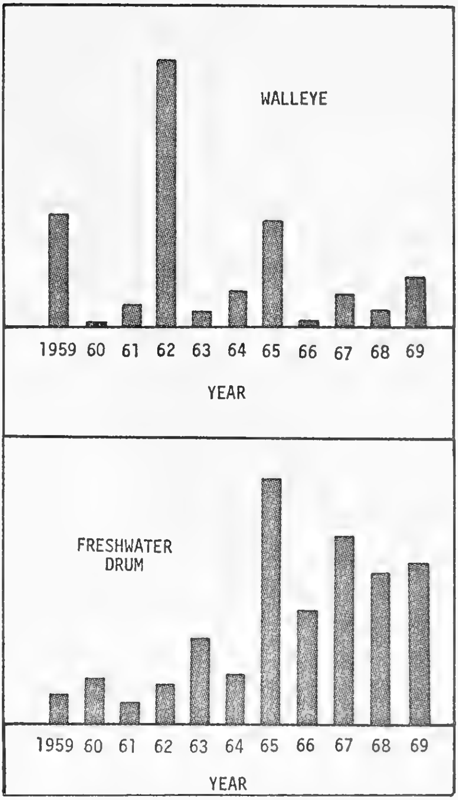


Fig. 4 - Here are shown the relative numbers of young-of-the-year walleye and freshwater drum (sheepshead) sampled with bottom trawls in Western Lake Erie at permanent index stations, 1959-69. The walleye, the last high value fish in Lake Erie, is in drastic decline with good hatches only every third or fourth year. Freshwater drum, on the other hand, are rapidly increasing in numbers and constitute a huge underutilized resource.

Introduction of Coho Salmon

Ever since 1870, researchers have stocked Lake Erie with several species of salmon fry. Their efforts failed. But the experimental introductions of yearling coho salmon in recent years appear successful. The newly coordinated coho program among the States began officially in spring 1968: 121,000 salmon were released in the tributary waters of Ohio, Pennsylvania, and New York. Plantings were continued in 1969 with the spring release of 230,000 yearlings and, again this spring, with another 545,000 fish. The technological advances over the past 15 years in raising coho salmon to yearling size (4-7 inches) have assured a better chance of success for current plantings.

These coho salmon reach adult size in the fall of the year following year of release. More often than not, they return to original release stream to spawn. Based on returns from 1968 stockings, the adults may range from 4 to 10 pounds. Because sufficient numbers are being caught by sport fishermen, the States plan to continue a hatchery and propagation program indefinitely.

However, important research information on these stockings is meager. Estimates of harvest of coho from the original 1968 stocking were about 10%. These catches represent sportsmen's landings and returns to weirs on spawning streams. The commercial fishery is prohibited from taking this species. Additional data suggest cohos move slowly about lake in clockwise direction during season. Actually, their midsummer distribution is restricted to colder and still-oxygenated waters on north side of eastern basin. Further degradation of oxygen regime in eastern basin eventually may place limits on Lake Erie's capacity to support this coldwater form.

Insecticides

BCF began monitoring insecticide residues in Great Lakes fishes about 5 years ago. In early 1969, the Food and Drug Administration announced that levels of DDT in Michigan coho salmon were dangerously high and exceeded the action level of 5 ppm. This prompted an immediate broader sampling of the Great Lakes. It focused on more important sport and commercial fishes. BCF was able to obtain considerable data in a few months.

Excepting Lake Superior, the levels of DDT and its derivatives and Dieldrin for Lake Erie fish are lower comparatively than in other Great Lakes. They fall well under action level of 5 ppm. Nevertheless, the problem is serious. In the past few years, growing concern about DDT buildup in the environment has led to bans on sale of these pesticides in several states.

The Mercury Crisis

The most recent environmental crisis in Lake Erie is mercury contamination of fish. On March 25, 1970, Canadian officials announced that levels of mercury in walleye, northern pike, and other species taken from Lake St. Clair were considerably above the 0.5 ppm action level set by Canada's Food and Drug Directorate. Later, they banned taking of fish for any purpose from Lake St. Clair and its tributaries. Immediately, U.S. public health and resource agencies became concerned about Lake Erie. Sampling programs were initiated. Since then, several hundred fish samples from Lake Erie-St. Clair areas have been examined by Federal and State agencies. As more data became available on fish taken from U.S. waters of Lake Erie, Ohio, Michigan, and New York began varying fishing bans.

Preliminary data from BCF sampling in Lake Erie show following ranges in mercury levels for certain fish from the western basin (the FDA tolerance level is 0.5 ppm): yellow perch (0.2 to 0.5 ppm), coho salmon (0.2 to 1.0 ppm), carp (0.1 to 0.8 ppm), white bass (0.3 to 1.5 ppm), channel catfish (0.3 to 0.6 ppm), freshwater drum (0.1 to 1.0 ppm), and walleye (1.0 to 3.0 ppm). An inspection of fish analyses by FDA shows most of their values within these ranges. Also, predator fish show higher values than forage fish. There are very little data from the eastern basin, but the mercury levels there are somewhat lower.

The consequences of mercury contamination have been tremendous. Sport and commercial fisheries have suffered considerable economic losses.

Conclusion

The environmental problems of Lake Erie are complex and discouraging. "And we certainly are in for further crises." Yet, BCF hopes that mounting national concern over fate of environment will generate greater urgency and support for all programs aimed at reducing degradation of Lake Erie's environment and its aquatic living resources. "Lake Erie is not dead. It can be saved if we all work together."

HARD-CLAM CULTURE METHOD DEVELOPED AT VIMS

A method of protecting hard-clam seed from natural enemies has been devised by scientists of the Virginia Institute of Marine Science (VIMS). "Aggregates"--shell, gravel, or other materials--are spread over sand or mud bottoms before planting seed. The aggregates protect seed clams from predators.

VIMS states: "Predators destroy nearly all unprotected clams smaller than one inch. The blue crab is the major predator in Virginia waters. Other crabs, boring snails, bottom-dwelling fish and waterfowl also take many clams. The hard clam (quahog) requires moderately high-salinity waters where these predators abound and often prevent natural reproduction from being successful."

Past Methods

In the past, experimental methods of protection included planting clams in screened trays or boxes; within fenced enclosures; under sheets of netting or hardware cloth; in saltwater ponds or tanks; and intertidally. However, reports VIMS, "these techniques are unreliable, expensive and cause silting and slow growth." So they have not been suitable for commercial use.

Spreading Aggregate

Scattering aggregate over bottoms or clam beds is a simple procedure. VIMS scientists believe that increased yields soon will pay initial cost of aggregate. There is no maintenance. The Maryland hydraulic escalator clam harvester automatically deposits buried shell on surface; so, if buried shell is available, harvesting clams will prepare beds for planting.

Besides boosting production from commercial beds, the new technique promises to encourage operations of clam hatcheries. Several now operate experimentally on Eastern Shore of Virginia, and elsewhere. VIMS states: "Hatcheries can offer an almost limitless supply of seed clams from selected, fast-growing parents. A major obstacle has been growing seed clams to usable size after they have been reared to setting. Holding millions of young clams in trays to avoid predators requires expensive handling, feeding, and cleaning operations. The use of aggregate makes it possible for these tiny clams to be grown on bottoms instead of in trays."

Fig. 1 - On left is fingernail size seed now planted by industry. On right is match-head size seed reared by hatcheries; these could be planted if protected with aggregate.

Tests With Hard Clams on Eastern Shore

In April 1967, experiments with aggregates began on seaside of Eastern Shore, where most hard clams are harvested in Virginia. During preliminary tests, scientists discovered 3 aggregates successfully protected small hard clams (Mercenaria mercenaria, also called Venus mercenaria). The three were: 1) crushed oyster shell, 2) crushed stone (as used in road building), and 3) stream bed gravel (sold as pea gravel).

An average of over 80% of the seed clams planted on these covers survived seasons when blue crab and other predators were most active. In two tests, more than 90% of the clams lived. In control plots, where clams were planted without aggregate protection, survival was about 16% but never over 30%.

Young clams of various sizes were grown in the VIMS Wachapreague Laboratory to serve as test animals. These ranged from $\frac{1}{25}$ to 1 inch--between extremely small seed not used by industry to fingernail size seed now planted.

Clams larger than match-head size survived best. Smaller clams, too mobile, would leave protection of aggregate and become exposed to predators. This moving, explains VIMS, is possible because the clam, unlike oyster, retains its foot after setting. In some tests, however, even clams as small as $\frac{1}{25}$ to $\frac{1}{5}$ inch survived in acceptable numbers in some plantings.

VIMS Recommendations

VIMS offers these suggestions to clammers wishing to start trial plantings with aggregates.

1. Select cheap and plentiful aggregates. Almost any aggregate can be used.

2. Before buying in bulk, test to see if aggregate particles are:

a. heavy enough to sink and remain on bottom.

b. small enough to pack well

3. Spread aggregate 1- to 3-inches thick over clam-planting area when using coarse materials (uncrushed shell), and one to two inches when using fine materials (pea gravel, crushed stone, or crushed shell). Level aggregate by dragging 4-ft. section of cyclone-type fencing over area.

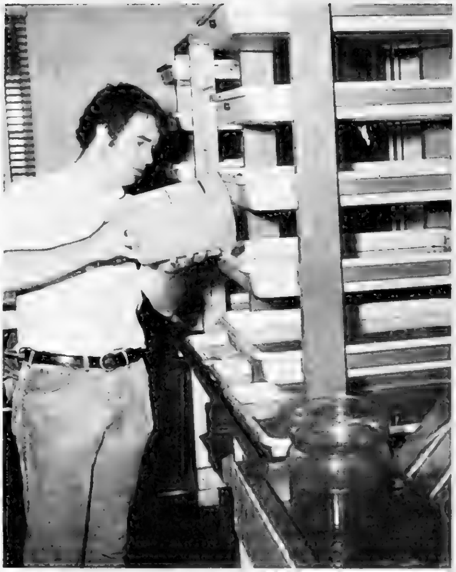


Fig. 3 - Young clams of various sizes were grown in VIMS Washapreaque Laboratory to serve as test animals in experiments with aggregates. Many trays of clam larvae were spawned, cultured, and maintained by VIMS scientists and technicians.

Fig. 2 - Three aggregates that successfully protected small clams from predators. Top left, crushed oyster shell. Top right, pea gravel. Bottom, crushed stone.

4. Scatter seed clams evenly over aggregate at rate of about 25 to 50 per sq. ft. The clams will burrow through aggregate and into bottom. It is important that you do not overplant because crowded clams will move away from each other--and possibly out of protected area. If too crowded, they will not grow as fast because of competition for food and space.

5. Aggregate can be put on bottoms any time. Clams should be planted when active--when water temperature is 48° F. or higher. Clams will burrow under aggregate in short time at higher temperatures. Plant at slack tide to avoid excessive clumping or scattering of clams.

△ △ △ △ △ △ △

RADIOECOLOGY: NEW TOOLS YIELD ANSWERS TO OLD PROBLEMS

Gary Milburn

Radioactivity is not new to our planet. It has been here since the earth was formed. Manmade radioactivity, in the form of nuclear fallout, appeared 25 years ago when the first atomic bomb exploded. In the northern hemisphere, about 60 percent of this radioactive material falls into the ocean (about 60 percent of the earth's surface in our hemisphere is covered with water). Additional fallout is leached from the soil and carried by rivers to estuaries and the ocean.

More recently, as man has learned to use atomic energy for peaceful means, radioactivity has become a waste product of nuclear power plants, and nuclear fuel production plants. Although the radioactive wastes from nuclear power plants are very carefully controlled, some radioactivity is released into the rivers that supply the water required by the reactors. For example, the Hanford Atomic Production Plant in Washington State releases radioactivity directly into the Columbia River. Much of this radioactivity is carried to the Pacific Ocean 350 miles downstream.

This radioactivity, whether from fallout or from reactor effluents, eventually enters the marine environment, where it is cycled continuously through sediments, water, plants, and animals. What happens to these materials? Are they accumulated by fish or other animals to a level that might be harmful to the animal or to man?

BCF Beaufort Research

To answer these and other questions, scientists at the BCF National Center for Estuarine and Menhaden Research, Beaufort, North Carolina, directed by Dr. Ted Rice, are studying the movements of these radioactive materials in the estuarine environment. The purpose of their research is twofold: (1) to determine the fate of radioactive elements released into the estuarine environment and the effect of this radioactivity on estuarine plants and animals, and (2) to develop and apply radioisotopic methods to studies of estuarine ecology. The laboratory also evaluates the radio-biological effects of the construction and operation of nuclear reactors on fishery resources. The work is jointly sponsored by BCF and Atomic Energy Commission.

Emphasis is placed on estuarine areas because fishery scientists have found that the bays, sounds, and associated nearshore areas that surround our coasts are among the world's most productive areas. Estuaries provide essential living space for more than 70 kinds of fish and shellfish that contribute 3 billion pounds, or two-thirds, of the total U.S. commercial fishing catch. Seven of the ten species most in demand, including shrimp, our most valuable fishery, and menhaden, our largest fishery, must have suitable estuarine nurseries.

The author is staff writer/editor, BCF National Marketing Services Office, 100 E. Ohio St., Rm. 526, Chicago, Illinois 60611.

Radioecology

Dr. Thomas Duke, chief of BCF's Pesticide Field Station, Gulf Breeze, Florida, explains: "The study of radioactivity in our environment and the use of radioisotopes in ecological studies is called 'radioecology'. The term is composed of two words, 'radio' which refers to radioactivity, and 'ecology' which is derived from the Greek 'Oikos', meaning 'house' or 'place to live'." Ecology is usually defined as the study of plants, animals, and other organisms and their relationship to their environment.

Research Results

The scientists have found that some organisms are 'biological indicators' of radioactivity in the environment because of their affinity for certain elements. For example, oysters accumulate zinc 65; scallops, manganese 54; clams and mussels, cerium 144; and tuna, iron 55. The oyster concentrates zinc to about 100,000 times its normal concentration in sea water. Because of the oyster's ability to concentrate radioactive elements, scientists were able to detect increased levels of radioactivity in oysters within 8-12 days after the Chinese nuclear tests!

Radioactive elements act essentially the same as their nonradioactive counterparts when released into the marine environment. Therefore, if radioisotopes are present in the environment, the organisms will be unable to distinguish them from nonradioactive forms, and the radioisotopes will be accumulated also.

Whither Radioactive Elements?

The fate of radioactive elements in the estuarine environment depends upon the route they take. Radioactive elements can remain in solution or settle to the bottom. Laboratory studies have shown that organisms accumulate radioactivity in different way: plants accumulate radioactivity directly from water; clams and oysters by feeding on suspended material that contains radioactivity; large fish, such as tuna, by feeding on other animals that are radioactive. Thus, radioactive elements are detectable in marine organisms, even though their concentrations in sea water are generally too low to measure.

Effects On Organisms

How do these radioactive accumulations affect these organisms? To determine the effects of radioactivity on the body chemistry and shapes of plants and animals, BCF scientists began carefully controlled experiments. They found that radiation interacts with salinity and temperature to affect survival, growth, and body shape of estuarine organisms. In one experiment, brine shrimp exposed to low-level radiation grew faster, were more uniform in size, and reached sexual maturity more quickly than those not exposed to radiation. In another study, young fish exposed to low-level radiation were longer and deeper bodied than those exposed to more radiation or to no radiation. Low levels of radiation actually made these animals healthier and bigger!

Further studies showed that many estuarine organisms, such as clams and oysters, could tolerate extremely high doses of radiation. The fatal radiation dose for oysters was approximately 300 times the fatal dose for white mice. The fatal dose for clams was 220 times that for white mice. Mammals (including man) are much more sensitive to radiation than most estuarine organisms. Therefore, it is generally assumed that so long as environmental radioactivity is safe for man, other animals will not be endangered.

Other Uses for Radioisotopes

In the course of their work, the scientists found other uses for radioisotopes. These isotopes (tracers) have been particularly valuable in studying the food and feeding habits of clams and oysters. Says Dr. Duke: "Before radioisotopes became available, it was difficult and time consuming to compare the suitability of different kinds of phytoplankton (minute plants that float in water) as food for oysters and clams. Some of the plants consumed by these animals are used for nutrition. Others are quickly discarded without being used. To test the nutritive value of different types of phytoplankton, these plants are labeled with radioactive elements and then fed to oysters and clams. After several hours the animals are dissected. The muscles that control the opening and closing of the shell are removed and analyzed for radioactivity. If radioactivity from the labelled plants appears in the muscle, then the phytoplankton was presumably used for nutrition by the animal."

Many of the experiments were done on animals held in the laboratory. Dr. Duke adds: "To better understand how radioactive materials move through the aquatic ecosystem, experiments ideally should be conducted in the natural environment, such as a sound or bay. For obvious reasons, however, the natural environment cannot be made radioactive for such studies."

To avoid contaminating the environment, experiments are conducted in a 40 by 60 foot salt-water pond in which a marine habitat is simulated. Several kinds of fish, crabs, and marsh grasses, along with oysters, clams, and snails, are placed in the pond. By introducing certain radiosotopes and using sensitive instruments, scientists can follow these materials as they are carried throughout the pond.

In one experiment, DDT, labeled with radioactive carbon, was traced through several steps in the food chain. Such studies enable scientists to explain how DDT moves in the aquatic environment and how organisms acquire DDT concentrations.

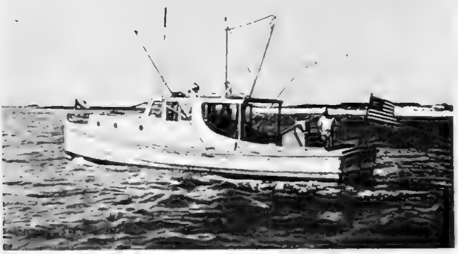
The scientists discover new research possibilities in the field of ecology as new radioactive materials become available. Instruments that measure radioactivity are highly sensitive. The application of radioactive tracers to problems beyond the range of standard methods has been possible.

BCF scientists are aware that radioecological studies will become more important as radioactivity in our environment increases.

BCF'S CENTER FOR ESTUARINE AND MENHADEN RESEARCH

A 1968 reorganization combined BCF's Biological Laboratory at Gulf Breeze, Fla., and Radiobiological Laboratory at Beaufort, N.C. The title of the combined labs was the National Center for Estuarine Research. In 1969, another reorganization combined the National Center for Estuarine Research with the Beaufort Biological Laboratory creating the Center for Estuarine and Menhaden Research.

The Gulf Breeze Laboratory was concerned with pesticides and the Beaufort Laboratory with radioactivity. The consolidation of the 2 labs strengthened research and facilitated solving problems on estuarine pollution, since radioactive material and pesticides have similar effects on some plants and animals.



This boat catches and transports live animals to the laboratory.

Research of the Center is concerned with: (1) fate of radioactive materials and pesticides in estuarine environment, (2) effect of radiation and pesticides on marine organisms, (3) application of radioactive tracer techniques to fishery biology, (4) effects of pesticides on the ability of marine organisms to survive, grow, and produce, and (5) cycling pesticides through water sediments and food chains of the estuary.

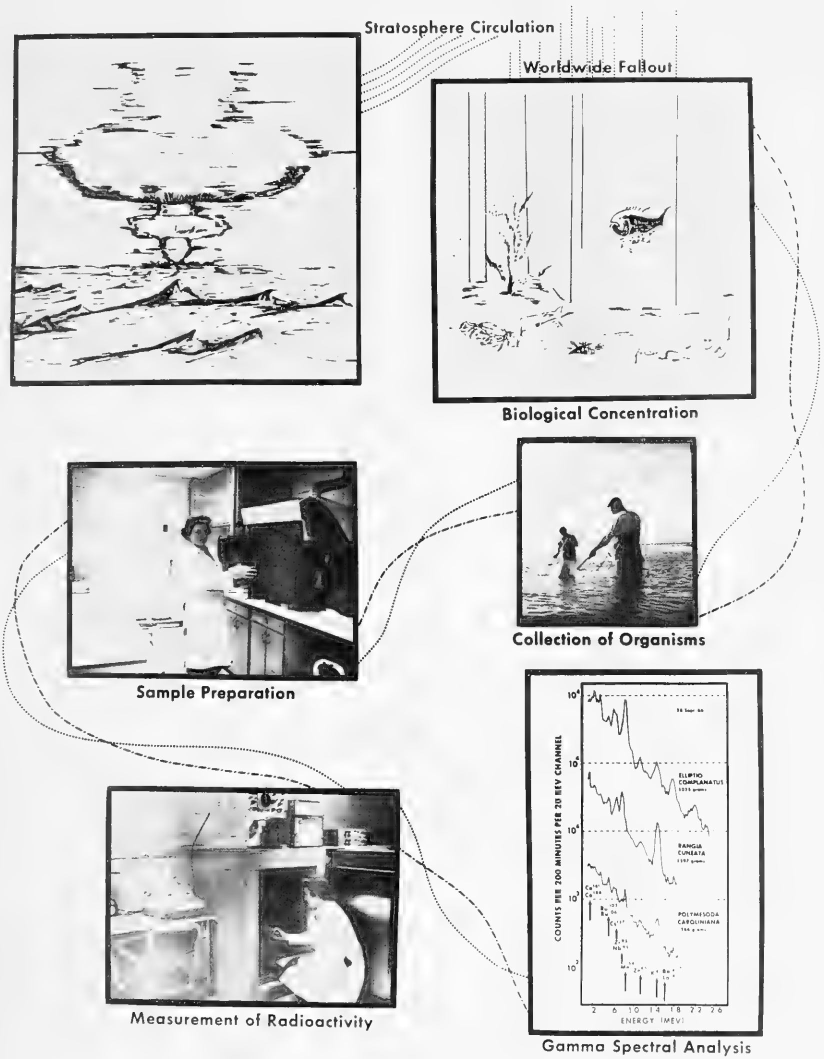
These approaches are used to tackle the problems of radiation at the Beaufort Lab: (1) data are collected in the lab to predict the fate of radioactive materials, (2) tanks and ponds are used to test questionable findings obtained in the lab, and (3) cycling of radioisotopes is observed in certain natural bodies of water, restricted from the public. The Laboratory believes that data collected by these three approaches, when integrated and correlated, make for a better understanding of the role of plants and animals in cycling of radioactivity in estuarines and marine areas.

Past significant accomplishments with pesticides by the Gulf Breeze Laboratory include: (1) determination of acute toxic effects of 200 formulations of pesticides on oysters and shrimp, and other organisms under controlled conditions in the laboratory. This information was passed on to the Pesticide Registration Board to assist them in labelling procedures. (2) Analysis of over 5,000 samples as part of nationwide monitoring program to determine levels of pesticides in fish and shellfish; (3) investigation of the effect of MIREX, a chemical used to control fire ants in the southeast, on estuarine organisms; and (4) discovery of occurrence of PCB (polyclorinated biphenyl) in seafood organisms in local area, located and stopped source.

The Center for Estuarine and Menhaden Research will lose the Gulf Breeze facility, if the President's reorganization plans become effective. The Lab will become part of an independent agency called the Environmental Protection Agency. (BCF Circulars 298 and 309.)

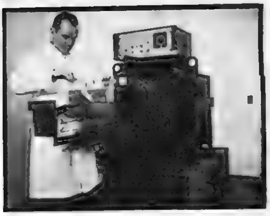
(See photo spread following pages.)

Monitoring Fallout Radioactivity in Estuarine Organisms



Radioactive materials are added to the estuarine environment through fallout from the explosion of nuclear weapons. These mateials often are accumulated and concentrated by seafood organisms. As part of a program to study the biological concentration of fallout radioactivity by estuarine organisms, investigators collect organisms in the natural environment and take them to the laboratory for analysis. The amount and type of radioactivity in the organisms are measured with specially designed electronic equipment. The radioactivity content of some fresh-water and estuarine clams is shown in gamma spectral analyses.

STUDYING EFFECTS OF RADIATION



USING COBALT 60 IRRADIATOR

INSERTING FISH INTO IRRADIATOR

IRRADIATING MARINE ORGANISMS WITH COBALT 60

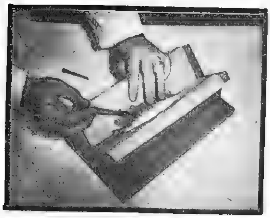
BIOCHEMICAL DETERMINATIONS

MEASURING TOTAL ELEMENT

MEASURING RESPIRATION

DETERMINING PROTEINS

ON ESTUARINE ORGANISMS



REMOVING BLOOD

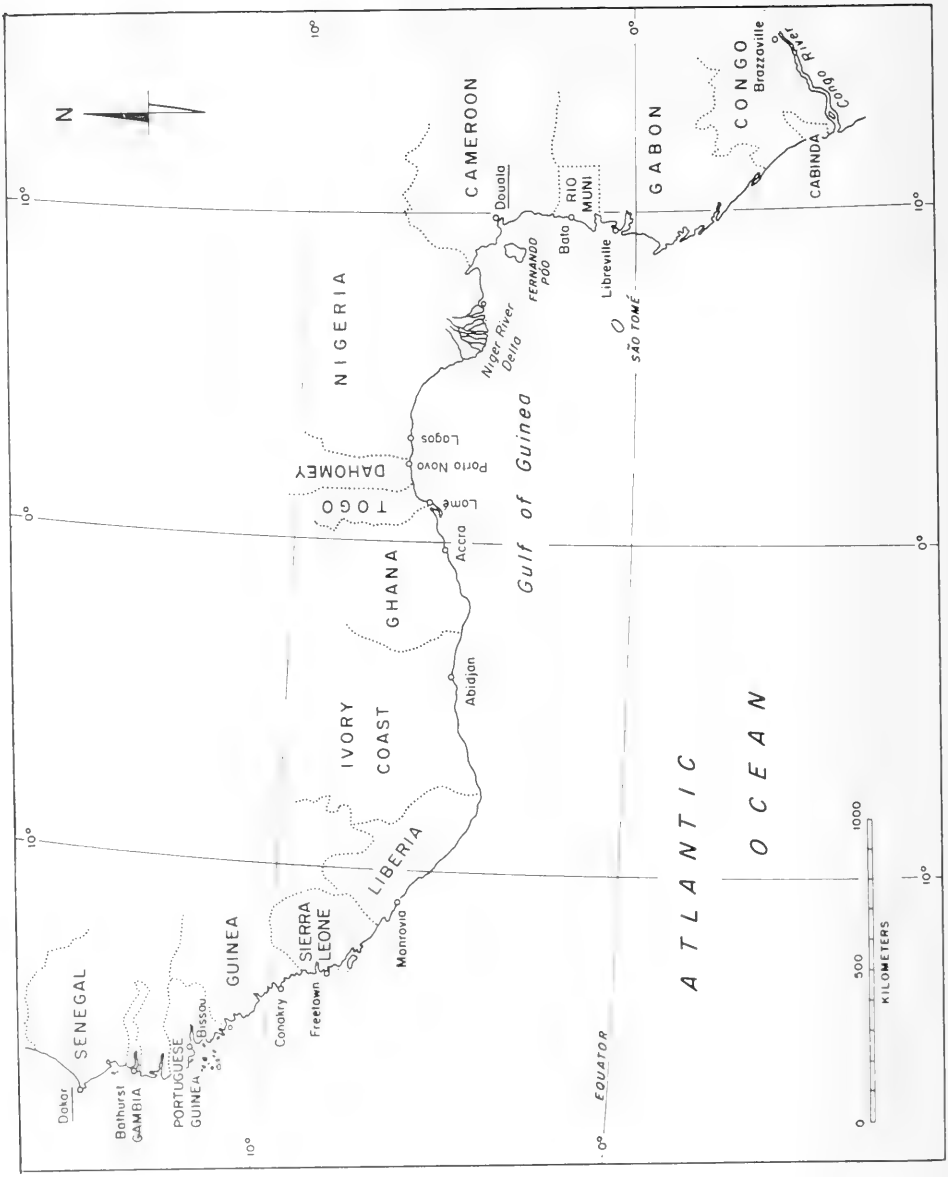
The effect of ionizing radiation on estuarine organisms is studied at the Radiobiological Laboratory. Organisms are exposed to gamma radiation from a cobalt 60 source which is contained in a specially built irradiator. After exposure to radiation, the organisms are subjected to various biochemical and cellular tests. Often, radiation-induced physiological changes occur first in the blood.

CELLULAR CHARACTERISTICS

COUNTING CELLS

MEASURING PACKED CELL VOLUMES

DETERMINING CELL TYPES



Map of West Africa.

THE COMMERCIAL SHRIMP POTENTIAL IN WEST AFRICA DAKAR TO DOUALA

Norman L. Pease

The increasing demand for shrimp for human consumption has created worldwide interest in using unexploited stocks. This interest is particularly evident in tropical and semitropical zones, where the right combination of environmental conditions can produce and support large populations of this highly prized crustacean. The West Coast of Africa is one such area.

Recently, countries in this area have become aware that they might have offshore shrimp resources that could be harvested to start a new industry. The African Development Bank (ADB), headquartered at Abidjan, Ivory Coast, is alert to these possibilities and has established a development program. ADB requested the Food and Agriculture Organization of the United Nations (FAO) Investment Center at Rome, Italy, to recruit someone to make a 3-month preliminary survey on the present knowledge about these shrimp resources.

The survey objectives were: (1) to ascertain biological information on shrimp from local research centers, (2) to determine the interest of existing commercial fishing companies in fishing for shrimp, and (3) to prepare an outline for a shrimp-resource survey. The writer made this survey during February-April 1969. This article was extracted from the report.

Marine research expanded in West Africa during the last decade. Most of it was directed toward implementing the harvest of finfish for local consumption; however, some shrimp research was conducted.

In 1966, Monod described shrimp species of West Africa and, in 1967, Crosnier, deBondy, and Lefevre identified 11 species believed available in commercial quantities:

Penaeus (M.) kerathurus (Forskal)
Parapenaeopsis atlantica Balss
Penaeus (M.) duorarum notialis Perez Farfante
Parapenaeus longirostris (Lucas)
Solenocera membranacea (Risso)
Plesionika williamsi Forest
Plesionika martia (A. Milne Edwards)
Aristeus varidens Holthius
Plesiopenaeus edwardsianus (Johnson)
Glyphus marsupialis Fihol
Parapandalus narval (Fabricius)

Mr. Pease is Supervisory Fishery Biologist, BCF Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi 39567.
Contribution No. 211.

Fig. 1 - The 'President Kennedy,' a training and research vessel built in U.S. for Ivory Coast, at dock in Abidjan. It was a joint Ivoirian-US AID enterprise. It is being used now in an FAO sardine project.

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Reprint No. 882

The first three species are found primarily within 50-fathom depth range; the other 8 between 50 and 400 fathoms.

FISHING CRAFT AND FISHERMEN

Throughout the world's tropical zone, natives traditionally use dugout canoes for fishing. In West Africa, canoe fishing employs many people and is important to the local economy. The canoes used in the marine fisheries are 25 to 50 feet long, cost \$50 to \$100 each, are made usually of soft wood because of its buoyant quality, and have an average useful life of about $1\frac{1}{2}$ to 2 years. Outboard motors have been introduced but, because of their cost, are beyond the reach of most fishermen, who depend on a combination of sails and paddles.

An example of this fishery has been compiled by the Nigerian Federal Fisheries Service in a study of a typical coastal village of about 1,000 inhabitants. Of about 300 adult men, 280 are all-season fishermen. During the dry season, January to May, about 80 additional fishermen are attracted to the village from the neighboring countryside because of the high prices paid for fishery products. Working from this village are 180 canoes, usually two men to a canoe. They use a variety of gear, including cast nets, traps, set nets, seines, and hooks.

Most of their effort is for finfish. However, juvenile shrimp (Penaeus duorarum notialis) are caught in the estuaries during nocturnal ebb tides by a net stretched between anchored canoes. The most productive fishing is during March and April, when the average daily shrimp catch per canoe is about 50 pounds. (Shrimp weights given are heads on, unless specified otherwise.) Assuming that at least 100 canoes from the village fish each day, the total shrimp catch would be about 2.5 tons per day during the peak production period. During the rainy season, the shrimp catch decreases, but the Federal Fisheries Service estimates that this village catches about 400 tons of shrimp per year. When this catch is multiplied by numerous similar villages throughout West Africa, the combined catch of juvenile shrimp must be impressive.

Fig. 2 - A pompanolike fish, Lichia sp., on sale in Abidjan, Ivory Coast. In 90° F. and above temperatures, and refrigeration or ice lacking, fresh fish must be sold quickly.

Spaniards Fishing Since 1950s

A Spanish fishing fleet has been dragging off West Africa for deepwater species of shrimp since the early 1950s. Parapenaeus longirostris and Plesiopenaeus edwardsianus are the major part of its catch. The vessels are 100 to 170 feet long, powered by 600- to 900-horsepower diesel engines, have freezing capacity of 45 to 180 tons, and usually carry 20 to 30 men. Shrimp trawls of Spanish design, with footrope lengths between 197 and 310 feet are used; however, catch rate does not increase in direct proportion to increase in footrope length. The best depth range for dragging varies between species, and between seasons of the year. Variations in catch rate have been observed between day and night drags and phases of the moon. Dragging normally is carried out round the clock; individual drags last between 3 and 5 hours (table). The vessels stay on the shrimp grounds 7 to 9 months and, approximately once a month, are supplied by a vessel from Spain, to which they transfer their catch.

Catch Data from a Spanish Shrimp Vessel							
Date	Drag Began	Drag Ended	Depth Fished	Catch of Heads-on Shrimp		Catch per Hour	
1968			Fathoms	kg.	lb.	kg.	lb.
12/19	0500	0930	136	235	517	52	114
"	1030	1430	136	250	550	62	136
"	1515	1900	136	154	339	40	88
12/20	0500	0945	140	231	508	48	105
"	1030	1330	140	190	418	63	138
"	1445	1830	140	150	330	40	88
12/21	0500	0900	130	150	330	37	81
"	0945	1445	130	150	330	30	66
12/22	0400	0830	210	300	660	66	149
"	1100	1600	210	250	550	50	110
"	1630	2030	210	275	605	68	150
"	2100	0200	210	300	660	60	132
12/23	0515	0915	120	200	440	50	110
"	1030	1430	120	250	550	62	136
"	1510	1910	120	300	660	75	165
"	2100	2400	120	300	660	100	220
12/24	0600	1000	212	375	825	93	215
"	1030	1430	210	450	990	112	246
"	1500	1900	210	400	880	100	220
"	2100	0100	210	350	770	87	191
12/25	0500	0900	212	400	880	100	220
"	0930	1430	212	450	990	90	198
"	1500	1915	210	300	660	70	169
"	2000	2400	210	250	550	62	136

SHRIMPING BY SOME WEST AFRICAN COUNTRIES

During the survey, I visited 8 countries and discussed shrimp resources with personnel of either national or international research organizations. I talked to owners, managers, and captains about local commercial fishing. They helped compile the following information.

SENEGAL

Commercial fishing for shrimp is more developed in French-speaking Senegal than in any other West African country. Its total coastline is about 275 miles. (All distances are given in nautical miles.) Its Continental Shelf is 10 to 50 miles wide. In 1967, shrimp production was 1.9 thousand short tons.

An organized canoe fishery has flourished since 1960, when 120 tons of young estuarine shrimp were produced for export. By 1968, this catch had increased to nearly 900 tons. Most of this production comes from the Casamance River system, which has nearly 1,000 fishermen at the height of the season. The Saloum and Senegal river systems contribute to this production. The fishery is active all year, but May through July is the peak production period.

Shrimp catches in offshore waters for adult Penaeus duorarum notialis began incidental to fish catches in 1963. For the next few years, several trawlers spent part of the year catching shrimp exclusively. Trawlers designed for shrimping began to appear in 1967; 28 vessels were shrimping actively in 1968. They work primarily in two areas off the coast--Dakar north to St. Louis, and Dakar south to Cape Roxo.

North of Dakar, shrimping is conducted on mud bottom in 15 to 40 fathoms. The normal season begins in November and ends in April or May. Catch rates in 1966-67 season averaged 350 to 750 pounds per day. Some highline vessels were able to double the production of average vessel.

South of Dakar, the fishing is also seasonal; the highest production is between December and July. This region has been more productive than northern one. Catches up to 1 ton have been made in 6 hours of dragging. Daily average catch rates have ranged from 450 to 1,600 pounds.

Dakar, the capital, has a population of 375,000. Its large port has over 6,500 feet of dock space for trawlers, and almost 1,300 feet for tuna vessels. Ice-producing capacity is 180 tons per day; plans are being made to double this. Diesel fuel for fishing vessels is not taxed and costs 16 cents per gallon. Fishing vessel regulations, enforced by Department of Fisheries, prohibit wooden vessels older than 15 years, and steel vessels older than 20. Annual fishing permits cost $40 per gross ton. Also, Senegalese-registered vessels pay a tax of $0.01 per ton of landed catch, and non-Senegalese vessels pay 13% of catch value.

The life cycle of the shrimp of Senegal are being studied jointly by a biologist of the Department of Fisheries and two biologists of the French research organization, Office de la Recherche Scientifique et Outre-Mer (ORSTOM).

SIERRA LEONE

Commercial fishing is relatively undeveloped. The only activities are the local canoe fishery, which includes shrimp, a tuna-transhipment facility, and 9 local small bottom trawlers. In the port of Freetown, the capital with a population of 128,000, dock space for fishing vessels is limited to 130 feet at the tuna facility. The 9 trawlers unload into canoes while at anchor.

The country has 3 large estuarine areas that should produce shrimp in commercial quantities. Its coastline is approximately 200 miles; its Continental Shelf varies from 22 to 75 miles wide.

The official language is English.

LIBERIA

Commercial fishing is conducted by two private companies that charter foreign-flag vessels. These catch shrimp incidental to fish--but do not attempt to catch shrimp exclusively. As a result of 2 months of exploratory shrimp fishing, one company is building 4 shrimp vessels for use this year.

A canoe shrimp fishery supplies fresh shrimp to local market. Best production is in spring, although catch statistics are not maintained.

Liberia's coastline is about 285 miles; its Continental Shelf 15 to 35 miles wide. Monrovia, with a population of 81,000, is the capital and major port. There is limited dock space for fishing vessels, but adequate waterfront space for more docks. Fishing-vessel licenses are $150 per vessel; diesel fuel is 15 cents per gallon.

English is the official language.

IVORY COAST

Three large estuaries provide excellent nursery areas for shrimp in Ivory Coast. The canoe fleet catches juvenile shrimp almost all year; in 1968, it caught nearly 400 tons.

Offshore commercial fishing for shrimp is very limited. At present, two trawlers drag for shrimp during July to October, the season of highest production. Their production, plus the incidental shrimp catch from fish trawlers, was: 1964--160 tons; 1965--145 tons; 1966--155 tons; 1967--171 tons.

Ivory Coast has 280 miles of coastline; its Continental Shelf is 10 to 16 miles wide. Abidjan, the capital of this French-speaking country, has 180,000 persons. At the turn of the century, it was a fisherman's camp; now it is an important industrial and commercial fishing port. The fishing vessel dock is being extended. A cold-storage plant will be built in the fishing port complex. It will have a blast freezing capacity of 90 tons per day, and a holding capacity of 3,000 tons.

Fig. 3 - The open-air auction shed at the fishing port in Abidjan, Ivory Coast. Minimum prices are fixed by law for fish landed by local fleet.

The government recently granted permission for three French/Ivoirian fishing companies combined to introduce not more than 10 shrimp vessels during the next 3 years. The companies have agreed to pool their resources and build a modern shrimp-processing plant.

The Ivoirian Fisheries Service is cooperating with a private French/Japanese venture in shrimp mariculture. Two large cement tanks, built several years ago on the coast east of Abidjan by the Fisheries Service; are being loaned for the shrimp-farming experiment.

Two biologists on the ORSTOM staff at Abidjan are studying distribution of offshore shrimp stocks. They use the laboratory's 82-foot research vessel 'Reine Pokou' to make sampling drags between 10 and 100 fathoms about once a month.

GHANA

Ghana, an English-speaking country, has a coastline of about 280 miles, and a Continental Shelf 15 to 40 miles wide. It is one of the most aggressive commercial fishing countries in West Africa; Ghanaians are among the most expert fishermen. Over the years, many emigrated to other West African countries to establish local fisheries. Thirty-foot motorized vessels were first introduced into Ghana in 1952; a 75-foot-and-above class appeared in 1962. By 1967, the offshore fishing fleet had grown to 439 vessels, and the estuarine fleet to 10,000 canoes.

With the introduction of larger vessels, fish production increased dramatically: from nearly 30,000 tons in 1961 to 115,000 tons in 1967. The major part of the catch is processed in manmade port of Tema, 20 miles east of Accra, the capital. Tema has 3,400 feet of dock space, a small boatyard, and limited vessel-repair facilities. The Tema-Accra area has 13,000 tons of cold storage space and produces 100 tons of ice per day.

Shrimp are taken in the estuaries by canoe fishermen and are caught incidentally in offshore fish trawling. Two fishing companies are planning to acquire new or converted vessels for catching shrimp exclusively.

The Ghanaian Fisheries Service conducts biological research and fishermen training programs. Most research is devoted to finfish because of their importance to the economy. Shrimp catch statistics are not collected. A biologist on the staff of a UN Special Fund Program at Tema has been sampling periodically offshore shrimp stocks. He plans to expand this work after he receives some needed vessel equipment.

TOGO

Togo's 40-mile coastline and its narrow Continental Shelf (15-20 miles wide) place a natural limitation on development of an offshore shrimp fishery. However, Togo has an estuarine canoe fishery for shrimp. The Department of Fisheries told me that the channels connecting the estuaries to the sea become closed by sediment during the dry season. This traps the juvenile shrimp effectively and creates a favorable situation for the canoe fishermen. With the rainy season, the increased flow of water reopens the channels and permits the normal shrimp life cycle to continue.

Lomé, the capital of this French-speaking country, has a population of 80,000. It has a manmade harbor for general cargo, but it does not have a fishing port. The West German government helped draw up plans to construct a fishing port about a mile east of the existing port.

Fig. 4 - Boiled, whole shrimp and live crabs at a fish market in Lomé, Togo. The shrimp are juvenile pink shrimp, *Penaeus duorarum notialis*, caught by canoe fishermen in local estuarines. This type of marketing is seen throughout West Africa.

The Togo Department of Fisheries, established in 1963, now has a program to determine the cyclical abundance of estuarine shrimp. A West German Fisheries Assistance Program operates two research vessels in fish trawling explorations. Recently, they made good catches of shrimp, incidental to fish trawling in 20 to 25 fathoms. They are constructing a shrimp trawl for a concerted effort to determine shrimp abundance.

NIGERIA

The commercial fishing industry is well established. Demand for fishery products is high. The availability of shrimp in offshore waters was determined several years ago when 28 vessels dragged for shrimp. During the recent civil war, most productive shrimp grounds off Niger River Delta were closed, and nearly half the vessels moved to other shrimp grounds. Fifteen shrimp vessels were restricted to working only the extreme western coastal area. This has resulted in a drop in landings, although comparative production figures are not known. The following shrimp landings by the 15 vessels for 1968 were collected by the Federal Fisheries Service. These indicate the seasonal production trend:

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Tons (short)	47	56	64	58	114	56	62	35	27	33	25	27	604

Nigeria has about 500 miles of coastline, and its Continental Shelf is 15 to 35 miles wide. Lagos, capital of this English-speaking country, has 675,000 persons. It is the largest port facility. Private fishing companies own about 2,000 feet of dock space. Cold storage space, fuel, water, ice, and repair facilities are available. State-owned dock facilities are not available, although plans have been prepared to construct a modern, centrally located fisheries terminal. Four additional ports are available: Pt. Harcourt, Calabar, Sapele, and Warri.

The Federal Fisheries Service has about 200 employes working on marine and freshwater (Lake Chad) projects. Three biologists in Lagos have been working exclusively on marine shrimp research. The Fisheries Service has a 70-foot, steel-hulled vessel for biological and oceanographic research. Shore facilities in Lagos include laboratories, behavior study tanks, a reference collection of local marine fauna, and a library well stocked with current research publications.

Fig. 5 - Part of the fleet of 42 sardine seine vessels in Abidjan, Ivory Coast. Vessels are licensed and the number strictly controlled by Fisheries Division.

CAMEROON

Cameroon, a French-speaking country, received its name from Portuguese explorers who found cameroes (shrimp) schooling abundantly off the coast. Until recently, however, shrimp have not been important in local commercial fisheries. The country has a coastline of 185 miles with a Continental Shelf 15 to 35 miles wide. Douala, the major port, has a population of 190,000.

Five fishing companies operate in Douala; of these, two now process shrimp and are preparing to catch and process shrimp on a larger scale. Several foreign-flag vessels are catching shrimp for one of the companies.

In a trip completed during my visit, one of these vessels, dragging two 37-foot beam trawls, averaged 800 to 1,000 pounds of shrimp per day. This catch, when graded, comprised two sizes: 15/20 and 40/50 per pound (heads off).

The second company used a 75-foot vessel on a shrimp exploratory survey within the 50-fathom contour. As a result, the company has ordered eight 72-foot shrimp vessels. It also is building a shrimp processing and freezing plant complete with machine and welding shops, radio room, parts storage, and offices.

About 540 feet of dock space are available for fishing vessels in Douala. Unused waterfront space is conveniently located for dock expansion, although dredging would be required.

There is no marine fishery research in Cameroon. Personnel from ORSTOM, Pt. Noire, Congo Brazzaville, have made dragging transects in Cameroonian waters.

CONCLUSIONS

The estuarine fishery for juvenile shrimp in West Africa indicates that shrimp breed there in substantial quantities. Life cycle studies of P. duorarum duorarum in the United States revealed that, when the shrimp reached adult stage, they migrated from estuaries to coastal waters, where they completed their life span. Generally, they stayed within the 50-fathom contour.

Evidence from limited studies in West Africa suggests P. duorarum notialis has a similar life cycle. Evidence shows possibility of expanding shrimp fishery to at least double present level, but it is inadequate to determine full development. This limits amount shrimp-fishing companies are willing to invest in relatively sophisticated shrimp catching and processing equipment required to promote export-oriented operations. Some expansion of shrimp fishery can be foreseen, but further developments would be facilitated greatly if more reliable information, based on a comprehensive scientific survey, were available.

It is apparent, too, from biological sampling of research programs in West Africa, and from fishing by Spanish shrimp fleet, that deepwater shrimp also are available. Again, information is lacking on their distribution and availability. Operational costs of offshore fishing generally are greater than those of inshore fishing. Also, operational techniques and gear requirements differ for inshore and offshore fishing. This type of information should be provided to fishing companies interested in the fishery.

To provide this information, exploratory fishing operations will be necessary. Objectives would be to define seasonal availability and distribution of shrimp resources and their potential for commercial use, and to provide estimates of abundance of major species and of their potential annual yield.

Shore facilities, which would be adequate for a thriving shrimp industry, vary considerably from country to country. Docks, shrimp processing plants, ice plants, vessel maintenance shops, and dry docks ultimately will have to be expanded or built in all potential major shrimp-processing centers. Fishing centers such as Dakar, Senegal, and Lagos, Nigeria, are equipped for shrimp processing--but all other major ports will require one or more of the facilities listed above.

Shrimp vessels will have to be built or brought from other areas to make up the required fleet. Most of existing fishing fleet was not designed for shrimping; many are small purse seiners underpowered for dragging operations. The requirements for deepwater shrimp vessels would be rigorous; this type of vessel also would have to be introduced.

Undoubtedly, the potential for development of the shrimp industry in West Africa is tremendous. Its growth will have a significant economic impact on the entire area before the next decade ends. All recent technological advances in the shrimp industry--including harvesting, processing, and merchandising--should be used to fully utilize these latent resources.

BIBLIOGRAPHY

CROSNIER, A.; E. DeBONDY; and S. LEFEVRE
1967. Commercial shrimps of the tropical West African coast. Office de la Recherche Scientifique Outre-Mer, Paris, Initiations-Documentations Technique, (7): 60.

_____ and J. J. TAUTER
1968. Notes on the Spanish shrimp fishery along the coast of Congo and Angola. Office de la Recherche Scientifique et Technique Outre-Mer, Centre de Pointe-Noire, Oceanographic Document No. 422 S.R., 7 p.

DiPALMA, SALVATORE
1968. The fisheries of Cameroon, 1967. U.S. Fish and Wildlife Service, Foreign Fisheries Leaflet No. 169, Washington, D.C., 5 p. (mimeographed).

FARFANTE, ISABEL PEREZ
1969. Western Atlantic shrimp of the genus Penaeus. U.S. Fish and Wildlife Service, Fishery Bulletin, Vol. 67, No. 3, x + p. 461-591.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
1968. Catches and landings, 1967. FAO Yearbook of Fishery Statistics. Vol 24, 408 p.

FEDERAL FISHERIES SERVICE
1967. Annual report, Nigeria. 38 p.

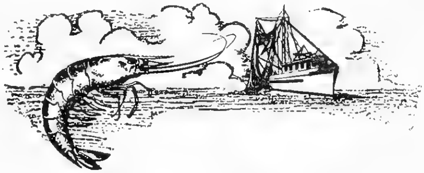
KRISTJONSSON, HILMAR
1968. Techniques of finding and catching shrimp in commercial fishing. FAO (Food and Agriculture Organization of the United Nations) Fisheries Reports, No. 57, Vol 2, pp. 125-192.

MONOD, T.
1966. Crevettes et crabes de la Cote occidentale d'Afrique, Memoires de l'Institut Fondamental d'Afrique Noire, (77): 107-234. Institut Fondamental d'Afrique Noire, Dakar, Senegal.

/U.S./ NATIONAL OCEANOGRAPHIC DATA CENTER
1968. Report on the Guinean trawling survey. Volume III Data report. Organisation of African Unity Scientific, Technical and Research Commission, Lagos, Nigeria, Publication 99, vi + 551 p.

WILLIAMS, F.
1968. Report on the Guinean trawling survey. Volume I General report. Organisation of African Unity Scientific, Technical and Research Commission, Lagos, Nigeria, Publication 99, viii + 828 p.

1968. Report on the Guinean trawling survey. Volume II Environment charts. Organisation of African Unity, Scientific, Technical and Research Commission, Lagos, Nigeria, Publication 99, 529 p.



THE ATLANTIC SURF CLAM FISHERY (1968)

Robert M. Yancey

The 1968 surf clam fishery provided 40.4 million pounds of meats--4.4 million pounds less than in 1967. A 9.1-million-pound decrease in New Jersey landings was offset partially by increased landings in New York and Maryland--3 and 5.2 million pounds. The southward shift in effort, which began in 1967, continued this year. The number of vessels decreased at Point Pleasant, N. J., but increased at Cape May-Wildwood, N. J., and at Ocean City, Md.

FISHING AREAS

There are four main surf clam fishing areas in the middle Atlantic bight: Long Island, N. Y., Point Pleasant, N. J., Cape May, N. J., and Ocean City, Md. As in the past few years, the New Jersey fishery contributed most to 1968 landings, although the 32.1 million pounds landed were a smaller share (80%) than in previous years (table). The importance of the Cape May-Wildwood area increased in 1968: landings exceeded Point Pleasant's for the first time in our observations.

Surf Clam Landings by Area (1968)

Area	Number of Vessels		Landings (Millions of lbs.)	
	1967	1968	1967	1968
Long Island, N.Y.	5	7	2.3	3.0
Point Pleasant, N.J.	34	30	22.9	14.0
Cape May-Wildwood, N.J.	26	42	18.4	18.2
Ocean City, Md.	2	7	1.2	5.2
Total	67	86	44.8	40.4

The areas fished by the New Jersey fleets in 1968 (fig. 1) were similar to 1967, but the irregular patterns of 1967 (Yancey, 1968) were filled by exploratory trips seeking dense beds of larger clams. Surf clams landed in New York were taken from the same areas off the southern coast of Long Island as reported for 1967. At Ocean City, Md., most vessels continued to fish inshore and north of the Ocean City inlet. In this area, little use was made of known offshore clam stocks.

FLEETS AND METHODS

The Point Pleasant fleet was reduced to 30 vessels, including one new boat; this was four fewer than in 1967 (table). Depths fished ranged from 12 to 37 meters (40 to 120 feet); average depth fished was 22 meters (73.2 feet). As usual, most vessels made 1-day trips during daylight hours, although a few overnight trips were completed when conditions were particularly favorable. An average of 2.5 days was fished each week, and up to 21 hours were fished each day. Monthly averages of hours fished per boat-day are shown in Figure 2. The average for the year was 9.8 hours, or 1 hour less than in 1967. Dredge hauls continued at an average rate of four per hour, as in the past.

The expanded fleet at Cape May-Wildwood consisted of 42 boats, or 16 boats more than the previous year (table). Four of these were new boats, while the balance of the increase came from Point Pleasant. The depths of clam beds fished off Cape May were 8 to 35 meters (25 to 116 feet), with an average depth of 15 meters (47.4 feet). Most boats made 1-day trips and fished up to 21 hours. Monthly averages are shown in Figure 2. The average for the year was 7.9 hours of fishing time per trip. Three dredge tows per hour were made in 1968, as in 1967.

Mr. Yancey is Fishery Biologist, BCF Biological Laboratory, Oxford, Maryland 21654.

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Reprint No. 853

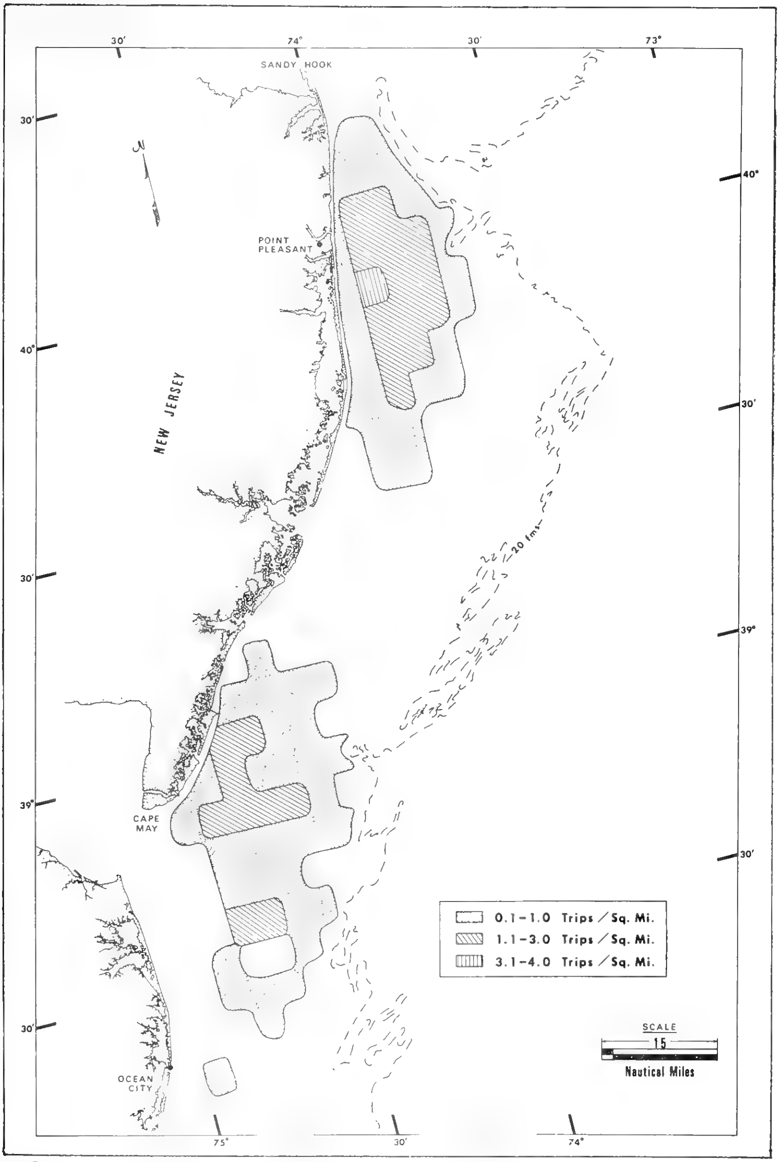


Fig. 1 - Area and intensity of surf clam fishing by New Jersey fleet, 1968 (based on 1,224 interviews).

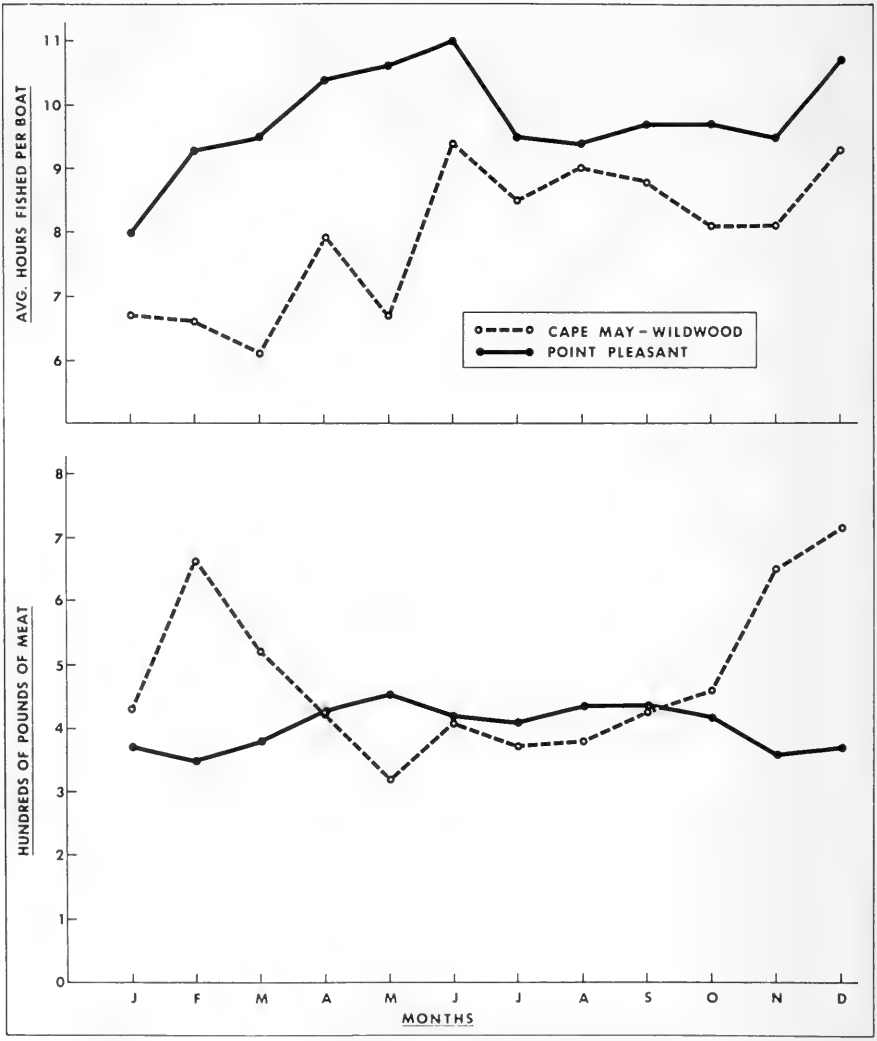


Fig. 2 - Monthly averages of daily effort (upper) and catch per hour (lower) at Point Pleasant and Cape May-Wildwood, N. J., 1968.

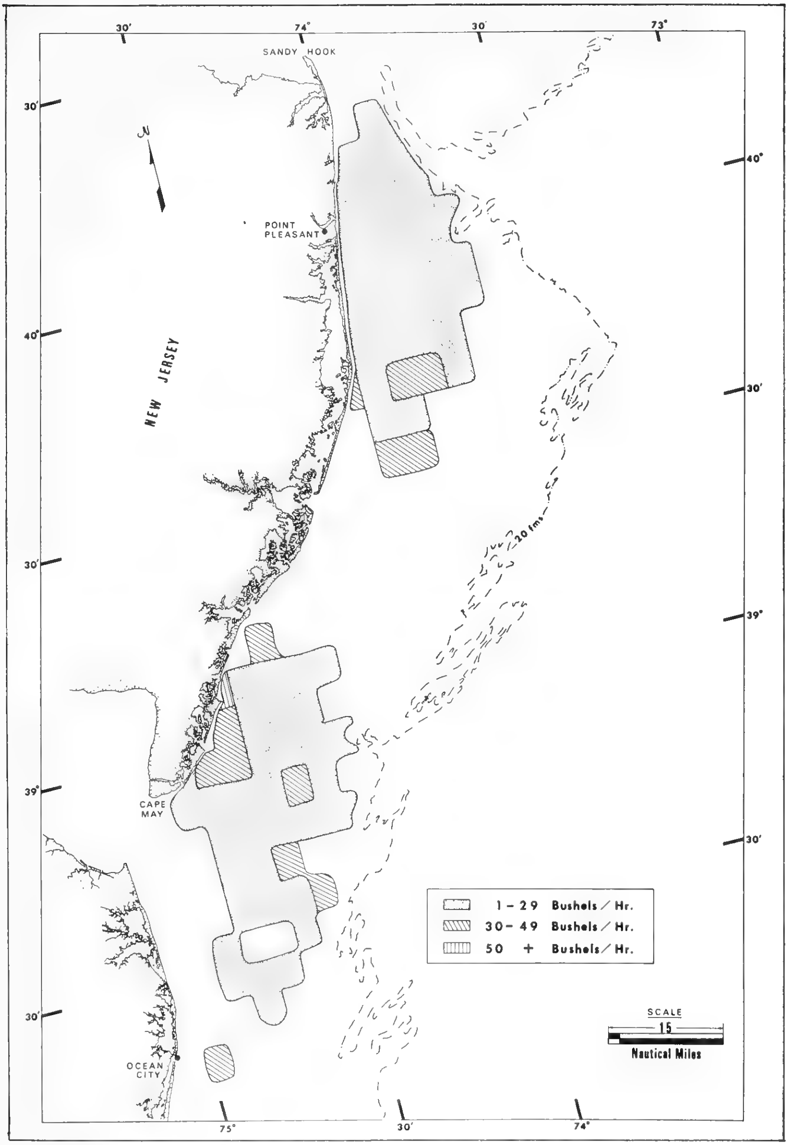


Fig. 3 - Catch per hour within the area fished by the New Jersey surf clam fleet in 1968 (based on 1,224 interviews).

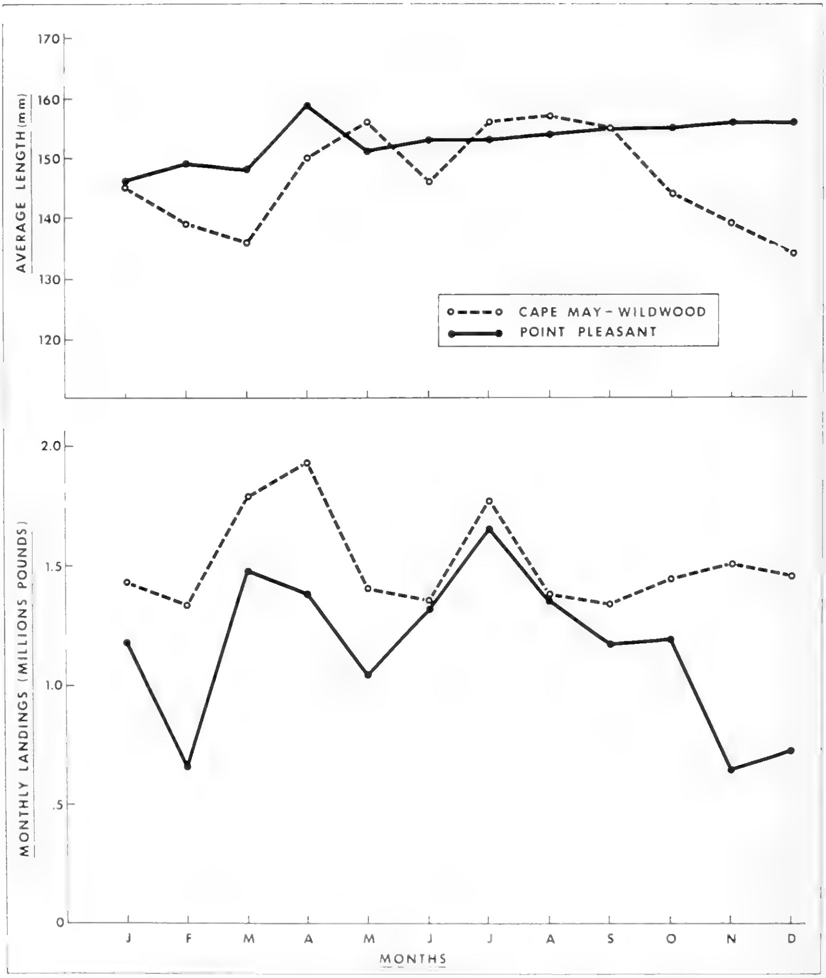


Fig. 4 - Monthly mean lengths of clams (upper) and landings of surf clams (lower) in New Jersey, 1968.

The New York fleet consisted of five (one new) full-time and two part-time vessels. The part-time vessels landed clams for fish bait.

Seven clam boats worked out of Ocean City during the year (five more than in 1967).

LANDINGS STATISTICS

Interviews by a port sampler provided information on fishing areas and effort in New Jersey. Landings in the middle Atlantic bight were provided by the BCF Office of Statistical Services.

Total landings of 40.4 million pounds of meats were 4.4 million pounds less than in 1967, despite an increase of 0.7 million pound in New York and 4 million pounds in Maryland (table). The deficit was caused by a 9.1 million pound decrease in New Jersey landings. New Jersey landings were 80% of the 1968 total; New York, 7%; and Maryland, 13%. The percentages contributed by the same States in 1967 were 92%, 5%, and 3%. The portion of the total landings used as fish bait (sport and commercial fishing) was about the same at last year (700,000 pounds).

The continuing shift in effort (Yancey, 1968) from Point Pleasant to Cape May-Wildwood was reflected again in the contributions to total New Jersey landings. Point Pleasant provided 43% (14 million pounds) in 1968--down from 55% in 1967. The Point Pleasant fleet, for the first time, landed fewer clams than the Cape May-Wildwood fleet.

At Point Pleasant

At Point Pleasant, landings per boat-day ranged from 10 to 768 bushels (170 to 13,056 pounds of meats) and averaged 233 bushels (3,961 pounds). The average in 1967 was 220 bushels (3,740 pounds). Catch per hour averaged 24 bushels (408 pounds) in both years. Figure 3 shows the catch per hour in the areas fished. The catch rate remained fairly uniform throughout 1968, although the rate dropped below average in the winter and rose again in the summer (fig. 2). Monthly landings varied more than the catch rate (fig. 4) and were generally lowest in the winter when storms limit the effort. The lengths of clams landed varied from 109 to 184 mm. (4.25 to 7.25 inches). The average length was 153 mm. (6 inches). This range and average length were essentially the same as the previous year. The monthly average lengths fluctuated very little during the year (fig. 4).

At Cape May-Wildwood

The Cape May-Wildwood share of the New Jersey landings increased from 44% in 1967 to 56% in 1968. The increase was due to a 60% increase in number of boats. Vessels landed from 15 to 1,177 bushels (255 to 20,009 pounds of meats) per day trip, and the average was 225 bushels (3,825 pounds). Monthly landings varied in a pattern similar to that for Point Pleasant (fig. 4). Catch per hour averaged 34 bushels (578 pounds) in 1967, and 28 bushels (476 pounds) in 1968. Catch per hour varied widely as effort switched from dense inshore beds of small (130 to 140 mm.) clams to the less productive offshore beds of larger (150 to 155 mm.) clams (fig. 2). The monthly average length varied inversely with the catch rate; when catch per hour was up, the average length of the clams was less. The lengths of clams landed ranged from 111 to 195 mm. (4.37 to 7.68 inches). The average length was 147 mm. (5.75 inches) or 6 mm. (0.25 inch) more than in 1967.

STATUS AND TRENDS OF THE FISHERY

Fishing effort continued to increase in 1968: about 18 vessels were added to the surf clam fleet, and hours fished per trip increased by about 1 hour in New Jersey. The southward shift in effort reported for 1967 was maintained in 1968. At the end of the year, the Cape May fleet was larger than that at Point Pleasant for the first time in our observations. The Ocean City, Md., fleet increased from two to seven boats.

Average lengths of the clams landed in New Jersey were not appreciably different in 1967. As usual, the average lengths of clams landed at Point Pleasant varied very little from month to month, while the average lengths of clams landed at Cape May varied as the fleet fished the inshore beds of small (120 mm.) clams or the offshore beds of larger (150 mm.) clams.

The catch rate stabilized at the 1967 level of 24 bushels per hour at Point Pleasant, but it decreased from 34 bushels to 28 bushels at Cape May. The catch rate at Cape May, like the average length, varied with the source of the clams.

The Ocean City, Md., fishery shows promise of further expansion and will probably contribute an ever-increasing portion to total landings.

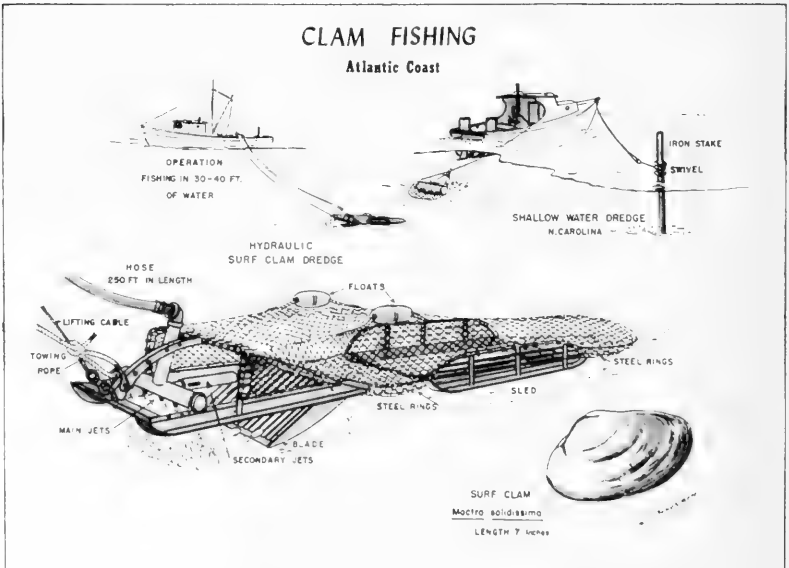
The New York fishery will probably continue its slow increase, but its expansion is limited by the extent of the beds off Long Island.

LITERATURE CITED

GROUTAGE, T. M. and A. M. BARKER
1967a. The surf clam fishery. Comm. Fish. Rev. 29(2): 55-58. Also Sep. No. 780.

1967b. The Atlantic surf clam fishery in 1966. Comm. Fish. Rev. 29(8-9): 64-67. Also Sep. No. 797.

YANCEY, R. M.
1968. The 1967 Atlantic coast surf clam fishery. Comm. Fish. Rev. 30(11): Also Sep. No. 829.



(BCF Circular 48)

BCF SCIENTISTS TAG AND RECOVER MENHADEN

Paul J. Pristas

In 1965, BCF biologists at Beaufort, N.C., began an extensive tagging program on the Atlantic menhaden, Brevoortia tyrannus. Later, they expanded the program from New York to Florida. In 1969, they tagged Gulf menhaden, B. patronus, from Cameron, La., to Moss Point, Miss. These studies are timely because of the record low catch in the Atlantic and the record high catch in the Gulf in 1969.

The results of this tagging provide direct evidence of growth, mortality rates, interchange of fish between fishing areas, and the importance of certain estuaries in the production of menhaden. This information is needed to determine the causes of fluctuations in menhaden abundance--to assess effect of fishing on the populations, to develop estimates of optimum harvest, and to support recommendations for managing the fishery.

Tagging & Recovery Equipment & Methods

The program's initial phase was to test equipment and methods for tagging menhaden and recovering the tags. A tagging gun developed by a Norwegian firm, Bergen-Nautik, for tagging herring proved satisfactory for menhaden; it has been used in our studies. The gun inserts a stainless-steel tag ($\frac{9}{16}$" by $\frac{1}{8}$" by $\frac{1}{32}$") into the body cavity of the fish. The tags are recovered on magnets in menhaden reduction plants. An electronic tag detector has been used with some success in recovering marked fish as they are conveyed from boat to plant (photographs).

In 1966, nearly 97,000 menhaden were tagged and released in the Beaufort, N.C., area while we developed the best methods possible for procuring, holding, handling, and releasing the fish. Analysis of later recoveries showed that the best way of taking fish from commercial catches was either by brail or dip net; they did not have to be anesthetized for handling; and individuals released immediately after tagging survived better than fish retained and released in a group. These procedures were used in a tagging program of the Atlantic menhaden fishery.

Expanded Tagging Program

In 1967, the program was expanded. Crews tagged menhaden in Florida, North Carolina, Chesapeake Bay, and New Jersey. We tagged 324,141 fish during the spring and summer, and 38,920 fish in the North Carolina fall fishery. Tag recoveries were increased by the installation of magnets in all menhaden plants on the Atlantic coast. In spring and summer 1968, BCF crews tagged 378,533 menhaden from New York to Florida; during fall fishery, 6,937 more. We also tagged 524 in December in Florida. This made 1968 our most productive tagging year: a total of 385,994 fish. In 1969, crews tagged 217,584 menhaden during spring and summer, and 3,091 during fall.

In 1969, BCF began the Gulf menhaden phase of its mark-recovery experiments; it continued tagging Atlantic menhaden. BCF magnets were installed at 4 plants in the Gulf area; 27,095 menhaden were tagged in spring. Recoveries of these tags during summer were encouraging. An additional 8,103 marked fish were released near end of fishing season.

The tagging of juvenile menhaden in tributaries also began in 1969. These fish were marked with tags about one fourth as large as those used for tagging commercial-size menhaden.

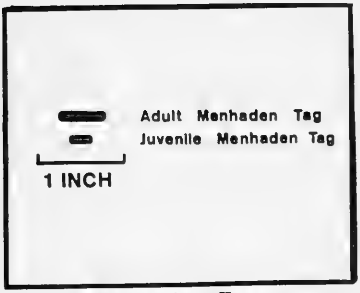
RESULTS

As of December 1969, more than 1,066,000 menhaden had been tagged and released in the Atlantic from New York to Florida. We estimate that nearly 203,000 tagged fish, or 19% of those released, have been recaptured (table). This percentage will increase when adjusted for tag losses due to shedding and mortality.

Mr. Pristas is with BCF Center for Estuarine and Menhaden Research, Beaufort, North Carolina 28516.

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Reprint No. 884

B. C. F. Menhaden Tagging and Recovery



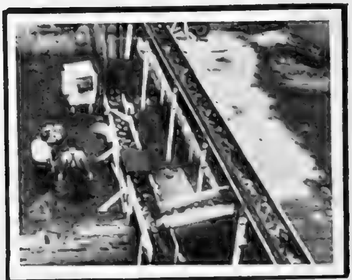
Menhaden Tags

A Menhaden Being Tagged

Tagging Aboard B.C.F. Vessel

Tagging Aboard Commercial Fishing Vessel

Recovery of Tags From Magnets in Menhaden Plant



Electronic Detector System for Recovery of Tagged Fish

Menhaden Tagging: Yearly Releases and Estimated Recoveries				
Year	Location	Releases	Recoveries	
		Number	Number	Percent
1966	Atlantic	96,627	11,262	11.7
1967	Atlantic	363,061	91,083	25.1
1968	Atlantic	385,994	84,106	21.8
1969	Atlantic	220,675	16,586	7.5
	Gulf	35,198	6,860	19.5
Total:	Atlantic	1,066,357	203,037	19.0
	Gulf	35,198	6,860	19.5

Tag recoveries indicate that Atlantic menhaden move northward along the coast in spring and summer, and southward along the coast in fall and winter. As the fish get older and larger, they migrate farther north.

Tags continue to be recovered from fish released in 1966. This proves that fish can survive for an extended period with an internal tag. Actual recoveries from some groups of marked fish have been higher than 60%.

Through October 1969, more than 35,000 menhaden have been tagged and released along the Gulf coast from Cameron, La., to Moss Point, Miss. We estimate that nearly 6,900 tagged fish, or 19% of those released, have been recaptured (table). This percentage also will increase when we make adjustments for tag shedding and tagging mortality.

These data did not show much movement of tagged fish in the Gulf during their first summer after tagging. Some westward movement of fish released at Empire, La., was apparent; some Cameron releases may have moved east as far as Empire, but not as far as Moss Point. Recoveries in 1970 will provide our first information on movements of Gulf menhaden in the period between fishing seasons.

To estimate rates of mortality and growth from tag returns, recoveries are needed from several years of fishing. The determination of the amount of movement between fishing areas also requires several years of recoveries.

Information obtained from these studies of Atlantic and Gulf menhaden will help us to utilize wisely the menhaden resources.

QUICK RELEASE BRANCHLINE CLIP DEVELOPED FOR LONGLINING

Michael G. Corbett

The longline auto-clip, an improved clip, has been developed for the automatic or manual attachment and detachment of longline branchlines and buoylines. Its use will improve safety, speed, and efficiency through better use of manpower.

A satisfactory clip must be easy to attach and detach, permit mainline to rotate freely, must not slide along mainline, and still be readily adaptable to mechanical attachment and detachment. Clips that fulfill some of these requirements have been developed.

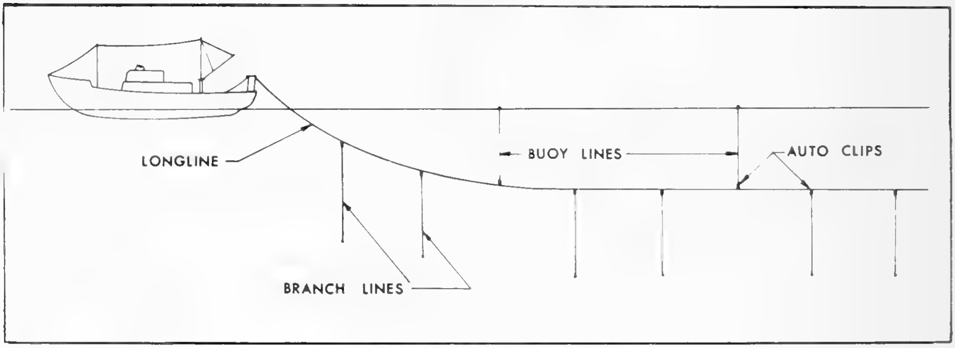


Fig. 1 - Typical longline operation.

Longlining is a method used extensively in commercial fishing for tuna, swordfish, and halibut (Fig. 1). It may be used for any fish that will strike a baited hook. A fishing boat pays out a main or longline, to which are attached branchlines and buoylines at spaced intervals. Each branchline has one or more baited hooks; each buoyline has a float. In tuna fishing, the longline may be 10 to 12 miles long and carry 1,000 branchlines and buoylines.

Early systems for handling longline gear used knots for attaching branchlines and buoylines to the longline. Fishing-gear technologists have emphasized frequently the advantages of a readily detachable clip to secure these lines to the longline. Such a system enables baiting of hooks prior to shooting (paying out) the longline, speeds both shooting and hauling (line retrieval) processes, and decreases labor requirement.

Generally, these clips are heavy wire bent in shape to allow them to be snapped onto longline. In use, however, these clips often slip along longline or, occasionally, deform under tension of pull from a large fish and sometimes unsnap from longline when they strike the boat during haulback. Known designs of such clips cannot readily be adapted to a mechanical attaching and detaching operation.

The BCF Exploratory Fishing and Gear Research Base, Gloucester, Mass., developed the longline auto-clip. It has these features: 1) mechanical attachment and detachment from moving mainline, 2) capacity for simple alternate manual operation when necessary, 3) nonslippage of branchline along mainline, 4) a design suitable for further development of a fully automated longline fishing operation, 5) strength equal to or greater than other longline components, 6) positive holding of branchline(s) with fish to mainline, and 7) simple fabrication by conventional techniques.

Mr. Corbett is Mechanical Engineer, BCF Exploratory Fishing and Gear Research Base, Gloucester, Mass. 01930.

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Reprint No. 885

DESCRIPTION

Figure 2 shows configuration of longline auto-clip. The clip includes an upper and a lower body plate (A). These body plates are identical and are formed by die stamping from corrosion resistant 6061 T6 aluminum alloy strapping. Three spring guide projections (1) and a jaw stop projection (2) extend inwardly on each body plate. These projections are formed during the die stamping operation. On the midline at the front end of each body plate is a slot or throat (3) that tapers and terminates in a radius of curvature equal to or very slightly smaller than the radius of the longline. On either side of the throat are ears (4); each ear has a hole. A third hole is located on the midline near the back end of each body plate. The two body plates are held apart by bushings (B) mounted on rivets (C). The bushings are of a nylon and formaldehyde resin, "Delrin,"[1] having a relatively high strength and a low coefficient friction.

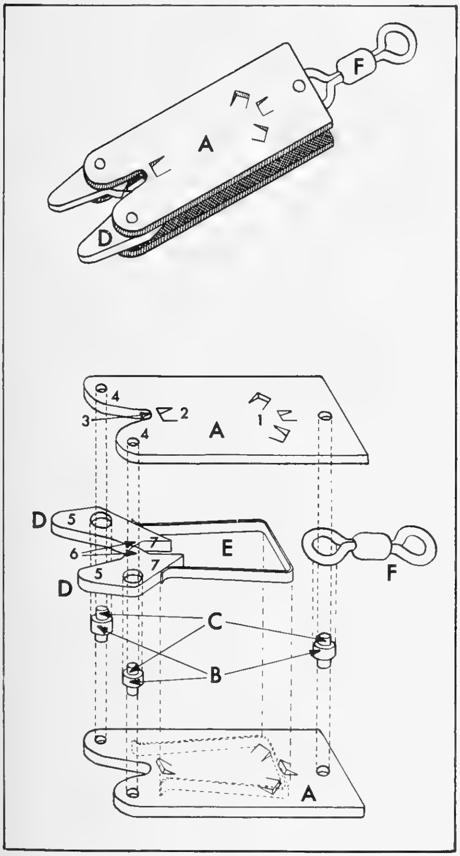


Fig. 2 - Auto-clip (exploded view).

A. Body plates	1. Spring guide projections
B. Bushings	2. Jaw stop projection
C. Rivets	3. Slot or throat
D. Jaws	4. Ears
E. Spring	5. Jaw lips
F. Swivel	6. Jaw teeth
	7. Jaw points

Pivotally mounted on the bushings between the body plates are the jaws (D). The jaws are of identical shape and are assembled in a mirror-image relation. The jaws have rounded lips (5), which extend beyond body plates. The jaw teeth (6), in closed position, extend across throat of body plate, terminate in jaw points (7), and form an enclosure with the throat within which is secured the longline. Pivotal movement of the jaws is limited by contact of jaw points with jaw stop.

The jaws are held normally in a closed position by pressure exerted by ends of the spring (E). Force exerted by a rope or line within the enclosure formed by the jaw teeth and throat tends to act with the spring pressure, causing the jaws to close tightly. The spring is a flat strip of corrosion resistant 304 stainless steel bent to be held in position by spring guide projections. The ends of spring are curved to provide a sliding contact with outside edge of jaw points. The swivel (F) pivots freely around bushing and rivet at back end of clip. The clip is finished in a flat black hardcoat anodizing to reduce its attractiveness to fish and prevent longline damage caused by fish striking it.

Other important features of the clip are weight, tensile strength, shape, and size. Weight is minimal ($3\frac{1}{2}$ ounces) through use of aluminum in its construction. Tensile strength has been tested to exceed 1,000 pounds, which equals or exceeds strength of any other branchline components. Shape and size (Fig. 3) have been designed to: 1) fit the hand for manual operation, 2) adapt to mechanical indexing and orientation, and 3) adapt to mass production manufacturing processes.

The mechanical principles are not new; the application of these principles, through concept and design of the auto-clip, is new to

[1] Trade names do not imply endorsement of commercial products.

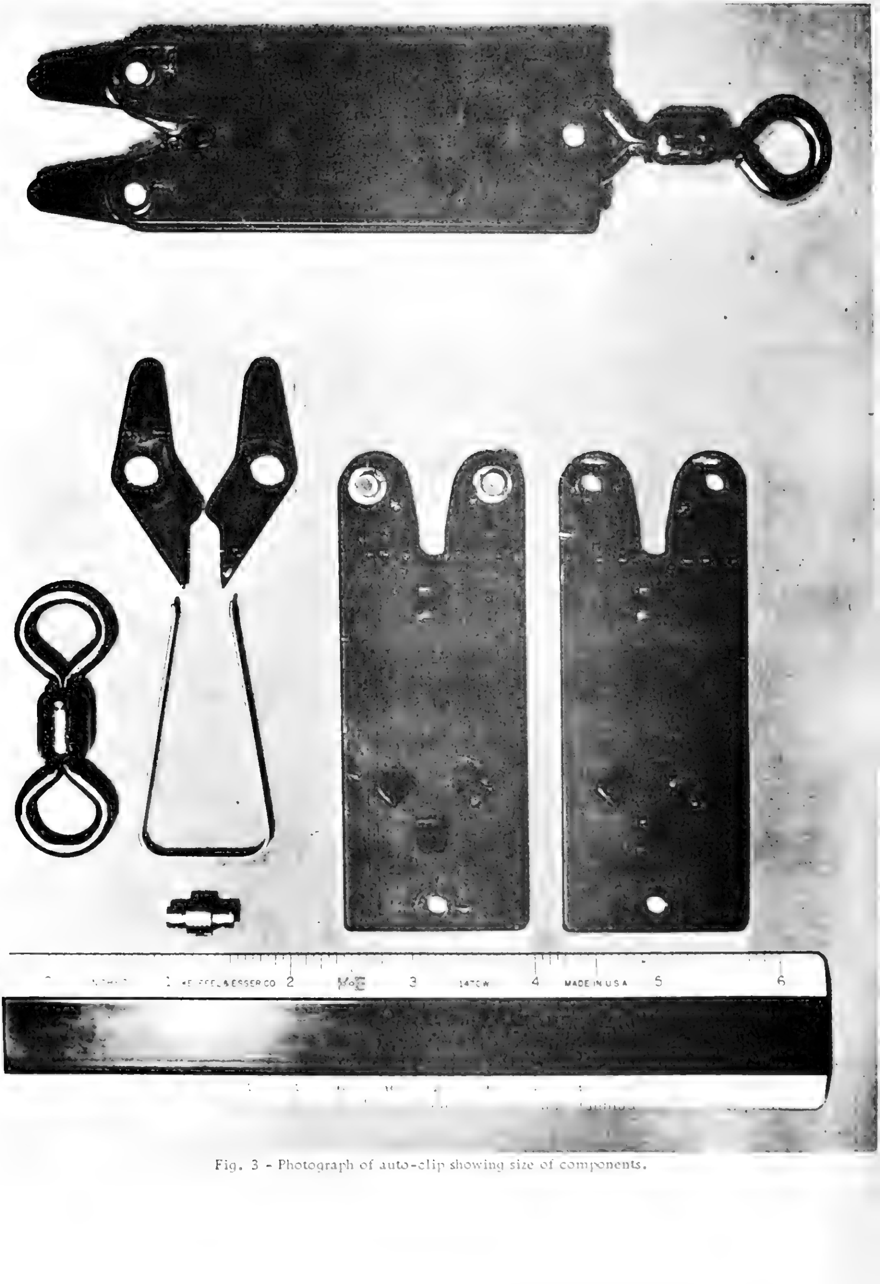


Fig. 3 - Photograph of auto-clip showing size of components.

fisheries. Other applications of this attachment principle are the semitrailer truck tractor-to-trailer hitching device and German Rolleiflex strap-to-camera hitch. Although these devices operate similarly to the longline auto-clip, their application and design are different.

THEORY OF OPERATION

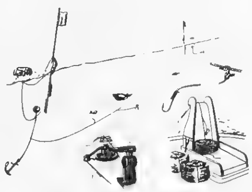
The longline auto-clip is an integral part of longline fishing gear: It is one component of the branchline consisting of clip, line, leader, and hook. The clip is connecting link of branchline for its attachment to longline. Buoylines are also attached by auto-clips to the longline at intervals of several branchlines, and are connected to buoys on sea surface above--thereby suspending fishing gear below sea surface. The line component of the branchline, or buoyline, is connected to the barrel swivel, which permits rotation of the line.

During setout of the fishing gear, the longline is payed out behind the moving vessel. Baited branchlines are attached either mechanically or manually to longline by pushing clip onto moving longline. As longline is inserted between jaws of clip, the jaw teeth are forced apart against spring tension. This allows longline to slip past jaw teeth and into throat of the clip. Once longline is in throat of clip, the jaw teeth snap shut under pressure of the spring.

The branchline attached by auto-clip cannot slide horizontally along the longline unless the auto-clip is precisely perpendicular to the longline. At any other angle to the longline, the clip "grabs" the longline to prevent slippage. This feature permits longline construction without knots or hardware to hold branchlines at their spaced positions--and it also permits flexibility of longline gear change by enabling metered branchline and buoyline attachment to the longline. This flexibility is virtually impossible with other clips or methods that require a pre-knotted longline for positioning and holding of branchlines and buoylines. The "grabbing" action of the auto-clip does not cut or fray the longline under normal (fish) pressures because of the rounded edges of the clip components.

When longline gear is retrieved, the clip-attached branchlines and buoylines approach from various angles and under varying tensions--depending on catch, weather, sea, and vessel maneuvering. Regardless of approach angle or tension, clip-attached branchlines and buoylines may be readily released from the longline either mechanically or manually. If operation is mechanical, the longline is directed through a fairlead sheave designed to orient, detach, and catch the clips with their attached lines. If detaching operation is manual, or if branchline is snarled about the longline preventing mechanical detachment, the fisherman removes the clip by grasping it with one hand and closing the protruding jaw lips. The thumb and forefinger of either hand, whether gloved or not, can readily close the jaw lips at a grab. This act releases the clip and, simultaneously, deflects it away from mainline. The fisherman does not have to take hold of the clip to release it.

Use of the longline auto-clip reduces and possibly eliminates manual handling of longline gear. The result is to improve safety aboard vessels, reduce labor requirements, and increase speed and efficiency of the fishing operation.



Halibut longline

A REMOVABLE DECK-BLOCK MOUNTING PAD

Michael G. Corbett

Equipping the BCF research vessel 'Delaware II' with a stern fished hydraulic jet dredge for survey work on ocean quahog, Arctica islandica, required that a block be mounted at the stern in the middle of the trawl passage. The purpose of the block is to provide a lead forward to the trawl winch for the quahog dredge haulback wire. On the Delaware II, the hydraulic dredge is hauled up the stern ramp.

It was expected that this block would be required only for the few cruises on which the hydraulic jet dredge was used. On non-clam cruises, the block would be in the way and obstruct trawling operation. Rather than weld a pad to the deck and burn it off each time, it was decided to make a quickly removable block mount and cover the space when the pad was not in use.

Figure 1 shows the block mount assembly. Its removable parts consist of the pad with its attached mounting bolt (part no. 1), gaskets, the bottom retaining washer (part no. 3), a nut,

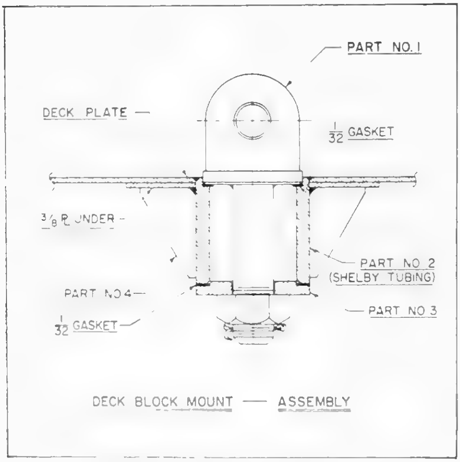


Fig. 1 - Drawing of assembly.

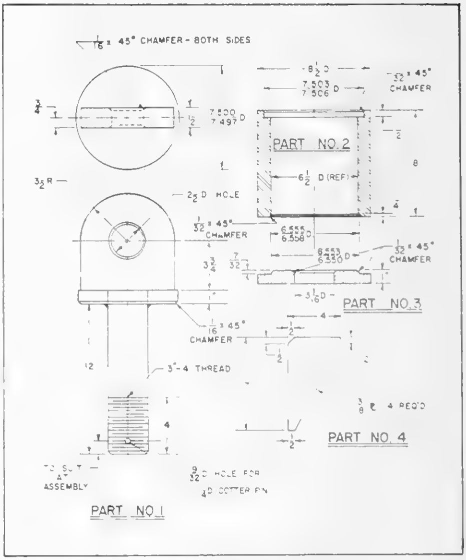


Fig. 2 - Detail drawing.

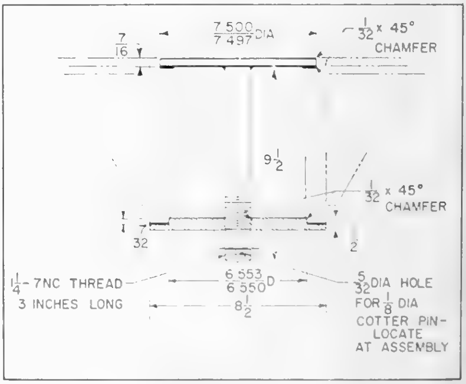


Fig. 3 - Cover plate assembly.

Mr. Corbett is Mechanical Engineer, BCF Exploratory Fishing and Gear Research Base, Gloucester, Mass. 01930.

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Reprint No. 886

and a cotter pin. Permanently welded to the deck plate are a reinforcing plate and a flush-mounted length of seamless tubing (part no. 2) with gussets (part no. 4).

Figure 2 is a composite detail drawing of the components, which can be used to duplicate the assembly. Most of the dimensions could be modified to suit any specific situation.

Figure 3 shows the cover plate that mounts flush with the deck when the pad is not in use. It has its own washer, nut, and cotter pin.

The removable deck-block mounting pad worked well. The pad could be turned in any direction before tightening to accommodate the required lead for a particular job. If this feature was not needed or desirable, the pad could be keyed to lock it in place.

THE FOLLOWING PUBLICATIONS OF THE DEPARTMENT OF INTERIOR, FISH & WILDLIFE SERVICE, ARE AVAILABLE FROM DIVISION OF PUBLICATIONS, BCF, 1801 N. MOORE ST., ARLINGTON, VIRGINIA 22209.

SHRIMP

"Contributions to the Life History of Several Penaeid Shrimps (Penaeidae) Along the South Atlantic Coast of the United States," by William W. Anderson, SSR-Fish. No. 605, May 1970, 24 pp.

Shrimp is the most valuable fishery resource of the U.S. south Atlantic coast. In 1966, shrimp contributed 40% of the $27 million exvessel value for all fishery landings in this area. Three species of shallow water penaeid shrimp are of greatest commercial importance: white shrimp, Penaeus setiferus; brown shrimp, P. azticus; and pink shrimp, P. duorarum. Information is also included on the seabob.

This report reviews the shrimp fishery for trends in yield--for the area as a unit, by states, and by species for the 10-year period 1958-67. Data are presented on size distribution, ovary development, sex ratios, and spawning seasons.

"A trend toward steady decline in total shrimp landings is indicated."

SCOMBRID FISHES

"Size, Seasonal Abundance, and Length-Weight Relation of Some Scombrid Fishes from Southeast Florida," by Grant L. Beardsley Jr., and William J. Richards, SSR-Fish. No. 595, May 1970, 6 pp.

One of the major centers for saltwater sport fishing in the U.S. is along the coast of Florida from Palm Beach to Key West. The BCF Tropical Atlantic Biological Laboratory (TABL), Miami, sampled 7 species of scombrid fishes received from sport fishermen for mounting by taxidermist. Sampling was to determine seasonal presence of scombrids in this area to compare with sampling of their larvae in the Straits of Florida.

The species studied were: wahoo, little tuna, skipjack tuna, king mackerel, Spanish mackerel, and blackfin tuna. Length-weight relations, calculated weights at given lengths, size distribution, and seasonal abundance are presented in this paper for each species.

A FLORIDA BAY

"The Flora and Fauna of a Basin in Central Florida Bay," by J. Harold Hudson, Donald M. Allen, and T.J. Costello, SSR-Fish, No. 604, May 1970, 14 pp.

Florida Bay, located at the southern tip of the Florida peninsula, serves as a nursing ground for pink shrimp. This paper is a study of Porpoise Lake, a basin in the central part of the bay. Samplings were taken of the area, which is known to contain 196 species of plants and animals. A detailed description and listing of the species is presented, but no attempt is made to relate these organisms to the environment, except in very general terms.

HAWAIIAN SKIPJACK TUNA

"Distribution of Fishing Effort and Catches of Skipjack Tuna, Katsuwonus pelamis, in Hawaiian Waters, by Quarters of the Year, 1948-65," by Richard N. Uchida, SSR-Fish. No. 615, June 1970, 37 pp.

The report is based on "detailed data on catch, location, and effort obtained each year from all vessels that fish full time for skipjack tuna in Hawaiian waters." It summarizes the amount of "effective" fishing--trips when skipjack tuna are caught--the catch, and catch per standard effective trip.

Fishing for skipjack is "highly seasonal." The effort and catch in first quarter usually were 15% and 9% of annual totals. In May, fishing intensified. Second-quarter catches, by 32% of annual effort, produced 33% of annual catch. In third quarter, effort increased to 36% of annual total--and catches increased sharply to 46% of annual take.

Abundance declined in fall, and so did fishing. Fourth-quarter figures: 15% of annual effort and 12% of annual catch.

SONAR

"Studies on Continuous Transmission Frequency Modulated Sonar," by Frank J. Hester, SSR-Fish. No. 607, June 1970, 26 pp.

In 1961, the Inter-American Tropical Tuna Commission proposed a catch quota for the overfished yellowfin tuna stock. This quota could be increased if fishing for small yellowfin (less than 25 pounds) could be controlled. However, it is difficult to determine the size of fish before caught, and an attempt had never been made.

The BCF Tuna Resources Laboratory conducted a study from 1963-68--designing and constructing a shipboard sonar with fine echo frequency discrimination that could locate and classify fish schools. The equipment performed as theory predicted, but difficulty with sea noise and maintaining contact with fish schools showed additional work was necessary for commercial application. This report discusses these problems, some results, recommendations, and target-strength measurements for several species of fishes.

CHUM SALMON

"Synopsis of Biological Data on the Chum Salmon, Oncorhynchus keta (Walbaum) 1792," by Richard G. Bakkala, FAO Fisheries Synopsis No. 41, Circular 315, March 1970, 89 pp.

Chum salmon have the widest distribution of any Pacific salmon. They inhabit widely different environments during their life, returning to spawn in the river from which they originated. The chum spawns in 5 countries: the U.S., Canada, Japan, Korea, and USSR; they are most abundant on the Asian continent.

Bakkala reviews nomenclature, taxonomy, morphology, distribution, ecology and life history, population dynamics, fishery, and protection and management of the chum.

NORTHERN SQUAWFISH

"Laboratory Tests of an Electrical Barrier for Controlling Predation by Northern Squawfish," by Galen H. Maxfield, Robert H. Lander, and Charles D. Volz, SSR-Fish. No. 611, July 1970, 8 pp.

Northern squawfish prey extensively on young sport and commercial fishes. During early spring and summer, they prey heavily on salmon (Oncorhynchus spp.). The salmon are released from upstream hatcheries on Columbia River and must run gauntlet of squawfish-infested areas on way to sea.

Controlling these predators requires finding a way to block their entry into release areas of hatchery-reared salmon--without interfering with salmon migration.

The authors "explored in the laboratory effectiveness of electrical fields previously found to direct the movements of salmon fingerlings."

TRAVELING SCREENS

"Preliminary Designs of Traveling Screens to Collect Juvenile Fish," SSR-Fish. No. 608, July 1970, 15 pp.

Biologists and engineers have been studying the problem of protecting juvenile salmon, shad, and striped bass from destruction in rivers with dangerous hydroelectric or irrigation developments. They have studied possibility of deflecting fish from their normal routes to alternate routes around dangerous areas.

Many methods of deflecting fish were examined: bands of rising bubbles, curtains of hanging chains, electrical stimuli, lights, etc. Although efficient under certain conditions, these were never completely reliable.

The traveling screens described in the report were developed to overcome these disadvantages. A traveling screen is a conveyor belt placed on edge diagonally across path of juvenile fish migrating downstream--and so are guided into bypass at downstream end of structure.

"Two horizontal traveling screens were designed and operated for 2 years at the Carson National Fish Hatchery, Carson, Wash... The screens demonstrated their potential capacity to divert young salmon moving downstream."

PACIFIC SALMON COMMISSION

"International Pacific Salmon Fisheries Commission Annual Report 1969," 53 pp.

The International Pacific Salmon Fisheries Commission held 15 formal meetings during 1969, with approved minutes submitted to the U.S. and Canadian Governments. This report reviews the meetings and recommendations for regulations governing the 1969 sockeye and pink salmon fishery for U.S. and Canadian Convention Waters. Summaries of catch and escapement of sockeye and pink salmon are also presented.

INTERNATIONAL

EUROPEAN COMMON FISHERIES POLICY ADVANCES

The Common Market's (European Communities') Agricultural Ministers agreed in principle on June 29 to introduce a common fisheries policy before Nov. 1, 1970. The six member countries originally agreed on an April 30 deadline, but disagreement between France and others postponed it.

French Pressure on EC

France had maintained that fishery policy should be completed before negotiations starting June 30 for entry of countries into Common Market. The other member countries advocated postponement until Denmark and Norway, at least, could join negotiations. However, under French pressure, the Agricultural Ministers adopted on June 29 the framework of a common fisheries policy. Denmark and Norway expressed disappointment that they were not consulted.

Limiting Fishing Proposed

To expedite adoption of policy before entry negotiations, the EC Commission proposed limiting fishing within 3-mile territorial limit for not over 5 years. During this period, the Commission would investigate problems and propose to the Ministerial Council supports designed to assure income of coastal population dependent on this fishery. (U.S. Embassy, Copenhagen, July 9.)

ICNAF HOLDS 1970 MEETING

Delegates from 14 member countries attended the 20th annual meeting of the Northwest Atlantic Fisheries Commission (ICNAF), St. John's, Newfoundland, June 1-6, 1970. Observers from FAO, ICES, and Japan were present.

The Commission approved proposals for: (1) international inspection, (2) regulation of yellowtail flounder fishery in Subarea 5, (3) modification of mesh-size regulations in Subareas 2 and 3, (4) regulation of seal harvest off Canada, and (5) additional regulation of salmon fishery throughout Convention area. Regulatory proposals become effective within about 6 months if there are no objections.

International Inspection

International inspection procedures would enter into force July 1, 1971. Inspection officers of an ICNAF country would be allowed to board vessels of another member. Observance of applicable ICNAF recommendations could be verified. Infringements would be reported to country of vessel concerned for further handling.

Yellowtail Flounder Fishery

For yellowtail flounder, the proposals would apply quota and trawl regulations in Subarea 5. Quota would limit catches during 1971 to: (a) 16,000 metric tons from grounds east of 69° W. long. (b) 13,000 metric tons from fishing grounds west of 69° W. long. After any closure required by quota, vessels affected would be allowed incidental catches of yellowtail flounder not over 5,000 pounds, or 10% of their total catch in area. This is the same now provided for haddock and cod.

The trawl regulation proposed would extend trawl regulations in Subarea 5 to yellowtail flounder. Mesh sizes at least $4\frac{1}{8}$ inches (synthetic fiber) would be required.

The Commission also asked ICNAF scientists to assess further yellowtail flounder resource during coming year so Commission can consider regulatory adjustments in 1971.

Modification of Mesh Size

The Commission recommended that mesh size required for regulated species in Subareas 2 and 3 be increased from $4\frac{1}{8}$ inches to $4\frac{3}{4}$ inches (synthetic fiber). Proposed date of entry into force for requirements is July 1, 1971. Present exemption for redfish (ocean perch) fishing in Divisions 3N, 3O, and 3P of Subarea 3 will be continued under proposed new requirements.

Harp Seal Harvest Limit

The Commission proposed a harvest limit of 245,000 harp seals from ice pack off Canada in 1971. This is first time Commission has approved quota for seal harvest.

The Commission also proposed that 1971 open season for harp and hooded seals begin not earlier than March 12, and close not later than April 24.

Salmon Fishery

Several ICNAF countries did not accept 1969 proposal for ban on high-seas fishing for salmon outside national fishery limits. As interim measure, Commission has proposed that countries fishing for Atlantic salmon freeze size of their fleets and level of catch at 1969 level. This freeze would apply during 1971 and be reviewed further in 1971.

1971 Annual Meeting

The 21st annual meeting of the Commission will be held in Halifax, Nova Scotia, Canada, May 25-June 5, 1971.

USSR & JAPAN TO DISCUSS 'SAFE-FISHING OPERATIONS' IN NORTH PACIFIC

On July 14, the Japanese Ambassador to Moscow presented a plan for operation, free from Soviet seizure, of Japanese fishing vessels around Soviet-held islands of Habomai, Shikotan, Kunashir, and Iturup off Hokkaido.

Plan highlights are:

(1) Japanese fishermen shall operate without Soviet interference inside 12 miles around the 4 islands, but not within 3 miles of coastline; (2) Japan is willing to comply "as much as possible with countermeasures that may be devised by the Soviet Union regarding the operation free from seizure of Japanese fishing vessels"; and (3) the Japanese vessels in the "safety zones" will be mainly those that operated there before.

Negotiations between USSR and Japan are scheduled for Moscow in September 1970.

Many Seizures Since 1946

The Soviet Union has been holding the 4 islands since World War II. She has promised to return Habomai and Shikotan when a Soviet-Japanese peace treaty is negotiated. However, she appears adamant about retaining Kunashir and Iturup, but Japan is not abandoning her claim.

The Soviet Union claims a 12-mile territorial limit, and has seized all Japanese fishing vessels and crews in those waters. Between 1946 and 1969, the Soviets apprehended over 1,300 Japanese fishing vessels and nearly 12,000 Japanese fishermen. Over 20 Japanese vessels were sunk and 32 fishermen drowned in those seizures. Three vessels and 8 fishermen are still being held.

Soviets Seek Japanese Aid

According to Japanese sources, the Soviets are eager to get Japanese financial and technical assistance to expand their Far-Eastern facilities for processing, preserving, and distributing fishery products. The Japanese expect the Soviets to ask for this assistance as a price for granting fishing rights off the 4 islands. ('Kyodo,' July 15; 'Japan Times,' July 15 & 16; 'Yomimuri,' July 14.)

FISH CULTIVATION MAY INCREASE 5 TIMES BY 1985

World fish cultivation has grown to roughly 4,000,000 metric tons of fish and shellfish. It could expand to 20,000,000 tons by 1985, according to FAO estimates.

If achieved, it would help to provide better diets and protein-rich foods in developing areas, especially where malnutrition is aggravated by a steadily increasing population. "Aquaculture, often in combination with agriculture, is a promising means of exploiting fish as a source of highly nutritious, inexpensive proteins," FAO says.

Based Partly On Questionnaire

The estimates are contained in the current FAO Fish Culture Bulletin. They are based on questionnaires sent to governments and on available data.

The authors of the article emphasize that the research is tentative and suitable statistics are lacking, especially for shellfish culture.

"We do not claim a high degree of accuracy for the above figures. . .but believe that they indicate at least roughly the magnitude of the industry." The figures are an estimate of average national production in recent years.

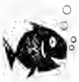
In Indonesia, breeding fish involves 200,000 Javanese. Fish and rice are staple diet. FAO encourages raising fish in ponds. (Photo: UNations)

The study estimates finfish cultivation in 36 countries, producing 100 tons or more, at 3,000,000 metric tons. The remaining one million is a composite of shellfish production for all countries.

Asia No. 1

Mainland China is first among the 36 nations with 1,190,000 metric tons. Japan is second with 487,000 tons, followed by India with 480,000 tons, and the USSR with 190,000 tons. Of the 3 million tons, more than 2,600,000 came from 9 countries of Asia and the Far East.

The FAO Bulletin states: "This shows the unequal distribution of the industry in the world. In the continents of Africa and South America, aquaculture is in its very early infancy and probably those regions have the maximum area available for cultivation of fresh and brackish-water species. Even in Asia and the Far East, which produce the major proportion of cultivated fish, there appears to be considerable scope for expansion. For example, in the Philippines, Indonesia and India, which already have a total of about a million hectares under culture, there is still an estimated area of about 8.2 million hectares that can be reclaimed for fish culture."



COMMUNIST CHINA & JAPAN CONCLUDE 'PRIVATE' FISHERY AGREEMENT

On June 20, in Peking, Japan and Communist China extended for 2 years their nongovernmental agreement on the fisheries in East China and Yellow Seas. The new agreement was signed only 2 days before the old one expired. It was the first time since Dec. 1965 that the 2 countries have conducted full negotiations.

Political Aspects

The joint communique included: condemnation of Sato government's policies toward U.S. and Asia, renewal of U.S.-Japan security treaty, U.S. intervention in Cambodia, and "revival of Japanese militarism and expansionism." The Chinese press claimed "sabotage activities" by a handful of reactionaries in Japanese fishing circles and violation of earlier agreements had hampered negotiations.

Japanese Eager for Agreement

The Japanese catch in the agreement area is about 700,000 metric tons. So the Japanese negotiators accepted all political demands. The new agreement will run longer than previous ones. It includes new clauses on fishing practices and conservation.

Regulations

Supplementary regulations include: clear designation of vessel names, better "surveillance procedures for violators," stricter punishment of offenders, seasonal ban on "Taisho" shrimp fishing, restrictions on trawl fishing, and a ban on "tackle-net" fishing. "Tackle-net" gear is believed to be stick-held dip net (Boke ami).

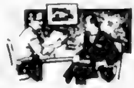
Ban on Tackle-Net

The tackle-net ban is most controversial item of the new agreement because the Japanese use it to catch about 400,000 metric tons of mackerel and horse mackerel. The Chinese do not use tackle-nets. Their demands for ban are attributed to "showy fishing methods of big (Japanese) fishing fleets" whose "fish-attracting lights irritate the Chinese."

The Japanese also agreed to pay US$55,600 as "reparations for 20 cases of injury."

Japanese News Media Favorable

Reaction of the Japanese news media has been generally favorable. They have played down political aspects in favor of what is felt to be real progress in management of East China Sea and Yellow Sea fisheries. Though "private" negotiations may frequently be cumbersome and useless, the Japanese Government supports them. They will continue until Japan and China restore diplomatic relations.



CANADA

NEWFOUNDLAND PLANS DEVELOPMENT PROGRAM

The development of new catching methods and intensified search for unexploited stocks are among major items of the about C$1 million 1970 federal-provincial program for Newfoundland fisheries.

The program calls for introduction and demonstration of new and improved fishing gear and fish-processing equipment; exploration for more pelagic fish (herring, sand launce, and capelin), shellfish, and Irish moss; and technical demonstrations to fishermen.

New & Traditional Methods

Newfoundland fishermen will be made familiar with new and traditional methods. A large side trawler will test feasibility of using seine-netting gear on this type of vessel, particularly for flounder on Grand Banks.

Bottom Trawls on Stern Trawlers

Bottom trawls (Atlantic western trawls) will be built in Newfoundland and their ability on stern trawlers demonstrated. These trawls have been successful on side and stern trawlers in other areas. They have very high vertical openings permitting catch of more high-swimming bottom fish than conventional bottom trawls. They are more effective on rough ground, and repair costs are much less.

Exploration & New Traps

Two large vessels will explore for herring, sand launce, and capelin off Newfoundland. New types of capelin and herring traps will be demonstrated to fishermen in Ferryland area and Placentia Bay, where crabs will be explored. Experiments with cod traps of synthetic materials and Japanese-designed, low-cost, fish-catching and handling devices will continue. (Fisheries Council of Canada, June 1970.)

* * *

SALTFISH CORPORATION CREATED

On April 1, Canada set up the Canadian Saltfish Corporation as the sole marketing organization for saltfish. Headquarters is St. John's, Newfoundland.

During its first year, the corporation will follow most policies already set by commercial markets. At the same time, however, it expects to plan the development of new markets and products for the consumer in 1971.

Explores New Ideas

The corporation is exploring new marketing ideas--boneless or semiboneless fish, consumer-ready portions, etc. It hopes to develop these in consultation with fishermen and marketing outlets outside Canada, particularly New York and Puerto Rico. (U.S. Consul, St. John's, Newfoundland, June 16.)

* * *

SALMON FLEET VALUE INCREASES

The number of vessels in British Columbia's commercial salmon fleet is decreasing, but replacements are adding to overall investment in fishing capacity. Jack Davis, Canada's Fisheries and Forestry Minister, froze the fleet in Sept. 1968.

This year, 6,581 vessels are registered--compared with 6,925 last year--a drop of 5%, but value has increased 3.3%, or C$3 million.

Davis Disappointed

Davis was disappointed in results and hinted further restrictions to limit continued value increase. He said: "With a good season in 1970 there is the danger that boat construction will pick up and tonnage rise. We must prevent this from happening and I therefore plan to make a further announcement soon about salmon vessel replacement."

Regulations

It is now mandatory to remove a "category A" boat from the fleet before bringing in another. Exceptions are boats under construction in 1968 and those lost at sea.

Value of Fleet

Value of the fleet in 1970 is $98 million, up $3 million from 1969. This includes $2½ million resulting from replacement of 112 "category A" boats by higher-value vessels; 8 vessels for $265,000 were brought into fleet along with 5 vessels for $165,000 built under Indian Fishermen's Assistance program this year.

CANADA (Contd.):

Company Boats Down By 60

Company-owned salmon vessels decreased by 60 this year. The minister wants these maintained at last year's ratio of 12% of total fleet. In 1969, company boats totaled 793 worth $12.5 million. In 1970, total dropped to 733 worth $13 million. Difference reflects higher value of replacement vessels. (Department of Fisheries, June 19.)

* * *

REPLACEMENT RULE ON SALMON VESSELS IS IN EFFECT

A ton-for-ton replacement rule to bring new category "A" boats into commercial salmon fleet has gone into effect. A fisherman who plans to bring a new boat into the fleet must have one with matching tonnage to take out--or a collection of smaller boats to equal that tonnage. However, if a large vessel is retired, only one new vessel can be licensed to replace it. Boats under construction at the time of announcement are excluded.

100% Increase in License Fees

Next year, there will be a 100% increase in salmon-fishing license fees for all "A" category vessels, except smallest class (29 feet and under), which remains $100. Boats over 30 feet, but less than 15 tons, go from $100 to $200; those over 15 tons from $200 to $400.

Owners of category "A" vessels can drop back to "B" category and pay the $10 license fee; this license has a 10-year terminal date.

License fees were raised this year to set up a "buy-back" fund to allow government to buy salmon vessels offered on the market. It stands at C$0.5 million today; next year's fees will add $1 million.

Present Regulations

Present regulations, set Sept. 1968 when the salmon fleet was frozen, allowed a boat-for-boat replacement. Since 1968, there has been a reduction of 788 vessels in the fleet, but only a slight reduction in tonnage. This was caused by larger higher-powered vessels replacing smaller category "A" boats and boats under construction when freeze was announced.

The initial freeze increased value of category "A" boats. Company ownership of salmon boats was curtailed by setting a ratio of 1:8 to total fleet. Fleet reduction will speed up, and fishermen should see improved economic returns for their work and investment. (Dept. of Fisheries, June 26.)

* * *

HERRING STOCKS OFF BRITISH COLUMBIA RECOVER RAPIDLY

Although herring stocks off Canada's west coast, at a low ebb since disastrous season in 1968, are rapidly recovering, there will be no commercial reduction fishery this year.

The herring spawn deposit was 270 miles, more than twice the mileage in 1969 and greater than 25-year average of 204 miles.

Herring Move Inshore

In the fall, herring move inshore and, during the spring, spawn along shoreline. It requires 250,000 tons of herring to produce spawn deposit found this year. Eggs are found on vegetation and 500 eggs may be attached to an inch of eel grass.

Small Surplus

Dept. of Fisheries regional director said there will be a small surplus this winter above spawning requirements, but not sufficient to bring an economic return to fishermen. The advisory group said a greater effort should be made to encourage development of a herring food industry.

In 1963, the peak herring season, more than 250,000 tons were harvested. Production decreased to 133,000 tons in 1967, and to 18,000 tons in 1968. (Dept. of Fisheries of Canada, June 23.)

EUROPE

EUROPEANS LOOK TO U.S. FOR FISHERY PRODUCTS

Despite fairly good supplies of locally caught fishery products, European markets increasingly are finding insufficient supplies of certain species to meet demand. But it is rising consumer demand that causes rising price trend in this already high fish-consuming area. With the inability of European fleets to supply adequate quantities, buyers are looking for other sources.

U.S. Shrimp Sales Double

Since 1964, U.S. shrimp sales to Europe have doubled each year. In 1969, frozen shrimp, mainly from Maine and valued over US$5 million, were sold largely to Sweden. Shrimp from Alaska now is entering the markets. Markets in Norway and Denmark also are taking more. In Norway, shrimp fishermen have been concerned somewhat by the low prices, which undercut their sales; they are now seeking ways to improve marketing.

Eels Popular

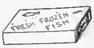
Eels are another U.S. product gaining sales in Europe. For some years they have been selling in the Netherlands but, recently, active buying interest was found in West Germany and Denmark. U.S. producers have found market possibilities excellent.

New Demand for Crayfish

Each year, during early August, Scandinavian festivals require tons of freshwater crayfish. In the past, these have been obtained from Turkey, other southern European countries, and locally. These supplies are no longer adequate. This year, for the first time, crayfish from the U.S. Pacific Northwest are being shipped to Scandinavia.

Herring Wanted

Herring packing plants in West Germany use large quantities of fresh and frozen herring in their preserved snacks. Herring supplies are short in Europe, so they seek them from fisheries off the U.S. and Canada. A new filleting plant opened recently in Massachusetts to pack shipments for German and Scandinavian markets. (U.S. Embassy, Copenhagen, Aug. 13.)



WEST GERMANY

FACTORY TRAWLER LANDS 780 TONS OF FILLETS

The new West German factory trawler 'Sonne' set a record for Bremerhaven with a landing of 780 metric tons of cod, redfish, and saithe fillets--and 308 tons of fish meal produced from a catch of more than 2,000 tons. The Sonne record was made on an 83-day trip that spanned northern waters of North Atlantic.

Completed in March 1969, the vessel is 284 ft. long, has 3 machine processing lines, and can fillet and freeze 40 tons of fish a day.

Switch-Fishing Vessel

Like some other large German stern trawlers, she is a switch-fishing vessel. She can change in about 30 minutes from bottom to midwater gear. She has a complex array of acoustic fish-finding devices.

From her maiden trip, the Sonne brought back 625 tons of fillets from a catch of 1,600 to 1,800 tons. The second trip produced 725 tons of fillets. On the third trip, she went after herring in northwest Atlantic. She returned in Dec. 1969 with the fillets from a 2,000-ton catch. Her fourth trip produced about 600 tons of fillets.

Exceeded Fish-Room Capacity

On Mar. 4, 1970, the Sonne left St. Pierre and trawled off Labrador, West Greenland, and in Barents Sea. Towards end of May, her fillet production began to exceed the 750-ton capacity of her fish rooms; the surplus had to be put into provision rooms.

The price paid for her record landing was not revealed, but she earned over US$360,000 from her latest voyage. ('Fishing News', June 2.)

IRELAND

1969 WAS BEST YEAR

In 1969, according to Department of Agriculture and Fisheries, the Irish fishing industry enjoyed its best year ever. Catch value of sea fish (excluding salmon) was US$7.2 million, a 24% increase over 1968.

Exports are rising steadily due to increase in landings and new marketing patterns that are improving prices and providing exporters with new opportunities.

Between 1968 and 1969, exports rose from 25,094 to 52,576 metric tons and value from $6.4 to $8.5 million. Varieties accounting for increase were herring, lobster, shrimp, scallops, and oysters.

Research & Development

Research and development are opening possibilities. Development work on mussels resulted in 10% increase in production and 25% rise in value of landings. Oyster production jumped 72% and value 122%. Crab landings of 600 tons, worth $96,000, were processed at new plants along coast. Including value added by processing, this crab meat netted about $240,000 in exports.

Due to uncertain landings and sizes, industry has not shown enough interest to fulfill potential.

Encouragement by Government

One main objective of Sea Fisheries Board in trying to resolve this situation was to stimulate onshore activities.

A first step was to improve size and quality of fishing fleet. It has been doing this by providing grants for boat building, equipment, and gear. Investment in vessels grew from under $1.2 million in 1968 to $2.4 million in 1969. The latest projection sees an annual investment rate of $3.8 million by 1972.

To complement investment in vessels, the Board tried to persuade individuals and companies to invest in industry. It was only achieved by introducing a high-powered marketing style tailored to individual needs. Since mid-1967, this approach has met with some success--new investments total $3.2 million and new companies 17. Eleven companies are completely Irish, 5 have foreign participation, and one, a fish-meal factory, is owned by a Scottish firm.

Another 30 projects are said to be under construction. (U.S. Emb., Dublin, June 17.)

ICELAND

HERRING CATCH FELL 60% IN 1969

Iceland's 1969 herring catch was 56,893 metric tons, a decline of 60% from the 142,820 tons in 1968. Only 87 vessels fished; in 1968, 119.

The 1969 catch:

Where Caught:	Metric Tons
Southwest of Iceland	22,111
North Sea	21,926
Off U.S. East Coast	12,785
Arctic Waters	71
	56,893

Use of Herring Catch	1969	1968
	Metric Tons	
For Freezing	4,177	7,776
Salting	19,379	28,834
Canning	1,266	1,451
Reduction	3,808	55,712
Landed on Ice	28,078	49,204
Other	185	157
	56,893	142,820

Mostly between June and October, 6 vessels fished herring off U.S. east coast. The 12,785 tons caught were transferred to freighters outside 3-mile limit for transfer to shore reduction plants. Catch value was US$197,000. (U.S. Emb., Reykjavik, July 7.)

DENMARK

COLDER CLIMATE WILL AFFECT FISH STOCKS

Greenlandic industrial life may be seriously affected by a rapidly changing climate. In all probability, weather will get colder during next 10-20 years; a new mild period is not expected until next century. This prediction by H. C. Ørsted's Institute, Copenhagen, is based on studies of core drillings east of Thule.

Further Investigations Planned

If further investigations confirm this, Denmark's investment policy in Greenland would have to be altered, an official said. Of primary concern is the possibility that cod stocks would move south, and Greenlanders would have to find new catch areas to maintain their plants.

U.S. to Aid

Recently, the National Science Foundation, Washington, announced US$1.2 million would be available for research in ice-cap borings to determine previous climatic trends. New investigations must be carried out with aid from U.S. because Denmark does not possess necessary equipment for drilling inland ice.

Milder Climate Better for Fish

Milder climate, which prevailed from late 1800s up to 1930, caused a decline in seal and whale catch but provided better conditions for fish. By end of 1930s, however, signs of a decline in temperature appeared before man had an opportunity to use fully the new fishery wealth. In the 1950s, there was evidence of a significant rise in sea temperatures, but not to level of the 1930s. Recent poor cod year-classes are believed result of new temperature declines. (U. S. Emb., Copenhagen, June 30.)

NORWAY

SEEKS CONTRIBUTIONS TO 'NORWEGIAN SALMON SHOP'

The head of the Norwegian Directorate for Fish and Wildlife proposes that Norway start negotiations with other salmon-fishing nations for direct contributions to the operation of the "Norwegian Salmon Shop." He said Norway is carrying entire expense for cultivation of salmon-spawning grounds and inspection of fishing area--while other countries, especially Denmark, West Germany, and Sweden, catch Norwegian salmon.

He Proposes Contributions

The director proposes that these nations contribute to cultivation work in Norwegian rivers and inspection of fishing areas by contributing to fund that might be administered by his directorate. (U.S. Emb., Copenhagen, July 9.)

* * *

SARDINE PRODUCTION AND EXPORT TRENDS REPORTED

A few years ago, the winter herring kept canneries busy early in the year. Industry's raw fish need for kippers was only about 1% of season's catches. Things have changed. In 1969, total catch was not more than Norwegian industry could utilize; the situation is repeating itself in 1970. At auctions this year, fresh-fish buyers could outbid canning industry, which has been left with trifling quantities at prices 2 to 3 times higher than last year.

Despite this, the canneries have been able to maintain production fairly well, processing frozen raw material for sild sardines.

Exports Compare With 1969

Exports of sardines this year compare favorably with same period 1969. But exports

1969 Exports to Main Markets

	Jan.-Dec. 1967		Jan.-Dec. 1968		Jan.-Dec. 1969	
	Tons	US$1000	Tons	US$1000	Tons	US$1000
United States	11,506	10,109	12,355	11,066	12,331	11,636
Great Britain	4,931	3,763	4,340	3,459	3,568	3,047
Australia	1,891	1,416	2,006	1,602	1,918	1,571
South Africa	1,317	897	1,497	1,020	1,433	1,002
Canada	841	788	804	785	798	818
Sweden	2,034	1,427	2,124	1,461	2,638	1,711
Total	28,216	22,262	28,992	23,345	27,277	23,123

NORWAY (Contd.):

to biggest market, the U.S., were interrupted by U.S. longshoremen's strike in Gulf and East Coast ports during first months of 1969. ('Norwegian Canners Export Journal,' Mar.)

* * *

PURSE SEINERS MAY SEEK CAPELIN OFF LABRADOR

Some of Norway's largest purse seiners probably will fish capelin off Labrador--following research leader Finn Devold's report to the Norwegian Fisheries Association of large resources. The association advocates a guarantee of about US$5,600 to explore that fishery.

Would Fish During Summer

If research cruise is successful, the purse seiners will go off Labrador during the summer. It would then be necessary for motherships to bring raw material to fish-meal factories, particularly in northern Norway.

The capelin resources off Labrador are not exploited today. (U.S. Emb., Copenhagen, July 16.)

* * *

GOVERNMENT AND UNION SIGN AGREEMENT

The Norwegian Fisheries Department and the Fishermen's Union signed a one-year agreement in June to support the fishing industry, particularly where coastal populations would have trouble finding other jobs.

The agreement provides for US$34 million, down US$2 million from 1969's agreement, but about US$1.8 million above June 1968 agreement. These amounts do not include money provided specifically to support stockfish trade. The support proposed must be approved by parliament.

5-Year Program Fails

The year ending May 31, 1969, ended the 5-year period in which the union and government pledged to make the fisheries independent of State price support (General Fisheries Agreement of 1965). Actually, state price support has gained substantially since 1964-65. The agreement was based on assumption that support would result in a reasonable improvement in fishermen's incomes through greater efficiency. Incomes would have been unreasonably low without state financial aid.

Cod Fishery Aid

The new agreement, when approved, will be valid from June 1, 1970, until May 31, 1971. The support will involve US$8.7 million for cod fishery (US$8.8 million in year ended May 31, 1970), and US$5.3 million for herring fishery (US$9.5 million). Also, US$2 million (US$0.7 million) will be available to Fisheries Department for special support to cod fisheries, including stabilization efforts in case of unexpected market failures.

Subsidy Amounts

The estimated subsidy for cod will remain at 0.5 cent per lb.; mackerel and sprat for human consumption will get 0.6 cent/lb.; herring 0.7 cent/lb.; shrimp 0.5 cent/lb.; crabs 0.7 cent/lb.

The arrangement for freight subsidies from distant waters has been expanded to include Faroe Islands, Shetland Islands, Orkney Islands, and Irish Sea. Norway has been criticized for keeping prices artificially low by these support devices. (U.S. Embassy, Copenhagen, July 21.)

* * *

INCREASES MACKEREL EXPORTS TO U.S. & SWEDEN

Fifty thousand 400-gram packages of frozen mackerel fillets were scheduled for shipment to U.S. during July, the director of Norway's Mackerel Association reported. The association has been trying to develop the U.S. market. It looks forward to larger orders. The director expects to visit the U.S. later this year to learn more about market prospects.

Swedish Interest

Sweden has imported large packs of round mackerel during 1970. She is interested in this product. Market prices in Sweden are good, and sales are expected to increase. Frionor covers the market.

NORWAY (Contd.):

Netherlands

The Netherlands previously imported mackerel from Norway. She has been unable to meet the price increase during 1970. Because of 20% duty increase by European Communities on June 15, imports from Norway have practically stopped. The Netherlands now is importing French and Japanese mackerel.

New Foreign Markets Important

Norway learned in 1969 the importance of developing new markets abroad and increasing mackerel sales. The association believes it essential for Norway to deliver her own product to live up to standards foreign countries expect of her products. ('Fiskaren,' June 25.)

* * *

FACTORYSHIP TO OPERATE OFF NORTH COAST

The factoryship 'Norglobal', recently built from a bulk carrier, was slated to start fish meal and oil production in mid-July near Bear Island for summer capelin. The fishing operations at Bear Island will allow experts to break in the machinery before the vessel sails for the South Atlantic later this year.

Continuous Production

The production machinery will handle a maximum of 300 metric tons of raw material in 24 hours. Production will be continuous in 12-hour shifts manned by 25 men. The ship's normal crew is 60-65 men. The raw material storage capacity corresponds to 40 hours of full operation. The meal pellet storeroom can hold about 10,000 tons; the fish oil storerooms about 2,400 tons. The storerooms can be filled in one month if sufficient supplies of raw material are available.

It Will Be Mothership

The factoryship has the most up-to-date production and transport equipment. The ship's discharge pumps have a capacity of 800 tons of fish an hour and fully automatic scales. The fish meal is pelleted in four pellet presses; each handles hourly a minimum capacity of 8 tons of pellets. The vessel will be mothership to a purse-seine fishing fleet of 12 to 15. The vessel's products will be landed by transport vessels, which also service the expedition.

World's Largest

The Norglobal is the largest floating fishmeal factory in the world. It has a deadweight of 27,300 tons. Total investment is about US$7 million. Nordsildmel will market the products. (U.S. Embassy, Copenhagen, July 23.)

* * *

GROUP STUDIES AFRICAN MARKETS

A Norwegian fishery delegation recently visited 4 African countries to study market conditions, especially for stockfish in Nigeria. Up to now, governments have not permitted stockfish imports due to exchange problems. In Nigeria, a license to import Norwegian stockfish is expected to be issued, but the quantity is unknown. The delegation offered a government loan credit to Nigeria to buy stockfish, and a gift of some aid to areas hardest hit by the civil war. Nigeria was considering the offer.

Other Potential Markets

The Norwegian delegation found sales possibilities in Liberia, Ivory Coast, and Ghana. Excluding stockfish to Nigeria, Norway's fish exports to Africa have been minimal.

Seven Norwegian trawlers are fishing off Ghana.

The 4 Want Fishing Trade

The four countries visited are attempting to develop a fishing trade but lack know-how. Their governments contract with foreign trawlers, especially East European, to deliver frozen fish. A refrigerated distribution chain is being developed throughout the four countries.

Non-African Countries Active

The number of U.S. tuna vessels in the area has increased. The French fleet is particularly active in the Ivory Coast. Italy has offered aid to expand the fleets of the 4 countries. (U.S. Embassy, Copenhagen, Aug. 13.)

* * *

NORWAY (Contd.):

FRIONOR EXPECTS NEW FISH-FILLET RECORD IN 1970

The director of Norway's Frionor Frozen Fish A/L reports the freezer plants' frozen-fillet production and sales have never been steadier than now. Unless a raw material shortage occurs, last year's record production of 82,000 metric tons (200,000 tons of raw material) will be surpassed by far. During the first 5 months of 1970, production was running about 30% higher than in same period 1969, and plants were working full force without restrictions.

Presently, there are no stocks at the freezer plants because exports are in step with production. Market prices also continue to rise.

Coastal Areas Aided

This expansion is important to the coastal areas. Problems in other industry sectors have been somewhat eased. When difficulties arose in dried fish sales, many fishermen sold to filleting plants. Improved utilization has reduced operating costs, but these have been counterbalanced by higher prices for fish and increasing duties in the Common Market. The duty into France is 24% ad valorem, and into Western Germany and Benelux countries 16.2%.

Frionor's Annual Report

Frionor's last annual report showed major progress in selling more processed products--grill products, fish sticks and portions; these gained 34.5%. The regular fillet trade increased 26.4%. Sales of frozen fish in the round increased 23.2%.

The U.S. market has been the largest purchaser of Frionor products: about 38%.

Frionor noted good progress also in exports to EFTA countries and Australia, but exports to the Common Market declined somewhat due to recent tariff increases. Communist Bloc (COMECON) purchases, previously large buyers of Frionor products like saithe fillets, also declined. These sales have increased recently. (U.S. Embassy, Copenhagen, Aug. 13.)

* * *

VESSEL WILL FISH SALMON OFF GREENLAND

The Norwegian M/S 'Skrolsvik' recently headed for Greenland waters via Cape Farwell, Faeringehaven, and Disko Bay, where the gear will be tried out for salmon fishing. This is the first time in many years that a vessel from north Norway will participate in the salmon fishery off Greenland. About 25 Danish vessels fish in the area. Some from Møre, Norway, are expected to leave for Greenland waters.

600 Nets

Skrolsvik, manned by 10, is equipped with about 600 monofilament salmon nets; 500 of these will be used at first, the remainder held in reserve. The vessel will fish off West and East Greenland until November. Investment cost for gear, nets, floatage, drift material, and food is about US$36,700. (U.S. Embassy, Copenhagen, Aug. 11.)

* * *

REPLACES 120 SHRIMP PEELERS WITH TWO NEW MACHINES

Two Danish shrimp-peeling machines have been installed in Norway. If they meet expectations, they would operate 24 hours and peel 176 lbs. of raw shrimp an hour, or more than 4 metric tons a day. They would replace about 120 female shrimp peelers.

The two machines, including cost, transportation, installation, and additional equipment cost over US$70,000.

12 Machines Produced

A Danish engineer who installed them said his firm previously had manufactured 10 similar machines. Several were sent to Greenland; one to Alaska. With these machines, Norwegian shrimp production may soon equal Greenland's. The market for frozen shrimp is reported stable, and the demand increasing.

15 Vessels Supply Plants

The supply of raw material for Norway's industry has been much larger than industry was able to handle. Fifteen vessels now are delivering raw material to the peeling plants. Several of the vessels, however, had to ship their catches to other areas.

The new shrimp-peeling machines and 60 shrimp peelers are expected to handle more than 5 metric tons a day. (U.S. Embassy, Copenhagen, Aug. 4.)

USSR

ARTIFICIAL SATELLITES WILL AID FISHERY RESEARCH

Soviet scientists plan to use artificial earth satellites for fishery and oceanographic research. They believe satellites are necessary to exploit successfully resources in the seas far from shore and Continental Shelf. Some 156-187 million square miles will be surveyed.

At 10-15 day intervals, the satellites will map currents, temperature, chemical composition, and density of the waters. These data are essential for determining commercial concentrations of fish, other marine animals, and distribution by species.

Fishery Expansion Needed

There is a need for large-scale expansion of fisheries into the open oceans because stocks along coasts and on Continental Shelf fished by Soviets are approaching maximum sustainable yield. Global exploration for commercial concentrations of fish can be carried out only by satellites.

Plankton Surveys

The scientists also plan plankton surveys. They expect plankton to be used for human consumption in the future. Data on salinity, temperature, chemical composition, and density of ocean waters will be collected partly by satellites and partly by buoys that will transmit information to orbiting satellites.

Some studies of world's oceans already have been conducted by satellite "Soyuz-9". ('Izvestia,' July 1.)

* * *

TEST NEW TRAWLS, DEVELOP ACOUSTIC SYSTEM

The Kaliningrad fleet of Soviet Western Fisheries Administration is introducing aboard its 'Atlantik'-class factory stern trawlers a new, light weight bottom trawl with a vertical opening of 65.6 feet. This is 19.7 feet larger than opening of conventional trawls designed by Atlantic Fisheries Research Institute (ATLANTNIRO).

The new trawl makes it possible to increase vessel's towing speed to 6.6 knots and catches by 30%. The Far Eastern and Azov-Black Sea Fisheries Administrations will adopt the new trawl soon.

Test New Trawls

The Soviets also are testing in east-central Atlantic a large-mesh midwater trawl, and a wingless trawl with 20-inch mesh size. When tests are completed, the trawls will be introduced aboard Atlantik-class stern trawlers.

The lightweight bottom trawl with a large vertical opening is a modified conventional trawl. It is suitable only for very smooth bottom because a rough bottom would tear the light twine.

Large-Mesh Midwater Trawl

The large-mesh midwater trawl with very wide opening can be used for herring, mackerel, or alewives. The purpose of large-mesh netting at trawl mouth is to "corral" fish toward center and cod-end of trawl, where mesh size is reduced to normal 4.5-5 cm.

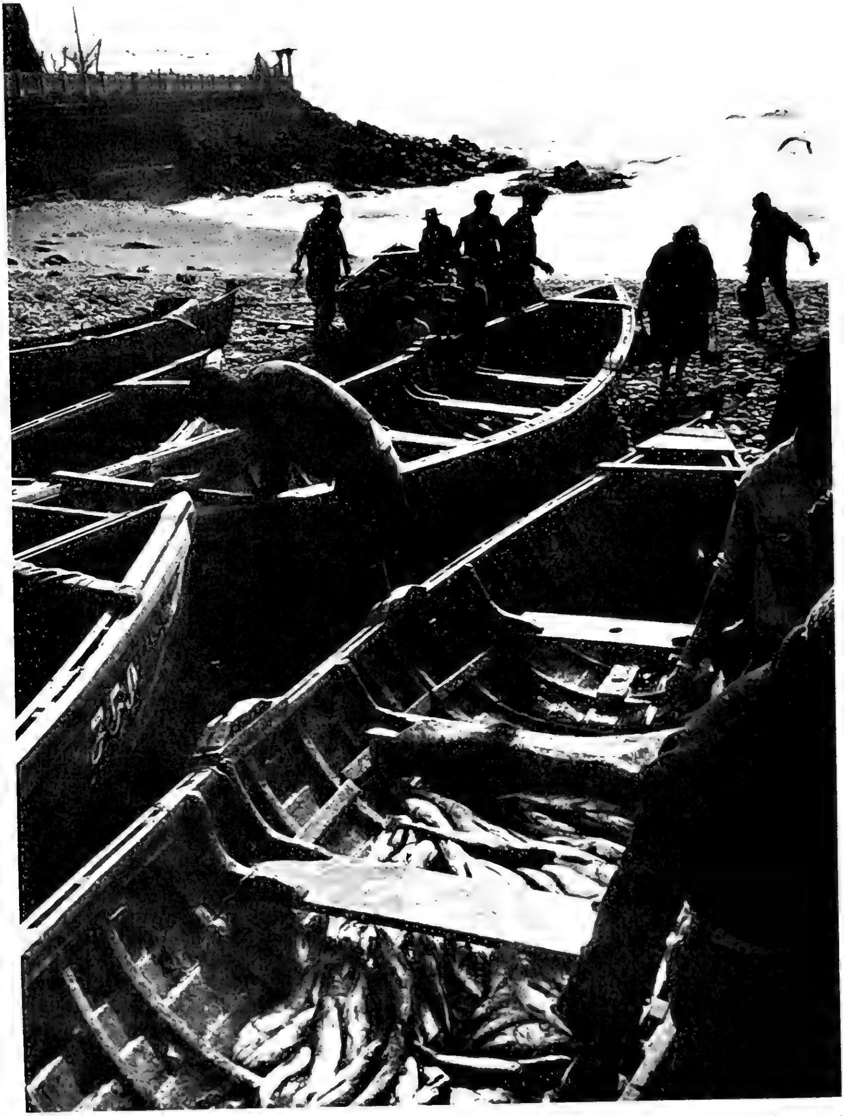
The Soviet mesh size is relatively "modest" compared to Canadians' midwater trawls with 42" meshes at trawl mouth tested in 1969.

If tests are successful, as Soviets claim, stern trawlers may be expected to use the new trawl to fish herring and mackerel.

New Underwater Acoustic System

The Sakhalin branch of the Soviet Science Academy has designed an underwater acoustic-electronic device ('Kalmar'), now in serial production. The device fits into a small buoy. It is intended to detect sounds made by marine mammals and warn against underwater earthquakes and tsunami waves.

The new device is not the echo-sounder 'Kalmar' used aboard Soviet vessels to locate fish schools.



CHILE: A small fishing port where fishermen sell catch directly to customers from open boats. (FAO: S. Larrain)

LATIN AMERICA

PERU

EPCHAP TAKES CONTROL

On July 1, Peru's EPCHAP assumed complete control of Peruvianfish meal and oil sale. EPCHAP is Empresa Publica para la Commercializacion de Harine y Aceite de Pescado. EPCHAP already had sold 30,000-40,000 tons of fish meal.

Although there are many unanswered questions about what payment fishmeal plants will receive, the operation is working and market conditions should hold up prices.

EPCHAP will receive 3% of gross value of meal it sells in payment for its marketing service. In 1969, this would have produced about C$6.6 million.

To Take Over Consorcio

To facilitate marketing, EPCHAP will take over control of the foreign and domestic installations and equipment of Consorcio Pesquero del Peru. The Consorcio has substantial cargo-discharging facilities in Stockton, California; Wilmington, North Carolina; and Europe. Previously, it has controlled 40% of Peru's fish-meal exports.

Because Consorcio has charged its members only 1.5% of gross value, movement is reported in industry to have government reduce 3% rate authorized for EPCHAP.

Closed Season For Anchovy

On July 1, the official newspaper, "El Peruano," announced a complete closed season, or "veda", for fishing anchovy (basis of fishmeal industry). It was to run from July 11 to August 31. The Government had imposed a partial veda on May 13. This allowed port of Ilo to continue operating; it also allowed fishmeal plants that had not caught 10,000 tons during regular season to catch 300,000 tons more.

This unusual "complete" closing may be response to fears that anchovy was overfished in 1969/70 season. The announced reason was to permit a joint Norwegian-Peruvian study of migratory habits of anchovy. This investigation will cost about $50,000 and involve marking 200,000 anchovy along coast during veda. Once fishing season opens, marked fish will be retrieved electronically at fishmeal plants. Presently little is known about anchovy's migratory habits. (U.S. Embassy, Lima, July 7.)

PANAMA

1969 SHRIMP CATCH DROPPED BELOW 1968's

Panama's 1969 shrimp catch (preliminary information) was 12,230,892 lbs., down 969,460 lbs. from 1968. The 1969 figure does not include 231,714 lbs. of "Solencocera" variety.

Value of shrimp exported decreased from US$9.64 million in 1968 to slightly more than $9 million in 1969 (f.o.b. Balboa).

Catch of premium-grade whites remained close to levels of recent years. However, catch of pinks dropped to almost half of 1968 and to ten-year low.

Greater Production Sought

Industry and government are trying to develop more efficient use of marine resources. This may lead to greater shrimp production in the future.

Two developments are especially encouraging: 1) an experiment to forestall shrimping before shrimp reach maturity was conducted in March 1970; the results were promising.

The government, on recommendation of National Fishing Association, declared 1-month closed season on shrimping. Government studies concluded that industry was not getting maximum yield because shrimp, especially more valuable whites, were being caught before maturity. The experiment was considered very successful and probably will be repeated in 1971.

2) Industry experiments point to possibility of profitable shrimp fishing in waters not fished before. (U.S. Embassy, Panama, May 13.)

ASIA

JAPAN

TUNA CO-OP PLANS DIRECT SALES TO RETAILERS

In an effort to stabilize fish prices, the Federation of Japan Tuna Fisheries Cooperative Associations (NIKKATSUREN) plans to sell tuna directly to retailers. Fish wholesalers will be bypassed. Savings will be passed on to tuna producers and retailers by buying at high prices from producers and selling at low prices to retailers.

How It Would Work

The tuna purchased from vessel owners will be sold to retailers in round or dressed form. Since freshness cannot be determined until fish are thawed and cut open, NIKKATSUREN will assume the buyer's risk of getting round fish of substandard quality. In the beginning, retail outlets will be volume consumers--supermarkets, hotels, "sushi" (raw fish served with rice) restaurants, and wholesalers in outlying areas. A plan also under consideration would establish eventually cold-storages, distribution centers, and processing facilities in consumer areas.

Direct Sales Are Test

NIKKATSUREN's idea of direct sales will serve as a test case in reforming existing fish distribution system. Representatives of NIKKATSUREN and major supermarket chains have discussed the direct sales plan. Supermarket operators welcomed the idea as an improvement in customer service, although concerned about possible friction with established wholesalers and brokers.

NIKKATSUREN officials explained that they do not intend to ignore existing marketing structure. They hope venture will stimulate business. They stress the fact that direct sales would comprise only a fraction of fish trade's total volume, their objective conforms to Government's price stabilization policy.

The venture will be a 3-year experiment. During that period, NIKKATSUREN hopes to sell 7,430 metric tons of tuna worth US$6.89 million. ('Suisan Keizai Shimbun,' May 29.)

* * *

PLANS TUNA-REARING EXPERIMENT

Japan's Shizuoka Prefectural Fisheries Experimental Station plans a tuna-rearing experiment this year.

The first objective is to rear young bluefin taken in Suruga Bay's set-net fishery during May-Aug. each year to marketable size. This would increase their commercial value.

The ultimate aim is to rear the tuna to maturity and achieve spawning and fertilization under controlled conditions.

US$7,000 has been earmarked for the project, which includes building two octagonal floating pens for Uchiura Bay off Numazu City. Each side of the pen will be 16.4 feet long, the enclosure 30 feet deep. One-year-old bluefin trapped in the set nets will be transferred to the pens and reared until two years old. About 100 fish will be placed in each enclosure.

Bluefin Yearlings

Bluefin yearlings captured in the set nets measure 12-16 inches and weigh 0.7-1 pound. Two-year-olds reach 4-18 pounds. They would grow considerably if they could survive winter in Japan, where water temperatures drop to 12° C. (53.6° F.). This and feeding are the major problems in the experiment.

One Successful Experiment

The only successful Japanese bluefin rearing experiment so far was the one by Nagasaki Prefectural Fisheries Experiment Station. One tuna was kept alive for one month; the fish grew from 4 pounds to about 5.7 pounds. ('Suisan Keizai Shimbun,' Apr. 22, and Japanese press article from W.L. Klawe, IATTC.)

* * *

Apr. 1 and Mar. 31 Fiscal Year	Planned Sales Quantity	Planned Sales Value	Estimated Average Monthly Sales	Estimated Average Price
	Metric Tons	US$1,000	Metric Tons	US$/Metric Ton
1970	1,286	1,072	160	833
1971	2,160	1,944	180	900
1972	3,984	3,873	332	972
	7,430	6,889		

JAPAN (Contd.):

INCREASE PRICE FOR EXPORT CANNED WHITE-MEAT TUNA

Effective May 12, the Tokyo Canned Tuna Sales Co. announced new prices for canned white-meat tuna packed in brine for export to U.S. In standard pack (48 7-oz. cans), new price reflects a US$0.55 increase, which brings U.S. destination price to around $17.70 a case.

Canned White Tuna in Brine Export Prices (Exwarehouse Shimizu)

Can & Case Size		Price per Case New Price US$	Old Price US$
Solid:	7-oz. 48's	13.22	12.67
	$3\frac{1}{2}$-oz. 48's	7.97	7.69
	$1\frac{3}{4}$-oz. 24's	12.83	12.31
	$66\frac{1}{2}$-oz. 6's	15.28	14.64
	6.6-lb. 6's	26.39	25.28
Flake:	$6\frac{1}{2}$-oz. 48's	9.67	9.28
Chunk:	6.6-lb. 6's	23.58	22.56

Reason for Rise

Decision to raise price was based on: (1) lack of supply to meet vigorous demand by trading firms; (2) continued firm frozen tuna export market in U. S.; and (3) high albacore prices on domestic market.

Export prices for canned light meat tuna remain unchanged. ('Suisan Tsushin', May 11.)

* * *

FROZEN-TUNA EXPORTS DROP DURING JAN.-JUNE 1970

During first-half 1970, Japanese frozen-tuna exports were 22,432 metric tons--about 10,500 tons, or 32%, below same period in 1969 and less than half 1968 period. Particularly notable is the sharp decline in exports of albacore, sold mostly to the U.S. ('Suisan Tsushin,' July 24.)

* * *

1969 LANDINGS WERE SLIGHTLY BELOW 1968's

In 1969, Japan's fishery landings totaled about 8.61 million metric tons (excluding whales), slightly below 1968 landings of 8.67 million tons. Decline was due largely to sharp reduction in squid and saury catches. ('Suisan Tsushin,' May 7.)

* * *

NEW FIRM TO BUILD 1,100-GROSS-TON TUNA PURSE SEINER

On June 5, 1970, Overseas Purse Seine Fishing Co. was established with capital of US$194,000, invested jointly by 8 Japanese fishing firms. The new company plans to build a 1,100-gross-ton, 800-ton carrying capacity tuna purse seiner by Jan. or Feb. 1971 for use in eastern Pacific yellowfin tuna fishery.

Original plan was to have vessel built in U.S., but higher costs there ($2 million compared with about $1.6 million in Japan) changed plan. Total cost: about $1.8 million.

The company plans to hire a U.S. skipper. The seiner will have a brine-freezing unit (minimum temperature -18° C., or -0.4° F.), and 4 speedboats and one skiff to be purchased from U.S. for estimated $56,000. Deck gear will include power block costing about $83,000.

Plans For Seiner

The present plan is to send seiner in early 1971 to eastern Pacific yellowfin tuna regulatory area until season closes around April. Then vessel will operate 2-3 months outside area. If fishing is not good, it will go to Caribbean Sea and fish until mid-May. Then, across Atlantic to operate off west Africa. Operations may be extended to bluefin tuna fishery in Indian Ocean between Indonesia and Australia. Operational plan is for continuous fishing for 4 years without returning to Japan. Replacements (for 16-man crew) will be flown from Japan periodically.

Much Hope in New Industry

Industry hopes new company will modernize outmoded purse-seine fishery.

The Japanese Fisheries Agency intends to back the plan financially. It is considering a subsidy in fiscal 1971 for exploratory trips to develop new grounds. ('Suisan Tsushin,' June 8 & 9.)

* * *

JAPAN (Contd.):

TUNA PURSE SEINER MODIFIED FOR EASTERN PACIFIC TRIP

The Japanese Kawajiri Gyogyo-owned purse seiner 'Hakuryu Maru No. 55' (499.5 gross tons) experienced failures in eastern Pacific yellowfin tuna fishery in 1969 and early 1970. It returned to Japan in late April for modifications.

Important Changes

Important changes included conversion to double deck, enlargement of fish holds, and improvement of engine system. Modifications were completed in mid-June.

The vessel is fishing off the Japanese islands until fall, when it will depart for eastern Pacific tuna fishery. ('Suisan Keizai Shimbun,' June 4.)

* * *

TUNA LONGLINERS FISH ATLANTIC IN RECORD NUMBERS

Around 250 tuna longliners were fishing in the Atlantic at the end of July, a record: 100 Taiwanese, over 70 South Korean, about 50 Japanese, and 10 each Cuban and Panamanian.

The Panamanian flag vessels are manned mostly by South Koreans, and practically all are under charter to a South Korean fishing company. (The use of foreign-registered vessels by Koreans is due to their country's law prohibiting import of vessels older than 7 years.)

Fleets May Increase

Tawian, and possibly Cuba and Panama, may add to its tuna fleet. Japan fears increased Atlantic tuna fishing effort may lead to Atlantic Tuna Commission's questioning of longline-fishing intensity. In the past, the Japanese had close to 180 longliners in the Atlantic during peak periods. They believe tuna fishing most stable when this fleet numbered about 100-120 vessels. ('Suisan Tsushin,' July 30.)

* * *

LARGE STERN TRAWLER WILL BE BUILT

A 5,300-gross-ton stern trawler, largest of its kind in Japan, will be built by Usuki Shipyard for Hoko Suisan Fishing Co. Construction is to start Dec. 1970 and be completed by Oct. 1971.

Outstanding Features

Outstanding features will be a "surimi" (minced fish meat) producing plant and plants to reduce fish into meal and solubles. The vessel will join Hoko Suisan's 4,252-ton trawler 'Katata Maru' in the North Pacific. ('Suisan Keizai Shimbun,' July 13.)

* * *

TWO TRAWLERS SENT TO NORTHWEST ATLANTIC

On April 11, 1970, the Japanese Fisheries Agency licensed two stern trawlers for the northwestern Atlantic north of 45° N. lat. on a 6-month experimental basis. The vessels, owned by Nihon Suisan, are: 'Tokachi Maru' (2,501 gross tons) and 'Zao Maru' (2,530 gross tons).

In 1971, the firm plans to send to northwest Atlantic a 4,000-ton-class stern trawler costing over US$4 million.

In the past, several major Japanese fishery firms have explored in that area for alternate resources for their trawlers operating off west Africa.

Membership In ICNAF Sought

The Fisheries Agency is seeking Diet (parliament) approval of Japan's membership in International Commission for the Northwest Atlantic Fisheries (ICNAF). If admission is gained, Japanese trawlers will be allowed to extend operations beyond present northern boundary established by the Agency. ('Shin Suisan Shimbun,' May 11.)

* * *

JAPAN (Contd.):

LICENSES 33 VESSELS FOR EASTERN PACIFIC SAURY FISHING

The Japanese Fisheries Agency decided to license 33 saury vessels this year to fish in the North Pacific east of 165° E. longitude. The 33 do not include the 2 vessels licensed in early 1970 for exploratory saury fishing in the eastern Pacific. The 2 vessels received a 75-million-yen (US$208,000) Government subsidy.

Applications Limited

By mid-July, owners filed applications for 44 vessels. To limit number to 33, June 20 was set as cutoff application date. Decision was based on fear that unrestricted fishing off North America would create international problems and might irritate U.S. fishermen. The Agency action showed the government was controlling saury operations. (In 1969, 7 Japanese vessels fished saury in eastern Pacific.) Most of the vessels vary from 291 to 549 gross tons. Included is a 1,167-ton mothership (with three 96-ton vessels) and one 690-ton mothership (with 296-ton vessels).

2 Fishing E. Pacific

In mid-July, 2 of the 33 vessels licensed were fishing in eastern Pacific. The 535-ton 'Tone Maru' was off San Francisco, exploring northward toward Seattle. It was landing about 1 ton of saury a day. Size of fish was small and schools sparse. This indicated best fishing season in that region may be from around late-Aug. to Oct.

Subsidized Saury Explorations

The 2 trawlers exploring for saury in North Pacific on Government-subsidized cruise are 'Akebono Maru No. 15' (499 gross tons) and 'Habomai Maru No. 21' (299 gross tons). These were fishing in central Pacific between 160° E. and 170° E. longitudes. Fishing was not good; catches average 2 to 4 tons per vessel a day. The 2 vessels were scheduled to return to Japan in September. They will depart then for west coast of North America (Pacific Northwest). ('Suisan Tsushin,' July 15 & 22.)

* * *

JAPANESE & MAURITIANS SIGN TUNA-FISHING AGREEMENT

A new tuna fishing/cannery agreement was signed July 15 by Japanese and Mauritian interests. The invested capital for new firm, Mauritius Tuna Fish and Canning Enterprises, Ltd. is about US$800,000; each side has half the shares.

Job Possibilities

It is hoped that up to 1,200 Mauritians will get jobs: some on new vessel to be purchased, others in cannery and tin-producing plants to begin operation early in 1971, and others in cold-storage plant under consideration.

After the signing ceremonies, Mauritius Minister of Commerce Guy Marchand, sensitive to local unemployment, emphasized these employment possibilities at a press conference. (U.S. Emb., Port Louis, July 18.)

* * *

JAPAN & S. KOREA WILL DISCUSS CONTINENTAL SHELF BOUNDARY

Japanese and S. Korean firms plan to exploit oil and natural gas resources on Continental Shelf in Sanin coastal area, Korean Straits, and East China Sea. The plans are incentive for negotiations to establish a boundary on Continental Shelf between the two countries.

Korean "Sea-Bed Mineral Resources Development Law," Jan. 1970, set up 7 mining areas on Shelf; 3 of these overlapped areas Japanese seek to exploit.

Talks in Fall

Both Korea and Japan are expected to "suspend" claimed rights over Shelf until agreement is reached. Talks are to begin in September or October. ('Asahi,' July 9.)

Neither country is party to Convention on the Continental Shelf. It provides that, in absence of other agreement, Continental Shelf boundary between two member countries is median line.

NORTH VIETNAM

FISHERIES MINISTER SEEKS POLISH AID

During a visit to Poland, the North Vietnamese Minister of Fisheries, Nguyen Trong Tinh, was interviewed by a Gdansk newspaper, 'Glos Wybrzeza'. Tinh said:

". . .Fish is the second staple after rice for the North Vietnamese. It is thus not surprising that the Government attaches so much importance to the increase in fishery catches--the second bread of Vietnam.

"At the time of France's colonial rule over Vietnam there existed only private fishing. Influential shipowners, representing French capital, exploited fishermen. The situation changed after we gained independence. Private fishing enterprises ceased to exist. Cooperatives were set up run by the fishermen themselves."

Fishing During War

How do they fish during war?

"Our fishermen sailed on the Bay of Tonkin at night. Units which did not manage to come back before daybreak fought against the enemy. Fishing units barely equipped with arms shot down 32 aircraft."

Development Plans

"Fishing is administered by the Central Office of Fisheries Administration, established in 1960. State and cooperative enterprises are subordinate to it. The Office's task is to work out plans for the development of fishing and supervise it.

"The plans envisage the development of the three basic sectors of fishing: breeding (fish culture), catching, and processing. Availing ourselves of the assistance of the socialist countries, especially Poland, we want to develop gradually all kinds of fishing, from boat fishing in the Bay of Tonkin to trawler fishing in the South China Sea.

"The abundance of fish in the Bay of Tonkin makes it possible to intensify fishing by introducing gradually limited mechanization. This applies to processing as well. At present the processing industry produces sauces and fried fish. The long-term plan envisages the setting up of 2 new central enterprises and 8 provincial ones. In this way a large state fishing enterprise will be situated in every seashore province.

"At present North Vietnam has about 8,000 various kinds of vessels catching about 500,000 metric tons of fish. Among them are the traditional junks but we have more and more motorboats. The enterprise in Haiphong has two refrigerating (freezer) trawlers and well-organized preserving (canning) and fish meal plants, constructed with the assistance of Soviet specialists.

"The Bay of Tonkin, abounding in fish (there are more than 900 species), guarantees. . .the possibility of a rapid development of fishing."

"Minister Tinh's current visit to Poland is also to serve this goal," the newspaper said.

TAIWAN

TUNA FISHERY GROUP FORMED

On June 16, the Taiwan Regional Tuna Exporters Association was formally established to represent tuna producers and exporters. It will help to obtain government loans and provide guarantees. Presently, its activities are limited to advisory services.

60 Members So Far

Only 60 of Taiwan's 352 companies in tuna fisheries and exports have joined. Eventually, all companies in the tuna industry are expected to participate. ('Katsuomaguro Tsushin,' June 26.)

INDEX

Index continued page 80.

INDEX (CONTINUED)

U. S. GOVERNMENT PRINTING OFFICE : 1-7 : 435-134/2

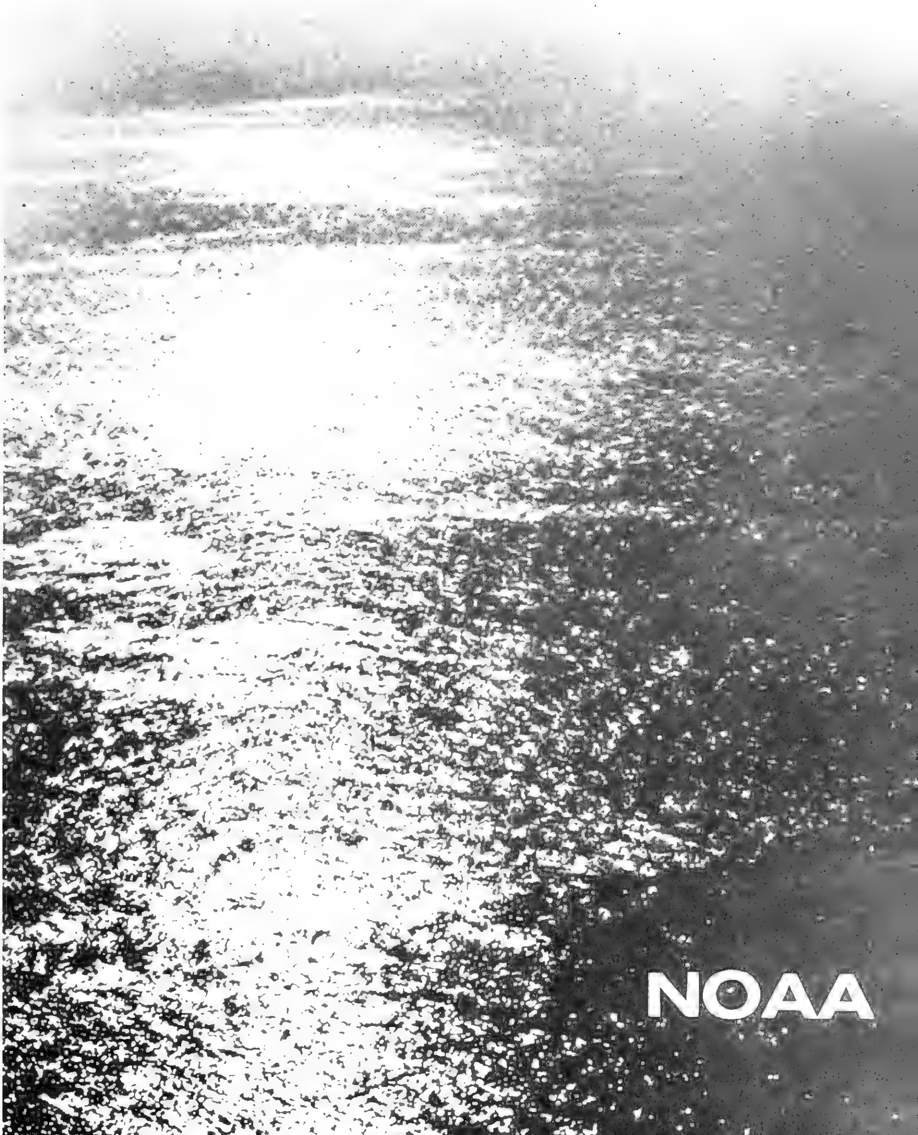
UNITED STATES DEPARTMENT OF THE INTERIOR
Walter J. Hickel, *Secretary*
Fred J. Russell, *Under Secretary*
Leslie L. Glasgow, *Assistant Secretary for Fish and Wildlife and Parks*
Charles H. Meacham, *Commissioner*, U.S. FISH AND WILDLIFE SERVICE
Philip M. Roedel, *Director*, BUREAU OF COMMERCIAL FISHERIES

BACK COVER: Massachusetts State Fishery Biologist checks mixed catch aboard BCF's 'Albatross IV'.
(R. K. Brigham)

COMMERCIAL FISHERIES Review

VOL. 32, NO. 10

OCTOBER 1970



U.S.
DEPARTMENT
OF
COMMERCE
National
Oceanic and
Atmospheric
Administration

NATIONAL MARINE
FISHERIES SERVICE

NOAA

U.S. DEPARTMENT OF COMMERCE
Maurice H. Stans, Secretary
Rocco C. Siciliano, Under Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Dr. Robert M. White, Acting Administrator

NATIONAL MARINE FISHERIES SERVICE
Philip M. Roedel, Director

Secretary of Commerce Maurice H. Stans

Dr. Robert M. White

COMMERCIAL FISHERIES

Review

A comprehensive view of United States and foreign fishing industries--including catch, processing, marketing, research, and legislation--prepared by the National Marine Fisheries Service (formerly Bureau of Commercial Fisheries).

Fishermen's Memorial
Gloucester, Mass.

CONTENTS

Philip M. Roedel

A Message from the Director

We have become part of the new National Oceanic and Atmospheric Administration. NOAA attests our government's recognition that "the oceans and the atmosphere are interacting parts of the total environmental system upon which we depend not only for the quality of our lives, but for life itself."

NOAA will strive to improve our understanding of this environmental system--and the way we use it.

NOAA is a functioning agency. It is large enough for a mission that involves nearly three-fourths of the surface of our planet. It brings together 13,000 persons representing a broad range of scientific talent, a great fleet, and remarkable equipment that probes the seas and the atmosphere. As new challenges emerge, it must be prepared to meet them.

Why NOAA? President Nixon explained: "By employing a unified approach to the problems of the oceans and atmosphere, we can increase our knowledge and expand our opportunities not only in those areas, but in the third major component of our environment, the solid earth as well."

NOAA means that the strengths of many organizations are joined, which for us means that the strengths of others can be added to our own in carrying out our mission. Secretary of Commerce Stans has commented on how the members of the new NOAA family will benefit from the union. For example, the combined NOAA fleet will be able to accomplish far more than did its component parts. With a closely coordinated program, it will be able to collect more data to meet both our needs for fishery information and those of others for mapping and charting. The fleet will enable the National Oceanographic Instrumentation Center to test equipment at sea. It will permit the Sea Grant Program "to provide training facilities for the education of young people in this exciting and challenging field."

What are our roles--the roles of the National Marine Fisheries Service?

Our primary role is to gain, through scientific studies, enough information about the size, distribution, and susceptibility to capture of fish stocks--so that we will know how many fish can be taken without endangering a species and can contribute to programs designed to manage fisheries for conservation purposes. At the same time, we must gather enough information to help insure that the aquatic environment will be protected.

In cooperation with other entities, we will work toward development of management techniques at international, national and state levels that will permit rational allocations of stocks among the nations of the world, and among user groups in the United States--commercial, sport, and others.

We will aid the fishing industry where factors such as the common-property nature of the resource prevent the industry from doing the job itself.

And we will help insure that the American public is adequately informed about the products it buys.

We will work with other Federal agencies to assist developing nations meet some of their food needs from the sea.

As the National Marine Fisheries Service, our responsibilities are much broader than were those of its component parts--the Bureau of Commercial Fisheries and the Marine Sport Fish Laboratories of the Bureau of Sport Fisheries and Wildlife. Now we are assuming responsibilities for all living marine resources.

We must first consider the resource, then the needs and desires of all user groups will be given equal attention. These include both recreational and commercial interests--remembering that recreational users include not only sport fishermen but such people as those who go to watch whales migrate, to take pictures, or merely to escape the pressures of daily routine.

The basic goal of our organization is conservation: the wise use of living marine resources. This requires not only a strong biological base, but input from a variety of scientific disciplines. Finally, if conservation in its broadest sense is to become a reality, we must have a sound understanding of the legal, social, and political factors affecting resource use.

In 1970, NMFS and its predecessor agencies complete a century of service. In time, the names and dates of these organizations may be jumbled in the public mind, but their achievements will remain clear to us: They contributed much to piercing the darkness that was upon "the face of the deep."

In an early issue of COMMERCIAL FISHERIES REVIEW, I will discuss with you what we have done to reshape the Bureau of Commercial Fisheries for its vital role in NOAA--as the National Marine Fisheries Service.

BCF JOINED TO NEW NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

President Nixon's plan to reorganize the Nation's oceanic and atmospheric organizations into a single part of the U.S. Department of Commerce--the National Oceanic and Atmospheric Administration (NOAA)--went into effect on October 3, 1970.

The President sent his plan to Congress on July 9. After 60 consecutive days in session, neither house disapproved it.

(See CFR July 1970.)

The Bureau of Commercial Fisheries (BCF) was transferred to NOAA and renamed NATIONAL MARINE FISHERIES SERVICE.

NOAA

NOAA's largest component by far is Commerce Department's Environmental Science Services Administration (ESSA): 10,000 employes, 83% of NOAA's personnel, and estimated Fiscal 1970 expenditures of almost $200 million. Estimated budget of the other elements entering NOAA is about $71 million.

Other components of NOAA are:

FROM DEPARTMENT OF THE INTERIOR

1. Bureau of Commercial Fisheries (BCF)
2. Marine sport fish activities of Bureau of Sport Fisheries and Wildlife (BSFW)

   BCF and BSFW formerly made up The Fish and Wildlife Service.

3. Marine Minerals Technology Center of the Bureau of Mines

FROM DEPARTMENT OF DEFENSE

1. United States Survey of the Army Corps of Engineers
2. National Oceanographic Data Center of the Navy Department
3. National Oceanographic Instrumentation Center of the Navy Department

FROM DEPARTMENT OF TRANSPORTATION

National Data Buoy Project of the U.S. Coast Guard

FROM NATIONAL SCIENCE FOUNDATION

Office of Sea Grant Programs

NOAA'S ROLE

After listing the principal functions of the agencies and programs to be combined in NOAA, President Nixon outlined this role for it:

"By employing a unified approach to the problems of the oceans and atmosphere, we can increase our knowledge and expand our opportunities not only in those areas, but in the third major component of our environment, the solid earth, as well. . . .

"Drawing these activities together into a single agency would make possible a balanced Federal program to improve our understanding of the resources of the sea, and permit their development and use while guarding against the sort of thoughtless exploitation that in the past laid waste to so many of our precious natural assets. It would make possible a consolidated program for achieving a more comprehensive understanding of oceanic and atmospheric phenomena, which so greatly affect our lives and activities. It would facilitate the cooperation between public and private interests that can best serve the interests of all.

"I expect that NOAA would exercise leadership in developing a national oceanic and atmospheric program of research and development. It would coordinate its own scientific and technical resources with the technical and operational capabilities of other government agencies and private institutions. As important, NOAA would continue to provide those services to other agencies of government, industry and private individuals which have become essential to the efficient operation of our transportation systems, our agriculture and our national security. I expect it to maintain continuing and close liaison with the new Environmental Protection Agency and the Council on Environmental Quality as part of an effort to ensure that environmental questions are dealt with in their totality and that they benefit from the full range of the government's technical and human resources."

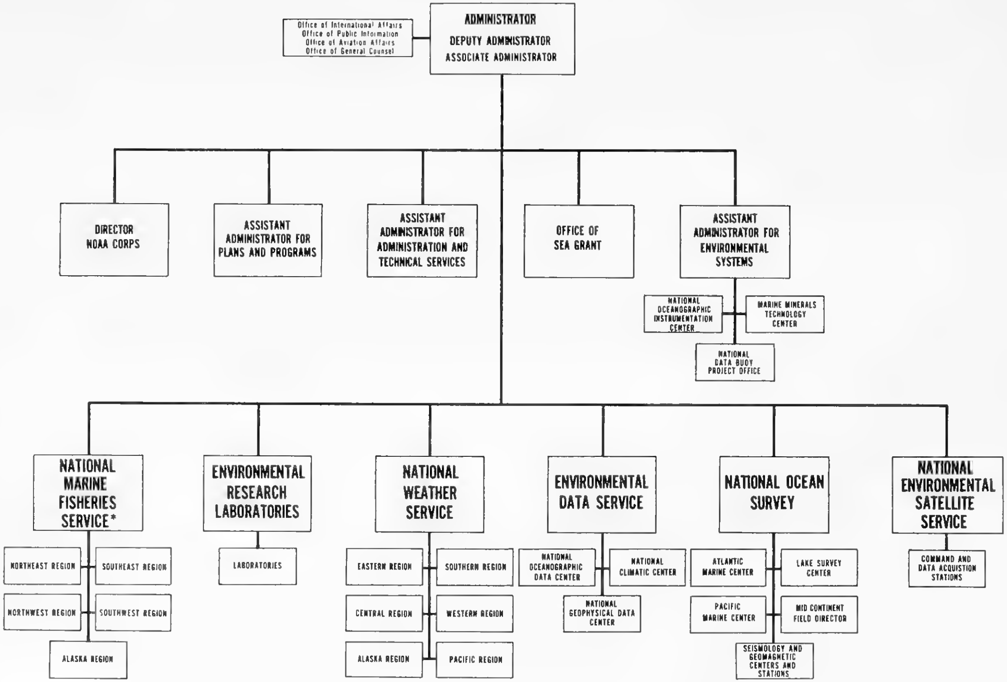
100 YEARS OF BCF
& ITS PREDECESSORS

1871 - 1903	-	First known as United States Fish Commission, the one-man commission was independent agency.
1903	-	Placed in newly established Department of Commerce and Labor. Renamed Bureau of Fisheries.
1913	-	Department of Labor was separated from Commerce. Bureau of Fisheries remained in Commerce until 1939.
1939	-	Bureau of Fisheries and U.S. Department of Agriculture's Bureau of Biological Survey were transferred to U.S. Department of the Interior.
JUNE 30, 1940	-	The 2 Bureaus were merged to form the Fish and Wildlife Service.
1956	-	The Fish and Wildlife Act of 1956 created the Bureau of Commercial Fisheries and the Bureau of Sport Fisheries and Wildlife.
OCT. 3, 1970	-	BCF transferred to NOAA in Commerce Department. Renamed National Marine Fisheries Service.

U.S. DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

(PROPOSED INTERIM Organization)



*MARINE SPORT FISHERIES LABORATORIES TEMPORARILY REPORT TO THE OFFICE OF THE DIRECTOR

SEPTEMBER 25, 1970

U.S. & CANADIAN SCIENTISTS DISCUSS PACIFIC GROUNDFISH SITUATION

Groundfish scientists of the U.S. Pacific coast states and Canada met in San Francisco in July to discuss demersal fisheries of the Pacific coast. They were members of the Technical Sub-Committee (TSC) of the International Trawl Fishery Committee. Also attending were observers from BCF, the International Halibut Commission, and the California Bottomfish Program.

The 1969 trawl catch of 158.3 million pounds was a slight increase over 1968 catches and above the 10-year average. The California Department of Fish and Game reports that scientists have been concerned with decline in petrale sole in British Columbia and Washington catch--and drastic decline in recent years in Pacific Ocean perch in Pacific Northwest.

Concern Over Some Species

The decline of petrale sole is attributed to unfavorable environmental conditions and intense fishing. Foreign fishing "appears to be the cause of the sharp decline in ocean perch." TSC scientists also were concerned over other species: lingcod, sablefish, Pacific cod, English sole, and Dover sole show minor fluctuations from those of recent years. Increasingly, Dover sole have become more important for British Columbia and Washington fishermen. It has been the leading Oregon and California trawl-caught species.

Bottomfish Research

Research on bottomfish remained at about last year's level. The U.S. Commercial Fisheries Research and Development Act, 88-309, supports most Washington and Oregon bottomfish research programs. In recent years, BCF research has increased on hake and Pacific Ocean perch, "species of international concern."

Soviet Trawl Fisheries

The groundfish scientists also discussed Soviet trawl fisheries off the coast. Observations suggest that USSR coastal hake fisheries have declined as the result of the intense fishery, says California's Department of Fish and Game. Recruitment to the fisheries is below that of past years. The Soviet pattern of operations off California has changed slightly in 1970. In previous years, BMRT trawlers left California in April; this year, several trawlers have continued past that time to fish off northern California.

FISHERIES LOAN FUND IS EXTENDED 10 YEARS

The Fisheries Loan Fund has been extended for 10 years. It has a capital authorization of $20 million.

The legislation extending the Fund also qualifies U.S. nationals of American Samoa as loan applicants. It extends the maximum loan maturity for new constructions from 10 to 14 years. Loans are limited to $40,000 at 8% interest.

Established in 1956

The loan program was established by Fish and Wildlife Act of 1956. It authorizes loans by the Secretary of the Interior to finance or refinance cost of buying, building, equipping, maintaining, repairing, or operating new or used commercial fishing vessels or gear.

DRUM SEINE REDUCES CREW OF BCF-CHARTERED VESSEL

The BCF-chartered 'Sunset' continued to fish successfully in August with a reduced crew made possible by using a drum seine. Two capacity catches of about 145 tons were made, a total of about 500 tons landed in August.

The fish/water separating screen used with the pump was working effectively. Before, aboard the 'S.G. Giuseppe', about 10% of fish-carrying capacity was lost because of excessive water taken in the hold.

Problems Remain

Several problems must be solved before maximum efficiency is achieved, notes BCF La Jolla: The pursing system needs to be overhauled; the net modified to eliminate or reduce drying-up time; a forward level wind and new side roller installed; and the net floats near center of spool need to be replaced with larger, crush-resistant floats.

ATLANTIC MENHADEN RESOURCE STATUS STUDIED

The catch of Atlantic menhaden through August 1970 was more than double the 1969-period catch. Most of the increase came from Chesapeake Bay, where the catch was $3\frac{1}{2}$ times above 1969 period. However, about 80% of Chesapeake Bay fish have been one-year-olds, an unusually high percentage even for the Bay. Normally about 50-60% of fish are one-year-olds; the range over last 15 years has been 18-91%. The 1970 exploitation rate in the Bay also appears higher than in recent years.

The abundance of one-year-old fish could indicate that 1969 year-class was relatively strong; but the catch of one-year-old fish has not been a reliable indicator of year-class strength. The preliminary data suggest that the rate of exploitation is higher, and the 1969 year-class is more available to the fishery. If this is so, then the resource continues to be in serious trouble despite this year's increased catch.

Gulf of Mexico Record

In the Gulf of Mexico, a new record will be set in 1970. This catch results from strong 1968 and 1969 year-classes of Gulf menhaden. Although the juvenile surveys are not complete, preliminary data indicate the 1970 year-class index is only half the 1968 and 1969 indexes.

Recruitment Patterns Studied

To further investigate recruitment patterns, juvenile menhaden in selected Atlantic and Gulf estuaries are tagged in the summer and fall before they migrate outward. Juveniles tagged last fall in Rhode Island estuaries occurred this spring and summer in Florida and North Carolina catches.

Analyses of the population dynamics of Gulf and Atlantic menhaden have been completed. They are being used as guidelines to recommend management procedures.

FISHERY-RESOURCE STUDY AIDED BY SPACE PROGRAM

The U.S. space program is helping to find and determine the abundance of fishery resources. An agreement between NASA and BCF enables the Bureau to use equipment at NASA's Mississippi Test Facility at Bay St. Louis and NASA's "know-how" in applying the data obtained to fishery problems.

Aerospace Sensing Studies

Initial aerospace sensing studies will involve sighting with light amplifiers, laser, aerial photos, and other equipment designed to help detect fish schools and to study sea-surface conditions from high altitudes.

NASA's engineering and management skills will be used to help develop additional sensing equipment, and to provide test and evaluation studies.

The Mississippi Test Facility is ideal to assist BCF in implementing its remote sensing activities.

Dr. Leslie L. Glasgow, Assistant Secretary of Interior, said: "Aerospace sensing offers two distinct but related opportunities to gather information on the status of oceanic resources. First is the location and assessment of living marine resources, and secondly, the sensing of broad physical, chemical, and biological conditions of the ocean which affect those resources."

NASA-BCF Cooperation

The latest NASA-BCF agreement is another cooperative effort in a series dating to mid-1960's. Then, photos and other data from manned and unmanned space flights provided valuable information on the ocean environment, including pollution.

MONTHLY SEA-SURFACE TEMPERATURE CHART AVAILABLE FOR N. PACIFIC

A new monthly sea-surface temperature chart for the northwestern Pacific is included in the Fishing Information publication of BCF's Fishery-Oceanography Center, La Jolla, Calif. Yearly and long-term sea-surface temperature anomaly charts for the area will be published later.

Dr. R. Michael Laurs, leader of Fishery-Oceanography Group, says that with this chart sea-surface temperature conditions now are monitored over entire north Pacific and eastern tropical Pacific.

Charts Will Aid Scientists

This is first time that such monthly charts are available "on a near real-time basis" for the entire North Pacific. The extensive coverage will enable BCF scientists and others "to study large-scale changes in sea surface temperature patterns that may affect the distribution, abundance, and availability of commercially important fishes in the north and eastern tropical Pacific."

Satellite Receiver In Operation

In July, an Automatic Picture Transmission (APT) satellite receiver was installed at La Jolla to provide more weather and sea-surface temperature information for fishery advisories along west coast and over eastern tropical Pacific.

During August, the APT tracked ESSA weather satellites nearly every day before issuance of the daily albacore and eastern tropical fishery advisories prepared by Dr. Nathan Clark and Forrest Miller. Cloud-cover photos were excellent. Infrared sea-surface temperature photos were of moderate quality. Both sets of photos, when combined with ship observations, have provided valuable information to analyze and forecast weather and sea-state conditions over albacore and tropical tuna-fishing areas.

Mark Sweeney handles the APT. Larry Eber prepares the necessary background information to track satellite.

ANCHOVIES SPAWN IN CAPTIVITY

At BCF La Jolla, in August, R. Leong obtained anchovy spawning by injecting gonadotropins and salmon pituitaries at 48-hour intervals. Between 72 and 96 hours after first injection, the anchovy spawned. The eggs were trapped in an outflow of tank. Of about 5,000 eggs spawned, about 20 floating eggs were seen with developing embryos.

Extreme Day-Night Regime

A contributing factor to spawning activity has been extreme day-night regime: 4 hours of daylight and 20 hours of darkness that preceded hormone injections. This regime has been found superior to many others tested in bringing anchovy gonads to near-spawning condition. Anchovy larvae hatched from these eggs are developing normally in tanks at La Jolla.

GREAT LAKES SALMON SET STATE RECORDS

Coho and chinook salmon caught recently in Michigan waters of Great Lakes have set new state records, according to Michigan Department of Natural Resources. The records very likely apply to all the Great Lakes.

The record-sized salmon were caught in eastern Lake Michigan, where coho were first planted in tributary streams in 1966 and chinook in 1967.

Coho & Chinook

The coho, or silver salmon, caught near Manistee weighed 26 pounds, 4 ounces, and was $38\frac{1}{2}$ inches long. The record for this species is 31 pounds, set in British Columbia in 1947.

The record chinook, or king salmon, for the Lakes also was caught in Manistee area. It weighed 42 pounds and was 46 inches long. Michigan fishery officials believe chinook running up to 50 pounds may be caught soon. The record chinook, one of the largest salmon species, was caught on the west coast. It weighed over 100 pounds.

U.S. OYSTERS & CLAMS WELL RECEIVED AT BRUSSELS FAIR

Fresh Blue Point oysters and hard-shell clams were introduced to food tradesmen in September at the Brussels International Food Trade Fair. The products were delivered by jet air freight in prime condition and proved big hits.

Buyers were complimentary about Blue Point's flavor and size. Hard-shell clams are virtually unknown in Western Europe. Importers welcomed chance to add a fresh shellfish to their line. Several major firms said they would start importing clams and oysters immediately.

Dutch Situation

The oyster beds in Holland are being destroyed by pollution and land fill. Holland used to be largest supplier of fresh oysters to Belgium. The shortage now presents an opportunity for other oyster-producing nations.

BCF CONDUCTS RESEARCH ON PESTICIDE RESIDUES

Scientists of the BCF Fishery-Oceanography Center, La Jolla, Calif., are participating in a nationwide survey of pesticide residues in marine fishes. So far, the survey has been limited to DDT and the products into which it breaks down. Since January 1970, samples of livers from small numbers of sand bass, rock cod, ocean white fish, hake, bonito, jack mackerel, and other species have been collected from Cortez Bank on Baja California coast northward to Santa Monica Bay.

Pesticides are known to accumulate in the livers of fish, so presence of even small amounts can first be detected in that organ. However, no general relationship has yet been established between pesticide amounts in liver and those in flesh. Preliminary investigations indicate that pesticide amounts in flesh are substantially lower than those in liver.

First Findings

Preliminary study shows that lowest amounts of DDT were in livers of fish taken off Baja California; the highest amounts in livers of fish collected from Santa Monica Bay. Levels of DDT in livers of all fish examined ranged from less than $\frac{1}{25}$ part per million parts of liver in 10 sand bass from Baja California--to average of 1,000 parts per million (ppm) in a group of 5 rockfish from Santa Monica Bay (not a commercial fishing area). The DDT in flesh of Santa Monica rockfish was 30 ppm. Other species from Santa Monica Bay had much lower levels in both livers and flesh. Samples of 41 rockfish from Santa Catalina Island had average of only 12 ppm of DDT in livers. Federal regulations limit DDT to 5 ppm in fish flesh sold for human consumption.

Study Fishes' Food

BCF La Jolla recently began to study pesticide levels in microscopic food of fishes in California Current and effect of pesticides on anchovies.

SANTA BARBARA OIL SPILL CAUSED LITTLE PERMANENT DAMAGE

The Santa Barbara (Calif.) oil spill caused minimal, if any, permanent damage to the ecology of Santa Barbara Channel. This was theme of a report of the U.S. Geological Survey based on information from government agencies and universities. Biologists found no evidence that a significant number of marine fauna was affected adversely by either short-term or long-term effects of the spill. Even though some marine animal deaths reasonably can be attributed to oil, it is not clear whether the oil came from spill area or from natural seeps.

The Findings

Neither representatives from the University of Southern California nor Interior Department could find evidence that deaths of seals, sea elephants, or whales were more than normal, nor that any deaths were due to oil contamination.

Fish life counts and commercial catches showed no decline for comparable periods of February to July in 1968 and 1969. Though algae and marine grass in intertidal zones of Channel Islands were damaged, they had recovered almost fully by August 1969.

□□□□□□□□

NEW BOOKLET ON INVESTIGATING FISH KILLS

A 21-page booklet, "Investigating Fish Mortalities," has been published by the Federal Water Quality Administration (FWQA).

Commissioner David D. Dominick described it as a comprehensive guide for the field investigator in obtaining samples, preparing specimens for analysis, and evaluating data to determine cause of deaths.

The booklet has a checklist to aid investigator in thorough study of kill and in reporting symptoms of dead or dying fish.

Investigation Important

Dominick said: "It is particularly important that significant fish kills are reported and scientifically investigated because they may indicate violations of Federal-State water quality standards or enforcement conference recommendations." The field investigator's observations of dead fish and their environment are essential to determine whether kill resulted from manmade pollution or from adverse natural conditions. Dominick also said: "Where pollution is the cause, the investigator's findings can be a major factor in helping to correct the situation."

U.S. State Relations

FWQA has established voluntary reporting procedures with the states through its 9 regional offices to provide a swift response to fish kills. The states exercise primary responsibility for investigating fish kills within their boundaries, but FWQA shares this responsibility where interstate waters are affected.

FWQA can provide technical assistance to states in conducting investigations.

Copies may be obtained from Office of Public Information, Federal Water Quality Administration, U.S. Department of the Interior, Washington, D.C. 20242.

BIGHT NAMED FOR HENRY B. BIGELOW (1879-1967)

The New England coast between Cape Ann and Cape Small of the western Gulf of Maine forms a large open bay, a bight. The bight has been named Bigelow Bight by the Board of Geographic Names, Geological Survey, U.S. Department of the Interior, in honor of Henry B. Bigelow (1879-1967). He was an early contributor to oceanographic knowledge of the area (C.G.S. charts 70 and 1106).

The name was suggested by Dr. Joseph J. Graham, U.S. Biological Laboratory at Boothbay Harbor, Maine. His recent oceanographic studies show this bight has oceanic conditions that differ from the remainder of the coast and from the offshore waters of the Gulf of Maine.

Bigelow Bight always has been important to coastal fishermen for its pelagic and bottom fisheries.

'OCEAN QUEEN' MAKES DEBUT

The Ocean Queen, world's largest tuna purse seiner, recently made her debut in South Pacific.

Designer and builder is Campbell Machine, Inc., San Diego. Owner is Ace Fisheries Co., captain, Roland Virissimo.

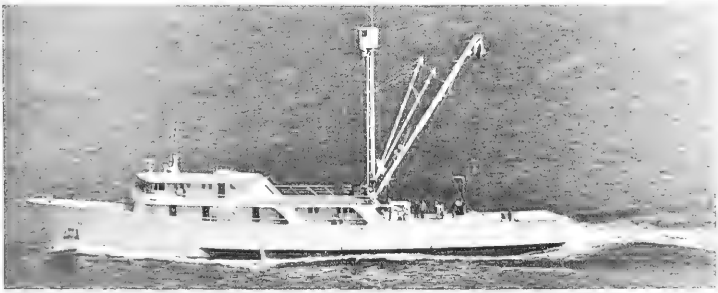
The vessel is 202 feet long, has 42-foot beam, and capacity of over 1,300 tons of fish. Powered by a General Motors 20-cylinder, 3,600-hp. diesel engine, she has cruising speed of 16 knots and range of 7,200 miles. Auxiliaries: 3 Caterpillar No. 353 diesels w 250 kw. generators; 1 Caterpillar No. 343 diesel with 150 kw. generators.

'QUO VADIS', NEW SEINER, IS READY FOR WORK

The new seiner Quo Vadis is seen in photo returning to San Diego Harbor (Calif.) after sea trials in early September 1970. The hull was designed by Rados Western Corp., machinery and interior by San Diego Marine Construction Co. Built for R. A. Watt, vessel is skippered by Joe Rogers. Her length is 202'9", beam 36'3". Powered by an Alco 3,100-hp. diesel, she has a fish capacity of 1,000 tons, cruises at 15.9 knots loaded, and has a cruising range of 17,000 miles.

Quo Vadis was expected to leave for fishing in early October.

The builder is scheduled to produce 7 or 8 more similar or larger seiners for various owners.



Checking stomach contents of cod. (Photo: Robert K. Brigham)

MARSH CLAMS ARE UNEXPLOITED RESOURCE, SAYS VIMS

Vast beds of marsh clams are awaiting use by man, scientists of the Virginia Institute of Marine Science, Gloucester Point, reported in September. They were attending Regional Seafood Seminar at Virginia Beach. Dexter Haven discussed the distribution and abundance of Rangia, the marsh clam, in Virginia waters. Dr. Marvin Wass described its general biology.

Although sampling for Rangia in Virginia has not been completed, Haven said they are very abundant in parts of James and Rappahannock rivers. They are found off lower Machodoc Creek on Potomac and far up the river, but most Potomac tributaries have not been sampled. Marsh clams have not been found in York River.

Many in James R.

In James River, extremely large populations occur from below Jamestown Island to Windmill Point. Haven reported: "On July 16, 1970, we took our hydraulic dredge to the vicinity of Hog Island on the James River near the Surry Power Plant intake for cooling water. Clams were lifted by the dredge at the rate of 1-2 bushels per minute. These clams shucked out about 8 pints per bushel. However, yields at other seasons might be lower." He estimated that in this stretch of river over a ton of meats could be recovered in a day.

The Marsh Clam

Dr. Wass reported that first record of a living Rangia on east coast was by Harry Wells in 1955 in Newport River, North Carolina. Wass stated: "It is not known when or how they were first introduced into Virginia, but they were certainly present in Back Bay by 1960, and probably entered the James River about that time. The marsh clam is the same family with the well-known surf clam and the little Mulinia, probably the most abundant clam in Chesapeake Bay. Both are used by wild ducks for food."

If some natural predators on juvenile Rangia were not present, Wass thinks, the clams might set so heavily that many would starve when plankton productivity was low.

Food in Texas & Mexico

One report states marsh clams were canned as early as 1892 in Galveston, Texas, and marketed as "Little Neck Clams." In 1957, marsh clams in Mexico were served in clam-and-rice dish called "Paella a Valenciana."

Possible Food

In sections of James and Rappahannock rivers, marsh clams are so abundant they make up probably 98% of the weight of everything living in the bottom, the VIMS scientists claim.

Haven stated: "This is an enormous mass of usable food. Rangia might possibly be eaten by humans cooked in chowders, steamed or cooked in other ways. They also could be manufactured into poultry feed and cat and dog food."

When used for human consumption, Rangia should be harvested and handled under health laws regulating oyster and clam use. It is not safe to eat those taken from polluted waters, the scientists warn.

12-MONTH OUTLOOK FOR VIRGINIA-AREA CRABS REMAINS POOR

The outlook for crab stocks for the next 12 months remains poor, say W. A. Van Engel and Mark E. Chittenden Jr., who conduct crab surveys for the Virginia Institute of Marine Science (VIMS), Gloucester Point, Va. Relatively few crabs from the 1969 hatch appeared in samples taken routinely to form basis for predicting catch a year in advance.

Van Engel said: "The crabs which hatched out during the summer of 1969 began to reach commercial size this month (Sept. 1970) and will form the major part of the commercial fishery through August 1971. At that time the 1970 hatch will reach legal size and will become the major source of the catch. Since the number of young crabs hatched out in 1969 appears below average, the catch for the fall of this year and next summer is expected to be below average."

Estimate 50 Million Pounds

The scientists estimate combined Maryland-Virginia commercial catch for Sept. 1970 through Aug. 1971 may be only 50 million pounds. From Sept. 1969 through Aug. 1970, unconfirmed landings are believed close to 70 million pounds. However, this figure is short of the 100 million pounds predicted by VIMS for that crab season.

Why Decline?

Van Engel had based his higher estimate on unprecedented number of young crabs appearing in late summer 1969. But surveys in early spring 1970 indicated stock of young crabs had been greatly reduced. He believes many were destroyed by the unusually heavy rains before and during Hurricane Camille in August 1969, and the severe cold of last winter, although it could not be verified.

Van Engel added: "Most of the crabs caught in the last 12 months were hatched in 1968. Numerically this was the biggest crop ever reported." He noted that crabs hatched that year were so numerous they overcrowded bay and lacked adequate food.

Less Meat Per Crab

Food demand was greater than the environment could provide, so the crabs were in poor condition. They became vulnerable to the freshwater flooding and the severe cold that followed.

Van Engel said: "The most unexpected blow to the economy came when the crab houses realized that they were getting less crab meat per 100 pounds of crabs brought from the crabbers than any time previously. Malnutrition resulted in a reduction in average size of crabs which in turn yielded less meat. Both Maryland and Virginia crab houses reported getting only 8 to 10 pounds of meat per 100 pounds of live crabs bought, instead of the usual 14 pounds."

Long-Range Outlook Brighter

Although the 12-month outlook for crab stocks remains poor, the long-range outlook is brighter.

"Crab stocks appear to be on the increase again," said Chittenden. "Small crabs hatched in 1970 are already present in Virginia waters and in such large numbers that we predict larger than average supplies for the 12 months beginning September 1971."

Many factors could cause change in crab population before 1971, the scientists stated. But with average crab survival, crabbers can look forward to above-average catches in the late pot fishery of 1971. Similar catches are expected to continue through dredge fishery of 1971-72, and into pot fishery of 1972.

SOUTH CAROLINA COMMERCIAL CATCHES ARE ABOUT AVERAGE IN FIRST HALF

Landings of fish and shellfish during first 6 months of 1970 have been about average for most species, reports South Carolina's Marine Resources Division. Total catches exceeded 3.5 million pounds. The run of brown shrimp in 1970 has been well above 1969's. During June, about 357,194 pounds of shrimp worth $180,370 to the fishermen were landed at S.C. ports. Last year's brown shrimp crop in June was only 23,387 pounds. Although drought hampered "run" of browns during latter June 1970, landing reports from dealers up to August indicate a heads-on catch of around one million pounds for July. This preseason sampling indicated an average or slightly better season for browns.

White Shrimp

Experimental sampling for white shrimp has indicated that the major commercial crop is in the Southern coastal area. Spawning stocks of white shrimp were down this spring. This probably accounts for apparent shortage in Charleston area. However, Georgia's white "roe" shrimp crop was extensive enough to support a fair fishery during May-June. The Marine Resources Division says there is reason to believe that Georgia's spawning crop contributed significantly to Southern portion of South Carolina's shrimp fishery. The postlarvae are carried into S. Carolina's southern sounds, bays, and estuaries via the oceanic currents.

Sea Bass Near Record

As of August, landings of sea bass were approaching all-time high. Over a million pounds were landed during January-June 1970. Large concentrations are located off S. Carolina coast. Potentials for expansion are significant, the Division believes.

Blue Crabs Down

Blue-crab production through June 1970 was down almost 800,000 pounds. Poor April-May catch accounted for decrease in overall fishing. Many crabs were in precommercial size class and needed just one molt before attaining legal size. The July reports from crab dealers and processors indicate a better trend: almost a million pounds were reported. This was below last July's by only a few thousand pounds. If prices remain constant, annual production should be good. No large crab kills in commercial fishing areas were reported this year. Fall and winter sampling by Division biologists showed abundance of juvenile crabs which would enter summer fishery. N. Carolina crab production is good this year; trend is even better up the coast.

Hard Clams

Landings of hard clams exceeded 77,000 pounds during first-half 1970, a significant increase over past years. The prices for clams in New York market have been good; clammers were receiving up to $22-23 per bushel for little necks. Cherrystones were around $9-10 per bushel. The Marine Resources Division says that the hard-clam fishery appears to have a potential for considerable expansion. The supply has been moderate, demand good, and market steady.

Alewives

The production of alewives during April, peak of the herring run, was down 850,000 pounds. This was due to a power failure at the Santee-Cooper. The locks were closed. Fresh water flow was cut back into the Cooper River. This caused critical change in salinity--and resulted in considerable commercial loss.

GIANT BLUE WHALE'S VOICE DETECTED BY NAVAL SCIENTISTS

The vanishing blue whale has a strong underwater voice--"its powerful, half-minute murmur can travel over 100 miles"--report scientists of the Naval Undersea Research and Development Center (NUC), San Diego, Calif. The blue whale, the world's largest animal, grows to more than 100 feet and up to 130 tons. Overhunting has greatly reduced the stocks. Catch dropped from 6,908 animals in 1948 to only one in 1965.

The discovery occurred during a 6-week expedition of Dr. William C. Cummings, a NUC senior scientist, and Dr. Raymond M. Gilmore, Dr. Joseph R. Jehl Jr., and Steven L. Bowen, of San Diego Natural History Museum.

Expedition Departs From Southern Tip of South America

The expedition departed Punta Arena, Chile, aboard National Science Foundation's 125-foot ship 'R/V Hero'. Cummings and Paul O. Thompson, research psychologist, sighted 4 blue whales, about 75 feet long, near Guafo Island, southern Chile. Immediately, they lowered a hydrophone (underwater microphone), readied shipboard electronics, and began observing whale behavior.

Two Types of Whale Signals Noted

The blue whales voiced two kinds of signals: one lasted precisely 37 seconds, including a 2-second break. The second type lasted as long, but it exhibited two breaks, 1.5 and 3.5 seconds. Most acoustic energy was at 24 cycles per second, a murmuring sound about as low in pitch as man can hear.

Blue-whale signals are much longer than those recorded from other whales. They are extremely complicated--with overtones extending pitch up to about 250 cycles per second, about middle C on musical scale.

Cummings reported: "An interesting fact is that the blue whale produces these signals at very standardized intervals. There is a precise duration of 100 seconds from the beginning of one voice sequence to the beginning of the next. We have also found precise timing in the phonations (sounds) of other whales, but its significance is still a mystery. We still have no idea what the sounds mean.

"Beginning with our own work on right whales (so called because old time whalers considered them the 'right' ones to go after), we have learned that these great beasts have very characteristic phonations. Five years ago, I discovered that right whales repeat a complicated, 12-minute stanza of signals in exactly the same way, signal for signal. More recently, others have reported a similar occurrence among humpback whales, the so-called song of the whales...a good analogy for this phenomenon might be a man reciting the same poem over and over again. This thrilling experience with the blue whales once again pointed out the orderly conduct of whale voices.

"It is clear that whale phonations are not voiced indiscriminately. They may well represent a simple kind of communication. Even though it may be a very elementary form of communication compared to man's, our biggest job as behaviorists is to learn what is implied in the sound produced by the whales."

Whales Respond to Other Whale Voices

Cummings and his coworkers have shown that different species of marine mammals can recognize one another's voices. They played back the eerie screams of the killer whale, a predator of other whales, which caused gray whales and beluga whales to leave an area.

Helpful To Salmon Fishery

This knowledge recently was put to practical use in an Alaskan river. There, Dr. James F. Fish, NUC oceanographer, successfully kept hundreds of belugas from devouring young salmon before the fish could reach the open sea.

TECHNICAL NOTES FOR INDUSTRY

NEW RECOMMENDATIONS FOR PRESERVATION OF FISH BY FREEZING

M. L. Anderson

During recent years, research has given us greater insight into the causes of toughening in fish during frozen storage. This article discusses the research findings--and uses these as a basis to recommend new freezing techniques.

Recommendations for preserving fish by freezing have been based on the results of studies made over a period of about 40 years. The studies were designed to determine the effects of storage time, storage temperature, and other variables on quality of stored product.

The researchers have found that fish retain their quality best when they are (1) of good quality initially, (2) wrapped in material that is a good barrier to passage of air and moisture, and (3) deep-frozen, preferably at -20° F. However, holding times, temperatures before fish are frozen, and rate of freezing them have not always been considered critical.

Retaining Quality in Frozen Storage

The retention of quality in fish when held in frozen storage as recommended has been attributed largely to the effect of low temperature in slowing the rates of reactions that decrease quality. If the storage temperature is not low enough, the reactions causing toughening and development of rancidity usually end the product's storage life quickly.

Although much was known about the nature of the reactions causing rancidity, little was known about the nature of those causing toughening. About 20 years ago, evidence began to accumulate that toughening in frozen-stored fish is accompanied by the hydrolysis of lipids--by the breakdown of fats and related compounds as the result of the action of enzymes. Because of differences in the extent that the hydrolysis of lipids affects the toughening process in various species of fish, the relation was not generally recognized. During the past five years, however, studies have shown that the two phenomena are definitely related. We now know enough about the toughening process to propose a model for the way toughening takes place in frozen tissue.

What does this information on the nature of the process that results in loss of quality mean for the fisherman, the handler, the processor, and the distributor of fish preserved by freezing? Here is the way prefreezing handling, freezing rate, and storage temperature affect the course of lipid hydrolysis--and affect the development of toughening.

Prefreezing Holding Time & Temperatures

The products of lipid hydrolysis begin to accumulate after the death of the fish. The rate at which these products accumulate depends on the temperature at which fish are held--the higher the temperature, the faster the products form. Before a fish is frozen, these products of lipid hydrolysis exert some effect on the proteins of a fish; but soon after it is frozen, they exert their full effect. Even in a fish deep-frozen at recommended temperatures, they will bring about toughening in less than two weeks. The greater their amounts present, the greater the toughening.

This finding indicates that after fish are caught and, before they are processed, those destined for freezing should be held in ice. Ideally, when they are removed from the water

M. L. Anderson is Research Chemist, BCF Technological Laboratory, Gloucester, Massachusetts 01930.

in which they are caught, their temperature should be held as close to 32° F. as possible until they are frozen. Because a time-temperature relation applies to lipid hydrolysis during storage of fish in ice, they should be frozen as quickly as possible after capture--preferably before onset of rigor.

Freezing Rate

Paradoxically, although lowering temperature tends to slow rate of chemical reaction, some reactions occur more rapidly at temperatures just below 32° F. than at those just above it. In short, the favorable conditions for reaction in the frozen muscle just below 32° F. more than offset effects of decreased temperature on reaction rates. Some reactions that cause toughening are of this type. Recently, researchers reported that reactions causing decreases in the substances which contribute to flavor of very fresh fish are also of this type. These findings argue strongly for use of very-quick-freezing techniques, such as can be obtained with liquid nitrogen, liquid carbon dioxide, or liquid Refrigerant 12.

Storage Temperature

Recommendations for storing fish at about -20° F. have been based on assumption that retention of quality for long periods at that temperature is due simply to effect of temperature on slowing reaction rates. Researchers thought that if fish were held in storage long enough, the changes in quality would be just as extensive as those that occur more quickly at higher storage temperatures. We now have found that lipid hydrolysis proceeds to various levels of completion, depending on the temperature of storage. In the range of practical storage temperatures, the lower the storage temperature, the less the extent to which lipid hydrolysis will occur.

This new finding means that the potentials for retention of quality through lowering temperature of storage are greater than we had predicted previously. To reap benefits of storage at low temperature, however, we must maintain low storage temperature. If we allow temperature to rise--even for a short period--the hydrolysis of lipid will not only occur at an increased rate but will tend to approach a higher level of completion.

Recommendations

1. After fish are caught and, before they are processed, hold in ice those fish destined for freezing.

2. During period of iced storage before freezing, lower temperature of fish quickly to 32° F., and hold them at that temperature.

3. Freeze the fish as soon after capture as possible--preferably before onset of rigor.

4. When freezing fish, use very-quick-freezing techniques, such as can be obtained with liquid nitrogen, liquid carbon dioxide, or liquid Refrigerant 12.

5. While holding fish in frozen storage, do not at any time allow their temperature to rise above -20° F.

NORTHERN SHRIMP: Its Fresh & Frozen Life When Cooked at Different Stages of Freshness

Burton L. Tinker and J. Perry Lane

Norwegian and Swedish scientists have reported that the quality and yield of northern shrimp, Pandalus borealis, can be enhanced by cooking the catch soon after harvesting. BCF's Gloucester Technological Laboratory sought to determine the extent of the advantage of cooking shrimp within 2 hours after catching over shrimp cooked 24 hours after catching--and over shrimp not cooked at all. We also investigated the freezing of shrimp at sea.

This study was concerned with raw frozen shrimp and with frozen shrimp because New England northern shrimp are marketed in both forms.

The shrimp used were caught in Gulf of Maine during February 1968 in three days of fishing.

The Test

The shrimp cooked at sea were cooked by the following method: A gas-fired Frialator[1/] of 10-gallon capacity was filled with sea water, which was heated to boiling. Two wire baskets, each containing about 5 pounds of washed shrimp, were immersed in the boiling water (water resumed boiling in less than a minute) for 2 minutes. This procedure was repeated until 50 pounds of shrimp from each tow were cooked. After cooking, they were allowed to cool on deck to ambient temperature (32°-42° F.). The cooling time was 2 to 3 hours. Half the shrimp were packed in fillet tins and stored in ice within insulated containers; half were individually quick-frozen (IQF). The quality and storage life of shrimp reported in this paper were determined periodically by a laboratory taste panel.

Results of Study

The results of this study showed that cooking at sea improves the texture and enhances the flavor of northern shrimp. More important, the quality of shrimp cooked at sea less than 8 hours after landing was better than the quality of shrimp held for more than 8 hours before cooking. The texture of the shrimp cooked at sea was firmer, and the shelf life was longer than that of shrimp cooked ashore 24 hours after being caught.

Shrimp cooked at sea and stored at 33° F. rated an average score of 6.6 (fair to good), and they had an average acceptable shelf life of about 3 weeks. This compared with a shelf life of 1 week for shrimp cooked ashore. The shrimp cooked and frozen at sea had an average quality rating of 7.0 (good), compared with 6.3 (fair to good) for shrimp frozen in raw state. The samples cooked and frozen at the laboratory were of low quality throughout the test (5 months).

Mr. Tinker is Chemist
Mr. Lane is Supervisory Research Food Technologist } BCF Technological Laboratory, Emerson Avenue, Gloucester, Mass. 01930.

1/Trade names are used to simplify description of experiment, not to endorse commercial products.

USE OF ANTIFOAMING AGENTS IN SHRIMP COOKING

John C. Leyczek Jr.

When shrimp is cooked in brine, one problem noted by some processors is the formation of an excess amount of foam. This is particularly noticeable in cooking at sea.

Recently, several silicone antifoam emulsions have been evaluated for use as defoamers in shrimp cookers. The antifoamants were FG-10 from Dow Chemical, and AF-72 silicone antifoam from General Electric. 1/ Both antifoamants are approved by the U.S. Food and Drug Administration for use as direct food additives in concentrations decribed in their literature. The permissible concentrations vary according to the individual foam, and the user should observe these.

Testing Emulsions

To test the emulsions, each was added to a uniform amount of water that contained a 16% salt solution by weight. Dow's FG-10 was added in 10 ppm, and General Electric's AF-72 was added in concentrations of 30 ppm. Then, the solution was brought to a boil, and an equal amount of shrimp added to each.

Results showed that both emulsions were successful in retarding formation of foam ordinarily produced when shrimp is cooked.

Dow's FG-10

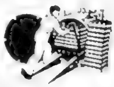
Dow's FG-10 emulsion is a food grade 10% silicone emulsion designed for aqueous solutions. It is effective at temperatures up to 212° F., in concentrations from 10 to 100 ppm. It can be ordered directly from Dow Corning Corporation, 886 Washington Street, Dedham, Massachusetts 02026. The price for a 5-gallon can is 56 cents per pound.

GE's AF-72

General Electric's AF-72 is a 30% silicone emulsion designed for aqueous solutions in concentrations up to 33 ppm. However, this emulsion did not mix with brine solution as easily as Dow's FG-10. It required a little more stirring. It can be ordered directly from General Electric Company, 2120 Commonwealth Avenue, Auburndale, Massachusetts 02166. The price for one to 25 cans is \$1.53 per pound, and \$1.23 per pound for orders over 25 cans.

Mr. Leyczek is Northeastern Cooperative Student with BCF Technological Laboratory, Emerson Avenue, Gloucester, Mass. 01930.

1/Trade names are used to simplify description of experiment, not to endorse commercial products.



GETTING MEAT FROM UNCOOPERATIVE CRABS

Because picking meat from crab by hand is tiresome--and because the meat adheres tenaciously to the shell--the search for a mechanical process to separate meat from shell has challenged ingenuity of industrial scientists.

One was Dr. Wayne Tretsven, BCF Technology Laboratory, Seattle. He saw two basic needs: the need to recover meat not now being recovered by hand-picking method; the need to improve efficiency of present manual method. For example, sections of the crab that are hard to pick, such as tips of legs, might be picked with aid of a machine, whereas prime sections, such as the large leg section of the Dungeness crab, can best be separated manually.

Dr. Tretsven's Approach

Dr. Tretsven visualized a combined manual and machine process in which the prime-value, easy-to-separate meat is recovered by hand, and the lesser-value, hard-to separate meat is recovered by machine. In the machine recovery, he pictured a centrifugal method in which the shell portions, after having been chopped into $\frac{3}{4}$-inch lengths, are separated from the meat by the difference in density of the meat and shell in brine.

A centrifugal provides several options in adjusting operation to (a) size of crab, (b) difficulty in separating meat from shell, (c) availability of labor, and (d) market for the product. You can produce an aseptic product free from possibility of human contamination because if you choose a completely mechanized operation--with small hard-to-pick crabs, for example--the crab is not touched by hand after it is butchered and cooked.

Sought Continuous Process

Dr. Tretsven had difficulty developing his process, primarily because he wanted a continuous rather than a batch process. To accomplish this, he had to use a centrifugal, which will discharge solids continuously. The only centrifugal available, however, was one designed to separate solids such as wood pulp. Nevertheless, it worked remarkably well.

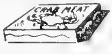
The main difficulty was that it broke the crab meat into particles smaller than is most desirable. To solve this problem, Dr. Tretsven suggested several changes in the centrifugal's design, which the manufacturer is undertaking.

Crab-Meat Yield Up 50%

Even at present stage of development, the process is impressive: it increases yield of crab meat by 50%. This improved yield results from virtually complete separation of meat from shell, and less loss of soluble protein and flavor components from meat.

Dr. Tretsven has tried his process with three species of crab: Dungeness, blue, and tanner (also called snow crab). The yields he obtained from Dungeness crab waste after crab had been picked was 14 to 20%; from cooked blue-crab claws 31%; from cooked tanner-crab bodies 52%; and from cooked tanner-crab legs 29%.

Dr. Tretsven's process has the potential of rapidly producing in a continuous operation an aseptic, uniform, flavorful product at low cost and minimum labor and waste. Because of these advantages, he is confident that crab processing in the future will be done by this method.



TRAILER SHIPMENT OF LIVE DUNGENESS CRAB

To sell Dungeness crab meat successfully, advise the scientists of BCF's Seattle Technology Laboratory, you have to keep in mind that it's a delicious but delicate product subject to rapid spoilage. So, the best way is to deliver it alive.

The first real step in this direction was taken about 3 years ago by the laboratory. It perfected a method of shipping live crab by air. The aim was to ship live Dungeness crab from Washington State, where they grow to a nice 2-pound size, to Hawaii, where they don't grow. The method was so successful that live Dungeness crab can be air-shipped to almost anywhere in the world.

By Truck

How about shipping them by truck? Of course, a truck takes longer, and this gives the crab more chance to die, which they do easily enough.

This problem of crab mortality was solved by using the know-how acquired in learning how to air-ship live crabs and by taking advantage of the fact that weight is not crucial in truck shipment. The laboratory developed a system of holding crab. It used shallow trays flooded with filtered, recirculated, refrigerated seawater. Dungeness crab are kept in good condition for at least 7 days. And, in 7 days, live crab can be trucked to virtually any place in the United States.

Trial Shipments

The researchers, in cooperation with industry, took a 30-foot refrigerated commercial trailer and installed a refrigerated-seawater system with plastic trays, each holding 8 crabs.

Fig. 1 - Loading live Dungeness crab in holding trays aboard a crab boat on the coast of Washington.

Figs. 2 & 3 - Unloading trays of live Dungeness crab from 30-foot refrigerated trailer at a market in Portland, Oregon.

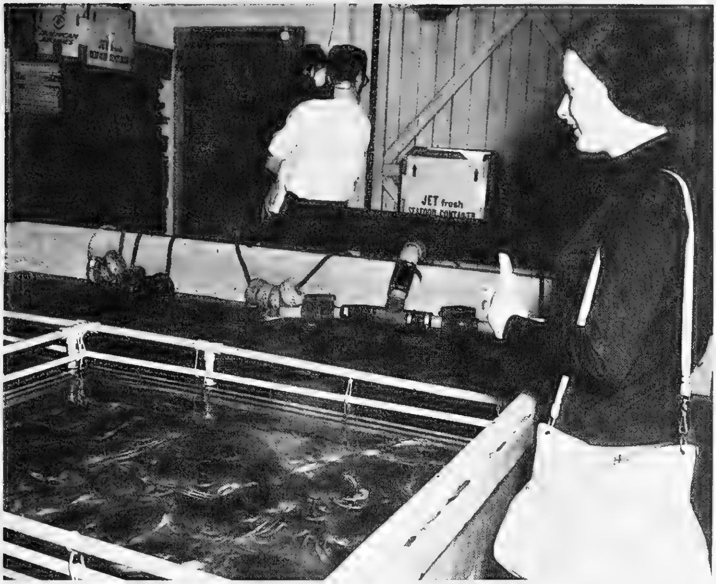


Fig. 4 - Customer for live Dungeness crab held in tank after being shipped from coast of Washington.

In the first over-the-road test, 3,600 pounds of live Dungeness crab were loaded into the trailer at a plant on the Washington coast and trucked to Portland, Oregon, by way of Seattle, a distance of 380 miles. The run was a complete success: all the crabs were alive and well.

In the next test run, the truck owners shipped 4,200 pounds of live crab from Westport, Washington, to California, where they made deliveries to Port Morrow, Santa Barbara, Redondo Beach, San Pedro, and Long Beach. The total distance was about 1,300 miles. The results were encouraging enough for the firm to contract for two 40-foot trailers to be outfitted for regular crab hauling. At present, live Dungeness crab are being air-shipped from Alaska to Washington State, and distributed by truck along the coast.

Now there's an industry based on shipping live Dungeness crab by air and truck--and there are happy gourmets.

FISH PROTEIN 'ISOLATES' ARE MODERN FOOD INGREDIENTS

Wider use of fish protein concentrates as pure isolates is indicated by work of the BCF Technology Laboratory, Seattle, Washington. Believing that underutilized species of fish could be used as a basic source of protein, its scientists separated and concentrated fish proteins into isolates. These contain over 90% protein and should have wide appeal in the food industry.

Fish protein concentrate (FPC) was developed by BCF primarily for use as a nutritious protein supplement; fish protein isolates also may be used in foods for their desirable 'functional' properties.

A Food's 'Functionality'

Functionality in a food is its ability to impart desirable characteristics to a processed food. Egg albumin, for example, is used to make meringues, or to give sponginess to angel food cake. Lean meat is used to bind fats and water in processed meats such as frankfurters. Egg yolk is used for similar purposes to emulsify the water, vinegar, and oil in mayonnaise. Less familiar examples are coffee whiteners and synthetic whipped toppings, where sodium caseinate is used as a lipid emulsifier and whipping agent.

In recent years, vegetable proteins have been isolated and modified to fill functions in processed foods industry, where demand for them is increasing continually. Protein isolates made from fish have an added advantage over vegetable proteins: they are superior nutritionally.

How Lab Prepares Isolates

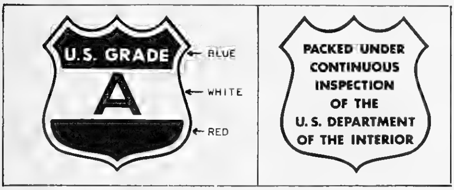
Fish protein isolates are prepared at Seattle Technology Laboratory by extracting minced, eviscerated, and deboned fish with a mild saline solution to remove most water-soluble constituents and oil. Then, the extracted muscle protein is treated with an enzyme, and the modified proteins are isolated, washed, and dried. The isolates are white, bland to the taste, and have good properties as moisture binders, emulsifiers, and whipping agents in processed foods.

The work at Seattle suggests that in the future FPC may be produced in several forms. Like many natural products, purified fish proteins will appear as an indistinguishable component in many foods blended to suit the preferences of people everywhere.

U.S. STANDARDS FOR FROZEN RAW SCALLOPS ANNOUNCED

To help the consumer select high-quality fishery products, BCF has published a voluntary standard for frozen raw scallops.

About 27% of the fishery products processed in the United States (about 327 million pounds in 1969) is inspected by the U.S. Department of the Interior (USDI). Many of the products carry the USDI shield.



Shield using red, white, and blue background.

Shield with plain background.

Under the inspection program, products are graded "A", "B", or "not acceptable." Inspection for compliance with sanitation and public health requirements is part of the BCF inspection service at processing plants.

The voluntary program, paid for by the processor, is similar to the also-voluntary Agriculture Department grading of poultry and dairy products. Any commercially harvested scallops are eligible for grading under the new standard. The U.S. scallop industry harvests 3 major areas: off Alaska, southeastern U.S., and the traditional scallop grounds off New England. Industry representatives worked with BCF technologists and scientists in developing the technical aspects.

Requirements for Product

Some requirements to receive Grade A state that the scallops must have good flavor and odor, reasonably uniform color, and be practically free from extraneous material. For Grade B, some of the defects noted are allowed within certain tolerances.

Current standards cover 17 fishery products, including precooked breaded scallops. The standards guide the processor in preparing a high-quality product; they provide the distributor, wholesaler, retailer, and consumer with an accurate description of quality level.

Copies of Standards Available

A processor does not have to subscribe to the USDI service to adhere to the standards. They may be used in a processor's quality-control program, but the U.S. Grade A shield may not be displayed on the package unless the plant subscribes to the program. Copies of the standards for frozen raw scallops may be obtained from Publications Unit, BCF, 1801 N. Moore St., Arlington, Va. 22209.

Standards also are available for fish blocks, cod fillets, haddock fillets, halibut steaks, ocean perch fillets, breaded fish portions, fried fish portions, salmon steaks, fried scallops, raw breaded shrimp, raw headless shrimp, sole and flounder fillets, breaded fish sticks, fried fish sticks, headless dressed whiting, and raw fish portions.

The Red Grouper of the Gulf of Mexico

Luis R. Rivas

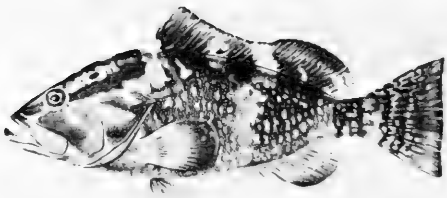


Fig. 1 - The red grouper (Epinephelus morio). B & W photo of color plate. Adult specimen from Puerto Rico. (Evermann & Marsh, 1902.)

The red grouper (Epinephelus morio) is probably the most abundant and commercially important grouper in the Gulf of Mexico, according to Jarvis (1935: 3) and Moe (1969: 2). This is supported by records of the BCF Exploratory Data Center, Pascagoula, Miss., during 1950-1970.

There are 259 stations from which the red grouper was recorded--but only 144 for the scamp (Mycteroperca phenax) and 145 for the black grouper (M. bonaci). Records for other species of groupers (Mycteroperca, Epinephelus) are much fewer, despite the same fishing effort.

Unfortunately, an index of abundance from U.S. catch statistics is not available because the various species are combined as "groupers". Mexican statistics, however, distinguish the red grouper ("mero") from other species. According to Carranza (1959: 222), the Mexican red grouper fishery of Campeche Bank is a very important source of food and revenue: it represented 66% of total fish production in 1955. Between 1950 and 1964, production of red grouper in Mexico increased from 2,000 to 7,000 metric tons. It declined to about 6,450 in 1968 (Solis Ramirez, 1970).

Red grouper was 77% (4,991 m. tons) of Campeche Bank fish production in 1963; it was worth US$726,645 (Gutierrez, 1965). It declined to 70% in 1967-68 (Solis Ramirez, 1970).

In the United States, except for Florida Gulf coast, the red grouper catch is only incidental to red snapper fishery (Moe, 1969: 76;

L. R. Rivas is Staff Ichthyologist, BCF Exploratory Fishing and Gear Research Base, Pascagoula, Miss. 39567.
Contribution No. 234.

COMMERCIAL FISHERIES REVIEW
Reprint No. 887

Jarvis, 1935: 3; Carpenter, 1965: 27). Commercial snapper fishermen catch very few red grouper because they fish much below these groupers' usual depths.

The red grouper is a valuable fishery because of its relative abundance, excellent flavor, and size suitable for various types of processing. The Florida west coast red grouper stocks may be overfished and should be managed if yield continues to decline despite increasing effort (Moe 1969: 77, 81). A similar situation occurs on Campeche Bank (Solis Ramirez, 1970: 128).

THE RED GROUPER

The red grouper is easily identified by the straight-edged dorsal fin membrane which, in other groupers, is notched between the spines (Figure 1). (For keys, descriptions, and figures to identify genera and species, see Smith, 1961, and Rivas, 1964. Moe (1969: 3) gives a brief taxonomic description). In Mexico, it is called "mero"; in Cuba, "cherna americana", or "cherna de vivero." In addition to Mexico, there is an active Cuban fishery for red grouper on Campeche Bank.

Little is known of the biology, distribution, ecology, and other aspects of its life history. In 1969, Moe dealt mostly with age, growth, and reproduction of red grouper from a small area off the central Florida Gulf coast. Some needed information is presented in this article.

MATERIALS AND METHODS

This study is based on biological, ecological, geographical, and other data stored on IBM cards at the BCF Exploratory Data Center. It comprises 20 years of exploratory work. Data on depth, water temperature, etc., for a given station are punched on "station cards". Data for a given species, its place of capture (station), number of specimens, weights, etc., are punched on "species cards". The cards are read into a Univac 9200 computer and information quickly retrieved in printout form.

The exploratory work extends from Cape Hatteras, N.C., to the bulge of Brazil (Fortaleza); it is most intensive in the Gulf of Mexico. Therefore, horizontal distribution for the red grouper in the Gulf is covered adequately. Over 20 years, 259 stations scattered throughout the Gulf yielded 634 specimens weighing 0.25 to 38.5 pounds, and totaling 4,175. Average weight is 6.6 pounds.

The red grouper is a bottom fish. We have no records at less than 4 or more than 62 fathoms. Work with bottom-sampling gear extended from 2 to 2,000 fathoms, so vertical distribution, too, is covered adequately.

In the sections on depth distribution, temperatures of occurrence, and seasonal abundance, the Gulf of Mexico is divided into a northern and a southern portion. The northern Gulf is north of a line from the Rio Grande to Cape Sable, Florida; the southern Gulf is south of that line and west of easternmost edge of Campeche Bank.

GEOGRAPHICAL DISTRIBUTION

The red grouper is restricted to the tropical and subtropical western Atlantic from Cape Hatteras to Brazil (Smith, 1961). Unverified literature records from New England are probably stragglers. Our northernmost record is 50 nautical miles E of Cape Fear, N.C., and the southernmost 107 nautical miles NNW of Cayenne, French Guiana. The red grouper is primarily continental; its center of abundance is Florida shelf and Gulf of Mexico (Moe, 1969: 3).

Our data, Figure 2, show geographical distribution of the red grouper in Gulf. It occurs with less-abundant groupers: the snowy grouper (Epinephelus niveatus), Warsaw grouper (E. nigritus), rock hind (E. adscensionis), Kitty Mitchell (E. drummondhayi), red hind (E. guttatus), yellowfin grouper (Mycteroperca venenosa), scamp (M. phenax), gag (M. microlepis), yellowmouth grouper (M. interstitialis), and black grouper (M. bonaci).

The red hind, although very good to eat, is too small and scarce to attain commercial importance. The scamp, however, is much larger, of excellent flavor, and is served as a delicacy in restaurants along our Gulf coast. The yellowfin grouper is said to be occasionally poisonous.

DEPTH DISTRIBUTION

Data analysis indicates red grouper occurs at different depth ranges and mean depths according to its latitudinal distribution in Gulf (Figures 2, 3). In northern Gulf, depth range extends from 4 to 62 fathoms with a mean

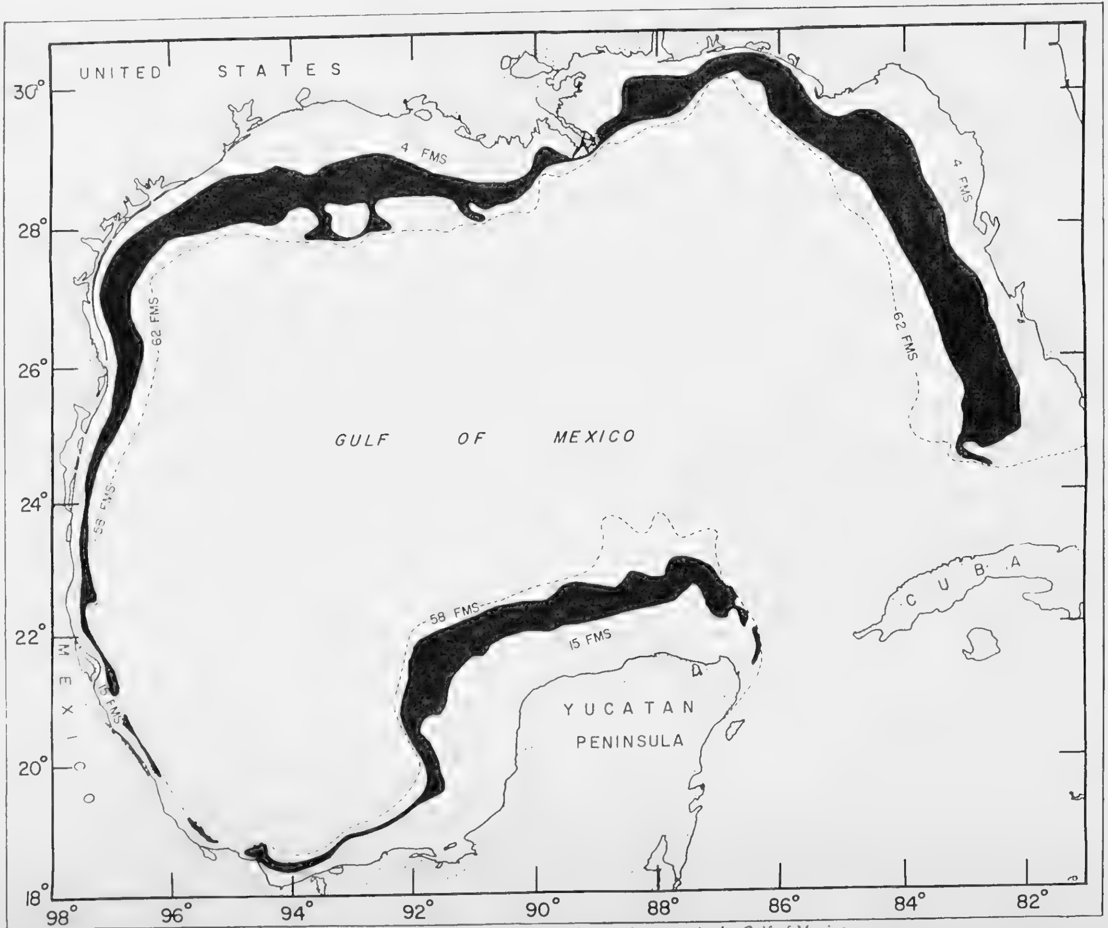


Fig. 2 - Horizontal and vertical distribution of the red grouper in the Gulf of Mexico.

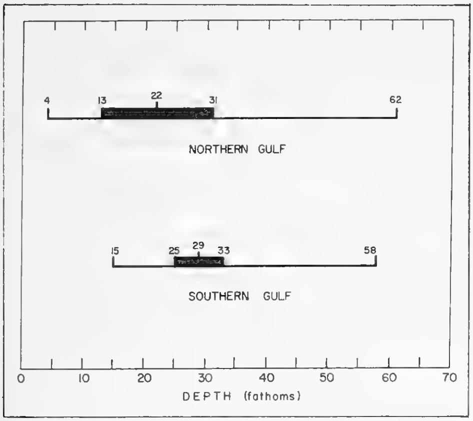


Fig. 3 - Depth distribution (fathoms) of red grouper in Gulf. Black bar indicates 68.26% of records, obtained from one standard deviation on each side of mean and rounded to 70% and nearest fathom for convenience.

depth of 22; about 70% of records extend from 13 to 31 fathoms. The red grouper is found between about 10 and 400 feet (about 2 to 67 fathoms) off the central Florida west coast (Moe, 1969: 68). In southern Gulf, range extends from 15 to 58 fathoms--a mean depth of 29, and about 70% of records extend from 25 to 33 fathoms.

As with the snappers (Rivas, 1970: 43), juveniles and young of the red grouper occur shallower than the mean depth, and larger adults occur deeper than the mean depth (Figure 4). Only specimens weighing an average of 3 pounds were taken at depths of less than 15 fathoms, and only specimens weighing an average of 11 pounds were taken at more than 40 fathoms. This agrees with indications of size/depth relationship discussed by Moe (1966: 17, 1969: 71) for red grouper off central Florida Gulf coast. According to our records, its average weight in Gulf is 6.6 pounds. The largest specimen weighed 38.5 pounds.

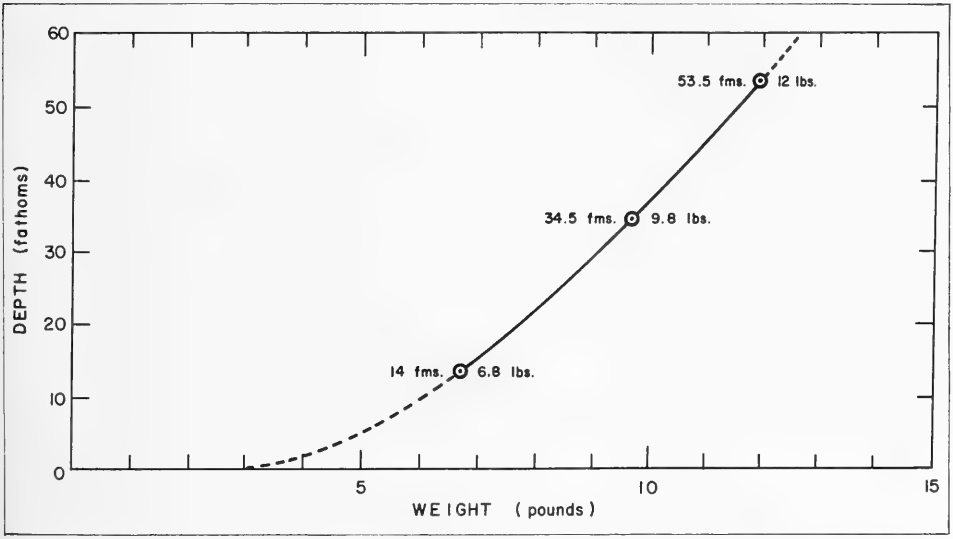


Fig. 4 - Weight/depth relationship of red grouper. The curve was constructed by joining 3 points, each representing average weight at average depths of 3 depth intervals (4 to 24, 25 to 44, and 45 to 62 fathoms) comprising species' entire depth range.

SEASONAL ABUNDANCE AND MIGRATION

Seasonal changes in water temperature cause seasonal fluctuation in occurrence and abundance of fishes in Gulf. In northern Gulf, tropical species appear in spring, become more abundant in summer, and are absent or nearly absent in winter (Rivas, 1968: 2).

To establish seasonal abundance from catch records, the seasonal fishing effort must be determined--because greater fishing effort during a season could indicate greater abundance due to increased effort and not to favorable temperatures.

Temperature fluctuations in Gulf do not reflect the four seasons. Rather, these fluctuations may be better interpreted in terms of the "cold season" (November through April) and "warm season" (May through October) of the year. Also, there are seasonal temperature differences between northern and southern Gulf, and within each of these regions (Rivas, 1968; see also next section).

Seasonal effort, therefore, was obtained from the number of fishing stations occupied during the cold season, compared to number occupied during warm season (Figure 5). Throughout the Gulf, 2,685 bottom-sampling stations, within red grouper's depth range, were occupied since 1950. In northern Gulf, of 2,142 stations, 1,093 (51%) were occupied during cold season; 1,040 (49%) during warm season. In southern Gulf, of 543 stations, 349 (64%) were occupied during cold season, and 194 (36%) during warm.

Since fishing effort in northern Gulf is practically the same for the two seasons, valid interpretations of abundance can be made. Figure 5 shows seasonal fishing effort compared with seasonal abundance of red grouper in northern Gulf. Of 109 stations yielding red grouper in northern Gulf, 20 (18%) occurred during cold season of year, and 89 (82%) during warm season. In northern Gulf, therefore, the red grouper is much more abundant during warm season. The much-reduced abundance during cold season is emphasized further by paucity or absence of records during November through March. There are only two records for November, none for December, one for January, one for February, and one for March.

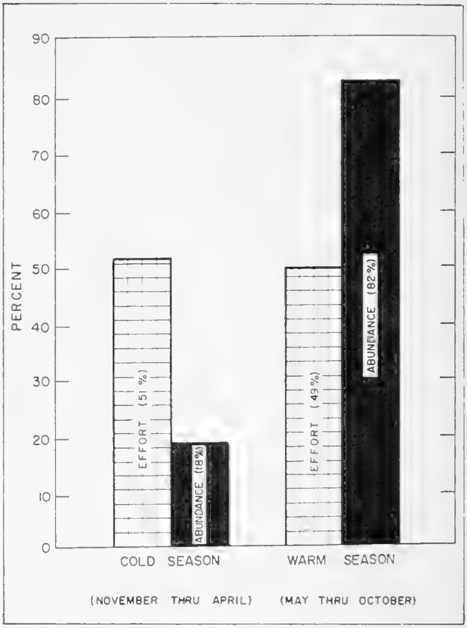


Fig. 5 - Seasonal fishing effort and seasonal abundance for red grouper in northern Gulf. Effort is expressed as percentage, for each season, of total fishing stations (2,142) since 1950. Abundance is expressed as percentage, for each season, of total stations (109) yielding red grouper since 1950.

The near-absence of red grouper in northern Gulf during cold season indicates its movement away during late fall. Off the Florida Gulf coast (northern Gulf), the red grouper appears to move inshore in summer and offshore in winter (Moe, 1963: 103; 1969: 71). This hypothesis is not supported by our data since there are very few or no red grouper records for the winter--and those fish were taken at about the same depths as those in spring, summer, and early fall. Furthermore, our extensive depth coverage with bottom-sampling gear down to 2,000 fathoms has yielded no red grouper below 46 fathoms during cold season. Results from tagging are inconclusive (Beaumariage, 1969: 13; Moe, 1966: 17; 1967: 228).

Because of the unequal seasonal fishing effort in the southern Gulf, no valid interpretations of seasonal abundance can be made.

However, Jarvis stated in 1935 that, on Campeche Bank, the greater part of red snapper catch, including red grouper, is made between October and April. Off Quintana Roo (Yucatan), the greater catches of red grouper are made during December and January (Carranza, 1959: 222). These statements indicate that in southern Gulf the red grouper must be more abundant during cold season.

Circumstantial evidence suggests that there may be a seasonal migration between northern and southern Gulf, rather than a seasonal inshore-offshore movement. However, Smith wrote in 1961 that adult groupers have a strong homing tendency, and that their migration to remote places must be accomplished by ocean currents during pelagic larval stages.

If migrations of adult red grouper actually occur between northern and southern Gulf, the path must be along western perimeter. It is not probable that these strictly bottom fish, which occur at less than 70 fathoms, could cross the 185-nautical mile gap (100 to 2,000 fathoms) between Campeche Bank and the Florida shelf. (A movement of at least 500 nautical miles was reported for a tagged red grouper by Moe in 1966.)

TEMPERATURES OF OCCURRENCE

Since the red grouper is strictly a bottom fish, only bottom temperatures are considered here.

The fish occurs at different temperature ranges and means according to season and its latitudinal distribution in Gulf (Figure 6). In northern Gulf, during cold season, bottom temperatures at mean depth of 22 fathoms (Figure 3) range from 61° to 69°, with a mean of 65°. During warm season, temperatures range from 63° to 84°, with a mean of 67°. In southern Gulf, during cold season, bottom temperatures, at mean depth of 29 fathoms (Figure 3), range from 73° to 78°, with a mean of 76°. During warm season, temperatures range from 68° to 82°, with a mean of 77°. These temperature patterns for northern and southern Gulf agree with vertical extent of surface temperatures (Rivas, 1968: 3).

In northern Gulf, therefore, there is a seasonal fluctuation of 2° in mean bottom temperature at 22 fathoms, but only of 1° in southern Gulf at 29 fathoms. In northern Gulf, also, the mean bottom temperature is about 10° lower at 22 fathoms than in southern Gulf at 29 fathoms, regardless of season. This is explained by the 735-nautical mile latitudinal extension of Gulf comprising about equal portions of temperate and tropical zones (see also Rivas, 1968: 2).

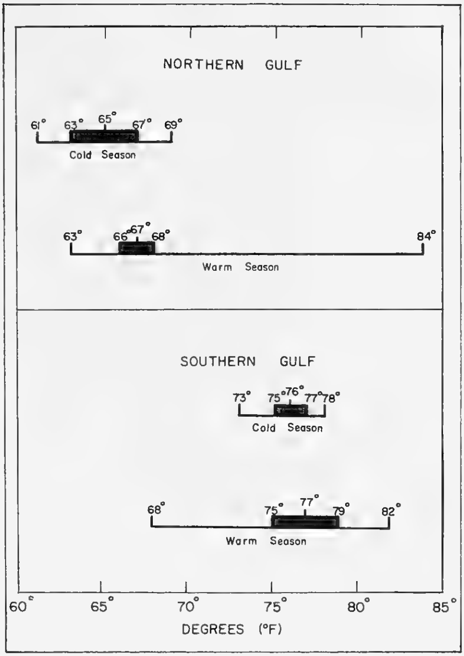


Fig. 6 - Seasonal temperatures of occurrence (°F) of red grouper at its mean depth of occurrence in northern (22 fathoms) and southern Gulf (29 fathoms). Black bar indicates 68.26% of records, obtained from one standard deviation of each side of mean and rounded to 70% and nearest degree for convenience.

The temperature range of 61° to 84° for red grouper, including all seasons and entire Gulf, indicates a wide temperature tolerance. This is supported by its latitudinal range, which extends from north temperate zone southward to Brazil.

HABITAT

Optimal temperatures, depths, or seasons are not necessarily indicative of red grouper abundance unless they are associated with suitable bottoms. As do the snappers, groupers prefer hard bottoms of broken relief with coral heads and outcrops of rocks (Carpenter, 1965: 8). This type of bottom is described and called "live-bottom habitat" by Struhsaker (1969: 272). Off Florida's west coast, the red groupers frequently occupy the crevices, ledges, and caverns formed by the limestone reefs (Moe, 1969: 68).

Groupers need shelter and seek crevices and holes in which to hide (Smith, 1961: 2:2). Field observations indicate that red groupers seldom stray from shelter. They normally avoid midwater and, usually, stay on or very near the bottom. Usually, a grouper hooked on very light tackle will dart for the nearest hole, from which it is difficult to dislodge.

ACKNOWLEDGMENTS

I am grateful to BCF Exploratory Fishing Base personnel for help: Charles M. Roithmayr, for valuable suggestions, Michael D. Brown, for the graphs, and John D. Schlotman for the photograph.

LITERATURE CITED

BEAUMARIAGE, D. S.
1969. Returns from the 1965 Schlitz tagging program including a cumulative analysis of previous results. Florida Dept. Nat. Res., Techn. Ser., No. 59, 38 pp.

CARPENTER, J. S.
1965. A review of the Gulf of Mexico red snapper fishery. U.S. Fish Wildl. Serv., Circ. 208, iv + 35 pp.

CARRANZA, J.
1959. Pesca y recursos pesqueros. In E. Beltran (Ed.), Los recursos naturales del sureste y su aprovechamiento, pt. 2, vol. 3, Chap. 5, pp. 151-238. Inst. Mexicano Rec. Nat. Renov., Mexico, D.F.

GUTIERREZ, T.
1965. Atlas pesquero nacional. Secr. Indust. Comer., Com. Nac. Consult. Pesca, unpaged, 40 pls.

JARVIS, N. D.
1935. Fishery for red snappers and groupers in the Gulf of Mexico. Invest. Rep. U.S. Bur. Fish., No. 26, 29 pp.

MOE, M. A.
1963. A survey of offshore fishing in Florida. Florida Bd. Conserv., Prof. Papers Ser., No. 4, 117 pp.

1966. Tagging fishes in Florida offshore waters. Florida Bd. Conserv., Tech. Ser., No. 49, 40 pp.

1967. Prolonged survival and migration of three tagged reef fishes in the Gulf of Mexico. Trans. Amer. Fish. Soc. 96(2):228-229.

1969. Biology of the red grouper Epinephelus morio (Valenciennes) from the eastern Gulf of Mexico. Florida Dept. Nat. Res., Prof. Papers Ser., No. 10, 95 pp.

RIVAS, L. R.
1964. Western Atlantic serranid fishes (groupers) of the genus Epinephelus. Quart. Jour. Florida Acad. Sci. 27(1): 17-30.

1968. Fishermen's atlas of monthly sea surface temperatures for the Gulf of Mexico. U.S. Fish Wildl. Serv., Circ. 300, 33 pp.

1970. Snappers of the western Atlantic. Commer. Fish. Rev., 32(1): 41-44. (Also Rep. No. 860.)

SMITH, C. L.
1961. Synopsis of biological data on groupers (Epinephelus and allied genera) of the western north Atlantic. FAO Fish. Biol. Synop., No. 23, Sect. 1, 30 pp.

SOLIS, RAMIREZ M.
1970. The red grouper fishery of Yucatan Peninsula, Mexico. Proc. Gulf Carib. Fish. Inst., 22nd Annual Sess., pp. 122-129.

STRUHSAKER, P.
1969. Demersal fish resources: Composition, distribution, and commercial potential of the Continental Shelf stocks off southeastern United States. U.S. Fish Wildl. Serv., Fish. Ind. Res. 4(7): 261-300.

Fish Behavior Studies from an Undersea Habitat

William L. High and Alan J. Beardsley

Saturation diving from an undersea habitat permits scientists to make direct observations and to maximize their effective underwater time. During Mission I of Tektite II in the U.S. Virgin Islands, the authors conducted studies of fish behavior in and near pots (traps).

Three pot designs were studied: (1) the typical Virgin Island pot of chicken wire and wood strips, (2) an experimental collapsible pot utilizing nylon web and an aluminum frame, and (3) a commercially manufactured plastic pot.

The Virgin Island pot captured the greatest number of fish, although they were smaller than those captured in the experimental pot. The plastic pot caught few fish. Numerous behavioral characteristics relating to fishes within the influence of the pots were noted, including territorial defense, social behavior, and predator-prey relationships. Bait seemed to play a minor role in attracting fish to the pots.

For over 15 years, fishery scientists have utilized scuba gear effectively as a research tool. The ability to descend beneath the surface to observe directly harvesting gear in action and to study animal behavior has provided valuable information for the development of improved fishing gear and techniques (High, 1969). However, due to the effects of water pressure, divers can remain submerged only for relatively short time periods if they wish to return directly to the surface without decompressing. If a diver remained too long, nitrogen held in his tissues would cause the bends, a serious diver disease, when he returned to the surface.

The use of undersea habitats is one way in which the scientist-diver can remain under pressure for extended periods, either within the dry living space of the chamber or swimming in the water. At the conclusion of his study, the diver need only make a slow ascent to the surface using a decompression chamber. This permits nitrogen to escape slowly from saturated tissues, thereby eliminating those conditions responsible for the bends.

Recently, we utilized an undersea habitat for 2 weeks in research on fish behavior. Our experiments were carried out from the Tektite II undersea habitat (Figure 1) in the U.S. Virgin Islands. During the first mission of Tektite II (April 4-17, 1970), we investigated the behavior of fish around and within commercial and experimental fish pots. This study has direct application to the existing commercial pot fishery for reef fishes in the Virgin Islands, as well as the developing sable fish (Anoplopoma fimbria) pot fishery in the northeastern Pacific Ocean off Washington. Prior to Tektite II, we had collected information on fish behavior to pots using underwater TV, short-duration diving, and inferences from catch data; during Tektite II, we made direct observations of fish behavior for up to 7 hours a day.

METHODS AND MATERIALS

The steel Tektite habitat consisted of two 18-foot-high cylinders, each $12\frac{1}{2}$ feet in diameter, connected by a tunnel $4\frac{1}{2}$ feet in diameter (Figure 1). The cylinders were partitioned horizontally near the middle, creating

Mr. High and Dr. Beardsley are Fishery Biologists with BCF, EF&GRB, 2725 Montlake Blvd. E., Seattle, Washington 98102.

COMMERCIAL FISHERIES REVIEW
Reprint No. 888

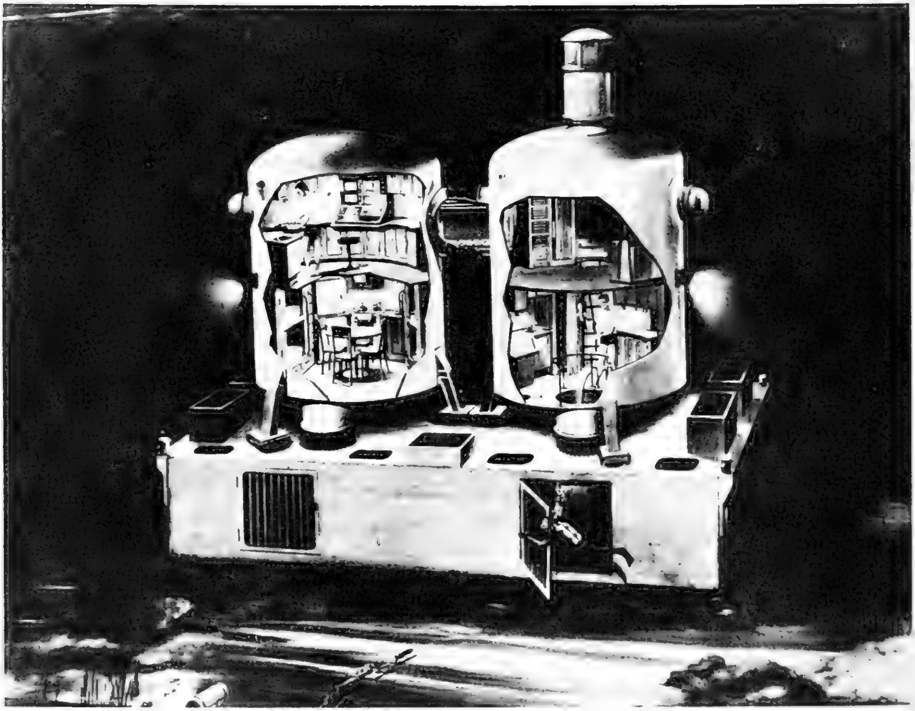


Fig. 1 - Artist's conception of the Tektite II 4-room underwater living and research habitat 50 feet beneath the Caribbean Sea.

four individual rooms. The gas mixture inside the habitat was controlled to 8% oxygen and 92% nitrogen at the ambient pressure of approximately 45 feet of seawater. The habitat site was selected because of the generally calm, warm, clear water and the nearby biologically diverse coral reef. Over 300 species of fish are represented in nearby waters (Randall, 1968).

Divers left the habitat wearing double scuba tanks permitting excursions from the habitat up to $1\frac{1}{2}$ hours. Diver safety equipment included dual regulators, tank pressure gauge, watch, compass, emergency sonic pinger, and CO_2 inflatable marker float. Hand-held, battery-operated lights were used during night dives. Observations of fish behavior were recorded using pencil and acetate cards.

Experiments were conducted with a total of six pots, two each of three different designs. Duplicity in pots permitted modifications in one pot while the other was being used as a control.

Virgin Island Pots

Two identical pots were borrowed from a local Virgin Island commercial fisherman (Figure 2). These pots were constructed of chicken wire ($1\frac{1}{2}$-inch mesh) supported by a frame made of $\frac{3}{4}$-inch by $1\frac{1}{2}$-inch wooden stringers. External dimensions were 20 inches high, 3 feet across and 4 feet long. The chicken wire tunnels were oval in shape and terminated in a right angle with the trap tunnel gate below. A plywood door at one end of the pot provided access to the pot interior for baiting and fish removal.

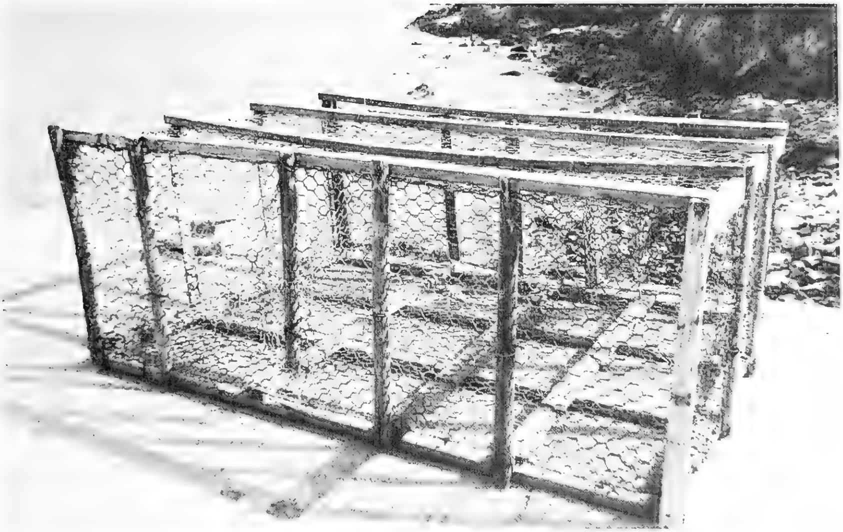


Fig. 2 - The typical Virgin Island fish pot constructed of chicken wire and wood lathe has two tunnels, one on each side.

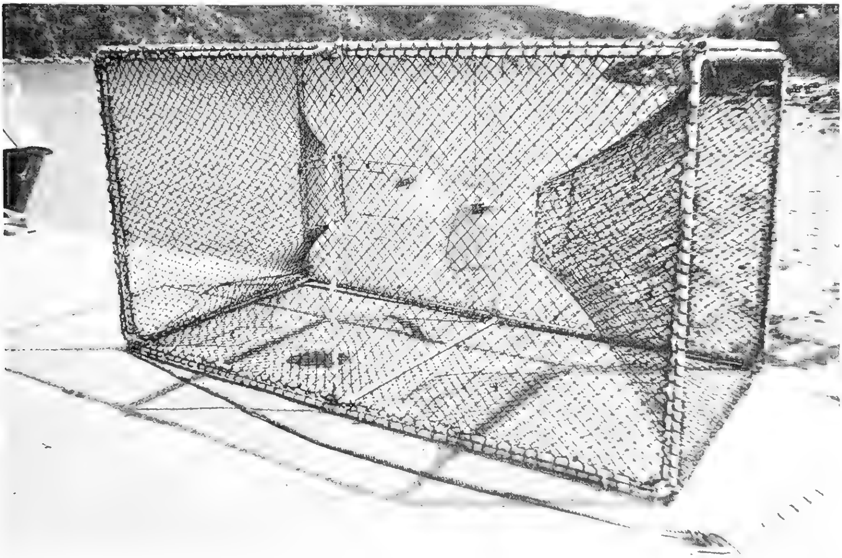


Fig. 3 - The lightweight experimental pot could be easily collapsed for shipment. One cone-shaped tunnel was placed in each end.

Fig. 4 - Underwater view of experimental pot lid opened to release captured fish.

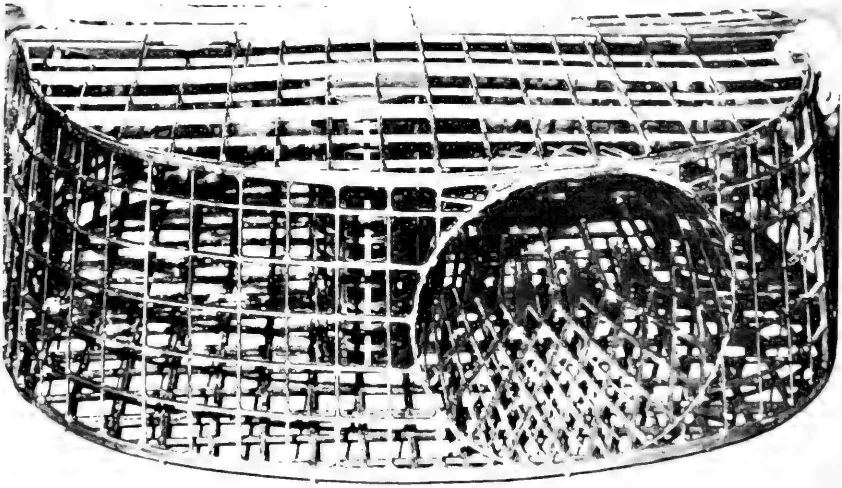


Fig. 5 - This small, molded-plastic pot proved ineffective for either fish or lobsters.

Two experimental collapsible pots--similar in design to the sablefish pots now being tested in the northeastern Pacific--were constructed in Seattle, Wash., and shipped to the Virgin Islands (Figure 3). These pots used 2-inch nylon web hung on a framework of $\frac{5}{8}$-inch-diameter aluminum rod. Nylon web formed the tunnels that led directly into the pot interior. Overall dimensions of these pots were 3 feet high, 3 feet across, and 6 feet long. Both 3- by 3-foot frames forming the top of the pot could be swung open for access to the pot interior (Figure 4).

The remaining two commercial pots were oval and constructed of black molded plastic (Figure 5). The mesh size of the plastic was $1\frac{3}{4}$ inches, and the external dimensions of these pots were $2\frac{3}{4}$-foot diameter by 1-foot high. Flexible plastic "spears" projected inward from the 8-inch-diameter tunnels to discourage the escape of either fish or lobsters.

During the 13-day experiment, experimental pot parameters were varied, including: triggers on tunnels, size of tunnel openings, location of pot relative to reef, type of bait, and length of time pots were fished.

Bait included crushed sea urchin, fish meal, conch, chopped fish, and a local cactus commonly used by Virgin Island fishermen. At the conclusion of a designated fishing period, fish were enumerated by species and then released.

RESULTS

During comparative fishing experiments on the coral reef, the three pot types exhibited distinct differences in their rate of fish capture and in species composition of the catch (Figure 6). The black plastic pots rarely caught fish, so catch records for these pots have not been included. In general, the Virgin Island-style pots caught greater numbers of fish than the experimental pots (Figure 6), but the fish were smaller. Only in the experimental pots were the larger, 4- to 5-pound Nassau groupers, caught. This selectivity by size of fish can be attributed to the larger tunnel and overall pot size. Spiny lobster entered the experimental pots; as many as four were caught during a 24-hour period.

It was possible to make many valuable observations of the behavior of fishes, both

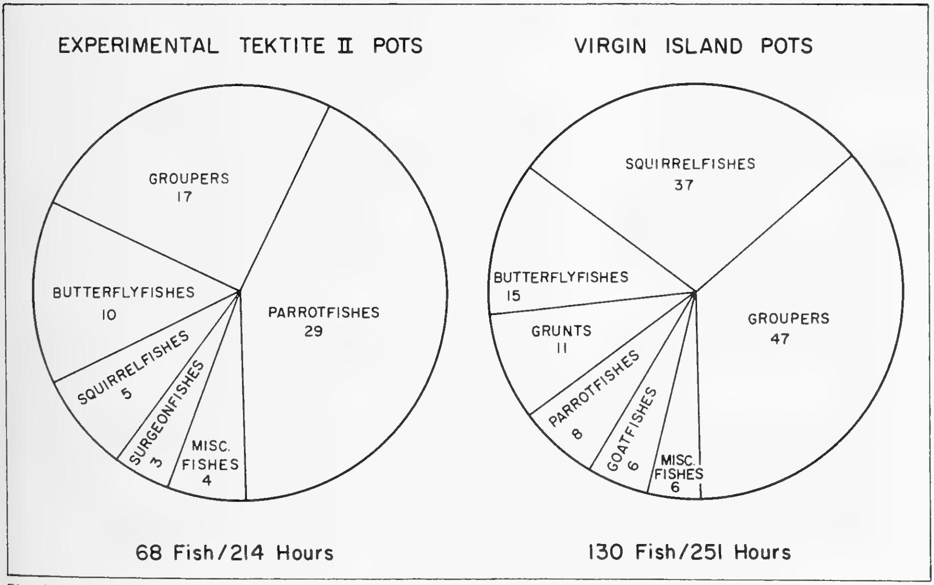


Fig. 6 - Catch (no. of fish) by fish family for experimental and Virgin Island pots. Only those sets where the bait was the same and pot locations were similar are considered here.

undisturbed on the reef and in the vicinity of pots. The behavior of an individual fish species may be as characteristic of that species as body morphometry or color. For example, some species were found consistently as solitary individuals and approached the pot with caution (groupers); other schooling species either would enter the pot readily as a group (squirrelfishes, goatfishes) or independently (parrotfishes, bigeyes); paired fish would follow their mates readily into the pots (butterflyfishes and some parrotfishes).

Pot's Location on Reef Important

We found that the location of the pot on the reef is an important factor determining the number and species of fish caught. Although squirrelfish were numerous on all reef areas surrounding the habitat, they tended to congregate in localized areas, including a soft coral seawhip located on the sand flats three feet from the reef. One Virgin Island pot was placed 15 feet from the coral seawhip for two 24-hour periods. The pot caught five fish; only one was a squirrelfish. When the pot was moved within 5 feet of the coral seawhip, catches increased to 25 squirrelfish in 24 hours. On another occasion, when the experimental pots were placed over the "territory" of a grouper, the grouper often would enter the pot to chase away intruders within the pot.

The motivation causing fish to enter pots is not clear. It probably results from complex and interacting stimuli. Even if the biologist observes directly, it is difficult for him to quantify objectively the individual stimuli responsible for fish entry.

Bait's Minor Role

Although it was assumed bait plays an important role in attracting fish into pots, we could see no difference between bait types: cactus, crushed sea urchin, fish meal, conch, and chopped fish; all bait types attracted about the same number of fish. Moreover, unbaited pots caught as many fish as baited ones. Also, once fish were inside the pots they immediately attempted to escape and ignored the bait.

We observed these alternate reasons for fish entry: (1) use of the pot as a residence or territory, which was defended against intruding fish of the same species (groupers); (2) random movements of fish on the reef (butterflyfishes, parrotfishes); (3) curiosity (butterflyfishes, squirrelfishes); (4) social behavior or gregariousness with one or more fish attracting others into the pot (butterflyfishes, squirrelfishes); and (5) predator-prey relationships, where the predator (groupers, parrotfishes) would chase the prey (squirrelfishes, parrotfishes) into the pot, or the predator would be attracted into the pot by the already captured prey (groupers, parrotfishes). Although parrotfish are not generally considered predators, they were observed on numerous occasions attacking weak and dead parrotfish in the trap.

Behavior Inside Pots

Once inside the pots, butterflyfishes, goatfishes, squirrelfishes, and parrotfishes would swim in circles continuously--compared to groupers' intermittent search behavior. The fish would congregate in the corners of the pot and, on several occasions, fish (we assume parrotfishes) bit through the nylon web creating holes large enough for fish to escape. Fish spent little time near the tunnel openings of the experimental pots, and only two fish were seen escaping through these openings. The complexity of the Virgin Island-type tunnel largely prevented escape by all fish species. However, the number of parrotfish in a Virgin Island pot decreased from four to two during a 4-hour interval.

After several days' observation of freshly baited Virgin Island pots, it was concluded that the rate of fish entry follows a relatively consistent pattern. Many observations were made on pots placed near the squirrelfish school under the soft coral seawhip. This school was large enough (about 60 fish) that some fish were active near the pot at all times. Following release of fish from the previous study period, fish would investigate the pot and, eventually, one would enter. The time to the first entry would vary, but once the first fish was inside, other fish followed rapidly (Figure 7). Daytime catch rates were higher than those during darkness. When the number of fish inside approached 25, the rate of entry would drop off sharply. It appeared that the relatively large number of fish swimming inside and trying to escape frightened other fish from the area. This "saturation effect" always occurred long before the volume of the pot limited fish entry. The saturation effect is not unique to Virgin Island reef fishes; it has been inferred too from catches of sablefish in the northeastern Pacific.

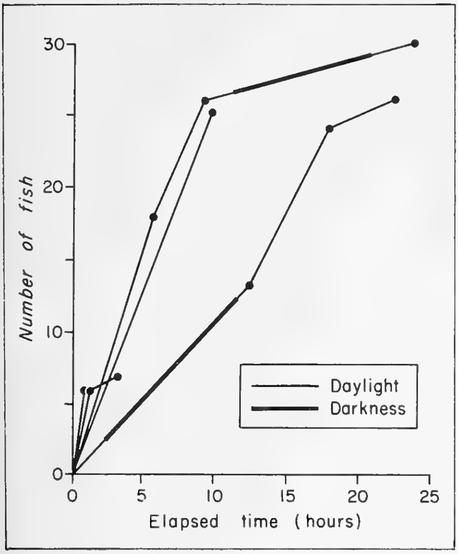


Fig. 7 - Date of fish entry into Virgin Island pots during five different sets. Dots indicate time of fish enumeration.

Our attempts at capturing the larger pelagic fishes (jacks, mackerels, and snappers) proved futile. An experimental pot was buoyed upward by flotation bags until it hung some 25 feet above the seabed. A low-intensity light inside the pot attracted many small fishes and invetebrates after darkness, but none of the large pelagic fishes (up to 50 pounds) would enter. These large fish also would circle under the habitat's lights each night, but we did not observe any foraging on the numerous smaller animals similarly attracted.

CONCLUSIONS

After our early observations, it became apparent that a broad spectrum of behavior patterns is exhibited by the variety of fish species present on the coral reef. Although our research during Tektite II has direct bearing on the local Virgin Island pot fishery (placement of pots, use of bait, time between lifts, rate of escape, etc.), its relevance to the sablefish fishery in the northeastern Pacific may not be as straightforward. We were able to observe repeatedly the "saturation effect" as the number of squirrelfish built up in the pots and believe this phenomenon may be occurring with sablefish in the northeastern Pacific. Since each species exhibits its own behavior patterns, it is difficult to draw conclusions from a study of a particular species and transfer these observations to another species. By and large, the most legitimate way to reach conclusions regarding the behavior of a fish species in a species-specific fishery (sablefish) is to observe the species. Future studies in Pacific Northwest waters undoubtedly will include more observations of sablefish held in salt-water pens.

Diver's Effect On Fish

A major concern of behaviorists making direct underwater observations is the possible effect of the diver upon the animals under study. Divers are well aware that exhaust bubbles from conventional scuba gear may frighten fish. Although most fishes seemed to adjust quickly to the diver's presence, it was necessary to remain at a greater distance than probably would have been necessary using rebreathing apparatus that does not exhaust bubbles.

The advantages of saturation diving over conventional scuba techniques are obvious. But, to most scientists, the experience is so novel that it is difficult to preplan experiments due to a lack of experience and knowledge of the full potential this type of diving offers. Missions in coming years undoubtedly will profit from the expertise of aquanauts currently being trained in the Tektite program.

LITERATURE CITED

HIGH, WILLIAM L.
1969. Scuba diving--a valuable tool for investigating the behavior of fish within the influence of fishing gear. Proceedings of the FAO Conference on fish behavior in relation to fishing techniques and tactics. FAO fisheries reports No. 62, Vol. 2. pp. 253-267.

RANDALL, JOHN E.
1968. Caribbean Reef Fishes. T.F.H. Publications, Inc., 318 p.

Sea Bob Fishery of the Guianas

Warren F. Rathjen and B. C. C. Hsu

"Assuming demand in other countries increases at least as rapidly as U.S. demand, the world's estimated harvest potential of shrimp and prawns from known populations may be reached by 1980." So wrote Donald P. Cleary, BCF economist, in Commercial Fisheries Review, March 1970.

Evidence of new shrimp sources being tapped are illustrated graphically by the increases during recent years in shrimp harvesting in Northeast Pacific and Northwest Atlantic. The catch of small shrimp in Alaska has tripled since 1965. Off New England, the shrimp catch has doubled each year for the past 4 years. There is some reason to speculate that the production of shrimp from existing sources may be reaching its upper limit.

There are some unconventional supplies that never have been fished heavily in some parts of their range. These include certain shrimp inhabiting great depths of the ocean basins and, somewhat surprisingly, at least one species found near shore along much of the tropical and semtropical shoreline of the western Atlantic. A species in the latter category is the sea bob, Xiphopeneus kroyeri, found in the Atlantic from southern Brazil to Cape Hatteras, North Carolina.

Compared to other shrimp species, the sea bob is small. Frequently, it is found mixed with large quantities of small fishes; separating shrimp from catch is laborious.

Significant fisheries for sea bob exist in Brazil. Neiva and Wise (1964) reported a catch there in excess of 6,000 metric tons (heads on). Neiva (1968) indicated that landings in 1965 tripled those of 1964. Most of the catch in this fishery, centered at Santos, is made by trawls. In the United States, there is some trawl fishing for sea bobs, primarily in Louisiana. Landings there averaged about a half-million pounds annually from 1965 to 1967. The publication, "Survey of the Sun-Dried-Shrimp Industry of the Northern Gulf of Mexico," (Love, 1967) describes the fishery in Louisiana. Sea bobs also are taken in Central and South America.

FISHERY IN THE GUIANAS

The "Guianas" (fig. 1), including Guyana (formerly British Guiana), Surinam (Dutch Guiana), and French Guiana all have fisheries for sea bobs.

Although sea bobs are the predominant species taken, other varieties of shrimp, known locally as "white-bellies" (P. schmitti), are found in the catches in varying quantity. Accurate data on production by species are not generally available. Croker (1967) stated that Guyana production in 1956 was about 800,000 pounds (heads on), but estimates were that 4 to 5 million pounds could be harvested if a suitable market were found. In Surinam, 1956 production was more than 1 million pounds, and 5 to 6 million pounds can be produced annually.

More recent figures have been gathered for Surinam and French Guiana. From 1960 to 1968, Surinam production averaged 1.2 million pounds per year. In French Guiana, production in 1963 to 1965 averaged about 130,000 pounds a year.

A definite seasonal trend can be noted from available information on landings. In French Guiana, there are no significant landings from December to April; fishing there is sharply curtailed due to a reduced catch rate. A similar cycle is evident in Surinam; figure 2 illustrates relationship between rainfall and monthly variations in landings. The peak of the Guianas' fishery occurs in summer. A comparable phenomenon exists off Brazil, where top landings are from December through June during southern summer. In Brazilian fishery, Neiva and Wise

Mr. Rathjen is Fishery Biologist with BCF Exploratory Fishing and Gear Research Base, Woods Hole, Mass. 01930.
Mr. Hsu, formerly of the School of Fisheries, University of Washington, Seattle, Wash., was killed recently in an auto accident.

COMMERCIAL FISHERIES REVIEW
Reprint No. 889

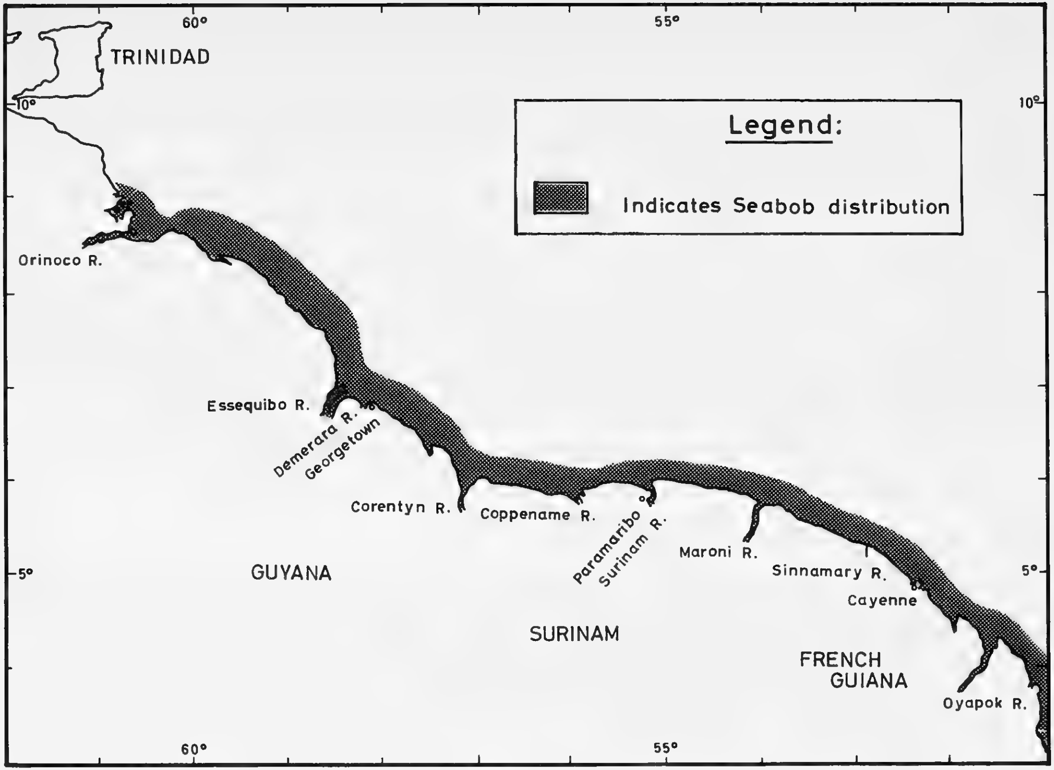


Fig. 1 - The Guiana coast of South America. Shaded portion indicates approximate range of sea bob, Xiphopeneus kroyeri, a small shrimp.

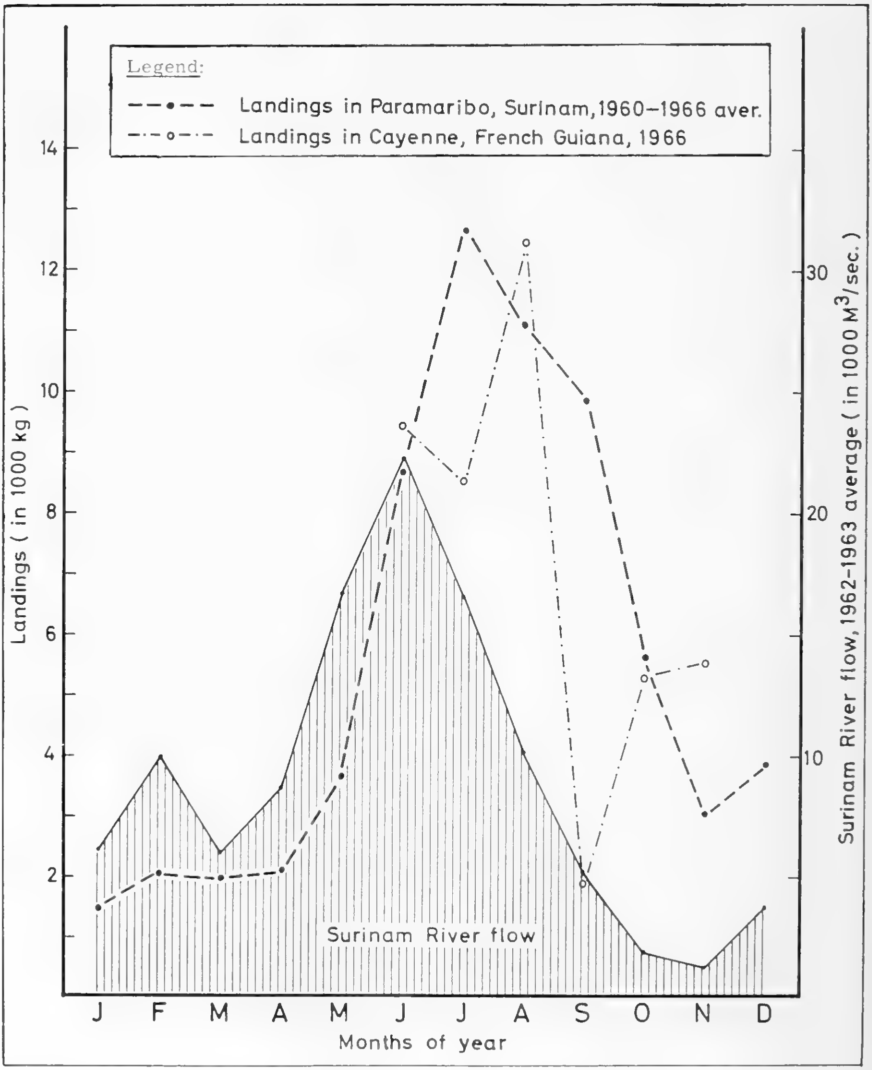


Fig. 2 - Correlation between river flow and landings of sea bobs in Surinam and French Guiana. Catches are highest during periods of maximum river flow.

suggest that this high catch rate is associated with spawning concentrations.

There is reason to believe that the present use of sea bob in the Guianas is but a fraction of potential.

One producer in Cayenne suggested that the supply from nearby waters could probably supply, without too much difficulty, about 10 tons of shrimp a day. Today's fishery is comparatively primitive. It depends on stationary (set) fishing gear. It is restricted to seasonal conditions that favor an abundance of shrimp in the mouth of river estuaries where the sea bobs occur. Experimental trawling has indicated sea bobs abundant in coastal waters. One French Guiana source says they are available in good quantities from 5 to 16 fathoms. Durand reported in 1959 a widespread distribution for the species off French Guyana with the peak of abundance in the more shallow (5 fathoms) waters. Higman, writing in 1959 about explorations off Surinam, said sea bobs were present in depths shallower than 16 fathoms; greatest abundance was from 10 to 15 fathoms. Similar resources are known to exist off Guyana.

In Guyana and Surinam, most production is consumed locally; exports are insignificant. In French Guiana, however, the opposite is true: much of the production is shipped to France after first being cooked, packaged, and frozen. The size of the whole shrimp produced for this market varies from about 70 to 100 per pound. One source reports the demand in France equals 3,000 tons a year.

GEAR AND METHODS

The gear used in this fishery is the "chinese seine." Bonnet, in 1933, described a comparable gear in the shrimp fishery of California a century ago. In some ways, the "channel net" used in North Carolina also is similar (Guthrie, 1966).

The chinese seine, essentially, is a bag net (fig. 3). It is anchored to wooden stakes driven in the bottom and fished by tidal action. Often a series of nets is fished side by side (fig. 4), forming a barrier across portions of the river mouth or estuary. Tides along the Guianas range about 8 to 12 feet between high and low water. The "seines" or nets are constructed of synthetic webbing

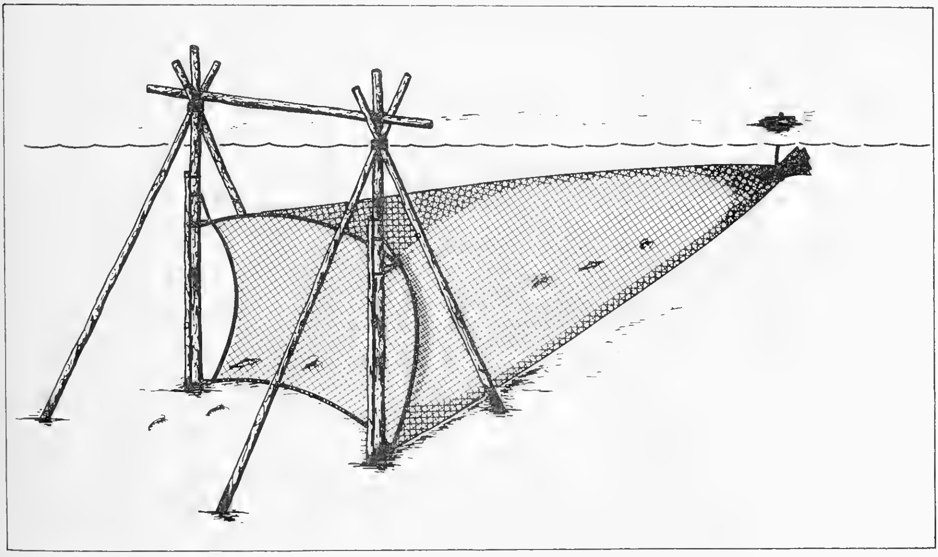


Fig. 3 - Diagram of a "chinese seine," a type of bag net used to fish for sea bobs in the Guianas. These nets are set near mouths of estuaries and, sometimes, are fished in groups of 6 or more units. Some fish also are taken.

varying from up to 10 inches (stretched mesh) at the mouth, and tapering to $\frac{1}{2}$ to $\frac{2}{3}$ of an inch in the bag or cod end. The overall size of the nets ranges from 20 to 25 feet wide by 10 to 20 feet deep at the mouth, and 60 to 80 feet long.

A bateau or canoe-type boat (figs. 4 and 5) of up to about 16 feet is used to tend the nets (2 to 10 in number of units) and to transfer catches ashore.

The usual sequence of operations is:

1. At fishing site, the net is streamed into the current caused by tidal flow (fig. 6).

2. The forward (mouth) portion of the net is retained at bow of boat.

The footrope holding poles (fig. 7), with either vine or chain rings, are put to one side of boat.

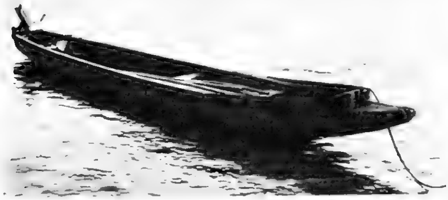


Fig. 4 - Boat used in chinese seine fishery at mouth of Surinam River. Most boats are outboard powered.

Fig. 5 - Boat used in chinese seine fishery near Georgetown, Guyana. In background, part of string of chinese seine nets near mouth of Demerara River.

Fig. 6 - Fisherman overhauling chinese seine net during setting procedure. Nets are fixed to stakes and fished by tidal action. Catches are taken from net at slack tide.

Fig. 7 - Pole with ring made from vines used to hold bottom of net to fixed stakes. In background are nets taken ashore for overhaul.

3. The ring of footrope holding pole is slipped over fixed stake, one holding pole for each lower corner of the net (two). The lower corners of the net are then fixed individually, one at a time, to each holding pole; they are then submerged and driven to the bottom. The top of each holding pole then is affixed to respective fixed stake.

4. With mouth of net then spread between fixed stakes, the cod end is tied and set into water. A float is affixed to cod end for recovery purposes.

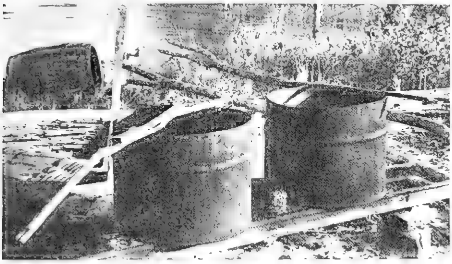


Fig. 8 - Cut-down oil drums are used to boil shrimp after they are brought ashore. The sea bob shrimp are cooked in a brine solution.

At appropriate stage of tide (slack water), the cod end is retrieved by the floatrope, and the catch emptied into baskets in the stall. Then, usually, the net is reset to fish on opposite tide (flood vs. ebb).

In Surinam, one net can be expected to produce about 65 pounds of shrimp per ebbing (outgoing tide). Some fishermen fish up to a dozen nets which, when fishing is good, can be expected to capture over 500 pounds per tide.

Some Processing Is Done

Some processing is involved in preparing shrimp for "market." In Guyana and Surinam, the shrimp are boiled in brine (fig. 8) by fishermen or their families. The shrimp then are sun-dried on frames (fig. 9), and the "meats" separated from the "heads" much in the manner wheat kernels are separated from chaff. The product (fig. 10) is relished by East Indian residents of both countries as a condiment for mixture with other foods or simply rice. Conversely, the procedure in French Guiana involves cooking and freezing (heads on) for shipment to metropolitan France.

Fig. 9 - Shrimp drying in sun on frames. After shrimp are dried, meat is separated from head by sifting. The inedible portions are valued as feed for chickens and other animals.

Fig. 10 - After drying, the sea bob shrimp shown here are ready for market. The dried product is sold for over one (U.S.) dollar per pound.

Part of the solution may be found in using specially designed trawl nets capable of eliminating most fish catch but retaining shrimp. Part of problem in trawling for sea bobs is capture of large quantities of undersized "trash fish" along with sea bobs. The fish make it difficult to pick out shrimp--besides degree of damage to tiny shrimp while still in the cod end due to the heavy pressure.

Much technological development is needed. Production in French Guiana is held down by the limited fresh water readily available for mechanical peeling. In one of the world's "wettest" parts, this probably can be overcome.

Processes now being developed might permit separation of shrimp "meat" from sea bobs for use in specialized products where only a fraction is shrimp.

The next decade will witness developments in sea-bob use.

POTENTIAL

No reliable estimates are available that project possible landings from this fishery. About three million pounds are taken by stationary gear at less than half the available fishing sites. Fishing is conducted within a very limited part of the sea bob's range. These factors suggest that an increase by a factor of ten times or more might be anticipated by pursuing more aggressive fishing techniques (trawls).

LITERATURE CITED

BONNET, PAUL
1933. The California shrimp industry, Fish. Bull. #38, Cal. Dept. Fish and Game, 20 p.

CREVIGON, FERNANDO
1964. Exploratory fishing off the Orinoco Delta. Proc. Gulf and Carib. Fish. Inst., 17th Annual Session, p. 20-23.

CROKER, RICHARD S.
1967. The shrimp industry of Central America, the Caribbean Sea, and northern South America. U.S. F.W.L.S. Foreign Fisheries Leaflet 74, 125 p.

GUTHRIE, JAMES F.
1966. The channel net for shrimp in North Carolina. Commercial Fisheries Review, vol. 28, no. 11, p. 24-26. (Sep. No. 773)

LOVE, TRAVIS D.
1967. Survey of the sun-dried-shrimp industry of the north central Gulf of Mexico. Commercial Fisheries Review, vol. 29, no. 4, p. 58-61. (Sep. No. 787)

NEIVA, G. de S.
1967. Observations on the shrimp fisheries of the central and southern coast of Brazil. In Proc. FAO World Scientific Conf. on the Biology and Culture of Shrimps and and Prawns, p. 1-12.

______, and J. P. WISE
1963. The biology and fishery of the sea bob shrimp of Santos Bay, Brazil. Proc. Gulf and Carib. Fish. Inst., 16th Ann. Session, p. 131-139.

RECENT DEVELOPMENTS IN PERUVIAN FISHERIES

Robert H. Lander

The Peruvian fishery for anchoveta (Engraulis ringens) is the world's largest by weight. Annual publications of the Food and Agriculture Organization of the United Nations (FAO) contain the landing statistics. International oceanographic expeditions have studied and reported biological and physical aspects of the rich upwelling area off Peru, which provides the plankton diet of anchoveta.

Most non-FAO publications on this fishery are in Spanish. Also, the distribution of material to libraries in the northern hemisphere is limited, and distribution of certain FAO working documents is necessarily restricted. These facts serve to reduce availability of information.

In June 1970, I completed a 1-year tour with FAO at the Instituto del Mar del Peru, in Lima's seaport of Callao. I have selected for this article some recent, reportable general developments in Peruvian fisheries.

ANCHOVETA

Strong recruitment of this species was evident by early December 1969. High catches--sometimes exceeding 300,000 metric tons weekly--characterized the last half of the 1969-70 season. Official landing statistics await publication but will be on the order of 11 million metric tons. Other species also enter the meal plants: in one atypical case, I observed a set of 50 tons estimated to be 20% "pejerrey," an atherinid normally caught for table food by inshore gillnetters.

The seiners, many with a hold capacity of 350 tons and with even larger ones now being built (Commercial Fisheries Review, 1969), can be filled under ideal conditions from a single set. Typically, the catches are pumped into barges anchored offshore because the beach is shallow and Peru has few harbors. In turn, huge volumes of fish and water are pumped ashore where the fish are weighed and processed.

Considerable differences between plant layout and the high costs of installing magnets or more sophisticated equipment--efficient enough to recover reasonably high proportions of internal tags from the high volumes processed--greatly complicate early prospects for quantitative tagging experiments. In August 1970, however, the first coastwide release of tagged fish (about 200,000) was nearly complete under Peruvian/FAO cooperation. The objective is to find preliminary information on the degree of intermingling between fish from different areas to help decide if the major northern (Chimbote) and central (Callao-Pisco) parts of the stock should be managed as a single unit.

Fishing occurs year round in the far southern area off Ilo and Mollendo near Chile; this area contributes less than 10% of total landings. The other areas typically have a closure of about 2 months (usually July-August, but mid-May to August in 1970). In addition, shorter and earlier closures have been enforced the past few years to take better economic and biological advantage of an apparent excess of growth over natural mortality for fish shorter than 12 cm.; recruitment commences on fish about 7.5 cm. long. In connection with these closures and a general weekend shutdown, management is based

Mr. Lander is Fishery Biologist, BCF Biological Laboratory, 2725 Montlake Blvd. E., Seattle, Wash. 98102.

COMMERCIAL FISHERIES REVIEW
Reprint No. 890

mainly on quotas derived from scientific investigation. To improve overall economic efficiency, it is possible that plant quotas on meal production also will be introduced beginning September 1 for the 1970-71 season.

The population of guano birds competes with man for the resource. It has rebounded slowly since the drastic southward incursion of warm tropical waters, or El Niño, along the Ecuador-Peru coast during early 1965 (Bjerknes, 1966, Figure 5d; Quinn and Burt, 1970). The bird population was below 5 million in December 1969, down from over 25 million estimated from past censuses before fishery blossomed (personal communication with Dr. R. Jordán, Instituto del Mar del Peru). About 11 tons of anchoveta are required to produce a ton of guano (bird droppings) and about 6 to yield a ton of higher-priced fishmeal. Therein lie a host of fascinating biological and economic problems of great interest to Peruvian, FAO, and other investigators, and to naturalists. Economists point out that fishmeal is second only to copper in generating income to Peru--nearly $250 million annually. The penalty for killing a guano bird still is severe; it was capital punishment during Inca days.

TABLE FISH

Perhaps the most striking economic feature of Peruvian table fish is the high ratio of retail to wholesale prices--often 5 or 10 to 1. The greatest potential and present production is off northern and north-central Peru, where the 100-meter depth curve is farthest from the arid, sandy coastline. Some 75 species are landed--about 30 each month of the year. Bonito are the most important in both landed weight and value. More efficient and cheaper methods of harvesting, processing, transporting, and selling are being sought actively under a new Peruvian/FAO marketing project.

Increased capture and better utilization of table fish is of special interest to the Ministry of Fisheries, which went into effect during February 1970. Its director, General Tantaleán, has ambitious plans. For example, the Danish government already has contracted to build 12 new freezer plants. Still uncertain following the devastating earthquake of May 31, 1970, however, is the extent to which plans for fisheries and other sectors can be implemented on an acceptable schedule to provide more protein and income for Peru's 13 million people.

LITERATURE CITED

BJERKNES, J.
1966. Survey of El Niño 1957-58 in its relation to tropical Pacific meteorology. Bull. Inter-Amer. Trop. Tuna Comm., 12(2): 1-62.

COMMERCIAL FISHERIES REVIEW
1969. Peru builds fiberglass seiners. 31(1): 51.

QUINN, WILLIAM H., and WAYNE V. BURT
1970. Prediction of abnormally heavy precipitation over the Equatorial Pacific dry zone. J. Appl. Meteorol., 9(1): 20-28.

SEASONAL AND GEOGRAPHIC CHARACTERISTICS OF FISHERY RESOURCES

California Current Region--IV. Pacific Mackerel

David Kramer and Paul E. Smith

The fishery for the Pacific mackerel (Scomber japonicus) was until 1936 the third largest in southern California, surpassed only by those of the Pacific sardine and tuna. This mackerel has declined until, in 1970, a 2-year moratorium was implemented by the California Legislature in an attempt to conserve the remainder of the resource and to assist in its revival.

Unlike our previous reports in this series (Kramer and Smith, 1970a, b, c), which briefly discuss the potential for each of the fisheries described, this deals only with the seasonal and geographic characteristics of the Pacific mackerel resource and describes briefly its decline and the result.

Summerized data (1951-60) for the Pacific mackerel from the collections of the California Cooperative Oceanic Fisheries Investigations (CalCOFI) show that the major centers of spawning (10% or more occurrences of larvae in standard plankton tows) appear first in January in a small, inshore area south of Point Eugenia, Baja California (Figure). (The organizations, area of investigations, and treatment of the data were reported by Kramer and Smith, 1970a). The extent of the spawning centers remains small in this area with a trend of spawning northward--in 5% or more occurrences of larvae--until April, when the major centers extend farther offshore and to areas off northern Baja California. Finally, in May, the centers of spawning appear off southern California and, by July, extend a considerable distance offshore and north of Point Conception. Later, by October, the centers are found only off central Baja California. (Data for August, September, November, and December in the decade are insufficient for summarization to show the trends depicted in figure.)

Its Range

The Pacific mackerel once ranged from southeast Alaska (Rounsefell and Dahlgren, 1934) to Banderas Bay, Mexico (John E. Fitch, California Department of Fish and Game--CF&G--correspondence). CalCOFI data on mackerel larvae (Kramer, 1960, 1969) indicate that the spawning populations extend only as far north as Point Conception, California. Richard E. Parrish (CF&G, correspondence) has reported repeated traces of Pacific mackerel taken with jack mackerel off Pt. Sur, California. Data on larvae indicate that the Pacific mackerel extends southward along the coast and into all of the Gulf of California. Larvae found by the CalCOFI (Ahlstrom, 1956) at the mouth of the Gulf indicate that the resource may extend at least to Banderas Bay, as reported by Fitch.

Tagging Program 1935-1943

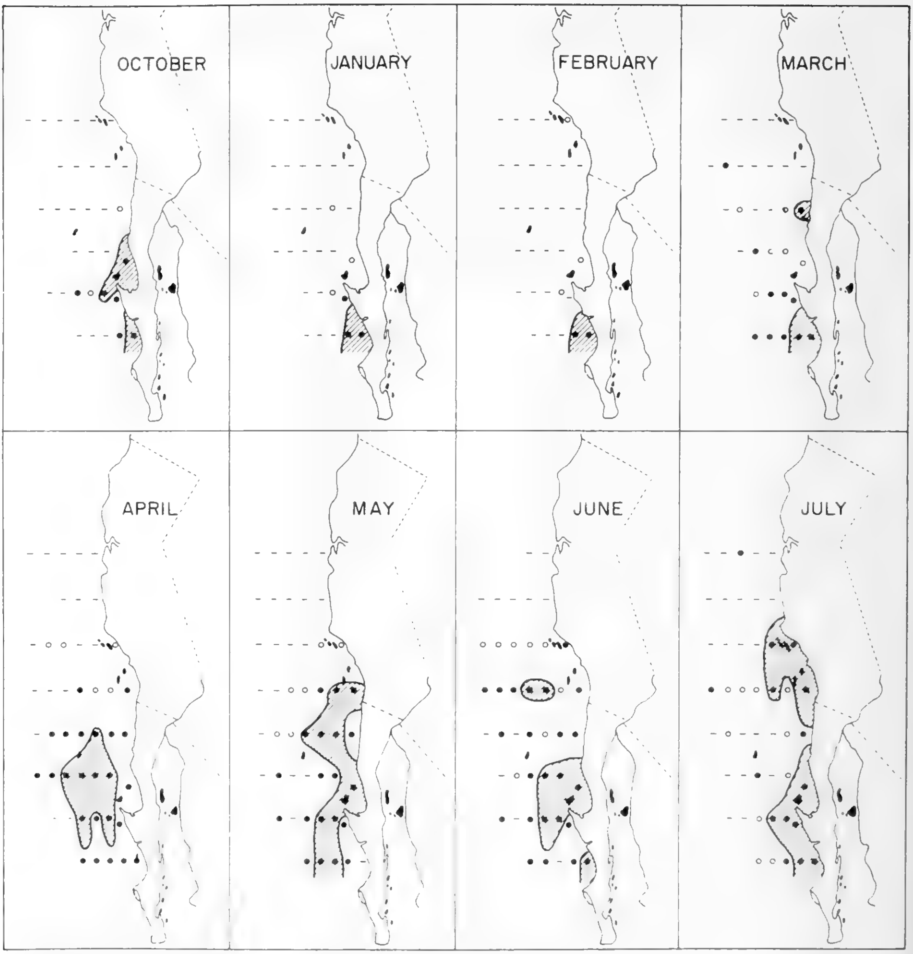
In 1935-43, a tagging program was carried out by CF&G (Fry and Roedel, 1949) in order to understand the movements of the mackerel and determine to what degree the populations from other areas (Roedel, 1952) contributed to the major fishery off southern California. Mackerel were tagged throughout their range--by the Fisheries Research Board of Canada off the Columbia River, and by CF&G from central California to San Roque Bay, about half way down Baja California. Tag returns showed that there was an interchange of fish throughout the region covered by the program, and that all regions contributed to the southern California area.

Decline of Fishery

Blunt and Parrish (1969) reported that this major California fishery, which reached a

The authors are Fishery Biologists, BCF Fishery-Oceanography Center, La Jolla, California 92037.

COMMERCIAL FISHERIES REVIEW
Reprint No. 891



Percent occurrences of Pacific mackerel larvae in 1951-60 on the survey pattern of the California Cooperative Oceanic Fisheries Investigations (CalCOFI). Each line, circle or dot represents a pooled statistical area (see Kramer and Smith, 1970a). (o)--less than 5% occurrence; (•)--equal to or greater than 5% occurrence; shaded area--equal to or greater than 10% occurrence; (-)--area occupied with no occurrence.

peak catch of 73,000 tons in 1935, had declined to record low catches of 583 tons in 1967 and 1,565 tons in 1968. Also, that in Baja California the catch had been declining since 1963 and, in 1968, had dropped to 1,334 tons. This decline is reflected in part by our summarized data for 1951-60, where "high" abundance of spawning populations are indicated by 10% or more occurrences of larvae. (Our previous reports on relatively abundant fishes used 49% for jack mackerel, 20% for Pacific saury, and 50% for Pacific hake.)

Blunt and Parrish estimated the present spawning biomass of Pacific mackerel at less than 5,000 tons. They stated further that "Certain environmental factors detrimental to good recruitment are indicated and if this continues through 1969, long term loss of the fisheries is a distinct possibility." In 1969, California landings were 1,178 tons; no figures are available for Baja California landings for that year.

Legislature Acts

On March 31, 1970, the California legislature passed a bill providing that "Pacific mackerel may not be taken or possessed at any time for any purpose except loads or lots of fish may contain 18% by weight of Pacific mackerel taken incidentally to other fishing operations. Such Pacific mackerel, incidentally taken, may be used for any purpose." This is a 2-year act to ". . . remain in effect only until the 61st day after adjournment of the 1972 Regular Session."

On August 14, the Governor of California signed the bill into law. It will go into effect on November 25, 1970.

LITERATURE CITED

AHLSTROM, ELBERT H.
1956. Eggs and larvae of anchovy, jack mackerel, and Pacific mackerel. Calif. Coop. Oceanic Fish. Invest. Rept. 1 April 1955 to June 30, 1956: 33-42.

BLUNT, C. E., Jr. and RICHARD H. PARRISH
1969. The Pacific mackerel fishery: A summary of biological knowledge and the current status of the resource. Calif. Dept. Fish & Game, Marine Res. Operations, MRO Ref. No. 69-7, 25 p. (mimeo rept.).

FRY, DONALD H., Jr. and PHIL M. ROEDEL
1949. Tagging experiments on the Pacific mackerel (Pneumatophorus diego). Calif. Div. Fish & Game, Fish Bull. 73, 64 pp.

KRAMER, DAVID
1960. Development of eggs and larvae of Pacific mackerel and distribution and abundance of larvae 1952-56. U.S. Fish & Wildl. Serv., Fish. Bull. 60(174): 393-438.

1969. Synopsis of the biological data on the Pacific mackerel, Scomber japonicus Houttuyn (Northeast Pacific). U.S. Fish & Wildl. Serv., Circ. 302: 1-18. (Also FAO Species Synopsis No. 40.)

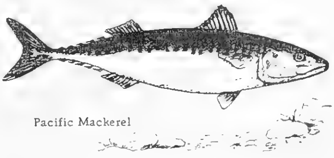
__________, and PAUL E. SMITH
1970a. Seasonal and geographic characteristics of fishery resources, California Current region--I. Jack mackerel. Commer. Fish. Rev., 32(5): 27-31. (Also reprint No. 871.)

1970b. Seasonal and geographic characteristics of fishery resources, California Current region--II. Pacific saury. Commer. Fish. Rev., 32(6): 46-51. (Also reprint No. 876.)

1970c. Seasonal and geographic characteristics of fishery resources, California Current region--III. Pacific hake. Commer. Fish. Rev., 32(7): 41-44. (Also reprint No. 880.)

ROEDEL, PHIL M.
1952. A racial study of the Pacific mackerel, Pneumatophorus diego. Calif. Dept. Fish & Game, Fish Bull. 84. 53 pp.

ROUNSEFELL, GEORGE A. and EDWIN H. DAHLGREN
1934. The occurrence of mackerel in Alaska. Copeia, 1934: 42 pp.



Pacific Mackerel

INTERNATIONAL

JOINT N. ATLANTIC HERRING STUDY CONDUCTED BY CANADA, USSR, & U.S.

Research vessels from Canada, USSR, and U.S. began a cooperative study in September which fishery scientists hope will lead to accurate spawning estimates for herring of Georges Bank, off U.S. North Atlantic coast. Such estimates are necessary if the resource, now fished heavily by several nations, is to be managed wisely.

The international study was undertaken by BCF; the St. Andrews, New Brunswick, laboratory of Canada's Fishery Research Board; and Kaliningrad laboratory. It is sponsored by International Commission for Northwest Atlantic Fisheries (ICNAF), composed of 15 nations that traditionally fish Northwest Atlantic.

The study is part of 3-month international effort, which also includes annual survey of groundfish of Continental Shelf from Cape Hatteras, N.C., to Gulf of St. Lawrence.

The 'Kvant', a Soviet vessel assigned to groundfish survey, visited Woods Hole, Mass. Sept. 20-23.

Georges Bank

Georges Bank, about 150 miles due east of Cape Cod, Mass., is one of world's most productive fishing banks. It has supported for many years large and valuable U.S. fisheries for haddock, cod, redfish, flounder, and hake.

The large herring population was unfished until 1961. Then, it was fished first by the Soviet fleet, and later large German and Polish fleets. More recently, U.S. fishermen have been fishing for herring to export to Europe.

In 1968, the total catch reached high of 408,000 metric tons; in 1969, it dropped to 307,000 metric tons despite greatly increased fishing.

Based on the declining annual catch, BCF biologists have estimated that the herring population now has been reduced to less than 25% its original size.

Data Needed

Georges Bank herring normally are caught at various depths. Nevertheless, they spawn on the bottom during fall months. They attach their eggs to stones and gravel. Their general spawning area is known, but scientists lack data on spawn distribution and density of egg masses. So no reliable estimate of the amount of spawn produced each year could be made by collections of surface vessels with conventional gear. The joint study was deemed necessary.

The Operation

BCF's research vessel 'Albatross IV' sailed from home port of Woods Hole, Mass., September 23. A few days before, the Soviet 'Alferas' searched for concentrations of eggs and directed Albatross to location.

Submarine dives, using the 2-man Canadian submersible 'Pisces I' will observe distribution, characteristics of egg masses, and abundance of spawn, while photographs and samples are taken.

Samples of spawn also will be taken by scientific dredges from Albatross, and results will be compared with information obtained by direct observation from the submersible.

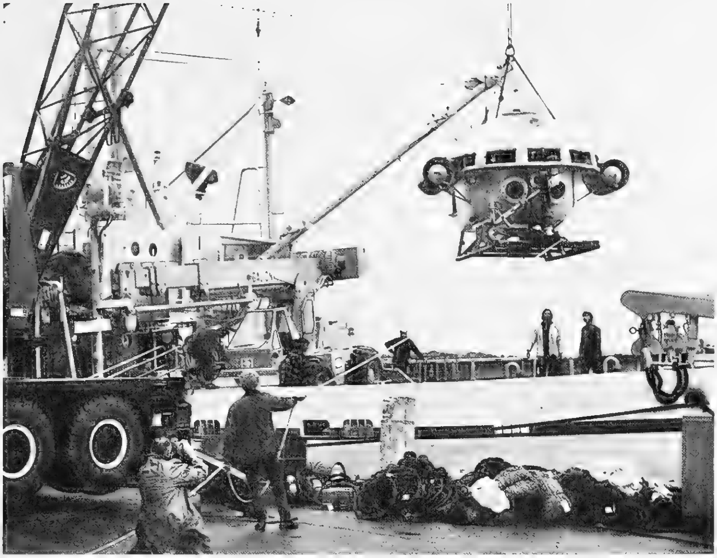


Fig. 1 - Loading Canadian submarine 'Pisces' aboard Albatross IV.

Fig. 2 - USSR research vessel M/V Kvant arriving at Woods Hole. (Photos: R. K. Brigham)

HADDOCK FISHERY PROSPECTS FOR 1970-71

Information on the status of the Northwest Atlantic haddock stocks offers little ground for optimism, says the British Ministry of Agriculture, Fisheries & Food.

The haddock resources are not extensive. The main stocks on Georges Bank and Brown's Bank suffered severe depletion in mid-60s, followed by weak recruitment. Neither area can now support good catches. The international catch is to be regulated by international agreement in 1970-72.

In Northeast Arctic

In Northeast Arctic in 1969, the British catch fell despite increase in fishing; most of catch was made off Norway early in the year. This reflects anticipated fall in abundance evident for all except "jumbo" haddock, the survivors from good year-classes of early sixties.

There are no prospects of real improvement until year-class spawned in 1969 (first evidence indicates it is very good) reaches marketable size in 1972-73.

Meanwhile, haddock landings will remain very patchy. There will be an occasional good catch when stocks are discovered. Catch rates of haddock off Iceland have fallen steadily over the past five years, due mainly to a succession of small year-classes. Returns for last-quarter 1969 indicate improvement in abundance of small haddock.

Faroese Haddock

The improvement in abundance of Faroese haddock in last-quarter 1969 should mean better catches of smaller fish in 1970. Medium fish are likely to be less abundant, and large haddock somewhat above average.

North Sea Small Haddock

A glut of small haddock in North Sea in 1969 resulted from presence of two good year-classes, 1966 and 1967. In general, the 1967 brood is stronger, on a par with record 1962 year-class. In some areas, however, the 1966 year-class also is contributing much. Haddock are now so plentiful that their growth rate has slowed; they are entering catches less quickly than they would under more normal conditions.

Big Fleets in Action

The fleets began tapping this stock in 1968--very heavily by Danish cutters for industrial purposes. Fishing on this large scale has big effect on stocks, but the real threat comes from large fleets that do not normally fish in North Sea. They could easily scoop the pool.

Forecast Catches

There are masses of small haddock around legal minimum size (11 inches) still coming into fisheries. Catches almost everywhere should increase to a maximum in 1971, then start to decline. There will be a greater proportion of medium haddock in 1970 catches, and large haddock from 1971 to 1973.

But this rosy outlook could be reversed if heavy fishing materializes by countries not normally fishing the North Sea. If so, catch rates could be fairly high in 1970--but could decline sharply in 1971. ("Fishing Prospects, 1970-71," report of Fisheries Laboratory, Lowestoft and Suffolk, Ministry of Agriculture, Fisheries and Food.)

1969 WORLD FISHERY PRODUCTION FELL SLIGHTLY

For the first time since 1950, world fish production fell slightly in 1969, reports FAO. Output was down only 1% in developed countries--but 5% in developing countries.

FAO's annual review, "The State of Food and Agriculture, 1970," states: "Smaller landings of fish used for reduction to fish meal and oil were the main reason for this interruption of the rapid long term growth which has raised fish supplies to three times the pre-war and immediate post-war levels.

"Last year, price increases for fish meal and oil blunted to some extent the economic impact on the industry of short supplies. A continuation of recent price trends would, however, have serious market implications for industries in those countries where reduction products are in price competition with other components of animal feed rations or of food products. Substitution was already a significant phenomenon in 1969 in the United States, where feed compounders took advantage of low soybean meal prices and substantially reduced their purchases of fish meal."

Brighter Outlook for Food Fish

Some food fisheries also had poor catches, but these were compensated for largely by improvements in others. FAO believes a brighter outlook is justified for food-fish production. Predictions were for record supplies of north-east Pacific salmon for 1970 and accelerated development of fisheries for domestic consumption in developing countries.

FAO & USSR CONDUCT FISHERY TOUR OFF WEST AFRICA

Twenty fishery scientists from African countries participated in a study tour, July 27-August 29, along the northwest African coast aboard the Soviet fishery research vessel 'Akademik Knipovich' of Sebastopol. The vessel is a 3,730-ton stern-trawler.

The "Sea-Going Group Fellowship Tour," fourth of its kind, was arranged by FAO in co-operation with the USSR under the United Nations Development Program. Purpose of the tours is to train scientists and other specialists from developing countries in modern techniques of fishery science and technology.

The Tour

The tour began in Dakar, Senegal, sailed to the Canary Islands, and ended in Casablanca, Morocco. The scientists watched normal fishing operations and carried out studies and experiments in fishery biology and oceanography under Soviet and FAO instructors. They visited shore research institutions.

The vessel, launched in 1964, is named after a Soviet academician. It belongs to the All-Union Research Institute of Marine Fisheries and Oceanography (VNIRO) in Moscow and is used normally for Antarctic fishery research and exploratory fishing.

Tour director was Dr. A. Bogdanov, USSR, director of VNIRO, and co-director was Dr. Erdogan F. Akyuz (Turkey) of FAO's Department of Fisheries. Previous tours sailed the Black Sea, central Mediterranean, and Caribbean.

FROZEN-FISH PRODUCTION GUIDELINES PUBLISHED

A valuable guide for persons who produce and sell quick-frozen fish has been prepared by specialists on fish and refrigeration from the International Institute of Refrigeration (I.I.R.) and OECD.

The booklet meets a growing need. Production of quick-frozen fish is increasing worldwide. The preparation and commercialization of quick-frozen fish demands precautions to maintain quality.

This booklet is available for $1.80 in combined English-French version from:

OECD
2, rue Andre-Pascal
75 - Paris, France

MEETINGS

INTEROCEAN '70 IN DUSSELDORF, NOV. 10-15

Interocean '70, an international congress with an exhibition of marine research and exploitation, will be held in Dusseldorf, Germany, Nov. 10-15, 1970.

The following subjects will be stressed:

1. Use of oceans' food reserves.
2. Use of seas' mineral resources on and under sea bed.
3. Keeping seas free of pollution.
4. Application of ocean research to shipbuilding and shipping.
5. Protection of coast and security of coastal waters.

For more information:

Dusseldorfer Messegesellschaft mbH
Att.: Eulenberg
NOWEA
4 Dusseldorf 10 - Postfach 10203
Germany

FAO MARINE POLLUTION CONFERENCE

The FAO Technical Conference on Marine Pollution and its Effects on Living Resources and Fishing will be held in Rome, Italy, Dec. 9-18, 1970.

INDIAN OCEAN SYMPOSIUM

A symposium on the "Indian Ocean and Adjacent Seas--Their Origin, Science and Resources" will be held at Cochin, India, Jan. 12-18, 1971. It is sponsored by the Marine Biological Association of India.

For information, contact:

Dr. E. G. Silas
Jyothi Buildings
Gopalaprabhu Cross Road
Cochin - 11, INDIA

U.S.

INSTITUTE OF OCEAN LAW, MONTAUK, NEW YORK, NOV. 16-19

The New York Ocean Science Laboratory will sponsor an Institute Of Ocean Law at Gurney's Inn, Montauk, New York, Nov. 16-19.

The laboratory, at Montauk, N.Y., is operated by Affiliated Colleges & Universities, Inc., a consortium of 8 metropolitan colleges and universities.

The laboratory grew out of a 1966 meeting of scientists at Gurney's Inn "to discuss ways and means to combat the problems of pollution and erosion affecting the Long Island area."

The Topics

Topics to be covered include: coastal zone ecological problems; organizing to deal with coastal zone jurisdictional conflicts and responsibilities; legal aspects of oil transport and storage; local fishery problems today; the need for a New York law of acquaculture; legal considerations of dredging and land fill operations; special problems of waste from vessels, garbage and solid waste disposal; and thermal and radioactive pollution effects from atomic and conventional generating stations.

For complete details, write: Dr. John C. Baiardi, Director, NYOSL, Box 867, Montauk, N.Y. 11954.

CANADA

NEW 'HALIFAX PROCESS' PROVIDES EXCELLENT FPC DINNER

On July 30, Nova Scotian and other dignitaries from as far away as Japan ate world's first fish protein concentrate dinner. (They included Premier G. I. Smith, the main speaker.) Host was Cardinal Proteins Ltd., which completes C$5 million FPC plant at Canso, Nova Scotia, in September. It was scheduled to process 200 tons daily of fresh fish, including abundant but not now marketable species. It is expected to employ 60-70 workers.

The dinner was excellent. It was impossible to detect the FPC by taste or odor.

'Halifax Process'

Halifax process was developed by Canadian Federal Government's Fisheries Research Board scientists. One who helped refine the process was a former BCF scientist, Dr. Ernst Pariser, now a Cardinal director and on M.I.T. staff.

The Canadian Food and Drug Directorate is in the process of approving FPC sale within Canada. No Canadian objections are anticipated. (U.S. Consul, Halifax, Aug. 10.)

SOVIET PORT PRIVILEGES IN VANCOUVER WILL BE REASSESSED

The Soviet Government has requested a meeting on the question of allowing its fishing supply ships to stop in Vancouver. The practice was banned recently by an amendment to Canada's Coastal Fisheries Protection Act.

Canada's Minister of Fisheries and Forestry, Jack Davis, reportedly said this Soviet need gives Canada a "handy stick" in getting some agreement with the Soviets on where and when all fishing on the Pacific coast should be allowed.

Davis' Position

Replying to an open letter from the St. John's Port Association, Davis has indicated there is no thought now of closing east coast ports to foreign fishing and supply vessels. This course has long been recommended by the Fisheries Council of Canada. Davis said, also, that the situation will be kept under review and the policy reassessed from time to time in light of objective conditions. (Fisheries Council of Canada, Aug.)

* * *

ONTARIO CONSIDERS INTRODUCING JAPANESE SALMON INTO GREAT LAKES

The Province of Ontario is considering the introduction of two species of Japanese salmon, O. masou and O. rhodurus, into the Great Lakes. Experimental lots are being subjected to physiological tests. A few salmon have been planted in an isolated research area.

FRANCE MAY BE 1970's LARGEST FISHING VESSEL BUILDER

As 1969 ended, France became the world's top builder of fishing vessels in aggregate tonnage; she eclipsed Poland and East Germany.

In 4th-quarter 1969, France had 49 steel vessels (136,656 tons) under construction, and 72 more (92,898 tons) on order. Poland had 19 vessels under construction (101,039 tons), and 15 (65,949 tons) on order; East Germany was building 37 vessels (67,676 tons). This was reported in Lloyds Register Shipbuilding Returns.

1969 Construction

In 1969, France completed 68 fishing vessels: 9 seiners, 58 shrimp trawlers, and one training ship--a total of 11,791 tons.

Launched last year were 1 trawler, 1 seiner, 5 shrimpers, 1 research vessel, and 2 transport ships, and work was started on 1 transport, 2 trawlers, 2 seiners, and 24 shrimp vessels.

Aimed At Export

France is biggest fishing member of Common Market. Despite demands of her own large and diverse fleet, most recent building has been aimed at export. Of 1968 completions, more than two-thirds were for foreign owners.

Builds Smaller Vessels

Her nearest rivals, Poland and East Germany, concentrate on series-built trawlers and huge floating factories. France's efforts center on smaller vessels: mainly shrimp trawlers for Kuwait, Cuba, Greece, Senegal, the Ivory Coast, and the Cameroons. All 62 fishing vessels exported last year were under 350 tons, and 58 were under 150 tons.

Stern Trawlers In 1960s

During 1960s, France developed stern-trawler types--from 500 to 2,400 GRT--for French owners. These were designed for middle- and distant-water fishing in Atlantic, North Sea, and Arctic. They use both demersal and pelagic trawls.

Tropical Tuna Fisheries

The other main section of fishing industry is tropical tuna. After its start on U.S. west coast, French owners and builders have helped to pioneer the modern tuna purse seiner.

Versatile Builders for Export

It is for export that French shipbuilders have had to be most versatile. Nearly all orders have been for vessels entirely different from traditional French designs. Several years ago, a South Korean contract included 61 longliners and stern and side trawlers built to owner's requirements. These vessels differ from 8,425-GRT, French-built factory trawlers for Soviet fleet (still biggest fishing vessels in world).

A 36-meter, stern-trawler type designed for French owners has been sold successfully in Ireland and Mauretania.

Standard & Tailor-Made

For the future, French builders are ready to market standard fishing-vessel types, especially for "mass requirements" of developing countries. But they will remain open to tenders for tailor-made vessels. ('Fishing News International', July.)

USSR

DEEP-WATER TRAWL DEVELOPED

A trawl to catch halibut, grenadier, and poutassou (an Antarctic cod) at 2,000 meters has been designed by the Soviet Polar Fisheries Research Institute (PINRO). The trawl will be used by vessels in "little-explored areas of Atlantic, and in Antarctica." (TASS, March 10.)

(U.S. scientists from Institute of Marine Sciences, Miami University, aboard 'Elliot Pillsbury' in Puerto Rico Trench, caught a fish, "Bassogicas," at nearly 8,000 meters, a record. 'Mainichi,' June 18.)

Deep-Water Trawl Research

Soviet deep-water trawl research goes back to 1961. Intermittently, the Soviets report "successes in mastering the staggering technical problems" of deep-water trawling. Recent Soviet concern about Continental Shelf fishery resources induced them to expand deep-water fishery research. They are exploring availability of commercially exploitable species, and increasing the testing of reliable deep-water gear.

Murmansk Fleet's Trawls

In Feb. 1969, the Northern Fisheries Administration (SEVRYBA) ordered all factory stern trawlers of Murmansk fleet equipped by year's end with deep-water trawls (with special otter boards) to fish at 1,300 meters.

Kaliningrad Fleet

The Atlantic Fisheries Research Institute (ATLANTNIRO) is working on deep-water gear. The Kaliningrad fleet of Western Fisheries Administration is being equipped with deep-water trawls.

In late 1968, the Soviets, Poles, and East Germans began joint research of deep-water fishing gear.

In May 1970, the Soviet Western Fisheries Administration reported its stern factory trawler 'Slavgorod' had fished at 2,000 meters off Canada's Labrador Peninsula.

Soviet Plans

The Soviets either plan or are building a class of stern freezer trawlers especially equipped for deep-water fishing.

The Soviet Deputy Minister for Shipbuilding wrote in Dec. 1969: ". . .many coastal states will extend their territorial zones considerably. . .the need to develop means to bring marine animals from greater depth than before has arisen."

In Mar. 1970, an All-Union Conference on Deep-Water Fishing at Kaliningrad was attended by representatives of all 5 Main Fishery Administrations, the Ministry of Fisheries, and scientific research institutes. It indicated Soviet concern in this research. A large part of the enormous investments in the Soviet fishing fleet in the future depends on success or failure of this research. (BCF Office of Foreign Fisheries, Sept. 1970.)

NORWAY

FISHERMEN HAVE GOOD FIRST HALF

The Norwegian catch of most fish was considerably greater by July 1, 1970, than during 1969 period. Cod catch rose substantially. Haddock fishery in North Norway was less encouraging because catches in Finnmark were only 4,300 metric tons, compared to 13,400 tons in 1969 period.

Fillet plants received a record quantity of cod, 65,086 tons, against 47,749 tons last year (preliminary figures). Less cod went into drying because marketing outlook is poor until Nigeria returns to market.

Herring & Industrial Fishery Better

The herring and industrial fishery (for fish meal and oil) fared much better than expected. This was due to record catch of capelin, improved North Sea herring fishing, and good trawl fishing for Norway pout and other industrial fish. These fisheries rose 43% above 1969.

The quantity used for fish meal was about 1,100,000 tons, compared to 742,000 tons last year. The increase in herring was due to better fishing off Shetland and Orkney Islands. Capelin reached a winter record of about 998,000 tons (489,000 tons a year earlier). Landings of Norway pout and other industrial fish were 57,000 tons against 35,000 last year. Conservation controls on mackerel fishery prohibited large catches for industrial purposes before July 31. The brisling fishery was relatively weak: only 3,638 tons went into canning; in 1969, 5,400 tons.

NORWAY (Contd.):

Favorable Export Conditions

Export conditions were reported favorable; prices for most products were higher. Herring and herring products are rather scarce. Exports of herring meal and oil are below last year's. Canned goods shipped rose 13.5%. Frozen fillets were in a sellers market: exports were up 16%, exceeding last year's record. A shortage of haddock fillets resulted in greater exports of saithe fillets to U.S. Export of fresh and frozen herring was also large because of improved North Sea fishing. ('Fiskaren')

* * *

POOR HERRING CATCHES PREDICTED IN 5 YEARS

The herring-larvae census of March-April 1970 indicates very weak recruitment of herring larvae "Zero Group". It was lowest ever registered. The weak recruitment also applies to other year-groups of herring.

According to Norwegian researcher Ole Johan Østvedt, the consequence of weak zero group this year will not show up in herring fishery for 5 years.

Sharp Decline Unexplained

The data were scheduled to be released during late September. Østvedt emphasized that it is not known why number of herring larvae decreased so sharply. The number depends on feeding conditions in the sea, the spawning period, and temperature conditions. (Reg. Fish Att., U.S. Embassy, Copenhagen, Sept. 15.)

* * *

CONSIDERS EXTENDING FISHING LIMIT

Norwegian Fisheries Director Klaus Sunnanå recently proposed that the fishing limit be extended to include entire Continental Shelf. Fisheries Minister Einar Moxness called proposal "captivating". Despite consideration for Norway's extended coastline, Moxness questioned whether idea was realistic.

Moxness said extension would be necessary if international agreements and effective regulation fail. (Reg. Fish Att., U.S. Embassy, Copenhagen, Sept. 1.)

ICELAND

FIRM EXPANDS IN U.S.

The Federation of Iceland Co-operative Societies (SAMBAND) in Reykjavik is active in Iceland and abroad. After World War II, SAMBAND had several freezing plants. In 1951, a sales subsidiary, Iceland Products, Inc., was formed and an office opened in New York City. Fish sales increased considerably. SAMBAND's managers soon realized that Iceland Products would have to enter the processing field to establish itself under rapidly changing market conditions.

Steelton, Pa., Processing Plant

The company bought a small processing plant in Steelton, Pennsylvania, in 1958. It offered a variety of fish sticks and portions, along with the other Icelandic fish products. As sales increased, a processing plant was built in Camp Hill, Pennsylvania.

During first year in old Steelton plant, about 15 workers turned out 402,000 lbs. of fish sticks and portions. In 1965, Steelton's last year, production had risen to 4,912,000 lbs. In 1968, just over 11 million pounds were produced and sold. In 1969, production reached 19,187,000 lbs.

Camp Hill Plant

The Camp Hill plant uses high-speed cutting saws, slicers, breading and batter machines, conveyor fryers, blast freezer, carton sealers, machinery to close corrugated cartons, and hundreds of feet of conveyors. Over half the output is sold in precooked form, to be heated by users.

The plant operates under voluntary continuous inspection of U.S. Department of the Interior. All products bear U.S. Grade A quality shield. Strict standards apply to breading percentage, absence of defects, uniformity, etc. Most products are packed for institutional trade.

In 1969, the company sales to 43 states in U.S., Puerto Rico, and Canada topped $10 million.

The management team at Iceland Products is headed by 4 Icelanders, and several Americans. To follow up recent market gains and to explore fresh opportunities, a new marketing company has been founded. Called Iceland Products Marketing, its office is in Harrisburg, Pa. ('Atlantica Iceland Review')

* * *

ICELAND (Contd.):

ECONOMY STRONG,
INDUSTRY BUYS TRAWLERS

With general economic prosperity and a favorable trade balance, Iceland's fishing industry is considering the purchase of new trawlers. The magic number seems to be two per firm.

Ogvrvik has purchased two stern trawlers of 1,050 GRT from Poland at about US$1.7 million each; UTHAF has contracted, tentatively, for two slightly used stern trawlers from Spain at US$7 million each. And, for some time, the Reykjavik municipal trawler firm has been in the market for two stern trawlers. Other fishing firms now are clamoring to get state and municipal loans necessary to buy new trawlers. (U.S. Embassy, Reykjavik.)

DENMARK

FIRM TO SELL NEW FISHING
VESSELS TO USSR

According to the director of Burmeister and Wain, Copenhagen, the shipyard is negotiating with the Soviet Fisheries Ministry for continued delivery of freezer fishing vessels. The vessels under consideration will be equipped with fillet plants to meet Soviet popular demand for improved consumer products.

The vessels will be more mechanized than the 17 delivered under the expiring contract.

Negotiations cannot be settled until October, when the Soviets have established the framework of their new 5-year plan.

The Danish Shipyard Assoc. invited a Soviet delegation to visit during September.

Soviet Shipbuilding

The Soviet Union has developed a large shipbuilding industry of its own and, recently, sold vessels to Sweden and Norway. But she still appears to need specially constructed vessels. During the last 6 years, Burmeister and Wain delivered vessels worth US$70.5 million. (U.S. Embassy, Copenhagen, Aug. 13.)

GREENLAND

COD FISHERY FAILS

The Greenland cod-fishery situation is catastrophic, reports the Royal Greenland Trade Department (RGTD). The primary cause is a climatic change. This has brought large ice floes along the coast, which block ports in southwest Greenland and trap boats in port. Foreign fishermen on the banks outside West Greenland have had to abandon these grounds. Greenlandic vessels are unsuited to fishing at sea.

First-Half 1970 Landings Drop

RGTD's director said cod landings amounted to only 2,828 metric tons during the first six months of 1970; these compared to 4,342 tons in the same period last year. It indicates a further substantial drop in the fishery because the 1969 fishery was only about half the 1968 amount. The 1970 catch was attributed largely to the new Greenland trawler. Catches by Greenland inshore fishermen were very small this year.

Shrimping Compensates Somewhat

To compensate somewhat for the failing cod fishery, four Danish cutters have been fishing shrimp at Godthaab, where they have discovered new shrimp grounds. The cutters are now landing large catches in Godthaab, at times more than the factory can handle readily. (U.S. Embassy, Copenhagen, Aug. 4.)

A Japanese expert working for FAO shows Indian fisherman how to measure opening of shrimp trawl. (FAO: S. Bunnag)

ASIAN TUNA PRODUCERS DISCUSS AMERICAN SAMOA PRICES

Japanese tuna industry members and representatives of Taiwanese and S. Korean tuna fishing industry met in Tokyo on July 16 to discuss prices of tuna landed at American Samoa. They also discussed need for cooperation among Asian tuna suppliers in negotiating monthly tuna prices of tuna landed at American Samoa.

Rotate in Handling Negotiations

The participants agreed to have S. Korea, Taiwan, and Japan, in that order, alternate every 3 months in conducting price negotiations. S. Korea would handle these for Aug., Sept., and Oct.

Vessels of the three countries based in American Samoa number: 50 Taiwanese, 20 S. Korean, and 2 Japanese longliners. ('Katsuomaguro Tsushin', July 20, 21.)

TAIWANESE-INDONESIAN TUNA AND SHRIMP FISHING VENTURE PLANNED

The Taiwanese Tai-shun Enterprises and the Indonesian Hai-shun Co. plan a joint tuna and shrimp fishing venture based in Indonesia. The two firms acquired fishing rights in the Banda Sea from Indonesia in 1968. They will set up a joint company with a capital equivalent of US$55,600. Taiwanese will control 51% and Indonesians 49% of shares. The company was scheduled to begin fishing around mid-August 1970 with twenty 40-50 ton tuna vessels, and later 120 vessels.

Experimental Fishing Scheduled

After two years of experimental fishing, full-scale operations will get under way. Two 500-ton refrigerated carriers, to be purchased in Japan, will be used to freeze and transport the catches. Initially, the vessels will operate out of Ambon, pay a fishing fee of $1,750 annually per vessel of less than 99 gross tons. Most of the catch will be exported to Japan. ('Suisancho Nippo', July 20.)

Fish-pond farming in Hong Kong (FAO: J. Olsen)

S. KOREA & TAIWAN ORDER TRAWLERS FROM JAPAN

Two 3,000-gross-ton trawlers with freezing facilities will be built for S. Korea in 1970 at Japan's Shimonoseki and Nagasaki shipyards. A Japanese trading firm placed the order for a S. Korean fishing company. The trawlers will be the largest ever acquired by S. Korea.

Taiwan Orders Trawlers

Another shipbuilder has contracts to export two 350-ton trawlers each to 2 Taiwanese fishing companies. This will be the first private export of Japanese fishing vessels to Taiwan. The cost will be about US$833,000 per vessel ($3.3 million total).

Shipbuilder Applies for Loan

The shipbuilder has applied for loan with Japan Export and Import Bank through Ministry of International Trade and Industry (MITI). Terms are 30% down and balance in 6 monthly installments over 5 years.

The first trawler is scheduled to be delivered in 1970; the other 3 by Mar. 1971.

The entire catch of shrimp, sea breams, etc., by the 4 vessels will be imported into Japan by Daien Reizo. ('Minato Shimbun,' June 13.)

JAPAN

KRILL RESOURCE WILL BE TAPPED

Japanese experts plan in 1971 to exploit untapped resources of krill. They believe this will help solve the worldwide shortage of animal protein.

Krill is a species of small shrimp. It grows to about 5 centimeters in length 2 years after spawning. Its known habitat is the Antarctic Ocean, but it also is found in the Japan Sea and in the northwestern Pacific.

Development of krill resources long has been called for. For years, the Soviet Union has conducted research on exploitation of the resources but no effective method has been found.

Agency Plans

Under the Fisheries Agency's plan, a 100-gross-ton vessel will be chartered in 1971 to catch krill. The ship will operate from April to September off northern Japan and north of eastern Hokkaido. The catch target is about 1,000 tons in 19 voyages.

In the coming experiment, a fish-pump also will be used to ensure effective operations. Intensive studies on catching krill will be made during the next 2 years in the seas near Japan. Also, the use of smaller shrimp as a new source of animal protein will be studied.

Estimate of Resource

The agency plans to begin exploration of Antarctic krill resources in 1973. Krill resources are estimated to total 100 million tons by some officials. An annual sustained yield of krill is estimated at 50 million tons, or equal to the world fish catch.

Problems & Advantages

Fishery experts admit that consumption of raw or boiled krill has not been proved completely safe. But, they claim, in liquefied form it has protein, is rich in flavor, and good for seasoning and fish feed. ('Mainichi', Aug. 20.)

* * *

EXPORTS OF TUNA CANNED AS PET FOOD RISE SHARPLY

Japanese canned pet food made of tuna approved for export during Jan.-June 1970 totaled 699,356 cases. This was 3 times above the 1969 period exports of 237,059 cases.

100,000 Cases Monthly to U.S.

Exports to U.S. during first 6 months of 1970 continued at about 100,000 cases a month. These were far above corresponding monthly exports during 1968 and 1969; then, U.S. buyers were holding down purchases to reduce inventories.

Export Prices

Export prices for canned pet food are US$ 2.78 a case, f.o.b., for pure tuna pet-food pack, and 10% higher for mixed vegetable-tuna pack. ('Suisan Tsushin,' Aug. 14.)

* * *

JAPAN (Contd.):

EXPORTER TO BUY CANNED TUNA FROM PUERTO RICO FOR U.S SALE

A major Japanese firm that exports canned tuna to the U.S. plans to tie up with a U.S. tuna packer in Puerto Rico. The Japanese will supply raw material to the packer and buy the canned tuna from it. Major Japanese firms occasionally have purchased canned tuna from U.S. packers, but only when product was in short supply in Japan.

Benefits to Japanese

If arrangement develops, and Puerto Rican packer can be supplied Atlantic-caught tuna regularly, Japanese would benefit. They would be able to buy whatever size and style of pack they need. Moreover, they could plan sales more easily because price of canned tuna purchased from U.S. packer would be stable--so long as raw material price remained at a certain level.

Sales Planning Easier

Japanese firms that buy canned tuna from Tokyo Canned Tuna Sales Co. find it difficult to formulate sales plans because company sets price as well as quantity to be sold. If Puerto Rican-packed tuna is similar in quality to Tokyo's, other firms undoubtedly would start quietly to handle Puerto Rican product. Even some leading U.S. importers of Japanese canned tuna are reported turning to Puerto Rican packed tuna, which they sell under their own brand names.

Competition at Manufacturer's Level

Until recently canned tuna produced in U.S. and Japan was handled by different buyers at intermediate distribution level. Competition between two products did not arise until they appeared in Japanese supermarkets. Now, competition is at manufacturer's level; there, the price, quality, and supply stability largely determine whether buyer purchases Japanese product or Puerto Rican pack. All other factors are about equal, so determination will be made on whether supply is constantly available.

Japanese packers have had advantage in quality and labor costs. Because cost of raw material is rather high and many packers bid for frozen tuna, prices became unstable. Besides, the Japanese product is at a decided disadvantage because of higher freight costs, import duty, and difference in productivity. ('Suisan Tsushin,' July 29.)

Prices Increased

The above report is related directly to announcement by Tokyo Canned Tuna Sales Co., July 17, 1970, increasing export price for canned tuna in brine, packed in 13-oz. 24s by 80 yen (US$0.22) a case for canned white meat tuna, and 40 yen ($0.11) a case for canned light meat tuna.

The new prices are: canned white meat tuna 5,030 yen ($13.97) and canned light meat tuna 3,800 yen ($10.55), ex-warehouse, Shimizu. The company said prices were increased because of low supply of that can size, which is in good demand for both white and light meat packs. ('Suisan Tsushin,' July 20.)

* * *

CANNED-MACKEREL EXPORTS TO U.S. ROSE DURING JAN.-JUNE 1970

Japan exported 69,240 metric tons of canned mackerel during Jan.-June 1970. This compared with 65,392 tons for first-half 1969.

Exports of natural-packed mackerel in 1970 totaled 457,991 cases; this was above entire 1969 figure of 395,000. It was close to 467,429 cases (natural) exported to Philippines during Jan.-June 1970. In the past, the Philippines has been the predominant buyer of canned mackerel--taking 40-50% of Japan's exports; but, in 1970, she had purchased only 26% of the exports by June.

* * *

IMPORTS HERRING FROM CANADA

Canada has shipped 1,430 tons of frozen herring to Wakkanai, Japan, part of the 10,000-ton 1970 import quota. It was Japan's first import of herring from Canada.

The imported herring were 20 to 30 centimeters long, somewhat small, but rate of yield of herring roe (12 to 13%) was better than expected. After roe is removed, herring is dried. ('Minato Shimbun', May 31.)

* * *

JAPAN (Contd.):

SALMON MOTHERSHIP FLEETS END BERING SEA OPERATIONS

Japanese high-seas salmon fishing by 11 motherships ended last week in July, about a week later than in 1969. The delay was caused by lost fishing time because of rough seas in June, which slowed vessel movement.

Fleet operations

The fleets, anticipating a heavy run of Bristol Bay red salmon into sector west of Abstention Line (175° W. long.), remained there about two days longer than in previous years; however, the westward migration of reds fell somewhat below expectations. In late July, the fleets, in two groups, began to scatter in northern and southern sectors of Area A (north of 45° N. lat.), where good fishing for other species continued. ('Nihon Suisan Shimbun,' July 17.)

* * *

SALMON MOTHERSHIPS IN NORTH PACIFIC REACH GOALS

The 11 Japanese North Pacific salmon mothership fleets and 369 catcher vessels that fished Area A (north of 45° N. latitude) attained their quota in late July. They had planned to catch 46,545 metric tons for 1970.

Catch composition was: 35.7% reds; 54.6% chum; 5.7% pinks; 2.8% kings; and 1.2% silvers. Despite preseason forecasts of abundance, the fleets had trouble catching Bristol Bay reds because there was no heavy migration into mothership fishing area. So, except for 'Meiyo Maru' (she returned with a 50.7% catch of reds), all other motherships failed to harvest 50% reds.

However, the fleet commanders expect a good season in 1971 because many immature Bristol Bay reds this year were observed migrating westward toward Attu Island. ('Suisan Keizai Shimbun,' Aug. 3 & 6.)

* * *

STUDY TEAM TO TOUR FOREIGN FISHING PORTS

The Japan National Fishing Port Association planned to send a study team, starting Sept. 17, on a 1-month tour of foreign fishing ports. The group was scheduled to visit 8 countries, including the U.S., Italy, France, Netherlands, and West Germany.

The purpose is to understand better the operations of foreign fishing ports in order to obtain data needed to modernize Japanese port administration and operations. The team will study basic port facilities: breakwaters and piers, fish distribution facilities (including wholesale markets and transportation systems), storage and processing plants, vessel operations, and marine engine repair facilities. ('Suisancho Nippo,' July 30.)

* * *

ARTIFICIALLY REARED LARVAL YELLOWFIN TUNA DIE

On Aug. 18, the last batch of artificially hatched larval yellowfin tuna reared at Kinki University's fishery laboratory died after 20 days.

After feeding had been started, it appeared the surviving larvae might continue to grow normally but, because of transportation, feeding, and water-quality problems, die-offs increased.

Reached 9 mm.

The longest surviving hatchlings had grown to a length of 9 mm., compared with 2.5-2.7 mm. at hatching, a record growth in Japan; separation was observed between dorsal and caudal fins. A week before they died, 200 of over 14,000 larvae hatched artificially on July 26, 1970, had still been alive. The larval tuna had been kept in a culture tank 5 meters in diameter.

Prof. Harada of Kinki said comparative studies will be made of data to determine the conditions necessary for tuna cultivation. He is hopeful of greater success next year.

The yellowfin tuna rearing project is being conducted with the Japanese Fisheries Agency's 3-year fish-propagation research program. ('Katsuo-Maguro Tsushin,' Aug. 20.)

* * *

JAPAN (Contd.):

SAURY FISHING OFF CANADA'S WEST COAST IMPROVES

In late August 1970, six Japanese saury vessels were reported fishing off Vancouver near 49° N. lat. and 127° W. long. From August 25-26, those vessels began catching 5 to 10 metric tons per vessel per day. This was about same as during late-August 1969 explorations in that area.

Water temperature was reported around 14.5° C., or 58° F. The saury catch was medium fish (110 fish per 22-pound box) mixed with smaller sizes about 24 centimeters long.

More Vessels On Way

In late August 1970, several more vessels were reported proceeding toward Vancouver. They were expected to begin fishing in first week Sept. The number of saury vessels off Vancouver would total 9 (not counting 3 small vessels accompanying one mothership).

Japan Licensed More Vessels

In 1970, 33 commercial vessels and 2 government-subsidized exploratory vessels were licensed to fish saury in eastern Pacific east of 165° E. long. and N. of 34°54' N. lat. (excluding Bering Sea). The nine off Vancouver may be joined by vessels transferring from Pacific ocean perch fishery in Gulf of Alaska. It is unlikely that more will be sent from Japan because it would be too late in season.

The number of Japanese commercial vessels in 1970 eastern Pacific saury fishery will be less than half that licensed by Japan. ('Suisan Tsushin', Sept. 1.)

* * *

FROZEN AND CANNED TUNA EXPORT PRICES RISE AGAIN

Japanese frozen-tuna export prices continue to increase. F.O.B. prices for direct exports to U.S. are: $680-725 a short ton for albacore (round); $605-625 for yellowfin (gilled-and-gutted); and $360-395 for skipjack (round).

Compared with January 1970, prices for albacore are up $152 a ton; for yellowfin, $175.

Compared with August 1969, they have advanced $214 and $225, respectively.

Prices for Italy

Prices for yellowfin tuna exports to Italy are: cost, insurance, freight (c.i.f.) $720 a metric ton for gilled-and-gutted; $770 for dressed-with-tail. However, shipments are small, averaging around 700 tons a month.

Canned Tuna

The Tokyo Canned Tuna Sales Co. announced on August 24 a price increase for canned tuna in brine to U.S., effective immediately. It was 11th price increase since beginning of business year 1969 (April 1969). ('Suisancho Nippo', Aug. 31; 'Suisan Tsushin', Aug. 28.)

* * *

PLANS SALES OF REFRIGERATED TRUCKS TO STABILIZE THAI SHRIMP SUPPLY

The Japan Marine Products Importers Association plans to export 20 refrigerated trucks to Thailand over 5-year period. The purposes are to secure a long-term, steady supply of frozen shrimps--and to help balance trade now favoring Japan.

Thai Suggestion

Impetus was provided by Thai leaders. During recent cabinet-level conference with Japanese officials, they urged Japan to help offset trade imbalance by buying more primary goods. Frozen shrimp is Thailand's most important fishery export item to Japan.

Improve Trucking System

By exporting trucks, the Association hopes to improve trucking system from ports to Bangkok, where most shrimp processors are located. This would increase availability of good-quality shrimp for shipment to Japan.

In 1969, Thailand supplied 6,395 metric tons (worth US$15.15 million), or about 13% of Japan's frozen-shrimp imports. ('Suisan Keizai Shimbun', Aug. 13.)

* * *

JAPAN (Contd.):

TO REGULATE VOLUNTARILY SOUTHERN BLUEFIN TUNA FISHERY IN PACIFIC

The Federation of Japan Tuna Fishery Cooperative Associations (NIKKATSUREN) recently decided to voluntarily regulate fishing to protect southern bluefin tuna in "high latitude" region of South Pacific. This is around Tasmania and New Zealand between 40-45° S. latitude. The Federation is composed of longline tuna-vessel owners.

This decision attempts to stop sharp decline in catches of recent years. The catch per vessel has dropped to less than 1 ton per day; 7 or 8 years ago, it was 10-20 tons. Also, the Government's Distant-Water Fisheries Research Laboratory had warned about declining hook rate.

Vessel Owners Queried

Early in 1970, NIKKATSUREN sought opinion of all vessel owners fishing bluefin on condition of resource and need for regulation. The response indicated regulation was necessary.

In drawing regulations, NIKKATSUREN will consult Distant-Water Laboratory for scientific advice on fishing season and areas to be regulated.

Japan Alone Can Do It

Some Japanese feel foreign vessels fishing southern bluefin should be asked to help. However, NIKKATSUREN feels foreign fishing is at low level, so regulation by Japan alone would be effective. NIKKATSUREN hopes new regulations can be put into effect before FAO's Indian Ocean resource-management conference convenes this fall. ('Suisan Keizai Shimbun', Sept. 1.)

* * *

INCREASE OCEAN FREIGHT RATE FOR FROZEN TUNA TO U.S.

Beginning Oct. 1, 1970, the ocean freight rate for frozen-tuna exports from Japan to the U.S. west coast was increased 10.55% (from \$45 to \$49.75 a short ton).

The present freight rate for frozen-tuna shipments to Italy, a special rate of \$67.10 a metric ton, expires at the end of October 1970. Japanese shippers hope the present rates will not increase. ('Suisancho Nippo', Sept. 2.)

* * *

NEW FISH-PROCESSING DEVICE IS OPERATIONAL

A high-speed fish-processing device, which mechanically removes head, tail, guts, and bones, and fillets fish, was developed by Takubo K.K. (Takubo Industrial Company), Sakai City, Osaka Prefecture.

Described as Takubo 707-Model D, the device was tested in June aboard the 'Haruna Maru' (4,000 gross tons) in the North Pacific. It demonstrated ability to process 124 fish (Alaska pollock) per minute, completely remove black membranes, and recover 42.5-43% of flesh.

Slated for Large Trawlers

The machine is a modification of an earlier model. It will be installed on recently launched 5,000-ton 'Yamato Maru' and other large trawlers under construction.

The Model D

The Model D is 4.3 meters (14.2 feet) long, 1.6 meters (5.3 feet) high, and 0.925 meter (3 feet) wide. Factory price is 3.6 million yen (US\$10,000). ('Minato Shimbun', July 25.)

* * *

FISH-MEAL PRODUCTION PROBABLY WILL TOTAL 550,000 METRIC TONS

Japanese production of fish meal and pressed cake during Fiscal Year 1970 (April 1, 1970-March 31, 1971) will total 551,800 metric tons: 402,300 tons by shore plants, and 149,500 tons by factoryships and trawlers. ('Minato Shimbun')

日本

PHILIPPINES

TO BEGIN INLAND FISHERY DEVELOPMENT PROJECT

As part of the Agriculture Four Year Development Plan (1971-74), the Philippine Fisheries Commission seeks national self-sufficiency in fish production (principal local source of animal protein) by mid-1972. Later, it will concentrate on expanding fishery exports.

What Must Be Done

To achieve these, all sectors of fishing industry must be improved: (1) processing and marketing expanded and modernized; (2) scientists trained to increase production; (3) more extension workers abreast of latest research findings.

Controlled Pond Culture

Basic to self-sufficiency drive, the industry is reorganizing and diversifing. It is moving from less productive fisheries into controlled pond culture.

Two pond-culture research stations (one brackish, the other fresh) will be established to provide technical base for increased production methods. Concurrent with research will be training of personnel--scientists, extension workers, and commercial pond operators. (U.S. Embassy, Manila, Sept. 1.)

THAILAND

TO CULTIVATE ALGAE FOR FOOD

Thailand is planning, with W. German aid, to cultivate algae for food. West Germany is to provide more than US$300,000 in technical aid for algae-food experiments. Her scientists will work with Thai scientists of Bangkok's Institute of Food Research and Product Development for the next 3 years. The Germans hope to grow algae that will meet "acceptability criteria" so production and consumption of algae food could be initiated.

According to the director of the German research team, the major problem is whether the single-cell fresh-water algae cultivated successfully in Germany will thrive in tropical climate.

Experiments in Germany

Initial experiments at the Cardisbiological Research Station in Dortmund, Germany, show that single-cell algae can be collected, dried, and reduced to a powder that provides the basis for highly nutritional soups, crackers, and puddings. Algae were processed into a palatable green powder and tested successfully on German hospital patients suffering from protein deficiencies. The algae powder contains 51% protein and all essential amino acids for protein formation.

Multiple-cell algae (or fresh-water weeds) already are used as food in parts of Thailand. According to the Germans, the single-cell algae have the advantage of growing much-faster than the multicell variety. ('New York Times,' Aug. 2.)

LATIN AMERICA

PERU

FISH MEAL INDUSTRY RECOVERS

The fish-meal situation in Peru, world's major producer and exporter, is rebounding from 1968-69 decline of 386,000 tons. This is the word from the Foreign Agricultural Service of the U.S. Department of Agriculture.

Production in 1969-70 now is estimated at 2.15 million short tons--267,000 tons above 1968-69 and substantially above preliminary estimate. The increase reflects largely the fishing industry's success in its efforts to increase allowable catch by one-sixth over that recommended by Peruvian Marine Institute.

Exports Drop

Exports are expected to approach 1.9 million tons--14% below 1968-69 record and 11% below 1967-68. Supplies are only 3% below 1968-69 volume, so expected decline reflects more the high meal prices and uncertainty about export commitments under new Ministry of Fisheries than of reduced stock.

Much Stock Accumulates

Despite 1969-70 season's slow beginning, much stock accumulated in first quarter (Oct.-Dec.) from low volume of 110,000 tons on Sept. 30, 1969. Although stock accumulation continued in second and third quarters to volumes exceeding 1968-69 level, tonnage was substantially under 1967-68.

In third week of September 1970, the fish meal available appeared more than ample to handle rate of market uptake. Continuation of such prices into the 1970-71 season could push stocks to substantially higher volume.

U.S. Agriculture Service Observations

Foreign Agricultural Service observes: (1) Despite much talk from time to time about need to conserve Peru's anchovy stocks, it would appear that catch could continue to be sustained at present volume of 11 million tons. (2) A poor start of the fishing season does not necessarily mean a failure or a sharp decline in output. (3) Fish-meal prices in one season may indicate more the uncertainty of impending events and market psychology than of supplies. (4) Peruvians have not mastered fully the art of getting the most product value out of their exports, despite willingness and ability to hold a substantial volume of stocks. (5) Given present circumstances and price levels, Peru's exports may be related more closely to import demand in key importing countries--the U.S. and West Germany--than to supplies available for export.

VENEZUELA

PLAN TO MAKE GUIRIA WORLD FISHERY PORT

The Corporacion Venezolana de Formento (CVF) and the Venezuelan Ministry of Agriculture (MAC) are attempting to develop the fishing grounds of the "Golfo de Paria" on the eastern coast and make of Guiria an International Fishery Port and the area's fishing center. Already under construction are breakwaters, quays, and a shipyard in the Port of Guiria.

Financing 60 Vessels

CVF is helping to finance 50 shrimp and 10 tuna vessels.

The shrimp vessels are about 80 gross tons; estimated cost without equipment, US$191,000; 510-hp. engine; length 27 meters, steel hull.

Tuna vessels are about 50 gross tons; estimated cost without equipment US$143,000, 425-hp. engine; length 23.60 meters, steel hull.

Sales Opportunities for Foreigners

The vessels are to be constructed locally. This offers opportunities for foreigners to sell motors, marine hardware, communications system equipment, and navigation equipment. Construction of the Guiria Port creates need for equipment to freeze, process, and handle fish.

Firms interested in either project should contact: Corporacion Venezolana de Fomento (Programa Pesquero) Division de Promocion Industrial, Edificio La Perla, Bolsa a Mercaderes, Caracas, Venezuela.

A Chicago firm is negotiating with Ministry of Agriculture concerning use of a self-propelled fish-freezing and processing plant for Guiria. The plant would process shrimp, tuna, catfish, and others for domestic use and export. The Ministry is very interested in this proposal. It suggested the firm form a local company or a joint venture with local company. (U.S. Embassy, Caracas, Aug.18.)

BCF'S TROPICAL ATLANTIC BIOLOGICAL LABORATORY, MIAMI, FLORIDA

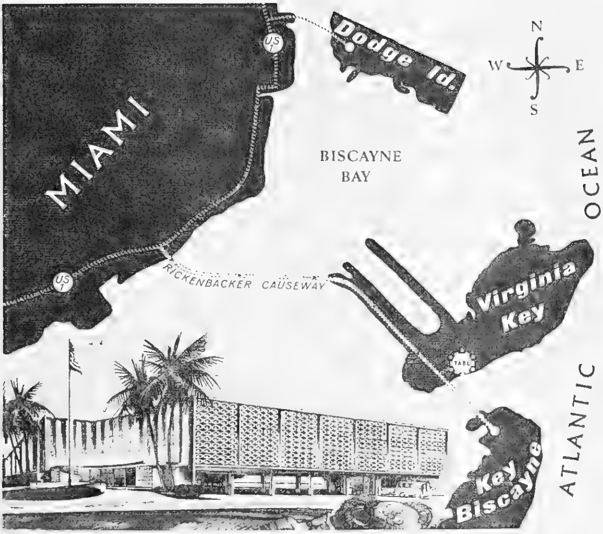


Fig. 1- Tropical Atlantic Biological Laboratory, Miami, Florida.

BCF's Tropical Atlantic Biological Laboratory occupies a 5-acre tract of land on shores of Biscayne Bay. The laboratory (TABL) is near Virginia Key Campus of the Institute of Marine Sciences, University of Miami; the site of a U.S. Dept. of Commerce Environmental Science Services Administration facility; and the Miami Seaquarium. There are 75 employees, of whom 26 are scientists. The Laboratory's two research vessels, 'Geronimo' and 'Undaunted,' logged nearly 2,000 days and about 2,000 miles on 27 research cruises completed between 1964 and 1970 in the Caribbean Sea and the tropical Atlantic Ocean.

Laboratory facilities include specially designed aquaria for rearing fish, a nontoxic dual seawater system, a serological laboratory, a photographic laboratory, hard and soft X-ray capabilities, a modern library of 1,500 books of which 700 are current periodicals from all parts of the world, and an ichthyological museum containing thousands of marine specimens. The staff also has access to the excellent library of Rosenstiel School of Marine and Atmospheric Sciences, University of Miami.

The Laboratory was first established in 1959 at Wash., D.C. The staff was transferred to Miami in 1965 when a new building was constructed on land donated to the Federal Gov't. by Dade County. The Laboratory was founded as a result of U.S. Government's participation in ICITA (International Cooperative Investigations of the Tropical Atlantic)--a 2-year synoptic survey of fishery resources of

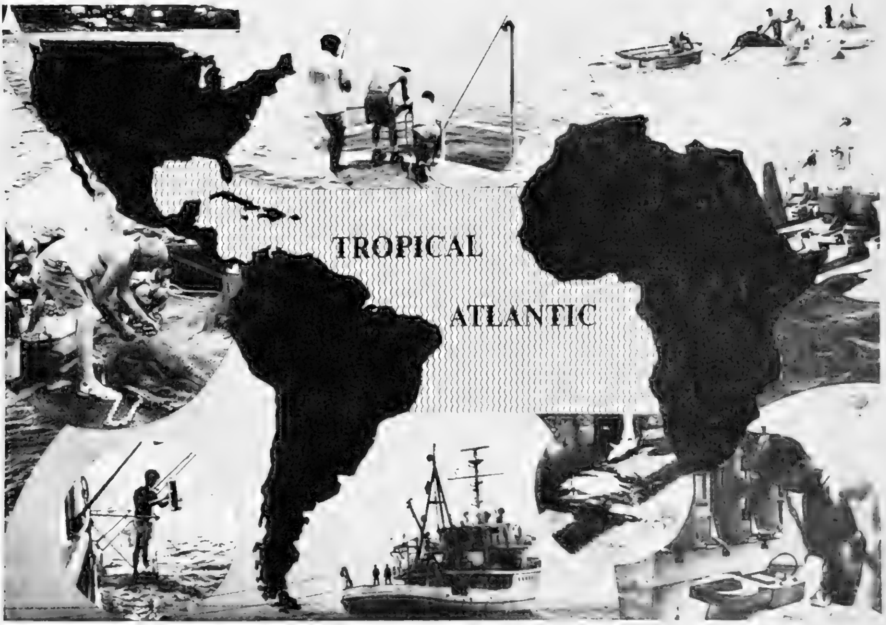


Fig. 2 - The area under investigation by TABL marine scientists and some of the research operations.

waters off West Africa from the Congo River north to the Cape Verde Islands, under the sponsorship of UNESCO's Intergovernmental Oceanographic Commission. The finding of potential commercial quantities of tuna and other fishery resources made it feasible to continue investigations in the area of the Gulf of Guinea.

Broad objectives of the Laboratory are: (1) to obtain and make available to U.S. fishermen knowledge needed to increase total fishery yield at reduced costs; (2) to assist fishermen to increase the yield of marine protein food resources from the tropical Atlantic Ocean; and (3) to provide knowledge needed to develop and apply sound conservation policies, particularly for Atlantic tunas.

The Laboratory's several significant contributions during its short period of existence include: participation with other nations in discovery of Guinea Undercurrent and Atlantic Equatorial Undercurrent; participation in first transmission of oceanic data from a research vessel on station via communications satellite (NASA's Syncom II) to a shore-based receiving center (National Oceanographic Data Center, Washington, D.C.) and return of corrected data to vessel; coordination of a statistical and biological sampling program with West African countries; publication (by the American Geological Society) of an atlas of mean monthly sea surface temperatures in tropical Atlantic between Africa and South America from about 3 million observations; and preparation of more than 170 scientific papers. The Laboratory is carrying out research necessary for the participation of the U.S. in the International Commission for the Conservation of Atlantic Tunas. A program of intensive investigation of large stocks of calico scallops found off the coast of northern Florida was begun in 1969.

Visiting investigators are welcome. Arrangements should be made by correspondence with the Laboratory Director. (BCF Circular 305.)

INDEX

Index continued page 72

INDEX (CONTINUED)

☆ U. S. GOVERNMENT PRINTING OFFICE : 1970 435-335/1

Managing Editor: Edward Edelsberg

Production: Jean Zalevsky
Alma Greene

Throughout this book, the initials BCF stand for the Bureau of Commercial Fisheries.

On Oct. 3, 1970, BCF became the National Marine Fisheries Service. The November issue will reflect this change.

Address correspondence and requests to: Commercial Fisheries Review, 1801 North Moore Street, Room 200, Arlington, Va. 22209. Telephone: Area Code 703 - 557-4246.

Use of funds for printing this publication was approved by the Director, Bureau of the Budget, April 18, 1968.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Price 60 cents (single copy). Subscription Price: $7.00 a year; $2 additional for foreign mailing.

UNITED STATES
DEPARTMENT OF
COMMERCE
PUBLICATION

COMMERCIAL FISHERIES Review

VOL. 32, NO. 11

NOVEMBER 1970

U.S.
DEPARTMENT
OF
COMMERCE
National
Oceanic and
Atmospheric
Administration

National
Marine
Fisheries
Service

U.S. DEPARTMENT OF COMMERCE
Maurice H. Stans, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Dr. Robert M. White, Acting Administrator

NATIONAL MARINE FISHERIES SERVICE
Philip M. Roedel, Director

COVER: Biologists of the National Marine Fisheries Service (NMFS), Beaufort, North Carolina, are studying populations of estuarine fishes, such as menhaden. It requires some close-in work with a gill net.

The samples collected will be used to determine size, composition, seasonal abundance, and distribution of estuarine fish species.

With this information, scientists are developing a detailed "Estuarine Case History." The goal is to establish the basic principles governing the ecology of estuaries. NMFS Beaufort scientists hope to manipulate an estuary's productivity and to predict the effects of changes caused by man.

COMMERCIAL FISHERIES

Review

A comprehensive view of United States and foreign fishing industries--including catch, processing, marketing, research, and legislation--prepared by the National Marine Fisheries Service (formerly Bureau of Commercial Fisheries).

Fishermen's Memorial
Gloucester, Mass.

Managing Editor: Edward Edelsberg

Production: Jean Zalevsky
Alma Greene

Throughout this book, the initials NMFS stand for the NATIONAL MARINE FISHERIES SERVICE, part of NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), U.S. Department of Commerce.

Address correspondence and requests to: Commercial Fisheries Review, 1801 North Moore Street, Room 200, Arlington, Va. 22209. Telephone: Area Code 703 - 557-4246.

Publication of material from sources outside the Service is not an endorsement. The Service is not responsible for the accuracy of facts, views, or opinions of these sources.

Use of funds for printing this publication was approved by the Director, Bureau of the Budget, April 18, 1968.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Price 60 cents (single copy). Subscription Price: $7.00 a year; $2 additional for foreign mailing.

CONTENTS

Unloading the catch. (R. K. Brigham)

THE FISHERY PRODUCTS SITUATION

Donald R. Whitaker
Current Economic Analysis Division, NMFS

Except for a few species, such as sea scallops and king crab, fish and shellfish supplies were generally adequate for trade needs in the first 9 months of 1970. Liberal supplies of some finfish species were available.

Consumption of fishery products will increase again this year on both a total and per-capita basis. Prices have averaged higher than a year ago at all levels. This indicates a strong demand for fishery products in general. Higher prices have attracted considerable imports and, for the rest of 1970, supplies of many frozen products will be heavier than a year ago.

New England Food Fish

Catches of major New England food fish (flounders, cod, haddock, and ocean perch) are running about 10% below last year. This means consumption of fresh fillets of these species is down by a similar percentage. Prices of fresh fillets are up considerably this year and are expected to remain above year-earlier levels through the winter. Supplies of fresh fillets will be seasonally low through the winter.

Frozen Fish Fillets

Supplies of frozen fish fillets have been heavy all year, and consumption of major New England species has increased sharply. First-quarter consumption advanced 17% over a year earlier; second-quarter consumption was up 11%. Leading the increase were frozen cod fillets. Demand for frozen fillets shows little sign of easing, despite mostly firm or rising prices. Wholesale prices of frozen ocean-perch fillets have been averaging 25 to 30% higher than a year ago. Haddock fillets have been 4 to 6% above 1969. Wholesale prices of frozen flounder fillets have weakened in recent months because of abundant supplies.

Inventories of frozen fillets at the start of fourth-quarter 1970 were a fourth higher than last year because of much higher stocks of flounder and ocean perch. Stocks of cod fillets were down considerably from last year. Prices of frozen fillets rise seasonally in the winter. Heavy stocks may offset some of the seasonal increase; however, domestic catches of haddock will be small, so some substitution of other frozen fillets for haddock is expected.

Fish Sticks & Portions

Production of the popular fish sticks and portions was 10% above a year earlier in the first half of 1970. Consumption of fish sticks and portions was about 8% above the first half of 1969. Consumption was up despite higher prices, especially for cod sticks and portions.

Inventories of sticks and portions have been consistently higher than last year because consumption has been running at less than production. At the start of fourth-quarter 1970, inventories were a fifth higher than a year ago. Although supplies of sticks and portions are expected to be ample in the coming months, prices likely will continue higher than a year ago. This is mainly because prices of the raw material for sticks and portions have been rising this year.

Canned Tuna & Salmon

Supplies of canned tuna are running a little heavier than a year ago. Domestic production of canned tuna in oil has been higher, while imports of canned tuna in brine are running less than last year. Retail prices of canned tuna are averaging 11% above last year. Higher prices are the result of rising costs of raw tuna and of strong consumer demand.

Supplies of canned salmon will be greater during this winter than last year. Canned salmon appeared on the October Plentiful Foods list of U.S. Department of Agriculture. Prices of canned salmon are running below a year earlier.

Shrimp & Oysters

Shrimp supplies have been relatively heavy all year and consumption has increased. Shrimp will be abundant for the rest of 1970, and wholesale prices likely will average lower than a year ago. Oysters are also expected to be a little more plentiful than during last winter. Supplies of most other shellfish are lighter than last year, and firm-to-strengthening prices are in prospect for the fourth quarter.

JOHN GOTTSCHALK JOINS NMFS

John S. Gottschalk

John S. Gottschalk has been named assistant to Philip M. Roedel, Director of the National Marine Fisheries Service (NMFS). Mr. Gottschalk was Director of Interior Department's Bureau of Sport Fisheries and Wildlife for the past 6 years; from 1959 to 1964, he directed that Bureau's regional office in Boston, Mass. He joined the U.S. Fish and Wildlife Service in 1945. He worked on river basin studies, Federal aid to States, and was chief of the Division of Fisheries.

His Duties

Mr. Gottschalk will advise Director Roedel on problems of sport fisheries. When the National Oceanic and Atmospheric Administration (NOAA) was established on Oct. 3, 1970, the research programs on marine sport fish formerly conducted by Interior Department were transferred to NMFS. Included were laboratories at Sandy Hook, N.J.; Narragansett, R.I.; Tiburon, Calif.; Panama City, Fla.; and Aransas Pass, Tex.

Mr. Gottschalk also will be liaison with recreational fishing groups in the United States. He will handle special studies: for example, unnecessary disputes between fishing groups.

Rich Experience

Mr. Gottschalk was born in Berne, Ind. He received an AB degree from Earlham College in 1934, and a Master's degree in fisheries biology from Indiana University in 1943. He served as Superintendent of Fisheries, Indiana Department of Conservation, from January 1938 to September 1941.

He is a past vice president of the Wildlife Society. In 1955, he received an American Motors Conservation Award, a national citation for outstanding service in conservation. He is also a past president of the American Fisheries Society.

Director Roedel said: "We are delighted to have a man of Mr. Gottschalk's knowledge, experience, and ability. He is nationally known as a conservationist and fishery scientist. We feel he is the ideal man to head up our marine sport fish program."

FEWER MID-ATLANTIC COAST FISH AND SHELLFISH FORECAST

The abundance of most fish and shellfish that support the Middle Atlantic Coast fisheries will decline in 1971, according to the Virginia Institute of Marine Science (VIMS) at Gloucester Point.

Striped-bass abundance is expected to decline somewhat but fish will be of good size. This species is cyclic: good broods are produced at about 6-year intervals. The hatch of young in 1970 appears to have been good. These fish will not enter the fishery in 1971, but they promise a good year for pan-size stripers in 1972.

Some Decline Inevitable

After the near-record year for spot in 1970, some decline in 1971 seems inevitable, VIMS states. The fish that supported the 1970 fishery were mostly 2-year-olds; a few will still be around in 1971 as 10-inch fish, but small fish will be scarcer than usual. "The result will be only mediocre spot fishing in 1971," notes VIMS.

Croaker and grey sea trout probably will continue to increase at 1970 rate, but the numbers will be far below their peak in the 1940s.

River Herring & Shad

The pound-netters begin their season in early spring, when the river herring and shad come into Chesapeake Bay and swim up rivers to spawn. In 1969, and again in 1970, the foreign trawlers, mostly Soviet, cut deeply into supply of river herring, which are backbone of pound-net fishery. VIMS points out that the success or failure of 1971 season probably will depend largely on extent foreign fishermen harvest this resource.

Shellfish Decline

Shellfish abundance also is expected to decline, except for surf clam, expected to increase sharply.

Catches of hard clams will be at about 1969 level because production has declined only slightly since 1963. Production of soft clams has declined sharply since 1965; no production is expected in 1970.

Blue Crabs

The VIMS prediction for blue crabs was for a smaller-than-average year-class available from September 1970 through August 1971. Small crabs hatched in 1970 were present in Virginia waters in late October, however. They are so numerous that scientists are predicting larger-than-average supplies for the 12 months beginning September 1971.

Oyster abundance has trended downward since 1960. Levels in 1970 were expected to be about equal to or slightly below 1969.

SUSQUEHANNA RIVER SHAD WILL BE AIDED BY NEW AGREEMENT

The State-Federal Advisory Committee for Susquehanna River Shad Studies and 5 power companies operating dams on the lower river have agreed to do more to restore American shad to the river above the dams.

The Susquehanna is one of the great rivers of the Atlantic seaboard. It drains a large part of New York State, about half of Pennsylvania, then passes through a small piece of Maryland before emptying into Chesapeake Bay. Before the dams were built, migratory fishes in abundance came up from the sea where they had spent part of their lives. Construction of dams 40 years ago severed the link between river and sea.

Fish Collection Facility

Key feature of the agreement is development and construction of a $500,000 fish-collection facility at Conowingo Dam in Maryland, near river's mouth, by Philadelphia Electric Power Co. and Susquehanna Power Co. It is expected to operate by May 1971, in time for next season of shad run.

50 Million Fertilized Eggs

Pennsylvania Power & Light Co., Safe Harbor Water Power Corp., and Metropolitan Edison Co. will spend an estimated $250,000 over 5 years to acquire and plant at least 50 million fertilized American shad eggs in Susquehanna or tributaries above Conowingo.

U.S. & States in Committee

The advisory committee consists of representatives of Maryland Fish and Wildlife Administration, Pennsylvania Fish Commission, New York Department of Environmental Conservation, and the Interior Department. The committee will monitor results of program to determine if more action, including construction of fishways, is needed.

Federal Power Commission

The agreement is subject to a decision by the Federal Power Commission that the cost to power companies can be classified as operating expenses.

FISHING ON UPPER MISSISSIPPI R. REFUGE PERMITTED BY SPECIAL RULE

A special regulation of the U.S. Department of the Interior's Bureau of Sport Fisheries and Wildlife permits, under certain conditions, commercial fishing--in addition to sport fishing and to taking of frogs, turtles, crayfish, and clams--in all waters of the Upper Mississippi River Wildlife and Fish Refuge during the open season in 1971.

This special regulation will be effective during Jan. 1-Dec. 31, 1971. The Refuge includes parts of Illinois, Iowa, Minnesota, and Wisconsin.

Maps Available

Maps delineating the 125,000-acre Refuge water areas are available at refuge headquarters, Winona, Minn. 55987; also, from Regional Director, Bureau of Sport Fisheries and Wildlife, Federal Bldg., Fort Snelling, Twin Cities, Minn. 55111.

VAST CALICO SCALLOP BEDS ENCOURAGE NEW FISHERY

Scientists have located extensive calico scallop stocks off North Carolina, Florida's east coast, and eastern Gulf of Mexico. Also, they have found small concentrations off South Carolina and Georgia. There are 1,200 square miles of scallop beds just off north Florida. The Florida area appears potentially best.

Calico scallops are so called because of their mottled shells. They are closely related to the bay scallop.

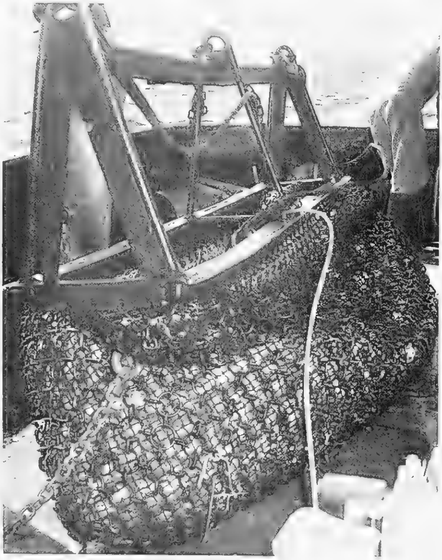
Tom Costello, chief of scallop investigations, NMFS Tropical Atlantic Biological Laboratory, Miami, Florida, says: "Although Florida landings of calico scallops in 1969 were only 160,000 pounds of shucked meats, the landings may be 15 to 20 million pounds by 1975." Most of the catch is now sold directly to restaurants. As landings increase, there will be limited distribution to food markets.

"We've known about these beds since 1960," adds Costello, "but we didn't realize how extensive they were until later when our scientists began making surveys of the beds. Our cruise reports helped stimulate the interest of commercial fishermen but, until recently, two factors prevented rapid development of these resources: One was the changes in location and productivity of the beds from year to year; the other was the lack of mechanical equipment for sorting, shucking and eviscerating the scallops."

The Fishery

Four vessels designed specifically for scallop fishing and processing recently entered the fishery. They have the necessary equipment to process the catch as it is brought aboard. Scalloping trips usually last 5 to 8 days. While on the beds, fishing is continuous, day and night, with a 14-man crew working 12-hour shifts. Catches run as high as 200 pounds of processed scallop meats per hour, and average about 100 pounds per hour. These vessels have been so successful that the manufacturer may build more.

"Although we've done a lot to help in locating and assessing the beds," points out Costello, "industry has developed the sorting, shucking, and eviscerating machines."



A 40-bushel catch of calico scallops made with an 8' tumbler dredge aboard NMFS research vessel 'Oregon'.
(J. B. Rivers)

Calico scallop on $\frac{1}{2}$ shell. (L. May)

Calico scallops are small. Hand shucking has been economically feasible only where special labor and supply conditions have existed. Although the present machines do the job, industry continues to improve and modify them.

Locating Calico Scallops

Locating commercial concentrations has been one factor limiting industry growth. To help overcome this obstacle, NMFS scientists have developed new techniques to locate and assess the beds. One is RUFAS. (See page 8.) Using RUFAS, beds can be viewed, filmed, and charted quickly and economically.

This monitoring is required to assess annual concentrations of calico scallops soon after they spawn, usually in May and June. As the scientists locate beds, they prepare charts for industry showing commercial concentrations.

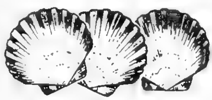
RUFAS fishery data are combined with catch information from commercial vessels. These data are used to determine the annual potential of major scallop beds so future predictions will be more precise and quickly available.

Age, Growth, Location Changes

To learn more about the age and growth rates of calico scallops, scientists have marked and released them for later recovery. This information enables researchers to predict when newly discovered beds of young scallops will reach harvestable size.

The scientists also are trying to determine why scallop beds shift from year to year. They have observed that most beds are in a north-south direction along the flow lines of coastal or Gulf currents. Typical beds are 100 to 300 feet wide, and up to 1,500 feet long. The average density is 4 scallops per square foot; sometimes, there are 8 per square foot.

The scientists believe that the location of new beds probably depends on currents and other environmental conditions that influence the free-swimming scallop larvae before they settle and grow. One hypothesis is that the calico scallop resource is an annual crop that will support an extensive harvest each year with only minimum brood stock required to reseed the grounds.



COUNTING SCALLOPS IN 150 FEET OF WATER

Counting scallops on the seabed is no problem to scientists of NMFS' Exploratory Fishing and Gear Research Base in Pascagoula, Miss. They use RUFAS (Remote Underwater Fishery Assessment System), which "flies" just over the scallop beds. Base engineers and the electronics industry developed it.

RUFAS

RUFAS is a towed vehicle with an optical system capable of looking at the seabed, according to engineer Wilber Seidel. It is connected by electrical cable to the vessel, which tows it and also serves as remote control center. The operator, or pilot, can maneuver RUFAS to any position over the seabed from the control center. Electric motors turn maneuvering vanes on the vehicle. Special sensing devices determine its height above seabed and look ahead for uncharted obstructions.

Optical System

The optical system consists of special lights, television, and 35 mm. motion-picture cameras. It is electrically operated from the control center. When RUFAS is looking at the seabed, the TV monitor and video-tape recorder also give scientists a continuous high-quality picture of the terrain. The motion picture camera is turned on when the scientists want to record biological phenomena.

Vast Scallop Beds

The calico scallop beds off the north Florida coast are extensive. NMFS scientists and the fishing industry predict an annual catch of 15-20 million pounds as early as 1975. With wholesale price over $1 per pound, this new fishery would be very valuable.

During a recent RUFAS survey, 120 miles of the scallop beds were viewed, and 4,500 feet of 35 mm. color film were exposed, plus 23 hours of video tape.

RUFAS has provided timely information to commercial fishermen about the location and abundance of calico scallops. It has provided scientists valuable knowledge about growth rates, spawning, and density--all vital to proper management of this developing fishery.

The current RUFAS is not designed for the extreme pressures of deep water, though it has surveyed to 35 fathoms. A more sophisticated model is on the drawing boards. It will have greater depth capability, broader seeing range, and contribute to NMFS' new program to monitor and assess more living marine resources.

[illegible] ...ater fisheries assessment system). (Photo: J. B. Rivers)

GULF SCIENTISTS STUDY BENEFITS OF DATA-BUOY NETWORK

A study to determine public and economic benefits from a data buoy network in the Gulf of Mexico is underway within the Gulf Universities Research Corp. (GURC). Scheduled to be completed by April 1971, the study will provide criteria for design and deployment of the network to get the most use out of it. Contract for the study is with the U.S. Coast Guard.

GURC has encouraged initial deployment of the National Data Buoy System in the Gulf as a first priority for scientific and practical reasons, according to Dr. James M. Sharp, GURC president.

He stated: "A better understanding of the climatology and dynamic processes of the waters and air masses in the Gulf of Mexico is an objective of long standing in Gulf coast universities. In addition to the Gulf's being an excellent natural laboratory for oceanographic and meteorological phenomena study, a better means of describing and predicting physical processes in the Gulf can help solve many problems of public and economic interest."

Benefits of Network

Dr. Sharp said improved forecasting of storms and hurricanes would strengthen coastal protection. Improved forecasting of surface conditions and currents for fishing, offshore service, coastal transportation, and pleasure craft would be another benefit.

He emphasized that moisture crossing the Gulf shoreline provides most of the rainfall for the central and eastern U.S. It creates ground fog affecting coastal air traffic.

What Is Needed

To develop climatological understanding--and knowledge of dynamic processes needed for accurate description and prediction of Gulf ocean and atmospheric weather--requires a way to report oceanographic and meteorological measurements from the Gulf.

Dr. Sharp emphasized: "Both air and water traffic in the Gulf are limited so that reports from these sources are meager, especially when weather and sea state conditions are severe.

"Weather satellites and long range radar have improved coastal protection and weather prediction but, as Camille, Celia and unnamed but sudden destructive tropical storms in the Gulf have shown, there is still room for improvement."

Dr. Sharp said this improvement can come only when the Environmental Sciences Services Administration (ESSA) Gulf system and scientists have this information available to develop the understanding of processes that leads to accurate prediction.

Data On Other Oceans Needed

Dr. Sharp stated that there is similar need for data from other oceans. Many Federal and state agencies, and the transportation, fishing, and mineral extraction industries operating in the ocean areas need improved description, as well as prediction, of physical processes.

Coast Guard's Role

The U.S. Coast Guard has conducted studies of "requirements, design and economics of obtaining data from ocean areas by means of instrumented buoys." These studies included comparison of data buoys with other observational means--satellites, aircraft, ships, platforms, etc.

The Coast Guard plans development of prototypes of data buoys for acquiring ocean data. Engineering tests and evaluation buoys are scheduled to be deployed in the Gulf within the next year. Operational buoy network to cover limited ocean areas will be available within a few years.

PACIFIC SAURY: Fishery Studied from Vessel & Plane

I. 'JOHN N. COBB' LOCATES SCHOOLS & EVALUATES HARVESTING SYSTEMS

The John N. Cobb returned to Seattle, Wash., on September 10 after an 18-day cruise in Puget Sound and Washington-Oregon coastal waters to test methods of harvesting Pacific saury (Cololabis saira). The vessel serves the Exploratory Fishing & Gear Research Base of the National Marine Fisheries Service.

The principal cruise objective was to locate concentrations of Pacific saury and to evaluate the commercial potential of three prospective harvesting systems--fish pump, purse seine, and lampara seine--used along with a light-attraction system.

GEAR

Lighting System: The light array consisted of 11 light booms 16 to 30 feet long, each carrying a 2,000-watt bank of incandescent lights. Two booms were 12 feet apart on the stern; the others were at about 15-foot intervals along portside and along starboardside from bow to after end of house. Two portside booms in the seine-pursing area and the two stern booms in lampara hauling area had a 1,000-watt quartz-iodide light with a red filter. These lights were switched on and off from a low-voltage, remote-control box with a 100-foot cord, usable anywhere on the

Fig. 1 - Saury jumping wildly alongside the Cobb when the white lights are first turned on.

vessel. A 5-kw. searchlight was used to detect surface concentrations of saury and to "draw" them to vessel.

Seining System: The net was $\frac{3}{4}$-inch stretched mesh, 6-thread knotted nylon, 4,500 meshes long by 1,500 meshes deep. The length of corkline was 150 feet, leadline 144 feet, and breastlines 24 feet. One hundred-fathom $\frac{3}{4}$-inch braided towlines were attached to each end of corkline.

There was no chance to test two 150-fathom lampara seines.

Fish Pumping System: The fish-pumping system consisted of a collecting funnel, submersible pump, discharge hose, and fish/water separator. The funnel was canvaslike material supported by 8-foot aluminum frame. It was floated alongside starboardside. The hydraulic-powered submersible pump was bolted to funnel frame and discharged through a flexible 10-inch hose. The hose passed aft around stern, where it was connected to a steel 10-inch pipe at rail on portside of stern. This pipe discharged into a fish-sorting table with a bed of gradually diverging stainless-steel rods. The water passed through this, fell to the deck and flowed out through scuppers.

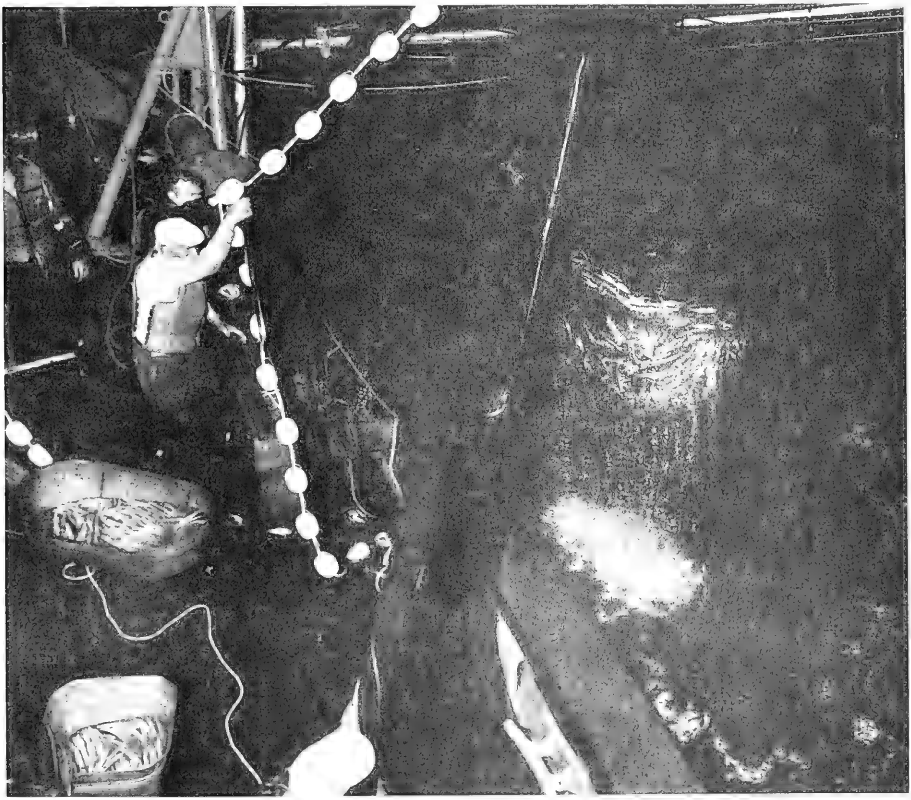


Fig. 2 - 800 lbs. of saury caught in 150-foot seine being strapped aboard Cobb.

METHODS OF OPERATION

During first two cruise days, work was conducted in Puget Sound to develop handling techniques and to make diver measurements on saury seine.

Searching and fishing for saury were conducted off Washington-Oregon during darkness. Search patterns, run in north-south zig-zag fashion, were restricted to waters ranging from 57° to 61.5° F. Saury were detected primarily by scanning spotlight over surface. Several banks of alluring lights were also lighted during scouting. When saury were located, the main engine was stopped. Saury were concentrated around vessel with the banks of alluring lights, and by sweeping spotlight from fish to vessel.

When working the fish-pumping system, fish were concentrated under the bow alluring lights. The pump and funnel were set off the starboardside aft, and the pump was turned on. Then, fish were moved about 60 feet along starboardside to area in which pump was located by turning on and off, in sequence, banks of lights along side of vessel. A 450-watt underwater thalium-iodide light with a red filter was located inside funnel next to pump intake.

The purse-seine-type net was set from Cobb's stern and operated without using a skiff. When a large school was accumulated alongside, the vessel was run in a circle. A buoy was dropped and a 100-fathom towline paid out. The net was set from stern on windward side of circle. The other 100-fathom towline was laid out while returning to

Fig. 3 - Saury caught by Cobb in first offshore set of 150-ft. saury seine.

retrieve the buoy. Then the lines were hauled and the seine dried up and brailed. The corkline was held up and out away from vessel during brailing by 3 cylindrical plastic floats on corkline--and by a line snapped on corkline running out over a block on light boom just ahead of purse davit. All light banks were on while setting and while hauling most towlines. As net neared the vessel, all lights were turned off, except 2 banks near center of net.

RESULTS

Operations in coastal waters were limited to 9 nights; 600 linear nautical miles were surveyed, extending from 44 to 86 miles offshore. Sixty percent of available search time was spent off Washington. Most foul weather was encountered off Oregon; efforts there were limited to northern and central Oregon.

operation, and the pump funnel could not be oriented at proper distance from vessel. Only a few of the available fish passed into the funnel as they were led along side of vessel. Fish that entered funnel were pumped aboard readily. Lighting techniques used to "run" school along vessel to pumping position were very successful.

Seining Experiments: During first 2 days of work on Puget Sound, the purse seine was rigged and handling techniques developed during 4 test sets. Diver observations during the last 2 sets indicated the net configuration during hauling was satisfactory. However, when set offshore, the net did not always perform as in Puget Sound. About 80% of available fish were encircled by net. Most of the catch was lost around breastline or over corkline at station 2 due to foulups and inadequate rigging. At stations 4 and 5, with a 20- to 25-knot wind blowing, the leadline was so light that the net passed above most fish. Chain was added and tom weights obtained to keep gear down, but lack of fish did not allow gear to be tested again.

Location, Surface-Water Temperature, and Saury-Catch Data for Stations Occupied During John N. Cobb Cruise No. 70-9

Date	Station	Position		Surface Water Temperature	Time Stations Were Occupied	Estimated Quantity of Saury Observed	Gear Type	Catch	Fork Length cm.	
		Lat. N.	Long. W.		Minutes	Tons		Lbs.	Mean	Range
8/28/70	1	47°12'	126°27'	60°	90	3-5	Pump	1	27	27 >
9/01/70	2	45°03'	125°50'	58°	90	7-9	Seine	800	26	19-30
9/02/70	3	44°34'	125°12'	58°	30	2-3	Pump	-	-	-
9/02/70	4	44°33'	125°11'	58°	60	3-5	Seine	400	26	18-30
9/03/70	5	44°30'	125°08'	58°	60	6-8	Seine	300	26	18-30
9/03/70	6	44°34'	125°04'	58°	120*	7-9	Pump	100	27	25-31

*Actual pumping operations were limited to 10 minutes.

Sizable concentrations of saury were located on 3 of 9 operative nights, one night in Washington waters, and two nights in Oregon waters. Results of the 6 fishing attempts (3 pump stations and 3 seine stations) are summarized in table. At stations 1 and 2, saury concentrations were not located until about 0330 P.s.t.; so working time was limited to about 90 minutes before daylight.

Pumping Experiments: The pump was fished at stations 1, 3, and 6. The fish hose was blown off pump at stations 1 and 3, which limited pumping operations to about 2 minutes and 4 to 5 seconds, respectively. In each case, the lengthy repairs required temporary halts. Station 6 was the only time when pump operated without mechanical problems. However, on this occasion, rough weather hampered

The use of lights for seining was successful. As vessel got underway and began paying out towline, the fish initially would stay with boat. Later, they began dropping away until only a few remained with boat by time seine set was two-thirds completed. Most, if not all, of the fish, were regrouped, however, during 10 to 15 minutes required to pull net to vessel's side. As net neared vessel, all fish were relocated to pursing area and successfully held in that position as enclosure was completed.

II. SAURY SCHOOLS SPOTTED FROM AIRCRAFT

Numerous schools of Pacific saury were sighted from a Coast Guard aircraft on September 24. The schools were detected visually at night by their reflected bioluminescence. Identification of the fish as saury was based on a previous overflight, when "sea truth" data were provided by simultaneous catches obtained from the John N. Cobb.

As observed on an earlier flight, the saury schools characteristically were about as large as a house and irregularly shaped. Within the region surveyed from off Cape Flattery, Washington, to the California-Oregon border, the saury were sighted in two areas 30 to 60 miles offshore.

The first area was in an 85-mile band extending from west of Cape Flattery to west of Cape Elizabeth, Washington.

The second area was in an 80-90-mile band between Cape Arago, Oregon, and Crescent City, California. Saury schools were still being sighted off Crescent City when daylight terminated operations.

Where "heavy concentrations" of saury were seen, the schools typically were about 50-100 yards apart, with 25 or more schools within a $1\frac{1}{2}$-mile band of water. Heaviest concentrations were at the survey's northern end (west of Cape Flattery). There, within a 5-mile area, three almost-continuous bands of fish, each about 800 to 1,200 feet long and 600 to 800 feet wide, were observed.

No Japanese saury vessels were sighted. This suggests fleet may be working to the north, off British Columbia.

A.T. Pruter, Seattle Base Director, states: "Aircraft spotting appears to be a very effective way to locate schools of saury and may be necessary if we are to have a U.S. fishery."

Spotting aircraft would aid U.S. fishermen--and be unavailable to foreign fishermen.

For further information contact: A.T. Pruter, Base Director, Exploratory Fishing and Gear Research Base, National Marine Fisheries Service, 2725 Montlake Blvd. East, Seattle, Washington 98102 (Phone: 583-7729).

COMMERCIAL GEODUCK-CLAM FISHERY UNDERWAY IN NORTHWEST

Washington State's newest commercial fishery--for geoduck clams--is underway. Catches of 8,506 pounds were reported by Washington Department of Fisheries, as of Aug. 30, 1970.

Most of the clams are going to restaurants. Some restaurants are featuring a crown steak from the big clam, which they call a "king clam."

ROCKFISH HAVE STRONG HOMING ABILITY

Last year, Richard Carlson and Richard Haight, biologists at the NMFS Auke Bay (Alaska) Biological Laboratory, discovered that yellowtail rockfish, Sebastes flavidus, possess a well-developed homing ability. They tagged and released in Auke Bay 35 fish held in captivity for 3 months at the laboratory. Within days, the fish migrated the 5 miles back to the place where they were captured originally.

SCUBA surveillance of the rockfish population at the home site showed that this shallow-water species descended into deeper water during winter, but returned to the same home site in spring.

Harder Tests for Rockfish

This year, the biologists tested the strength of this homing ability by releasing fish at sites intended to present varying degrees of difficulty: forcing the fish to cross over deep water, placing them in other channels influenced by different water conditions and currents, placing them north and south of their home site, and forcing them to pass through other yellowtail populations.

In each case, the fish returned home, either within days or within a few weeks. So far, the releases have been between 5 and 7 miles distant from the home site. The next step in the experiment will be to see how far these fish will migrate in their effort to return home.

NMFS RESEARCH VESSELS EXPLORE FOR SKIPJACK TUNA

Two research vessels of the U.S. Department of Commerce are exploring an area on the equator, about 2,000 miles south of San Diego, for skipjack tuna.

The EASTROPAC expeditions of 1967 and 1968, sponsored by the National Marine Fisheries Service (NMFS), indicated there is "a likely region for concentrations of skipjack," said Dr. Alan R. Longhurst, Director of the NMFS La Jolla, Calif., laboratory.

The two vessels are the 'David Starr Jordan' operated by the NMFS La Jolla laboratory, the 'Townsend Cromwell' by the NMFS laboratory in Honolulu.

Fig. 1 - David Starr Jordan.

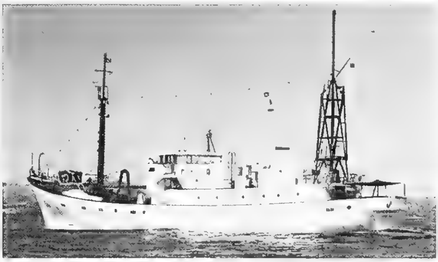


Fig. 2 - Townsend Cromwell.

NMFS is part of the Commerce Department's new National Oceanic and Atmospheric Administration (NOAA).

Cromwell sailed from San Diego Oct. 28 and is slated to return Dec. 1; Jordan left Nov. 2 and will return to San Diego on Dec. 17.

Yellowfin & Skipjack Main Species

Yellowfin and skipjack tunas are the two main species caught by U. S.-flag vessels, many based in San Diego and San Pedro. The tropical yellowfin-tuna fishery is regulated by an annual catch quota. So the Nation's largest high-seas fishing fleet has a serious problem finding alternate tuna resources. Some boats can turn to the late-summer temperate tuna fisheries, some to the eastern tropical Atlantic. But the most important alternative, say fishery biologists, is the stock of oceanic skipjack in the eastern Pacific--unregulated and underfished.

Expedition's Object

The expedition's object, said Dr. Longhurst, is to learn if skipjack tuna are abundant under fishable conditions in this area. Cromwell is making a rapid north-south survey, measuring temperatures, salinity, oxygen, surface chlorophyll, and other oceanographic features. The information is radioed to Jordan. Both ships then proceed to investigate with electronic fish-finding apparatus, mastman, and trolling gear the occurrence of skipjack in likely places.

One scientist watches for birds and porpoises often associated with tuna.

SPACE-AGE TECHNOLOGY USED TO FIND FISH

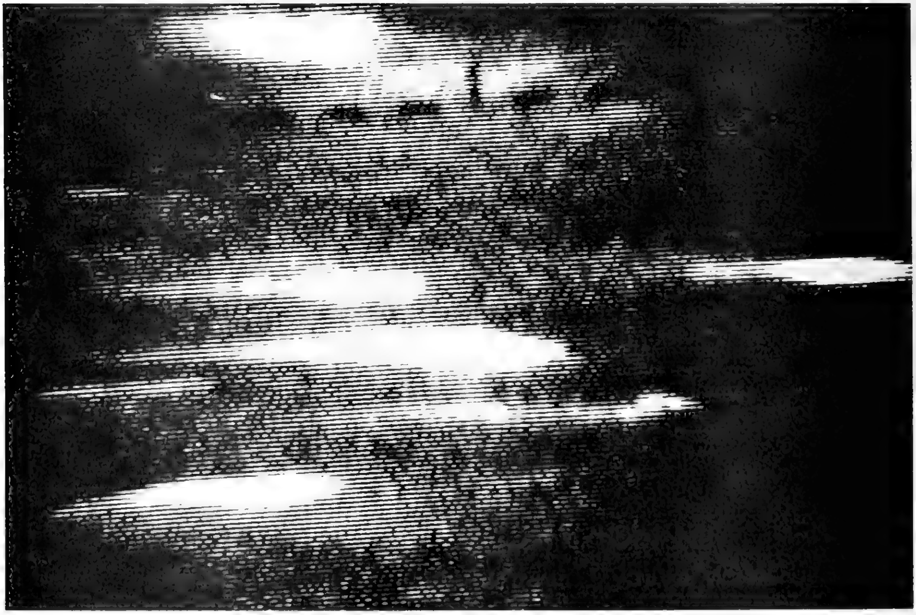
The National Marine Fisheries Service (NMFS) plans to move some personnel to NASA's Mississippi test facility to use its sophisticated technical equipment. This will allow NMFS to expand its Remote Sensor technology program, says William Stevenson, who will be in charge. Historically, locating and assessing fish stocks have taken place from slow-moving ships covering very little ocean surface. In some fisheries, up to 85% of vessel-operating time is spent finding fish. New technology in remote sensing may revolutionize detection, identification, and censusing of open-sea fishery resources.

The Equipment Used

Recent studies at NMFS' Exploratory Fishing and Gear Research Base in Pascagoula, Miss., have shown that airborne sensors can be used to locate and identify surface and near-surface fish schools.

Using aerial photography and special films and cameras, scientists have found that they can locate and identify fish schools. Identification is based on differences in color or spectral reflectance. Observations were made of 15 commercially important species. Measurements were made on single specimens, on groups, and on schools inside impoundments. The results showed different species reflected different color spectrums; these could be used for identification.

With multispectral photographic system and spectroradiometers, NMFS scientists penetrated the water optically, detected the presence of fish schools, and measured the color pattern or spectral reflectance.



Spanish mackerel swimming at night create a "fire" in the water. The "fire" is caused by tiny organisms that glow when disturbed by swimming fish. NMFS scientists use image intensifiers to amplify this light 40,000 times or more. They believe that these devices can be used from aircraft to help fishermen find and identify schools of fish.

Oil Slicks Useful

Preliminary tests indicate that oil slicks from large fish schools, such as menhaden, can be detected and used to locate and identify these schools. Fish-oil slicks also have different temperatures than the surrounding sea surface. So the presence of fish can be detected by monitoring sea-surface temperatures.

Image Intensifiers

The Pascagoula Base has explored another approach to finding and identifying open-sea fish stocks. This uses low-level light sensors, such as image intensifiers, coupled to closed-circuit TV to detect bioluminescence, or "fire" as fishermen call it, associated with schools of fish. Florida fishermen use "fire" to find Spanish mackerel at night. This "fire" results from movement of fish schools, which cause luminescent organisms to glow momentarily. The bodies of rapidly swimming fish are outlined with lights; each leaves a trail of fire as it moves.

The image intensifiers amplify surrounding light 40,000 to 100,000 times. Scientists have been able to observe thread herring schools at night from altitudes of 500 to 5,000 feet.

Preliminary tests suggest that low-level light sensors may be used effectively from high altitudes to locate and possibly identify open-sea fish schools over large areas.

Value to Commercial Fishermen

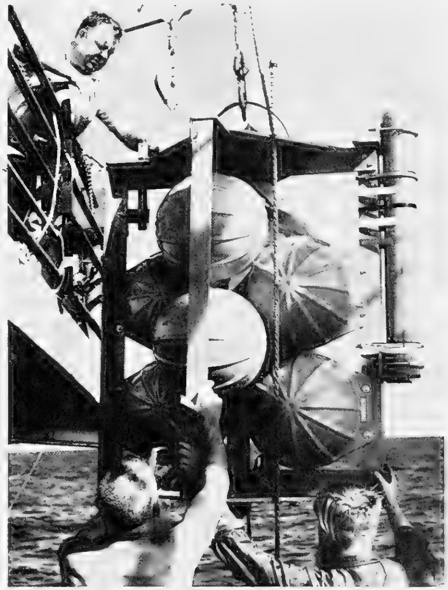
The Pascagoula research may lead to a system that will sharply reduce the time commercial fishermen spend looking for fish. Such information will permit development of underutilized fishery resources, which now cannot be harvested economically because of search time and other factors. Scientists will have tools to tell them quickly whether fishermen can harvest a resource--and how much they can harvest without depleting it.

MODULAR BUOY SYSTEM

Scientists at Woods Hole Oceanographic Institution (Mass.) prepare (below) to lower into the ocean a modular buoy system composed of glass spheres bolted to a fiberglass frame-work. Four such buoys and associated equipment were deployed by Woods Hole to depths of 4,500 meters for 2-month periods in a study of Gulf Stream currents. Each unit stands 67 inches high and provides 340 pounds of buoyancy.

Each mooring included a magnetic tape current meter, an acoustic release holding an 800-pound anchor, and the buoy for returning the package to the surface.

Called Cablemates, the 16-inch glass spheres and cases are manufactured by Corning Glass Works. They are designed for simple attachment to equipment such as the buoy rack. The amount of buoyancy is changed by adding or removing individual Cablemate units.



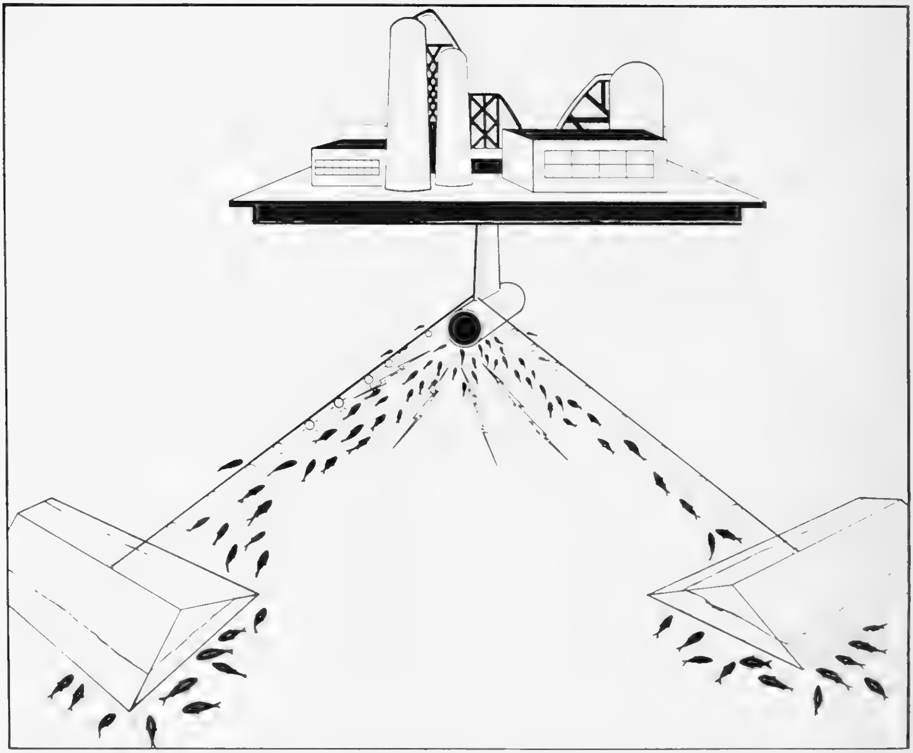
A FISHING PLATFORM MAY SOME DAY REPLACE TODAY'S GEAR

The commercial fisherman is still the hunter of the seas. Despite modern technology, he fishes much the same way his precursors fished--with nets, traps, lines, or similar types of gear.

The NMFS Exploratory Fishing and Gear Research Base in Pascagoula, Miss., is trying to change this ancient approach to fishing. It is developing an automatic fishing platform that may be in operation in 1971. The large latent potential of the Gulf of Mexico is one reason for the development of the platform.

The Fishing Platform

The purpose of the fishing platform is to attract small, loosely schooled fish with submerged rafts and to guide the fish with special lighting to a central point. There they can be concentrated with an electrical field and



An automatic fishing and processing platform that attracts fish with lights--and uses electricity to concentrate them at the intake of a pump--is being developed at NMFS Exploratory Fishing and Gear Research Base, Pascagoula, Miss. The fish can be processed automatically aboard the platform for human or animal food.

pumped aboard a floating platform. The fish could be automatically processed for human and animal food.

The principles behind the platform are not new. SCUBA divers in the northern Gulf of Mexico have observed the small submerged rafts attract and concentrate fish. The rafts, which resemble small tents, attract two types of fish: the "jacks"--amberjack, blue runner, and rainbow runner; the "baitfish" associated more loosely with the structures, and consisting of Spanish sardine, scaled sardine, and round scad. Daily observations showed that over 100,000 baitfish were attracted to each structure. Studies at Pascagoula will determine the best shape and size of the submerged rafts for attracting fish.

Lights to Concentrate Fish

Lights have been used for many years to concentrate fish for commercial fishing. Herrings, anchovies, jacks, squids, and some mackerellike fishes have been concentrated in large quantities around surface and subsurface lights. These fish generally are small and are distributed in small schools along most Gulf and Atlantic coastal areas.

Using underwater mercury vapor lights, the scientists were able to concentrate and catch up to 3 tons per set of these fishes. Commercial purse seining around these lights was economically feasible, but catches were about one-third lower during full-moon periods than during new moon. Studies continue to evaluate the correct type and amount of light for attracting and controlling these fishes.

Early as 1966, submerged lights attached to a fish pump were used to sample open-sea fishes in the Caribbean. Although catch rates sometimes reached 900 to 1,800 fish pumped per minute, the fish were not concentrated sufficiently to make this process commercially feasible. The scientists believe that electricity will concentrate even more fish at the intake.

Electronics Used

Laboratory studies using modern electronics show that specific types of pulsed DC can effectively lead and concentrate fishes. Research will evaluate and determine the best kind and amount of electricity to attract and lead fishes. The results will be used in field tests of the commercial harvesting system utilizing light, electricity, and pumps.

NEW RESEARCH ON FISH-FLESH OIL OXIDATION

Only one method has been completely successful so far in stopping all oxidation of oil in the flesh of fish: keeping all air away by hermetically sealing fish in metal containers. Several series of silver (coho) salmon have been kept frozen in cans for years with no measurable rancidity developing.

In summer 1970, for the first time, pink salmon was frozen in cases to be tested. The oil in pink salmon oxidizes more rapidly than in any other species of fish, but samples examined at the end of August showed no discoloration or rancidity. The fish had been stored frozen for one year.

A New Variable Tried

Now NMFS' Pioneer Research Laboratory in Seattle is trying a new variable in an effort to reduce the cost of processing fish in cans for freezing to a practical level. Samples of sockeye salmon were packed exactly as for canning by being put through a commercial automated salmon-canning line. Then they were withdrawn just before they would have gone to the retort, and were frozen.

This method of packing eliminates hand labor, but it results in two possible disadvantages: Bone is left in the fish. And, because of greater head space in machine-packed fish, there is possibility that small residual amount of air left after vacuum seaming might be sufficient to cause oxidation.

The initial examination of fish packed in this way was favorable. The fish had a pleasing appearance in the can; after thawing and cooking, the color was brighter than that of sockeye from the same batch of fish that had been canned (retorted) in usual way.

PICKLED THREAD HERRING SERVED AS SNACKS

Over last several years, I have been experimenting with new methods of utilizing various fish and shellfish in Puerto Rico which are not presently utilized, or not fully utilized. One of them is thread herring (Opisthonema oglinum). So far, it is used only for fish oil and meal productions in the Atlantic and Gulf coasts, but I found that excellent-quality picked-herring can be made from the thread herring which are over five inches in length. The fish can be chocked and salted or fileted, salted, and pickled exactly the same way as pickling the herrings on the east and west coasts. They can also be salted and smoked. I believe the thread herring in the Pacific Ocean (Opisthonema libertate) which are found in abundance in the Gulf of Panama can also be utilized in the same way.

Little Snacks

New Industry Possible

In Puerto Rico, thread herring are caught by beach seines and gill nets as incidental to catch and are not actively sought after. Large schools of them can be sighted throughout the year around the islands, and a large number of them can be captured by $2\frac{1}{2}$-inch mesh gill nets. Thus, it is possible to establish a new industry which processes thread herring for local, states and Caribbean markets.

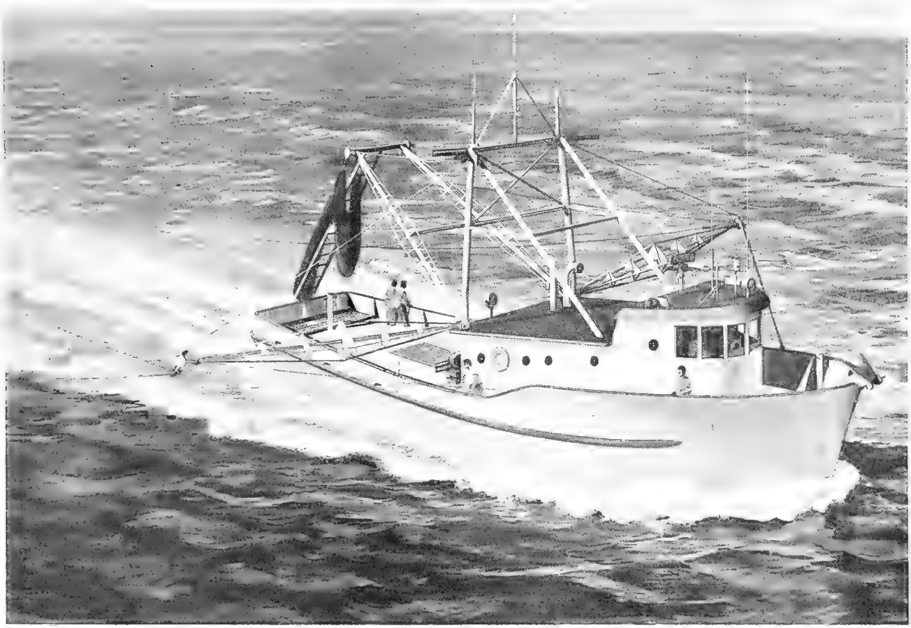
--Robert Y. Ting
Associate Professor
University of Puerto Rico

NEW ALUMINUM SHRIMP TRAWLER

A new shrimp-trawler design is available from Alcoa. The 76-foot design specifies aluminum for major components, including hull, deckhouse, rigging, and fish hold liner and shrimp stowage system. The beam is $23\frac{1}{2}$ feet and draft 9 feet.

Among aluminum innovations are new welding specifications, improved alloys, and a penboard and stanchion system for storing just-caught shrimp. Drawings and bill of materials are available from Alcoa, 1501 Alcoa Building, Pittsburgh, Pa. 15219.

ALCOA



New aluminum shrimp trawler.

SHRIMP FARMING MAY HELP MEET GROWING CONSUMER DEMAND

Scientists at the NMFS Biological Laboratory in Galveston, Texas, believe that shrimp farming (mariculture) may be the answer to the growing demand for shrimp. At present, Americans eat about one million pounds a day--about one-third world production.

The Galveston scientists collect live female shrimp in spawning condition, spawn them in the laboratory, hatch the eggs, and rear the larvae.

Female shrimp are collected in the Gulf of Mexico and transported to the laboratory. Each female carries 500,000 to 1,000,000 eggs. The eggs hatch in about 12 hours--provided conditions are suitable. The small shrimp, called larvae, are fed small algae (diatoms) and brine shrimp.

After two weeks, the young shrimp are transferred to brackish-water ponds. There they will grow to about 4 inches with natural foods. Growth can be spurred by adding fertilizers or feed to the ponds. However, growth diminishes as shrimp approach size ($3\frac{1}{2}$-$4\frac{1}{2}$ inches) at which they normally leave estuaries and move offshore.

Live Bait Market

Cornelius Mock, in charge of hatchery engineering, believes the first profitable commercial operations probably will be shrimp culture for live bait markets. The relatively high price paid for bait will permit profitable production of small shrimp in ponds despite the unavailability of efficient culture techniques. Under normal weather conditions, two crops could be harvested annually.

The Problems

Several problems have prevented development of shrimp farming for food market, says Mock: (1) the high cost of obtaining young shrimp for stocking (2) no efficient foods are available, and (3) the low price per pound for shrimp of small sizes that can be raised in ponds.

Despite these problems, several private companies have built hatcheries for growing and selling young shrimp. Many companies and universities are researching shrimp culture.

Galveston Research

The Galveston research will aid long-term commercial development. Scientists are refining hatchery techniques to reduce operating costs and to increase survival of larval shrimp. They hope to determine the nutritional requirements of shrimp and to formulate artificial foods for shrimp of all sizes. They must also develop methods to hold shrimp throughout their entire life cycle. Once these methods are developed, selective breeding will begin.

Recently, the researchers freeze-dried the diatoms used to raise larval shrimp. Later, the diatoms were mixed with sea water and fed to larval shrimp. The results were good. This technique may permit the storage of food. It also may make raising young shrimp more flexible and less dependent on the timely success of diatom cultures.

They also have tried supplemental feeding to accelerate growth of larger shrimp. Pelleted rabbit and trout foods and corn meal have been tested; so far, little or no growth has occurred.

Next Steps

Because of recent developments at the Galveston Laboratory, scientists may soon attempt to increase local shrimp stocks by seeding natural populations. Stocking artificially reared shrimp in natural waters may be desirable where production is poor because of adverse environmental conditions. Techniques have been developed to rear large numbers of shrimp from eggs deposited in the laboratory to about $\frac{1}{2}$-inch long, a suitable size for stocking. With present facilities, about one million shrimp can be produced each year. Expansion of hatchery facilities will permit production of more small shrimp. It will enable scientists to determine feasibility of supplementing wild populations by seeding.

GETTING MORE MEAT FROM FISH

Doubling the yield from fishery resources--without catching more--may sound like a dream, but NMFS scientists are working to make it a reality. They are using special processing machines to recover almost twice as much meat from fish as present techniques produce. Many species--rockfish, flounders, haddock, cod, and others--are filleted. The normal yield of meat from each fish ranges from 25 to 30%.

At the NMFS Technology Laboratory in Seattle, Wash., scientists using the new machines have obtained meat yields of 37 to 60%.

These machines have been used in Japan since the early 1950s to prepare boneless and skinless flesh from dressed fish, fillets, and chunks of flesh from large fish. The Seattle scientists learned of the machines in 1968 during the visit of a Japanese scientist. The NMFS Technology Laboratory in Gloucester, Mass., also obtained a similar machine to study Atlantic Coast species.

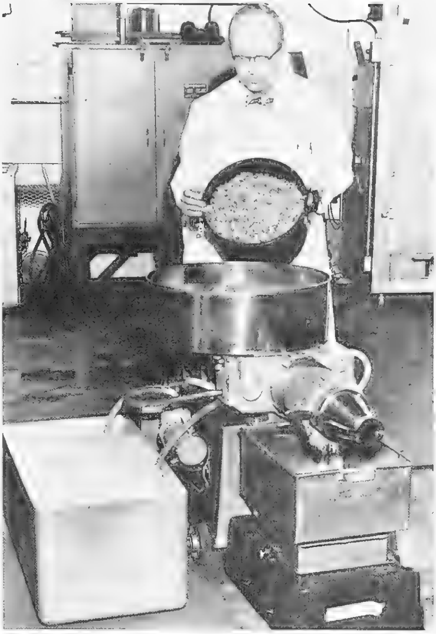
The Machine

Headed and eviscerated fish are fed into the machine and pass between a belt and a perforated drum. The pressure applied by the belt on the fish forces the flesh through the drum perforations, while the skin and bones pass to the waste discharge chute. The fish flesh can be passed through a meat strainer to remove any traces of bone. The final product is minced fish, free of bones and skin.

The Seattle scientists have used the minced fish to develop foods that no longer resemble fish. These foods can be flavored and modified to taste like cheese, spiced meats, or other items. The Gloucester scientists are using the minced fish in new products: fish cakes, canned fish, and fish frankfurts. They used the minced fish as a starting material in fresh fish sausage, croquettes, casseroles, fish loaf, and jellied roll.

Potential Value

The potential value to the New England fishing industry was shown by Gloucester scientists. In 1967, 312 million pounds of New England fish were filleted. They estimated that



A final process in preparing minced fish is to pass it through a meat strainer to remove any remaining bones. This machine helps NMFS technologists recover large amounts of fish flesh that previously were discarded. Minced fish has been used by NMFS technologists on both coasts to develop new foods--such as fish cakes, fish frankfurts, and canned minced fish. These new methods will increase the use of fishery resources and help develop new markets.

about 126 million pounds of meat were recovered. Had the wastes been run through the Japanese flesh separator, another 57 million pounds might have been recovered. At 10¢ a pound, this would have been worth $5.7 million.

This new technology could help U.S. fishing industry produce the fast-growing, processed, high-protein snack-type and convenience foods using the long-neglected species as protein source. Successful introduction of fish protein into only one or two of these high-volume food products could create a new demand for exploiting the underutilized fishery resources.

ANCHOVY POPULATION INCREASED FIVEFOLD IN 16 YEARS

An extensive reanalysis of the anchovy larvae data for 1951 through 1966 has confirmed the existence of a large population of anchovy off West Coast. The increase has been on the order of fivefold (figure). This was reported by NMFS' Fishery-Oceanography Center, La Jolla, Calif.

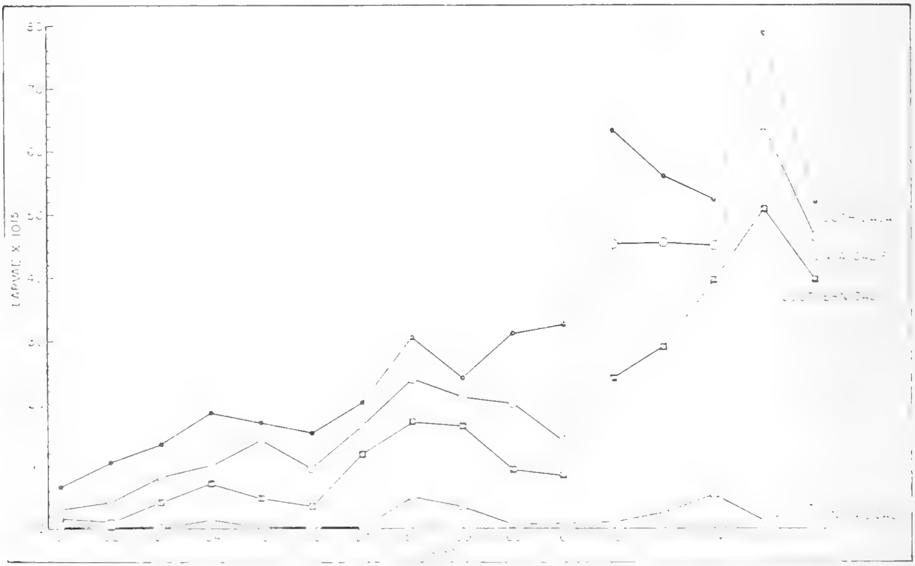
Most of the increase was noted off southern California, especially 80 to 280 miles off coast.

Work is now in progress to define more closely the estimates of spawning biomass through direct estimation of anchovy spawning biomass from anchovy eggs; these eggs have been collected with new nets since 1966.

STAMINA OF HATCHERY-REARED FISH TESTED

A see-through plexiglass tunnel--a "stamina tunnel"--is being used in fish hatcheries of the U.S. Department of Interior's Bureau of Sport Fisheries and Wildlife to test the stamina of fish. The tunnel will help determine their ability to survive after being planted in natural waters.

The tunnel carries a stream of water of controllable velocity. It is being used to see if fish are able to maintain their normal position against a natural flow of water.



Numbers of anchovy larvae off the Pacific West Coast, 1951-66.

OYSTERS CAN BE GROWN SUCCESSFULLY IN MSX-INFESTED AREAS

Oysters can be grown successfully in areas infested with the microscopic parasite MSX, reports Dr. Jay D. Andrews, Virginia Institute of Marine Science (VIMS). The problem is getting commercial quantities of resistant seed oysters. A VIMS unit is conducting research aimed at rearing disease-resistant oysters to rehabilitate abandoned oyster grounds in lower Chesapeake Bay.

Native and selected laboratory-bred offspring have been reared from spatfall to market size without intolerable losses, Dr. Andrews said. Predation, winter smothering, and storm damage remain important causes of mortality.

Resistance to MSX

Offspring of oysters native to lower Chesapeake Bay have exhibited resistance to prevailing levels of MSX activity in 7 consecutive year-classes from 1964 through 1970, Dr. Andrews reported. Fewer than 20% per year of these year-classes have died. This excludes losses from smothering and predation.

Resistant Seed Oysters

Use of areas where MSX is active requires resistant seed oysters. These may be obtained in two ways: 1) Brood oysters heavily selected by MSX for several years may be bred in hatcheries--and thus produce genetically resistant seed. The hatchery method has not yet been proved economically feasible, and the quantity of seed needed is too large for hatcheries. 2) "Obtain seed with acquired resistance gained by exposure to MSX from egg and larval stages to seed size. The parents of these natural sets in seed areas are upriver; they are not exposed or selected and do not exhibit resistance."

Native-Set Oysters Hardy

MSX-active areas usually have predators that prevent tiny seed oysters from surviving. Certain marginal areas, such as Piankatank River, have produced resistant seed, but growth and spatfalls have been inadequate. These seed areas must be monitored with susceptible imported oysters to determine level of MSX activity, and to insure that seed oysters have acquired necessary resistance. Few native-set oysters die or are infected with MSX.

SAN PEDRO AGAIN NO. 1 COMMERCIAL FISHING PORT

The fleet of San Pedro-Terminal Island, Calif., caught $40.5 million worth of fish in 1969, the largest ever for any U.S. port. It was the 21st consecutive year that San Pedro led all U.S. ports in value of catch. For the 4th successive year, it led all ports in volume of catch--406.9 million pounds.

MEETING

WORLD MARICULTURE SOCIETY MEETS IN TEXAS, JAN. 28-29, 1971

The second annual workship of the World Mariculture Society (WMS) will be held at the Galvez Hotel in Galveston, Texas, Jan. 28 & 29, 1971.

WMS promotes the study of mariculture and marine science and disseminates information in these fields. It is based at Louisiana State University, Baton Rouge, La. 70803. Secretary-Treasurer is James W. Avault.

Hundreds of gillnetters fish Kvichak Bay (adjoining Bristol Bay, southern Alaska). Note 2 lines of boats waiting to sell catches to buying scows.
(NMFS-Alaska Photo: J. M. Olson)

FISHING JURISDICTION-- ALASKA'S POSITION

C. A. Weberg
Director of International Fisheries
State of Alaska

Fishermen on both coasts of the United States and Canada, particularly on the West Coast and Alaska, are working hard to obtain extended fisheries jurisdiction.

Why all this interest in recent months and years?

Until 1966, United States jurisdiction extended three miles or to the territorial waters limit. With the rapid increase of foreign fishing vessels, plus new technologies and ability to harvest tremendous quantities of fish on a year-round basis right at our front door, the U.S. Congress passed legislation in 1966 which extended the fishery jurisdiction from three to twelve miles.

This law provides that no foreign fishing vessel can take fish in the area from the coast to a line 12 miles seaward unless an agreement has been reached between the United States and the foreign country allowing special concession to this provision. Our offshore islands also fall under the cover of this statue.

A number of other nations, including Canada, also adopted a similar law providing the coastal states with exclusive fishery jurisdiction out to 12 miles.

Other countries, particularly several in South America, have unilaterally claimed up to 200 miles as within their exclusive jurisdiction and are actively enforcing their claims.

At the time of the passage of Public Law 89-658, which established the U.S. Contiguous Fishery Zone, many persons connected with the fishing industry believed that the new law was inadequate for the protection they sought, and they advocated distances out to the Continental Shelf or 200 miles, whichever was the greatest. However, they recognized the problems associated with obtaining greater jurisdiction and more or less agreed to 12 miles as the best that could be obtained at that time.

Some U.S. fishing interests are opposed to extended jurisdiction for coastal states because they conduct some of their fisheries near the coasts of other nations.

A measure of resource protection was provided in 1958 when the Law of the Sea Conference adopted a convention concerning the Continental Shelf, giving the coastal state authority over shelf organisms which, at the harvestable stage, are either immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil. Several species of crab have been found to qualify as creatures of the Continental Shelf and have been afforded special consideration.

Reprinted from 'Alaska Fish & Game', Sept.-Oct. 1970.

In the past few years, foreign fishing fleets have taken increasingly larger amounts of the renewable resources off the coast of Alaska.

In 1969, the fleets operating mainly on Alaska's Continental Shelf harvested approximately three billion pounds of fish, including shellfish and a small number of whales. These fisheries are conducted with little or no control by the United States with the exception of several bi-lateral agreements and conventions. The consequence of lack of complete control is that several species of fish may be dangerously near the point of over-exploitation.

While it is true that the United States fishermen do not presently utilize many of the stocks being harvested by these foreign fleets, we expect to in the near future and must insist that a viable resource be available when we are ready.

Additional problems caused by the lack of adequate jurisdiction are connected with the "incidental" catch of species. Foreign vessels trawling for pollock and other species are taking large quantities of immature halibut. This species has been subject to strict conservation regulations imposed under a convention between the United States and Canada. Subsequently, our fishermen are catching fewer mature halibut because of lack of control over this situation.

Emergence of previously undeveloped nations into the marine fisheries arena further complicates the problem. Entry of South Korea into the high seas fishery for Bristol Bay salmon has caused serious concern for this particular stock which has been nurtured and conserved by Alaska and is the object of considerable research by the International North Pacific Fisheries Commission and the federal and state governments.

It appears, therefore, that the best solution to the problem lies in extending the coastal states' fishery jurisdiction to include the Continental Shelf or a set distance of 200 miles, whichever is the greatest distance, and to provide special consideration for migratory species, such as salmon, which go beyond these limits. Perhaps abstention from fishing salmon anywhere but in the coastal zone is a possibility.

Foreign nations could continue to fish stocks of interest to them but only under regulation of the coastal state. By using this means, the coastal state having a vested and special interest in the resource could retain a viable resource for the benefit of its citizens.

MOVEMENTS OF TAGGED BLUE CRABS IN NORTH CAROLINA WATERS

Mayo H. Judy and Donnie L. Dudley

The infrequent exchange of crabs between estuarine systems or between widespread coastal areas shows that a commercial fishery for blue crabs in one area cannot depend on migration of commercial-size crabs from another area.

From 1957 to 1965, 17,237 female and 5,691 male adult blue crabs were tagged and released in North Carolina waters, including two rivers, two sounds, and two ocean areas. Total recoveries were 6,947 tags, or 30.3%. Most recoveries (90-95%) were made within 6 months--and 60-65% of these were recaptured within 3 months after release. Of crabs caught away from tagging sites, 83% of females and 80% of males were caught within 24 km. of release areas. Females moved from estuaries into high-salinity waters in warm weather and returned to estuaries in late fall and winter. Males displayed limited movement between estuary and ocean but generally remained in estuaries.

BLUE CRAB FISHERY

The blue crab, Callinectes sapidus, supports an important commercial fishery along the Atlantic coast from Delaware Bay south to Miami, Fla., and along the Gulf coast from Florida to Texas. Annual landing records of blue crabs over the years show large and sudden fluctuations in abundance that have caused serious economic problems for the industry. As a direct result of these fluctuations, the Atlantic States Marine Fisheries Commission inspired an investigation of the blue crab in the South Atlantic States by the National Marine Fisheries Service Biological Laboratory in Beaufort, N.C. This report resulted from the investigation.

Our article reports male and female crab movements within and between estuaries, between estuaries and the ocean, and movement in the ocean by summarizing recaptures from a large-scale tagging program in North Carolina coastal waters during 1957-65.

Data on seasonal movements of blue crabs are necessary to understand their life history and establish sound management practices. Therefore, the migrations and localized movements of this species have been emphasized in many blue crab studies. Investigations in Chesapeake Bay (Churchill, 1919; Fiedler, 1930; Truitt, 1939; Van Engel, 1958); in Texas (Daugherty, 1952); in Louisiana (Darnell, 1959); in South Carolina (Fiedler, 1962); and in Florida (Tagatz, 1965, 1968) indicated that crab movements were closely related to phases of the life cycle. In Delaware Bay (Cronin, 1954; Porter, 1956) and in Chincoteague Bay (Cargo, 1958) research indicated that crabs scatter widely within their respective habitats but show only limited movement to other inland and coastal waters.

Movements Related to Life Cycles

Generally, movements related to the life cycle are: Early stage immature crabs, after development from eggs hatched in the ocean, move to less saline waters of sounds and rivers, where they mature in approximately 1 year. After their last molt, crabs mate and females begin a gradual movement to high salinity waters for spawning (eggs passed

The authors are Fishery Biologists with Center for Estuarine and Menhaden Research, National Marine Fisheries Service, Beaufort, North Carolina 28516.

COMMERCIAL FISHERIES REVIEW
Reprint No. 892

from ovaries to abdominal appendage) and hatching their eggs. Since spawning occurs only during warm weather, the actual spawning process may occur from a few weeks to a few months after mating but, once spawning occurs, the eggs will hatch in about 2 weeks. After their eggs have hatched, adult females gradually move from the ocean back into lower salinity waters. In most waters, adult males generally remain in low salinities all year, but in South Carolina and Florida many males, as well as females, migrated to the ocean at spawning time.

MATERIALS, METHODS, & STUDY AREAS

From 1957 to 1965, we tagged and released 22,928 adult crabs obtained from commercial fishermen and from our own gear. Crabs were captured by crab pots, otter trawl, haul seine, and trot lines. A plastic carapace tag (Rounsefell and Everhart, 1953) was attached to each crab by slipping a preformed loop of stainless steel wire (0.4 mm.) over one lateral spine, drawing the wire and tag taut over the back and securely winding the other end of the wire around the opposite spine (fig. 1). The tag bore a serial number on one side, and the laboratory address and reward notice (25 cents) on the other. Display posters at crab dealers and processors and contact with individual crabbers publicized the tagging study. Tag-return data were obtained either by direct contact with the fisherman or by use of tag-return envelopes.

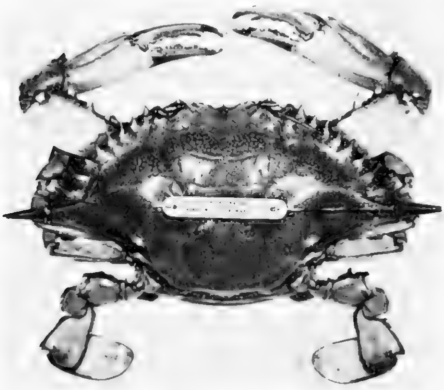


Fig. 1 - Tagged blue crab.

Crabs were tagged in the Newport and White Oak Rivers, Core and Bogue Sounds, and two ocean areas in the general vicinity of Beaufort and Oregon Inlets (fig. 2).

RESULTS

General

From the 17,237 female and 5,691 male crabs tagged, we recovered 6,947 tags (30.3% of total). Insufficient information accompanied 260 tags (3.7% of tags returned). Thus, 5,260 female returns (30.5% of females released) and 1,427 male returns (25.1% of males released) were used in the final analysis.

Release and recovery data for blue crabs (all female tag groups, and one male tag group) released in the Newport and White Oak Rivers, Core and Bogue Sounds, and Ocean Area #2 are shown in tables 1 and 2. (Due to very limited male-crab movement, data for males are shown in table form only for Newport River area.) Due to limited tagging and to small percent of tags returned, no table was prepared for crabs released in the Oregon Inlet area.

Although tag recovery is influenced by fishing intensity, it was beyond the scope of this study to deal with catch statistics. No tagging area had a uniform blue-crab fishery throughout the year. That our tag returns were dependent on fishing pressure was reflected by especially high and low recovery rates for some areas and times. Recovery rates were especially high in inside waters during winter and spring, and in the ocean during spring and summer when fishing effort was usually high in these areas (tables 1 and 2). Although fishing effort altered seasonal distribution of recoveries, we do not believe it materially affected conclusions regarding crab movement.

The percentage of tags returned varied widely with the area of release. The rate of tag returns was highest (51.4%) from White Oak River, and lowest (15.4%) from Oregon Inlet area.

Returns from tagging sites accounted for 77.2% of all recoveries (5,166 crabs). Tagging site, in this study, is defined as the river

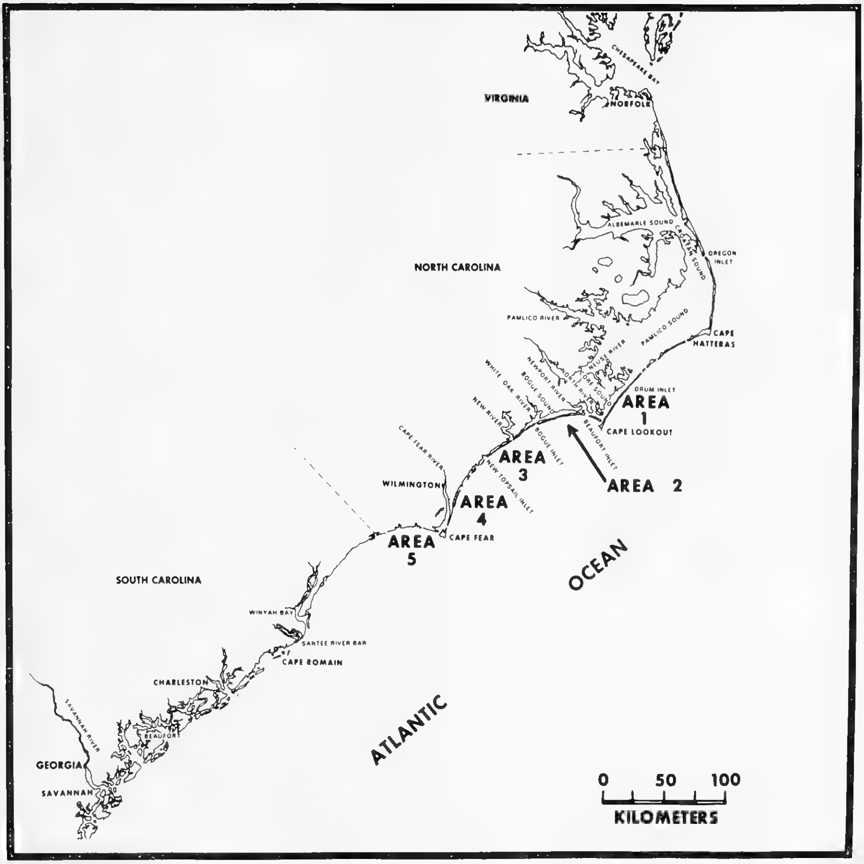


Fig. 2 - Atlantic coast, Chesapeake Bay to Savannah, showing areas where tagged blue crabs were released and captured.

Table 1 - Recovery of female blue crabs tagged in Newport and White Oak Rivers, Core and Bogue Sounds, and in the ocean off Beaufort, N.C., by quarters 1957-65

Released		Recovered										
Area	Number	Area recovered	Jan.-Feb.		Apr.-June		July-Sept.		Oct.-Dec.		Total recovered	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Newport River	6,814	Site............	471	30.0	304	19.4	98	6.2	127	8.1	1,000	63.6
		Other rivers.....	6	.4	4	.3	3	.2	---	---	13	.8
		Sounds...........	45	2.9	35	2.2	11	.7	4	.3	95	6.0
		Ocean............	2	.1	293	18.6	157	10.0	11	.7	463	29.5
											1,571	23.0 1/
White Oak River	2,699	Site............	605	41.9	686	47.5	14	1.0	---	---	1,305	90.3
		Other rivers.....	---	---	20	1.4	---	---	---	---	20	1.4
		Sounds...........	12	.8	37	2.6	4	.3	---	---	53	3.7
		Ocean............	---	---	43	3.0	23	1.6	1	.1	67	4.6
											1,445	53.5 1/
Core Sound	3,335	Site............	202	24.0	268	31.8	56	6.6	115	13.6	641	76.0
		Other sounds.....	---	---	6	.7	2	.2	---	---	8	.9
		Rivers...........	5	.6	9	1.1	6	.7	---	---	20	2.4
		Ocean............	3	.4	119	14.1	50	5.9	2	.2	174	20.6
											843	25.3 1/
Bogue Sound	1,583	Site............	289	44.5	59	9.1	10	1.5	58	8.9	416	64.1
		Other sounds.....	1	.1	1	.1	3	.5	1	.1	6	.9
		Rivers...........	2	.3	10	1.5	9	1.4	---	---	21	3.2
		Ocean............	1	.1	138	21.3	63	9.7	4	.6	206	31.7
											649	41.0 1/
Ocean (Off Beaufort, N.C.)	2,448	Site............	7	1.0	183	26.3	302	43.3	23	3.3	515	73.9
		Other ocean areas	1	.1	14	2.0	4	.6	1	.1	20	2.9
		Sounds...........	57	8.2	31	4.4	10	1.4	21	3.0	119	17.1
		Rivers...........	14	2.0	22	3.2	5	.7	2	.3	43	6.2
											697	28.5 1/

1/ Percent based on number released in each area, other percentages based on total number recovered from each release area.

Table 2 - Recovery of male blue crabs tagged in Newport River, by quarters 1957-61

Released		Recovered											
Area	Number	Area recovered	Jan.-Feb.		Apr.-June		July-Sept.		Oct.-Dec.		Total recovered	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Newport River	4,290	Site............	358	35.5	218	21.6	158	15.7	152	15.1	886	87.9
		Other rivers.....	2	.2	1	.1	2	.2	2	.2	7	.7
		Sounds...........	30	3.0	16	1.6	19	1.9	9	.9	74	7.3
		Ocean............	1	.1	12	1.2	20	2.0	8	.8	41	4.1
											1,008	23.5[1/]

1/ Percent based on number released in each area, other percentages based on total number recovered from each release area.

or sound where crabs were released or, in the ocean, within 24 km. from release area. We considered distance greater than 24 km. as showing more than just random movement. Recoveries at tagging sites accounted for 73.7% (3,877 crabs) of all female returns, and 90.3% (1,289 crabs) of all male returns. The difference between site recoveries of females and males was highly significant (X^2 = 39.7, P.01 = 6.63). No crabs tagged at Oregon Inlet were recovered there. In other areas, 63.6 to 90.3% of tagged females and 87.9 to 100% of males were recovered at tagging site. Site recoveries in rivers and sounds were higher during winter and spring, and in the ocean during spring and summer. The percent of on-site returns was consistently higher for males. The percent-return-by-area for females was altered greatly by their movement to and from the ocean.

Returns other than those at tagging sites indicated limited crab movement. Only 20 tags were recovered outside of North Carolina: 17 from Chesapeake Bay, 3 from South Carolina. All crabs recovered in the bay were released in Oregon Inlet area only a short distance from bay. Two of the 17 crabs recovered in Chesapeake Bay were males; all other recoveries from outside North Carolina were females.

MOVEMENT

Location and Distance

Crabs recovered away from their respective tagging sites were separated into two categories: Those caught within 24 km. of release, and those caught beyond 24 km. These two categories included 1,383 female and 138 male crabs. Those recovered within 24 km. of release accounted for 1,143 females (83% of nonsite recoveries) and 110 males (80%). Of these, 800 females and 42 males were recovered in ocean, and 343 females and 68 males in inside waters.

Crabs recovered more than 24 km. from release accounted for 240 females (17% of nonsite recoveries) and 28 males (20%). Ocean recoveries accounted for 135 females and one male. The male crab was recovered in Area 3, 56 km. from release site. Areas 2 and 3 had highest numbers (54 and 39) of females recovered in ocean. These crabs were at least 24 km.--but not more than 80 km.--from release sites. Other ocean recoveries included 26 crabs from Area 4, nine from Area 5, four from Area 1, and three from South Carolina waters. Crabs recovered in Area 4 were 40 to 160 km. from tagging sites; in Area 5, 120 to 210 km. away; in Area 1, 40 to 80 km. from release sites.

Of those caught in South Carolina waters, one was recovered in Winyah Bay, 298 km. away; another off Santee Bar, 314 km. distant; and another off Beaufort, S.C., 442 km. from tagging site. These three represented longest migrations during this study.

The few remaining crabs (105 females, 27 males) that moved more than 24 km. from release sites were recovered in inside waters. Crabs that moved from ocean to inside waters included 59 females and 3 males. Fifteen of those females, and 2 of males, were released in Oregon Inlet area and recovered in Chesapeake Bay. These crabs were 65 to 205 km. from release site but not more than 48 to 65 km. inside bay. Other crabs had moved among various inland habitats. Over all, the distance from release to recovery for females recaptured in inside waters ranged from 40 to 258 km.; males 40 to 80 km.

Direction

Tagged crabs caught more than 24 km. from release areas were grouped by direction of movement. Of the 240 females, 84% (201 crabs) had moved south or southwest, and 16% (39 crabs) north or northeast. Movement of male crabs was opposite that of females. Of the 28 males, only 14% (4 crabs) had moved south or southwest, and 86% (24 crabs) north or northeast.

Speed

Crabs are capable of rapid movement. Knowing the time of release and recapture for recovered crabs--and the approximate distance of travel--allows an estimate of movement speed. Using only the earliest recoveries allows estimates of maximum speed.

Of crabs that traveled 16 to 24 km., the daily travel for the 100 earliest returns averaged 2.9 km. and ranged from 1.7 to 12.1 km. Four crabs averaged 8 km. per day. For travel greater than 24 km., we determined speed from the first recoveries at various distances from the release site. The most rapid movement was 11.6 km./day by a crab that traveled 314 km. (table 3).

Table 3 - Time-distance relationship for 8 blue crabs, Callinectes sapidus

Time out	Distance moved	Kilometers per day
Days	Kilometers	
4	32	8.0
5	40	8.0
33	80	2.4
31	105	3.4
34	121	3.5
39	137	3.5
42	153	3.6
27	314	11.6

LONGEVITY

Only 1.5% of the females (79 crabs) and 1.1% of the males (16 crabs) were recovered after 1 year at liberty. Eight of the females and three males were recaptured after 2, but less than 3, years. Greatest liberty periods were 940 and 1,058 days for recaptured females, and 540 and 769 days for males. These were all caught within 24 km. of their release sites.

CONCLUSIONS

In North Carolina, after the waters have warmed and during warm weather, female crabs move to high salinity for the purpose of spawning and hatching their eggs (Dudley and Judy, unpublished data). In late fall and winter, females move back into the estuaries. Only a few male crabs move from the rivers and sounds into the ocean. There was some movement by both male and female crabs between rivers and sounds; but males were less active than females and tended to remain in the area where they were tagged. Coastwise movement, mostly by females, was usually less than 80 km. and was generally south.

Commercial-size blue crabs in North Carolina do not engage in migrations that would make them available to a succession of fisheries along the coast. Thus, in North Carolina, the commercial fishery for blue crabs in any estuarine system is dependent on the number of crabs which reach maturity within that system. The population of blue crabs in one estuary, however, may be influenced by what happens in another estuary. Blue-crab larvae hatch and develop in the ocean and can be transported long distances from their point of origin (Nichols and Keney, 1963). So, even though the adults do not move up and down the coast, there is probably an interchange between estuaries as the result of larval transport.

LITERATURE CITED

CARGO, DAVID G.
1958. The migration of adult female blue crabs, Callinectes sapidus Rathbun, in Chincoteague Bay and adjacent waters. J. Mar. Res. 16(3): 180-191.

CHURCHILL, E. P., Jr.
1919. Life history of the blue crab. Bull. Bur. Fish. 36: 91-128.

CRONIN, L. EUGENE
1954. Blue crab studies. In Bien. Rep. 1953 and 1954, Mar. Lab., Dep. Biol. Sci., Univ. Del., Publ. 2: 65-70.

DARNELL, REZNEAT M.
1959. Studies of the life history of the blue crab (Callinectes sapidus Rathbun) in Louisiana waters. Trans. Amer. Fish. Soc. 88(4): 294-304.

DAUGHERTY, F. M., Jr.
1952. The blue crab investigation, 1949-50. Tex. J. Sci. 4(1): 77-84.

DUDLEY, DONNIE L., and MAYO H. JUDY
Unpublished Data. Occurrence of larval, juvenile, and mature crabs in the vicinity of Beaufort Inlet, N.C.

FIEDLER, R. H.
1930. Solving the question of crab migrations. Fish. Gaz. 47(6): 18-21.

FISCHLER, KENNETH J., and CHARLES H. WALBURG
1962. Blue crab movement in coastal South Carolina, 1958-59. Trans. Amer. Fish. Soc. 91(3): 275-278.

NICHOLS, PAUL R., and PEGGY M. KENEY
1963. Crab larvae (Callinectes) in plankton collections from cruises of M/V Theodore N. Gill, South Atlantic coast of the United States, 1953-54. U.S. Fish and Wildl. Serv., Spec. Sci. Rep. Fish. 448, iii + 14 pp.

PORTER, HUGH J.
1956. Delaware blue crab. Estuarine Bull. Univ. Del. Mar. Lab., 2(2): 3-5.

ROUNSEFELL, GEORGE A., and W. HARRY EVERHART
1953. Fishery science; its methods and applications. John Wiley and Sons, Inc., New York. 444 pp.

TAGATZ, MARLIN E.
1965. The fishery for blue crabs in the St. Johns River, Florida, with special reference to fluctuation in yield between 1961 and 1962. U.S. Fish & Wildl. Serv., Spec. Sci. Rep. Fish. 501, iii + 11 pp.

1968. Biology of the blue crab, Callinectes sapidus Rathbun, in the St. Johns River, Fla. U.S. Fish. and Wildl. Serv., Fish. Bull., vol. 67, No. 1, pp. 17-33.

TRUITT, R. V.
1939. The blue crab. In Our Water Resources and their conservation. Chesapeake Biol. Lab., Contrib. 27: 10-38.

VAN ENGEL, W. A.
1958. The blue crab and its fishery in Chesapeake Bay. Part I - Reproduction, early development, growth, and migration. Com. Fish. Rev. 20(6): 6-17.

ROY I. JACKSON

FAO'S JACKSON VIEWS FOOD NEED AGAINST PLANET'S 'LIFE-CARRYING CAPACITY'

Roy I. Jackson, Assistant Director-General (Fisheries), Food and Agriculture Organization (FAO) of the United Nations, looked at the future of world fisheries in the decades ahead against the background of "increasing world population and deteriorating aquatic environment" and saw both problems and hope--"if we behave rationally."

Mr. Jackson was keynote speaker at centennial celebration of American Fisheries Society in New York City on Sept. 14, 1970.

World population is doubling every 37 years, he said. If current rates of increase continue to apply, 3.7 billion population today will reach 29 billions in 100 years.

Industrial development--with its alteration of environment, pollution, and consumption of resources--increases exponentially in relation to population growth. Most of this development is profitable by conventional economic standards, but it often overlooks social costs and leads to uses that would deny the earth to future generations.

Jackson said: "Aquatic environments, communities, and species, once lost, are nonrenewable resources. To keep fish stocks and other living aquatic resources as renewable resources may require that fishery biologists become true guardians of the waters."

Estimates of Future Fishery Production

Estimates of future production from world fisheries range from values already exceeded to values 30 times the present catch. Estimates for FAO's Indicative World Plan indicate possible annual catches of 140 million metric tons before the year 2000. About 100 million tons of these would come from marine species such as those fished today. The balance would come from freshwater fisheries, fish and shellfish culture, and species unused or underused today. Developments of aquaculture and fisheries on new species could increase the estimates several times. "The need for research and management will become increasingly acute as fisheries continue to develop," Jackson emphasized.

Difficult Period Ahead

"The total picture of world problems is obscure and somewhat grim. But there are reasons to take heart," said Jackson. The population problem is at least recognized. In highly developed countries, environment has the limelight. "Famine is not necessarily imminent. The world food supply, which includes fish protein, can be adequate in the decades immediately ahead." But to have supply produced where it is needed most will require changes in traditional social and economic practices.

Jackson concluded: "We have a formidable and exciting task in implementing our concern for the future. We must remain aware that even a century is too little foresight. The truly long-term life-carrying capacity of the planet must be our most vital concern."

ROY JACKSON'S SPEECH

Mr. Jackson's speech was titled: "Famine and the World Fisheries." Nearly all of it follows.

In the century just past we humans have changed our numbers, our way of living, and our environment faster than in any comparable period of history. The rate of change continues to accelerate. Our fisheries problems are sometimes regarded as minor among growing world concerns. But they are ecological concerns, and are part of what Garrett Hardin calls "the tragedy of the commons". The commons is the earth, and the essence of the tragedy resides in the remorseless consequences of not obeying Nature: the ever-expanding world population, accumulation of its wastes, and disruptions from expanding technology.

Nature and man's fate are inseparable, and future fishing cannot be evaluated apart from the world of men or from the environment. We must estimate how many people may exist in the future. It is imperative that we recognize that both the quality of human existence and the quality of the environment in which fish live will be determined largely by what we humans do to the total environment. We must determine how much food, particularly animal protein, the future population will require, and consider possible new foods. We can make informed guesses about the sizes and kinds of future catches and which sea and freshwater area will produce them. None of us believes any longer, if any of us ever did, that aquatic resources are limitless. ...

The Future Population

Today we are 3.7 billions. Many of us have lived through one doubling of the world's population and many of us will live through a second--in 37 years. (Based on the UN medium assumption for population growth rates.)

There are enormous differences in population distribution by countries and by regions. Today 28% live in the so-called "developed regions", which include Europe, the Soviet Union, North America, Oceania, and Japan; and 72% live in the so-called "developing regions", which include the Far East (excluding Japan), the Near East, Africa, and Latin America.

Undoubtedly these differences will be aggravated. Some countries will be less interested or less successful in limiting their populations. If present regional trends continue for the next 100 years, 10 per cent will inhabit the developed countries and 90 per cent the developing regions.

The demographers' predictions that I have seen stop at the year 2030, because unknown changes in the rate of increase are expected. If intrinsically desirable progress in health and social justice continues, the population could, for a time, become even larger than present trends indicate. But rates of population growth will eventually decrease. Wars, disease and famine will reduce survival in proportion to our failure to limit births. This aspect of the tragedy of the commons has no purely technical solution.

The Future Environment

Our multiplying population and advancing technology combine to make us the most influential part of the earth's ecosystem. We are responsible for the most precipitous changes, both damaging and beneficial. Peoples of advancing cultures have always prided themselves in being "conquerors of nature". We have been paramount among them, and we are increasingly prodigious consumers as well.

I use the word "consumers" advisedly, because it is as consumers of natural resources, renewable and nonrenewable, that we must see ourselves. On the average, with massive inequalities, we enjoy higher standards of nutrition, health, and shelter than society has ever known. To acquire these essentials--and many nonessential amenities--for our greatly increased numbers we are increasing greatly our per-capita consumption of the resources of the earth that are essential for our life processes.

We know that every stock, every living population, if its numbers are to be sustained, must come into balance with its environment and its food supplies. As we now live, our renewable living resources depend on nonrenewable natural resources: oil, coal, other minerals, environments, and ecosystems. Since they include self-reproducing organisms, ecosystems are not customarily listed among nonrenewable resources. But once destroyed, their former structure cannot be reconstituted. The supply of all these nonrenewable resources, including conventional energy sources, is limited. All the food that is produced or caught or distributed by modern methods costs a great deal in energy, whether this be used to make steel, or to fuel chemical fertilizer plants, tractors or fishing boats. Therefore, we must be aware of the eventual consequences that can come from exercizing our clear capability of looting the commons.

We create wastes in proportion to our use of resources. Wastes that are not neutralized, stored, or put to beneficial use become pollutants. The quantities and varieties of pollutants increase exponentially in relation to our population growth. In the United States the rate of increase of industrial wastes is three times as high as the rate of population increase. And in the U.S. today there is three times as much industrial pollution as domestic pollution.

The waters where our inland fisheries and the artificial culture of fishes take place are highly sensitive to pollutants. Our coastal fisheries are in zones that are first to be affected by the outpourings from the land. The Federal Water Quality Administration lists five major kinds of pollution in coastal areas: bacterial contamination; decomposable organic materials that deplete dissolved oxygen; pesticides, herbicides, and toxic wastes from chemical manufacturing; materials that act as fertilizers for some life forms at the expense of others; and inert materials that fill invaluable estuarine areas and smother benthic life forms.

To this list we can add thermal pollution, oil spillages, and, for heightened drama, dumpings of leftover mustard gas in the Baltic and nerve gas in the Atlantic. Even what we cast into the air finds its way into the sea.

We know that the blight is broad and spreading. The historic Rhine has been an historic sewer for a long time. The deeper layers of the Baltic have much less oxygen and much more phosphorus than at the beginning of the century. The Soviet Union, in spite of its vast area and centralized authority, finds that its rivers, lakes and coastal waters are rapidly deteriorating. More examples, of varying scope, can be found in every continent and on most inhabited islands of the world.

In his keynote address to the 93rd Annual Meeting of the American Fisheries Society, Justin W. Leonard spoke of the "ecological illiterate", those who plan and operate our technological society but think that food comes from the supermarket and water from the tap. Seven years ago he said, "ecology and natural history have become old-hat. They aren't quite respectable anymore". Times have changed again. Everywhere we hear loud alarms, read passionate convictions, and see action to protect or restore the quality of our environment.

But there is still a danger that the subject can become old-hat again if we let up on either investigating or publicizing the continuing issue. We must continue to examine and report the more obvious effects of pollution. But as specialists we should continue to uncover and relate the less obvious effects of conflicting uses of water as well.

The effects of altered water flow regimes on snails can be taken as examples. In the Potomac River the oyster drill, a snail, is killed each year during spring freshets. This permits an extension of oyster culture up the estuary. Proposed dams on the Potomac will regulate spring flows, the drills will not die, and fewer oysters will live to be eaten by man. In the Nile River region perennial irrigation replaces seasonal flooding. This also favours increases in a snail, the intermediate host of a parasitic worm. The worm causes extremely debilitating schistosomiasis disease in man. In Upper Egypt the new Aswan High Dam development may increase the intensity of infestation. At the same time it may seriously reduce the Eastern Mediterranean sardine fishery while providing an impoundment for freshwater fish.

In the case of the Nile, man faces the immediate problem of evaluating whether the increased electrical power and starch and freshwater protein are worth the increased disease and decreased marine protein. A less immediate but perhaps more important problem is whether the impoundment behind the dam, which has a lifetime probably measurable in decades, has a long-term value equivalent to the marine environment that will be affected.

An economist might calculate, by using widely accepted economic value criteria, that the most profitable use of the Nile can be obtained by damming it, and that the most profitable use of the Rhine is as a sewer. Also some apparently calculate that the most profitable way to obtain oil from Saudi Arabia is to first flame off the natural gas and add a bit more carbon dioxide to the already overburdened atmosphere. I disagree with most conventional profit valuations. They include private costs but overlook social costs, and lead to uses that would deny the earth to our generations of progeny.

Besides the continued expansion of present multiple uses of water, we can expect more kinds of uses, especially in the ocean. The ocean floor is criss-crossed with cables, and pipelines are following suit. Oil derricks now line the horizon in many nearshore areas, and underwater oil storage tanks may become common. Mining from the sea floor will certainly increase. Except that boats must dodge and gear may foul, these physical structures and activities do not conflict greatly with fishing. Accidental release of oil from wells, huge tanks, or pipelines, however, could cause much pollution. Other uses of the sea might, for example, require diversion of currents to change weather patterns. This kind of activity should be approached very cautiously. It could, in some ways, be very useful to terrestrial man while very harmful to aquatic systems.

The Future Fisheries

The fisheries can do much to help meet the continuously increasing demands for food. Estimates indicate that the world catch of fish today could supply about 70% of the animal protein requirement of the present population. This figure is subject to many qualifications, and it should not be interpreted to mean that fish does supply that much of human needs. More than half of it is consumed by livestock, and the world distribution is very uneven. But it shows how important fish protein could be in the world diet.

The record of the past quarter-century is encouraging for the decades immediately ahead. Since 1946, catches have increased about 6% per year--considerably faster than the world population--to reach a total of 64 million metric tons in 1968. . .Of this total, about 7 million tons came from fresh water. Forty-one per cent of the marine fish catch is taken in the Atlantic, 55% in the Pacific, and only 4% in the Indian Ocean. Divided another way, 54% is taken in north temperate waters, 29% in south temperate waters, and 17% in tropical waters. The north-south division shows the great expansion of fishing beyond the northern waters, where 73% of the total was taken 10 years before (1958). . . .

A detailed estimate of the potential was completed by FAO this year as part of the Indicative World Plan for Agricultural Development. The FAO study produced several figures for the world aquatic potential, because much depends on what is included in the potential. The largest possible harvest source is the plants of the sea--plus freshwater fisheries. . . .Ocean plant production is fairly generally agreed to be in the range of 150-200 billion tons per year. Man's annual harvest could approach this production if it were technically feasible to catch and process the very small plants and animals at an economic cost. Although the technological and economic possibilities for the year 2070 are not predictable, no method for economically harvesting or using a significant proportion of this material is even conceivable at present.

The FAO study succeeded in making estimates for nearly all those animals that now support major fisheries: whales, large pelagic fishes (tunas, bill-fishes), medium to large demersal fishes (cods, flounders, seabreams, etc.), and shoaling pelagic fishes. Under ideal conditions of exploitation, these together could provide catches of about 100 million tons. But the limit of the "traditional" ocean fish (excluding squid and other molluscs) is likely to be reached in the 1970s. Even this may be optimistic, because it would require that we obtain the maximum catch from all stocks. Preliminary figures suggest that the 1969 world fish catch was somewhat less than that of 1968--the first decline since FAO started collecting comprehensive world statistics nearly a quarter of a century ago.

The familiar types of crustaceans (shrimp, rock lobsters) could provide somewhat over 2 million tons per year. Large quantities (1.2 million tons in 1968) of squid, cuttle fish, and octopus are being caught. No estimates could be made of their potential, but since various species of squid are found commonly in all parts of the ocean, their potential must be large.

No projected estimate was made for the other molluscs (clams, oysters, mussels) of which the 1968 world harvest was 2.2 million tons, because the possibilities for increased harvest come more from cultivation than from natural production.

Finally, estimates of potential catches from the sea must include the smaller but exceedingly abundant animals, such as the krill (euphausids) of the Antarctic and the lantern fish (myctophids). At present it is not possible, to my knowledge, to harvest these economically, though the Soviet Union seems close to using krill on a commercial scale. The potential of these small animals is vast--probably several times the present world catch of all fishes.

The yield of freshwater fisheries for 1968 was 7.4 million tons, about 11.5% of the total world production. This excludes the very large subsistence and sport fisheries, estimated to be at least half as large as the recorded commercial catch. Inland fisheries could provide much more food than they do now. Their future depends largely on the prevention of further deterioration in water quality, and on the improvement of those waters that are already despoiled. On the brave assumption that this will be done, let us consider the future production of fish from fresh water.

The catch from large inland lakes and rivers probably could be doubled, but the major increase from lakes and reservoirs will come from smaller bodies of water where management techniques can be applied. In these waters up to five times the present catches seems possible. But controlled culture is our greatest opportunity for increasing fish production. The larger lakes produce about 5 kg/ha. (a hectare, ha., is 2.471 acres); the smaller lakes produce up to 150 kg/ha. Managed ponds in tropical and subtropical areas commonly produce 1,500 to 2,000 kg/ha., and under very intensive management 6,000 to 7,000 kg/ha.

Generally fish are fed supplemental materials that are not now consumed by humans, and some convert vegetable proteins into animal protein, including all ten essential amino-acids, very efficiently. For example, some work in the United States has shown that channel catfish have a feed conversion of 1.3 (that is, it takes only 1.3 pounds of feed to produce 1 pound of flesh). By contrast, beef cattle have a feed conversion of about 16.

The Lines of Action

Our action must be fundamental. To deal with effects without also dealing with causes is inadequate and superficial. What M. King Hubbert has written applies to fishermen as to all men. As he sees human history, the period of rapid population and industrial growth that has prevailed during the last few centuries is an abnormal, brief, transitional episode. He foresees a period of non-growth that will pose no insuperable physical or biological problems but that will entail a fundamental revision of our current economic and social thinking.

Future non-growth of the human population is a certainty. When this will occur, at what maximum number, and through what mechanisms--barring natural catastrophe--depends entirely on us humans. This is not just a problem for Asians, Africans, or Latin Americans. It must be faced by every one of us in our own neighbourhood.

In many of our activities, we, the technologically developed cultures in particular, follow the archaic approach to the problem of the commons, that of free and unlimited access. If this approach is justifiable at all, it is justifiable only under conditions of low population density. As the human population has increased the commons has had to be abandoned in one aspect after another. Traditionally we have treated the air we breathe and the waters of the earth, along with their inhabitants, as commons. This is changing, and it must change more radically, and soon.

Properly oriented changes can only occur where there are perceptive and knowledgeable persons to show the way, to monitor, and to be watchdogs. Most natural history movements have addressed themselves to terrestrial communities; there has been a dearth of guardians of the waters. Meanwhile we fishery biologists have to a large extent allied ourselves with conventional exploitive processes. Even personally we have not been sufficiently appalled by the demise of environments and the extinction of aquatic species and communities.

Within the framework of the problems we must face as citzens of the world and as general watchers of the waters there are particular fisheries problems that we must face as fisheries scientists and administrators. The pressing problems of the world fisheries, at least for the early part of the coming century, are three:

(1) to manage the limited resources of "traditional" fisheries in the most effective way;

(2) to develop fisheries on the large resources of less familiar animals;

(3) to increase cultivation, especially of species (for example some molluscs and freshwater fish) that feed directly on plants.

We must be particularly concerned with proper management. The past record of management shows the effects of our reluctance to abandon the commons with respect to fisheries. On the high seas, the Antarctic whales were rescued on the limit of commercial extinction--possibly absolute extinction of blue whales. Where only one country is concerned the record often is not much better--the California sardine is an example. But there have been successes; effective conservation of the whales in the Antarctic is beginning, and fishing is controlled in several major fisheries.

Future Management of Fisheries

Three forms of jurisdiction have been proposed for future management: wide extensions of fishing limits, to place most fish stocks under national jurisdiction; direct international, United Nations, control of high seas resources; and expansion of the present pattern of regional international fishery bodies and commissions. . .

Management must start with control of the individual fisherman. We generally assume that anyone should be free to fish on the high seas, or any national within his own territorial waters, so long as he does not use obviously damaging methods like poisons, explosives, or devices that catch immature fish. Fishing is constrained by restricting the effectiveness of each fisherman--by explicitly prohibiting the most effective gear, or by closing areas or seasons.

The traditional assumption, that fishing is free to all, is unrealistic and has led to inefficient resource management. Each fish stock is limited. If it is accepted that fishing is a privilege, not a right, then one likely method of controlling excess fishing is to charge for this privilege. This control could be accomplished if the payment, license fee, were in proportion to the privilege conferred. In several major fisheries, for example Pacific salmon, the gross value of the catch greatly exceeds the basic cost of harvest--sometimes several fold. There the right to fish with the most efficient gear might be worth up to 80% of the gross value of the catch.

Who gets this license fee is a matter of jurisdiction. Inshore it could clearly go to the coastal state, offshore it might, under one scheme, go to the proposed international agency.

If we optimistically assume that improved management practices are instituted, it is possible to visualize the ocean fisheries of the early twenty-first century. On the fishing grounds that are familiar today--the Grand Banks of Newfoundland, the anchovy fishery off Peru--the fishing vessels will be fewer. They will be helped by a flow of information on the distribution of fish, and on weather and water conditions from satellites and buoys. These vessels will make large catches and pay substantial license fees. Some of these fees will be used to provide the satellites and other information systems, and the scientific research on which the management is based.

The other major sea fisheries, dominant in weight but probably not monetary value, will be in the Antarctic on krill, and along the major upwelling systems on the small lantern fish and other animals. By harvesting the traditional stocks efficiently, it would become possible for men and vessels to be diverted to these less familiar stocks as well as to stocks like squid and whiting that are not being used to the extent they might be.

Technology's Role

The development of the technology to harvest and use the less familiar fish will demand initially the resources of the richer developed countries, and will at first be of less concern to the developing countries, for whom FAO has a special responsibility. But there are already shifts in emphasis and interest in fisheries from the highly developed countries to the intermediate nations. Because labour costs are less and other economic opportunities are fewer, the new fisheries are likely to be developed and used by developing countries in the long run. This is probably economically desirable for the world as a whole.

Fish flesh contributes about 11% of the animal protein now consumed by man. This percentage should increase considerably in the future. In order to do this we must develop more efficient catching methods and provide adequate transport and processing, especially in the developing countries. For example, the control of insect infestation of fish products in Africa could double the amount of fish reaching consumers. Above all we must alter our eating habits. Thousands of tons of good protein are unused because even people who do not already have adequate protein in their diets refuse to eat all but a few traditional species.

Controlled culture of marine and freshwater species is a great opportunity for increasing production. By using techniques such as the raft method developed for mussels in Spain, the possibilities for shell fish seem very large. Running freshwater cultures are highly efficient in converting fish food to human food. We must develop and apply these techniques to commercial production. Controlled culture is limited by economic considerations rather than natural productivity, at least until we run short of nonrenewable resources.

Some Hopeful Signs

I have said earlier that the total picture of world problems is obscure and may be short on hope. But there are some developments from which we can take heart. The population problem is at least recognized as the central theme of the tragedy of the commons. And in highly developed countries the environment has the limelight. There is action as well as talk.

National and international actions are having some positive effects on fisheries management, and initiatives that affect fisheries resources have multiplied in recent years and even months. The President of the United States has proposed fundamental changes in the agencies that deal with environmental problems, including fisheries research and administration. Pacem in Maribus, the convocation on the oceans, held at Malta in June 1970 highlighted the growing competence of the world to exploit the oceans' resources. The need to strengthen present measures and introduce new ones to preserve renewable resources and make beneficial and equitable use of the others was clearly expressed. We in FAO are striving to strengthen the growing network of regional international fishery bodies. A third Conference on the Law of the Sea is expected to be held soon. Many other important initiatives could be added to this short list. A great value of the exploited ocean may be that it will encourage nations to regard one another as partners in world progress.

About "Famine and the World Fisheries" we can conclude that famine is not necessarily imminent. The Second World Food Congress, held in June 1970, in The Hague under FAO auspices, concluded that world food supplies can be adequate in the decades immediately ahead. Animal protein, which includes fish, is an essential part of this food supply. It is both humane and very pragmatic that we increase production and that it ends up--preferably is produced--where it is needed most. This will require some changes in traditional economic practices, and it will certainly require that we eschew the disruptions of warfare, which bring famine and disease faster than any other human activity.

New Protein Sources

Whatever its portents for the far future, carefully applied technology is needed to grow or catch the foods that the growing population will require. In addition it could provide some new sources. Scientists apparently have isolated bacteria that require only methane to multiply. The bacteria are 50% protein. In Britain a plant is being built to produce 60,000 tons of protein per year, and a hydrocarbon-based yeast factory to produce 4,000 tons per year is due to be finished in 1970. An American scientist states that in less than 10 years it will be possible to produce protein artificially from petroleum in unlimited quantities. These developments could become important in providing protein, so long as the limited supply of fossil fuel lasts.

This is my view of the near future. But to conserve nonrenewable resources and preserve the environment for ourselves and the renewable resources in the increasingly crowded and technically complicated world of the next 100 years will be a formidable as well as exciting job. Fisheries workers must shoulder much of the aquatic part of that job. If we do not, who will? And we must remain aware that even a century is too little foresight. The truly long-term life-carrying capacity of the planet must be our most vital concern. There is still time to implement this concern, and fortunately Nature eventually corrects many of our mistakes--if we behave rationally.

FERRO-CEMENT FISHING BOATS DELIVERED TO FAO

Two ferro-cement fishing boats have been delivered to FAO for work in the United Arab Republic (Egypt).

The boats will be used in Lake Nasser to demonstrate new fishing techniques, and as prototypes for similar craft. The 5-year, $2,684,000 project is being financed under the UN Development Program with matching contributions by Egypt.

A Nervi Production

The vessels, designed specially for use in Egypt, were built in Rome to FAO specifications by Nervi and Bartoli. Pier Luigi Nervi is a pioneer in reinforced concrete. His firm built sports stadia and arenas in Rome for the 1960 Olympics, and a bus terminal in New York.

Ferro-Cement

Except for wooden flooring inside the hulls, the boats are entirely of ferro-cement, a process developed by Prof. Nervi over 25 years ago. Steel rods and wire mesh are shaped into the form of a hull and plastered over with fresh cement. When dry, the whole is as sturdy and seaworthy as wood or steel.

Ferro-cement differs from reinforced concrete in making greater proportional use of steel over cement. It produces suprisingly thin and light hulls. The hull of the smaller FAO boat is only 2.2 centimeters ($\frac{7}{8}$ inch) thick, the larger 2.5 centimeters (1 inch).

The boats underwent preliminary tests by FAO technicians at Fiumicino, near Rome, and were pronounced ready. They will be shipped by freighter from Naples to Alexandria, UAR, cradled one within the other, then transshipped to Aswan on Lake Nasser, created by damming the Nile.

The Craft

The two craft are completely open and undecked. The larger is 10 meters by 3.06 meters (32 feet, 8 inches by 10 feet), weighs 5.1 tons and has 5-ton carrying capacity. It is powered by a 15-HP Petter inboard air-cooled Diesel engine for a rated speed of 6.5 knots.

The smaller craft measures 7.50 by 2.38 meters (24 feet, 7 inches by 7 feet, 10 inches), weighs 2.8 tons, and has a 2-ton carrying capacity. It is powered by a 7.5 HP Petter inboard air-cooled Diesel for a rated speed of 6 knots.

The two boats were designed by Øvind Gulbrandsen and Arne Fredrik Haug of Norway, naval architects in FAO's Fishing Vessel Section.

Nervi Cites Advantages

Prof. Nervi foresees a growing future for cement that floats. The 80-year-old architect and engineer said the process was especially suited to fishing because of its extreme strength and imperviousness to water.

He noted: "There is no danger of warping, rotting, rusting or water-logging. A hundred years from now these boats will be as dry as they are today. As for sturdiness, the hulls are a complete, monolithic whole. If you strike them they resound like a bell would. Stresses and strains are spread evenly throughout. And they are resistant to fire and marine growths."

Prof. Nervi added that a yawl he built in 1948 was afloat and well at Anzio, south of Rome.

Watzinger Agrees

Herman Watzinger of Norway, Director of the Fishery Industries Division, said ferro-cement is competitive with other materials, especially in wood-scarce countries like Egypt. He emphasized:

"Ferro-cement boats are quite simple to build and maintain, and repairs are easy to make. They are not prey to marine borers, which makes them ideal for use in tropical climates. Hulls can be perfectly finished so that they are virtually indistinguishable from other materials."

Teaching at Lake Nasser

At Lake Nasser, an FAO boat-builder, Michael A. Shawyer of the United Kingdom, will teach local builders how to construct boats in ferro-cement. He was trained in ferro-cement by Nervi earlier this year. Another Nervi-trained FAO boat-builder, Richard G. Lefebre of Canada, now is teaching ferro-cement construction in Dahomey under FAO Freedom from Hunger Campaign.

Fig. 1 - The two ferro-cement boats at Fiumicino, Rome.

Fig. 2 - Plastering a ferro-cement boat hull. To assure good penetration, the mortar is applied from inside, forced through reinforcement, and smoothed on outside. (FAO photos)

CANADA & SCANDINAVIA DISCUSS FROZEN GROUNDFISH BLOCKS

Representatives of the 4 principal suppliers of frozen cod blocks to the U.S. (Canada, Iceland, Denmark, Norway) met in Copenhagen Oct. 2 to discuss the market and outlook. They noted substantial market improvement and reaffirmed domestic policies for maintaining a stable world market.

1970 Production Steady

They also noted that present stocks remain low and demand continues to increase. The 1970 production has remained nearly constant compared to 1969, so the market has firmed. Seasonal factors normally contribute to market strengthening at this time of year. A Canadian stabilization program has been in use during 1970, but market conditions have required no price support purchases. (Reg. Fish. Att., U.S. Embassy, Copenhagen, Oct. 6.)

CANADA-USSR DRAFT AGREEMENT ON PACIFIC COAST FISHERIES

Under a proposed 2-year agreement, the Soviet fishing fleet will move off the Big Bank area of the continental shelf on Vancouver Island's west coast in return for port privileges and a fishing area inside the territorial boundary off Queen Charlotte Islands, but outside the continental shelf.

Canadian Fisheries and Forestry Minister Jack Davis said on Oct. 21, 1970, that draft versions of the proposed 2-year agreement would be completed in Moscow at an early date.

The agreement followed 4 weeks of negotiations in Ottawa. Representatives of all west coast fishing groups were present as advisers and observers. They approved draft agreement.

Main Provisions of Agreement

Davis said the Soviet fleet voluntarily will give up fishing on Big Bank, where heavy runs of salmon and herring occur. In return, they will be permitted to fish in an area of comparable size within the 12-mile limit off Queen Charlotte Islands. Canadians have never fished this area to any extent.

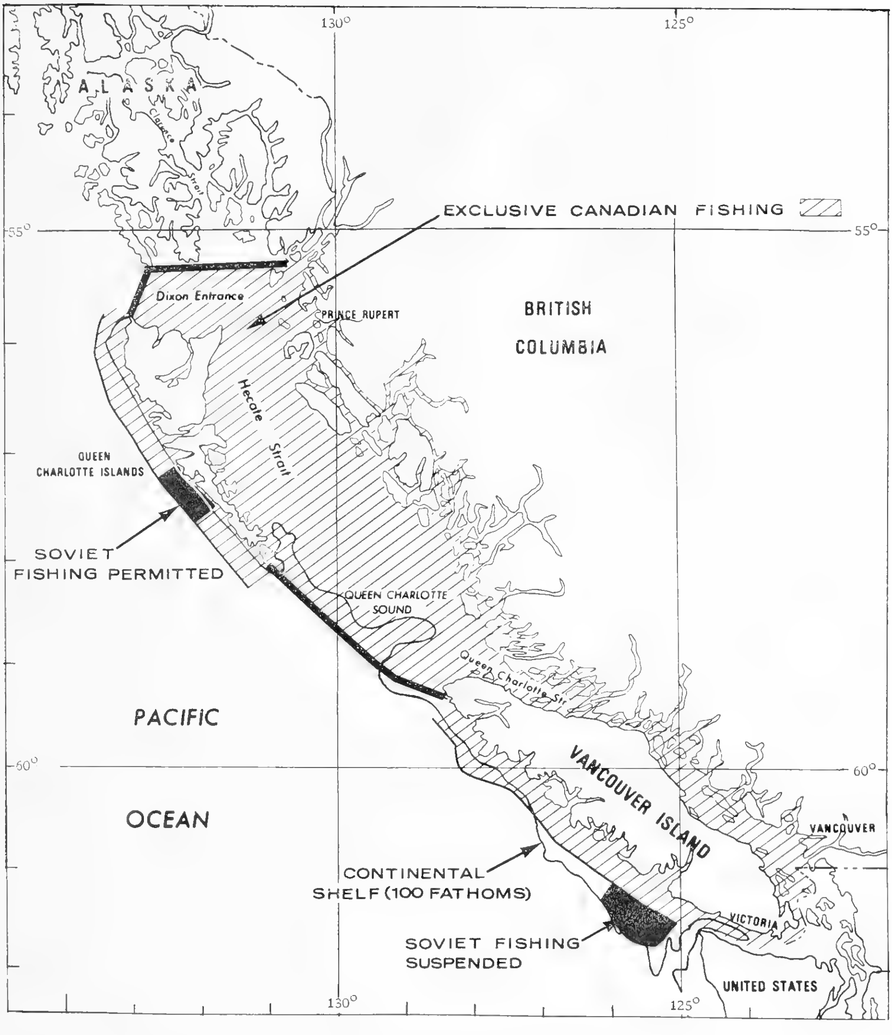
The most important advantage given to the Soviet fleet is the reopening of Vancouver port to their supply ships. This privilege was removed in March 1970. The USSR later asked for a conference to discuss this point.

Exchange of Research Information

Mr. Davis said the Soviet delegation was interested in exchanging research information. This will be done under the proposed agreement. Studies of stocks that range beyond British Columbia coastal waters will be emphasized.

After a series of collisions between Soviet trawlers and Canadian salmon trollers in July 1970, Canada protested sharply to Soviet authorities. They agreed to add this subject to their discussions.

(See following page for map.)



130°
125°
ALASKA
Clarence Strait
EXCLUSIVE CANADIAN FISHING
55°
55°
Dixon Entrance
PRINCE RUPERT
BRITISH
COLUMBIA
Hecate Strait
QUEEN
CHARLOTTE ISLANDS
SOVIET
FISHING PERMITTED
QUEEN CHARLOTTE
SOUND
Queen Charlotte Str.
PACIFIC
60°
60°
OCEAN
VANCOUVER ISLAND
VANCOUVER
CONTINENTAL
SHELF (100 FATHOMS)
VICTORIA
SOVIET FISHING
SUSPENDED
UNITED STATES
130°
125°

WORLD OIL EXPORTS EXPECTED TO RECOVER

Marine oil exports were expected to recover slightly in last-quarter 1970. The increase would reflect larger exports of fish body and liver oils, mainly anchovy oil from Peru. This was the prediction of the U.S. Department of Agriculture in September 1970.

Edible marine-oil exports in 1970 are estimated to be a reduced percentage of total exports of edible oils and fats--only 6.7% against 7.5% in 1969, and 8.4% in 1968. Therefore, the pressure from larger marine oil exports, which peaked in 1968, has diminished sharply since then.

Fish Oil Availability

The net availability of fish oil for export in 1970 is expected to recover, but it will be significantly below 1968 record. The anticipated increase in Peru, South Africa, and Denmark should more than offset declines in U.S., Norway, and Iceland.

Latest trade data show aggregate exports from selected producer-exporter countries (Peru, Norway, Iceland, Denmark, and the U.S.) in first-half 1970 totaled 275,000 short tons--more than 3% above 1969 period. Increased exports from Peru accounted for virtually all the net increase.

Fish-oil stocks in bonded warehouses in Rotterdam on Sept. 1 were 45,400 tons, compared with only 17,400 tons on July 1. Despite increase in recent months, total is less than half the large quantity of a year ago.

World Market Strong

The strength of world market for fats and oils in 1970 has reversed price relationship between meal and oil. Oil has become higher priced than meal. This fundamental change should be remembered when projecting export availabilities because high oil prices could help improve oil-extraction rates.

In recent years, fish-oil production has increased relative to fish-meal production. This trend reflects improved recovery equipment and the species caught because oil content varies widely.

Fish-Reduction Industry Expands

Expansion in the fish-reduction industry in recent years has depended largely on catching more fish. Improved fish-finding and catching equipment are likely to facilitate more expansion, but more emphasis on increasing efficiency and productivity is expected. Reportedly, many reduction plants in Peru are not yet equipped to utilize fully modern processing technology--such as "stickwater" plants, which recover products that otherwise would be lost.

Together, Japan, the Soviet Union, and Norway account for about 90% of world output.

Whale Oil Exports Drop

World exports of whale oil declined sharply in recent years to about 30,000 tons because of depleted whale stocks. Output now appears stabilized at roughly 90,000 tons, or just over one-fifth the 1960 volume.

Unless Japan retains less oil because of high oil prices, exports are not likely to change significantly. Whale oil prices in August 1970 of about 11.7 cents per pound were 72% above prices a year ago. Rotterdam stocks of 13,700 tons on Sept. 1 were only slightly below those of a year earlier.

Baleen Whale Oil

The bulk of baleen whale oil is from Antarctic pelagic catch. The 1970 and 1971 Antarctic whaling quota remains unchanged at 2,700 blue-whale units (BWU)--about 56,000 tons of oil. Last season, the catch totaled only 2,471 BWU because Norway did not participate.

Sperm Whale Oil

Exports of sperm whale oil are not expected to change appreciably this year from 1969's 105,000 tons. Soviet exports have trended upward over past decade, about in line with output. Roughly two-thirds the Soviet output is exported. Exports by other countries, largely Japan, have dropped sharply. This reflected reduced output.

U.S. Ends Sperm & Baleen Imports

On Aug. 3, 1970, the U.S., world's major importer of sperm whale oil, ceased importation of sperm and baleen whale oil except for scientific purposes. This action was taken under Endangered Species Conservation Act of 1969. The act prohibits import, except for science, of wildlife and its products determined to be threatened with worldwide extinction. Revisions of the endangered species list will be based on scientific evidence and conclusions of Scientific Committee of International Whaling Commission.

EUROPE

USSR

STREAMLINES FISHERIES ADMINISTRATION

Soviet Fisheries Minister Ishkov has ordered a reorganization of the 3 Estonian fishery administrations into a single 'Okean'. The 3 are: Refrigerated Fleet, Trawler Fleet, and Production Administration, which coordinates both fleets. Estonia's fishing industry is part of Soviet Main Western Fisheries Administration, ZAPRYBA.

Merger's Benefits

The merger will mean a single budget and plan for Estonian fisheries. It will reduce administrative staff by 15-20% ("shifted to production"), coordinate operations of fishing and transport fleets, vessel maintenance and repairs, and prevent frictions.

Previous Problems

In the past, conflicts among the 3 Estonian Administrations interfered with vessel repairs in port, disrupted unloading, and caused costly and unnecessary demurrage of factory stern trawlers at sea. This was because motherships that had fulfilled their load plan for fish species to be transshipped refused catches even if hold space was available.

Okean's 3-Month Trial

Okean is the first experiment of its kind in Soviet fisheries. After 3 months, by Dec. 1, 1970, recommendations based on results will be made to extend it to other administrations. ('Vodnyi Transport', Sept. 22.)

* * *

FISHERIES BESET WITH VESSEL-REPAIR PROBLEMS

For years, a major problem of the Soviet fishing industry has been organization of efficient dock repair facilities for its huge distant-water fishing fleet. Repair yards are short in all major fishing ports, and bottlenecks ensue. The Ministry of Fisheries has acted to solve the problem.

One way was to institute a 2-year operation cycle without docking for overhauls; current vessel repairs were to be performed by the crews at sea.

Another measure included repairing large-tonnage vessels (mainly 2,300-GRT factory stern trawlers) in docks normally used for smaller vessels.

Problem Unsolved

These measures have not solved the problem. Fleet is still in repair docks for over 100 days a year; and 70 large stern factory trawlers do not sail at all. This is an annual loss of 400,000 metric tons of catch. Repairs of medium trawlers take even longer. Delays lose hundreds of millions of rubles.

Why Delays?

Delays are caused by: (a) shortage of vessel-repair facilities in shipyards; (b) existing facilities are not fully used. Many have 25% of their capacity occupied by "unrelated work."

This "paradoxical" situation is due to fact that vessel repair is not coordinated under single administration. The port of Arkhangel'sk (White Sea), for example, has 4 ship-repair yards; these are under 3 different ministries (one the Fisheries Ministry). This is the case in almost every port. If the vessels to be repaired are from the Ministry running the repair yard, they are placed in dock; if there are no such vessels, the yard does unrelated work rather than repair another Ministry's vessels (though these may be waiting at their "own" overloaded facility).

In the Fisheries Ministry, one-third the repair yards are administered by Central Administration for Fishing Fleet Repairs, and two-thirds by the 5 Main Fishery Administrations.

Centralization Suggested

The Soviet State Planning Commission (GOSPLAN) suggests that all vessel repairs (including fishing vessels) be centralized under the Federal Production Association. GOSPLAN believes this would make possible maximum use of facilities, and application of a unified national repair policy; permit mechanization and automation of repair, drastic reduction of manual labor, elimination of conflicts, and cooperation among yards; and reduce repair time and costs.

* * *

USSR (Contd.):

SCIENTIST DISCOVERS NEW WAY TO IDENTIFY SALMON

A Soviet scientist has discovered a new method of identifying salmon populations during their migration in the ocean.

The scientist, S. Konovalov, works for the Soviet Institute of Marine Biology, Far-Eastern Section of Siberian Branch of Soviet Academy of Sciences.

Scales' Shape & Design Vary

He found that the shape and design of scales of various Pacific salmon species vary greatly under the microscope. He compared the scale design of salmon fished in the ocean with that of salmon in rivers of Kamchatka, Sakhalin, and Maritime Provinces. He determined the population of salmon fished thousands of miles from their "home" river. The characteristic shape and design of scales are retained for life.

The new method of determining salmon migration routes is claimed to be simpler and more efficient than the one based on genetic characteristics. (TASS, Sept. 22.)

* * *

BUILDS 'DOLPHINARIUM' ON BLACK SEA

The Soviets are building an aquarium for dolphins--a 'dolphinarium'--in Batumi on the Black Sea, the USSR's first. It is 30 meters long, 6 meters deep, has a water-filtering system and 2 separate pools where dolphins can be isolated for experiments.

Objectives are to keep dolphins under nearly natural conditions to study their behavior, reactions to various stimuli, and to record and study their "voices" in an attempt to determine how they communicate.

Useful to Commercial Fishing

The studies are important to commercial fishing because many fish are very sensitive to the sounds of dolphins. Using such sounds, fish could be "corralled" into nets or, once inside, could be scared from trawl mouth or purse-seine opening. This would increase gear efficiency and catches.

'Sonar Organ' Study

Most important is the study of a "sonar organ" in dolphins by which they locate their prey. The organ is less sensitive than the seal's, which can locate fish as small as 1 meter at depths to 600 meters, but the dolphin's is likely to have similar wave length.

The 'dolphinarium' will be operative in early 1971. ('Vodnyi Transport')

* * *

SCIENTIST PREDICTS USE OF SPACE STATIONS IN FISHERIES & OCEANOGRAPHY

A Soviet authority on atmospheric research has predicted the use of space stations to measure ocean temperatures, observe the wanderings of the Gulf Stream, watch the movements of large fish concentrations, and to detect evidence that pollution destroys plant life in the oceans. Dr. K. Y. Kondrat'ev, formerly rector of Leningrad University, made these predictions. (N.Y. Times, Oct. 6, 1970.)

Noted It in 1968

Back in Oct. 1968, Kondrat'ev had mentioned in a 'Pravda' article the possibility of using satellites for oceanographic and fishery research. Soviet satellites 'Soyuz' 6, 7, 8, and 9 reportedly studied marine and oceanographic resources.

* * *

"BLACK MARKET" IN FISH PRODUCTS PROSPERS

In Sevastopol and Kerch, on Black Sea, private "merchants" run a prosperous trade in frozen or processed mackerel, herring, silver hake, horse mackerel, even spiny lobster.

Tons of fish are stolen by port workers unloading fishing vessels. Thefts are made easy by lax or nonexistent surveillance and by the absence of a fence in Kerch. The stolen fish are sold by private speculators in local market.

Situation Accepted

This was reported to Deputy Director, Azov-Black Sea Fisheries Administration, and

USSR (Contd.):

director of Kerch Oblast Fisheries Administration. Both accepted facts, voiced concern, but implied that little, if anything, could be done. They conceded that the system of fish delivery and acceptance was defective, but they failed to propose improvements. ('Vodnyi Transport')

In the Soviet Union, all trade is controlled and operated exclusively by the State. So operations of private "merchants" are illegal.

DENMARK

DANES SEEK CONTINUED FISHING PRIVILEGES IN POLISH 12-MILE ZONE

A Danish delegation is negotiating with Polish authorities to obtain permission for Bornholm fishermen to continue fishing up to 3 nautical miles from the Polish coast. In April 1970, Poland established a 3- to 12-mile fishery limit effective January 1971. Denmark is attempting to document the existence of a small Danish fishery for several years.

Sweden Won Privileges

A Swedish delegation recently acquired transitional fishing privileges from Poland. Swedes who fish salmon most of the year off Poland can fish 3 to 6 nautical miles from Polish coast during salmon season. Then they can fish 6 to 12 nautical miles from coast. (Reg. Fish. Att., U.S. Embassy, Copenhagen, Oct. 13.)

NORWAY

CAPELIN FISHERY OFF LABRADOR FOUND UNPROFITABLE

The Norwegian research vessel 'Selvag Senior', which conducted exploratory fishing for capelin off Labrador, returned recently to Bergen with 175 metric tons of capelin. The vessel then delivered the fish to a herring meal factory.

Capelin schools were found on the outside banks, but the catch was so small that the crew had no desire to fish. Tests revealed very small capelin; some went through meshes, while others clung to net walls. The remaining few were 20 large capelin. This raw material is of little use because it contains less oil than large capelin.

The vessel also investigated nearby areas but found considerably smaller schools. She made three tests and caught about 78 tons--considered far from a profitable fishery. (Reg. Fish. Att., Copenhagen, Oct. 8.)

* * *

REPORT ON HERRING & SARDINE PRODUCTION

In recent years, the Iceland herring season opened July 1-10. This year, no date was fixed because no Norwegian vessel planned to fish this herring.

For many years, the fishery was important to the fishing industry. The run has changed. The schools started to move away from Iceland's coastal waters. The fishing moved to waters around Bear Island. In 1969, the herring schools disappeared. Norwegian expeditions filled only about 1% of the planned 250,000 barrels. The complete failure of last year's Iceland herring season discouraged fishing this year.

Substitutes Needed

Faced with complete disappearance of this traditional raw-material source, the canning industry had to look for other types of suitable herring. This work has been successful, but the new herring supplies are much more scattered in time and place.

Summer 1970

In summer, the interest focuses normally on brisling fishery. This past season was characterized by small and scattered catches. The July production was reduced due to summer holidays. The catches barely kept freezing vessels supplied.

The canneries hoped for increased supplies from newly reopened fishing areas. These areas were closed by Norway until brisling met requirements of size and fat content. Up to July 27, the industry had received many fewer brisling than last year. ('Norwegian Canners Export Journal'.)

o o ● o o

ASIA

JAPAN

FISHERIES AGENCY WILL INCREASE SKIPJACK TUNA PROGRAM

The Japanese Fisheries Agency is asking 117 million yen (US$325,000) for its skipjack tuna development program for fiscal year 1971 (Apr. 1971-Mar. 1972). The agency is accelerating its effort to increase production because of growing Japanese demand for higher-priced fish. Skipjack is considered best suited to meet that demand.

Present & Possible Catch

Japan catches annually around 200,000 metric tons of skipjack. The Pacific catch could be increased to 1.5 million tons without creating resource problem. However, a large increase in landings must be based on solving three problems: (1) getting live bait, (2) labor shortage, and (3) expanding markets.

Live Bait Indispensable

(1) Live bait is indispensable in pole-and-line skipjack fishery. One metric ton is needed to catch 7 tons of skipjack. Live anchovy can be held only about 20 days; this restricts range of operation.

By using South Pacific islands as supply points, the operating radius could be increased greatly. Under a 2-year program starting in 1971, the Agency plans to commission a 284-ton commercial vessel to assess bait-fish abundance around Palau, Truk, Espiritu Santo (New Hebrides), and Noumea (New Caledonia); the vessel's crew will determine whether the fish can be kept in bait wells for extended period. The vessel will test-fish with bait fish it catches.

Acute Labor Shortage

(2) Another basic problem is how to reduce manpower aboard skipjack vessels, which require about 40 men. The acute labor shortage makes it difficult for owners to keep crewmen. So fishing operations must be mechanized to reduce labor.

Four types of mechanical fishing poles have been developed recently by private firms. They perform well and will be ready soon for commercial exploitation.

The agency is developing a labor-saving skipjack fishing device. This uses a rotating system similar to reel-type mechanical squid-fishing gear. Much time and expense will be required to perfect the system, but the gear will be capable of catching several times more fish than mechanical poling device.

Market Expansion Necessary

(3) Market expansion is another problem. Without it, the increase in catch would have no economic value. Basically, it would be necessary to promote consumption of frozen skipjack and development of domestic and export markets for canned skipjack, particularly for chunk-style pack. An effort to do this is being made by the Federation of Japan Tuna Fisheries Cooperative Associations. This year, it started selling tuna direct to the retailers. ('Suisan Tsushin')

* * *

AUTOMATED SKIPJACK TUNA FISHING GEAR DEVELOPED

A Japanese fishing-gear manufacturer, Suzuki Tekkosho, has almost perfected a mechanical pole-and-line skipjack-tuna fishing gear. The firm plans to manufacture it in 1971.

The gear is a hydraulic device that lowers and lifts the poles. One hydraulic unit operates 4 poles. There is still problem of uneven tensile strength of bamboo poles, which causes some fish to fall off hook. The use of glass rods is being studied to obtain uniform strength.

Nichiro Also Developing It

The Nichiro Fishing Company is also developing mechanical skipjack fishing gear. Described as rotating-type skipjack poling gear, it consists of ten 19.7-inch long glass rods mounted on upper part of electrically rotated belt.

The second series of tests aboard Nichiro's skipjack vessel 'Kuroshio Maru No. 73' (239 gross tons) in mid-August was partially successful. The problem of fish slipping off the hook again was encountered. With modifications, the gear is expected to perform well. It is attracting wide attention. ('Katsuo-maguro Tsushin', Sept. 4.)

* * *

JAPAN (Contd.):

TUNA LONGLINE FLEET NUMBERS 700

In early September 1970, Japan's distant-water tuna longliners (over 190 gross tons) numbered about 700 vessels. About 580 were fishing, 60 were traveling to fishing grounds, and 60 were en route home or in port.

Bluefin & Other Tunas

Some 165 vessels were fishing southern bluefin (100 vessels off western Australia, 40 off New Zealand and Tasman Sea, and 25 off Cape Town). The rest were fishing other tunas, mostly in Pacific but also in Indian and Atlantic oceans.

Between 20 and 30 longliners were reported fishing Atlantic albacore. ('Suisancho Nippo', Sept. 7.)

* * *

YAIZU TUNA FISHERMEN GET WAGE INCREASES & OTHER BENEFITS

The Yaizu chapter of the Japan Seamen's Union and the Yaizu Tuna Vessel Owners Assoc. signed a new contract on Sept. 12, 1970.

Main points: An increase in base pay, additional leave with pay, and payment of survivor annuity.

New Wage Scales

Wages are increased by monthly average of 5,300 yen (US$14.40). The monthly base pay is: skipper serving also as fishing captain, 92,350 yen ($256.53); fishing captain, 83,850 yen ($232.92); captain, chief engineer, and chief radio operator 76,600 yen ($212.78); first mate, first engineer, 64,300 yen ($178.61); deckhand, 44,900 yen ($124.72).

Production bonuses will be paid at same rate as before if prices of landings fall below exvessel 350 yen a kilogram ($882 a short ton); the bonuses will be adjusted if prices rise above that level.

Death Benefits

After one year's continuous service aboard the vessel, the crewmen become eligible for 18 days of paid leave (previously, 17 days). Where death occurs on duty, 1-million yen ($2,778) consolation money will be paid (same as before) plus 4 million yen ($11,111) as survivor annunity. ('Suisan Keizai Shimbun', Sept. 18.)

* * *

FROZEN-SHRIMP IMPORTS PREDICTED FOR NEXT 20 YEARS

Japanese frozen-shrimp imports may reach an estimated 87,000 metric tons by 1975, and 120,000 tons by 1980--compared with 1969's 48,886 tons. These estimates are based on a study by the Industrial Structure Deliberative Council's Import Trend Subcommittee. They reflect the anticipated increase in shrimp production in regions supplying frozen shrimp.

Imported From	Actual Imports 1969	Estimated Imports 1975	1980
	(Metric Ton)		
Southeast Asia	22,441	35,000	42,000
Middle and Near East	10,620	18,000	25,000
Latin America	8,388	13,000	20,000
Australia	3,383	5,000	8,000
USSR	2,320	9,000	10,000
Africa	1,734	7,000	15,000
Total	48,886	87,000	120,000

In southeast Asia, Indonesia's shrimp production in Kalimantan and West Irian will increase by about 10,000 tons when the joint Japanese-Indonesian shrimp ventures are fully operational.

By 1975, the Philippines and Thailand are expected to increase output by about 2,000 tons; Vietnam by 2,000-3,000 tons, and Malaysia by 3,000-4,000 tons.

In the Middle and Near East, there is no indication that Persian Gulf production will increase. In East Pakistan, West Pakistan, and India, production is expected to increase 5,000 tons by 1980.

In Latin America, Mexico likely will maintain present production level. In other Central American countries, shrimp exports to Japan can be expected to increase to 3,000-4,000 tons by 1980.

Imports from northern countries of South America are also likely to increase despite competition with U.S.

In Africa, there are still many undeveloped shrimp resources. If harvested, these can increase production sufficiently to supply Japan with 15,000 tons by 1980.

In Australia, availability of more supplies will depend on extent of development in northwest and south and in eastern New Guinea. Shrimp demand in Australia is growing, so a sharp increase in exports cannot be expected. Increased supply can be expected from New Zealand, which recently began exporting frozen shrimp to Japan. ('Suisancho Nippo', Sept. 18.)

* * *

JAPAN (Contd.):

LONGLINE SALMON FISHING OFF JAPAN ENDS

Japanese salmon longline fishing off Japan (Zone B) reached quota of 11,150 metric tons on June 30, the season's final day. The important features were: (1) Runs appeared 10 to 15 days later than usual; (2) Catch at start was poor. It increased gradually until June 20, but declined after June 25; (3) Catch at first was mainly red salmon, with some chums but no pinks.

In previous off-year (1968), quota was not reached because runs disappeared in early June. The catch and development of fishery in areas for longline vessels in Zone B in 1970 was similar to 1966 off-year.

Prices Stable

Catches differed depending on type of vessels. Values ranged from US$1,389 (poorest) to $4,167 (best) for two trips during season. The best catch in a single trip brought $2,222-2,778.

The shore price for fresh pink salmon, unlike that for other species, remained stable this year at 89¢-$1.00 per kilo. This was bright spot for fishermen. ('Shin Suisan Sokuho')

* * *

NORTH PACIFIC WHALERS ATTAIN 1970 GOALS

The 1970 Japanese North Pacific whaling expedition ended Sept. 12 when the third of its 3 fleets attained the assigned catch.

The combined catch was 516 fin whales and 2,151 sei whales, or 798.16 blue-whale units (BWUs) and 2,700 sperm whales. The combined output was 49,270 metric tons of baleen-whale products and 31,755 tons of sperm-whale products. ('Nihon Suisan Shimbun', Sept. 18.)

* * *

FISHERIES AGENCY WILL DEVELOP NEW FISHING GROUNDS

The Japanese Fisheries Agency will concentrate on exploring new fishing grounds in fiscal year 1971 (Apr. 1, 1971-Mar. 31, 1972). The Agency first began to explore world fishing grounds in FY 1968 for trawling, longlining, and purse seining.

In FY 1970 exploration continued, and 2 new projects were begun: (1) Two vessels surveyed the E. Pacific for saury, and (2) two 250-ton vessels searched for cuttlefish in Tasmanian Sea during Feb.-Mar. 1970, catching about 34 metric tons of cuttlefish larger than those found off Japan.

FY 1971 Explorations

In FY 1971, explorations will include: (1) trawling off New Zealand and E. Africa; (2) purse seining in Tasmanian Sea; (3) tuna longlining in South Atlantic; (4) saury fishing in NE Pacific; and (5) fishing off Caroline Islands and New Caledonia for skipjack. Virgin fishing grounds will be explored for skipjack tuna and cuttlefish. The Agency has high hopes for a cuttlefish fishery in the Tasmanian Sea; 2 vessels (300 and 500 tons) will be sent there.

Also, the Agency will develop coastal trawling off Shikoku, Kyushu, and Hokkaido.

Japan's 1969 Catch

Japan's 1969 catch was 8,620,000 metric tons, slightly below 1968's 8,670,000 tons. ('Mainichi')

* * *

4 TRAWLERS FISH NORTHWEST ATLANTIC

Four Japanese stern trawlers were fishing in September in NW Atlantic regulated by International Commission for the Northwest Atlantic Fisheries (ICNAF). They were: 'Zao Maru' (2,530 gross tons), 'Shirane Maru' (2,528 gross tons), 'Tokachi Maru' (2,501 gross tons), and 'Suzuka Maru' (2,500 gross tons). ('Suisan Tsushin', Sept. 14.)

Plans called for vessels to concentrate on herring in late September or early October.

* * *

JAPAN (Contd.):

FISHERMEN FEAR SLUDGE DUMPING WILL RUIN FISHING

On Sept. 17, 1970, 19 Japanese fishery organizations petitioned the Fisheries Agency and the Liberal Democratic Party urging the Government to ban the planned open-sea dumping of sludge accumulating at Tagonoura port (Shizuoka Prefecture).

The government and the Prefecture plan to dump it off Chiba Prefecture, where fishermen claim it would ruin the good fishing grounds for skipjack and other tunas.

The sludge at Tagonoura, caused by the paper industry of nearby Fuji city, has seriously polluted the water.

Fishermen Angry

Marine pollution off Japan is arousing fishermen's ire. ZENGYOREN and the National Water Pollution Control Measures Council planned a fishermen's protest march in Tokyo for Oct. 8. ('Suisan Tsushin', Sept. 19.)

Pollution Serious

Water and air pollution have reached serious proportions in overcrowded Japan. The Japanese Government is acutely aware of environmental pollution problems. At present, various agencies deal with pollution control. But the solution will require a unified administrative approach.

* * *

NEW PURSE SEINER WILL HAVE U.S. SKIPPER

The president of the Japanese Overseas Purse Seine Fishing Company was scheduled to visit San Diego, Calif., on Sept. 18 to hire a U.S. skipper for his company's purse seiner now being built in Japan. The Japanese hope to learn from skipper the U.S. purse-seining technique.

1,000-GT Seiner

The seiner is a 1,000-gross-ton vessel designed by a U.S. architect. It will be powered by a 3,500-hp. engine capable of 18 knots. Cost is about US$1.8 million. Completion is scheduled for Feb. 1971. ('Suisancho Nippo', Sept. 3 & 4.)

* * *

TWO LARGE STERN TRAWLERS LAUNCHED

A 5,000-gross-ton stern trawler ordered by Nihon Suisan Company was launched July 17. The 'Yamato Maru' is the first 5,000-ton trawler to be built in Japan.

Size & Capability

Main specifications are: overall length 108.94 meters (359.5 feet), width 17 meters (56.1 feet), depth 10.7 meters (35.3 feet), main engine 5,900 hp., cruising range 23,000 nautical miles, crew 130. Construction cost is about 1.6 billion yen (US$4.4 million). The Yamato was scheduled to be delivered to her owners on October 14.

For Pacific & Atlantic

The Yamato Maru will be deployed in the North Pacific, Eastern Atlantic off West Africa, and in South Pacific off Australia.

Japan's second 5,000-ton stern trawler, 'Rikuzen Maru', ordered by Hokoku Suisan Company, was launched September 22. Both trawlers were built by Hitachi Shipyard in Hiroshima. Both have same main specifications. ('Minato Shimbun')

* * *

NICHIRO WILL IMPORT FROZEN TUNA FROM NORWAY

Nichiro Fishing Co. plans to import frozen tuna (presumably bluefin) from Norway for sale on Japanese market. At first, it plans to buy 200 metric tons; if venture is successful, it hopes to build a cold storage in Bergen, Norway, for full-scale operations.

Nichiro's 'Kuroshio Maru No. 37' (470 gross tons) sailed in early June for Norway to pick up the tuna. Plans called for her to catch another 100 tons on her return trip.

Adequate Freezing Needed

Earlier, Marubeni Iida imported tuna from Norway. Freezing during shipment was inadequate and quality of meat deteriorated. It could not be sold on Tokyo Wholesale Market.

That problem is not expected to occur with Kuroshio Maru. Her holds operate at a minimum temperature of -45° C. (-49° F.) ('Katsuo-maguro Tsushin')

* * *

JAPAN (Contd.):

JOINT SHRIMP VENTURE IN GABON

The Pessing Co., a joint Japanese-Gabon shrimp venture, was established in Jan. 1969. It chartered a 315-ton shrimp trawler, 'Kohoku Maru No. 3', from Hokkaido Kosho Fishing Co.

This vessel has been exploring for shrimp off Gabon since Jan. 1969. Results reportedly were favorable. The Pessing Co. chartered the vessel on June 1, 1970, to begin commercial operations. Part of catch from the exploratory work was exported to Europe; the remainder was delivered to Japan.

Buys 2nd Shrimp Trawler

The Pessing Co. also purchased the 'Gyofuku Maru No. 15' (314-ton shrimp trawler) from Hokkaido Kosha. The trawler left Japan on June 5, 1970, for Gabon. The trawler's name will be changed to 'Pessing No. 1.' It will catch bottomfish for local markets. The operation will receive technical assistance from Hokkaido Kosha Co. ('Suisancho Nippo')

Started With $42,000

The capital needed to start joint venture was US$42,000. Two Japanese companies, Hokkaido Kosha and Kawakami International, each supplied $15,500. The Gabon Industrial Co. supplied $11,000.

* * *

JOINT FISHING VENTURES OVERSEAS NUMBER 55

The Japanese Fisheries Agency has reported 55 joint ventures in foreign countries by Japanese fishery firms; 7 of these are related to tuna fishing.

The difficulty of conducting tuna fishing profitably abroad may account for the relatively few joint tuna ventures. ('Katusomaguro Tsushin', Aug. 27.)

* * *

JOINT COLD-STORAGE OPERATIONS WILL BE ESTABLISHED IN KENYA

The Taiyo Fishing Co. will take part in a joint cold-storage venture in Kenya to be named Kenya Fishing Industries. The firm will be set up in Mombasa as a local corporation by Taiyo and Japan's Ataka Industries, and the British Maritime Fisheries.

Capital & Capacity

The company will have capital of 60 million yen (US$167,000); Taiyo and Ataka each will put up $36,000.

An 1,800-ton-capacity cold storage is scheduled to be completed by the end of Mar. 1971, and operations to start in April.

A Stabilizing Factor

The cold storage will help stabilize Taiyo's tuna-fishing-base operations at Mombasa; at present, the firm is using a moored refrigerated carrier to store tuna purchased from foreign vessels. ('Suisan Keizai Shimbun', Aug. 20.)

* * *

SAURY FISHING WAS POOR IN NORTHEAST PACIFIC BUT GOOD OFF JAPAN

Fifteen Japanese vessels were fishing saury off U.S. west coast and Vancouver, Canada, on Sept. 11. Included were 1 mothership (1167 gross tons) accompanied by three 96-ton trawlers and 2 vessels on resource survey cruises (50% of cost subsidized by Govt.). The two survey cruises were organized by the Japan National Saury Association.

The 15 vessels were dispersed over a wide area, between 40°-48° N. latitudes, searching for large saury concentrations. About two-thirds of the vessels arrived in late Aug. or early Sept.; the rest began fishing in early August.

For about one week in late Aug. 1970, saury fishing off Vancouver Island had improved; daily catches ranged from 5 to 10 metric tons per vessel. Around Sept. 2-3,

JAPAN (Contd.):

the daily catch declined to about one ton per vessel. In 1969, however, saury fishing off Vancouver improved suddenly around second week in September. The Japanese hoped for a similar occurrence this year.

Off Japan

The saury fishing off Japan got into full swing on Sept. 1 when the fishery was opened to large vessels (over 40 gross tons). Fishing off Hokkaido and Sanriku (NE. Honshu) was reported generally good; there was increasing percentage of large fish in the catch.

Nationwide saury landings, as of Sept. 1, were 31,635 metric tons, roughly triple the comparable catch in 1969 (only 10,895 tons). The 1970 catch was about 60% of 1969 catch (52,000 tons). Saury fishermen hope that 1970 landings might approach 200,000 tons. At worst, they think catch will not fall below 100,000 tons, double 1969's.

Good Catches Stabilize Prices

The good catches are stabilizing saury prices in Japan. On Sept. 9, exvessel saury prices at Sanriku were 80-130 yen a kilogram (US$202-328 a short ton). Extra-small saury were bringing 30-35 yen a kilogram ($76-88 a short ton). Most fresh large and medium fish were being sold in the cities.

Particularly noticeable were active offers for medium saury by canneries, and no active buying by tuna-bait dealers. In 1969, the dealers were leading purchasers throughout season. ('Suisan Tsushin', Sept. 11.)

* * *

COASTAL SAURY CATCH MAY REACH 90,000 TONS

As of Oct. 4, 1970, the saury catch off Japan totaled 54,000 metric tons. This surpassed the 1969 season's 52,000 tons (1969 was poorest recent year).

Landings were about 500 tons a day. At that rate, another 30,000 tons or more were expected to be landed in 1970.

Prices Vary

Exvessel saury prices at Hokkaido ports on Sept. 30 were 140-180 yen a kilogram (US$353-454 a short ton); at Kesennuma and Ofunato (northeastern Honshu), they were much higher: 245-324 yen a kilogram ($637-817 a short ton).

Average Value Lower

By Sept. 20, the value of landings (42,264 metric tons) was 3,390.2 million yen (US$9.4 million). This averaged 80 yen a kilogram ($202 a short ton); in same period 1969, average value was 98.6 yen a kilogram ($248 a short ton). ('Minato Shumbun', Oct. 6; 'Suisan Tsushin', Oct. 5, 1970.)

* * *

TRAWLERS FISH OFF MIDWAY ISLAND

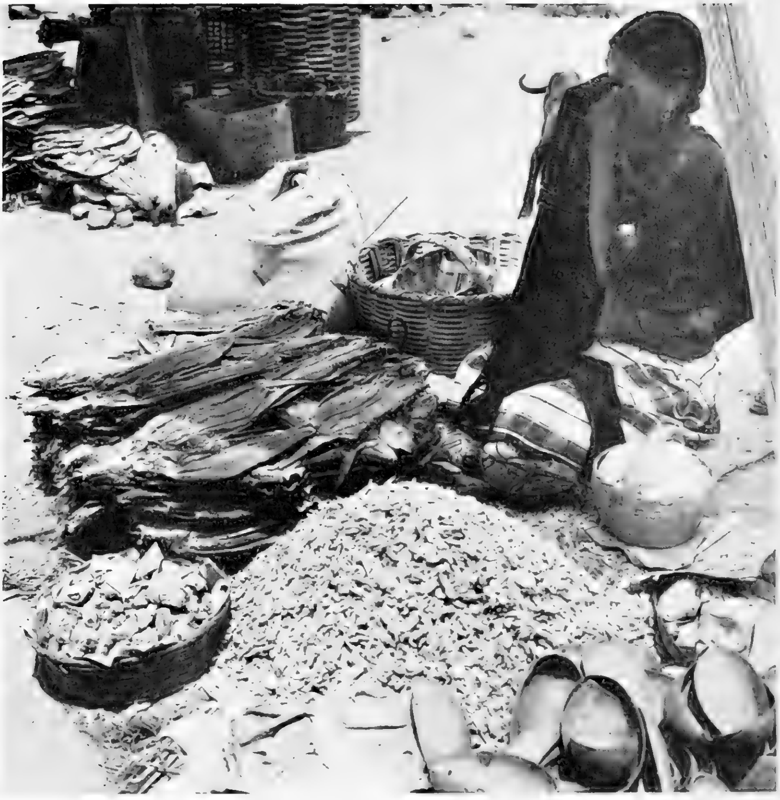
The Japanese trawler 'Akebono Maru No. 71" (3,500 gross tons), owned by Nichiro Fishing Co., began fishing on Aug. 30, 1970, for "Kinmedai" (beryx splendens) and "tsubodai" (quinguarius japonicus) off Midway Island in central Pacific.

The area also was being fished by 2 other Japanese firms: Nihon Suisan with one 2,500-ton trawler, and Tokushima Suisan with 'Orient Maru' (350 gross tons). Also, several Soviet trawlers were reported within visual range of Japanese vessels.

Fishing was reported slow. Akebono Maru's daily production was about 25 tons of processed fish, poor for her size.

The 'Tsubodai'

The 'tsubodai' was introduced into Japan by Nihon Suisan, which had been fishing it off Midway for one year. Because it has a dark skin, this species' marketability was doubted at first. But it is gaining acceptance due to its good flavor and texture. Its oil content is high. The waste is processed into fish meal and oil and produces a higher yield than other species. ('Minato Shimbun', Sept. 27, "Suisan Tsushin', Sept. 12, 1970.)



The rural population of southern Mexico's Oaxaca valley is nearly all Zapotec Indian. The market day in each village is held on a different day of the week.

Dried fish and dried small shrimps are sold in Tlacolula. (FAO photo)

LATIN AMERICA

MEXICO

W. GERMANY MAKES GIFT OF RESEARCH VESSEL

Mexico's second fishery research vessel, 'Alejandro de Humboldt', arrived in Veracruz recently. She was offered to Mexico as a gift by W. German Pres. Luebke during a state visit in 1964. The vessel was built in Lauenberg for US$1.2 million.

The Humboldt

Mexico's first fishery research vessel was the 24-meter 'Antonio Alzate' commissioned in Nov. 1969. The Humboldt is 42.25 meters long, has a beam of 9.60 meters, and a draft of 3.35 meters. She is powered by an 8-cylinder diesel engine of 1,150 hp. turning 900 r.p.m. with a reduction gear to 300 r.p.m. for her reversible pitch propeller. Two smaller diesel auxiliaries provide power for air conditioning, lighting, and tunnel freezing and storage facilities at -35° C. (-31° F.).

Bottom & Midwater Trawling

The Humboldt is rigged primarily for bottom and midwater trawling. She has a hydraulic main winch and 1,000 meters of cable on each drum. An electric longline hauler is provided for possible longline fishing. A hydrographic and a fishery wet laboratory also are provided. Bridge equipment includes 3 echosounders, gyrocompass, automatic pilot, full bridge control of main engine and propeller, radar, and ample radio communication equipment. Accommodations are provided for 10 crewmen and scientific party of 8. All accommodations and both laboratories are air conditioned.

Mazatlan-Based Vessel

The Humboldt was scheduled to leave Veracruz about October 3 for Mazatlan, where the Alzate also will be based. A German captain and engineer will remain aboard for 6 months to help train their counterparts, already aboard, and other crew members.

When the training period is completed, the Humboldt will be assigned to the current FAO/UNDP fisheries project in Mexico for 4 years. In 1971, she will work in Gulf of California, in 1972 on west coast of Baja California from U.S. border to Cabo San Lucas, and in 1973 in Gulf of Tehuantepec on Pacific Coast. (U.S. Embassy, Mexico, Sept. 30.)

* * *

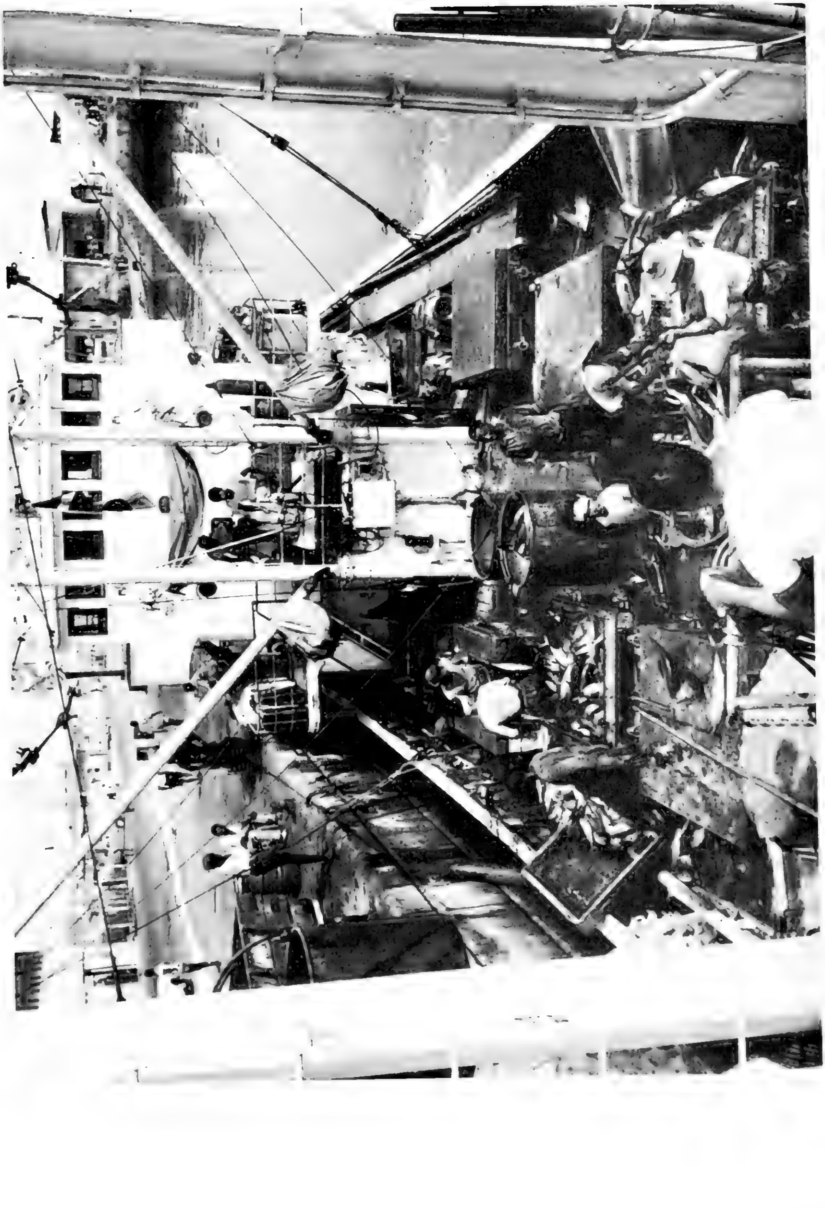
JAPANESE TO HELP DEVELOP MEXICO'S COASTAL FISHERIES

At Mexico's request, Taito Seimo, a Japanese fish-net manufacturer, sent 2 fishery specialists to Mexico to help develop her coastal fisheries.

Mexico has the large trawlers and other vessels needed to develop her abundant coastal fishery resources but, reportedly, those vessels are not being used effectively. The Japanese specialists will work on this problem. Also, they will assist in surveying the coastal fisheries.

Mexico A Stepping Stone

Taito Seimo has helped set up a set-net fishery in Vera Cruz on the east coast of Mexico; it will now provide consultant services also on the west coast. When firmly established, Taito Seimo could offer technical service and supply fishing gear to Latin America. ('Minato Shimbun').



Japanese tuna boat unloading in Tema, Ghana. (FAO: A. Defever)

AFRICA

SOUTH AFRICA

ANCHOVY NET ADAPTED FOR MACKEREL FISHING OFF WEST COAST

There was a short run of mackerel off South Africa's west coast from June 26 to July 27 this year. The fishery was 50 to 80 miles northwest of Cape Colombine. Factories in Saldanha Bay and St. Helena Bay reported record catches of 77,813 tons for July. It is estimated that the bulk was landed during first 2 weeks.

Netting Mackerel Difficult

Several boats used $1\frac{1}{8}$-inch pilchard nets; others used $\frac{1}{2}$-inch anchovy nets. Both groups found it difficult to net mackerel. They improved matters by inserting a length of 2-inch mesh and, in some cases, 3-inch mesh to the bottom of their anchovy nets.

The increased depth and the faster fall through water of these larger nets improved catch. But by the time the additional netting had been delivered and fitted, the mackerel run was almost ended. So the nets were not tested thoroughly.

Skippers were enthusiastic over performance. More use of this method will be made in 1971 to avoid spending vast sums on special nets for mackerel.

Adapting Anchovy Net

One of the most successful methods in enlarging and adapting an anchovy net is to match up meshes of the different-sized sections. The $\frac{1}{2}$-inch mesh anchovy net section is 25 to 30 fathoms deep. Below it are 20 rows of 3-in. mesh. This 3-in. mesh is cut--leaving one row attached to $\frac{1}{2}$-in. mesh.

The new section, 2-inch mesh ranging in depth between 10 and 20 fathoms, is rigged (loose stitched) on the single 3-in. mesh row; the latter remains attached to $\frac{1}{2}$-in. mesh section. Then, the original 19 rows of 3-in. mesh are rigged on to bottom of new section. During this process, the lead line remains attached to bottom of 3-in. mesh.

With this method, the removal or addition of the extra 2-in. mesh section can take as little as half a day. ('South African Shipping News & Fishing Industry Review', Sept. 1970.)

SOUTH-WEST AFRICA

PELAGIC FISH RESOURCES WILL BE SURVEYED

The South African Division of Sea Fisheries soon will begin a major research program into the distribution of South-West African pelagic fish resources.

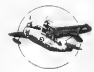
The object is to assess the commercial potential of fish shoals north of Cape Cross--and to carry out extensive environmental studies in their vicinity. The region extends from Hollams Bird Island to the Kunene River; it covers much of the Walvis Bay fishing grounds.

Aircraft & Vessels for Survey

Two aircraft, a research vessel, and two fishing vessels will be used.

One aircraft will use an airborne infrared radiation thermometer to carry out surface temperature studies to delineate areas of special interest for fish-spotting by the second aircraft. Information from both aircraft will be collected, analyzed, and relayed immediately to the vessels. These will then conduct a special sampling program in specified areas.

The program was slated to run continuously from Sept. until Dec. 1970. Then it will be reviewed before beginning further studies. ('The South African Shipping News and Fishing Industry Review', Sept. 1970.)



INDEX

U. S. GOVERNMENT PRINTING OFFICE: 1970

BACK COVER: Sorting the catch aboard NMFS 'Albatross IV'.
(R. K. Brigham)

A UNITED STATES
DEPARTMENT OF
COMMERCE
PUBLICATION

COMMERCIAL FISHERIES *Review*

VOL. 32, NO. 12

DECEMBER 1970

U.S.
DEPARTMENT
OF
COMMERCE
National
Oceanic and
Atmospheric
Administration

National
Marine
Fisheries
Service

U.S. DEPARTMENT OF COMMERCE
Maurice H. Stans, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Dr. Robert M. White, Acting Administrator

NATIONAL MARINE FISHERIES SERVICE
Philip M. Roedel, Director

COVER: Iced-up Gloucester trawler. (Warren F. Rathjen)

COMMERCIAL FISHERIES
Review

A comprehensive view of United States and foreign fishing industries--including catch, processing, marketing, research, and legislation--prepared by the National Marine Fisheries Service (formerly Bureau of Commercial Fisheries).

FISHERMEN'S MEMORIAL--GLOUCESTER, MASS.

Managing Editor: Edward Edelsberg

Production: Jean Zalevsky
Alma Greene

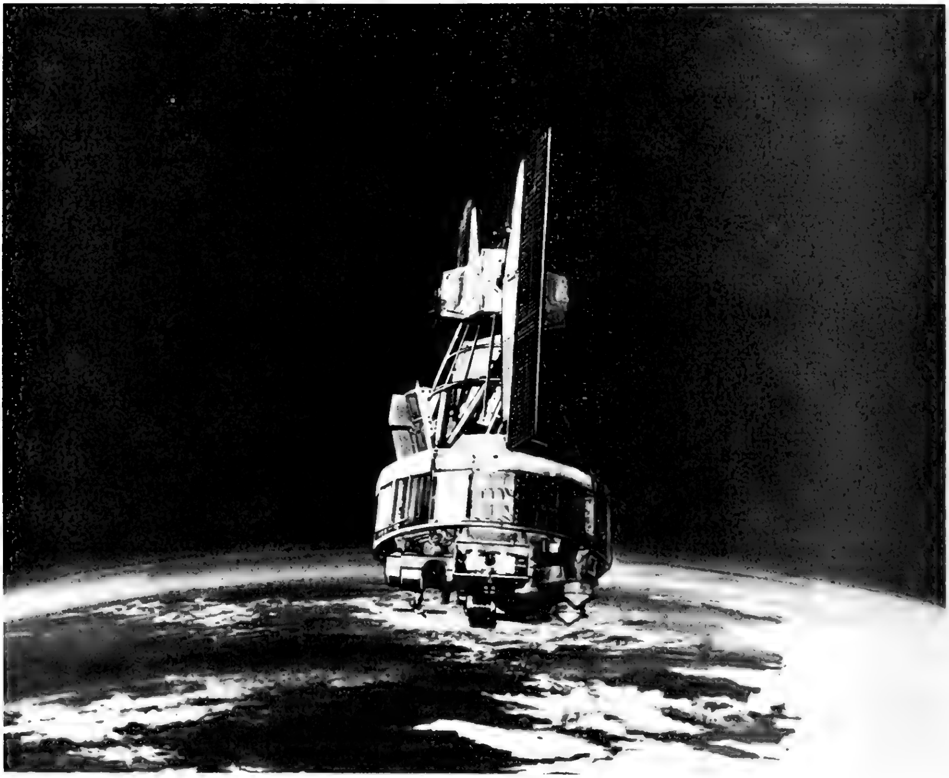
Throughout this book, the initials NMFS stand for the NATIONAL MARINE FISHERIES SERVICE, part of NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), U.S. Department of Commerce.

Address correspondence and requests to: Commercial Fisheries Review, 1801 North Moore Street, Room 200, Arlington, Va. 22209. Telephone: Area Code 703 - 557-4246.

Use of funds for printing this publication was approved by the Director, Bureau of the Budget, April 18, 1968.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Price 60 cents (single copy). Subscription Price: $7.00 a year; $2 additional for foreign mailing.

CONTENTS



Nimbus (Photo: NOAA)

U.S. & CALIFORNIA MODERNIZE A FISHING OPERATION

Machines may replace men on the boats that fish mackerel, anchovy, and bonito out of San Pedro, Calif., if an experiment to mechanize wetfish purse-seining is successful. This is reported by Izadore Barrett, Acting Director of the National Marine Fisheries Service (NMFS) laboratory in La Jolla.

The experiment, begun in summer 1970, is sponsored jointly by NMFS and the California Marine Research Committee (MRC). It involves the 83-foot fishing vessel 'Sunset', reactivated after long idleness by its new skipper, Nick Jurlin of San Pedro.

Sunset Changes

Among the fishing improvements installed on Sunset by NMFS and MRC are a hydraulically driven net drum that winds up the large purse seine; before, it took half the crew to stack it on the stern. Another is an improved pursing winch that closes the bottom of the net and neatly stores its lines. A pump that sucks up the fish concentrated in the pursed net has replaced the laborious dip-net operation. With these and other improvements, Sunset has been operating with only 5 men, instead of the usual 10.

Effects on Crew

Mr. Barrett explained that in a fishery top-heavy with underpaid manpower, crew reductions that maintain equal, or produce greater, catching efficiency benefit owner and crew. The loss of jobs in the wetfish fleet as a result of such technological improvements can be absorbed by natural attrition, while the remaining higher-paying jobs will emphasize the essential skills of commercial fishing without the drudgery. A study by NMFS fishery biologists and economists has shown that the boat owner can pay off the cost of mechanization in 5 years--and should even make higher profits during this period.

At last reports, Sunset, fishing with a reduced crew, was a "high-liner" (a leader) among 21 boats fishing for anchovy. Results are being watched carefully.

Mr. Barrett notes that several boats have begun to instal fish pumps in what may be the first steps toward modernizing the San Pedro wetfish fleet.

U.S. WEATHER SATELLITES AID FISHERMEN

With the help of scientists at NMFS La Jolla (Calif.) laboratory, U.S. tuna fishermen now have an eye in the sky to warn them of impending storms and rough seas that affect fishing. In July 1970, an automatic picture-transmission (APT) satellite receiver was installed in lab to provide detailed photographs of weather patterns over fishing grounds. This information is transmitted from three U.S. weather satellites--NIMBUS IV, ESSA-8, and ITOS-1--as they move through sky in orbits covering principal tuna grounds from Pacific Northwest to eastern tropical Pacific.

Improve Fishery Advisories

Using the satellite photographs, Dr. Nathan Clark, Meteorologist, and James Renner, Fishery Biologist, have been able to improve accuracy of weather forecasts presented in fishery advisories. The advisories have been issued for the past 3 years, mainly for albacore fishermen. Forrest Miller, Meteorologist with Inter-American Tropical Tuna Commission, working under contract to NMFS, also uses satellite photographs to inform fishermen via radio of location, intensity, and movement of intertropical convergence zone and tropical storms.

New Research Project

Encouraged by APT's usefulness to influence fishing strategy, a new research project has begun at NMFS La Jolla to obtain direct readout of thermal infrared data from APT system--and to relate this information to sea-surface temperature patterns and gradients along Baja California and eastern tropical

Pacific. Dr. R. Michael Laurs, Leader of Fishery-Oceanography Group, is in charge.

How La Jolla Helps Fishermen

APT project is latest La Jolla effort to help U.S. fishermen catch more fish. La Jolla provides fishery advisories to albacore fishery off the West Coast, and to tropical tuna fleet west of Mexico and Central America. These advisories, said Izadore Barrett, Acting Director, consist of daily forecasts of weather and sea-surface conditions for specific fishing grounds. There is special emphasis on surface winds, sea temperatures, and sea state as these relate to special needs of tuna fishermen. The advisories also contain marine weather forecasts based on information from National Weather Service and Navy's Fleet Numerical Weather Central. Information on daily albacore catches is included.

BOTTOM-FISH DISTRIBUTION AFFECTED LITTLE BY TEMPERATURE CHANGES

Temperature changes over the past 20 years have had little effect on the distribution of bottom fish on the continental shelf between Nova Scotia and Long Island. So reports NMFS Woods Hole (Mass.) Laboratory. Its study of research-vessel distributional data and recent temperature trends did not show any important correlation.

Four key species were studied: American plaice, haddock, yellowtail flounder, and butterfish.

Temperatures Up Since 1957

Water temperature increased from the early 1940s to a maximum in 1952-53. Then temperatures declined through 1957. Since 1957, temperatures have trended upward. The effect of these changes on abundance of groundfish has not yet been examined.

CATFISH FARMING GROWTH CITED IN NMFS STUDY

The U.S. production of farm-reared channel catfish is expected to double within the next few years. This forecast is contained in NMFS study, "A Program of Research for the Catfish Farming Industry," conducted for Economic Development Administration (EDA) of Commerce Department.

The forecast is based on estimate of 22 million pounds of catfish produced in 1968 on 25,000 acres of water.

Industry Potential

The report states that the industry has the capacity to strengthen and diversify the economy of the southcentral States, where it is concentrated. Orderly growth of the industry, however, depends on expansion of markets and construction of processing plants to handle anticipated increased production.

The report reviews harvesting and processing techniques. It notes that mechanical harvesting units and skinning machines are being used.

NMFS & EDA Aid Industry

The technical assistance program for catfish industry is being continued by NMFS with EDA financial aid. The Catfish Farmers of America, a trade group, has requested EDA to help develop the industry.

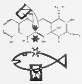
A copy of the report may be obtained from U. S. Department of Commerce, Economic Development Administration, Publications Division, Washington, D.C. 20230.

A NEW DEVICE SUCCESSFULLY TESTS NUTRIENT VALUE OF FISH FEEDS

A "fish nutrient chamber," a plastic bottle-type device, has tested successfully the nutrient value of fish feeds. The work was done by researchers of Interior Department's Bureau of Sport Fisheries & Wildlife.

The chamber holds a fish and allows oxygenated water and nutrients to enter at one end; at the other end, fish wastes exit with water. The researchers can determine closely how much fish growth results from various kinds and quantities of feed.

Much of the research has involved rainbow trout, but it is believed that such other species as salmon and catfish can be used.



RAPID SALTING PROCESS DEVELOPED

Whiting can be salted, dried, and packaged in one day using a new process developed at NMFS Gloucester (Mass.) Fishery Products Technology Laboratory. The usual salting and drying process takes weeks to months.

The salted whiting was prepared in a few minutes for use in a fish cake mix. When taste-tested, the fish cakes were very acceptable.

Another positive feature of the salted fish is that it is stable. It retains good color, odor, flavor, and texture after more than a month's storage at 80° F.

More information willl be made available after a patent has been granted.

NEW SELF-DESTRUCT PLASTIC MAY BE PACKAGING MATERIAL

A new packaging plastic has been developed in Sweden. Reportedly, it will keep its strength as long as needed, but it will decompose after use. It is a chemically modified polyethylene with some additives, which give it strength--but will accelerate decomposition when exposed to sunlight.

For Wrapping & Packaging

The makers hope the new plastic will be adapted for use as container wrapping and packaging materials. For information: Tetra Pak, of Raabyholms, Alle, Lund, Sweden. ('Air Cargo', Nov. 1970.)

MERCURY FOUND IN FUR SEALS

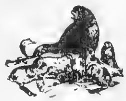
Scientists of NMFS Marine Mammal Biological Laboratory in Seattle have found high concentrations of mercury in the livers of northern fur seals (Callorhinus ursinus) collected in 1970.

Mercury in liver samples ranged from 0.05 to 0.35 ppm in ten 3-month-old pups taken on St. Paul Island, Alaska; from 3.0 to 19.0 ppm in 29 young males ages 2 and 3 years taken on St. Paul Island; and from 19.0 to 172.0 ppm in 29 adult females ages 5-19 years taken off Washington State.

Age A Factor

The data indicate higher concentrations are associated with age. Among adult females, the youngest had the lowest concentration, and the oldest had the highest concentration of mercury. The source of mercury is not known, nor the possible effects on fur seals understood.

--Ray Anas



ARMY VETOES DREDGING PROPOSALS IN FLORIDA WATERS

The Secretary of the Army has upheld a recommendation by the Army Corps of Engineers that developers of Honeymoon Island in Pinellas County, Florida, be denied a permit for dredging and filling. The developers sought to dredge 9 million cubic yards of fill material from Gulf of Mexico to create a 120-acre enlargement of Honeymoon Island in Gulf of Mexico opposite City of Dunedin.

The Secretary's Statement

The Secretary said the work would not be in the public interest: "After thorough consideration of all facts of the case and close analysis of the views of responsible local, state and federal officials and agencies, there appears to be little justification for allowing a major alteration of the Florida coastline, with the resultant irretrievable damage to the environment and to fish and wildlife. The esthetic and environmental aspects of developing the shoreline of the Florida coast with

non-water-oriented facilities creates in the Department of the Army's view an unfortunate and undesirable reduction in natural shore conditions which cannot be considered to be in the genral public interest."

U.S.-STATE PROGRAM TO RESTORE SHAD TO CONNECTICUT RIVER

Juvenile shad resulting from the $3\frac{1}{2}$ million fertilized eggs planted in Spring 1970 by Interior Department's Bureau of Sport Fisheries and Wildlife in Connecticut River were being studied for growth and survival during their downstream migration in Fall 1970.

The upstream parts of the river have been closed to shad for more than 100 years because of high dams. A cooperative Federal-State restoration program is trying to restore runs to river's lower parts and tributaries.

1970 OREGON SHRIMP HARVEST IS STATE RECORD

A record catch of at least 13.3 million pounds of shrimp has been landed at Oregon ports in 1970, according to Jack Robinson, Fish Commission biologist. The total should reach 13.5 million pounds when all figures are in. The fishing season closed October 31. For the past 3 years, landings were about 10 million pounds. Dockside value to Oregon fishermen will top $1.5 million.

The Fishery

The Oregon shrimp-fishing industry began only 13 years ago with 6 boats; now it has 56. Shrimp boats, mainly oceangoing trawlers, range from 45 to 85 feet. When not shrimping, these boats fish tuna, bottom fish, crabs, and salmon.

Shrimp are caught with modified otter trawls--big nets with one end opened like a gaping mouth 4 feet high by 40 feet wide and tapering to a small closed end. The trawl is dragged along bottom, scooping up and trapping the shrimp in its narrow end. The net, constructed of $1\frac{1}{4}$-inch nylon mesh, catches commercial-size shrimp--but allows small shrimp to escape.

How Ports Ranked

Coos Bay landings totaled 4,680,000 pounds. Newport was second with 2,945,000 pounds and may top 3,000,000 pounds. Astoria-Warrenton reported over 2,600,000 pounds, and Garibaldi 1,340,000 pounds. Port Orford, which landed 74,000 pounds in 1969, made a major comeback with 1,205,000 pounds. Brookings, the southernmost port in Oregon, reported 520,000 pounds.

1971 Prospects Bright

The record 1970 catch contributes significantly to the state's economy. According to Robinson, the prospects for 1971 appear bright. The strong 1968-69 year-classes should contribute excellent-sized shrimp.

COLUMBIA RIVER SALMON CATCH IS EXCELLENT

The Columbia River fall salmon fishery produced excellent commercial catches, reports the Oregon Fish Commission. Landings of coho approached 4.9 million pounds, the best since the mid-1920s. The bulk was taken below Bonneville. Only 184,000 pounds were landed in Indian commercial fishery above Bonneville; this reflects the general distribution of coho in Columbia River. Primary areas are in lower river. Few coho pass over Bonneville Dam and enter Indian fishery area.

Large % Hatchery Origin

Studies by the National Marine Fisheries Service (NMFS) and Oregon Fish Commission in 1969 show that 66% of coho taken below Bonneville and 48% of Indian catch above Bonneville Dam were of hatchery origin.

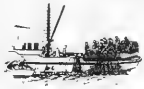
Chinook

Columbia River chinook landings were the best since 1951, almost 4.9 million pounds: nearly 4.2 million pounds in commercial fishery below Bonneville Dam, and over 700,000 pounds in Indian fishery above Bonneville. A preliminary report by NMFS states that between 1964 and 1968 35% of commercially caught fall chinook below Bonneville Dam and 49% of Indian catch above Bonneville were of hatchery origin.

Return of the native. Back to hatchery comes chinook salmon released 4 years before as fingerling. (USIA)

Large numbers of fall chinook salmon have returned to Fish Commission hatcheries in Columbia River system. Some chinook hatcheries in Oregon and Washington did not receive enough adult chinook to satisfy their egg-take requirements, but Big Creek hatchery's record return of 17,500 fall chinook yielded 33.4 million eggs. Eggs surplus to Big Creek hatchery's needs were supplied to other state and Federal hatcheries. The needs of all Columbia River hatcheries have been satisfied.

The Oregon Fish Commission says the hatchery program is making a "meaningful contribution to Nature's production of salmon in Oregon."



SALMON RETURN TO WILLAMETTE RIVER

Salmon have returned to Oregon's Willamette River, once too polluted for them. The 1970 spawning run of coho and fall chinook salmon is greater than all previous migrations, reports NMFS.

Credit goes to cooperative efforts by industry, state, and Federal agencies that improved water quality. Modern fishways are being installed at the Willamette Falls industrial center.

Salmon Counted

Using a technique developed by NMFS engineers, TV camera and video tapes, more than 35,000 coho and 7,500 "lunker" chinook salmon were counted at a new fishway.

Oregon is building 2 more new fishways: 84% of funds provided by Department of Commerce and administered by NMFS; 16% by private industry. (Information from Dr. Fred Cleaver.)

ALASKA ENJOYS GOOD FISHING

Alaska's 1970 fishery landings will be about a half-billion pounds worth $85-$95 million to fishermen. These preliminary estimates show a very good year, reports NMFS Juneau. The 1970 fishing season, like 1969's, appears to have made Alaska No. 1 state in value of landings, and either No. 2 or 3 in quantity.

SALMON

Preliminary catch estimates indicate that 1970 salmon fishery may equal or exceed 1966 bonanza of 333.3 million pounds. This would be largest since 1949, when 346.4 million pounds were landed.

Estimated landings for the 5 species of salmon were up over 1969: kings 4%; pink 15%; coho 18%; chum 105%; and sockeye 123%. Although salmon pack did not meet preseason predictions, still 1970 was one of best years.

The season's canned salmon pack of 3.68 million cases was second largest in 20 years; it fell just under 3.91 million cases in 1966. Four of the 5 species gained over 1969: sockeye, pink, chum, and coho salmon packs increased and totaled 1,794,000, 1,327,000, 472,000, and 56,000 standard cases. King salmon dropped to 27,000 cases from last season's 35,000. Sockeye and pink dominated season's pack: Bristol Bay provided most of sockeye pack (1,151,000 cases); Kodiak alone provided about one-third (465,000 cases) of pink pack.

HALIBUT

Preliminary estimates indicate 1970 Canada-U.S. halibut catch will reach 58 million pounds. It will parallel closely the 1969 catch, by regulatory area, which totaled 58.6 million pounds.

The Canadian and U.S. fleets landed estimated 26.7 million pounds of halibut in Alaska in 1970; this was increase of 26% from 1969. These landings were worth about $8.5 million to fishermen.

SHRIMP

An estimated record Alaskan catch of 71 million pounds worth $2.84 million to fishermen is anticipated in 1970. This is a 48% increase over 1969's record 47.8 million pounds.

One of most spectacular aspects of Alaska's 1970 industry is "explosive growth of the Kodiak shrimp fishery." It may produce estimated 60 million pounds of shrimp worth $2.4 million, exvessel, by season's end. This quantity alone more than doubles combined shrimp landings expected from rest of Alaska, Washington, Oregon, and California.

CRAB

Alaska crab landings--king, Dungeness, and snow--are expected to approach 75 million pounds in 1970, down about 5 million from 1969. It appears that 1968/1969 trend will be repeated this season: Estimated landings of king and Dungeness declining 7% and 20% from 1969, snow crab increasing 36%.

The estimated average 1970 price to fishermen for king crab was 27 cents per pound, down slightly from 1969. Dungeness crab was steady at 14 cents, and snow crab increased from 10 to 11 cents.

Alaskan Landings and Value to Fishermen 1969 and 1970 1/

Fishery	1969 Pounds	1969 Dollars	1970 Pounds	1970 Dollars
	(weight and value in millions)			
SALMON (Total)	211.87 2/	42.58	333.31	59.85
King	11.81	3.81	12.30	4.12
Sockeye	64.97	16.64	145.19	30.93
Coho	7.67	2.14	9.02	2.39
Pink	104.46	16.75	119.69	16.76
Chum	22.97	3.24	47.11	5.65
HALIBUT (Total)	21.20	7.14	26.71	8.55
State Landings--U.S. Fleet	16.64	5.58	19.11	6.11
State Landings--Canadian	4.56	1.57	7.60	2.43
SABLEFISH	0.47	0.06	0.49	0.07
SHELLFISH (Total)	130.30	22.44	148.04	20.81
King Crab	57.75	16.17	51.03	13.52
Dungeness Crab	11.53	1.65	9.17	1.28
Snow Crab	11.21	1.13	15.23	1.68
Shrimp	47.84	1.91	71.00	2.84
Scallops	1.89	1.55	1.45	1.42
Clams	0.09	0.03	0.16	0.04

1/Data furnished by Alaska Dept. Fish & Game and International Pacific Halibut Commission; 1969 figures subject to minor revisions, 1970 figures preliminary estimates.
2/Due to rounding, figures do not necessarily total.

ANCHOVY SPAWNED SUCCESSFULLY IN LA JOLLA LAB

For the first time, an important commercial open-sea fish has been spawned successfully under artificial conditions, reports Izadore Barrett, Acting Director, NMFS Fishery-Oceanography Center, La Jolla, Calif. Anchovy larvae produced from this artificial spawning fed and grew as normally in an aquarium as their counterparts in the sea. Additional batches have been produced in succeeding months and are continually being used for experimental purposes.

No member of the clupeid family--to which the anchovy, sardine, and herring belong--has ever been artificially induced to spawn in the laboratory. The results offer unique opportunities to study the response of marine fish eggs and larvae to such environmental factors as pesticides and heated effluents.

How It Was Done

Roderick Leong, NMFS fishery biologist who achieved this scientific first, has been working on inducing spawning in laboratory fish for more than a year under physiologist Dr. Reuben Lasker. During the experiments, Leong subjected adult anchovies kept in large aquaria to 4 hours of light and 20 hours of darkness for 4 months at about 15° C.

The fish were all from the same school. At intervals, they were injected with several types, dosages, and combinations of hormones. The combination that produced heavy spawning included commercial preparations of human chorionic gonadotropin (HCG) plus carp or salmon pituitary extract. In either case, it was not necessary to strip the fish to obtain sexual products--as usually is done with salmon and trout--because the fish released and fertilized the eggs themselves. The percentage of eggs hatching from these trials varied from under 19% in one trial to over 80% in others.

Insure 1 Male & 1 Female

During the experiments, the anchovies were fed squid and trout food, supplemented occasionally by ground anchovies and brine shrimp. Not all the injected fish spawned. Leong says it is not yet possible to synchronize gonad development completely, or to recognize superficially the sex or level of sexual maturity in anchovies. Therefore, 15 to 20 fish were injected in each experiment to insure that at least one male and one female would be mature enough to spawn.

Several weeks after the induced spawning, Leong observed that one group of anchovies in a large holding tank began to spawn spontaneously. This group had been held under same light and feeding conditions as injected fish. New eggs were found in special collectors for several consecutive days; the percentage of viable eggs ranged from 30 to 80%. Leong is experimenting with temperature change as a method to induce spontaneous spawning because this may be a way to obtain eggs without hormonal injections.

An Important Fishery

The northern anchovy is one mainstay of commercial fisheries off California. Fishermen were expected to take about 110,000 tons between September 1970 and May 1971.

COPEPOD WAX MAY BE A KEY TO HUMAN METABOLISM

Studies of naturally grown and laboratory-bred copepods may hold keys to important factors in human metabolism, Scripps Institution scientists believe. The copepods are tiny, shrimplike, marine organisms that weigh as little as 1/140,000th of an ounce or grow to an inch long in the deep ocean.

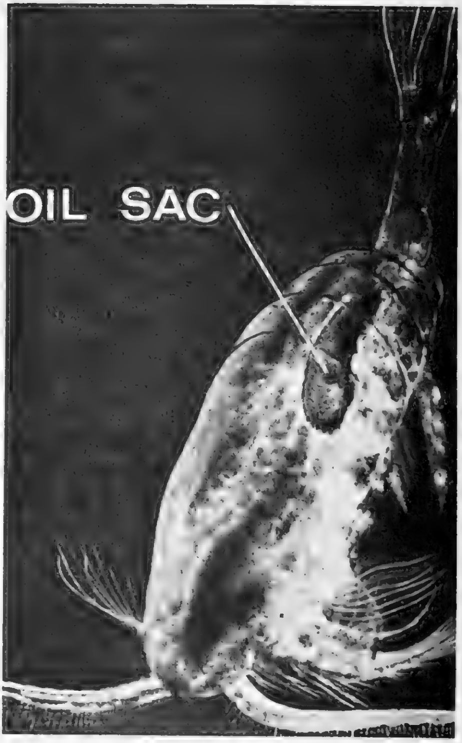
Copepod investigations at Scripps Institution of Oceanography, University of California, San Diego, have led to these conclusions:

Half the Earth's production during photosynthesis is converted for a time to wax by the copepod, the ocean's most numerous and diverse marine animal.

The copepod population off California alone is estimated to have 800,000 tons of liquid wax, a much larger amount than the oil of the 'Torrey Canyon' or Santa Barbara spills.

The copepod is the first animal in marine food chain. It is the predominant animal that can "graze" on microscopic algae (diatoms and dinoflagellates).

'Who eats whom' in the ocean may be determined by the nature of the wax and hydrocarbon compounds in the predator and the prey.



Enlarged photo of $\frac{1}{8}$th-inch marine copepod 'Calanus', "insect of the sea." Oil sac is toward rear of its tiny body. Wax is used for energy storage and food supply during periods of starvation and hibernation in long winters. Wax is made from oils of algae that it eats (darker area below sac).

Scripps Study

Scripps has duplicated the complete life-cycle of the copepod in the laboratory. A team has been studying the occurrence of wax in copepods for more than a year. Copepods are called "insects of the sea."

The scientists report that wax appears to be a major medium for transferring and storing energy in marine organisms. The copepod lives upon microscopic plants called phytoplankton and converts their fat into polyunsaturated liquid wax. It stores this in its oil sac.

These waxes are unique because they are metabolized readily by the copepod, which uses them as a reserve supply of energy. These waxes differ from plant leaf waxes, bees' wax, and animal waxes, which are not metabolized easily.

Dr. A. A. Benson, director of Scripps' Physiological Research laboratory, said: "Further along in the marine food chain the copepods are eaten by predators--sardines, anchovies, herring, and young salmon--who, in turn, convert the waxes back into common fats so widely used for human food. These fishes are the world's specialists in metabolism of waxes."

This wax metabolism helps control the copepods' ability to survive their hostile environment, Dr. Benson added, and it may serve a similar purpose in higher marine animals.

Waxes As Possible Keys

Waxes are compounds of ordinary fatty acids combined with fatty alcohol, the scientists say. They are studying the conversion of this fatty alcohol back to the fatty acids of fishes.

Dr. Benson notes: "Additional knowledge about this apparently complex chemical process may give us the key to an important factor in human metabolism. The intermediate compound which must participate in this conversion occurs as a major component of human heart muscle and brain, but its existence has never been explained. We hope that nature's specialists in this process, the copepods and anchovies, will give us clues to answers, with the possible end result that we might have a better understanding of the energy production of heart muscle and nerve activity in the brain."

The scientists estimated 800,000 tons of liquid wax were contained in the copepod population off California by actually counting the quantity of the organisms in a cubic meter of seawater.

The major copepod of the oceans, Calanus, has been grown artificially by Dr. Michael M. Mullin of Scripps, and by Dr. Gustav A. Paffenhofer, a visiting German zoologist, on pure cultures of diatoms, green single-cell algae.

They grew the copepods throughout their life cycle by almost-hourly feedings.

"The well-fed Calanus contains 70 percent of its dry weight as wax, which is 40 percent of its total fat," reported Dr. Judd C. Nevenzel.

"We have analyzed the wax and fat content of single copepods weighing only 1/2,500th of a gram, or 1/140,000th of an ounce, added Richard Lee, a graduate student. "Deep-sea copepods are larger, nearly an inch long, and are 60 percent wax. Arctic copepods have been found that contain 70 percent lipid, which is made up of 91 percent wax."

WARM SPOT IN N. PACIFIC OCEAN CAUSING EASTERN U.S. TO GROW COLDER

Eastern U.S. and other parts of the world have been experiencing cooling trends in recent years. Explanations include: air pollution is blotting out part of the sunlight; increased volcanic dust may be doing this; the world may be experiencing a cyclical variation in the sun's energy output.

NOAA Expert Suggests Cause

A fourth possibility has been suggested by Jerome Namias, chief, Extended Forecast Division of National Weather Service, and research scientist for Scripps Institution of Oceanography. He points to oceans as a cause. Observed changes in ocean temperature seem linked to large-scale displacements of air currents around the globe, he notes.

Meteorologists generally accept that the oceans are generators of world weather. This is one reason why the two were brought together in 1970 in a new Commerce Department agency--the National Oceanic and Atmospheric Administration (NOAA).

The oceans cover about 70% of earth's surface. They change temperature much more slowly than air above, and so act as "a sort of governor" on global climate.

Namias Argument

Meteorologist Namias argues that air-sea relationship is so basic that "scientists may be overlooking the most important factor by neglecting this interaction" when trying to explain cooling trends. He believes it "quite possible" that warm surface water in North Pacific is responsible for colder winter in eastern U.S.

How could warm ocean water produce cold winds thousands of miles away? Namias says that you need to visualize the high-level river of air that undulates from west to east around Northern Hemisphere. This planetary flow, whose core is the jet stream, is a permanent feature of the atmosphere, although its distance from Equator and sinuous shape are changing constantly.

Winter Jet Stream Shifted

During the 1960s, says Namias, a persistent shift took place in winter jet stream. A pattern akin to that in accompanying map occurred more often than previously. Cold air from the north swept down repeatedly over eastern two-thirds of U.S. The result was that in the east "winter temperatures averaged 1 to 4 degrees Fahrenheit below the 1931-60 mean," he says, while "west of the continental divide, temperatures averaged above normal."

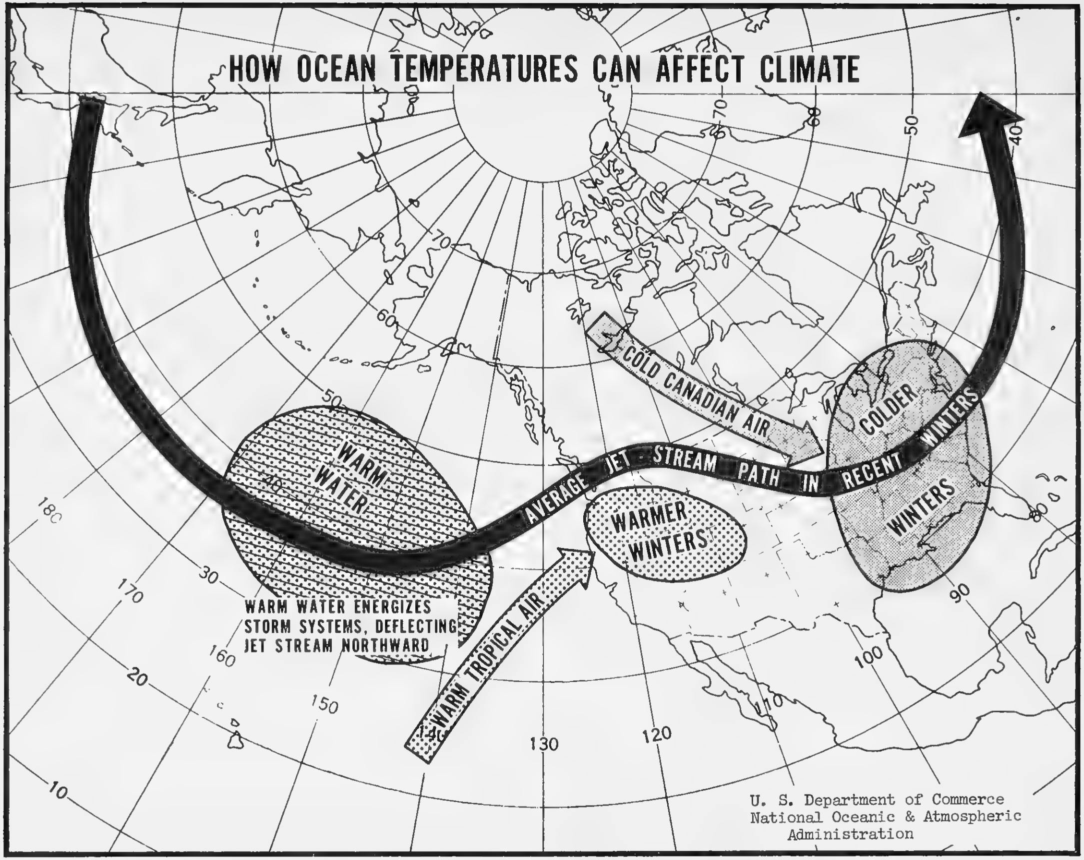
During practically all 10 winters, temperatures averaged below normal in eastern half of U.S.

The demonstrable link between global wind flow and this particular cooling trend makes it "unlikely" that air pollution and volcanic activity have much to do with it, Namias thinks.

More Probable Cause

Much more probable is an association with an ocean-temperature change in which "the sea surface over much of the North Pacific was abnormally warm." This has strengthened storm systems there. Ultimately, this generated more frequent wind flows than usual from Canadian Arctic into eastern U.S.

Even though we may not know what causes such oceanic warming, Namias notes, it is important to recognize significant effect it can have on climate. "It may be shortsighted to invoke extra-terrestrial or manmade activity to explain these fluctuations."


HOW OCEAN TEMPERATURES CAN AFFECT CLIMATE
COLD CANADIAN AIR
COLDER WINTERS
AVERAGE JET STREAM PATH IN RECENT WINTERS
WARMER WINTERS
WARM WATER
WARM WATER ENERGIZES STORM SYSTEMS, DEFLECTING JET STREAM NORTHWARD
WARM TROPICAL AIR
U. S. Department of Commerce
National Oceanic & Atmospheric
Administration

HOW TO USE NEARLY ALL THE OCEAN'S FOOD

Frederick J. King and Joseph H. Carver

The stark realities of the world population explosion and of world hunger cannot be ignored. Most nutritionists estimate that the present state of world food production does not provide an adequate daily diet for two-thirds the population. Even in the U.S., the underprivileged generally lack a good diet. This point was acknowledged by a recent meeting of concerned citizens in Washington, D.C., under the aegis of President Nixon. It was also recognized by President Kennedy in a March 1961 message to Congress.

Hunger can mean different things to different people. By and large, the nutrient most lacking in deficient diets is good-quality protein; seafoods, in general, are known as excellent sources. They are also good sources of polyunsaturated lipid. In abundant diets, which typically do not have a protein deficiency, the ability to replace other lipid sources with typical seafood polyunsaturates is an important consideration.

Resources Must Be Developed

Although some claim that a specific approach will solve overt or hidden hunger, most experts believe several conventional and unconventional resources will have to be expanded or developed to meet our present and future desires or choices for good-quality foods (Mateles and Tannenbaum 1968). Seafood is an example of a conventional resource, yet the ocean's capacity to produce food has not been achieved. For example, under present conditions and fishing techniques, there is a significant waste of potentially edible animal protein. Most vessels look for particular species; other species that come up with the catch are thrown overboard. This wastes time, effort, and potentially nutritious food. Even with species saved, more than half the body may be discarded at sea or ashore. It has not been economically feasible to harvest other species or to process them for food.

Total Oceanic Production

These considerations lead to the concept of total oceanic production of seafood (TOPS). It envisages using all potentially edible parts from all species landed. Traditional or conventional species and market forms of seafood are included. Also, "unconventional" applications are needed to utilize the remainder of the harvest. Obviously, these applications should tailor a product for consumer acceptance--rather than try to educate a consumer to a particular species that might become less available. Successful applications also would increase efficiency of harvesting effort and thereby maintain ocean's food resources in a more economically healthy condition.

Processing & Storage Techniques

To increase efficiency of utilizing our marine resources for food, we need to develop appropriate processing and storage techniques afloat and ashore. Such a development has occurred in Japan during last 20 years (Tanikawa 1963). To meet increasing domestic demands for good-quality protein foods, a family of machines and appropriate technology were developed. The machines remove edible flesh from bones and skin and convert the minced flesh into a "universal" material that can be preserved by freezing. It is called "surimi." It can be considered basic ingredient in manufacturing food items, such as fish cake or paste ("kamaboko"), several kinds of sausages ("chikuwa," "tokuyo," and ham sausage). Potentially, surimi can be used in other products, such as soups, fish puffs (different fish flavors), meat-flavored chunks, frankfurters, dehydrated cubes or

The authors are Research Chemists, National Marine Fisheries Service, Fishery Products Technology Laboratory, Gloucester, Massachusetts 01930.

COMMERCIAL FISHERIES REVIEW
Reprint No. 893

flakes, controlled size portions, and snack-type items.

At present, such applications in U.S. seafood industry are limited to Japanese types of products made from surimi. However, another U.S. food industry dealing with proteinaceous flesh as food, the poultry industry, has learned recently how to use meat/bone separators to recover edible meat from processing "wastes" such as poultry necks and backs. This comminuted (pulverized) poultry meat (or "poultry surimi") is being added to soups, various types of meat sausages, or used as a binder for canned or frozen poultry meat.

Surimi-Type Ingredient

These considerations are similar to those developed by Miyauchi and Steinberg (1970). Although they used different species and machines, a more fundamental difference between their report and this one is present emphasis on a surimi-type ingredient rather than end-use food items. Obviously, various foods are helpful to evaluate or discuss the applicability of a food ingredient. Equally helpful, and perhaps more important in commercial applications, is developing technological and economic information on this surimi food ingredient.

The successful use of Japanese machines for seafood production, and the use of similar machines in the U.S., led us to explore potential applications of such machines in domestic seafood industry. This work involved three considerations: 1) sources of raw material, 2) technological and economic considerations in processing this material into surimi food ingredient, and 3) potential applications of this surimi.

Sources of Raw Material for Machine Separator

The ocean's fauna include many species. For this work, the sources of raw materials may be grouped into two broad categories: fish frames (waste material obtained from filleting lines), and underutilized fish (species caught incidentally to other species, or not presently caught). Characteristically, the anatomy or size of these underused species is not amenable to present filleting methods. Thus, this source could be used as headed and gutted (H&G) fish rather than fish frames.

The potential volume and value of these two sources are important considerations. The greater potential volume will come from underutilized species (headed and gutted fish). However, accurate figures on the sustainable harvest of this resource are hard to find (Bardach 1968). Although potential volume of filleting wastes is smaller, it depends on landings of fish used for filleting. So, it can be estimated with reasonable certainty. In New England alone, for example, the potential volume of machine-separated meat from filleting wastes has been estimated at 56.9 million pounds annually (Carver and King 1970).

Raw-Material Cost Important

Obviously, the cost of raw material is as important as its availability in considering its potential use. In developing cost estimates for these two categories, we have attempted to recognize all cost increments up to point where the material enters a meat/bone separator. For fish frames, an estimated value of 6 cents per pound appears reasonable (Table 1). For underutilized species (H&G), about 9 cents (Table 2), even though there is much speculation about estimate because of variety of species involved. For example, some underused species may require special harvesting methods, heading and gutting machinery, or they may have an unattractively low yield of machine-separable ground meat.

Marine Invertebrates Included

Theoretically, such marine invertebrates as crustaceans, molluscs, and other groups are considered as sources. Although some of these species now are fully utilized, edible meat can be recovered from processing wastes. Typically, these wastes come from such cooked animals as crabs, lobsters, or shrimp. Ground meat has been recovered from such wastes by machine separators (Carver and King 1970; Miyauchi and Steinberg 1970). It contains shell fragments and has lost some important functional properties of raw meat. However, it can be processed into such food products as spreads, pastes, or bisques. Recovery of raw meat from animals containing a brittle exoskeleton has been done with an ordinary chopper followed by filtering. However, a meat/bone separator was unsuccessful in removing raw meat from intact rock crab legs or cores. For such reasons, it is advisable to consider marine invertebrates separately from finfish sources.

Table 1 - Estimated cost of raw material source for machine-separated ground meat when obtained from fish frames

Description of processing or handling step	Estimated cost in cents per pound	
	Cost added by step indicated	Total cost at step indicated
1. Price of filleting wastes--contain heads but no viscera and no skins from filleting operation	1	1
2. Handling, temporary storage by icing, and transport to using facility	1	2
3. Beheading (to remove eyes for aesthetic reasons)		
a. Labor 4 men @ \$2.50 per hour each @ 250 lbs. per hour each.	1	3
b. Yield of 48% usable material remaining[1/]	$\frac{3}{.48}$	6.25[2/]

1/Experimentally determined value using cod frames.
2/If heads can be sold for gurry at one cent per pound, this figure will be reduced by 1 ¢ (52%) or 0.52 cents.

Table 2 - Estimated cost of raw material source for machine separated ground meat when obtained from underutilized fish

Description of processing or handling step	Estimated cost in cents per pound	
	Cost added by step indicated	Total cost at step indicated
1. Ex-vessel price for harvest[1/]	3	3
2. Heading and gutting, Theoretical machine with capacity of 1000 lbs. per hour and two men at \$2.50 per hour each to operate it. Cost of machine and its operation.	2	5
3. Yield of suitable raw material for separation of flesh after step 2 is 55 percent.[2/]	$\frac{5}{.55}$	9.1[3/]

1/This figure is based on special trips for this material. Ex-vessel prices for material caught incidental to efforts for species with other end uses may be lower, but this source of supply may be smaller and more erratic.
2/Assumed average value for all species. The yield of headed and gutted ocean perch was determined on 107 individuals in one lot with an average yield of 55.4% ± 2.1%. The yield of headed and gutted red hake was determined on 10 representative individuals in a 75 pound lot with an average yield of 62.1% ±7.6%. Yield data for nine other species are presented in Miyauchi and Steinberg (1970).
3/If heads and viscera can be sold for by-products at one cent per pound, this figure can be reduced by 1 cent (45%) or 0.45 cents.

Machines For Experimental Work

Most experimental work reported here was based on using the Bibun[1/] family of machines. The basic unit in this family is a meat/bone separator (Figure 1). This machine removes flesh from suitable materials by squeezing and tearing actions. It contains a wide flexible belt that moves against the outside of a rotating, perforated metal drum. The belt and drum move at different speeds in same direction. In operation, flesh is separated from skin and bones by a shearing action due to difference in speeds between drum and belt. Since flesh is softer and is less cohesive than skins or bones, the pressure developed between drum and belt drives it through perforations of drum. Skin and bones remain behind on belt.

The Strainer

The strainer (Figure 2) is used to "finish" comminuted (pulverized) flesh obtained from a separator. Material fed into this machine is moved by an auger against a stationary perforated metal cylinder (Figure 3). These perforations are only about one millimeter in diameter, so any small bones or pieces of

1/The use of trade names facilitates description of experimental procedures; no endorsement is implied. At least two other Japanese firms, Yaniqiya Machinery Works, Ltd., and Ikeuchi Iron Works, Ltd., one Swedish firm, A. B. Iwema, and at least two U.S. firms, Beehive Machinery, Inc. and Stephen Paoli Manufacturing Co., manufacture meat/bone separators. The Bibun Machine Construction Co., Ltd. is the only firm we know that manufactures a strainer as well as a separator.

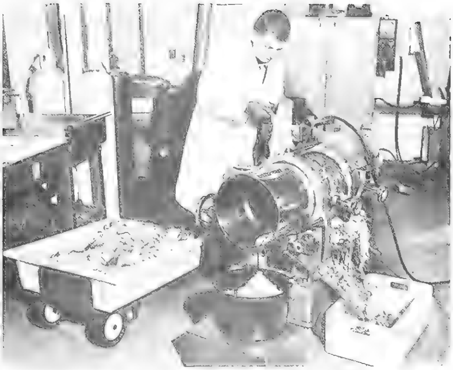


Fig. 1 - Processing filleting leftovers in Bibun meat/bone separator.

Fig. 2 - Processing machine-separated flesh through a Bibun strainer.

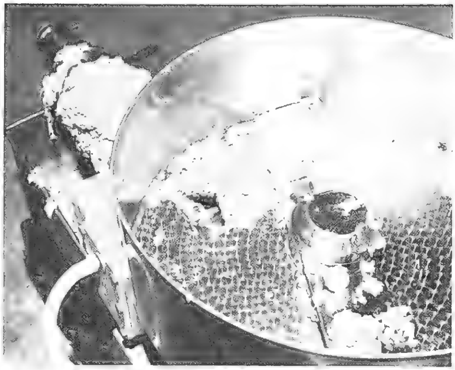


Fig. 3 - Close-up view of a Bibun strainer.

skin present are separated from flesh, which is homogenized by passing through these holes. The auger is kept cold to prevent heat damage to fish flesh by circulating cold water inside it.

Although this strainer was designed for use with material containing raw flesh and bones, we have tried using it to remove shell fragments from cooked blue crab, lobster, and shrimp material. The shell fragments and the lower moisture content of the flesh in these materials created some difficulties in processing them through this machine. However, by redesigning auger and by adjusting throughput rate, it appears these difficulties can be overcome. After passing through small holes of strainer, these shellfish pastes or bisques did not have organoleptically detectable (involving sense organs) shell fragments.

Considerations In Using Machines

An estimate of the cost of using this family of machines is given here. The figures used are intended merely to visualize the process. A commercial processor should check our assumptions against his particular situation. In this concept, one separator and two strainers are assumed at an initial total cost of $20,000 and depreciated over 5 years. (Leasing instead of buying machines might reduce cost.) To this cost, add costs for running machines, such as energy utilization, replacement parts, and maintenance.

To develop this concept, we also assumed these machines should handle up to 4,000

Table 3 -- Yield of flesh obtained from several species of headed and gutted fish using a meat-bone separator. 1/

Source of material	Scientific name of species	Yield of flesh obtained	Reference source
H & G Northern anchovy,	Engraulis mordax	92.6	Calculated from table 1 of
H & G Spiny dogfish	Squalus acanthias	77.0	Miyauchi and Steinberg (1970)
H & G English sole	Parophrys vetulus	84.1	"
H & G Pacific hake (Puget Sound)	Merluccius productus	88.4	"
H & G Pacific herring	Clupea harengus pallasi	69.5	"
H & G Lingcod	Ophiodon elongatus	77.0	"
H & G Silvergray rock-fish	Sebastodes brevispinis	80.6	"
H & G Starry flounder	Platichlhys stellatus	79.4	"
H & G Pacific cod	Gadus macrocephalus	69.4	"
H & G Croaker	Micropogon undulatus	70	Miyauchi and Steinberg(1970)
H & G Croaker	"	75	"
H & G Porgy	Calamus sp.	65	"
H & G Ocean perch	Sebastes marinus	69.4	
H & G Ocean perch	"	62.4	
H & G Whiting	Merluccius bilinearis	86	
H & G Mackerel	Scomber scombrus	65.0	
H & G Red hake	Urophycis chuss	69.8	
H & G red hake	"	83	
H & G Israeli carp	Cyprinus sp.	72.4	

1/ Yield data based on material entering and leaving the separator. It is not based on the whole animal since it does not include the heads and viscera.

Table 4. --Yield of flesh obtained from fish frames (filleting wastes) using a meat-bone separator [1/]

Source of material	Scientific name of species	Yield of flesh obtained
Cod frames	Gadus morhua	59.0
Cod frames	"	66
Pollock frames (large)	Pollachius virens	60
Pollock frames (small)	"	72.2
Haddock frames	Melanogrammus aeglefinus	56
Wolffish frames	Anarhichas lupus	66
Cusk frames	Brosme brosme	70
Whiting frames (from only large fish)	Merluccius bilinearis	55
Ocean perch frames	Sebastes marinus	38.6
Ocean perch frames	"	31.2
Yellowtail flounder frames	Limanda ferruginea	47
Rockfish frames	Sebastodes sp.	51.0 [2/]
Trout frames	Salmo gairdneri	68 [2/]

1/ Yield data based on material entering and leaving the separator. It is not based on the whole animal since it does not include heads, viscera, or fillets.

2/ Calculated from Figure 2 of Miyauchi and Steinberg (1970)

Table 5. -- Comparison of fillet yield with yield of edible flesh obtained from filleting leftovers.

Source of material as landed 1/	Yield of fillets 2/	Yield of machine-separated flesh obtained from filleting waste 3/	Total estimated yield of edible flesh 4/
Cod, eviscerated	37	19	56
Cod, eviscerated	37	12	49
Wolffish, eviscerated	34	20	54
Cusk, eviscerated	36	22	58
Whiting, eviscerated (large fish only)	48	17	65
Pollock, eviscerated	40	18	58
Pollock, eviscerated	38 5/	20	58
Haddock, eviscerated	40	17	57
Yellowtail flounder, whole	34	16	50
Ocean perch, whole (min. amount of candling)	30	19	49
Ocean perch, whole (avg. amount of candling)	25	20	45

1/ Scientific names of species are given in Tables 3 and 4

2/ Estimated values based on current commercial filleting yields. Values expressed as lbs. of fillets per 100 lbs. of fish as presently landed (whole or eviscerated). These values are for "skin-off" fillets. For "skin-on" fillets, these values would be higher by about 3 lbs. per 100 lbs. of fillets.

3/ Values expressed as lbs. of edible flesh per 100 lbs. of fish as presently landed (whole or eviscerated). These yield figures are lower than those in Tables 3 and 4 because fillets, heads (eviscerated fish) or heads and viscera (whole fish) were not fed into a separator.

4/ Sum of values for fillet yield and machine-separated flesh yield given in preceeding columns. Expressed in lbs. of edible flesh per 100 lbs. of fish as presently landed (whole or eviscerated).

5/ Measured yield for this lot of fish which were smaller than those normally used in the trade.

Table 6 -- Recent prices for some present-day frozen fish products. All of these prices are F.O.B. Boston or Gloucester, Massachusetts. They do not include charges for storage over one to three months.

Description	Marketing Unit	Price per pound
Frozen blocks 1/		
Cod (regular)	16 1/2 lbs.	$0.30
Cod (minced)	13 1/2 or 16 1/2 lbs.	0.15
Haddock (regular)	16 1/2 lbs.	0.38
Pollock (regular)	16 1/2 lbs.	0.21
Flounder (regular)	16 1/2 lbs.	0.42
Greenland Turbot (regular)	16 1/2 lbs.	0.32
Ocean Perch (regular)	16 1/2 lbs.	0.21
Frozen fillets, 10 lb. package of cello wrapped fillets.	Five 10-pound packages per master carton.	
Cod	"	$0.33
Haddock	"	0.55
Pollock	"	0.28
Flounder	"	0.58
Greenland Turbot	"	0.40
Ocean Perch	"	0.37
Whiting	"	0.31
Ocean Catfish	"	0.38
Hake	"	0.26

1/ Block is a trade designation for fillets (regular block) or pieces from fillets (minced block) which are packaged into a box and then frozen en masse.
Scientific names for these species, except Greenland turbot (Reinhardtius hippoglossoides), are contained in Tables 3 or 4.

pounds of input material per hour during 7,000 hours of operation in this depreciation period. Based on these somewhat arbitrary assumptions, a machine cost of less than 0.1 cent per pound of input material was obtained. To this add relevant labor costs. (Overhead and other indirect costs will be totaled with projected costs of products obtained.) Since all the machines are assumed to have automatic feed and discharge systems, the assumed labor costs were based on two semiskilled operator-laborers at $2.50 per hour each. Adding this labor cost of 0.125 cent per pound of input material to machine cost of less than 0.1 cent per pound, you get a total cost of about 0.2 cent per pound.

The costs of using these machines must be absorbed by yield of final product, so several laboratory tests were made here and elsewhere to estimate yields from various sources. The yields presented here were based on using only the separator. In other experiments, the ground flesh output from separator was fed into strainer. It was found that the strainer could be operated in a variety of ways to influence properties of comminuted flesh. However, there was relatively little effect on yield of material when over 100 pounds of ground flesh were processed through strainer.

Data show large variation among fish species. Much of this variation may be due to seasonal variability in feeding habits, as well as species differences in anatomical structure and size. This variability appears reduced when you recalculate available results from a basis of whole fish (as purchased) to a basis of headed and gutted fish as fed into a separator (Table 3). In absence of enough data on size or plumpness of fish used to yield of machine-separated flesh, these figures should be considered estimates.

With frames (filleting wastes), available yield data appear more consistent (Table 4). It appears that a yield value can be estimated with reasonable accuracy for a given anatomical structure. For a species, the principal batch-to-batch variations in yield of machine-separated flesh appear related to individual skill of hand-labor in cutting out fillets before we obtained the frames. If one combines yield of machine-separated flesh from these frames with estimate of filleting yield, the total amount of edible flesh can be estimated (Table 5).

Using Ground Edible Flesh From Machine Separation

In considering applications for ground edible flesh or "surimi" as an ingredient in food products, economic projections should be made to estimate whether addition of this food ingredient is justifiable. One such projection follows.

By using reasonable assumptions, arbitrary prices for machine-separated flesh can be derived. We have estimated a price of 6.25 cents per pound for fish frames delivered to the family of machine separators (Table 1), and a cost of 0.2 cent per pound using these machines (previous section). Assuming average yield of 60% for ground flesh (Table 4), value of meat at this stage is $\frac{6.45}{.60}$ or 10.8 cents per pound. (If skin and bones can be sold for meal production at one cent per pound, this figure can be reduced by 0.4 cent per pound.) Although this flesh can be used immediately, we assume it will be packaged and frozen-stored for later use in a food product. Packaging costs for labor and materials (10-pound waxed cartons in a 5-unit master case) are estimated at 2 cents per pound. Then, by adding freezing cost of one cent per pound, we obtain total value of 13.8 cents per pound for this meat. Storage costs are estimated at one cent per pound for first month, and 0.5 cent for each succeeding month. The duration of this storage period, transportation costs to final processor or user, profit, overhead, and insurance costs will vary considerably. If we assume these costs will average 20% of frozen meat's value, a final value of about 17 cents per pound is derived.

By using similar assumptions and calculations, a final value can be derived for frozen-stored meat obtained from underutilized (headed and gutted) fish. In this case, the raw material cost will be higher, say 9.1 cents per pound (Table 2), if harvesting costs have to be borne by this material. However, the yield of machine-separated meat should be higher, and an average yield of 78% is reasonable (Table 3). Using these figures, a final value of about 18 cents per pound is derived for frozen-stored meat delivered to final processor or user.

The estimated values of 17 or 18 cents per pound for this frozen-stored fish meat product ("surimi") are favorable when compared with recent prices for frozen-stored fish fillets (Table 6). The values are presumed at least comparable with poultry, beef, or pork meat.

On the basis of these value projections, it appears that several food applications are economically justifiable. Some potential applications already have been considered, although economic projections have not always been included.

Fish cakes and canned fish products have been proposed (J.M. Mendelsohn, unpublished work cited in Carver and King 1970). It has been used as a binder or matrix in fish loaf or jellied roll-type products (Carver and King 1970; Learson, et al., 1969). It has been proposed as basis for sandwich or hors d'oeuvres types of spreads (Miyauchi and Steinberg 1970). It can be used to make a beefless frankfurt or similar products (Carver and King 1970). In this application, more recent studies have demonstrated that by processing machine-separated flesh through the strainer, complete elimination of all bone particles in the product is assured and its textural quality improved.

Another potential application occurs in institutional or commercial mass feeding. These enterprises continually seek ways to maintain or upgrade nutritional quality of their menus, while holding line on ingredient costs. Several of their popular recipes, hamburgers, sloppy joes, meat loaf, American chop suey, stuffed pepper, chili con carne, or spaghetti with meat sauce, depend on ground beef for animal protein ingredient. Results of preliminary tests suggest it is possible to continue freshly prepared machine-separated fish flesh with ground beef ("hamburger") in such recipes. Currently, we are determining the frozen storage life of this minced fish flesh by combining it with ground beef in these recipes.

CONCLUSIONS

On the basis of preliminary evidence, it appears that meat/bone separators and ancillary machines could be employed profitably by U.S. seafood industry. Further exploratory work is suggested to determine storage characteristics of the ground flesh ingredient ("surimi") and to develop food applications for it.

ACKNOWLEDGMENTS

The Bibun separator and strainer were loaned to us by Food Masters, Inc., 253 Summer Street, Boston, Mass. 02210. Mr. Roger Reiser and Dr. Robert Beck gave us valuable suggestions for food applications of "Bibunized" fish flesh, as well as instruction in operating these machines.

We are grateful to Mr. David Miyauchi, Mr. Fuad Teeny, and Dr. Maynard Steinberg, Seattle Technological Laboratory, National Marine Fisheries Service, Seattle, Washington, for providing their unpublished experimental results.

Also, Mr. Edward J. Murphy, Marketing Program, National Marine Fisheries Service, Gloucester, Massachusetts, for assistance in providing economic data from commercial processors; to Dr. Frederick Bell, Dr. Bruno G. Noetzel, Mr. Richard Kinoshita, and Mr. Erwin Penn, Division of Economic Research, National Marine Fisheries Service, College Park, Maryland, for reviewing economic data.

Photographs by Mr. Robert K. Brigham, National Marine Fisheries Service, Woods Hole, Massachusetts.

REFERENCES

BARBACH, J.
1968. Harvest of the sea. George Allen and Unwin, Ltd., London, England. 303 p.

CARVER, J. H. and F. J. KING
1970. The economic potential for mechanical recovery of meat from low value fish products. Food Engineering (in press)

LEARSON, R. J., L. J. RONSIVALLI, B. W. SPRACKLIN, and F. HEILIGMAN
1969. Process criteria for producing radiation-sterilized fish products. Food Technol. 23 (8): 85-91.

MATELES, R. I. and S. R. TANNEBAUM (editors)
1968. Single cell protein. The M.I.T. Press, Cambridge, Mass. 480 p.

MIYAUCHI, D. and M. STEINBERG
1970. Machine separation of edible flesh from fish. Fishery Industrial Research 6(4): 165-171.

TANIKAWA, E.
1963. Fish sausage and ham industry in Japan, p. 367-424. In C. O. Chichester, E. M. Mrak and G. F. Stewart (editors) Advances in Food Research, vol. 12, Academic Press, New York City.

HYDROGEN SULFIDE KILLS

Richard W. Hamilton

The following is a fictionalized account of a tragic incident that we must be prepared to read as truth at some time in the future. Circumstances can and have caused it to happen. That it has not happened more frequently is plain luck.

"Dateline: Anywhere, World; Anytime, 20th Century.

"With her engines muttering, the purse seiner crawled alongside and bumped into the dock with a dull thud. Lines snaked out, slack was taken in, and tied securely. The captain, the plant manager, even the spotter pilot, crowded expectantly onto the deck to watch the unloading of the first catch in over a week. Since the plant had been operating spasmodically all summer long, the arrival of a boat with fish covering the bottom of her hold was an event with more than usual import.

"As the hose man stepped gingerly into the hold, the pumps were turned on and valves opened. In preparation for the jolt that always comes when water under pressure jets out of the black orifice at the end of a high pressure hose, the man spread his feet and braced himself. He felt the hose quiver and he involuntarily tensed himself. The water came--only it was not water. It was dark and thick. Instantaneous, unannounced, DEATH spewed out.

"Rescue attempts began immediately. A man instinctively lunged into the hold. He did not even reach his stricken comrade before he too was felled. Hooks were tried, more lunges, more limp bodies. Seven men lay unmoving in and around that ill-fated hold. Not until local authorities with gas masks arrived were rescue attempts successful. Miraculously, two men recovered; five died.

"What hellish substance caused this nightmare? Hydrogen sulfide gas." End of transmission.

THE GAS

The gas (H_2S) is composed of only two elements: hydrogen and sulfur. It is known chemically as hydrosulfuric acid. It is written symbolically as H_2S--indicating a composition of two atoms of hydrogen and one atom of sulfur. If air is assigned a density of one, then H_2S has a density of 1.186. This means that it is heavier than air and will remain in the bottom of a fish hold or storage tank.

The gas is easily detected by the human nose in extremely low concentrations. The odor--rotten eggs--may be recognized in concentrations as low as two parts per billion. One of the most dangerous and deceptive characteristics of H_2S is that it quickly fatigues the sense of smell, thereby stripping a person of his only source of warning. Concentrations as low as 10 ppm are toxic, even though 600 ppm may be survived for as long as 30 minutes. At high concentrations, collapse, coma, and death from respiratory failure may come within a few seconds after one or two breaths. Low concentrations produce irritation of the eyes, nose, mouth, and throat. Headache, dizziness, nausea, lassitude may also appear.

Another dangerous characteristic of the gas is that it has a flash point of 500° F. Thus, if H_2S is present in high-enough concentrations and comes in contact with a surface heated to this degree, an explosion and fire will result. The gas is potentially explosive in concentrations from 4.3 percent to 46 percent.

How Gas Is Produced

Hydrogen sulfide is produced in the laboratory by the reaction between calcium

The author is Microbiologist, National Marine Fisheries Service Food Products Technology Laboratory, Pascagoula, Mississippi 39567.

COMMERCIAL FISHERIES REVIEW
Reprint No. 894

sulfide and magnesium chloride. Commercially, it is manufactured by reacting dilute sulfuric acid with iron sulfide, by emiting hydrogen vapor with vaporous sulfur, or by heating paraffin and sulfur. There are many important uses for H_2S--in manufacturing other chemicals, in metallurgy, and in research laboratories.

When produced on purpose and contained, hydrogen sulfide aids mankind. When produced accidentally and not contained, it may be one of the very deadly poisons. In this latter case, hydrogen sulfide is produced biologically--primarily by bacteria. Several types of bacteria produce H_2S, but we are concerned here with only those species that can produce toxic quantities of H_2S in the fishing industry.

What conditions are necessary for the microbial production of H_2S?

1. A temperature high enough for bacteria to grow.

2. Absence of oxygen.

3. A source of organic sulfur.

When these conditions coexist, even for a few hours, biologically produced H_2S may reach toxic concentrations.

An examination of any fishery installation will reveal several areas where these conditions might exist, either intermittently or permanently. When a suspension of protein material such as fish flesh and slime is allowed to stand untreated, even for a short while, a series of events occur that will lead to the evolution of H_2S.

Initially, there is a rapid microbial growth with a twofold result: (1) an anaerobic (no oxygen) environment is created, and (2) the temperature is raised. As this microbial degradation or fermentation proceeds, even more heat is evolved, and conditions favorable for the growth of H_2S-producing bacteria come into existence. After the favorable temperatures are reached, these bacteria attack the sulfur-containing amino acids--cystine, its reduced form, cysteine, and methionine. All of these amino acids occur in fish flesh. The release of large quantities of the morbid gas--hydrogen sulfide--follows. An external source of heat, from processing or daytime temperatures, may allow the fermentation stage to be shortened or preempted with the almost-immediate evolution of H_2S.

Thermophilic (heat loving), anaerobic, sporeforming bacteria, such as Clostridium nigrificans, are everywhere; when H_2S is detected, they are usually the culprits. Other bacteria in the same genus probably better known to the public are Clostridium tetani and C. botulinum, the causes of "lockjaw" and botulism poisoning, respectively.

A Lesson In Deduction

Armed with this knowledge, we are now prepared to objectively assess conditions at the site of the tragic accident. Analyzed samples of the contents of pipes and lines leading to and from the pumps revealed the presence of a supersaturated solution of H_2S along with a tremendous amount of organic material.

Let us list all the facts we know:

1. The plant has not operated for over a week.

2. The time is mid-August with daytime ambient temperatures in sunlight as high as 105-110° F.

3. Analysis of pipe contents revealed large amounts of organic material as well as H_2S. Since this factory uses fish as a raw material, we can assume the organic substance was of animal origin; also, that it contained the sulfur-containing amino acids cystine, cysteine, and methionine.

4. The sealed pipelines afforded an anaerobic environment.

5. Whatever killed the crewmen was not present in the hold when the hose man first entered it--because neither he nor the men around the hold complained of unusual conditions.

6. No outward danger signs were present to signal impending disaster.

The inescapable conclusion: The victims succumbed to hydrogen sulfide gas--because:

1. An anaerobic environment existed in the closed pipelines.

2. The summertime temperatures were high enough to enhance, or at least allow, the growth of H_2S-producing bacteria.

3. Organic sulfur was present in the form of fish proteins.

4. Hydrogen sulfide producing bacteria are found anywhere and their presence in the closed pipeline is almost a certainty.

5. With a shut-down of over a week, there was more than enough time for a lethal concentration of H_2S to be evolved.

How To Prevent This

The sorrowful sequence of events just described need never be repeated. Even though the potential circumstances for H_2S intoxication exist in many segments of the fishing industry throughout the world, the prevention of this type of accident is extremely easy:

1. All water lines leading to and from pumps should be flushed before and after each use.

2. Stickwater, bailing water, and other such solutions should never be stored untreated. They should be processed as quickly as possible--either acidified or otherwise treated so that bacterial growth will be prevented or retarded.

3. All storage tanks should be equipped with forced air ventilation.

4. With the many relatively inexpensive H_2S-testing kits now commercially available, routine testing of potential danger areas should be a must.

FPC'S QUALITY VIRTUALLY THE SAME AS ITS RAW MATERIAL'S QUALITY

D. L. Dubrow   N. L. Brown
E. R. Pariser   H. Miller Jr.

Several years ago, the National Marine Fisheries Service (then the Bureau of Commercial Fisheries) began a program designed to produce a satisfactory protein concentrate from whole fish. The purpose was to help alleviate the protein malnutrition that affects much of the world's population and to provide an economic stimulus to the U. S. fishing industry. A high-quality protein is needed to supplement the vegetable proteins, which are the world's principal source of this important nutrient.

The use of fish for this purpose is ideal because the seas abound in unutilized species. The concept of FPC is not new. Knobl (1967) reviewed descriptions of several processing methods. Chemical methods have used isopropyl alcohol as a solvent (Guttman and Vandenheuvel, 1957; Dambergs, 1959; Power, 1964; and National Marine Fisheries Service, 1966).

Isopropyl alcohol has been shown highly efficient in removing lipid and water from raw material. A product containing high-quality protein can be obtained by isopropyl alcohol extraction of various species of fish.

Thus far, few investigations have compared the chemical composition and nutritive quality of the raw material with that of the FPC processed from it. So we have not known whether the solvent extraction and later processing produces any significant change in quality from that of raw material.

This report presents results of a comparison of FPC's chemical composition and nutritive quality with the same properties of the raw fish used as starting material.

The FPC data were obtained in early stages of National Marine Fisheries Service program, when a batch cross-current method of extraction was used. Although the present method is a straightforward stagewise countercurrent method, we have found no difference between the two methods of extraction with respect to chemical composition and nutritive value. The principal difference is in the efficiency and economy of solvent usage. For this report, the FPC data are representative of FPCs prepared by isopropyl alcohol extraction of red hake regardless of extraction method.

WHAT WE FOUND

The chemical and nutritive properties of freeze-dried whole fish and FPC (fish protein concentrate) made from red hake (Urophycis chuss) were studied. Samples of whole fish were collected during July, October, and November 1964, and January 1965. The products were analyzed for proximate composition, amino acid concentration, and protein efficiency ratio (PER).

The samples of freeze-dried whole fish showed only slight changes in chemical composition, notably in lipid content, which ranged from 9.8% to 14.2% (dry weight). The PERs ranged from equal to casein to PERs significantly better than casein (July, October, and January).

The FPC samples prepared from same catches of fish showed only slight differences in concentration of crude protein; this ranged from 86.5% to 89.9%. The PERs of these samples also ranged from equal to casein (October and November) to PERs significantly better than casein (July and January).

With the exception of the October period, FPC's nutritive quality did not differ significantly from raw material's.

The authors are with National Center for Fish Protein Concentrate, National Marine Fisheries Service, College Park, Md. 20740.
Dr. Brown's present address: National Academy of Sciences, Office of the Foreign Secretary, Washington, D.C. 20418.
Mr. Pariser's present address: Education Research Center, Massachusetts Institute of Technology, Cambridge, Mass. 02138.

COMMERCIAL FISHERIES REVIEW
Reprint No. 895

EXPERIMENTAL PROCEDURES

Raw Material

The whole red hake was chosen as raw material for this study because it is an under-utilized species and readily available to this laboratory. The fish were caught near Block Island, off Rhode Island. The hake were taken directly from net as soon as they arrived on deck and placed immediately on ice. About 100 to 200 pounds of hake from each catch were brought to the laboratory, where they were stored in a freezer at -40 C. The fish were used in a series of experiments within 3 weeks.

Product Preparation

A. Freeze-Dried Whole Fish

Because the nutritive value of raw fish is difficult to evaluate in feeding trials, we chose arbitarily to freeze-dry the fish. This technique would provide a product suitable for testing--yet one likely to be as similar to raw material as possible in chemical and nutritive characteristics.

Twenty-pound samples of the frozen whole raw hake were placed into liquid nitrogen and ground, first through a Rietz[1/] extructor, and then through a Rietz disintegrator in a stream of liquid nitrogen. The ground particles, collected in liquid nitrogen, were loaded into freeze dryer in an excess of liquid nitrogen; then they were freeze-dried at pressure of 300 to 500 μ for 24 hours. During this period, the temperature of the platen was kept at 40 C. When drying was completed, the vacuum was broken with nitrogen. Then the samples were stored under nitrogen at -20 C.

B. Fish Protein Concentrate

Hake used for FPC production were from same catch as those used for freeze drying. Each production run consisted of 20 pounds of whole hake ground through a .25-inch end plate.

The solvent used for each test was fresh 91% (v/v) isopropyl alcohol. It was mixed with fish in a ratio of solvent to fish of 2 to 1. The slurry was stirred briefly and then transferred to extraction unit. After 30 minutes, the mixture was pumped to a basket centrifuge for separation of solids. The second extraction was made by running hot solvent distillate through the solids in centrifuge basket while centrifugation continued. This extraction was continued for 30 minutes at distillate temperature of 78 C. Centrifugation continued for another 15 minutes. The third extraction consisted of a continuous extraction of solids with isopropyl alcohol. (Described by Brown & Miller, 1969.) The liquid was removed continuously from extractor and evaporated, and the condensate pumped back to the extractor. After final separation of solids, the extracted material was desolventized under vacuum at 40 C. for 16 hours. The dried product was ground through a Wiley mill equipped with a screen having 0.5-mm openings.

Product Analysis

A. Chemical Analysis

Moisture, ash, and crude protein were determined by procedures of Association of Official Agricultural Chemists (1965). Lipids were determined by method of Smith, Ambrose, and Knobl (1964); amino acids by method of Moore, Spackman, and Stein (1964); and available lysine by method of Carpenter (1960).

B. Nutritive Evaluation

Samples of freeze-dried fish were fed in amount desired (ad libitum) to male albino rats (Charles River CD strain), randomly allotted to groups of 8 rats each. The samples were added to a nutritionally adequate basal diet at 10% level of crude protein (Campbell, 1960). The gain in weight and amount of food consumed were recorded each week for 4 weeks; the PER was then calculated.

RESULTS

Freeze-Dried Whole Fish

A. Chemical Analysis

Table 1 shows the proximate composition of freeze-dried whole fish at each sampling period. The freeze-dried raw material from each catch varied in its concentration of lipid and, to a slight extent, in its concentration of crude protein. In general, the concentration of lipid was lowest in October sample--9.8%. In contrast, samples of July, November, and January catches were 14 to 15%. Thus, the

1/Trade names are used merely to simplify descriptions; no endorsement of the products is implied.

Table 1. Proximate composition of freeze-dried whole red hake (Urophycis chuss) caught during 1964-65

Date of catch		Crude protein	Lipid	Ash	Moisture
		----------------Wt %----------------			
1964:	July	74.5	13.1	12.5	3.01
	October	76.7	9.7	13.1	2.74
	November	75.0	14.2	12.7	2.88
1965:	January	75.5	13.7	11.4	3.36

Note: The crude protein, lipid, and ash are reported on the basis of dry weight.

concentrations of crude protein and ash in October fish were slightly higher than these concentrations in the other samples.

Table 2 shows amino acid composition and available lysine concentration of freeze-dried samples. A comparison of all amino acids recovered, as percent of total crude protein, revealed that 83% (October) to 92% (January) of protein can be accounted for. Undoubtedly, other components of the nitrogen--such as various amines, ammonia, urea, creatine, taurine, and anserine--could make up this difference because there is a concentration factor from raw wet fish to freeze-dried product.

Thompson and Farragut (1965) reported an observation with whole alewives (Alosa pseudoharengus). They postulated that considerable metabolic energy is used when spawning commences, and that excretory processes of fish do not keep pace. So metabolic nitrogen products build up in the body.

In our study, although physiological condition of fish was unknown, the fish caught in October exhibited a slightly higher concentration of total nitrogen (crude protein) and lower concentration of amino acids than did other samples. The concentrations of amino acids did not reveal any marked changes during sampling periods; rather, they reflected changes related to an increase in total recovery as percent of the protein. The values obtained for available lysine fluctuated from period to period and, apparently, did not reflect any trend.

B. Nutritive Evaluation

Table 3 gives the mean total weight gain, food consumed, and protein efficiency ratio values from feeding trials of freeze-dried ground hake. The differences within each catch of fish were not significant, but differences between catches were highly significant ($P < .01$). The freeze-dried fish used in diets prepared from November sampling resulted in lower PERs than did other samples. To check accuracy of these data, we did another experiment (Nov. 1964B). The results confirmed previous test: protein quality was comparable to casein. The PERs obtained with diets made of freeze-dried fish from July, October, and January were better than those obtained with casein.

FISH PROTEIN CONCENTRATE

A. Chemical Analysis

Table 4 shows proximate composition of FPCs. The crude protein ranged between 85.5 and 88.9%. Very little difference was found in protein concentrations of FPCs produced from fish in July, October, and November--but concentration increased in FPC made from January fish.

Values for total residual lipid in FPCs show that removal of lipids by solvent-extraction procedure was not affected by the fish's physiological state. However, the composition of the residual lipids, which was not determined, may reflect differences.

Table 2. Amino acid analysis and available lysine of the standard reference samples: freeze-dried whole red hake (*Urophycis chuss*)

Amino acid	Data for red hake caught on: July 1964	October 1964	November 1964	January 1965
	------------% of protein	--------------		
Available lysine	6.84	6.99	6.58	7.35
Total lysine	7.32	7.36	7.35	7.63
Histidine	1.91	1.78	1.91	1.92
Arginine	5.85	5.77	5.89	5.96
Aspartic acid	8.74	8.50	9.07	9.50
Threonine	3.82	3.68	3.98	4.07
Serine	3.86	3.75	4.00	4.08
Glutamic acid	12.67	12.62	13.64	14.05
Proline	4.52	4.09	4.27	4.57
Glycine	7.02	7.13	7.48	7.70
Alanine	6.08	5.67	6.11	6.50
Valine	4.61	4.31	4.59	4.88
Methionine	2.70	2.65	2.91	3.02
Isoleucine	3.86	3.71	4.00	4.21
Leucine	6.42	6.17	6.76	7.07
Tyrosine	2.76	2.62	2.83	3.01
Phenylalanine	3.57	3.31	3.70	3.82
Total	85.71	83.13	88.49	91.99

Table 3. Mean weight gain, food consumed, protein efficiency ratio (PER), and adjusted PER of animals fed freeze-dried ground whole red hake caught during 1964-65

Date of catch		Group	Tests	Rats/test	Weight gained Mean	Weight gained Standard error	Food consumed Mean	Food consumed Standard error	Protein efficiency ratio[1/] Mean	Protein efficiency ratio[1/] Standard error
			--------#--------		----------------g----------------					
1964:	July		6	8	159.7	2.5	377	2.0	3.39	0.04
	October		6	8	157.8	2.1	411	2.4	3.58	0.04
	November	A	2	8	131.8	2.0	419	3.1	2.90	0.03
		B	2	8	145.4	2.9	378	3.7	3.08	0.04
1965:	January		1	8	158.6	3.2	390	5.7	3.46	0.05

1/ The protein efficiency ratios were adjusted to a protein efficiency ratio of casein equal to 3.00.

Table 4. Proximate composition of FPC produced from whole fish caught during 1964-65

Date of catch		Crude protein	Lipid	Ash
		----------------Wt %	----------------	
1964:	July	86.2	0.4	14.2
	October	85.5	0.1	14.7
	November	86.1	0.3	14.6
1965:	January	88.9	0.2	12.9

Note 1: The data are on the basis of dry weight.

Note 2: Crude protein is calculated on the basis of N x 6.25.

The concentration of ash remained relatively constant (14%) for July, October, and November samples of FPC, but concentration in January sample decreased, which reflected the increase in protein.

To compare proximate composition data of FPC with those of freeze-dried whole fish, we had to place them on a moisture-free and lipid-free basis. When this was done, the values of crude protein in freeze-dried fish showed higher concentration in January than in other months. The same was true of ash concentration.

Table 5 lists results of amino acid analyses and determinations of available lysine concentrations in FPCs produced from raw fish caught during sampling periods. These data also show differences in percentage recovery, ranging from 96.0 to 102.0% of the protein. Most concentrations of amino acids either increased or decreased according to the recovery. Lysine, histidine, arginine, and proline, however, remained relatively constant. The concentration of available lysine fluctuated from period to period with no apparent trend.

In general, the major difference between amino acid concentration of FPCs, compared with that of freeze-dried samples, is the greater recovery, as percent of protein, from FPC samples.

B. Nutritive Evaluation

Table 6 shows results of feeding FPC diets to laboratory animals.

Table 5. Amino acid analysis and available lysine of FPC's produced from fish caught in different months of the year

Amino acid	Data for FPC produced from fish caught on: July 1964	October 1964	November 1964	January 1965
	---------------% of protein---------------			
Available lysine	8.09	7.87	8.19	7.70
Lysine	8.28	8.23	8.31	8.31
Histidine	2.01	1.90	1.95	1.93
Arginine	6.70	6.78	6.69	6.77
Aspartic acid	9.75	9.67	10.61	10.49
Threonine	4.28	4.21	4.58	4.56
Serine	4.32	4.23	4.69	4.65
Glutamic acid	14.38	14.39	15.83	15.62
Proline	5.10	5.13	5.13	5.18
Glycine	7.52	7.62	8.46	8.72
Alanine	6.49	6.26	6.93	7.56
Valine	5.13	4.74	5.33	5.34
Methionine	3.11	3.22	3.44	3.43
Isoleucine	4.28	4.23	4.68	4.63
Leucine	7.16	7.16	7.88	7.85
Tyrosine	3.10	3.25	3.41	3.24
Phenylalanine	3.86	3.98	4.32	4.21
Total	95.47	95.00	102.24	102.35

Table 6. Mean weight gain, food consumed, protein efficiency ratio (PER), and adjusted PER of animals fed diets of FPC produced from raw fish caught in various periods of the years 1964-65

Date of catch		Group	Tests	Rats/test	Weight gained: Mean	Weight gained: Standard error	Food consumed: Mean	Food consumed: Standard error	Protein efficiency ratio[1/]: Mean	Protein efficiency ratio[1/]: Standard error
			------#	-------	------------	------------	-----g-----	------------	------------	------------
1964:	July		6	8	151.8	2.2	365	3.9	3.34	0.04
	October		6	8	139.0	2.0	412	2.9	3.09	0.04
	November	A	2	8	130.3	4.0	418	9.2	2.85	0.07
		B	2	8	141.5	3.8	363	6.4	3.12	0.05
1965:	January		1	8	154.0	8.6	363	12.0	3.62	0.12

1/ The protein efficiency ratios were adjusted to a protein efficiency ratio of casein equal to 3.00.

According to PER values obtained from feeding trials, the nutritive values of protein in FPCs processed from same catch of fish did not differ significantly. But a highly significant difference ($P < .01$) occurred in FPCs made from different catches. The FPCs processed from July and January fish were better than those prepared from October and November fish. Furthermore, the two latter groups were comparable only with casein, whereas the former two FPCs were better than casein. Compared with freeze-dried whole fish, the differences in PER from catch to catch were similar, with exception of October fish. In this instance, the freeze-dried sample had a significantly higher PER than FPC. At this time, we are unable to explain these results.

Chemical analysis revealed little information that could be related to nutritional data.

CONCLUSIONS

The results of tests over 6 months indicated certain aspects of FPC's nutritional value are affected by the raw material. Both freeze-dried samples of fish and FPCs prepared from same fish were found to have PERs comparable with casein, whereas PERs of other samples were superior to casein. Chemical analyses of the samples failed to yield any clues as to cause of this difference.

A longer study would have been useful in providing more detailed information on seasonal changes. However, this study has shown that, with one exception, the quality of FPC is no different from quality of raw material (or, at least, of freeze-dried raw material). Furthermore, it has shown that processing with isopropyl alcohol had no significant effect on nutritive value of raw fish.

LITERATURE CITED

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS
1965. Official Methods of Analysis, 10th Ed., Association of Agricultural Chemists, Washington, D.C.

BROWN, N. L. and H. MILLER, Jr.
1969. Experimental production of fish protein concentrate (FPC) from Mediterranean sardines. Commer. Fish. Rev. 31: 30-33 (Sep. 851).

BUREAU OF COMMERCIAL FISHERIES
1966. Marine protein concentrate. Fishery Leaflet 584, U. S. Department of the Interior, Washington, D. C.

CAMPBELL, J. A.
1960. Evaluation of protein in foods for regulatory purposes. Agric. Food Chem. 8: 323-327.

CARPENTER, K. J.
1960. The Estimation of available lysine in animal protein foods. Biochem. J. 77: 604-610.

DAMBERGS, N.
1959. Extracts of fish muscle. 2. Solvent-water ratio in extraction of fat and water soluble. Fish. Res. Bd. Canada 16: 63-71.

GUTTMAN, A. and F. A. VANDENHEUVEL
1957. The production of edible fish protein (fish flour) from cod and haddock. Fish. Res. Bd. Canada, Prog. Rep. Atlantic Coast, No. 67: 29-31.

KNOBL, G., Jr.
1967. The fish protein concentrate story. Part 4. World efforts toward FPC. Food Technol. 21: 56-59.

MOORE, S., D. H. SPACKMAN and W. H. STEIN
1958. Chromatography of amino acids on polystyrene resin. Anal. Chem. 30: 1185-1206.

POWER, H. E.
1964. Characteristics and nutritional value of various fish protein concentrate. J. Fish. Res. Bd. Canada 2: 1489-1504.

SMITH, P., M. AMBROSE and G. KNOBL, Jr.
1964. Improved rapid method for determining total lipids in fish meal. Commer. Fish. Rev. 26: 1-5.

THOMPSON, M. H. and R. N. FARRAGUT
1965. Amino acid composition of the alewife (Alosa pseudoharengus). Fishery Ind. Res. 3: 47-53.

THE 1970 SALMON RUN

Joan Bergy

- - -

In June and July the run of Sockeye or Red salmon in western Alaska was one of the biggest in history. Fishermen brought in a catch of over 20 million of these fish, the second biggest since 1938. For the consumer it meant a bountiful national supply of the Reds, considered the tastiest of all canned salmon. To FDA's Seattle District and the salmon canning industry it meant weeks of careful planning and extraordinary efforts to bring this bounty quickly to the Nation's tables and assure its wholesomeness.

- - -

Out of nowhere appears the cannery, on a long coastal inlet. Behind is Seattle and the flight from Juneau, over ragged snow-clad peaks, dense coniferous forests, blue water, innumerable islands, and an incredibly gapped coastline.

The float plane lands and taxis to the dock. Here in this remote location, far from any city, an FDA inspection is about to begin. A salmon cannery is near where the fish are. Some are in major coastal cities and towns, and some are completely isolated, like this one in Alaska.

The inspector's job, evaluating how the salmon is canned, is one of the most important consumer protection tasks he will ever perform. This FDA responsibility is one shared with the Alaska Health Department, the Oregon and Washington Departments of Agriculture (in their respective States), the National Canners Association, and the United States Army and Air Force.

The cannery is a self-contained village where all work and live together, from July to mid-September, while the salmon are surging up the inlets. Here fishermen and cannery workers of a dozen nationalities or races mingle in single-purpose activity. Families are housed in the cannery village; singles stay in dormitory-style bunkhouses. Groceries and supplies are sold at cost by the cannery store but prices are high because everything must be brought in by boat or float plane.

Radio is the link with the outside. Through it pass the cannery's communications with suppliers, charter flying services, other canneries, fishermen, headquarters offices, and even physicians. Oldtimers say they used to can salmon without radio communications, but today they wonder how they ever did.

The plant superintendent welcomes the FDA inspection. He remembers the year a team of inspectors came in before the season. Together they went through the cannery and talked about sanitation and improvements that the plant later implemented. Regular FDA inspections identify deficiencies in the operation. Inspectors' reports help the superintendent and cannery do a better job.

During the night tenders have collected the fresh-caught salmon from the fishing boats and delivered the cargo to the canneries. Salmon are unloaded into steps of a vertical conveyor belt from the hold of the tender. The inspector observes the way the fish are unloaded, the sanitation of the conveyors and flumes for transporting them, whether a cannery employee is monitoring the quality of raw salmon received, and whether decomposed fish are disposed of so they will not be processed for human food.

The conveyor moves the salmon into large bins in the fish house. With a little climbing and plank walking, the inspector reaches the rim of the bin to evaluate the quality of the fish lot.

What's a good fish? Condition and appearance of fresh fish are a shiny skin with an iridescent quality, bright clear eyes, bright colored gills, no odor or decomposition or slime, firm flesh, and a firm backbone with "no creaking."

Another indicator related to quality is water markings. Fish on the way to spawning

The author is Consumer Specialist, FDA Seattle District.
Reprinted from 'FDA Papers', Oct. 1970.

grounds develop light-to-heavy water markings, or "mating colors." A Pink salmon flattens out, a hump forms on the back, and the color turns to dark olive. Chums change to a calico color, the jaw hooks, and the teeth stick out. The bodies of Sockeye turn red and the head becomes green. Salmon with moderate to heavy water markings produce a lower quality product that has less flavor.

Fish caught in gill nets have characteristic slash marks caused from swimming into the nets, catching their gills and strangling. Salmon caught in purse nets are not damaged and live until the net is drawn up like a purse string. Today the appearance and condition of the fish is judged to be good quality and the percentage of water-marked fish is low.

It's coffee time. The cannery people gather for coffee, rolls, and conversation, but the inspector stays behind to observe the washdown of equipment and general cleanup that takes place while the crew is on a break.

Medium-sized canneries are equipped to process up to 75,000 fish a day during years of big salmon runs. Larger canneries can handle more, in some cases, as many as 125,000 salmon. Species of salmon vary in size: Kings, Silvers, and Chums may weigh up to 30 pounds; Sockeyes up to 8 pounds; and Pinks up to 6 pounds.

A bonanza run of 38 million Sockeyes in the Bristol Bay area in western Alaska during the seasonal run in June and July of this year produced a catch of over 20 million fish and 1,250,000 cases of canned salmon. The sizes of runs in other salmon-producing areas were average this year. The price cannery fishermen are paid for their catch depends on the world market and where the fish are caught. Prices for whole salmon may vary from ten to twelve cents a pound for Chums and Pinks to 25 to 50 cents or more for Sockeyes.

Back to the fish house. The salmon are lined up in tracks on a conveyor belt to pass through the guillotine, where the heads are removed. The egg sacs are pulled. In a separate operation, the eggs are dipped in a brine solution, salted, and packed in wooden containers for shipment to Japan as prized salmon caviar. Not many years ago the eggs were discarded. But now they are an important part of the operation and might bring as much as $5 a pound at retail in Tokyo. Even though the eggs are for export, FDA inspects some of the operations for sanitation.

The conveyor moves the salmon to the Iron Chink, an ominous machine that butchers the fish by slitting open the belly, removing the intestines and other organs, and lopping off the fins and tail. Before the invention of the Iron Chink in 1905, a fast "slitter" could hand butcher some 2,000 fish in a 10-hour day. Most people said then that a mere machine could not beat such a record, but one Iron Chink succeeded in replacing six slitters. Fish scales are removed by a brush and rinse operation. At the sliming table salmon are sorted into one group ready for canning and another for touch-up butchering and trimming.

When the salmon are butchered, the inspector looks for evidence of decomposition by smelling the insides, noting the firmness of the flesh, and evaluating its color. Decomposed fish become soft, the ribs and backbone separate from the flesh, the body wall turns red (termed "belly burn") and a strong fishy odor is present.

The inspector, whose mission is to protect the consumer, must keep in mind that the product moving through hands and equipment is food that will be eaten. Are aprons, gloves, plastic cuffs, and slickers kept clean by washing off with chlorinated water at intervals? Are workers' heads covered with hairnets, hats, or scarves? If pieces of fish fall on the floor, are they discarded or thoroughly washed before being returned to the processing line? Are cutting boards smooth instead of gouged or worn, and are they sanitized daily?

Wooden equipment is a potential enemy of sanitation, for it can harbor bacterial contamination. Are tables and bins constructed of stainless steel or other nonabsorbent material? Are all surfaces and utensils that come into contact with the product cleaned as frequently as necessary to prevent contamination? The inspector gives extra attention to these points.

It's time to can. But first, reforming machines are shaping the cans that soon will be filled with salmon. The cans are shipped flat, without lids or bottoms. The golden containers, now formed and bottoms fitted, are ready for salmon and file down a conveyor. Salt and perhaps salmon oil is added. The slicer machine cuts salmon to size and the filler machine places it in the can. At some canneries the cans are weighed automatically and those that are underweight are rejected. At others the weighing is done manually. "Patch girls" add more salmon to the underweights, weigh them again, and send them on. Employees remove any bone or skin hanging over the sides of the cans. The tempo is fast. The lines at this cannery pack 240 to 250 cans per minute.

Clean machinery is one of the inspector's primary concerns. The inspector probes the interior of the filling machine in search of decomposed salmon or other filth. He checks to see if the plant has a written cleanup schedule and whether conveyor belts and machinery are thoroughly scrubbed and sanitized after each day's operation. If he observes decomposed fish, he can collect samples. If he notices unsanitary conditions, he will record it with his camera.

The sealing operation is critical. The can and cover are aligned in the lidder machine where the flared top of the can and the lid are loosely joined in the first step in making the top can seam. These cans are then conveyed into the sealer where the seam is completed under a vacuum. This final seaming operation presses out the seam and forces the sealing compound into the contact areas. The cans emerge from this machine with an internal vacuum and a seam that will maintain the contents commercially sterile. The old method of producing a vacuum was to punch a hole in the hot can after processing. Juice and steam would squirt high in the air. Then before the can cooled a drop of solder was placed over the hole. This primitive method was eliminated by a system of exhaust boxes which heated the open top cans. The invention of vacuum closing machines replaced the exhaust boxes.

Employees are required by the cannery rules to examine can seams at regular intervals and to keep records on their findings. The FDA inspector visually inspects seams on sealed cans by running a finger around the edge to detect roughness, unevenness, or sharpness. He examines different code lots and determines if there are any defective cans.

Gondolas or stacks of trays transport the sealed cans into large retorts for processing under steam pressure. The National Canners Association recommends processing times based on time-temperature studies designed to establish optimum conditions for producing a safe product. Half-pound cans are processed at 240° F. for either 75 or 80 minutes depending on whether they are to be air cooled or water cooled. Processing times are long to destroy any food poisoning organisms that might be present and also to soften the bones.

Each canning retort is equipped with continuous recording time-temperature thermometers and a standardized mercury thermometer. Retorting records and can-seam examination records for code lots are kept on file two years. The FDA inspector carefully reviews retort records because undercooked salmon may result in serious spoilage. Another check point for the FDA inspector is to ascertain if an employee is reviewing and endorsing all records at the end of processing of each code lot.

Cooling of the cans may be done in the retort with cold water or by air cooling outside the retort. All water used for cooling must contain one part per million residual chlorine to prevent possible recontamination of the sterilized cans.

Generally, cans are not labeled but are stored to await shipment from Alaska to ports in the contiguous States via barge or steamship. In cannery lingo, cans are shipped 'bright' (unlabeled). Depending on the cannery and the holding procedures used prior to canning, such as storage in ice, refrigeration, or freezing, it takes eight hours to several days for the salmon to make its way from the water to the inside of a can.

Some canneries generate their own electrical power and provide a water system, and all develop pest control measures and engineer waste disposal. The inspector is concerned with the operation of these systems as they affect the quality of the food produced.

The potability and constancy of the water supply is crucial because water is in contact with the fish throughout processing. The recommended practice is to use fresh water for the entire operation. In areas where water is in short supply, sanitized sea water is permitted during the preliminary operations in the fish house. After fish are butchered, fresh sanitized water must be used. The inspector reviews the kind of water used, the operations of the chlorinator unit, the daily records on the level of chlorine residual in the water, and the construction of the water system.

Pests are controlled by several means, but screens, closed doors and windows, and buildings in good repair are the best deterrents of all. Inspections include review of the measures taken to exclude pests and a check for evidence of bird and vermin activity both inside and outside the plant.

Sewage disposal is checked for routes of possible contamination. Discarded fish parts, referred to as "gurry," attract pests when disposed of close to the shoreline. To solve this problem one cannery has a barge that collects solid gurry and several times a week the barge tows it out to sea and unloads it. Others grind it up and pump it out into the bay area. This problem of solid waste disposal is a major one the industry must solve before 1972 to meet Federal and State standards for water quality that go into effect at that time.

It's been a long day. The inspector and the plant superintendent sit down to discuss the inspection report. Because FDA's job is to assure that the food is processed under optimal conditions, the discussion focuses on deficiencies in the operation and plant improvements noted since the last inspection and other satisfactory conditions. The inspector supplies a list of his observations to the plant manager and invites discussion on any questions about his findings.

The inspection is over but the effort to provide the consumer with a quality product continues.

The Canned Salmon Control Plan, grandfather of all FDA voluntary compliance programs, made its debut 34 years ago. In the words of the National Canners Association, it is "an expression of a desire on the part of the salmon industry to improve the quality of its product and to restrain from the market any portion of its pack considered unmerchantable from any cause."

The plan represents a cooperative effort on the part of the Food and Drug Administration, the salmon canners, and the National Canners Association whereby the canners agree to submit their product to the scrutiny of the NCA for a determination of its fitness for food and FDA grants an exemption from technical requirements of the law by permitting unlabeled cans to be shipped to facilitate buyer labeling at distribution points.

Under the leadership of Franklin D. Clark, Regional Food and Drug Director, Seattle, and Walter Yonker, Director, Northwest Research Laboratory, National Canners Association, the plan calls for a minimum of one annual inspection of all member plants by FDA and NCA. Plants must meet minimum requirements as described concerning raw materials, plant sanitation, water supply processing, finished product, waste disposal, and sanitary and operational procedures.

If a plant is operating under conditions that do not meet these requirements as reported by the NCA or FDA inspectors, the Regional Food and Drug Director confers with NCA and the packer on the problems and if conditions warrant it the firm is suspended from the plan. A follow-up inspection is made to determine if improvements have been made. A plant may be reinstated if it meets the requirements of the plan; if not, the suspension continues and the product is subject to regulatory action by FDA. The consumer benefits from the twofold protection of the plan and the law.

This year, 78 canneries who produce more than 99 percent of the Nation's canned salmon are participating in this voluntary plan. The FDA's Seattle District expects to expend a total of six man-years of inspectional, analytical, and administrative time in carrying out its responsibilities under the plan and inspecting canneries that are not participating in the program.

Quality is the goal of the Canned Salmon Control Plan. In addition to inspections the Northwest Research Laboratory of the National Canners Association at Seattle examines representative samples of every code lot of canned salmon.

Check points in this evaluation include decomposition, can seams, measurement of vacuum, net weight of contents, ratings on color and amount of oil and liquid, presence of water markings and bruises or other handling marks, and evidence of poor cleaning or filling. The code lot is given a rating which serves as a "report card" to the cannery and to companies buying the product for their labels.

Is the plan working?

Over the years significant improvements have been made in the Canned Salmon Control Plan. Within the past three years the NCA has placed increased emphasis on finished product examination to pick up conditions, such as decomposition, that would make the code lot unmerchantable for any reason.

Statistics on the results of the NCA examination of every code lot demonstrate that the quality of the pack has improved.

FDA inspection reports indicate that the general level of sanitation has risen with the increased emphasis on cleanup schedules and procedures. Inspectors report a change in plant attitude: they say there is more awareness of the need for sanitation in all phases of the operation.

An estimated half-million dollars has been spent by industry on improvements in the past four years. Processing plants, once burdened with worn wooden equipment in years past, have become showplaces of the industry.

The record is still not perfect, but in the words of Mr. Clark, "We have a lot less trouble now than before."

During 1970 some 65 to 75 million salmon are expected to be harvested from the waters of Alaska, Washington, and Oregon. If the catch materializes, 3.75 million cases of canned salmon will be produced to stock the shelves of every grocery store in America.

Results of Northwest Research Laboratory's Examination of Canned Salmon

	Total Pack In Cases	Number of Cans Examined	Number of Cases Reconditioned	Number of Cases Destroyed
1967	3,225,000	167,272	12,448	2,324
1968	4,100,000	303,040	18,642	1,948
1969	3,250,000	167,393	6,395	13

SURFACE TUNA-SCHOOL FISHING & BAITING AROUND SAMOA ISLANDS

Thomas S. Hida

The NMFS research vessel 'Charles H. Gilbert' returned to Honolulu on April 14, 1970, after completing a series of offshore and inshore surveys around the Samoa Islands. One of her primary missions was to survey the distribution and abundance of surface tuna schools through visual observations, trolling, and live-bait pole-and-line fishing. In the vicinity of the islands, 144 schools were seen. These included 28 skipjack tuna, 11 yellowfin tuna, and 10 mixed yellowfin-skipjack tuna schools.

Most of the observations and all of the live-bait fishing were carried out during the offshore surveys. Baiting was carried out in conjunction with live-bait pole-and-line fishing.

Other objectives accomplished by the 'Gilbert' included: (1) collecting blood samples from 216 skipjack tuna, Katsuwonus pelamis, and 26 yellowfin tuna, Thunnus albacares, for subpopulation studies; (2) making thirteen 30-minute surface plankton tows with a 1-meter net for larval tuna studies; (3) tagging and releasing 840 skipjack and 91 yellowfin tunas for growth and migration studies, and (4) conducting 35 inshore bottom fishing stations and a few miscellaneous stations in cooperation with the Government of American Samoa.

Because reports dealing with baiting and pole-and-line fishing near Samoa Islands are scarce, the cruise findings regarding these operations are presented in detail. (The results of the four other objectives will be reported elsewhere.)

OFFSHORE SURVEY

Pole-and-Line Fishing

A total of 144 schools was sighted in the area covered by two offshore surveys (fig. 1). In most instances, schools were accompanied by bird flocks composed of a few to over 1,000 birds. Birds most commonly associated with the schools were terns, boobies, and shearwaters. Schools sighted were identified as: 28 skipjack tuna, 11 yellowfin tuna, 10 kawakawa, Euthynnus affinis, 10 mixed yellowfin and skipjack tunas, 1 mixed kawakawa, dolphin, Coryphaena hippurus, and shark (unidentified), and 84 unidentified. The locations of the schools, with dates, are given in table 1. Many schools seen were not investigated because they were too far away, too fast or too small; more schools would have been fished had there been more live bait available. Sixteen schools were successfully fished. The catch included 1,075 skipjack tuna (4 to 17 pounds), 160 yellowfin tuna (2.5 to 60 pounds), and a few other fish. The locations of the tagged tuna releases are indicated with a "T" in figure 1.

Only 12 of the schools sighted were estimated to be large. Information on these schools, estimated to be over 50 tons, is given in table 2. Five were "breezers," six were "boilers," and one, which was loosely schooled over a wide area, was designated as a "jumper" (see Scott,[1] 1969 for school descriptions). Activity of the "boilers" was not intense, with fish breaking surface only in small patches in pursuit of forage. Six of the schools had 5-10 pound skipjack tuna, two schools were of 20-50 pound yellowfin tuna, and four were mixed schools of 5-11 pound skipjack tuna and 5-60 pound yellowfin tuna. Locations of the large schools are indicated in figure 1 with an "X".

Trolling

Surface trolling was conducted with four lines during most of the daylight runs. Identification of schools and size of fish were often determined by troll-caught fish, especially during the second offshore survey when there was a shortage of live bait aboard the

Mr. Hida is Fishery Biologist, National Marine Fisheries Service, Southwest Region, Hawaii Area Fishery Research Center, Honolulu, Hawaii 96812.

1/ "Tuna Schooling Terminology," James Michael Scott. Calif. Fish Game 55(2): 136-140. 1969.

COMMERCIAL FISHERIES REVIEW
Reprint No. 896

Table 1.--Noon Positions, Dates and Number and Kinds of Schools Sighted Around the Samoa Islands During Cruise 117 of the 'Charles H. Gilbert'

Noon Position		Date	Number of Schools Sighted[1/]						
Lat. (S.)	Long. (W.)	1970	SJ	YF	KK	Mixed YF, SJ	UN	Mixed KK, DO, SK	Total
12°00'	169°15'	2/8	-	-	-	-	4	-	4
South of Pago Pago		2/11	-	-	-	-	5	-	5
16°55'	170°45'	2/12	2	1	-	-	4	-	7
16°03'	170°13'	2/13	4	-	-	-	2	-	6
14°33'	170°23'	2/15	2	-	-	-	2	-	4
14°30'	169°22'	2/16	-	1	-	1	3	-	5
13°37'	169°24'	2/17	-	-	-	-	1	-	1
14°09'	171°00'	2/23	-	-	1	-	2	-	3
14°27'	171°45'	2/25	1	-	-	-	-	-	1
13°49'	173°15'	2/26	-	3	-	2	4	-	9
13°50'	172°08'	2/27	-	-	2	-	3	-	5
14°12'	172°12'	3/1	1	1	1	1	1	-	5
14°45'	171°02'	3/2	1	-	-	-	5	-	6
14°19'	170°36'	3/5	-	-	-	-	3	-	3
14°18'	170°35'	3/6	-	-	-	-	4	-	4
14°19'	170°39'	3/10	-	-	1	-	1	-	2
14°17'	170°53'	3/11	-	-	1	-	-	1	2
14°51'	170°30'	3/14	2	-	-	-	1	-	3
14°11'	170°14'	3/18	-	2	-	-	4	-	6
14°02'	169°22'	3/19	-	-	-	2	4	-	6
14°39'	168°36'	3/20	4	-	-	1	2	-	7
14°38'	170°14'	3/21	3	-	-	-	5	-	8
14°25'	170°47'	3/23	3	-	-	-	4	-	7
15°42'	170°45'	3/24	-	-	-	-	2	-	2
14°23'	170°35'	3/25	-	-	-	-	1	-	1
14°15'	170°56'	3/26	2	1	1	1	4	-	9
13°46'	171°45'	3/27	-	-	-	-	2	-	2
13°42'	173°08'	3/28	1	1	-	-	3	-	5
14°15'	172°29'	3/29	-	-	1	-	5	-	6
13°44'	171°50'	3/31	-	-	2	2	1	-	5
15°03'	171°16'	4/1	2	1	-	-	2	-	5
Total			28	11	10	10	84	1	144

[1/] SJ = skipjack; YF = yellowfin; KK = kawakawa; UN = unidentified; DO = dolphin; SK = shark.

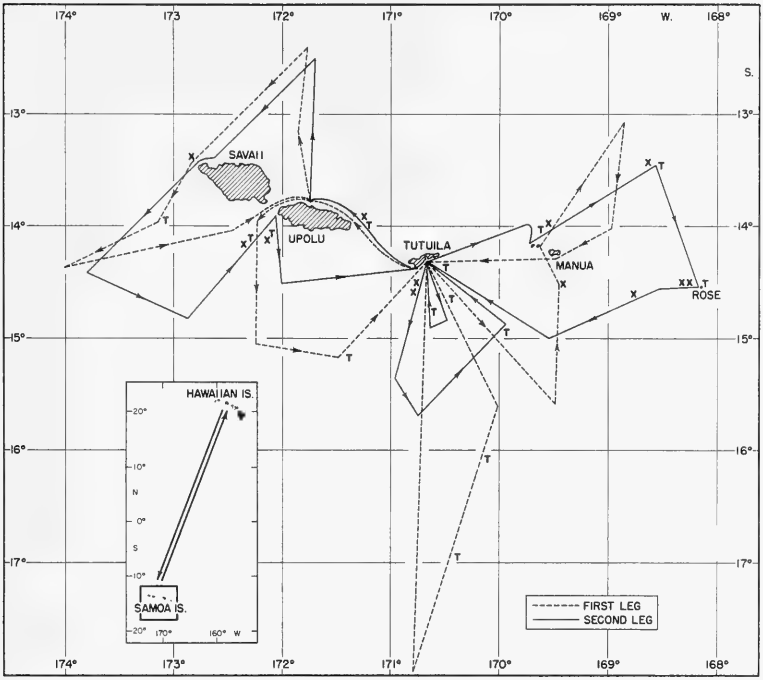


Fig. 1 - Offshore survey track chart, 'Charles H. Gilbert' cruise 117, January 30-April 14, 1970, showing locations of tag releases "T" and large schools "X."

'Gilbert'. The troll catches included 46 skipjack tuna, 30 yellowfin tuna, 31 kawakawa, 2 dolphin, and 1 shortbill spearfish, Tetrapturus angustirostris.

Environmental Conditions

The surface temperatures recorded by expendable and mechanical bathythermographs around the Samoa Islands during the survey ranged between 28° and 30° C. The thermocline depths were usually 30 to 60 meters ranging from 20 to 78 meters. The thermocline was not as "sharp" as that encountered in the Equatorial Countercurrent and the eastern tropical Pacific. Temperatures were typically 25°-27° C. at a depth of 100 meters; 20°-23° C. at 200 meters; and 15°-16° C. at 300 meters. The weather changed rapidly in the area, with seas mostly moderate and winds usually blowing from points between northeast and southeast. The water color was the typical deep blue of the open tropical Pacific.

Transported Bait

Prior to leaving Honolulu, 135 buckets of threadfin shad, Dorosoma petenense, were loaded into three baitwells aboard the 'Gilbert' for use as live bait in pole-and-line fishing. The shad had been acclimated to sea water and were held in swimming pools for several months prior to the cruise. Shad mortalities were high during the rough 10-day voyage to Samoa. Only 30 buckets survived, but these worked well as chum during the first offshore survey for as long as they were available.

Table 2.--Information on Large Tuna Schools Seen in the Vicinity of the Samoa Islands During Cruise 117 of the 'Charles H. Gilbert'

Position Lat. (S.)	Position Long. (W.)	Date 1970	Species Common Names of Tuna	Fish Size Pounds	Type of School[1/]
14°30'	169°21'	2/16	Yellowfin	20-50	Boiler
13°25'	172°45'	2/26	Yellowfin	30-40	Boiler
14°09'	172°11'	3/1	Yellowfin-Skipjack	7-16	Boiler
14°12'	169°35'	3/19	Yellowfin-Skipjack	5	Breezer
13°30'	168°41'	3/19	Skipjack Yellowfin	11 60	Breezer
14°39'	168°25'	3/20	Skipjack	10	Boiler
14°37'	168°25'	3/20	Skipjack	10	Boiler
14°45'	168°51'	3/20	Skipjack	6	Boiler
14°26'	170°42'	3/23	Skipjack	8	Breezer
14°27'	170°46'	3/23	Skipjack	7-8	Breezer
13°54'	171°21'	3/26	Skipjack	5	Breezer
14°12'	172°04'	3/31	Skipjack Yellowfin	6 9	Jumper

[1/] See Scott, 1969 for school terminology.

INSHORE BAIT SURVEY

Tutuila, American Samoa

Bait scouting was conducted from the shore in Tafuna, Alofau, and Fagasa Bays. Baiting conditions were poor in all three localities and suitable baitfish scarce. Therefore, baiting was confined to Pago Pago Harbor. A night light was submerged a few feet below the sea surface whenever possible in Pago Pago Harbor in depths ranging from 13 to 20 fathoms. Only eight sets with a lampara net were made around the light. No set was made unless an accumulation of baitfish was seen under the light.

A total of 54 buckets of a mackerel, Rastrelliger kanagurta, 22 buckets of sardines, Sardinella melanura and Herklotsichthys punctatus, and 4 buckets of bigeye scad, Trachurops crumenophthalmus, was caught night baiting. Small jacks, silversides, mullets, and a few other fish were also caught. Juvenile bigeye scad were not caught in large quantities, although it was the most common fish hooked by natives in the harbor.

Most Rastrelliger and sardines were 5 to 7 inches long and were considered too large to be an effective live bait for small skipjack tuna. Problems were encountered in trying to keep Rastrelliger alive in the baitwells. On two occasions, after a few hours in the baitwells, they began surfacing in convulsive movements, turned on their sides and sank to the bottom. Mortality was very high and believed to be the result of oxygen deficiency. Unlike the other bait species, this larger baitfish could not be crowded into the baitwells.

Thirty-one sets were made with a bait seine (22 feet deep by 80 fathoms long) in 8 days of baiting in Pago Pago Harbor. Eighty-eight buckets of sardines, the most prevalent species, were caught; the largest catch in one set was 20 buckets. A few silversides, juvenile jacks, surmullets, mullets, anchovies, tangs, and puffers were also caught in the seine. A few attempts to set on Rastrelliger during the day in the deeper parts of the harbor were unsuccessful because they swam under and out of the seine before it could be pursed.

In summary, the most common baitfish found in Pago Pago Harbor with possibilities as a live bait was Rastrelliger, followed by sardines. The harbor was deep, mostly over 13 fathoms, and offered fairly good baiting conditions. Day seining for Rastrelliger would probably be more effective using a seine 30-40 feet deep. At the time of the surveys, most Rastrelliger and sardines were larger than desired as chum for small skipjack tuna. It is assumed that they would have been smaller and more suitable as live bait had the survey been conducted a few months earlier. Also, smaller ones may prefer areas other than Pago Pago Harbor and may have eluded detection during this survey.

Upolu, Western Samoa

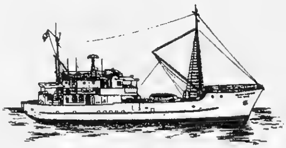
In Western Samoa, bait scouting was limited to Apia Harbor. Little bait was evident around the main dock area and the adjacent shoreline, but the shallower and sandier grounds along the northwestern shores of the harbor appeared more suitable for baiting.

Observations under night lights showed a scarcity of suitable baitfish. Only a few mullet and schools of tigerfish (Theraponidae), which were too large for use as live bait, were attracted to the light. Five daytime seine sets were made in the harbor. The catch included 13 buckets of large (3-4 inch) silverside, tentatively identified as Hepsetia pinguis (Lacepède), and 5 buckets of small (2.5-inch) sardines. The silverside died in the baitwell before they could be used for fishing, probably affected by the long skiff ride from baiting area to vessel. The sardines, on the other hand, did very well in the baitwell and were effective as chum.

Baiting was poor in Apia Harbor during the survey. Further scouting should be conducted in other areas and at different times to better assess the live-bait resources of Western Samoa.

ACKNOWLEDGMENTS

Mr. Peter Whitehead of the British Museum (Natural History) was kind enough to identify the sardines from samples sent to him. Mr. Susumu Kato of NMFS, Fishery-Oceanography Center, La Jolla, Calif., and Mr. Hiromu Heyamoto of NMFS, Exploratory Fishing and Gear Research Base in Seattle, reviewed this paper.



AIRBORNE LOW-LIGHT SENSOR DETECTS LUMINESCING FISH SCHOOLS AT NIGHT

Charles M. Roithmayr

The National Marine Fisheries Service (NMFS) is aware of the need for new and improved methods of assessing fish stocks. Fishery data are inadequate because they have produced wide-ranging population estimates. Systematic appraisals of world fish stocks vary from 55 to 2,000 million metric tons; obviously, this wide range is not suitable for management purposes.

NMFS presently assesses fish stocks from samples caught by research and commercial vessels. The evasive behavior of fish caused by vessels and gear often results in considerable bias of the catch rate. Stock assessment is difficult because the samples are collected with few vessels in a small area over a long period. The most reliable assessments are based on collections over a large area in a short time. Any new assessment method requires more accurate and rapid detection. All indications point toward use of remote sensors to collect the information required to assess and manage the Nation's fishery resources.

Detection of pelagic fish schools from aircraft is well established in the world's commercial fishing. In Florida, spotters often fly as low as 300 feet to detect Spanish mackerel schools that blend with coral bottom and submerged vegetation. In California, night and day operations ranging 125 miles or more offshore are conducted with single-engine aircraft. During the dark of the moon, the fish spotter may remain in the air from dusk until dawn searching for luminescing schools of tuna and anchovy (Squire, 1961 and 1965). Airborne remote sensors are needed that can rapidly detect fish schools day and night.

REMOTE SENSORS

Remote sensors are instruments that extend man's visual abilities far beyond normal range. With radio telescope, he explores objects far out in space. Television cameras mounted in satellites can spot a hundred-foot object on earth from 500 miles. By extending his senses with such devices, man can locate targets that he cannot observe directly.

NMFS scientists at the Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi, in cooperation with National Aeronautics and Space Administration (NASA) Spacecraft Oceanography Project, are testing airborne sensors to detect and identify fish schools in daylight and at night (Peace and Drennan, 1969; Drennan, 1969; Benigno, 1970).

The sensors include aerial cameras (Bullis, 1968; Bullis and Pease, 1968), spectrometers to measure reflectance spectra of fish schools and associated fish oils (Bullis and Thompson, 1970), and low light sensors to detect schools from high altitudes at night. Background information on bioluminescence and the results of tests with low-light sensors are presented here.

BIOLUMINESCENCE IN THE SEA

Bioluminescence is light produced by living animals and plants comprising thousands of species of marine organisms, including plankton. The lanternfishes and euphausiid shrimp that predominate in the deep scattering layer possess luminous organs.

Direct observations and the use of sensitive underwater photometers reveal the universal occurrence of bioluminescence in the oceans. The phenomenon occurs in all temperate seas, particularly during warm season. It occurs more often and with greater intensity throughout the year in tropical and subtropical seas. Studies in the Atlantic and Indian Oceans, and in the Mediterranean Sea, have shown luminescent organisms always present

Mr. Roithmayr is Fishery Biologist, National Marine Fisheries Service Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi 39567. Contribution No. 240.

COMMERCIAL FISHERIES REVIEW
Reprint No. 897

where measurements were made with underwater photometer (Clarke and Wertheim, 1956; Clarke and Breslau, 1959; Clarke and Kelly, 1964).

The major concentrations of luminescing organisms are in the upper 100 meters, usually within the lighted zone, and in waters where most pelagic fishes abound. Population densities of luminescent organisms vary considerably. The maximum concentration reported for Phosphorescent Bay, Puerto Rico, was 7,600 cells per liter (Clarke and Breslau, 1960); cell densities as high as 220,000 per liter were found in Oyster Bay, Jamaica, in the West Indies (Seliger, Fastie, Taylor, and McElroy, 1962). The luminous dinoflagellate, Pyrodinium bahamense, is the most abundant organism in both bays.

Most bioluminescence in the sea is caused by dinoflagellates that emit light when stimulated. The light is produced by a biochemical reaction catalysed by a specific enzyme in the presence of water and oxygen. Light-emitting luciferin is oxidized by the enzyme luciferase, and some luciferin molecules absorb energy and thereby reach excited state. When stimulated, each molecule of luciferin releases one photon (unit) of light. If sea water is stirred, the luminous discharges of individual microorganisms look like sparkling crystals. If the water is agitated rapidly, the points of light emitted by dinoflagellates fuse into a bright glow. Turbulence resulting from the swimming motion of fishes provides the mechanical stimulation that outlines their bodies with light, and leaves behind a luminous trail.

What Low-Light Sensor Achieves

Visual observations and feasibility tests using an airborne low-light sensor during moonless periods show that: 1) bioluminescence associated with fish schools makes the schools conspicuous; 2) the perimeter of the school is usually well defined; and 3) the school is detectable to sensor and television camera from aircraft at 5,000 feet.

Potential applications of low-light sensor include detecting herring, sardine, mackerel, and tuna schools at night on traditional grounds where luminescing schools are known to occur; observing the reaction of fish to bioluminescence associated with fishing gear; and to make "real-time" observations as part of a remote sensing system in exploratory fishery-resource assessment.

PRACTICAL SIGNIFICANCE OF BIOLUMINESCENCE IN COMMERCIAL FISHERIES

1. Pacific Sardine (Sardinops caerulea)

Bioluminescence has been used in detection and capture of sardine schools off the U.S. Pacific Coast. Once the most important fishery in the western hemisphere, it is now under a moratorium due to the absence of commercial concentrations. The greatest catch occurred in 1936-37: 790,000 tons landed. It is still fished off Mexico's Pacific coast.

The sardine schools are located by their luminous glow during moonless periods. Before the new moon, fishing occurs from one hour after sunset until moonrise and, during the new moon, from one hour after sunset until one hour before sunrise. Following the new moon, fishing is done from moonset until one hour before sunrise. On the average, 19 nights are fished during each lunar period during sardine season. Before new moon, good catches are made from one hour after sunset until moonrise; after new moon, the best fishing occurs immediately after moonset (Scofield, 1929).

The seiner passes close to the glow to assess school's extent and density. Identification of species is determined by luminescent trails left by individual fish darting from vessel. Sardines show long rocket-like streaks, smelts swim in "S"-shaped curves, and anchovies display short spurts (Higgins and Holmes, 1921).

The lampara seine used is particularly efficient because its webbing stimulates organisms to luminesce as it is pulled through water. The fish, frightened by bright glare associated with fibers, are herded into bag. As wings are pulled in, a "scarer" consisting of several paddles on a long rope is raised and lowered through the water. The luminescence produced by the whirling paddles frightens fish away from net opening, thereby preventing their escape.

2. Skipjack (Katsuwonus pelamis), Yellowfin Tuna (Thunnus albacares), Bluefin Tuna (T. thynnus)

In the eastern Pacific, luminescing schools of skipjack, yellowfin, and bluefin tuna are sighted by spotters aboard tuna purse-seine clippers during dark of the moon.

Table 1. Summary of Commercial Fishes Detected by Luminescence

	East Pacific	West Africa	Gulf of Mexico	Gulf of Maine
Coastal:	sardine (*Sardinops caerulea*)	sardine (*Sardinella aurita*)	thread herring (*Opisthonema oglinum*)	herring (*Clupea harengus*)
	anchovy (*Engraulis mordax*)	herring (*Sardinella eba*)	Spanish mackerel (*Scomberomorus maculatus*)	mackerel (*Scomber scombrus*)
	mackerel (*Scomber japonicus*)	mackerel (*Scomberomorus maculatus*)	bluefish (*Pomatomus saltatrix*)	butterfish (*Poronotus triacanthus*)
	smelt (*Atherinopsis californiensis*)		menhaden (*Brevoortia patronus*)	menhaden (*Brevoortia tyrannus*)
	saury (*Cololabis saira*)		ladyfish (*Elops saurus*)	
	jack mackerel (*Trachurus symmetricus*)		bluerunner (*Caranx crysos*)	
			tarpon (*Megalops atlantica*)	
Oceanic:	bluefin (*Thunnus thynnus*)	yellowfin (*Thunnus albacares*)		
	yellowfin (*Thunnus albacares*)	skipjack (*Katsuwonus pelamis*)		
	skipjack (*Katsuwonus pelamis*)			

	Mediterranean Sea	Caribbean Sea	Australia	North Sea	Indian Ocean	South Africa	Philippine Islands
Coastal:	sardine (*Sardinella aurita*)	sardine (*Sardinella* either *anchovia* or *brasiliensis*)	pilchard (*Sardinops pilchardus*)	herring (*Clupea harengus*)	mackerel (*Rastrelliger kanagurta*)	pilchard (*Sardinops ocellata*)	sardine (*Sardinella fimbriata*)
	mackerel (*Scomber scombrus*)					maasbanker (*Trachurus trachurus*)	

All lights, except for navigation, are extinguished while searching. The spotter in crow's nest periodically flashes a high-powered spotlight over the water. When beam passes over a school, disturbance of the fish causes a bioluminescent glow called a "fireball" (Scott 1969). Generally, the glow is uniform throughout school. "Popper" refers to a fireball school in which brilliant bursts of light are caused by activity of individual fish. Before purse seine is set, the fishermen identify the species--because anchovy and jack mackerel also cause bioluminescence. The large luminescent outlines usually distinguish tuna from other fishes.

More Susceptible to Night Capture

The logbook records of Pacific tuna purse seiners show that luminescing schools of skipjack, yellowfin, and bluefin tuna were more susceptible to capture at night (Whitney, 1969). Only 50 to 54 percent of daylight sets were successful, while night sets ranged from 69 to 77 percent. The average night catch of yellowfin tuna during dark of the moon is about the same as during the day, about 14 or 15 tons per set. Off southern California, spotter pilots rely on bioluminescence to detect tuna schools between September and June. At night, they fly only when moon is dark, before the moon rises, or when moon is overcast. As verified by ship sonar, schools have been seen from aircraft as deep as 35 fathoms.

3. Atlantic Mackerel (Scomber scombrus)

In the Gulf of Maine, bioluminescence helps purse-seine fishermen detect and catch mackerel. Luminescent patches associated with moving schools are visible at depths to 10 fathoms during moonless periods (Sette, 1950). Fishermen scouting at night can identify at least four species according to type of luminescence. Long brilliant streaks indicate Atlantic mackerel, starlike flashes identify butterfish, bright zig-zag lines characterize Atlantic herring, and a dim glowing sphere is recognized as a school of Atlantic menhaden.

4. Atlantic Herring (Clupea harengus)

Maine stop seine fishermen are most active at night when searching coves to locate herring by their "fire". They follow the luminous trails until the school enters a shallow inlet, where it can be trapped.

5. Spanish Mackerel (Scomberomorus maculatus)

During night fishing in Florida coastal waters, the vessel cruises at 5 knots in areas where luminescing schools of Spanish mackerel are likely to be seen. The captain periodically flashes a spotlight, and the fish show the "fire" produced by their sudden movements. Catches of 10,000 to 20,000 pounds per set are not unusual.

6. California Anchovy (Engraulis mordax)

Off California, schools surface at night and are visible as luminous spots (Messersmith, Baxter, and Roedel 1969). The schools expand as dawn approaches. Night catches up to 160,000 pounds per set have been made using purse seines.

7. Thread Herring (Opisthonema oglinum)

Spotter pilots have seen large luminescing schools of thread herring as far as five miles off Florida's southwest coast.

DEVELOPMENT OF LOW-LIGHT SENSORS

Research by the U.S. Army Electronics Command on night-time search and identification of enemy targets has produced the starlight scope. Unlike the infrared sniper scope, it needs no light of its own. It uses only natural light (moonlight, starlight) or the faint luminescence of decaying jungle foliage. It amplifies light 40,000 times and transforms darkest night into day. The heart of the starlight scope is the image-intensifier tube (Fig. 1), which consists of several bundles of very thin glass fibers. Each fiber transmits light in a straight line down length of fiber, which prevents both distortion and leakage. The scope's objective lens focuses the light against a chemical film that discharges electrons. These electrons, boosted by a 15,000-volt electrostatic field, impact onto a phosphor-coated screen whose light then loosens additional electrons. The process is repeated three times. The high-voltage electron acceleration produces a brighter image at the ocular lens. The only power source is a small built-in battery.

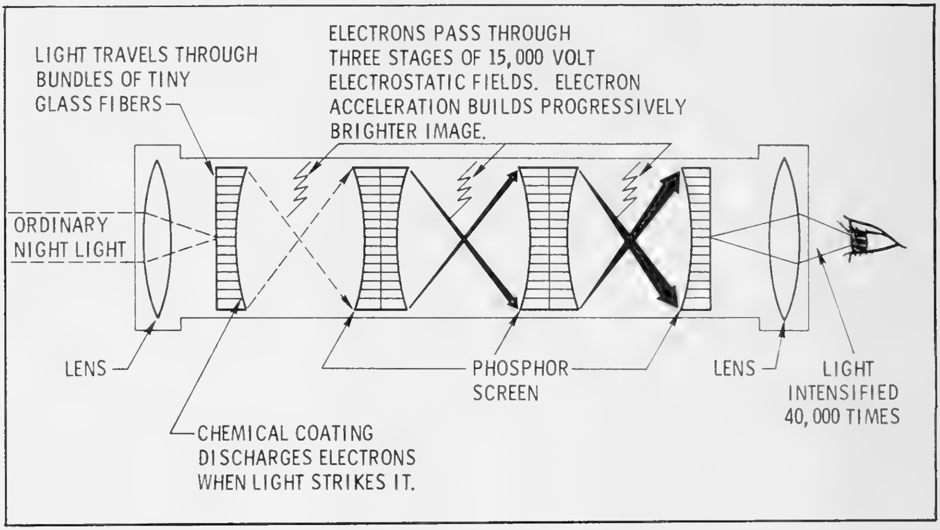


Fig. 1 - Diagram of image intensifier tube of starlight scope.

NMFS PASCAGOULA RESEARCH

During October 1968, tests were conducted at Port St. Joe, Florida, aboard a commercial seiner. The starlight scope was used to detect bioluminescence associated with Spanish mackerel schools during dark of the moon (Fig. 2). With scope coupled to a closed circuit television camera, the image of luminescing school was recorded on video tape (Fig. 3). Figures 4 and 5 show each moving fish outlined by light around its reflective body, which is followed by a luminous trail. The trail is produced by stimulation or organisms in turbulent wake of the fish.

Fig. 2 - Spanish mackerel captured following tests with starlight scope.

During dark of the moon, in January and February 1969, luminescing fish schools were recorded on video tape with SANOS (stabilization airborne night observation system) scope and closed-circuit television. Data were recorded from a Grumman Albatross

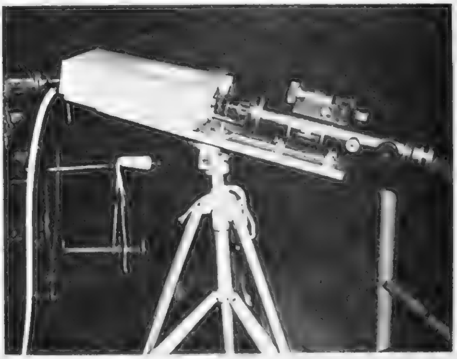


Fig. 3 - Starlight scope coupled to television camera.

Fig. 4 - School of Spanish mackerel showing associated bioluminescence as detected with star light scope and seen on television screen. School is 5 to 10 feet below surface; its distance from sensor is about 50 feet.

Fig. 5 - A Spanish mackerel outlined by definite field of light around body.

and a helicopter stationed at St. Petersburg, Florida, Coast Guard Air Base. A commercial fish spotter was chartered to spot schools of thread herring during daylight over commercial fishing grounds off Sanibel Island, Florida. A search of the same area at night revealed luminescing schools near surface. At altitude of 3,500 feet, a luminescing school was amplified by the low-light sensor before appearing on television screen (Fig. 6). The width of crescent-shaped school was estimated by spotter pilot at 150 feet. Night aerial search near Ft. Myers Beach, Florida, revealed an elliptical school with long axis of about 500 feet (Fig. 7). Sporadic flashes in school probably were caused by nocturnal predators, such as shark or tarpon. Luminescing schools were detected in same general area during three consecutive nights.

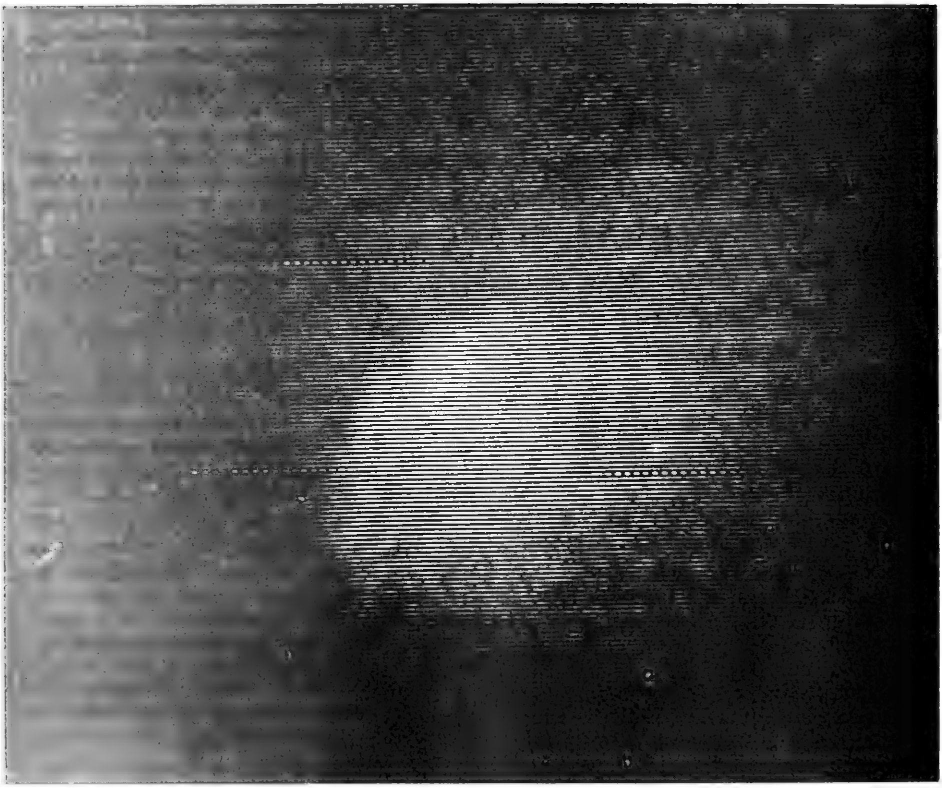


Fig. 6 - A school of thread herring 150 feet in diameter spotted from the aircraft at 3,500 feet. The faint luminescence was amplified by lo-light sensor before appearing on TV screen shown in photo.

With SANOS scope in helicopter (Fig. 8), several schools about 300 feet wide were sighted off Sanibel Island from 500 to 5,000 feet altitude. The luminescence was visually intense from spotter aircraft at 2,000 feet as helicopter videotaped school at 500 feet. The glow was brilliant despite twilight and early morning haze, probably because helicopter noise frightened school.

... ual and low-light-sensor observations ...ring moonless nights show that:

1. Bioluminescence makes school conspi- ...

2. Perimeter of school usually is well defined.

3. The school is detectable to sensor and television camera from 5,000 feet.

Results show that low-light sensors can detect fish schools invisible to naked eye at night.

APPLICATION OF LOW-LIGHT SENSORS TO FISHERIES & RESEARCH

Low-light sensors may be applied in two ways:

1. As direct fishing aid by mounting sensor and television camera in crow's nest of a purse seiner, with television screen in pilot house. Then the captain could detect herrings, sardines, mackerels, and tunas at night where schools are known to occur. Airborne sensors would shorten search time, increase successful sets, increase catch per day, and reduce vessel trip time. For daylight fishing of menhaden, tuna, and thread herring, detecting the schools before sunrise would provide advance information on concentrations. Data indicate that purse-seine sets during early daylight hours produce larger catches than at other times.

2. Probably more important application of low-light sensors would be as a prime sensor in fishery research. Scientists are concerned with schooling behavior at night. Observations of bioluminescence with the unaided eye are insufficient to determine what influence

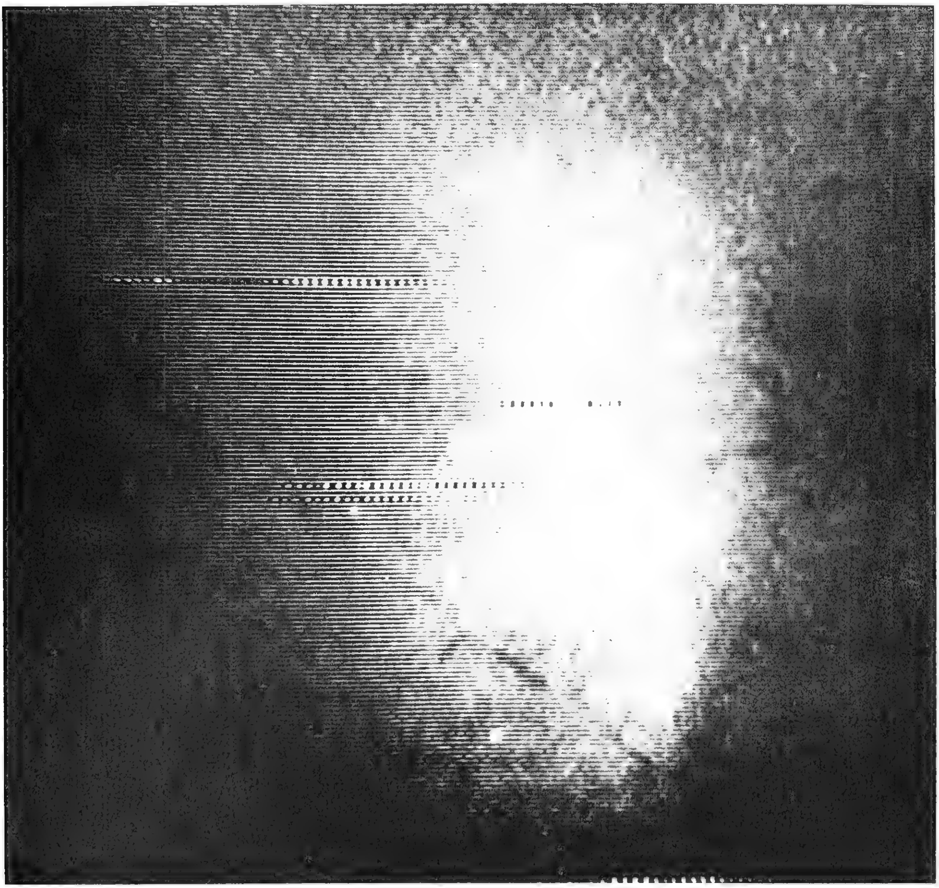


Fig. 7 - A large luminescing school of thread herring 500 feet in diameter amplified by airborne low-light sensor. Flashes inside school may be preadators attacking from below.

Fig. 8 - SANOS scope mounted in hatch of Coast Guard helicopter used as survey aircraft during fish-school detection tests. TV camera is coupled to the scope's eyepiece. TV monitor is in lower right corner of photo facing operator.

it has on the school. Luminescence invisible to unaided eye would be detectable with highly sensitive sensor. Night fishing with Isaacs-Kidd midwater trawl has confirmed presence of associated cone of luminescence (Boden, 1969). Photometric measurements indicate that amount of light ahead and inside trawl is greater than that above or below it. The low-light sensor can detect the reactions of fish to luminescence associated with the trawl, which also may provide new insights on night midwater trawling.

The airborne sensor can greatly assist in resource assessment by providing "real-time" observations of number and size of schools. Also, it would rapidly record data for analysis and interpretation by computers. This new technology would supply reliable information on status, size, movements, inventory, and forecast of traditional and new stocks in large areas on a time scale not now possible.

LITERATURE CITED

BENIGNO, J.A.
1970. Fish detection through aerial surveillance. Technical Conference on Fish Finding, Purse Seining and Aimed Trawling, Reykjavik, May 1970, FAO, FII: FF/70/78, 13 pp.

BODEN, B. P.
1969. Observations of bioluminescence on SOND 1965 Cruise of R.R.S. "Discovery". J. Marine Biol. Assoc. U.K. 49(3), London: 669-682.

BULLIS, H.R., Jr.
1968. A program to develop aerial photo technology for assessment of surface fish schools, Proc. Gulf Carib. Fish. Inst. 20th Annual Sess.: 40-43.

______ and N. L. PEASE
1968. Photographic imagery studies for aerial fish school surveys. Proc. Fifth Space Congress, March 1968, Cocoa Beach, Fla. (unpublished).

______ and J.R. THOMPSON
1970. Annual report, fiscal years 1968-69, Bureau of Commercial Fisheries Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi (in press).

CLARKE, G.L. and L. R. BRESLAU
1959. Measurements of bioluminescence off Monaco and northern Corsica. Bulletin de L'Institut Oceanographique, Monaco 56(1147): 31 pp.

1960. Studies of luminescent flashing in Phosphorescent Bay, Puerto Rico, and in the Gulf of Naples using a portable bathyphotometer. Bulletin de L'Institut Oceanographique, Monaco, 57(1171): 32 pp.

______ and M.G. KELLY
1964. Variation in transparency and in bioluminescence on longitudinal transects in the western Indian Ocean. Bulletin de L'Institut Oceanographique, Monaco, 64(1319): 20 pp.

______ and G.K. WERTHEIM
1956. Measurements of illumination at great depths and at night in the Atlantic Ocean by means of a new bathyphotometer. Deep-Sea Research 3(3): 189-205.

DRENNAN, K.L.
1969. Fishery oceanography from space. Proc. Sixth Space Congress. Space, Technology, and Society. Canaveral Council of Technical Societies, Cocoa Beach, Fla.: 9.1-9.6.

HIGGINS, E.H. and H.B. HOLMES
1921. Methods of sardine fishing in southern California. California Fish and Game 7(4): 219-237.

MESSERSMITH, J.D., J. L. BAXTER, and P.M. ROEDEL
1969. The anchovy resources of the California current region off California and Baja California. California Mar. Res. Comm., CalCOFI Rept., 13: 32-38-1969.

PEASE, N.L. and K.L. DRENNAN
1969. Aerial photo reconnaissance of surface schooling fish. Symp. on Invest. and Res. of the Carib. Sea and Adjacent Regions. FAO Fisheries Rept. No. 71.1, FAO Rome: 162-163.

SCOFIELD, W.L.
1929. Sardine fishing methods at Monterey, California. Fish Bull, No. 19, Div. of Fish and Game of Calif., 62 pp.

SCOTT, J.M.
1969. Tuna schooling terminology. Calif. Fish and Game 55(2): 136-140.

LITERATURE CITED (Contd.)

SELIGER, H.H., W.G. FASTIE, W.R. TAYLOR and W.D. McELROY
1962. Bioluminescence of marine dinoflagellates. I. An underwater photometer for day and night measurements. J. of General Physiology 45(5): 1003-1017.

SETTE, O.E.
1950. Biology of the Atlantic mackerel (Scomber scombrus) of North America. Part II. Migrations and habits. U.S. Fish Wildl. Serv. Fish Bull. 49, 51: 358 pp. (P. 267).

SMITH, J.D., J.L. BAXTER and P.M. ROEDEL
1969. The anchovy resources of the California current region off California and Baja California. California Cooperative Oceanic Fisheries Investigations, Reports XIII, 1 July 1967 to 30 June 1968: 32-38.

SQUIRE, J.L., Jr.
1961. Aerial fish spotting in the United States commercial fisheries. Commer. Fish. Rev. 23(12): 1-7. (Sep. No. 633)

1965. Airborne oceanographic programs of the Tiburon Marine Laboratory and some observations on future development and uses of this technique. Oceanography from Space. Woods Hole Oceanog. Institution, Woods Hole, Mass.: 119-123.

WHITNEY, R.R.
1969. Inference on tuna behavior from data in fishermen's logbooks. Trans. Amer. Fish. Soc. 98(1): 77-93.

COLLECTING COASTAL PELAGIC FISHES WITH ARTIFICIAL LIGHT AND 5-METER LIFT NET

Donald A. Wickham

The National Marine Fisheries Service (NMFS) Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi, has used underwater lights and a large-diameter lift net to attract and capture live coastal pelagic fishes for experimental studies. The gear design and fishing methods evolved from our observations of the behavior of coastal pelagic fishes around underwater lights, and their responses to conventional lift nets. This article provides details for building and rigging the 5-meter (16.4 feet) diameter lift net--and the mounting platform used to position underwater lights and an echo sounder transducer over the net. The methods of fishing this gear and handling the live fish are described.

Artificial lights have been used to attract fish at night for capture with a great variety of fishing gear. Light-attraction techniques in the world sardine fishery were reviewed by von Brandt (1960). The Japanese have used hand-held dip nets and lift nets to capture light-attracted saury. Recent developments in Japanese night-light fishery were reported by Anonymous (1968). Borisov (1956) described equipment and fishing methods of the Soviet Caspian Sea fishery in which lift nets are used to harvest light-attracted sprat. Methods for collecting and keeping live clupeoids for experimentation were described by Verheijen (1956), who obtained his specimens from ring nets around night lights in the Mediterranean Sea. In Gulf of Mexico, Siebenaler (1953) collected various live tuna-bait fishes with an $8\frac{1}{2}$-foot square trap lift net and 150- or 300-watt light. Recently, personnel of the Exploratory Fishing Base at Pascagoula have used several types of high wattage lights and a 5-meter (16.4 feet) diameter lift net to capture numerous coastal pelagic species for experimental studies.

FISH BEHAVIOR & LIFT NET DESIGN

Prior to designing the light attraction and lift net shown in Figure 1, a variety of light sources and net designs were used at night-lighting stations in the Gulf of Mexico. Fish were attracted to almost every type and intensity of light used. A bright-point source light, with a well-defined intensity gradient, created a better organized or structured aggregation than did a dispersed field of light created by several sources. Maeda (1951) described the structure of the communities around fishing lights in Japan. Most coastal pelagic fishes attracted to artificial light in Gulf of Mexico also exhibited preferential spacing within light field, probably in relation to light intensity. Many of these fishes did not accumulate directly beneath light but occupied dimmer zones. Fish would move to center of light field when light was dimmed gradually.

To capture as many fish as possible from the dim light zones, the lift net was designed with the largest hoop that could be operated from research vessel's outrigger. The large opening improved catch because the hoop would often reach the level of the fish before they could detect it.

Fish in the path of a rising net escape by rapidly dispersing horizontally and/or sounding obliquely out of the path of the approaching net. Several features of the net may have reduced the fright stimulus produced

The author is Fishery Biologist, National Marine Fisheries Service Exploratory Fishing and Gear Research Base, P.O. Box 1207, Pascagoula, Mississippi 39567.
Contribution No. 225.

COMMERCIAL FISHERIES REVIEW
Reprint No. 898

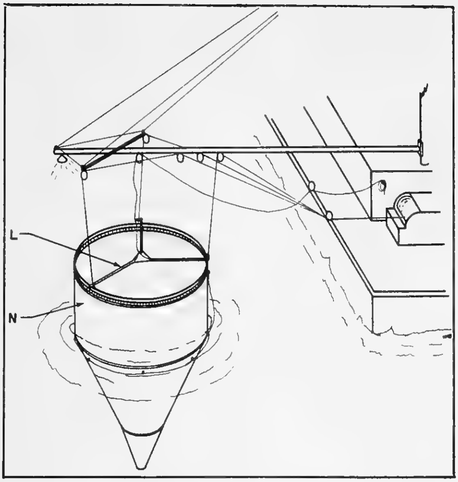


Fig. 1 - Diagram of design and rigging for the 5-meter lift net (N) and the underwater lamp and echo-sounder transducer mounting platform (L).

during fishing. The net was rigged with 3 separate lift lines because a bridle caused a fright response and the fish evaded capture. The 3 lift lines produced some vibrations during a lift, but they did not elicit fright reactions--and the fish were not much disturbed before visually detecting the net. The visual fright stimulus produced by the net's approach was reduced by making the top 10-foot section of webbing hang straight down from hoop before tapering to cod end. Although pressure wave that precedes rising net was not measured, the straight-side design also may have reduced this pressure wave, or lowered it to within the net opening.

LIFT NET HOOP DESIGN

The lift net hoop was made by rolling a 2- by 2- by $\frac{1}{4}$-inch angle iron and a 1-inch iron pipe to a 5-meter (16.4 feet) diameter circle and welding the iron pipe to the angle iron. The hoop was constructed in 2 equal parts bolted together with overlapping angle-iron stiffeners (Fig. 2). This construction permits hoop to be dismantled for easy storing.

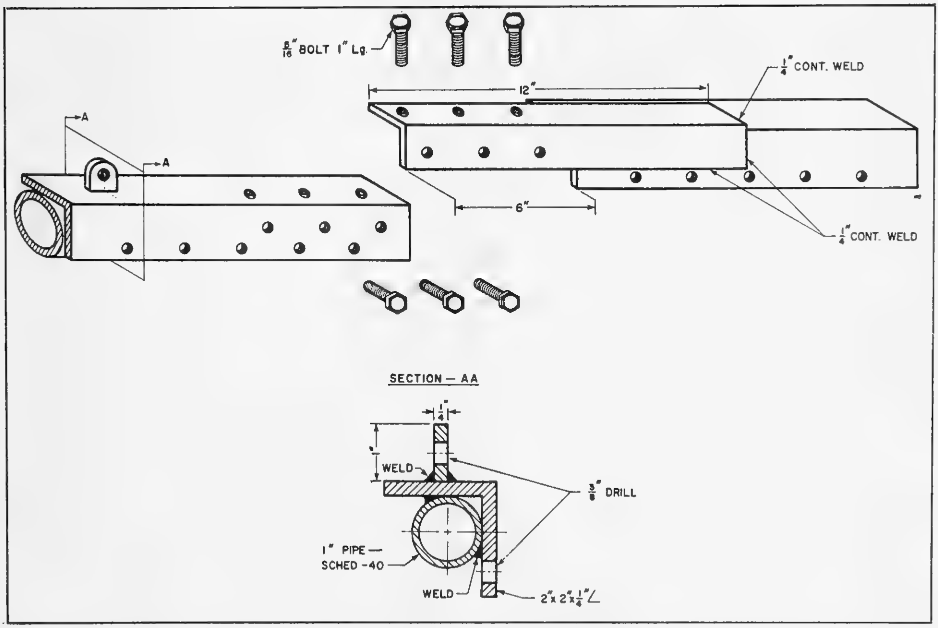


Fig. 2 - Design and construction of lift-net hoop frame. Upper diagram shows method of bolting together the hoop's two halves. Cross section of lift-net hoop frame (Section AA) shows details of angle iron and pipe frame, lift-line pad eyes, and net-attachment holes.

The hoop's lower flange was drilled with $\frac{3}{8}$-inch holes spaced at 3-inch centers for net attachment. Lift lines were attached to 3 pad eyes equally spaced on hoop's top flange.

LIFT NET RIGGING

Operation of a lift net with 3 separate lift lines, instead of a single line bridle, required special rigging to put a block directly above each lift point. The rigging's general layout is shown in Figures 1 and 3. A specially built yard arm was bolted across end of vessel's outrigger to space and support the blocks for the two outboard lift points. The inboard block was attached directly to outrigger. The yard arm is 15 feet long of 2-inch schedule 80 iron pipe; it is supported by guy wires leading to tip of outrigger and to top of main mast. The lift lines run from net hoop through series of 4-inch blocks that bring lines together and lead through a single 6-inch snatch block to vessel's main winch. The lift lines are attached at winch and wrapped together around drum. Lift lines are 75-fathom lengths of $\frac{5}{16}$-inch stainless-steel wire rope.

The net hoop can be suspended directly from yard arm and outrigger by short lengths of chain joined by large Brummel hooks (Fig. 4). This support rigging allows outrigger to be raised to vertical with net attached because lift lines are not holding weight of net and can be slackened. Capability for traveling with net in vertical position facilitates navigation in narrow channels and docking (Fig. 5).

Fig. 4 - Short lengths of chain suspend lift net hoop directly from outrigger and yard arm when net is not in use. Large Brummel hooks connect chains for quick attachment and release of hoop. The slack-wire rope-lift line, a 4-inch block, and one prototype underwater light mounting platform arms also are shown.

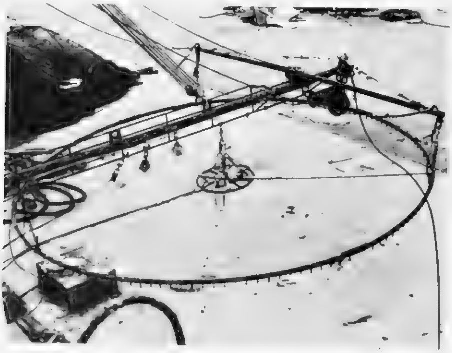


Fig. 3 - Rigging of outrigger and yard arm for deployment of 5-meter lift net. Details of net hoop and lift line rigging are shown with prototype model of underwater light mounting platform.

Fig. 5 - George M. Bowers departing on collection trip with 5-meter lift net suspended from port outrigger. The net hoop was attached to outrigger and yard arm (see Fig. 4) permitting lift lines to be slackened and outrigger raised to clear dock.

NET DESIGN

The net was made of $\frac{1}{2}$-inch stretched-mesh knotless nylon webbing dyed dark green. It was strengthened at seams with nylon tape (Fig. 6). The opening was 5 meters (16.4 feet) in diameter. The top 10 feet of webbing were hung from hoop with a straight fall, whereas remaining section tapered to the cod end. The 28-foot total length provided sufficient slack for cod end to be hoisted aboard vessel for emptying. Rings for choker lines were sewn into net around cod end and in other appropriate areas. An iron weight was attached to cod end to sink webbing during fishing. Grommets were placed at 3-inch centers in band of dacron sewn around top of net. Small Brummel hooks attach net to hoop and permit quick installation and removal of webbing for storage out of the sun (Fig. 7).

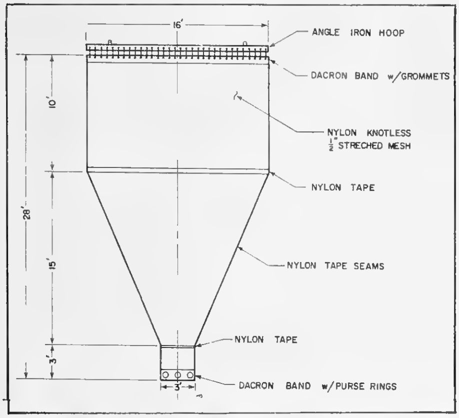


Fig. 6 - Diagram of lift net showing measurements and major design features.

Fig. 7 - Small Brummel hooks attach the net to the hoop and quick removal of the net for storage out of the sun when not in use.

LIGHT SOURCES & UNDERWATER MOUNTING PLATFORM

The first light-attraction source was a 1,000-watt quartz-iodide lamp mounted on vessel's outrigger and directed downward above net. Although this lamp attracted fish successfully because of its mounting location, its light zone and attracting ability were considerably reduced by vessel's hull. Reflection from water surface also reduced lamp's efficiency, especially when seas were choppy.

Fish aggregations were monitored originally by an echo sounder using vessel's hull-mounted transducer. Transducer's location proved unsatisfactory for detecting fish near surface and directly over lift net.

Various arrangements for positioning an underwater light and echo-sounder transducer above lift net were evaluated before satisfactory design was developed. This design, described below, consists of a mounting platform braced by 3 arms that extend to lift lines (Fig. 8). Platform is suspended from outrigger by a line used to position it at any selected depth below surface. Figure 3 shows

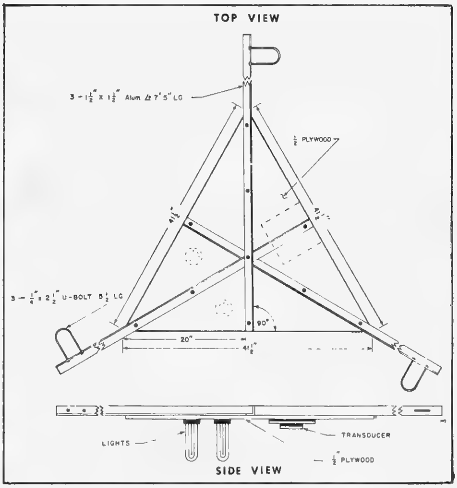


Fig. 8 - Design details of mounting platform used for positioning underwater lights and echo-sounder transducer over lift net.

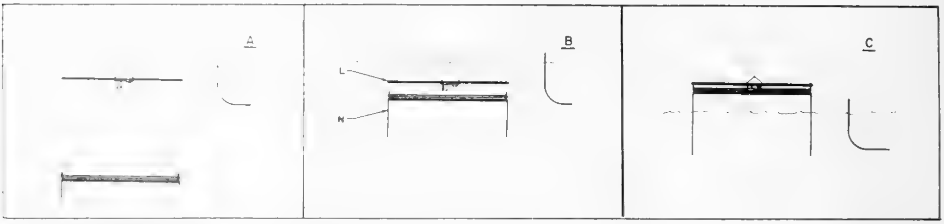


Fig. 9 - Diagram shows sequence of events during a net lift; A - Lift net and underwater light mounting platform in fishing position, B - During a lift, the lifting lines pass through hoops on mounting bracket as net moved upwards until net hoop reaches and contacts arms of mounting bracket, C - The net hoop and mounting bracket begin moving upward together, both emerging from water at same time. (N) Lift net. (L) Underwater light mounting platform. Fig. 1 shows the lift net and light mounting bracket in position C.

a prototype platform suspended over net hoop. Final mounting platform was constructed of $1\frac{1}{2}$- by $1\frac{1}{2}$- by $\frac{1}{4}$-inch aluminum angle. Mounting platform is centered over net by 3 arms that are attached loosely to lift cables by u-bolts, through which lift cables can move freely.

The arms prevent platform from flipping when vessel rolls. A widely spread bridle attached to arms also adds to stability. Vertical movement is dampened but not eliminated with this device. During a net lift, the lift lines move through u-bolts in arms of mounting platform, but the platform does not move until net hoop contacts tips of arms. From moment of contact, arms rest on net hoop and mounting platform is raised with lift net so that they emerge from water together. The lift sequence is shown in Figure 9. The mounting platform supports a 1,000-watt mercury vapor lamp, a 1,000-watt quartz-iodide lamp, and an echo-sounder transducer. Because the underwater lights must be extinguished immediately after emergence, a 1,000-watt quartz-iodide flood lamp, which is suspended from outrigger over net, is turned on when underwater lights are turned off.

FISHING PROCEDURE

The fishing procedure involves selection of an area of clear water where fish schools can be seen at surface or detected by echo sounder. At sunset, the vessel, with deck lights off, anchors or drifts on station depending on current conditions. The net is lowered to desired depth, usually near bottom, and underwater lamps are positioned usually just below vessel's keel. At keel depth, the light is equally visible in all directions; the transducer is near enough to surface so that fish accumulating beneath lights can be detected. The underwater mercury vapor lamp is turned on, and the echo sounder monitored until a satisfactory accumulation of fish is indicated. Prior to a lift, the vessel's main engine and winch are turned on to permit the fish time to adapt to these sounds. The underwater quartz-iodide lamp is turned on, and the mercury-vapor lamp extinguished. The light field is slightly reduced because of differences between the lights in spectral composition and efficiency--and because of the water's attenuation characteristics. A variable transformer is used to permit gradual dimming of underwater quartz-iodide lamp. Dimming the light concentrates the fish around the light and over the net prior to a lift, and it reduces visibility of approaching net. After light is dimmed, the net is lifted as quickly as possible. The hoop of rising lift net passes fish and contacts arms of mounting platform. The mounting platform and net hoop emerge together. The quartz-iodide lamp, suspended from outrigger, is then turned on, and the underwater light extinguished. The surface light retains the fish not captured in the general area for capture on following lifts. The surface lamp also provides light for handling catch without turning on deck lights. If two nets were fished, the alternate net and light would be deployed from the opposite outrigger at this time. After removal of the catch, the net and platform are lowered back to their respective positions, the underwater lamps are turned on, and the surface light is extinguished. The procedure described above is repeated until a sufficient quantity of fish is captured.

Other Best Catches Made

Best catches with the lift net and light attraction were made in the summer around dark of the moon in clear calm water. The most productive night times for fishing were in the early evening and predawn hours. The latter period usually produced larger and denser aggregations. Visual and echo-sounder observations and lift net catches indicated reduction of fish aggregations in light field during midnight hours. Peak periods in catches could be caused either by increased susceptibility of fish to light attraction, or by changes in light-intensity preferences resulting in greater dispersion around light even though fish continue to be attracted. Experimental fishing with more efficient gear (purse seine) would be necessary to evaluate these hypotheses.

HANDLING TECHNIQUES FOR LIVE FISHES

Methods of handling live coastal pelagic fishes depend upon the species. The hardy fishes (scaled sardines, Harengula pensacolae; round scad, Decapterus punctatus; rough scad, Trachurus lathami; and chub mackerel, Scomber colias) are removed from lift net through cod end, which is quickly swung on deck and emptied into water-filled plastic tubs. The catch is then hand sorted into the large transportation tanks. When catch is large, only a small part is brought aboard at one time to prevent injury to fish.

The delicate species (Spanish sardine, Sardinella anchovia; round herring, Etrumeus teres; Atlantic thread herring, Opisthonema oglinum; and anchovies, Anchoa spp.) are removed by dumping catch back into mouth of net, where the fish are removed by dip net. The dip nets have small mesh ($\frac{1}{2}$-inch stretched mesh) knotless webbing, which causes less injury to fish than knotted netting. Sometimes, a plastic liner is used in dip net for extremely delicate species. The fish removed in small batches with the dip net either are placed in tubs for sorting, or are introduced directly into the transportation tanks if the catch consists mostly of the desired species.

On the stern of the 'George M. Bowers' are two portable 1,500-gallon rectangular fiberglass tanks for transporting live fish (Fig. 5). Each is divided into two compartments by a removable wood-and-fiberglass screen. The divider keeps several species separated; it also acts as a baffle by reducing water sloshing caused by vessel's roll. Fewer fish probably would be injured in cylindrical transportation tanks or tanks with rounded corners than in rectangular tanks.

During transport at sea, the tanks are supplied with a constant flow of fresh sea water and, though often crowded, the fish survive well. Upon entering harbors or other areas of doubtful water quality, the tanks are shifted from the flow-through system to the recirculating system powered by a small portable pump. Recirculation keeps fish alive for short periods, but survival time is prolonged when water is cool and the fish are not crowded.

Immediately upon return to the Base, the fish are removed from transportation tanks by dip net and transferred in water-filled plastic tubs to sea-water laboratory (Wickham, MS). In laboratory, the fish are placed either into holding tanks or into the large experimental pool. Temperature and salinity shock is minimized by gradually introducing the fish into the system.

The equipment and techniques described here have supplied the Exploratory Fishing and Gear Research Base at Pascagoula, Mississippi, with fish for controlled field and laboratory studies. These techniques also could be adapted to supply live bait for commercial and sport fisheries.

LITERATURE CITED

Anonymous
1968. Japan hopes new method will boost saury catch. Fish News Int., 7(11): 76, 78.

BORISOV, P. G.
1956. Experimental and commercial fishing in the USSR with the help of electric light. Contribution to Conseil Permanent International pour l'exploration de la mer, meeting Baltic-Belt Seas Committee, No. 4, 11 p.

von BRANDT, A.
1960. Fishing Methods in World Sardine Fisheries. In Proceedings of World Scientific Meeting on the Biology of Sardines and Related Species, Ed., Rosa, H., Jr. and Murphy, G., Rome, 1959, Vol. II, Subject synopsis No. 3: 563-623.

MAEDA, HIROSHI
1951. Analytical studies on marine lamp-communities. Publ. Seto Mar. Biol. Lab., 1(4): 195-213.

SIEBENALER, J. B.
1953. Trap lift net for catching tuna bait fishes. Commer. Fish. Rev., 15(8): 14-17. (Also Sep. No. 356)

VERHEIJEN, F. J.
1956. On a method for collecting and keeping clupeids for experimental purposes, together with some remarks on fishery with light-sources and a short description of free cupulae of the lateral line organ on the trunk of the sardine, Clupea pilchardus Walb. Pubbl, Sta. Zool. Napoli, 28: 225-240.

WICHKHAM, DONALD A.
Salt-water recirculation system and laboratory at the Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi. Manuscript.

THERMAL POLLUTION OF COLUMBIA RIVER MIGHT THREATEN SMELT

George R. Snyder

The smelt, or eulachon (Thaleichthys pacificus), fishery of the Columbia River and its tributaries is unique. The fish are caught commercially in the mainstem with gill nets, but commercial and sport fishermen are allowed to use dip nets in the tributaries.

Smelt are an accessible item for the winter dinner table. They are relatively easy to capture in the tributaries, and the commercial harvest provides a timely income. The 1968-69 harvest (1,120,000 pounds) was worth more than $280,000; the economic value of the sport fishery was estimated at $570,000. The 1969-70 winter season was estimated to have equalled or exceeded the 1968-69 catch.

Most smelt enter the Columbia River in late November or early December, when the river temperature averages 45° F. If the temperature varies above or below normal, schools act erratically: They are delayed, migrate farther upstream, or simply fail to enter their spawning tributaries.

The Columbia River smelt is anadromous. The adults spawn in fresh water but spend most of their life cycle in salt water. The major tributary spawning occurs in the Cowlitz River, but runs have been observed in the Lewis and Kalama Rivers (see figure 1). In past years, smelt were common in the Sandy River and migrated as far upstream as Cascade Locks in the Columbia River. The distribution of schools of smelt in the Columbia River is not well known; some are found between Puget Island and Vancouver. Schools enter tributary streams to spawn, but some remain in the mainstem. The 1969 season was a cold-water year, so the Cowlitz River run was delayed. The 1970 season was another atypical year in the Cowlitz. The run was delayed, but extensive runs ascended the Lewis River during April.

Apparently the males move into the tributaries first. Smelt spawn at 3 to 4 years, and most die soon after. Spawning occurs primarily at night.

Deposit Demersal Eggs

Female smelt deposit demersal eggs: eggs that sink slowly toward bottom. A female of average size produces about 25,000; the range possibly is 7,000 to 60,000 eggs.

The eggs are adhesive and surrounded by double membranes. As the egg settles and touches an object, the outer membrane ruptures and attaches to the substrate--usually to sand grains or debris. The inner membrane contains the embryo.

The eggs are not attended by the adults. Development takes about 3 weeks at 47° F.--from time of deposition to hatching of fry. The fry emerge from egg "shell" with yolk sac attached. They are about 4 millimeters long (6 fry placed end on end would measure one inch). The fry are weak swimmers and must leave fresh water and enter salt or brackish water soon after hatching. They are swept along with river current. Sensitive to light, they stay near bottom during downstream migration to the ocean.

The author is Fishery Biologist, NMFS Biological Laboratory, 2725 Montlake Blvd. E., Seattle, Wash. 98102.
Article is updated version of one that appeared in 'Oregon Sportsman' in July 1969. With permission of magazine.

COMMERCIAL FISHERIES REVIEW
Reprint No. 899

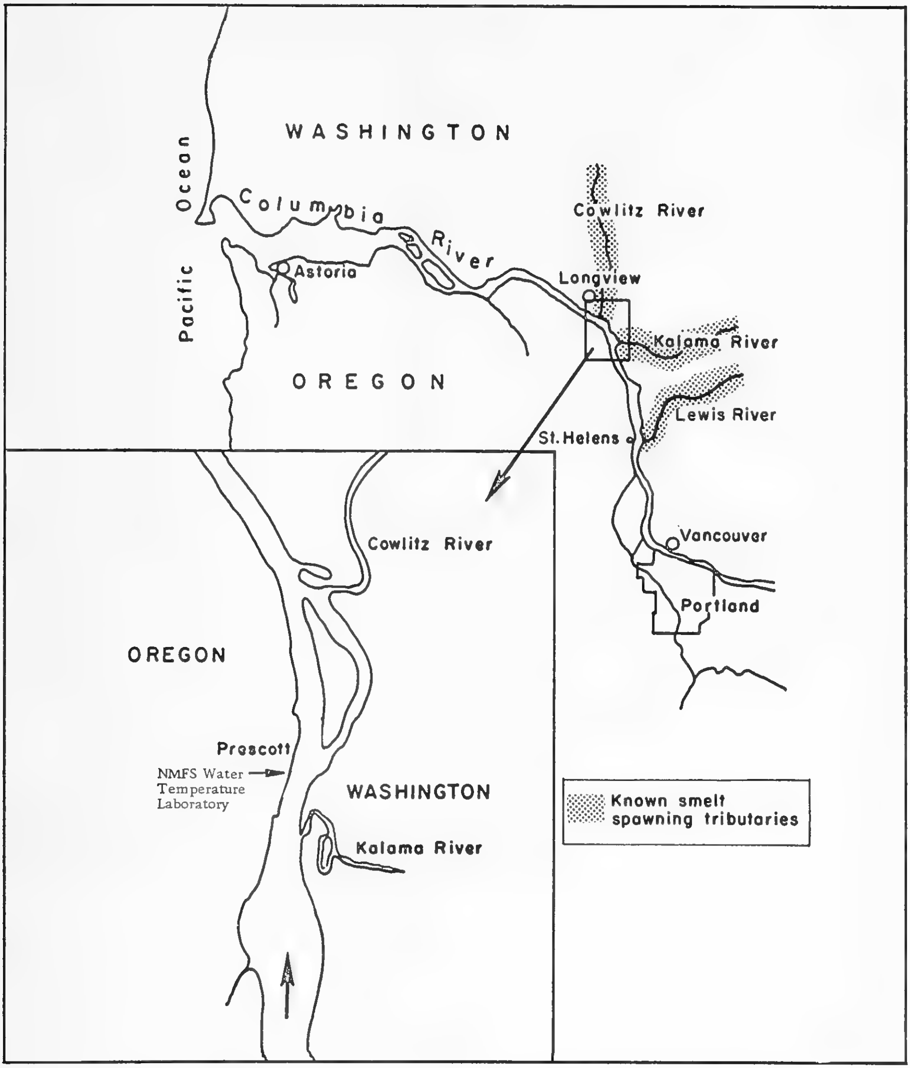


Fig. 1 - Location of smelt spawning areas in relation to NMFS water temperature laboratory.

Nuclear Plants

Smelt seem to require narrow ranges of water temperature. Recent industrial development in this section of the river, however, has led to proposals for installing large thermal nuclear electric plants. These plants can alter local river temperatures.

Two such plants proposed for above Cowlitz River lie directly in migration route of smelt that ascend Kalama and Lewis River and of other anadromous species in Columbia.

Thermal nuclear plants require large quantities of water to cool their condensers. For each unit of heat converted into electricity, two units of heat are ejected into adjacent waterways.

Without "offstream" cooling facilities, these plants could discharge large quantities of heated water directly into path of migrating fish. Fortunately, one company has announced plans to install cooling towers to prevent discharge of all but 15 c.f.s. of waste heat into river.

Studies Underway

The National Marine Fisheries Service (NMFS) initiated an investigation to determine what effect temperature increases would have on aquatic animals and plants between Kalama and Longview, Wash. NMFS is cooperating closely with State and Federal agencies to investigate effects of thermal pollution on anadromous fish such as salmon, trout, sturgeon, shad, and smelt in the Columbia River.

During August 1967, a covered barge was towed to Carter's Marina, Prescott, Oreg., and converted to a modern aquatic research laboratory to determine thermal tolerance of anadromous fish. The laboratory uses Columbia River water, cooling or heating it with chillers or heaters in a once-through system. Fish are taken with purse seines, beach seines, trawl nets, and dip nets. The fish are subjected to increases in water temperature to determine lethal and sublethal levels for eggs, fry, and adults.

During winter 1968, adult smelt were examined to determine their thermal tolerance. Fish exposed 1 hour to 16° F. suffered 50% mortality after a 32-hour holding period. Most females placed in water heated 7° F. above river temperature failed to deposit eggs.

Tests were conducted during 1969 to verify preliminary observations that adult smelt

Fig. 2 - NMFS Water Temperature Laboratory on Columbia River--$\frac{1}{4}$ mile below proposed Trojan thermalnuclear electric plant site. (Photo: Robert K. Brigham)

Fig. 3 - Technicians collecting smelt from Cowlitz River with dip net for experimentation.

Fig. 4 - Adult smelt being captured with short-handled dip net when major run is in river.

Fig. 5 - Transferring smelt from Cowlitz River to transportation tank; oxygen is provided to insure maximum survival.

Fig. 6 - Placing smelt in holding tanks on floating lab for several days before testing.

Fig. 7 - Adult smelt subjected to increases in water temperature in 50-gallon test tanks. Each tank contains similar number of fish; the water in tank on right was 1° C. warmer than in tank on left.

Fig. 8 - Biological technician checks tanks periodically to assess effects of increasing temperatures on smelt.

are intolerant to temperature increases. The first fish were taken from mainstem of Columbia River by commercial fishermen cooperating with Washington Department of Fisheries.

More fish were obtained from Cowlitz River by laboratory staff. Fish were dip netted from a boat and on the beach. They were transported by tank trucks to Prescott and placed in tanks aboard floating lab. (They were first transferred to holding tanks to determine handling mortalities and placed in test tanks with heated water.)

Temperature-Tolerance Studies

The general results of temperature tolerance studies verified earlier results: adult smelt are sensitive to temperature increases. Increases of 10° F. killed all test fish in 8 days. Temperature increases of 5° F. killed 50% in same time period. Higher temperatures killed fish in shorter period. Studies of smelt eggs showed these more resistant to temperature increases than the adults. Again in 1969, adult fish were reluctant to deposit eggs after subjection to increased temperatures.

Smelt populations could face serious problems if thermal nuclear plants are allowed to discharge heated water into river. The problems could be compounded if water-temperature regulations and standards for Columbia are based on tolerance limits of steelhead trout and salmon, the most valuable anadromous fish. The most favorable temperatures for salmon and trout range from 42 to about 60° F. The thermal electric power industry states that more heat could be allowed into Columbia during winter; also, that this increase, theoretically, could benefit salmon production during near-freezing temperatures. However, our present knowledge of thermal tolerance levels for smelt indicates some temperature increases could be detrimental.

Water-temperature standards for the Columbia River--recommended by Washington State--allows addition of more heat into the river at lower temperatures than during summer. Oregon standards for Columbia allow only increases of 2° F. at any time, not to exceed 68° F. Water-temperature standards for interstate waters should be consistent and designed to protect all commercial and sport fish.

Industrialization & Smelt's Fate

Many experts predicted that severe winter temperatures during December and January, 1968-1969, would keep smelt from entering Cowlitz River to spawn. The smelt did enter the river--but they were 5 weeks late. If colder water produces erratic and nonpredictable smelt runs, would warmer water produce similar situation? The fate of smelt runs in lower Columbia River may be determined by increasing industrialization.

CARIBBEAN-ADJACENT REGIONS
BIBLIOGRAPHY AVAILABLE

As part of its contribution to Cooperative Investigation of the Caribbean and Adjacent Regions (CICAR) the National Oceanographic Data Center sponsored preparation of Volume I of CICAR Bibliography on Meteorology, Climatology, and Physical Chemical Oceanography. This volume contains more than 3,000 references (2,000 with abstracts) on these subjects in Caribbean Sea, Gulf of Mexico, Greater and Lesser Antilles Regions, and adjacent coastal areas of North Central and South America. Subject, geographical, and author indexes are included.

How Much & Where

Volume I was prepared by American Meteorological Society from their files in Meteorological and Geoastraphysical Abstracts Office, and from Government library files in Washington, D.C., area.

The Bibliography costs \$7; the indexes to Bibliography are \$6 a copy; the complete set is \$13. Write to: National Oceanographic Data Center, Department of Commerce, NOAA, EDS, Rockville, Md. 20852.

OCEANOGRAPHY

"Marine Atlas of the Pacific Coastal Waters of South America," by Merritt R. Stevenson, Oscar Gullén G., and José Santoro de Ycaza, 20 p. and 99 charts, \$40. University of California Press, 2223 Fulton St., Berkeley, Calif. 94720.

The atlas resulted from a $2\frac{1}{2}$-year international cooperative study "to determine seasonal variations of selected properties and of surface circulation in the Pacific coastal waters of South America." The data were gathered quarterly by scientists from Colombia, Ecuador, Peru, Chile, and the Inter-American Tropical Tuna Commission (IATTC).

During field operations, IATTC was data-clearing center for participants and helped process data by computer.

The investigation was begun "to learn more about the occurrence of the El Niño (The Child) condition. . . . El Niño occurs irregularly; it may appear 2 years in succession and then may not appear for a number of years."

INTERNATIONAL LAW

"International Law and the Resources of the Sea," by Juraj Andrassy, 191 p., maps, \$7.50. Columbia University Press, 440 West 110th St., New York, N. Y. 10025.

The legal status of the ocean bed transcends legal interest. It could affect world's economic balance and structure of international relations. The basic issue is between preserving at least the most important aspects of freedom of the seas--and the taking of the ocean bed by nations and its exploitation by competing economic interests. This would diminish freedom of navigation and fisheries, and multiply dangers of polluting the oceans.

The book has 3 parts: The first deals with the natural and technological factors that caused the current problems. The second is concerned principally with "the evolution of the continental shelf as a legal concept." The last discusses legal solutions.

MARINE EXPLORATIONS

"Man and the Sea: Classic Accounts of Marine Explorations," edited by Bernard L. Gordon, 498 pp., $9.95, 1970. Doubleday & Company, Inc., 277 Park Avenue, New York, N.Y. 10017.

"This book has been prepared to give students of marine science historical and contemporary insights into the growth and development of oceanography," Prof. Gordon writes.

He has selected the writings of marine explorers through history: from the past, such men as Franklin, Halley, and Agassiz; from the present, accounts of such explorers as Cousteau, Piccard, and Carpenter.

The book contains 71 selections, starting with "The Flood" in the Book of Genesis and reaching to "The Promise of Seaweed," written in 1969.

SMALL-CRAFT NAUTICAL CHARTS COMPLETE COVERAGE OF TEXAS COAST

Commerce Department's National Oceanic and Atmospheric Administration (NOAA) has announced completion of small-craft nautical-chart coverage of the entire 334-mile Texas coast from Galveston to Brownsville with publication of two new charts--892-SC and 893-SC. The charts are being issued by NOAA's National Ocean Survey (formerly Coast and Geodetic Survey and U.S. Lake Survey).

What They Cover

Small-craft Chart 892-SC covers the Texas Intracoastal Waterway from Carlos Bay to Redfish Bay. It includes for first time coverage of Copano Bay. Chart 893-SC covers the Waterway from Redfish Bay to Middle Ground. It includes for first time coverage of entire Baffin Bay area.

Where to Get Them

The new charts cancel Conventional Charts 892 and 893. They can be purchased for $1.50 each from National Ocean Survey chart agents, or from National Ocean Survey, Distribution Division (C-44), Washington, D.C. 20235.

THE FOLLOWING PUBLICATIONS ARE AVAILABLE FROM PUBLICATIONS SERVICES UNIT, NMFS, 1801 N. MOORE ST., ARLINGTON, VIRGINIA 22209:

LAKE MICHIGAN

"Physical and Ecological Effects of Waste Heat on Lake Michigan," 101 p. Prepared by Great Lakes Fishery Laboratory, NMFS, Ann Arbor, Michigan, in cooperation with Bureau of Sport Fisheries and Wildlife and Federal Water Quality Administration. Fish and Wildlife Service, Sept. 1970.

"There is reason for concern about potential serious ecological damage to Lake Michigan as a result of the discharge of industrial and municipal waste heat," the report states. By year 2000, the waste heat load at predicted rate of increase would be 10 times today's load. The power industry would be responsible for most of it. There is no sign that the rate of increase in required power capacity, which has been doubling each decade, will diminish.

Not enough is known about ecological effects of "massive heated effluents." The information needed now is not available, so interim standards must be set for Lake Michigan based on present knowledge.

"The purpose of the present report is to present the available evidence that substantiates this concern. The evidence reasonably demonstrates that heat addition, as presently proposed, is an essentially cumulative problem that would contribute to inshore eutrophication and be intolerable from the fish and wildlife standpoint by year 2000."

It is in public interest to stop this process now. The Department of the Interior supports stringent standards for Lake Michigan. It believes no "significant amounts" of waste heat should be discharged into the lake.

NEW YORK BIGHT

"Evaluation of Influence of Dumping in the New York Bight with A Brief Review of General Ocean Pollution Problems," 65 p., plus 3 appendices, June 1970.

In Feb. 1970, Interior Department appointed an Ad Hoc Committee "to review the practice of ocean disposal in the New York Bight and to make appropriate recommendations." Committee chairman was Dr. Roland F. Smith, Assistant Director for Marine Resources, National Marine Fisheries Service.

The Committee's findings, verbatim, were:

1. The New York Harbor Complex must rank as one of the largest grossly polluted areas in the United States.

2. The major sources of pollution in the New York Bight . . . are (1) sewer and industrial outfalls, (2) ocean disposal of sewage sludge and dredge spoil, (3) river discharge and land runoff, (4) wastes from vessels, (5) accidental spills, and (6) harbor debris.

3. No significant improvement in the water quality in the New York Bight can be expected until the mid-70's. Complete secondary treatment is not scheduled for New York City and Passaic Valley Sanitation Commission until 1976. Additional pollution treatment facilities in up-river and shoreline communities will not be completed until the mid-70's. Vessel pollution should be significantly reduced under the provisions of the Water Quality Improvement Act of 1970.

4. Even with completion of all currently proposed pollution abatement programs, conditions in the New York Bight will fall short of what must be the ultimate goal of protecting coastal ocean environments from serious degradation.

5. There will be increased pressure for more ocean disposal of sewage sludge and dredge materials in the New York Bight. This will raise to a potentially critical level the threat of pollution to land and surrounding ocean.

6. The projected increase in pollution from ocean disposal practices calls for stricter control of future ocean disposal practices in the New York Bight.

7. The major threat to full enjoyment of the proposed Gateway National Recreation Area and other beaches in the New York Bight is pollution. To date, however, there has not been demonstrated any connection between present ocean dumping practices and water pollution at any of the proposed Gateway sites.

8. The present ocean disposal of sewage sludge and dredge fill may be a serious threat to the sanitary quality of local populations of ocean quahogs and surf clams (4-10 mile radius).

9. Accumulation by fish and shellfish of heavy metals and other persistent toxic compounds is another potential health hazard in the New York Bight. This threat appears to be most serious from the sludge disposal areas.

10. Ocean disposal of sludge and dredge spoil materials, along with pollution from other sources, offer a potential threat to local fish populations.

11. There is a need for one agency to accumulate all pertinent water pollution data in the New York Bight.

12. The fundamental problems associated with pollution abatement and control are institutional--economic, legal, social, etc. The fact of the matter is that technology is available for cleaning up the New York Bight.

13. Known alternatives to present ocean disposal practices will cost substantially more. Further studies are needed to detail more clearly the relative advantages, operational costs, and potential environmental problems of each alternative. Substantial alterations in consumer habits and existing institutions also will be required.

Ocean Pollution

1. Ocean pollution is the unfavorable alteration of the marine environment, wholly or largely as a by-product of man's actions, through direct or indirect effects of changes in energy patterns, radiation levels, chemical and physical constitution, and distribution, abundance, and quality of organisms. These changes may affect man directly or indirectly through his supplies of food and other products, his physical objects or possessions, and his opportunities for recreation and appreciation of nature.

2. The problem of ocean pollution is part of the total problem of waste disposal with all its social, political, economic, and legal constraints. Any workable solution to controlling ocean pollution must consider the total problem.

3. Controlled ocean disposal of wastes is a legitimate use of the sea. However, the effects of various types of ocean disposal must be carefully considered.

4. The high seas have a limited capacity to assimilate certain biologically active waste products; coastal areas have a limited capacity to receive any waste material.

5. The ultimate goal of disposal programs must be to allow into the ocean only that which can contribute to improving the ocean environment, that which is essentially inert, or that which can be assimilated without adverse effects.

6. The disposal of all types of wastes into the ocean is projected to increase substantially in this decade unless adequate controls are initiated.

7. Unless reversed, this trend portends serious health hazards and threatens fishery resources and the marine environment in a number of localities. Unfortunately, the extent and magnitude of these dangers are not well understood nor adequately documented.

8. The extent of specific Federal authority to enforce waste disposal regulations and ocean pollution beyond the territorial sea (generally 3 miles) needs to be clarified.

9. At present, no Federal agency has authority to develop water quality standards beyond the territorial sea.

10. Action by regional, State, and local governmental bodies to control ocean disposal of wastes is not generally adequate, stressing the need for more appropriate support and guidelines at the Federal level.

11. Present and projected demands upon our natural resources call for substantial emphasis on ways of reusing, recycling, and reclaiming materials which are now considered waste. Legislation to encourage this is needed.

12. Without proper consideration of legal, economic, and other institutional constraints, pollution and deterioration of coastal waters and even the high seas can be expected to increase.

14. Aside from physical and aesthetic aspects of pollution, most other major deleterious effects are toxicological. These present an array of complex environmental problems affecting man and marine organisms and operating essentially at the cellular level.

14. Opportunities for interagency cooperative programs are not being exploited adequately. Substantial data and expertise existing in any given agency are, for a variety of reasons, not always used by another agency.

15. Research by Federal agencies on problems of ocean disposal and ocean pollution is not generally duplicative; on the contrary, there are many areas which are not receiving enough attention, or are receiving no attention at all. They include:

a. Detailed knowledge of coastal circulation and ecology

b. Understanding of economic and social aspects of ocean pollution

c. Ecological and oceanographic data bases

d. Inventory of what is being, and what has been, dumped and their effects

e. A knowledge of extractable materials in the wastes that can benefit fish and shellfish production

f. The fate of pathogenic organisms in marine waters

16. The Committee developed interim guidelines for the Corps of Engineers.

Recommendations

The Committee states that "recommendations do not solve problems"--but recommendations "can serve as a starting point for planning and organization" by government agencies concerned. The Committee recommended policies and activities that would make significant contributions toward abating the problems.

INTERNATIONAL

FAO COMMISSION URGES PROTECTION OF INDIAN OCEAN TUNAS

International action to prevent depletion of large tunas in the Indian Ocean was recommended in Oct. 1970 by UN commission meeting in Rome. The commission recommended development of the Ocean's vast fishery resources by scientific planning and cooperation.

The 28-nation group urged that "serious consideration" be given international measures to manage heavily exploited large-tuna species caught by longline.

The commission recommended that its 8-nation tuna committee be reconvened promptly with participation of all nations that fish tuna actively in the Indian Ocean.

Shrimp in Iran-Arabian Gulf

The commission also warned of the "urgent need" to manage the shrimp fisheries in the gulf between Iran and Arabian peninsula. Because these fisheries lie in waters under national jurisdiction, FAO was asked to notify the governments concerned and to promote international action. A group will assess shrimp stocks in the gulf and elsewhere in the Indian Ocean.

Indian Ocean Commission

The Indian Ocean Fishery Commission is one of 6 FAO regional fishery bodies. It was established in 1967 to develop fishery resources to help meet increasing world demands for rich protein food.

The Indian Ocean covers almost one-fifth the earth's marine area. In 1968, it yielded 2,400,000 metric tons of fish of the world catch of 64,000,000 tons. Roy I. Jackson, FAO Assistant Director-General for Fisheries, has said the Indian Ocean's annual yield might be increased five times.

FAO operates many field projects in the Indian Ocean region under the UN Development Programme and the Freedom-from-Hunger Campaign. These include preinvestment surveys of fishing harbors in India and fishery surveys in Somalia.

A Korean child enjoys seafood meal. (FAO)

FAO STUDIES DISTRIBUTION OF PROTEIN-RICH FOODS

Methods of promoting distribution of new, protein-rich baby foods to millions of malnourished children were studied in Rome in Nov. 1970 by the Protein Advisory Group of FAO, UNICEF, & the World Health Organization. The group discussed current and future marketing operations for these foods in more than 10 countries and ways to expand their use in other parts of the world. A major obstacle is family resistance to unfamiliar foods.

Launching new foods is complex problem. The operation must consider local preferences and habits. Market and consumer research is necessary to collect information needed to establish new products.

Current Emphasis on Children

The current FAO study emphasizes provision of protein-rich foods for children because of grave effects of protein deficiency on mental and physical growth. However, the complete program seeks also to close the "protein gap" for millions of adults.

Unless major new sources of protein are developed, it is estimated that, by 1985, the shortage of protein in developing countries will amount to 3.6 million tons annually. This is equal to amount now consumed by the 6 Common Market countries.

'Superamine'

A successful program has been operational in Algeria since 1966. There, a protein-rich infant food, 'Superamine', was developed and marketed.

Superamine is a low-cost protein formula based on local raw materials: hard wheat, 28%, chick pea, 38%, and lentil flour, 19%. The formula is processed to form a precooked mixture to which are added dried skimmed milk, 10%, sugar, 5%, vitamins, calcium, and vanilla flavoring.

N.A. Wilkie, FAO Food Promotion Officer, has reported: "According to the National 4-year Plan, Algeria will be producing 8,000 tons a year of Superamine by 1974.

"The Algerian government's confidence in the results of this program can be measured by its investment plans. Government funds have been allocated to finance 3 additional production plants in the period 1971/74. Its objective is to meet the annual dietary needs of between 200,000 and 300,000 infants, approximately all those suffering from acute or mild conditions of protein deficiency. It is an ambitious and challenging plan."

Nations Interested

Algeria already has shipped Superamine to help Nigeria, the United Arab Republic, and Tunisia. Recent test marketing of Superamine in the UAR showed that ready commercial market could be created for 1,000 tons a year, even without subsidized distribution. The UN is working with governments in North Africa, the Near East, and other regions to develop and market their own protein-rich infant food.

Similar projects are operational in Turkey, UAR and Yugoslavia. Tunisia, Cuba, Iran, Morocco, and Madagascar also are interested.

OIL POLLUTION HARMS MARINE LIFE, FAO CONFERENCE TOLD

Up to 10,000,000 tons of oil are spilled each year into the oceans. The oil has a toxic effect on all marine animals--and there is no effective method to neutralize it. The only way to prevent more pollution and preserve the ocean's protein-rich food is to prevent spillages. This was the theme of a paper presented by Max Blumer, Woods Hole Oceanographic Institute, Mass., to FAO's Technical Conference on Marine Pollution and its Effects on Living Resources and Fishing, in Rome, Dec. 9-18, 1970.

The conference attracted hundreds of marine biologists, oceanographers, and pollution experts from many nations to discuss the scientific basis and to recommend remedial action.

A prospectus prepared for conference warned that pollution is a spreading international problem, and that it is time for necessary countermeasures.

Oil is $\frac{3}{4}$ Pollution Incidents

Blumer estimated that oil pollution involves one to ten million metric tons of crude oil and oil products a year. In the U.S. alone, oil accounts for three-fourths of about 10,000 pollution incidents reported annually.

Countermeasures are effective "only if all the oil is recovered immediately after the spill," he said. However, no existing technology can do it. All proposals to clean away oil, such as dispersing it or sinking it, are inefficient because the oil continues to poison the marine environment in one form or another. Detergents and dispersants, supposedly nontoxic, are harmful to environment. This was shown in aftermath of Torrey Canyon disaster.

Oil Harms All Marine Organisms

Blumer challenged claims that oil pollution is not necessarily harmful to all marine organisms:

"All crude oils are poisons for all marine organisms. Many crude oil distillates are more severely poisonous because they contain higher proportions of the immediately toxic compounds. Long-term toxicity may harm marine life that is not immediately killed by spills, and oil can be incorporated into the meat of marine animals, making it unfit for human consumption. Crude oil and oil products may cause cancer in marine organisms. Even at very low concentrations oil may interfere with processes which are vital for the propagation of marine species."

He added that the most toxic oil compounds are water soluble. This makes recovery of oil slicks futile, except for esthetic improvement. "Treatment with detergents, even the 'nontoxic' ones, is dangerous because it exposes marine organisms to higher concentrations of soluble and toxic hydrocarbons and because it disperses oil into droplets that can be ingested and retained by many organisms."

Danger to Whole Ocean

Eventually, natural bacterial action decomposes spilled oil. But the most toxic oils disappear much more slowly than less harmful ones. The possibility exists that products of bacterial oil degradation may be more toxic than oil itself.

Blumer denied that marine animals will naturally avoid oil spills. Lobsters, for example, are attracted to crude oil distillates. This leads to severe contamination or death. It was also "highly improbable" that "tainted" fish and shellfish become edible again in time.

Blumer noted the damage done to Lake Erie and warned it could happen to the ocean over a longer period. "A polluted small lake can be reclaimed within a few years. Lake Erie may or may not be restored within fifty years, but a polluted ocean will remain irreversibly damaged for many generations."

EUROPE

NORWAY

CAPELIN FISHERY LOOKS GOOD AT LEAST UNTIL 1973

The Norwegian capelin fishery looks favorable until at least 1973, unless the greatly increased catch overtaxes the resource. The 1970 catch exceeded 1,300,000 metric tons, about double 1969, and a record. Capelin became the main source of supply for fish meal when herring began to decline in 1968.

Problem Ahead

Recent investigations of the capelin resource indicate the 1970 recruitment was somewhat poorer than expected. The fishery seems to develop into an all-year operation with more units participating. So research scientists say it is questionable whether the stock can withstand continuous fishing. According to T. Monstad, there is danger of overexploitation and a shift in natural foundation if two or more years indicate continuous poor survival.

Questions Remain

Despite studies in recent years there are insufficient data to ascertain whether regulation should be started. It has been established that capelin grow during summer up to Oct.-Nov. Researchers feel that there should be no fishing during growth period to maintain foundation of stock. It is questionable whether minimum mesh size would maintain stock.

Optimism until 1973

Most recent investigations in the Barents Sea show evidence of capelin from 1967, 1968, and 1969 year-classes. The 1967 year-class was unusually good and is expected to spawn in 1971. Good year-classes also were found during 1968 and 1969. This indicates possibility of a useful capelin fishery at least until 1973. (Reg. Fish. Attaché, U.S. Embassy, Copenhagen, Oct. 27, 1970.)

USSR

SOVIETS TRAIN WOMEN AQUANAUTS

Three women aquanauts are being trained for marine research in the Chernomor Underwater Laboratory on the Black Sea. The first part of their training included pressure-chamber work at depths of 12, 30, 60, and 100 meters. After they complete a course in aqualung diving, they will be ready to join the Chernomor team. ('Moscow News', Oct. 13, 1970.)

Tektite II Girls First

[Ed. Note: The Soviets are claiming a "first": "until now there have been no women aquanauts either in the Soviet Union or abroad." Actually, in summer 1970, 4 U.S. women scientists participated in "Tektite II" in the Virgin Islands.]

* * *

SOVIETS BEGIN ANTARCTIC WHALING SEASON

Three Soviet whaling factoryships have sailed for Antarctica: 'Sovetskaia Ukraina,' Oct. 7, from Odessa; 'Iurii Dolgorukii', Oct. 11, from Leningrad; and 'Sovetskaia Rossiia', Oct. 15, from Vladivostok. These fleets participated in 1969 Antarctic season.

It is the 25th trip for the Sovetskaia Ukraina.

ASIA

JAPAN

TUNA ASSOC. PROPOSES REGULATING S. BLUEFIN TUNA FISHERY

The Federation of Japan Tuna Fishery Cooperative Associations (NIKKATSUREN) has proposed a preliminary plan to regulate the Japanese southern bluefin tuna fishery. Its purpose is to set up voluntary restrictions on longline fishing to protect declining resource.

Areas To Be Affected

The proposal would restrict entry of Japanese vessels in these areas during specified periods: (1) Great Australian Bight--Oct. to Mar.; (2) off Sydney--Mar. to July; (3) off South Africa--Oct. to Mar.; and (4) west of Australia in "Okiku" ground--Dec. to Mar. The "Okiku" grounds are bluefin spawning area.

The waters off Sydney are migrating route for young bluefin. The other two areas are where percentage of small fish in catch markedly increases seasonally. At present, about 250 Japanese longliners are fishing areas to be restricted.

What NIKKATSUREN Foresees

The Japanese longline catch of southern bluefin off Australia and South Africa has decreased in recent years: from record 70,000 metric tons in 1960 to 44,000 tons in 1968. This indicates bluefin resource is in danger without controls.

If its proposal is implemented, NIKKATSUREN explained, the average age of southern bluefin taken will increase from present 6 years to 6.5 years; as a result, the fish would be larger.

While total catch during first year of the regulatory program would decrease, the previous catch level (as in 1960) would be restored and surpassed after several years. Also, the spawning rate would increase by 20%; at present, it is estimated to be less than one-tenth of that under natural conditions (when there is no fishing). ('Minato Shimbun', Oct. 16, 1970.)

* * *

OCEAN DEVELOPMENT CENTER PLANNED

The Japanese plan to build a semi-governmental development center on a 66,000-sq.-meter plot at Oppama, Yokosuka, Kanagawa Prefecture. Patterned on a French center, it will be the first in Japan.

The Center's Facilities

The center will have sea labs (completed by spring 1971) a deep-sea diving simulator, diving training pool, water tanks, and multipurpose labs with a staff of 229.

Also, a 4-man undersea habitat will be built at 100 meters in Sagami Bay near Yokosuka.

Private industry, universities, and government agencies will be allowed to use center for research in oceanography, ocean engineering, diving, geology, and fishery studies.

The center will serve as base port for the 'Shinkai', a deep-sea research vessel owned by STA.

How Financed

The center will be financed by KEIDANREN (Federation of Economic Organizations) and Science and Technology Agency (STA). The first 5-year program will begin in fiscal year 1971 (starts Apr. 1971) and cost 6,500 million yen (US$18,055,000). Projects for first year are expected to cost KEIDANREN 2,000 million yen ($5,555,555) and government (STA) 150 million yen ($416,666). The government will send necessary bill to the Diet. ('Japan Times', Sept. 29, 1970.)

* * *

NEW PRESERVATIVE FOR MEAT & FISH DEVELOPED

A synthetic liquid preservative has been developed in Gumma Prefecture. When sprayed on meat or fish, it will keep them fresh 4 to 5 times longer than an untreated product.

The major ingredients are pyroligneous acid (charcoal byproduct), lactic acid, sodium chloride, and lemon essence. It is said the

JAPAN (Contd.):

new preservative is free from such poisonous substances as formalin and methyl alcohol.

Useful in Major Items

A recent test proved that meat sprayed with new preservative remained fresh for 4 days; unsprayed meat spoiled after only 1 day. The preservative is supposed to be especially useful for meats and chicken, which are highly perishable. Fish and shellfish also can be treated effectively.

One liter of the preservative (enough to treat 1,000 chickens) costs 400-500 yen ($1.11-1.39). Patent rights are being applied for. ('Mainichi Shimbun', Oct. 10, 1970.)

* * *

SCIENTISTS OBTAIN LIQUID PROTEIN FROM KRILL

Japanese scientists have succeeded in producing liquid protein from euphausia, a shrimp only 3 to 4 centimeters long caught by Kyokuyo Hogei Co. during past Antarctic whaling season. The work was done in the Tokai Regional Fisheries Research Laboratory of the Japanese Fisheries Agency on an FY 1970 budget of 400,000 yen ($1,111).

The laboratory researchers believe that this liquid protein, when commercially produced, can be used in manufacture of soup flavors, pet foods, and snack foods. The shells will be used to produce feed.

Heated With Enzymes

When Antarctic euphausia is heated with enzymes at 20^{o}-30^{o} C. for 4-5 hours, it is reduced to a mash (42% water, 42% protein, 0.1% fat, 7.2% ash, and 8.7% sugar).

The laboratory plans to begin commercial production in 1971. If successful, it will go on to study products from mackerel and jack mackerel. ('Shin Suisan Sokuho')

* * *

BRISTOL BAY CRAB FLEETS REACH QUOTA

The 2 Japanese crab fleets accompanied by factoryships 'Keiko Maru' (7,536 gross tons) and 'Koyo Maru' (7,658 gross tons) attained their goals by late Sept. 1970: tanner crab catch quota and combined production goal of 85,000 cases ($\frac{1}{2}$-lb. 48s) of king crab. The fleets had been operating in Bristol Bay crab fishery since March.

Keiko Maru returned home on Sept. 26, and Koyo Maru on Oct. 8.

Commander's Evaluation

The Koyo Maru fleet commander said condition of king-crab resource has not changed much and present catch allocation is good. He noted that the size of king and tanner crabs in 1970 was same as in 1969--but somewhat smaller than 7 or 8 years ago.

The king-crab catch rate per "tan" in 1970 by Koyo Maru fleet was slightly higher than 1969 average of 6.9 crabs. ('Suisan Keizai Shimbun', Oct. 19, 1970.)

* * *

JAPANESE TRAWL FISHING IN NORTHWEST ATLANTIC

In mid-Oct. 1970, four Japanese stern factory trawlers (2,500-gross-ton class) were fishing in northwest Atlantic area of International Convention for the Northwest Atlantic Fisheries (ICNAF). These were: 'Zao Maru' (2,530 gross tons), 'Shirane Maru' (2,528 GT), 'Tokachi Maru' (2,501 GT), and 'Suzuka Maru' (2,500 GT), all owned by Nihon Suisan. These trawlers were dispersed over wide area to conduct detailed groundfish survey.

Fishing Egg-Bearing Herring

But in Oct., fishing was concentrated on egg-bearing herring; ocean perch and argentines also were caught. Fishing in 1969 showed egg-bearing herring abundant in ICNAF area during October-early November.

Squid Fishing in December

From December 1970, when squid fishing begins to pick up, stern trawlers will start concentrating on squid. These vessels are likely to be joined by about 10 other trawlers from squid and octopus fisheries off Spanish Sahara and Mauritania. Thus, as in 1969, about 14-15 Japanese trawlers are likely to fish in ICNAF area during coming squid season. ('Suisan Tsushin', Oct. 12, 1970.)

* * *

JAPAN (Contd.):

SKIPJACK-TUNA FISHING IS GOOD IN SOUTHWEST PACIFIC

A Japanese-Australian joint company (Gollin Kyokuyo), exploring pole-and-line skipjack fishing off New Ireland (east of New Guinea), reports good fishing. Seven 40-gross-ton wooden vessels are active. Catch per vessel averages 5 metric tons a day. Most landings were frozen and shipped to Japan, where they sold for 120 yen a kilogram (US$302 a short ton).

Commercial Fishing Feasible

Survey off New Guinea began in Mar. 1970. It has found skipjack and baitfish abundant. Indications are that the area definitely can support full-scale commercial fishing.

A company official explained that he would like the line-and-pole operations mechanized, and the wooden vessels replaced with steel or fiberglass hulls (because of heavy infestation of wood borers). ('Suisan Keizai Shimbun', Oct. 13, 1970.)

* * *

PURSE SEINERS EXPLORE FOR TUNA IN SOUTHWEST PACIFIC

Two Government-subsidized purse seiners are exploring for tuna in the southwestern Pacific. The 'Taikei Maru No. 23' (210 gross tons) departed Japan Oct. 15, the 'Tokiwa Maru No. 58' (357 gross tons) Nov. 17, 1970.

The vessels are surveying two areas: (1) off Palau; and (2) off northern New Guinea. ('Minato Shimbun', Sept. 27, 1970.)

* * *

FISH SPINY LOBSTER OFF MOZAMBIQUE

In September 1970, a Nichiro Fishing Co. vessel landed 20 metric tons of spiny lobsters caught off Mozambique (southeast Africa). The average weight was 200 grams. Nichiro expects to find a good market in Japan. If sales are successful, lobster fishing may be expanded.

Nichiro estimates that a year of exploratory fishing is required before commercial fishing can be started.

Local Fishermen Use Pots

The lobster grounds are outside Mozambique's 12-mile fishery zone. Local fishermen are fishing lobsters with pots. More Japanese trawlers could arouse their protests.

Nichiro Experience

Several years ago, another Nichiro trawler took about 10 tons of lobsters in the same area. The lobsters were quick frozen and sold in Japan at US$0.88-1.01 per lb. This year (1970), Nichiro is boiling, freezing, and packing the lobsters and expects to sell them at $1.26-1.51 per lb.

The good catch has stimulated interest in other companies, which are watching Nichiro's sales. ('Minato Shimbun')

* * *

BUILDS THIRD 5,000-GROSS-TON TRAWLER

The 5,000-gross-ton stern trawler 'Ohtori Maru' was scheduled to be launched Oct. 30, 1970, at the Maizuru Heavy Industries shipyard. The vessel was ordered by Ohtori Suisan Co., established jointly by Kyokuyo Hogei and Tokunaga Kabushiki Kaisha companies. It will be the third 5,000-ton trawler to be built in Japan. The other 2 are 'Yamato Maru' (Nihon Suisan Co.) and 'Rikuzen Maru' (Hokoku Suisan Co.).

Production Capacity

Ohtori Maru will be equipped with quick-freezing capacity of 70 metric tons; "surimi" (minced meat) production capacity of 40 tons a day; and a meal plant capable of processing daily 125 tons of fish. After completion in late Feb. 1971, the vessel will be sent to Bering Sea.

Its Dimensions

Main specifications: overall length 105 meters (344.4 feet); width 17.6 meters (57.7 feet); depth 11 meters (36.1 feet); and main engine 5,900 hp. ('Nihon Suisan Shimbun', Oct. 14, 1970.)

* * *

JAPAN (Contd.):

EXPORTS USED FISHING VESSELS

The Japanese exported 54 used fishing vessels (including 23 tuna longliners) during April-Sept. 1970.

Of the 54, 24 (14 tuna longliners) went to S. Korea; 10 (6 trawlers, mostly shrimp) to Indonesia; 9 to Panama; 5 to the Philippines; and 6 to other countries.

S. Korea Receives Many

Exports to S. Korea included a 200-gross-ton refrigerated carrier and vessel parts for two 120-ton trawlers, three 100-ton trawlers, and over 600 small coastal fishing craft. The vessels were supplied in accordance with the fishery cooperation fund provided by Japan. ('Suisancho Nippo', Oct. 16, 1970.)

* * *

SUCCESSFULLY RECRUIT U.S. TUNA FISHERMEN

Susumu Sugano, president of the Japan Overseas Purse Seine Fishing Co., reportedly signed 7 U.S. tuna fishermen during a recent trip to San Diego. They will serve aboard 1,000-gross-ton Japanese purse seiner now being built in Japan. It's a 1-year contract beginning in Feb. 1971.

The 7

The 7 men are a fishing captain, deck boatswain, winch man, seine skiff operator, two speedboat operators, and a net man. They are scheduled to visit Japan twice during construction of the seiner to give technical advice. The ship's master and the chief engineer will be Japanese.

Plan for Vessel

The vessel is scheduled to be completed late Feb. 1971. It will fish in eastern Pacific yellowfin tuna regulatory area during open season. Then it will proceed to Atlantic fishing grounds. ('Suisan Keizai Shimbun', Oct. 15, 1970.)

* * *

FROZEN ALBACORE TUNA EXPORT PRICE TO U.S. HITS HIGH

In mid-Oct. 1970, the price for Japanese frozen round albacore exports to the U.S. reached a high of c. & f. US$800 a short ton for delivery to California tuna packers. This is an increase of $250 a ton in $1\frac{1}{2}$ years.

U.S. Demand Rises

The price increase is attributed to rising U.S. demand for albacore. It has put that species in short supply because annual world catch for years has been around 200,000 metric tons. ('Suisan Tsushin', Oct. 14, 1970.)

* * *

FISH FLOUNDER OFF WESTERN KAMCHATKA & IN BERING SEA

In 1968, a decline in flounder stocks off west Kamchatka forced 3 Japanese firms (Hokoku Suisan, Hoko Suisan, Hakodate Kokai Gyogyo) to suspend fishing. In 1969, only the 'Nojima Maru' fleet of Hokoku Suisan again fished flounder off western Kamchatka. Fishing was "reasonably good" because the flounder resource had recovered. Processing part of the catch into fillets resulted in a financial gain that was "better than keeping the mothership at dock."

Vessel Lengthened

To use the 'Kashima Maru' (about 7,000 gross tons), now a reefer, as a full-time mothership for year-round flounder fishing in Bering Sea, Nippon Suisan lengthened vessel by 10 meters in fall 1970. It replaced existing meal plant with a larger one to use more efficiently the waste from filleting.

The Kashima Maru fished during 3 winter seasons. In winter 1967/1968, for first time, it suffered a large deficit from fishing in Gulf of Alaska. Fishing the Bering Sea, however, for the 2 winter seasons 1968/1969 and 1969/1970 was better. The market for flounders processed in Bering Sea (Nov. to Mar.) was especially good. Nippon Suisan is confident that year-round fishing in Bering Sea will prove profitable. ('Minato Shimbun')

The cod bag breaks surface several yards from trawler, while hungry Royal Albatrosses and Yellow-browed Mollymawks cluster round and try vainly to take fish through mesh. (Royal Albatross extreme left and distant right.)

Sea birds are constant companions, day and night, of the trawler. Albatrosses may travel as much as 600 miles back to their young on the Campbell or Southern Islands of New Zealand with food. (FAO)

SOUTH PACIFIC

AUSTRALIA

REPORT ON FISHING VESSELS & PEOPLE

In 1968-69, there were 9,244 vessels and 16,460 persons in Australia's general fisheries. Value of vessels and equipment was US$70,418,000. The data are incomplete because fishing is seasonal and many fishermen are part-timers.

Number & Value of Vessels

The highest number of vessels was registered in South Australia--2,591; then, New South Wales, 2,345; Western Australia, 1,412; Queensland, 1,349; Victoria 871; Tasmania, 566; and Northern Territory, 110.

Western Australia vessels and equipment were valued at $16,065,000; Queensland $14,597,000; South Australia $11,024,000; N.S.W. $8,905,000; Victoria $7,051,000; Tasmania $6,705,000, and Northern Territory $6,135,000.

Value of Vessels Rises

There has been a gradual decline in vessels since 1964/65, when 9,426 were registered. In 1967/68, the total increased to 9,354; it dropped again to 9,244 in 1969.

However, the value of boats and equipment increased from $40,041,000 in 1964/65 to $56,601,000 in 1967/68; it reached US$70,419,000 in 1968/69.

Thirty-three boats operated in the pearl shell and trochus shell fisheries. Three whale chasers operated from one shore station in Western Australia.

Queensland was the only State with vessels listed at 100 ft. and over (9). The largest number was in 20-ft. and under 30-ft. bracket. In this category, South Australia had 1,851; New South Wales 1,690; Queensland 471; Victoria 252; Tasmania 99, and Northern Territory 37.

Western Australia registers its boats under different classifications. There were 50 boats 55 ft. and over; 205 35 to 55 ft.; and 346 over 25 ft. and under 35 ft.

People

In 1968-69, 16,460 persons worked in general fisheries, compared with 14,965 in 1967-68, and 11,414 in 1964-65.

In 1968-69, south Australia had highest number--4,361; New South Wales had 3,471; Western Australia 2,785; Queensland 2,539; Victoria 1,571; Tasmania 1,160; and Northern Territory 573.

In 1968-69, another 1,425 persons worked in edible oyster industry, compared with only 997 in 1964-65 season. In pearl and trochus shell fishery, there were 473 people, compared to 997 in 1964-65.

Whaling had changed only slightly: 48 working at sea in 1969, compared with 45 in 1964-65; 32 on shore against 38 for same periods. ('Australian Fisheries', Sept. 1970.)

INDEX

☆ U. S. GOVERNMENT PRINTING OFFICE : 1970

Holiday Greetings

from the

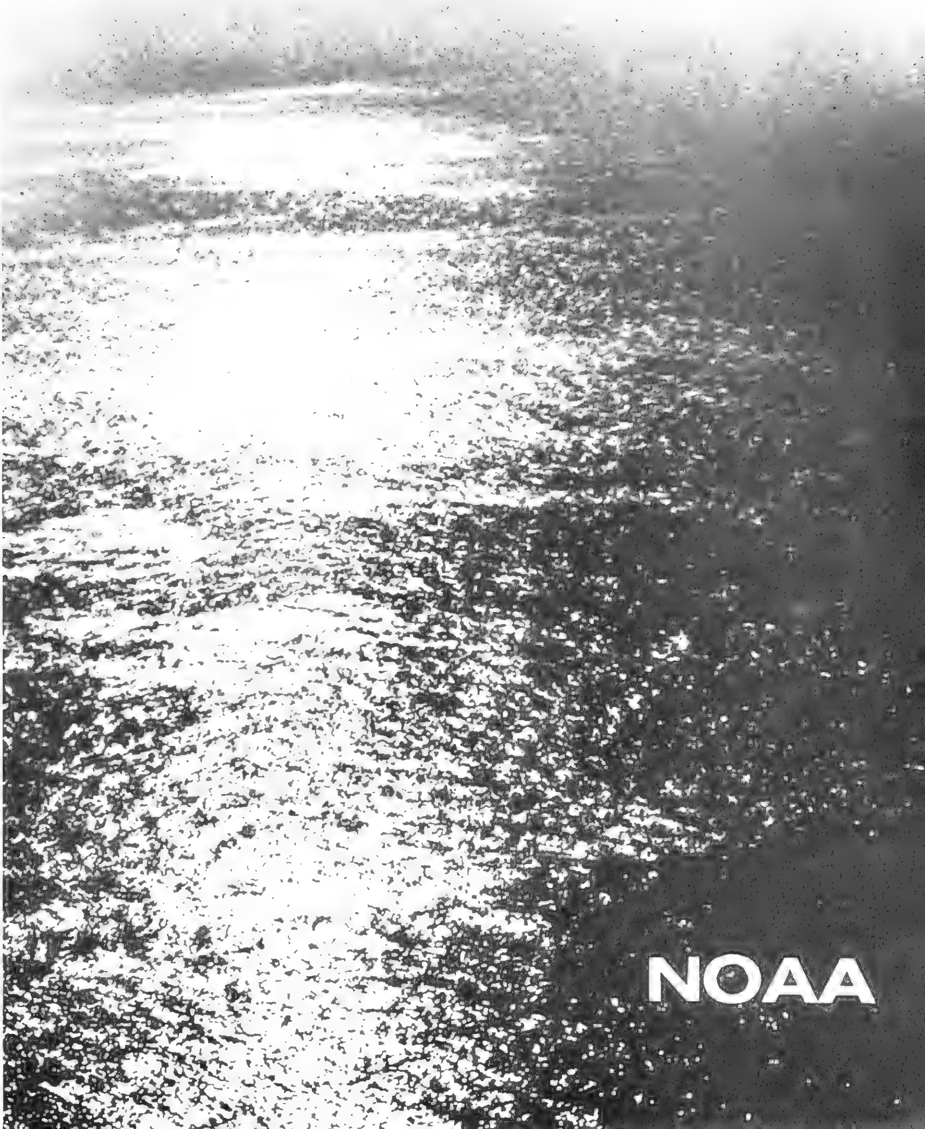
National Marine Fisheries Service

ITED STATES
ERTMENT OF
MMERCE
LICATION

COMMERCIAL FISHERIES
Review

INDEX FOR 1970

VOLUME 32



U.S.
EARTMENT
OF
OMMERCE
National
ceanic and
mospheric
ninistration

AL MARINE
ES SERVICE

U.S. DEPARTMENT OF COMMERCE
Maurice H. Stans, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Dr. Robert M. White, Acting Administrator

NATIONAL MARINE FISHERIES SERVICE
Philip M. Roedel, Director

COVER: President Nixon's plan to reorganize the Nation's oceanic and atmospheric organizations into a single part of the U.S. Department of Commerce--the National Oceanic and Atmospheric Administration (NOAA)--went into effect on October 3, 1970.

The Bureau of Commercial Fisheries (BCF) was renamed NATIONAL MARINE FISHERIES SERVICE (NMFS) and became part of NOAA.

COMMERCIAL FISHERIES

Review

A comprehensive view of United States and foreign fishing industries--including catch, processing, marketing, research, and legislation--prepared by the National Marine Fisheries Service (formerly Bureau of Commercial Fisheries).

Fishermen's Memorial
Gloucester, Mass.

Co-Editors: Jean Zalevsky
Alma Greene

An index of Volume 32, Numbers 1 through 12, issued in 1970. It is a subject index, with an author index for only the feature articles in each monthly issue. Indexing of other material is based on the principal subject with some cross-reference. The use of "_____" in entries denotes the omission (repetition) of the major subject heading which appears in ALL CAPS.

Publications listed in the "Books" section have not been indexed.

\- - - - - - - - - - - -

Use of funds for printing this publication was approved by the Director, Bureau of the Budget, April 18, 1968.

\- - - - - - - - - - - -

A limited number of back issues of Volume 32, Numbers 1 through 12, are still available until the supply is exhausted. Copies are available free upon request from Commercial Fisheries Review, U.S. Bureau of Commercial Fisheries, 1801 N. Moore St., Rm. 200, Arlington, Virginia 22209.

INDEX TO VOLUME 32 (NUMBERS 1 - 12 INCLUSIVE)--1970

The reference gives the month and page number.

AUTHORS & TITLES

AUTHORS & TITLES

Issued January 1971

☆ U. S. GOVERNMENT PRINTING OFFICE : 1971 435-338/6