A day nursery school in Rangoon, Burma, where an experimental meal including fish flour was served each day. In foreground, Mary Ross of U. S., an FAO nutritionist. (FAO/S. Bunnag)

U. S. AWARDS CONTRACT FOR FISH PROTEIN CONCENTRATE PLANT

The U. S. Department of the Interior awarded a contract on October 21 for a large-scale, pilot-demonstration plant in Washington State to produce fish protein concentrate (FPC).

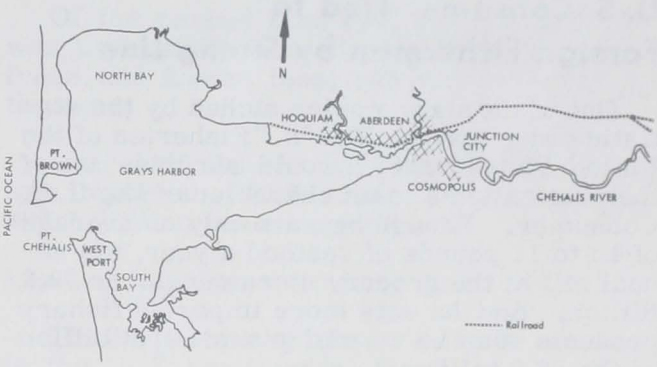
The plant will use the solvent-extraction process developed by BCF scientists. The BCF product, made from whole Atlantic red hake, a codlike fish, looks like a light-tan flour and is nearly odorless and tasteless. It is more than 80 percent animal protein and has nutritional minerals. About 6 pounds of fish are needed to produce 1 pound of FPC.

Experts concerned with the world's population explosion and the desperate need to find new food sources believe FPC can become a lifeline to a better tomorrow for hungry millions throughout the world. Today, about 2 billion of the more than 3 billion people on earth, including 50-70 percent of preschool children, suffer from protein malnutrition.

Contract Winner

Ocean Harvesters, Inc., of Los Angeles, Calif., was selected to build and operate the plant at Port of Grays Harbor, Aberdeen, Wash. The plant will not produce FPC on a commercial basis. It will show the practicability of the BCF solvent-extraction process and accumulate information on the technical and economic aspects of production to aid private industry in building plants for commercial production.

The plant will begin to operate during the 1970 fishing season. Hake and hakelike species are plentiful near Grays Harbor. Other species also can be used.



Port of Grays Harbor. (U. of Wash. Press)

BCF Process

BCF scientists at the College Park, Md., laboratory and at a model-scale plant in Beltsville, Md., near Washington, D. C., worked 3 years to develop the present process for making FPC. One breakthrough was achieved with the discovery that isopropyl alcohol would satisfactorily extract oil and water from the fish. It was an indispensable step toward making a stable and palatable product from an inexpensive fish.

The scientists found that FPC blends well with other foods. It was tested successfully as an ingredient in soups, beverages, noodles, bread, gravy, and cookies. The addition of FPC increased their nutritive value appreciably.

FPC Approved by Scientific Groups

The National Academy of Sciences advised Interior Secretary Udall that "fish protein concentrate, from whole hake, as prepared by the Bureau's process, is safe, nutritious, wholesome, and fit for human consumption." The Food and Drug Administration approved it.

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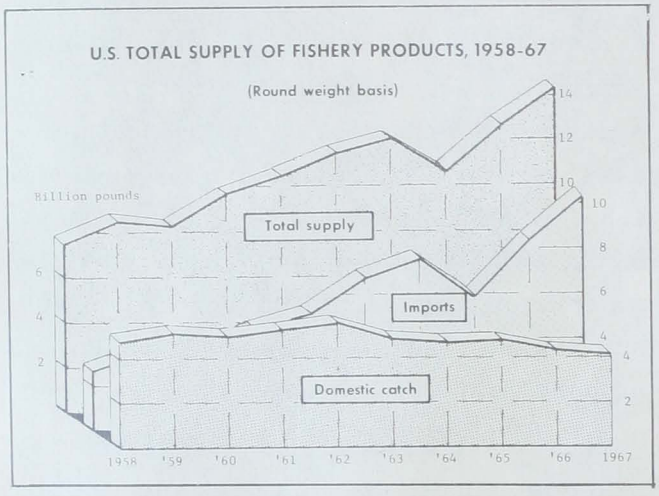
UNITED STATES

U. S. Consumer Tied to Foreign Fisherman by Strong Line

One of the many stories etched by the statistics and text in BCF's "Fisheries of the United States--1967" would surprise one of the publication's main characters--the U. S. Consumer. Though he eats only an average of 10 to 11 pounds of seafood a year, his annual bill at the grocery store runs over $2.6 billion. And he eats more imported fishery products than he would guess: $1.2 billion of the $2.6 billion.

In 1967, the supply of all fishery products in the U. S., on a live-weight basis, was 14.2 billion pounds; 71% of this was imported. (For 1968, the estimates are 17.5 billion pounds--75% imported.) Of the 14.2 billion pounds in 1967, a little more than 9 billion pounds (live weight) were used for industrial purposes--for animal feed, fish feed pellets, Irish moss extracts, etc. About 82% of the 9 billion was imported.

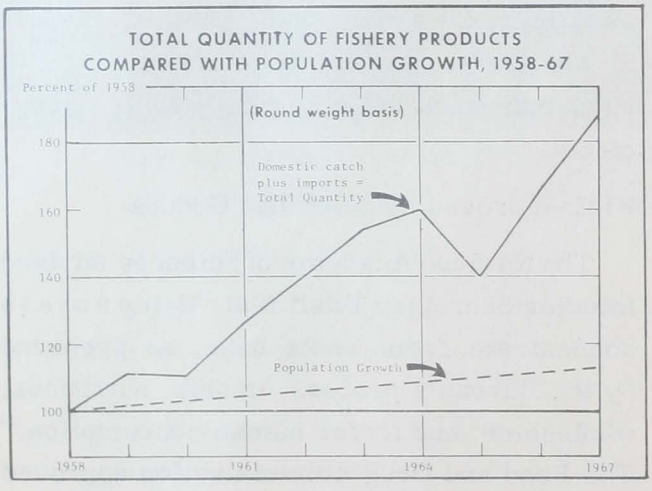
Fish meal and scraps are the most important industrial products. These are protein feeds for animals. About 75% of the fish meal used in the U. S. is imported. So agriculture too--in the production of meat and other animal products--depends to a significant degree on foreign fishing industries.

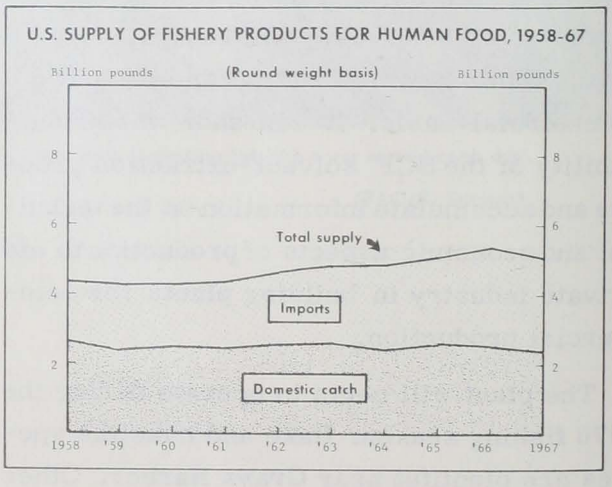


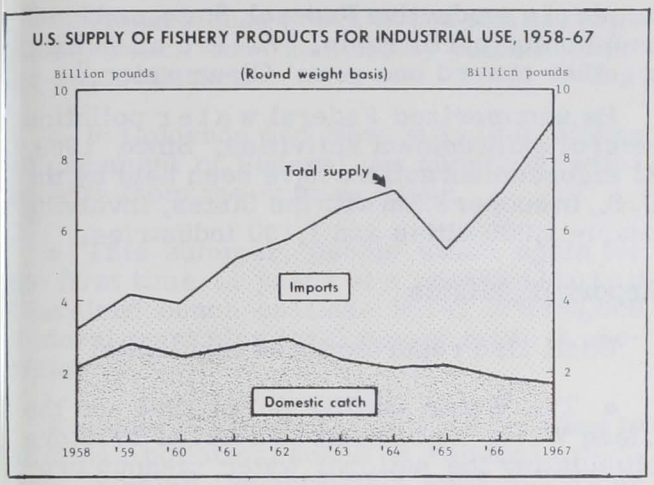
EDIBLE SEAFOOD

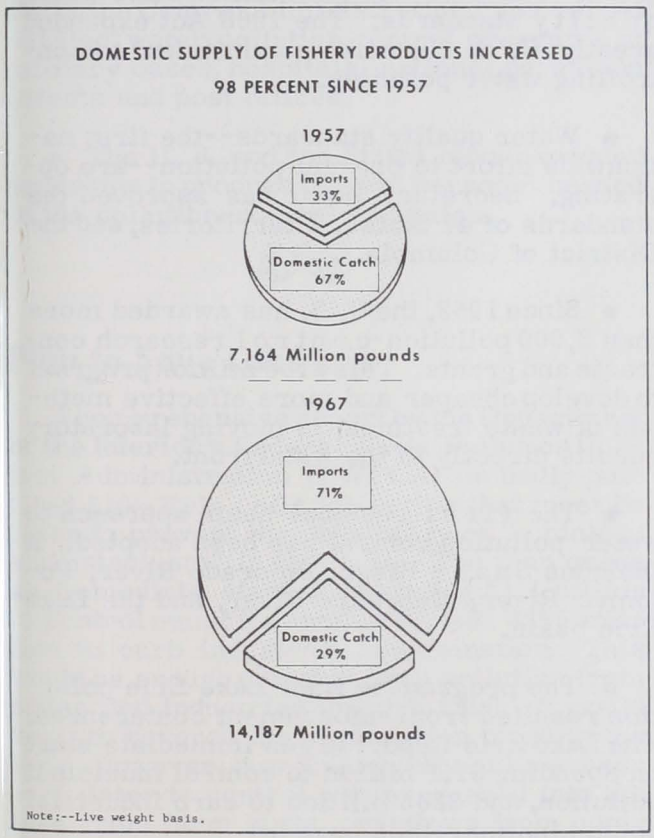
In 1967, the total U. S. supply of edible seafoods was 5.1 billion pounds, live weight. About 53% of this was imported. (In 1968 the figures are 5.5 and 40%.) The imports included frozen fillets, steaks and blocks; frozen tuna for canning; canned tuna, sardines, lobster, crab, and oysters; frozen lobster meat, lobster tails, and packaged frozen scallops.

However, most imported fishery products are fresh or frozen in bulk or wholesale packages. Then U. S. processors further process these items and market them under labels the U. S. consumer knows. Most important of these products are frozen fish sticks, fish portions (used in fish sandwiches) fish steaks, fillets, scallops, shrimp, and canned tuna.









Fish sticks have become popular in U. S. households. They are made mostly from frozen blocks of groundfish fillets. In 1967, 80% of the U. S. supply of groundfish and ocean perch fillets was imported. The U. S. turned out 158.4 million pounds of frozen fish portions, 73.9 million pounds of frozen fish sticks, and 82 million pounds of fresh and frozen fillets and fish steaks. This was a total of 314.3 million pounds. In 1967, 189.5 million pounds of frozen slabs and blocks and 94.1 million pounds of fillets were imported--a total of 283.6 million pounds.

Tuna and Shrimp

Of the canned tuna sold in the U. S., 45% was processed domestically from imported fresh and frozen tuna; 14% was imported in the can.

Over half the shrimp eaten in the U. S. was imported: 202.7 million pounds of the 394.7 million pounds consumed.

Leading Exporters

The largest exporters of edible seafood to the U. S. are Canada, Japan, and Mexico. Canada supplies most frozen fillet blocks to make fish sticks, portions, steaks, and fillets. Mexico is the number one supplier of frozen shrimp. Japan is the source of most imported tuna. Often, it is less expensive for U. S. processors to import these items than to buy them at home; sometimes, availability of domestic products is the deciding factor.

10 U. S. Firms Participate in Munich Food Fair

Ten U. S. fish-processing firms displayed their products at the International Food Fair in Munich, West Germany, Sept. 21-29. BCF's Office of International Trade Promotion, which fosters and coordinates U. S. participation in such fairs, reported excellent prospects for sales in several European nations.

Some Firsts

Several items were shown in Europe for the first time and attracted both trade visitors and public. These included Maine sardines in a flip-top aluminum container; eels, considered a prime delicacy; and 2 forms of fish chowder.

Other products displayed and provided were: canned river herring and roe, canned Gulf and Alaska shrimp, frozen Maine shrimp, individually-quick-frozen (IQF) jumbo shrimp, IQF oysters, and breaded scallops.

Albacore Fishery Is Productive Off Northwest

For the third year in a row, the albacore fishery off the west coast was centered in the Northwest. Fishing there set a record. There was little commercial activity off California.

Up to September 21, Oregon landings were 17,200 tons. This was 45% more than a year earlier--and more than the total 1967 Northwest catch of 16,000 tons. If the weather continued good, it was predicted that 1968 Northwest landings could reach 20,000 tons.

California Catch Poor

California's albacore catch was even lower than last season's catch and the poorest since 1941. Up to September 21, landings were about 3,000 tons. Last season's catch was only 6,800 tons.

Despite California's poor catch, total Pacific coast production may reach or top 23,000 tons. This would put 1968 well above the average--despite major geographic dislocations in where albacore were found.

Prices Up

Exvessel prices were above last year's: in California, $425 per ton; in the Northwest, $425 for cannery fish and $400 for fish in the freezer.

50,000 Miles of U. S. Streams and Rivers Are Cleaner

U. S. grants to cities and towns to combat water pollution have helped to clean up more than 50,000 miles of streams and rivers in the last 8 years, Secretary of the Interior Stewart L. Udall has reported. He said Federal aid to construct waste-treatment plants now totals over $1 billion and has enabled communities to build $4.4 billion worth of waste-treatment facilities.

Udall said: "The Federal construction grant program has meant cleaner water in more than 50,000 miles of America's streams and rivers. This achievement is a classic example of a productive Federal, State, and local community partnership. We are all pulling together toward one goal: Clean water."

He summarized Federal water pollution control enforcement activities. Since 1960, 33 enforcement actions have been held by the U. S., in cooperation with the States, involving nearly 1,000 cities and 1,100 industries.

Report Highlights

Udall also reported these highlights:

- The Water Quality Act of 1965 and the Clean Water Restoration Act of 1966 are stimulating the national water cleanup program. The 1965 Act established State water quality standards. The 1966 Act expanded greatly U. S. financial commitment to controlling water pollution.

- Water quality standards--the first nationwide effort to prevent pollution--are operating. Secretary Udall has approved the standards of 41 States, 2 territories, and the District of Columbia.

- Since 1962, the U. S. has awarded more than 3,000 pollution-control research contracts and grants. This $100 million program to develop cheaper and more effective methods of waste treatment is moving laboratory results directly to the waterfront.

- The first regional-basin approach to water pollution control has been adopted. It includes Snake River, Colorado River, Potomac River, Delaware River, and the Lake Erie basin.

- The program to fight Lake Erie pollution resulted from enforcement conferences. The Lake Erie Report urges immediate start on spending $1.1 billion to control municipal pollution, and $285 million to curb industrial contamination. (See page 5.)

- Enforcement actions on Lake Michigan and the Boston Harbor area resulted in agreements to stop pollution. The 4 States bordering Lake Michigan, and the cities and industries involved, agreed on a strict schedule to build pollution-control devices. The Boston Harbor agreement will help to restore the million-dollar shellfish industry to New England.

• Fishermen are back at the North Platte River, which once was nearly suffocated by its own pollution.

• In Colorado and New Mexico, strong enforcement of Federal law removed radioactivity from the Animas River.

• This summer, people swam again for the first time in years at a once-polluted Cleveland beach on Lake Erie. A $325,000 Federal grant plus local money made it possible.

• Federal agencies are cooperating to eliminate pollution caused by Federal activities. Interior Department's Federal Water Pollution Control Administration "has helped develop water pollution control programs at military bases, hospitals, national parks and forests and post offices."

• The U. S. and the States have expanded programs to produce trained personel needed in the pollution-control campaign.

Plan to Save Lake Erie

A comprehensive report by the Department of the Interior's Federal Water Pollution Control Administration (FWPCA) on badly polluted Lake Erie calls for action that must be taken to prevent the possibility of "a biological cataclysm" in this lake. The plan urges an immediate start on spending $1.1 billion to control municipal pollution, and $285 million to curb industrial contamination. This would be enough money to curb pollution from cities and industries through 1990. It would begin to reverse the degradation trend in the lake. However, more money would be necessary later to control wastes washed into the lake from farm lands, overflows from combined sewers and, after 1990, to compensate for population increase.

Owe It to Posterity

Secretary of the Interior Stewart L. Udall said that "while Lake Erie is seriously polluted, this report has found that it can be rescued. We owe it to posterity to make an all-out effort to save this most seriously polluted of the Great Lakes while there is still time.

"Rising pollution of the Great Lakes, the largest treasury of fresh water on earth, is the natural resource tragedy of our time and could, unless checked, eventually destroy these magnificant inland seas. This looming potential disaster has only recently attracted national attention because pollution is a patient assassin which chokes its victims ever so slowly and silently."

Udall said vigorous action already is being taken by Interior Department, the States, and local governments to stop the rising tide of pollution in these lakes. But these efforts will never succeed without public support.

FWPCA Head Hopeful

FWPCA Commissioner Joe G. Moore Jr., in his introduction to the report, acknowledges that "man is destroying Lake Erie." He points out, however, that of the Great Lakes, Erie is "the most amenable to corrective measures because of its relatively small volume, rapid flushout time and the high volume of input of excellent quality Lake Huron water."

He adds: "The cleanup of Lake Erie is less a problem of engineering than it is a problem of diverse, inadequate, and unwieldy. . .governmental policies, funding, and management. The technical engineering methods of waste control are known or close at hand. . . ."

The Problem Areas

The report identifies 298 municipal and 182 industrial polluters around the lake, the amount and types of their pollutants, control measures required, and schedules of measures needed, or being followed, to diminish pollution.

The most serious problem is the accelerated aging of the lake. This is caused by nutrients, phosphorus and nitrogen, in sewage, and some industrial wastes that act as a fertilizer to stimulate algal growths. The organic remains of this superabundant aquatic crop place a severe demand on the oxygen in the water. The demand is estimated to be 18 times greater than the oxygen depletion caused by treated sewage.

The report states that nearly one-fourth the lake becomes nearly devoid of oxygen in

its bottom waters during the summer. This situation is becoming worse. Man's activities have prematurely added an estimated 15,000 years to the natural age of the lake. But "the rate of aging. . .can be brought back to near the natural rate."

Even if the present trend is reversed, the report warns, the algae problem will persist for several years. This is because the nutrients already stored in bottom sediments are recycled in summer. "Therefore, it is possible that in a relatively short time the overproductivity of Lake Erie can become self-sustaining because of this ever-increasing reserve. It is also possible that if this alarming process grows, Lake Erie may face a sudden biological cataclysm that will exhaust, for all time, most of the oxygen in the greater part of the lake."

To reverse this trend, FWPCA recommends drastic reductions in discharges of phosphorus into the lake.

Only the joint management of water resources by Canada and the U. S. can achieve a cleanup of the lake, the report concludes.

States in Lake Michigan Basin Act on Pesticides

The conservation and resource agencies of Illinois, Indiana, Michigan, and Wisconsin signed an agreement during the summer to protect the Lake Michigan basin from any more pesticide pollution. Under the agreement, reports the Great Lakes Commission, the States will "inventory, monitor and tighten enforcement" over all possible sources of contamination in the lake area.

Farm & Urban Run-off

Surface run-off waters from about a third of the 4-State land area drain into Lake Michigan. The waters carry along some chemicals used to control insects on farms and in towns.

The Commission says the lake's pesticide contamination was dramatized by "recent findings that DDT was the most probable cause of the death of some 700,000 coho salmon fry hatched from eggs taken from Lake Michigan brood stock."

Minnesota Acts

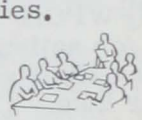
In an action related to the 4-State compact, the Minnesota Conservation Department halted, in August, the use of "hard" pesticides on all lands it controls. "Hard" pesticides are those that do not break down into harmless compounds after application.

Advisers Appointed to Aid Columbia R. Temperature Study

Interior Secretary Stewart L. Udall has appointed a Technical Advisory Committee for Biological Effects to help in the study of whether hot water discharges could harm salmon and other aquatic life in the Columbia River.

The 16-member committee will assist Interior's Federal Water Pollution Control Administration (FWPCA), BCF, and the Atomic Energy Commission in the 2-year study that started February 1968.

The advisory committee members represent States, the Federal Government, and power companies.



Interior Department's Marine Resources Programs Unified

Dr. J. L. McHugh

The Department of the Interior's marine resources programs have been brought together under an Assistant Secretary for Fish and Wildlife Parks, and Marine Resources, Clarence F. Pautzke.

He will be supported by a new Office of Marine Resources (OMR). Acting chief of OMR is Dr. J. L. McHugh, on detail from his permanent post as Deputy Director of BCF.

Office's Duties

OMR will coordinate and advance Interior's "marine resources policies, programs, plans, and legislation. It will work with other Federal agencies, state and local governments, international organizations private industries, universities, the scientific community and the public."

OMR will coordinate Interior's contributions to the marine resources data systems. It will help develop policy guidelines for "marine pollution control, estuarine studies, international research, survey and development activities, multi-use of the coastal zone and high seas."

Inflation Hits King Crab

Probably few food products have gone up as much in price as have king crab this year, reports BCF Seattle. The September wholesale price of fancy canned king crab (24/7½ oz. cans) at $31.00 to $31.50 per case was about 57.5% above a year earlier. In contrast, the average Bureau of Labor Statistics index for all selected fishery products for July 1968 was 22.7% less than a year ealier.

The following wholesale price quotations reflect the sharp price increase in king crab over last year.

	1968	1967	% Increase
King Crab - canned, fancy: 24/7½ oz. cased	$31.00-$31.50	$19.50-$20.50	57.5
King Crabmeat - frozen:			
5 lb. blks/lb.	2.60- 2.65	1.49- 1.53	62.5
2½ lb. blks/lb.	2.65- 2.70	1.51- 1.55	74.2
1 lb. blks/lb.	2.80- 2.85	1.53- 1.61	77.0
Dungeness Crab - canned: 24/6½ oz. case	17.00	15.50	9.7

The scarcity of king crab this year has stimulated competitive buying from fishermen to a point where September exvessel prices of 30 cents to 35 cents a pound were almost triple the 11 cents per pound price of 1967.

Loran 'All-Weather' Navigation Begins in Gulf of Mexico

On November 1, a $2 million Coast Guard radio-electronic system went on the air making possible precise, all-weather navigation throughout the Gulf of Mexico. Three Loran (for Long Range Aid to Navigation) stations went into operation.

Rear Admiral Ross P. Bullard, Eighth Coast Guard District commander, said "the system amounts to a revolution in navigation for the Gulf of Mexico. Mariners who use it will be able to pinpoint their locations without visual reference. Whether they are out of sight of land, or if it's overcast, if the compass is broken, regardless of winds and currents . . . Loran will give them a fast and accurate position fix."

The Loran system took 17 months to construct. It places an electronic grid over the entire Gulf. By obtaining readings on 2 of the Loran "grid" lines, the user can determine his position merely by finding where the 2 lines cross on a Loran chart.

Before Loran

The Coast Guard said that before its system went into operation navigation in the Gulf was limited to one or more of these methods:

Celestial fixes: obtainable only in clear weather, accuracy limited by an individual's skill.

Dead reckoning methods: "calculated guessing at best." It is accurate only when careful attention is given to correct observation--and to such factors as currents, winds, time underway, compass readings, and depth soundings. Accuracy is limited by individual's skill.

Radar: usable for point-to-point navigation only when there is an identifiable land mass in range.

Radiobeacons: limited in range and having wide margin for error.

Depth soundings: navigating along fathom curves by depth soundings is common practice in Gulf. It is rudimentary dead reckoning that provides only remotest index of position and wastes time and fuel.

The Loran System

Loran has been used since World War II, but the new chain in the western Gulf is the first built primarily for commerce rather than defense. There are two Loran types: "A" and "C." Loran "A" is the type operated by the Coast Guard in the Gulf. It guarantees accuracy within one mile at its maxiumum useful range of about 800 miles.

Loran "C" is even more precise and complex. Its range and accuracy are far greater than needed in the Gulf. Its equipment also is much more costly--more than such users as commercial fishermen can afford. A good Loran receiver for type "A" is about $2,000.

The new system incorporates two existing stations at Cape San Blas and Venice, Fla. With a third station at Biloxi, Miss., they had formed a Loran chain that provided good coverage only in the eastern Gulf. By the time their signals reached the western Gulf, they were no longer usable for position fixes.

The station at Biloxi was closed Nov. 1 when the new Grand Isle facility began transmitting. This was done to integrate the old chain and the new one to give better coverage throughout the Gulf.

How Loran Works

Loran navigation is based on measurement of time that elapses at a receiver between arrival of signals transmitted simultaneously from 2 different points. The receiver acts like an electronic stopwatch. The Coast Guard explains: "It begins counting when it receives the first signal and stops when it receives the second. The elapsed time gives one reading. A smooth curved line can be drawn through any number of points where the time elapsed between reception of the two signals is constantly the same." This line is a "line of position" or "a Loran line."

The Loran transmitting stations operate in pairs. Each pair produces the 2 signals needed to get one line of position reading. Pairs are further arranged in chains of 3 or more stations. When the chain arrangement is used, the intermediate stations operate in both adjacent pairs. In the Gulf Loran chain, there are 4 pairs of stations:

--Port Isabel and Galveston
--Galveston, the master station, and Grand Isle.
--Grand Isle and Cape San Blas
--Cape San Blas and Venice

For each pair, a straight line (the base line) can be drawn through the 2 stations. At this base line, all the Loran Lines are perpendicular, and from there they extend out over the Gulf in long sweeping curves through various arcs. For example, because the base line between Galveston and Port Isabel is at considerable angle to the base line between Grand Isle and Galveston, the Loran lines of position from the 2 pairs cross hatch the Gulf in a distorted grid pattern. The same is true of the other pairs.

How Navigator Uses It

To find out where he is, the Loran navigator gets readings from 2 pairs of stations. These readings correspond to Loran lines of position overprinted on regular nautical charts. He locates the lines on his chart and traces them to the point of intersection. That point is his location. It is then easy for him to translate this information into latitude and longitude, or relative bearings.

Commercial Fishermen Aided

The Coast Guard believes commercial fishermen in the Gulf can benefit much from Loran. Its precision navigation can mean greatly reduced running time to and from fishing grounds--saving fuel. When good fishing areas are located, they can be pinpointed for later trips or to guide other boats to the area.

Accurate position reports through Loran also will bring help faster. The Coast Guard has had to search thousands of square miles of ocean when looking for a fishing boat in distress that gave only the vaguest indication of its position. In some cases, the time consumed in such a search could mean the difference between life and death--or between loss of a valuable boat and catch and a safe return to port.

Loran charts for the Gulf and air navigation charts are available. Coast and Geodetic Survey chart No. 117 also is available. Others, as they are published, will be obtainable through authorized sales agents.

Data Center Gathers Definitive Story of the Sea

During 1967 the ocean data-gathering agencies of the U. S. Government reported the findings of over 600 cruises of their research and exploratory vessels to the National Oceanographic Data Center (NODC) in Washington, D. C. It was the first time that complete information on the total national marine-science effort became available in one place. NODC also filled a role in global oceanography: It was one of two nerve centers providing information to oceanographers everywhere. The second center is in Moscow.

NODC is sponsored by U. S. Government agencies interested in the marine environment. It is governed by an Advisory Board representing these agencies and the National Academy of Sciences. The U. S. Naval Oceanographic Office manages the Center. NODC's mission "is to acquire, process, preserve, and disseminate unclassified oceanographic data for scientific, industrial, and defense purposes."

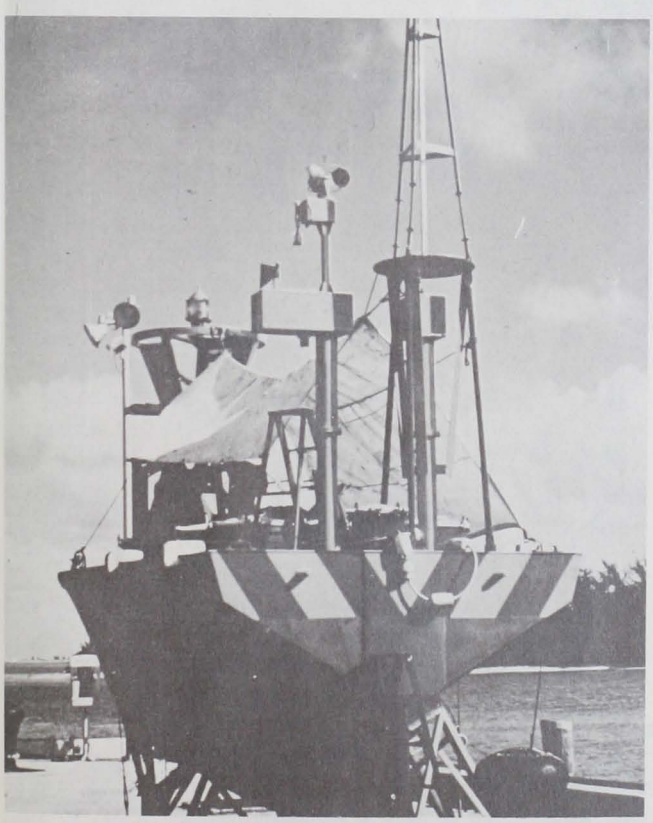


Fig. 1 - Nomad (Navy Oceanographic Meteorological Automatic Device) buoy transmits data up to 2,000 miles over standard 100 words-per-minute radioteletype circuits. (U. S. Navy)

Reorganizes to Meet Challenge

Early in 1968, NODC reorganized its operation to cope with the great changes taking place in data gathering. Nansen bottle casts are being replaced by continuously recording salinity-temperature-depth (STD) systems that can be kept in place. The mechanical bathythermograph (BT) is giving way to the more exact XBT. More buoys are being anchored throughout the oceans. These are equipped to sense and record great amounts of data. The types and amounts of oceanographic data received from manned and unmanned satellites are increasing rapidly.

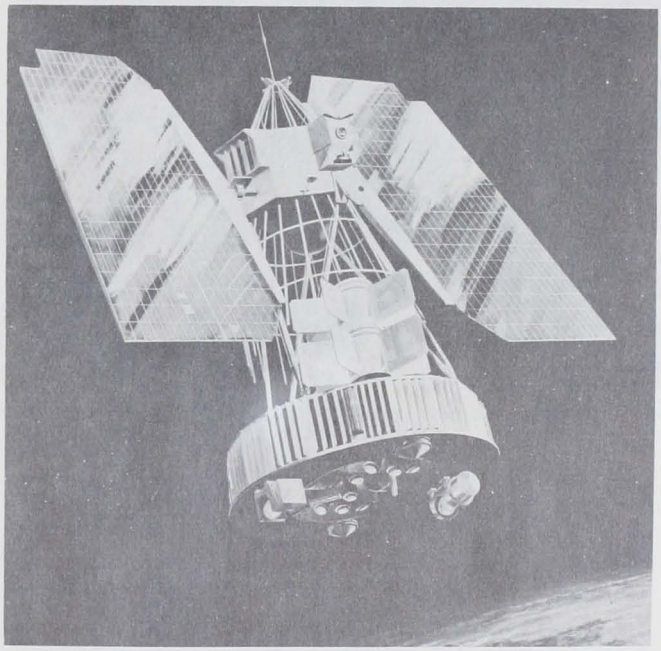


Fig. 2 - Nimbus weather satellite (NASA).

National Marine Data Inventory

NODC conducted the first National Marine Data Inventory (NAMDI) during fiscal year (FY) 1968 in order to become a central bank of information on the national effort in oceanography. It recorded the more than 600 cruises conducted by U. S. agencies. NAMDI includes information on quantity and type of data, area of operations, and persons participating. Track charts and narratives are available for many cruises. Statements on sampling and analytical techniques are included. The results are being automated.

When this task is completed, NODC will be able to answer--by use of punched card or magnetic tape sorts--such questions as: "Has

Fig. 3 - Ocean Science Important to Ice Patrol Vigilance--The constant study of the ocean currents, which greatly influence iceberg movements, is important to the Ice Patrol's predictions and tracking plots for iceberg seasons. Here, a Salinity Temperature Depth Sensor system is used on the Coast Guard oceanographic vessel "Evergreen" on a mission to determine if the source of the Labrador Current is in the Hudson Strait. The Sensor systems instantaneously record readings of salinity, temperature, and depths down to 1,500 meters. (U. S. Coast Guard)

anyone sampled euphasids in Providence Channel? Who took cores in the Indian Ocean? Where? Who has them now? Were South Pacific plankton species studied during the austral winter? What was the total number of United States research vessels operating in the Atlantic during the last fiscal year?"

World Data System

As one of the two centers of the world data system, NODC makes available to world's scientists information from a list of cruises included in a U. S. Declared National Program (DNP). Information from 366 cruises was identified as DNP.

Vast Influx of Information

A great stream of information flows into NODC. Oceanographic station data (Nansen casts) and bathythermograms continue to exceed the influx of other data types. During FY 1968, over 31,000 oceanographic stations and 110,000 BT observations were received. Biological data came at a rate of about 500 stations per month. In geology, a good start was made on sediment data from the U. S. Naval Oceanographic Office and Scripps Institution of Oceanography. Seismic reflection

Fig. 4 - Nansen bottle is attached to wire to obtain temperature, pressure, and water sample at predetermined depth.

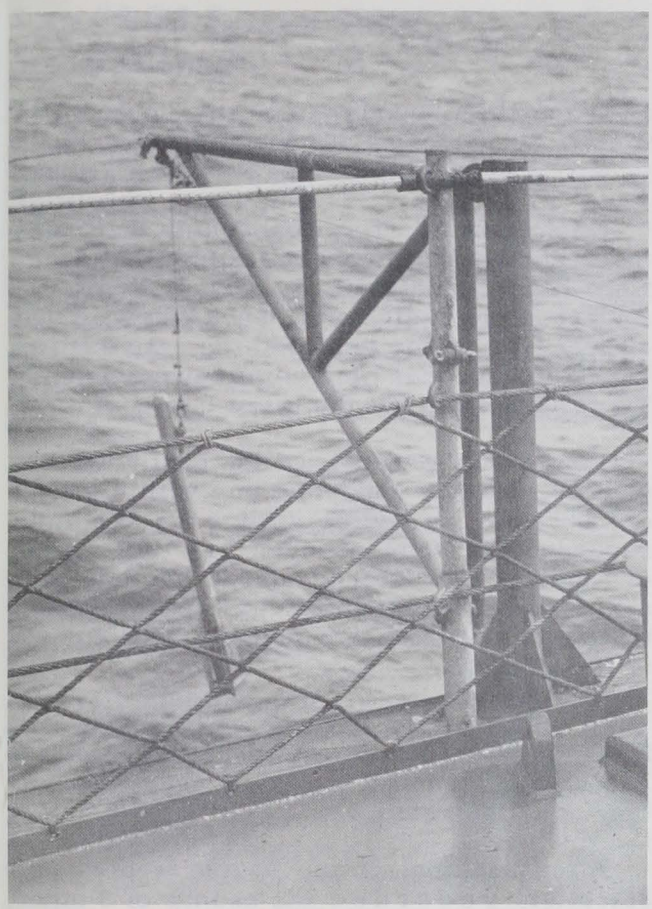


Fig. 5- Bathythermograph makes quick record of temperatures at different depths. Data are useful in finding fish.

Fig. 6 - Biologist using a light transparency meter to measure turbidity in the waters of Galveston Bay, Texas.

data holdings increased by 32,000 miles of records--primarily for the Mediterranean, Atlantic, and Pacific.

NODC Achievement

NODC data processing of Nansen casts has compiled the most comprehensive file ever set up in oceanography. After $2\frac{1}{2}$ years of work, the Nansen cast data file of geosorted stations has been made worldwide. It consists of 54 reels of magnetic tape, each more than a half-mile long, packed in 556 characters per inch. The file has over 280,000 stations in every ocean of the world; it has over 6 million tape records. The oceanographer can find comprehensive information about "temperature, salinity, oxygen, phosphorus, nitrogen, and silicate data observed at specific depths."

NODC hopes to get a new computer that will increase its processing capacity at least 8 times. It will enable the Center to furnish information about "biology, geology, salinity, temperature, depth, sediment chemistry, and a host of user-oriented systems."

NODC Director

The NODC operation is headed by Dr. Thomas S. Austin, former director of BCF's Tropical Atlantic Biological Laboratory in Miami, Fla. Dr. Austin became NODC director on July 2, 1967. He serves too as Director of World Data Center A, Oceanography.

OCEANOGRAPHY

Scientists Record Whale 'Talk'

Scientists from the U. S. Naval Oceanographic Office (NOO) and the University of Rhode Island successfully recorded the sounds of 7 different species of whales and dolphins inhabiting the North Atlantic on a recent cruise off Nova Scotia, Newfoundland, and New England. The tapes now are being studied to compare the mammal 'talk' with similar sounds heard by Navy sonarmen tracking submarines.

In addition, the scientists under Dr. H. E. Winn, professor of oceanography, University of Rhode Island, bounced sonar signals off the aquatic mammals to determine the strength of the resulting echoes. These echoes, reported Lt. J. Lawrence Dunn, a NOO biologist, have been known to create problems for the Navy's antisubmarine forces.

Sight 7 Species

Sailing on August 13 aboard the "Trident," an 180-foot research vessel operated by the university, "the scientific party and crew recorded sightings of several hundred whales and dolphins of seven species" from August 20 to 22, reported Lt. Dunn. The scientists successfully launched active and passive sonobuoys--sophisticated acoustical devices used to pick up mammal 'talk' and the echoes bounced off their bodies. The expendable active sonobuoys were used as sound sources for bouncing signals off the mammals. These buoys also enabled the scientists to receive acoustic data while sailing a normal course. The passive buoys were used to transmit the mammal 'talk' to the ship.

Early Success

Lt. Dunn recalled: "We encountered a pod (school) of killer whales" after the ship had barely cleared the harbor at St. Johns, Newfoundland. "The proximity of the nearby land mass made our active sonobuoy work impossible, and problems with the videotape system prevented the university personnel from carrying out planned observations on this species."

On the next day, however, the scientists spotted large numbers of pilot whales and recorded their sounds before the Trident was forced by icebergs and the illness of a university graduate student to return to St. Johns.

On August 15, after abandoning their plan to circumnavigate Newfoundland, the scientists headed southwest to Cabot Strait. On August 16, they sighted finback whales about 60 feet long. They deployed the active sonobuoys and recorded mammal echoes despite the failure of one of the three buoys.

Rough weather hindered the hunt until August 20, when the Trident came within inches of a 55-foot sperm whale. After the scientists recorded the sound produced by this whale, and another encountered later in the day, they again saw finbacks. But the sperm whales talked so loud that they obscured the sounds of the finbacks.

"I obtained my revenge on one of the offending sperm whales by tagging him with a Fisheries Research Board of Canada whale tag," Lt. Dunn said.

After shaking off the sperm whales, the scientists recorded the sounds of 3 other species--pilot whales and bottlenose and dolphins--during August 21 and 22.

Data from 'Oceanographer' & 'Discover' Cruises Microfilmed

The Environmental Data Service, a component of the Environmental Science Services Administration (ESSA), has microfilmed most of the observed geophysical data gathered during the USC&GSS Oceanographer's 1967 Global Cruise and the USC&GSS Discoverer's 1968 African Cruise.

Copies of these preliminary data and reduced geophysical data from the USC&GSS "Pioneer's" 1964 International Indian Ocean Expedition and the Pioneer's 1965 and "Surveyor's" 1966 West Coast Upper Mantle Project are now available from the Environmental Data Service, Silver Spring, Maryland 20910.

Two C&GS Survey Ships Commissioned

Hydrographic survey sister ships of the Coast and Geodetic Survey, "Fairweather" and "Rainier," were commissioned October 2 in Seattle, Wash.

The 1,627-ton, 231-ft. vessels, equipped with the latest electronic, depth recording, and positioning equipment, will chart U. S. coastal waters to help provide safe navigation for commercial shipping and recreational boating. They will operate in Alaskan and West Coast waters.

Vast Undersea Valley Shown Off Oregon

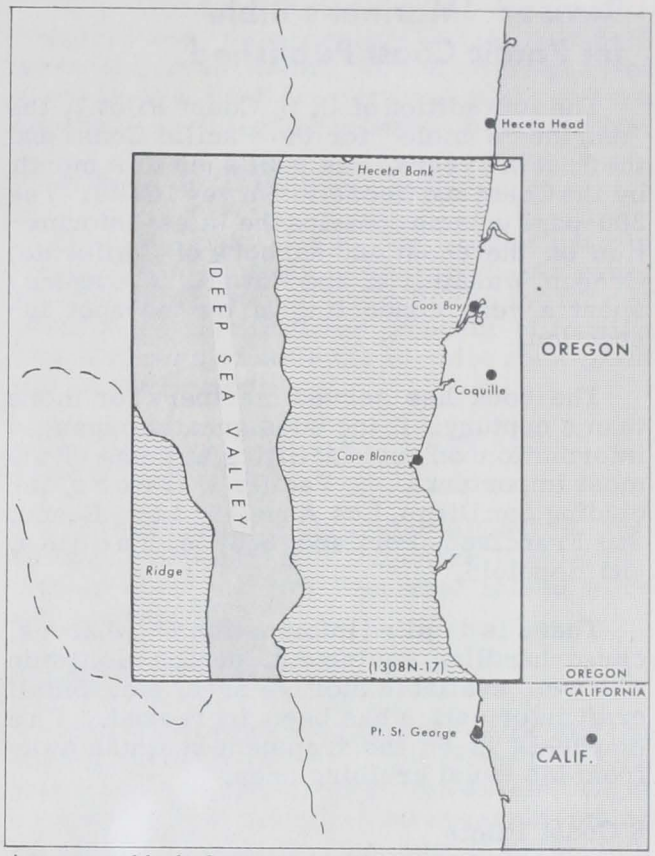
A new map of the ocean floor published by the Coast and Geodetic Survey shows a vast undersea valley off the Pacific Coast. The valley extends about 400 miles along Oregon and California. Approximately 35 to 60 miles from the coast, about one to two miles below the sea surface, the valley is 15 to 60 miles wide.

About 140 miles of the valley appear on the new bathymetric map. The map covers approximately 13,000 square statute miles of sea bottom. It extends 65 to 95 miles seaward off the south Oregon coast, from Cape Ferrelo to the Umpaqua River. Depths range from a few feet off the coast to over 10,500 feet about 40 miles west of Cape Sebastain.

Noteworthy Features

The other noteworthy features on the new map include part of an extensive ridge west of the valley rising over 3,100 feet from the bottom, and the southern tip of Heceta Bank, 35 miles west of Florence, which rises to within 167 feet of the water's surface.

The bathymetric map provides the most detailed bottom topography of the area published. It is one of a series planned by CGS for the seabeds off the Atlantic, Pacific, Alaskan, and Gulf coasts.

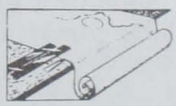


Area covered by bathymetric map (1308 N -17) of sea bottom off south Oregon, including vast undersea valley.

Maps Aid Development

The maps are designed to aid Federal, state, and industrial interests explore and develop the potential resources of the continental shelf. It is an area of approximately 862,000 square statute miles off the U. S. coasts. Economic development of these resources depends heavily on bottom topographic maps; few exist. Knowledge of the sea bottom is essential for marine engineering, scientific studies in recovering offshore oil and minerals, and to evaluate shoreline erosion and accretion.

Previous maps include the shelf off northern Oregon, southern California, the Aleutian Islands, northeastern Gulf of Maine, and the mid-Atlantic coast (from Cape Cod, Mass., to Chincoteague Bay, Md.).



Revised 'Mariner's Bible' for Pacific Coast Published

The 10th edition of U. S. Coast Pilot 7, the "mariner's bible" for the Pacific Coast and the first in 5 years, was published this month by the Coast and Geodetic Survey (CGS). The 380-page volume contains the latest information on the coast and harbors of California, Oregon, Washington, and Hawaii. The agency spent a year conducting an on-the-spot inspection.

The book has served mariners for more than a century. It includes greatly expanded information on port facilities at some of the most important U. S. Pacific harbors, including San Diego, Los Angeles, Long Beach, San Francisco, Portland, Seattle, Tacoma, and Honolulu.

There is detailed information on wharves, cargo-handling equipment, depths alongside wharves, available storage area, etc. Small craft information has been increased. The emphasis is on the transient boatman away from his usual cruising area.

8 Coast Pilots

CGS publishes eight coast Pilots covering all U. S. coastal and intercoastal waters. New editions appear about every 5 years.

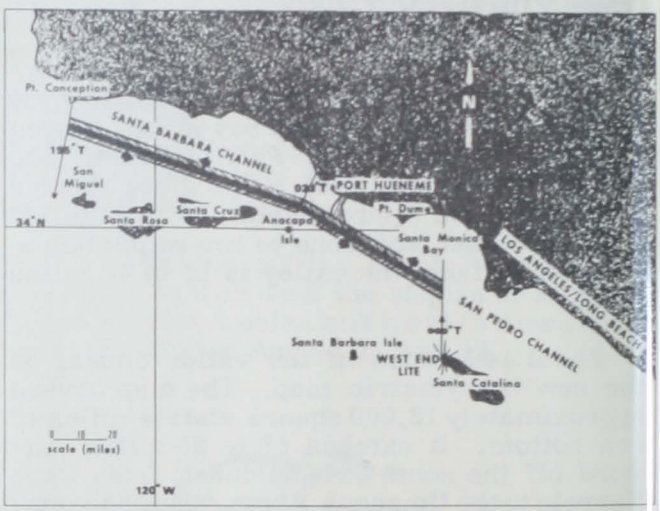
Generally, the book furnishes information that cannot be shown graphically on marine charts, such as navigation regulations, outstanding landmarks, channel and anchorage peculiarities, dangers, weather, ice, freshets, routes, pilotage, and port facilities. Cumulative supplements, containing changes, are published early each year.

Coast Pilot 7 describes the numerous bays, harbors, and rivers along the coasts of California, Oregon, and Washington. It also describes the offshore Channel Islands of southern California, the Sacramento and San Joaquin Rivers and their delta region, the Columbia River, and the large "inland sea" comprised of the Straits of Juan de Fuca and Georgia, and Puget Sound. A chapter on Hawaii describes the 8 larger islands and many small outer islands of the Archipelago.

The new edition costs $2.50. Available from the Coast and Geodetic Survey (C44), Rockville, Md. 20852, or from CGS sales agents. Annual supplements are distributed free.

Coast Guard to Set up Sealanes in Southern California

The U. S. Coast Guard has established coastwise sealanes in Southern California from Point Conception thru the Santa Barbara Channel to Santa Monica Bay. The new sealanes, effective Jan. 1, 1969, will provide safe passage thru areas of potential oil exploration and minimize risk of collisions. Similar plans already operate in New York, Delaware Bay, and San Francisco.



The sealane idea is similar to the divided highway of land transportation. The sealane is composed of 2 lanes, each one-mile wide, with traffic flow in opposite directions, separated by a "buffer" zone 2 miles wide. This idea has had good results on the Great Lakes since 1911. With the cooperation of domestic and foreign shipping lines, the risk of collision will be held to a minimum.

An overall plan includes a system of coastwise lanes extending from Point Conception to San Diego and linking the ports of Los Angeles/Long Beach, Port Hueneme, and San Diego.

Foreign Fishing Off U. S. in September

NORTHWEST ATLANTIC

One hundred and sixty-nine fishing and support vessels from the USSR, Poland, East and West Germany and Romania, were sighted in September, 44 fewer than in August. Such a decrease, due mostly to the departure of small Soviet side trawlers, is normal at this time.

Soviet: Soviet vessels--32 factory stern trawlers and 56 medium side trawlers--were observed fishing intensively along the 40- and 50-fathom curve, from Cultivator Shoals to the northern edge of Georges Bank, taking moderate amounts of herring and mackerel.

Polish: Polish vessels, about 35 in August, decreased to 24--9 stern trawlers and 15 large side trawlers fishing herring on the northern edge of Georges Bank. In September 1967, 38 Polish trawlers and support vessels were sighted there.

East Germany: The fleet, 31 vessels in August, decreased to 20 in September. Nineteen freezer stern trawlers and 1 factoryship were fishing herring east of Cape Cod and Nantucket, and on the northern edge of Georges Bank. In September 1967, 11 East German trawlers were sighted on Georges Bank.

West German: Fourteen freezer stern trawlers and 7 side trawlers (2 pair trawling) were observed fishing in the same general area as the East Germans. Only 4 stern trawlers were sighted in September last year.

Fishing in the Contiguous Zone

Special Coast Guard Sea and sea patrols were instituted early in the month. As exact measuring is very difficult, due to the lack of good shore line features, reports of foreign vessels fishing inside the 12-mile zone could not be confirmed.

GULF OF MEXICO, SOUTH ATLANTIC, AND CALIFORNIA

No foreign vessels were sighted in September. Reports of a Japanese long-liner fishing south of San Clemente Island were not confirmed.

PACIFIC NORTHWEST

Thirty-three Soviet vessels were sighted during September--25 large stern trawlers and 8 processing and support vessels. Light catches were observed aboard vessels fishing off Washington in the first half of the month; in the second half, when fishing had switched to off Oregon, good catches of Pacific hake were observed.

The nature of Soviet hake fishing has changed considerably this year. In 1966 and

Fig. 1 -"Ryanyy," whale catcher ship. This type of vessel highly maneuverable and capable of 18-20 knots. It is 208 feet long. (BCF/Crosby)

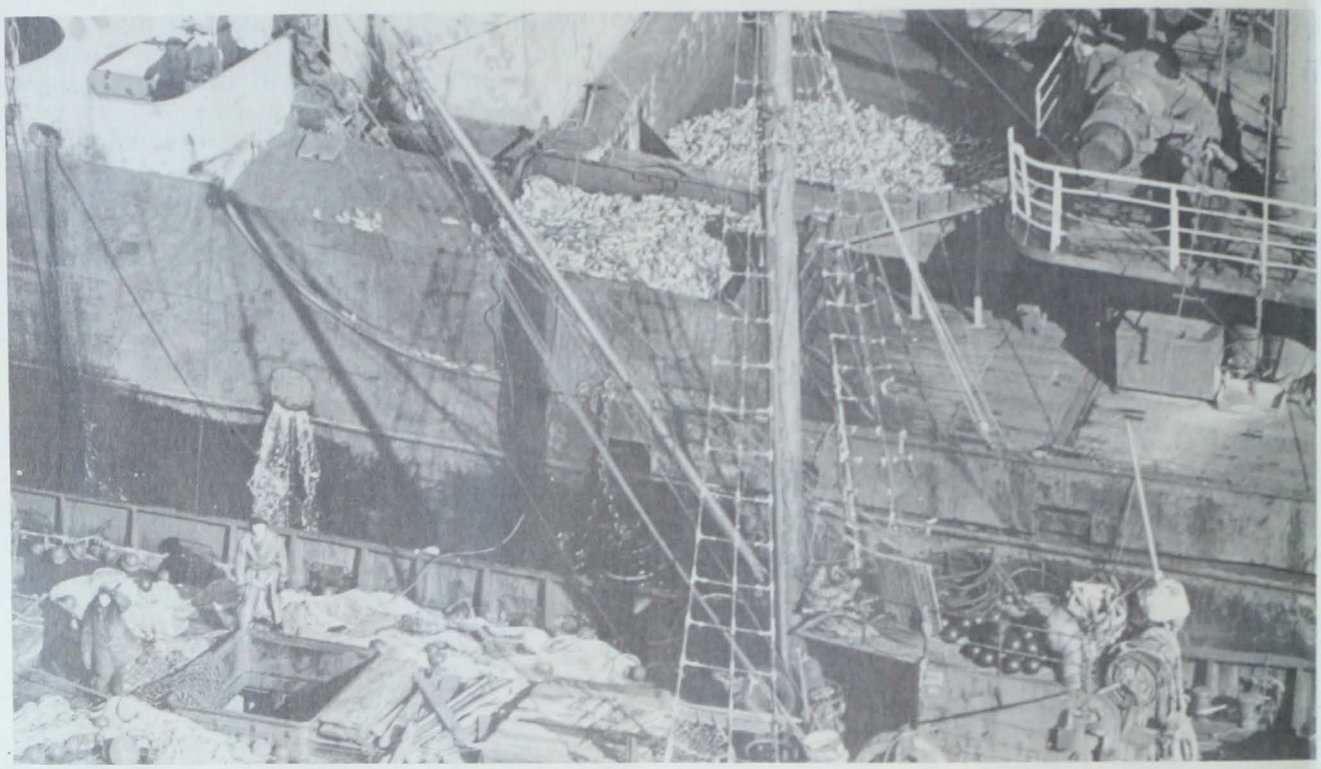


Fig. 2 - Unloading Pacific ocean perch from the "SRT Som" to the refrigerator reefer ship "Evaron." Note perch in bins aboard Evaron. (BCF/Branson)

1967, vessels were mostly medium side trawlers; this year there were more stern than side trawlers. There is evidence that experimental pair trawling with medium trawlers has not proved successful. Over 180 vessels were sighted in 1966 and 1967, compared to only 86 this year, but because of the greater efficiency of stern trawlers, the smaller number does not mean that Soviet hake catches will decrease.

ALASKA

Soviet: Soviet vessels fishing off Alaska fluctuated between 20 and 30, about half the number sighted in September last year.

Six stern trawlers along the Aleutians, and 2 in the Gulf of Alaska, fished for ocean perch. Ten medium trawlers fishing for pollock, flatfish, perch, and gray cod, along the Continental Shelf edge in the eastern and central Bering Sea, ended the fishery in mid-September. One whale catcher, sighted in central Bering Sea, is believed to have belonged to a fleet of 8 catchers and 1 factoryship.

Japanese: The 180 Japanese vessels observed during September had dropped to 130 by the end of the month because of declining ocean perch and minced meat and meal fisheries. A drop in effort in ocean perch fisheries is typical for that time of year. At mid-month, there were 6 factoryship fleets in the minced meat and meal fishery in the eastern and central Bering Sea; one returned to Japan at month's end, while the remaining 5 factoryships and 91 trawlers, spread out on the Continental Shelf, north of the eastern Aleutians and Alaska Peninsula, to northwest of the Pribilofs.

The 2 king crab factoryship fleets on the Continental Shelf, north of Port Moller, will stay on into October to take advantage of the high catches of tanner crab. One combination processing and fishing vessel, observed fishing tanner crab in the central Bering Sea in July, was sighted there again, presumably still fishing tanner crab.

The 9 vessels long-lining for sablefish in the Gulf of Alaska had decreased to only 1 or 2 by the end of the month.

Two stern trawlers fishing shrimp near Two-Headed Island, off southwest Kodiak Island, ended their operations by mid-September.

Note: During surveillance patrols, vessels are sighted, recorded, and identified as to type. Vessels are counted only once; if a vessel was sighted more than once it is counted as only one vessel, excluding duplicate sightings. Since vessels continuously arrive and depart, the total number of identified vessels for the month will always be larger than the actual size of the fishing fleets observed.

STATES

Alaska

SALMON CATCH IS 88% ABOVE 1967

BCF Juneau provides this summary of 1968 fishery developments in Alaska: The 1968 salmon catch is estimated at 260 million pounds with an exvessel value of $37.5 million--up 88 percent in volume and 52 percent in value over 1967.

King salmon landings remained relatively stable at 11.5 million pounds worth $3 million.

Chum salmon landings of 75 million pounds were the highest since 1944; the value of $7.5 million set a record.

Coho salmon landings of 18.5 million pounds were the highest since 1964, and the $4.5 million value a record.

The red salmon pack of 207,694 cases in Western Alaska was the lowest since the fishery began.

Pink salmon were large in number but small in size. They averaged 3 pounds per fish throughout Alaska.

Alaska salmon have more production and marketing opportunities because of modern transportation systems. For example: nearly 500,000 pounds of pinks were shipped from Prince William Sound to the supermarket trade, and frozen chum salmon have entered markets in Sweden and Japan.

Crab Landings

King crab landings of about 85 million pounds will be down 33 percent from 1967 landings of 127.7 million pounds. But value will set a record--up about 66 percent from $15 million to over $25 million.

On September 20, the Alaska Department of Fish and Game raised minimum size of king crab to 7 inches (carapace width) for all Alaska. Previously, minimum legal size had been $5\frac{3}{4}$ inches for Bering Sea area, and $6\frac{1}{2}$ for Aleutiian Islands area.

Dungeness crab landings in 1968 will approach 12 million pounds. These are slightly higher than 1967 landings of 11.6 million pounds, but increased exvessel prices will raise value 20 percent--from $1.5 to $1.8 million.

Tanner crab landings will top 3 million pounds in 1968; the 1967 catch was only 118,000 pounds.

Shrimp landings may be slightly less than in 1967. Estimates are for a year-end total of 40 million pounds, compared with 42 million pounds in 1967.

Scallop landings will hit 1.5 million pounds of meats with an exvessel value of $1.4 million. This is the first year scallops have been landed commercially.

* * *

SHELLFISH INDUSTRIES CONSOLIDATING

Ownership and management of the Alaska shellfish industry are changing. Shellfish operators in Alaska are mostly corporations with headquarters out of the state. Most often they are financially related to brokerage or marketing firms. Some have been engaged in salmon and other fisheries of Alaska for decades.

During the past 5 years, there have been consolidations of established shellfish packers with new entrants. Foreign operators, notably the giant Japanese firms Taiyo, Mitsubishi, and Nichiro, also have entered the industry. They did this usually by joint venturing with established domestic firms. The new domestic entrants, national rather than state level, are generally parts of the larger national food processing and marketing industry.

Recent Changes

Alaska's pioneer king-crab operation, Wakefield Fisheries, was sold recently to Hunt Wesson Foods, Inc., a subsidiary of Norton Simon, Inc. General Mills acquired Point Chehalis Packers with plants at Kodiak and Cordova. Mergers of nationally active firms include Ralson-Purina and Westgate-California Foods. For longer 1eriods, the national firms of Castel and Cooke, Vita Foods Inc., New England Fish Company, Nakat Packing Company (a subsidiary of A&P), and the

California Packing Corp. (or "Del Monte") through its subsidiary, the Alaska Packers Assoc., have been active in Alaska.

Regional Operators

Operators that are more regional in character (Pacific Northwest and Alaska) are Washington Fish and Oyster Co., Columbia-Wards, Pan-Alaska Fisheries, Ivar Wendt of Seattle ("Pacific Pearl"), Whitney-Fidalgo Seafoods, Kayler-Dahl, Petersburg Fisheries, and others.

* * *

MORE NATIVE RESIDENT ALASKANS HIRED

Alaska Commissioner of Labor Thomas J. Moore reports that "more Alaska natives worked in more jobs in more fish processing and canning plants in western Alaska in 1968 than in any other year in history." Moore attributes this sharp upsurge to a realization by cannery owners that it makes good sense to hire qualified local workers.

During the first 8 months of 1968, nearly 200 Eskimos were placed in fish processing and canning jobs in one small western community. Two years ago, only 70 Eskimos found jobs in the same community.

California

SAN PEDRO FISHERMEN'S INCOME DECLINES

From 1963 to 1967, the average annual income for fishermen in the San Pedro, Calif., fleet fell from about $4,600 to about $4,100. (The average family income in U. S. is $8,900.) During 1958-1968, the fleet decreased from 63 boats with a capacity of 5,745 tons to 28 boats with a 2,470-ton capacity. All vessels were built before 1945. These preliminary data were reported by William Perrin of the Operations Research program of BCF's Fishery-Oceanography Center.

High Cost of Replacing Fleet

Perrin visited the Seattle-Tacoma (Wash.) region to get estimates of how much it would cost to replace the San Diego wetfish seiners. He talked to representatives of 3 boatbuildi companies. While the estimated market valu of the San Pedro vessels ranges from $20,0 to $60,000--estimates of the cost of buildi vessels to replace them range from $120,0 to $400,000, depending on size and equipmen

San Pedro is No. 1

In 1967, for the 19th consecutive year, Sa Pedro was the No. 1 U. S. port. Its landing were worth $28,598,000. In 1950, it set th all-time record for landings in a single season with 848 million pounds of fishery products.

* * *

FISHING INDUSTRY DOES NOT SHARE IN THRIVING ECONOMY

California's economy has been prosperin for years, but the fishing industry and flee have not shared its success. The somber story of the industry is outlined in the 196 report of BCF's Fishery-Oceanography Center in La Jolla, Calif. The Center is dedicated to advancing basic fishery science--and to conducting research on problems relevant to fisheries in its area in order t improve them.

Resources and Problems

In 1966, the fish industry used as ra material about 250,000 metric tons of 50 species of fish and invertebrates worth $87 million. Of the total, 60,000 tons worth $32 million were caught by foreign vessels and transshipped to California processing plants. Th imports were 22% of the total weight an 37% of the value.

By 1966, landings had declined to under a third of the 1939 figure. The tuna industry depended increasingly on foreign catches. In 1939, the California fleet's total catch was over 750,000 metric tons worth $18 million; only 3,000 additional tons were imported.

Many Causes

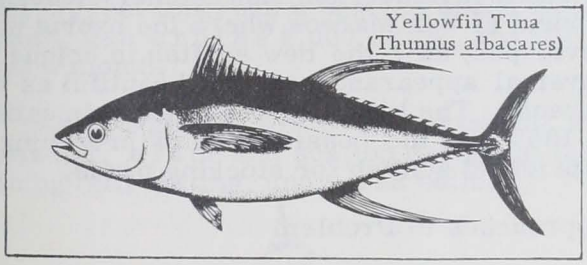
This decline "is the basis of the problem facing the California fish industry and its fishing fleet," states the La Jolla report. It continues: "Attributable to no single cause, the failure to participate in the generally rising prosperity of the California economy can be blamed on unwisely heavy fishing of

some resources, on natural changes in resource abundance due to climatic trends, and on increasing foreign competition in the tuna fisheries and in the fish meal and oil markets."

1939 vs. 1966

In both 1939 and 1966, the 5 main elements of the California fisheries were tuna, salmon, industrial fish, fresh fish, and invertebrates.

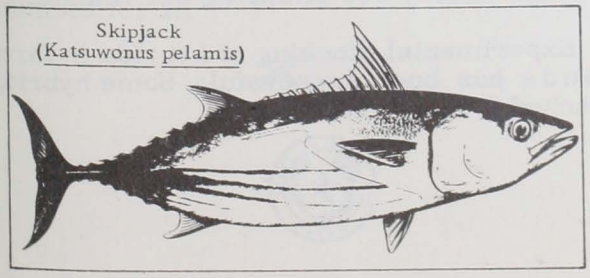
By 1966, tuna landings had increased about 33% over 1939. Yellowfin tuna (Thunnus albacares) dominated in 1966 as in 1939; the proportions of the other species remained about the same. In 1939, canners imported only 3,178 tons; by 1966, imports were 60,832 tons. These imports were 45% of the value of raw materials used by processors; in 1939, the figure was only 5%.


Yellowfin Tuna
(Thunnus albacares)

By the early 1960s, researchers realized that stocks of yellowfin tuna had reached their maximum sustainable harvest. In 1966, the yellowfin were brought under effective international regulation for the first time.

Underutilized Tuna Species

With yellowfin tuna landings at a peak, it became important to increase the harvest of underutilized tuna species--or imports would continue to spiral. The La Jolla report states: "Fortunately, it appears possible that the skipjack tuna (Katsuwonus pelamis) population and perhaps those of the temperate tunas are not fully harvested and ways of increasing the take of these species by California vessels are now being studied within the Fishery-Oceanography Center."


Skipjack
(Katsuwonus pelamis)

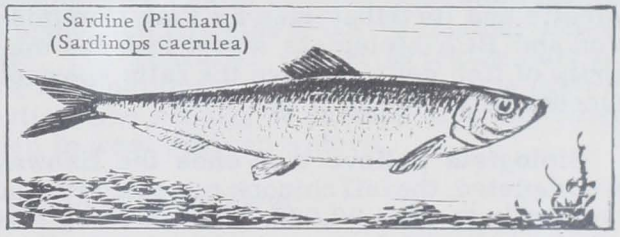
Salmon Fishery Stable

The salmon fishery off Northern California has been stable since the late 1930s. The value of landings has increased.

Industrial Fishery Troubled

The industrial fishery ("wetfish fishery") is worst off. It uses pelagic species of the California Current. These are reduced to fish meal and oil--canned as inexpensive canned products (mostly for export) and processed into animal foods. This fishery declined from great prosperity in the 1930s and 1940s to current despair. In 1939, landings topped 500,000 tons; by 1966, they had dropped to about 60,000 tons.

The decline is attributed mostly to the collapse of the northern subpopulation of the Pacific sardine (Sardinops caerulea). This began during the 1940s and hit bottom in the 1950s. In 1939 sardine landings were 500,000 tons--79% by weight and 34% by value of all landings; in 1966, they were only a few hundred tons.


Sardine (Pilchard)
(Sardinops caerulea)

Fresh Fish

The fishery for fresh fish is less depressed than the industrial fishery. The landings in 1966 were about the same as in 1939, but their value was higher.

Fishery for Invertebrates

The fishery for invertebrates has remained a minor one in California's total fishery economy. This is true despite the more than twofold increase in landings--due mostly to increased exploitation of squid and market crab.

Oregon

FALL CHINOOK RUN PAST
WILLAMETTE FALLS SETS RECORD

A record 4,260 fall chinook conquered Willamette Falls, historic barrier to spawning salmon in the Willamette Basin, in 1968, the Oregon Fish Commission has announced.

The number passing over the cul-de-sac portion of the multimillion dollar Willamette Falls fishway, together with the old ladder, was more than double the 1967 count. Most fish used the new cul-de-sac fishway. This was reported by Roy Sams, project leader on the Columbia River Watershed Development Program.

Small But Significant Number

The number of fish, though relatively small, is significant, Sams emphasized. He noted that the fledgling upriver run has built up steadily from the period when the fall chinook faced virtually impassable conditions. Recent aerial surveys of the Willamette and its tributaries by Fish Commission and BCF biologists attest that the majority of fish getting above the falls spawned successfully.

Biologists believe that once the fishway is completed, the fall chinook run could expand eventually to over 90,000. To develop this potential, the Fish Commission and the Fish and Wildlife Service have planted millions of juvenile fall chinook in the Willamette system since 1963.

Sams said the development of a 90,000 run could be speeded greatly with money to expand the present salmon pond rearing program in the Willamette Valley.

More Ponds Proposed

The Fish Commission is pleased with the successful rearing program conducted at the Salem Cascades Gateway Park in 1968. It has proposed 4 more pond rearing sites. These and the Salem pond could produce annually 25 million fall chinook smolts. The ponds would be located on the Molalla, North Santiam, South Santiam, and on the main stem Willamette near Eugene.

How successful the pond rearing program will be depends on the return of adult fall chinook; the first are expected in 1970.

Texas

HYBRID SUNFISH EXPERIMENTS
ARE SUCCESSFUL

The Texas Parks and Wildlife Department may have a solution to sunfish overpopulation in lakes and ponds: a hybrid sunfish. It is a cross between the female redear and the male green sunfish. The hybrids grow much faster than their parents and have only a fraction of their reproductive capacity.

Harmon Henderson, fish hatchery superintendent at San Marcos where the hybrid was developed, says the new sunfish is unique in physical appearance and as beautiful as its parents. The hatchery began experimenting in 1963 with the possibilities of producing a hybridized sunfish for stocking ponds.

Approaches to Problem

According to Henderson, the problem with normal sunfish is that one female may produce 12,000 to 65,000 eggs. The population explosion produces too many fish that cannot grow.

Henderson notes various methods used to control sunfish populations, including rotenone treatments of ponds and seining. Ponds with controlled water levels have been lowered sufficiently to expose sunfish nests and eggs to air in order to destroy them.

Hybrids May Be Answer

These measures are not needed with the hybrid. The hybrid are reproduced at a ratio of 4 males to 1 female. An experimental pond, drained after hybrid eggs hatched, had an average of only 300 offspring per female.

Experimental stocking of hybrids in farm ponds has been successful. Some hybrids reached 2 pounds in 2 years.

BUREAU OF COMMERCIAL FISHERIES PROGRAMS

'Delaware II' Replaces 'Delaware'

BCF Gloucester (Mass.) has a new research vessel--the Delaware II. The vessel was delivered by the builder, South Portland Engineering Co., on October 4.

The Delaware II replaces the M/V Delaware, which will be sold by the General Services Administration in November. The new vessel will conduct exploratory fishing and gear research in the Northwest Atlantic--from Maine to Virginia--and in international waters off eastern Canada.

Delaware II

The vessel, which costs about $1,400,000, is 155½ feet long, has a service speed of 12.5 knots, can cruise 8,000 miles, and stay at sea a month.

She is equipped for stern trawling, side trawling, clam and scallop dredging, longlining, gill netting, and purse seining.

'Hybrid' Purse Seine Is Tested

BCF tested its fast-sinking, "hybrid" purse seine aboard the tuna purse seiner "Liberty" fishing off Oregon.

Although the Liberty was last to arrive on the fishing grounds, it was reported in mid-October to have caught more than the other vessels: 10 tons of bluefin tuna, 75 tons of albacore, and 60 tons of bonito.

Purse Seine Design Next

Enough was learned from making the net and testing it to go on to the next phase. This is the design of purse seines tailored to the net's length, depth, weight, and type of fishing planned for it.

Floating Trap Net in Oahe Reservoir Proves Effective

The effectiveness of a BCF-developed floating trap net used in Oahe Reservoir is surprising observers. The reservoir is on the Missouri River in South and North Dakota. During its first tests, the floating net took 33,043 pounds of buffalo fish in 187 lifts--177 pounds per lift. Conventional hoop nets took 30,285 pounds in 471 lifts--64 pounds per lift.

Other species, mostly carp and carpsucker, made up less than 10 pounds per floating net lift--and less than 13 pounds per hoop net lift.

'Undaunted' Receives Satellite Photos

BCF's Undaunted has become the first fishing vessel to receive television photos transmitted from the ESSA VI weather satellite. The research vessel is taking part in the international program to study the distribution and biology of surface tuna and other fish in west African waters.

Undaunted's Receiver

The Undaunted has an automatic picture transmission (ATP) satellite receiver aboard. It records the picture transmitted from the satellite passing overhead. It is expected that such information will help BCF scientists locate and track productive water masses. If successful, inexpensive APT satellite receivers could be placed aboard commercial fishing vessel.

'Point of No Return' for Larval Anchovies Is Found

At 22° C., anchovy larvae could go without food for 3 days after hatching--or between 36 and 60 hours after the yolk was exhausted--and still exhibit good survival if they received food by noon of the third day. But if feeding was postponed until fourth day after hatching,

nearly all larvae died of starvation. Their survival curves were almost identical to those of control group that was not fed. This was learned in an experiment by Rovert May, Biological Technician in the Behavior-Physiology program at the BCF Fishery-Oceanography Center at La Jolla, Calif.

The Experiment

Four groups of larvae were fed at successively later times after hatching; a fifth group not fed, served as control. Mr. May followed the mortality in each container daily at noon.

"These results imply that the period of yolk absorption in the life history of the northern anchovy is less critical in terms of survival than might have been expected."

Can Fish Schools Be Spotted from Space?

During the Apollo 7 flight, BCF's "Oregon II" released Rhodamine B dyes and fish oils into the Yucatan Channel. It was part of a program to evaluate observations made from space. The observations may prove useful in detecting and assessing fish schools.

A Coast Guard plane flying between 400 and 10,000 feet photographed the waters in which the dyes and oils were released. These photos will be compared with those taken from the Apollo spacecraft.

La Jolla's 'Advisories' Benefit Fishermen

The Fishery-Oceanography Center at La Jolla, Calif., continued in September its successful daily albacore fishing information broadcasts and 15-day bulletin series. Albacore production continued to swell the record for the Pacific Northwest, especially for Oregon.

The La Jolla staff reports: "Our advisory services have earned a considerable number of favorable responses this season. When San Diego fishermen's wives telephone us for

a last-minute verbal appraisal to be relayed to their husbands who are pointing into 30-knot winds and 8-foot seas off Oregon at the time--we can only conclude that our service activities are hitting the mark!"

Scientists Bug Salmon

Salmon and steelhead trout have fallen prey to--spies.

For several years, James H. Johnson of the BCF Biological Laboratory in Seattle, Wash., and his crew of fishery researchers have been snooping into the habits of these species. The effectiveness of the sonic tags with hydrophone receivers developed in their Seattle electronics shop have led to a wave of spying by other scientists on a number of other marine species. Johnson has helped marine behavior studies from Canada to the Caribbean and from lobsters to humpback whale.

Tool for Migration Studies

The sonic tag and the hydrophone monitors that pick up its signal were developed as a tool to study migration of salmon and steelhead on the Columbia River.

The University of Wisconsin borrowed Johnson and his tracking boat for a salmon "homing" project. The team tracked one pink salmon over 50 miles--from Friday Harbor in the San Juan Islands of Washington State toward his home in British Columbia. The sonic-tagged salmon took a long way home. (Perhaps it was trying to shake the snoops.)

Other Species Tracked

Shore monitors and technical assistance were provided the Fisheries Research Board of Canada to obtain data from sonic-tagged Atlantic lobsters. The Canadians hope to resettle this species off the coast of British Columbia. Similar equipment was loaned to track shad in the Connecticut River, and bull shark in the Rio San Juan of Costa Rica.

Once, Johnson went to Bermuda to join a team of scientists from Rockefeller University and Woods Hole Oceanographic Institution in an attempt to attach sonic tags to humpback whales. The whales outwitted the biologists at every turn. Finally, when tags were attached, the whales quickly brushed them off with a flick of their flippers.

BCF Bugging Since 1955

BCF has been bugging salmon since 1955, when the first crude tag and receiving equipment were developed. The tag was nearly 5 inches long, 2 inches in diameter, and transmitted for about 8 hours. Since then, miniature transmission packages have been developed. These make it possible to reduce tag size to about one fourth its original bulk and increase transmission time to 3 months. Originally, tags were attached to a salmon's back, where they frequently tore loose. Now they can be inserted in the stomach, where they have been known to remain until the salmon dies after spawning.

Study Fish Loss Between Dams

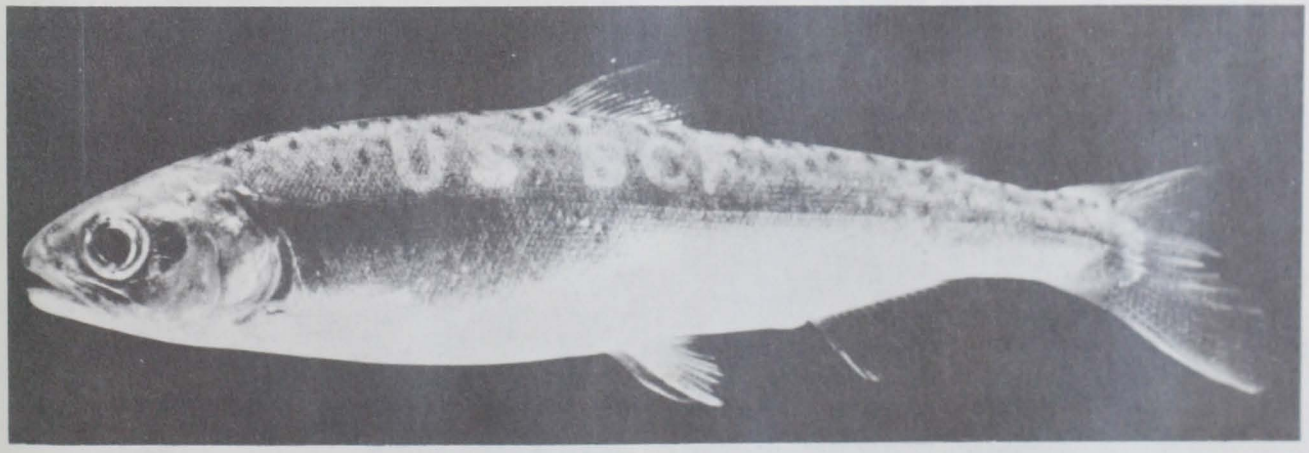
The last sounds heard from Johnson and his crew of biologists and technicians indicated they were completing a 2-year study aimed at finding the reason numbers of salmon and steelhead trout disappear between major dams on the Columbia River. The biologists are determined to find the answer. In this sense, the studies aim to help the fish; in another, sonic research on salmon behavior in the sea may lead to more effective means to capture them.

A Salmon You Can Call Your Own

A simple method to brand young salmon for research purposes was developed and has been used for the past few years by BCF biologists in Seattle, Wash., and Auke Bay, Alaska. Fish branding is being used in studies of growth, behavior, migration patterns, and survival of young fish. Also, it may be used to identify and measure the contributions of many different stocks of the salmon fishery.

The branding irons are small and made of copper or brass. Their tips are solid silver to provide the most efficient transfer of heat. The irons either may be heated in boiling water (212° F.) or chilled with liquid nitrogen (-324° F.) for "freeze branding."

The irons are held lightly against the skin of an anesthetized salmon for about one second. The heated or chilled iron marks the fish with a visible brand that grows with the fish and can last its lifetime.



Many marks or combinations can be used so that individual fish or groups can be recognized easily by their own brands over long periods.

Culture of Oysters Off Bottom Advances

For the past dozen years, BCF has been experimenting with the off-bottom culture of oysters (Crassostrea virginica) along the U. S. east coast. Early studies at Cape Cod, Mass., showed that oysters suspended off bottom improved in "growth, survival, and quality."

Later studies in Chesapeake Bay showed excellent oyster sets can be obtained by suspending shells from rafts. In 1965, in one area, over 20 oyster spat per shell were collected on suspended shells; this compared with 5 spat per shell on the bottom.

At the BCF Biological Laboratory at Oxford, Maryland, studies include the off-bottom culture of oysters in natural and man-made ponds. William N. Shaw has reported "preliminary findings indicate that natural ponds are excellent for growing and fattening oysters, and artificial ponds can be used to produce seed oysters . . . the off-bottom culture of oysters appears to have commercial application along the Atlantic coast."

The photos show aspects of off-bottom oyster culture in Massachusetts and Maryland.

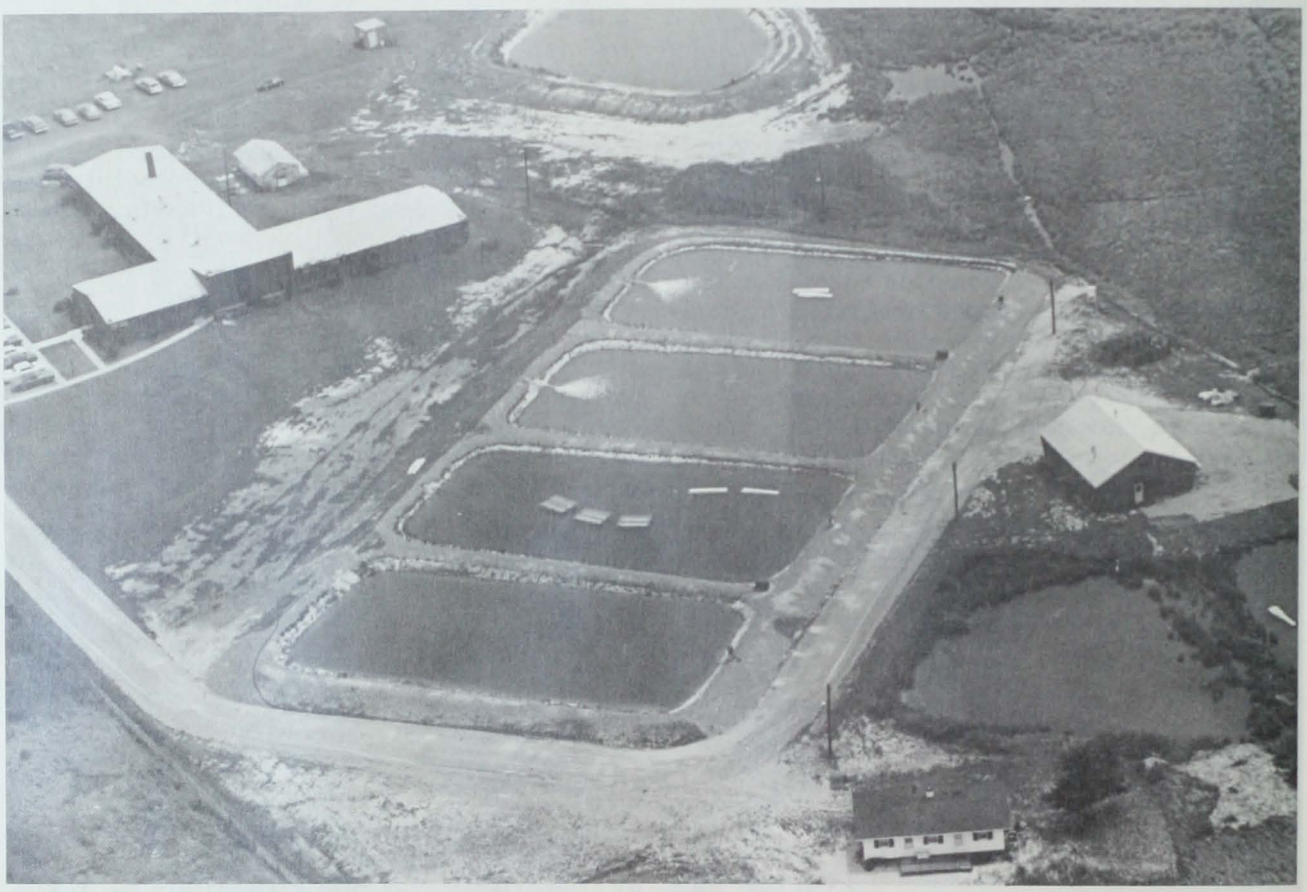


Fig. 1 - Four $\frac{1}{4}$-acre, man-made, salt-water ponds in front of BCF Biological Laboratory, Oxford, Md. Built above sea level, each pond is about 75 feet by 145 feet by 3.3 feet deep. Each holds about 312,500 gallons of water. The ponds have clay bottoms and sides. Dual pipe and pump systems permit weekly alternations and flushing to prevent fouling.

Oysters are being grown in these ponds. Some are on strings and suspended from rafts. (Photo: Robert Williams.)

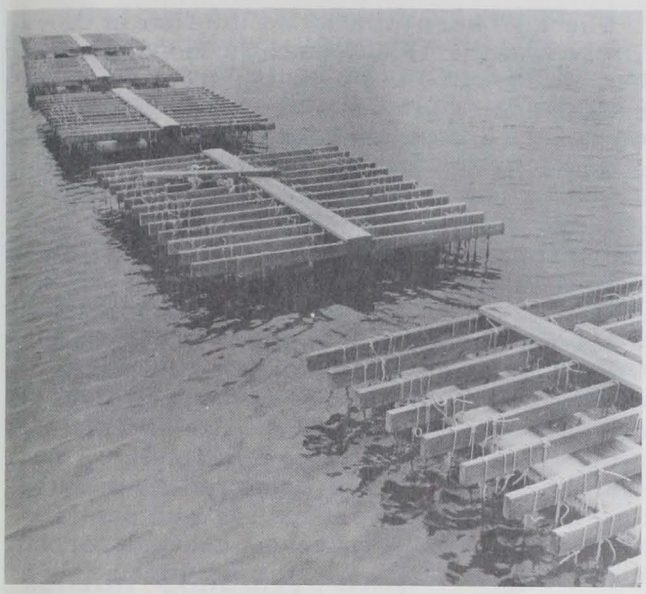


Fig. 2 - Styrofoam rafts in Broad Creek, eastern shore of Chesapeake Bay, Maryland. Strings and bags of shells are suspended from rafts to catch seed oysters. The rafts then can be towed to growing area.

Fig. 3 - Strings attached to rigid structure. Growing on the strings are shells with oysters attached.

Fig. 4 - String of 1-year-old oysters grown from raft in Oyster Pond River, Chatham, Mass.

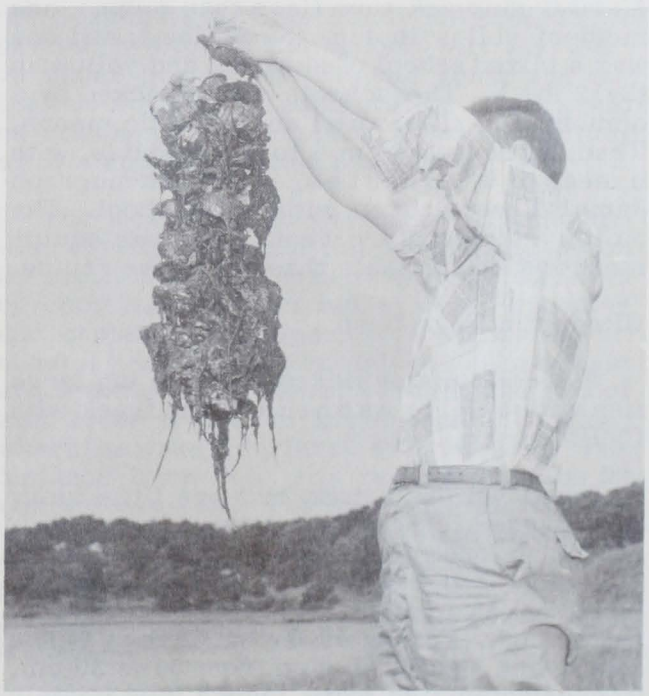


Fig. 5 - 2-year-old oysters grown from raft in Taylors Pond, Chatham, Mass.

'Cromwell's' Sonar Tracks Tuna Schools

A major mission of a cruise by the Townsend Cromwell in Hawaiian waters (No. 38, 8/14-9/13) was to collect data from CTFM sonar on movements of tuna schools and on their environment to investigate the association between them. (CTFM is continuous-transmission, frequency-modulated sonar.)

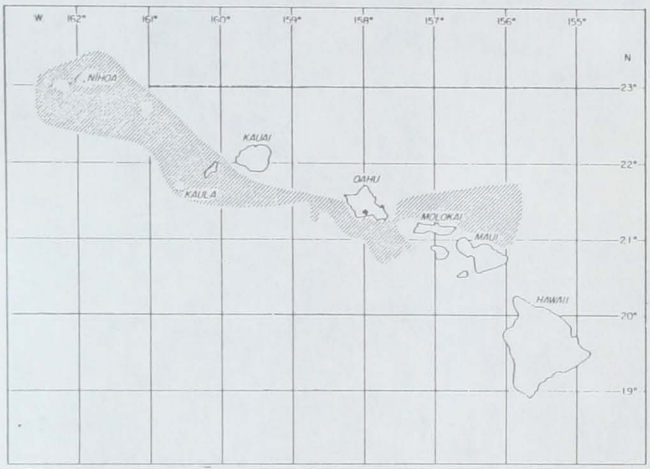


Fig. 1 - Area of operation, Townsend Cromwell, Cruise 38.

Nine tuna schools were contacted by the sonar; 3 medium skipjack tuna (8-12 lbs.), 4 small skipjack tuna (less than 4 lbs.), one medium yellowfin tuna (30-60 lbs.), and one was a mixed school of skipjack and yellowfin (8-12 lbs.). The schools were tracked by a combination of visual and acoustic means. Tracking ranged from 4 to 118 minutes, with a mean of 61 minutes. Bathythermograph samples were taken with each school. The salinity-temperature-depth recording equipment was not available throughout the cruise.

Ultrasonic Tags Used

A second major mission was to tag large fish with an ultrasonic tag and track with CTFM sonar.

Seven yellowfin tuna and one little tunny were tagged. The tags were cylindrical, ultrasonic ones 3 inches long, $1\frac{1}{8}$ inches in diameter, and emitting a pulse of 37 kHz ($\pm$200 Hz) at a rate of 1 per second. All fish were caught trolling on the banks near Nihoa Island and ranged in size from 50 to 80 cm. The selected fish were tagged immediately after capture, then released.

The tags were attached to the fish in three different ways: 1) attached by a monofilament line. A 35-cm. line, with tag attached at trailing end, was tied to caudal peduncle. 2) two hooks were attached to tag. The first was attached firmly to tag; the second was connected at end of a rubber band in a position opposing the first. The firmly attached hook was inserted at base of first dorsal fin, and the second hook was placed at base of second dorsal fin under tension of the rubber band. 3) tag was inserted into stomach via mouth. After 2 unsuccessful attempts--in which it was assumed tags had been regurgitated--4 prongs lined with plastic were attached firmly to tag to make regurgitation difficult. A reflex swallowing action occurred as soon as tag touched fish's throat and tag was partially swallowed. A tag's exposed end was forced the remainder of the way into stomach with a narrow pole.

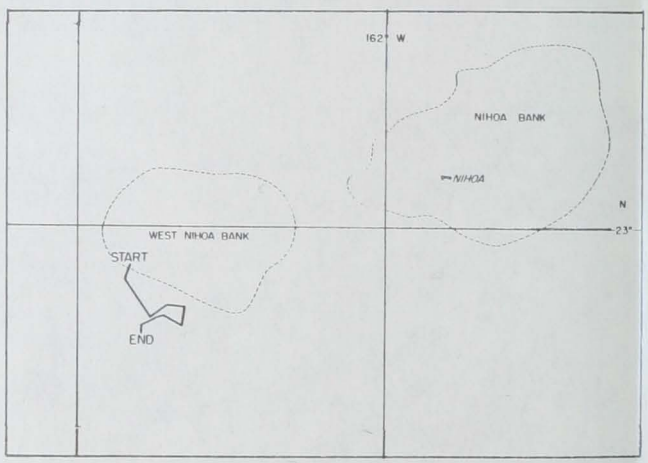


Fig. 2 - Path of tagged yellowfin.

Tracking Tags

A 40-50 cm. little tunny was tagged by the first method and tracked for 2 hours 11 minutes. Contact with the tag was lost at the bottom of the sea. The second method was attempted with a 75-85 cm. yellowfin. Contact terminated after 44 minutes, when the tag dropped rapidly to the bottom. Two 50-65 cm. yellowfin were tracked using the third method (without prongs). One fish was followed for 33 minutes, and the other only 1 minute. Contact was terminated in each case after tag was observed on sonar to drop rapidly to bottom. It was assumed the tags had been regurgitated. The first 2 yellowfin (80-90 cm.) that were tagged internally with the

modified tags were tracked for 6 and 23 minutes, respectively. Contact with tags ended while fish were still in midwater. It was assumed that either fish swam out of range or malfunction occurred in the sonar. Two more yellowfin (60-80 cm.) were tracked with modified tags for 5 hours and 58 minutes and for 7 hours and 54 minutes (fig. 2). In first case, tracking was discontinued after tag settled to bottom. The ship was anchored near tag, and the tag was still audible the following morning, 19 hours after it had been activated. In the second instance, contact with tag was lost shortly after fish began to sink to a 1,000-fathom depth.

'Jordan' Conducts Pacific Albacore Survey

The R/V David Starr Jordan cruised the waters off California and Oregon from mid-July to mid-August "to establish the distribution and availability of albacore in offshore waters during the middle of the Pacific coast season--and to test prospects for commercial exploitation of albacore beyond the traditional limits of the fishery (beyond 300 miles from shore)." (Cruise 26.) She covered 5,340 miles.

Albacore were taken every day in the survey grid, although fishing was not continuous throughout daylight hours because of schedule limitations. The computed catch-per-effort data gave good indications of commercial fishing potential from the easternmost line--127° W., to 131° W.--and between 40° and 45° N. in second-half July. Another good area was near 46° N., 127° W. in the second week of August.

Considering 100 fish per 100 line-hours to be the minimum for good commercial trolling (100 fish per day), there were 6 days out of 23 and 3 more that exceeded 90 fish per 100 line-hours.

Water & Tuna Body Temperatures

Gary Sharp of the Population Dynamics Program conducted a physiological experiment in which 450 blood samples were taken and 46 albacore body temperatures were recorded. Body temperature was lowest when albacore were caught in waters having temperatures within the optimal catch-temperature range (62°-64° F.). "This is the first physiological evidence that corroborates the frequency vs. catch-temperature relationship derived from fishermen's logbooks over a 5-year period."

The sea-surface temperature in most of the survey grid encompassed a small range from 16.5° to 18.0° C. (61.7° to 64.4° F.). Fishermen's logbook records show that the major part of the commercial catch is taken in these temperatures. The thermocline was relatively shallow, between 20 and 30 meters. Except for the initial northbound leg (127° W.), the weather was fair and sunny with light winds offshore, but the coastal region had occasional strong northerly winds. The observed currents were very weak and were directed eastward at 135° W., and southward nearer shore.

'Jordan' Follows Fish Schools With Radar & Sonar

The David Starr Jordan cruised the waters off California (cruise 28) from Sept. 23-27 primarily to follow fish schools with the Decca radar-plotter and Simrad sonar and establish swimming speed of fish. This would be compared and evaluated with laboratory speeds and respiration studies.

The scientists developed a technique whereby fish schools could be positioned on the oscilloscope screen and tracking achieved by coordinated operation of sonar operator and captain. Ship speed was maintained at about $1\frac{1}{2}$ knots and the fish school was kept at a heading to port side of vessel. The school was never permitted to get behind the ship, where the wake interferes with viewing. The distance from ship was recorded on the 30 kHz recorder. The following information was taken at intervals while school was in view: time of observation, distance to school, heading of school from due north, or some other bearing, and declination of Simrad transducer.

At the time of observations, the plotter was manually operated to indicate the point on a chart relative to all other positions.

What Scientists Found

The BCF La Jolla scientists reported: "We found that the Decca radar could be used by accurately positioning the ship between two points of land. An accuracy of measurement to 200 ft. or better was easy to maintain by manually dialing the plotter, keeping the two points of land positioned on the preset standardized concentric ring of the radar. Our best position was maintained between 'Ship Rock,' Catalina Island and Pt. Fermin on the mainland. The best area of operation was the lee of Santa Catalina Island because targets were always available except at night.

"The recorder of the sonar was extremely important because it provided a visual picture of the distance of the school from the ship." Also, it provided a continuity with time, so if school was lost momentarily on oscilloscope screen, the pick-up again could be verified by reference to the previous target mark on the recorder.

The scientists added: "We attempted two methods to identify the fish we were tracking--the first of these, dynamite, half pound to $1\frac{1}{2}$-pound charges, exploded at the surface and at various depths to 100 m, was unsuccessful. No fish appeared at the surface after its use. The second method--a television camera maintained in the bow chamber--was similarly unsuccessful because the fish were either too deep or avoided the vessel." In one instance, the captain saw the anchovy school the scientists were tracking.

Results and Conclusions

The scientists concluded: "Once we familiarized ourselves with the potentialities of the equipment, we found that it was a simple matter for a team of two people to keep contact with a fish school for virtually any period desired throughout the day. The maximum time we followed any school was 2 hours and it seems certain that this could have been done for the entire day. . .no schools could be seen at night from about 1800 on. . . . Target identification remains the essential item of information still unknown."

'Delaware' Surveys Northern Shrimp in W. Gulf of Maine

The Delaware returned to Gloucester, Mass., on Sept. 13 after a summer shrimp survey in the western Gulf of Maine. (Cruise 68-8, Sept. 4-13, 1968.) The chart shows where concentrations of northern shrimp (Pandalus borealis) were found. This was the fourth in a series of cruises designed to collect data on the northern shrimp.

Otter trawl tows were made in 43 to 120 fathoms and caught 5 to 1,000 pounds of shrimp. Average size in individual catches varied from 36 to 50 per pound (whole shrimp).

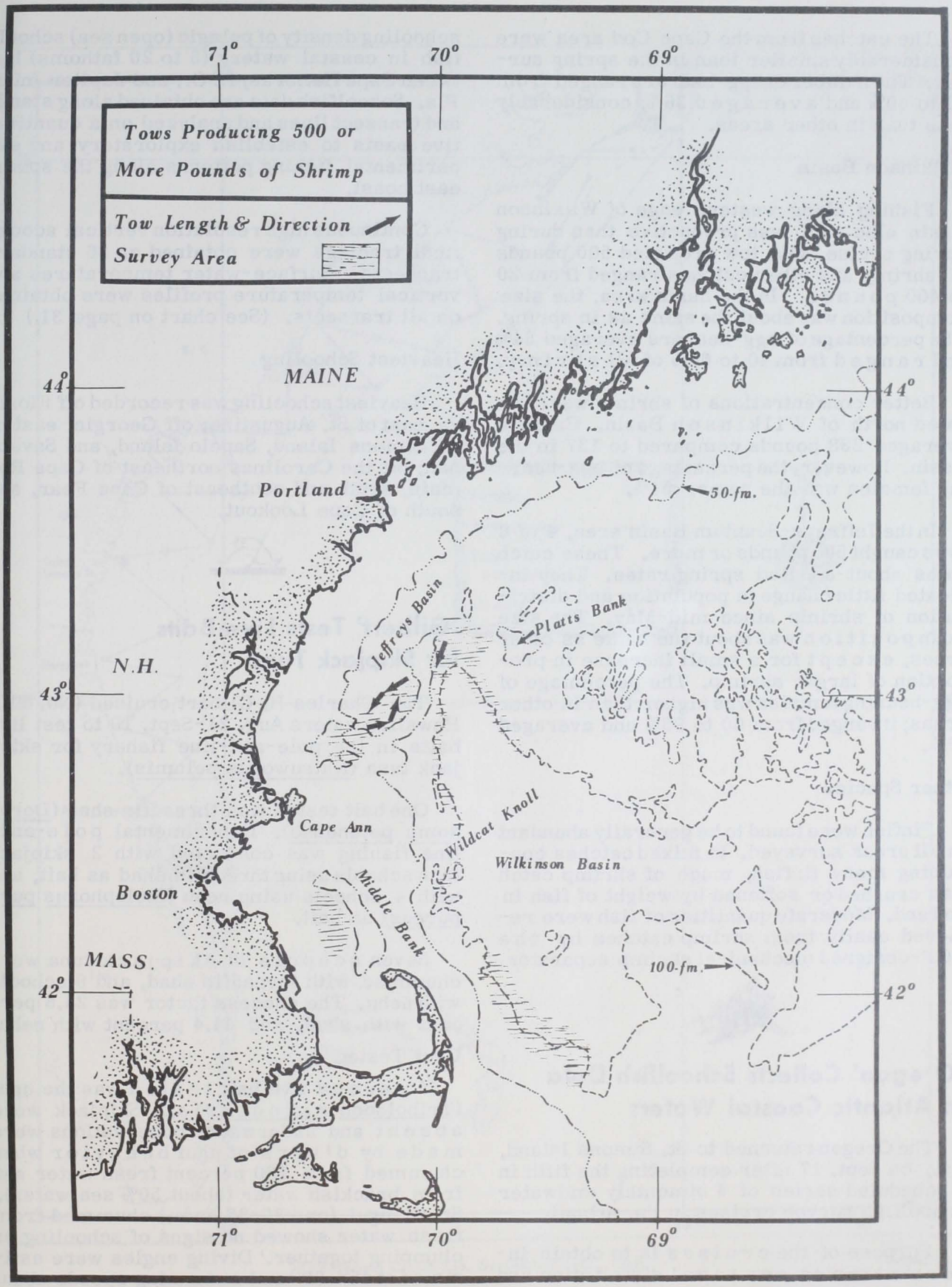
Procedure

A 70-foot, Maine-type, roller-rigged shrimp net was used for all fishing. Experience had shown that it was impractical to use a chain-rigged net in the sampling areas. All tows were 1 hour; they were shortened only because of hangups or soundings of very rough bottom. No exploratory try-net tows or night tows were made. Nighttime fishing for northern shrimp with bottom trawls proved unproductive during earlier cruises. Apparently, this was due to diurnal migrations of shrimp off the bottom during darkness. After each tow, data on catch size, pound count, and shrimp length were taken.

Results

Some shrimp were taken in each of the 37 tows completed. The average catch per tow was 220 pounds of shrimp, but 5 tows (14% of total) produced 500 pounds or more. This rate was about half the winter rate, when 30% of tows yielded 500 pounds or more of shrimps; it equals the 14% of the fall cruise and is 6% below the spring cruise figure. The length of shrimp varied from 11 to 34 millimeters; most were in mid-twenties range.

The best shrimp catch in the Middle Bank (Stellwagen Bank) area was 360 pounds. Catches of 1,000 pounds or more were made here during winter and spring surveys. Generally, the size of Middle Bank shrimp was the same as before--40 to 50 whole shrimp per pound. The percentage of egg-bearing female shrimp ranged from 91 to 54% and averaged 72% for all catches in this area. Trash fish and starfish were prevalent in all catches.


71°
70°
69°
Tows Producing 500 or More Pounds of Shrimp
Tow Length & Direction
Survey Area
44°
MAINE
Portland
50-fm.
Jeffreys Basin
Platts Bank
N.H.
43°
Wildcat Knoll
Cape Ann
Wilkinson Basin
Middle Bank
Boston
MASS.
100-fm.
42°

The catches from the Cape Cod area were considerably smaller than in the spring survey. The number of egg-bearers ranged from 32 to 40% and averaged 36%, considerably less than in other areas.

Wilkinson Basin

Fishing along western edge of Wilkinson Basin also was less productive than during spring cruise. One tow produced 500 pounds of shrimp and other catches ranged from 20 to 400 pounds. In the basin area, the size composition was about the same as in spring. The percentage of egg-bearers averaged 54% and ranged from 40 to 66% of all shrimp.

Better concentrations of shrimp were located north of Wilkinson Basin. Catches averaged 238 pounds compared to 137 in the Basin. However, the percentage of egg-bearing females was the same: 54%.

In the Jeffreys-Scantum Basin area, 4 of 8 tows caught 500 pounds or more. These catch rates about equaled spring rates. They indicated little change in population and distribution of shrimp since mid-May. The size composition was about the same as other areas, except for a small increase in proportion of larger shrimp. The percentage of egg-bearing females was higher than in other areas; it ranged from 60 to 95% and averaged 78%.

Other Species

Finfish were found to be generally abundant in all areas surveyed. In mixed catches containing many finfish, much of shrimp catch was crushed or softened by weight of fish in cod end. Moderate quantities of fish were removed easily from shrimp catches by the BCF-designed mechanical shrimp separator.

'Oregon' Collects Schoolfish Data in Atlantic Coastal Waters

The Oregon returned to St. Simons Island, Ga., on Sept. 17 after completing the fifth in a scheduled series of 6 bimonthly midwater schoolfish survey cruises in the Atlantic.

Purpose of the cruises is to obtain information on seasonal distribution and schooling density of pelagic (open sea) schoolfish in coastal waters (5 to 20 fathoms) between Cape Hatteras, N. C., and Jupiter Inlet, Fla. Schoolfish data are obtained along standard transect lines and analyzed on a quantitative basis to establish exploratory and experimental fishing patterns along the southeast coast.

Continuous high resolution vertical acoustical tracings were obtained on 26 standard transects. Surface-water temperatures and vertical temperature profiles were obtained on all transects. (See chart on page 31.)

Heaviest Schooling

Heaviest schooling was recorded off Florida, east of St. Augustine; off Georgia, east of St. Simons Island, Sapelo Island, and Savannah; off the Carolinas northeast of Cape Romain, south and southeast of Cape Fear, and south of Cape Lookout.

'Gilbert' Tests Live Baits for Skipjack Tuna

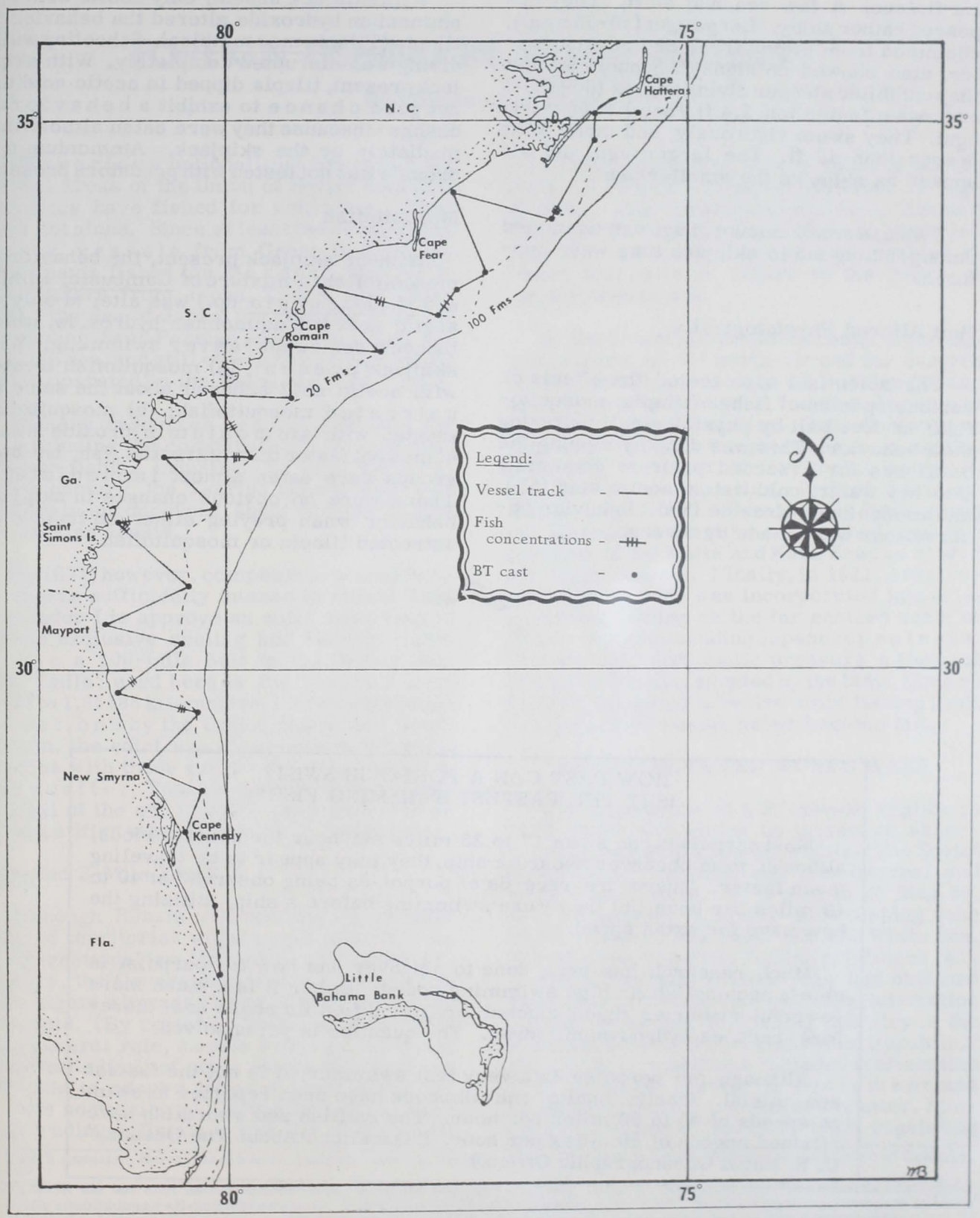
The Charles H. Gilbert cruised (No. 110) Hawaiian waters Aug. 21-Sept. 19 to test live baits in the pole-and-line fishery for skipjack tuna (Katsuwonus pelamis).

One bait tested was threadfin shad (Dorosoma petenense). Experimental pole-and-line fishing was conducted with 2 skipjack tuna schools using threadfin shad as bait, and with 4 schools using nehu (Stolephorus purpureus) as bait.

Seven schools of skipjack tuna were chummed with threadfin shad, and 9 schools with nehu. The success factor was 28.6 percent with shad, and 44.4 percent with nehu.

Ugui Tested

A second live bait tested was the ugui (Tribolodon hakonensis). Skipjack were absent and underwater observations were made by divers of ugui behavior when chummed from 100 percent fresh water and from brackish water (about 50% sea water). Small ugui (ca. 30-35 mm.) chummed from fresh water showed no signs of schooling or clumping together. Diving angles were estimated at 45°-60° and swimming speeds about



R/V Oregon Cruise 133, September 9-17, 1968.

1.1 ft./sec. A few reached 50 ft. They appeared rather shiny. Large ugui (50-55 mm.), chummed from either fresh or brackish water, also showed no signs of schooling. But they exhibited steeper diving angles (60°-80°) and swam faster (ca. 2.4 ft./sec.) than small ugui. They swam vigorously, and many went deeper than 40 ft. The larger ugui did not appear as shiny as the smaller ugui.

Twice, a small amount of ugi was chummed during fishing and 16 skipjack tuna were captured.

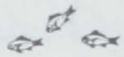
Bait Altered Physiologically

The scientists also tested the effects of various species of fishes (tilapia, mosquitofish) as live bait by physiologically altering their behavior. This was done by dipping the baitfishes for 1 second prior to chumming into hot water, cold water, acetic acid (5%), and ammonium hydroxide (5%). Behavior observations were made by divers.

With skipjack absent, only acetic acid and ammonium hydroxide altered the behavior of tilapia (Tilapia mossambica). Schooling while diving was disrupted completely. With skipjack present, tilapia dipped in acetic acid did not get a chance to exhibit a behavioral change--because they were eaten almost immediately by the skipjack. Ammonium hydroxide was not tested with predators present.

Mosquitofish

Without skipjack present, the behavior of mosquitofish (a mixture of Gambusia, Limia, and Mollienesia sp.) was altered only by acetic acid and ammonium hydroxide, which induced somewhat faster swimming. With skipjack present, (a) mosquitofish treated with acetic acid behaved about the same as untreated mosquitofish; (b) mosquitofish treated with ammonium hydroxide swam somewhat faster than untreated fish, but both groups were eaten almost immediately. There were no obvious changes in skipjack behavior when preying either on treated or untreated tilapia or mosquitofish.



HOW FAST CAN A PORPOISE SWIM?
IS IT THE FASTEST SWIMMING FISH?

Most porpoises can swim 17 to 23 miles per hour for short periods, although, to an observer aboard a ship, they may appear to be traveling much faster. There are records of porpoises being observed at 40 to 43 miles per hour, but they were swimming before a ship, utilizing the bow wave for extra speed.

Much research has been done to discover just how the porpoise is able to accomplish its high swimming speed. Either it is a much more powerful swimmer than expected, or it modifies its shape and, therefore, reduces hydrodynamic drag. The question is yet unsolved.

Although the porpoise is a very fast swimmer, it is not the fastest sea animal. Marlin, bonito, and albacore have been reported to swim at speeds of 40 to 50 miles per hour. The sailfish and swordfish have attained speeds of 60 miles per hour. ("Questions About The Oceans," U. S. Naval Oceanographic Office.)