



Dumping catch aboard BCF's research vessel "Oregon" off Florida's east coast. (Photo: J. B. Rivers)

PRESIDENT ASKS \$516 MILLION FOR MARINE SCIENCE AFFAIRS IN FISCAL 1969

President Johnson asked Congress in March for \$516 million in fiscal year 1969 (July 1, 1968-June 30, 1969) to pay for marine science affairs. This is 15 percent above the FY 1968 figure.

The President transmitted to Congress the recommendations in the second annual report of the National Council on Marine Resources and Engineering Development (better known as Marine Science Council). The Council is a

Cabinet-level advisory group headed by Vice President Humphrey.

The Vice President said of the report, "Marine Science Affairs--A Year of Plans and Progress": It is "an account of policies, programs, and accomplishments of the Federal Government for utilizing the oceans more effectively in meeting goals and aspirations of our Nation."

The President stated that the additional money is needed to:

Speed research to make fish protein concentrate (FPC) available in the War on Hunger.



Fig. 1 - FPC.



Fig. 2 - BCF expert W. R. Heard explains how SCUBA is applied to fishery research.
(Dr. D. Hoopes)

Broaden education and research in marine sciences, particularly in Sea Grant and other university programs. (See "Manpower Is 'Vital Ingredient' of Marine Sciences, Says Wenk," CFR Feb. 1968.)

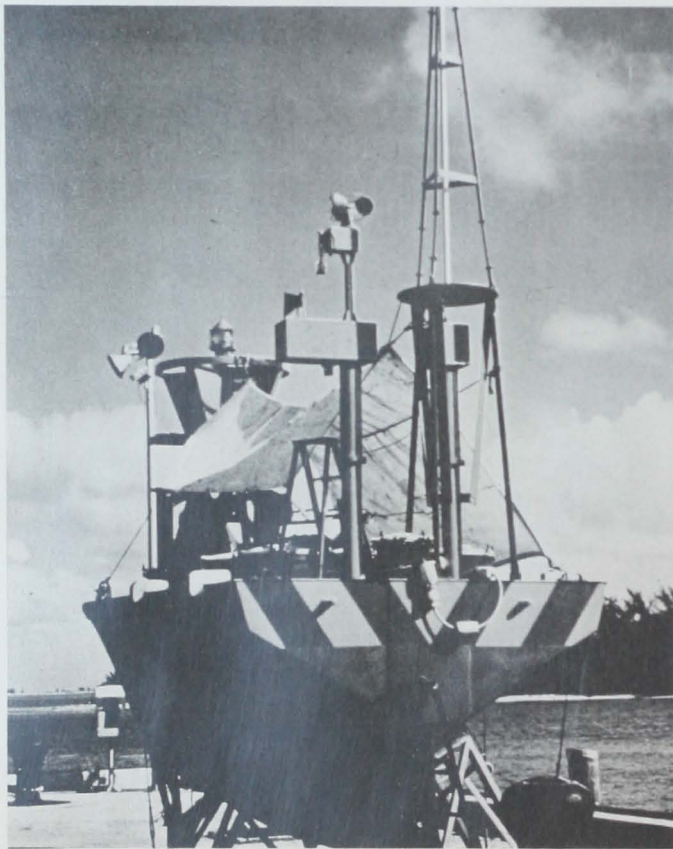


Fig. 3 - Nomad (Navy Oceanographic Meteorological Automatic Device) buoy transmits data up to 2,000 miles over standard 100 words-per-minute radioteletype circuits.
(U. S. Navy)

Develop improved ocean buoys to collect accurate and timely data for better prediction of weather and ocean conditions.



Fig. 4

Continue mapping Continental Shelf to aid resource development--"and other industrial, scientific, and national security purposes."

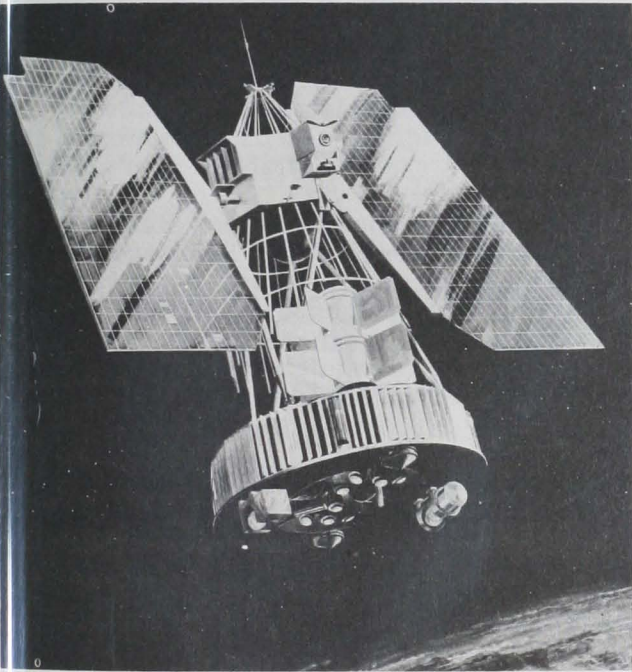


Fig. 5 - Nimbus weather satellite (NASA).

Apply space craft technology to oceanography--and improve observation and prediction of ocean environment.

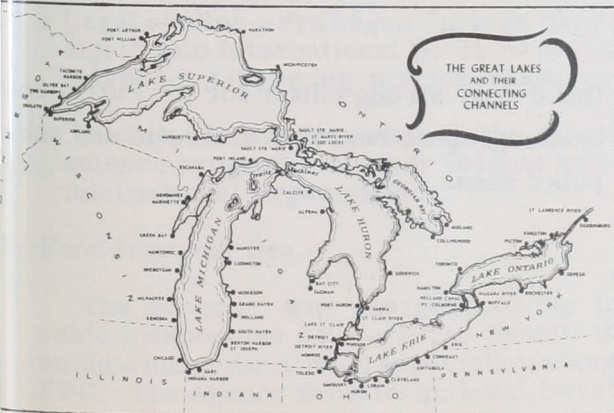


Fig. 6

Increase research and planning to improve U. S. Coastal Zone and to promote development of Great Lakes, ports, harbors.



Fig. 7 - Oil covers Yorktown, Va., public beach after 1967 spill.
(Virginia Institute of Marine Science)

Prevent or lessen pollution from oil spillage
and other hazardous ship cargoes.

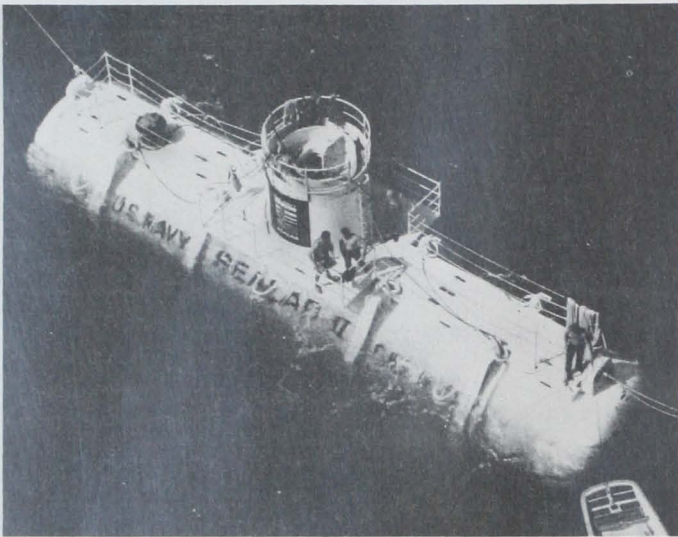


Fig. 8 - Navy's Sealab II. (U. S. Navy)

Expand Navy's advanced technology for
work in deep oceans--"and for rescue,
search and salvage."



Fig. 9 - The 310-foot, 8,449-ton, 21,000-horsepower U. S. Coast
Guard "Glacier," America's largest icebreaker, opens a channel in
the Antarctic's McMurdo Sound. The vessel now is engaged in a 2-
year international oceanographic study of the Weddell Sea.

(R. F. Clayton)

Build very strong cutter for Ice Patrol and
oceanographic research in Arctic and sub-
polar areas.

REPORT ON FY 1968 ACTIVITIES

In 1967, President Johnson selected 9 priority areas of marine science recommended by the Marine Sciences Council for support during FY 1968. The following is a progress report on these 9 areas:

1. International Cooperation

- The U. S. proposed to the U.N. General Assembly that it create a Committee on the Oceans to promote international cooperation. The committee should work for an international legal structure to aid exploration and use of the seabed.
- Marine science cooperation was emphasized during the Latin American Summit Meeting at Punta del Este and in the communiqué following Japanese Premier Sato's U. S. visit.
- The U. S. and other nations persuaded the International Telecommunication Union to reserve certain radio frequencies for transmitting oceanographic data.
- "Plans were developed to propose establishment of international marine preserves."
- 50 foreign scientists took part in "Oceanographer's" global scientific expedition.
- British, Australian, and Canadian divers began aquanaut training in the U. S. to prepare for SEALAB III in summer 1968.
- Red tape was cut in arranging visits by Soviet fishery research ships to U. S. ports for projects of mutual benefit.
- Legal studies were begun "to gain new insight" into international problems involved in developing marine resources.
- "Studies were completed of the marine science programs of other nations and of international organizations."

2. Food from the Sea

The program was designed to tap the sea's inexpensive protein to benefit the world's hungry millions, especially through FPC. The Agency for International Development

(AID) is the lead agency for the program; BCF is developing the technology.

Last year--

- AID opened a new office which, after surveying many countries, selected Chile for pre-investment market surveys.
- FPC produced from hake was approved for people by the U. S. Food and Drug Administration (FDA).
- BCF planned to build a pilot plant in the Pacific Northwest to produce FPC.

3. Sea Grant Program

The National Sea Grant College and Program Act was passed. Its purposes: to speed training and education of specialists, especially ocean engineers and technicians; to advance applied research; to spread marine science information.

To carry out the program, the National Science Foundation set up an Office of Sea Grant Programs, issued guidelines for obtaining grants, and made its first awards.

4. Data Systems Study

The Council studied the needs of Government, private industry, and scientists for marine science and technology data.

5. Estuary Study

Programs were planned to use a new laboratory under the Corps of Engineers-- "to study estuarine navigation, water quality, shore erosion, and the effects of pollution and natural influences on fish, shellfish, health, recreation, and beauty of the Chesapeake Bay."

6. Surveys of Mineral Resources

"The objective is to accelerate planning, surveys, and survey methodology related to marine minerals." In FY 1968, surveys were continued off the Atlantic and Northwest coasts. New mineral deposits off Alaska were outlined. The Council sponsored

sored a study of the economic potential of minerals of the U. S. Continental Shelf and Slope.

7. Ocean Observation and Prediction

A stepped-up program in FY 1968 resulted in an experimental breaker and surf forecasting service for southern California beaches to protect coastal commercial fishermen and bathers; completed a study showing the technologic feasibility of ocean data buoys to monitor ocean and atmospheric processes; set up the Regional Center for Tropical Meteorology in the National Hurricane Center in Miami, Florida, and strengthened the center. Improved weather information will be provided to shore communities, industries, and marine operators in the Tropical Atlantic.

8. Deep Ocean Technology

The loss of the U.S.S. "Thresher" and of unarmed H bombs off Palomares, Spain, emphasized the need to have better "search and salvage systems in the deep ocean." The Navy speeded its Deep Submergence Systems Project.

9. Subpolar Oceanographic Research Vessel

A Coast Guard ship replacement for one on International Ice Patrol was to be designed to permit oceanographic research in subpolar regions. Congress did not vote funds and another request for the vessel is being made.

BCF IN 1967

The U. S. seeks to help the domestic fishing industry improve its position in world production through scientific, technologic, and economic means. The U. S. also seeks to harvest the oceans' riches more fully to help feed the world's hungry millions. The Bureau of Commercial Fisheries (BCF) is the prime agency in these endeavors.

The money requested for the FY 1969 fishery development and seafood technology programs of BCF would continue these major programs:

1. Resource Development and Management

Its purposes are: "to gather data to predict abundance and distribution of fish

stocks"; to learn how many fish of one species can be caught each year without endangering the population; to gather information needed for international negotiations on high-seas fishery resources.

During 1967, this program

- "improved prediction of abundance and distribution for skipjack, bluefin and albacore tuna in the Pacific, and groundfish and sea scallops in the North Atlantic." It developed a prediction model to obtain maximum yield from the Tortugas, Florida, pink shrimp fishery.
- began to assess brown shrimp in the Gulf of Mexico;
- developed lobster and menhaden tagging programs;
- developed sonar equipment for monitoring salmon migration in Alaska streams with State cooperation;
- continued pesticide monitoring along the estuaries of the East Coast and the Gulf of Mexico;
- completed 2 phases of the fishways at Willamette Falls in the Columbia River system;
- tested successfully the experimental drifting buoys designed to obtain ocean data up to 400 miles;
- developed spacecraft oceanography to analyze biologically important ocean conditions;
- coordinated large-scale international investigations of tuna in Eastern Tropical Pacific.

2. Processing and Marketing

Its research seeks to convert raw fish into marketable products. In 1967, this program did the following:

- helped to expand commercial use of Spanish mackerel, soft clams, mullet, and catfish;
- helped to develop East Coast markets for fish products from the Pacific Northwest.

It did this by bringing together processors, buyers, and airline representatives;

- won FDA approval for human consumption of FPC;
- gave technical assistance to AID in selecting countries for FPC programs;
- developed new fish products;
- developed irradiation techniques aboard ships to increase the shelf life of fresh fish.

- tested successfully a prototype electrical trawl to harvest Great Lakes alewives;
- developed mechanized seining and conveyor equipment to reduce time and labor in harvesting farm-pond fish;
- improved midwater trawls and precision depth telemetry system to harvest Pacific hake;
- introduced improved pot gear and bait to expand commercial fishing for crab off southeast Alaska.

4. Economic Research

This is conducted to improve economic efficiencies in commercial fishing industry--"management, harvesting, processing, transporting, and marketing."

During 1967, fishermen were advised in planning and forming cooperatives. The economic research programs at East Coast universities were coordinated.

Advanced Technology

It is designed to help industry find fish more quickly and catch them more efficiently through new "harvesting methods, fishing tactics, and locating techniques."

During 1967, the program

- developed methods to estimate size of surface fish schools by aerial photography;



COLD WATERS PASTURE RICH ALGAE FAUNA

Current studies by Dr. John S. Bunt, Institute of Marine Science, University of Miami, indicate that marine microalgae, a base of the ecological food chain, develop in Antarctic waters below the normally accepted limit of the light zone.

Adjacent waters of the Antarctic continent, during the summer, maybe the world's richest area of marine life. Low temperature, which enables it to hold more dissolved oxygen and carbon dioxide than seas to the north, may be one reason for this abundance of life.

SCUBA divers at McMurdo Sound penetrated through 16 feet of ice to collect samples of microalgae and protozoa living in the frigid water. An analysis of these algae indicates that the annual primary production of the Antarctic waters may exceed 30 million tons of organic carbon. (Reprinted with permission from "Science News", weekly summary of current science, copyrighted 1966 by Science Service, Inc.)

Steelhead Eggs Are Fertilized With Frozen Sperm for First Time

A significant breakthrough has been achieved in the preservation of fish sperm in a living state, reported BCF's Regional Director in Seattle, Donald Johnson. A team of Oregon State University (OSU) scientists, working under BCF contract, in cooperation with the BCF Columbia Fisheries Program Office in Portland, has made the first successful attempt to fertilize salmonid eggs with cryo-preserved (refrigerated) spermatozoa.

They fertilized the eggs of steelhead trout with spermatozoa that had been frozen and refrigerated in liquid nitrogen for 14 and 28 days. These eggs developed into alevins--newly hatched fish still attached to the yolk mass--which appeared to be normal.

Important Advance

Dr. Fred C. Cleaver, director of the BCF Columbia Fisheries Program Office, said the development promises to facilitate more efficient fish cultural practices and enhance research into fishery genetics and disease control.

"We're at the point of improving fish stock that animal husbandry was 40 years ago," noted Dr. Cleaver, "and this new development moves us another notch ahead in our attempts to breed better, stronger fish." He pointed out that preservation of fish sperm for long periods would make it possible to retain the sperm for fertilization of eggs that ripen at a later time; also, sperm could be transported from one fish hatchery to another for more effective use.

For the past century, fishery scientists have attempted to preserve spermatozoa of fishes in a viable condition for extended periods of time. Except for some work with herring in 1953, these attempts either have failed or yielded inconclusive results.

Study Began in 1966

In 1966, BCF contracted with OSU to develop methodology for the cryo-preservation

(refrigeration) of viable salmonid sperm. Three scientists from the university's Department of Fisheries and Wildlife, Howard F. Horton, James R. Graybill, and Arthur S. H. Wu, went to work on the project. Dr. Raymond C. Simon, professor of fisheries, conducted chromosome analysis and gave other assistance.

They developed a "Solution 48" composed of 7 components. They discovered that the best survival of viable sperm was obtained in samples frozen in this solution in combination with dimethyl sulfoxide (DMSO). Alevins were produced from eggs fertilized with this frozen sperm.

The scientists noted: "These alevins appeared to be as normal as young fish produced from unfrozen spermatozoa. The fertility rate was low (0 to 18 percent), but to our knowledge this is the first successful attempt to fertilize salmonid eggs with cryo-preserved spermatozoa."

The OSU team said these findings "warrant further investigation." "We believe that the percent fertilization can be increased by placing the sperm with the eggs immediately after the semen is thawed." This hypothesis is expected to be tested.

Other Study Findings

The study team reached additional conclusions:

Undiluted semen can be transported in a styrofoam cooler for 3 hours without detectable loss of viability.

No differences were detected in the gross morphology (form and structure) of spermatozoa of coho salmon, chinook salmon, rainbow trout, and steelhead trout.

Spermatozoa in undiluted semen will remain viable for at least several days when refrigerated at four degrees centigrade.

The concentration of sperm in semen of coho salmon and rainbow trout is 2.3 to 230 times greater than that for most farm animals.

An extender should be developed which will maintain viable sperm in greatly diluted semen.

There is a direct relationship between concentration of additive in the extender and optimum rate of freezing semen samples.



Interior Suggests Legislation to Control Oil Pollution

Interior Department has submitted to Congress proposed legislation to help control pollution of U. S. waters by oil spills and other hazardous substances. The measure is designed to carry out major recommendations made in "Oil Pollution--A Report to the President," prepared jointly by Interior and the Department of Transportation.

Main Provisions

The main provisions of the suggested legislation would:

- Prohibit oil discharge from a shore facility or a ship within 12 miles of shore. This would cover the 3-mile territorial and the 9-mile contiguous zones. The previous standards of liability were limited to "gross or willful negligence" and to the 3-mile limit.
- Hold responsible for cleaning up affected areas the discharger of oil, including ship and shore facility owners.
- Empower the U. S. to clean up oil spills whenever pollutor fails to act, but would require the pollutor to reimburse U. S. Present law limits owner's liability to ship's salvage value; the proposal will extend it to the full costs of cleanup.
- Protect against large and dangerous discharges of pollutants other than oil by requiring pollutor to do what U. S. considers necessary to remedy situation. If pollutor does not act, the U. S. will take the necessary steps and hold former liable for costs.



Foreign Fishing Off U. S. Atlantic Coast Discussed

Representatives of commercial and sport fishing interests and Federal and state fisheries officials met at the State Department in Washington, D.C., on March 21 to discuss problems of foreign fishing off the Atlantic coast of the U.S. from Maine to Cape Hatteras.

Ambassador Donald L. McKernan, Special Assistant for Fisheries and Wildlife to the Secretary of State, said: "I called this meeting to discuss with fishing interests and state officials the growing problems in the area. After a review of the facts, we had a frank discussion of the problems and actions which might be taken to relieve the burdens facing our fishermen since foreign fleets started heavy fishing here about seven years ago. Recently, the problems have intensified and have expanded to new areas, bringing new segments of our public into contact with international fisheries problems."

Agencies Collaborate

Ambassador McKernan added that the meeting did not arrive at a firm course of action for the future, but the discussion of various possibilities was useful. "We did not expect this meeting to reach broad decisions," he said. "Ideas explored here will be studied and further refined in subsequent meetings, where more specific lines of action will be developed. The real purpose of this meeting was to establish a new era of collaboration among the Federal agencies concerned, the state governments, and the fishing interests concerned. The meeting succeeded very well in doing this, as I see it, and laid a good basis for future cooperation."

Many Participated

BCF, the U. S. Bureau of Sport Fisheries and Wildlife, the U. S. Coast Guard, and the Department of State participated. Officials from Maine, New Hampshire, Massachusetts, Rhode Island, New York, New Jersey, Virginia, and North Carolina, also took part.

In addition to representatives of sport and commercial fishing interests, regional groups and national organizations had been invited. (U. S. Department of State, March 21, 1968.)



1968 Great Lakes Fish Stocking Underway

Great Lakes sport and commercial fishing is being revitalized this spring with salmon and trout plantings totaling nearly 8 million fish, reports the Great Lakes Commission. Of the 2 principal participants, Michigan is concentrating on salmon and Wisconsin on trout; Pennsylvania, Ohio, and New York are initiating their salmon programs.



Stocking lake trout in Lake Superior.

Some 4.1 million lake trout yearlings are being planted in the Great Lakes waters of five states by the U. S. Bureau of Sport Fisheries and Wildlife; Ontario is releasing 500,000 young trout along the northern shore of Lake Superior. Lake Superior is receiving 2,320,000 and L. Michigan 1,800,000. Last fall 263,000 fingerlings of the 1967-year class were planted in Lake Superior by Minnesota and Wisconsin.

Cohos

In Michigan, 1,850,000 coho fingerlings are being released in 18 streams; 10 tributaries of Lake Michigan will receive 1.1 million; 5 Lake Superior streams--350,000; and 3 tributaries of Lake Huron--400,000, the first sizeable planting for Lake Huron.

Wisconsin will plant 25,000 yearling cohos in a Kewaunee County stream--and 200,000 will be stocked in Great Lakes tributaries in 1969. This year's emphasis is on trout. The state is releasing more than 200,000 lake trout in Lake Superior streams. Also, 180,000 other trout--rainbows, browns and brooks--will be stocked in Lakes Michigan and Superior.

Lake Erie

Cohos will be introduced into Lake Erie on a limited basis this year until the program is evaluated. Pennsylvania will release 87,000 fingerlings into tributaries west of Erie; Ohio will stock the Chagrin River with 25,000 coho smolt.

New York has placed 6,000 coho fingerlings in Cattaraugus Creek, west of Buffalo; 25,000 yearlings are scheduled for release in the Salmon River at the east end of Lake Ontario. New York's present supply of about 180,000 coho fry will go into Great Lakes streams in 1969.

Minnesota's Plans

Minnesota expects to release its first coho in Lake Superior in 1969: about 100,000 yearlings are scheduled for the French River at a site about 12 miles from Duluth. Minnesota now is constructing fishways on several North Shore rivers, primarily to enable rainbow trout (steelhead) to bypass falls on these streams. The work is being done under the Anadromous Fish Act; Federal funds pay for half the cost.



Great Lakes Production 1967 and 1966

The following are preliminary Great Lakes catch statistics:

State	Lake	Production	
		1967	1966
. . (1,000 Pounds) . .			
New York	Erie	254	220
Pennsylvania	Erie	478	573
Ohio	Erie	9,831	10,516
Michigan	Erie	1,052	1,389
Michigan	Huron	3,211	3,769
Michigan	Michigan	19,558	11,522
Indiana	Michigan	675	87
Illinois	Michigan	106	302
Wisconsin	Michigan	36,818	30,853
Michigan	Superior	3,991	4,604
Wisconsin	Superior	1,980	1,970

Lake Michigan Exceeds Erie

The total catch from Lake Michigan--57,157,000 pounds exceeded Lake Erie's 54,124,000 pounds for the first time since 1903. That year was the only time the total Lake Michigan catch exceeded the total Lake Erie catch. In 1903, the reported Canadian catch was low--and the cause may have been incomplete data.

For every year before and after 1903, Lake Erie production (including Canada) was much greater than Lake Michigan's.



OCEANOGRAPHY

Scripps' "Argo" Uses Computer and Satellites on Global Cruise

A sea-going computer and a satellite navigation system are being used by the research vessel Argo, which departed San Diego, Calif., March 7 on a year-long, 61,000-mile, scientific exploration. She will cruise the Pacific, Indian, and Atlantic Oceans for the Scripps Institution of Oceanography, University of California at San Diego. Dr. William A. Nierenberg, director of Scripps, described the cruise as "primarily a deep-sea, geological-geophysical exploration of the world ocean. . . . This expedition marks the first time that calculations of a ship's position at sea will be obtained automatically, using the vessel's speed and direction in conjunction with data received from the satellite, all being fed directly to the computer, to establish her position and thus improve the scientists' knowledge of the exact locations where data are being taken."

Dr. Robert L. Fisher, associate research geologist at Scripps, is in overall charge of the expedition called "Circe." Dr. Fisher said: "This computer will be used for geophysical and oceanographic data compilation and data reduction throughout the expedition. The satellite navigation system's shipboard receiver will be installed at Penang, Malaysia, about May 1, and will function during the remainder of the cruise. Rapid, frequent, precise fixing will permit on-the-spot revision and modification of investigations to take advantage, immediately, of knowledge just gained. Formerly, gaps or omissions--which can be easily remedied with the ship in the area--might not become apparent until months after a cruise was completed and the data analyzed."

The Computer

The IBM 1800 has a 32,000-word core storage capacity with a cycle time of two microseconds (millionths of a second). It is directly connected to the ship's scientific instruments and can gather information from them at up to 8 million bits a second.

The Satellites

The ship's navigator will be aided by 3 Navy satellites. The satellites will be or-

biting roughly a north-south course 600 nautical miles above the earth every 80 minutes and transmit signals to the shipboard receiver. This system will enable the navigator to determine his position precisely in any weather even substantially better than a tenth of a mile. This is much more accurate than the conventional celestial "fix" or listening to land-based LORAN stations.

Dr. Fisher emphasized that such accuracy will be especially helpful in the Bay of Bengal, which is cloud-covered much of the time during the northeast monsoon season. Other electronic aids to navigation are not available there. Argo will be in the bay 6 of the 12 months.

What Scientists Seek

Expedition scientists will investigate "ocean bottom topography, magnetic patterns, heat flow, thickness of sediments in ocean basins and along continental shelves, distribution and types of hard rock, chemical properties of sediments and the water above them, and variations in the earth's magnetic field near the magnetic equator. Hydrographic casts will be made, bathythermographic observations collected, and biological tows completed."

The expedition's scientists and graduate students represent the U. S., Great Britain, Canada, Australia, Colombia, France, The Netherlands, and South Africa.



Coast Guard Leads Data Buoy Development

The President's Council on Marine Resources and Engineering Development has assigned to the U. S. Coast Guard leadership of a development program for national data buoy systems. The development program begins on July 1.

The systems would contain unmanned automatic data buoys to provide marine meteorological and oceanographic data necessary for weather forecasting. These would also aid other Government-wide operations.

The program is based on a Coast Guard-managed study sponsored by several Federal agencies needing marine data.

The study concluded that the systems are the cheapest means of satisfying many Federal requirements for marine meteorological and oceanographic data. Also, the systems are attainable within 5 years.



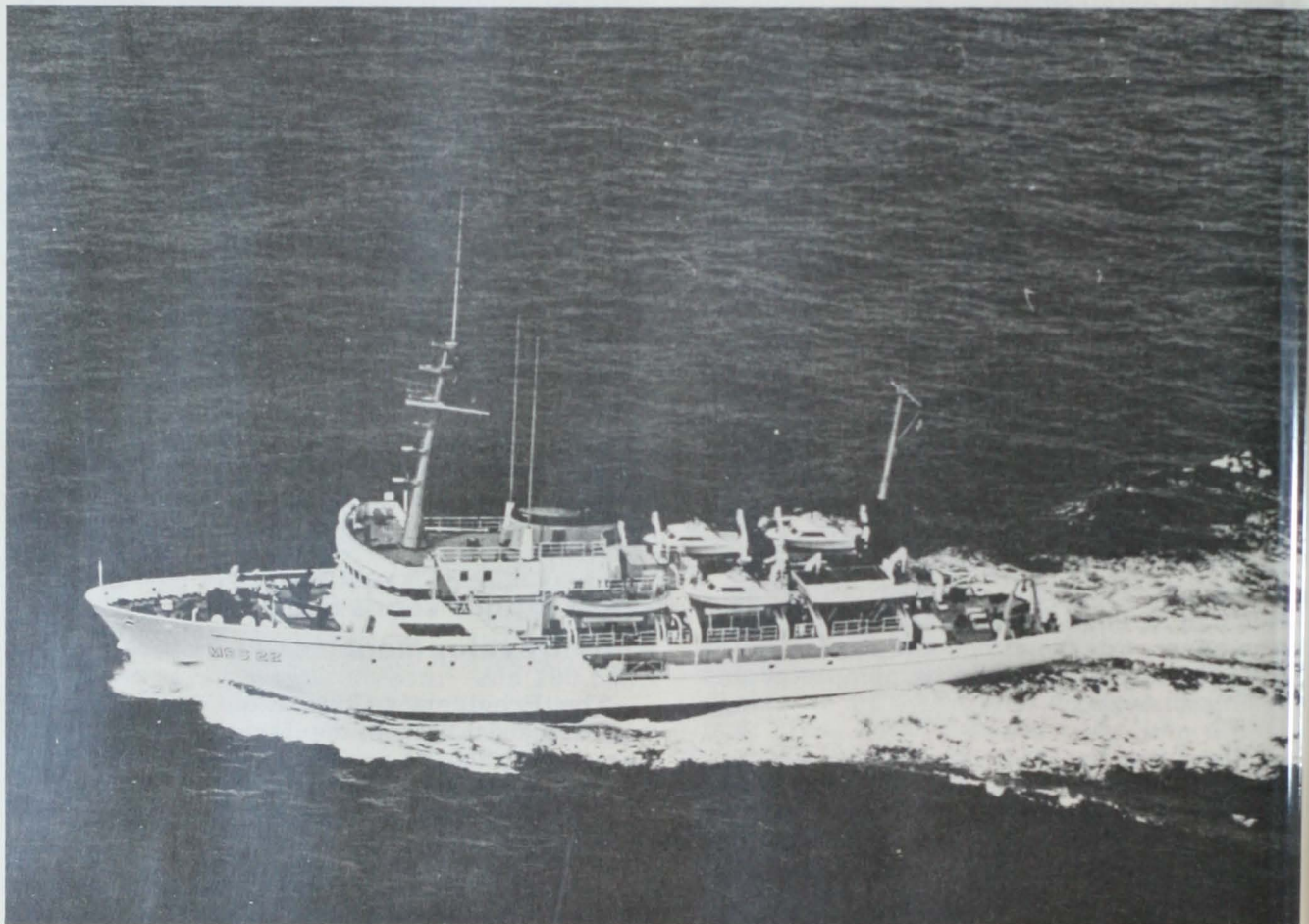
New Hydrographic Survey Vessel Commissioned

A new U. S. hydrographic survey vessel equipped with electronic devices to probe America's coastal waters was commissioned by the Environmental Science Services Administration (ESSA) on March 23 at Jacksonville, Fla. She is the "Mt. Mitchell."

survey vessels. The others are the USC&GSS "Fairweather" and "Rainier." Two larger vessels were built in Jacksonville before the Mt. Mitchell: the USC&GSS "Oceanographer" and "Discoverer," for ocean surveys in the Pacific and Atlantic.

The \$4.3 million, 231-foot, 1,660-ton, white-hulled Mt. Mitchell will take part in the U.S. Coast and Geodetic Survey's long-range program of marine charting and scientific exploration in the Atlantic.

The ship can cruise 8,000 miles and carry 79 officers, crew, and scientists. Her primary function will be to conduct hydrographic surveys in coastal waters in the Atlantic and the Gulf of Mexico. She also has some equipment for oceanographic surveying.



USC&GSS Mt. Mitchell.

(Photo: ESSA)

The Mt. Mitchell is the first of 3 sister ships built at Jacksonville to be commissioned for the ESSA fleet of ocean and hydrographic



STATES

Florida

MASS CULTURE OF PINK SHRIMP AND POMPANO STUDIED BY MIAMI U.

A \$225,000 grant for a 2-year project to develop techniques for the mass culture of pink shrimp and pompano was awarded to the Institute of Marine Sciences (IMS), University of Miami (Fla.), by the National Science Foundation.

The aquiculture (sea farming) project is under Dr. Clarence P. Idyll. It will be conducted at the Florida Power and Light Co.'s Turkey Point plant. The purpose is to show that a predictable supply of high-quality pink shrimp and pompano can be mass produced in the shallow parts of the ocean at a predictable cost. The information and techniques learned will be passed on to commercial fishermen. The 2 highest-priced seafoods in the U. S. were chosen for study because of their value and the cost of aquiculture.

The Sea Grant Program requires that "matching" funds be provided by large industrial firms interested in diversifying their operations. Much money has been contributed to the project by Armour and Co. and the United Fruit Co. The Florida Power and Light Co. has made its property available and paid to build outdoor ponds.

IMS INTEREST IN SHRIMP

The Institute of Marine Sciences became interested in the commercial culture of pink shrimp in 1964, after 15 years of research on the Tortugas species. During that time, in the late 1950s, IMS biologists succeeded in raising shrimp from the egg to the young-adult stage in the laboratory. In 1965, Dr. Idyll went to Japan to study Dr. Motosaku Fujinaga's successful shrimp farm at Takamatsu. In summer 1967, Dr. Won Tack Yang, who will be involved in the shrimp experiments at Turkey Point, visited Japan to learn the latest developments in shrimp farming.

The shrimp research was scheduled to begin by stocking each of 4 $\frac{1}{4}$ -acre ponds with 5,000 shrimp (about 2 $\frac{1}{2}$ -inches long) in early March. These are the species of shrimp fished in the Tortugas. They should grow to 5 $\frac{1}{2}$ to 6 inches long after about 3 months in the Turkey Point ponds.

When a hatchery building is completed, egg-bearing female pink shrimp will be collected in the Tortugas and placed in indoor spawning tanks. The eggs will then be raised in the hatchery through the 11 larval stages and about 12 postlarval stages. The shrimp will still be less than $\frac{1}{2}$ -inch long but can be put into outdoor growing ponds. There, experiments can be conducted on different kinds and quantity of foods, various water temperatures and salinities, and pond size in relation to shrimp size. Tests of food preferences of pink shrimp now are being carried out in the lab.

This project does not compete with shrimp fishermen. There probably will always be more shrimp produced in the areas where fished than is possible on a shallow-water farm; and aquiculture is not feasible in the open ocean.

Use of Warmed Water?

The scientists may learn if the heated effluent from the Turkey Point plant can be used. The plant uses sea water to cool its condensers, both in the fuel oil and nuclear facilities. When the cooling water is pumped out, it can reach about 10^o F. This heated water could benefit growing shrimp in the winter, when natural sea-water temperatures are low. This project may reveal if a nuclear plant pollutes Biscayne Bay.

Pompano Project

As the pompano project begins, the small pompano (1 to 2 inches long) will be caught in the surf along the upper East Coast of Florida. They will be raised in the Turkey Point ponds for about a year to reach marketable weight (about 1 pound). As more is learned about controlling the life cycle, the farming operations can be advanced to earlier stages. (Institute of Marine Sciences, U. of Miami, Feb. 22, 1968.)



Oregon

FISH COMMISSION SEEKS TO ESTABLISH ABALONE

Two hundred adult red abalone from California were planted at Whale Cove, north of

Newport in Lincoln County, reports the Oregon Fish Commission. They supplement over 5,000 juvenile abalone planted there in summer 1967 as part of the Commission's effort to establish the species along the north coast.

The adult shellfish were gathered from the Fort Bragg area south of Eureka. They measured 5 to 9 inches across the shell; the largest weighed up to 4 pounds.

Seventy-five selected adults were retained in tanks at Newport. They are being conditioned for spawning attempt under laboratory conditions. If the experiment succeeds, as expected, it will give the commission a ready source of juvenile abalone for further stocking.

It is not known whether water temperatures in the natural environment at Whale Cove will become high enough for successful natural spawning. In southern California, where the abalone is an important sport and commercial species, spawning occurs at 62 to 64 degrees Fahrenheit. Oregon's coastal waters seldom get this warm for any appreciable period.

Abalone Thriving in Whale Cove

The young abalone planted in Whale Cove in summer 1967 are doing extremely well, according to a Commission biologist. Most were planted when thumbnail size and have at least doubled in size. Whale Cove was selected as the first planting site on the north coast because brown algae, the primary item of the abalone diet, are abundant there. Also, limited access to the area and the interest of local residents and divers should protect the transplanted animals.

The red abalone occurs naturally on the coast of Coos and Curry Counties, as far north as Coos Bay.



Texas

EDA APPROVES FUNDS FOR BROWNSVILLE HARBOR EXPANSION

The Economic Development Administration (EDA) has approved \$1,249,800 in grants and a \$1,560,000 loan to help expand harbor and port facilities in the Brownsville area of

Texas. The program is expected to create about 775 jobs in a 5-year period as the projects are built and begin operating.

The projects include the planned expansion of the fishing harbor. EDA approved a \$720,000 grant for this. The applicant was the Brownsville Navigation District. A local investment of \$480,000 will complete the total cost of \$1,200,000. The project involves a new basin, improvement of docks and ramps, widening of a road, and installation of street lights, sewer lines, and a one-million gallon overhead water tank. The Navigation District estimated the project will increase the port's business by \$30 million a year.

EDA is interested in increased capacity to process seafood products--and in the effect on the Gulf and overall market of increasing the supply of marketable seafoods.

* * *

FY 1966-67 LANDINGS

32.3 million pounds of fish worth \$1.7 million were taken from Texas bays and the Gulf of Mexico during fiscal year 1966-67, according to the Texas Parks and Wildlife Department.

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GALVESTON BAY YIELDS 6,000,000 POUNDS OF SEAFOOD

The total annual yield from Galveston Bay of commercial seafood products--such as shrimp, crabs, and fin fish--averages about 6,000,000 pounds. This was reported recently by J. R. Singleton, executive director of the Texas Parks and Wildlife Department.

A half-million pounds of oyster meat were taken from Galveston Bay in 1959. The figure increased to 4,000,000 pounds in 1966. (The 1967 season was still in progress.)

* * *

BIG FISH IN BAYS ATTRACT ILLEGAL NETTERS

The bays of Texas, especially Lower Laguna Madre, "are full of big fish," and this has produced an increase in illegal netting. So stated Tom D. Moore, regional director of the Texas Parks and Wildlife Department, in mid-March.

Low-flying Department pilots reported seeing more big fish in the shallow waters of the Lower Laguna Madre, near Port Isabel and Port Mansfield, than ever before. Sportsfishermen and trotliners have been very successful, and illegal netters have got into the act.

Hurricane Beulah The Cause

The increase in numbers and size of fish in the bays commonly follows hurricanes, explains E. G. Simmons, the Department's regional coastal fisheries supervisor. He believes Hurricane Beulah in September 1967 was even more productive than most storms.

Since Beulah, more than 50,000 feet of illegal nets have been confiscated in Laguna Madre. "Many fishermen had been arrested and convictions obtained."



North Carolina

1967 LANDINGS DOWN 10.5%

BCF figures show total North Carolina landings of shellfish and finfish for 1967 were 219,588,328 pounds worth \$8,385,149. This was a 10.5 percent drop in weight and 12.1% decline in value from 1966 totals.

In 1966, total landings were 245,484,687 pounds worth \$9,543,757.

The menhaden catch dropped most in 1967: 31,741,327 pounds fewer than 1966's 182,288,821 pounds.



Alaska

SCALLOPS: TO SHUCK OR
NOT TO SHUCK ~ AT SEA

BCF Juneau reports that "aside from all of the recent excitement about 40,000-pound trips, 1,000 pounds per hour drags, and high \$1.30 per pound product price, the paramount problem with Alaska scallops is to catch, process and market them at a profit."

The fishing industry and all others concerned are trying to decide between two alternatives: Should the Alaska scallop indus-

try follow the method used by the East Coast scallop industry--shuck and freeze scallops aboard the vessel? Or, should Alaska scallops be landed alive and be shucked and processed in shore plants?

Fear East Coast Fishermen

Some Kodiak-based processors are thinking of legislation to require all portions of the scallops to be recovered by processors under the "wanton waste" clause. These processors fear that East Coast scallop vessels and fishermen will invade Alaskan waters, process the scallops onboard, and market them in "stateside ports" without benefit to Alaskans.

BCF Juneau concludes: "Whatever the individual or community ideas maybe, one fact remains: at present every pound of scallops processed is costing the processor money."

* * *

NEW SCALLOP FISHERY DEVELOPS RAPIDLY

The new scallop fishery in Kodiak, Alaska, is growing fast. It now has 4 vessels. Two others--the halibut schooner "Seattle" of Ballard, Wash., and the scallop dragger "Viking Queen" of New Bedford, Mass.--were expected to start fishing soon. The latter will test fish scallop beds in the Gulf of Alaska with U. S. aid.

Record Catch

On a 1-week trip, the Alaskan king crab vessel "Virginia Santos" landed a record 10,000 pounds of scallop meats. This equals 110,000 pounds comparative shell weight. The Santos made the first commercial landing of scallops on Jan. 10, 1968--35,000 pounds, shell weight. The yield of meats to shell weight has been 9-10 percent; exvessel price 7 cents per pound, shell weight.

Possible Alternative to King Crab

Observers believe that it has yet to be demonstrated that Alaskan scallops can be caught, processed, and marketed at a satisfactory profit. Scallops offer a possible alternative to king crab. The 1967 catch of king crab dropped 24 million pounds from 1966's record catch.

The decline in king crab catch also has renewed interest in developing the latent tanner crab resource.

* * *

MARINE SCIENCE COMPLEX PLANNED

Bills have been introduced into Alaska's House of Representatives and Senate for a \$5 million bond issue to provide capital improvements for the "Trident Program." Conceived by Governor Hickel, the program would create a complex of marine research and educational facilities.

The program has 3 parts: the Alaska Institute for Fisheries Development, the Alaska Maritime Academy, and the Alaska Marine College, a sea-grant institution.

The Bond Issue

The sale of bonds would provide the money to pay part or all the cost of matching Federal and/or local funds that may become available to acquire, build, and equip the physical facilities.



California

BASKING SHARK FISHERY LAUNCHED

The basking shark fishery was launched Feb. 15 when 3 vessels caught six 25-foot sharks and a 15-foot juvenile at Morro Bay. This was reported by BCF Terminal Island, Calif. The average weight of the livers was about 1,000 pounds. The value of the livers depends on the amount of squalene in the oil.

The basking shark may reach 40 feet. It often can be seen at the surface basking in the sun and feeding on plankton.

Squalene is a hydrocarbon with very little nutritive value. When present in fish, it keeps away parasites. It gives a brilliant sheen to natural and artificial silks when used to finish them. Squalene also is used as lubricant, carrier of perfumes, and to fill thermometers.

Worth 20 Cents a Pound

At 35 percent squalene, the amount found in 3 sharks caught previously, the liver oil is worth 20 cents per pound. Oil samples were sent to prospective buyers in Japan and New York.

The fishery was expected to gain momentum in March when many basking sharks appear off the coast between Morro Bay and Santa Barbara.

* * *

INTEREST IN DRIED SEAWEED INCREASES

A sharp increase in the world price of dried seaweed has renewed interest in it in California, reports the State's Resources Agency. The seaweed is not macrocystis, which has been harvested in quantity for many years. It is gelidium, less than 2 feet tall; other small feathery forms also are being considered.

For about 20 years, 2 men have harvested and dried seaweed near Cambria; each produces about 10,000 pounds of dried material.

In southern California, the seaweeds can be found in many places. Commercial interests have scouted the harvestable areas. The Fish and Game Commission is preparing regulations for the orderly use of seaweeds. Harvesting may be allowed by summer 1968.

Permit to Harvest Kelp

The Commission issued a 1-year permit to the A. B. S. Fishing Co. to harvest kelp with herring eggs attached from Tomales Bay and San Francisco Bay. The product is prepared by salting and refrigeration. It is exported to Japan, where it is sold as a table delicacy for \$3 a pound. So far, the company has harvested 9 tons.



Washington

HAKE FISHERY CUT AS MARKET DEMAND DROPS

Landings of Pacific hake during the 1967/68 fall-winter season in Puget Sound, through February, were about $2\frac{3}{4}$ million pounds. For the same period during the 1966/67 season, landings were 6 million pounds. The decreased landings can be explained largely by the reduced market demand for hake.

$\frac{3}{4}$ of Landings at Everett

About 75 percent of the catch was landed at Everett, Wash., the remainder at Bellingham and La Conner, Wash.

If the hake fishery follows the pattern of 1965/66 and 1966/67, vessels will continue to fish hake in Puget Sound through May.



BUREAU OF COMMERCIAL FISHERIES PROGRAMS

Oregon II' Tests Sonar and Longlines on First Cruise

BCF's new exploratory fishing vessel, Oregon II, has completed Cruise 1. During Sept. 6, 1967-Feb. 9, 1968, she conducted a series of 8 performance trial trips in the Gulf of Mexico. Five trips were concerned with testing sonar equipment, and three with testing experimental bottom and surface longline gear.

Fishing Gear

Bottom longline gear units consisted of 3 baskets of gear shackled together with a buoy and anchor attached to each end. One basket each of hook sizes 6, 7, and 9 (total 300 hooks) was fished at each station. A basket had 100 circle hooks on 6- to 12-inch monofilament gangions attached at 10-foot intervals to a $\frac{1}{4}$ -inch nylon or polyethylene mainrope.

The swordfish longline gear used 5-fathom drops at each buoy. Buoys were placed 300 yards apart; a small weight was placed every 50 yards. Number 3 shark hooks on 2- to 3-fathom gangions were placed every 50 feet on the longline. The first set consisted of 210 hooks; later gear additions brought number of hooks per set to 530.

Results of Bottom Longlining

36,100 bottom longline hooks, baited with squid and ladyfish, were fished at 119 stations in 20 to 300 fathoms during 44 days of fishing.

The most abundant foodfish by number and weight was the Atlantic tilefish, (Lopholatilus chamaeleonticeps); 322 weighing 1,928 pounds were caught at 48 stations. It was thought that this species did not occur in potentially commercial concentrations in the Gulf--but it was taken from all major Gulf areas sampled during Cruise 1. Tilefish were taken in 100-200 fathoms, although major concentrations were in 150- to 200-fathom depth range. Maximum tilefish catches of 285, 166, and 104 pounds per 300 hooks were made off Texas, the Campeche Bank, and in the northern Gulf, respectively. Size ranged from 1 to 27 pounds in weight; average was 6 pounds. The gray tilefish (Caulolatilus microps) was found in smaller numbers from 100 to 150 fathoms along eastern edge of Campeche Bank.

The yellowedge grouper (Epinephelus flavo-imbatus) was the second most abundant foodfish taken: 113 fish weighing 1,168 pounds were caught at 21 stations. The depth range was 75-150 fathoms; greatest abundance occurred at 100 fathoms. A catch of 271 pounds on a 300-hook set off Texas was the highest. A 105-pound catch from Campeche Bank was the highest from other Gulf areas. Yellow-edge grouper were not taken from Florida, and only 2 were caught in northern Gulf. Average weight was 10.5 pounds; size range was 4 to about 20 pounds.

Other foodfish taken in small quantities were: red snapper, vermilion snapper, wenchman, scamp, porgies, hake, and warsaw, red, and black grouper. Shark was the largest single bottomfish component; 561 sharks weighed 2,642 pounds, or 32 percent of total bottomfish catch. The bulk of shark total was taken from northern Gulf area and comprised mostly dogfish (Squalus) and smoothhounds (Mustelus), averaging about 3 pounds.

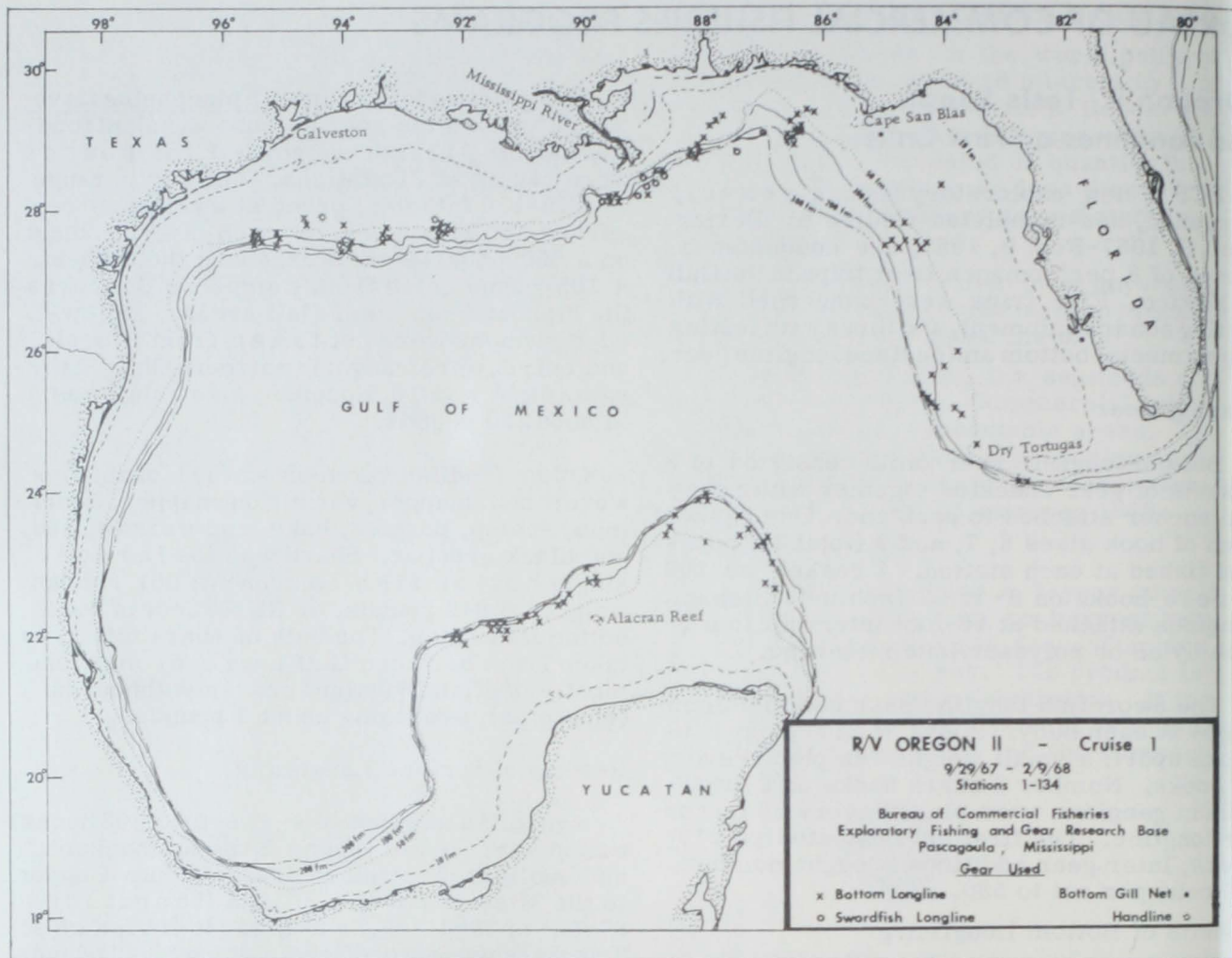
Results of Surface Longlining

Swordfish longline sets--8 sets (3,308 hooks) baited with $\frac{1}{2}$ - to 1-pound Spanish mackerel and mullet were fished from DeSoto Canyon to the Mississippi River Delta (longitudes 87°03' to 89°41' W.) and in 210 to 400 fathoms. Twenty-seven swordfish weighing 3,048 pounds and ranging from 19 to 270 pounds (113 pounds average) were caught. Swordfish were taken at each station, but best fishing was off Mississippi River in 330 to 350 fathoms; there 3 sets (1,260 hooks) produced 21 fish weighing 1,543 pounds. Only 2 fish, weighing 305 pounds, were caught in DeSoto Canyon area (448 hooks).

Sharks were predominant fish taken on each longline set--75 percent of total catch; 93 sharks weighed 9,545 pounds. Hammerhead sharks were most abundant, but silky and dusky sharks were also caught in moderate numbers. Other sharks were mako, tiger, and bignose. One 70-pound white marlin was taken off Mississippi River Delta.

Sonar Used

Trips 1, 2, and 4 were in northern Gulf, and Trips 5 and 6 in eastern Gulf. During Trip 4, in October, numerous schools of surface



and subsurface herringlike fishes, including menhaden, were located by sonar in Cape San Blas-Cape St. George, Florida, area. Once, 105 surface schools were visually counted on surface within 5-mile radius of vessel. When sea surface became turbulent and schools sounded, they were detected by sonar in mid-water and near-bottom areas. Water depths ranged from 4 to 9 fathoms. Simultaneous aerial photographic and sonar detection were initiated during cruise.

Trips 5 and 6 concentrated in area from off Boca Grande to Fort Myers Beach, Florida, where commercial thread herring seiners were active. Minimum depth operational limitations of Oregon II (4 fathoms) restricted sonar operations in near-shore areas, where many commercial activities were centered. However, numerous large schools (over 50 tons) were detected in offshore areas. Thread

herring concentrations were found as far as $8\frac{1}{2}$ miles offshore in depths to 7 fathoms.

Commercial vessels generally used aerial spotters. In some instances, water turbidity and lighting conditions were not favorable for reliable aerial detection--and sets were made solely on sonar information supplied by Oregon II. The value of sonar capabilities was clearly demonstrated to industry: the Oregon II returned to area in December after industry requested sonar assistance.

Coordinated Approach

Coordinated sonic fish-school measurements, aerial photography, and commercial vessel school samplings were made during November and December. Operational techniques and problems for this coordinated approach were studied and tested.

Additional coordinated resource assessment techniques are scheduled. Also planned during current fiscal year is design and development of a multisectional, narrow-beam, sonar device capable of making 2- or 3-dimensional measurements of pelagic fish schools. The long-range search and detection sonar is not suitable for these measurements, particularly in shallow water, because of its beam width (10°) and low frequency (20 KC).

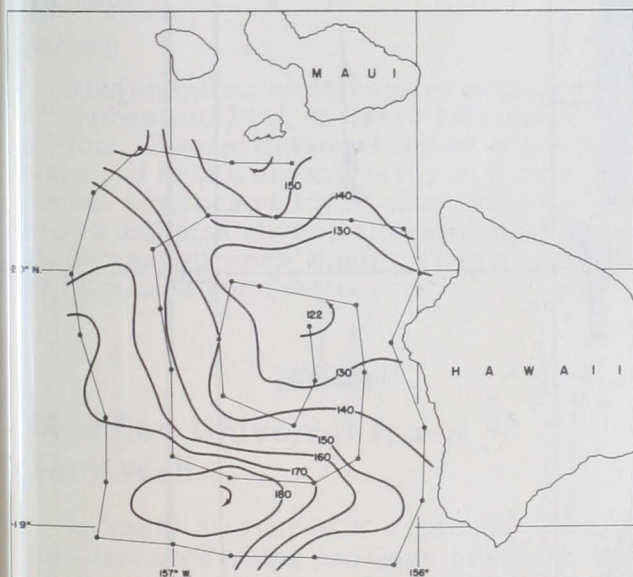
During Trip 6, the sonar operation was demonstrated to industry members, 2 biologists from the St. Petersburg Biological Laboratory, and 3 members of another BCF program.



'Gilbert' Studies Thermocline West of Hawaii

The Charles H. Gilbert spent 4 days of its latest cruise determining the thermocline topography west of Hawaii (Cruise 107, Jan. 9-Feb. 24, 1968, Hawaii to Johnston Island).

Thirty-seven BT (bathythermograph) observations were made. Chart shows the thermocline topography measured.



Depth (meters) of the 20° isotherm during the first 4 days of Gilbert cruise 107.

Other Missions

The Gilbert had 2 other missions: (1) to determine the direction and speed of near-

surface currents west of Hawaii and near Johnston Island, and the changes in current direction with time.

Thirty-four longline stations were occupied during the entire cruise. The drift of the longline gear during each station was used to determine the current.

The first 24 stations, off Kona, demonstrated the presence of a current flowing ESE toward the southern portions of the Kona Coast, and the presence of a cyclonic (counterclockwise) eddy in the northern half of the station pattern, as in chart. There is some indication of a 20-day periodicity in the speed and direction of flow south of the cyclonic eddy which might, upon further analysis, be evidence of periodic vortex shedding off South Point.

(2) To fish with longline gear, which is also used to determine currents. Also, to tag and release all tuna and billfish brought up alive and in good condition; the intent was to determine the changes in catch rate with time.



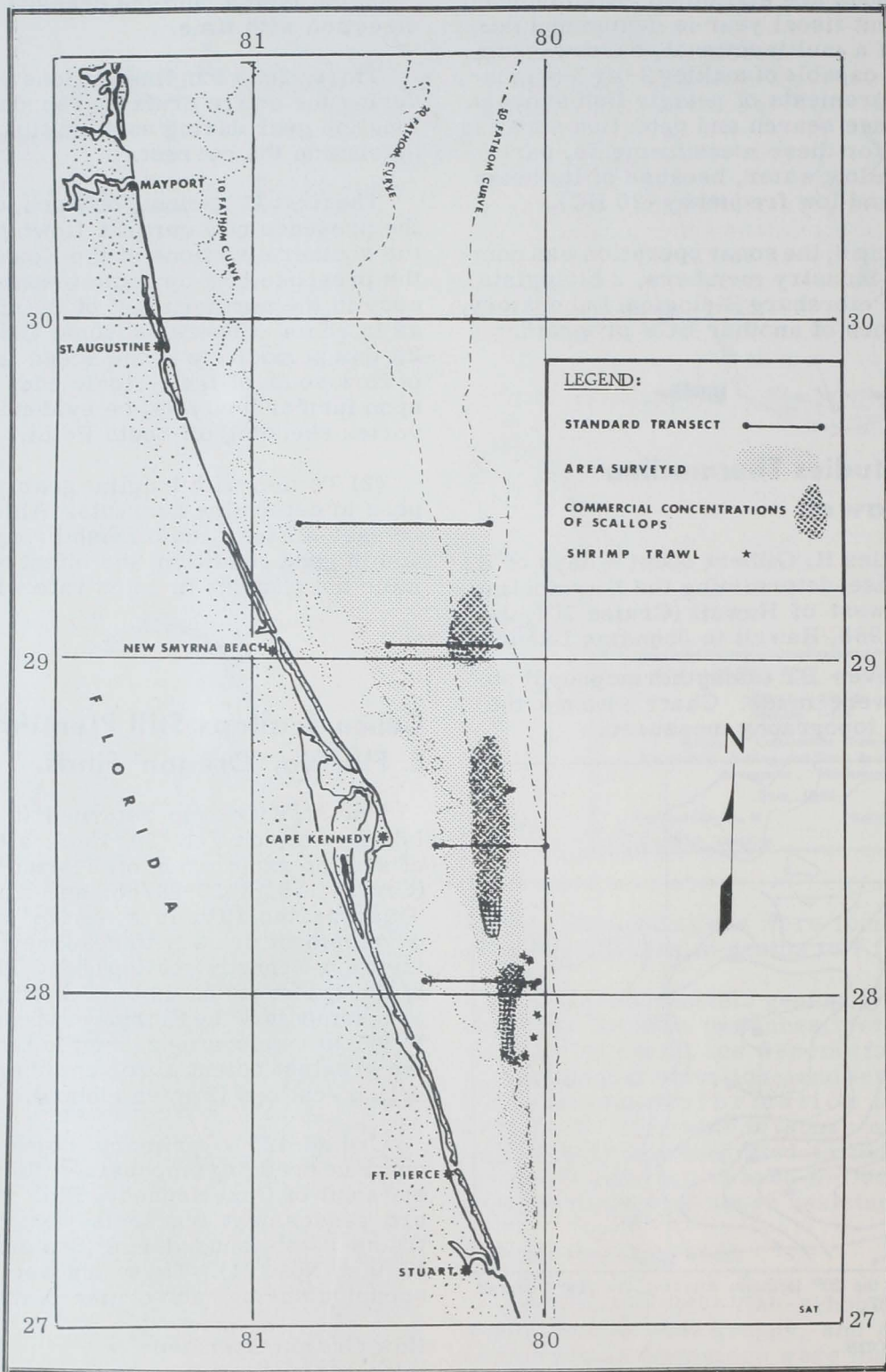
Calico Scallops Still Plentiful Off E. Florida, 'Oregon' Finds

The R/V Oregon returned to St. Simons Island, Ga., on Feb. 29, 1968, after 17 days of scallop exploration off Florida's east coast (Cruise 126, 2/12-29/68; see chart p. 20). This was the fifth in a series of industrial development cruises to resurvey intensively the Cape Kennedy scallop beds. The purpose of the explorations is to maintain up-to-date assessments of the Florida east coast grounds. Previous explorations showed them to have the greatest potential for commercial use of calico scallops (*Pecten gibbus*).

Cruise 126's primary objective was to continue dredging emphasizing the areas north and south of Cape Kennedy, Fla. Four standard assessment transects were run along tracts established during September 1967 (Cruise No. 121). These transects have been occupied during each cruise in the series.

How Oregon Operated

208 dredging stations were occupied in the 10- to 40-fathom depth range from east



R/V Oregon (Cruise 126).

of Jacksonville Beach to Stuart, Fla.; 197 stations were made with an 8-foot tumbler dredge fished with 2-inch bag rings, 20-rings deep; 11 stations were occupied with a 6-foot tumbler dredge fished with 2-inch bag rings, 13-rings deep. All dredges are fitted with 2½-inch-stretched mesh nylon liners.

The Findings

East of New Smyrna Beach, where commercial concentrations were located in September, catch rates remained commercially significant; these ranged up to 23.7 bushels of scallops per 30-minute drag in the 23- to 31-fathom range. Counts ranged from 55 to 103 meats per pound.

East of Cape Kennedy (between latitudes 28°30' N. and 29°00' N.) catch rates were again commercially significant--ranging up to 29 bushels of scallops per 30-minute drag. Counts ranged from 68 to 144 meats per pound.

In the survey area's southern portion, from 28°00' N. to east of Stuart, catches up to 14.9 bushels of scallops per 30-minute drag and counts of 143 meats per pound showed areas of commercial significance.

A 1-day dredging demonstration was conducted for observers. Fishing information was relayed to vessels engaged in the scallop fishery.

Shrimp

Nine nighttime stations were occupied east of Melbourne, Fla., in 22-30 fathoms with a 65-foot, 4-seam flat trawl fished with a single warp and bridle arrangement on 8-foot chain doors. Catches of 15/20 count (heads off) brown and pink shrimp (*Penaeus aztecus* and *P. duorarum*) were small. They ranged up to 10 pounds per 2-hour drag.



Modified Universal Trawl Tests Well

In early March, BCF's Seattle (Wash.) Exploratory Fishing and Gear Research Base cooperated with the commercial trawler "Junior" to demonstrate the effectiveness of a modified version of the Base-developed "universal" trawl.

The modified trawl is designed for mid-water and ocean bottom use. It differs from earlier versions of the universal trawl used

to harvest Pacific hake in having less webbing and larger mesh size in the wings--and so is easier to tow.

For 2 days, Junior fished alongside 3 other commercial trawlers and its catch was double any one of the 3. Six hauls by Junior caught 30,000 pounds of rockfish and 5,000 pounds of mixed flounders and Pacific cod.

Trawlers Plan To Use Trawl

Based on Junior's and similar earlier catches by BCF's "John N. Cobb," several captains of Pacific Northwest trawlers plan to build universal trawl nets from plans supplied by the Seattle Base.



Report on Pacific Saury

The Pacific saury (*Cololabis saira*) is a common fish in the waters off California and is known to extend across the temperate zone of the northern Pacific. This species eats copepods, euphausiids, and anchovy larvae. It competes with adult anchovy and mackerel for food--and is an important forage fish for temperate tunas. Japanese, Soviet, and Korean fisheries have competed for saury in the western Pacific for the last few years. Soviet exploratory vessels have delimited the major concentrations of Pacific saury in the last 3 years and have begun experimental fisheries in the eastern Pacific off Oregon and northern California. Major commercial uses for this species are as fresh fish, canned, smoked, and dried for human consumption and as the preferred long-line bait for the Japanese tuna fleet.

Million Metric Tons

We compiled data in January 1968 from past California Current fish egg and larval surveys to estimate the stock size of sauries which spawn in the 300,000-square-mile area. There appears to be a 9-year average of 264,000 metric tons of adult Pacific saury spawning in this area in March, April, May, and June. It is apparent from the distribution of spawning that we have encompassed the southern boundary of spawning rather well, but we have not defined either the offshore or northern extent of the saury spawning grounds. Scanty data along the edge of our survey area would indicate that the

264,000 metric ton estimate may only represent $\frac{1}{3}$ to $\frac{1}{4}$ of the saury stock in the eastern Pacific. Thus it now seems likely that nearly a million metric tons of Pacific saury exist in this part of the Pacific Ocean. (Paul E. Smith, BCF Fishery Biologist, La Jolla, Calif.)



Genetic Composition of South Pacific Skipjack Tuna Studied

The following was prepared by the BCF Biological Laboratory in Honolulu:

Kazuo Fujino, of our laboratory, spent 2 weeks fishing for tuna in Tahiti recently. His object was not food or sport, but to fill small plastic vials with blood drawn from the fish he caught. Dr. Fujino's specialty is the population genetics of marine animals, particularly the tunas, and blood samples afford the basic data he needs.

Tuna abound in Tahitian waters. Research cruises in the 1950s found many schools in the Society and nearby Marquesas Islands. The skipjack tuna (*Katsuwonus pelamis*) is particularly plentiful. It was the skipjack tuna that Dr. Fujino flew 2,500 miles to study, for one large gap in scientific knowledge of the skipjack tuna concerns the precise relation of these of the central South Pacific to those elsewhere.

Found in World's Warm Waters

Skipjack tunas are found in warm waters around the globe--in the Atlantic Ocean, the Indian Ocean, and the Pacific Ocean. Small but growing commercial fisheries exist in the Atlantic Ocean. Only a few of the fish are caught in the Indian Ocean at present. In the Pacific Ocean, the sea of tunas, in 1966, the Japanese took 224,000 metric tons (494 million pounds) in the waters near the home islands as far south as the Marianas. In the same year, the large U. S. fishery in the eastern Pacific caught 60,400 metric tons (133 million pounds) off Mexico and Central America. A third fishery, in the Hawaiian Islands, took 4.3 metric tons (9.4 million pounds). All these skipjack tuna were worth about \$78 million to the fishermen.

And this large catch is far from reaching its peak, according to research of several scientific institutions, including ours. Sci-

entists have estimated that the present yield of the central Pacific Ocean might be increased many times--with development of more effective methods of locating and taking the fish. Such an industry, based in Hawaii, would greatly strengthen the State's economy.

Problem of Conservation

Serious scientific problems attend bringing such a resource into production, however, and it was one of these that stimulated Dr. Fujino's trip to Tahiti.

History provides incontrovertible proof that man can wipe out wild species. The buffalo is a spectacular example; so is the largest of all living creatures, the blue whale. If the animal species of the sea are to be used wisely, they must not be harvested so heavily that they cannot reproduce themselves. In an elementary economy, the farmer saves seed grain, the rancher does not slaughter all his breeding animals; in the as yet primitive economy of the sea, which is based on hunting, a fishery might risk devastating a species, or all of a species in a certain area, if it is not carefully managed.

Therefore it is considered essential to understand the relation of the fishes in one area of the ocean to those in another. For example: Is there a single great skipjack tuna population in the Pacific Ocean? If catches were increased in the central Pacific, would enough of the stock be left elsewhere to replenish that area? Or are there several smaller populations, or subpopulations that do not interbreed?

Population Genetics Provides Leads

The discipline of population genetics provides some leads to answers; it depends upon the fact that certain characteristics are conveyed from one generation to the next, according to well-understood laws. In fishes, as in many other animals, some of these characteristics are blood types, and the presence of certain proteins in the serum.

Since it deals with populations, this branch of genetics requires many samples. The blood type of a single fish, or a few dozen fish, tells little or nothing about the whole population. But when hundreds of fish are sampled, then the population geneticist can draw conclusions about the population. The reason is that isolated subpopulations, groups

of fish that do not breed with fish from other groups, will display distinct proportions of blood types or other characteristics; these proportions change very, very slowly with the generations. So, in theory, if the fish from the eastern Pacific, say, never mingle with fish from off Japan to breed, then in time distinguishable subpopulations would be established.

In practical terms, this would also mean that if the population from off Japan, as an example, were brought to so low a level it could not reproduce itself, the area would not be repopulated by fish from the eastern Pacific--for they never would reach Japan. If, on the other hand, a single, great, freely intermingling population exists, the depletion of fish in any single area likely would be followed in time by replenishment.

Blood Center Established

To throw light on the subpopulation structure of the tunas, our laboratory has established a Tuna Blood Group Center. Samples come to it from all over the world. In recent months, shipments of skipjack tuna blood, for example, have been received from the Gulf of Guinea (off west Africa), and from the Trust Territory of the Pacific Islands in the western Pacific. And Dr. Fujino journeyed to Tahiti to obtain samples.

In all, 14,000 samples of tuna blood have been analyzed or are awaiting analysis at the Center. Because the species is important to the future of tuna fisheries in the central Pacific, more samples (12,000) of skipjack tuna blood have been taken than of any other species. But albacore are represented by 300 samples, bigeye tuna by 500 samples, yellowfin tuna by 700, southern bluefin tuna by 300 samples; there are others.

From this storehouse, Dr. Fujino has drawn the materials for a series of scientific papers for journals in this country and abroad. One of his papers outlines what is known of the subpopulation structure of the skipjack tuna in the Pacific Ocean. He reports that the skipjack tuna of the tropical western Pacific, those taken in the waters of the Trust Territory, belong to a subpopulation that does not appear in the Hawaiian fishery. Also different from the Hawaiian fish are those taken in Japanese coastal waters. Whether these differ from those of the Trust Territory is not yet known.

Questions Remain

There is some evidence that the skipjack tuna of the Hawaiian fishery may consist of representatives of more than one subpopulation, but the evidence is not yet clear. Nor is it entirely clear whether the skipjack tuna of Hawaii and those of the eastern Pacific come from a common population, or whether there is a population in one of the two areas that does not appear in the other area.

Dr. Fujino recommends that genetic studies throughout the Pacific be prosecuted more intensely--and that they be backed up by tagging fish in certain areas to determine what migratory patterns may exist.



Tag Offshore Lobsters

BCF and the Massachusetts Division of Marine Fisheries are conducting extensive tagging operations on offshore lobster grounds during April. The program began in March and will continue in June. The BCF research vessels "Albatross IV" and "Delaware" will be used during 3 cruises to catch, tag, and release 6,000 lobsters on the Continental Shelf fishing grounds.

This tagging study is part of the lobster research program of the BCF Biological Laboratory at Boothbay Harbor, Maine. The Exploratory Fishing and Gear Research Base at Gloucester, Mass., is cooperating while conducting exploratory fishing with deep-water lobster pots designed especially for the offshore fishing grounds.

The Tags

All lobsters are being tagged with back tags of bright-yellow vinyl plastic. The tags are coded and numbered to designate time and place of release. The commercial lobster fleet may expect to catch these tagged lobsters for several years because the tag is retained through successive moults. Lobstermen who catch the tagged lobsters will be paid the current landed value, plus a \$1.00 reward for each lobster delivered to port with tag intact.

Information gathered will be used to determine migration patterns, growth rates and mortality rates of offshore stocks.



Ann Arbor Holds Training Seminar

A training seminar designed to exchange information and ideas between BCF and industry was held in Green Bay, Wisc., March 8-9. It was organized by BCF's Exploratory Fishing and Gear Research Base at Ann Arbor, Mich.

BCF personnel from biology, exploratory fishing, technology, marketing, and economics provided much useful information to fishermen and processors. Their subjects were: status of fish stocks and production, fish harvesting and handling procedures, processing and packaging, market expansion, and fishery economics.

State Representatives Attended

Personnel from the conservation departments of New York, Michigan, Wisconsin, and Pennsylvania also attended. They were particularly interested in fishing methods and equipment useful in controlling rough fish--and to investigate commercial fishing possibilities.



Miami Lab Has New Radio Station

A powerful new radio station became operational on March 11 at BCF's Tropical Atlantic Biological Laboratory (TABL) in Miami, Fla. The 1,000-watt, 4-frequency Coastal Station--call letters KAG--makes possible immediate voice contact between the lab and research vessels at sea. Theoretically, the station can reach ships by voice anywhere in the world. It has contacted regularly TABL's research vessel "Undaunted," which is investigating waters 6,000 miles away--off Angola, West Africa. The station will improve TABL's coordination and direction of its oceanographic activities.

Other Agencies Can Use It

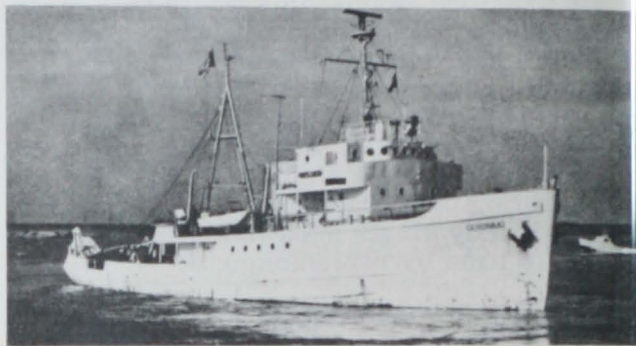
TABL will share the station with other oceanographic institutions in the Virginia Key area--with ESSA and the Institute of Marine Sciences. Both agencies often send ships to distant waters for long periods.

Before, with few exceptions, contact between oceanographic vessels on the high seas and their land bases was by written radiogram. Often, important communications were delayed for many hours. "Now scientific findings can be dictated by radio directly to a tape recorder at the home lab, transcribed within a few minutes, and placed under study the same day they were gathered aboard the research vessel."



'Geronimo' Is Taken Out of Service

BCF's research vessel Geronimo was laid up on March 8, 1968. Studies had shown that her research could be done more effectively and economically by BCF's "Undaunted" and by other vessels available in the Gulf of Mexico area.



The Geronimo was transferred from Washington, D. C., to the Gulf area in 1965 and based at Galveston, Texas.

In 1963, she worked with the communications satellite "Syncom II" to transmit oceanographic data. In 1964, she participated in the International Cooperative Investigation of the Tropical Atlantic.

The vessel, a converted tugboat built in 1944, is 143 feet long and displaces 760 tons.



BCF and Industry Promote Rainbow Trout

BCF and industry have been successful in introducing fresh rainbow trout to markets in the Cleveland, Ohio, area. In 3 days at the end of February, 1,200 pounds of the trout were flown in and sold through a supermarket chain. More orders were placed the next week. Akron, Ohio, is next on the trout-promotion list.

Cleveland is the latest inland area in which BCF has generated interest in air shipments of fishery products.



Safety Bulletins Issued on Explosives, Radar Use

BCF's Northeastern Region, Gloucester, Mass., has issued 2 important fishing vessel safety bulletins:

I. EXPLOSIVE ORDNANCE-- WARNING TO FISHERMEN

All fishermen are warned of the danger of snagging explosive ordnance in their fishing gear. Explosives have been reported snagged in nets or dredges from the Gulf of Mexico to the Gulf of Maine. Most hazardous area is east of Cape Henry between 36-00 and 37-00 N. latitude and 74-40 and 75-00 W. longitude.

The U. S. Coast Guard advises all fishing vessel captains to regard any metallic object having fins, propeller or horns as dangerous. If in doubt about its identify--treat it as an explosive and do not attempt to bring it along-side or aboard. Release it and notify the nearest Coast Guard or Navy station--giving your position and description of the object.

If unable to release the object:

(1) Stream it aft as far as possible (2) keep crew forward away from stern of vessel (3) notify Coast Guard and stand by for instructions.

If a suspected explosive is not detected until brought on board:

(1) Lash securely in place immediately.
(2) Keep it covered and wet down (3) avoid touching or jarring (4) notify Coast Guard or Navy immediately.

Locations of reported snagging by fishing vessels may be obtained from BCF--408 Atlantic Avenue, Boston, Mass. 02210.

II. RADAR AND WOODEN HULLS

BCF advises all fishing vessel operators that radar equipment should be used with a thorough understanding of its capabilities and limitations. One disadvantage of radar is its weakness in returning a picture from wooden objects. Only a small percentage of the 780 documented fishing vessels operating from New England ports is of steel construction--so your radar operations on the fishing grounds are confined almost entirely to wooden hulls. It is believed that fiberglass hulls react in like manner to radar waves.

The radar picture your vessel presents is directly proportional to the amount, location, and shape of metal surfaces on board. Request a radar check of your vessel from one of your fishing fleet companions. This should be carried out in clear weather at known distances. If your vessel does not register sharp and clear, then action should be taken to increase the radar visibility. Excellent methods of providing this extra protection and safety are: (1) Installation of radar targets on the mast head--similar to targets used by U. S. Coast Guard on navigational buoys; (2) increasing a amount of metal surfaces on spars and pilot house.