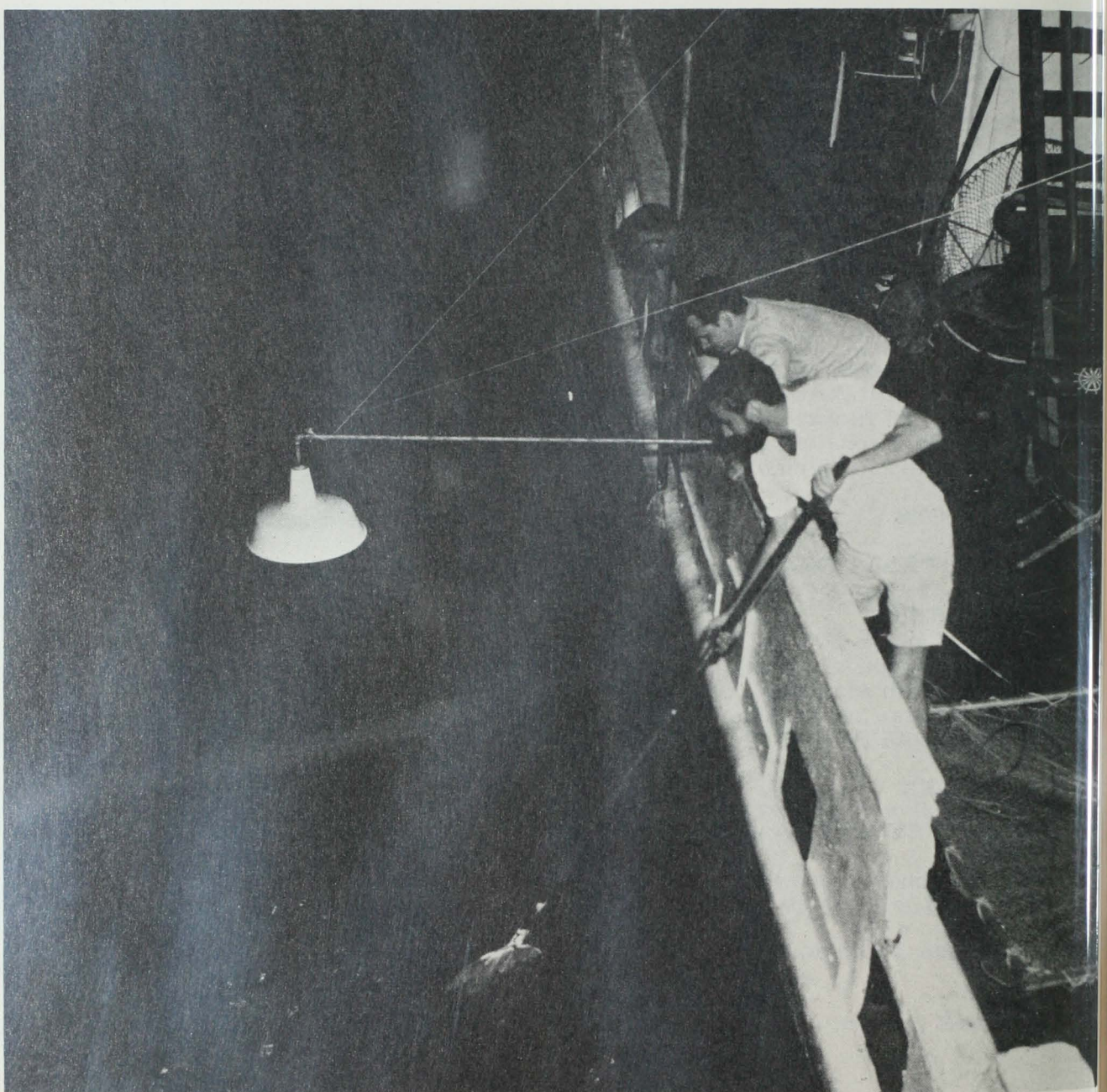


Dip netting at a light attraction station aboard the BCF research vessel 'Oregon'. (Photo: T. Iwamoto.)

OALS FOR DECADE OF OCEAN EXPLORATION OUTLINED

)bjectives for U.S. and world participation International Decade of Ocean Explora- during the 1970s are set out by the Na- l Academy of Sciences and the National emy of Engineering in a new report, "An nic Quest". The report emphasizes the lopment of U.S. programs that could con- te to the Decade. It analyzes 4 major s of ocean use: Biology & Living Re- rces, Geology & Nonliving Resources, sics & Environmental Prediction, and chemistry & Environmental Change.

The concept of the Decade was proposed by sident Johnson on March 8, 1968, and de- bed in the May 1968 report of the National ncil on Marine Resources and Engineer- Development. The Council later asked the demies to advise on the scientific and en- ering aspects of U.S. participation.

The report also emphasizes the need for oved technology to carry out the U.S. ion. Nearly all of the U.S. oceanographic bility--including personnel, facilities, rms, and special installations--would to be upgraded.

he report cautions "that if much less than million of new money per year (averaged the Decade)" is made available for the ects discussed, "it would be undesirable dentify the set of programs as an Inter- nal Decade of Ocean Exploration." To ement all programs, "as much as $500 ion" a year is needed.

THE REPORT

The report proposes this basic objective the Decade: "To achieve more compre- ive knowledge of ocean characteristics and their change and more profound understanding of oceanic processes for the purpose of more effective utilization of the ocean and its resources."

Despite the emphasis on utilization, it continues, "anticipated benefits are long-term in nature, and justification of the Decade goes beyond immediate economic returns."

These are the four areas covered by the report and the major recommendations:

I. BIOLOGY & LIVING RESOURCES

U.S. Fisheries

- Explore and assess the production potential of many living resources in the Gulf of Mexico and Caribbean Sea and Gulf of Alaska.

- Explore ocean stocks of tuna and tuna-like fish, especially skipjack, in the Eastern and Central Equatorial Pacific. Devise ways to utilize them.

- In Northwestern Atlantic, where many nations fish many species, investigate the interactions. This will provide basis for management policies.

International Fisheries

- Explore "production potential of the oil sardine, mackerel, shrimp, and other fisheries stocks of the Arabian Sea." Encourage countries bordering sea to use more of these resources.

- Investigate potential of krill and deep-water fishes of Antarctic Ocean. Devise ways to extract and to get them to world markets.

- Assess fishery resources of southern Chile and Argentina (in cooperation with local

governments), especially those in semiprotected fjords, where local industries might be encouraged.

• Cooperate with local governments to explore and assess fishery resources--especially stocks of demersal fishes and prawns--of Indonesian archipelago's continental shelf.

II. GEOLOGY & NONLIVING RESOURCES

Continental Margins

• International cooperation to reconnoiter emerged and submerged continental shelf of Atlantic's eastern margin, from northern Norway to Cape of Good Hope. Measure continuously "seismic, magnetic, and gravity parameters, and with bottom sampling and coring, along lines spaced at 50-mile intervals."

• International cooperation in "geological-geophysical surveys of the contiguous shelves and slopes of different countries."

• Help coastal states in "detailed hydrographic surveys in nearshore waters and harbors."

• "Cooperative hydrographic survey and charting of the continental margins."

Small Ocean Basins

• Conduct geological-geophysical investigations of selected basins--Mediterranean, East Indies, Red Sea--to assess mineral-resource potential, especially petroleum.

• Continue deep-sea drilling program. Emphasize small ocean basins and continental margins.

Ridges & Trenches

• On mid-ocean ridges, especially Mid-Atlantic, conduct geological and geophysical studies. These should involve "precise n gation and hard-rock sampling capability manned and unmanned devices"--and sur for metal-rich brines.

• Study a trench at a continental ma (Peru-Chile Trench). Dredge and co sea and sample on land. Conduct geophys profiles at sea and on land. Carry out tailed earthquake seismology studies of s marine earthquakes using land-based se mometers."

III. PHYSICS & ENVIRONMENTAL PREDICTION

Monitoring

• Use more ships-of-opportunity and a craft to collect near-surface oceanograp data. Encourage developing nations to se "simple shore stations of standard desig

• Establish more-permanent "ship and land midocean monitoring stations." Th should include heavily instrumented isl observatories.

• Investigate requirements of "an effec system for oceanographic monitoring of North Pacific."

• "Support pilot studies of new monito techniques, such as free-fall transport me suring devices, moored current-meter a rays, deep-sea bottom-pressure records, a air-dropped expendable and retrievable i strument packages."

Air-Sea Interaction

• In Western Indian Ocean, investig ocean's reaction to monsoonal changes winds. Use existing numerical model to d sign observational program.

• In Western Pacific and China Seas, use existing data to build preliminary numerical model.

• In Equatorial Pacific, carry out observational program. Use research vessels, buoys, ships of opportunity, planes, and island stations to explain "large-scale, long-term, ocean-atmosphere interaction."

Deep Ocean

• "Complete world coverage of deep-water temperature, salinity, and dissolved-oxygen measurements. Obtain direct measurements of deep-water flow in selected locations."

IV. GEOCHEMISTRY & ENVIRONMENTAL CHANGE

• "Conduct geochemical survey of selected chemical and radio-chemical substances on meridional traverses in the Atlantic, Pacific, and Indian Oceans."

• Monitor the rate that natural and man-made substances are added to the ocean by rivers and winds.

WHAT TYPES OF ORGANISMS, OTHER THAN SHARKS, ARE POTENTIALLY DANGEROUS TO SWIMMERS?

The most dangerous animal other than sharks is probably the barracuda; indeed it is feared more than sharks by West Indian divers. Its usual length is only 4 to 6 feet, but it is aggressive, fast, and armed with a combination of long canines and small teeth capable of cutting as cleanly as a knife.

Although no authentic record of deliberate attacks on man exists, the killer whale is potentially more dangerous than either sharks or barracudas. This carnivore measures 15 to 20 feet and hunts in packs. It attacks seals, walruses, porpoises, and even baleen whales.

The moray eel, which is as long as 10 feet, lurks in holes in coral reefs and may inflict severe lacerations on a diver who pokes his hand into its hiding place, or it may grasp the diver in its bulldoglike grip until he drowns.

The octopus is probably overrated as a villain because of its evil appearance; nevertheless, its bite is poisonous. The giant squid has been known to pull man beneath the water to his death. The Portuguese man-of-war has tentacles up to 50 feet long with stinging cells which are painful to a swimmer brushing against them.

There is a large group of animals dangerous to swimmers or waders who step on them. These include the sting ray, stonefish, zebra fish, toadfish, and many others. The giant tropical clam (Tridacna), weighing as much as 500 pounds, has been depicted as trapping divers; however, no authentic records exist. ("Questions About the Oceans," U.S. Naval Oceanographic Office.)

UNITED STATES

BCF and Industry Promote New England Pollock

BCF and industry are cooperating in a campaign to shift emphasis from the depleted haddock resource to the underutilized pollock resource. BCF marketing personnel have been assigned to the haddock marketing area.

BCF personnel have made numerous personal contacts in the attempt to fill the market void created by the lack of haddock. As a result, industry has placed sample orders for pollock with chain stores, wholesale distributors, institutional feeders, and restaurants. Most of these establishments want to find out how their customers will react to pollock before committing themselves to large orders. A few already have agreed to accept regular shipments.

Much Publicity

The food chains in particular are anxious to tie in their efforts with the campaign. Many food editors and home economists have agreed to publicize pollock by feature stories, recipes, and fish-cookery demonstrations.

BCF also is conducting short-term explorations and gear testing to assist industry in providing a continuous supply of pollock.

Haddock Abundance Drops Further

A spring groundfish survey completed by BCF's 'Albatross IV' on April 10 showed a further drop in haddock abundance. The vessel completed 270 otter-trawl hauls from Cape Hatteras, N. Carolina, to western Nova Scotia.

The average catch in pounds-per-30-minute haul was $\frac{3}{4}$ of the 1968 survey level and $\frac{1}{3}$ of 1966's.

The decline in BCF's abundance index for commercial-size Georges Bank haddock has continued since 1965. The same trend is s in the catch-per-day indices of the U.S. h dock fleet.

Decline Inevitable

The decline was inevitable because o trition of the last good year-class--the spawned in 1963.

Haddock do not enter the fishery unt years old. However, BCF obtains an e indication of the incoming year-class siz measuring, each July, the abundance o month-old haddock on Georges Bank.

'Oregon II' Discovers Scarlet Prawns Off Northeastern South America

Experimental trawling by BCF's Orego on the Continental Slope off Surinam French Guiana revealed concentrations giant scarlet prawns (bright red shri yielding under 20-count tails. The total c for 13 successful trawl hauls in 350 to fathoms was slightly over 2,000 pounds. largest single catch was 404 pounds. species is presently fished only off West rica by Spanish deep-sea trawlers. Oregon has shown that there are also c centrations of this species on the western of the Atlantic Ocean.

Optimism for Fishery

The staff of BCF's Pascagoula (Miss.) E ploratory Fishing Base will continue to i prove deepwater fishing techniques. They attempting to at least double the catch per time--and to encourage and assist U.S. fi ermen to begin harvesting this speci These shrimp are a prized delicacy in Euro Small quantities exported to the U.S. h brought premium prices. This suggests difficulty in marketing future U.S. producti

ls Major Killer of Young Oysters

CF Milford (Conn.) Biological Labora- s SCUBA examination of local oyster in early spring shows that many beds mulate a sufficient layer of silt during winter to bury many young oysters. On 1, for example, on one bed of 1966-gen- on oysters, many oysters, mostly doubles ingles, were buried under as much as a inch of bottom material. Most were still ; only 3.6% had died because of smother-

nother bed with a heavy population of 1968 oysters also had accumulated a heavy r of silt. By May 1, 14.9% of the spat ady had been killed; by May 16, however, tality on this lot had increased to 33.1%, ably due primarily to smothering by -but also partly due to predation by rock s.

n other beds, indicated mortalities due to ocation by silt range as high as 40 to 50%, igher. Much of this mortality can be ded by transplanting the oysters to beds of silt during March, or early April, while oysters still are essentially dormant.

ject Launched to Aid aware River Oysters

he Delaware River Basin Commission launched a research project to rescue the s sagging oyster industry. It has con- ted with the University of Delaware for a ar $100,000 research project to apply a essful Japanese production technique to Delaware.

he Commission said that Japan has be- e a major oyster producer in the last rter-century by growing shellfish sus- ded in water rather than on sea bottom. viously, Japanese oyster production had ndled drastically, as it has in the U.S. The . annual crop dropped 50% in the last half- tury.

aware's Oyster Industry

n recent years, the Commission noted, Delaware oyster industry has been "racing ard extinction." Annual production fell from 4.2 million pounds in the 1950s to only 34,000 pounds a decade later.

Much of the drop is attributed to a predatory snail, the oyster drill. Scientists who designed the research project believe that taking oysters off the bottom, where snails live, will eliminate the problem.

Under the "off-bottom" system, young oysters are suspended from rafts in the bay on racks, in bags, or by stringing the shells.

Besides lifting the shellfish out of the oyster drill's reach, a principal advantage of the off-bottom system is the use of the full depth of water--compared to the limited space available on the bottom. Also, much of the bottom is not suitable for oysters.

The Research Project

The research will include the control of marine organisms that compete with oysters for food and growing space and a study of oyster growth; evaluation of the oyster's market value; the local economics of the off-bottom method and location of good growing sites in Delaware Bay.

If the off-bottom research project is successful, the knowledge gained will be turned over to commercial growers. In Japan, more than 90% of the oyster crop is produced by the off-bottom system.

An oyster research project conducted by BCF in Massachusetts showed that off-bottom oyster growth is twice as fast and far more productive than the conventional method.

Whaling Catch Regulations Published

BCF has announced regulations for the U.S. whaling industry in the North Pacific Ocean for the 1969 season. The regulations, which became effective upon publication in the May 29, 1969, issue of the "Federal Register," limit the U.S. catch to 48 fin whales and 60 sei whales.

The quotas were recommended by the Commissioners of the North Pacific member nations of the International Whaling Commission. Whaling Commissioners from the U.S.,

Japan, the USSR, and Canada agreed that it would be necessary to establish limits for their respective countries for the North Pacific for 1969.

Underwater Research Vehicle RUFAS Makes Debut

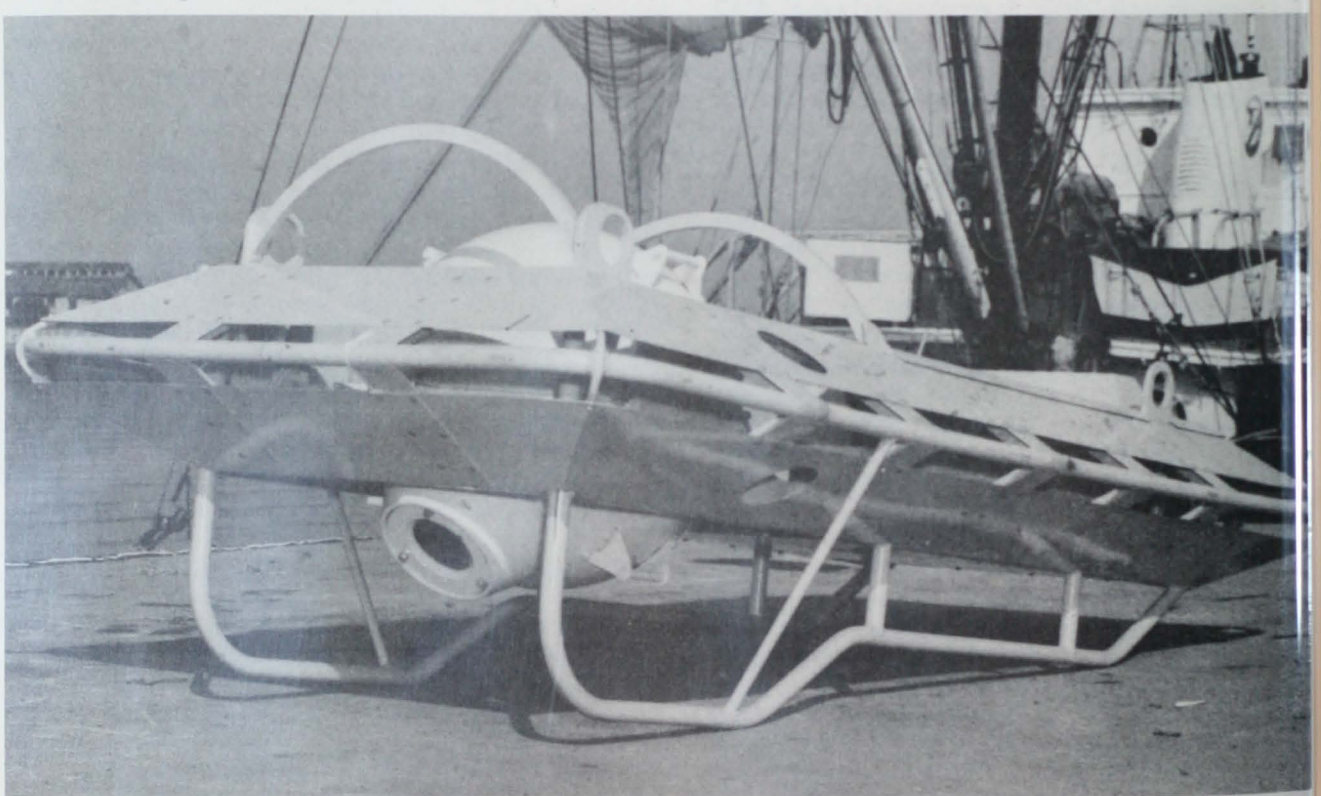
The remotely controlled underwater research vehicle named RUFAS, a cooperative effort of BCF's Pascagoula (Miss.) Base and the General Electric Co., Bay St. Louis, Miss., was scheduled to make its debut in June 1969. It will survey the Cape Kennedy calico scallop beds first delineated in the early 1960s by BCF.

Useful Tool

This equipment, designed to observe ocean-bottom conditions, makes it possible for scientists to predict availability, lo tion, and patterns of scallop occurrenc Broader application of this new concep fishery search and assessment will a rapid and accurate visual evaluation of unc water objects, harvesting equipment, bot topography, fauna, and flora. RUFAS is su for monitoring many different subsur biological activities.

The Vehicle

The Mark I model of RUFAS has an erational depth range to 300 feet at a 5-k towing speed. It will have diving vanes c trollable by cable from a tow vessel. T will enable it to dive, rise, and hold its a tude at any position above bottom. Unde water lights, vertical sounder for bott reference, 16-mm. sequence camera, a underwater TV camera connected to a vide tape recording system will be installed provide visual-assessment capability.



Remote underwater fishery assessment system (RUFAS) developed at BCF Exploratory Fishing and Gear Research Base, Pascago Miss., with General Electric engineers of Bay St. Louis, Miss.

Local Tuna Fish Reared for First Time

...onths of experimentation by scientists at B... ...s Tropical Atlantic Biological Labora... ...(TABL) on Virginia Key, Florida, culmi... ...at the end of May in the rearing of larval tu... ...beyond the yolk sac from eggs collected in... ...e ocean. The scientists believe it was th... ...rst time anywhere.

...Carl J. Sindermann, laboratory direc... ...said the achievement was a breakthrough im... ...research. He cautioned, however, that it ... ...only the first of many steps before sci... ...s will know whether tunas can be reared to... ...lthood under artificial circumstances.

... Sindermann said: "The tunas are re... ...bly contradictory fish. They are among th... ...st rugged of the pelagic fish while in the se... ...t once captured are extremely delicate an... ...ust be handled with the utmost care." H... ...ed that although a few species of marine fi... ...ave been cultivated successfully outside th... natural habitat in recent years, the sc... ...rids (tunas and tunalike fishes) have pr... ...nted almost insurmountable problems.

Tuna Eggs

...e tuna eggs involved in the TABL ex... ...eriment were collected off Miami Beach, Fl... by biologist Dr. Edward Houde in a ma... catch of plankton. At first, Dr. Houde kn... hat he had several hundred fish eggs--bu... not know what species they were. The tu... ggs were about $\frac{1}{25}$ of an inch in diame... ...ter and were not easily separable from eggs of other fish species. He placed some eggs in a large (140-gallon) tank of seawater, others in a smaller tank that contained a large amount of green algae called Chlorella. The alga is believed to sustain the minute zooplankton (microscopic animals) fish larvae eat.

The next day, about 200 hatchlings could be seen swimming around in the Chlorella-laden tank. Many larval fish subsist initially on their own yolk sacs. Most of the TABL larvae survived for almost 2 weeks, or about 10 days beyond the yolk-sac stage. By the 14th day, only 6 fish were still alive, but these were feeding actively on zooplankton. Meanwhile, Program Leader Dr. William J. Richards had definitely identified the tiny fish--about $\frac{1}{4}$ inch long, almost transparent, bearing large heads, large black eyes, and big jaws--as members of the "little tuna" group, Euthynnus alletteratus, in the Atlantic Ocean. These are commonly called "bonito" by Florida fishermen.

Larval fish seldom look anything like their parents until they reach the juvenile stage. This is judged to be about $\frac{3}{5}$ of an inch in the case of the little tunas in the TABL experiment.

Laboratory scientists believe the larval tunas finally died because of a series of maladjustments: water temperature was slightly lower than the 78.8 to 80.6° F. required, the light on the tanks should have been brighter, and more acceptable zooplankton food should have been provided.

Second Attempt Underway

After the first collection of eggs had hatched, Dr. Houde and his assistant, Barbara Palko, were able to distinguish tuna eggs from others in a batch collected on June 3. They claim that identifying marks were the size of the eggs, the faintly amber color of the oil globule, and the distribution of pigment on the embryo (all visible under a microscope). The two biologists used the same methods to hatch the second collection of 1,000 tuna eggs. All the eggs hatched, but most of the larvae survived for only 2 to 4 days beyond the yolk-sac stage. Thirteen days after hatching, 6 of the larvae were still alive and feeding on zooplankton, but then they also died--of unknown causes. Efforts will be made in continuing culturing experiments to determine just what combination of factors apparently conspire to cause, first, the high mortality of the newly hatched tunas and, second, the death at the end of about 2 weeks of the seemingly healthy survivors.

Tu... tuna or bonito) larvae reared from egg at BCF's Tropical A... Biological Laboratory, Miami. ('Miami Herald')

Dr. L. L. Glasgow Testifies on Pollution by Pesticides

Dr. Leslie L. Glasgow, Assistant Secretary for Fish and Wildlife, Parks, and Marine Resources, U.S. Department of the Interior, testified on the effects of pesticides on sport and commercial fisheries before the Subcommittee on Energy, Natural Resources, and Environment, Committee on Commerce of the U.S. Senate, May 19, 1969.

His statement follows:

We welcome the opportunity to comment on the effects of pesticides on sport and commercial fisheries because we are deeply concerned about the contamination of our environment by the use of pesticides. The recent discovery of high DDT residues in Lake Michigan coho salmon has brought the problem into national focus.

The current hearings in Wisconsin, sponsored by the Environmental Defense Fund and the Wisconsin Department of Natural Resources, have put pesticides on trial in that State. Hundreds of pages of testimony have been generated both for and against the continued use of DDT. Other States have taken actions to restrict DDT uses that have ranged from the elimination of certain use patterns to the outright ban of this chemical.

Lake Michigan Watershed

In addition to our own Departmental studies to develop information on the effects of pesticides in fish in Lake Michigan, we are working with other Federal agencies and the States to monitor the origin and the occurrence of pesticide residues in the Lake Michigan watershed. These collaborative activities will ensure the maximum utilization of talent and resources.

Sources of DDT in Lake Michigan have not been fully identified. DDT reaches the Lake from a variety of sources. More than 50 percent appears to come from urban uses where many factors contribute to the burden. A few of these are: control of Dutch Elm Disease, mosquito control, uses on home lawns and shrubbery, dry cleaning plants, wool treatment plants, sewage treatment facilities, and many more. We expect that the use of DDT in Michigan's fruit producing areas constitutes a potent agricultural source of this pesticide.

One objective of the Department of the Interior for all our water resources, for the Great Lakes and Lake Michigan, in particular, is to establish and preserve for future generations an environment that will produce healthy stocks of fish and wildlife. A major step in attaining this objective would be to stop the use of hard pesticides that are contributing to the contamination of Lake Michigan. The combination of physical and biological factors have made this body of water especially prone to pesticide pollution. While we recommend the elimination of persistent pesticides that contaminate the environment we recognize that complete elimination at this time may not be practical or feasible. However, it is time to replace DDT with less hazardous pesticides. Continued use should not be permitted where environmental contamination occurs. Further, we should initiate the phasing out of other hard pesticides. They should be replaced by other less hazardous materials. We firmly believe that we should work toward this end; and that through cooperative efforts at all levels, solutions can be found to maintain both our food producing capability and an environment free from contamination.

Coho Salmon Seized

I would like to mention some of the pesticide problems that face our fisheries. The most dramatic are the economic implications of the seizure of coho salmon taken in Lake Michigan. The sport fishery on the Lake is valued at $200 million. Boats, tackle, motor rental and service industries have benefited enormously from the growth of salmon angling. The 1968 landed value of commercially caught coho salmon in the Lake was about $300,000. In that year, the Lake Michigan total commercial fish landings were valued at about $3 million. Under a recent ruling from the Food and Drug Administration, establishing DDT levels at 5 ppm in fish, the sport and commercial fisheries will be adversely affected.

The threat to the fishery resource through exposure to sub-lethal concentrations of pesticides is not nearly as striking as a major fish kill, but the effects of this exposure can be more significant. Existing evidence is adequate to demonstrate the relationship between present DDT levels in some fish and reproductive inhibition. Ten years ago New York State trout in Lake George failed to reproduce because of DDT levels in the

es. We have evidence that a similar situ-
n has occurred in sea trout in one of our
aries.

ticides in Estuaries

he United States shrimp fishery is our
valuable fishery resource. Larval
mp migrate in from the sea to the grow-
areas in our estuaries. We believe that
levels of pesticide pollution in the upper
hes of some estuaries of the United States
lready so high that shrimp using them for
sery areas may be lost.

nce 1965, we have monitored the pesti-
levels in our estuaries. Oysters and
r mollusks are used as bioassay animals
ause of their efficiency in extracting and
ing pesticides in their tissues. We have
ucted over 6,000 analyses from about 170
ions, sampled monthly.

n general, all samples except those col-
ed near the Canadian border show some
ee of pesticide contamination, primarily,
T. While none of the residue levels are
enough to constitute a human health prob-
, they could have a drastic effect on pred-
y animals in the estuary.

ticides Magnified in Food Chain

e also have evidence of secondary effects
gh magnification in the food chain. Pes-
residues in fish are considered the most
able cause of the decline in hatching suc-
s in a colony of brown pelicans off the Cali-
ia coast this spring. Many nests con-
d eggs with collapsed, very thin shells.
rimental studies have shown that mal-
s fed DDT at low levels produce eggs
significantly thinner shells and hatch
ficantly fewer young than ducks fed un-
ted food.

Our evidence is increasing that persistent pesticides are hazardous to terrestial wildlife. It has long been established that the use of DDT to control Elm Bark Beetles results in accumulation of DDT in earthworms--many thousands of robins have been killed as a result of eating such contaminated worms.

Furthermore, we suspect that this type of pesticide treatment is responsible for the flushing of DDT into storm sewers and subsequent discharge into rivers and lakes.

Major River Systems Affected

The presence of DDT and dieldrin has been demonstrated in all major river systems of the country where it enters the aquatic food chain of many species of fish and wildlife.

Its subtle effect on reproduction and survival on many species of fish and wildlife are illustrated in the above-mentioned thinning of eggshells.

The Department of the Interior recognizes the complexities of pesticide pollution and, in cooperation with other Federal agencies and the States, has developed a monitoring program to identify the sources of contamination in the Lake Michigan watershed. The States have responded by curtailing the use of DDT in the watershed. At the Federal level, we are working with the Department of Agriculture to withdraw registration of hazardous-use patterns of persistent chlorinated hydrocarbon pesticides.

In 1963, the President's Science Advisory Committee recommended the orderly phasing out of organochlorine pesticides. The Department of the Interior supports this position and is currently programmed to bring it about on all lands administered by Interior agencies.

Fishery Legislation Proposed in Congress

CONGRESS SHOWS INTEREST
IN "OUR NATION AND THE SEA"

On May 23, the President signed P.L. 91-15 continuing the National Council on Marine Resources and Engineering Development for one year, until June 30, 1970.

The Marine Resources and Engineering Development Act was enacted in June 1966. Its object was to develop, encourage, and maintain a coordinated, comprehensive, and long-range national program of marine science. It created a National Council of Marine Resources and Engineering Development, and a Commission on Marine Science, Engineering and Resources. The Commission was to make a final report in January 1969 and go out of existence 30 days later. Its report was titled: "Our Nation and the Sea." The Council was to expire on June 30, 1969.

One of the Commission's duties was to recommend a governmental organization plan and the estimated cost of it. This, with other Commission recommendations, was submitted to the President and Congress in early January. The report also contained 212 significant recommendations relating to many aspects of marine affairs.

The report of Chairman Garmatz, House Committee on Merchant Marine and Fisheries, stated: ". . . the fact, in view of the voluminous and comprehensive scope of the Commission's excellent report, that it is most unlikely that legislation establishing a new organizational structure for a national program in marine sciences can be enacted during the remainder of this fiscal year, it seemed . . . essential that the life of the Council should be extended for a reasonable period . . . to give Congress and the new administration a reasonable time to review and act upon the numerous recommendations."

Department of Marine Affairs

Already, the Commission's report has stirred several attempts to establish a Cabinet-level Department of Marine Affairs.

As early as January 16, Rep. Wilson, Calif., introduced a bill to establish a National Oceanographic Agency. Mr. Wilson commended the Commission's report for recognizing "the need for a coordinated attack on the unsolved problems of oceanography." He added: "We could make no better investment of the taxpayers' money than in oceanographic programs which will yield huge returns, provide greater understanding of our environment, and help further raise our national standard of living."

On March 25, Rep. Pepper, Fla., introduced H.R. 9482 to establish a Department of Oceanographic Services within the President's cabinet. This bill would coordinate and consolidate the major civilian marine functions of the Federal Government, enunciate national policies concerning the marine and maritime interests of the U.S., expand exploration of the sea, develop estuarine areas, and revitalize the U.S.-flag merchant marine.

On May 5, Rep. Anderson, Calif., introduced H.R. 10869 to establish a Cabinet-level Department of Maritime Affairs. He stated: "This bill would bring together and coordinate all U.S. commercial and governmental interests with respect to the sea."

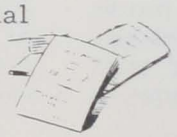
On May 14, Rep. Dellenback, Oregon, introduced H.R. 11240 to establish the National Oceanic and Atmospheric Agency.

On May 20, Sen. Murphy, Calif., introduced S. 2204 to establish the National Ocean Agency. It was cosponsored by Sens. Hatfield, Ore., and Tower, Tex.

Sen. Murphy said: "The truth is, however, that up to this time, we have only dipped into ocean exploration and development . . . the time has come when we must reorganize the Nation's oceanology program for the pl . . . the time has come when oceanology must be given the priority it deserves."

The Subcommittee on Oceanography, House Committee on Merchant Marine and Fisheries, has been holding a series of hearings since April 29 on a national oceanographic program. The report of the Commission on Marine Science, Engineering and Resources has received much attention.

--Barbara Lu



CEANOGRAPHY

OFAR' Scientists Discover lt Domes in Eastern Atlantic

Scientists of the U.S. Naval Oceanographic ice (NAVOCEANO) have discovered salt nes--geologic structures known to ac- nulate oil--in deep ocean sediment of the tern Atlantic. Previously, these struc- s had been found only on continental-shelf as, where petroleum companies now are centrating all offshore drilling operations.

The discovery was reported to the recent vention of the American Association of Pe- leum Geologists in Dallas, Texas, by Lt. ic Schneider, a research geologist who ds the Global Ocean Floor Analysis and search (GOFAR) project for NAVOCEANO.

y Affect Oil Searches

Lt. Schneider predicted: "The finding of nes along with organic-rich sediments own to contain oil) may thrust the search oil into the deep ocean areas. Our data w the domes to be located 400 miles west Senegal and 180 miles north of the Cape de Islands (Africa)."

He said the GOFAR scientists believe the e-shaped structures are salt domes be- se they have no magnetic signature--a test logists use to identify sedimentary and ous rock beneath the sea floor.

The structures appear to be pushing their up out of the sediments underneath the floor; they also are located near "docu- ted salt deposits on the Senegal continen- shelf."

a from USNS 'Kane'

The data were collected last summer when USNS Kane, NAVOCEANO's most modern search ship, traveled 20,000 miles across Atlantic from Bermuda to Liberia.

OFAR'

The GOFAR project is sponsored by the y. It is designed to increase man's under- nding of the geological processes that med and continue to mold the ocean floor.

Capt. T. K. Treadwell, NAVOCEANO Commander, explained: "The Oceanographic Office is interested in understanding these geological processes for the simple reason that it must provide the Navy and the marine community with accurate charts of the world's oceans. Regular soundings (depth measurements used to determine the topography of the ocean floor) are far more useful if we know the principles that determine the floor's features."

Coast & Geodetic Vessels Survey Alaskan Waters

Five U.S. Coast and Geodetic Survey ships are conducting extensive charting and ocean surveys in Alaskan waters this year. The 5 are: 'Fairweather,' 'Davidson,' 'Pathfinder,' 'Surveyor,' and 'McArthur'. Three ships left Seattle, Wash., their home port, in May; the remaining 2 were scheduled to sail in June. They will operate until fall.

The ships carry over 300 officers and crew and will collect information to benefit the increasing marine activity and economic development of Alaska's waterways. "Their survey data will be used for safe navigation of fishing and deep-draft cargo vessels, for locating oil-drilling sites, and for planning future mining, oil exploration, and waterfront construction."

The Plan

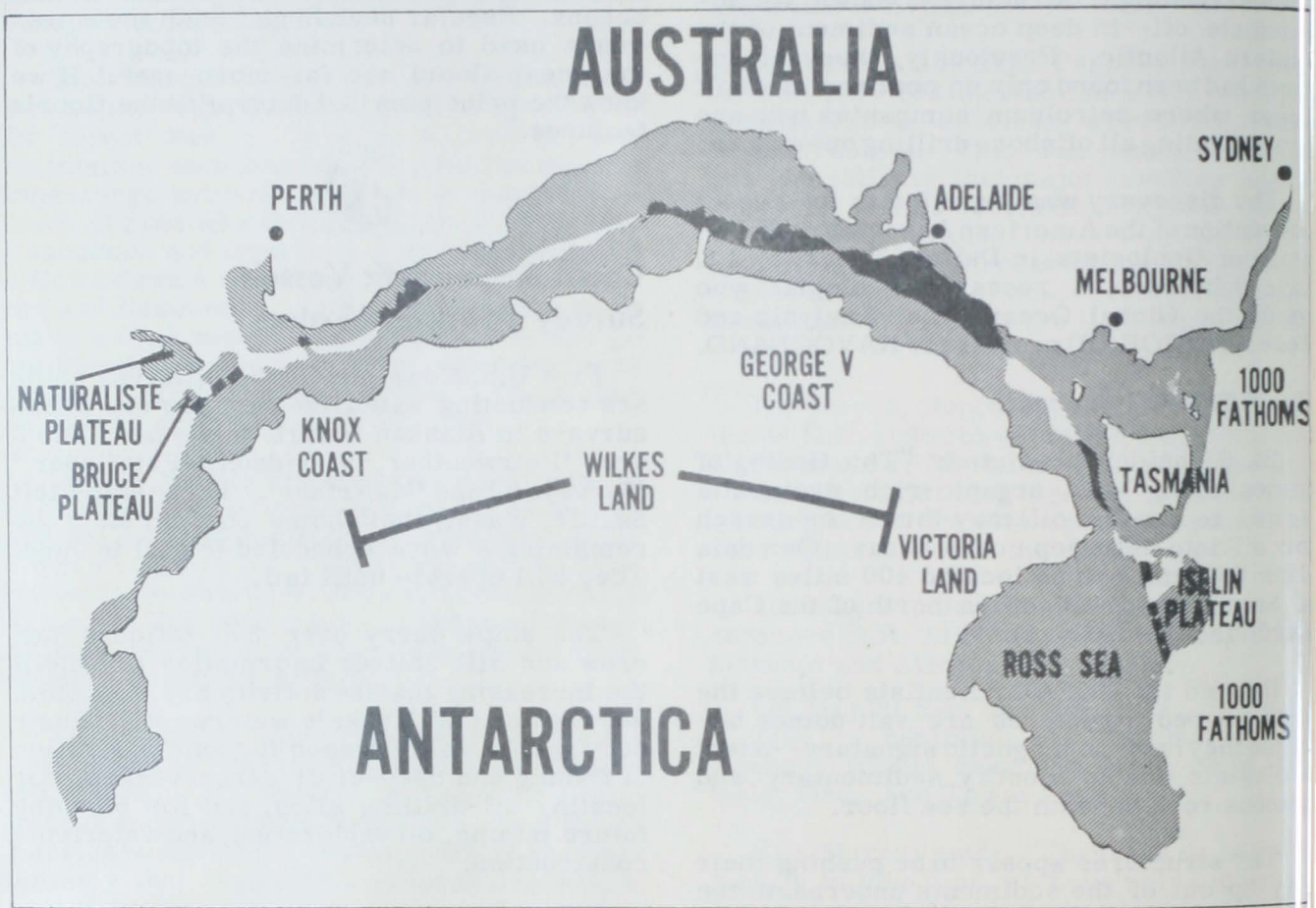
Four vessels will carry out hydrographic surveys several miles from shore. Their ship-based launches will determine depths in small inlets, bays, coves, and harbors. Their mission is to locate safe approach channels and anchorages; also, to determine the shallowest depth over navigational hazards, such as submerged rocks, shoals, reefs, and wrecks.

During winter, processing of survey data will begin for several new charts of the numerous sounds, bays, and harbors. Existing charts will be updated.

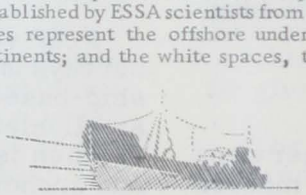
Australia and Antarctica Once Part of Supercontinent, U.S. Scientists Say

Two U.S. scientists report they have established that Australia and Antarctica, now separated by about 2,000 miles of water, were once part of an ancient supercontinent. The scientists, Walter Sproll and Dr. Robert S. Dietz, are geological oceanographers a ESSA's Atlantic Oceanographic Laboratorie in Miami, Florida.

Sproll and Dietz processed oceanographi data obtained by U.S. and Australian scientis in 1967 during the global cruise of the 'Ocea ographer.' The result, they say, was "precise fit" between the 2 continents.



Drawing depicts how Australia and Antarctica were once part of an ancient supercontinent before it broke up and drifted apart 2, miles. Drawing is based on a computerized fit established by ESSA scientists from data obtained in 1967 by the U.S. Coast and Geode Survey Ship 'Oceanographer'. The diagonal lines represent the offshore underwater continental shelves of Australia and Antarcti the solid black areas, the overlap of the two continents; and the white spaces, the underlaps.



Scientists Search Bottom North Central Pacific

ESSA oceanographers have investigated 3 ...or underwater features to determine the ...ory of the North Central Pacific basin. "T... study is part of a long-range program to ...ck the secrets of the deep ocean.

The 3 features are: a newly discovered ...gh (the name "Emperor Trough" will be ...posed); the Chinook Trough; and the Rat ...d Fracture Zone(s).

ESSA explains: "Troughs are giant decli...es in the ocean floor, while fracture zones ...long bands where the sea bottom appears ...ave been broken, similar to the geologic ...ts found on land, such as the San Andreas ...lt in California."

...ject Purposes

The project was undertaken in April and ... aboard ESSA's 'Surveyor'. The pur...es were to determine the interrelationship ...e 3 underwater features--and their re...onship with the 'linear magnetic anom...s' found in the area. These anomalies are ...nges from the normal magnetic field ob...ed on the earth's surface. They have ... attributed to sea-floor spreading, a ...ry in which semimolten rock from the ...h's interior rises and spreads laterally ...r the ocean floor. The theory ties in with ...of continental drift. In this, the giant land ...ses are moved over the earth's surface. ... magnetism in the semimolten rock is ...ked in" when it cools. It furnishes a rec... of the distance it has traveled since it ...e from great depth. The magnetized rock ... be detected on the sea surface by ship...ed instruments.

Emperor Trough

The northwest-trending Emperor Trough was discovered in 1968 by scientists of ESSA's Pacific Oceanographic Research Laboratory in Seattle, Wash. They used data gathered principally by the Surveyor. The trough runs at a 40° angle to the Emperor Seamount Chain, a range of submerged mountains. "Data on the depth, width, and length of the Emperor Trough are expected to be made public shortly."

The Emperor Trough appears to be the northeastern boundary of the Mellish Rise. The latter is an elevation in the ocean bed lying east of the Emperor Seamount Chain. The chain runs north and south from near the western tip of the Aleutian Islands until it meanders south-southwest; it terminates west of Midway Island in the Central North Pacific.

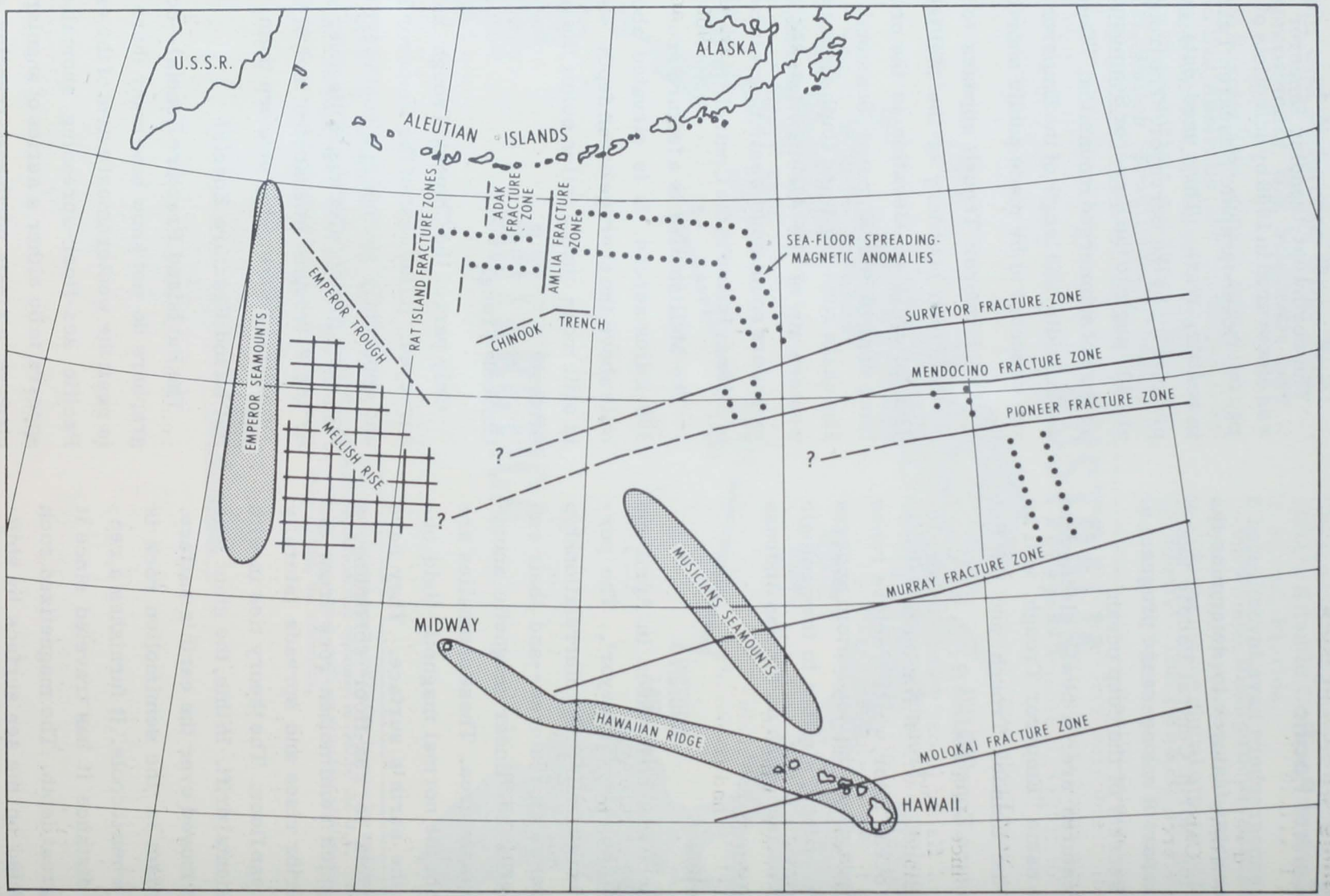
The Mellish Rise is a feature about 800 or 900 miles across. It is elevated about one mile above the average ocean depth. Its depth is still more than 3 miles below the ocean's surface.

Chinook Trough

Only part of the Chinook Trough has been surveyed. It lies east of the Emperor Trough and apparently swings in a southwest direction. One project aim was to discover whether the 2 troughs intersected and, if so, the structural relationship between them.

Rat Island Fracture Zone(s)

The Rat Island Fracture Zone(s)--oceanographers do not know how many there are--is near the westernmost extent of the eastern Pacific sea-floor-spreading anomalies. It appears to be either a series of angular fractures or a single northwest-trending structure. (See map on following page.)



Topography of North Pacific sea bottom where oceanographers aboard the U.S. Coast & Geodetic Survey Ship Surveyor recently conducted studies aimed at determining the history of this vast underwater region. Question marks at various fracture zones indicate their extent has not yet been determined.

Foreign Fishing Off U.S. in April

NORTHWEST ATLANTIC

April's good weather allowed uninterrupted surveillance from south of Nova Scotia to Cape Hatteras, N. Carolina; 237 vessels were sighted. In March 1969, there were 218.

Most were Soviet--30 factory stern trawlers, 131 medium side trawlers, 6 factory base ships, 4 refrigerated transports, 1 tug, and 1 tanker. (In April 1968, 188 had been sighted.)

Southern New England & Georges Bank

Soviet: Since January 1969, 15-20 stern trawlers had fished (mostly red hake) south of Block Island towards Nantucket. After fishing off the Virginia Capes for a short time, they shifted early in April to the vicinity of Hudson Canyon. No catches were observed.

By mid-month, 25-30 side trawlers were south of Martha's Vineyard and Nantucket. Catches were mostly herring. Earlier, some of these trawlers had fished off Virginia and North Carolina.

Many Soviet vessels were sighted on Georges Bank in late April for the first time in 1969. From 20 to 25 stern trawlers fished 75-100 fathoms along the eastern slopes, between Lydonia and Corsair Canyons. No catches were observed. (At that depth they may have been seeking whiting.)

Mid-Atlantic States

Soviet: Over 100 vessels fished off the Mid-Atlantic coast throughout the month. The fleet showed surprising mobility: it moved north and south several times in one week. At end of March, it was off the entrance to Chesapeake Bay. During first week in April, it shifted north off Delaware Bay, remained off Chesapeake entrance, and finally moved south off North Carolina.

On April 9 and 10, 107 medium side trawlers and 7 support vessels were in a 25-mile area, about 25-30 miles east of Currituck Sound, N.C. Moderate catches were mostly herring. A few vessels were scattered north of the fleet. On the same dates, 15 vessels (mostly stern trawlers) were in 2 groups, 30 miles south of Long Island and 60 miles east of New Jersey. No catches were observed.

By mid-month, an estimated 100 vessels (mostly side trawlers) had concentrated in a 15-mile area, 50 to 60 miles southeast of Cape May, N.J. A small group was south of Moriches, L.I. Catches were mostly herring. (In April 1968, 75-100 vessels had fished herring 40-60 miles south of Moriches.)

From the third week, the main concentration was in a 20-mile area, 65 miles south of Shinnecock, Long Island (north of Hudson Canyon). Heavy to moderate catches of herring were observed. A group of 25 vessels was widely scattered from east of Atlantic City to southeast of Cape May. Several stern trawlers had catches of red hake on deck.

Polish: Two factory stern trawlers, 28 large side trawlers, and 2 factory base ships were sighted.

Before mid-month, 20 to 25 vessels were 40 miles east to 60 miles southeast of Cape May. Moderate catches were mostly herring and some mackerel. After mid-month, about 25 dispersed off New Jersey, east of Barnegat Lightship to southeast of Cape May. Catches were mostly herring. (In April 1968, 25-30 vessels had fished off New York and New Jersey.)

Japanese: Ten stern trawlers were sighted, the largest number ever observed fishing off the U.S. Atlantic coast. They operated along the 50-100 fathom edge, from south of Martha's Vineyard to the southwest slopes of Georges Bank. Catches appeared to be whiting. All vessels had hydrophones hung from booms on the port side. Hydrophones are part of a recording system indicating trawl behavior (depth, etc.).

Spanish: Twenty pair trawlers fished from the Northeast Peak of Georges Bank to Brown Bank. Several had fair catches of cod on deck.

East German: Late in April, 2 side trawlers were 60 miles south of Martha's Vineyard. No catches were observed. (In April 1968, 3 side trawlers had fished herring 17-20 miles south of Shinnecock Inlet, L.I.)

U.S.-USSR Mid-Atlantic
Fisheries Agreement

The 'no fishing zone' restrictions ended on April 1. No Soviet support activities were observed in the loading zones.

On April 11, a 6-man U.S. team visited the Soviet Fishing Fleet Commander aboard the 'Robert Eihe,' about 50 miles off Norfolk, Va.

Polish Vessel Enters Port

On April 12, the Polish factory base ship 'Pomorze' entered the port of Philadelphia, Pa., to take on fresh water and small amounts of food and fuel. She had only a small cargo of frozen and bulk salted herring on board.

GULF OF MEXICO & SOUTH ATLANTIC

No foreign vessels were reported fishing in April 1969.

OFF CALIFORNIA

Soviet: Four side trawlers, 14 stern trawlers, and 3 support vessels fished west of San Francisco, stretching 80 miles north and south. Pacific hake, rockfish, red snapper and black snapper catches were observed. (About the same number had fished here in April 1968. Many were the same.)

OFF PACIFIC NORTHWEST

Soviet: Seven stern trawlers, 13 side trawlers, and 5 support vessels were sighted. Except for 1 support vessel, all were off Oregon. (In April 1968, 54 Soviet fishing vessels had been sighted.)

After mid-April, 1 stern trawler was observed with her deck bins filled with Pacific hake. Towards the end of the month, side trawlers took large quantities of hake. Some, fishing in pairs, landed an estimated 40,000 to 50,000 pounds for each tow. Individual side trawlers tows were estimated at 20,000 to 30,000 pounds.

Japanese: One longliner was sighted off Oregon. On one occasion, the catch observed was almost entirely black cod, with a few red snappers. (One stern trawler and 1 support vessel had been in the vicinity in 1968.)

OFF ALASKA

Soviet: The 165 vessels sighted at end of March dropped to 82 by end of April. In April 1968, 70 had been sighted. This year's increase is largely attributable to a second shrimp fishing fleet in the Gulf of Alaska--and to a continued herring and flounder fishery in eastern and central Bering Sea.

The decline in vessels fishing flou began in early April but, unlike prev years, withdrawals halted in mid-m About 15 medium trawlers and 5 suppor sels remained along the Continental Shel south of the Pribilofs, a favored Alask lock fishing area. Sightings indicated fishing had shifted from flounder to po

Herring fishing was sporadic. At mo end, only 5 medium trawlers and 1 proce refrigerator remained, north and west o Pribilofs, in central Bering Sea.

The deep-water trawl groundfish fish along the Shelf edge in eastern Bering was abandoned in early April. The ves transferred to the shrimp fishery in the G Late in the month, 2 medium trawlers sumed the groundfish fishery along the S edge, west of the Pribilofs.

Two factoryships and 8 tangle net-set trawlers fished crab north of the Alaska P insula. This year, as in 1968, most So catches were tanner rather than king cr

Fig. 1 - 'Pavel Chebotnyagin,' factory ship, receives picker b with loads of tanner crab.

One shrimp fishing fleet--15 medi trawlers and 2 factoryships--remained Portlock Bank, east of Kodiak Island. early April, a second shrimp fleet--1 canni

1E - Factory ship 'V. Putintsev,' nested with refrigerated transport 'Visili Perov,' and SRTM 8-407 alongside, on shrimp grounds. (Photos: Branson)

fa ryship and 6 medium trawlers--began fi ng near the Shumagins, in the western G . This was the first time the Soviets had fi d shrimp near the Shumagins since the U contiguous fishery zone was effected in M h 1967.

apanese: Fishing effort--125 to 130 ves- s --remained relatively stable.

bout 5 stern trawlers fished ocean perch a the Shelf edge, principally in the east- e ulf. This was the only known Japanese c perch fishery in the Alaska region.

n stern trawlers, 2 medium trawlers, a refrigerated transport fished herring i ntral Bering Sea during first 2 weeks of A . Then, much like the Soviets, the Jap- a reduced effort, and withdrew from the f ry during the third week.

bout 4 stern trawlers fishing groundfish a the Shelf edge, in eastern and central B ng Sea, had increased to 10 and 1 re- f rated transport by month's end. The ad- c nal vessels had come from the abandoned h ing fishery. Catches, mostly pollock, in- c d small amounts of sablefish, arrow- t flounder, and ocean perch.

Three minced meat and meal factoryship fleets remained along the Shelf edge, north of the Fox Islands in the eastern Aleutinas, through mid-month. In late April, they moved north onto the Shelf, northeast of Unimak Is. At month's end, a fourth fleet of about 15 vessels was nearing the eastern Bering Sea fishing grounds.

Two factoryships, with 30 tangle-net and pot-fishing trawlers, fished tanner and king crab north of the Alaska Peninsula. As before, Japanese crab vessels often mingled with their Soviet counterparts.

Three to 5 longliners fished sablefish in the Gulf off southeastern Alaska. In late April, 2 longliners were north of Fox Is. in eastern Aleutians. A third was along the Shelf edge west of Pribilofs. Eastern Bering Sea catches appeared to be sablefish.

South Korean: One stern trawler fished along the Shelf edge in the eastern Bering Sea, from west of the Pribilofs to near Unimak Pass. This same trawler made at least 2 trips to the eastern Bering Sea last year.

STATES

New York

REEF FISH STUDY BEGINS THIS SUMMER

During summer 1969, the New York State Conservation Department will start an extensive, long-range study of the fish populations of artificial reefs. The Department says little is known of these fish in northern waters. It is seeking information on kinds of reef fishes and their life stages spent there. This information is necessary to manage these fishery resources properly.

Reefs Selected

The reefs selected are the inshore reef in Great South Bay near Saltaire and the offshore reef near Fire Island Inlet. Sampling locations will be marked with red and white marker buoys.

The Study

The study will include general life history, movement, and population of sea bass and blackfish (tautog). Both will be tagged either with red and white Petersen Disk tags, or a new type of colored plastic streamer.

There will be a $1 reward for returning a tag. The public is asked to send both disks, if that type is used, or entire plastic streamer with where, how, and date fish was caught to: New York State Conservation Department, Setauket, New York 11785.

* * *

WATER-POLLUTION RESEARCH CENTER SET UP BY 9 COLLEGES

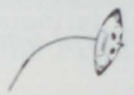
Nine colleges and universities in the New York metropolitan area are working together to organize an oceanographic research center at Montauk, the easternmost tip of Long Island. The center will seek solutions to pollution problems in the waters around Long Island. The 9 institutions have leased the buildings formerly housing the testing facilities of the Republic Aviation Corp. These will be converted to marine laboratories this summer.

The 9 are Adelphi, Dowling, Fordhar Hofstra, L. I., N. Y. Institute of Technology, New York University, St. John's, and the State University of N. Y. The new center also will coordinate the marine research now bei done independently by the 9 schools.

Isolate Pollutants First

Dr. James Alexander, acting director, sa the first research project would be to isola the compounds polluting Long Island water He added: "Pollution is Long Island's ma problem. Our aim will be to find out how t ecology has been affected."

Visiting professors and graduate student will study first pollution's effects on suc microorganisms as plankton.



Alaska

SEEKS U.S. FUNDS FOR EARTHQUAKE-CAUSED SALMON DISASTER

The Prince William Sound salmon fisher suffered a disastrous decline as a result o the March 1964 earthquake. The earthquak centered in this area. Land mass subsidenc in parts of Prince William Sound caused los of spawning grounds. These are covered wit salt water. In other areas, the land mas was uplifted. This caused instability an erosion of spawning beds. The result is substantial decline of salmon runs throughou Prince William Sound.

Montague Island Hard Hit

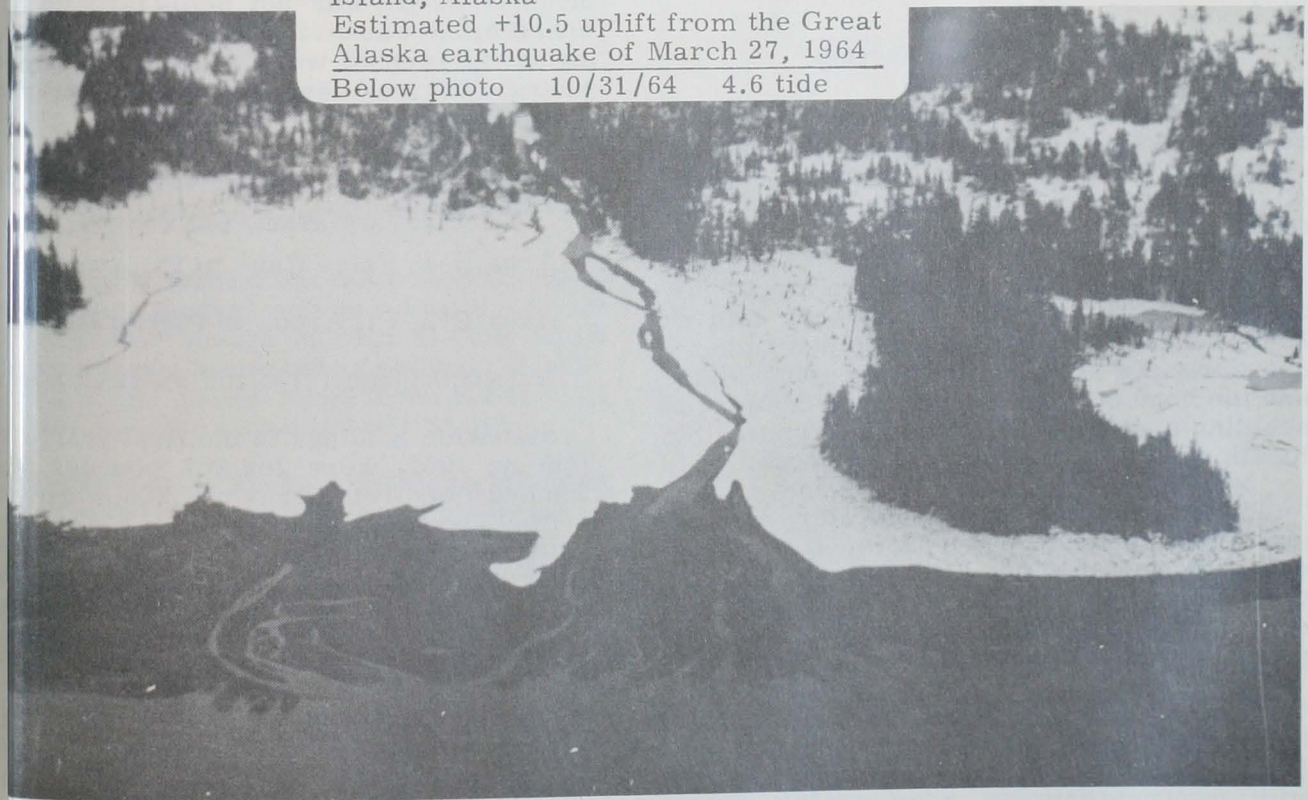
The situation is particularly serious o Montague Island. The island was tilted up ward 8 feet at its northeast end and 35 fee at the southwest. Before the earthquake Montague Island salmon runs were abou 700,000 each year; only 20,000 are expecte for 1969.

The Alaska Department of Fish and Gam has requested the Secretary of the Interior t find the Prince William Sound salmon fisher a fishery disaster under Public Law 88-309 The finding would permit 100% Federal fund ing for fishery restoration projects. Stat and Federal personnel are cooperating to pre pare a proposal for rehabilitation and re stocking of certain Montague Island streams

Above photo 4/7/65 1.2 tide

Wild Creek, Port Chalmers, Montague Island, Alaska
Estimated +10.5 uplift from the Great Alaska earthquake of March 27, 1964

Below photo 10/31/64 4.6 tide



ial photographs showing overwinter changes in the channel of Wild Creek which illustrate extreme instability following the Alaska rthquake. Most streams in Prince William Sound in areas uplifted 6 feet or more displayed similar action. (Photos: Jerre Olson)

California

Will The Shrimp Boats Keep A Comin'?

W. A. Dahlstrom and D. W. Gotshall

The quota system applied to California's ocean shrimp fishery has enabled this infant industry to grow to lusty maturity in less than two decades. From a modest beginning of 206,107 pounds landed in 1952, the first year of the fishery, landings hit a new high of 2,272,545 pounds in 1968. The question is, will it always be that way?

The answer is a qualified yes. The ocean shrimp fishery can prove stable and profitable for many years to come, with one provision. The quota system must be strictly adhered to, or the fishery could disappear in a single season.

Two other questions might be, "How and why are quotas set," and "Why is this fishery so susceptible to overfishing?" Both good questions, but before we answer them, let's review the history of the ocean shrimp fishery.

California Ocean Shrimp

Prior to 1952, it was a latent, unutilized resource. The groundwork for utilizing this resource was carried on by marine biologists of the California Department of Fish and Game.

During some of the bottom fish investigations conducted by the Department before 1950, occasional net hauls contained numerous shrimp. With these encouraging signs and the hope of developing a new resource, a scouting plan was designed to determine the location and extent of our shrimp beds.

During 1950 and 1951, exploratory fishing was conducted from the Department research vessel 'N.B. Scofield'. Tows were made over the areas where shrimp had been found and over areas where the bottom and depth appeared suitable for shrimp.

From exploratory fishing and data received from commercial fishermen, we learned that ocean shrimp are always found in association with green mud bottoms. This does not mean, however, that there are shrimp where there is green mud. Some unknown fact are involved because shrimp concentrati large enough to support commercial fish are not found on all of the green mud ar located off California.

As a result of the 1950-51 search, f dense concentrations of ocean shrimp w charted along the California coast.

Areas Established

In 1951 the California State Legislatu enacted laws empowering the Fish and Ga Commission to regulate the new ocean shri fishery. The area of the shrimp beds and t abundance of shrimp on them were used a basis to designate three fishing areas, ea with a specified limit or quota. By 1956 had become apparent that a portion of one these areas (B) was not being fully utiliz Therefore it was divided and the two shrim ing areas formed were allotted separa quotas. The four designated shrimping ar along the California coast are:

Area A, from the Oregon-California bor to False Cape;

Area B-1, False Cape to Pt. Arena;

Area B-2, Pt. Arena to Pigeon Pt.;

Area C, Pigeon Pt. to the Mexican bord

Statewide landings in the first year of t fishery, 1952, were 206,107 pounds. Th climbed steadily to peaks of 2,006,274 poun in 1960 and 2,095,278 pounds in 1963. Lan ings fluctuated between 980,608 pounds a 1,425,875 pounds from 1964 to 1967 becau of lower shrimp abundance, reduced quot in Area "A", and little or no harvest fro Areas "B-1", "B-2", and "C".

The all time high of 2,272,545 poun landed in 1968 was made possible because shrimp abundance, an increased quota Area "A", and landings of 191,925 pounds

The authors are Marine Biologists, California Department of Fish and Game.
Reprinted from 'Outdoor California', May-June 1969.

A... "B-2". After initial landings of about 22:...000 pounds each year during 1952 and 11...in Area "C", Area "A" became the prin...l area of production and has remained the t...producer since then.

...atewide landings have average 1,699,734 p...ds annually over the past 10 years. The 11...ears of shrimping have brought approxi...ly $1,800,000 to the state's fishermen. I...t season's record catch of 2,272,545 p...ds was worth approximately $270,000 to t...fishermen.

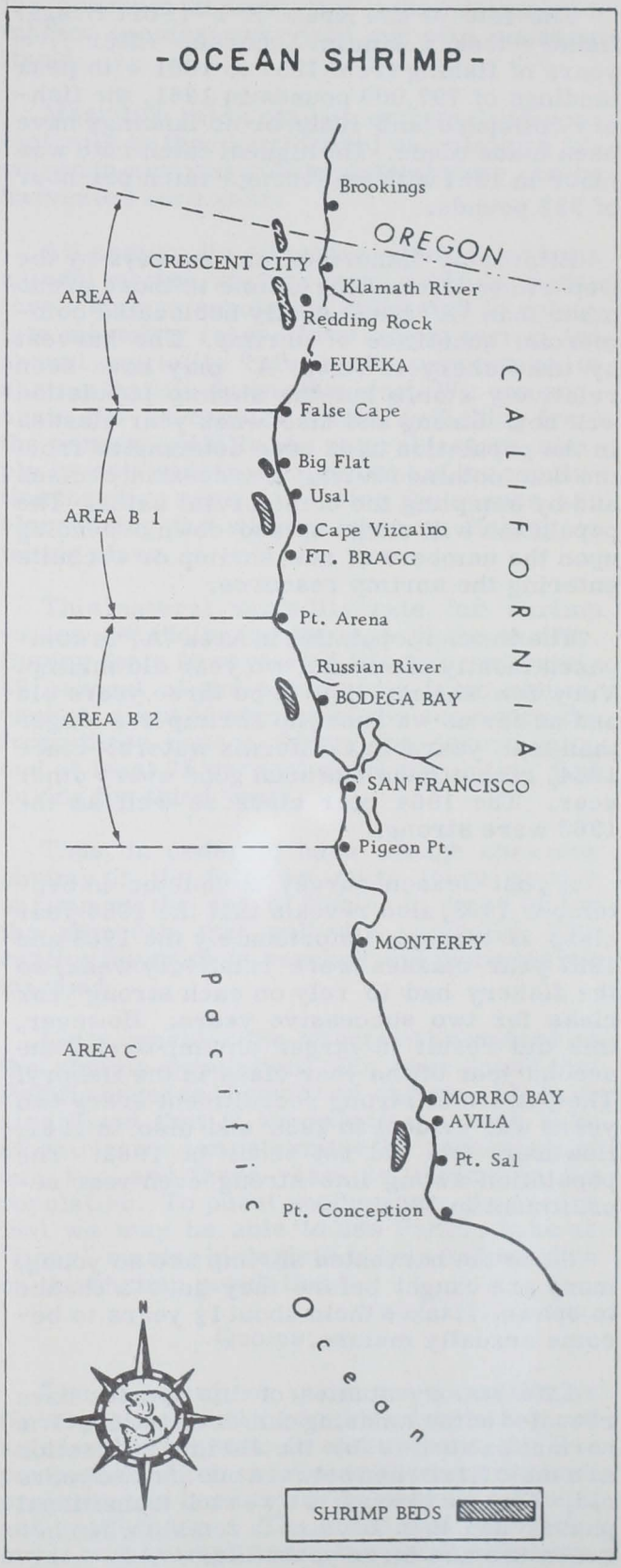
Statewide Landings - Ocean Shrimp

Year	Pounds Landed
1952	206,107
1953	295,524
1954	299,768
1955	847,062
1956	1,170,074
1957	1,425,631
1958	1,730,222
1959	1,785,228
1960	2,026,787
1961	2,006,274
1962	1,786,289
1963	2,095,278
1964	980,608
1965	1,425,875
1966	1,213,959
1967	1,404,821
1968	2,272,545

Population Characteristics

...he ocean shrimp has the scientific name ...Pandalus jordani and is actually a small ...wn--small enough so that it falls into a ...e commonly marketed as shrimp. Heads-...counts per pound range from about 70 to ..., and average about 100 per pound.

Shrimp beds do not have stable populations ...evidenced by the failure of the fisheries in ...ea "B-1", "B-2", and "C". Landings in ...ea "C" (Morro Bay) have virtually ceased ...ce 1953 because the fishermen have not ...en able to find the shrimp in commercial ...antity. The fishery in Area "B-2" (Bodega ...y) also declined after six years of fishing ...m 1953 to 1958. Landings have been spo...dic and some years fishermen are unable ...find the shrimp in commercial quantity.



The fate of the Area "B-1" (Fort Bragg) fishery took a similar course. After five years of fishing from 1957 to 1961 with peak landings of 797,000 pounds in 1961, the fishery collapsed and little or no landings have been made since. The highest catch rate was made in 1961 with an average catch per hour of 952 pounds.

Efforts by fishermen and surveys by the Department from time to time in those areas other than "A" have usually not located commercial quantities of shrimp. The harvest by the fishery in Area "A" may have been relatively stable but the shrimp population was not. Strong and also weak year classes in the population have been determined from the data obtained during the research cruises and by sampling the commercial catch. The population will surge up and down depending upon the numbers of new shrimp or recruits entering the shrimp resource.

The shrimp population in Area "A" is composed mostly of one and two year old shrimp. Very few shrimp live to be three years old and as far as we know, no shrimp live longer than four years in California waters. Since 1964, recruitment has been good every other year. The 1964 year class as well as the 1966 were strong.

A post-season survey completed in September 1968, also reveals that the 1968 year class is strong. Unfortunately the 1965 and 1967 year classes were relatively weak, so the fishery had to rely on each strong year class for two successive years. However, this did result in larger shrimp during the second year of the year class in the fishery. The pattern of strong recruitment every two years was evident in 1959 and also in 1961. However, this did not occur in 1963. The population swung into strong even year recruitment in 1964.

Since the harvested shrimp are so young, many are caught before they have a chance to spawn. It takes them about $1\frac{1}{2}$ years to become sexually mature.

Life history studies of this species have revealed some amazing characteristics. The normal pattern is for the shrimp to function as a male first when between one and two years old, then go through several transitional phases and then become a female when between two and three years old.

During strong recruitment years, however, it has been observed that many shrimp as high as 70 percent of a year class, start changing sex to females between and two years old and will not function males. This occurred in 1967 and resulted a strong 1968 year class.

Range

The range of this species is from Unala to San Diego. They appear to have a maxim density off central Oregon. Area "A" is California bed closest to the area of maxim density. Our other shrimping areas further away and never have had the potent of Area "A". Initial surveys of the areas 1950 and 1951 revealed a much larger popul tion in Area "A" than in either Areas "B" "C". Therefore, the original quotas were at 1,500,000 pounds in Area "A", 400,000 Area "B", and 200,000 pounds in Area "C The Area "B" resource comprised one b off Bodega Bay and one off Ft. Bragg.

We believe that it is not possible to ha stable populations in Areas "B-1", "B-2" a "C" because of the fact that species on t extremities of their range are known to flu tuate widely and our observations indicate th the populations have been relatively sm and do not have large potential. Even in t absence of fishing or with limited fishing, t resource has not returned to its former le of abundance in these areas.

Natural mortality is high and probabl good portion of this is caused by preda fishes. Fishing no doubt contributed its sh to upset the delicate balance between cruitment and mortality and send the po lations down to low abundance levels. though shrimp still remained in the areas, t populations were reduced to a point wher became uneconomical to catch them.

The populations in these areas remain a low level and only in Area "B-2" does t population occasionally make a slight com back. Usually this is because a new ye class enters the population but its potenti is limited and provides only a fishery of abo one season's duration. This occurred 1962, 1963, 1965, and 1968 when landin ranging from 180,000 to 250,000 pounds we made.

Estimating Population

How do we determine the number and ...ds of shrimp on a particular bed? Since ... we have used our research vessels, the ...B. Scofield' and 'Alaska', to survey the ... Two surveys were made each year, one ... to the opening of the season and the sec... in the fall after fishing had ceased. . Until ..., a shrimp net was towed in areas where ...mp were concentrated and also outside of ... ...oncentrations to determine total area and ...dance.

... 1965 we changed our survey methods in ...ttempt to improve our estimates. Area ... was selected for a three-year intensified ...y.

First we compiled all information from ...ermen's records and our research ...ses to determine the area where concen... ...ions of shrimp had been found since 1951. ... resulting survey area, covering 270 ...are miles, was divided into sub-areas ...ed on where shrimp concentrations tended ...e more uniform through the years.

Next, our statisticians were given the task ...etting up a random survey plan that would ...d reliable estimates from the limited ...ber of days that the research vessel was ...lable.

The sampling system which was designed ...ese specialists involved several complex ...stical formulas and the use of computers ...lculate the estimates. We have used this ...ey plan since March 1965 in Area "A".

During the last four years, marine biolo... ...s have spent 205 days at sea and have made ... tows. After a survey was complete, the ... was fed into a computer, which in turn ...ulated the average number of shrimp per ... A calculation was then made to deter... ...e how many possible tows $\frac{1}{2}$ mile in length ...ld be made in the survey area. The total ...mated population was then calculated by ...tiplying the average number of shrimp per ... by the total number of possible tows.

Mortality Rates

One of the most important facts we need to ...w about any fish population is the mortality ...e. The end product of all our research, no ...tter what species, is to be able to predict the optimum harvest that a population of a marine species can yield and still maintain itself.

Mortality rates play an extremely important role in the complicated calculations involved in arriving at how many shrimp can be harvested each year.

All shrimp die either from fishing or from natural causes, such as being eaten by predators. We use population estimates to calculate mortality rates. In simplest terms, the annual mortality rate is the percentage of shrimp that die during the year. We can separate the percentage killed by fishing from the percentage killed by natural factors, simply by determining the percent of the population that dies naturally during the season and also during the winter, when no fishing is taking place.

This natural mortality rate for shrimp varies depending on the age of the shrimp. During their first year of life, approximately 67 percent of the shrimp die from natural causes; about 50 percent of the survivors die from these causes during the second year, and at least 75 percent of the population dies during the third year.

Thus, in order to have enough spawning shrimp in the fall, we must leave enough shrimp at the end of fishing to make up for the numbers that will die naturally. The earlier the quota is reached, the more shrimp we need.

Let's consider the effects of predators on the shrimp population. We have found that Pacific hake feed heavily on shrimp. We have also found that if we examine enough hake stomachs we can determine the percentage of one, two, and three year old shrimp in the population. To put it another way, it appears that we may be able to use Pacific hake as "finny" marine biologists to help collect data on the shrimp population.

Quotas

The bag limit or quota on a particular fishery is designed to provide a continuing and safe level of harvest. In other words, the Department of Fish and Game shrimp research program has been trying to prevent a "boom and bust" fishery. The boom and bust fishery is best exemplified by the sardine fishery.

Each California shrimp bed has a separate quota. The quotas from 1952 through 1960 were based on harvesting 25 per cent of the estimated population. Landings and catch rate per hour were also used as guidelines. Areas "B-1", "B-2", and "C" have had a minimum quota of 250,000 pounds since the year each Area failed.

A decline in the northern California shrimp population (Area "A") in 1964 prompted Department biologists to examine other methods for setting the quota for that area. The biologists found that there seemed to be a relationship between the number of females left at the end of the commercial fishery in the fall and the number of one year old shrimp produced by these females.

In 1965 the quota for Area "A" was set to allow a minimum of 300,000,000 females to survive and spawn. These females produced an estimated 1,800,000,000 one year old shrimp, or six young shrimp for every spawning female. In the fall of 1966 a spawning population of 150,000,000 females produced approximately 400 million one year old shrimp, or slightly less than a 3 to 1 increase.

The one year olds produced by the 300 million females supported the fishery during 1967 and 1968; in fact the 1968 California catch was the largest ever landed from Area A.

Thus we learned that we had to leave a sufficient spawning stock for continued reproduction.

The quota for Area "A" is determined during the winter, following a fall research cruise. From the cruise data, the biologist in charge at Eureka determines the number of shrimp that will be on the bed when the season opens the following spring, and then calculates how many pounds of shrimp can be harvested and still leave enough females for spawning in the fall. The fall population estimate and our calculated mortality rates are used to make these predictions.

The recommendations are sent through staff to the Director. After review, the Director makes a recommendation to the Fish and Game Commission which in turn establishes a quota, during a public meeting, for the coming season. At this time shrimp fishermen and processors have an opportunity to make their own recommendations to the commission concerning the quota.

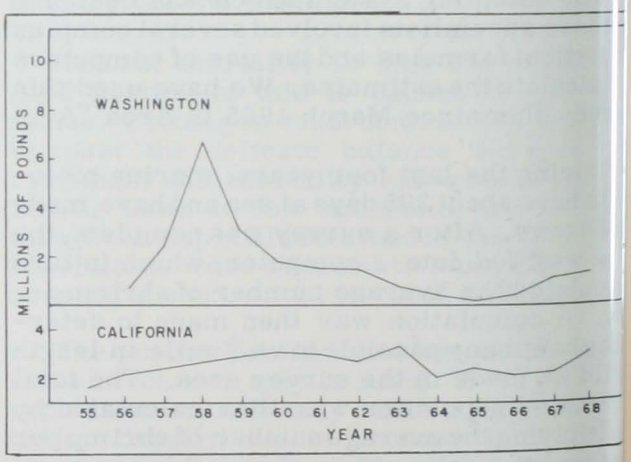
Why Conservative

When quotas were originally established i 1952, it was realized that the areas had limite potential. These quotas based on one-four of the total population would serve as a ste ping stone to increase or decrease the quot depending upon the change of abundance of t shrimp in each area.

Initially the small quotas were attained ar shortly thereafter the fisheries decline Area "A", however, has continued on a sus tained yield basis since inception of the fis ery in 1952.

If overfishing takes place in this area, w believe events will follow the pattern of th other areas in California and that an industr based on shrimp in California will be virtuall non-existent. The backbone of the Californi shrimp landings has been the Area "A" be and we believe that through the flexible use c a quota system the resource has been able t sustain itself.

A good example of the tragic consequence of overfishing can be provided by what hap pened in the State of Washington. With un restricted fishing, landings peaked at 6.4 mil lion pounds in two years (1968). Since the there has been a steady decline in effort an landings, and during 1964, 1965, and 196 virtually nothing was landed.



Apparently this same thing happened with California's Area "B" and "C" beds. Area off Morro Bay peaked during 1953 with land ings of 200,000 pounds. In 1954 less tha 10,000 pounds were landed. Peak landing occurred during 1957, 1963, 1965 in Area B- In 1961, 800,000 pounds were landed fro Area B-1; the following season saw landing drop off to 250 pounds.

Importance of Fishery

What would happen to the economy of the north coast regions of Eureka and Crescent City if the Area "A" shrimp bed failed? The most noticeable effect would be reduced summer employment. Shrimp processing in Eureka and Crescent City now employs between 400 and 500 persons each summer. A large number of these workers are high school students. In many cases this is the only employment open to these students.

The economic value to the 30 to 45 fishermen who participate in the fishery must also be considered. These fishermen have received an average of $180,000 annually for the past 10 years. We estimate from the wholesale price of shrimp, that the Area "A" shrimp fishery in the past 10 years has contributed an average of $600,000 annually to the north coast economy.

Evidently the fishermen are prospering from the shrimp fishery and other fisheries they pursue during the year. Five new boats, 50 to 60 feet in length, have been built and have been or will be involved in the shrimp fishery.

Crescent City is in the process of building two new fish processing plants. The success of the companies that will operate these plants will depend in part upon the shrimp landings.

It would be tragic to see the shrimp industry fail because of lack of shrimp. The Monterey sardine industry remains as a powerful example of what can happen when an important fishery fails. Empty and abandoned canneries, rusting equipment, and large purse seiners slowly going to pieces from disuse are constant reminders of what can happen when a "inexhaustable" supply of fish suddenly vanishes.

Future

What about the future of the ocean shrimp resource? We are convinced that California can maintain a healthy fishery for future generations. The continued sustained yield of Area "A" since 1952 speaks for itself. The key to the future of California's ocean shrimp industry is in Area "A". Our statisticians have calculated that Area "A" can safely harvest 1.5 to 2.0 million pounds each year. In some years greater harvests may become possible.

Efforts will be made to work out a joint management plan with the State of Oregon for management of the Area "A" shrimp population because vessels operating out of Brookings, Oregon, also fish the same area and harvest from the same population.

For California to have a continued stable fishery, a quota system is necessary. The cooperation and understanding of the members of the Department of Fish and Game, the Fish and Game Commission and the members of shrimp industry are the essential ingredients. If this resource is properly managed, it can continue to produce savory shrimp cocktails and Louis for many years to come.

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ANCHOVY LANDINGS FAR EXCEED LAST SEASON'S

California landings of anchovies for reduction were estimated at 27,246 tons for the 1968/69 season, the California Department of Fish and Game (DFG) reported May 24. The quota for the season that ended May 15 was 75,000 tons. Landings were much greater than the previous season's, when there was little fishing and the total was 6,505 tons.

In the Northern Permit Area, with a quota of 10,000 tons, landings were 2,736 tons. The 5 zones of the Southern Permit Area had landings of 24,510 tons. The bulk of landings--12,046 tons--were in offshore Zone V. Zone II, Point Hueneme to Point Vicente, and Zone III, Point Vicente to Dana Point, attained quotas of 5,000 tons before end of season and were closed.

Insufficient Plant Capacity

DFG said southern fleet remained active until season's end. But considerable time was lost because vessels were unable to unload for lack of sufficient plant holding and processing capacity. State, Federal, and university biologists have estimated the anchovy population in California waters at a minimum of 2 million tons.

Anchovies taken in the reduction fishery are processed into oil and fish meal for poultry and livestock feed, also used as bait and for canning.

Study Anchovy Population

DFG noted that anchovy population studies are continuing. During April, 10,000 anchovies were tagged in Ensenada; the total tagged now is 380,719. Tag recoveries for April were 55, and 42 in May; total recoveries are 965.

The latest tag recoveries bolster earlier data showing a strong north-to-south movement and an exchange of fish between major fishing areas in Southern and Central California.

Florida

GOV. KIRK SIGNS AQUACULTURE BILL

On June 4, Gov. Claude R. Kirk Jr. signed into law an aquaculture bill permitting the private leasing of waters overlying state-owned land. The act provides the legal structure for leasing the waters to develop domestic seafarming of oysters, shrimp, pompano, catfish, and other fresh and saltwater seafoods.

The governor said: "This bill provides for the creation of a good, clean industry which may very well become the most important in Florida and, indeed, the world. Florida has more coastal waters than any other state. With the advent of domestic seafarming under this bill, we may very well become the leader in feeding the starving peoples of the world. Within a period of 24 months more than $150 million will be invested in Florida aquaculture under this bill. Industry has hesitated coming in to Florida because we had no specific law. We had 42 companies expressing an interest in investing in aquaculture here, and now we expect them to move in."

Texas

ELECTRIC BROODER
FREES MALE CATFISH

Male channel catfish at the Texas Parks and Wildlife Department's San Marcos fish hatchery now have more leisure time. They don't have to "egg sit" anymore--the whole process has been automated.

Until now it has been the practice of male catfish to herd the female toward the nest, fertilize the eggs and then chase the female from the area since females are notoriously cannibalistic toward their offspring.

The male would then tend the eggs during the seven-day incubation period, fanning the nest with his tail to keep the water agitated and the silt off the eggs. State hatchery personnel have recently begun using a machine which will do this better than the catfish, since male catfish have been known to shuck the whole thing and leave the eggs unattended.

Now, almost immediately after the eggs are laid and fertilized, the male is driven from the nest and the eggs are removed. They are then placed in baskets which are in tur placed in a long trough where water is agi tated by fans driven by an electric motor.

Harmon Henderson, hatchery superi tendent for the Department, says surviv rate in the hatching trough has been treme dous.

The first hatch of eggs from a single cha nel catfish numbered approximately 36,00 all of them quite active. (Reprinted fro 'News' of Texas Parks & Wildlife Dept 6/2/69.)

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RESTOCK OYSTERS IN SAN ANTONIO BA

The Texas Parks and Wildlife Departme has completed restocking oysters in most San Antonio Bay and part of Espirito Ba The flooding caused by Hurricane Beulah Sept. 1967 had virtually eliminated oyste from these bays.

Terry Leary, marine fisheries coordina tor, reported that the Department has bee trying to restock the area using disaster a money from BCF--but heavy rains and re sulting low salinities in the past two yea prevented it.

Leary says a natural seeding has occurre in the lower part of San Antonio Bay. T result has been a very hardy oyster that a pears capable of surviving in almost fre waters.

Fresh Water In Shell

"Ordinarily, when an oyster comes in co tact with fresh water, it literally 'clams up Leary noted. "But we have opened some these oysters up and found fresh water on inside of the shell."

The Department did not want to go outs the San Antonio-Espirito Bay system and po sibly bring in new oyster diseases. So it co tracted with local oyster fishermen to dred up 500 barrels of these oysters at Panth Point and transplant them on reefs in oth parts of the bay.

Leary says the work will be completed ju in time for spawning season. Since each oy ter may release up to a million spat, t reefs now devoid of oysters will be repop lated in a short time.