UNITED STATES DEPARTMENT OF THE INTERIOR
Stewart L. Udall, *Secretary*
John A. Carver, Jr., *Under Secretary*
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FISH AND WILDLIFE SERVICE, Clarence F. Pautzke, *Commissioner*
BUREAU OF COMMERCIAL FISHERIES, Donald L. McKernan, *Director*

# Annual Report Exploratory Fishing and Gear Research Bureau of Commercial Fisheries Region 2

## For Fiscal Year 1964

by

Harvey R. Bullis, Jr., Director
John R. Thompson, Assistant Director

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# Report of the Base Director

By

Harvey R. Bullis, Jr.
Base Director

A number of significant events occurred during the past fiscal year in exploratory fishing. Outstanding among these was the completion of the preliminary shrimp trawling coverage of the Continental Shelf and Slope along the mainland of the Americas from Cape Hatteras, N.C., to eastern Brazil. This was accomplished with the two Oregon cruises off the coasts of Venezuela and Colombia in the fall of 1963 and the spring of 1964. We now have to extend our cruises along the Antillean stretches to complete the preliminary phase of our gigantic task, and plans are current on this aspect of explorations. There remains the major task of following up these preliminary investigations with more thorough explorations with a wider variety of gear, with simulated production-type cruises, and with additional time in selected areas of commercial promise. The South and Central American aspects of our exploratory work will be published during fiscal year 1965.

Another important event during the year was the completion of a survey of the bottom trawl fish resources over the Continental Shelf from Cape Hatteras, N.C., to St. Lucie Inlet, Fla. A comprehensive evaluation of the catch composition, distribution, and densities of the fishes involved is currently underway.

The Faunal Survey Program became fully functional with the addition of a printer-tabulator to our Automatic Data Processing (ADP) Unit. Comprehensive data review and analytic services have been made available to all exploratory projects in the Region. In addition, 12 data summaries on the distribution of various commercial species have been prepared for Regional fishermen and for scientists studying the fauna of the South Atlantic and Gulf coasts. The rapid data retrieval that can be achieved by ADP will expand greatly the future use of exploratory fishing information.

The underwater motion picture footage showing fishing efficiency and escapement behavior has been evaluated, and a preliminary report has been submitted for publication. The conclusions that can be drawn from this study made in 1963 indicate a startlingly low efficiency factor of conventional trawls in deepwater shrimping. In photographic observations in deep water over the past year we used some color film in an attempt to obtain footage of improved quality, but the lighting requirements appear to exceed the limit of the prototype system. Components for an improved model capable of working at greater depths with greater illumination have been purchased and constructed, and testing of this unit will begin early in the coming year.

Work on the development of electrical shrimp trawling methods has progressed during the year to the point where it should be possible to conclude this phase of shrimp gear studies early in fiscal year 1965. An electronics firm is now manufacturing the electrical components for this system, and reportedly two vessels are testing the equipment in the Gulf. When fully perfected, the electrical trawl should be of revolutionary significance to the shrimp industry, permitting round-the-clock trawling for grooved shrimp and increasing the catch per trip. We also believe that electrical methods may eventually provide the means to trawl on many bad bottom areas not now suitable for standard trawls.

In June, plans were completed for the new vessel that will replace the Oregon at the Bureau's Base in Pascagoula. This vessel will be in stark contrast to the vessel so far used in the program, for it will have far greater range, operating endurance, versatility, and sea-keeping qualities. Present plans are for construction to commence during fiscal year 1965, with delivery expected in fiscal year 1966.

The R/V Oregon has been scheduled for transfer to St. Simons Island, Ga., at the start of fiscal year 1965 where it will service both the South Atlantic Exploratory Program and the Caribbean and Tropical Atlantic Program. The Oregon operated out of the Base at Pascagoula for 14-1/2 years. When news of the transfer was released, requests were received from commercial fishing interests in the Gulf to summarize the accomplishments that had been compiled by the Oregon over this period. The following resumé lists a number of the projects undertaken with estimates of the accrued value to fishery development and expansion.

# Resumé of Accomplishments in Fishery Development Made by the R/V Oregon

By

Francis J. Captiva
Fleet Supervisor

## SHRIMP

### Gulf of Mexico

The first project, undertaken at the request of the Gulf States Marine Fisheries Commission, was to discover productive shrimp grounds beyond the areas that were being trawled by the existing shrimp fleet (in 1950 the shrimp fishery operated within the 25-fathom curve). This project entailed systematic exploratory surveys in 25- to 100-fathom depths on the Continental Shelf areas of the Gulf of Mexico from the Dry Tortugas to the Rio Grande. The Gulf was surveyed between May 1950 and September 1951, and intensive exploratory study was devoted to those areas that showed commercial promise. The success of the shrimp survey (1950-54), which was reported to the industry by cruise reports, served to open the deeper waters of the Continental Shelf area to trawling, and shrimp production increased.

The value to the shrimp industry resulting from the move into deeper waters is readily seen by a review of the shrimp landing statistics for the 26- to 50-fathom depth range along the U.S. coast of the Gulf of Mexico (table 1). Projecting an average of the documented landings (1956-63) for 1951-55 results in an ex-vessel value of about $28,596,414.

Table 1.--Shrimp landing statistics, 26-50 fathoms, Gulf of Mexico

| Year | Depth range | Catch, heads off | Value, ex-vessel, 60¢/lb. average |
|---|---|---|---|
| | Fathoms | Pounds | Dollars |
| 1956..... | 26-50 | 6,074,900 | 3,644,940 |
| 1957..... | 26-50 | 3,290,510 | 1,974,306 |
| 1958..... | 26-50 | 2,416,551 | 1,449,930 |
| 1959..... | 26-50 | 2,661,255 | 1,596,753 |
| 1960..... | 26-50 | 3,595,491 | 2,157,294 |
| 1961..... | 26-50 | 3,580,457 | 2,148,274 |
| 1962..... | 26-50 | 3,386,521 | 2,031,912 |
| 1963..... | 26-50 | 4,323,974 | 2,594,384 |
| Total | | 29,329,659 | 17,597,793 |

### South America

With the Saltonstall-Kennedy funds in 1956, the exploratory fleet was increased by addition of the chartered vessels Pelican, Combat, and Silver Bay, and the area of operations was expanded to include the Caribbean Sea and the east coast of the Americas from Cape Hatteras to the Equator.

The Oregon made two extended exploratory cruises along the northeast coast of South America between Trinidad and the Amazon River in 1957 and 1958 and a followup cruise in 1963. Large brown and pink shrimp were discovered over extensive areas in 20 to 50 fathoms on bottom suitable for shrimp trawling gear. This information was immediately released to the industry and resulted in this resource being harvested by American-flag vessels in 1959. About 50 flag vessels landed 7,630,000 pounds of shrimp (heads-off weight) in the first 2-1/2 years. About 200 U.S. vessels are now engaged in this fishery, with annual landings reaching 9,748,855 pounds in 1963. It is expected that when shore facilities grow, production will increase to at least 20 million pounds per year. The development of this fishery, which industry calls the "greatest shrimp fishery in the Western Hemisphere" (75,000 square miles of grounds versus 10,000 square miles for Campeche Bank and 7,000 square miles for Tortugas), is a direct result of the Oregon explorations. A statistical summary of U.S. imports from these grounds is shown in table 2.

These cruises also revealed that the shallower water areas (under 20 fathoms) of the Shelf had vast stocks of small shrimp (sea bobs) and a variety of food and industrial fishes. Although commercial utilization of these stocks is limited at the present time, we expect that they will furnish increasingly greater income to the U.S. fishing industry as shore facilities are developed to handle a diversified catch.

Table 2.--Exports of shrimp (heads-off) caught by American-flag vessels from the northeast coast of South America

| Year | British Guiana | Surinam | French Guiana | Barbados | Total |
|---|---|---|---|---|---|
| | Pounds | Pounds | Pounds | Pounds | Pounds |
| 1959..... | 967,000 | 283,000 | -- | -- | 1,255,000 |
| 1960..... | 3,568,000 | 381,000 | -- | -- | 3,949,000 |
| 1961..... | 3,505,820 | 447,058 | -- | -- | 3,952,878 |
| 1962..... | 4,129,000 | 1,035,814 | -- | -- | 5,164,814 |
| 1963..... | 5,509,398 | 1,205,450 | 2,788,822 | 245,185 | 9,748,855 |
| 1964..... (Jan.-Apr.) | 2,149,150 | 549,450 | 1,099,425 | 207,700 | 4,005,725 |
| Total.. | 19,828,368 | 3,906,772 | 3,888,247 | 452,885 | 28,076,272 |

Note: Total ex-vessel value to U.S. industry at 60¢/lb. -- $16,845,763.00.

## DEEPWATER SHRIMP (BEYOND 100 FATHOMS)

In July 1950, while exploring the range limits of the brown and pink shrimp, the Oregon discovered royal-red shrimp on the Continental Slope of the Gulf of Mexico. In 1955, after the brown and pink shrimp survey was completed, a series of cruises provided a more comprehensive picture of this resource. Commercial concentrations of royal-red shrimp were found to exist in the north Gulf, the southeast Gulf, and off the Florida east coast at depths from 160 to 275 fathoms. Because modifications in shrimp vessels, gear, and fishing techniques are necessary to fish the deepwater areas, use of this resource has been slow in developing. The industry has shown some interest in this resource, however, as evidenced by recent landings of royal-red shrimp from the Florida east coast and Gulf grounds. Reported landings to date are as follows:

| Year | Pounds |
|---|---|
| 1962..... | 69,200 |
| 1963..... | 38,987 |
| 1964 (Jan.-July)... | 80,000 |
| Total..... | 188,187 or $112,912.00 ex-vessel value |

In 1957, and 1958, four vessels fished these stocks for about 6 months. Shrimping stopped because of adverse weather conditions, gear problems, and marketing difficulties. Statistics on royal-red shrimp landings for this period are unavailable; however, catches of 500 pounds of shrimp (heads-off) per vessel per fishing day were reported. Industry participation in this fishery has so far been seasonal, coinciding with low production periods in the inshore fishery. Of particular interest to the development of this fishery is the fact that one large, well-equipped vessel operating out of Savannah, Ga., caught about 80,000 pounds (heads-off) of red shrimp in 1964 in 6 months of fishing.

## INDUSTRIAL FISH

The Oregon's early shrimp explorations were instrumental in defining the extent of the industrial bottomfish potential in the north Gulf of Mexico and were to a large extent responsible for the decision of a pet food manufacturer to erect a canning plant in the north Gulf area. This industry, which has extended its horizons to include raw material for reduction to high protein meal and for mink food, employs a year-round fleet of about 50 vessels to supply its demand. A statistical summary of the north Gulf landings from the industry's inception in 1952 is shown in table 3.

Since the bulk of the catch in table 3 was taken from north Gulf waters in less than 20 fathoms, the industry expressed concern that the inshore industrial bottomfish stocks could be subject to depletion and requested us to use the Oregon for exploring the deeper waters to determine the industrial fish potential in areas outside the heavily fished grounds. A series of Oregon cruises in 1960, 1961,

Table 3.--North Gulf of Mexico industrial trawl fish landings, 1952-63

| Year | Catch | Value to the vessel at $35.00/ton |
|---|---|---|
| | Tons | Dollars |
| 1952..... | 2,500 | 87,500 |
| 1953..... | 8,500 | 297,500 |
| 1954..... | 13,000 | 455,000 |
| 1955..... | 18,500 | 647,500 |
| 1956..... | 22,500 | 787,500 |
| 1957..... | 26,000 | 910,000 |
| 1958..... | 41,000 | 1,435,000 |
| 1959..... | 42,500 | 1,487,500 |
| 1960..... | 40,500 | 1,417,500 |
| 1961..... | 39,000 | 1,365,000 |
| 1962..... | 48,000 | 1,680,000 |
| 1963..... | 39,500 | 1,382,500 |
| Total.. | 341,500 | 11,592,500 |

and 1962 enabled us to assess the offshore stocks available to the fishery. This work established that offshore waters had abundant industrial bottomfish stocks, comprised of entirely different species. The industry has taken seasonal advantage of these findings; however, the available statistics do not reflect catch by depth, thus we cannot estimate accurately how much value has accrued to industry as a result of the offshore exploratory work.

## TUNA

The Oregon discovered yellowfin tuna in the Gulf of Mexico in 1954. Intensive exploratory fishing with Japanese-type longline gear over a 2-year period established that the Gulf had commercial concentrations of yellowfin tuna. Two small canneries were established in the north Gulf area in 1956 to process the catch of five longline vessels that began fishing for tuna in late 1955. A combination of unsuitable vessels, inadequate processing facilities, and depressed market conditions stopped these operations in 1959. That the resource is as large as the Oregon's explorations indicated is borne out by the 1963-64 catch records of Japanese and Cuban tuna longline vessels, which in 4 months of fishing in the Gulf of Mexico produced 8,088 tons of yellowfin tuna.

Table 4.--Tuna catch statistics for U.S. vessels in the Gulf of Mexico

| Year | Catch | Value to fisherman at $240.00/ton |
|---|---|---|
| | Pounds | Dollars |
| 1956..... | 322,000 | 38,640 |
| 1957..... | 745,000 | 89,400 |
| 1958..... | 615,000 | 73,800 |
| 1959..... | 230,000 | 27,600 |
| Total.. | 1,912,000 | 229,440 |

## RED SNAPPER

In 1956, the Oregon discovered an uncharted submerged rocky ridge off the Texas coast. Industry was informed by a cruise report. Captain C. B. Jones of Freeport, Tex., in a personal communication, reported that more than 200,000 pounds of red snapper were taken off this ridge by commercial fishermen in the 2 months following release of this information and that over 500,000 pounds of snapper worth more than $100,000 were taken from the ridge during the ensuing year. Although this ridge is reported to be still a major production area for snapper fishermen, catch statistics for the ridge are not available.

In 1957, at the request of the industry, the Oregon began trawling experiments for red snapper. The aim was to design and develop trawling gear suitable for operating on rocky bottom where the snapper live.

That the experiments were successful was demonstrated by two simulated commercial-type cruises, in 1959, which produced 45,000 pounds of marketable snapper. Industry has been slow to accept trawling partly because of the special skills required and partly because of the cost of rigging vessel and gear. In 1964, however, a Pensacola vessel, equipped to trawl for snapper, reported profitable catches. As a result, a Panama City operator has ordered two trawlers equipped specifically for snapper trawling, and a Pascagoula company will begin snapper trawling this fall.

## SCALLOPS

In 1958, the Oregon discovered large concentrations of calico scallops in the northeastern Gulf of Mexico. Industry was advised

and commenced fishing these stocks in 1959. Production in 1959 was reported to be 102,500 bushels, worth $102,500 to the fisherman. Production at that time was limited to the volume of scallops that inexperienced labor could shuck manually. This fishery has been subjected to seasonal and marketing fluctuations and has not realized its full potential to date. Bureau statistical information subsequent to 1959 groups bay and calico scallops together, thus the true value of this resource is not available.

## OTHER POTENTIAL RESOURCES

The foregoing resume of Oregon activities lists only the projects that directly benefited industry. Equally important, though less tangible in value, are the gear research, oceanographic studies, and general faunal survey work carried out by the Oregon in the Gulf of Mexico, Caribbean Sea, and southwest Atlantic Ocean. The surveys have added considerable background information on the fishery resources of these areas and will prove invaluable to future research and commercial development projects. The intangible accomplishments include the following:

1. Discovery that the Gulf of Mexico, Caribbean Sea, and southwestern Atlantic Ocean abound with fishery resources that are not now used by American fishermen. These resources include such species as bluefin and blackfin tuna, skipjack, mackerel, sharks, swordfish, bonito, marlin, anchovies, sardines, herringlike fishes, flounder, trout, butterfish, clams, scallops, deepwater crabs, lobsters, and scarlet prawns. Some of these resources are not being used because present U.S. economics do not enable fishermen to harvest them profitably, because they require gear or methods that are familiar to local fishermen, and because marketing is uncertain. All, however, have significant potential as future fisheries.

2. Collection of oceanographic observations--such as temperature profiles, plankton sampling, water chemistry, and current densities--and meteorological observations has an important bearing on the development of a given fishery.

3. Gear research and development projects have provided industry with more effective and efficient methods for harvesting the fishery resources of the area. These include: (1) underwater motion pictures of fishing gear in action, which provide a sound basis for evaluating the mechanical properties of existing gear and point out the need for modifications, (2) underwater motion pictures that show how different species escape the gear and thus permit visual evaluation of the gear's effectiveness, (3) electrical shrimp trawls that increase production on normally untrawlable grounds and during periods when the shrimp are burrowed in the substrate, (4) cruise chart additions that indicate bad bottom areas, (5) technical assistance to industry that helps in the design, construction, and operation of improved and novel types of fishing gear, and (6) development of instrumentation and techniques that aid in detecting concentrations of fishery stocks.

Funds allocated for the operation and maintenance of the Oregon and staffing of the exploratory fishing and gear research projects at the Base in Pascagoula totaled $2,147,452 for fiscal years 1950-64. Tables 1-4 show an estimated gross income to the U.S. fishing industry, as a direct result of the Oregon's exploratory findings, to be in excess of $46,000,000. Other production resulting from the Oregon's discoveries, where it has not been possible to obtain complete detail on the use of exploratory data (such as in snapper fishing, as well as the smaller landing of scallops and tuna), could well add some 5 to 10 million dollars to this total.

## Staff

Harvey R. Bullis, Jr., Base Director
John R. Thompson, Assistant Base Director
Francis J. Captiva, Base Fleet Supervisor
Marilyn M. Nelson, Secretary to Base Director

### Gulf of Mexico Exploratory Fishing and Gear Research Program (Pascagoula):

Richard A. Waller, Acting Chief, Gulf of Mexico Exploratory Fishing and Gear Research Program, transferred to Washington, D.C. 1/15/64

James S. Carpenter, Acting Chief, Gulf of Mexico Exploratory Fishing and Gear Research Program, effective 1/15/64

Hilton M. Floyd, Fishery Methods and Equipment Specialist, transferred from Brunswick, Ga., effective 7/21/63
Tomio Iwamoto, Fishery Biologist
Kenneth W. Osborn, Fishery Biologist, transferred from Galveston, Tex., effective 9/15/63
Richard B. Roe, Fishery Biologist, EOD 9/29/63
Bennie A. Rohr, Fishery Technician, EOD 10/13/63
Travis H. Ogle, Fishery Aid, EOD 9/26/63

### Caribbean Program (Pascagoula):

Norman L. Pease, Fishery Biologist, reinstated 5/24/64
Stanley M. Warlen, Fishery Biologist, EOD 9/15/63
Shelby B. Drummond, Fishery Technician, EOD 8/9/63

### Offshore Gear Research Program (Pascagoula):

Paul J. Kruse, Jr., Fishery Biologist

### Menhaden Program (Pascagoula):

J. A. Butler, Fishery Methods and Equipment Specialist, reinstated 8/4/63

### Faunal Survey (Pascagoula):

Judith Gatlin, ADP Clerk
Bruce W. Maghan, Fishery Technician, EOD 10/8/63

### Administration, Clerical, and Maintenance (Pascagoula): [1]

Dorothy M. Latady, Administrative Assistant
Edith J. Seamen, Administrative Clerk, EOD 7/21/63
Gloria A. Fetzik, Clerk-Typist, EOD 8/19/63
Alice Colmer, Librarian
T. Arlene Daniel, Clerk-typist, EOD 8/8/63
Mary E. Severinsen, Clerk-typist, EOD 9/23/63
Carol V. Taylor, Clerk-typist, resigned 9/27/63
Karen Y. Stone, Clerk-stenographer, EOD 3/12/64
Lorenza Nathan, Caretaker

[1] Assigned to total building--combined facility.

### Summer Seasonal Aids:

William N. Eschmeyer, Fishery Technician, EOD 6/4/64, resigned 9/3/64

### R/V Oregon (Pascagoula):

Johnnie H. Tyler, Master
Frank J. Hightower, First Officer
Sven J. Svensson, Supervisory Chief Engineer
Robert Roper, First Assistant Engineer, transferred to R/V Geronimo, 6/29/63
Jake Marinovich, First Assistant Engineer
Charles Birds, Jr., First Cook, EOD 11/13/63, transferred to R/V Geronimo 6/29/63
Frederick Weems, Skilled Fisherman
August Barich, Skilled Fisherman
Rasmus Mortensen, Skilled Fisherman, retired 11/15/63
Peter Rosetti, Skilled Fisherman
Edward Thompson, Skilled Fisherman

### South Atlantic Exploratory Fishing and Gear Research Program (Brunswick):

Robert Cummins, Jr., Chief, South Atlantic Exploratory Fishing and Gear Research Program
Joaquim B. Rivers, Fishery Methods and Equipment Specialist
Paul J. Struhsaker, Fishery Biologist
Floyd A. Nudi, Fishery Biologist

### Administrative and Clerical (Brunswick):

Harriet Lamb, Administrative Clerk
Martha N. Huff, Clerk-Stenographer

### R/V Silver Bay (Brunswick):

Hilton M. Floyd, Master, transferred to Pascagoula 7/21/63
Milan Willis, Master, EOD 8/12/63, resigned 3/13/64
Howard King, Master, reinstated 3/23/64
James Barrett, First Officer
Robert M. Mattos, Chief Engineer
David Page Hudgins, First Assistant Engineer, resigned 10/25/63
Franklin Philip Tippins, First Assistant Engineer, EOD 11/4/63
James E. Karr, Cook, transferred to R/V Geronimo 6/19/64
George Wentzell, Fisherman, Skilled, transferred to R/V Geronimo 6/12/64
Ernest Williams, Fisherman, Skilled
Frank B. Fratus, Jr., Fisherman, Skilled, EOD 9/19/63
Harvey M. Bledsoe, Fisherman, Skilled

Gear Research Program (Panama City):

Frederick Wathne, Chief, Gear Research Station
Charles M. Fuss, Assistant Chief
John Holt, Fishery Methods and Equipment Specialist
Larry Ogren, Fishery Biologist
David Wotherspoon, Fishery Methods and Equipment Specialist
Doyne Kessler, Fishery Biologist
William C. Williams, Fishery Aid, EOD 9/29/63

Administrative and Clerical (Panama City):

Crystal Kelly, Clerk-Stenographer
Joanne Creel, Clerk-Stenographer

R/V George M. Bowers (Panama City):

Richard E. Adams, Master, transferred to R/V Geronimo 6/4/64
Anthony Veara, Engineer
Arthur Hatcher, Cook-Fisherman
Laurence Vice, Fisherman, Skilled

## Oregon Replacement - Design Project

By

Francis J. Captiva
Fleet Supervisor

In July 1963, the Congress of the United States appropriated funds for the design of a modern fishery research vessel to replace the R/V Oregon. In August 1963, a contract for furnishing design services for the new vessel was awarded to the firm of Robert H. Macy and Associates of Pascagoula, Miss.

Historically, the major problem encountered by a vessel designer is combining the many characteristics desired by the intended owner or operator. Because many of the desirable characteristics are in direct conflict with each other, the designer and the owner must compromise to obtain a ship that satisfies both the needs of the owner and the expected service conditions. The design for the new vessel proved no exception in this respect.

That the principal requirements for an exploratory fishing vessel are somewhat similar to those for general oceanographic ships was recognized in the early planning stages and was helpful in developing our design concept, for a number of these vessels have been recently constructed. The requirements common to both types of vessel concern adequate seakeeping ability, seaworthiness, safety, reliability, maneuverability, speed, cruising range, living quarters, facilities for scientific work, and versatility. The main difference between these two types of vessel is one of degree rather than one of kind. For example, there is more commercial-type fishing aboard an exploratory fishing vessel.

No attempt was made to design an all-purpose vessel; our efforts were directed toward designing a highly specialized exploratory fishing vessel equipped to make hydrographic and biological observations which, in the light of current knowledge of fish distribution and behavior, must be regarded as essential to an exploratory fishing program.

The operational objectives for the vessel were established in the following priority and were the influencing factors in the final design concept:

1. To conduct exploratory surveys and commercial-scale fishing operations, wherein selected types of fishing gear are used to locate commercially important stocks and associated species within an unexplored area or to determine the availability or limits of distribution of an established resource.
2. To perform fishing gear research involving the testing of various types of fishing gear, including novel gear and equipment, in order to improve the efficiency and effectiveness of commercial fishing operations.
3. To make continuing observations of fishery resources by obtaining samples of a fishery stock with conventional or especially designed fishing gear.
4. To conduct fundamental research wherein observations are made on the water masses and their biota, on and above the sea floor.

The final designs were completed in July 1964.

It is estimated that bids will be opened in June 1965 with award of contract shortly thereafter. About 18 months will be needed to build the vessel.

The hull design was subjected to comprehensive tank tests at the Netherlands Ship Model Basin. The results obtained from the model tests indicate that the new vessel will be a highly satisfactory vessel.

The Oregon replacement will be an all-welded steel vessel of the North Atlantic

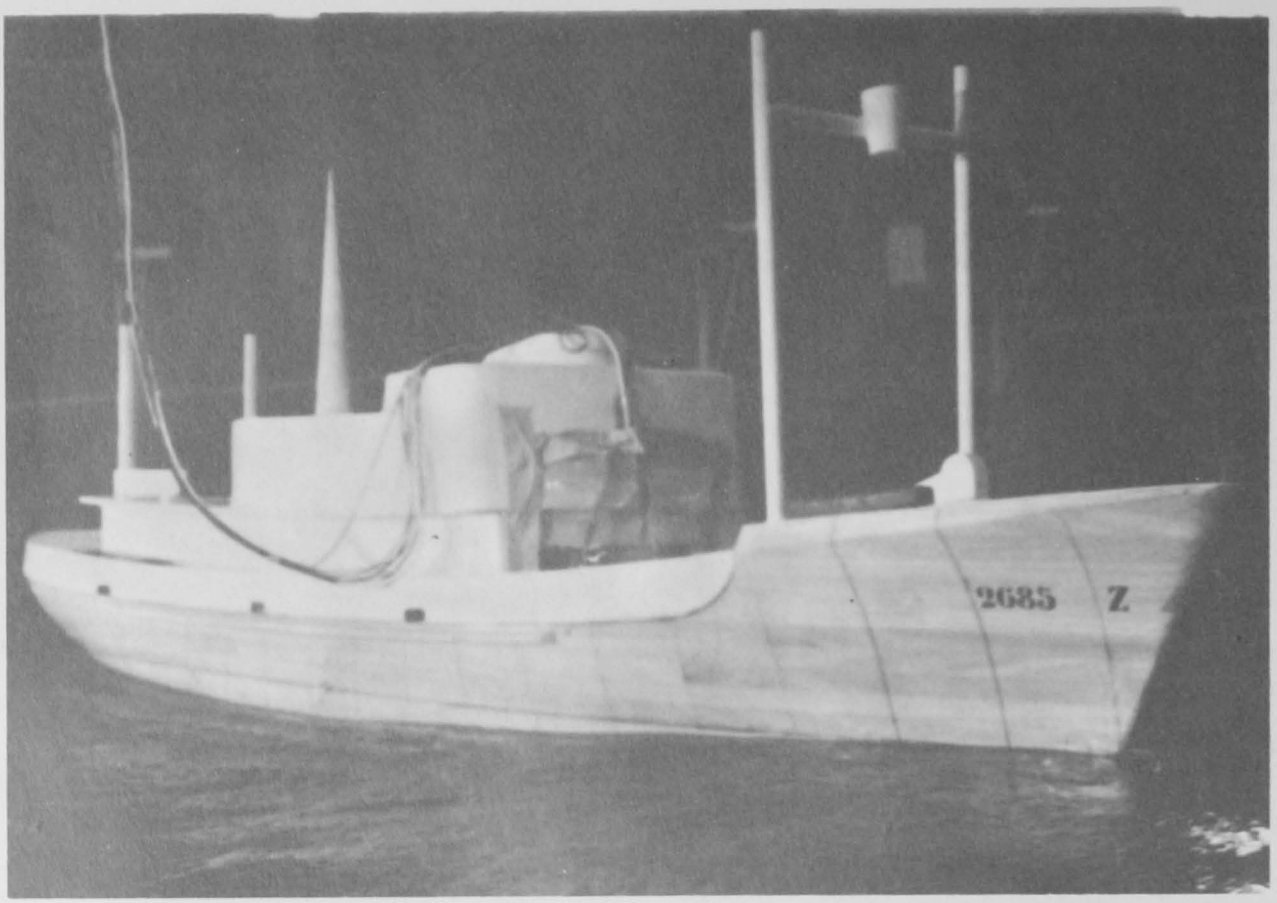


Figure 1.--Model of the Oregon replacement vessel.

trawler type, designed for fishery and oceanographic research and built to operate in all areas from temperate climates to the tropics. Overall length will be 170 feet, beam 34 feet, and draft 14 feet. It will have two 800-hp. diesel engines driving one controllable pitch propeller through a compound reduction gear. Maximum speed will be about 15 knots, with an economical service speed in excess of 13 knots. Endurance will be about 60 days, with an operating range of about 11,000 miles.

The vessel will have a partial deck below the main deck, two super-structure decks, and a forecastle. It will also have accommodations for 25 persons in 3 single cabins and 11 double cabins. Adequate facilities will be provided for off-duty relaxation and study. All living and working space, except for the wet and specimen laboratories, can be heated and air conditioned. Each of the seven laboratories in the vessel will be fully equipped for the purpose intended.

The vessel's design will permit it to function as a side trawler, stern trawler, double-rig shrimp trawler, gill netter, purse seiner, or dredger, and to use any other fishing method. Many special and unique features are incorporated in the vessel's design, such as centralization and semiautomation of propulsion and gear handling machinery and equipment, semiautomation of the catch handling and processing, duplication of vital equipment, adherence to rigid stability and flooding criteria, interchangeability of parts between main and auxiliary machinery, absence of gypsy heads and overhead running rigging, modern fish detecting and communications equipment, laboratories located at the point of minimum pitching and readily accessible from the working deck, spacious protected working deck areas both fore and aft, and an all-hydraulic gear handling complex designed to provide a high degree of versatility and dependability.

In short, the vessel will take scientists to sea; will have modern, well-equipped laboratories, electronic aids, and gear handling devices at their disposal; will permit them to fish and to make observations at depths and under sea conditions once considered impractical; and will accomplish all this with up-to-date comfort and efficiency.

## The Gulf of Mexico Exploratory Fishing and Gear Research Program, Pascagoula

By

James S. Carpenter
Acting Program Chief

Objectives of the Gulf of Mexico Program are (1) to obtain information on the current and potential fishery resources of the Gulf of Mexico so as to meet present and future industry needs and (2) to compile a basic faunal list, which will increase our knowledge of the Gulf. Principal efforts in fiscal year 1964 have been: (1) Seasonal coverages of deepwater and shallow-water shrimp species; (2) evaluations of the fauna of the Continental Shelf and Slope; and (3) assistance with the Offshore Gear Research and Off-Season Menhaden Projects.

Information has been given the industry and the scientific community through published and duplicated reports, correspondence, and personal communication. Such information has included descriptions of new or modified fishing methods and types of fishing gear, as well as knowledge gained by exploratory fishing on resources not now fished and on potential commercial species not now harvested. In addition, the program has benefited the scientific community by distributing thousands of specimens to numerous universities, colleges, museums, and other institutions in this country and abroad.

### FACILITIES

During fiscal year 1964, facilities have been improved by renovating and air conditioning the 26- by 40-foot machine shop, which houses personnel of the Gulf Program, the Offshore Shrimp Gear Research Program, and the Menhaden Program (fig. 2). This building is now called the "Gulf Building" and has four offices, a receptionist area, and a specimen laboratory. A 20- by 30-foot section on the east end of the net shed was remodeled and air conditioned. This area will house the reference collection and other specimens that will be moved from the main building.

Figure 2.--Exterior view of the newly renovated machine shop in which are housed personnel of the Gulf, Offshore Shrimp Gear Research, and Menhaden Activities.

With the use of the ADP complex, analyses were made on several Gulf species that were being studied. The ADP analysis showed large gaps in seasonal coverage. Future cruise plans for the Oregon replacement entail filling these gaps.

With the transfer of the Oregon to St. Simons Island, Ga., on July 1, 1964, the Base will be without an exploratory vessel. During the interim between shifting of the Oregon to the Georgia station and the arrival of its replacement, data that have been accumulated in the past 14 years will be analyzed and put into manuscript form. To accomplish this, all personnel, with the exception of a skeletal force in each program, will be shifted to the Faunal Survey Program where continued ADP programming will enable us to look back on what has been done and to schedule future cruises that will permit the new vessel to be used to the best advantage.

As the results of the past work emerge from this analysis, the future plans of the Gulf Program will be strengthened. Even now, despite the numerous services to the industry supplied by exploratory fishing, much remains to be accomplished with the resources of the Gulf of Mexico.

Also, during the 2 years when the Base will be without an exploratory vessel, the Gulf Program personnel will assist the industry by participating on cruises--such as snapper trawling and tuna longlining--and will be available for consultations with industry.

During the fiscal year Gulf Program personnel made seven cruises on the R/V Oregon, five of which were devoted to explorations in the Gulf of Mexico. Of the 207 days at sea, 115 days were spent in the Gulf of Mexico. Principal aims of the Gulf cruises were to evaluate the royal-red shrimp grounds in the southeastern, northern, and northwestern Gulf on a seasonal basis; to expand the seasonal coverage for inshore shrimp in the northwestern Gulf; and to carry out deepwater faunal transects throughout the northern Gulf. During the cruises, 394 stations were made in the Gulf. In addition, cruise 91 explored the previously unexplored Continental Shelf and Slope off the Mexican coast. During the fiscal year, two fishery biologists, one fishery technician, and one fishery aid were added to the program--bringing the program complement up to six.

## SHELLFISH PROJECT

By

Richard B. Roe
Project Leader

This project was initiated for the exploration and development of commercial shellfish stocks in the Gulf of Mexico. Included in the project are shrimp, clams, scallops, and other harvestable or potentially harvestable marine invertebrates. In the past year, much emphasis has been placed on exploring the offshore populations--royal-red shrimp (Hymenopenaeus robustus) and speckled shrimp (Penaeopsis megalops)--and the inshore populations--brown shrimp (Penaeus aztecus), white shrimp (Penaeus setiferus), and pink shrimp (Penaeus duorarum). Neither clams nor scallops were studied this fiscal year; a report summarizing past work is in preparation.

During the early part of the year, the accumulated data for shrimp explorations were analyzed by the ADP system. Upon completion of this phase, a chart was drawn for the Gulf of Mexico on which geographical subdivisions were laid out (fig. 3). Development of this map has improved our evaluation of the seasonal abundance of shellfish stocks and has facilitated cruise scheduling to provide a more comprehensive coverage along the Continental Shelf and Slope off the Gulf Coast States.

The most recent result of this effort was the series of Oregon cruises carried out during the winter. It became apparent from these data that our coverage of inshore shrimp populations was inadequate for the northwestern Gulf during the winter; therefore, two cruises (89 and 90) were scheduled to improve the coverage.

### Royal-Red Shrimp

Five Oregon cruises were devoted all or in part to exploratory fishing for shellfish resources in the Gulf of Mexico. Two cruises (86 and 88) were concerned with the royal-red shrimp grounds off the Dry Tortugas (fig. 4) and collected information on the summer and winter catch rates. Although the two trips yielded 6,300 pounds of royal reds (heads-on) in 60 drags, all but 1,300 pounds were taken on cruise 86 (July 23 to August 14, 1963) in 32 drags. The smaller poundage taken on cruise 88 (November 18 to December 13, 1963) was attributed to the fact that the depth range of royal-red shrimp had a uniform temperature, which caused the shrimp to inhabit a wider area of bottom. Shrimp from both trips averaged 31-35 to the pound (heads-off). Although data imply that royal reds may have a seasonal pattern, there may actually be almost no seasonal fluctuation in abundance, but, instead, a difference in environment, such as temperature, may make the population harder to sample at certain times of the year.

Investigations for royal reds in the northwestern Gulf were not as complete as those in the southeastern Gulf, owing to the exploratory nature of the cruises. Oregon cruises 89, 90, and 91 were primarily concerned with sampling the inshore shrimps; cruise 91, explored along the coast of Mexico. Some time was spent on the first two trips in search of

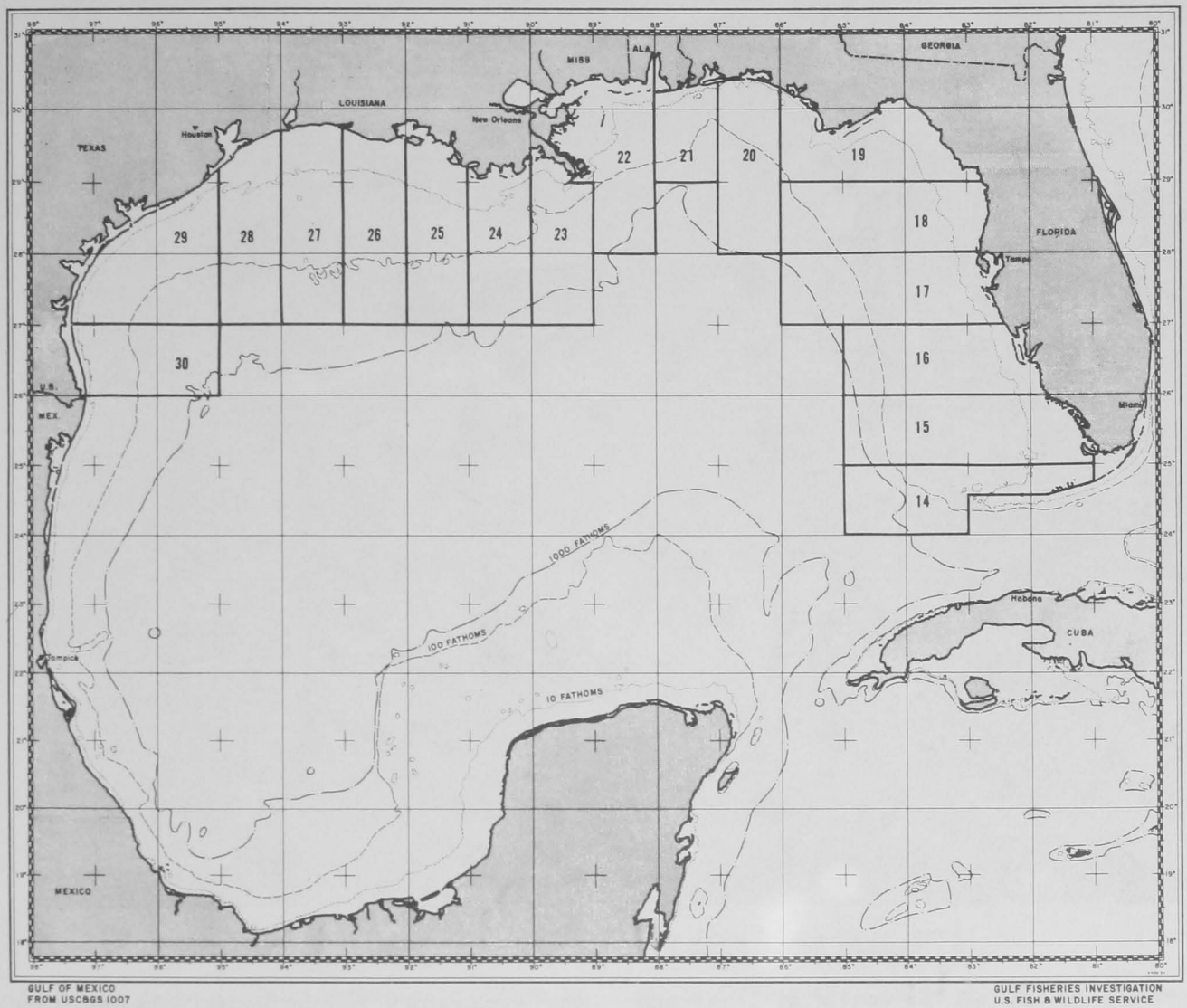


Figure 3.--Chart of the Gulf of Mexico with shrimp exploration subdivisions numbered.

Figure 4.--Sorting a royal-red shrimp catch aboard the Oregon.

trawling bottom off the coasts of Texas and Louisiana, but this effort proved rather futile. Very little trawling bottom was located at the 200- to 300-fathom depths, characteristic of the royal-red shrimp grounds, and catches were below commercial feasibility. Fair catches were made off Brownsville, Tex., in 240 fathoms and off the Louisiana coast in 220 fathoms.

During cruise 91 (March 30 to April 17, 1964) spot checks were made for royal reds off Brownsville and off the Mississippi River Delta. Catches from the former area were again light and scattered, though fair catches were made off the Delta region, the best being 340 pounds of heads-on shrimp from three 3-hour drags. Royal reds were found concentrated in 220 to 225 fathoms in both regions, though some individuals were taken as deep as 240 fathoms.

During the week of May 8, 1964, a commercial shrimper landed over 2,000 pounds of royal reds (tails) in Harvey, La., for experimental commercial canning of the species. These shellfish, it was understood, have been trawled off the Delta in areas delineated by the exploratory fishing vessel Oregon. This was the first report of commercial activity on the royal-red shrimp in the Gulf of Mexico during the fiscal year.

## Inshore Shrimps

Explorations for inshore shrimps were made along the Texas and Louisiana coasts during cruises 89 and 90 (fig. 5). The cruises were concerned primarily with determining the abundance of these animals during the winter. Brown shrimp were more abundant than either pink shrimp or white shrimp throughout the northwestern Gulf. Catches of all three species were light and scattered, indicating that the population was not large enough to support a commercial fishery. Pink shrimp were taken in such small quantities that they could not be considered an important part of the winter resources of that region. Average counts for brown and white shrimp were 26-30 and 21-25, respectively. A general pattern of depth distribution was noted for the three species: white shrimp predominantly in

Figure 5.--Brown shrimp taken off Texas by the Oregon during 1963.

6 to 20 fathoms, pink shrimp in 12 to 15 fathoms, and brown shrimp in 16 to 52 fathoms. Much of the inshore work this past season was severely hampered by heavy seas and high winds.

## BOTTOMFISH PROJECT

By

James S. Carpenter
Project Leader

The bottomfish project was again de-emphasized during the 1964 fiscal year. On cruises 89 and 90, fish trawls rigged with roller gear were tried as was a snapper trap designed by a commercial snapper fisherman. Because of a combination of bad weather and extremely rough bottom, and since the Oregon was not designed for this type of fishing, the operations were unsuccessful.

During Oregon cruises 86, 88, 89, 90, and 91, incidental catches of bottomfish were taken while fishing the Continental Shelf and Slope zones for shallow-water and deepwater shrimp. For all the Gulf cruises during the fiscal year, gadiform fishes, such as hake and whiting, dominated the catches from 200 to 300 fathoms, and rattail fishes, or grenadiers, dominated the deeper water catches. Inshore drag catches along the Louisiana and Texas coasts on cruises 89 and 90 were mostly sciaenid and sparid fishes, notably croaker and the long spined porgy. During cruise 91 to the Texas and Mexican coasts, large catches of the deep-sea snapper or wenchman were taken from 100 fathoms. Because of the unexplored nature of the offshore waters south of the border off Mexico, all specimens collected established new distribution records. Several new species and rare specimens were taken from this area on cruise 91 and also from the Yucatan slope on cruise 88.

During the fiscal year, the enthusiasm of the commercial fishermen concerning roller-rigged fish trawls for catching red snapper reached a new high. These interests resulted in the initial explorations by the Bureau's

charter vessel Silver Bay. A commercial fisherman out of Florida showed that modified fish trawls were feasible for catching snapper. While fishing in 40 fathoms off Pensacola, he caught 500 to 1,500 pounds of fish per day from an area where handline operations were not taking fish. Recently, 8,000 pounds of snapper were taken in a 3-day period by this same fisherman. Presently, several Florida trawlers are fishing with roller-rigged trawls. Five more trawlers are either under construction or in the planning stage. Base advice and assistance were requested on the overall fishing operation, gear, rigging, and handling.

## PELAGIC FISH PROJECT

By

Kenneth W. Osborn
Project Leader

During the year preliminary trials were made with monofilament tuna gill nets. Although nets were carried on board the Oregon on six cruises, only on the last cruise (92) were surface schools of fish observed in sufficient concentrations to warrant testing the gear. One school was encircled, but no fish were caught. On this same cruise, tuna and tunalike fish were taken on trolling lines in the Yucatan channel and in the Gulf of Mexico, although no surface schools were observed.

In cooperation with the off-season adult menhaden programs, we used monofilament menhaden gill nets on three cruises.

Plankton samples were taken for a study of the juvenile Gulf menhaden at the Biological Laboratory in Beaufort.

## FISHING ACTIVITIES BY FOREIGN VESSELS

By

James S. Carpenter
Fishery Biologist

During June 1964, Japanese longline fleets were observed by U.S. snapper vessels on several occasions. One fleet of nine small

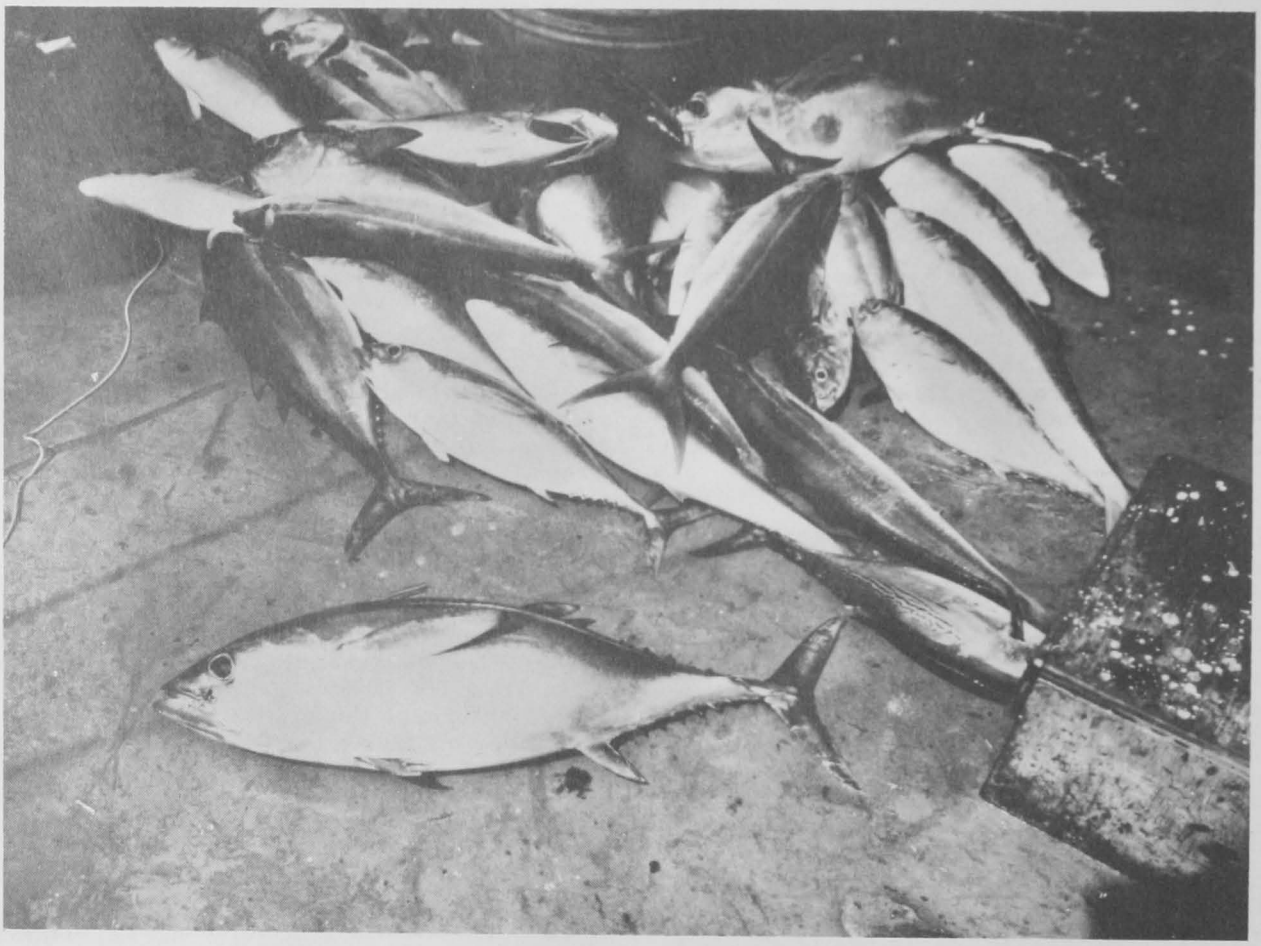

Figure 6.--Troll-caught blackfin tuna, bonito, and runners aboard the Oregon.

catcher boats and two large mother ships was seen in the middle of the Gulf of Mexico, near the end of June. Also, snapper fishermen have reported longline gear in the Gulf, sometimes extending for several miles. Damaged portions of some of this gear have been recovered.

In February, four Cuban fishing vessels were apprehended by the U.S. Coast Guard in U.S. territorial waters, south of Key West, Fla. These vessels had bonito, albacore, dolphin, and other pelagic fish that had been taken with trolling gear.

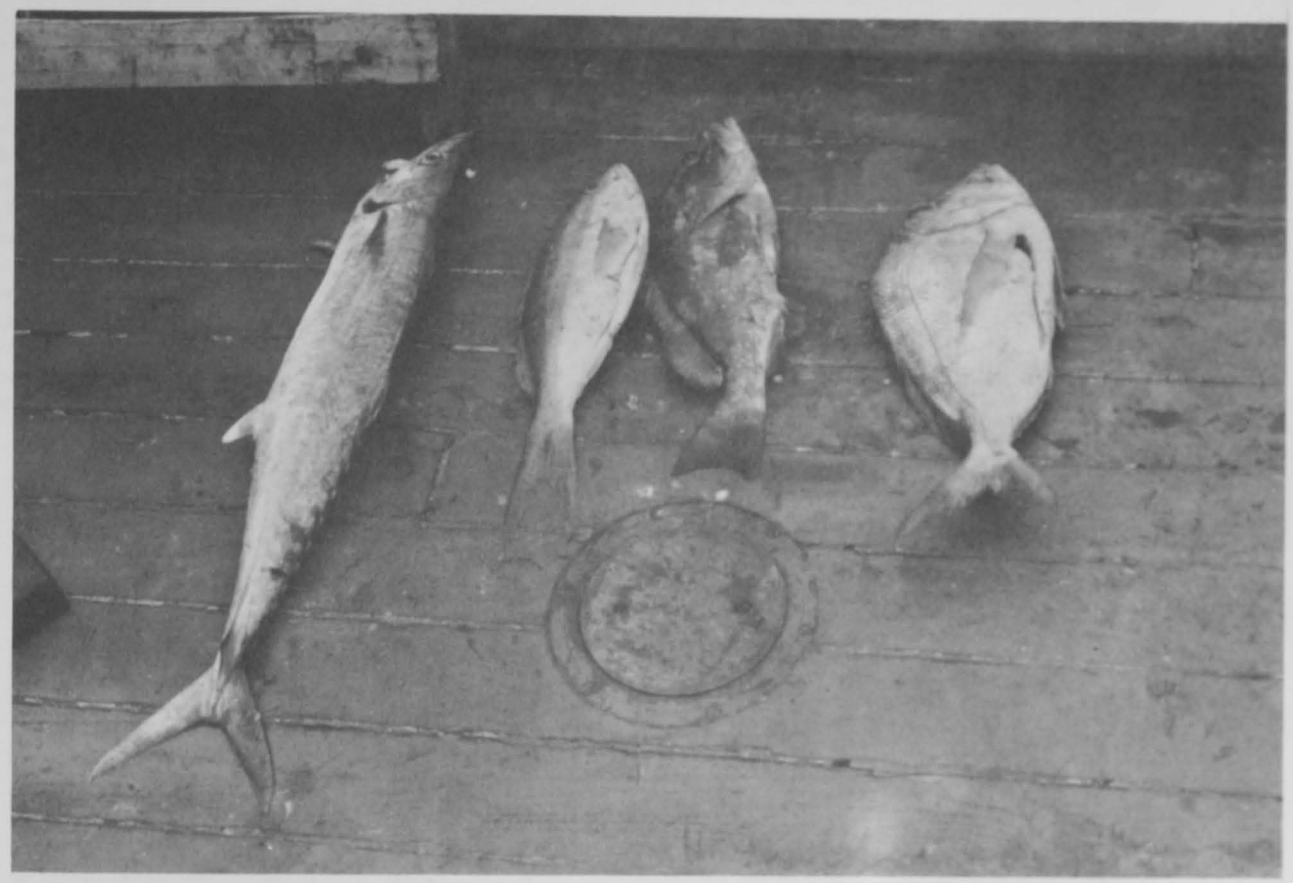

Figure 7.--Part of the catch of a Cuban fishing vessel apprehended off Florida coast. Left to right: King mackerel, yellowtail snapper, red grouper, and porgy.

## Offshore Gear Research, Photoinstrumentation, Pascagoula

By

Paul J. Kruse, Jr.
Project Leader

One of the modern "space age" research tools now in use at the Pascagoula Base is photoinstrumentation. The highly valuable and often unique information supplied by this media is aiding the Base in its commercial fishery research. Photographic interpretation is furnishing new and extremely valuable information on the various escape reactions of fish and shellfish to trawls and dredges, as well as time and motion studies of gear efficiency itself. When complete, this knowledge will be a valuable contribution toward understanding the parameters that have to be met in increasing the efficiency and effectiveness of commercial types of gear. In addition, we are collecting photographic data that can furnish the commercial fishermen and scientists alike with a visible explanation of bottom characteristics in specific locations.

The first generation of the photoinstrumentation gear, most of which was designed at the Base in Pascagoula, permitted us to observe

animal and gear characteristics connected with midwater trawling (Kruse, in press) and deep-water shrimp harvesting. These studies, to depths of 225 fathoms, unique in commercial fishing studies, are soon to be improved and expanded by a second generation of motion picture photographic gear.

The 35-mm. Edgerton CA-8 pulse camera [2] and electronic flash units (on loan from the National Geographic Society) have been fitted with a compact aluminum sled designed at the Base in Pascagoula. This complete and compact photographic reconnaissance package now permits a strip of 500 negatives to be taken along the sea bottom over 2 miles long.

First generation trawl-mounted motion picture equipment built at the Base from highly modified military surplus cameras is being replaced by a deep-sea unit, especially designed to take photographs on the Continental Slope. This new unit, designed at the Base, will have a 3-mile depth capability and will be completed by fiscal year 1966. Slow-motion studies will be possible at film speeds to 400 frames/second. Color photography, which was marginal with the first generation system because of low light levels, will now become standard procedure, permitting better observation of animal behavior. The new size of the motion picture system will permit it to be shipped to a port of embarkation in its own shipping container. The first generation system was so large that it had to be transported by Bureau truck. The 16-mm. and 35-mm. film clips, now being processed on shipboard, permit rapid evaluation of both the fishing and the photographic operation. Exposure computations will no longer be necessary when the new automatic exposure system is incorporated. Increased resolution and depth of field, resulting from a higher lens position, will permit us to measure the organisms on the film. The new

[2] Trade names referred to in this publication do not imply endorsement of commercial products.

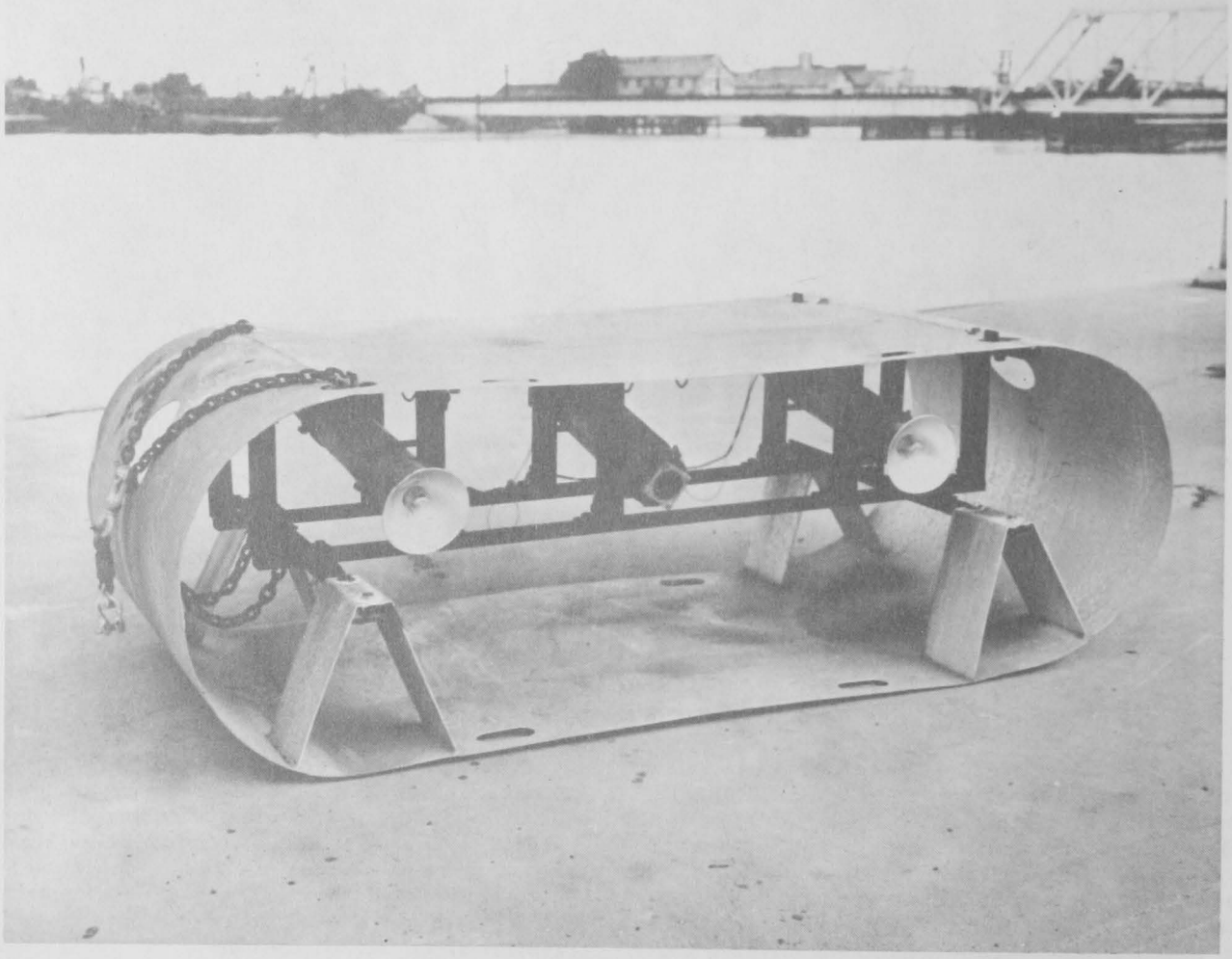

Figure 8.--Edgerton still camera in specially designed compact aluminum sled.

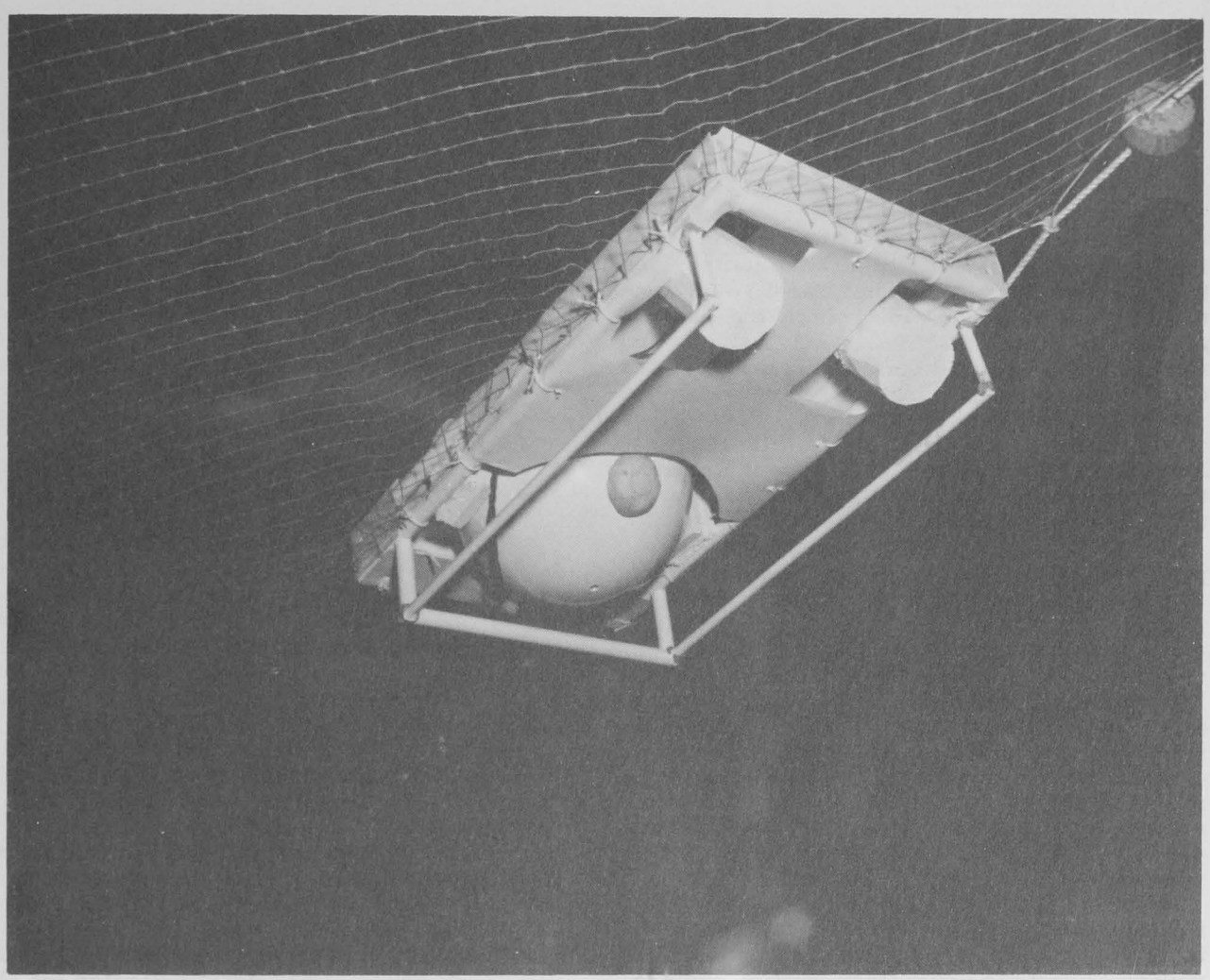

Figure 9.--Model of the specially designed trawl-mounted deep-sea motion picture camera system.

camera is not limited to a sequence of 2-minute running periods as was the previous model. This means that continuous running times up to 12 minutes will be possible.

To date, the still photographic file contains several thousand negatives. Base researchers use these photographs to illustrate their scientific papers. The numerous reels of black-and-white and color motion picture films have shown us that some species have greater ability to escape nets than we thought. Unusual bottom formations have come to light, some of which are unexplained. Numerous craters of various sizes, as well as a small spring-hole-type opening, have been observed in the sea floor, specially on the red shrimp grounds.

The relation of these phenomena to shrimp and shrimping operations has yet to be determined. Foot by foot quantitative density and catch per unit of effort estimates are being made from the deepwater red shrimp motion pictures.

Deep-sea photographic reconnaissance has become part of the regular sampling program on many Oregon and Silver Bay cruises. Adaptability of this gear has permitted impromptu studies to be made when conditions permit. One of these was the photographic study of scallop density in a small part of the bed lying off of Cape Kennedy, Fla. The results confirmed our belief that the scallops were extremely dense on the beds.

A closed circuit underwater TV chain has been obtained. When a sufficient length of cable and proper cable handling gear are available, the TV and deepwater photographic gear will be electronically coupled and manually operated by a shipboard observer-operator. Both photographic systems are now controlled by present programmers.

# Off-Season Menhaden Explorations - Gulf of Mexico, Pascagoula

By

Johnny A. Butler
Project Leader

Explorations for off-season menhaden in the Gulf of Mexico began in October 1963. The importance of the Gulf menhaden fishery has been accentuated in recent years by its continued growth in volume and increasing markets for the end-products: fish meal, fish oil, and fish solubles. This importance has stimulated the Bureau to carry on an extensive menhaden research program in the Gulf. Part of the Bureau funds appropriated for this research have been allocated to the Branch of Exploratory Fishing for menhaden explorations during the off-season months.

The aims of the project are to determine the presence and availability of off-season stocks of menhaden and other clupeids, to study any migratory patterns noted, to sample areas in and beyond present fishing zones, and to cooperate with the Bureau's Biological Laboratory in Beaufort in the collection of menhaden, other clupeids, and plankton samples. Achievement of these objectives will help solve some of the domestic industry problems, such as increasing the catch of menhaden or allied species suitable for use as similar end-products, and the fuller use of the industry's vessels and plants.

In keeping with the regional exploratory fishing aims--systematic assessment of the biological resources and compilations of resource inventory--the first year's explorations followed two simultaneous approaches: aerial scouting and field sampling.

The objectives of aerial scouting were to search for surface fish schools in selected areas, both within and beyond existing fishing grounds; to investigate sea and weather conditions relating to commercial fishing and aerial spotting operations during the off-season months, November through April; and to collect surface water temperature data for use in studies of the relations between fish and temperature. Aims of field sampling were to test and develop reliable sampling gear and techniques and to cooperate with specimen and data collection activities of the Bureau's Biological Laboratory at Beaufort.

Aerial scouting operations began in November 1963, with Flight No. 1. This flight was made primarily to learn what problems of operations we might encounter offshore during the winter; to evaluate the aircraft, pilot, and related equipment; to develop techniques of scouting and data collection; and to search for surface fish schools. Four flights were made from December through April. The aircraft (fig. 10) used an infrared radiation thermometer to measure surface water temperatures (fig. 11). Figures 12, 13, 14, 15, and 16 show the flight tracks, surface water temperatures, and locations of fish schools recorded.

During the five flights between Galveston, Tex., and the Florida Keys, 139 fish schools were seen. These schools were between Fort Walton Beach and Cape Sable, Fla., and were seen on flights during November, December, and April. No schools were noted in any other areas during the flights nor were any schools seen in waters colder than 68° F.

If the individual monthly flights can be considered typical for the time and place, the following weather patterns may be drawn: the eastern and northeastern areas probably have better conditions for fishing and aerial operations than do the northwestern and western sections, even though the movement of frontal systems hinders operations somewhat. Surface water temperatures were found to be generally higher in the easternmost sector, ranging from a low of 55° F. to a high of 81° F. Comparative temperatures for the westernmost sector, between long. 93° and 95° W., were a low of 56° F. and a high of 65° F. Sea conditions were generally less favorable for purse seining operations west of the Mississippi Delta.

The data recorded during the survey are quantitatively inadequate for definite conclusions; however, the data collected at 231 observation stations may be useful background for future studies. Much valuable information and experience were gained. The efficiency of the aircraft, pilot, and equipment proved satisfactory for this type of survey. The experience gained in the installation, operation, and interpretation of the infrared radiation thermometer equipment is valuable. The documentation of meteorological data relating to aerial spotting and commercial fishing in the areas is useful to industry and to other research programs.

Field sampling was performed in the Gulf during Oregon cruises 88, 89, 90, and 91. Sampling was also carried out in Mississippi Sound from an outboard powered skiff, Vessel "X".

Of prime importance in field sampling of a species is the development of reliable, efficient, and consistent sampling gear; therefore, the selection of gear received primary attention this fiscal year. Gill nets are known to be very effective in catching herring and herringlike fishes and are used commercially to catch menhaden for crab bait. Gill nets are selected by mesh size, and various meshes were tested to ensure that different year

Figure 10.--Type of aircraft used in aerial survey.

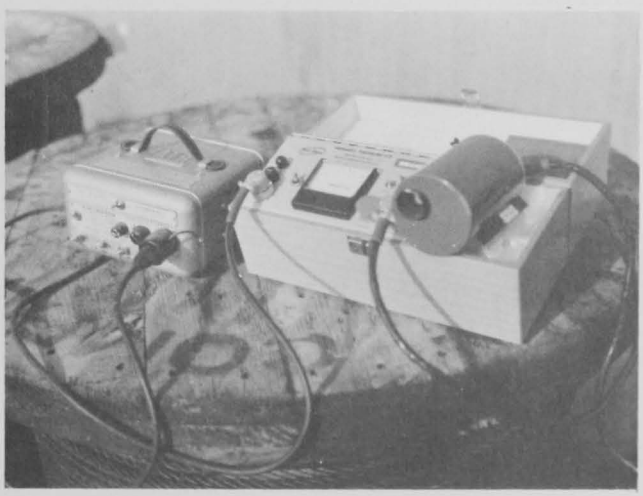

Figure 11.--Infrared radiation thermometer.

classes of menhaden would be caught during the off-season. Owing to varying turbidity in the various waters to be sampled, comparisons were also made of gill nets constructed from multifilament and monofilament nylon netting.

The gill nets were hung-in 50 percent on the cork and leadlines with each finished panel measuring 300 feet by 10 feet (for use on the Oregon) and 150 feet by 10 feet (for use on Vessel "X"). Mesh sizes varied by 1/8-inch stretched measure graduations between 2-1/2-inch and 3-inch stretched mesh. The different mesh size panels were tied together with a 12-foot spacing between panels.

Each station usually had 1,500 feet of gill netting for the Oregon and 750 feet for Vessel "X". The nets on the Oregon were rigged to fish on the surface and at the bottom. Areas fished from Vessel "X" were shallow, and the nets were rigged as surface nets.

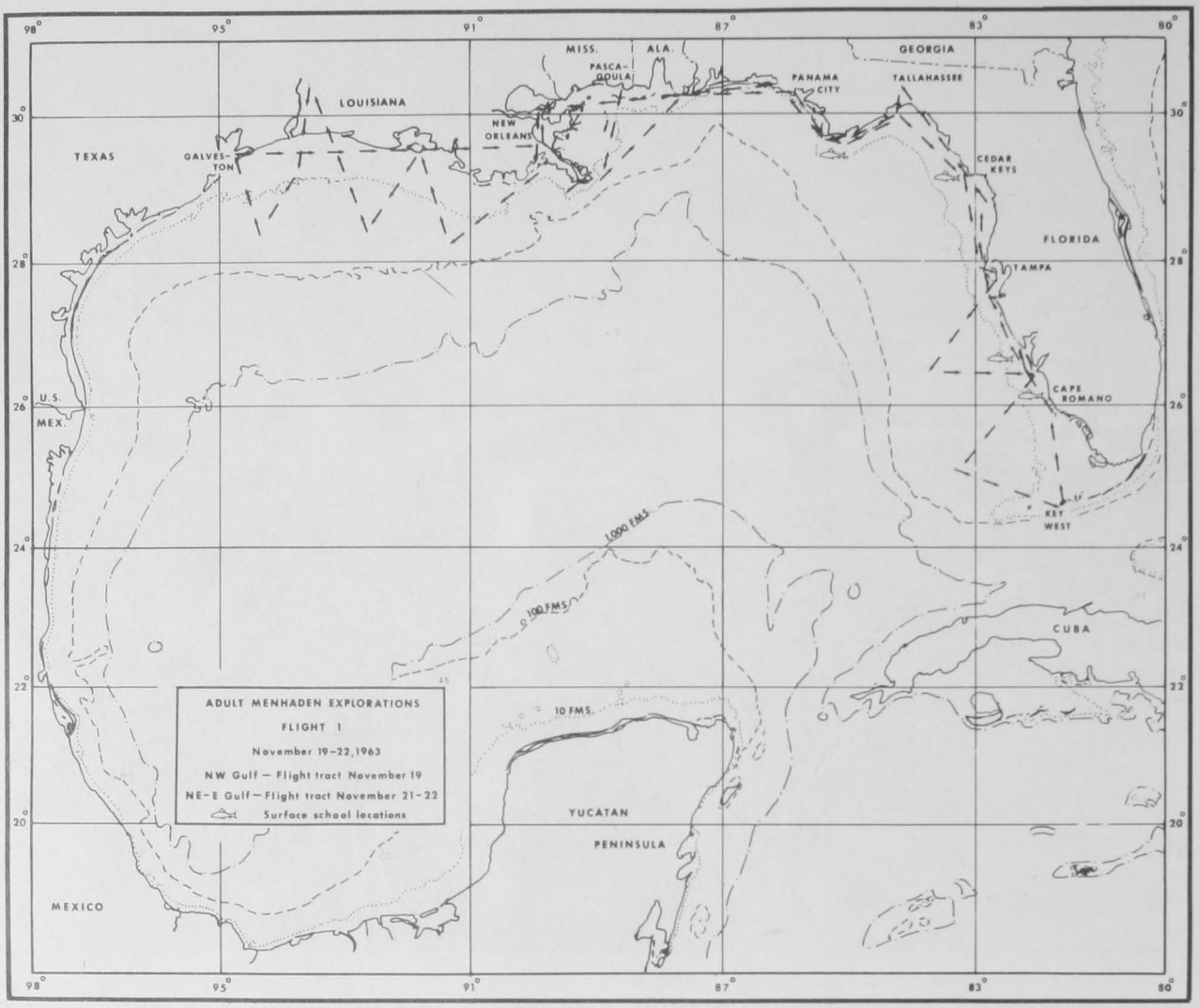


Figure 12.--Flight No. 1.

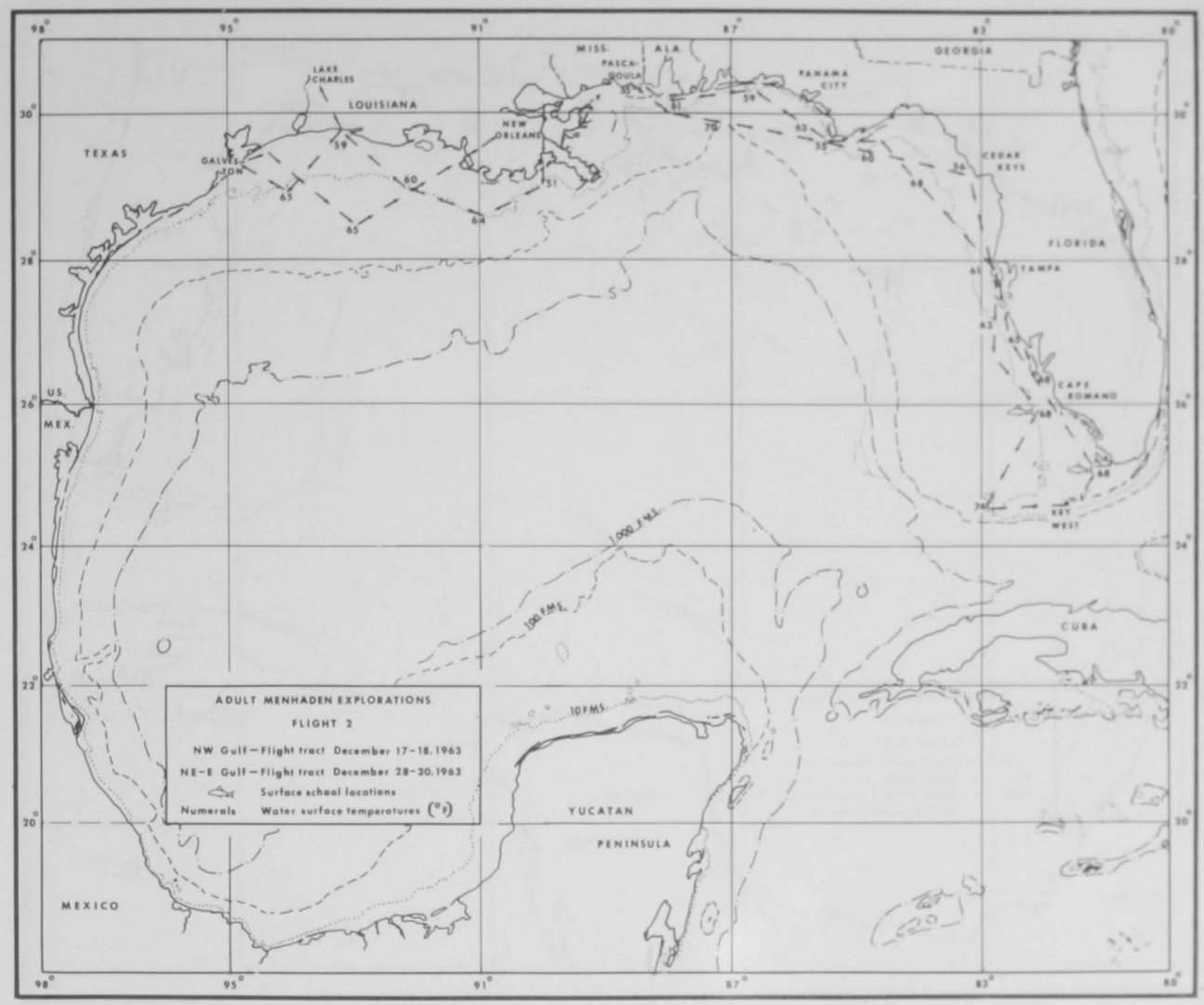


Figure 13.--Flight No. 2.

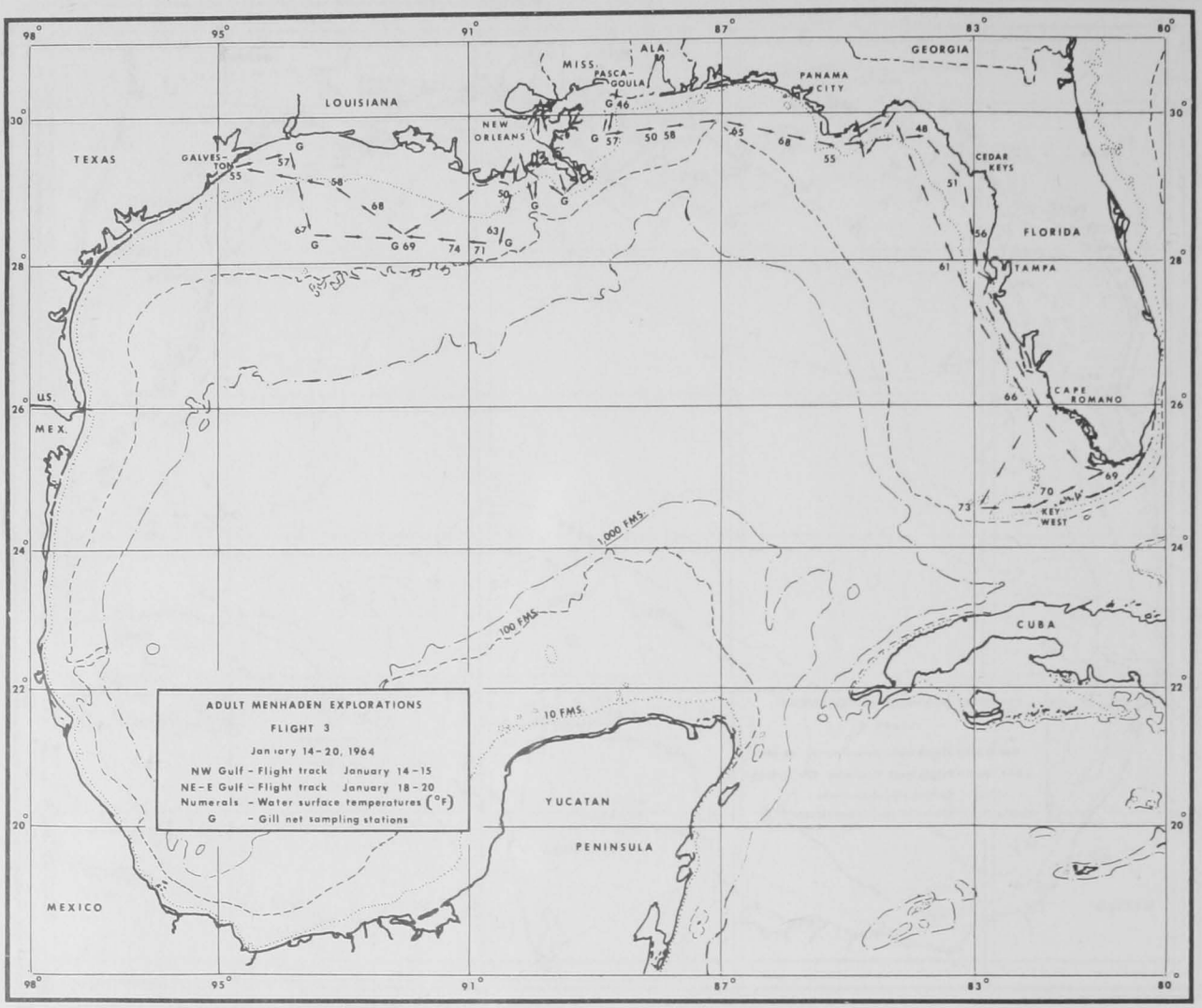


Figure 14.--Flight No. 3.

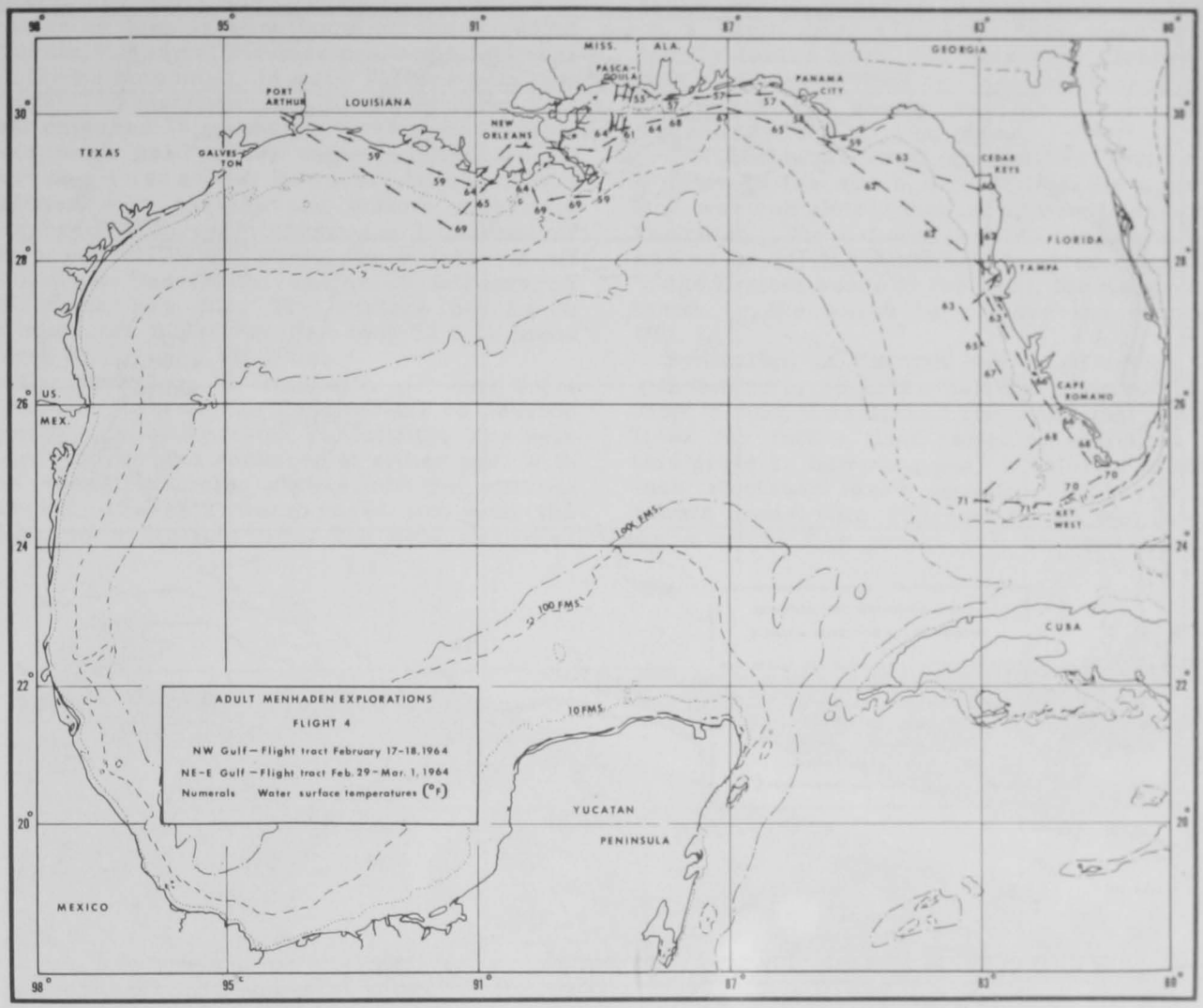


Figure 15.--Flight No. 4.

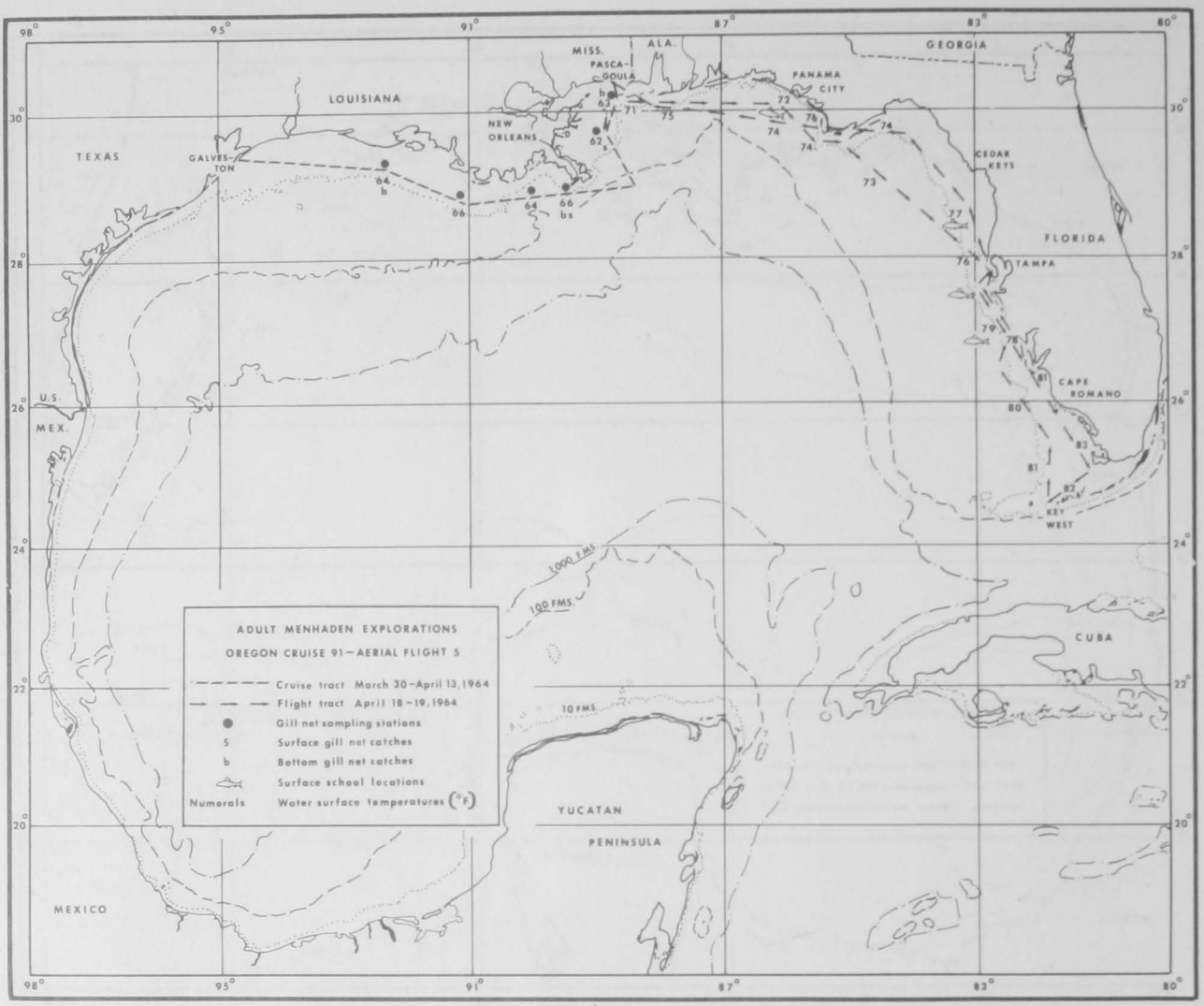


Figure 16.--Flight No. 5.

During November, January, February, March, and April, the Oregon used gill nets in waters as deep as 50 fathoms off the coasts of Florida, Alabama, Mississippi, and Louisiana. Of the 65 sets used, 33 were surface sets that caught 163 menhaden and 32 were bottom sets that captured 38 menhaden. Surface and bottom sets were used at the same locations in all but one instance; however, simultaneous catches with surface and bottom nets only occurred at three locations--in 8 fathoms off Horn Island Pass, Miss., in 9 fathoms off Southwest Pass, La., and in 20 fathoms off Barataria Bay, La. The surface net in 20 fathoms off Barataria Bay took 52 ripe menhaden on January 14, 1964.

The technique to fish with gill nets from a vessel such as the Oregon was to develop speed, reliability, and versatility. The nets were buoyed and anchored at either end. With the vessel steaming slowly into the wind or current, the nets were payed out over the stern in a straight line. The nets were retrieved on the starboard side by using a hydraulically operated power block mounted on a boom (fig. 17). After they were completely hauled back, the nets were cleared of fish on the main deck and were restacked into net boxes for resetting. This system was satisfactory for all weather.

The technique used aboard the skiff was similar to the above, except that the operation was completely manual and performed by two men. The net was set off the stern and hauled up off the starboard quarter. Because of the limited space in the skiff, the nets were taken to the beach to remove the catches (fig. 18).

Evaluation of the data collected during 99 gill net sets, 65 in the Gulf and 34 in Mississippi Sound, established the following guidelines for future field sampling activities in this project: Sampling gear is to be of 2-5/8-inch stretched mesh monofilament nylon in panels measuring 300 feet by 10 feet each. As many as five panels will be used in each

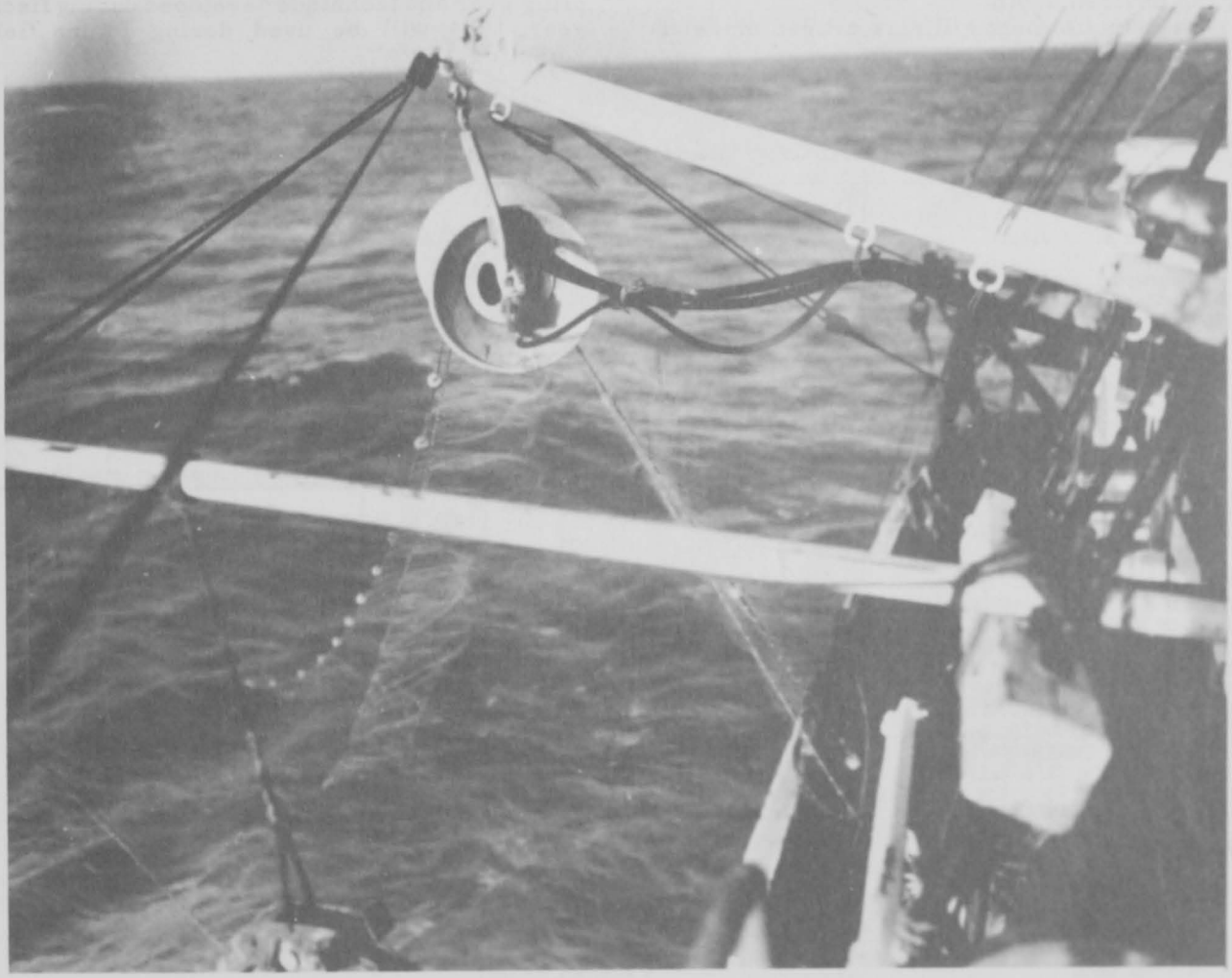

Figure 17.--Power block retrieving menhaden gill net--R/V Oregon.

Figure 18.--Vessel "X" gill net catch.

set. These gill nets will be rigged to fish at surface and at the bottom. When fish appear to be in midwater, the bottom fishing nets will have adjustable buoys to place the nets at the desired depth.

The monofilament gill nets proved more effective under all conditions except in very turbid water where the multifilament and monofilament nets gave similar results. The greater efficiency of the monofilament nets in clear water is due to the transparency of the netting. Nets made from 2-5/8-inch stretched mesh caught larger numbers of menhaden than did the other mesh sizes and also caught menhaden between 4-1/2 and 8-1/2 inches long, with an average length of 7 inches. The menhaden caught by the other four mesh sizes averaged more than one-half inch smaller than those caught in the 2-5/8-inch stretched mesh nets.

Data collected during the flights in offshore areas during the winter have been recorded on ADP punch cards. All these data are available for easy reference in any future similar or related studies.

The 99 gill net stations in the Gulf of Mexico and in Mississippi Sound yielded 2,168 menhaden. These catches clearly showed the effectiveness of the gill nets made from 2-5/8-inch stretched mesh monofilament nylon for catching off-season menhaden. The catches have been noted on the ADP cards. The sampling gear and technique developed during fiscal year 1964 will be used during future field sampling.

Table 5.--General aerial observation data, flight Nos. 1-5, Gulf of Mexico

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| POSITION: | | | | | | | |
| Longitude W. | 81° & 82° | 83° & 84° | 85° & 86° | 87° & 88° | 89° & 90° | 91° & 92° | 93° & 94° |
| Latitude N: | | | | | | | |
| Northern limits | 28° 34' | 29° 45' | 30° 22' | 30° 20' | 29° 06' | 29° 36' | 29° 30' |
| Southern limits | 24° 35' | 27° 25' | 29° 20' | 29° 35' | 28° 10' | 28° 12' | 28° 30' |
| NUMBER OF OBSERVATIONS: | | | | | | | |
| Dec. 1963 | 21 | 10 | 7 | 6 | 4 | 6 | 7 |
| Jan. 1964 | 20 | 12 | 4 | 6 | 7 | 8 | 8 |
| Feb. 1964 | 13 | 3 | 7 | 8 | 4 | 7 | 1 |
| Mar. 1964 | 7 | 4 | 5 | 2 | 0 | 0 | 0 |
| Apr. 1964 | 21 | 9 | 7 | 7 | 0 | 0 | 0 |
| Total | 82 | 38 | 30 | 29 | 15 | 21 | 16 |
| HOURLY RANGE OF OBSERVATIONS[1] | 0835 to 1715 | 0915 to 1715 | 0930 to 1515 | 0826 to 1545 | 0811 to 1531 | 1100 to 1640 | 0926 to 1510 |
| MOON PHASES[2] | 1-2-4 | 1-2-4 | 1-2-4 | 1-2-4-8 | 1-8 | 1-8 | 1-8 |
| MINIMUM & MAXIMUM WATER DEPTHS | 1-21 f | 1-19 f | 2-100 f | 1-20 f | 3-50 f | 1-50 f | 1-24 f |
| RANGE OF WATER COLORS[3] | 1-2-3-5 | 1-2-3-5 | 1-2-3-5 | 2-3-5 | 1-2-5 | 1-2-5 | 2 |
| PREDOMINANT WATER COLOR[3] | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| RANGE OF SEA CONDITIONS[4] | 1-5 | 1-7 | 1-5 | 1-5 | 3-5 | 3-7 | 5-7 |
| PREDOMINANT SEA CONDITIONS[4] | 3 | 3 | 3 | 3 | 3 | 3 | 7 |
| RANGE OF WIND SPEEDS | 0-20 | 0-25 | 0-25 | 0-20 | 6-15 | 6-25 | 16-25 |
| PREDOMINANT WIND SPEEDS | 6-10 | 6-10 | 6-10 | 6-10 | 11-15 | 11-15 | 16-20 |
| SURFACE WATER TEMPERATURES: | | | | | | | |
| DEGREES F. MINIMUM & MAXIMUM | 55°-81° | 44°-73° | 55°-74° | 46°-75° | 50°-74° | 53°-74° | 56°-65° |
| AIR TEMPERATURES-MINIMUM & MAXIMUM | 44°-79° | 44°-73° | 45°-70° | 22°-70° | 28°-62° | 43°-64° | 40°-57° |

CODES

[1] Central Standard Time

[2] 1 = First quarter
2 = Half moon
4 = Full moon
8 = New moon

[3] 1 = Blue
2 = Green
3 = Turquoise
4 = Yellow
5 = Brown (muddy)

[4] 1 = Calm
3 = Slight chop
5 = Moderate swell
7 = Pronounced sea

Table 6.--Fish school observation data, flight Nos. 1-5, Gulf of Mexico

| POSITION: | | | | | | | |
|---|---|---|---|---|---|---|---|
| Longitude W. | 81° & 82° | 83° & 84° | 85° & 86° | 87° & 88° | 89° & 90° | 91° & 92° | 93° & 94° |
| Latitude N.: | | | | | | | |
| Northern limits | 28° 34' | 29° 45' | 30° 22' | 30° 20' | 29° 06' | 29° 36' | 29° 30' |
| Southern limits | 24° 35' | 28° 43' | 29° 35' | 29° 35' | 28° 10' | 28° 11' | 28° 30' |
| NUMBER OF SCHOOLS SIGHTED | 23 | 8 | 25 | 0 | 0 | 0 | 0 |
| TYPE OF FISH | Clupeids* | Clupeids* | Clupeids* | | | | |
| NUMBER OF LOCATIONS | 9 | 1 | 1 | | | | |
| SCHOOL SIZE-MINIMUM & MAXIMUM[1] | 1-5 | 2-4 | 3-4 | | | | |
| AVERAGE SCHOOL SIZE[1] | 4 | 4 | 4 | | | | |
| SHAPES OF SCHOOLS[2] | 1-3-5 | 2-3 | 1-3 | | | | |
| DEPTH OF WATER AT SCHOOL LOCATIONS (FATHOMS) | 2-3-5-8-9 | 10 | 20 | | | | |
| COLOR OF WATER[3] | 2-3 | 1 | 2 | | | | |
| SEA CONDITIONS[4] | 1-3 | 3 | 3 | | | | |
| SURFACE WATER TEMPERATURES (°F.) | 68-78-81 | 76 | 74 | | | | |
| TIME OF DAY - CENTRAL STANDARD TIME | 4 @ 0950 to 1040<br>3 @ 1500 to 1520<br>2 @ 1553 to 1613 | 1240 | 1330 | | | | |
| DATES OF SIGHTINGS | 3 on 12/28/63<br>1 on 12/29/63<br>2 on 4/18/64<br>3 on 4/19/64 | 4/18/64 | 4/19/64 | | | | |
| MOON PHASES[5] | 1-2 | 1 | 1 | | | | |

CODES

[1] 1 = Less than 1 Ton
2 = 1-5 Tons
3 = 6-10 Tons
4 = 11-25 Tons
5 = 26-50 Tons

[2] 1 = String
2 = Tear drop
3 = Semi-circular
5 = Dumbell

[3] 1 = Blue
2 = Green
3 = Turquoise

[4] 1 = Flat calm
3 = Slight chop

[5] 1 = First quarter
2 = Half moon

*Clupeids (Herringlike fishes)

Table 7.--Aerial spotting data, flight Nos. 1-5, Gulf of Mexico

| POSITION: | | | | | | | |
|---|---|---|---|---|---|---|---|
| Longitude W. | 81° & 82° | 83° & 84° | 85° & 86° | 87° & 88° | 89° & 90° | 91° & 92° | 93° & 94° |
| Latitude N.: | | | | | | | |
| Northern limits | 28° 34' | 29° 45' | 30° 22' | 30° 20' | 29° 06' | 29° 36' | 29° 30' |
| Southern limits | 24° 35' | 27° 25' | 29° 20' | 29° 35' | 28° 10' | 28° 11' | 28° 30' |
| NUMBER OF OBSERVATIONS: | | | | | | | |
| Dec. 1963 | 21 | 10 | 7 | 6 | 4 | 6 | 7 |
| Jan. 1964 | 20 | 12 | 4 | 6 | 7 | 8 | 8 |
| Feb. 1964 | 13 | 3 | 7 | 8 | 4 | 7 | 1 |
| Mar. 1964 | 7 | 4 | 5 | 2 | 0 | 0 | 0 |
| Apr. 1964 | 21 | 9 | 7 | 7 | 0 | 0 | 0 |
| Total | 82 | 38 | 30 | 29 | 15 | 21 | 16 |
| AIRCRAFT ALTITUDE MINIMUM-MAXIMUM | 200'-5000' | 200'-7500' | 200'-4500' | 200'-4500' | 200'-1200' | 200'-2000' | 200'-500' |
| RADIUS OF OBSERVATION *(Miles) | 5-9 | 9 | 8-9 | 2-9 | 9 | 5-9 | 5-9 |
| VISIBILITY CONDITIONS[1] | U-H-F | U-H-F | U-H | U-H | U | U-H-F-R | U-F-R |
| PREDOMINANT VISIBILITY CONDITIONS[1] | U | U | U | U | U | U | U |
| SKY COVER[2] | C-P-O | C-P-O | C-P-O | C-P-O | C-P-O | C-P-O | C-P-O |
| PREDOMINANT SKY COVER[2] | C | C | C | P | O | O | O |
| SURFACE WIND DIRECTION[3] | 1-2-3-4-5-6-7 | 1-2-3-5-6-7 | 1-2-3-4-5 | 1-2-3-4-7 | 1-2-3-7 | 1-2-3-7 | 1-2-3-4-5-7 |
| PREDOMINANT WIND DIRECTION[3] | 3 | 3 | 3 | 1 | 2 | 2 | 2 |
| SURFACE WIND SPEEDS[4] | 1-2-3-4 | 1-2-3-4-5 | 1-2-3-4 | 1-2-3-4 | 2-3 | 2-3-4-5 | 3-4-5 |
| PREDOMINANT WIND SPEEDS[4] | 2 | 2 | 2 | 2 | 3 | 3 | 4 |
| AIR TEMPERATURE MINIMUM-MAXIMUM | 44° - 79° | 44° - 73° | 45° - 70° | 22° - 70° | 28° - 62° | 43° - 64° | 40° - 57° |

CODES:

[1] U = Unlimited - More than 10 miles
H = Haze
F = Fog
R = Rain

*9 mile radius considered maximum for positive identification

[2] C = Clear
P = Partly cloudy
O = Overcast

[3] 0 = N
1 = NE
2 = E
3 = SE
4 = S
5 = SW
6 = W
7 = NW

[4] 1 - 0 = 5 Knots
2 - 6 = 10 Knots
3 - 11 = 15 Knots
4 - 16 = 20 Knots
5 - 21 = 25 Knots

Table 8.--Fishing vessel sightings, flight Nos. 1-5, Gulf of Mexico

| POSITION: | | | | | | | |
|---|---|---|---|---|---|---|---|
| Longitude W. | 81° & 82 | 83° & 84 | 85° & 86° | 87° & 88° | 89° & 90° | 91° & 92° | 93° & 94° |
| Latitude N.: | | | | | | | |
| Northern limits | 28° 34' | 29° 45' | 30° 22' | 30° 20' | 29° 06' | 29° 36' | 29° 30' |
| Southern limits | 24° 35' | 27° 25' | 29° 20' | 29° 35' | 28° 10' | 28° 11' | 28° 30' |
| NUMBER OF VESSELS | 81 | 16 | 15 | 13 | 23 | 6 | 7 |
| NATIONALITY OF VESSELS[1] | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| TYPES OF VESSELS[2] | 1-9 | 1-3-9 | 1 | 2-4 | 1 | 1 | 1 |
| PREDOMINANT TYPE[2] | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| WATER DEPTHS | 14 - 21 f | 5 f | 2 f | 5 - 6 f | 10 - 48 f | 4 f | 8 f |

CODES

[1] U.S.A.
[2] 1 = Shrimp trawler
2 = Fisher trawler
3 = Snapper boat
4 = Menhaden seiner
9 = Oyster tonger

Table 9.--Size range of menhaden caught in gill nets of various mesh sizes, 1963-64, Gulf of Mexico

| Fork length range per mesh size in inches | | | | | Fork length range per mesh size in inches | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Stretched mesh size | Minimum | Maximum | Average | Fish in sample | Stretched mesh size | Minimum | Maximum | Average | Fish in sample |
| Inches | Inches | Inches | Inches | Number | Inches | Inches | Inches | Inches | Number |
| 2-1/2 | 4.6 | 8.6 | 6.5 | 145 | 2-7/8 | 4.4 | 8.6 | 6.2 | 114 |
| 2-5/8 | 4.3 | 8.3 | 7.0 | 567 | 3 | 4.4 | 8.5 | 6.2 | 164 |
| 2-3/4 | 4.3 | 9.1 | 6.4 | 201 | | | | | |

Table 10.--R/V Oregon menhaden gill net stations

| Sta. | Cruise | Date | Gill net description | Menhaden caught | Type of set | Position | | Time fished | Time of set | Depth | Water color | Sea condition | Wind direction & speed | Temperature | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Latitude N. | Longitude W. | | | | | | | Air | Water | |
| | | | | | | | | | | | | | | | Surface | Bottom |
| | | | | Number | | | | Minutes | Hours | Fathoms | | | Miles/hour | °F. | °F. | °F. |
| 4496 | 88 | 11-18-63 | 1 - 300'X10' section 3" stretch mesh monofilament | 4 | Bottom | 30° 10' | 88° 32' | 27 | 1500 | 8 | Green | Light swell | ESE 10-12 | -- | 73 | -- |
| 4497 | 88 | 11-18-63 | " | 0 | Surface | 30° 10' | 88° 32' | 42 | 1510 | 8 | " | " | ESE 10-12 | -- | 71 | -- |
| 4498 | 88 | 11-18-63 | " | 0 | Bottom | 30° 05' | 87° 40' | 25 | 2125 | 13 | " | " | ESE 6-8 | -- | 71 | -- |
| 4499 | 88 | 11-18-63 | " | 0 | Surface | 30° 05' | 87° 40' | 45 | 2135 | 13 | " | " | ESE 6-8 | -- | 70 | -- |
| 4500 | 88 | 11-19-63 | " | 0 | Bottom | 30° 01' | 86° 47' | 25 | 0415 | 62 | " | " | ESE 10-12 | 68 | 73 | -- |
| 4501 | 88 | 11-19-63 | " | 0 | Surface | 30° 01' | 86° 47' | 35 | 0430 | 62 | " | " | ESE 10-12 | 68 | 73 | -- |
| 4502 | 88 | 11-19-63 | " | 0 | Bottom | 29° 52' | 85° 56' | 30 | 1120 | 19 | " | " | ESE 10-12 | 70 | -- | 71 |
| 4503 | 88 | 11-19-63 | " | 0 | Surface | 29° 52' | 85° 56' | 30 | 1205 | 19 | " | " | ESE 10-12 | 70 | 71 | -- |
| 4505 | 88 | 11-19-63 | " | 0 | Bottom | 29° 34' | 85° 07' | 30 | 2020 | 4 | " | " | ESE 4-6 | 70 | 65 | -- |
| 4506 | 88 | 11-19-63 | " | 0 | Surface | 29° 34' | 85° 07' | 35 | 2025 | 4 | " | " | ESE 4-6 | 70 | 65 | -- |
| 4507 | 88 | 11-20-63 | " | 0 | Bottom | 28° 35' | 84° 00' | 50 | 0845 | 18 | " | Moderate chop | ESE 15-20 | 70 | 72 | -- |
| 4508 | 88 | 11-20-63 | " | 0 | Surface | 28° 35' | 84° 00' | 30 | 0850 | 18 | " | " | ESE 15-20 | 70 | 72 | -- |
| 4510 | 88 | 11-20-63 | " | 0 | Bottom | 27° 41' | 82° 54' | 60 | 1940 | 5 | " | " | ESE 8-10 | 73 | 67 | -- |
| 4511 | 88 | 11-20-63 | " | 0 | Surface | 27° 41' | 82° 54' | 30 | 1950 | 5 | " | Light swell | ESE 8-10 | 73 | 67 | -- |
| 4513 | 88 | 11-21-63 | " | 0 | Bottom | 26° 20' | 82° 12' | 30 | 0655 | 5 | " | " | E 6-5 | 69 | 68 | -- |
| 4514 | 88 | 11-21-63 | " | 0 | Surface | 26° 20' | 82° 12' | 35 | 0655 | 5 | " | " | E 6-5 | 69 | 68 | -- |
| 4516 | 88 | 11-21-63 | " | 0 | Surface | 25° 51' | 81° 50' | 30 | 1130 | 6 | " | " | E 4-6 | 71 | 70 | -- |
| 4517 | 88 | 11-21-63 | " | 0 | Bottom | 25° 51' | 81° 50' | 35 | 1135 | 6 | " | " | E 4-6 | 71 | 70 | -- |
| 4518 | 88 | 11-21-63 | " | 0 | Bottom | 25° 39' | 81° 41' | 30 | 1445 | 5 | " | " | ESE 10-12 | 71 | 71 | -- |
| 4519 | 88 | 11-21-63 | " | 0 | Surface | 25° 39' | 81° 41' | 55 | 1450 | 5 | " | " | ESE 10-12 | 71 | 71 | -- |
| 4584 | 89 | 1-13-64 | 5 - 300'X10' sections 2-1/2, 2-5/8, 2-3/4, 2-7/8, and 3" stretch mesh monofilament | 2 | Bottom | 30° 10' | 88° 32' | 60 | 1530 | 8 | " | " | NW 20-25 | 39 | 53 | 52 |
| 4585 | 89 | 1-13-64 | " | 14 | Surface | 30° 10' | 88° 32' | 62 | 1550 | 8 | " | " | NW 20-25 | 39 | 53 | 52 |
| 4586 | 89 | 1-14-64 | " | 1 | Bottom | 28° 55' | 89° 27' | 123 | 1055 | 8 | " | " | N 18-20 | 39 | 64 | 63 |
| 4587 | 89 | 1-14-64 | " | 0 | Surface | 28° 56' | 89° 27' | 120 | 1110 | 8 | " | " | N 18-20 | 39 | 64 | 63 |
| 4588 | 89 | 1-14-64 | " | 1 | Bottom | 28° 50' | 90° 00' | 50 | 1845 | 20 | " | " | NNE 8-10 | 46 | 48 | 63 |
| 4589 | 89 | 1-14-64 | " | 52 | Surface | 28° 49' | 90° 00' | 100 | 1850 | 20 | " | " | NNE 8-10 | 46 | -- | -- |
| 4590 | 89 | 1-15-64 | " | 0 | Bottom | 28° 10' | 90° 36' | Lost net | 0315 | 50 | " | " | NE 12-14 | 59 | 62 | -- |
| 4591 | 89 | 1-15-64 | " | 0 | Surface | 28° 10' | 90° 36' | 55 | 0335 | 50 | " | " | NE 12-14 | 59 | 62 | -- |
| 4592 | 89 | 1-15-64 | 4 - 300'X10' sections 2-5/8, 2-3/4, 2-7/8, and 3" stretch mesh monofilament | 0 | Bottom | 28° 27' | 91° 33' | 45 | 1600 | 27 | " | Moderate chop | NE 20-25 | 59 | 62 | 63 |
| 4593 | 89 | 1-15-64 | " | 0 | Surface | 28° 27' | 91° 33' | 25 | 1630 | 27 | " | " | NE 20-25 | 59 | 62 | -- |
| 4594 | 89 | 1-16-64 | " | 0 | Bottom | 29° 37' | 93° 40' | 44 | 1416 | 5 | " | Light swell | NNE 15-20 | 54 | 52 | -- |
| 4595 | 89 | 1-16-64 | " | 0 | Surface | 29° 37' | 93° 40' | 40 | 1540 | 5 | " | " | NNE 15-20 | 54 | 58 | -- |
| 4671 | 89 | 2-01-64 | " | 0 | Bottom | 28° 36' | 93° 14' | 50 | 1630 | 20 | " | Moderate chop | NE 10-12 | 56 | -- | -- |
| 4672 | 89 | 2-01-64 | " | 2 | Surface | 28° 36' | 93° 14' | 90 | 1645 | 20 | " | " | NE 10-12 | 56 | -- | -- |
| 4679 | 89 | 2-05-64 | " | 0 | Bottom | 29° 40' | 88° 51' | 55 | 1620 | 5 | " | " | SW 25-30 | 73 | 58 | 56 |
| 4680 | 89 | 2-05-64 | " | 17 | Surface | 29° 40' | 88° 51' | 30 | 1630 | 5 | " | " | SW 25-30 | -- | 58 | 56 |
| 4681 | 90 | 2-17-64 | " | 0 | Bottom | 30° 10' | 88° 32' | 90 | 1520 | 7 | Muddy | Moderate swell | E 25-30 | 57 | 55 | 56 |
| 4682 | 90 | 2-17-64 | " | 9 | Surface | 30° 10' | 88° 32' | 65 | 1529 | 7 | " | " | E 25-30 | 57 | 55 | 56 |
| 4684 | 90 | 2-18-64 | " | 0 | Bottom | 29° 40' | 88° 50' | 90 | 1130 | 5 | Green | " | W 15-20 | 54 | 57 | 54 |
| 4685 | 90 | 2-18-64 | " | 0 | Surface | 29° 40' | 88° 50' | 50 | 1145 | 5 | " | " | W 15-20 | 54 | 57 | 54 |
| 4686 | 90 | 2-19-64 | " | 0 | Bottom | 28° 52' | 90° 00' | 45 | 0645 | 20 | " | Moderate chop | NW 15-20 | 54 | 62 | 65 |
| 4687 | 90 | 2-19-64 | " | 0 | Surface | 28° 52' | 90° 00' | 45 | 0730 | 20 | " | " | NW 15-20 | 54 | 62 | 65 |

Table 10--Continued

| Sta. | Cruise | Date | Gill net description | Menhaden caught | Type of set | Position | | Time fished | Time of set | Depth | Water color | Sea condition | Wind direction & speed | Temperature | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Latitude N. | Longitude W. | | | | | | | Air | Water | |
| | | | | | | | | | | | | | | | Surface | Bottom |
| | | | | Number | | | | Minutes | Hours | Fathoms | | | Miles/hour | °F. | °F. | °F. |
| 4716 | 90 | 2-25-64 | 4 - 300'X10' sections 2-5/8, 2-3/4, 2-7/8, and 3" stretch mesh monofilament | 0 | Bottom | 29° 10' | 92° 20' | 50 | 0855 | 6 | Green | Light chop | N 15-20 | 43 | 53 | 57 |
| 4717 | 90 | 2-25-64 | " | 6 | Surface | 29° 10' | 92° 20' | 70 | 0905 | 6 | " | " | N 15-20 | 43 | 53 | 57 |
| 4721 | 90 | 2-25-64 | " | 0 | Bottom | 28° 55' | 92° 23' | 60 | 1555 | 16 | " | Calm | N 2-4 | 58 | 58 | 68 |
| 4722 | 90 | 2-25-64 | " | 0 | Surface | 28° 55' | 92° 23' | 63 | 1605 | 16 | " | " | N 2-4 | 58 | 58 | 68 |
| 4761 | 90 | 3-07-64 | " | 0 | Surface | 28° 16' | 91° 36' | 45 | 1145 | 38 | " | Light swell | SE 8-10 | 74 | 65 | 62 |
| 4763 | 90 | 3-07-64 | " | 0 | Bottom | 28° 37' | 91° 46' | 55 | 1620 | 20 | " | " | SE 10-12 | 67 | 65 | 62 |
| 4764 | 90 | 3-07-64 | " | 0 | Surface | 28° 37' | 91° 46' | 45 | 1745 | 20 | " | " | SE 10-12 | 66 | 65 | 62 |
| 4765 | 90 | 3-07-64 | " | 0 | Surface | 28° 42' | 91° 08' | 45 | 2245 | 8 | " | Calm | SE 8-10 | 69 | 63 | 62 |
| 4766 | 90 | 3-08-64 | " | 7 | Bottom | 28° 42' | 91° 08' | 66 | 0014 | 8 | " | " | SE 8-10 | 69 | 63 | 62 |
| 4772 | 90 | 3-10-64 | " | 33 | Surface | 29° 06' | 90° 03' | 45 | 0815 | 7 | " | " | NW 8-10 | 46 | 62 | 64 |
| 4773 | 90 | 3-10-64 | " | 0 | Bottom | 29° 06' | 90° 03' | 45 | 0825 | 7 | " | " | NW 8-10 | 46 | 62 | 64 |
| 4782 | 91 | 3-30-64 | 4 - 300'X10' sections 2-5/8, 2-3/4, 2-7/8, and 3" stretch mesh monofilament<br>1 - 300'X10' section 2-5/8" stretch mesh multifilament | 0 | Surface | 30° 10' | 88° 32' | 55 | 1607 | 7 | - | - | -- | -- | -- | 64 |
| 4783 | 91 | 3-30-64 | " | 1 | Bottom | 30° 10' | 88° 32' | 109 | 1616 | 7 | - | - | -- | -- | -- | -- |
| 4784 | 91 | 3-30-64 | " | 6 | Surface | 29° 40' | 88° 51' | 45 | 2245 | 5 | - | - | -- | -- | -- | -- |
| 4785 | 91 | 3-30-64 | " | 0 | Bottom | 29° 40' | 88° 51' | 60 | 2355 | 5 | - | - | -- | -- | -- | 63 |
| 4789 | 91 | 4-01-64 | " | 24 | Surface | 28° 55' | 89° 27' | 50 | 0435 | 9 | Green | - | -- | -- | -- | 64 |
| 4790 | 91 | 4-01-64 | " | 20 | Bottom | 28° 55' | 89° 27' | 45 | 0555 | 9 | " | - | -- | 70 | -- | 64 |
| 4791 | 91 | 4-01-64 | " | 0 | Bottom | 28° 50' | 90° 00' | 60 | 1035 | 20 | Blue | Light chop | E 5-10 | 71 | 65 | 64 |
| 4792 | 91 | 4-01-64 | " | 0 | Surface | 28° 50' | 90° 00' | 45 | 1050 | 20 | " | " | E 5-10 | 70 | 65 | 64 |
| 4793 | 91 | 4-01-64 | " | 0 | Surface | 28° 42' | 91° 08' | 45 | 2005 | 8 | Green | " | SE 5-10 | 69 | -- | 65 |
| 4794 | 91 | 4-01-64 | " | 0 | Bottom | 28° 42' | 91° 08' | 45 | 2120 | 8 | " | " | SE 5-10 | 69 | -- | 65 |
| 4795 | 91 | 4-02-64 | " | 0 | Surface | 29° 10' | 92° 20' | 45 | 0635 | 7 | " | " | S -- | 66 | -- | 65 |
| 4796 | 91 | 4-02-64 | " | 2 | Bottom | 29° 10' | 92° 20' | 45 | 0750 | 7 | " | " | S -- | 66 | -- | 65 |

# Table 11.--Vessel "X" menhaden gill net stations

| Sta. | Cruise | Date | Gill net description | Catch | | Position | | Time fished | Time of set | Depth | Water condition | Sea condition | Wind direction & speed | Temperature Water | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Menhaden | Other | Latitude N. | Longitude W. | | | | | | | Air | Surface |
| | | | | Number | Number | | | Minutes | Hours | Fathoms | | | | °F. | °F. |
| A1 | A1 | 10-29-63 | 300'X10', 2-1/2" stretch mesh monofilament | 10 | 82 | 30° 21' | 88° 34' | 10 | 1000 | 1/2 | Clear | Calm | N 20 | -- | -- |
| A2 | A1 | 10-29-63 | " | 3 | 27 | 30° 21' | 88° 34' | 10 | 1020 | 1/2 | " | " | N 20 | -- | -- |
| A3 | A1 | 10-29-63 | " | 1 | 31 | 30° 21' | 88° 34' | 10 | 1040 | 1/2 | " | " | N 20 | -- | -- |
| 1 | 1 | 3-18-64 | 300'X10', 2-5/8" stretch mesh multifilament | 32 | 8 | 30° 18' | 88° 35' | 45 | 0935 | 1 | Moderate turbid | Slight chop | SE 10 | -- | -- |
| 2 | 1 | 3-18-64 | 150'X10', 2-5/8" stretch mesh monofilament | 95 | 25 | 30° 18' | 88° 35' | 50 | 0940 | 1 | " | " | SE 10 | -- | -- |
| 3 | 1 | 3-18-64 | 300'X10', 2-5/8" stretch mesh multifilament | 11 | 5 | 30° 18' | 88° 35' | 30 | 1130 | 2 | " | " | SE 10 | -- | -- |
| 4 | 1 | 3-18-64 | 150'X10', 2-5/8" stretch mesh monofilament | 110 | 6 | 30° 18' | 88° 35' | 30 | 1135 | 2 | " | " | SE 10 | -- | -- |
| 5 | 1 | 3-18-64 | 300'X10', 2-5/8" stretch mesh multifilament | 5 | 51 | 30° 21' | 88° 35' | 40 | 1410 | 1 | Very turbid | " | SE 10 | -- | -- |
| 6 | 1 | 3-18-64 | 300'X10', 2-1/2" stretch mesh monofilament | 7 | 70 | 30° 21' | 88° 35' | 40 | 1415 | 1 | " | " | SE 10 | -- | -- |
| 7 | 2 | 3-24-64 | 300'X10', 2-5/8" stretch mesh multifilament | 0 | 10 | 30° 21' | 88° 35' | 30 | 0910 | 1 | " | " | SE 8 | 68 | -- |
| 8 | 2 | 3-24-64 | 150'X10', 2-5/8" stretch mesh monofilament | 3 | 11 | 30° 21' | 88° 35' | 30 | 0920 | 1 | " | " | SE 8 | 68 | -- |
| 9 | 2 | 3-24-64 | 150'X10', 2-5/8" stretch mesh monofilament | 0 | 5 | 30° 21' | 88° 35' | 50 | 1000 | 1 | " | " | SE 8 | 68 | -- |
| 10 | 3 | 4-09-64 | 300'X10', 2-5/8" stretch mesh monofilament | 9 | 32 | 30° 18' | 88° 35' | 60 | 1215 | 1 | Clear | " | NW 6 | -- | -- |
| 11 | 3 | 4-09-64 | 300'X10', 2-5/8" stretch mesh multifilament | 2 | 0 | 30° 18' | 88° 35' | 60 | 1215 | 1 | " | " | NW 6 | -- | -- |
| 12 | 3 | 4-09-64 | 150'X5', 2-1/2" stretch mesh monofilament | 1 | 34 | 30° 18' | 88° 35' | 35 | 1228 | 1 | " | " | NW 6 | -- | -- |
| 13 | 3 | 4-09-64 | 150'X5', 2-1/2" stretch mesh monofilament | 0 | 26 | 30° 18' | 88° 35' | 15 | 1312 | 1 | " | " | NW 6 | -- | -- |
| 14 | 3 | 4-09-64 | 150'X5', 2-1/2" stretch mesh monofilament | 2 | 2 | 30° 21' | 88° 35' | 20 | 1436 | 1/3 | " | " | NW 6 | -- | -- |
| 15 | 3 | 4-09-64 | 300'X10', 2-5/8" stretch mesh monofilament | 71 | 19 | 30° 21' | 88° 35' | 30 | 1520 | 3 | " | " | NW 6 | -- | -- |
| 16 | 3 | 4-09-64 | 300'X10', 2-5/8" stretch mesh multifilament | 2 | 0 | 30° 21' | 88° 35' | 30 | 1520 | 3 | " | " | NW 6 | -- | -- |
| 17 | 4 | 4-16-64 | 300'X10', 2-5/8" stretch mesh monofilament | 196 | 32 | 30° 18' | 88° 35' | 60 | 1105 | 2 | Moderate turbid | " | E 15 | -- | 71 |
| 18 | 4 | 4-16-64 | 300'X10', 2-5/8" stretch mesh multifilament | 59 | 8 | 30° 18' | 88° 35' | 60 | 1105 | 2 | " | " | E 15 | -- | 71 |
| 19 | 5 | 4-23-64 | 150'X10', 2-1/2" stretch mesh monofilament | 51 | 16 | 30° 18' | 88° 35' | 35 | 1000 | 1 | " | " | SE 8 | 83 | 76 |
| 20 | 5 | 4-23-64 | 300'X10', 2-5/8" stretch mesh multifilament | 61 | 8 | 30° 18' | 88° 35' | 60 | 1030 | 1 | " | " | SE 10 | 83 | 76 |
| 21 | 5 | 4-23-64 | 300'X10', 2-5/8" stretch mesh monofilament | 279 | 19 | 30° 18' | 88° 35' | 60 | 1030 | 1 | " | " | SE 10 | 83 | 76 |
| 22 | 5 | 4-23-64 | 150'X5', 2-1/2" stretch mesh monofilament | 183 | 34 | 30° 18' | 88° 35' | 110 | 1110 | 1 | " | " | SE 10 | 85 | 76 |
| 23 | 5 | 4-23-64 | 300'X10', 2-5/8" stretch mesh multifilament | 3 | 12 | 30° 19' | 88° 35' | 40 | 1320 | 1 | Very turbid | " | SE 15 | 85 | 74 |
| 24 | 5 | 4-23-64 | 300'X10', 2-5/8" stretch mesh monofilament | 2 | 13 | 30° 19' | 88° 35' | 40 | 1320 | 1 | " | " | SE 15 | 85 | 74 |
| 25 | 6 | 5-06-64 | 4 - 300'X10' sections, 2-5/8", 2-3/4", 2-7/8", and 3" stretch mesh monofilament<br>1 - 300'X10', 2-5/8" stretch mesh multifilament | 584 | 174 | 30° 18' | 88° 35' | 100 | 1040 | 1 | " | " | SE 15 | 86 | 76 |
| 26 | 7 | 5-14-64 | 4 - 150'X10' sections, 2-5/8", 2-3/4", 2-7/8", and 3" stretch mesh monofilament<br>1 - 100'X5', 2-1/2" stretch mesh monofilament | 119 | 83 | 30° 18' | 88° 35' | 30 | 1045 | 1 | Moderate turbid | " | NW 8 | 75 | 75 |
| 27 | 8 | 5-18-64 | " | 0 | 101 | 30° 18' | 88° 35' | 45 | 0935 | 1 | " | Calm | E 3 | 80 | 77 |
| 28 | 8 | 5-18-64 | " | 31 | 53 | 30° 18' | 88° 36' | 45 | 1150 | 1-1/2 | " | Slight chop | E 10 | 81 | 77 |
| 29 | 9 | 5-26-64 | " | 0 | 89 | 30° 18' | 88° 35' | 30 | 0920 | 1 | Clear | Calm | SE 5 | 84 | 83 |
| 30 | 9 | 5-27-64 | 100'X5', 2-1/2" stretch mesh monofilament | 41 | 19 | 30° 22' | 88° 35' | 75 | 1145 | 5 | Moderate turbid | Slight chop | SW 15 | 90 | 81 |
| 31 | 9 | 6-03-64 | 4 - 150'X10' sections, 2-5/8", 2-3/4", 2-7/8", and 3" stretch mesh monofilament<br>1 - 100'X5', 2-1/2" stretch mesh monofilament | 0 | 46 | 30° 18' | 88° 35' | 45 | 1005 | 1 | Clear | " | NW 8 | 80 | 77 |

# Caribbean and Tropical Atlantic Exploratory Fishing and Gear Research Program, Pascagoula

By

J. R. Thompson
Assistant Base Director

Two cruises of the Oregon and one of the Silver Bay explored the Caribbean and tropical Atlantic areas during the fiscal year. The two Oregon cruises, one off Venezuela and one on the Caribbean coast of Colombia, completed the preliminary survey of the outer Continental Shelf and upper Slope zones of the central western Atlantic mainland from Cape Hatteras to southern Brazil. The Silver Bay cruise extended our Antillean explorations from the Bahamas to the outer coast of Hispaniola.

## SHELLFISH

Rough bottom conditions on the Continental Shelf were generally not favorable for shrimp trawling; best fishing was found off Colombia between Punta San Bernardo and Golfo del Darien where the Oregon located a 700-square-mile area with depths between 10 and 40 fathoms where shrimping could be carried out successfully. Two nights of fishing in this area with a double shrimp trawl rig (one 40-foot net and one 65-foot net) yielded about 540 pounds of heads-on shrimp and scattered brazilian shrimp. Elsewhere on the Colombian Shelf, shrimp catches were light.

Some trawlable bottoms were found in Golfo del Paria, where a search was made for South American white shrimp in cooperation with the Instituto Oceanografico, Universidad de Oriente, Cumana, Venezuela, and in the eastern half of the Caribbean coastal area of Venezuela, but shrimp catches were regularly light. Between Caracas and the Golfo del Venezuela the bottom was again rough and only small quantities of brown and brazilian shrimps were caught in the few successful drags.

Off Hispaniola, depths out to 110 fathoms were marked everywhere by very rugged bottom topography and heavy concentrations of coral, rock, and sponge. Commercial species of shrimps were taken in less than one third of the drags made between 25 and 100 fathoms, always in small numbers.

Royal-red shrimp were present in small numbers in all areas dragged in depths of 200 to 400 fathoms, with best catches being made off western Venezuela and south of San Marta, Colombia. Only scattered individuals were found off Hispaniola. Other deepwater shrimps taken in small numbers in all areas included the scarlet prawns. In addition, one drag in the Gulf of Paria yielded 25 pounds of scallops.

## BOTTOMFISH

A good potential snapper fishery, both lane and red snapper, was found off Colombia and Venezuela in depths less than 60 fathoms by shrimp trawl catches of from 10 to 50 pounds per drag. Fish trawling investigations must be made to obtain a better measure of the commercial potential of this resource.

Fish concentrations in deeper waters were light, with a noticeably lower concentration of whiting and hake than in the Gulf. Predominant fishes in royal-red shrimp depths and beyond were the grenadiers. Fish catches were light off Hispaniola.

## PELAGIC FISH

Efforts to catch pelagic fishes were restricted to two 60-hook longline stations off Hispaniola, trolling captures, and gill net sets. The two longline sets off Hispaniola caught only four whitetip sharks. Gill net sets, for tunas, were all unsuccessful, being largely gear trials rather than production sets. Trolling captures were made throughout the cruises.

## MISCELLANEOUS

An apparently uncharted flat-topped seamount was discovered about 30 miles east of Cozumel Island. The top leveled smoothly at 150 fathoms, covering an area of over 20 square miles. Extensive sounding transects were made of the area.

During the Colombia cruise, in cooperation with the National Geographic Society, a series of 500 bottom 35-mm. color photographs were taken along the 100-fathom curve in the northern Gulf of Mexico. A report of the cruise is scheduled for publication in the Explorer's Club journal.

## Faunal Survey Program, Pascagoula

By

J. R. Thompson
Assistant Base Director

The Faunal Survey Program is comprised of four projects: Automatic Data Processing and Analysis; Specimen Sorting and Distribution; Atlas Preparation; and Distribution Analysis. The program is quartered in the main Base building.

### AUTOMATIC DATA PROCESSING AND ANALYSIS

The purposes of this project are to maintain card files of field information from all programs, to provide summary type tabulations of often-requested information of use to industry and the scientific community, and to provide the information needed for the continued efficient production of faunal atlases and exploratory fishing and gear research information.

All files of information from the field were complete through the end of the fiscal year. Files contain currently about 16,000 station cards with 35 coded items of station information and roughly 200,000 species cards with 29 coded items (fig. 19).

A taxonomic code assuring retrieval by number of categoried information to the level of genus was punched into the cards during the fiscal year. This code is based on the FAO (Food and Agriculture Organization of the United Nations) code for phylum and family and on an arbitrary but functional and expandable generic code devised to fit particularly the local situation but also applicable to worldwide application. A locally devised species code, commensurate with the higher category codes, will be added in fiscal year 1965.

Delivery of a printer-tabulator in November 1963 completed the basic ADP unit (Stage II), and allowed the production of basic tabulated listings of species and station information, which in turn allowed a more systematic approach to the exploratory fishing endeavors and to answering routine requests from the industry. All shrimp exploration in the fiscal year was based on results of ADP tabulations, which showed gaps in previous coverage.

### SPECIMEN SORTING AND DISTRIBUTION

During the year, 116 lots of fishes and invertebrates (exclusive of plankton), containing over 7,000 individual specimens, were distributed to more than 100 specialists cooperating in the study and identification of exploratory specimens. Identifications received to date have made explorations much

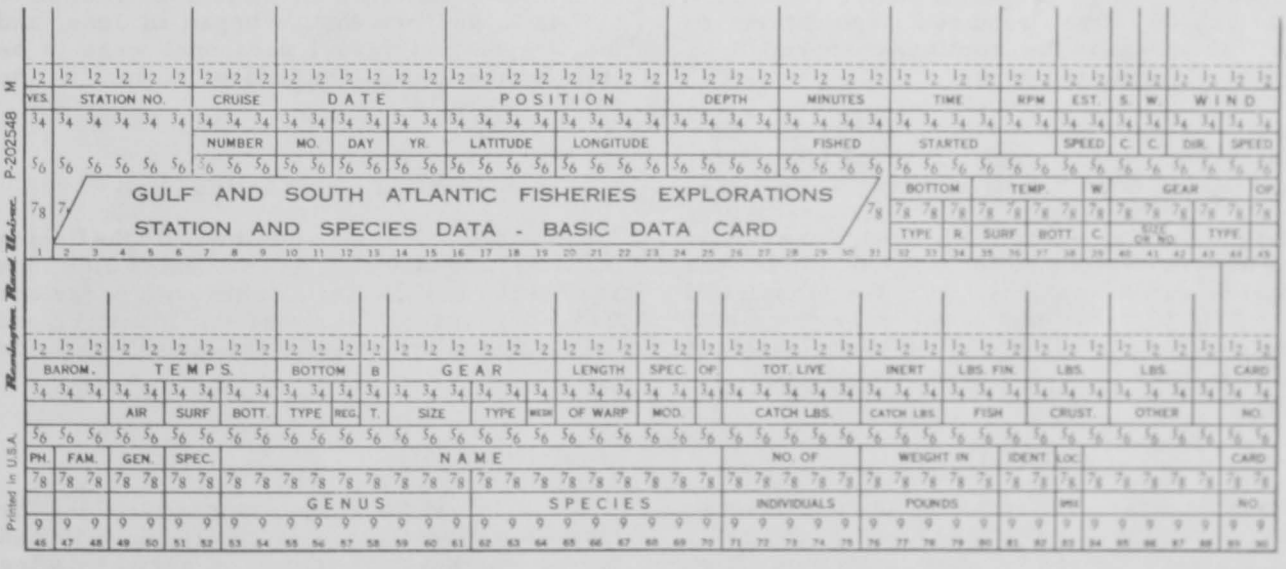


Figure 19.--Basic multipurpose ADP card. Columns 1-31 contain the same information on both station and species cards. Station cards are based on information entered in the upper row of items in columns 32-90; species cards are based on information entered in the lower row of items in columns 32-90.

more meaningful than they would otherwise have been.

## ATLAS PREPARATION

The Atlas Preparation Project has been occupied largely with the preliminary steps of selecting media for preparation of atlas-type presentations and culling the species studied for those that would best serve as models on which to pattern atlas portrayals.

A rough qualitative portrayal was made up of the foodfish trawl resources of the east coast of the United States. The rough portrayal was made in black and white, whereas the final products will be in colors to represent the seasons.

At the Branch Program Leaders' meeting at Old Point Comfort, Va., in April, it was agreed that a preliminary, one species presentation in color would be supplied the Washington Office by the end of August 1964. Rearrangement of Base facilities and redeployment of personnel will commence soon after the end of the fiscal year to allow us to meet this and future deadlines.

## DISTRIBUTION ANALYSIS

This project, which is not yet active, will take the data from the tabulator and the results of early atlas trials and combine them to produce zoogeographical and ecological descriptions of the area from North Carolina to southern Brazil in the Atlantic, Caribbean Sea, and the Gulf of Mexico. The project will provide a great deal of information for the fishery industry and the scientific community.

# South Atlantic Exploratory Fishing and Gear Research Program, Brunswick

By

Robert Cummins, Jr.
Program Chief

The South Atlantic Exploratory Fishing and Gear Research Program has continued to develop four basic objectives. These are: (1) to determine what kinds of marine animals can be taken by exploratory fishing in the area; (2) to determine the relative abundance of these animals; (3) to determine what species have a potential commercial value and; (4) to ascertain the availability of such species on a seasonal and geographical basis. To accomplish these aims required explorations in new areas and the continued appraisal of previously explored areas.

The program was continued in three projects: Shellfish Explorations, Bottomfish Explorations, and Pelagic Fish Explorations. Because it was known earlier in the fiscal year that the Silver Bay, an otter-trawler best suited to bottom trawling, was to be released from charter in June, we emphasized bottomfish explorations. With the transfer of the Oregon to the east coast in the new fiscal year, emphasis will be shifted to shellfish and pelagic fish explorations.

## FACILITIES

The charter contract for the M/V Silver Bay ended in June after 7 years of use by the Bureau. The Silver Bay underwent shipyard haulouts in August and June and was returned as received to the owners in Portland, Maine. The Silver Bay completed 5,748 exploratory fishing stations off the southeastern coast of the United States and in the Gulf of Mexico and Bahamas.

Renovation of the former St. Simons Light Attendant Station was completed. Personnel and equipment were transferred from Brunswick, and the offices were occupied.

Final approval of a long-term lease for land on the Intracoastal Waterway and construction authority for a temporary dock and warehouse were received in May. Construction of the dock and warehouse began in June, and the Oregon and vessel personnel were to be transferred from the Gulf of Mexico to the east coast in July.

## INDUSTRY DEVELOPMENTS

Close contact was maintained with the fishing industry in developing new fisheries along the southeast coast. On numerous occasions Branch personnel assisted the industry, and the exploratory vessel was often used for this purpose.

### Royal-Red Shrimp

Early in 1964 a vessel formerly fishing for industrial-fish in the Gulf of Mexico returned to the southeastern coast to begin trawling the Florida East Coast royal-red shrimp grounds previously located by Bureau exploratory fishing vessels. Production has been continuous, and weekly catches have been

about 40 to 80 boxes of heads-off shrimp. Landings are made at Port Canaveral and Mayport, Fla., and Thunderbolt, Ga. Some marketing problems have arisen, and the red shrimp sell for less than other commercial penaeid shrimps. The vessel uses double-rigged trawls. This operation is the first continuous successful effort at commercial red shrimp production.

## Black Sea Bass

A portion of one cruise was devoted to fish trapping off South Carolina where a small fishery for black seabass is developing. One to three dozen baited wire mesh crab traps are used depending on the size of vessel and crew. Trips are usually daily, and landings commonly range from 2,000 to 3,000 pounds or more. Vessels of various sizes are used; a small shrimp type vessel provides excellent deck space and maneuverability. Although primarily a winter fishery, some vessels continued trapping into late spring of 1964. Marketing problems are associated with new fish dealers and an easily glutted market. Landings are made in Mt. Pleasant, Georgetown, and McClellanville, and are sold either locally at Wilmington, or in New York, N.Y. The fishery now operates on only a few small fishing grounds near port.

## Calico Scallops

The development of mechanical scallop processing equipment by one organization has been continuous. A full-size production model scallop shucker and a scallop eviscerator have been fabricated in Brunswick, Ga., and installed in St. Augustine, Fla. Although this machinery was designed for shipboard use, trial tests have shown that it will do the job on shore. Trials have proven that both shucking and evisceration principles are entirely feasible commercially. Some modifications of a mechanical nature will doubtless continue with use. The primary effort by this firm is now being devoted to developing production facilities, locations, and associated arrangements.

Figure 20.--The former St. Simons Light Attendant Station renovated as an office for the South Atlantic Fisheries Explorations Program.

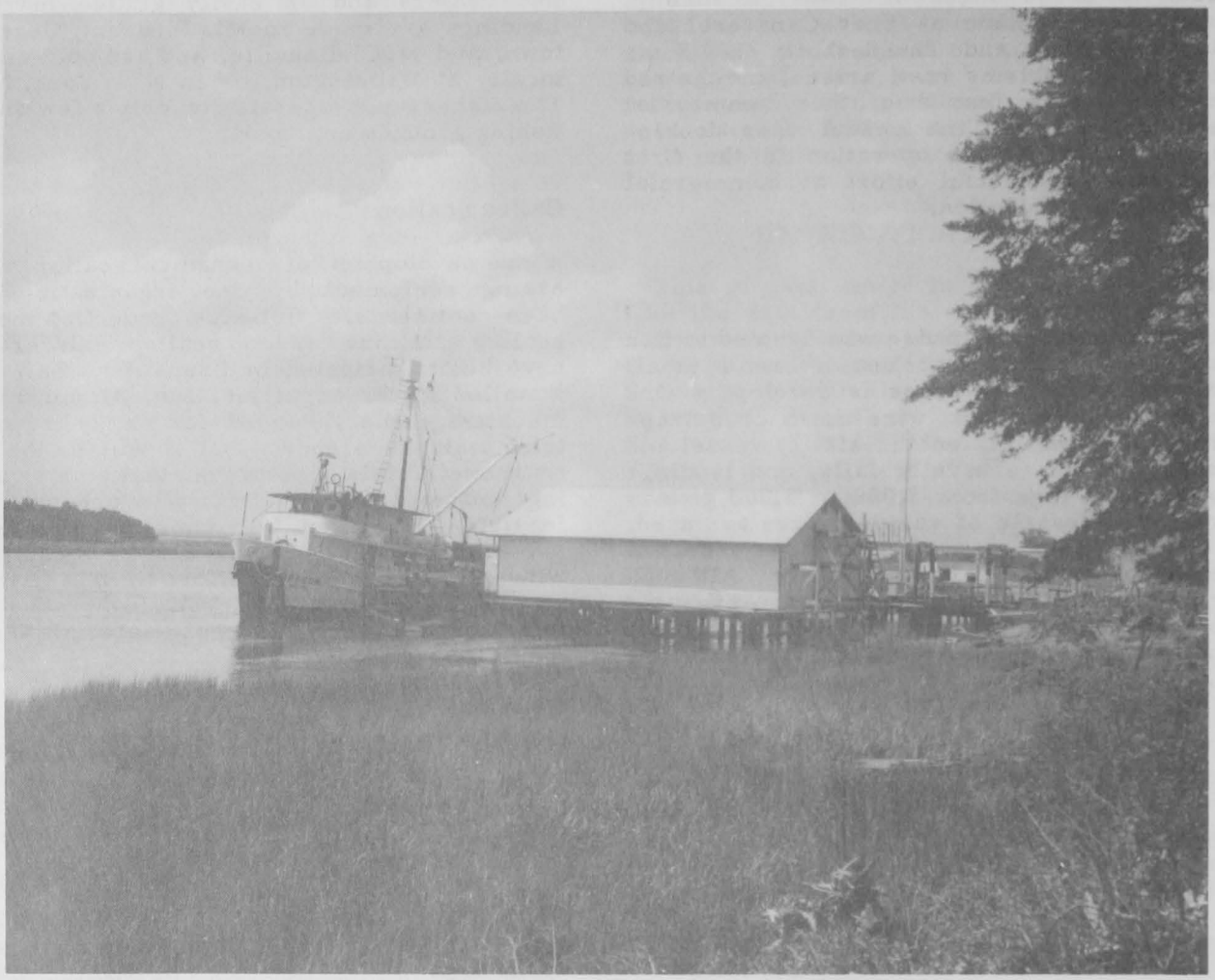

Figure 21.--The new dock and warehouse for the South Atlantic Fishery Explorations Program.

## BOTTOMFISH PROJECT

By

Paul J. Struhsaker
Project Leader

The R/V Silver Bay made five bottomfish trawling cruises during the past year. Much of the effort was devoted to basic surveys in areas that had received little investigation in previous years. These areas were primarily off Florida south of Cape Kennedy, off Georgia, and off North Carolina and South Carolina near the edge of the Continental Shelf. In addition, seasonal studies were made in several areas where previous Silver Bay cruises had indicated commercial trawling was feasible.

An exploratory trawling cruise was made off Georgia during December. Its primary purpose was to continue to collect information on the distribution, composition, density, and availability of bottomfishes in this area. A secondary purpose was to make a preliminary survey of the topographic features of this region in order to ascertain the extent of trawlable bottom and to determine if "broken-bottom" areas similar to those previously located off South Carolina and northern Florida exist off Georgia. More than 900 miles of transects were surveyed with a sonic fish detector. In three areas, moderate catches of commercial foodfishes were made off Savannah, Sapelo Island, and Cumberland Island. The most productive area was off Savannah in 35 to 40 fathoms where catches were dominated by the pink porgy. In the same area in 70 to 80 fathoms, catches of three and four thousand pounds of small (12 count) butterfish were made per 60-minute drag.

A 14-day cruise was completed off South Carolina during January. Its principal objective was to determine how available bottomfishes were to fish trawls in the winter. The

Figure 22.--A medium-sized bag of snapper, grouper, and ecologically associated species being swung aboard the Silver Bay.

Figure 23.--A 4,000-pound catch of small butterfish taken in 75 fathoms off Savannah.

secondary objective was to make preliminary trials with fish traps. Inclement weather hampered exploratory operations at this time. Most trawl catches were dominated by small (3 to 4 count) scup, which averaged 1,653 pounds per 1-hour drag. Moderate amounts of lutjanids and serranids were also taken in these drags. Nine stations with modified crab type and arrowhead fish traps were operated east of Cape Romain in 13 to 17 fathoms. Catches were generally small and ranged up to 70 pounds of black sea bass per trap per 3-hour set.

During February and March we made a basic fish trawling survey between Summer Haven and Jupiter Inlet, Fla. Trawling conditions were favorable throughout the area except at the edge of the Continental Shelf in 30 to 60 fathoms. Most catches were small; commercially important species were captured only occasionally. Extensive fish shoals were recorded off Summer Haven in 20 fathoms. Our trawling in this area caught as much as 8,000 pounds of filefish, 475 pounds of snappers, and 125 pounds of porgies per drag. This area is apparently the southern boundary of the extensive "broken bottom" area previously delineated by the Silver Bay off Northern Florida. Catches of from 750 to 1,500 pounds of small (2-4 count) spots, croakers, and other sciaenids were made off Cape Kennedy.

During March and April, we made a 22-day exploratory fishing cruise off North and South Carolina. The primary cruise objective was to conduct a seasonal fish trawling survey of Long, Onslow, and Raleigh Bays. Filefish dominated all catches inside 25 fathoms. Snappers and groupers were taken between 26 and 40 fathoms throughout the survey area. In one area off Cape Fear where dragging was productive an average drag caught 400 pounds of grouper, 300 pounds of gray triggerfish, 90 pounds of snappers, 50 pounds of hogfish, and 20 pounds of white porgies. The groupers caught were gag, scamp, and speckled hind. The snappers caught were red snapper, yelloweye snapper, mutton snapper, blackfin snapper, and yellowtail snapper. Three areas were located off Raleigh Bay near the edge of the Continental Shelf at which extremely heavy concentrations of bottomfishes were recorded on depth recorders. The bottom was untrawlable in these areas with the exploratory gear used, but small catches of the trawls and handlines demonstrated that shoals were comprised of black sea bass, red snapper, pink porgy, and vermilion snappers.

During May, a 20-day exploratory trawling cruise was made on the outer Continental Shelf of South Carolina, Georgia, and northern Florida. Results of trawling and sonic fish detection transects confirmed previous observations that the little utilized filefish is now the overwhelmingly dominant fish in 13 to 50 fathoms off this coast. Snapper and grouper were also taken in trawls throughout the survey area. Handlines fished 3 hours in 31 to 34 fathoms at lat. 32°21' N., long. 79°02' W., produced 1,425 pounds of speckled hind, gag, large red snappers, and amberjacks.

With this additional work completed during fiscal year 1964, we have completed the first phase of bottomfish explorations off the southeastern coast. The entire Continental Shelf from Cape Hatteras, to St. Lucie Inlet, Fla., has had a basic trawling survey.

A primary step in an ecological survey is to construct a preliminary description of the animal communities with which one is concerned. A comprehensive evaluation of the composition and distribution of the fish fauna off the southeastern coast of the United States is now under way with this objective in mind. This, in turn, will provide a better understanding of the commercial potential of the fish stocks of this area as a whole.

## SHELLFISH PROJECT

By

Floyd A. Nudi
Acting Project Leader

During four cruises in fiscal year 1964, we explored for calico scallops (Pecten gibbus) at 237 fishing stations on the Florida east coast in the 12- to 50-fathom depth range. A brief resurvey of the Cape Kennedy scallop grounds was made during September and October at the request of the commercial fishing industry. Catch rates were low throughout the area; dead shells comprised more than 90 percent of catches. Live scallops were predominantly 1 to 1-1/2 inches in diameter.

During November commercial quantities of scallops were found in an area roughly 10 miles long and 2 miles wide, centered at 28°30' N., in 26 to 27 fathoms of water. Here the average catch rate was 12 bushels of shell stock per 30-minute drag. The scallops in this area averaged 2 to 2-1/4 inches in diameter and yielded an average of 107 meats per pint.

During February and March the bed was sampled at several areas and shell stock was obtained for mechanical shucking tests. The scallop population had two size groups: The 2- to 2-1/4-inch mature commercial size group and the 1- to 1-3/4-inch maturing size group. As much as 4 to 5 bushels of commercial size shell stock was taken per 30-minute drag, with dead shell again dominating the catches.

Two underwater camera stations were made on the Cape Kennedy scallop bed during Cruise 54. An Edgerton CA-8 still camera

Figure 24.--Part of a 9,000-pound catch of filefish taken off northern Florida.

mounted on an aluminium sled and equipped with electronic flash units was used to expose 200 feet of 35-mm. black and white film. The resulting photographs clearly reveal the orientation of the scallops to the substratum and should aid in future gear development.

Deepwater shrimp explorations off the southeastern coast were limited to 18 stations on the royal-red shrimp grounds east of St. Augustine to Daytona Beach during February. Catches were low, ranging from 0 to 70 pounds of royal-red shrimp (21 to 46 heads-on count) per 3-hour drag. During this cruise the self-contained Edgerton still camera was used and 500 feet of 35-mm. black and white film were exposed at five underwater camera stations in the 200- to 225-fathom depth range.

Incidental, nighttime catches of rock shrimp were made with large-mesh fish trawls in several areas off the Florida east coast in March. Best catches were made in 20 fathoms east of St. Lucie Inlet where up to 110 pounds of 31-36 count (heads-on) shrimp were taken in a 90-minute drag. A 40-pound catch was made in 14 fathoms east of Hetzel Shoal.

## PELAGIC FISH PROJECT

By

Joaquim B. Rivers
Project Leader

No pelagic fish explorations were scheduled for fiscal year 1964. We observed numerous near-bottom, midwater, and surface schools of fishes while we were doing other phases of the exploratory program. Larval and juvenile fishes were sampled at the surface with dip nets, 1-meter nets, and midwater trawls. Personnel of the Bureau's Biological Laboratory, Brunswick, Ga., are studying most of these collections. Off the north coast of Hispaniola in October, two short longline sets, for tuna, made only small catches of sharks.

## Gear Research Progam, Panama City, Panama

By

Fred Wathne
Program Chief

The program has emphasized the field testing of a prototype electrical shrimp trawl and continued studies of the burrowing habits and electrical response of pink shrimp. Work on trawl mechanics instrumentation, begun last year, has been deferred in favor of electrical trawl field tests.

Initial field tests with the electrical trawl demonstrated that this gear was capable of taking shrimp that were not available to standard trawls during daylight hours. Tests have been made under two general types of conditions: (1) soft mud bottom where shrimp were taken with standard gear in significant quantities during daylight and (2) mud-sand bottom where shrimp were not taken in standard gear during daylight. The geographical areas worked include St. George Sound (Carrabelle, Fla.), off Cape San Blas, and the Key West-Tortugas grounds.

Generally, results on both bottom types were similar in two respects. The electric gear caught significantly more shrimp during daylight than the standard trawl, but not all the shrimp that were available (the average catch on standard gear at night). On the harder mud-sand bottom, daylight catches with the experimental gear ranged to 60 percent, but were usually only 10 percent to 20 percent of the shrimp available.

Indications are that electricity stimulates the shrimp to move out of the bottom, but significant numbers avoid the trawl. Direct observations indicate this avoidance results

Figure 25.--An electrical trawl using longitudinal electrodes.

from the shrimps lying on their sides immediately after clearing the bottom. Subsequent electrical pulses then move them laterally rather than up into the water. This problem is now under study.

The preliminary electrical response experiments have been completed, and a publication is in preparation. Electrodes and pulse width are the two factors which most significantly affect the shrimps response levels at normal water temperatures (20° to 30° C.).

The burrowing behavior work has revealed that this pattern under a normal environment is influenced largely by light level. We have not been able, however, to acquire instrumentation sensitive enough to measure shrimp light-threshhold levels.

## GEAR DEVELOPMENT PROJECT

By

John K. Holt and David G. Wotherspoon
Fishery Methods and Equipment Specialists

The immediate aim of this project is to develop and demonstrate a functional electrical trawling system for use on present shrimp grounds. Factors considered as evidence of successful demonstration are an increase in catch large enough to justify additional costs and a system that can be handled about as easily as conventional trawls.

Six field trips using a prototype electrical shrimp trawl have been made during the year. Testing was conducted on two general types of bottom: soft mud bottom where shrimp were taken with standard gear in significant amounts during daylight and harder mud-sand bottom where shrimp were not taken in standard gear during daylight.

A 30-foot trawl with 6-foot doors was towed from the starboard outrigger. The electrical trawl was fished simultaneously on the port side. Drags were 1 hour long. Night drags were primarily to determine the approximate quantity of shrimp available in the area.

The electrical gear was very effective during daylight on soft mud bottom, but relatively ineffective on harder sand-mud bottom (tables 12 and 13).

We have investigated a number of factors in our attempt to explain the contrasting catches on the two types of bottom. The first factor was adequacy of electrical stimulus. Increasing field strength, pulse width, and pulses per shrimp did not significantly affect results on hard bottom. Installing a mechanical tickler chain behind the electrode array did not improve the catch, nor did the use of transverse electrodes (longitudinal electrodes were used initially). The relative cohesiveness of the two general bottom types was another factor, for we assumed that the shrimp may be able to "break-out" of one easier than the other. Cohesiveness, however, does not appear to have a significant influence.

Observations on natural occurring shrimp, i.e., shrimp that had not been previously captured and transplanted, revealed that when the electrical trawl first affected them, they cleared their burrows and moved on their sides. Subsequent pulses caused them to move laterally and very close to the bottom rather than up into the water. This response was similar with slow and fast pulse rates and with longitudinal and transverse electrodes. Because this response would permit almost all of the shrimp to escape under the footrope of a normally operating trawl and because it was not the typical response observed either in aquaria or with static electrodes in the field, we attempted to create a response that approximated "normal" behavior rather than design a trawl to fish closer to the bottom. The first attempt was to incorporate a mechanical tickler behind the electric array. The shrimp did not respond to the tickler chain as we had assumed they would, i.e., with a strong vertical hop. Instead, they merely rolled over or passed under the chain as it moved by them. These actions agree with our results as mentioned above. These observations were made, however, during daylight in clear water on shrimp that had just been electrically stimulated from their burrows, and it is probable that they would respond differently at night.

We next attempted to make a close contact between the bottom and the electrode. We theorized that when the electrode was somewhat off bottom rather than on the bottom it provided a stimulus that caused the shrimp to "roll" in an attempt to avoid the electrical field. Observations were made with both longitudinal and transverse electric arrays weighted heavily to obtain as close contact as possible. This weighting may have reduced the problem somewhat; however, most shrimp responded as before.

Observations in somewhat turbid water indicate the lateral response may be a natural avoidance of exposure in clear water--an instinctive desire to get back into the bottom. In turbid conditions, shrimp move higher off the bottom and remain de-burrowed for longer intervals.

## SHRIMP BEHAVIOR STUDIES

By

Charles M. Fuss, Jr.
Project Leader

Shrimp behavior studies have continued with emphasis on learning more of the burrowing habits of the pink shrimp and their responses to electrical stimuli. In addition,

Table 12.--Results of electrical shrimp trawling, George M. Bowers Cruise 48, Phase I--soft bottom, October 1963

| Date | Tow No. | Shrimp Catch | | Remarks |
|---|---|---|---|---|
| | | Electrical trawl | Standard trawl | |
| 1963 | | Pounds | Pounds | |
| Oct. 16.... | 2 | 30 | 12 | |
| 16.... | 3 | 26 | 15 | |
| 16.... | 4 | 40 | 34 | Twilight |
| 16.... | 5 | 33 | 30 | Night |
| 16.... | 6 | 25 | 21 | Night |
| 17.... | 7 | 30 | 11 | |
| 17.... | 8 | 34 | 9 | |
| 17.... | 9 | 36 | 13 | |
| 17.... | 10 | 28 | 14 | |
| 17.... | 11 | 15 | 12 | Power off |
| 18.... | 12 | 25 | 8 | |
| 18.... | 13 | 19 | 12 | Power off |
| 18.... | 14 | 22 | 8 | |
| 18.... | 15 | 25 | 9 | |

Table 13.--Results of electrical shrimp trawling, George M. Bowers Cruise 48, Phase I--mud-sand bottom, October 1963

| Date | Tow No. | Shrimp catch | | Remarks |
|---|---|---|---|---|
| | | Electrical trawl | Standard trawl | |
| 1963 | | Pounds | Pounds | |
| Oct. 19.... | 17 | 6 | 0 | |
| 19.... | 18 | 8 | 0 | |
| 19.... | 19 | 0.75 | 0 | Electrode line parted |
| 19.... | 20 | 3 | 3 | Night |
| 20.... | 21 | 0.5 | 0 | |
| 20.... | 22 | 3.0 | 0.5 | |
| 20.... | 23 | 24 | 23 | Night |
| 20.... | 24 | 20 | 23.5 | Night |
| 21.... | 25 | 2.5 | 0 | |
| 21.... | 26 | 4.5 | 0 | |
| 21.... | 27 | 1 | 0 | |
| 21.... | 28 | 2 | 0 | |
| 21.... | 29 | 3 | 0 | |
| 21.... | 30 | 1.5 | 0 | |
| 21.... | 31 | 10.5 | 11 | Night |

we have devised methods and facilities that enable us to observe how captive pink shrimp move off bottom and how they react to bottom water currents. Field observations continue to play an important role in all of these investigations.

During fiscal year 1964 the behavior of shrimp was studied in St. Andrew Bay and at Tampa Bay in the vicinity of Egmont Key. A survey by swimmers in the area directly east of Egmont Key located five bottom types (sand, sand-shell, sand-silt, silt-clay, and bottom with a heavy growth of turtle grass (Thalassia) and manatee grass (Syringodium)) in relatively shallow and clear water. We made observations in this area when conditions were unsatisfactory in St. Andrew Bay owing to turbidity and low salinities following heavy rains and surface runoff.

Additional equipment and facilities acquired or installed during the reporting year include a shallow water observation chamber (previously described in the Fiscal Year 1963 Annual Report), an Industrial Instruments Salinity Recorder, an electronic thermometer, a low-level light meter, a shallow water diving bell, and a 600-square-foot area to hold shrimp for observations. The observation chamber (fig. 26) was installed during the first quarter of this year adjacent to the dockside behavior laboratory. The U.S. Army Corps of Engineers provided a barge, crane, and tug to assist station personnel in the installation of the chamber. Four 8-inch screw anchors were used to anchor the chamber, which displaces about 5,000 pounds. Two holding cages are placed on the bottom in front of each of the two viewing ports. The diving bell (fig. 27) was fabricated with assistance from personnel of the U.S. Navy Mine Defense Laboratory and tested during R/V George M. Bowers cruise 47. The bell consists of an angle-iron frame with the upper portion covered by Plexiglas. Surface-supplied air from a low-pressure compressor prevents water from entering the Plexiglas "hood," thus creating an ideal refuge for underwater swimmers to exchange information without


Figure 26.--Underwater observation chamber at Behavior Facility.

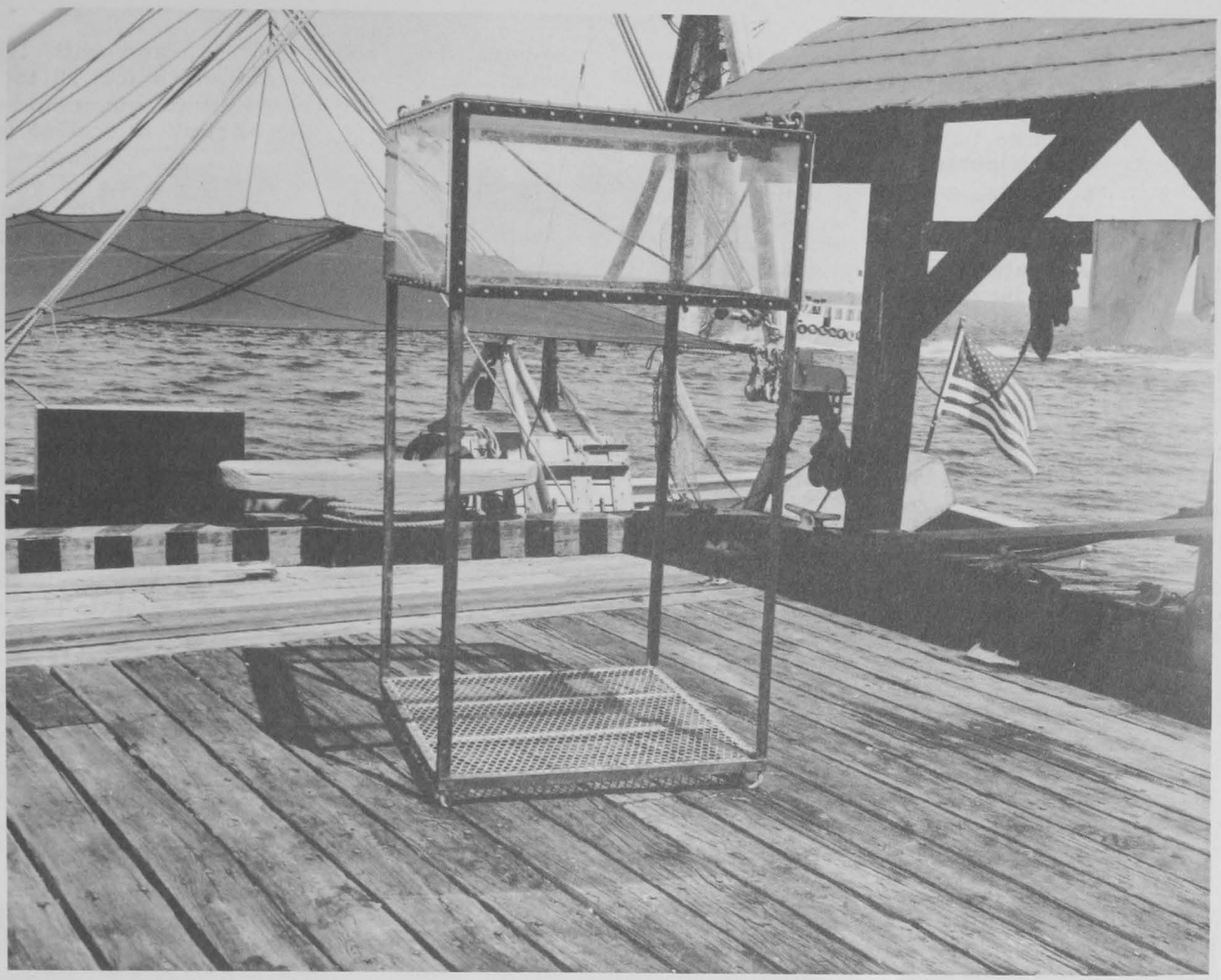

Figure 27.--Shallow-water diving bell.

returning to the surface, and thereby conserving their SCUBA air supply. The bell provides a platform for taking movies and has promises as a means of observation in future behavior studies.

A short film entitled "Shrimp behavior as related to gear research and development" was presented at the 16th annual session of the Gulf and Caribbean Fisheries Institute in November, and a paper on the burrowing behavior of pink shrimp was published in the March issue of the Bulletin of Marine Sciences of the Gulf and Caribbean.

## STUDIES ON THE BURROWING HABITS OF THE PINK SHRIMP (Penaeus duorarum)

By

Charles M. Fuss, Jr.
Fishery Biologist

Initial studies on this phase of the Shrimp Behavior Project were summarized in a paper entitled, "Observations on burrowing behavior of the pink shrimp, Penaeus duorarum Burkenroad," published during this fiscal year. Studies have continued with particular emphasis on the effects of light and temperature as factors regulating burrowing activity. Observations were made from the underwater observation chamber or by placing shrimp in covered aquaria on the behavior facility dock.

A method was devised for obtaining detailed information on the depth and posture of burrowed shrimp, similar to the procedure described by Chesher (1963, Bull. Mar. Sci. Gulf Caribbean 13(4):549-573) in his studies on the burrowing sea-urchin Moira atropos. In cardboard containers, shrimp are allowed to burrow in bottom material, and the anterior-posterior axis of the burrowed animal is marked with small dowels. The container is aerated for about 1 hour, while the shrimp is allowed to settle in his burrow and establish normal respiration. The container with the shrimp is then placed in a freezer and frozen solid. Decreasing temperature usually does not cause the shrimp to leave its burrow. After freezing, the

container is cut along the anterior-posterior axis with a power saw, thereby producing a sagittal section of the burrowed animal. One-half of the frozen burrowed shrimp and its sediment is then cut in transverse sections to obtain a fairly complete picture of a burrowed shrimp (fig. 28).

During the colder months, underwater and aquarium observations have indicated a direct relation between decreasing water temperature and the night activity of pink shrimp, as might be expected. The effect of temperatures below about 57° to 61° F. seems to mask or modify the expected night behavior patterns previously noted and related to bottom light intensity. Below about 57° F. the shrimp tend to remain burrowed regardless of light level. Figure 29 shows the effect of low water activity of pink shrimp. The animals were placed in aquaria and covered at night to eliminate ambient light, and the temperature was partially controlled by submersible heaters. The extent of activity above 57° F. is clearly seen as is the effect of light (or absence of light) when the hoods are removed from the aquariums or are placed on the aquariums. At low temperatures, even when light is eliminated, activity is severely restricted.

To determine the effects of fatigue on activity, shrimp are placed in covered aquaria and observed hourly in a dark room. With temperatures above 65° F. and with light absent, activity was continuous for 18 to 42 hours before the effects of fatigue could be noted. When tired, the shrimp burrowed into the substrate.

Preliminary observations on the effect of water current as a possible orientation factor in the burrowing habits of pink shrimp indicate that a positive directional orientation may be expected when water currents exceed about 0.5 knot.

A "burrow angle protractor" (fig. 30) is used to measure the angle resulting from the intersection of the water current axis and the anterior-posterior axis of the burrowed shrimp. Individual measured shrimp are released about 3 feet above the bottom and kept under surveillance by a diver until the shrimp burrows. The point of origin of the protractor is placed directly over the tip of the tail of the burrowed shrimp. The protractor is then oriented by using the current tell-tale (a piece of nylon string with a stabilizer at the tip to dampen yaw) so the Y-axis of the instrument and the axis of the current coincide. The angle of burrowing is then measured to the nearest 5 degrees by lining up the indicator arm of the protractor with the anterior-posterior plane of the burrowed shrimp. Burrowing angle is recorded as degrees left or right of the water current axis. A current

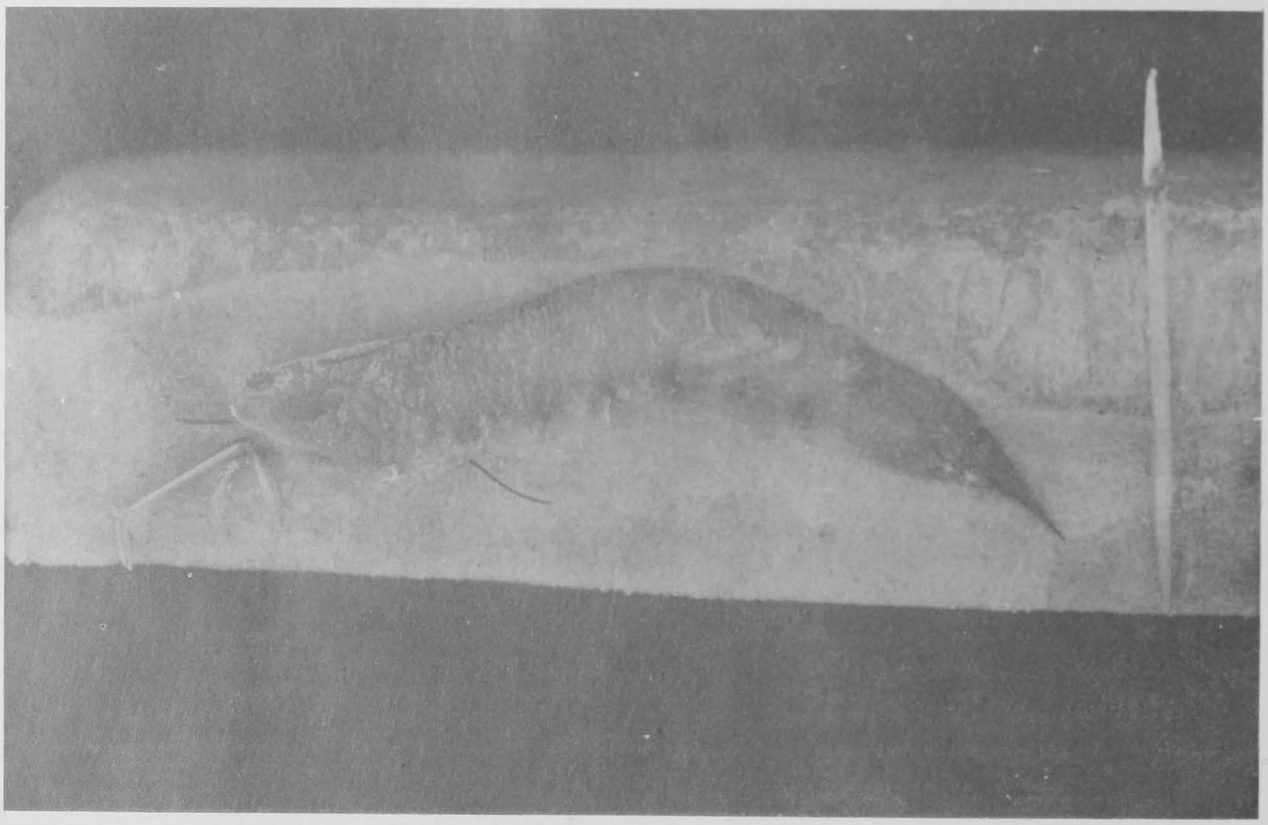

Figure 28.--Frozen sections of a burrowed shrimp.

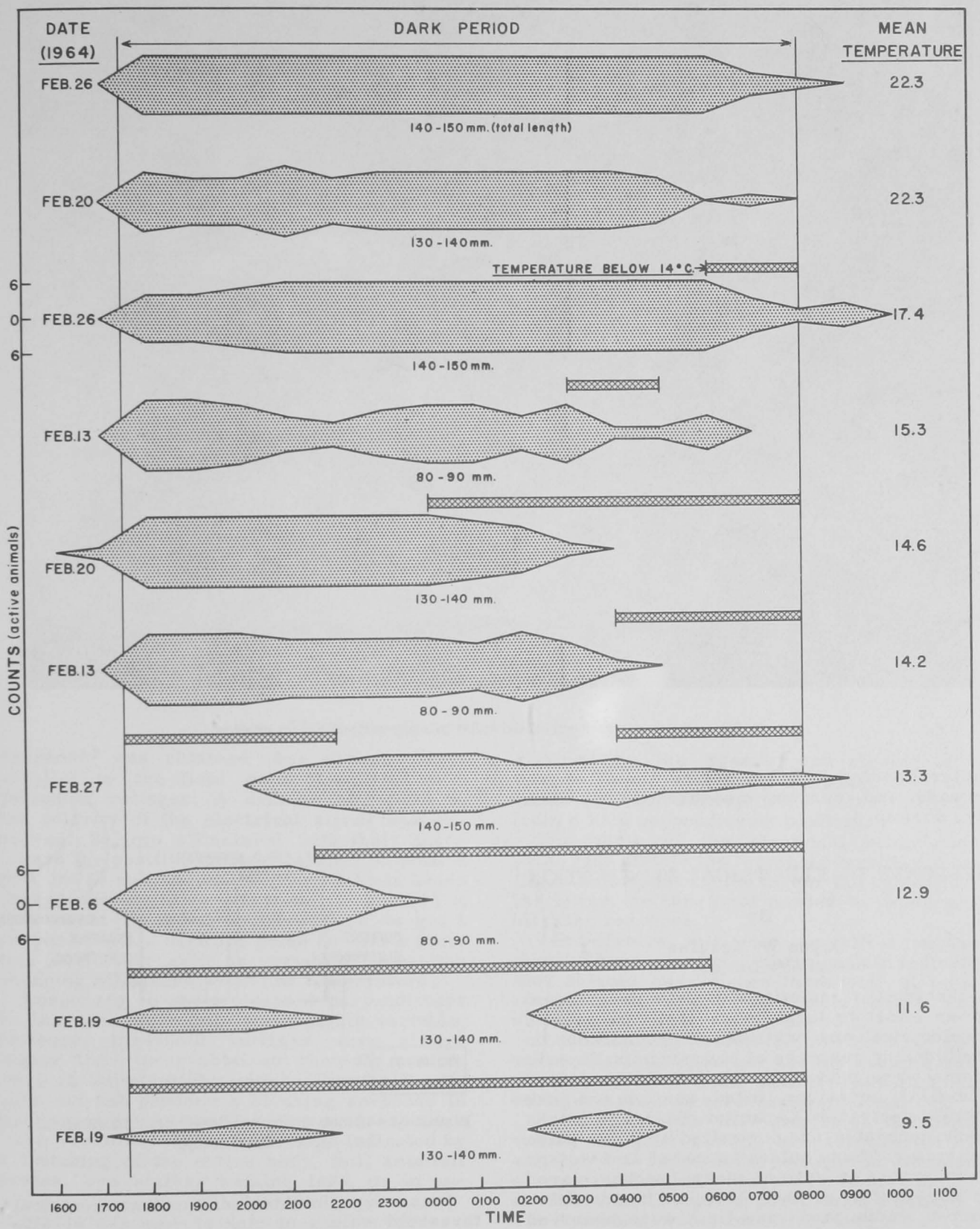


Figure 29.--The effects of light and low water temperature on night activity of the pink shrimp.

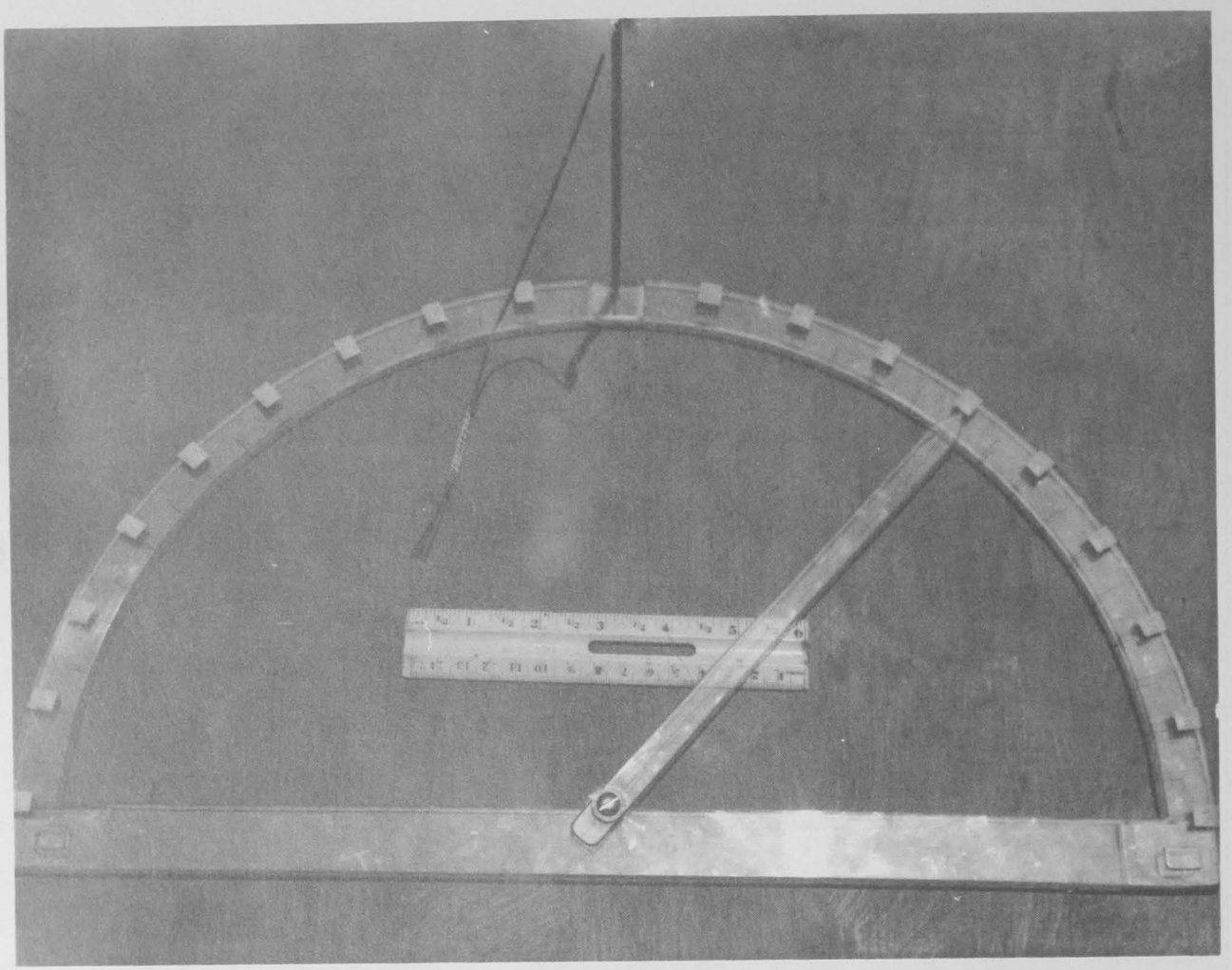

Figure 30.--Burrow angle protractor used in shrimp orientation studies.

meter reading is taken before and after the release and burrow measurement of each five shrimp.

## RESPONSE TO ELECTRICAL STIMULATION

By

Doyne W. Kessler
Fishery Biologist

Electrical stimulation studies were continued in an effort to learn more about the effects of electrical and environmental conditions on the blocking response of pink shrimp. Experiments were made in an 18- by 18- by 30-inch Plexiglas aquarium, fitted at each end with monel electrodes. Capacitor discharge pulses were generated and controlled by a d.c. pulse generator. These pulses appeared as a voltage drop across a pair of pickup probes placed in the center of the electrical field. Pulse height, width, and rise time were observed with an oscilloscope connected to the pickup probes (figs. 31 and 32).

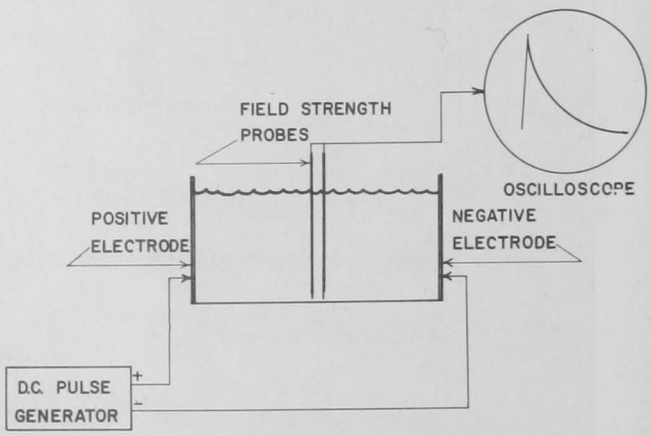


Figure 31.--Block diagram of electrical stimulation experimental setup.

These experiments indicate that electrical threshold values of pink shrimp are greatly affected by the position of the shrimp relative to the electrical field. A typical blocking

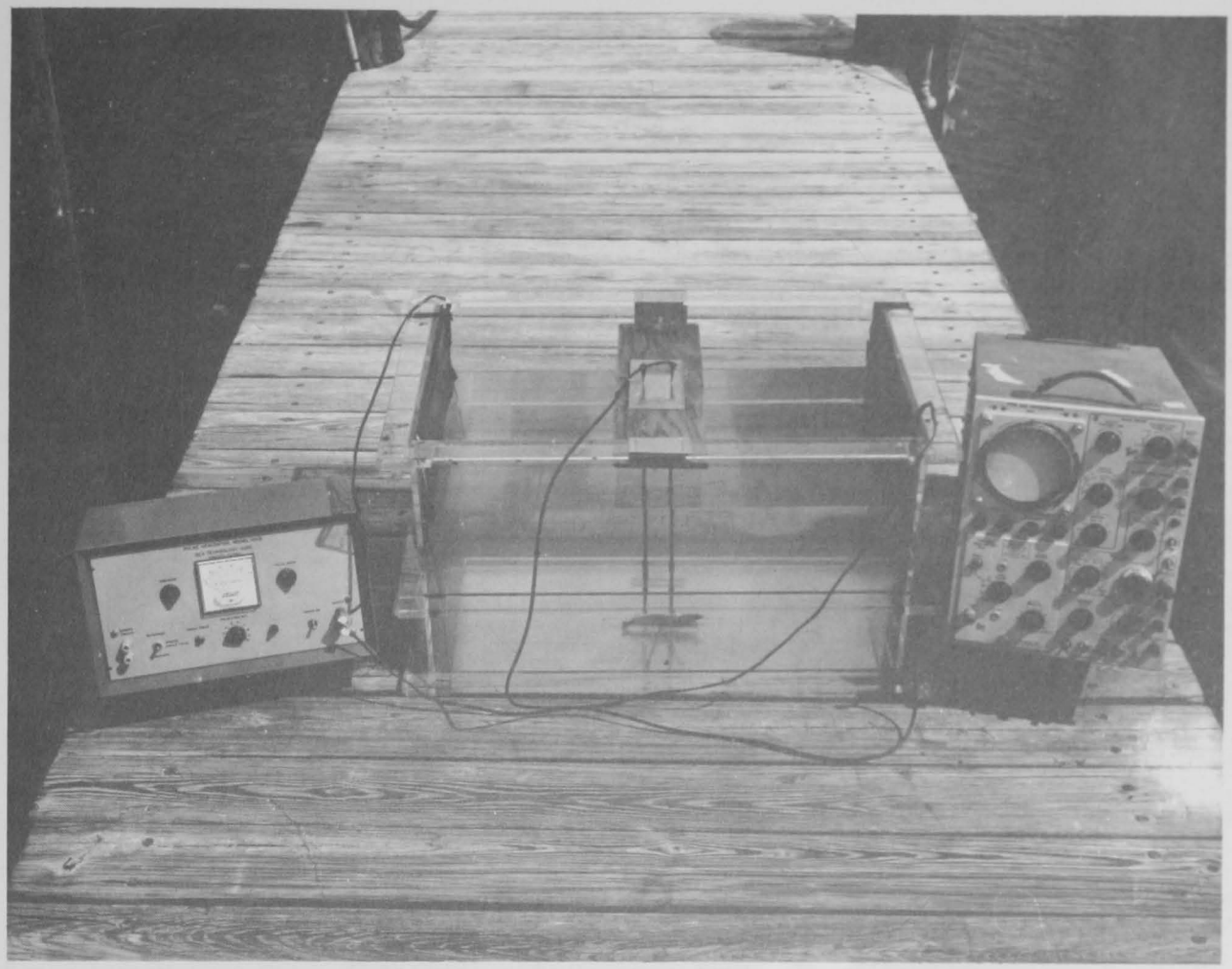

Figure 32.--Electrical stimulation equipment.

response[3] was obtained when shrimp placed parallel to the field were stimulated with threshold voltages. A definite effect due to the polarity of the electrical signal was observed. Shrimp stimulated with their heads toward the positive electrode always responded to a lower voltage than those with their heads toward the negative electrode. In general it took about twice as much voltage to get a response with a negative pulse as with a positive one. This ratio is variable, apparently changing with pulse width and temperature.

Responses in shrimp placed perpendicular to the electrical field were highly variable; however, threshold voltages were always higher than those obtained when the shrimp were in the parallel position. Threshold voltages did not produce a blocking response in the perpendicular position. Types of responses were variable, but were usually indicated by a twitching of the entire body, tail, antennal scales, eye stalks, walking legs, or in one instance by the opening and closing of a single claw. A blocking response was obtained if the shrimp were turned slightly from a true perpendicular position.

The width of the electrical stimulation pulse also affects the threshold response value (fig. 33). In general, the higher the pulse width the lower the threshold needed to produce a blocking response.

Temperature also has an effect on the threshold values of pink shrimp. Data indicate that shrimp have higher thresholds at temperatures above and below their normal environmental temperatures (fig. 34).

Size also has an effect on the threshold value of shrimp. Smaller shrimp subtend less of the electrical field, thus it takes a higher voltage to produce a response (fig. 35).

Results indicate that electrical threshold values for pink shrimp are not affected by salinity or fatigue. No change in average electrical threshold was observed for shrimp at 20, 30, and 40 parts-per-thousand salinity. The threshold value of shrimp fatigued overnight was about equal to that of shrimp burrowed for the same period of time.

[3] An escape reaction consisting of hops produced by contractions of the abdominal muscles.

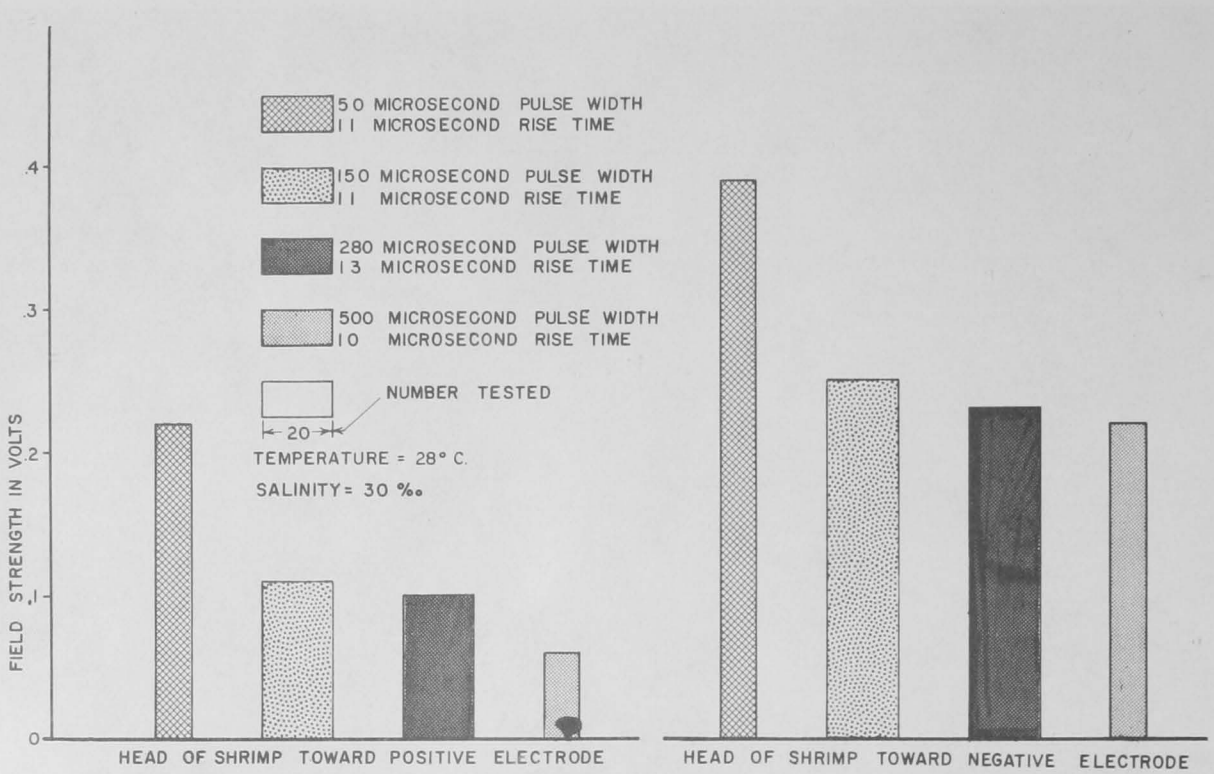


Figure 33.--Pulse width versus electrical threshold voltages of pink shrimp.

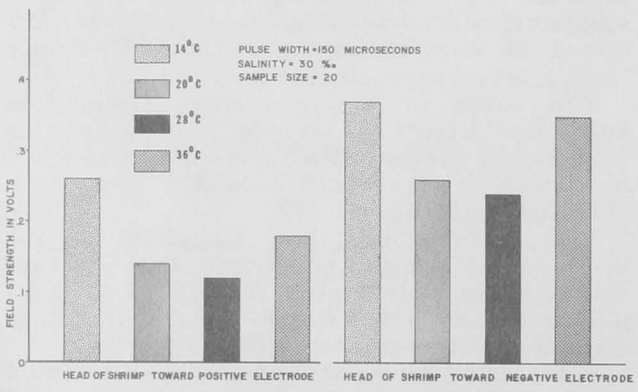


Figure 34.--Temperature versus threshold voltages of pink shrimp.

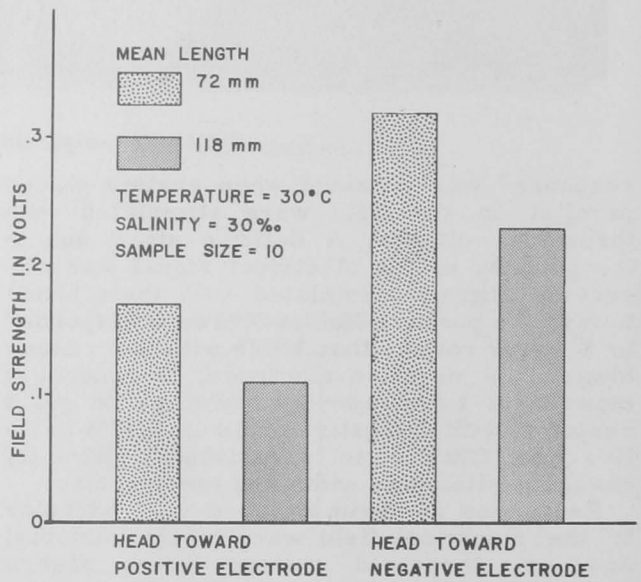


Figure 35.—Size versus threshold voltages of pink shrimp.

# BCF/AID Panama Spiny Lobster Project, Panama City, Panama

By

Norman L. Pease
Project Leader

Owing to a high degree of local interest in the work performed during the first year of operations, the original 1-year agreement with Agency for International Development (AID) for spiny lobster work in waters of the Republic of Panama was extended and work continued through December.

Field work during the second year was limited to the Gulf of Panama, where the Pelican made two cruises. The first of these cruises (cruise 15) was devoted largely to production-type lobster trapping; the second (cruise 16) was devoted largely to lobster trawling.

## LOBSTER TRAPPING

Cruise 15 was designed to simulate a one-boat, two-man trap-fishing operation with a string of 200 traps to demonstrate to the local population that a small-scale, self-sustaining commercial operation was feasible. Using information obtained during exploratory work in the preceding year, we set the traps along the coast of the northwestern portion of the Gulf of Panama and around the small islands therein.

One half the traps were hauled, rebaited, and reset each day. Daily catch rates varied widely--from 20 to 109 pounds of lobsters. Total catch during the cruise was 1,066 lobsters weighing 1,458 pounds. But once the traps, which were new at the beginning of the cruise, had remained in the water sufficiently long enough to become "seasoned," daily catch rates leveled out at an average of 87 pounds. This "post-seasoning" average catch represents slightly more than 3 pounds of lobsters per trap per week and compares favorably with expected yields under good fishing conditions in Florida waters. Thus, the cruise indicated that a commercial fishery, at least on a small scale, would be feasible.

## LOBSTER TRAWLING

The region selected for lobster trawling lay in 5 to 10 fathoms between Rio Mar and San Carlos, where previous Pelican work had indicated that trawls might prove successful. Because the bottom there is composed of rock, with overlying growths of low coral, rollers were attached to the footrope of the trawl. With the use of rollers and heavy chafing gear, all but the most insignificant gear damage was avoided.

Catches ranged from 10 to 210 pounds per drag; however, in contrast to the trap catches, the trawl catches were composed of about 60 percent sand lobsters (Evibacus princeps). These lobsters rarely enter traps, and although local fishermen were acquainted with them, they had attached no commercial importance to them. The sand lobsters are not as rigidly confined to rough-bottom areas as are spiny lobsters and hence are more readily taken by trawls.

When the lobster project ended, three private lobster fishing operations were in various stages of development. One company had converted a 33-foot diesel vessel for the fishery; another was completing a lobster pound; and a third had purchased a vessel to convert to lobstering.

## MISCELLANEOUS RESULTS

A routine function of exploratory fishing is the gathering of information concerning all of the fauna observed in the course of routine operations. During the spiny lobster operation we caught numbers of bay scallops up to 65 pounds and of marketable red snapper per drag. We relayed these results to the fishing industry.

In the case of the scallop information, industry response was almost immediate. Four shrimp trawlers, sent to the area where the Pelican had obtained several bushels of scallops in a bait trawl, caught more than 23,000 pounds of whole scallops in their shrimp trawls. A local shrimp plant rapidly converted a portion of its facilities for 24-hour scallop-handling operations, and more than 300 persons were employed within a short time to process, pack, and freeze the scallop meats. Within a short time, there were 15 trawlers, with crew averaging six men, working the beds. A change in gear from trawls to 6-foot metal dredges doubled the production rates of the vessels. In the first 2 months of operation, 658,161 pounds of whole scallops were landed.

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# Appendix

## Cruises of Oregon and Silver Bay

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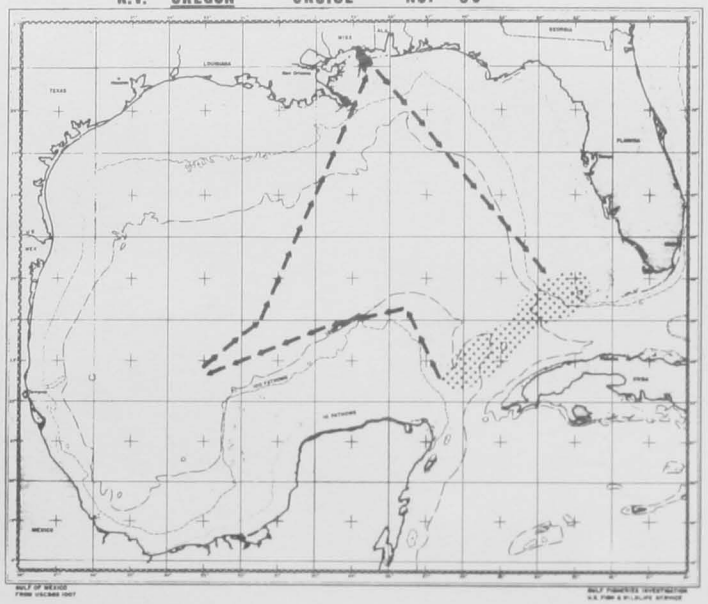

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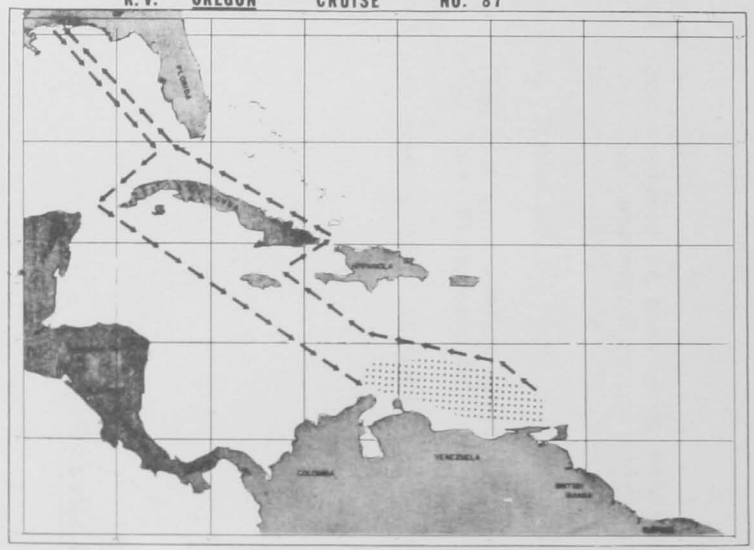

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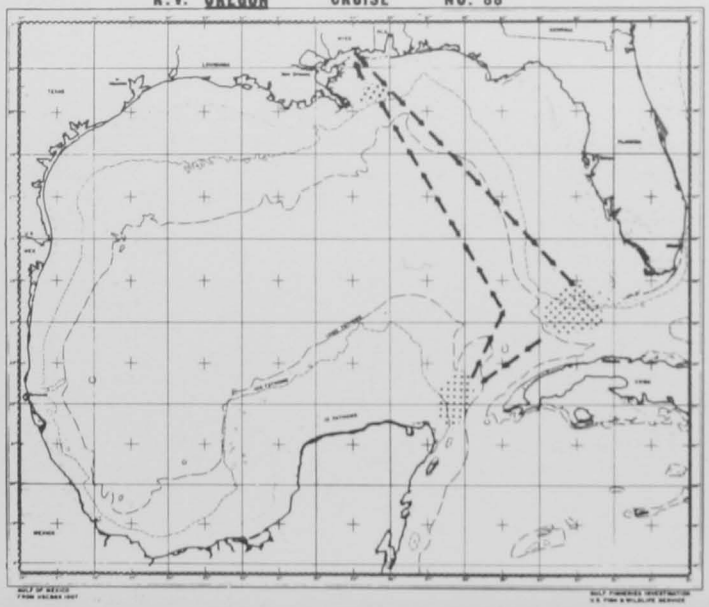

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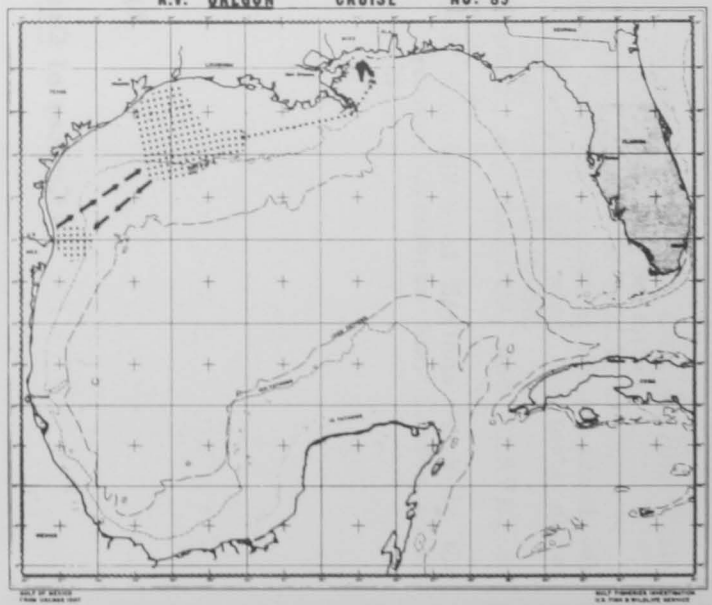

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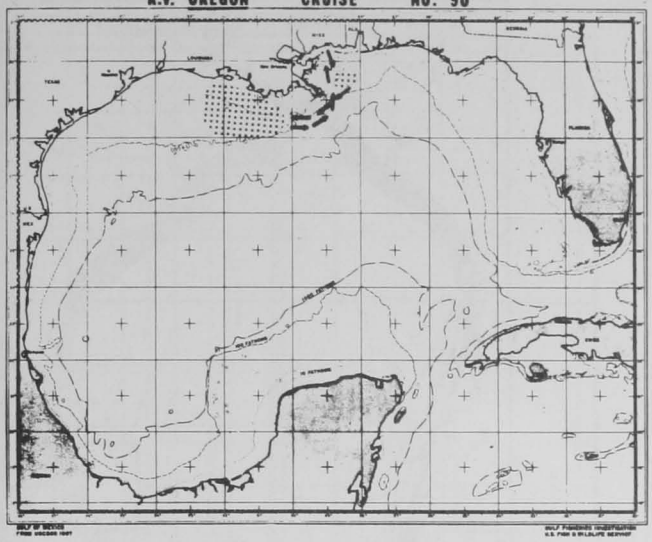

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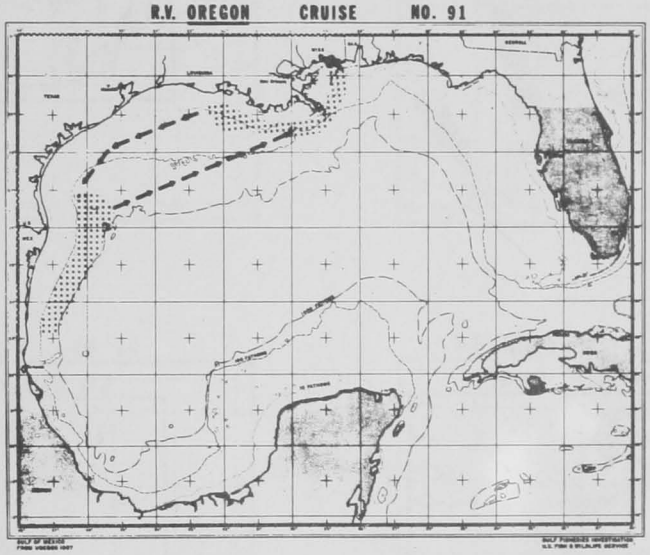

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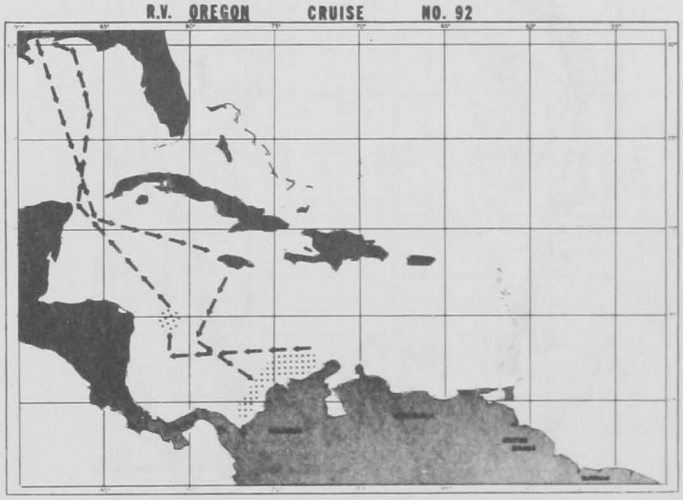
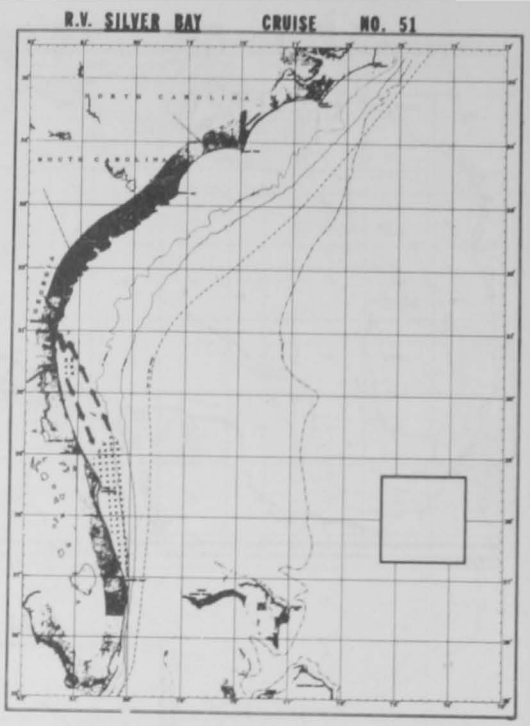


R.V. SILVER BAY CRUISE NO. 50

R.V. SILVER BAY CRUISE NO. 51



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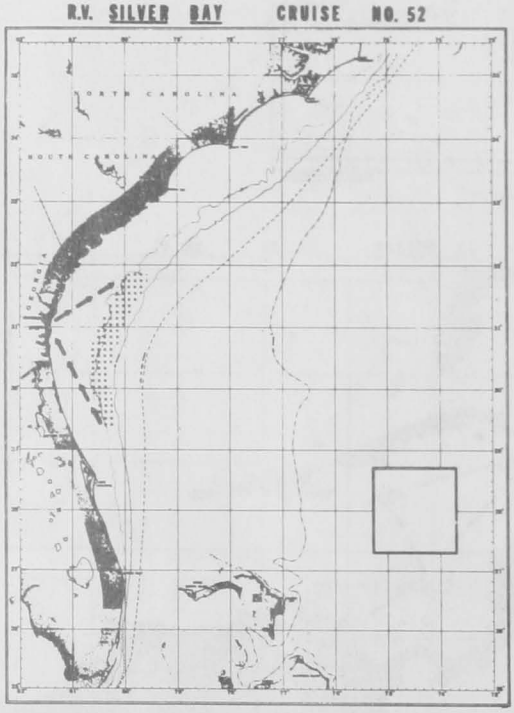

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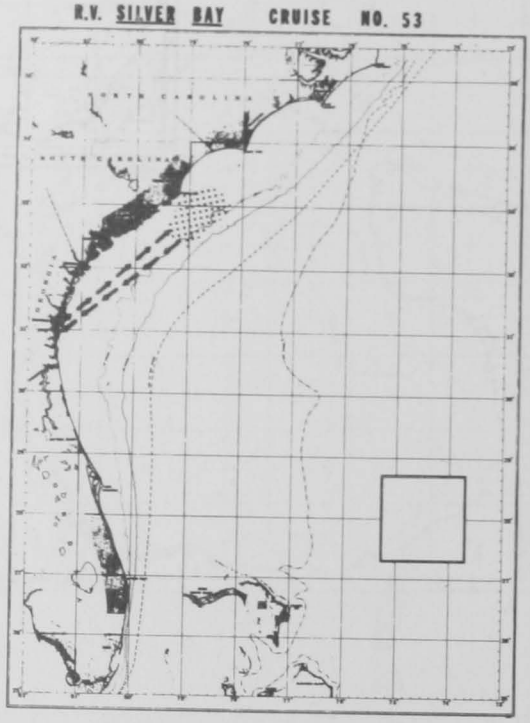

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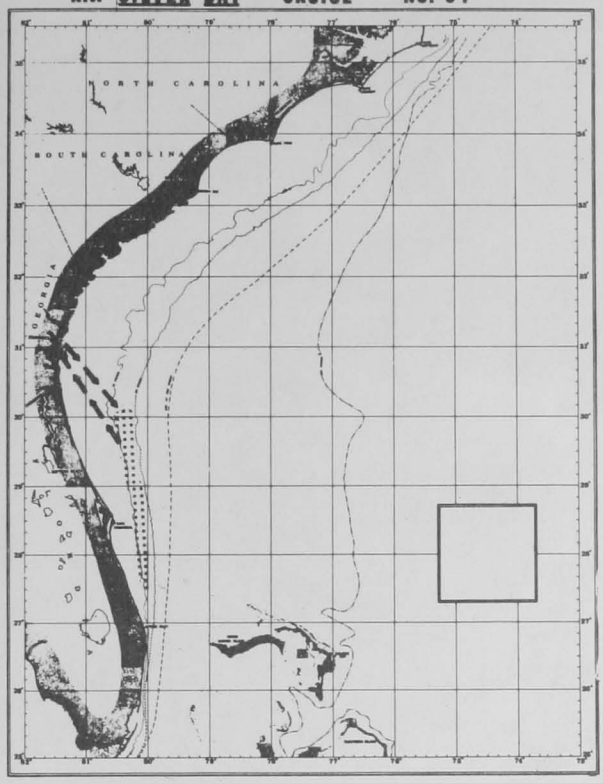


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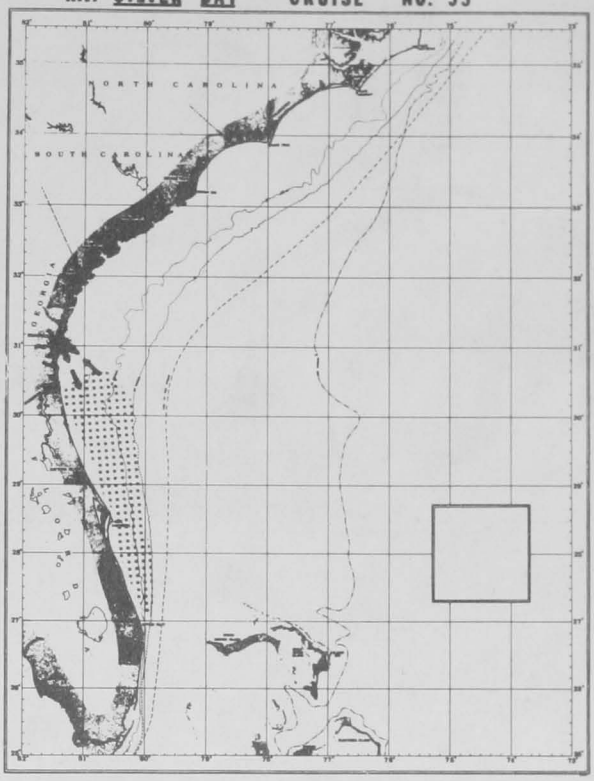


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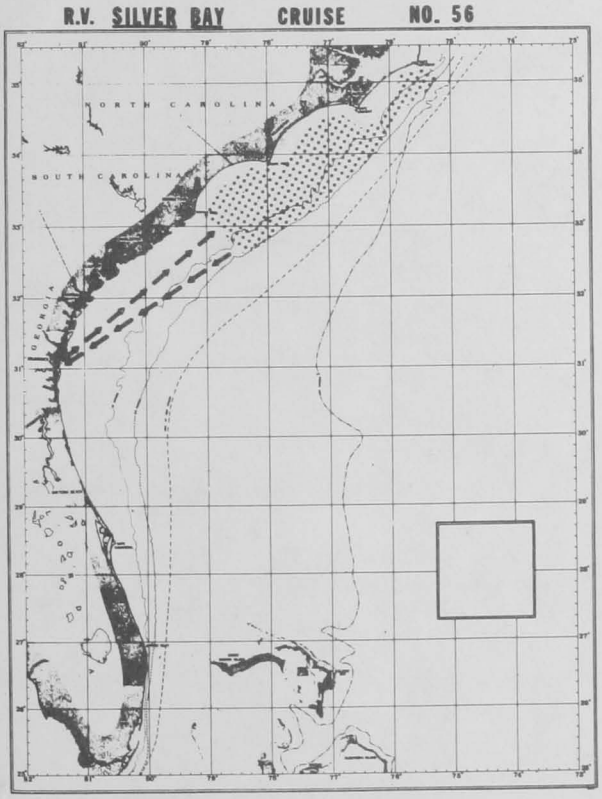


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