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EXPLORATORY SHRIMP FISHING IN THE GULF OF MEXICO, 1950-51 (Progress Report)

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INTRODUCTION

Shrimp exploration received the major emphasis in activities of the exploratory fishing vessel Oregon, operated by the Branch of Commercial Fisheries, U. S. Fish and Wildlife Service, since July 1950. The purpose of the explorations during the latter half of 1950 and in 1951 was to locate concentrations of marketable shrimp outside the range of the existing fishery, to outline the extent of good shrimp-fishing areas and the seasons of best fishing in these areas, and to adapt or develop practical gear designs and methods to meet any new conditions found. The emphasis on shrimp exploration and shrimp-gear studies followed the recommendations of the Gulf States Marine Fisheries Commission, but secondary projects also were undertaken and will be reported separately.

Many considerations influenced the plans of the operation. The first objective was to explore as wide an area of the Gulf of Mexico as possible and to work intensively only in the areas that seemed to offer promising possibilities for immediate commercial exploitation. During this period of preliminary coverage it was economical and expedient to obtain as much exploratory data as possible not only on shrimp but on other potential fishery resources as well.



FIG. 1 - M/V OREGON, EXPLORATORY FISHING VESSEL OPERATED IN THE GULF OF MEXICO BY THE SERVICE'S BRANCH OF COMMERCIAL FISHERIES.

This is consistent with the long-range program for investigation of the fishery

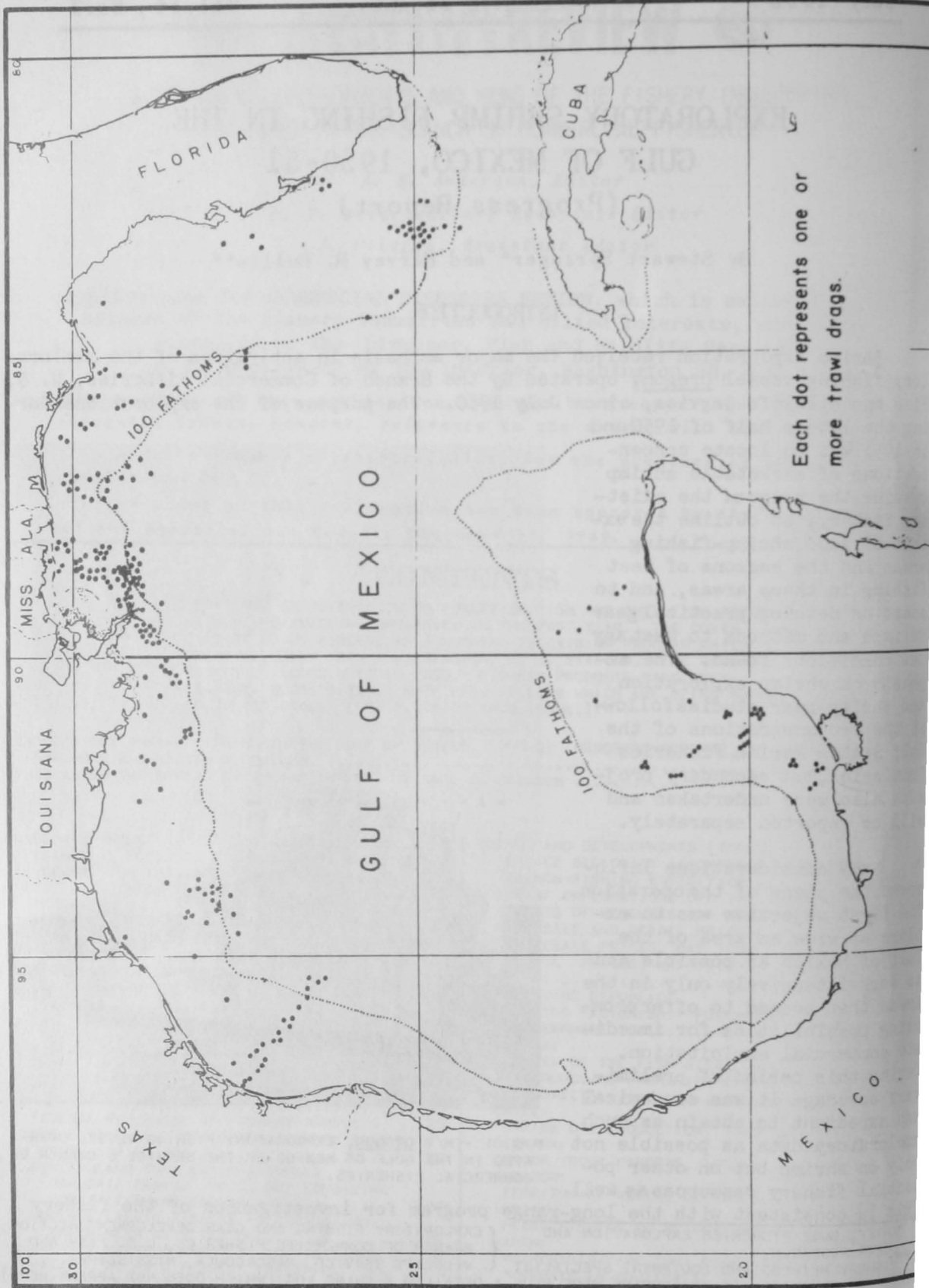
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NOTE: THIS ARTICLE AS IT APPEARS HERE PLUS A DETAILED FISHING LOG (WHICH DOES NOT APPEAR HERE), ALSO IS AVAILABLE AS FISHERY LEAFLET 406.



resources of the Gulf. An important part of the results of the explorations is the basic information assembled, which will facilitate planning future effective exploratory work.^{1/} Snapper-fishing spots have been included because, in general, these are rocky or coral-covered locations where shrimp trawling would probably result in lost gear. These locations should be avoided by shrimp trawlers. On the other hand, snapper-fishing spots frequently mark the location of "lumps" or small seamounts where repeated observations have shown that surface-feeding fish, such as little tuna, congregate, and which consequently might be expected to be better than average places for trolling or gill-netting surface fish.

A brief account of recent developments in the Gulf of Mexico shrimp fishery and a descriptive summary of initial Gulf explorations by the Oregon have been given by Springer (1951a and 1951b). The purpose of this report is to outline the progress made in shrimp exploration and summarize the data obtained. Separate reports will be made of explorations for other fishery resources.

GEOGRAPHICAL AND SEASONAL DISTRIBUTION OF EXPLORATION

The 1950-51 explorations covered the major areas of potential shrimp-trawling bottom in the Gulf. However, the drags were widely separated both as to geographical position and season. Unworked grounds near the principal regions of



FIG. 3 - TWO LARGE LOGGERHEAD SPONGES FROM OREGON STATION 232. THIS SPECIES IS COMMON ALL ALONG THE FLORIDA WEST COAST AND CONSTITUTES ONE OF THE MAJOR TRAWLING HAZARDS IN THAT AREA. ^{1/}AN ILLUSTRATION OF THE WAY IN WHICH INFORMATION COLLECTED DURING ONE TYPE OF FISHING CAN BE USED IN ANOTHER IS CONTAINED IN THE FISHING LOG (TABLE 1). THE FISHING LOG (TABLE 1) IS NOT INCLUDED HERE, BUT APPEARS AS AN APPENDIX TO THE FISHERY LEAFLET (NO. 406) ISSUE OF THIS REPORT.

shrimp production received special attention. Much of the available time was devoted to work near (but outside) the known shrimp grounds off the mouth of the Mississippi River, off the Texas coast, near Dry Tortugas, and in the Gulf of Campeche. Although the distribution of exploratory drags was extensive (see fig. 2), large areas received scanty coverage. In general, these areas are difficult to work either because they are remote from fishing ports or because the nature of the bottom causes excessive loss to conventional trawling gear. The use of special gear, which has now been developed, is expected to facilitate the exploration of rough bottom during 1952. This gear consists chiefly of small, inexpensive, and expendable nets and dredges to be used in connection with bottom samplers for the first examination of unknown bottoms. It is expected that adaptations of mud ropes, rollers, bottomless nets, and other devices to full-size commercial gear can then be tried in selected areas without excessive loss.

Drags were made by the Oregon in depths up to 500 fathoms, but the greatest number were made in the 20- to 60-fathom range. A large number of drags were made at night because catches of grooved shrimp are generally larger at night. Cruise plans for exploration in 1952 call for fishing in various parts of the Gulf at times that should give more information on seasonal changes in conditions.

GEAR USED

Several types of trawls were used by the Oregon in the shrimp-exploration program, and most of the commonly accepted designs were tried on a variety of bottom conditions, employing many minor modifications in rigging. Some of these trawls are described by Bullis (1951). Trawls were obtained from various trawl makers in the Gulf area or were built by the netmen aboard the vessel. Standard 8-foot to 12-foot try nets were used at the beginning of the exploratory-fishing program, but since the relationship of results with the try nets and with the larger nets seemed to be particularly difficult to establish, the try nets were subsequently used only to secure unrecorded additional information while working with larger nets.

A 40-foot flat trawl was used chiefly for first trials on unknown bottom. This net has been extremely valuable both for its simple construction and good fishing ability. From time to time other styles of nets were reduced in size to 40-foot models and used for this purpose, with somewhat less desirable results. A 40-foot balloon trawl was found to consistently "choke-off" at the throat, building up the catch in the body of the trawl and then tearing through the lighter webbing. By changing body tapers and wing designs this could be corrected; but it was observed that as the design improved it rapidly lost its identity as a balloon trawl and assumed many of the differentiating characteristics of the flat trawl. This same tendency has been noted in experimental designs which have been tried throughout the past year.

When good shrimp-fishing grounds were located and fairly good bottom was encountered, drags were made with the larger, standard trawls. A 100-foot flat trawl, a 74-foot balloon trawl, and a 65-foot wedge-shaped flat trawl were used in this way after August 1950. The catches from this gear gave a fairly accurate picture of what commercial boats might be expected to catch if fishing on the grounds. The different-style trawls were used to see if there was a noticeable difference in catch rate and to find out if one type was more suited to work a particular kind of bottom. Attempts to select the best "catcher" have been inconclusive. In the areas of very good fishing, such as the Dry Tortugas grounds, there was no appreciable difference between the 74-foot balloon trawl and the 100-foot flat trawl in pounds of shrimp per hour. The balloon trawl caught more trash fish and less bottom "trash," such as shells and sponge, and the catch of shrimp was generally in better condition than catches taken by the flat trawl.

Comparisons of the effectiveness of nets are very difficult to make even when most of the factors of difference can be determined. For example, several comparative pairs of drags were made in the same place, using a 40-foot flat trawl and a 100-foot flat trawl. The 40-foot net caught approximately two-fifths as much material in 30 minutes as the 100-foot net caught in 30 minutes. But since the vessel traveled 2 nautical miles dragging the 40-foot trawl for 30 minutes and only $1\frac{1}{4}$ miles dragging the 100-foot trawl for 30 minutes, the convenient relation established between the two sizes appears to be coincidental. Since 4 knots is the slowest practical speed for the Oregon with a 40-foot net, a reduction in speed could be made only with an additional drag against the vessel. Operating two 40-foot nets at the same time from opposite sides of the vessel was tried, and it worked satisfactorily. Comparison of the effectiveness of nets, however, have not been made in sufficient number to permit evaluation of the various rigs. Each rig combination (net, doors, cables, and boat) not only has an optimum working speed but is selective to a considerable degree. Trawling is often prevented by such obstacles as sharp coral, heavy growths of loggerhead sponges and shell, and soft mud which quickly bogs the trawl and doors. Even exploratory sampling was not feasible over coral and loggerhead-sponge bottom because of gear losses. Several variations of a bottomless trawl were made for the loggerhead-sponge area off the Florida coast and in first tests the new design eliminated up to 95 percent of the sponges. A series of comparative drags made in the Campeche area in August 1951 showed that the bottomless net caught slightly fewer shrimp, but the catch was nearly free of bottom "trash." Gear experimentation will be continued in 1952.

DRAGGING DATA AND SHRIMP-FISHING METHODS

At the start of the explorations for shrimp, a standardized procedure was set up for recording data. A fishing log has been extracted from these data to give a summary of each major shrimp-dragging operation. As the work progressed, new problems appeared requiring more or different information about the results of the drags. A complete tabulation of data is beyond the scope of this report, but pertinent information will be summarized in a final report.

Charts made by recording echo depth sounders illustrate some of the bottom conditions encountered by shrimp trawlers. Charts A and B in figure 4 show extremes in irregularity of soft-mud bottom near the mouth of the Mississippi River. Large catches of white shrimp are made by the shrimp fleet in the vicinity of these mud lumps, but a great amount of gear is lost by bogging in attempts to make drags in the areas where the irregularities are most pronounced. Charts C and D in figure 4 are characteristic of the "edge" where slopes of the continental shelf are steep. Frequently the "edge" is rocky, and the pinnacle (station 174, shown in chart C, figure 4) is coral-covered and a fair location for red-snapper fishing. A drag made over relatively smooth bottom with a steep slope (shown in chart D, figure 4) was unsuccessful because the net was overturned and twisted, evidently by the irregular currents in the vicinity. A drag made in a similar situation nearby loaded up with shell and heart urchins, resulting in damage to the net. Very often the irregularities in the bottom are noticed on the depth-sounder chart in time to save gear from damage by obstructions. Chart A of figure 5 shows an obstruction at the right of the center which was not noticed in time, and a part of a trawl was lost at that point (station 145). The differences between good trawling bottom and poor trawling bottom are not always apparent on depth-sounder charts. Chart B in figure 5 shows good trawling bottom while the similar-appearing bottom in chart C was covered with fine spikes of coral, which shredded nets in a very short time. The interference represented by a roundish area just above the bottom line in chart D in figure 5 probably is produced by shrimp or fish. The interpretation of depth-sounder interference patterns requires practice and a

wealth of experience that permits verification of the interpretation by catching the fish or at least by seeing them. In one instance, near Dry Tortugas, the appearance of the depth-sounder chart suggested that the Oregon was running at full speed onto an uncharted shoal, although the sounding lead showed 9 fathoms. Schools of herring-like fishes were seen soon after, but specimens could not be taken. This is as near as we have come to the identification of fish as a cause for depth-sounder interference in the Gulf.

At the beginning of the shrimp exploration little equipment was on hand for a detailed survey of bottom conditions for shrimp and shrimp trawling. Work on this has been started and will be reported in the future.

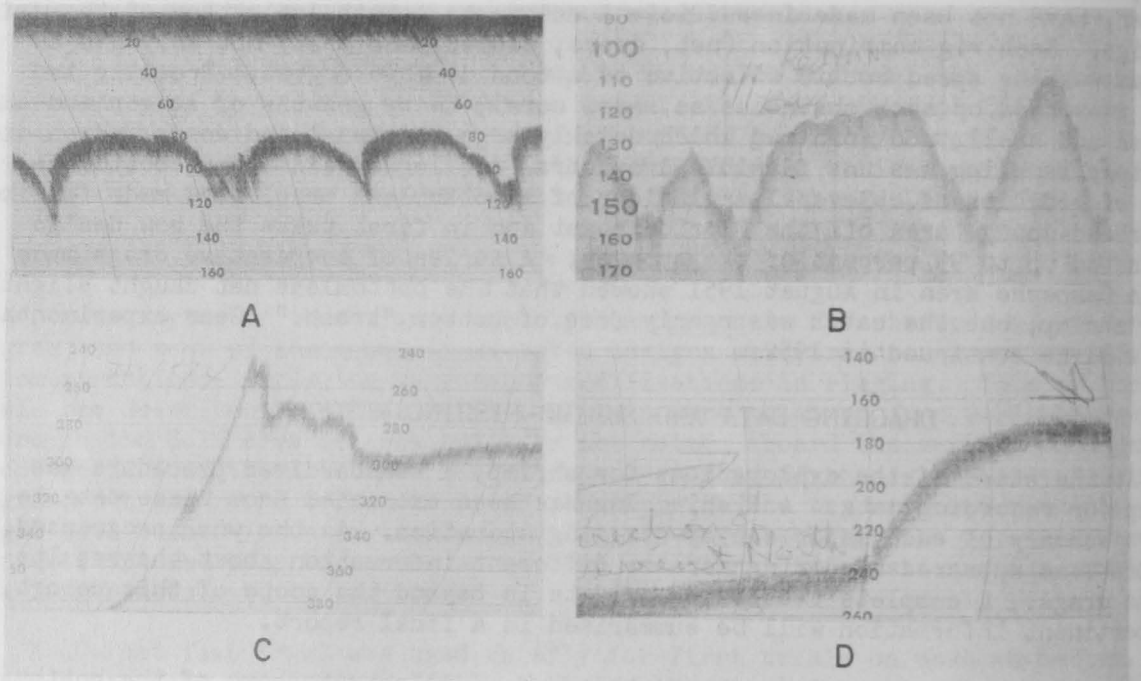


FIG. 4 - ECHO DEPTH RECORDER CHARTS SHOWING BOTTOM TYPE AND CONTOUR. SOUNDINGS ARE IN FEET.

- A - "MUD LUMP" AREA OFF THE MISSISSIPPI DELTA. BOTTOM IS SOFT MUD.
 B - ANOTHER "MUD LUMP" RECORDING IN DEEPER WATER OFF REDFISH BAY.
 C - A BOTTOM SECTION OF THE "EDGE" AT OREGON STATION 174. THE PINNACLE IS CORAL COVERED AND ROCKY.
 D - AN ABRUPT SLOPE CHARACTERISTIC OF THE "EDGE." ALTHOUGH NOT IN EVIDENCE THERE IS SOME CORAL PRESENT. RED SNAPPERS WERE TAKEN AT THE POINT MARKED BY THE ARROW IN THE UPPER RIGHT CORNER.

An important part of the exploratory-fishing data has been secured through the assistance of cooperators from institutions interested in the general program of Gulf fisheries research. The value of the cooperative study may be expected to be more apparent in subsequent and final reports where results of different lines of investigation are fitted together.

SOME OBSERVATIONS ON THE OREGON FISHING LOG, 1950-51

Summaries of information taken from the fishing logs of the Oregon will be given in a final report on shrimp exploration to be published later.

Most of the drags made had some kind of penaeid shrimp in the catch, but only species of commercial interest were shown in the log. Nineteen species were

identified from Oregon collections by M. D. Burkenroad, Institute of Marine Science of the University of Texas, or by F. A. Chace, Jr., Curator of Marine

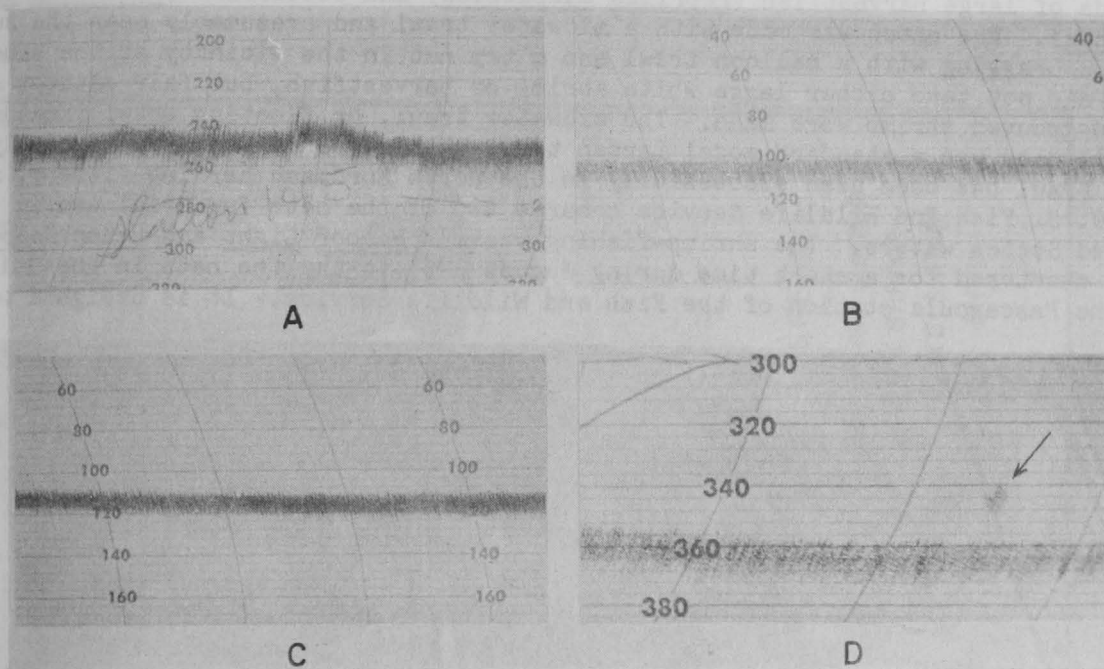


FIG. 5 - ECHO DEPTH RECORDER CHARTS SHOWING BOTTOM TYPE AND CONTOUR. SOUNDINGS ARE IN FEET.

- A - OREGON STATION 145. THE OBSTRUCTION AT RIGHT OF CENTER TORE OFF THE LEAD LINE AND TRAWL BODY. BOTTOM IS HARD MUD AND SAND.
- B - OREGON STATION 291. THIS SHOWS GOOD TRAWLING CONDITIONS OF SMOOTH BOTTOM AND SLIGHT SLOPE. BOTTOM IS GRAY MUD.
- C - OREGON STATION 223. HERE THE BOTTOM LOOKS AS GOOD AS IT DOES IN B BUT IS COVERED WITH SMALL FINGERS OF LIVING CORAL. TRAWLING IN THIS AREA WITH CONVENTIONAL SHRIMPING GEAR IS EXTREMELY HAZARDOUS.
- D - OREGON STATION 331. A RECORDING SHOWING AN INTERFERENCE SPOT, PROBABLY A SCHOOL OF FISH OR SHRIMP CLOSE TO THE BOTTOM.

Invertebrates, United States National Museum. It is probable that additional species will be identified from collections already made or from subsequent collections.

WHITE SHRIMP: The white shrimp, *Penaeus setiferus*, is usually taken by the fishery inside the 20-fathom curve by trawling during daylight hours. Because of its inshore range, the species has been of only incidental interest in the exploration. The three instances appearing in the fishing log of the capture of specimens of the white shrimp outside their usual depth range (43 fathoms, stations 340 and 342) or geographical range (station 237 near Dry Tortugas) are probably not indications of the existence of stocks of commercial interest in the vicinity.



FIG. 6 - DUMPING THE CATCH ON THE DECK OF THE OREGON DURING NIGHT FISHING.

A catch of $4\frac{1}{2}$ pounds of large white shrimp was made at night on August 15, 1951, in $7\frac{1}{2}$ fathoms off Chandeleur Islands, Louisiana, along with several hundred pounds of large harvestfish (Peprilus alepidotus) and butterfish (Poronotus triacanthus). The catch was made with a midwater trawl and presumably near the surface. Dragging with a balloon trawl and a try net in the vicinity at the same time did not take either large white shrimp or harvestfish, but fair catches of brown-grooved shrimp were made. The midwater trawl, or floating trawl (Krason 1949), used was a standard-model Larsen trawl obtained from Denmark. Recently this trawl has been used successfully in the north European herring fishery, and the U. S. Fish and Wildlife Service secured two of the nets for trial use in United States waters. The shrimp-fishing vessels Harbor Light and Helen Cooper were chartered for a short time during August 1951 to try the nets in the vicinity of the Pascagoula station of the Fish and Wildlife Service. It is designed to

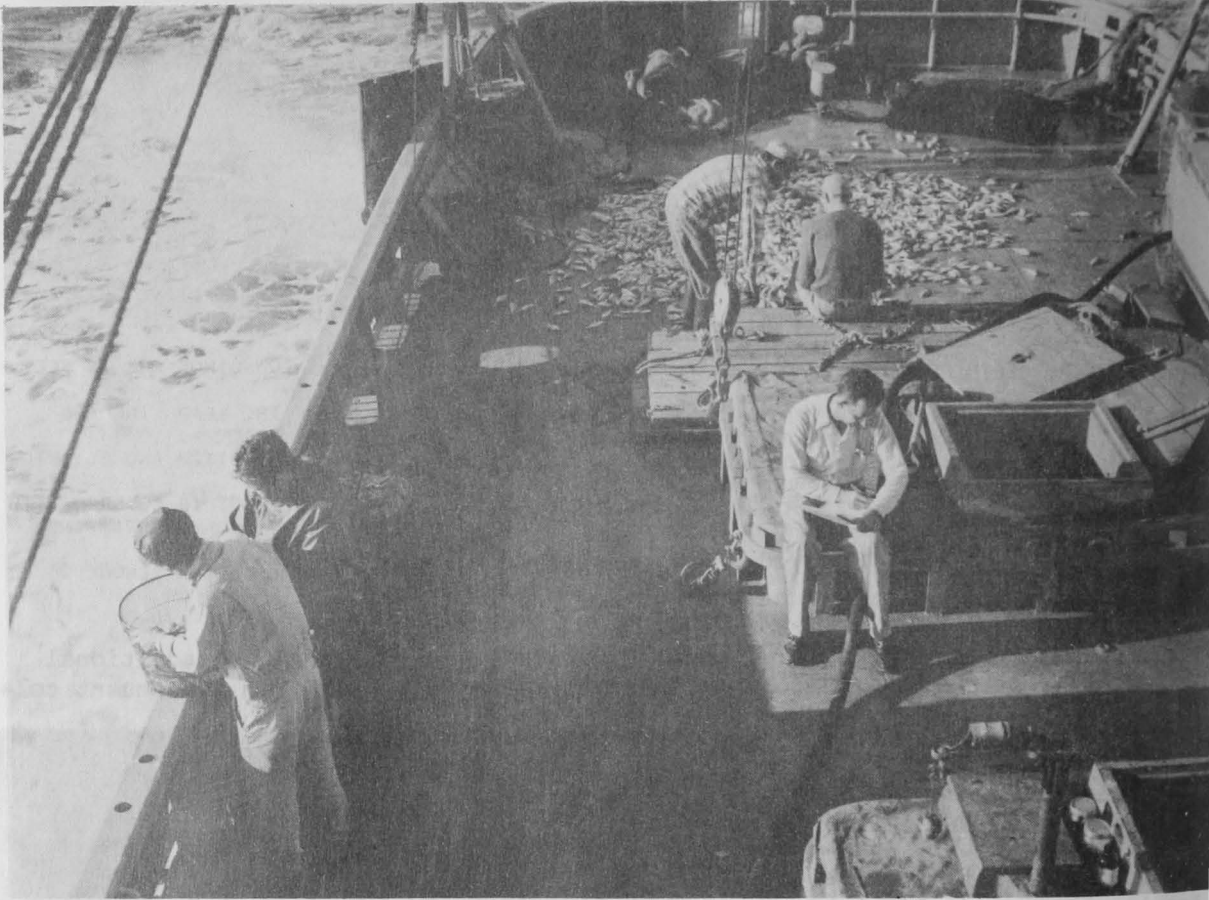


FIG. 7 - SORTING, WEIGHING, COUNTING, AND RECORDING THE CATCH ABOARD THE OREGON.

work above the bottom without doors. Two boats are required to pull the net, each boat handling a pair of cables, one to the float line, and the other to the lead line. The depth at which the net works is adjusted by the speed of the vessels and length of the towing cables. The first net tried at Pascagoula was of relatively fine mesh, with both vertical and horizontal spread of 48 to 52 feet. Setting and hauling was accomplished without great difficulty, but it was found that the net was too large to maneuver properly with the power available (165 horsepower in each boat), and a speed of $2\frac{1}{2}$ to 3 knots was all that could be reached. A smaller net with a 36- to 38-foot opening was constructed. Funds were available for only one day's trial of this net, but results were better than with the large net, and speeds of from 5 to 7 knots were attained, as well as better maneuverability.

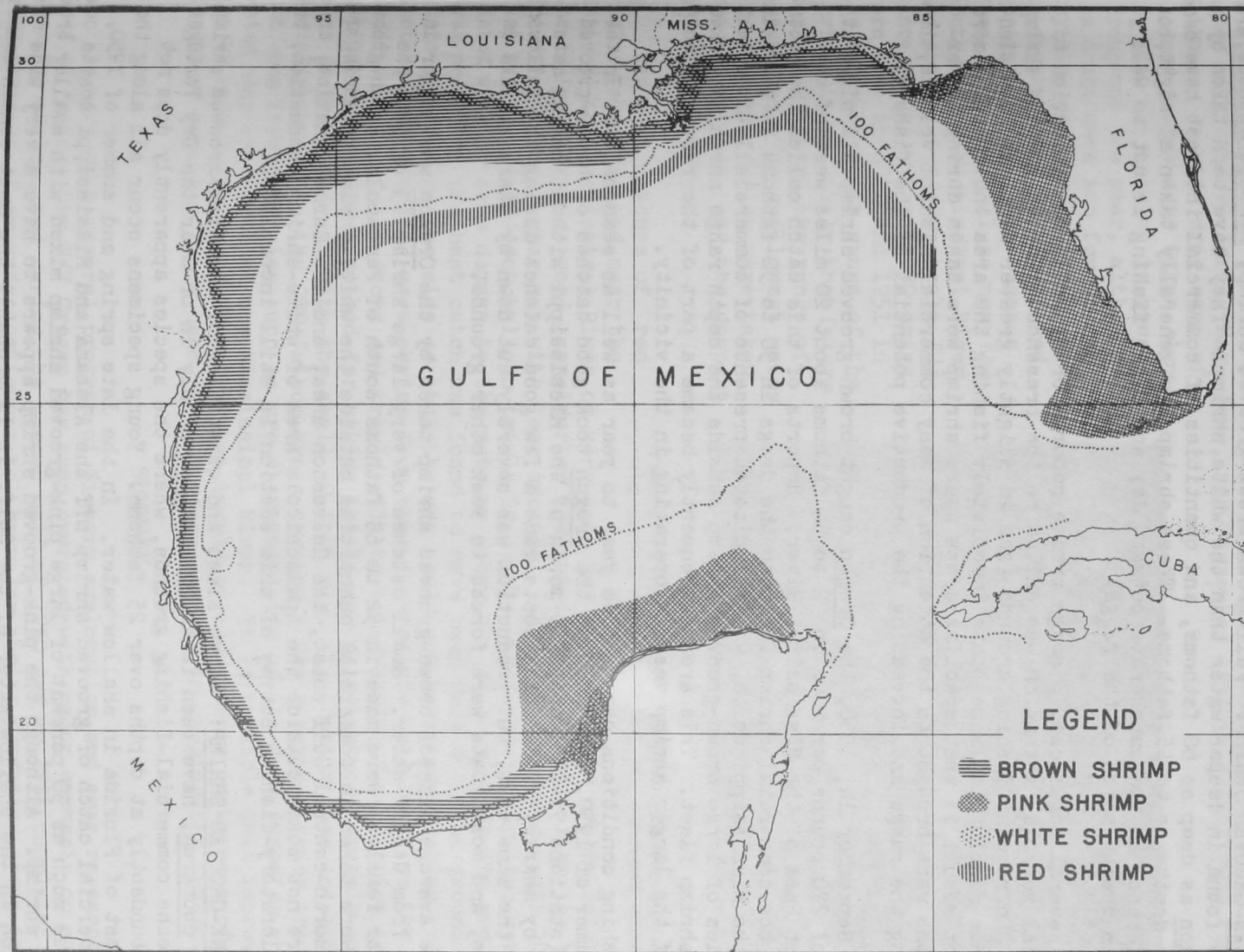


FIG. 8 - COMPOSITE CHART SHOWING KINDS OF MARKETABLE-SIZE SHRIMP MOST COMMON TO EACH GULF AREA. THE RANGES OF SOME SPECIES OVERLAP, AND COMMERCIALY-IMPORTANT QUANTITIES DO NOT OCCUR THROUGHOUT THE RANGE OF ANY OF THESE SPECIES. (BASED ON DATA FROM ALL AVAILABLE SOURCES.)

No indication of its effectiveness for shrimp was obtained because the few sets were made on schools of fish and were carried out to get preliminary data on the operation of the gear. Further trials of the gear by the Service are planned in the near future.

BROWN-GROOVED SHRIMP: Full-grown brown-grooved shrimp, Penaeus aztecus, are commonly found in deeper water than the white shrimp. They have been taken by the Oregon as deep as 68 fathoms, and quantities of commercial interest have been found in depths up to 45 fathoms. These shrimp are generally taken at night, but the difference in the catch rate between day and night fishing is not so well marked in deeper parts of the range.

On several occasions, through cruise reports or by radio communication to commercial vessels, attention was called to the presence of brown-grooved shrimp outside the regular fishing grounds (and in slightly greater depths). Occasionally, this resulted in some boats immediately fishing the area indicated. A more important result is that specific areas where shrimp were taken during the explorations were brought to the attention of many commercial fishing vessels, thus extending the range and increasing the productive potential of the fishery.

On September 14, 1950, the Oregon caught brown-grooved shrimp all night at a rate of 270 pounds per hour in 32 to 34 fathoms about 20 miles west of the Southwest Pass of the Mississippi River. Reports of this catch called the attention of the commercial shrimp fleet to the drags in 30 to 50 fathoms in the vicinity of the Mississippi delta, which indicated presence of commercially-important quantities of large brown-grooved shrimp outside the depth range normally worked by the shrimp fleet. This area subsequently became a part of the regular fishing range of the larger shrimp vessels operating in the vicinity.

Fishing conditions change from year to year as well as seasonally. In the late summer of 1950, for example, the Oregon took good catches of brown-grooved shrimp (stations 95-112) near the mouth of the Mississippi without having nets damaged by sharks. Commercial boats made a few good catches during the following fall in the same spot, but production was severely cut down by shark attacks on the nets, and most boats were forced to seek other grounds.

The average size of brown-grooved shrimp taken by the Oregon was larger in catches from deeper water. Small catches of very large shrimp (3 or 4 to the pound for females) were made in 52 to 68 fathoms south of Pensacola. Brown-grooved shrimp were taken in commercial quantities outside the white-shrimp producing area of the north-central Gulf coast, the Galveston area, and the Carmen, Mexico, area. They were not taken outside the Apalachicola area of white-shrimp production, but the exploratory-fishing survey of this section is still incomplete.

PINK-GROOVED SHRIMP: Large sizes and quantities of the pink-grooved shrimp, Penaeus duorarum, have been taken by the Oregon only in or near the Dry Tortugas or Campeche commercial-fishing grounds, where the species apparently does not occur abundantly at depths over 25 fathoms. Young specimens occur all along the west coast of Florida in shallow water. In the late spring and summer of 1950, the commercial catch of grooved shrimp off the Alabama and Mississippi coasts contained as much as 30 percent of large pink-grooved shrimp mixed with smaller brown-grooved shrimp. Although the pink-grooved shrimp appears to have a very wide distribution in the shallow water of the Gulf, it is probably the most common commercial species only in the east Gulf from Apalachee Bay to Campeche Bay. Its presence in quantities of value to the commercial fishery in the northern parts of the Campeche Bank and off the west coast of Florida north of the Dry Tortugas grounds is possible, but exploration has not yet shown good results in these areas.

RED SHRIMP: Red shrimp, Hymenopenaeus robustus, were taken by the Oregon in August 1950 in 195 fathoms and 232 fathoms, using a 40-foot shrimp trawl put out on a single trawling cable with a bridle. The shrimp were taken in quantities which indicated that commercial operation might prove feasible, provided larger size nets could be used successfully in the deep water.

The Oregon made a few exploratory drags in September and November 1950 and again in February, April, May, June, and September 1951 in depths from 190 to 240 fathoms. In each drag some of the red shrimp were taken, showing that the species is present throughout the year, although the drags were too few to show anything about relative seasonal abundance. Catches of red shrimp were made off Aransas Pass, Tex., as well as near the mouth of the Mississippi River and southeast of Pensacola, Fla. Since a total of only 30 drags were made in 1950 and 1951 in the apparent depth range of the shrimp, it is likely that future work will extend the range of occurrence. The shallowest water in which red shrimp were taken was 180 fathoms, and the deepest was 305 fathoms.



FIG. 9 - A LARGE CATCH OF PINK-GROOVED SHRIMP, FISH, AND BOTTOM TRASH FROM THE DRY TORTUGAS GROUNDS.

The best catches of red shrimp were obtained near the mouth of the Mississippi River on very soft mud bottom. Some of the catches with the 40-foot net were good, considering the short time the net was on the bottom. The use of larger gear met with less success. Of eight drags made with 100-foot flat trawls and 80-foot balloon trawls in 190 to 240 fathoms only, two were completed without some damage to the nets or doors due to bogging in the mud. The drag producing the best catch was found to have been made with the ground and head lines reversed on one side so that the net could not have been fishing properly. Another drag produced more shrimp from the wings of the net than from the tail. Modifications of the doors and trawls will be tried during future trips in an attempt to develop a method for making the longer drags proportionately as productive as shorter drags with the small 40-foot rig. The bottom does not appear especially uneven in the 200-fathom areas covered. Sonic depth-sounder tracings do not show irregularities such as are characteristic of the "mud lumps" in shallower water near the mouth of the Mississippi River. It is possible that improvements can be made in the performance of the trawls by adjustments in the cut of the doors, length of trawling cable used, and by minor changes in hanging the trawls.

SUMMARY

As part of a general program of fishery exploration and gear research in the Gulf of Mexico, the M/V Oregon has been operated with major emphasis on exploration for shrimp, and during the second half of 1950 and in 1951 completed exploratory coverage of grounds contiguous to the major shrimp-producing areas in the Gulf as well as partial coverage of some of the more-accessible grounds at considerable distances from regular shrimp-fishing activities of the commercial fleet. The fishing log supplemented by the data to be collected in 1952 will form the basis for a comprehensive report on shrimp exploration in the Gulf.

Preliminary phases of work with various designs of shrimp trawls, bottomless trawls, a midwater trawl, and related gear have been completed, and studies of the performance and limitations of common types of trawls will provide a basis for trying more radical gear in 1952.

Some progress in charting and classifying trawling conditions (types of bottom) in the Gulf was made during 1951. It is planned to continue this phase of the work in 1952, using a greater variety of exploratory gear.

Although 19 species of shrimp have been identified from Oregon catches, only species of commercial interest (white, brown-grooved, pink-grooved, and red) are shown in the fishing log, along with other important fishery resources, such as red snapper. On three occasions white shrimp were located outside their usual depth range or geographical range. Discoveries of new concentrations of brown-grooved shrimp by the Oregon have led to extension of the commercial fishing grounds and an increase in the productive potential of the fishery. Exploration in 30 to 50 fathoms in the vicinity of the Mississippi delta revealed the presence of important quantities of large brown-grooved shrimp beyond the normal depth range of the fishery, and this area has subsequently become a part of the regular fishing grounds for the larger vessels operating in the vicinity.

The Oregon has caught deep-water red shrimp throughout the year over a wide range of the Gulf in depths from 180 fathoms to 305 fathoms. Best catches of red shrimp have been made near the mouth of the Mississippi River on very soft mud bottom, and the species has been taken off Aransas Pass, Tex., and southeast of Pensacola, Fla. Catches indicated that commercial fishing of red shrimp might prove feasible when problems of fishing at such depths on the extremely soft bottom are solved. Experiments are continuing to improve effectiveness of the trawls by such methods as varying the cut of the doors and the length of trawling cable, and by changes in hanging the trawls.

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