The fact that 1952 produced a considerably smaller than average fishery catch off Bermuda, and reportedly along the eastern coast of the United States and Nova Scotia, the conclusion is that considerably more exploratory fishing must be carried out before the situation can be evaluated

The Bermuda Government has recently purchased and partially equipped a 60 foot long motor fishing vessel for future exploration. The craft was obtained from the British Admiralty at a very favourable price. It is intended that a five year research plan will be carried out under the general direction of the Bermuda Biological Station for Research, concurrently with oceanographic work already under way by that institution. The vessel has just been put into commission, and exploratory work on fisheries will probably commence in April, 1953. It is hoped that a satisfactory progress report may be presented at the next session of the Gulf and Caribbean Fisheries Institute.

Shrimp Exploration of the M. V. Antillas

C. B. Carlson
U. S. Fish & Wildlife Service
University of Miami Marine Laboratory, Coral Gables, Florida.

Under a cooperative agreement between the Gibbs Corporation of Jacksonville, Florida, and the Fish & Wildlife Service, the M. V. "Antillas" has been searching for new shrimp resources, primarily in areas which could be exploited by the existing class of shrimp trawlers. The exploratory work started early in April off Florida and Georgia and about a month was devoted to searching for shrimp and favorable bottom at depths beyond the range of the existing fishery. Two trips were made to Central America, one during May and June and the second during July. During September and October, the primary effort was devoted to deep water red shrimp of the upper Gulf of Mexico and the "Antillas" is now working on the Bahama Banks.

Florida & Georgia

A total of 78 sets were made in the offshore area from Brunswick, Ga. to Fort Pierce, Fla. at depths from 5 to 130 fathoms. The drags in shallow water were primarily made to assure proper functioning of the gear and for gear development work. While the work was done in the off season for white shrimp, quantities varying from a few to several pounds, and on one occasion up to 160 pounds, were taken during random drags on known grounds having mud bottom. Outside of these areas no commercial species of shrimp were found and only small quantities of fish, most of which are not market species, were taken. With the exception of the known fishing areas, no mud bottom was found until reaching depths of 80 to 100 fathoms. The bottom in the intervening area as shown by soundings was primarily various mixtures of sand and shell. A patch of mud bottom was found about southeast of Cape Canaveral and was explored from depths of 80 to 130 fathoms. While somewhat larger quantities of fish were found in this area than on the sand bottom, the catches were not of commercial magnitude. A small patch of bottom having some mud mixed with sand was found near the 20 fathom curve about south southeast from Cape Canaveral but no shrimp were taken.

As the 100 fathom curve was approached, the effect of the Gulf Stream became quite pronounced and surface velocity approached or exceeded trawling

speeds. Under these conditions it was almost impossible to maneuver the vessel properly and hold a predetermined course or depth. Since no extensive areas of mud bottom were found outside the known fishery or in areas where otter trawls could be satisfactorily operated, there is considerable question if any substantial unexploited new shrimp resources exist in offshore waters of northern Florida and southern Georgia. However, the work was performed only during one month of the year and explorations at other seasons might yield better results.

Honduras and Nicaragua

A preliminary exploration for shrimp off the coasts of Honduras and Nicaragua was made during the last four days in May. A total or 64 tows, comprised of 57 with "try nets" and 7 with "balloon trawls", were made off a stretch of coast line about 220 miles long between Cabo de Honduras, Honduras and Gorda Point, Nicaragua. In July the area was resurveyed and a total of 39 tows were made, mostly with a try net. It was intended on both of these trips to spend several weeks in the area, but circumstances reduced the time spent on the grounds.

Physical Characteristics of Area

The bottom along the north coast of Honduras from Guatemala to Cabo Honduras appeared to be generally hazardous for trawling, according to readings on the automatic depth meter. From Cabo Honduras to Miskito Channel, Nicaragua, a distance of over 200 miles, mud bottom predominates and is generally suitable for otter trawling between depths of 4 and 20 fathoms. Rough patches were frequently found at depths in excess of 20 to 25 fathoms. Also, the rivers and lagoons in the area probably have deposited portions of trees near their mouths which may be hazardous to gear if fishing were conducted inside the 3 mile limit. The land adjoining the area of good bottom is low and large rivers and lagoons are common. These geographical features should be conducive to populations of shrimp. Unfortunately, harbors are few, and numerous reefs lay outside the mud bottom which could be a menace to navigation.

Grooved Shrimp

During May grooved shrimp were found over much of the area surveyed, at depths varying from 8 to 20 fathoms, but no concentrations in any way comparable to the Campeche or Tortugas fisheries were indicated. The catch in try nets during a 15 minute tow generally varied from one to ten shrimp. Two drags at night with a balloon net, in areas where the try net yielded four grooved shrimp, resulted in catches of 42 pounds, about half of which was in the range of 15 to 30 count and the other half in the range of 30 to 60 count. During July the drags were made at distances from 4 to 60 miles offshore and in depth ranges of 4 to 35 fathoms. Again grooved shrimp were found to be widely scattered, chiefly between distances of 5 to 15 miles offshore with the best catches being made between depths of 14 and 19 fathoms.

The similarity of the results obtained on grooved shrimp during both May and July indicates a wide dispersion, but in view of the size of the area a rather large number of individuals must have been present on the grounds. The results, when considered in the light of experience elsewhere, indicate that the schooling of grooved shrimp off Honduras and Nicaragua, if it occurs, is seasonal. Since so little is known about the area two other observations may

be in order. First, with the limited time available, the schooling areas could have been missed and or, second, the area prospected may be a feeding or reserve area for some so far undiscovered schooling ground. In the present limited explanation only a very small portion of the bank off Nicaragua and Honduras could be surveyed.

White Shrimp

During May no white shrimp were found at depths in excess of four fathoms, but there were good indications that substantial quantities might be found within the three mile limit off Nicaragua. During July some white shrimp were found at depths of six and eight fathoms and several commercial vessels fishing near shore made substantial catches. First hand reports from several commercial trawlers, who made trips in August and September to Nicaragua for white shrimp, indicated a seasonal variation in abundance, since the catches become progressively lower. This decline in the catch might indicate the end of one season, with the expectation that a new one might soon start. The size of the white shrimp was quite acceptable to the trade, being mostly in the range of 20 to 30 shrimp per pound.

Red Shrimp

During 1950 and 1951 the Fish and Wildlife Service M. V. "Oregon" found red shrimp, *Hymenopenaeus robustus*, at depth between 180 and 350 fathoms, with the main concentration appearing to be between 200 and 250 fathoms. The "Antillas" spent part of September and October in what appeared to be the most favorable portion of the fishery discovered by the "Oregon", for the purpose of test fishing with large shrimp trawls to determine the commercial possibilities of the grounds.

The "Oregon's" best catches were southeastward of the Mississippi Delta and were made with special 40 foot trawls. Their trials with commercial gear met with less encouraging results, since the soft mud bogged down the larger nets, causing six gear failures out of eight drags.

One of the first problems requiring attention was the modification of conventional shrimp gear to permit fishing at depths to 300 fathoms, and devising gear that would withstand the strains involved. During initial trials standard equipment and hook-ups were used, with the exception of floats capable of withstanding the pressure at a depth of 400 fathoms, and of a weight of 140 pounds added to the back side of each otter board. The doors were crossed while setting on the first three trials but changing the attachment of the trawl from the trailing end to the rear side of the doors overcame this difficulty When it became obvious that "mudding-down" would be a serious problem, the runners of the doors were increased to a width of eight inches for greater bearing surface. Mud ropes were also attached to the foot ropes of the trawls. Eventually all the trawls fitted with mud ropes were lost, and it was found that the one-half inch diameter manila-clad wire rope combination used for foot rope was of inadequate strength for the deep water work. A new trawl made of 24-thread twine instead of the conventional 18-thread twine, and having a 6 x 19 ply plow steel cable for a foot rope, proved much superior to conventional trawls for the deep water work over soft mud bottom. Before hanging the trawl the wire foot rope was served with ⅝" diameter rope. Either this type of foot rope had superior advantages on soft bottom or it was used on firmer bottom, for the trawl did not mud down, although the otter boards showed evi-

dence of the bottom being equally soft. Of a total of 33 drags with balloon and flat trawls, 5 resulted in completely destroyed or severely damaged nets. On 2 other sets considerable damage to the net resulted. A total of 17 successful sets were made consecutively with the revised trawl.

The "Oregon" and the "Antillas" worked cooperatively on one day to determine more rapidly the depth range in which the red shrimp might be found. They were most abundant between 195 and 220 fathoms. In the depth range of 220 to 240 fathoms the red shrimp were generally larger, but the quantity taken rapidly decreased with increasing depth. Shallower than 195 fathoms the red shrimp population was replaced by a cocktail sized pink shrimp *Penaeopsis megalops*, having an excellent flavor.

The bottom on which the red shrimp were found consists of a narrow strip along the edge of the continental shelf, only a few miles wide. The bottom is very soft mud with occasional "snags," which may be rocky out-croppings, and frequent changes in heading were required to hold a constant depth. Difficult fishing conditions would constitute a further drawback in taking red shrimp commercially. The succession of northerly winds which interrupted the operations of the "Antillas" during most of October were considered unusual, but on the 200 fathom curve trawlers should expect more unfavorable fishing weather than on the inshore grounds.

The best catches, about a basket (80 lbs) of heads-on red shrimp, were made on the steepest part of the edge which lies directly south of the area between Pascagoula and Mobile. The location of the best catches suggests that the red shrimp were not necessarily more abundant along the steep slope, but were more concentrated within the narrow confines of their depth range, for both to the eastward and westward where lesser slopes prevail within the range, poor catches resulted.

An analysis of the problems involved raises some doubts about the possibility of successfully exploiting the red shrimp fishery at the present time. The species has a very pleasing flavor and should eventually command a premium price, but at first it would probably have to be sold at a competitive price with similar sizes of the commercially established species. This would make profitable fishing for red shrimp problematical, considering the high cost of producing the new species. At least one hour's time would be required to set and haul the trawl, and the hazards to gear are relatively high. Furthermore, a few random drags for brown shrimp at depths between 40 and 70 fathoms indicated that the commercial fishery for this species might be extended to depths of 60 fathoms and that better returns might be expected than from red shrimp. The brown shrimp taken in deep water were mostly in the 10 to 15 count range while the red shrimp could be divided into 2 groups, about half in the range of 15 to 25 count (females) and half in the 30 to 35 count range.