

animal protein in their diets, as compared with the present average of 65 grams in North America. To meet this challenge, the major fish producing countries of the world are providing greatly increased quantities of frozen or processed fish caught from large deep sea vessels usually powered by standard diesel engines. In subsistence fishing, however, usually carried out in coastal areas near the home community of the fishermen, the outboard is favored. Subsistence fishermen ordinarily take fish for their own consumption and the magnitude of the fishing operation is usually small. The fish taken is normally consumed in the fresh state.

Many nations of the world have turned to the outboard motor in programs designed to provide fish for local and regional markets. The fish are sold or bartered, often fresh, and in general processing is limited to cold storage or to the preparation of a product for local or regional consumption. Fish are frequently landed at or near established marketing centers or transported to such centers.

One of the most famous of largely unexplored areas of Africa is the fabled Timbuktu area of the Mali Republic. The economy depends in large part on the successful transport of salt. Long considered the white gold of Africa, salt arrives in Timbuktu from mines in the middle of the Sahara, and is then loaded into hundreds of outboard-powered dhows and taken down the Niger River to be traded and valued throughout much of the continent as a common currency as well as a vitally-required mineral. The role of the outboard motor here is considered virtually indispensable to the salt trade, as it is to the fishermen in other areas of Africa.

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## **Developing Tropical Atlantic Fisheries Through International Research**

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### **Abstract**

The Intergovernmental Oceanographic Commission of UNESCO, at the meeting of the Second Session in Paris, September, 1962, adopted an international program of physical, chemical, and biological research for the tropical Atlantic. Mr. Vernon E. Brock, Bureau of Commercial Fisheries, was appointed as International Coordinator. Seven nations have committed a total of 15 research vessels to this program. Two synoptic surveys, one each during midwinter and midsummer, are scheduled for 1963. The results of these surveys, to be published both as data reports and atlases, will be used to design a program of research concerned with the character and magnitude of the pelagic fishery resources of the tropical Atlantic.

THE INTERNATIONAL COOPERATIVE INVESTIGATIONS of the Tropical Atlantic will involve a minimum of fifteen oceanographic vessels of seven nations together with research workers from at least three additional nations. Results of these investigations, scheduled for mid-winter and midsummer, 1963, will

provide a synoptic picture of the tropical Atlantic from the west coast of Africa to the east coast of South America.

The EQUALANT I plan involves three phases. First, a 15-day synoptic set of physical, chemical and biological observations along tracks across the equator. Next, during a second 15-day period, studies of the equatorial circulation, through direct current measurements, will be made from some of the participating vessels, while others will pursue a variety of special studies. Finally, a repeat of the initial 15-day synoptic survey is scheduled. In addition to the programs common to all vessels and to the special studies mentioned for the middle 15-day period, a variety of special studies will be undertaken aboard many of the vessels during the 15-day synoptic survey periods. Work by Bureau and participating scientists aboard the GERONIMO, for example, includes sampling forage and benthic organisms (Bureau of Commercial Fisheries, U.S. National Museum, and University of Hamburg), studies in primary productivity (Yale University), and upper air meteorological observations (U. S. Weather Bureau).

In order to obtain the maximum practicable degree of uniformity for certain observations, the Bureau of Commercial Fisheries Biological Laboratory will supply C<sup>14</sup> kits and instructions, arrange for counting of the planchettes at one laboratory, provide one-meter plankton nets, and arrange for determining volume of the samples.

The International Cooperative Investigations of the Tropical Atlantic represent the largest and most concentrated attempt to understand the Tropical Atlantic Ocean to date. The International Indian Ocean Expedition is much larger, and less tightly integrated. Although there have been larger efforts in the Pacific, the program in the Atlantic has at least one unique characteristic. It is the first international cooperative venture wholly within the framework of the recently formed Intergovernmental Oceanographic Commission; the Indian Ocean expedition began before the Commission was established. It will provide a testing ground for the coordinating mechanisms of that Commission.

The investigations are a concrete expression of the growing interest in the oceanography and the living resources of the tropical Atlantic Ocean. As far as the living resources are concerned, two meetings held in Africa in 1960 served as a focus for this interest. The meeting of specialists on oceanography and sea fisheries held in Monrovia in December, 1960, considered problems relating to the demersal fisheries of the African shelf; the Symposium on Thunnidae in Dakar in the same month was concerned with the tuna fisheries of the eastern tropical Atlantic. The serious shortage of dietary protein for millions of people in West Africa, and the possibilities of utilizing the fisheries of the eastern Atlantic to alleviate this shortage, were factors in stimulating interest in these fisheries.

Early in 1961 proposals for two programs were developed, one concerned with the demersal fisheries and the other with the pelagic. The demersal fishery program was initially proposed by Dr. Postel, the Scientific Coordinator for CCTA (Commission for Technical Cooperation in Africa South of the Sahara). The proposal for investigations concerned with the pelagic fisheries came from the Director of the Bureau of Commercial Fisheries. The request to AID (Agency for International Development) for support of the demersal investigations of CCTA, brought this program to the attention of fisheries scientists in the Bureau of Commercial Fisheries and resulted in the proposal to strengthen

both the demersal and pelagic fisheries investigations by a coordinated attack.

In August, 1961, CCTA assembled a group of advisers in Lagos to plan the investigations of demersal fisheries. At this meeting, the schedule involved two, four-month periods of field work, one beginning in January and the other in July. The field work would consist of a series of trawl hauls made along five transects paralleling the coast, each transect at a different depth from shallow to deep water (15 to 600 meters). These hauls would be made by two research trawlers working station lines positioned 30 to 40 miles apart within an area between Cape Roxo (11°N) and Mossamedes (15°S).

The implementation of the CCTA trawling campaign was initiated in September, 1962, with the selection of the Scientific Director. He immediately began negotiations for suitable vessels and recruitment of a staff.

The implementation of the Bureau of Commercial Fisheries proposal for investigations of the pelagic fisheries of the eastern tropical Atlantic began during the fall of 1961 with the recruitment of the nucleus of a staff for this purpose at the Bureau's Biological Laboratory in Washington, D. C.

Some preliminary examination of available data for the eastern tropical Atlantic was made and the general plan of the investigations formulated. On February 26, 1962, the Director of the Bureau of Commercial Fisheries Biological Laboratory, Washington, D. C., arranged for a meeting with oceanographers in the eastern United States to explore the degree of interest in cooperative work in the tropical Atlantic. A high degree of interest in a cooperative investigation of this region was evident. Participants in the meeting proposed that the investigations be submitted to the IOC for consideration as an international effort.

The results of the February meeting were presented to the Bureau of the Intergovernmental Oceanographic Commission in April. The Department of State subsequently issued invitations to interested member countries and activities of the IOC, and, under the auspices of IOC, an International Working Group assembled in Washington, D.C., on June 20-22, 1962. The details of a program for the proposed investigations of the tropical Atlantic were developed by the participants in this meeting. This program was subsequently adopted at the September meeting of the IOC in Paris, and an International Coordinator selected.

I have given briefly the character and history of the International Cooperative Investigations of the Tropical Atlantic. It is apparent that these investigations will be largely concerned with a synoptic description of this region, primarily with the physical, chemical, and marine biological aspects. The character of the investigations reflect the common areas of interest of the investigators and, by being a joint effort, are much more extensive than would otherwise be possible.

However, their completion will provide a basis for further studies which, to a degree, will have less of the character of a common or joint operation. This is so because these future studies will be more advanced and be directed towards goals of the special interests of the investigators—such as those related to our interest in the tuna fisheries. The remaining areas of common interests will be cooperatively investigated to the degree that such cooperation is advantageous.

The fisheries investigations, following EQUALANT I and II, will be con-

cerned with the character of and the relations among the variations in abundance of pelagic fish stocks, in both space and time, and with the physical and biological environmental parameters that may influence these stocks. The synoptic oceanographic investigations completed during EQUALANT I and II will serve as guides in determining the regions where detailed studies of the pelagic fishes might be most profitably pursued. Further investigations of physical and biological oceanography of the region will probably involve both the establishment of monitoring stations, scheduling of cruises for periodic observations, and will include intensive studies for relatively restricted areas. In addition to these environmentally oriented investigations, work concerned with the accessibility of pelagic fishes to such gear as the purse seine is planned.

I have not attempted to give all the details of the work proposed in the tropical Atlantic since these are readily available from other sources, and are chiefly of interest to direct participants. However, this effort may prove to be a pioneering one in that a basis for establishing a multidisciplinary attack on both oceanographic and living resource problems of the oceans, by the cooperative effort of a number of nations, is in the making. From this point of view the success of the cooperative effort is most important. The living resources of the tropical Atlantic are subject to a rapidly growing harvest by both coastal and noncoastal states; therefore the investigation of these resources should be a joint responsibility of these states.

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## **Additional Recoveries of Tagged Reef Fishes from the Virgin Islands**

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IN THE PROCEEDINGS OF THE GULF AND CARIBBEAN FISHERIES INSTITUTE of the previous year, the author reported on a tagging study of reef fishes in St. John, Virgin Islands. A total of 4,093 fishes of 80 species, caught mostly in traps, were tagged; 1,247 recoveries were made, many of which were repeated captures of the same fish. Only 284 tagged fishes were recovered after one month or more of tag retention.

Since the publication of this study, thirteen additional recoveries of tagged fishes have been made at St. John. These are of particular value because of the long periods the fishes were at large with tags. The data are summarized in Table 1. Length measurements are fork length in millimeters (total length for fishes with truncate or rounded caudal fins). As will be noted, eight of these thirteen fishes are groupers (Serranidae), three are snappers (Lutjanidae), one is a grunt (Pomadasyidae), and one a trunkfish (Ostraciidae).