an opportunity to bounce the net and glide over the cork ropes. The remainder of the net is now closed, hand-hauled back to the boat and put on board. More than half of the catch may be gilled, but the remainder are free, as if captured by a purse seine net.

This net has been very successful. In the first haul made, it captured 1,040 fish, weighing over 300 pounds, in 15-20 minutes. In the second haul, 1,567 fish were netted. Two further hauls were made, bringing the day's total catch to over 6,000 fish. Due to an accident to one of the men who fell on the slippery deck, fishing operations had to be broken off, otherwise many more thousands could have been captured with the net in the one fishing operation. This larger net has been used on eight occasions between May 15 and June 30, 1951, and over twenty-five to thirty thousand fish have been taken by it. It is important to note that this net can be operated from all types of fishing boats, both sail and power, and whether decked or otherwise. It is believed that this is the first occasion when flying fish have been caught in this manner.

The Gear Development Program of the M-V Oregon

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AS AN INTRODUCTION to this report it would be profitable to discuss the present progress being made in gear development by the fishing industry itself in the Gulf of Mexico. For many years such experimentation by commercial boats was almost non-existent. Until late in the 1940's snapper fishermen were using the same techniques and gear employed by the fishery at its inception. Even today a large number of smacks travel around the Gulf under varying qualities of dead-reckoning. The location of good fishing grounds has been held in the highest secrecy, making it extremely difficult for a newcomer to break into the fishery. Until recently the shrimp fishery was moving ahead at only a slightly faster pace. During several decades there was practically no progress in trawl design. The recent discoveries of new shrimping grounds have rapidly changed the static attitude on gear, however. Until the Key West shrimp strike early in 1950, each area had its own favorite trawl style. The great influx of boats from all over the Gulf and South Atlantic States to the Key West grounds put the existing trawl designs on a competitive basis for the first time, and, of added importance, on a type of bottom previously unworked. Soon boats that had never used anything but flat trawls were trying out the so-called balloon trawls. Later, trawls embodying features of both styles were used. Many small refinements appeared, some of which were rejected, and some retained. Several trawl makers in the north Gulf tried to make balloon trawls without ever having seen one, and some peculiar designs were produced. Biloxi fishermen, not quite willing to go all the way with a new idea, were tying the wing-tips of balloon trawls up close to the trawl doors instead of allowing the customary 15 to 30 feet between wing-tip and door. A few extremely courageous New England boats were even trying to use roller type trawls on north Gulf snapper lumps. In other words, within a few months, trawl experimentation had become the rule rather than the exception.

By early 1951 many fishing areas had developed or adopted new or differently rigged trawls. Even in the period of the most intense experimentation, however, designs never exceeded the fishermen's sense of practicability.

With these developments came the rapid acceptance of the sonic depth

recorder as a piece of essential fishing equipment. Among the first to recognize the value of this instrument were the snapper boats. It rapidly proved to be an invaluable aid in locating old lumps as well as many new areas, saving many days of searching each trip. Early in 1950 boats on the Key West grounds found it to be useful in preventing loss of gear when working on unknown bottoms. Almost all new boats are equipped with depth sounders and many experienced fishermen now wonder how they got along without one.

With this general situation in the Gulf shrimp and snapper fishery as a background, the Fish and Wildlife Service planned its program of gear development. It had become apparent that if attempts were made to take on the job of refining gear now in use simply to make it more efficient, the program would find itself competing with commercial boats and would almost certainly do little more than duplicate many ideas already tried and rejected by the fishermen. This, then, left the alternative of developing and testing new techniques and equipment as well as surveying the gear of other fisheries for ideas that may be applicable locally. Several such projects are now under way at the Pascagoula station.

The reversing thermometer, used to obtain bottom temperatures, is one instrument that looks very promising, as an aid in the off-shore shrimp fishery. Results from the first year of trawling show an interesting correlation between catch rate (used as a measure of abundance), the size of the individual shrimp, and the bottom temperature. Results to date on red shrimp (*Hymenopenaeus robustus*) in deep water show a very definite maximum temperature above which none of this species has been taken, although they have always been found below it. If this continues to hold true, the reversing thermometer will almost certainly rank as an important component of the gear necessary to exploit this potential resource. This is one of the best examples of what are termed long-range projects. It will probably take several years to establish a reliable pattern of temperature correlation if such a pattern can be established.

It is believed that loran receivers will eventually prove to be as invaluable as the depth sounder to all fisheries that work beyond the sight of land. Using loran fixes, it is hoped eventually to plot all areas of good snapper fishing bottom. A few boats operating in the Gulf have already installed loran receivers. In time this will enlarge the secret and exclusive society of snapper captains to include practically anyone who is interested in engaging in this fishery.

The program has been cooperating with the Warren Fish Company of Pensacola in testing their new electric snapper reels. These, although still in need of modifications, have proved to be an important step in the mechanization of that industry. Tests aboard the OREGON have repeatedly shown that the amateur can easily catch as many pounds of fish as the most experienced fisherman, and many times catch more, when both are using reels.

Another experiment involved trying traps to catch snapper. Catches have been so poor, however, that the project has been discontinued. About ten different designs of traps of several different sizes were tried in different areas throughout the Gulf between January and June of 1951.

In the shrimp fishery it was decided to pursue a program of testing trawls of radical design. It has become obvious that such a program is not conducive to quick results. There is a possibility that basically the present gear is close to optimum, and that any drastic departure from it will not produce a successful gear. However, if one of these modified trawls does prove to be more efficient, or, as efficient but more economical, a valuable contribution will be made to

the fishery, perhaps permitting boats to work in areas now unsuitable for shrimping because of adverse bottom conditions. In addition there is a very definite need for trawl experimentation. The primary reason is that present gear is not sufficient to explore and adequately sample some areas of reported or suspected commercial potential. Coral and shell on the north coast of Yucatan, soft mud in the newly discovered red shrimp beds, large numbers of loggerhead sponges on the Florida coast, and the mud lump areas off the Mississippi Delta have been main concerns to date, and all these present different problems in adapting or designing gear. If gear can be developed to overcome these obstacles, a major problem in the exploitation of a possible commercial discovery will be well on the way to being solved.

Attempts are being made to evaluate the various components of shrimp trawls, to learn how different cuts and shapes, hangings, and the materials of a trawl affect catch-rate and selectivity of species. Trawls have been constructed and tested with the bottom completely removed back to the funnel, as have trawls with extremely lengthened jibs and wing-tips and with new jib shapes. After each series of tests the trawls are examined for areas of particularly severe strain or apparent poor performance. Whenever a possible improvement is devised it is incorporated.

The gear development program of the OREGON thus seeks to supplement, rather than duplicate experimentation by fishermen, and to work in fields which the industry cannot conveniently carry out trials.

Oceanographic Instruments, Their Use and Application in Marine Biology

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Introduction

Special problems in marine biological work may often require detailed data on only one or two of the major environmental oceanographic factors, while general marine biological problems usually require comprehensive data on all of the environmental conditions, i.e., salinity, temperature, oxygen, nutrients, transparency, currents, and bottom sediments. To obtain such data scientists have employed both biological and oceanographic instruments.

Many of the instruments used in marine work are suited to the requirements of both the marine biologist and the oceanographer. Since some of the present-day devices have been used successfully by both groups for years, it might be of value to call the attention of biologists to other recent developments in the field of oceanographic instrumentation.

Basic Oceanographic Instruments

Two basic oceanographic instruments, the Nansen bottle and bathythermograph, the conditions they evaluate, and their application to marine biology will first be described.

A Nansen water bottle or sampler, for collecting serial samples at sub-surface levels, is closed at any desired depth by sliding a messenger down the wire when the proper amount has been paid out. The trapped sample is not contaminated by water at higher levels nor lost by leakage after the bottle is brought on board. To enable temperatures and water samples to be taken at the same