

lines at night. The introduction of monofil nylon lines, and of wire lines in conjunction with hand reels, would improve the rate of fishing for these fish and for snappers which are taken at great depths by day. Deep water hand-lining results in the capture of some fine fish, but cotton lines are often lost to large fish and sharks. It is believed that the introduction of wire will greatly reduce this loss. Bottom and surface set longline gear will also be tried. Nylon trammel nets have proved very efficient for a wide variety of species, and local fishermen to whom some were loaned soon learned to use and appreciate them, making, for them, unprecedented catches. Gill nets are also likely to be effective for many species and will certainly be tried both at the surface and the bottom. Trammel nets are one answer to the problem of reef fishing. Set around the reefs they have taken a wide range of scale fish at night, when many fish apparently leave the shelter of the reefs. They are also effective for crawfish. Trials are also envisaged with traps woven from wire rather than the weak bamboo traps presently in use, and it is hoped that improvements will result.

These are, of course, only some of the main types of gear that it is hoped to popularize, but even so, their introduction among the small fishermen will take time and patience. Hence, the new Fishery Service has much to do to encourage and assist the development of Haiti's fisheries both on a comparatively large scale and among the peasant fishermen. There is still a long way to go before it can be said that Haiti's marine resources are being fully exploited, but there is no doubt that the seas around Haiti can produce much more than at present to feed her population. A start has now been made on this work—let us hope that it will be energetically and successfully followed up.

---

## **Experimental Trawling for Red Snapper**

WARREN F. RATHJEN

*Fishery Methods and Equipment Specialist U. S. Fish and Wildlife Service  
Pascagoula, Mississippi*

THE COMMERCIAL FISHERY for red snapper in the Gulf of Mexico is carried on almost exclusively by handline operations. In many instances during recent years the fishery has taken advantage of electronic devices such as loran and depth recording equipment. The use of mechanical reels is now widespread in the red snapper fishery. The basic approach to the production of red snapper, however, has remained essentially the same during the past century, in that the hook and line method of fishing accounts for practically all of the present catch.

There have been numerous attempts to develop methods other than the handline by which red snapper could be taken in quantity. It has been recognized that the use of other types of gear in the fishery might be desirable.

Attempts by various workers have dealt with the experimental use of traps and trawl lines (Jarvis, 1935); hoop nets and mechanical reels have also received attention (Smith, 1948; Siebenaler and Brady, 1952). In some cases, the results of these experiments have stimulated further consideration regarding use of gear other than the handline in the fishery. Experimental fishing with

traps carried on recently has included the use of underwater television for the purpose of observing the reaction of fish to the traps, thereby improving the efficiency of trapping gear (Marshall, 1958).

Until the present study, little effort had been made to utilize trawling as a method of catching red snapper. For the most part, it was not considered practicable to use trawls on the hard and often ragged bottom where snapper are commonly found. That red snapper could be taken with trawls has often been demonstrated by shrimp fishermen who, on occasion, take up to several hundred pounds during short trawl drags. These incidental catches of snapper taken in the shrimp fishery often result from trawling over or adjacent to rough bottom or wrecks which are ordinarily avoided because of the danger of damaging trawls.

Early in 1957, the Bureau of Commercial Fisheries initiated a study to use in the Gulf of Mexico, fish trawls developed for trawling on rocky bottom in the North Atlantic ground fish fishery. This gear differs from conventional shrimp trawling rigs in several respects. The foot rope is protected by wooden rollers up to twenty inches in diameter. Large bracket doors are used which are attached to the trawl by 10 - 30 fathom ground cables or "legs." The nets used in the present study were constructed from braided nylon, four and one half inch stretched mesh size. Heavy cowhide is attached to the bottom of the bag of the net to reduce the effect of chafing. This type of gear has proved to be effective in working over hard bottom in the Gulf; occasional damage to the gear has been limited to small tears which were readily repaired. In the early stages of the study trawls constructed of manila were used, but these were easily torn and required more maintenance than the trawls constructed from braided nylon.

In the Spring of 1957, the M/V *Silver Bay* was chartered to supplement the operations of the Service's M/V *Oregon*. The *Silver Bay* is a New England style beam trawler of steel construction, ninety-seven feet in length and is rigged with fore and aft gallows. The vessel is equipped to handle roller rigged fish trawls.

The program has been divided into two phases. The first phase, extending from the spring of 1957 until October 1958, was devoted to area coverage. Eight cruises were directed primarily toward red snapper trawling. Areas worked include the northern Gulf from Cape San Blas, Florida, to Brownsville, Texas; the eastern Gulf from Cape San Blas to Dry Tortugas, and the northern and western portions of the Campeche Bank area. Effort was mainly concentrated between the depths of twenty and fifty fathoms; limited explorations were carried on in water of less than twenty fathoms and in depths from 50-100 fathoms. Whenever practical the trawling was pursued on "broken bottom," typically consisting of areas of sand and shell with intermittent batches of limestone or coral. On a few occasions drags were made adjacent to snapper "lumps," usually composed of rugged masses of limestone or coral. In attempting to drag close to these lumps the net sometimes hung fast to the bottom. Although most of these did not result in severe damage to the trawl, it was not considered practical to work too close to very rugged bottom. At several locations, particularly off the Texas coast, large quantities of sponge were encountered. The principal problem resulting from these was not gear damage, but the danger of severe skin irritation to the man on deck.

It was not possible to give complete seasonal coverage to all areas in the

Gulf during the exploratory phase. In the northwestern Gulf, exploratory fishing efforts extended throughout the year. In the northeastern Gulf, cruises were completed during late winter and early spring. One cruise was devoted to the east Gulf in late summer of 1958 and Campeche Bank was investigated during a single cruise in spring of 1958.

In the initial or exploratory phase of the study it was desired to define areas of potential commercial importance. In the northwest Gulf best results were experienced in the "Little Campeche" area southwest of Galveston, Texas. One drag here during the first months of 1958 produced about 475 pounds of snapper ranging in size from 1 to 25 pounds. Catches here generally averaged less than 100 pounds per drag. Explorations in the east Gulf did not indicate any locations at which snapper were available to trawl operations in good quantity on a sustained basis. Occasional catches of snapper, of mixed sizes, up to 200 pounds were made in this area.

The most promising results of the exploratory phase of operations were accomplished on the Campeche Bank area during May of 1958. The best catches during this cruise (#8 M/V *Silver Bay*) were made south and southeast of Cay Arcas in 20 - 35 fathoms. In five days of exploratory operations (33 drags) 4600 pounds of snapper and 700 pounds of grouper were taken with the trawl

TABLE 1  
WEIGHT TABULATION OF SNAPPER AND GROUPER CATCH FROM  
*Silver Bay* CRUISE 8.

| Species                        | Common Name                  | Total Wt. | Average Wt. | Wt. Range |
|--------------------------------|------------------------------|-----------|-------------|-----------|
| <i>Lutjanus aya</i>            | Red snapper                  | 3298*     | 5 lbs.      | 1-27      |
| <i>Lutjanus synagris</i>       | Lane snapper                 | 1043*     | 2 lbs.      | 1-4       |
| <i>Lutjanus analis</i>         | Muttonfish                   | 879*      | 12 lbs.     | 3-20      |
| <i>Lutjanus cyanopterus</i>    | Cuban snapper                | 55        | 20 lbs.     | 15-25     |
| <i>Lutjanus griseus</i>        | Gray snapper                 | 30        | 2 lbs.      | 1-4       |
| <i>Lutjanus apodus</i>         | Schoolmaster                 | 58        | 8 lbs.      | 6-30      |
| <i>Lutjanus buccanella</i>     | Blackfin snapper             | 14        | 6 lbs.      | 3-8       |
| <i>Lutjanus vivanus</i>        | Silk snapper<br>(yellow-eye) | 7         | 7 lbs.      | 7         |
| <i>Ocyurus chrysurus</i>       | Yellowtail snapper           | 98*       | 1 lb.       | 1-4       |
| <i>Rhomboplites aurorubens</i> | Vermillion snapper           | 60*       | 1 lb.       | 1-2       |
| <i>Lachnolaimus maximus</i>    | Hogfish                      | 41        | 9 lbs.      | 3-12      |
| <i>Epinephelus morio</i>       | Red grouper                  | 870       | 12 lbs.     | 3-20      |
| <i>Epinephelus nigrita</i>     | Warsaw grouper               | 12        | 12 lbs.     | 12        |
| <i>Epinephelus guttatus</i>    | Red hind                     | 2         | 2 lbs.      | 2         |
| <i>Epinephelus striatus</i>    | Nassau grouper               | 8         | 8 lbs.      | 8         |
| <i>Mycteroperca microlepis</i> | Gag                          | 60        | 8 lbs.      | 2-16      |
| <i>Mycteroperca phenax</i>     | Scamp                        | 143       | 4 lbs.      | 3-6       |
| <i>Mycteroperca falcata</i>    | Scamp                        | 8         | 4 lbs.      | 4         |
| <i>Mycteroperca bonaci</i>     | Black grouper                | 274       | 15 lbs.     | 10-30     |
| <i>Promicrops itaiara</i>      | Spotted Jewfish              | 515       | 257 lbs.    | 150-365   |

\*Does not include large numbers of less than 1-lb. fish. (Note: For the most part, minimum sizes of snapper caught with the 5" stretched mesh cod end were ¾ to 1 pound. The numerous smaller fish were caught when a 2" stretched mesh liner was used for sampling purposes.)

in this area. The best individual drag accounted for 870 pounds of snapper and fifty pounds of grouper.

Further explorations on the Campeche Bank were carried on east of the Triangles, two drags resulted in catches of about 250 pounds of red snapper each. Exploratory drags to the north and east across the Bank did not reveal any large concentrations of red snapper. An encouraging feature of the work in the Campeche area was the performance of the gear, which required little attention, although much of the fishing effort was at locations where hard bottom was much in evidence. Occasional hang ups were encountered; however, no serious damage to the nylon trawl resulted. At the locations at which the best fishing was accomplished the depth recorder indicated that the bottom was generally even, with scattered patches of coral or sponge. When a sudden rise was observed on the depth recording apparatus the course of the vessel could usually be altered so that the obstruction could be avoided.

Twenty species were represented in the snapper and grouper catch taken on the Campeche Bank. A breakdown of these by weight is given in Table 1.

Incidental to the catch of snapper and grouper, many other species of fish were taken, including such varieties as porgies, butterfish, croakers and pinfish. Indications from the sampling with roller-rigged fish trawls suggest that this gear may be of importance in fishing for species other than red snapper in the Gulf of Mexico.

The second phase of the present study will be concerned principally with assessing the potential of areas giving good indications of red snapper during the exploratory work. Simulated production fishing was initiated in the fall of 1958 and will continue until the spring of 1959. It is anticipated that most of this effort will be concentrated on the Campeche Bank. The coverage will be pointed toward establishing whether this method of fishing can be pursued on a commercial basis.

#### BIBLIOGRAPHY

BULLIS, HARVEY R. JR.

1957-1958. Cruise reports: M/V *Oregon* Numbers 43 and 44, M/V *Silver Bay* Numbers 1, 2, 4, 5, 7, and 8. U. S. Fish and Wildlife Service, Pascagoula, Miss.

CAMBER, C. ISAAC

1955. A Survey of the Red Snapper Fishery of the Gulf of Mexico with Special Reference to the Campeche Banks. Florida State Board of Conservation, Tech. Ser. No. 12, 1-63.

JARVIS, NORMAN D.

1935. Fishery for Red Snappers and Groupers in the Gulf of Mexico. U. S. Fish and Wildlife Service, Invest. Rep. 26, pp. 1-29.

KNAKE, BORIS O.

1956. Assembly Methods for Otter-trawl Nets. U. S. Fish and Wildlife Service, Fish. Leafl. Wash. No. 437.

1958. Operation of North Atlantic Type Otter Trawl Gear. U. S. Fish and Wildlife Service, Fish. Leafl. Wash. No. 445.

MARSHALL, ARTHUR

1958. Cruise report, M/V *George M. Bowers*, No. 12. U. S. Fish and Wildlife Service, Miami, Florida.

SIEBENALER, J. B. AND WINFIELD BRADY

1952. A High Speed Manual Commercial Fishing Reel. Florida State Board of Conservation, Tech. Ser. No. 4.

SMITH, R. O.

1948. Experimental Fishing for Red Snapper. U. S. Fish and Wildlife Service, Comm. Fish. Rev. 10 (2), 1-10.

---

## Laboratory Experiments on Raising *Tilapia mossambica* in Salt Water

JACQUES S. ZANEVELD\*

*Caraibisch Marien Biologisch Instituut  
Curaçao, N. A.*

IN 1952 VAAS AND HOFSTEDE, in their "Studies on *Tilapia mossambica* Peters (ikan mudjair) in Indonesia," state that it is eurythaline and thrives and reproduces equally well in fresh and brackish water up to 30 parts per thousand salinity. From 30 parts per thousand to 40 parts per thousand its growth is satisfactory, but it does not reproduce.

The Leeward Islands of the Netherlands Antilles in the southern part of the Caribbean Sea are semi-arid and no fresh water ponds occur there, except temporarily. They are, however, provided with a great number of fairly large salt water inland bays with many arms. These bays are connected with the sea by a small entrance blocked by a bar. Remembering the brackish water fish ponds in Indonesia, called "tambaks," these West Indian bays seem well accommodated for the introduction and rearing of *Tilapia*.

It is highly desirable that a new source of cheap proteins become available to the inhabitants of these islands. Curaçao, with an area of 424 square kilometers, already has a population of 120,000. Moreover, there is a lack of bait fish. Both problems would be solved at the same time if *Tilapia* could be introduced into these bays and would be able to maintain itself.

The inland bays have a temperature varying between 26° and 34° C and a salinity from 36 parts per thousand to 40 parts per thousand. They have an area of one to two square kilometers and a depth of six to eight meters. The bottom is muddy, and sea grass and sea weeds grow along the borders. In the rainy period (November to March) humus from the island is washed into the bays. This may help in the production of bottom algae needed by these fishes.

Because of the high salinity, and with regard to the experience cited by Vaas and Hofstede, it appeared to be necessary before stocking a bay with *Tilapia* to carry on some laboratory experiments on its propagation in water of high salinity. By courtesy of Mr. H. W. Lyding, head of the fisheries in Surinam, on May 17, 1957, eleven *T. mossambica* were taken to Curaçao in plastic bags filled with rain water. All specimens arrived safely, and were placed in aquaria with fresh water, at a temperature of from 27° to 28° C. On June 10th, about 40 young were born. On August 11, ten specimens of this first generation to be born in Curaçao were put into a separate fresh water aquarium, through which a continuous flow of a mixture of fresh and salt water, in the proportion

\*Paper No. 13 from the Caribbean Marine Biological Institute, Curaçao, N. A.