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EXPERIMENTAL FISHING FOR RED SNAPPER

PART I-THE USE OF HOOP NETS

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INTRODUCTION

During the past 10 years, the hand line fishery for red snapper and other reef fish of the Gulf of Mexico, especially as prosecuted by the large smacks, has become increasingly unprofitable. This has resulted from a decrease in the average vessel fare and from an increase in the cost of operation. Because of their heavy construction for offshore work, these vessels are expensive to build, maintenance costs are high, and it is necessary to rebuild the hulls about every 10 years.

Two factors prevent the producers of red snapper and grouper from following the general trend toward packaged fillets. One is the original high cost of the fish, and the second is the low recovery in filleting, which runs from 25 to 30 percent. To continue on a profitable basis, two changes seem necessary. First is a more efficient method of capturing fish. Second is a change, necessarily gradual, from the present type of auxiliary schooner.

There has been no lack of market for red snapper, so the obvious solution is a change to mass production methods either by reducing the number of vessels or increasing the catch per man. Many attempts along this line have been made in the past 25 years, so far without success, because of the character of the bottom. With few exceptions, it is extremely rough and covered with live and dead coral forming ridges and valleys with a height of as much as several fathoms. No type of trawl, so far developed, can be used on such bottom.

This report is, in part, a sequal to Fishery for Red Snappers and Groupers in the Gulf of Mexico, by Norman D. Jarvis, (Investigational Report No. 26, U. S. Bureau of Fisheries, Washington, 1935). After a lapse of 14 years, the problems are much the same, and the attempts to solve them now are as then aimed toward changes in methods of fishing. Since 1931, the chief improvements have been that the fish are gutted on vessels shortly after they are caught, and therefore, reach port in better condition, and a part of the catch is now quick-frozen as soon as landed.

The present experiments were undertaken in cooperation with the Warren Fish Company, Pensacola, Fla., in the hope that hoop nets, or the Pacific Coast salmon gurdies, might prove successful in either increasing the total catch or make it possible to maintain present volume with lower expense per vessel.

It cannot be expected that a comprehensive investigation of this nature could be completed in the less than two months allotted to the work. But until more complete information is at hand, the material presented and conclusions drawn may serve as a guide to the commercial fishing industry and as a basis for further experiments.

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Six cruises were made out of Pensacola, Fla., during the period October 15 to December 1, 1945. Of these, 5 cruises were devoted to trials with hoop nets; salmon gurdies were used only on the sixth cruise. (Part II-The Use of Mechanical Reels, will be published in the March 1948 issue of Commercial Fisheries Review.)

THE FISHERY

Two types of auxiliary powered sailing vessels are used for hand lining out of Pensacola, Mobile, and other Gulf ports (Figure 1). The smaller one (ching) ranges in length from 30 to 40 feet, is usually powered with a gasoline medium or heavy duty engine, with a crew of four men. These vessels rarely work outside the 40-fathom line, their trips lasting from two days to a week. They bring in a fare of from 2,000 to 5,000 pounds.

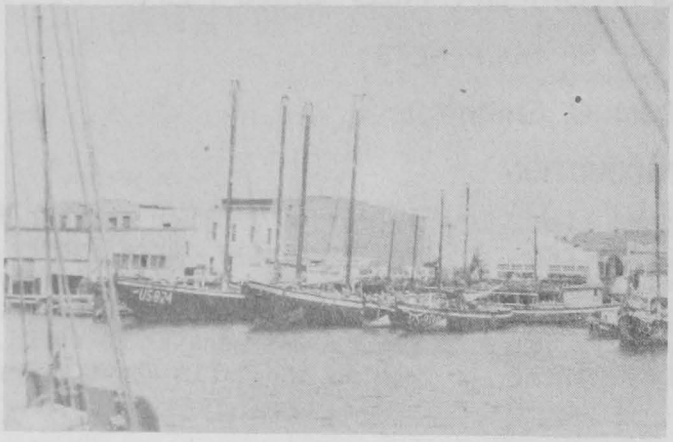

FIGURE 1 - RED SNAPPER SMACKS AND CHINGS PENSACOLA, FLORIDA

The second and larger type (smack) is a two-masted schooner from 50 to over 100 feet in length, with auxiliary diesel engines between 100 and 200 horsepower, and crew numbering up to 12. Insulated holds have a capacity of from 40,000 to 80,000 pounds of iced fish, with usual fares amounting to between 20,000 and 40,000 pounds, of which more than half are red snappers, and most of the remainder being groupers. The main fishing grounds are on Campeche Banks, off the Yucatan coast of Mexico, about 500 miles from Pensacola. A trip requires three weeks, of which one week is traveling time, and two weeks for fishing. Each vessel makes about 10 trips a year. The number of schooners operating out of Gulf ports in 1945 did not exceed 40.

Although the Pensacola-Mobile district is still the center of red snapper production, there has been a rapid development along the southwest Florida coast beginning in 1942. This fishery is centered around Tarpon Springs. Gasoline-powered motorboats from 30 to 45 feet are used with a crew of from two to four. These craft are much faster than the auxiliary powered sailing vessels used in the Pensacola region, and are, therefore, able to make faster trips to and from the fishing grounds located 25 to 80 miles offshore. Their average fare, from 2,000 to 4,000 pounds, is taken in from two to five days. The catch is mostly grouper in summer and snapper in winter. This is true generally in the snapper fishery. Red snappers spawn during July and August and there is always a lull in production at that time.

FIGURE 2 - HAND LINING - TRADITIONAL METHOD

Hand lining (Figure 2) is not only strenuous work, but needs also a high degree of skill. Good fishermen lose no time when fish are biting well. Depending on the depth, it takes from one to two minutes for the 3- or 4-pound lead

to reach bottom. While the line is going down, the fisherman leaves it unattended and cuts bait. As the line nears bottom, it is again taken in hand, and as soon as a bite is felt, the hook is set with a jerk which pulls the lead 2 or 3 feet off the bottom. It is left there for a few seconds and if fish are abundant, a bite is immediately felt on the second hook. Two fish are then brought to the surface as rapidly as their size will permit. At depths up to 30 fathoms, the size range for snappers is 2 to 8 pounds. Larger fish are found in deeper water further offshore.

Immediate attention must be given the catch on board. Although snappers and groupers keep exceedingly well on ice, they deteriorate quickly when exposed to sun or wind, and must not be allowed to dry out on deck. Every few minutes, the fish are forked down a hatch, and if they must remain on deck for a longer time they are wetted down at frequent intervals with sea water. The catch is gutted and iced at the end of each day, sometimes oftener if the rate of fishing permits.

Finding fish is the responsibility of the captain. On approaching the grounds, continuous soundings are taken with the armed lead. The depth and character of the bottom enable him to find the spot he is looking for. The lead also carries a baited hook, and at the first bite, several other fishermen put their lines over. If fish are biting, a flag buoy is put over and fishing is continued by drifting around the buoy. Because of variable winds and current, the main engine is used along with the steadying effect of the mainsail to maintain position. On most of the grounds, fish do not bite at night, but there are a few places, notably off the Texas coast, where night fishing is very good.

EXPERIMENTAL FISHING

Vessel and Equipment

The schooner Seminole, belonging to the Warren Fish Company, Pensacola, was refitted for experimental fishing. The registered dimensions of the schooner are 80' x 21' x 9'. Actual draft is 14 feet; tonnage, gross 71, net 64. The distinguishing characteristics of the Seminole is a pilot house around the wheel box at the stern. Pilot houses are not favored by most vessel captains as they say they cannot observe the set of the sails conveniently. Other non-standard equipment included an echo sounder, radio compass, and ship-to-shore phone.

Of the various navigation and communication devices installed aboard the Seminole, the echo sounder was by far the most useful. With it, it was possible to sail directly to the approximate depth desired, without losing time to take soundings with the lead.

Amidships on deck just forward of the engine trunk was a 3-drum hoist, such as is used on shrimp trawlers. This machine has a rating of 600 pounds pull on the cable with a safety factor of five. The lower and middle drums have a capacity of 800 feet of 3/8-inch diameter steel cable, while the upper drum has a capacity of 550 feet. The hoist is connected by an extension shaft and chain sprocket drive with a power take-off of 15 horsepower on the front of the main diesel engine. The rated capacity of the power take-off is 1,200 pounds.

Originally, it was the intention to operate a hoop net off both the starboard and port sides, but this proved impractical, due partly to strong currents which would sweep one net under the ship, and partly to lack of time to train the crew. But two 12-foot nets could not have been lifted together anyway, as neither the

power take-off nor the winch had sufficient power for this much strain. Both were overloaded with one 12-foot net.

The drums were fitted with 3/8-inch diameter flexible steel trawling cable such as is used in the shrimp industry. This cable has an allowable working load of 2,400 pounds, with a factor of safety of five. Since the cable gave no trouble, the load in lifting a 12-foot net seems to have been between 1,200 and 2,400 pounds.

FIGURE 3 - SEMINOLE - LOOKING AFT SHOWING BOOM

The booms on which the nets were swung overside were 16-foot lengths of 3-inch galvanized steel pipe, the butt end attached to the mainmast by a pintle. A 2-inch pipe was inserted in the outboard end to make an extension, increasing the over-all length to as much as 24 feet. The actual length of boom needed depends on the angle of suspension. Details of location and installation are shown in Figure 3. The boom was guyed fore and aft so that the cable led directly from the winch through a bronze sheave attached at the outer end of the boom, thence down overside to the hoop net. When not in use, and to facilitate docking, the boom was raised until the end did not project over the side. The nets were secured on deck alongside the mainmast rigging.

Fishing

The period devoted to fishing with hoop nets extended from October 18 to December 1, 1945. In this time, five trips were made offshore from Pensacola, usually in a southeasterly direction. These trips were made on October 18-19, 24-25; November 9-10, 16-17; and November 29-December 1. On the first trip, ¼-inch diameter tiller cable was used instead of trawling cable. It broke after 4 lifts. The second trip was blank as rough seas made it impossible to keep the nets on the bottom. This inability to work except in calm weather is the major disadvantage of hoop nets. It is also necessary to anchor the vessel which otherwise would drift away from the net.

Experimental data were obtained on four trips of approximately two days' duration each. Eighty-seven lifts were made with hoop nets with a total catch of 367 marketable fish, comprising 191 snappers, 165 porgies, and 11 leatherjackets. The catch per trip is summarized in Table 1. A total of 161 hours was spent away from the dock. Of these, 13 hours were required on each cruise to go to and return from the fishing grounds. Twelve hours each trip were taken up searching for fish, leaving 9 hours and 24 minutes actually employed in hoop net fishing. This is roughly 6 percent of the total time away from the dock.

Fishing procedure with the hoop nets was as follows:

On leaving Pensacola, the echo sounder was operated until a depth of from 31 to 37 fathoms was indicated. The vessel then slowed, and the armed lead with

baited hook was used to determine the character of the bottom and presence of fish. As soon as a snapper was caught, several hand lines were put over. When these began catching fish, a buoy was dropped, and the ship anchored near it.

Table 1 - Average Catch Per Lift 10 & 12-foot Diameter Rings

Date	Cruise	No. Lifts	Snappers	Porgies	Leather-jackets	Total fish	Average Per Lift			
							Snappers	Porgies	Leather-jackets	All
Oct. 18 19	1	4	4	17	0	21	1	4	0	4
Oct. 24 25	2	Heavy weather prevented trials								
Nov. 9 10	3	17	4	11	2	17	.25	.66	0	1
Nov. 16 17	4	49	85	40	9	134	2	1	.2	3
Nov. 29 30 Dec. 1	5	17	98	97	0	195	6	6	0	11
Totals	5	87	191	165	11	367	2.2	1.9	0	4.2

Since the current at the bottom, both in direction and velocity, is frequently different from that at the surface, hand lines must be used to show which side of the vessel is preferable for operation of the hoop net. It is essential that any drift should carry the net away from the vessel. Having determined drift, a boom on the appropriate side of the vessel is swung outboard far enough so that the hoop net will not foul the side of the ship when lifted to the surface. The net is then attached to the cable and swung overside, the bait bags filled and hung in the center of the hoop, and the winch brake eased to lower the net to the bottom. The cable was marked at 5-fathom intervals, and since the depth was known, the hoop net was checked as it neared bottom to prevent overrunning of the cable or damage to the net from striking bottom. After an interval on the bottom, varying from a few seconds to 5 minutes, the winch clutch was engaged at full speed and the net drawn to the surface as rapidly as possible. The bag of the net was then brought aboard, fish removed, bait bags replaced with freshly-filled ones, and the operation repeated.

Records of hoop net operation for all cruises show that from 4 to 18 minutes were needed to make a lift, depending, of course, on how long the net was left on the bottom. The 12-foot net was timed to determine the rate of sinking, and speed of hauling to the surface. Records were kept of 17 lifts from a depth of 37 fathoms. Time to sink to the bottom varied from 105 to 135 seconds, with an average of 118 seconds, or roughly, 2 minutes. This is at the relatively slow rate of 1.9 feet per second. The net was lifted from bottom to surface in from 35 to 55 seconds, the average being 42.5 seconds, or an average rate of lift of 5.3 feet per second. Since most of the cable was off the drum when the net was on bottom in 37 fathoms, and as the revolutions of the drum remained constant, the actual speed of the net was increasing as the surface was approached, due to successive layers of cable increasing the diameter of the drum. No check could be made as to whether or not the rate of lifting was ideal, but it was sufficiently fast for the snapper's swim-bladder or "pork" to expand with decrease of water pressure near the surface, and to protrude from the mouth.

The size, rigging, and handling of the hoop net itself were subject to continual change, with no final form at the time the experiments were discontinued.

Based on observations of the sea bass fishery carried on at New Smyrna Beach, Fla.,[1/] the original hoop net rings consisted of 1-inch diameter steel rods bent

1/"Fishing Hoop Nets in Florida," by K. P. Foster, appeared in the October 1945 issue of Fishery Market News, pp. 5-7. Also Separate No. 113.

and welded into circles of 8, 10, and 12 feet diameter. The 8- and 10-foot rings were quickly discarded on finding that the 12-foot rings could be handled as expeditiously as the smaller sizes. The first nets were attached to the lifting cable by four bridles of ½-inch cotton rope; and the bag of the net was made of 2-inch stretched mesh linen twine size 14/8. This was the heaviest linen twine then available. It was used in natural color without treatment of any kind. This mesh netting catches small fish, but does not tangle easily on the bottom, and the natural color closely resembles the bottom.

In addition to the extra weight and difficulty of handling the 12-foot ring, the length of the bag increased from 9 to 14 feet; and the four cotton rope bridles which worked so well on the small net, fouled badly on the larger one; 30 galvanized rings, 2-inch diameter, attached to the end of the 8-foot net provided sufficient weight to carry it down, and minimized chafing on the bottom, but the weight of 35 rings, 4-inch diameter, was not enough to carry down the 12-foot net.

Considerable difficulty was experienced with the bridles which attached the net to the lifting cable. After trying both four and six bridles made of cotton rope, four bridles were made from 8-foot lengths of 3/8-inch diameter steel rod, fastened to the cable by a shackle. This kept them in a fixed position when the net was on the bottom. Three steel rods would be an improvement, but leaves too large an arc of the ring unsupported and would require very heavy construction. As it was, it was necessary to strengthen the 1-inch diameter rod by welding to it a second ring of ½-inch diameter rod. This was attached to the lower outside of the main ring. Before this was done, the pull on the ring occasionally folded it up like a pocketbook.

After the first few lifts, it was apparent that both the power take-off and the hoisting winch were overloaded. The weight of the ring could not be reduced, nor was it desirable to slow the rate of lift. There remained the possibility of reducing the drag of the net by using a bag of larger mesh. This was constructed of 4-inch stretched mesh cotton twine.

A comparison of the catching power of various combinations of bridles and webbing is shown in Table 2. The data pertains to the 12-foot diameter net, as the 8-foot net was not used and the 10-foot net used only twice. The obvious conclusion from the Table is that 2-inch mesh netting and four steel bridle rods

Table 2 - Catch According to Number and Type of Bridles and Mesh of Net
12-foot Diameter Ring Only

Netting, Size and Kind	No. Lifts	Snappers	Porgies	Leather-jackets	Total fish	Average Per Lift			
						Snappers	Porgies	Leather-jackets	All
2" Linen[1]									
Bridles									
6 cotton rope	9	2	6	0	8	-	-	-	1
6 steel rods	13	9	24	4	37	.7	2	.3	3
4 " "	17	69	101	1	171	4	6	0	10
Totals	39	80	131	5	216	2.0	3.4	0.1	5.5
4" Cotton[1]									
Bridles									
6 steel rods	8	33	7	0	40	4	1	0	5
4 " "	28	27	8	3	38	1	.3	.1	1.4
4 " " plus extra bait	10	49	8	3	60	5	1	0	6
Totals	46	109	23	6	138	2.4	0.5	0.1	3.0

1/ Stretched mesh. Note: 2 hauls with 10-foot ring omitted.

are the most efficient combination, as they averaged 10 fish per lift, compared to 3 fish per lift using 4-inch cotton netting. From a commercial standpoint, these figures are useless, for fish are sold by the pound instead of by the piece. Lacking both a measuring board and scales, no figures on sizes and weights can be given. However, the observations of all persons on board were that the 4-inch cotton mesh caught larger fish than the 2-inch linen.

Superiority of steel rods over cotton rope for bridles is less open to question, except on the hypothesis that "there are always more fish on the port side." Tests were made with the vessel at anchor, with one hoop net with cotton bridles operated from the starboard boom, and a net with steel bridles swung from the port boom. These nets were raised and lowered alternately. During this test, members of the crew were hand lining on both sides of the vessel with good results.

Fluctuations in Catch According to Time of Day

It is generally true that fish bite best in the early morning and late afternoon, but not so well in the middle of the day. This theory is not too clearly borne out by the data in Table 3. For clarity, the 24-hour day has been used. It will

Table 3 - Catch According to Time of Day

Time	No. lifts	Snappers	Porgies	Leather-jackets	Total fish	Average per lift
6:00-8:59 a.m.	10	34	23	3	60	6.0
9:00-11:59 "	31	18	33	7	58	2.0
12:00-2:59 p.m.	25	73	91	0	164	6.5
3:00-5:59 "	20	66	17	1	84	4.0
6:00-8:59 "	1	0	1	0	1	1.0
Total	87	191	165	11	367	4.2

be noted that the best catches were made between 6 and 9 a.m., and from noon to 6 p.m., with relatively few fish taken from 9 a.m. to noon, although more lifts were made during this time of day than at any other. In the late fall, sunrise is near 6 o'clock; sunset, about 5:30. The best fishing was from 7:30 to 9:30 a.m., and from 2 to 4:30 p.m. Using hand lines, only occasional bites were felt during darkness, both morning and evening. On the first trip, October 18, a 1,000-watt floodlight was rigged over the stern at 7:30 p.m., and at the end of 1½ hours only a few squid, 2 small sharks and occasional schools of unidentified small fish 6 inches long had been observed.

Catch Versus Time Net Remained on Bottom

Table 4 shows variations in number of fish caught on the basis of number of seconds the net remained undisturbed on the bottom. In evaluating the Table, it is recognized that there are not enough lifts of 2½ to 5 minutes to give reliable averages. Too much emphasis should not be placed on the results of the 195-224-second group. One of the five lifts brought up 39 small snappers (2-pound) and 31 porgies for a total of 70 of the 94 fish in the group. Among the factors other than time which may have contributed to this freak catch are most likely an unusual number of hungry fish congregated in a tight school, and the certainty that the technique of handling the net was perfect. However, it is believed that the net should be left on the bottom for at least 1½ minutes. This is in contrast to the hoop net fishery for sea bass of the Atlantic Coast of Florida, where very good results are obtained from less than a minute on the bottom except for the first lift, which is left down 4 minutes to attract fish by diffusion of bait. The main point is how to obtain the largest possible catch per hour of fishing. Toward this end, it is important to discover the minimum practical time for leav-

ing the net down, for it takes an average of 2½ minutes for the net to sink to the bottom and be lifted to the surface from 37 fathoms, and it takes from 2 to 5

Table 4 - Catch Versus Time of Net on Bottom

Number Seconds on Bottom			No.						
Minimum	Average	Maximum	lifts	Snappers	Porgies	Leather-jackets	Total fish	Average per lift	Empty lifts
0	30	44	15	9	6	0	15	1.0	8
45	60	74	15	12	7	2	21	1.4	8
75	90	104	20	39	25	3	67	3.3	6
105	120	134	14	23	24	4	51	3.6	5
135	150	164	8	15	17	0	32	4.0	2
165	180	194	6	26	27	0	53	9.0	3
195	210	224	5	59	35	0	94	19.0	1
225	240	254	3	4	24	0	28	9.3	1
255	270	284	1	4	-	2	6	6.0	-
		Total ...	87	191	165	11	367	4.2	34

minutes to get the catch on deck and snap on fresh bait bags. Excluding a long series of blank hauls, and the cases where the net was left on bottom only a few seconds, the usual number of lifts per hour was from 6 to 7, or one lift every 9 minutes.

Observations on Netting

Considerable cutting of the net on coral bottom was anticipated, but such damage was negligible. All fishing was on dead coral and it is doubtful if nets could be used on live coral. At the time the experiments were discontinued, a hunt was started to find a more satisfactory netting than the 2-inch square linen costing over $4.00 a pound, with the added objection that the small mesh caught many fish too small for market. It was expected that a larger mesh of cotton would not only be cheaper, but also do two things: let the small fish out, and put less strain on the machinery. The only other netting immediately available was a heavy tarred cotton twine of 4-inch square mesh. This was too large, and 3-inch square mesh of No. 15 cotton is recommended.

Bait

Compared with hand lining, larger quantities of bait are needed for hoop net fishing. From 2 to 5 pounds of ground bait were put in the bags for each lift. Fifty to one hundred pounds of frozen jacks (Elops saurus) were used per day. It is essential to have the power operated meat grinder. This may be made by replacing the handle on a restaurant-size hand-grinder with a sprocket which is driven by a chain from a gasoline engine.

Operational Procedures

It is important here to take note of certain techniques which, perhaps almost as much as the abundance of fish, determine the success or failure of hoop nets.

First is getting the net properly positioned on the bottom. While it is desirable to get the net on the bottom as fast as possible, it is even more important that it should rest there with the bag neatly folded like an accordian, the ring or hoop lying freely on top, and the bridles not fouled with either bag or ring. If any of these conditions are not attained, very few if any fish will be retained in the upward journey, for the bag will not open completely and instantly. Also, in going down, the heavy steel hoop tends to travel faster than the net, and if not checked, the bag will be turned inside out, resulting in complete fouling on the bottom. Two helpful corrective measures are to slow down

the descent of the hoop by letting it pull cable off the drum; and to speed up the ball of the bag by attaching galvanized rings to the bottom. Depending on the size of the net, from 5 to 10 pounds of rings may be needed.

The second essential is that the winch must pick up the net swiftly and positively or fish will have enough warning to escape from inside the ring before it gets under way. A slipping clutch on the winch spells certain failure. Bottom fish instinctively flee downward to escape danger. Once inside they will seldom be lost so long as the lift continues smoothly upward.

The third important thing is the right use of bait. It is frequently difficult to know how to use bait to best advantage, for there is considerable difference whereby various fish find food. For example, sharks are attracted chiefly by smell, but barracuda strike at disturbances or moving objects without any regard for odor. However, the vast majority of fish follow a provocative scent back to its source.

For success with hoop nets, bait must first attract fish to the center of the net and second, hold them there. Ocean currents, carrying the odor from a piece of fish or other bait satisfy the first requirement, but differences of opinion exist as to the second point. The evidence in these experiments points to the need for relatively large quantities of bait. At first, one bait bag holding about 2 pounds of finely ground fish was tied in the center of the ring. Most of this bait probably was washed out of the bag by turbulence on the way down and up; some may have been eaten by small fish, at least the bag was empty on reaching the surface. Also, only small fish under 2 pounds weight were caught. A second bag was added, seemingly with better results. Even with two bags it was found that most of the bait was gone. So to the bags of finely ground bait was added a bag of chunks of fish (Figure 4). It seems that larger fish were caught with this combination, though due to other complicating factors, no statistical evidence is available to support the observations.

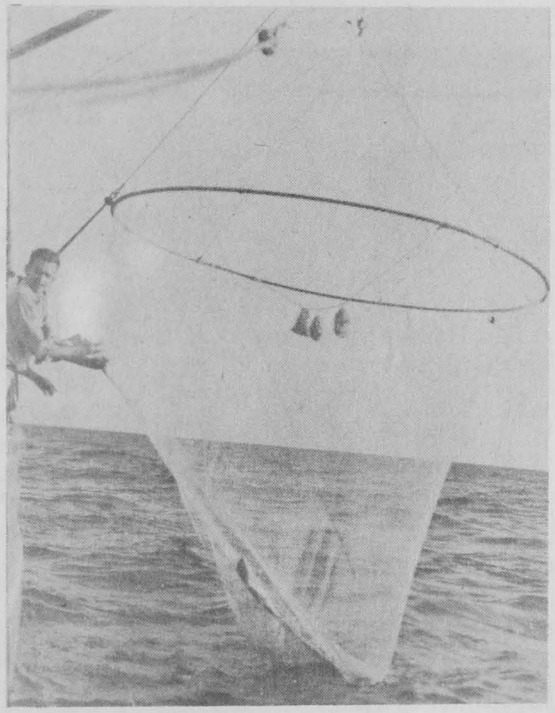

FIGURE 4 - 12 FT. HOOP NET. 3 BAIT BAGS.

One completely mystifying circumstance is that not even one grouper was caught in the 87 hauls, though a number were taken on hand lines to prove that they were not scarce. This must in some way be due to failure in presenting bait properly.

Table 5 shows the catch by hand lines for 80 minutes fishing on November 16 and November 30, 1945. The composite total of all species was 80 fish, taken by four men (average) at a rate of one fish per man every 4 minutes. (These figures should not be taken as representative of hand line fishing generally, for much of the time fishing was on thinly populated bottom where commercial fishermen would not linger.)

Table 5 - Catch by Hand Lines

Date	Time of Day From	To	Total minutes	No. Lines	Snappers	Groupers	Porgies	Leather-jackets	Total fish	Depth Fathoms
Nov.										
16	1130	1150	20	4	9	0	0	0	9	33.5
	1335	1345	10	4	12	0	0	0	12	33.5
	1345	1355	10	5	15	0	0	0	15	33.5
	1355	1405	10	3	9	0	0	1	10	33.5
30	1300	1330	30	4	24	2	8	0	34	37.5
			80	4 av.	69	2	8	1	80	

SUMMARY AND CONCLUSIONS

Both Jarvis and Schroeder in 1931-33, and the author in 1945, were faced with the problem of adapting mass production methods to what is now an obsolete type of fishing vessel. It is the writer's opinion that this problem cannot be solved. Any method which may be used will necessarily be a compromise, and therefore short of the desired efficiency. Early attention should be given to the designing of a 50- to 75-foot diesel powered vessel, able to cruise around 14 knots, equipped with mechanical refrigeration, echo sounding, radio compass, and with comfortable crew quarters.

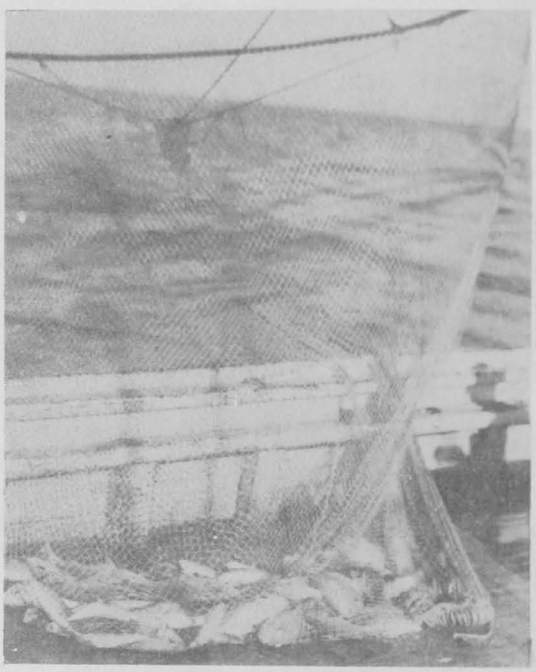

FIGURE 5 - THE RECORD LIFT - 70 FISH

Regardless of the vessel used, if hoop netting is to replace or even supplement hand lining, it must catch more fish or catch the same amount cheaper (Figure 5). The data show that hoop nets had not been developed far enough to equal four fishermen, the nets catching only 357 fish in 565 minutes, while the four men caught a total of 80 fish in 80 minutes.

In view of the incompleteness of the data, the only sound conclusion to be drawn is that the construction, installation, and use of hoop nets on red snapper smacks would not provide a solution to the economic problems. That is; hoop nets, as compared with hand lines, will not produce more fish with the same number of men or an equal amount with fewer, and finally, it will not catch as many fish in the same length of time as four fishermen. The only likely application is by small vessels for catching porgies and other small species on inshore grounds. Its success even there is doubtful, not because of the gear, but because of opposition to using it on the part of fishermen.