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DEVELOPMENT AND USE OF OTTER-TRAWLING GEAR FOR RED SNAPPER FISHING IN THE GULF OF MEXICO, JUNE 1957-MAY 1959

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SUMMARY

The snapper fishery of the Gulf of Mexico, traditionally a hand-line fishery, recently has been faced with severe economic problems and has been seeking a solution through the development of more effective fishing gear and methods.

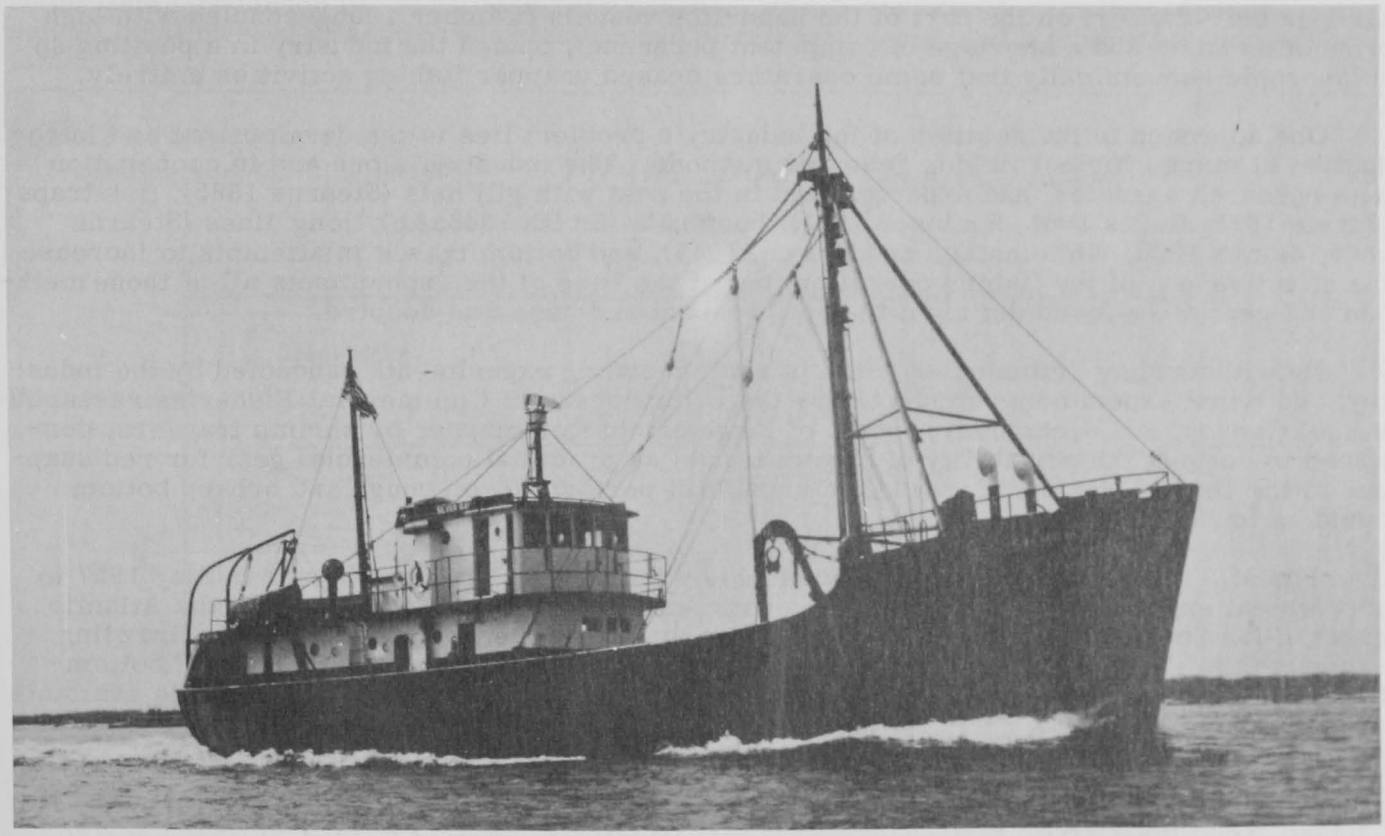

Fig. 1 - The M/V Silver Bay--96.4-foot North Atlantic dragger used in the snapper-trawl studies.

The U. S. Bureau of Commercial Fisheries chartered vessel Silver Bay, a 96.4-foot North Atlantic trawler, was used, therefore, to carry out a study designed primarily to develop otter-trawling gear and methods and to introduce these to the snapper fishery. The study was conducted intermittently from June 1957 through May 1959.

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Bottom-trawling gear, consisting of nylon netting, wooden rollers, and Vigneron-Dahl (V-D) rigging, was developed that successfully permitted trawling on rough and broken bottom and that could be used with vessels now existing in the Gulf of Mexico.

Commercial quantities of marketable snapper and grouper were taken with the gear developed. Two simulated-commercial cruises to the Campeche Banks area yielded catches totaling 44,504 pounds of marketable snapper and grouper from depths of 20 to 50 fathoms. Daily catches ran as high as 2,400 pounds and the maximum single drag yielded 1,775 pounds. On several occasions, trawl catches exceeded the catches of hand-line vessels working the same area.

Use of electronic devices (loran, radar, and especially depth-recorders) proved to be of great practical value.

Results suggest that the otter trawl can be a profitable commercial gear for snapper and grouper in the Gulf of Mexico fishery.

BACKGROUND

The commercial fishery for red snapper and grouper of the Gulf of Mexico has been carried out almost exclusively with hand lines for the past century. The hand-line method has proved unprofitable in many cases despite the willingness of the industry to adopt new accessory equipment, including mechanical reels (Siebenaler and Brady 1952), depth recorders, and electronic navigational aids (Rathjen 1958). Recently, a substantial decrease in production per unit of effort on the part of the hand-line vessels (Camber 1955), coupled with high production costs and a shortage of competent personnel, placed the industry in a position so unfavorable economically that some operators ceased snapper fishing activities entirely.

One approach to the solution of the industry's problem lies in the development and introduction of more efficient fishing gear and methods. The industry, alone and in cooperation with research agencies, had experimented in the past with gill nets (Stearns 1885), fish traps (Jarvis 1935; Bullis 1951; Springer 1951), hoop nets (Smith 1948a&b), long lines (Stearns 1885; Jarvis 1935; Whiteleather and Brown, 1945), and bottom trawls in attempts to increase the effectiveness of the fishing operation; but at the time of the experiments all of those methods and gear were found deficient in some respect and none was adopted.

Notwithstanding deficiencies noted in early trawling experiments conducted by the industry, additional experiments conducted by the U. S. Bureau of Commercial Fisheries research vessel Oregon, and occasional reports of large catches of snapper by shrimp trawlers, continued to suggest the possibility of bottom trawls as practical commercial gear for red snapper in the Gulf of Mexico, if trawl gear capable of performing on rough and broken bottom could be found.

The M/V Silver Bay, which was acquired by the Bureau through charter in May 1957 to supplement exploratory work already in progress in the Gulf of Mexico and off the Atlantic coast of the Southeastern States, was used largely, therefore, to conduct snapper-trawling experiments. The objective of the experiments was the design and development of bottom-trawling gear suitable for use in the commercial snapper fishery by fishing vessels available in the Gulf of Mexico.

VESSEL AND EQUIPMENT

The M/V Silver Bay, a conventional North Atlantic dragger of welded-steel construction, was built in 1946. The vessel has an over-all length of 96.4 feet, a beam of 22.6 feet, and a draft of 12 feet. Insulated hold space is available for approximately 200,000 pounds of iced fish. Accommodations are provided for 17 men. The main propulsion plant develops 562 brake-horsepower at 350 r.p.m., providing a cruising speed of nine knots, and fuel and water capacity are sufficient for 20 days of continuous operation. A heavy-duty double-drum trawling winch is driven by the main engine through a front power take-off and chain-and-sprocket drive. Capacity of each winch drum is approximately 650 fathoms of $\frac{11}{16}$-inch-diameter cable.

Vessel design and deck arrangement permit trawling from either the port or the starboard side. This arrangement, and the identical gear carried on each side, kept lost fishing time to a minimum for, when gear damage occurred on one side, the gear on the other side was ready to be used immediately.

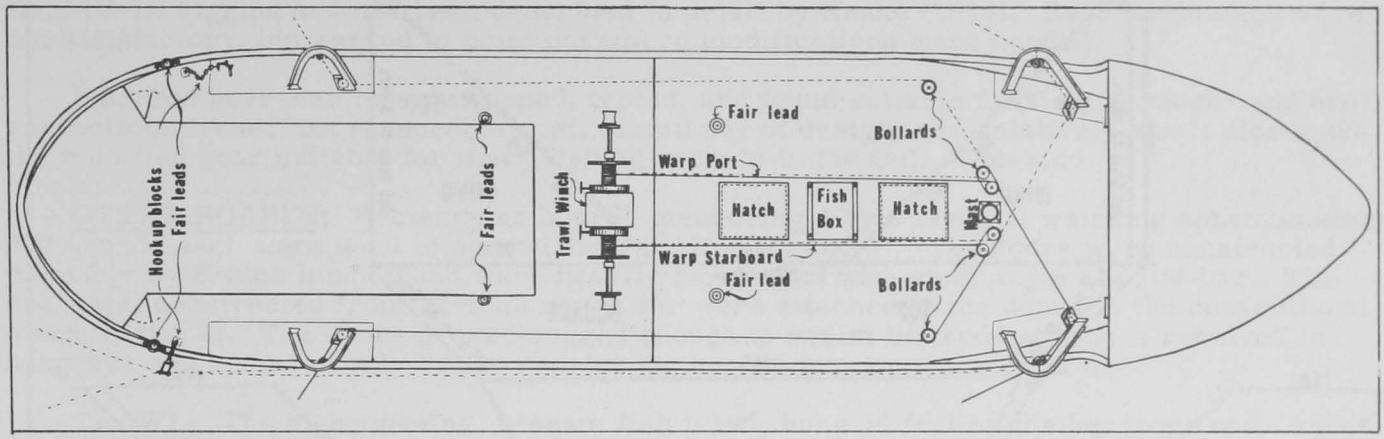


Fig 2 - Deck plan of M/V Silver Bay--the bollard-fairlead arrangement allows trawling from either the port or the starboard side of the vessel.

Electronic equipment aboard the Silver Bay included: Two loran receivers, radar, deep-water depth-recorder (0- to 2,200-fathom range), "white-line" depth-recorder (0- to 480-fathom range), shallow-water depth-recorder (0- to 450-fathom range), and a magnetic-compass automatic pilot.

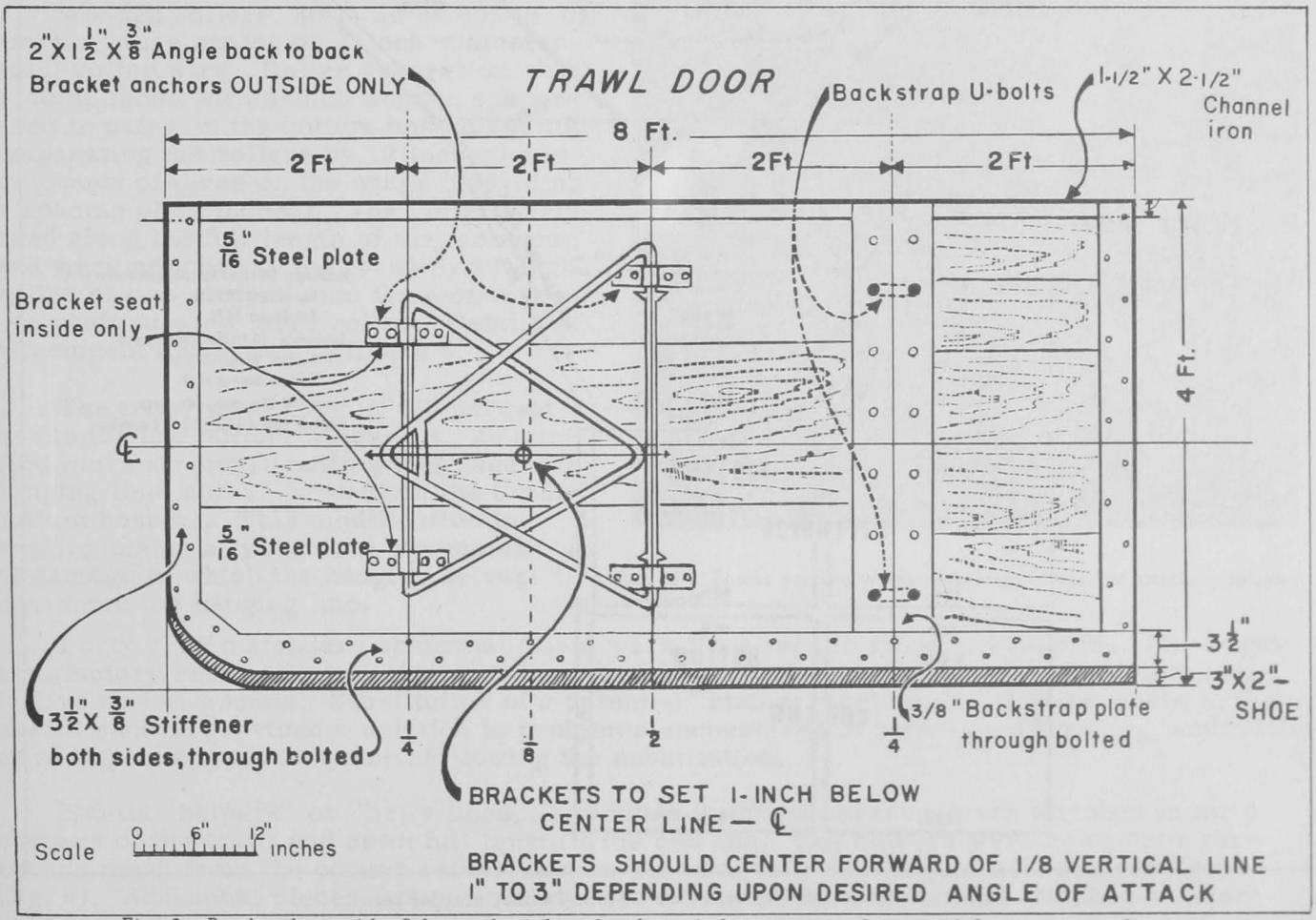


Fig. 3 - Bracket doors, 4 by 8 feet and reinforced with steel plate, were used to spread the snapper trawling gear.

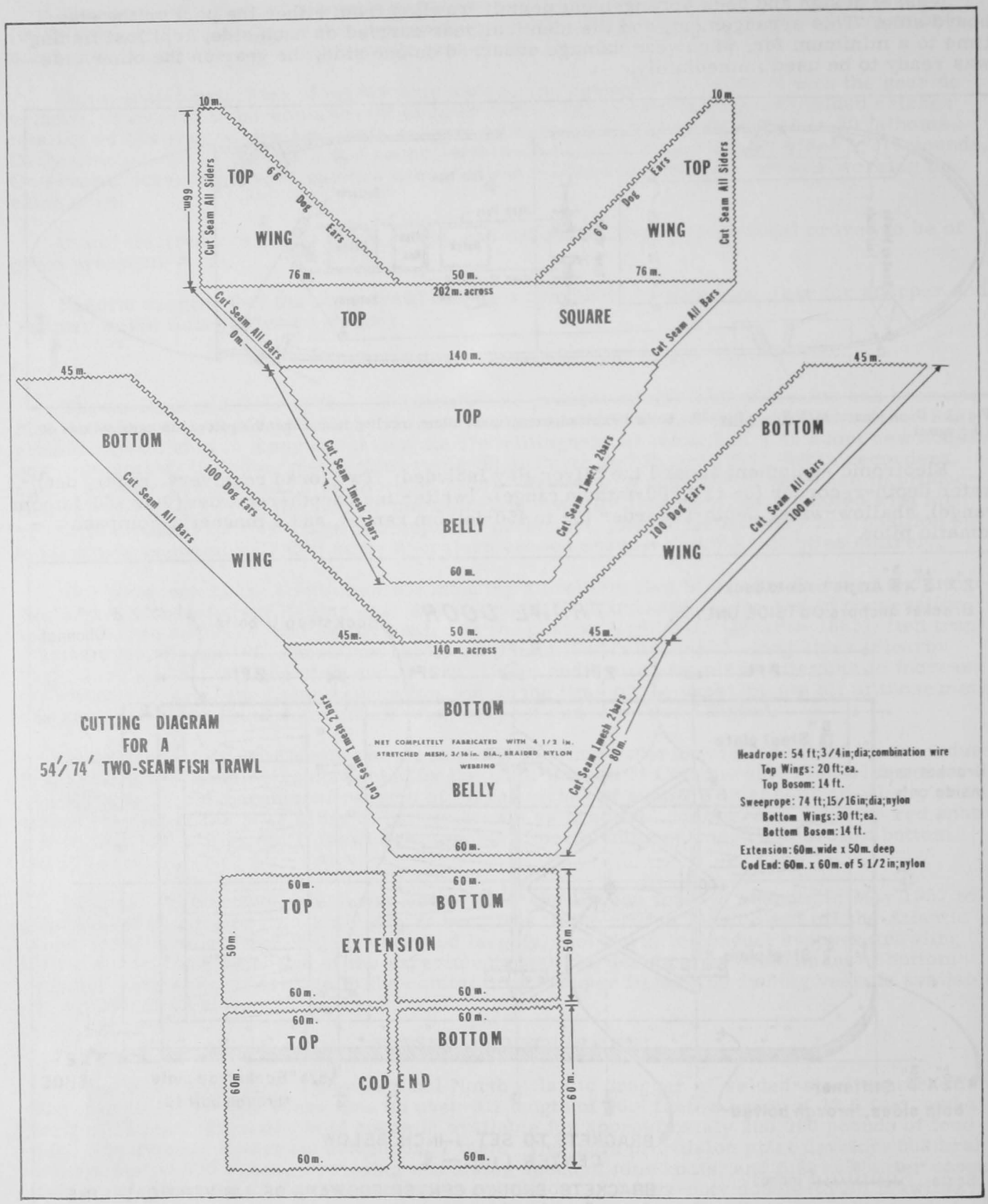


Fig. 4 - Construction diagram of the 54-foot-74-foot snapper trawl.

GEAR AND METHODS

Conventional North Atlantic gear, constructed from manila and cotton twine, was used at the beginning of the trawl studies. This gear was fished with bracket doors and Vigneron-Dahl (V-D) rigging and has been described in detail by Knake (1956). Results obtained were not satisfactory, but served to point out where modifications were needed.

Modified gear was then developed, tested, and found suitable for fishing rough- and broken-bottom areas. Its reasonable cost, simplicity of design, and relatively small size make the modified gear suitable for many fishing vessels in the Gulf of Mexico.

OTTER BOARDS: Rectangular boards measuring 4 by 8 feet and weighing approximately 900 pounds each were used to spread the trawl (figs. 3 and 6). The doors were constructed from $2\frac{1}{2}$- by 8-inch lumber and were heavily reinforced with steel angle and flat bar. The brackets, constructed from $1\frac{1}{4}$-inch round bar were attached to the doors in the conventional manner (fig. 4). The doors proved rugged enough to resist the sudden shocks received in hang-ups and required only minor repairs during the two-year period of use.

TRAWL: The high-opening, 2-seam fish trawl, hung 54 feet on the headrope and 74 feet on the footrope (fig. 4), was constructed from $5\frac{1}{2}$-inch-mesh braided nylon twine. Braided-nylon twine with a tensile strength of approximately 400 pounds was preferred to other types of nylon twine because its superior knot strength enabled the meshes to hold their shape even when the twine was subjected to great stress. The increased strength of the braided twine--2 to 4 times that of cotton twine of equivalent weight--enabled the gear to be fished on rough bottom with minimum gear loss or damage.

Wooden rollers, 20 to 24 inches in diameter, were strung on $\frac{5}{8}$-inch-diameter steel roller wire. Roller separation was accomplished with 6-inch wooden spacers used in pairs on the bottom bosom section (separating the rollers by 12 inches) and in groups of three on the wings (providing a spacing of 18 inches). The rollers were used along the full length of the footrope and were attached to the trawl by 20-inch roller chains stopped onto the footrope--one chain at each large roller. Details of attachment are shown in figure 5.

Fig. 5 - Bosom section of trawl showing method of attaching rollers to footrope.

The trawl was "hung in" 20 percent on the top and bottom wings (i.e., 20 percent more stretched netting was used than hanging line) and 37 percent on the top and bottom bosoms. This modification in hanging materially reduced a common type of damage in which the hanging selvage is torn from the hanging line.

Forty 7-inch standard spherical floats were first used to raise the headline. These gave satisfactory results at dragging speeds up to 3 knots, but were apparently completely ineffective at 4 to 5 knots. Substitution of a patented "rising-panel device" for the floats in the bosom section provided a solution to problems encountered in high-speed trawling, and catches at higher speeds increased following the substitution.

Manila "helpers" or "belly lines," $2\frac{1}{4}$ inches in circumference, were attached to the 4 corners of the trawl and sewn full length to the cod end. The helpers were sewn down the square mesh from the corner rather than on the bar, as is the custom with standard gear (fig. 6). Additional pieces, approximately 3 to 4 fathoms in length, were attached at intervals along the bottom wings and belly.

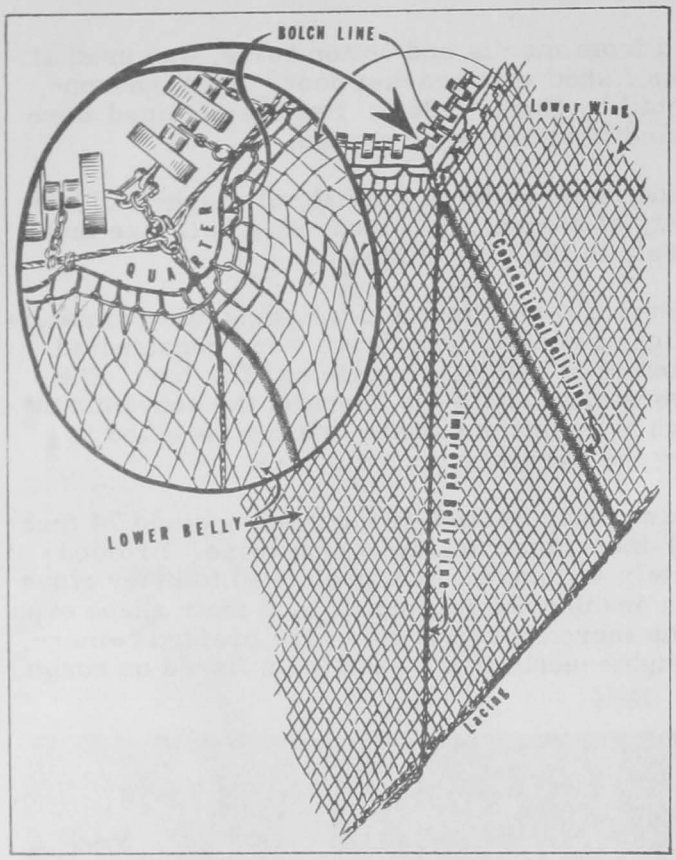


Fig. 6 - Detail of trawl quarter showing attachment of modified "helper" or "belly line."

The headrope was $\frac{3}{4}$-inch-diameter manila-clad wire rope. Doubled $\frac{3}{16}$-inch-diameter braided nylon twine was used to hang the webbing to the headrope and bolch line. Approximately 3 inches of slack was allowed in hanging. The bolch or hanging line (fig. 6) was approximately 20 percent longer than the nylon footrope and was stopped onto the latter in bights with single braided nylon twine. To prevent chafing by coral and rock, a heavy bull hide was attached full length to the bottom of the cod end.

FISHING METHODS: The roller gear, and associated Vigneron-Dahl rig, was handled by the side-trawl method described by Knake (1958). Although not mandatory, this method greatly facilitates handling heavy gear with minimum manpower (figs. 7 and 8).

The trawl was normally fished with two 10-fathom legs that were connected directly

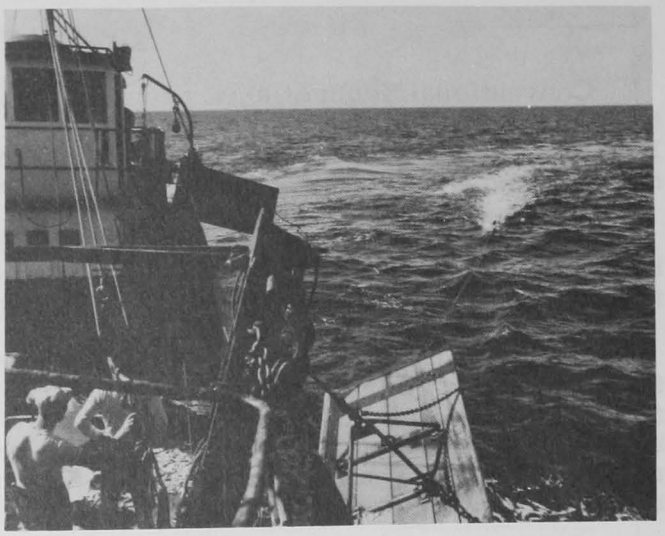


Fig. 7 - "Shooting" the trawl in the side trawling operation.

to the boards through a kelly-eye and stopper arrangement. In general it was found that the greater the distance between boards and trawl, the greater the catch; but the number of hang-ups increased proportionately with the length of the ground cables on bad bottom. A total of 15 fathoms of ground cable was added between legs and doors when bottom conditions were suitable. A 3:1 ration of towing-wire length to water depth was used normally, but on extremely rough bottom the ratio was reduced to 2:1.

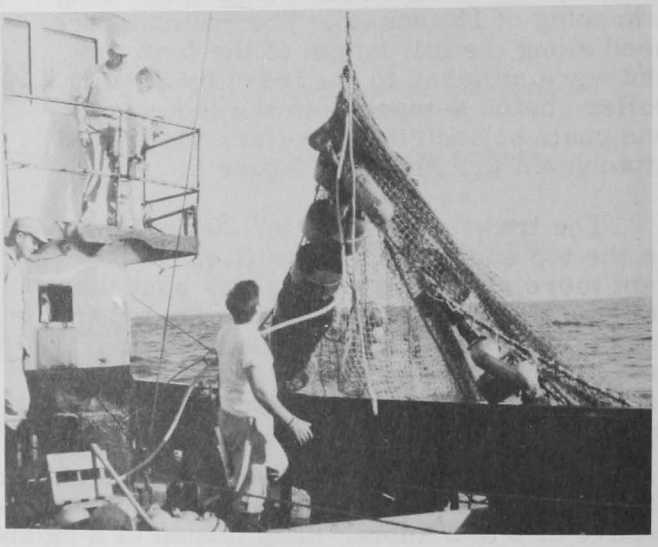


Fig. 8 - Bosom rollers being brought on deck with the "gilson" (whip). Wing rollers remain overboard.

FISHING RESULTS

Operations during the first year (June 1957-May 1958) were concerned primarily with gear design and modification and were confined to the known bad-bottom red snapper grounds of the north and northwestern Gulf of Mexico. Trawl catches in those areas were generally small, but were of sufficient magnitude to permit tentative evaluation of the effective-

ness of the gear. Results during this period have been reviewed by Rathjen (1958).

Trawling operations were extended to Campeche Bank in the spring of 1958 so that the trawl gear could be tested in areas being fished by hand-line vessels. A total of 5 cruises were completed on the Bank from May 1958 to May 1959. At least limited exploratory coverage was extended to all the areas of the Bank of known productivity. Good catches were confined to the areas south and west of Cayos Arcas. Two simulated commercial production cruises (Nos. 12 and 16) completed in those areas resulted in a total catch of 44,504 pounds of marketable snapper and grouper. Catch data by depth and season are summarized in table 1, and results of cruises 12 and 16 are summarized in table 2.

Table 1 - Snapper and Grouper Catch by Season and Depth, M/V Silver Bay Cruises 8, 12, 14, 15, and 16, Campeche Area

Season and Depth	No. Trawl Drags	Trawl Catch			Average Catch Per Drag		
		Snapper	Grouper	Total	Snapper	Grouper	Total
		(Pounds)					
Spring:							
0-10	0	0	0	0	0.00	0.00	0.00
11-20	1	9	0	9	9.00	0.00	9.00
21-30	122	13,329	3,209	16,538	109.25	26.30	115.55
31-40	41	9,916	800	10,716	241.85	19.51	261.36
41-50	13	1,488	168	1,656	114.46	12.92	127.38
51-60	3	7	20	27	2.33	6.66	8.99
61 +	5	0	0	0	0.00	0.00	0.00
Totals	185	24,749	4,197	28,946	-	-	-
Averages	-	-	-	-	133.77	22.68	186.45
Fall:							
0-10	0	0	0	0	0.00	0.00	0.00
11-20	0	0	0	0	0.00	0.00	0.00
21-30	74	22,330	1,109	23,439	301.75	14.98	316.73
31-40	2	753	41	794	376.50	20.50	397.00
41-50	0	0	0	0	0.00	0.00	0.00
51-60	0	0	0	0	0.00	0.00	0.00
61 +	0	0	0	0	0.00	0.00	0.00
Totals	76	23,083	1,150	24,233	-	-	-
Averages	-	-	-	-	303.72	15.13	318.85
Winter:							
0-10	0	0	0	0	0.00	0.00	0.00
11-20	0	0	0	0	0.00	0.00	0.00
21-30	59	9,583	1,209	10,792	162.42	20.49	182.91
31-40	18	2,568	95	2,663	142.66	5.27	147.93
41-50	5	430	0	430	86.00	0.00	86.00
51-60	1	150	0	150	150.00	0.00	150.00
61 +	0	0	0	0	0.00	0.00	0.00
Totals	83	12,731	1,304	14,035	-	-	-
Averages	-	-	-	-	153.38	15.71	169.09
All-Season Totals	344	60,563	6,651	67,214	-	-	-
All-Season Averages	-	-	-	-	176.05	19.33	195.38

Daylight trawl catches on Campeche Bank ranged as high as 2,400 pounds of snapper and grouper per day. The best individual drag resulted in 1,775 pounds of fish in 90 minutes of fishing time. Nighttime trawling consistently yielded much smaller catches.

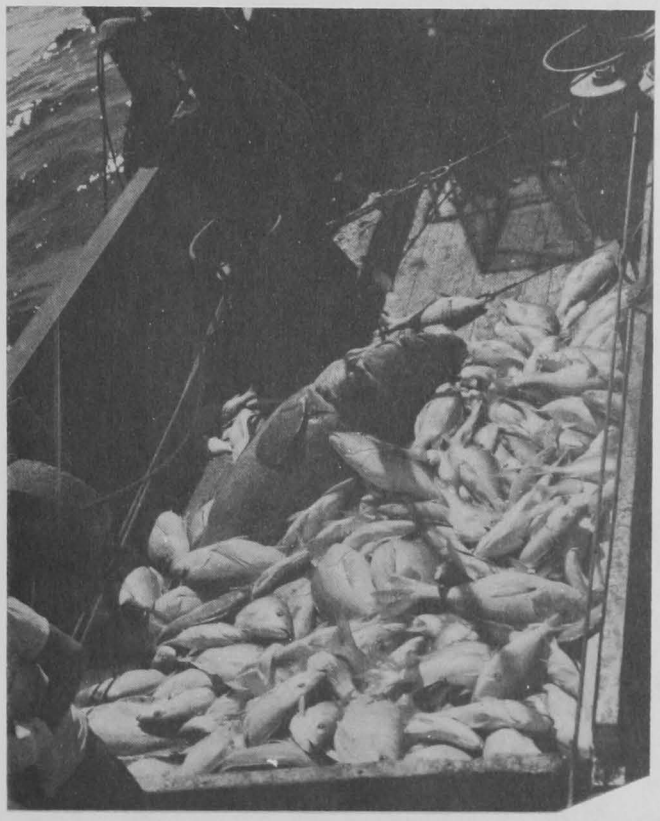


Fig. 9 - Large red snapper and jewfish taken in a trawl drag south of Cayos Arcas by the M/V Silver Bay.

A total of 11 species of snapper were represented in trawl catches (table 2), of which 3 species (red snapper, mutton snapper, and lane snapper) were taken in commercial quantities. Red snapper accounted for the largest part of the total catch, and that species was taken in all areas of operation--most commonly between 20 and 50 fathoms. Most of the snapper taken in water shallower than 30 fathoms weighed more than 1 pound, although smaller snapper were more abundant in deeper water. Lane snapper and mutton snapper were taken in quantities on Campeche Bank between 20 and 30 fathoms, but were absent from catches in other areas.

A total of 9 species of grouper were represented in the trawl catches. The species occurring commonly are listed in table 2. Red grouper, black grouper, and scamp accounted for the bulk of the grouper catch in all areas fished. On Campeche Bank, grouper catches made up as much as 10 percent of the total catch, but in other areas the percentage due to grouper was smaller. Grouper were present at all depths fished.

On several occasions, daily trawl catches greatly exceeded the hand-line catches of individual vessels fishing the same area. This

Table 2 - Catch Data--Simulated Commercial Trawling Operations of M/V Silver Bay Cruises 12 & 16, Campeche Bank

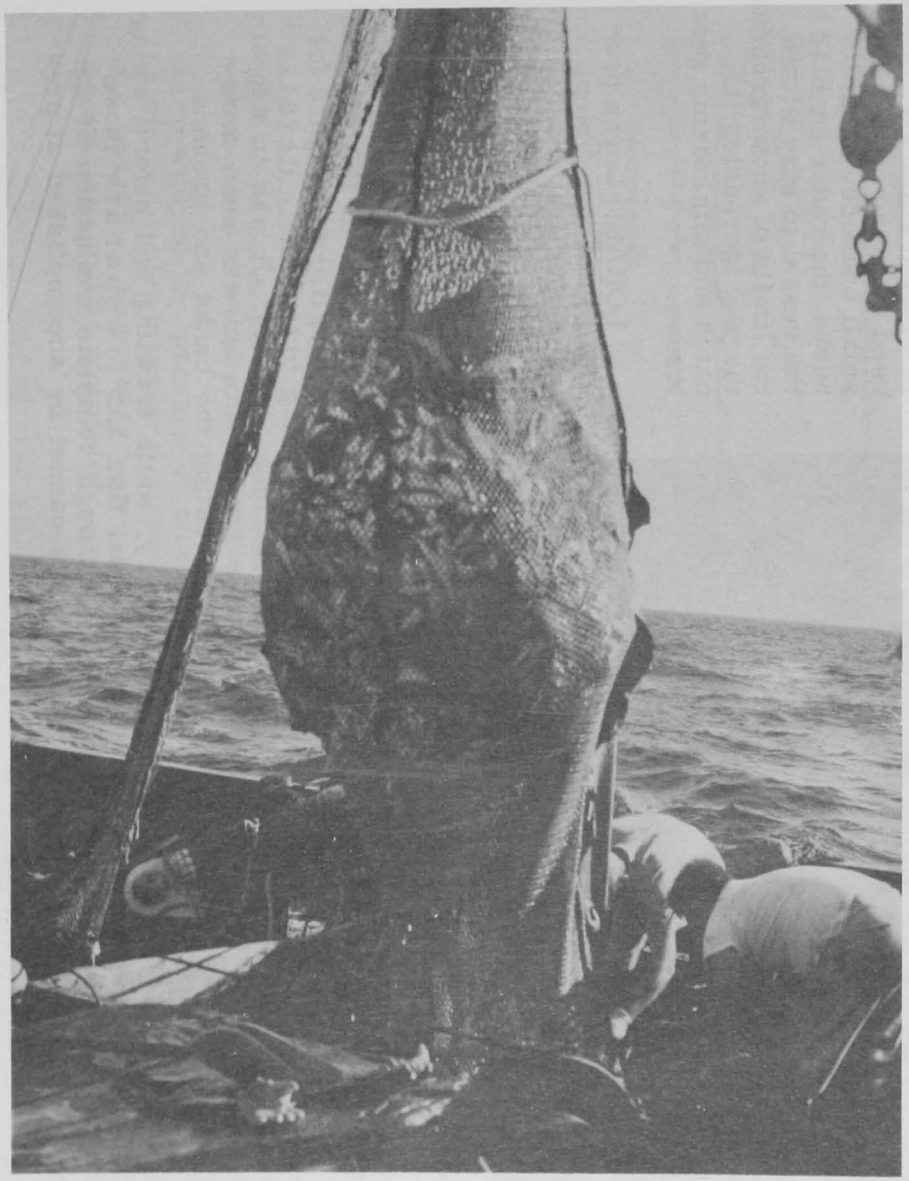
Species		Catch			
Scientific Name	Common Name	Cruise 12, November-December		Cruise 16, April-May	
		Total Weight	Average Weight	Total Weight	Average Weight
		(Pounds)			
Lutianus aya	Red snapper	1/ 11,449	5	14,271	8
Lutianus synagris	Lane or rainbow snapper	1/ 3,308	1½	624	1½
Lutianus analis	Mutton or king snapper	6,115	10	3,760	10
Lutianus griseus	Gray snapper	222	8	175	20
Lutianus apodus	Schoolmaster snapper	683	6	251	5
Ocyurus chrysurus	Yellowtail snapper	334	2	-	-
Rhomboplites auroroaberco	Vermilion snapper	1/ 900	½	-	-
Lachnolaimus maximus	Hog snapper	72	8	74	5
Epinephelus morio	Red grouper	446	8	427	10
Mycteroperca (2 sp.)	Scamp	312	4	628	8
Mycteroperca bonaci	Black grouper	392	12	948	15
Lutianus vivanus	Yelloweye or silk snapper	-	-	11	4
Garrupa nigrita	Warsaw grouper	-	-	20	10
Epinephelus (2 sp.)	Rock hind	-	-	22	3
Promicrops itaira	Jewfish	-	-	260	130
Totals		24,233	-	21,471	-

1/Indicates approximately 1,200 lbs. of unmarketable snapper taken when a 2-inch mesh liner was used for sampling purposes.

occurred most often when rough seas prevailed, but at other times trawl catches were larger owing, perhaps, to the fish not being attracted to the hand-line bait.

Fig. 10 - A 1,000-pound snapper catch dressed and ready for stowage aboard the M/V Silver Bay.

(A)



(B)

(C)

Fig. 11 - Escapement tests: (A) Releasing cod-end cover. The small fish which have sifted through the large mesh cod end can be seen just inside the cover. (B) Small fish which escaped through the cod-end mesh, but were retained by the 2-inch mesh cover. (C) Large fish retained by the $5\frac{1}{2}$-inch mesh of the cod end.

A number of experiments were conducted to determine the escapement rate of undersize snappers through the $5\frac{1}{2}$-inch-mesh cod end. These experiments, which consisted of intermittent use of 2-inch cod-end covers, indicated that approximately 95 percent of all snapper under one pound in round weight successfully escaped through the $5\frac{1}{2}$-inch mesh of the cod end (fig. 11).

Fig. 12 - Weighing the catch aboard the M/V Silver Bay prior to icing the fish.

USE OF ELECTRONIC FISHING AND NAVIGATIONAL AIDS

The electronic equipment carried by the M/V Silver Bay has been listed previously. Use of this equipment greatly facilitated snapper fishing operations.

RADAR: Radar was especially valuable when the vessel was fishing small grounds at night or during other periods of restricted visibility. When used in conjunction with small anchored radar buoys, the radar enabled the vessel to stay within the limits of known grounds, thereby increasing the catch and minimizing gear losses.

LORAN: Loran provided a means of pinpointing productive grounds and provided a means of easily relocating areas of high potential.

DEPTH RECORDERS: Each of the three depth-recorders carried aboard the vessel served a specific function. In combination, or singly, they were used to provide constant assessment of the sea bed and fish concentrations. The shallow-water depth-recorder, although not designed for fish finding, was used to delineate bottom conditions owing to the finely detailed bottom tracings that could be obtained with this machine (fig. 13). It was in use almost continuously while trawling. The deep-water depth-recorder was used more extensively for navigational purposes and for locating the banks and grounds.

The "white-line" recorder was used extensively, while trawling and before, owing to its ability to portray concentrations of demersal fish and to separate those concentrations from the sea bottom (fig. 14). Although complete evaluation of the effectiveness of this recorder in detecting fish schools cannot be accomplished at pres-

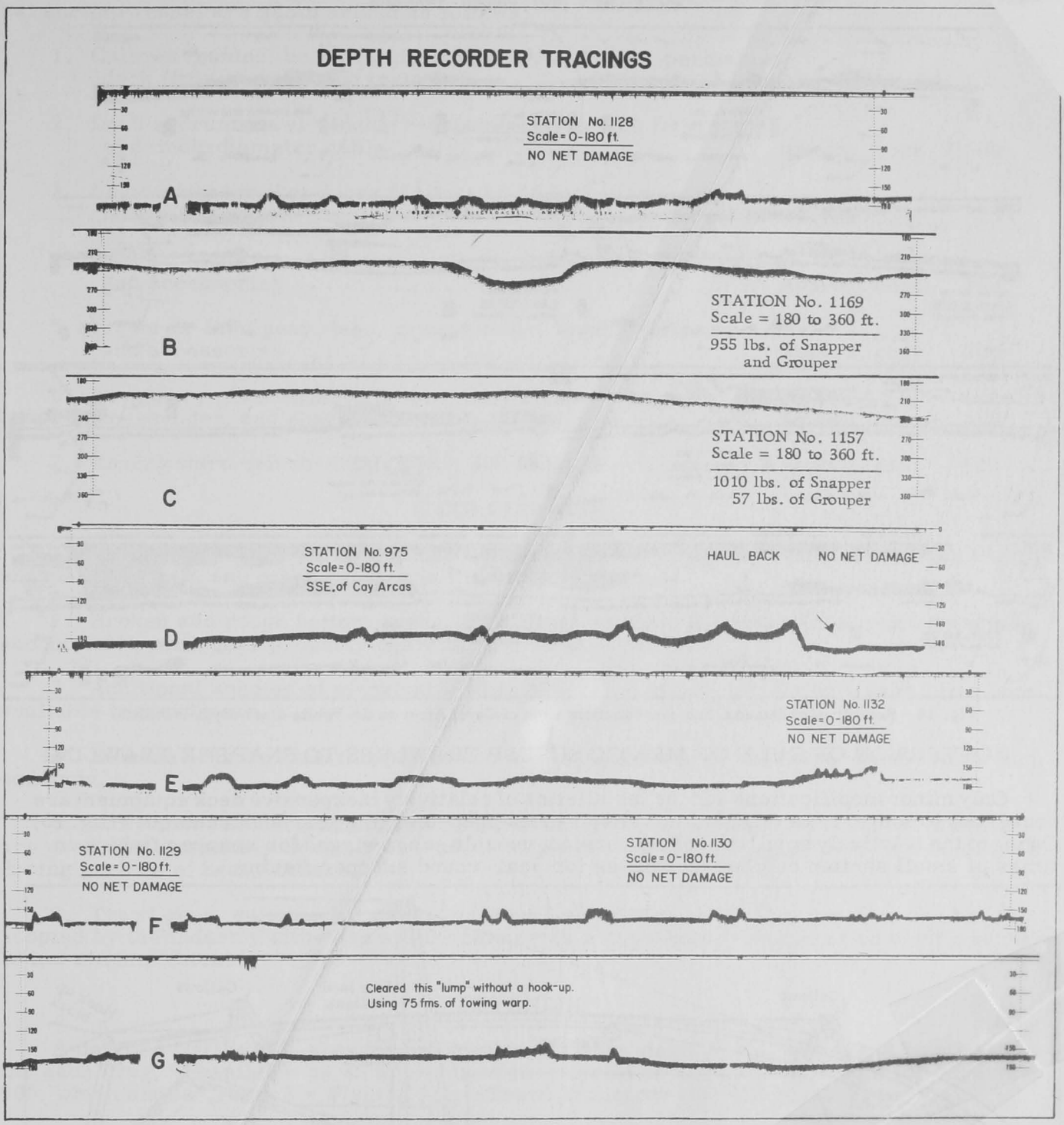


Fig. 13 - Depth-recorder tracings of sea bed on the red snapper grounds south and west of Cayos Arcas. The shallow-water recorder was not designed for, and did not pick up, fish concentrations.

ent--owing to the passage of small species of fish and squid through the $5\frac{1}{2}$-inch meshes of the cod end--on several occasions some correlation between catch and echo-tracings was possible. More experience with the machine is necessary before interpretations of the tracings can be completed.

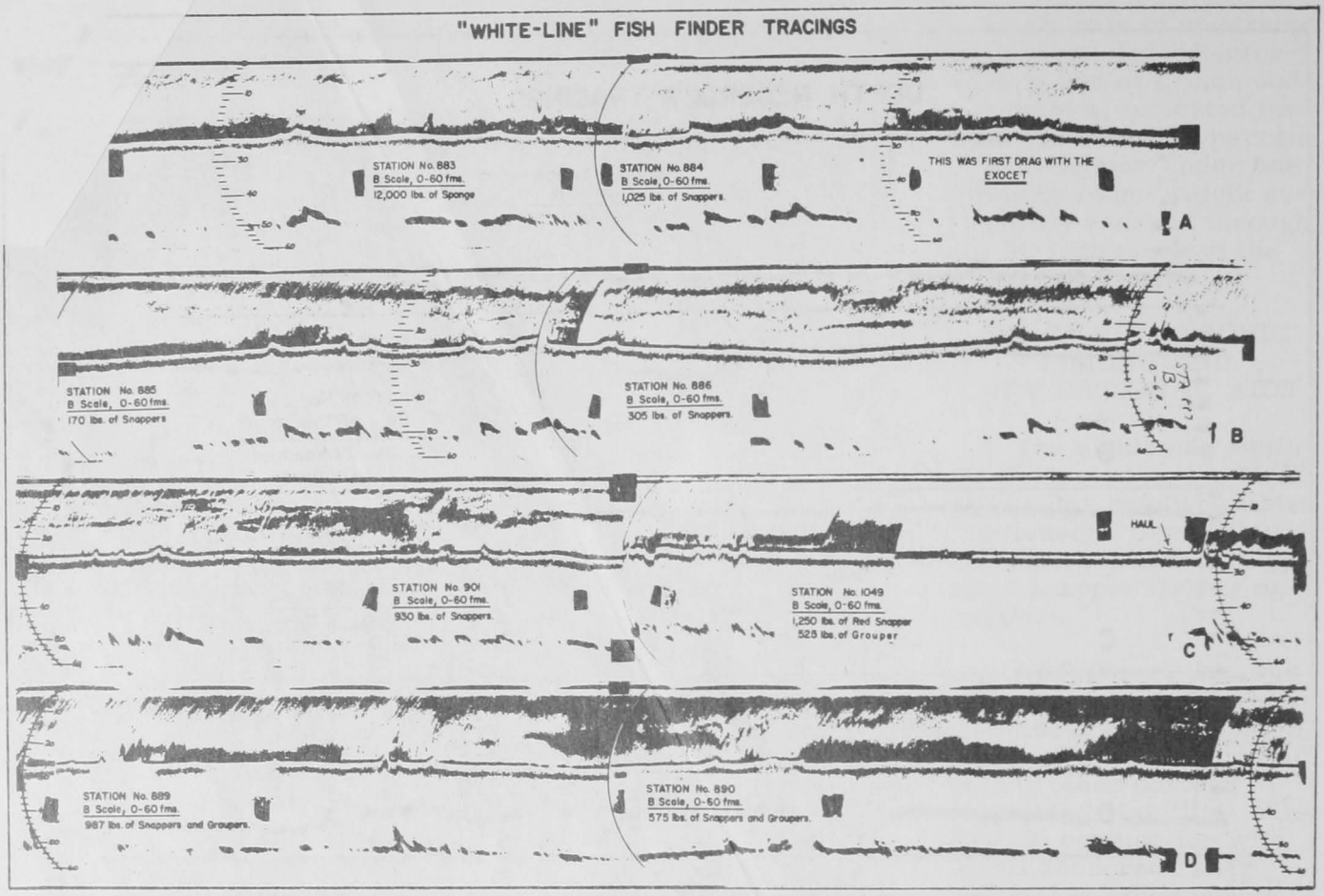


Fig. 14 - Recordings of demersal fish concentrations south of Cayos Arcas on the "white-line" depth-recorder.

CONVERSION OF GULF OF MEXICO SHRIMP TRAWLERS TO SNAPPER TRAWLING

Only minor modifications and the installation of relatively inexpensive deck equipment are necessary to convert existing shrimp vessels to snapper-trawling gear and techniques (fig. 15). Owing to the relatively small cost of conversion, vessels can be rigged for snapper fishing in times of small shrimp catches as well as for year-round snapper fishing.

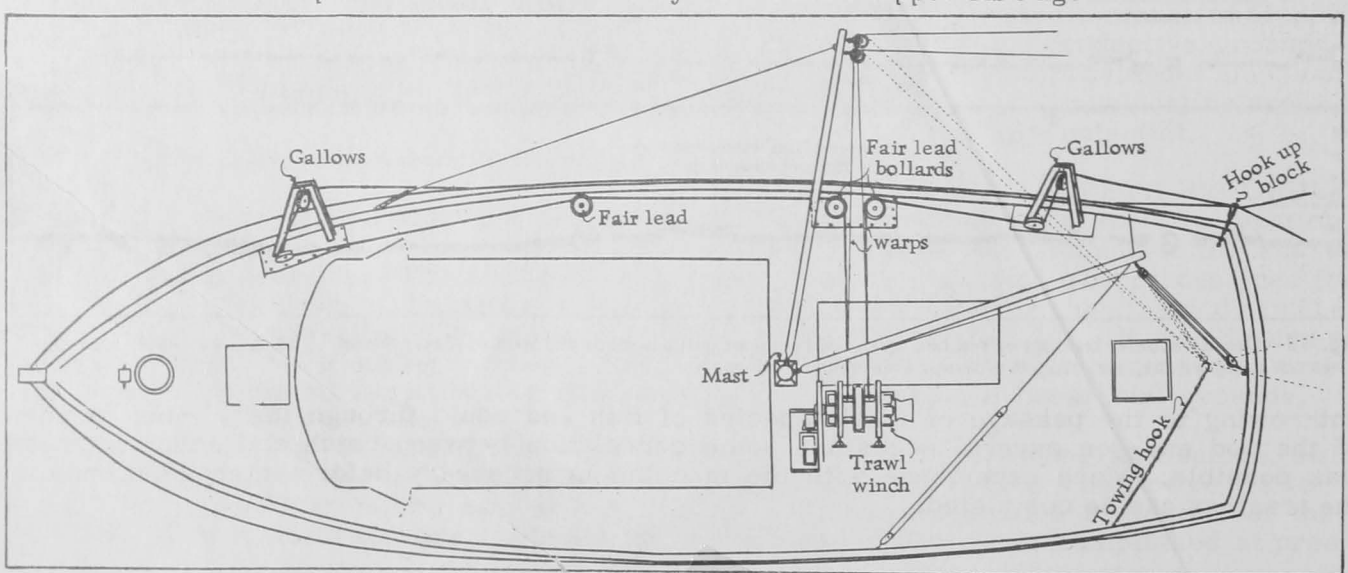


Fig. 15 - Deck plan of typical shrimp vessel, showing proposed location of gallows frames and fairlead blocks for side-trawl operations.

The modifications and approximate costs of conversion, at 1959 price levels, for a typical shrimp vessel are summarized as follows:

1.	Gallows frames, bollards (deck blocks), and other permanent deck fittings; including installation	Approx. cost $1,500
2.	Double-drum trawl winch[1]--capacity 150 to 200 fathoms of $\frac{5}{8}$-inch-diameter cable	Approx. cost 2,500
3.	Heavy-duty bracket doors ($6\frac{1}{2}$ feet by 44 inches, weight 500 to 600 pounds each), per pair	Approx. cost 300
4.	Braided nylon trawl ($\frac{54}{74}$ foot) rollers, floats, cod end, and accessories	Approx. cost 900
5.	Vigneron-Dahl gear, legs, ground cable, towing chains, and accessories	Approx. cost 200
6.	Accessory gear--quarter ropes, lazylines, messenger, and shackles	Approx. cost 150
7.	Towing warp $\frac{5}{8}$-inch-diameter[2], 300 fathoms	Approx. cost 500

CONCLUSIONS

1. Modified otter trawls can be used as effective commercial means of catching red snapper, grouper, and other species in the Gulf of Mexico.

2. Broken and rough bottom areas, previously considered untrawlable, can be worked economically with gear properly designed and constructed.

3. Additional species of marketable snapper, not generally caught with hand lines, are available to trawl gear.

4. Release of undersize snapper is accomplished effectively by large-mesh trawls and cod ends.

5. Daily trawl catches often surpass those of hand-line vessels when the two methods are used simultaneously in one area--especially when the fish are apparently not feeding or during periods of heavy seas.

6. Trawl gear, suitable for use by present Gulf of Mexico shrimp vessels, can be adopted by the industry either on a full scale or as a supplementary operation during periods of low shrimp catches.

APPENDIX

A detailed fishing log, showing geographic position, depth, date, catch, and related data for each drag, is available as an appendix to the reprint of this article. Write for Separate 600, which shows "Table 3 - Fishing Log--Trawl Stations--1957-59--M/V Silver Bay."

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1/Most large shrimp vessels are equipped with a suitable winch.
2/Half-inch-diameter wire may be used on vessels of under 40 gross tons.

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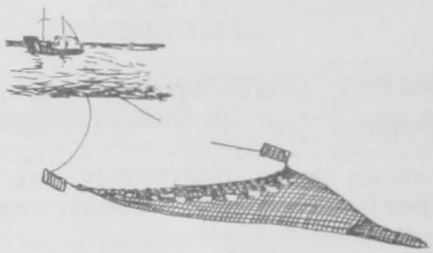

KELP AND HERRING SPAWN

Two commercial operators at Craig, Alaska, harvested 46 tons of kelp and herring eggs this spring. The procedure is to place kelp on herring spawning grounds to collect a layer of herring eggs on the kelp. A light covering of eggs on the kelp is sought; however, this spring approximately two-thirds of the total weight of the harvested product consisted of herring eggs.

The product is packed in barrels and shipped to the oriental market on the West Coast. The oriental trade there considers it a delicacy. U.S. Bureau of Commercial Fisheries biologists claim the number of eggs removed in this operation will have no measurable effect on herring production.