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A BRIEF HISTORY OF FLORIDA'S LIVE BAIT SHRIMP FISHERY
WITH DESCRIPTION OF FISHING GEAR AND METHODS

by

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Abstract

A brief history of the live bait shrimp fishery of Florida is given as well as descriptions of the methods of capture of the three major bait species.

The present fishery is growing in direct proportion to the growth of tourism and recreational fishing in Florida and it is expected that the bait shrimp fishery will capture more and more of the same shrimp that traditionally have been taken on the off-shore grounds.

The major portion of the shrimp catch from Florida estuarine areas is now being caught by roller-frame trawls. The roller-frame trawl evolution is described and construction features of the most advanced design given.

The roller-frame trawls are probably not destructive to the estuarine habitat. Methods of fishing, handling the catch, and kinds of organisms caught are described.

The roller-frame trawls of modern design are relatively inexpensive and easy to construct. They should be adaptable to a wide variety of uses in estuarine areas of the world where shrimp stocks are not now being exploited.

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The valuable offshore fisheries for shrimp, Penaeus setiferus (Linnaeus), P. aztecus Ives, and P. duorarum Burkenroad, of Florida have been studied for about 20 yr (Idyll, 1957; Joyce and Eldred, 1966) but less investigation has been made of the bait fishery conducted in coastal bays, lagoons and estuaries for juveniles of the same species. The bait shrimp fishery has grown rapidly in importance and has reached an efficient stage of development. There is a heavy demand for live bait shrimp by the recreational fishery of Florida, and considerable quantities of dead bait shrimp are also marketed.

Study of the bait shrimp fishery is important for several reasons. It is exploiting the same shrimp as the offshore fleet, and there may be conflict over future division of the catch. Then, anglers are sometimes concerned that damage may be done to the bay habitat and to young sport fish by the bait shrimpers. In addition, the roller-frame trawl now being used by a majority of the bait shrimpers in Florida is an efficient gear which should prove adaptable in tropical estuaries around the world.

Statistics of this fishery are collected by the Florida State Board of Conservation (Welch, 1965; Jones and Smith, 1966). In 1965, bait shrimp were caught and landed in 25 coastal counties of Florida. During that year 94,698,386 live shrimp and 218,000 kg of dead bait shrimp worth near \$1,460,000 at the wholesale level were reported. Retail values may be as much as three times that at the wholesale level.

Year-to-year fluctuations in landings from Nassau, Monroe and Santa Rosa counties suggest that annual abundance changes markedly in some areas (Table I). Counties having the largest estuarine areas generally produce the highest catches of bait shrimp. If man alters these estuarine "nursery grounds" by pollution and other adverse activities, both the bait and the offshore fisheries will suffer decreases in catch.

2 HISTORY OF THE FISHERY

The bait shrimp industry in Florida probably originated from a need by commercial hook and line fishermen for live bait for spotted seatrout, Cynoscion nebulosus (Cuvier), (Tabb, 1960; de Sylva, 1954). Tourists quickly learned of the value of live shrimp for sport angling, and the bait shrimp industry has risen in direct proportion to the increase in tourism in Florida. Until 1954, the bait shrimp fishery was centered in northeastern Florida between Cape Kennedy and Jacksonville. The white shrimp, P. setiferus, was caught most abundantly in the northern part of that sector while brown, P. aztecus, and pink shrimp, P. duorarum, were most important in the southern part. The fishery in northeast Florida operated originally on diurnal white shrimp which were caught by beach seine, cast net and otter trawls. The nocturnal brown and pink shrimp were fished later, using dipnets or channel nets. The latter are conical bags of 3/4- to 1-in stretched mesh netting attached to an iron pipe or reinforcing rod frame and suspended in the upper part of the water column from a bridge or from an anchored boat. This type of fishing is most successful during the monthly new and full moon ebb tides. Channel nets (Fig. 1) are still used in various parts of the state.

Dipnets were first used in conjunction with kerosene lanterns but the gear was probably not effective until the development of the "Coleman" gasoline lantern. Thousands of dipnet-Coleman lantern combinations are now in use in the bait shrimp fishery as well as in a rapidly growing recreational shrimp fishery. Although the dipnet fisherman sometimes catches large numbers of shrimp, his catch depends on surface runs of shrimp which are unpredictable; hence this gear cannot supply the present heavy demands of the bait industry.

The pushnet gear was apparently developed in northeast Florida near New Smyrna Beach about 1950 (de Sylva, 1954; Allen and Inglin, 1958). With this gear, one man can capture shrimp day or night, with 8-h catches ranging from 200 to 5,000 shrimp. Catches with the pushnet vary from 6 to as high as 400 shrimp per "push", depending on season and fishing area. In 1954 an estimated 1,300 people made their living exclusively from

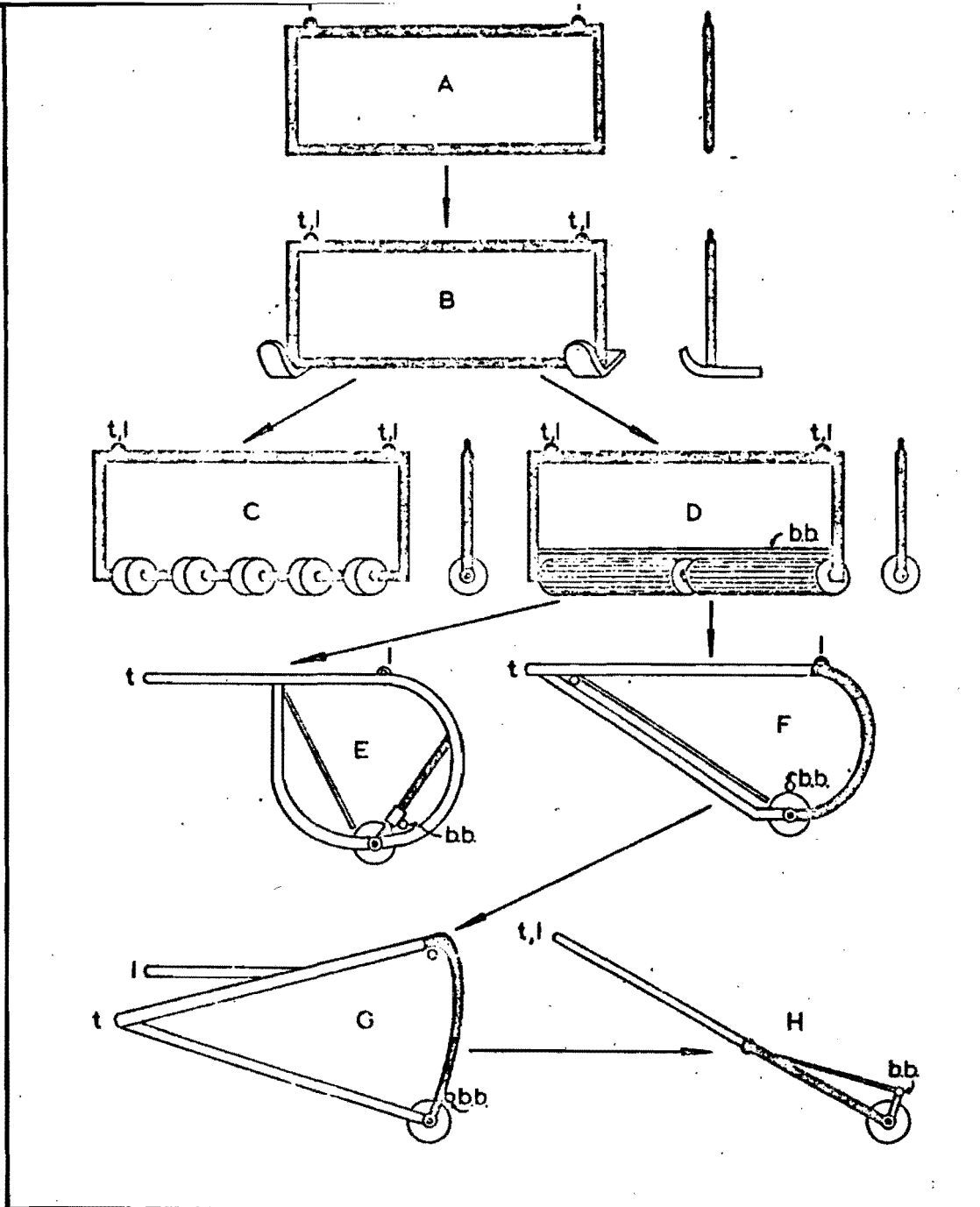


Fig. 1 Diagrammatic presentation of the evolution of the roller-frame trawl from the channel net through the "long yoke" and "short yoke" designs and culminating in the Still trawl (H).

- A = the channel net, equipped for lifting only
- B = the skid-equipped channel net frame (Higman, 1952)
- C = the wheel-equipped channel net frame (Higman, 1952)
- D = the roller-frame trawl of earliest known design
- E = west Florida "long yoke" frame (Woodburn, *et al.*, 1957)
- F = Biscayne Bay "long-yoke" frame (Tabb, 1958)
- G = Still "short-yoke" trawl frame (Tabb, 1958)
- H = Still trawl of 1967 illustrating return to basic simplicity of D but with important modifications

The basic features of the channel net frame have been retained by all these designs and are indicated in black. Design C was a dead end, the wheels apparently failing to provide sufficient bearing surface.

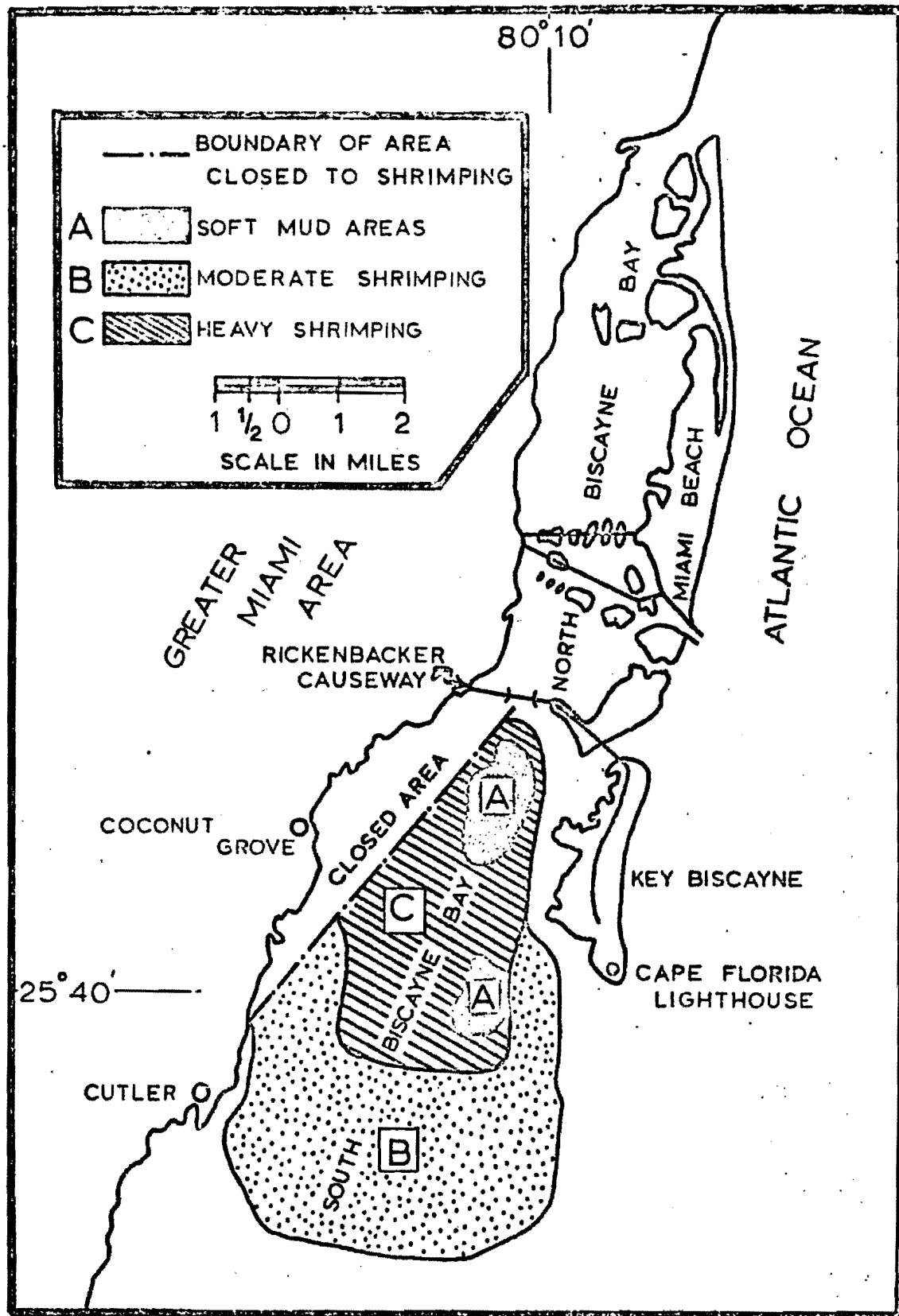


Fig. 2 The location of bait shrimp fishing grounds of Biscayne Bay, Dade County, Florida (after Tabb, 1958).

DIMENSIONS

- | | |
|--|---------------------------------------|
| (1) 117.5 cm (3' 6 ⁷ / ₈ ") | (16) 1.1 cm (7/16") Rod |
| (2) 368.0 cm (12' 2 ³ / ₈ ") | (17 & 18) See text |
| (3) 54.0 cm (21 ¹ / ₄ ") | Center of axle to bend |
| (4) 15.2 cm (6") | Radius of inside edge |
| (5) 100.0 cm (39 ³ / ₈ ") | Bend to middle of support. |
| (6) 42.0 cm (16 ¹ / ₂ ") | |
| (7) 1.2 cm (1/2") | I.D. (Inside diameter) |
| (8) 57.2 cm (22 ¹ / ₂ ") | Center of frame to near edge |
| (9) 1.2 cm (1/2") | I.D. |
| (10) 121.0 cm (4' 0") | Center of frame to middle of junction |
| (11) 1.9 cm (3/4") | I.D. |
| (12) 62.1 cm (24 ³ / ₈ ") | Center of frame to front edge |
| (13) 12.7 cm (5") | |
| (14) 1.1 cm (7/16") | Rod |
| (15) 2.5 cm (1") | I.D. |

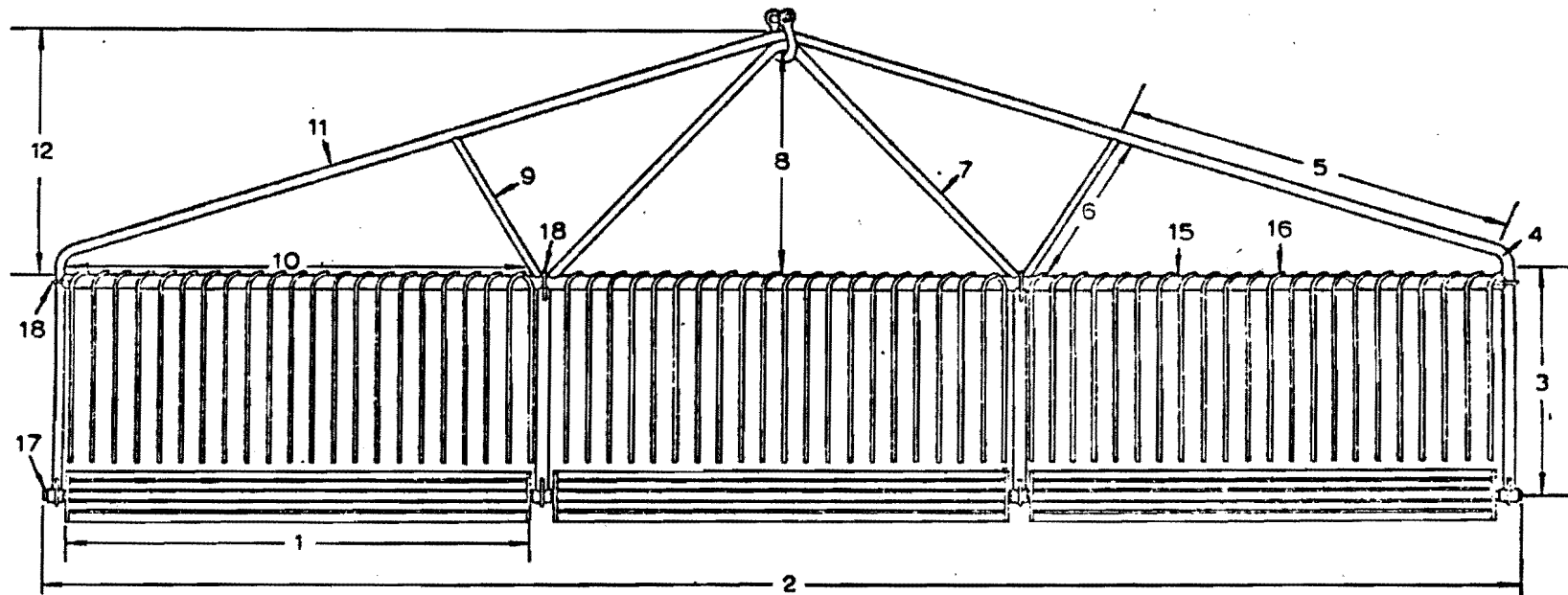
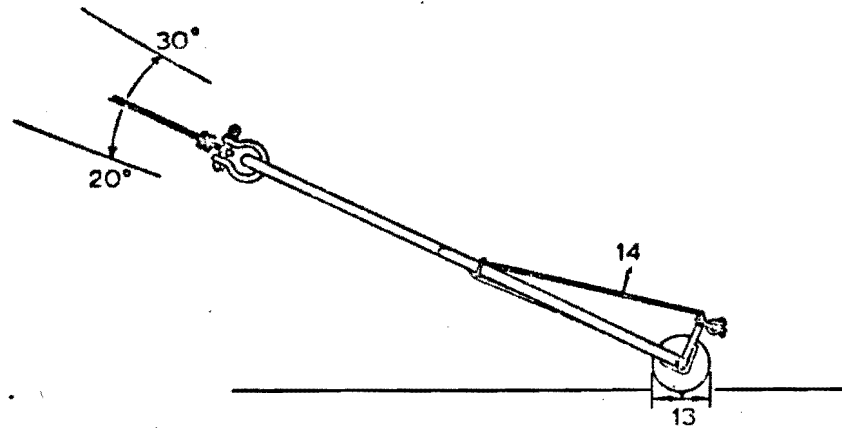


Fig. 3 Front and side views of the Still roller-frame trawl. Side view shown in fishing attitude.

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In Biscayne Bay, the larger double-rigged vessels fishing in about 15 ft (4.6 m) of water use approximately 100 ft (30 m) of 3/8-in galvanized wire towing cable for each net; about 75 to 80 ft (23 to 24 m) of cable are in the water during towing. Because galvanized wire rope rusts, it is standard practice to load the winch drums with 450 to 600 ft (137 to 183 m) of wire cable on each winch drum, cutting off the rusted end portions as needed. Some fishermen use 1/4-in (6 mm) stainless steel cable but this is reported to cut the sheaves of the lifting tackle.

There is no fixed warp-length to depth ratio; differences in the behavior of the shrimp often dictate that the attitude of the net frames be altered, which requires manipulation of warp length. As a rule, vessel speed and warp length are adjusted so that the angle between the warp and the water surface is about 20 to 30°. This causes the net frame to fall forward so that the leading edge of the upper net body (Fig. 5) forms an overhang; this prevents the vertical escape of shrimp flipping off the bottom.

The strainer bars are designed to exclude large objects from the net; sponges, water-logged coconuts, etc. cause damage to the catch if permitted to enter the codend. The spacing and orientation of the strainer bars in relation to the rollers is important. In older versions of the roller-frame trawls, the bars were often spaced approximately 4 in from center to center. The Still trawl has the bars spaced 2 1/8 in center to center. The narrower spacing does not hinder the passage of shrimp into the nets but reduces the amount of trash which is thrown up into the overlying water by the rollers.

The bars have been reported to serve as rakes, stirring the bottom to dislodge shrimp, but this is neither their designed nor their actual function. When viewed from the frame ends, the bars point toward the front edge of the roller axle (Fig. 4). In this position they cannot come in contact with the bottom; on vegetated bottom they may part the grass but they do not damage it or reach the root structures.

The "breaker bar" and associated 7/16-in rod (Fig. 3) forms the point of attachment of the lower edge of the net. The netting is securely laced to the 7/16-in rod. Biscayne Bay nets are made of 1-in stretched mesh netting and are tapered to a codend. The nets are 25 ft (7.6 m) long, of which about 8 to 10 ft (2.4 to 3 m) is codend. A lazy line is attached approximately 8 ft forward of the codend tie, and the free end is tied to the inboard side of the trawl frames in easy reach of the deck when the frames are in the raised position. A styrofoam float is attached to a line on the outboard side of each frame and is used to mark the position of the gear should the towing line part while under way.

4.1 Construction features of the trawl frame

In the interest of economy, the Still trawl frames are made of untested galvanized pipe. The axle sleeves in the rollers require tested pipe, however, since any flaws on the inside of these sleeves could cause the rollers to bind and drag rather than roll.

The roller axle and strainer bars should be constructed of cold-rolled steel for durability. Generally, the frame will last one and a half to two times as long as the rollers, so replacement rollers will be needed. To replace the rollers, the axle must be removed. This means that the welds (Fig. 3, point 17), must be accessible for removal. Spot welds on each end securing axle to frame are preferable to bolts passed through holes in the axle ends because vibration causes bolts to wear rapidly, resulting in the loss of one or more rollers. Spot welds can be removed rapidly. The welds should be inspected every 2 or 3 mo to see that they are secure.

The points of contact of the frame members are strengthened by flattening slightly the ends of the pipe to be welded. This is done at all points except at the bottom (Fig. 4, A to C), where the frame attaches to the axle housing. There, the gaps due to the two different pipe sizes are small and can be filled easily by the welder. With frames as large as the one illustrated (Fig. 3), it is necessary to strengthen the frame at these strain points. This is done by welding lengths of 7/16-in rod stock around the pipe sections (Fig. 3, point 18).

The frame should be built first without the strainer bars. When strainer bars are added, the frame and cross bar to which the strainer bars are attached will warp from the heat of welding. This can be corrected by placing the completed frame assembly on a flat surface, (with the axle and rollers in place) and applying downward pressure on the frame to re-align it. The free end of the axle can be spot welded then to the end axle housing.

The angle formed by the frame and the breaker bar should be approximately 85° to reduce the amount of bottom debris taken and to increase shrimp catch. The clearance between the breaker bar and the rollers is also important. It should be no more than $5/8$ in to keep shrimp from "skipping" under the net. Half of a $3/8$ in chain link is welded to the underside of the breaker bar (Fig. 4, point F) at each end. These are for attachment of lines which are incorporated in the net as described below.

The net is made of 1-in stretched mesh nylon or dacron bulk netting. The top panel is 220 meshes long and the bottom panel is 190 meshes long. Several net panels are cut from a single piece of bulk netting on a one-to-one taper starting from one end. Then, 50 meshes are counted before the second cut is made (Fig. 5). The second cut is made on an expanding one-to-one taper. By "dove-tailing" pieces in this fashion there is a minimum of wasted material.

With the 220-mesh top panel on top of the 190-mesh bottom panel, the seams are sewn securely. The top forward 30 meshes form an over-hang. A straight cut at 90° (right angle) is made across the 30-mesh top or over-hang to form the sides, which should be securely laced to the breaker bar support rod (Fig. 4, point D). A lightly greased length of polyethylene line is woven along the leading edge of the net mouth to help prevent wear by sand and shell debris. This line also distributes the load over the entire leading edge of the net.

Two- to three-foot lengths of polyethylene line are woven into the seams in the net, one on each side, about one foot from the leading edge of the net. These lines are fastened to the half-link of $3/8$ -in chain on the breaker bar by a $1/4$ -in shackle and help remove slack in the net when securely tied.

Two styrofoam floats are attached to the top of the net about 1 to 2 ft (0.3 to 0.6 m) from the codend tie. These elevate the codend and prevent its snagging on the bottom.

5 HANDLING THE CATCH

The catch containing fish, shrimp, plant fragments and other extraneous material is removed from the nets as quickly as possible to avoid harming the shrimp. The catch is sorted on tables mounted to the edge of live boxes provided with circulating sea water. In most cases the sorting tables have raised sides, 4 to 5 in high, with the outboard ends removable. The tables are constructed so that there is a slight slope toward the outboard end. The open end of the tables and the slope, permit crabs and active fish to "sort themselves". Many drags have almost no trash and are put in the bait tanks after a quick inspection for fish and crabs. If quantities of grass fragments are collected, they are removed completely to avoid the danger of clogging the pump intakes. At such times, the sorting is done rapidly and the fish and animals, other than shrimp, are returned to the bay before the shrimp are placed in the tanks. Observations of catch taken in each of 22 pairs of drags, containing between 6 and 34 lb (2.7 and 15.4 kg) of shrimp, fish and extraneous material, indicated that an average of only $4\frac{1}{2}$ min was required to sort each net haul.

Most shrimp recover quickly from sorting and are lively and ready for marketing the following morning. Most fish also survive this handling. Atlantic thread herring, Ephithonema oglinum, and sardines, Harengula pennsacolae, usually survived if not damaged by crabs or by gilling in the trawl meshes. Snappers and other bay species appeared to suffer no ill effects from the brief exposure. The short drags and sorting time, the small amounts of trash and the moist night air, usually prevent the fish from being severely damaged. Only one species, the blackcheek tongue sole, Symphurus plagiusa, was commonly killed by being gilled in the meshes of the trawl.

TABLE III

List of species of fishes taken in 44 roller-frame trawl drags expressed as per cent of total number of fishes. Size range is given in inches total length

Common Name	Scientific Name	No.	Per cent	Total L.in.
Blackedge moray	<u>Gymnothorax nigromarginatus</u>	2	.13	4
Hogfish	<u>Loachnolaimus maximus</u>	1	.06	4
Leopard searobin	<u>Prionotus scitulus</u>	8	.52	4-8
Bluestripe grunt	<u>Haemulon sciurus</u>	19	1.23	2-6
Bandtail puffer	<u>Sphaeroides spengleri</u>	5	.32	2-3
Inshore lizardfish	<u>Synodus foetans</u>	1	.06	8
Sand perch	<u>Diplectrum formosum</u>	55	3.56	3-8
Pinfish	<u>Lagodon rhomboides</u>	36	2.33	3-6
Dusky pipefish	<u>Synagathus floridae</u>	5	.32	6-8
Spotted seahorse	<u>Hippocampus erectus</u>	18	1.16	2-4
Striped burrfish	<u>Chilomycterus schoepfii</u>	82	5.32	3-8
Hogchoker	<u>Trinectes maculatus</u>	15	.97	4
Yellowtail snapper	<u>Ocyurus chrysurus</u>	2	.13	3
Redfin parrotfish	<u>Sparisoma rubripinne</u>	182	11.81	2-7
Gray snapper	<u>Lutjanus griseus</u>	7	.45	2-3
Lane snapper	<u>Lutjanus synagris</u>	22	1.42	3-4
Cowfish	<u>Lactophrys quadricornis</u>	158	10.25	1-8
Barbfish	<u>Scorpaena brasiliensis</u>	63	4.08	2-8
Planehead filefish	<u>Monacanthus hispidus</u>	16	1.03	1-3
Fringed filefish	<u>Monacanthus toliatus</u>	490	31.79	1-4
Gulf toadfish	<u>Opsanus beta</u>	172	11.16	2-10
White grunt	<u>Haemulon plumieri</u>	146	9.47	2-5
Mojarras	<u>Eucinostomus spp.</u>	25	1.62	2-5
Spotfin flounder	<u>Citharichthys spilopterus</u>	2	.13	4-5
Pigfish	<u>Orthopristis chrysopterus</u>	3	.19	3-8
Eyed flounder	<u>Bothus ocellatus</u>	1	.06	3
Cardinal fish	<u>Apogon sp.</u>	4	.25	3
		1,541		

7 DISCUSSION

The roller-trawl is the major fishing gear of the modern live bait shrimp fishery of Florida. Over the years, it has undergone considerable modification, chiefly to reduce weight and to produce large catches of shrimp with as little "trash" as possible. The Still trawl described here is the most advanced design in the industry, to our knowledge, and has been stripped of all but the essentials, such as rollers, strainer bars and breaker bar. Its light weight, low cost, and ease of fishing should make it adaptable in many estuarine areas of the world, particularly in the tropics, where large shrimp resources may exist but which are not now being exploited. It can operate in less than 6 ft of water and by suitable reduction in size can be adapted to small boats.

The gear may also be useful as a quantitative sampler. By the addition of a meter to record revolutions of the roller, the length of the towing track can be measured.