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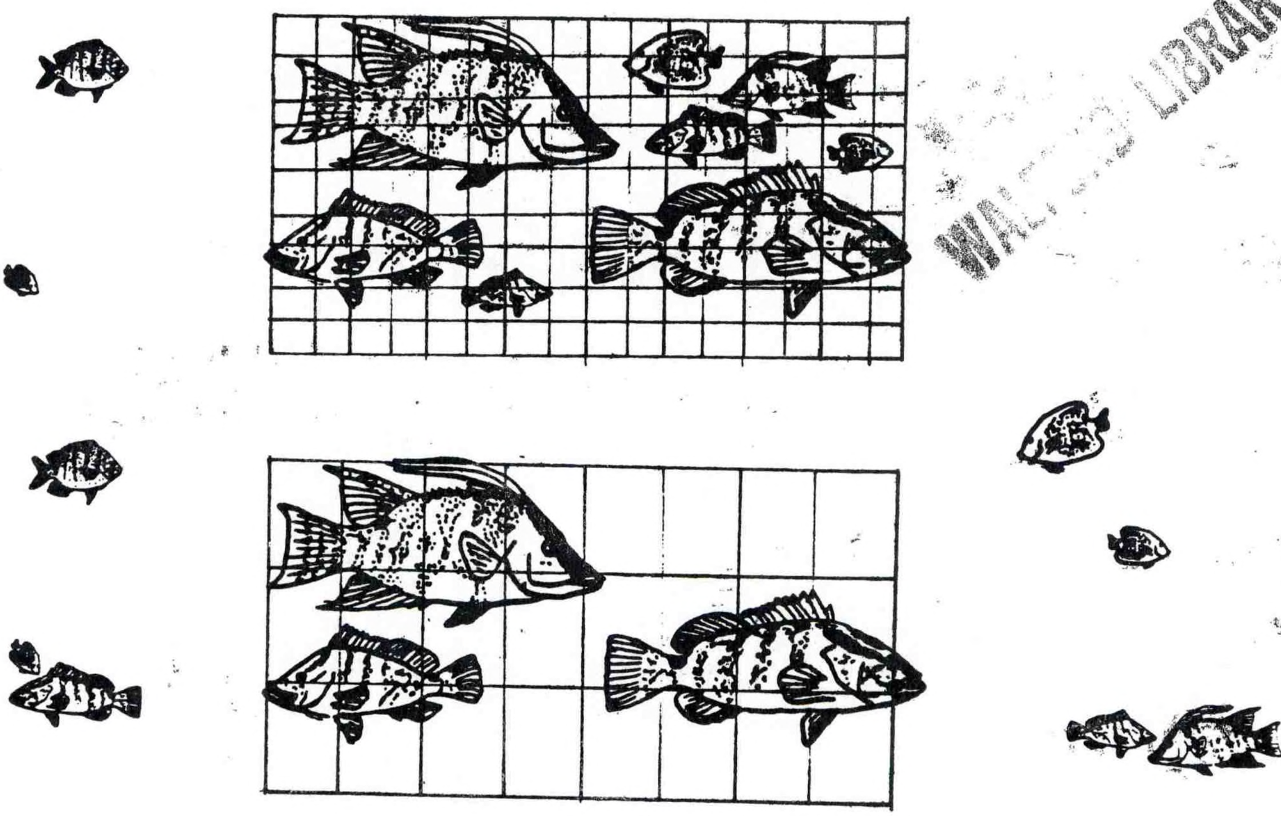

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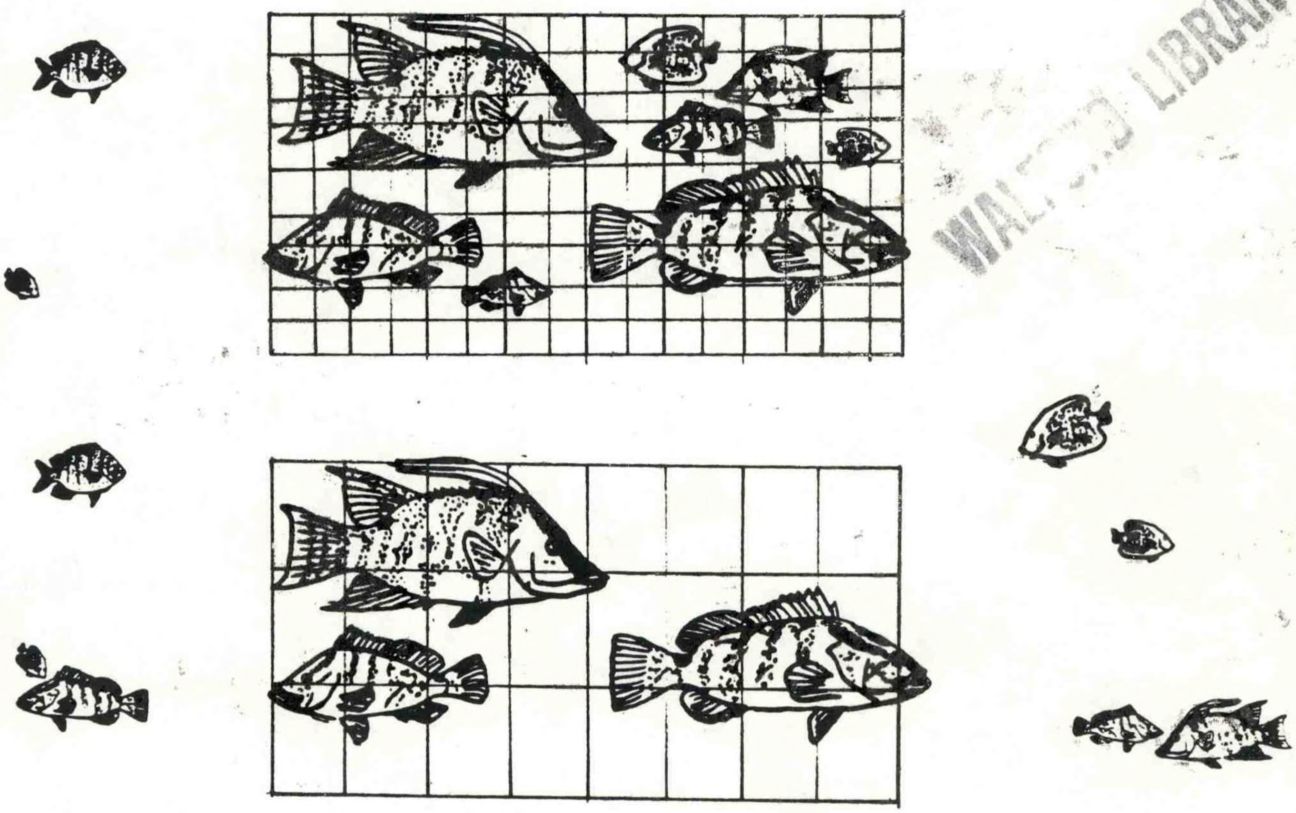

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ABSTRACT

Catch and mesh selectivity of wire fish traps were tested for eleven different mesh sizes ranging from 0.5 x 0.5" (13 x 13 mm) to 3 x 6" (76 x 152 mm). A total of 1810 fish representing 85 species, 28 families, and 757 kg were captured during 330 trap hauls off southeastern Florida from December 1986 to July 1988. Significant differences were noted in catches by mesh size. The 1.5" hexagonal mesh caught the most fish by number, weight, and value. Traps with smaller and larger meshes tended to catch fewer fish and less weight per trap haul. Median fish size increased with mesh size. Laboratory mesh retention experiments showed relationships between mesh shape and size and individual retention for snapper (Lutjanidae), grouper (Serranidae), jacks (Carangidae), porgies (Sparidae), and surgeonfishes (Acanthuridae). These relationships may be used to predict the effect of mesh sizes on catch rates. Mesh size greatly influenced catchability and may provide a useful basis for managing and regulating the commercial trap fishery.

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THE EFFECTS OF FISH TRAP MESH SIZE ON REEF FISH CATCH

INTRODUCTION

A concern exists that wire fish traps used in federal waters off the State of Florida may be too effective in harvesting reef fish stocks. Current Gulf and South Atlantic Fishery Management Council regulations allow minimum mesh sizes of 1 x 2", 1.5" hexagonal, and 1.5 x 1.5". In the Gulf of Mexico traps also must have two 2 x 2" escape windows on two sides. These mesh sizes retain snapper and grouper that are smaller than the minimum legal size limits and below the minimum size of first sexual maturity (Munro, 1983; Taylor and McMichael, 1983). From 38 to 50% of the fish captured in traps are species with no direct commercial importance. These non-target and undersized sized fishes incur injury and mortality from: (1) attempting to escape from traps, (2) embolisms caused by changes in ambient pressure as traps are lifted to the surface, (3) stress and handling at the surface before release, and (4) predators such as moray eels which enter traps and prey on fishes before the traps are hauled (Sutherland and Harper, 1983; Taylor and McMichael, 1983). Lost traps (ghost traps) which continue to catch fish have also been a concern although some evidence indicates that lost traps quickly become damaged and ineffective (Sutherland, Beardsley and Jones, 1983).

Determining the effects of mesh sizes on fish size and composition is important for wise fishery management. Adjusting trap mesh size can optimize fishery resource production by reducing juvenile and bycatch mortality and can reduce the chances of overfishing. Most studies of mesh selectivity have been conducted in heavily exploited areas outside of the continental U.S (Olsen et al., 1978; Stevenson and Stuart-Sharkey 1980; Hartsuijker and Nicholson, 1981; Hartsuijker 1982; Munro 1983; Luckhurst and Ward, in press; and Ward, in preparation). These studies may not be entirely applicable to the trap fishery in the southeastern U.S. due to differences in species availability, abundance, and size of fish present.

The Reef Fish Team of the Southeast Fisheries Center's (SEFC) Miami Laboratory studied the relationship of mesh size in wire fish traps to catch compostion and size distribution of reef fish off Florida. The specific objectives to be accomplished by this research were:

1) Document the size distribution of individuals and species caught by different mesh sizes.

2) Determine the effects of different mesh sizes on catch of target and non-target fishes.

3) Report the selectivity of meshes so that optimum mesh sizes can be determined for management purposes based on its capacity to reduce bycatch mortality and yet retain marketable fishes.

Here we report results covering the two years of the study. Sutherland et al. (1987, in press) discussed preliminary results from the first year of the study.

METHODS

Field Methods

Fish traps constructed with different sizes of wire mesh were fished off Key Biscayne, Florida with the Miami Laboratory's R/V CHARLES DARWIN to determine the species and size selectivity of catches. Field studies consisted of two phases: December 1986 until July 1987 and from October 1987 to July 1988. The first phase tested eight meshes (five square and three rectangular) measuring 0.5 x 0.5" (13 x 13 mm), 1.5 x 1.5" (38 x 38 mm), 1 x 2" (25 x 51 mm), 2 x 2" (51 x 51 mm), 2 x 3" (51 x 76 mm), 3 x 3" (76 x 76 mm), 2 x 4" (51 x 102 mm), and 4 x 4" (102 x 102 mm). Measurements were from "knot to knot." The second phase extended the sampling effort from the first phase and at the request of the Gulf of Mexico Fishery Management Council added two rectangular and one hexagonal-shaped mesh: 1.5 x 3" (38 x 76 mm), 3 x 6" (76 x 152 mm), and 1.5 x 2.3" (38 x 58 mm), respectively.

Mesh size will be referred to in English units for the remainder of the report. The hexagonal mesh will be referred to as 1.5" hexagonal. Size characteristics and measurement conversions appear in Table 1.

All traps used vinyl-coated wire and were rectangular shaped, measuring approximately 61 x 71 x 91 cm (2'h x 2.3'w x 3'l). Each trap had a single funnel entrance in one end that terminated in a 6 x 46 cm (2.5 x 18") vertical opening. The side and end panels of all traps were constructed of 1 x 2" (25 x 51 mm) vinyl coated wire mesh to present the same silhouette and presumably the same amount of visual attractiveness to fish. The top and bottom panels of the traps were constructed of the tested mesh. One trap was constructed entirely of 1 x 2" wire mesh, but had all inside panels lined with a 0.5 x 0.5" galvanized hardware cloth. The 1 x 2" mesh was considered the control mesh based on its wide popularity and usage off south Florida.

The traps were fished unbaited in trawls (strings) of four traps in depths of 7 to 40 m about 5 - 7 km east of Key Biscayne, Florida. Each trawl had traps attached at 50 m intervals to a 250 m groundline with a concrete or steel weight anchoring each end of the groundline. A subsurface or surface buoy was often attached to one end of each groundline to aid in relocation and retrieval of the gear. The traps were randomly attached to the groundline to prevent sampling bias and each set was fished under similar conditions of depth, bottom type and soak time to avoid confounding effects on mesh size. Soak times varied considerably due to weather but averaged 7 days (range 1 to 19 days). Lost, stolen or damaged fish traps were replaced or repaired as needed and different traps of a given mesh size were rotated into the fishing schedule.

The number of hauls for an adequate sample size was determined according to methods given by Bros and Cowell (1987). Mesh sizes added in phase II were fished more often in phase II to obtain comparable numbers of trap hauls.

Each captured fish was identified, weighed, and measured to the nearest millimeter of fork length. Total length, standard length, body depth and body width were recorded for many individuals. Where possible fish were released after measurements were made.

Some fish were captured in traps fished from the R/V CHAPMAN in March 1988 during cruise 88-02(23) in the southeastern Gulf of Mexico off southwestern Florida. Methods varied in that ten baited traps were fished individually at randomly selected sites with a soak time of 2 hrs. Half of the sampling sites were inshore and half offshore of the Gulf of Mexico Fishery Management Council's stress zone line running north of Key West, Fla. between 24^{o}5'N and 29^{o}0'N.

Economic Analysis

The effects of mesh size on the value of catches were analyzed based on voluntarily reported mean wholesale prices for each species by 30 seafood dealers from 6 Florida counties for May 1988 (Economics and Statistics Office, SEFC, NMFS, Miami, FL, pers. comm.). Wholesale price per pound was converted to mean price per gram and multiplied by the weight for each species from a standardized sample of 30 trap hauls per mesh size. Prices were adjusted according to fish size for some species.

Mesh Retention Experiments

The largest mesh that would retain a particular fish was determined during laboratory and field trials. Laboratory studies were conducted at the Southeast Fisheries Center's Miami Laboratory on Virginia Key (Miami), Florida. Most of the fish used in laboratory studies were captured in fish traps during field studies although some were obtained from other sources. A rectangular, plastic container (91 x 68 x 61 cm) was placed in circular, 2 m diameter tanks 0.8 m deep. Removable wire mesh panels of the different mesh sizes were fitted across the one open end of the container and the ability of individual fish to escape through the mesh was noted. Though many fish passed willingly through the mesh, a few species such as angelfishes (Pomacanthidae) had to be prodded or guided through the mesh by hand.

During phase II, fish were tested by gently pushing them through various meshes (beginning with the largest and proceeding to smaller meshes) until they were retained. Escapement studies based on voluntary fish behavior were abandoned because of behavioral complications discussed by Sutherland et al. (1987, in press). The hexagonal mesh could not be tested because its shape became distorted during testing.

RESULTS

Sample Size

Thirteen trap hauls was the minimum sample size necessary to estimate catch based on analysis of standard error of the mean for total weight and numbers of fish per haul for standard 1 x 2" traps (Bros and Cowell, 1987; Fig. 1). Thirty trap hauls per mesh was selected as the optimum sample size given cost and time constraints.

Regional Comparisons

Fish trap catch and effort data were summarized for field studies conducted off southeastern Florida for December, 1986 to July, 1988 and off southwestern Florida for March 1988 (Table 2). A total of 1810 fish representing 85 species, 28 families, and weighing 757 kg were captured during 330 trap hauls off southeastern Florida. Phase I included a total of 521 fish weighing 234 kg from 131 trap hauls. On the R/V CHAPMAN cruise off southwestern Florida a total of 750 fish representing 16 species and 130 kg were captured with 100 trap hauls inside the stressed area. A total of 153 fish representing 12 species and 27 kg were captured with 90 trap hauls outside the stressed area.

The relative percent contribution of various families to total catch was examined for southwestern Florida samples, and for southeastern Florida based on present data and previous data on commercial trap catches (Fig. 2). A 1980 survey of commercial trap catches off Dade and Broward counties showed that snapper, grouper, triggerfish and grunts, respectively, dominated commercial trap catches of southeastern Florida (Sutherland and Harper, 1983). The 1987-1988 catches were dominated by grouper, triggerfish, and grunts with snapper ranking 6th in weight. The southwest Florida sample was dominated by grouper, grunts and jacks, respectively.

Data from southwest Florida were confounded for the following reasons: 1) two regions were sampled (inside and outside of the GMFMC designated stressed area); 2) some traps may not have been placed in reef habitat; 3) only minimum sample sizes were obtained within a region for most mesh sizes; and 4) traps were fished differently (e.g. baited) from the other two studies. Unless otherwise specified all further discussion refers only to the southeast Florida (Dade county) data.

Catches

Mean catches ranged from a low of 0.58 fish/haul for a 4 x 4" mesh to 12.77 fish/haul for the 1.5" hexagonal mesh (Table 2, Fig.3, Appendix A). With the exception of the 0.5 x 0.5" mesh (which had the second highest average catch in numbers) the average number of fish per haul tended to decline with meshes larger or smaller than 1.5" hexagonal.

Mean total weight per haul ranged from a low of 0.65 kg/haul for a 3 x 6" mesh to a high of 4.59 kg/haul for the 1.5" hexagonal mesh (Table 2, Fig. 3, Appendix B). The average weight per haul tended to decline with meshes larger or smaller than 1.5" hexagonal.

Analysis of variance was not used to compare total numbers and total weight per haul by mesh because the data violated assumptions of the model. The data were not normally distributed because of zero catches for each mesh.

Mean weight per fish tended to increase with mesh size (Table 2, Fig. 3 - 4). The average weight per fish ranged from a low of 0.16 kg/fish for a 0.5 x 0.5" mesh to a high of 1.3 kg/fish for the 4 x 4" mesh. Mean weight per fish increased noticeably for meshes 2 x 3" and larger (Fig. 3).

Median fish size is a much better measure of central tendancy than the mean value because the weight/frequency distributions are strongly skewed (Fig. 4). Thus, a few large individuals give a disproportionate contribution to the mean values. Median size increased with mesh size (Table 2) ranging from a low of 0.08 kg for a 0.5 x 0.5" mesh to a maximum of 1.16 kg for a 4 x 4" mesh. Median weights of fish remained relatively constant (0.20 - 0.28 kg) for five smaller meshes ranging in size from 1 x 2" to 1.5 x 3" (Table 2, Fig. 4). Median weights of fish caught in traps with meshes of 2 x 3" or larger were about two to five times higher (0.38 - 1.3 kg).

The total number of species caught in larger mesh traps was considerably less than with smaller mesh (Table 2). The total number of species ranged from 7 caught in the 4 x 4" and 3 x 6" meshes to 47 species caught in the 1.5" hexagonal mesh. The smallest mesh tested (0.5 x 0.5") had fewer total species (35) than the three legal sized meshes (43, 41, and 47 for the 1 x 2", 1.5 x 1.5", and 1.5 hexagonal, respectively).

The effects of mesh size on individual weight was determined using a one-way analysis of variance on log-transformed data. The null hypothesis of no difference between mesh sizes was rejected ($F = 84.50$; df = 10, 1794; $p < 0.05$). An *a posteriori* least-significant difference test (LSD test) compared all possible pairs of mean catches (by weight) by mesh size. Forty-five of the 55 paired mean catches by weight differ significantly ($p < 0.05$, LSD test) by mesh size (Table 3). The ten paired catches that did not differ significantly, tended to be for meshes of similar size (i.e. one size larger or smaller).

Economics

The value of catches was examined based on market categories (Table 4, Appendix C). Primary commercial species had the highest market value and included the snapper (Lutjanidae), groupers (Serranidae), and hogfish (*Lachnolaimus maximus*, Labridae). Secondary commercial species had approximately half the market value of primary commercial species and included grunts (Haemulidae), porgies (Sparidae), triggerfish (Balistidae), and some jacks (*Seriola sp.*, Carangidae). Other species had limited or no market value. Primary commercial species were the major component of total value for most meshes although the relative contribution varied considerably (Fig. 5).

The estimated commercial wholesale value based on a standardized sample of 30 trap hauls per mesh, ranged from $0.41/haul for the 4 x 4" mesh to $5.42/haul for the 1.5" hexagonal mesh (Fig. 5). Catch value, although variable, tended to decrease for meshes smaller and larger than the 1.5" hexagonal mesh and was roughly correlated to total numbers and weight per haul (Fig. 6).

Mesh Retention

A total of 758 fish among 62 species was tested to determine their ability to escape different sized mesh. The largest mesh able to retain a fish was determined and plotted for the six most common families: snapper (Fig. 7), grouper (Fig. 8), grunts (Fig. 9), jacks (Fig. 10), porgies (Fig. 11), and surgeonfishes (Fig. 12). Because of biological variability there was often an overlap in the size range of fish that were retained by different meshes. The size of retained fish was directly related to mesh size and shape.

DISCUSSION

The ability of traps to catch fish depends on the availability of fish in the area, the willingness of a fish to enter traps, and the ability of a fish to escape a trap. The field studies examined availability and willingness to enter traps. Comparisons of catch between mesh sizes show the willingness of fish to enter traps and their ability to escape based on mesh size.

Regional Comparisons

Total catch per haul (number and weight) as well as the catch composition by various families varied between regions (Table 2, Fig. 2). These regional differences in catch reflect mostly differences in the availability of fishes between areas and time periods. The willingness of fish to enter traps may have been affected in the southwest Florida study because of the use of baited traps and two hour soak times. The catch results do reflect, however, the actual trap fisheries in southeastern and southwestern Florida. Trap fishermen in southwest Florida traditionally use baited traps for short soak periods while southeast Florida fishermen traditionally use unbaited traps for longer soak times (Sutherland and Harper, 1983).

Comparing our results to a study of the 1979 - 1980 commercial trap fishery off Dade and Broward Counties (Sutherland and Harper, 1983), we found commercial species comprised 66% by weight and 64% by number versus 77% by weight and 62% by number in 1980. This comparison reflects only data from 1 x 2" meshed traps, the predominate commercially used trap in 1980. We averaged 2.4 kg and 6.2 fish per haul compared to 5.6 kg and 11.1 fish per haul in the 1980 study. Catches with the 1.5" hexagonal mesh were similar to those reported during the 1980 study, averaging 4.6 kg and 12.8 individuals per haul. Differences in the present and earlier study partially reflect differences in trap designs, area fished, and method of fishing. In this study we tended to sample in shallower water with smaller traps which may account for the differences in catch data.

Selectivity

Commercial species will enter traps with a wide variety of mesh sizes. The walls of all traps were constructed with 1 x 2" wire mesh so that they presented the same visual silhouette and did not bias catches due to differential attraction. Luckhurst and Ward (in press) noted mesh selectivity could be biased by fish attraction to different trap silhouettes. The darker trap silhouette created by the 0.5 x 0.5" mesh lining a 1 x 2" mesh was apparently not more attractive to larger fish than were the other unlined traps which had a standard 1 x 2" wall mesh. Although the 0.5 x 0.5" trap had one of the highest catch rates by numbers (11.5 fish/haul), the mean weight/haul (1.8 kg) was similar to those reported for much larger meshes (Fig. 3, Table 2). The high numbers in the 0.5 x 0.5" mesh are partially accounted for by many small fishes, such as the tomtate (Haemulon aurolineatum), that could escape all larger mesh sizes. Other, size-related behavioral responses that effect recruitment to traps (Hartsuiker and Nicholson 1981) should have equally affected catches by different mesh sizes.

Captured fish size was approximately related to trap mesh size confirming earlier studies by Olsen et al. (1978), Stevenson and Stuart-Sharkey (1980), and Munro (1983). However, escapement of a particular fish was not strictly a linear response to mesh size; either the area of the mesh opening nor the greatest open dimension. Retention responses were influenced by mesh shape as well as the size of the opening.

Sutherland et al. (1987) showed that both fish size and body shape are important factors explaining differences in retention by a given mesh size between species. Slender (terete) fishes (e.g. eels, lizardfishes, cobia) of a given length (or weight) are much more likely to escape a particular mesh than are compressed (e.g. angelfishes, triggerfishes, butterflyfishes) or depressed (e.g. stingrays, flatfishes) fishes of the same length.

Rounded (fusiform) fishes fall between the two extremes. Thus, mesh size regulations aimed at optimizing one species may greatly affect capture of other species due to differences in body shape.

The relative effects of mesh size on numbers, weight, and value per haul were compared (Fig. 6). Two minimum mesh sizes currently legally specified (1.5 x 1.5", and 1.5" hexagonal) had the greatest percentage contribution to total weight and total value. Total value, total species caught, number of individuals, and mean total weight per haul tended to decline with meshes larger and smaller than the 1.5 hexagonal mesh. Mesh sizes 2 x 3" and larger, especially, tended to catch larger fish but fewer species and individuals. Based on these results, the presently specified legal minimum mesh size appear to do little to reduce bycatch.

Catchability

Results show that catchability (the proportion of a population removed by one unit of fishing effort) can be greatly influenced by mesh size and shape. Fewer primary commercial species were caught per haul with the largest mesh sizes. This reduced catch partially reflects the lower availability of large fish that can be retained in large meshes. Also, fish may be less willing to enter large meshed traps, perhaps because fewer retained fish make the trap less attractive.

Economics

Assuming constant effort, an increased mesh size would have immediate effects on total revenue of the trap fishery by lowering catchability. Larger mesh sizes would provide less revenue per trap haul. With larger mesh sizes, more effort (number of hauls) must be expended to obtain total revenue comparable with that of the smaller sized mesh. To achieve the same revenue with larger meshes as obtained with a 1.5" hexagonal mesh, fishermen would have to increase their number of trap hauls anywhere from 0.7 to 13 times depending on the mesh size (Figs. 5 and 6).

The simple economic analysis done here is limited. It does not consider: potential future benefits of allowing fish to escape and grow before entering the trap fishery; direct impacts on market prices due to supply; nor possible losses to the future fishery from natural mortality. Also, price per pound is highly variable between markets and over time. These considerations are beyond the scope of this study.

Mesh Retention

Laboratory studies show that mesh retention depends on the species and size of the fish tested (Figs. 7 - 12) as well as on the mesh shape and size (Sutherland, et al. 1987, in press). These results do not consider availability in the fished area or willingness to enter traps. Laboratory tests of mesh retention on individual fish show only the physical limitation of fishes to escape a given mesh size. Quite possibly some fish passing though a given mesh in the laboratory would not, or could not, under actual field conditions when a trap was pulled. With these qualifications it is possible to estimate mesh sizes necessary to allow the escapement of specific sized fishes for the majority of commercial species from Figures 7 through 12. For example, mesh size of 2 x 3" or larger should allow snapper and grouper less than 12" (30.5 cm) to escape (Fig. 6 and 7).

Escape windows (four 2 x 2") required in Gulf of Mexico regulations were not specifically investigated in this study due to logistical, fiscal, and time limitations. However, a conservative approximation of their effect can be obtained by extrapolation of the data from 2 x 2" traps. In the extreme the escape windows would make the trap function as 2 x 2" trap.

Based on our observations of fish behavior it is likely that most fishes able to escape a 2 x 2" opening will freely swim in and out of the escape window while the trap is resting on the bottom. However, when pulled most fishes react by swimming toward the bottom and are unlikely to find the escape window. Thus, injury and mortality from lifting and handling are still likely to occur. These fish would be more likely to escape during lifting if the entire top and bottom panels were made of the desired escape sized mesh similar to the trap used in the field study.

An advantage of fish traps over bottom longline, trawl, or hook and line fishing is the increased selectivity of fish traps based on mesh size. It is possible to fish traps with meshes that reduce the capture of fish below a minimum size. Hooks are less selective for fish size; small fish can be captured on large hooks. Thus, the mortality and injury associated with lifting smaller fish off the bottom can be reduced or avoided with fish traps more easily than with hooks. Presumably undersized hooked fish still face trauma from handling and embolism even if released.

SUMMARY

This study has described the effects of mesh size on selectivity, retention, catchability and value of fish trap catches. Catch composition using a given mesh size, varies between regions due to species availability. Mesh size and shape influence trap retention. In this study the most effective mesh sizes for total value per haul and total weight were the 1.5 x 1.5", and 1.5" hexagonal meshes, two legally specified minimum mesh sizes. Commercial species will enter a wide variety of mesh sizes. Increasing mesh size reduces catchability and revenue per haul which can be compensated for by increasing effort (number of hauls). Adjusting mesh size offers a means for regulating and managing the reef fish fishery. Fish traps with appropriate mesh sizes potentially may reduce bycatch, undersized fish injury, and mortality more effectively than similar management measures applied to bottom longline, trawl, and hook and line fisheries.

ACKNOWLEDGEMENTS

We thank Myles Raizin for critical comments and Ernie Snell for providing price data.

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Table 1. Dimensions of trap meshes used in field studies.

SHAPE	WIDTH (in)	LENGTH (in)	AREA (in)	DIAG. (in)	WIDTH (mm)	LENGTH (mm)	AREA (cm^2)	DIAG. (mm)
Square	0.5	0.5	0.25	0.71	12.7	12.7	1.6	18.0
Rectangular	1	2	2	2.24	25.4	50.8	12.9	56.8
Hexagonal	1.5	2.3	2.3	2.32	38.1	58.4	22.3	59.0
Square	1.5	1.5	2.25	2.12	38.1	38.1	14.5	53.9
Rectangular	1.5	3	4.5	3.35	38.1	76.2	29.0	85.2
Square	2	2	4	2.83	50.8	50.8	25.8	71.8
Rectangular	2	3	6	3.61	50.8	76.2	38.7	91.6
Rectangular	2	4	8	4.47	50.8	101.6	51.6	113.6
Square	3	3	9	4.24	76.2	76.2	58.1	107.8
Rectangular	3	6	18	6.71	76.2	152.4	116.1	170.4
Square	4	4	16	5.66	101.6	101.6	103.2	143.7

Table 2. Summary of fish trap catch and effort data by mesh size and region.

Southeastern Florida (Dade County)

MESH SIZE (INCHES)	TRAP HAULS (NO.)	TOTAL CATCH (NO.)	CATCH /HAUL (NO.)	TOTAL WEIGHT (KG)	MEAN WT /HAUL (KG)	MEAN WT /FISH (KG)	MEDIAN WT/FISH (KG)	TOTAL SPECIES (NO.)
0.5x0.5"	28	322	11.50	50.46	1.80	0.16	0.08	35
1x2"	34	210	6.18	80.65	2.37	0.38	0.21	43
1.5x1.5"	30	259	8.63	128.13	4.27	0.50	0.22	41
1.5 Hex"	31	396	12.77	142.24	4.59	0.36	0.20	47
2x2"	27	153	5.67	53.98	2.00	0.35	0.24	33
1.5x3"	31	213	6.87	84.40	2.69	0.39	0.28	32
2x3"	31	76	2.45	73.71	2.38	0.97	0.38	25
2x4"	27	78	2.89	59.14	2.19	0.76	0.50	18
3x3"	29	67	2.31	40.88	1.41	0.61	0.45	15
4x4"	33	19	0.58	25.10	0.76	1.32	1.16	7
3x6"	29	17	0.59	18.89	0.65	1.11	0.80	7
TOTALS =	330	1810		757.58				85

Southwestern Florida (Outside Stressed Area)

1x2"	45	114	2.53	19.95	0.44	0.18	0.14	12
1.5 Hex"	9	14	1.56	3.59	0.40	0.26	0.23	6
2x2"	9	7	0.78	1.14	0.13	0.16	0.14	2
1.5x3"	9	7	0.78	1.32	0.15	0.19	0.18	2
2x3"	9	9	1.00	0.86	0.10	0.10	0.09	4
3x3"	9	2	0.22	0.27	0.03	0.14	0.14	1
TOTALS =	90	153		27.14				12

Southwestern Florida (Inside Stressed Area)

1x2"	54	572	10.59	96.37	1.78	0.17	0.14	16
1.5 Hex"	9	69	7.67	10.77	1.20	0.16	0.14	9
2x2"	9	51	5.67	8.00	0.89	0.16	0.11	8
1.5x3"	9	43	4.78	10.23	1.14	0.24	0.23	8
2x3"	10	14	1.40	3.95	0.40	0.28	0.18	7
3x3"	9	1	0.11	0.14	0.02	0.14	0.14	1
TOTALS =	100	750		129.46				16

Table 3. Differences in mean fish weight as a function of mesh size. * = significant difference ($p < 0.05$ n = no significant difference ($p > 0.05$).

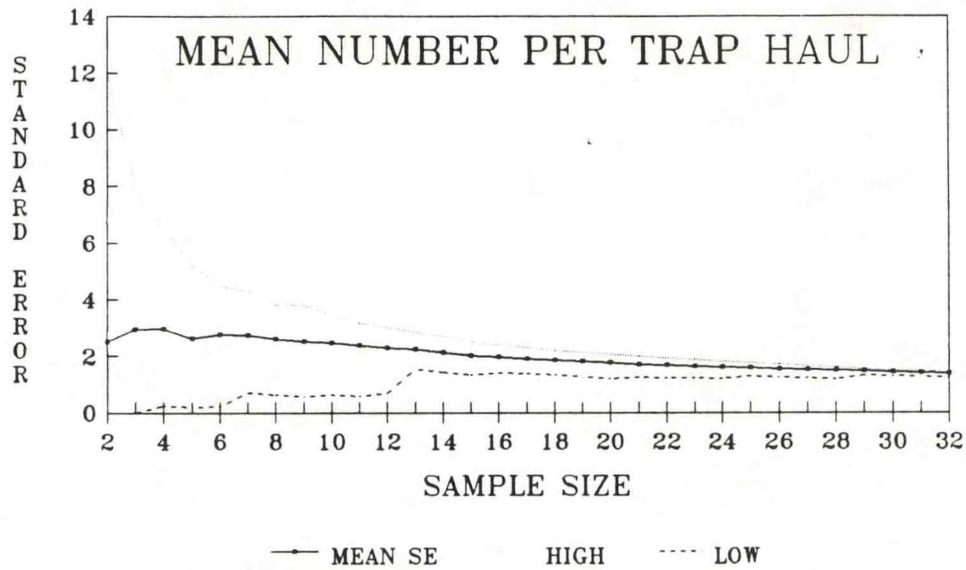
MESH SIZE	MESH SIZE (INCHES) 0.5 x 0.5	1 x 2	1.5 x 1.5	1.5 Hex	2 x 2	1.5 x 3	2 x 3	2 x 4	3 x 3	4 x 4	3 x 6
0.5x0.5											
1x2	*										
1.5x1.5	*	*									
1.5 Hex	*	n	n								
2x2	*	*	n	n							
1.5x3	*	*	*	*	n						
2x3	*	*	*	*	*	*					
2x4	*	*	*	*	*	*	*				
3x3	*	*	*	*	*	*	n	n			
4x4	*	*	*	*	*	*	*	*	*		
3x6	*	*	*	*	*	*	n	n	n	*	

Table 4. Species wholesale market value. Based on voluntary reports by 30 dealers from six Florida counties during May 1988.

SPECIES	NUMBER OF DEALERS REPORTING	PRICE = $/LBS MEAN	MINIMUM	MAXIMUM
Amberjack	13	0.38	0.20	0.50
Angelfish	1	0.15	0.15	0.15
Bait Fish	9	0.24	0.05	0.60
Grouper, Black	21	2.05	1.40	2.40
Grouper, Gag	15	1.96	1.40	2.30
Grouper, Nassau	5	1.65	1.45	2.00
Grouper, Red	19	1.63	1.15	2.20
Grouper, Scamp	13	2.21	1.70	2.80
Grouper, Snowy	8	1.76	1.45	2.20
Grouper, Warsaw	6	1.30	0.90	1.90
Grouper, Yellowedge	3	1.83	1.60	2.00
Grouper, Yellowfin	4	1.85	1.60	2.00
Grouper, Other, Mixed	5	1.78	1.65	2.20
Grunts	12	0.36	0.20	0.60
Hogfish	6	1.33	1.00	1.50
Jacks, Crevalle	13	0.29	0.20	0.70
Rays	2	0.06	0.05	0.06
Snapper, Lane	8	1.04	0.65	1.50
Snapper, Mangrove	17	1.44	1.00	2.25
Snapper, Mutton	10	1.77	1.50	2.05
Snapper, Yellowtail	8	1.86	1.50	2.40
Snapper, Other, Mixed	4	1.99	1.80	2.10
Triggerfish	8	0.71	0.50	1.05
Porgy (white snapper)	11	0.55	0.30	0.80
Misc. Food Fish	11	0.29	0.20	0.35

LIST OF FIGURES

STANDARD ERROR OF THE MEAN ANALYSIS
MESH SIZE STUDY 1987 -1988



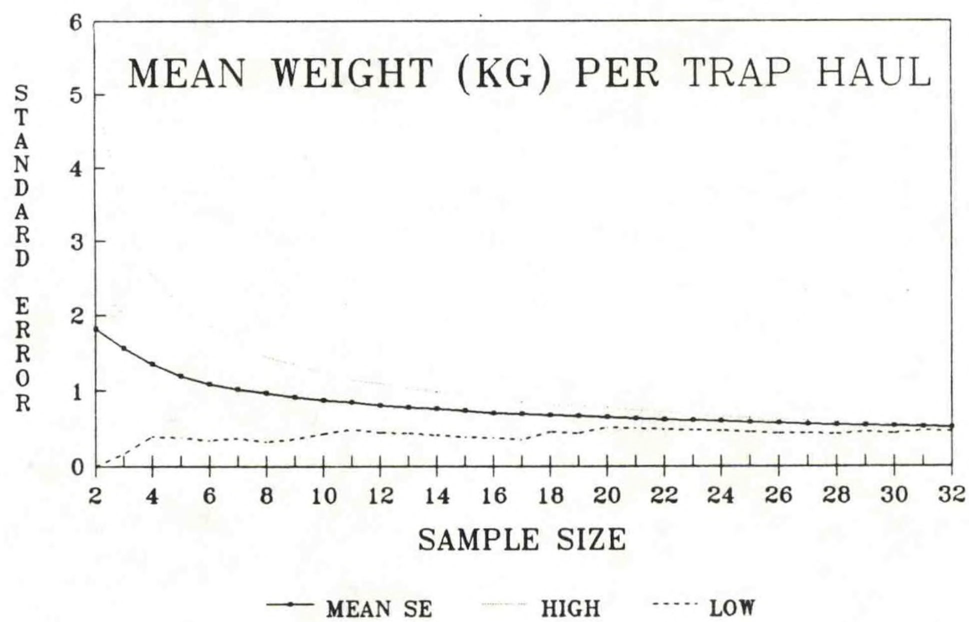
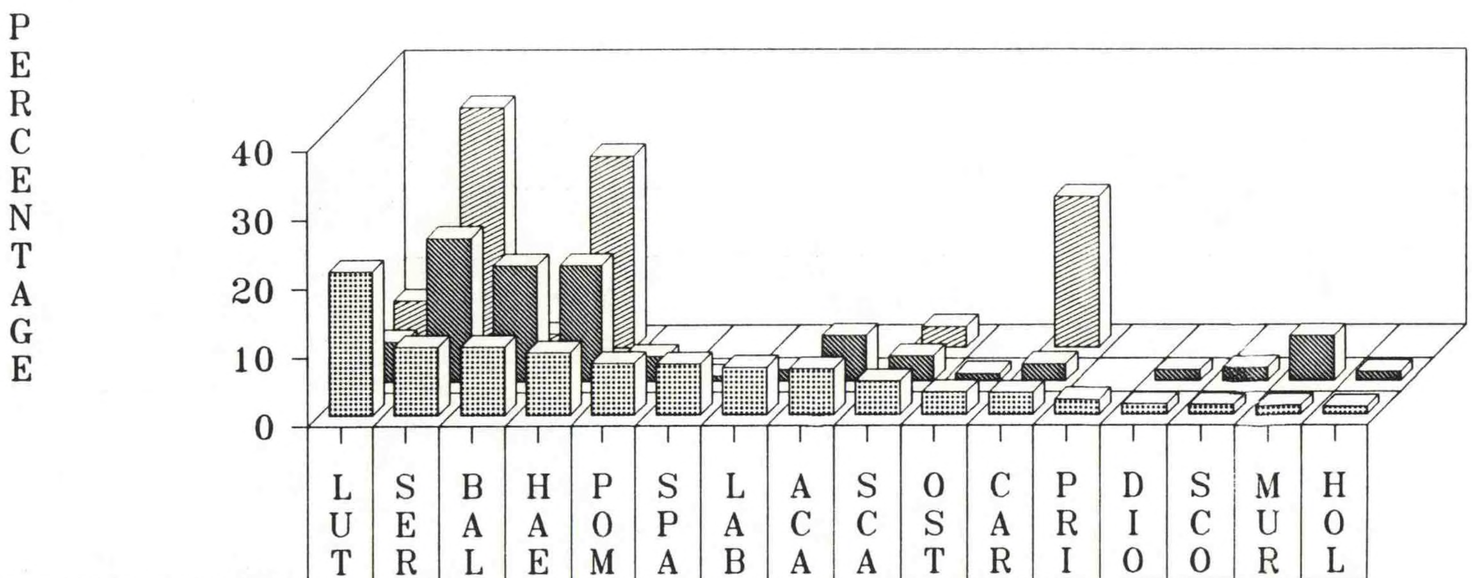


Figure 1. Effects of sample size on the standard error of the mean for numbers of fish per haul (top) and total fish weight per haul (bottom). See text for details.

Figure 2. Family catch composition by weight. 1980 data are for the commercial trap fishery in Dade and Broward Counties (Sutherland and Harper, 1983). 1987-1988 data are from southeastern Florida (Dade County). R/V CHAPMAN data are from a 1988 cruise off southwestern Florida. Sample size: 3011 kg (5,984 fish) 1980 Dade County; 757 kg (1810 fish) 1987-1988 Dade County; 157 kg (903 fish) 1988 CHAPMAN data.

Abbreviations: LUT (Lutjanidae, snappers); SER (Serranidae, groupers); BAL (Balistidae, letherjackets); HAE (Haemulidae, grunts); POM (Pomacanthidae, angelfishes); SPA (Sparidae, porgies); LAB (Labridae, wrasses); ACA (Acanthuridae, surgeonfishes); SCA (Scaridae, parrotfishes); OST (Ostraciidae, boxfishes); CAR (Carangidae, jacks); PRI (Pricanthidae, bigeyes); DIO (Diodontidae, porcupinefishes); SCO (Scombridae, mackerels); MUR (Muraenidae, morays); HOL (Holocentridae, squirrelfishes).

COMPARISION OF TRAP CATCHES BY FAMILY
1X2 MESH: 1980, 1987-88, CHAPMAN SURVEYS



	LUT	SER	BAL	HAE	POM	SPA	LAB	ACA	SCA	OST	CAR	PRI	DIO	SCO	MUR	HOL
CHAPMAN(1X2)	7	35	2.1	28					3.1		22					
1987-8 (1X2)	5.9	21	17	17	3.7	0.8	1.7	6.7	3.7	1.1	2.5		1.6	2	6.6	1.3
1980 SURVEY	21	10	10	9.1	7.5	7.4	6.9	6.7	4.9	3.3	3.2	2.2	1.5	1.4	1.3	1.1

FAMILY

1980 SURVEY 1987-8 (1X2) CHAPMAN(1X2)

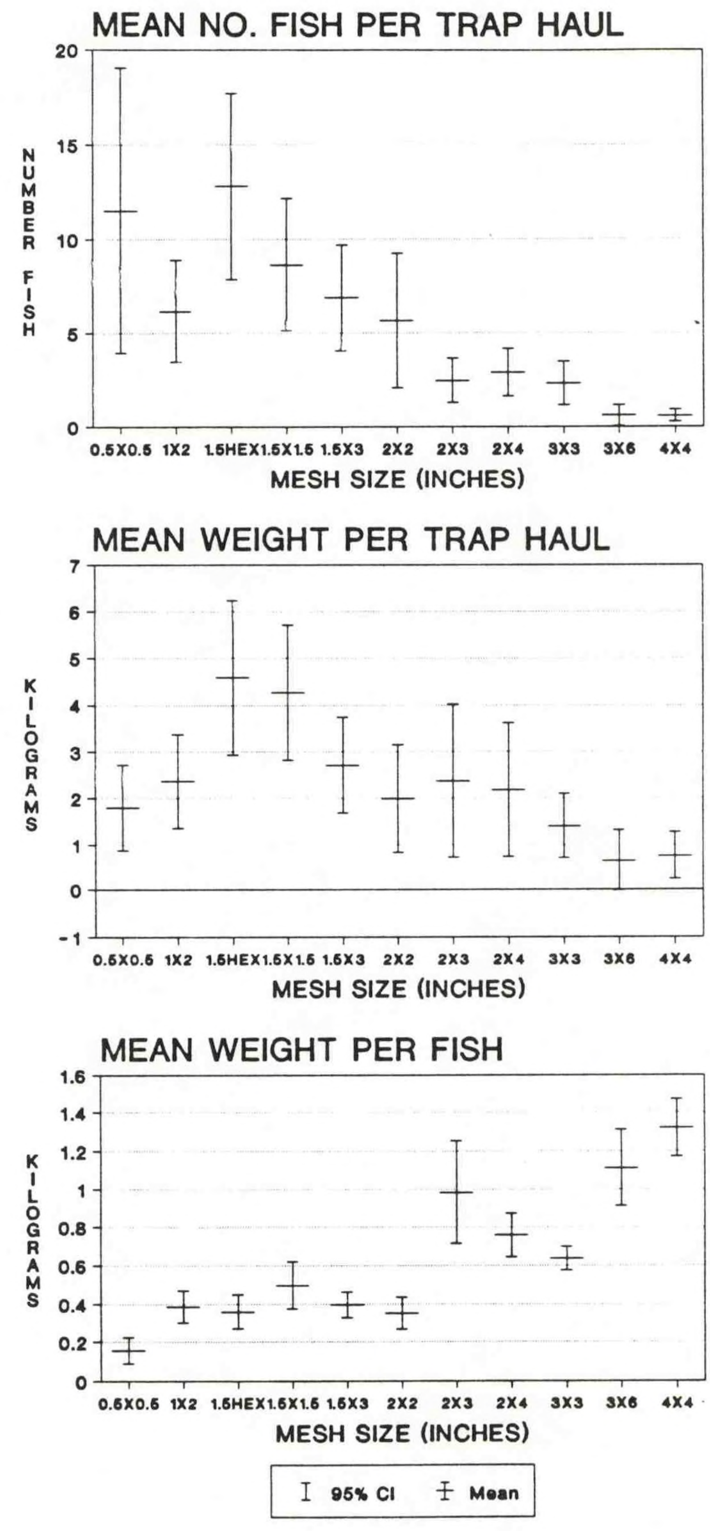


Figure 3. Effects of mesh size on fish trap catches. Bars show means and 95% confidence intervals. Sample sizes appear in Table 2.

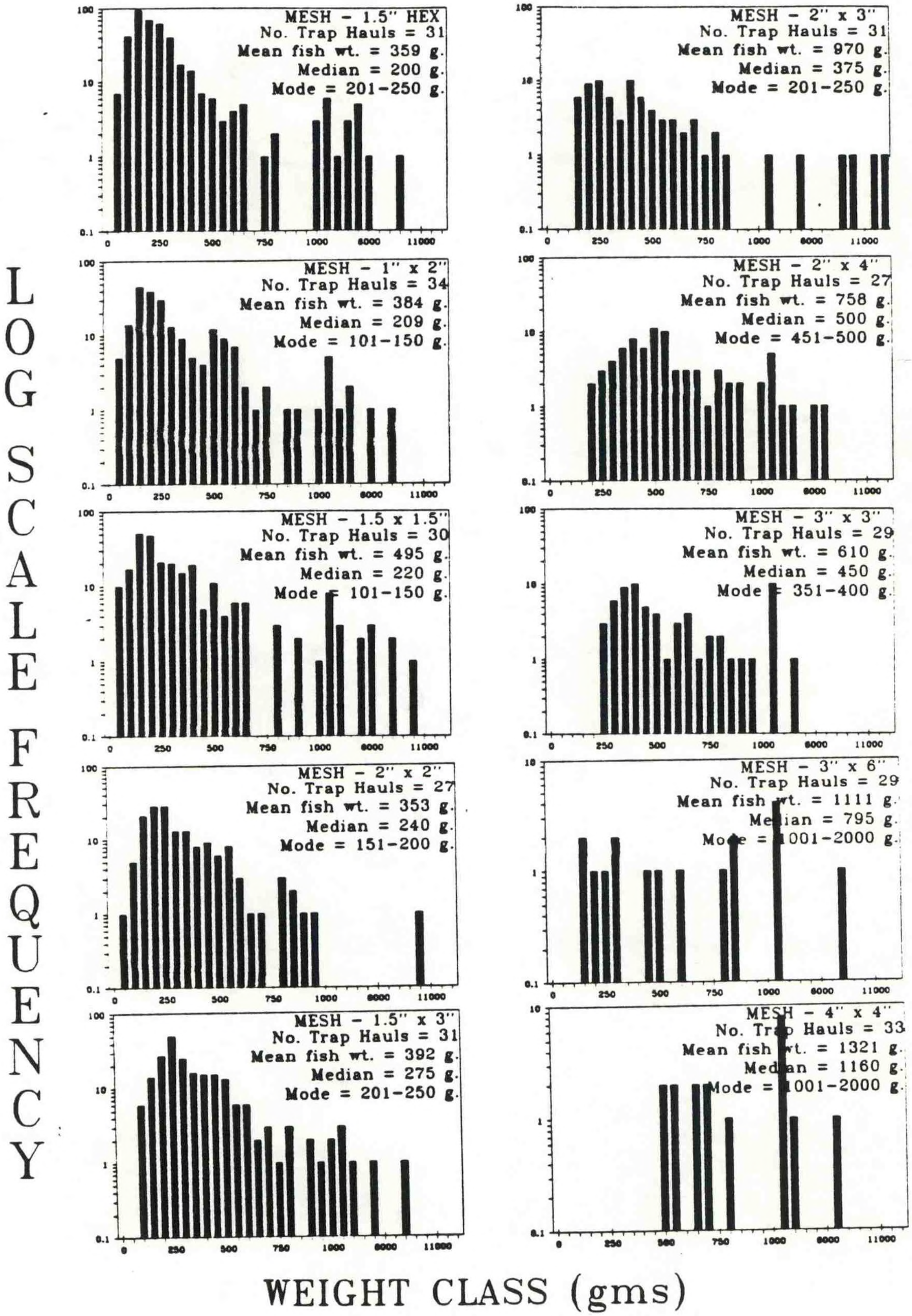
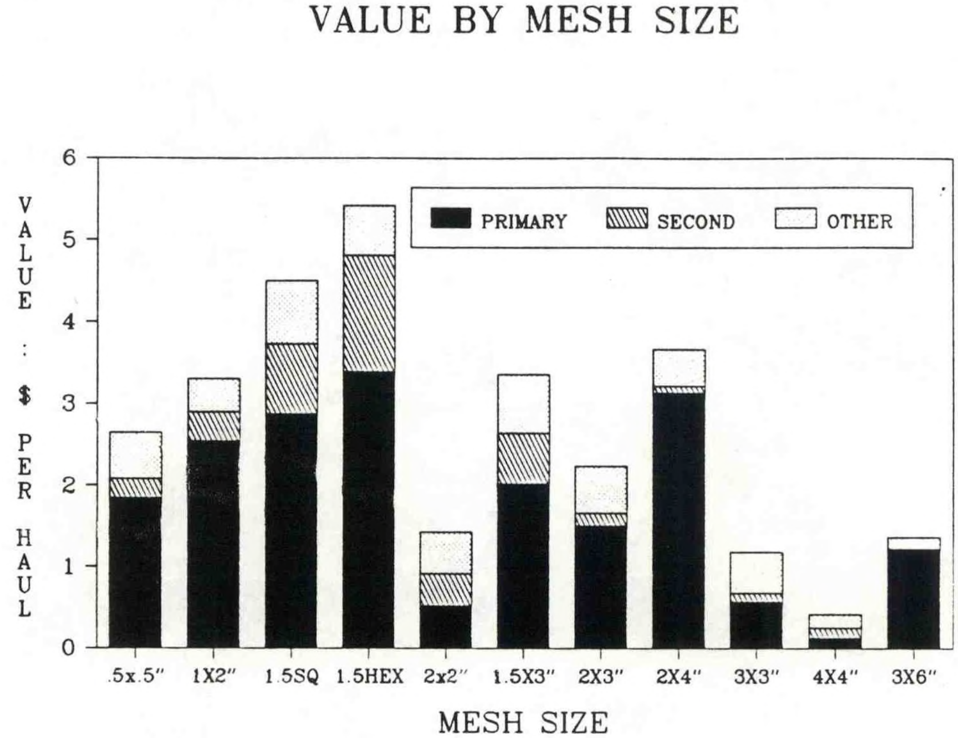


Figure 4. Weight-frequency of trapped fish by mesh size. Fish less than 1000 g were grouped into 50 g intervals. Fish greater than 1000 g were grouped into 1,000 g intervals.

Figure 5. Relative catch value by mesh size.



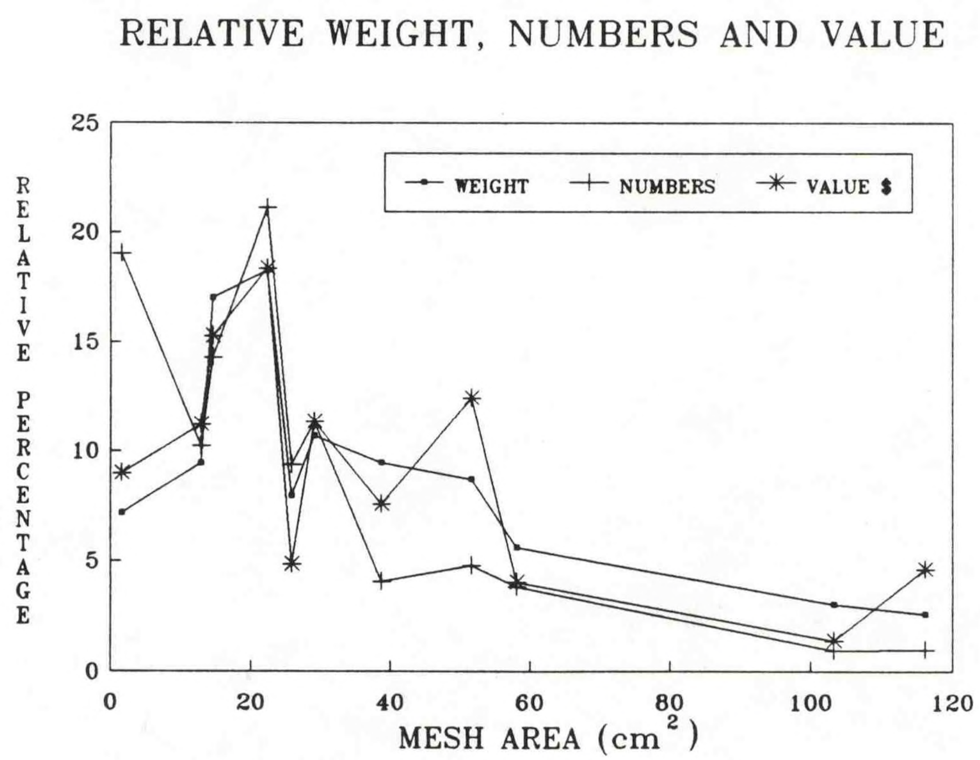
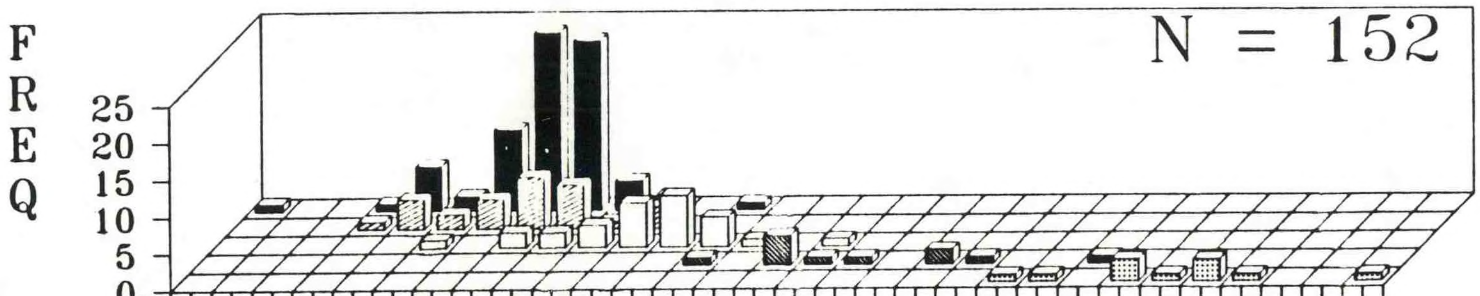


Figure 6. Relative effects of mesh size on mean total weight, mean total numbers, and mean total value per haul.

MESH RETENTION DATA
SNAPPER

FREQUENCY DISTRIBUTION



	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
1x2	1			1	6	2	11	24	23	4	2		1																	
1.5x1.5				1	4	2	4	7	6	1	3																			
2x2						1		2	2	3	6	7	4	1		1														
2x3													1		4	1	1		2	1			1							
> 3x3																					1	1		3	1	3	1			1

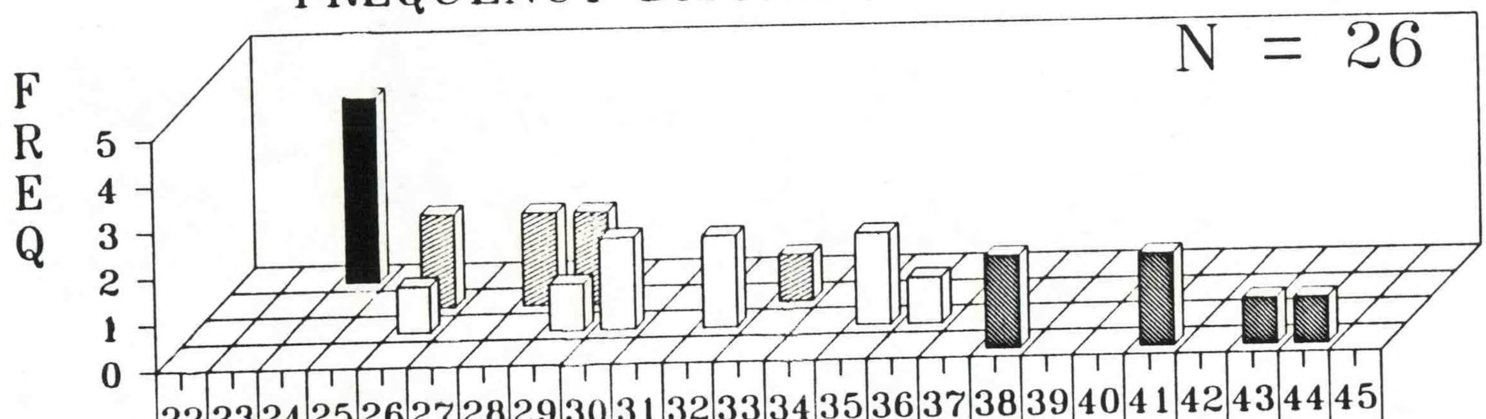
FORK LENGTH (cm.)

> 3x3   2x3   2x2   1.5x1.5   1x2

Figure 7. Sizes of snapper retained by different trap meshes.

MESH RETENTION DATA
GROUPER

FREQUENCY DISTRIBUTION



	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
1x2			4																					
2x2					2		2	2				1												
2x3					1			1	2		2			2	1									
> 3x3																	2			2		1	1	

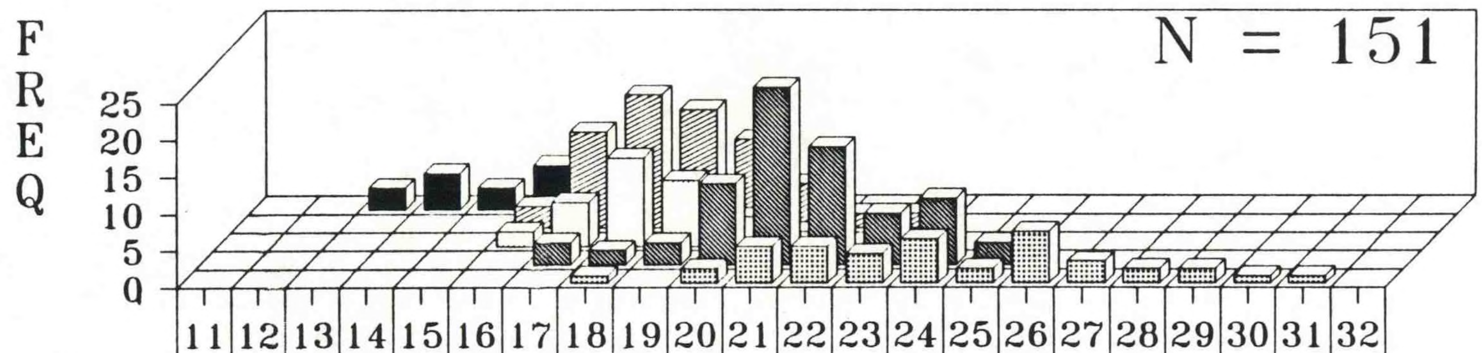
LENGTH (cm.)

> 3x3 2x3 2x2 1x2

Figure 8. Sizes of grouper retained by different trap meshes.

MESH RETENTION DATA
GRUNTS

FREQUENCY DISTRIBUTION



	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
0.5x05			3	5	3	6	6															
1x2						3	13	18	16	12	6	2	2									
1.5x1.5						2	6	12	9	4	2		1									
2x2							3	2	3	11	24	16	7	9	3							
2x3								1		2	5	5	4	6	2	7	3	2	2	1	1	

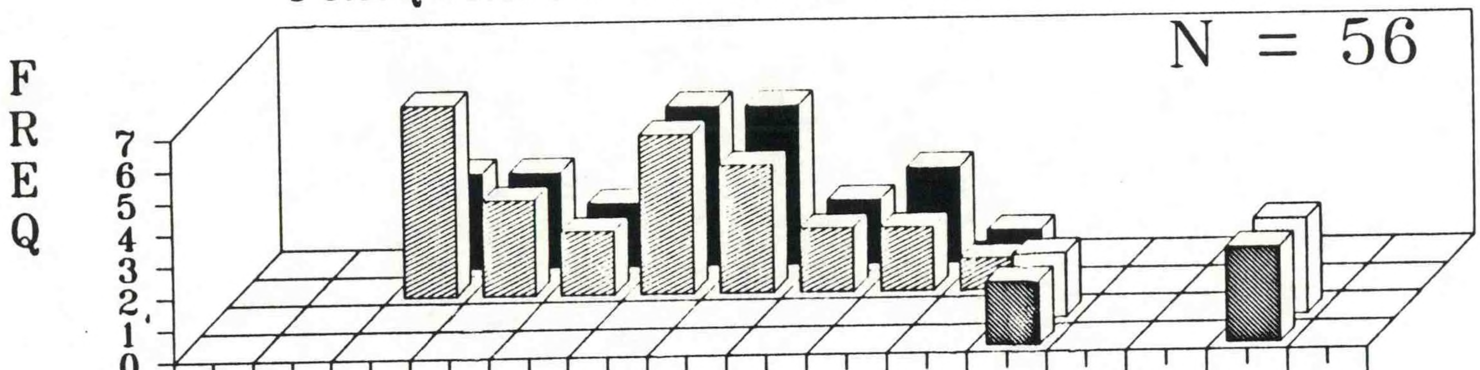
FORK LENGTH (cm.)

2x3 2x2 1.5x1.5 1x2 0.5x05

Figure 9. Sizes of grunts retained by different trap meshes.

MESH RETENTION DATA
JACKS

FREQUENCY DISTRIBUTION



	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1x2			3	3	2	5	5	2	3	1					
1.5x1.5			6	3	2	5	4	2	2	1					
2x3											2			3	
> 3x3											2			3	

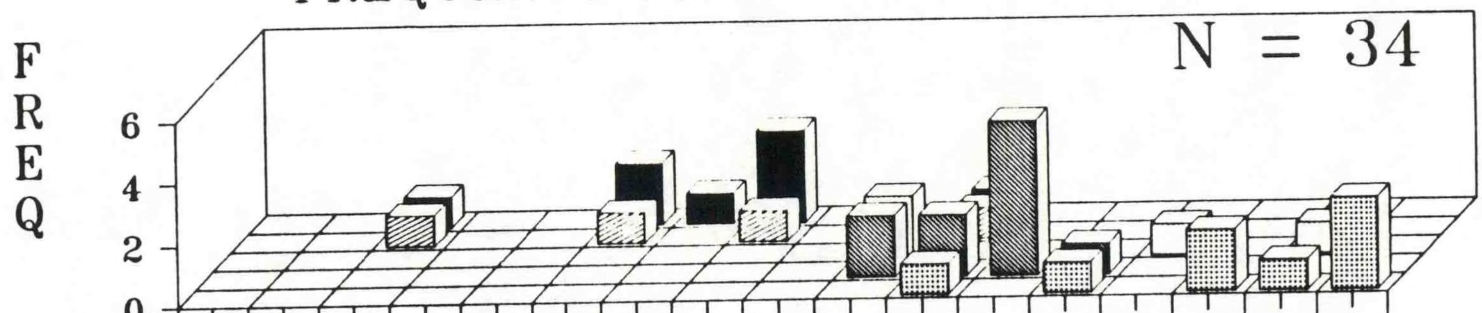
FORK LENGTH (cm.)

> 3x3   2x3   1.5x1.5   1x2

Figure 10. Sizes of jacks retained by different trap meshes.

MESH RETENTION DATA
PORGIES

FREQUENCY DISTRIBUTION



	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1x2			1			2	1	3			1						
1.5x1.5			1			1		1			1						
1.5x3										2				1		1	
2x3										2	2	5	1				
> 3x3											1		1		2	1	3

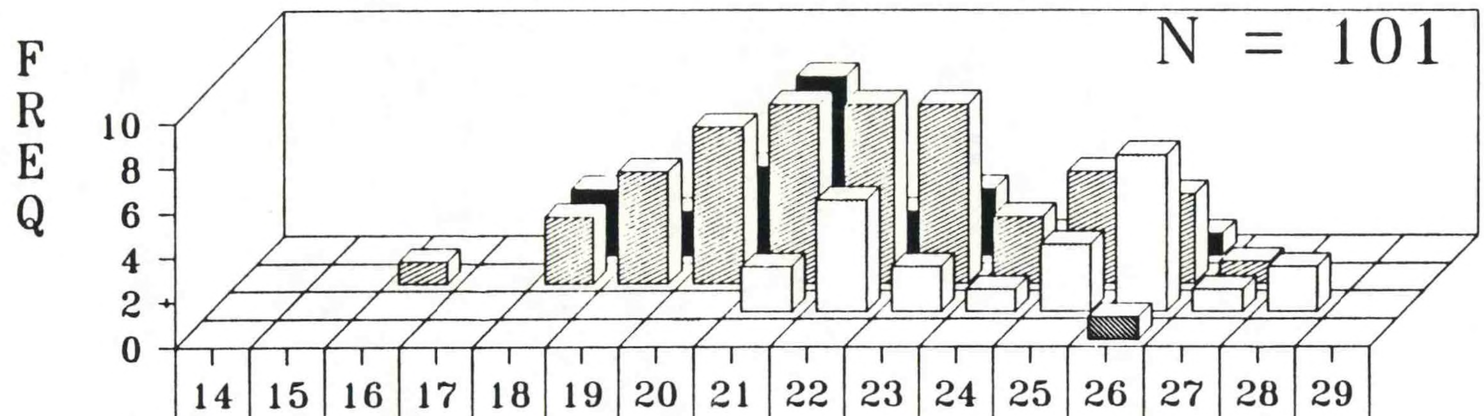
FORK LENGTH (cm.)

> 3x3   2x3   1.5x3   1.5x1.5   1x2

Figure 11. Sizes of porgy retained by different trap meshes.

MESH RETENTION DATA
SURGEONFISHES

FREQUENCY DISTRIBUTION



	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1x2					3	2	4	8	2	3	1		1			
1.5x3			1		3	5	7	8	8	8	3	5	4	1		
1.5x4.5								2	5	2	1	3	7	1	2	
3x3													1			

FORK LENGTH (cm.)

3x3 | 1.5x4.5 | 1.5x3 | 1x2

Figure 12. Sizes of surgeonfish retained by different trap meshes.

Appendix A. Weight (grams) of fish caught by various meshes off southeastern Florida between December 1986 and July 1988.

SPECIES	0.5x0.5 (g)	1x2 (g)	1.5X1.5 (g)	1.5 HEX (g)	2X2 (g)	1.5X3 (g)	2X3 (g)	2X4 (g)	3X3 (g)	4X4 (g)	3X6 (g)	TOTAL (g)
						MESH SIZE						
Acanthurus bahianus	595	1905	100	2810	724	1705	225					8064
Acanthurus chirurgus	245	1486	4553	3315	7607	8330	3893		6976			36405
Acanthurus coeruleus		2005	5555	4791	865	7039	1245		2860			24360
Aluterus schoepfi		9766		4510	475	11072	4425	17206	2175	4063	450	54142
Aluterus scriptus		507	600	675		605						2387
Anisotremus surinamensis		2910				1252			1020			5182
Anisotremus virginicus	450	2019	2289	5915	1505	4645						16823
Aulostomus maculatus	200											200
Balistes capriscus			425	970	377	2057	391					4220
Balistes vetula									1482			1482
Calamus bajonado			475		495		1220					2190
Calamus calamus		625			309	970	1155					3059
Calamus proridens						765	380	400				1545
Cantherhines macrocerus					780							780
Cantherhines pullus	99	128	375	680								1282
Canthidermis sufflamen	145											145
Caranx bartholomaei		675	21010	16805	320	6539		1425		6500		53274
Caranx crysos			975	375		695	784					2829
Caranx latus	121	900										1021
Caranx ruber			1040	380								1420
Chaetodipterus faber					405					1955		2360
Chaetodon capistratus	100	125	500	145	47							917
Chaetodon ocellatus	125	235	1755	800	669	370						3954
Chaetodon sedentarius		175		435								610
Chaetodon striatus				50	187							237
Chilomycterus schoepfi							329					329
Dasyatis americana			2140									2140
Diodon Holocanthus	137	1326	770	1025	879	922						5059
Epinephelus morio		1685	4200	3895	919							10699
Epinephelus sp.		1600										1600
Epinephelus striatus			1380									1380
Equetus acuminatus	97		113									210
Ginglyostoma cirratum		3600	2920	9380			13000					28900
Gymnothorax funebris	6500	3780		2550	9240		11700					33770
Gymnothorax moringa		1574										1574
Haemulon album			415					798				1213
Haemulon aurolineatum	13411	200		1337								14948
Haemulon carbonarium				250								250
Haemulon flavolineatum	1750	1820	3055	6765	201							13591
Haemulon parrai	645		615	2738	361	1998	485	400				7242
Haemulon plumieri	4861	6664	5080	11718	8471	3435						40229
Haemulon sciurus	387		1220	3117								4724
Halichoeres bivittatus	46											46
Holacanthus bermudensis			1575	5860	1174	1150		7176	10848	3800	7480	39063
Holacanthus ciliaris		400			248	745		540	317			2250
Holacanthus tricolor	19		740	500	260	250						1769

Appendix A. (continued)

SPECIES	0.5x0.5 (g)	1x2 (g)	1.5X1.5 (g)	1.5 HEX (g)	2X2 (g)	1.5X3 (g)	2X3 (g)	2X4 (g)	3X3 (g)	4X4 (g)	3X6 (g)	TOTAL (g)
						MESH SIZE						
Holocentrus ascensionis	210	912	580		196							1898
Holocentrus rufus		175	1180	612								1967
Kyphosus sectatrix				800								800
Lachnolaimus maiximus	4435	1340	6730	3892	2979	2970	450	3322	2080	1400		29598
Lactophrys bicaudalis				400	120							520
Lactophrys polygonia							111	1241	510			1862
Lactophrys quadricornis			300	1015		3111	1896	1348	580		1206	9456
Lactophrys trigonus											591	591
Lactophrys triqueter		900				485	372	207				1964
Lutjanus analis	1573	3020	12200	6241		5545	1460	11900	2700			44639
Lutjanus apodus				2660								2660
Lutjanus cyanopterus						7250		6500				13750
Lutjanus griseus		1255	1520	665								3440
Lutjanus jocu						766						766
Lutjanus synagris		104	2100	1723			105					4032
Monacanthus hispidus	587	3462	2291	1975	2948	990	1510		250			14013
Mulloidichthys martinicus	417											417
Mycteroperca bonaci	7350			5800			8750				7850	29750
Mycteroperca microlepis		13480		4650								18130
Ocyurus chrysurus		395	1375	4880	1680							8330
Pomacanthus arcuatus		980	1200	3755	2765	2285	1257	3565	4479	5680		25966
Pomacanthus paru		1572						1293		1700	810	5375
Priacanthus arenatus					285		336					621
Prionotus roseus	38											38
Pseudupeneus maculatus	2041	428		200		255						2924
Rachycentron canadum		1450										1450
Scarus coeruleus				975		2625						3600
Scarus taenipterus	585											585
Scorpaena plumieri		1649	400	270				605			500	3424
Seriola dumerili				8500								8500
Seriola rivoliana		450	282		540	340						1612
Sparisom chrysopterum	850	2197	2008	300	480	1879						7714
Sparisoma aurofrenatum	160	200										360
Sparisoma sp.	500											500
Sparisoma viride	350	570	405	1140	5467	460	4520	520	700			14132
Sphoeroides spengleri	724											724
Sphyraena barracuda	620		31680				13710		3900			49910
Umbrina coroides	90											90
Urolophus jamaicensis								695				695
TOTAL WEIGHT (g)	50463	80649	128126	142244	53978	83505	73708	59141	40875	25098	18887	756674
											COUNT	85
NUMBER OF SAMPLES	28	34	30	31	27	31	31	27	29	33	29	

* The following five partially decomposed fish were caught in the indicated meshes but were not weighed: Gymnothorax funebris (1.5x1.5") Sparisoma viride (2x3"); Holacanthus bermudensis, Pomacanthus arcuatus and Sphyraena barracuda (3x3").

Appendix B. Species and number of fish trapped by mesh size off southeastern Florida between December 1986 and July 1988.

SPECIES	NUMBER BY MESH SIZE .5X.5"	1X2"	1.5X1.5	1.5 HEX"	2X2"	1.5X3"	2X3"	2X4"	3X3"	4X4"	3X6"	TOTAL
Acanthurus bahianus	3	10	1	15	3	7	1					40
Acanthurus chirurgus	1	6	13	13	21	28	10		17			109
Acanthurus coeruleus		9	18	20	4	31	5	.	9			96
Aluterus schoepfi		18		10	1	21	8	36	4	6	1	105
Aluterus scriptus		1	1	2		2						6
Anisotremus surinamensis		6				3			1			10
Anisotremus virginicus	1	7	8	25	5	18						64
Aulostomus maculatus	1											1
Balistes capriscus			3	1	2	6	1					13
Balistes vetula									2			2
Calamus bajonado			1		1		2					4
Calamus calamus		2			1	3	4					10
Calamus proridens						2	1	1				4
Cantherhines macrocerus					1							1
Cantherhines pullus	1	1	3	7								12
Canthidermis sufflamen	1											1
Caranx bartholomaei		2	21	9	1	2		2		1		38
Caranx crysos			5	1		2	1					9
Caranx latus	1	2										3
Caranx ruber			3	1								4
Chaetodipterus faber					1					2		3
Chaetodon capistratus	1	3	11	2	1							18
Chaetodon ocellatus	1	3	15	10	6	4						39
Chaetodon sedentarius		1		7								8
Chaetodon striatus				1	2							3
Chilomycterus schoepfi							1					1
Dasyatis americana			1									1
Diodon holocanthus	1	7	4	5	4	6						27
Epinephelus morio		2	3	2	2							9
Epinephelus sp.		1										1
Epinephelus striatus			1									1
Equetus acuminatus	2		1									3
Ginglyostoma cirratum		2	2	2			1					7
Gymnothorax funebris	1	1	1	1	1		1					6
Gymnothorax moringa		2										2
Haemulon album			1					1				2
Haemulon aurolineatum	179	2		15								196
Haemulon carbonarium				1								1
Haemulon flavolineatum	17	15	21	52	1							106
Haemulon parrai	2		2	9	1	7	2	1				24
Haemulon plumieri	38	36	26	64	40	13						217
Haemulon sciurus	3		7	17								27
Halichoeres bivittatus	1											1
Holacanthus bermudensis			3	6	2	1		8	12	3	6	41
Holacanthus ciliaris		1			1	2		1	1			6
Holacanthus tricolor	1		4	2	1	1						9

Appendix B. (continued)

SPECIES	NUMBER BY MESH SIZE											
	.5X.5"	1X2"	1.5X1.5	1.5 HEX"	2X2"	1.5X3"	2X3"	2X4"	3X3"	4X4"	3X6"	TOTAL
Holocentrus ascensionis	1	4	2		1							8
Holocentrus rufus		1	7	4								12
Kyphosus sectatrix				1								1
Lachnolaimus maiximus	2	4	12	13	6	6	1	4	3	1		52
Lactophrys bicaudalis				1	1							2
Lactophrys polygonia							1	3	2			6
Lactophrys quadricornis			1	4		13	9	5	2		6	34
Lactophrys trigonus											1	0
Lactophrys triqueter		3				1	1	1				6
Lutjanus analis	2	1	6	4		9	2	3	2			29
Lutjanus apodus				10								10
Lutjanus cyanopterus						1		1				2
Lutjanus griseus		4	2	3								9
Lutjanus jocu						1						1
Lutjanus synagris		1	15	9			1					26
Monacanthus hispidus	4	28	14	12	21	8	8		1			96
Mulloidichthys martinicus	2											2
Mycteroperca bonaci	1			1			1				1	3
Mycteroperca microlepis		2		1								3
Ocyurus chrysurus		2	5	21	4							32
Pomacanthus arcuatus		1	2	5	4	4	3	5	8	4		36
Pomacanthus paru		2						2		2	1	6
Priacanthus arenatus					1		1					2
Prionotus roseus	1											1
Pseudupeneus maculatus	15	2		1		1						19
Rachycentron canadum		1										1
Scarus coeruleus				1		4						5
Scarus taenipterus	3											3
Scorpaena plumieri		5	1	1				2			1	9
Seriola dumerili				1								1
Seriola rivoliana		1	1		1	1						4
Sparisom chrysopterum	4	6	5	1	1	4						21
Sparisoma aurofrenatum	3	1										4
Sparisoma sp.	5											5
Sparisoma viride	1	1	1	2	10	1	8	1	1			26
Sphoeroides spengleri	20											20
Sphyraena barracuda	1		5				2		2			10
Umbrina coroides	1											1
Urolophus jamaicensis								1				1
TOTAL NUMBER	101	210	259	396	153	213	76	78	67	19	17	1810
NUMBER OF SAMPLES	28	34	30	31	27	31	31	27	29	33	29	

NOTE: The number of species reported differs om Appendix A because some fish were counted but not weighed.

Appendix C. Value of catches ($) by mesh size and species, standarized for 30 trap hauls.
Commercial classification: P = primary, S = secondary, O = other.

SPECIES	CLASS P,S,O	VALUE ($) 0.5X0.5"	1X2"	1.5X1.5"	1.5 HEX"	2X2"	1.5X3"	2X3"	2X4"	3X3"	4X4"	3X6"	TOTAL
Acanthurus bahianus	O	0.41	1.07	0.06	1.74	0.51	1.05	0.14	0	0	0	0	$4.98
Acanthurus chirurgus	O	0.17	0.84	2.91	2.05	5.4	5.15	2.41	0	4.61	0	0	$23.54
Acanthurus coeruleus	O	0	1.13	3.55	2.96	0.61	4.35	0.77	0	1.89	0	0	$15.26
Aluterus schoepfi	O	0	2.85	0	1.44	0.17	3.54	1.41	6.32	0.74	1.22	0.15	$17.84
Aluterus scriptus	O	0	0.15	0.2	0.22	0	0.19	0	0	0	0	0	$0.76
Anisotremus surinamensis	S	0	2.04	0	0	0	0.96	0	0	0.84	0	0	$3.84
Anisotremus virginicus	S	0.38	1.41	1.82	4.54	1.33	3.56	0	0	0	0	0	$13.04
Aulostomus maculatus	O	0.07	0	0	0	0	0	0	0	0	0	0	$0.07
Balistes capriscus	S	0	0	0.66	1.47	0.66	3.11	0.59	0	0	0	0	$6.49
Balistes vetula	S	0	0	0	0	0	0	0	0	2.4	0	0	$2.40
Calamus bajonado	S	0	0	0.58	0	0.67	0	1.43	0	0	0	0	$2.68
Calamus calamus	S	0	0.67	0	0	0.42	1.14	1.35	0	0	0	0	$3.58
Calamus proridens	S	0	0	0	0	0	0.9	0.45	0.54	0	0	0	$1.89
Cantherhines macrocerus	O	0	0	0	0	0.29	0	0	0	0	0	0	$0.29
Cantherhines pullus	O	0.04	0.04	0.12	0.22	0	0	0	0	0	0	0	$0.42
Canthidermis sufflamen	S	0.24	0	0	0	0	0	0	0	0	0	0	$0.24
Caranx bartholomaei	S	0	0.38	13.42	10.39	0.23	4.04	0	1.01	0	3.77	0	$33.24
Caranx crysos	S	0	0	0.62	0.23	0	0.43	0.48	0	0	0	0	$1.76
Caranx latus	O	0.08	0.51	0	0	0	0	0	0	0	0	0	$0.59
Caranx ruber	O	0	0	0.66	0.24	0	0	0	0	0	0	0	$0.90
Chaetodipterus faber	O	0	0	0	0	0.06	0	0	0	0	0.23	0	$0.29
Chaetodon capistratus	O	0.01	0.01	0.07	0.02	0.01	0	0	0	0	0	0	$0.12
Chaetodon ocellatus	O	0.02	0.03	0.23	0.1	0.1	0.05	0	0	0	0	0	$0.53
Chaetodon sedentarius	O	0	0.02	0	0.06	0	0	0	0	0	0	0	$0.08
Chaetodon striatus	O	0	0	0	0.01	0.03	0	0	0	0	0	0	$0.04
Chilomycterus schoepfi	O	0	0	0	0	0	0	0.04	0	0	0	0	$0.04
Dasyatis americana	O	0	0	0.28	0	0	0	0	0	0	0	0	$0.28
Diodon Holocanthus	O	0.02	0.15	0.1	0.13	0.13	0.12	0	0	0	0	0	$0.65
Epinephelus morio	P	0	0	0	11.47	0	0	0	0	0	0	0	$11.47
E. morio - medium	P	0	1.86	7.59	0	0	0	0	0	0	0	0	$9.45
E. morio - small	P	0	0.41	0	0.52	0.92	0	0	0	0	0	0	$1.85
Epinephelus sp.	P	0	0	0	0	0	0	0	0	0	0	0	$0.00
E. sp. - medium	P	0	2.77	0	0	0	0	0	0	0	0	0	$2.77
Epinephelus striatus	P	0	0	5.02	0	0	0	0	0	0	0	0	$5.02
Equetus acuminatus	O	0.01	0	0.01	0	0	0	0	0	0	0	0	$0.02
Ginglyostoma cirratum	O	0	0.42	0.39	1.2	0	0	1.66	0	0	0	0	$3.67
Gymnothorax funebris	O	0.92	0.44	0	0.33	1.36	0	1.5	0	0	0	0	$4.55
Gymnothorax moringa	O	0	0.18	0	0	0	0	0	0	0	0	0	$0.18
Haemulon album	S	0	0	0.33	0	0	0	0	0.7	0	0	0	$1.03
Haemulon aurolineatum	O	11.39	0.14	0	1.03	0	0	0	0	0	0	0	$12.56
Haemulon carbonarium	S	0	0	0	0.19	0	0	0	0	0	0	0	$0.19
Haemulon flavolineatum	S	1.49	1.27	2.42	5.19	0.18	0	0	0	0	0	0	$10.55
Haemulon parrai	S	0.55	0	0.49	2.1	0.32	1.53	0.37	0.35	0	0	0	$5.71
Haemulon plumieri	S	4.13	4.66	4.03	8.99	7.46	2.64	0	0	0	0	0	$31.91
Haemulon sciurus	S	0.33	0	0.97	2.39	0	0	0	0	0	0	0	$3.69
Halichoeres bivittatus	O	0.01	0	0	0	0	0	0	0	0	0	0	$0.01
Holacanthus bermudensis	O	0	0	0.52	1.87	0.43	0.37	0	2.63	3.71	1.14	2.56	$13.23
Holacanthus ciliaris	O	0	0.12	0	0	0.09	0.24	0	0.2	0.11	0	0	$0.76
Holacanthus tricolor	O	0.01	0	0.24	0.16	0.1	0.08	0	0	0	0	0	$0.59

Appendix C. (continued)

SPECIES	CLASS P,S,O	VALUE ($) 0.5X0.5"	1X2"	1.5X1.5"	1.5 HEX"	2X2"	1.5X3"	2X3"	2X4"	3X3"	4X4"	3X6"	TOTAL
Holocentrus ascensionis	O	0.12	0.43	0.31	0	0.12	0	0	0	0	0	0	$0.98
Holocentrus rufus	O	0	0.08	0.62	0.31	0	0	0	0	0	0	0	$1.01
Kyphosus sectatrix	O	0	0	0	0.41	0	0	0	0	0	0	0	$0.41
Lachnolaimus maximus	P	13.92	3.46	19.72	11.03	9.7	8.42	1.27	10.81	6.3	3.73	0	$88.36
Lactophrys bicaudalis	O	0	0	0	0.25	0.08	0	0	0	0	0	0	$0.33
Lactophrys polygonia	O	0	0	0	0	0	0	0.07	0.88	0.34	0	0	$1.29
Lactophrys quadricornis	O	0	0	0.19	0.63	0	1.92	1.17	0.96	0.38	0	0.8	$6.05
Lactophrys trigonus	O	0	0	0	0	0	0	0	0	0	0	0.39	$0.39
Lactophrys triqueter	O	0	0.51	0	0	0	0.3	0.23	0.15	0	0	0	$1.19
Lutjanus analis	P	5.1	10.39	44.41	22.22	0	15.58	5.51	51.55	10.89	0	0	$165.65
L. analis - medium	P	0.74	0	1.59	0.67	0	2.5	0	0	0	0	0	$5.50
L. analis - small	P	0	0	0	0	0	0.1	0	0	0	0	0	$0.10
Lutjanus apodus	P	0	0	0	0	0	0	0	0	0	0	0	$0.00
L. apodus - medium	P	0	0	0	1.58	0	0	0	0	0	0	0	$1.58
L. apodus - small	P	0	0	0	2.05	0	0	0	0	0	0	0	$2.05
Lutjanus cyanopterus	P	0	0	0	0	0	30.75	0	31.66	0	0	0	$62.41
Lutjanus griseus	P	0	1.33	3.71	0	0	0	0	0	0	0	0	$5.04
L. griseus - medium	P	0	0.49	0.59	0	0	0	0	0	0	0	0	$1.08
L. griseus - small	P	0	0.34	0	0.55	0	0	0	0	0	0	0	$0.89
Lutjanus jocu	P	0	0	0	0	0	3.25	0	0	0	0	0	$3.25
Lutjanus synagris	P	0	0	0	0	0	0	0	0	0	0	0	$0.00
L. synagris - small	P	0	0.08	1.8	1.43	0	0	0.09	0	0	0	0	$3.40
Monacanthus hispidus	O	0.08	0.4	0.3	0.25	0.43	0.13	0.19	0	0.03	0	0	$1.81
Mulloidichthys martinicu	O	0.29	0	0	0	0	0	0	0	0	0	0	$0.29
Mycteroperca bonaci	P	35.56	0	0	25.35	0	0	38.24	0	0	0	36.67	$135.82
Mycteroperca microlepis	P	0	51.35	0	19.43	0	0	0	0	0	0	0	$70.78
Ocyurus chrysurus	P	0	0	0	0	2.34	0	0	0	0	0	0	$2.34
O. chrysurus - medium	P	0	0	0.7	0.65	2.79	0	0	0	0	0	0	$4.14
O. chrysurus - small	P	0	0.38	1.13	4.77	0	0	0	0	0	0	0	$6.28
Pomacanthus arcuatus	O	0	0.29	0.4	1.2	1.01	0.73	0.4	1.31	1.53	1.71	0	$8.58
Pomacanthus paru	O	0	0.46	0	0	0	0	0	0.47	0	0.51	0.28	$1.72
Priacanthus arenatus	O	0	0	0	0	0.17	0	0.17	0	0	0	0	$0.34
Prionotus roseus	O	0.01	0	0	0	0	0	0	0	0	0	0	$0.01
Pseudupeneus maculatus	O	1.4	0.24	0	0.12	0	0.16	0	0	0	0	0	$1.92
Rachycentron canadum	P	0	3.38	0	0	0	0	0	0	0	0	0	$3.38
Scarus coeruleus	O	0	0	0	0.6	0	1.62	0	0	0	0	0	$2.22
Scarus taeniopterus	O	0.4	0	0	0	0	0	0	0	0	0	0	$0.40
Scorpaena plumieri	O	0	0	0	0	0	0	0	0	0	0	0	$0.00
Seriola dumerili	S	0	0	0	6.89	0	0	0	0	0	0	0	$6.89
Seriola rivoliana	S	0	0.33	0.24	0	0.5	0.28	0	0	0	0	0	$1.35
Sparisom chrysopterum	O	0.58	1.24	1.28	0.19	0.34	1.16	0	0	0	0	0	$4.79
Sparisoma aurofrenatum	O	0.11	0.11	0	0	0	0	0	0	0	0	0	$0.22
Sparisoma sp.	O	0.34	0	0	0	0	0	0	0	0	0	0	$0.34
Sparisoma viride	O	0.24	0.32	0.26	0.7	3.88	0.28	2.79	0.37	0.46	0	0	$9.30
Sphoeroides spengleri	O	0	0	0	0	0	0	0	0	0	0	0	$0.00
Sphyraena barracuda	O	0.22	0	10.47	0	0	0	4.38	0	1.33	0	0	$16.40
Umbrina coroides	O	0.01	0	0	0	0	0	0	0	0	0	0	$0.01
Urolophus jamaicensis	O	0	0	0	0	0	0	0	0.1	0	0	0	$0.10
TOTAL VALUE =		$79.40	$99.18	$135.01	$162.54	$42.84	$100.63	$67.11	$110.01	$35.56	$12.31	$40.85	$885.44

Morton Traps

you haven't fished if you haven't used the Morton Traps!

MORTON TRAP COMPANY

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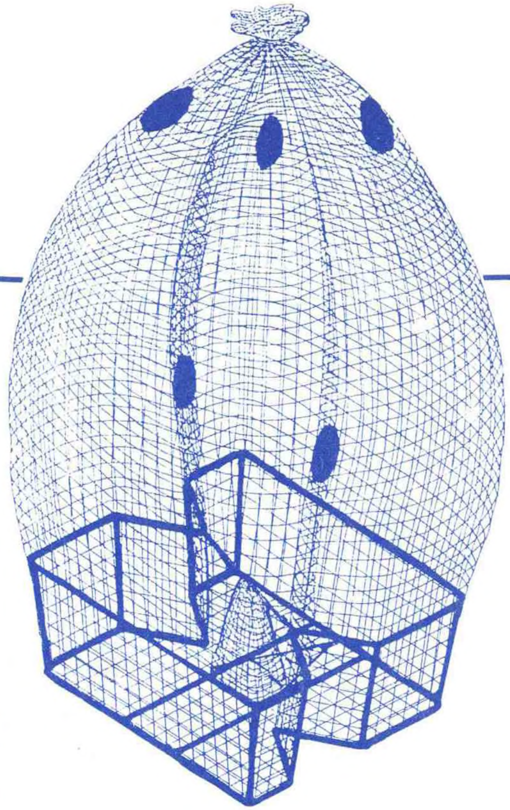
(919) 842-2119
NIGHTS: 842-2908, 842-9752

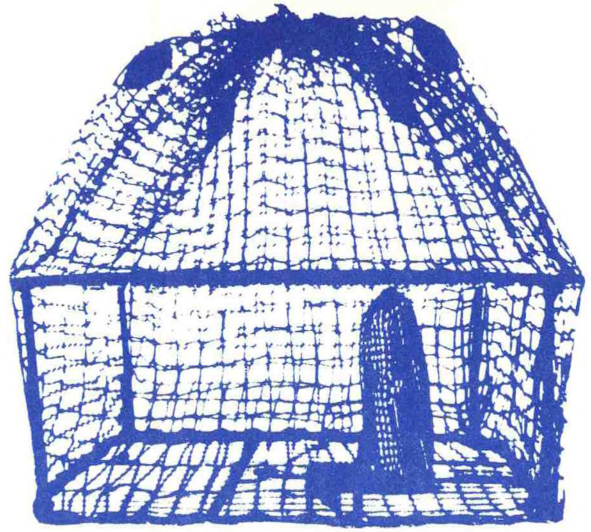


BIG-M

Size—32" x 36" x 14"
Weight—32 lbs.
Knotless Nylon No. 504
Base—½" Galvanized Steel

The BIG-M, specially designed for the commercial fishing industry, now available in V-type split webbing, which has proven very effective on all bottom species, snapper, grouper, tilefish, cod, etc. This design has proven itself on most every species and on fish from 1 lb. to the 50 lb. class. It provides maximum retention, while at the same time allowing a very large fish to enter the trap.

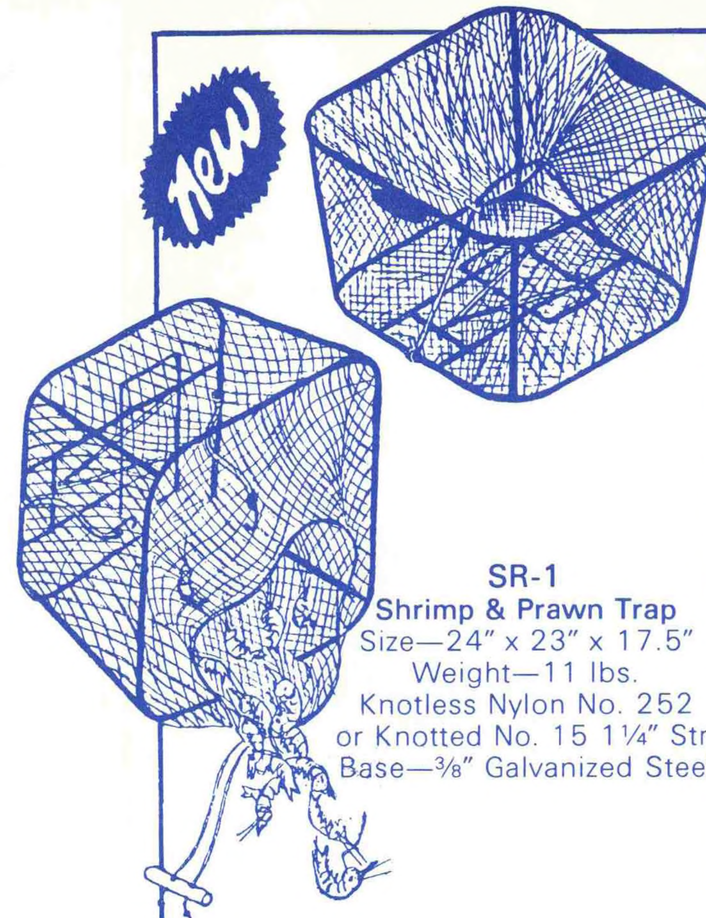
The BIG-M sells for $149.95 each, and must be shipped motor freight. For immediate shipment please send bank check or money order. Personal checks, please allow 3 weeks for delivery. No C.O.D. orders please. Freight cost will be payable to the carrier upon delivery.



F-1

Size—32" x 36" x 14"
Weight—30 lbs.
Knotless Nylon 504, 3" Str.
Base—½" Galvanized Steel

The F-1 is specially designed for flat fish such as fluke or flounder. The entry means is 3" high and 20" wide, allowing a fish in the 20 lb. class to enter the trap. The F-1 has proven very effective in night fishing using live bait with a chemical light attached in the bait well. Other baits may also be used. Like the other Morton collapsible traps, the F-1 is nestable and stows in a very small space. This trap is built only on special order. When ordering, please allow 3 weeks for shipment. The price for the F-1 is $149.95 prepaid. This trap must be shipped motor freight. Freight costs are payable to the carrier upon delivery.**



SR-1

Shrimp & Prawn Trap

Size—24" x 23" x 17.5"
Weight—11 lbs.
Knotless Nylon No. 252
or Knotted No. 15 1¼" Str.
Base—⅜" Galvanized Steel

The SR-1 is specially designed and patented by MORTON TRAP CO. for shrimp or prawn. a product of more than four years of research, it is very effective, both on trawls (longline) or single sets. The muzzle (or entrance) from the top of the trap is easily adjusted to any size, and may be collapsed for nesting while not in use. Sinks fast, dumps quickly, a pleasure to fish. Price $79.95, prepaid. May be shipped UPS Continental U.S. Add $7.88 East Coast and Gulf, $12.00 West Coast. Alaska and Hawaii will be shipped parcel post—add $12.00 each trap.*

M-2

Size—23" x 24" x 9"
Weight—11 lbs.
Knotless Nylon No. 504, 3¼" Str.
Base—⅜" Galvanized Steel

This trap is designed for commercial, as well as the sport, or table fisherman. Its compact size and nesting design allows it to be carried by the smallest boat. But don't be fooled by its size—it is capable of 200 lbs. or more per set. Its nestable design allows its 20 cu. ft. to nest in only 1.8 cu. ft. The M-2 is for fish in the ½ to 8 lb. class. It was developed in the sea bass fishery off the Carolina coast, but is now being fished for sculp, bass, perch, catfish, and many other species from Samoa to the Red Sea. The price of the M-2 is $79.95 prepaid. It may be shipped UPS, Continental U.S. for $7.88 East Coast or $12.00 West Coast for 2 traps. Alaska and Hawaii will be shipped parcel post ($12.00—2 traps) 2 trap minimum.

PLEASE CONTACT YOUR LOCAL DEALER:

ALL DESIGNS PATENTED:
U.S. PATENT NO. 4177601 / 269, 109 / others pending
*SR-1 also available 32"x36"x21" $149.95 (motor freight)
**F-1 also available 22"x28"x10 (one entrance) $79.95 (UPS)
CUSTOM DESIGNS AVAILABLE ON LARGE QUANTITIES

fishing costs have tripled! now-for the first time ever your catch can do the same!!

RESEARCH—MORTON FISH TRAPS: Research has shown the MORTON TRAPS to be as much as three times more effective on all trappable species, fresh and salt water. Research has also shown the MORTON TRAPS to use considerable less bait than rigid or conventional traps. Their innovative design has allowed the MORTON TRAPS to produce much better catches in the off-season or when fish are scattered than has been possible with conventional traps. Research has proven that traps of 450—650 lbs. per set are not uncommon.

Because the MORTON TRAPS look more natural on the bottom as the webbing bag moves and sways with the currents, it blends better with the growth on the bottom and produces much more catch, a better fish, and uses less bait. The fish trapped inside also move the webb bag in their efforts to escape, thereby progressively attracting more fish.

FEATURES: A collapsible floated webbing bag allowing the base to be one third the conventional size.

A holding compartment which has been increased by two-thirds over that of conventional traps with the same size base.

Its parachute effect, created by the floated webbing, makes it impossible for it to land on the bottom in the wrong position.

Being built largely of webbing makes it easy to handle and perfect for trawls and long lines as well as single sets.

May be built in your desired mesh size to allow juvenile or trash fish to escape.

Built in various muzzle designs in order to accommodate fish of many species.

Degradable Seam to Prevent Ghost Fishing.

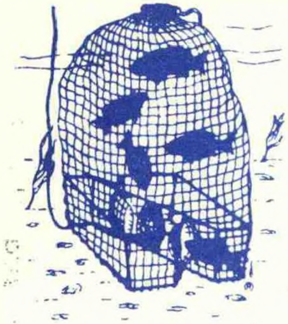
Hot Dipped Galvanized Frame to prevent rust.

new shrimp trapping

RESEARCH—SR-1 SHRIMP TRAPS: Research in southeastern North Carolina waters, by MORTON TRAP CO., has shown that shrimp trapping in shallow warm water is very feasible with the proper trap and bait. Research showed the SR-1 to be the best possible design, of all trap styles and designs tested. Research showed the SR-1 to be capable of 1—5 lbs. per set during daytime hours, pulled twice a day and much more when used in overnight sets.

FEATURES: The SR-1 with its entrance or muzzle from the top of the trap, has close to 100% retention. The muzzle is easily adjusted to accommodate any size shrimp and still maintain its retention. Dumps quickly, by simply unhooking the stretchable cables, without changing the size setting. Sinks fast, lands upright every time. Collapses quickly for nesting.

all new patented designs!



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US PATENT NOS. 4177601 / 269,109 / OTHERS PENDING

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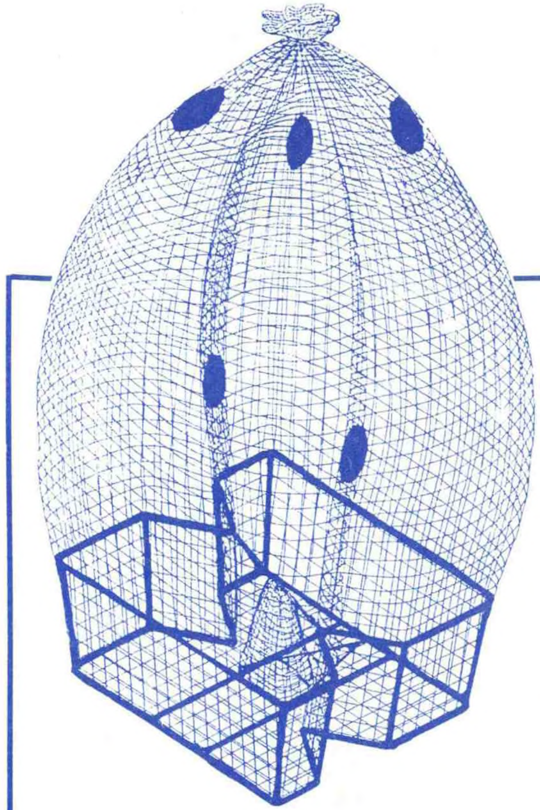

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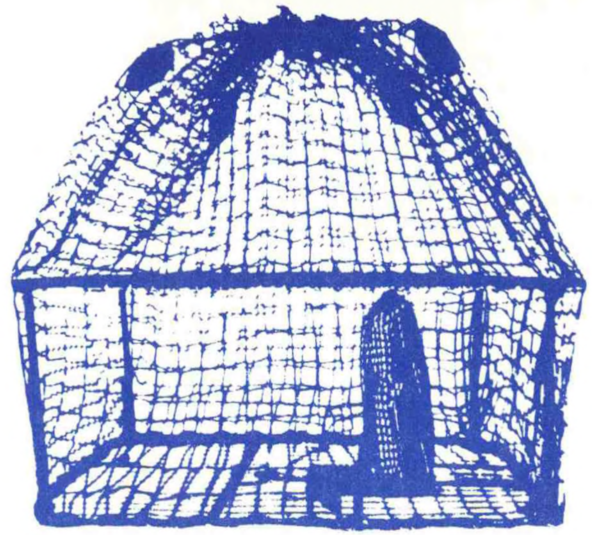
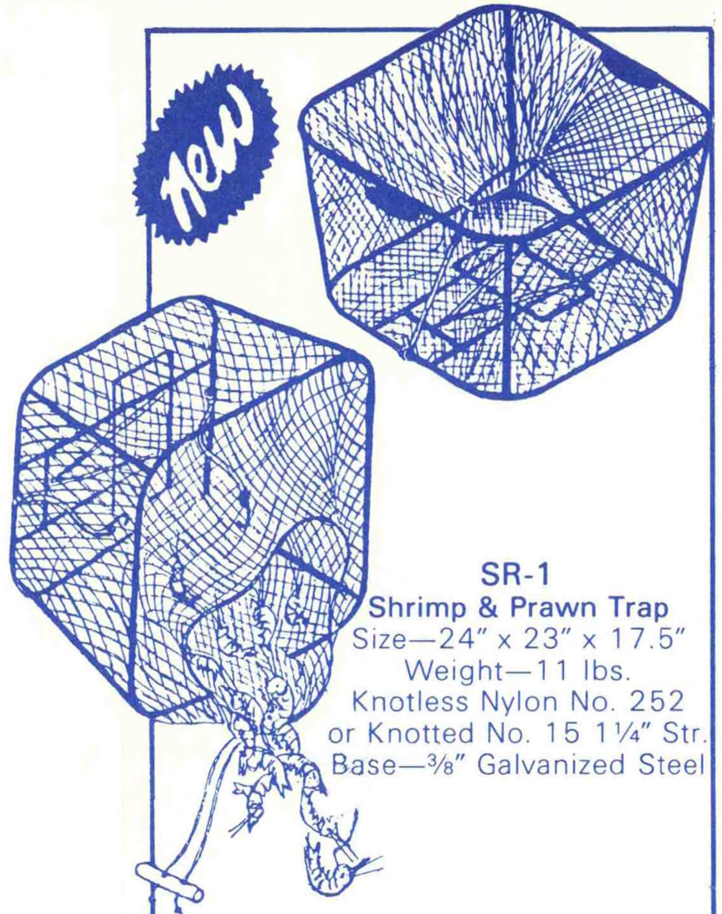


F-1

Size—32″ x 36″ x 14″
Weight—30 lbs.
Knotless Nylon 504, 3″ Str.
Base—½″ Galvanized Steel

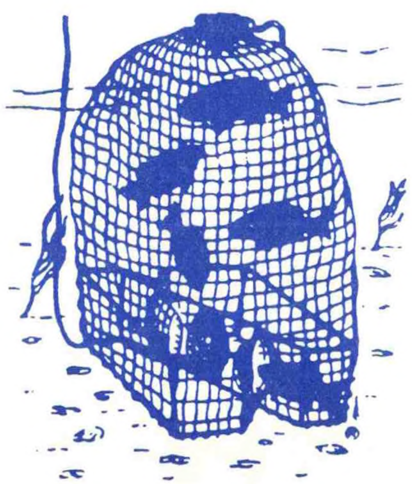
The F-1 is specially designed for flat fish such as fluke or flounder. The entry means is 3″ high and 20″ wide, allowing a fish in the 20 lb. class to enter the trap. The F-1 has proven very effective in night fishing using live bait with a chemical light attached in the bait well. Other baits may also be used. Like the other Morton collapsible traps, the F-1 is nestable and stows in a very small space. This trap is built only on special order. When ordering, please allow 3 weeks for shipment. The price for the F-1 is $149.95 prepaid. This trap must be shipped motor freight. Freight costs are payable to the carrier upon delivery.**



SR-1

Shrimp & Prawn Trap
Size—24″ x 23″ x 17.5″
Weight—11 lbs.
Knotless Nylon No. 252
or Knotted No. 15 1¼″ Str.
Base—⅜″ Galvanized Steel

The SR-1 is specially designed and patented by MORTON TRAP CO. for shrimp or prawn. a product of more than four years of research, it is very effective, both on trawls (longline) or single sets. The muzzle (or entrance) from the top of the trap is easily adjusted to any size, and may be collapsed for nesting while not in use. Sinks fast, dumps quickly, a pleasure to fish. Price $79.95, prepaid. May be shipped UPS Continental U.S. Add $7.88 East Coast and Gulf, $12.00 West Coast. Alaska and Hawaii will be shipped parcel post—add $12.00 each trap.*



M-2

Size—23″ x 24″ x 12″
Weight—11 lbs.
Knotless Nylon No. 504, 3¼″ Str.
Base—⅜″ Galvanized Steel

This trap is designed for commercial, as well as the sport, or table fisherman. Its compact size and nesting design allows it to be carried by the smallest boat. But don't be fooled by its size—it is capable of 200 lbs. or more per set. Its nestable design allows its 20 cu. ft. to nest in only 1.8 cu. ft. The M-2 is for fish in the ½ to 8 lb. class. It was developed in the sea bass fishery off the Carolina coast, but is now being fished for sculp, bass, perch, catfish, and many other species from Samoa to the Red Sea. The price of the M-2 is $79.95 prepaid. It may be shipped UPS, Continental U.S. for $7.88 East Coast or $12.00 West Coast for 2 traps. Alaska and Hawaii will be shipped parcel post ($12.00—2 traps) 2 trap minimum.

PLEASE CONTACT YOUR LOCAL DEALER:

ALL DESIGNS PATENTED:
U.S. PATENT NO. 4177601 / 269, 109 / others pending
*SR-1 also available 32″x36″x21″ $149.95 (motor freight)
**F-1 also available 22″x28″x10 (one entrance) $79.95 (UPS)
CUSTOM DESIGNS AVAILABLE ON LARGE QUANTITIES

fishing costs have tripled! now-for the first time ever your catch can do the same!!

RESEARCH—MORTON FISH TRAPS: Research has shown the MORTON TRAPS to be as much as three times more effective on all trappable species, fresh and salt water. Research has also shown the MORTON TRAPS to use considerable less bait than rigid or conventional traps. Their innovative design has allowed the MORTON TRAPS to produce much better catches in the off-season or when fish are scattered than has been possible with conventional traps. Research has proven that traps of 450—650 lbs. per set are not uncommon.

Because the MORTON TRAPS look more natural on the bottom as the webbing bag moves and sways with the currents, it blends better with the growth on the bottom and produces much more catch, a better fish, and uses less bait. The fish trapped inside also move the webb bag in their efforts to escape, thereby progressively attracting more fish.

new shrimp trapping

RESEARCH—SR-1 SHRIMP TRAPS: Research in southeastern North Carolina waters, by MORTON TRAP CO., has shown that shrimp trapping in shallow warm water is very feasible with the proper trap and bait. Research showed the SR-1 to be the best possible design, of all trap styles and designs tested. Research showed the SR-1 to be capable of 1—5 lbs. per set during daytime hours, pulled twice a day and much more when used in overnight sets.

FEATURES: The SR-1 with its entrance or muzzle from the top of the trap, has close to 100% retention. The muzzle is easily adjusted to accommodate any size shrimp and still maintain its retention. Dumps quickly, by simply unhooking the stretchable cables, without changing the size setting. Sinks fast, lands upright every time. Collapses quickly for nesting.

FEATURES: A collapsible floated webbing bag allowing the base to be one third the conventional size.

A holding compartment which has been increased by two-thirds over that of conventional traps with the same size base.

Its parachute effect, created by the floated webbing, makes it impossible for it to land on the bottom in the wrong position.

Being built largely of webbing makes it easy to handle and perfect for trawls and long lines as well as single sets.

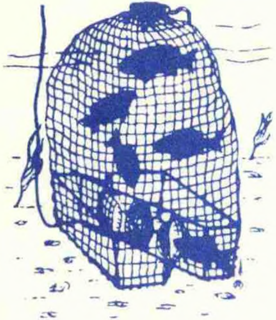
May be built in your desired mesh size to allow juvenile or trash fish to escape.

Built in various muzzle designs in order to accommodate fish of many species.

Degradable Seam to Prevent Ghost Fishing.

Hot Dipped Galvanized Frame to prevent rust.

all new patented designs!



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~~07712~~
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US PATENT NOS. 4177601 / 269,109 / OTHERS PENDING