Comparison of Catches by Bamboo and Wire Fish Traps in Jamaica

WARREN SHAUL & DANIEL REIFSTECK
Jones & Stokes Associates, Inc.
Environmental Planning & Natural Resources Sciences
1725 - 23rd Street, Suite 100
Sacramento, CA 95816 U.S.A.
27 Meadow Sweet Trail
Saunderstown, RI 02874 U.S.A.

ABSTRACT

The Jamaican demersal fishery is heavily overfished. This condition has resulted in declining incomes and the value of fish landed by many fishermen is less than the cost of replacing wire fish traps. To remain active in the fishery, fishermen are substituting less expensive platted bamboo for the customary wire mesh traps. The purpose of this research is to determine if the change to bamboo traps will reduce pressure on overfished stocks,*i.e.*, bamboo traps catch different species than wire traps. We recorded the catches of Antillean 'Z' bamboo and wire traps, fished off Alligator Pond, Jamaica, from November 1986 to April 1987.

There was a difference between the catch composition of bamboo and wire traps. Bamboo traps caught more Mullidae than wire traps. Conversely, wire traps caught more Sparidae and Scaridae. Trap size and water depth also affected catch composition. Even though substitution of platted bamboo for wire mesh could reduce fishing effort on some species, overexploitation of all species will continue until a significant proportion of the fishermen can obtain alternative employment.

INTRODUCTION

Portable fish traps are widely used throughout the world and are the primary method of fish harvest in Caribbean nearshore waters (Munro 1974). The preferred fish trap configuration varies from country to country and among fishermen (Munro 1974), but Jamaican fishermen rarely deviate from the Z-shape (Reifsteck and Shaul in progress). Almost 80 percent of the over 12,000 Jamaican fishermen use traps as their primary fishing gear. Traps account for more than 8 million pounds of fish and crustaceans landed annually, about 50 percent of Jamaica's total annual harvest (Jamaica Fisheries Division 1987).

Jamaican fishermen have probably used Z-shaped traps for over 100 years. The first traps were constructed of platted bamboo or cane supported on a wood frame and may have originated in Haiti (Johnson 1959). Platted bamboo was gradually replaced by galvanized wire mesh and most fishermen now use the longer lasting wire traps. However, platted bamboo traps have become increasingly more common since 1985, especially among south coast fishermen (personal observation). Generally, fishermen use bamboo traps when they cannot recoup the cost of the longer lasting wire traps or when continued fishing depends on trap replacement but wire mesh is unaffordable (fishermen personal communication). The cost of wire mesh increased from J$150 per roll in 1981 to J$567 in 1986 (Jamaica Fisheries Division, Annual Report; Jamaica Cooperative Union personal communication, Kingston, Jamaica). This price increase combined with declining incomes will probably cause increased use of platted bamboo traps.

Fishermen's incomes are declining due to overexploitation of Jamaica's fish resources (Haughton 1988). Total annual harvest declined from 24 million pounds in 1962 to about 16 million pounds in 1981 (Haughton 1985, Koslow 1989). Haughton (1985) also noted a decline in catch per unit effort (by as much as 60 percent) and a decline in the proportion of quality high-value fish (*e.g.*, *Lutjanidae* and *Serranidae*) in the total catch. Low-value trash fish (*e.g.*, small fish, *Sparidae* and *Gerreidae*) now comprise the majority of many fishermen's catches. Larger reef fish species are overfished and smaller reef fish species are intensely exploited (Munro *et al.* 1971).

Since 1957, management programs have focused on development, including outboard engine promotion and fuel and equipment subsidies (Jamaica Fisheries Division, annual publication). Coupled with population growth, economic decline, and deficient alternative income sources; management programs increased the number of fishermen and exacerbated fish resource degradation, fishermen conflicts, and the decline in fishermen's incomes. Although opportunities to develop effective management strategies decline as development of a fishery progresses (Pearse 1982 in Munro and Smith 1984), steps can be taken to prevent further resource degradation, resolve fishermen conflicts, and reduce fishing mortality. The Jamaica Fisheries Division is revising its fishery management plans. The new lobster management plan includes minimum size restrictions, seasonal closures, limited entry, gear restrictions and improved enforcement of regulations (Haughton personal communication, Fisheries Officer, Fisheries Division, Kingston, Jamaica). The Division also hopes to redirect effort from overexploited fish resources to underexploited or undeveloped fish resources.

Changes in fishing methods and gear directly affect the resource by changing the exploitation rate on the species and size of fish caught. Fisheries management requires input of information on the social, economic, and biological impacts of the gear change. The increased use of the platted bamboo traps by south coast fishermen could potentially affect the majority of Jamaica's fishermen and fish resources. South coast fishing areas yield nearly 75 percent of Jamaica's total harvest (Jamaica Fisheries Division 1987).

The purpose of this research was to determine if the substitution of platted bamboo traps for wire mesh traps could reduce fishing effort on species presently caught by the wire traps. The objectives were to determine if there is a significant difference between the catch compositions of wire and bamboo traps and which species are most affected.

METHODS

Beginning in November, 1986, and ending in April, 1987, data were collected from the island shelf area immediately south of Alligator Pond Beach, Manchester Parish. This beach was chosen because both platted bamboo and wire mesh traps are fished, we had met several of the fishermen, and a Fisheries Instructor who was stationed at the beach agreed to relay messages between our Kingston office and the Alligator Pond fishermen.

We accompanied fishermen in their canoes and recorded data on fish captured in their traps. Our sampling trips were made in a 6 m wooden canoe and in 10 m fiber glass canoes. The canoes were powered by 25 or 45 hp outboard engines.

The fish traps were set at depths of about 30 m within 7 km of the island and at about 55 m within 15 km. The fishermen located their traps by triangulation with onshore landmarks. All nearshore traps and many 24 km offshore were not buoyed. This practice prevented theft by competing fishermen. After the canoe was maneuvered onto the triangulated trap location, the fishermen pulled a 5 to 10 kg grappling hook along the ocean floor. The hook snagged a synthetic fiber line connecting two traps. Nearly all sets were made with two traps connected by a line equal to twice the water depth in length. The connecting line was brought to the boat on the grappling hook and the traps were hauled singly by hand. The fish were emptied from the first trap before the second was hauled. The trap may or may not have been baited with moldy bread. After both traps were brought on board, the triangulation point was re-established and one trap was dropped overboard. The canoe powered in a predetermined direction and when the slack was out of the connecting line, the second trap was dropped. Buoyed traps did not require grappling, but the procedure was similar because each buoy marked two traps connected by a line equal to twice the water depth. Usually the traps were found within a few minutes after establishing a triangulation point and very few traps were lost.

All of the traps were Z-shaped and had two entrance tunnels. The traps were constructed of either platted bamboo (Reifsteck and Shaul in progress) or wire mesh (Oswald 1981, Munro 1974). Soak times, *i.e.*, the period between successive pulls of the traps, varied from 1 to 7 days.

Trap depth, trap condition, mesh opening, and water depth were recorded for each trap pulled. Trap depth is the distance from the top to the bottom of the trap, where the bottom is the part that lays flat on the ocean floor. Mesh openings are hexagonal on both bamboo and wire mesh traps. The size of an opening is the straight line measurement between two parallel sides of the hexagon (Reifsteck and Shaul in progress). On wire mesh this measurement is between the sides composed of two-wire strands. The measurement between any two sides is adequate for platted bamboo.

One sample was composed of all fish captured in a trap. We recorded the number of fish in each trap and identified them to family. Over 100 species of fish comprise Jamaican trap catches (Munro *et al.* 1971). Working with fishermen in the confines of a canoe limited our ability to separate species. However, when species were separable, we measured total fish length. We did not usually keep samples separate for length measurements, but we never mixed bamboo and wire trap catches.

Analysis of variance, Newman-Keuls test, and other statistical methods were used to summarize and analyze the data (Zar 1974). The level of significance for all statistical tests was 0.05.

RESULTS

The shape of the traps was consistent, but fishermen used variable mesh openings and trap dimensions (Table 1). Openings were uniform in the factory-made wire mesh and variable, ± 0.4 cm, in the hand-platted bamboo mesh. Trap depth was more consistent in bamboo than wire traps because fishermen buy platted bamboo of a predetermined depth but cut wire mesh to fit

Table 1. The traps were constructed of either platted bamboo or wire mesh and were supported by a wood pole frame. Seven trap types as determined by construction material, mesh size, trap depth, and water depth were fished in our study.

Construction Material	Trap Type	Mesh Opening cm	Water Depth m(±10)	Trap Depth cm(±2.5)
Platted Bamboo	B1	2.8 ± 0.4	30	25
	B2	2.8 ± 0.4	55	25 to 35
	B3	3.7 ± 0.4	55	50
Wire Mesh	W1	2.5	30	25 to 40
	W2	2.5	55	30 to 40
	W3	3.3	55	65
	W4	3.3	55	100 to 120

Table 2. Trap catches included fish and crustaceans representing 33 families. The numbers indicate the total samples containing species from the corresponding families. Trap type is from Table 1, n is the total number of samples from a specific trap type, Total Families is the number of families captured in the trap type, X Families is the mean number of families per sample, X Fish is the mean number of fish per sample, and s is the standard deviation.

Family/Trap	B1	B2	B3	W1	W2	W3	W4
Fish:							
Acanthuridae		3			2	23	13
Aulostomidae		1					
Balistidae	2	1				5	1
Bothidae			1	1	2		
Branchiostegidae							1
Carangidae						1	
Chaetodontidae			4		2	5	5
Dasyatidae	1	1	1		1		
Diodontidae		3	1		1	5	
Echeneidae		3					
Gerreidae	6			6			
Grammistidae		1					1
Haemulidae	5	4		7	4	11	4
Holocentridae		6			7	24	13
Labridae					3	1	2
Lutjanidae	9	5	1	6	1	2	2
Monacanthidae	2	4		6		2	2
Mullidae	21	15		2	2	5	1
Muraenidae		2			1	4	3
Ostraciidae	3	4	2	2		3	1
Orectolobidae						1	
Pomacanthidae		2				7	1
Pomacentridae		1				1	
Scaridae	3	18		2	7	27	15
Sciaenidae				1			2
Scorpianidae			3	1			
Serranidae		1			5	12	5
Sparidae	18	4		9	3	1	
Tetrodontidae	1			2			
Crustaceans:							
Mithrax sp.		2	1				
Palinuridae	2	3	2		3	3	2
Portunidae	2	3		2	3		
Scyllaridae		1					
n	23	34	2	14	15	35	18
Total Families	13	26	6	13	16	20	18
X Families	3.30	2.87	3.71		3.13	4.26	4.22
s	1.66	1.36	1.90		1.55	1.92	1.77
X Fish	15.96	8.12	12.29		10.33	18.77	20.28
s	7.80	6.75	8.59		7.75	14.25	16.87

the desired trap depth. An increase of over 20 cm in trap depth usually corresponded with an increase in overall trap dimensions, including trap length and width, but not necessarily mesh opening.

Forty percent of the samples were taken with small traps in 30 m of water (Table 1). Both small and large traps were used at 55 m. Trap catches included more than 50 species of fish and crustaceans from 33 families (Table 2). Species representing 24 families were captured in both bamboo and wire traps. In general, the total number of species captured by a trap type depended on the number of samples,*i.e.*, more samples equates with more species captured.

Analysis of variance tests indicated a significant difference in the mean number of families per sample (Table 2). A Newman-Keuls test did not reject the hypothesis of no difference between the mean number of families per sample in bamboo (B1, B2) and wire (W1, W2) traps of similar dimensions. However, the mean number of families per sample was significantly greater for traps of greater depth (W3, W4). No significant difference was indicated in the mean number of families per sample between traps 65 cm deep and > 100 cm deep.

The mean number of fish per sample exhibited the same relationship between trap types as did the mean number of families per sample (Table 2). In general, the mean number of fish per sample from traps more than 65 cm in trap depth (W3, W4) was significantly greater than the mean for smaller traps (B1, B2, W1, W2).

Those families that averaged more than one fish per sample are listed in Table 3. Bamboo traps (B1, B2) caught significantly more Mullidae per sample than all wire traps. Wire traps (W1, W2) caught more Monacanthidae and Holocentridae than bamboo traps (B1, B2). Differences were often not statistically significant because of the high variability in catch between traps.

Water depth also influenced the catch per trap (Table 3). The bamboo traps at 30 m (B1) caught more Mullidae, Sparidae and Lutjanidae than the bamboo traps at 50 m. Conversely, the bamboo traps at 50 m caught more Scaridae. The wire traps at 30 m (W1) caught more Sparidae, Lutjanidae, Gerreidae and Monacanthidae than the wire traps at 50 m (W2), but the wire traps (W2) at 50 m caught more Scaridae and Holocentridae.

Another factor influencing catch per sample is trap depth (Table 3). Wire traps over 65 cm (W3, W4) in depth caught more Scaridae and Acanthuridae than smaller wire traps in the same water depth (W2). There is no discernible difference between the catches of wire traps 65 cm in depth (W3) and > 100 cm in depth (W4). The Lutjanidae caught in the wire traps > 100 cm in depth (W4) were the result of one sample (20 individuals, *Ocyurus chrysurus*)

There were no significant differences between the mean length of a species captured by the bamboo and wire traps. The mean length of the species we measured were: *Lutjanus synagris*, 15 cm, and *Ocyurus chrysurus*, 29 cm, (Lutjanidae); unidentified Sparidae, 16 cm; *Pseudupeneus maculatus*

Table 3. Only nine families averaged more than one fish per sample in the specified trap types. The mean number of fish per sample per family, X, and their respective standard deviations, s, are partial indication of the relative species (family) abundance by depth and of the trap selectivity.

Family	Trap Type	B1	B2	W1	W2	W3	W4
Mullidae	X	9.74	3.00	–	–	–	–
	s	8.09	6.12	–	–	–	–
Sparidae	X	2.83	4.07	–	–	–	–
	s	2.62	7.55	–	–	–	–
Lutjanidae	X	1.30	–	1.21	–	–	1.17
	s	2.32	–	1.81	–	–	4.71
Haemulidae	X	–	–	1.07	–	–	–
	s	–	–	1.90	–	–	–
Gerreidae	X	–	–	1.64	–	–	–
	s	–	–	2.34	–	–	–
Monacanthidae	X	–	–	2.50	–	–	–
	s	–	–	2.35	–	–	–
Scaridae	X	–	2.03	–	4.07	9.20	10.22
	s	–	3.29	–	5.76	11.89	12.44
Holocentridae	X	–	–	–	2.53	3.14	2.78
	s	–	–	–	4.94	3.47	2.96
Acanthuridae	X	–	–	–	–	2.94	2.94
	s	–	–	–	–	3.27	2.41
Number of Samples		23	34	14	15	35	18

(Mullidae), 18 cm; *Eucinostomus argentus* (Gerreidae), 13 cm; *Haemulon chrysargyreum* (Haemulidae), 16 cm.

Only two bamboo traps of the type B3 were sampled (Table 1). These two traps captured one 60 cm *Lutjanus analis* (Lutjanidae), six *Panulirus argus* (Palinuridae), and fish and crustacean species from four other families (Table 2).

DISCUSSION

Three factors significantly affected catch composition: construction material, water depth and trap size. The traps were set randomly in regards to construction material, but larger traps were set only in 55 m of water. This prevented comparison with smaller traps set in 30 m. Most data were collected during two months. Sample size was insufficient for valid comparisons between dates. Also, soak time was variable, but catch comparisons were valid because traps were usually fished as a unit. The sampling method and variable gear did not provide the information needed for stock density comparisons (Munro 1974).

Care must be exercised in attributing catch composition to physical differences in traps. Reef fish populations are very diverse and intra-specific association is common. Munro (1974) reported conspecific attraction that resulted in traps catching large numbers of the same species. This accounts for the high between-sample variability. A good example of this phenomena occurred in the largest wire traps (W4 in Table 3) where one trap caught twenty *Ocyurus chrysurus* (Lutjanidae). This species was not recorded from other traps and significantly increased the estimated mean catch per trap. A high mean catch value for a species was not considered significant unless the species was present in several traps. Fortunately, the major species were captured in 40 to 90 percent of the samples for a specific trap type.

Munro (1974) noted that catch is proportional to the area covered by a trap. We also found that the larger traps (W3 and W4) caught significantly more fish than the smaller traps. However, trap type W4 is about 35 cm deeper than trap type W3 and the catches are remarkably similar. This may indicate that increased catch due to larger trap dimensions approaches an asymptote.

Significant substitution of platted bamboo for wire mesh could reduce fishing effort on several families of reef fish, especially Scaridae, Holocentridae, and Acanthuridae. At the same time, Mullidae will be heavily impacted by increased bamboo trap use. The selectivity of trap types, either resulting from variable materials or dimensions, can be a valuable tool in regulating fishing effort. We considered promoting the use of bamboo traps to reduce fishing on some species, provide less expensive gear and encourage use of native materials and local labor. However, Jamaica's demersal reef fisheries are heavily overfished. Many gear types are utilized to exploit all species, including very small, immature individuals. Promotion of continued demersal fish exploitation will only worsen the situation. The only real solution lies in development of alternative employment,*i.e.*, fewer fishermen.

ACKNOWLEDGEMENTS

We served as U.S. Peace Corps volunteers in Jamaica from 1985 to 1987. We are indebted to the U.S. Peace Corps for the opportunity to live and work in Jamaica. We were assigned to the Fisheries Division, Ministry of Agriculture, and we obtained much of our background information through the personnel at the Kingston office. Fisheries Officer Milton Haughton was our advisor and friend. He helped us execute this study and generally survive the rigors of fisheries research in Jamaica. We are especially thankful to many fishermen at Alligator Pond, without whom this research would still be an idea.

REFERENCES

Haughton, M. (1988). An analysis of statistical data from the Jamaican shelf fishery. FAO Technical Report on expert consultation on fish stock assessment in the tropics, Hirtshals, Denmark, May, 1986. FAO Fish. Rept. 389:443-454.

Haughton, M. 1985. The urgent need for management of the Jamaican fisheries. Fisheries Division, Ministry of Agriculture, Kingston, Jamaica. 8p.

Jamaica Fisheries Division. 1987. 'Country Report. Fisheries Division, Ministry of Agriculture, Kingston, Jamaica. 8p.

Jamaica Fisheries Division. (annual publication). Annual Report, Fisheries Division, Ministry of Agriculture, Kingston, Jamaica.

Johnson, T. 1959. Lobsters - big business. In the *Farmers' Weekly*, May 23, 1959, Kingston, Jamaica.

Koslow, J.A., F. Hanley, and R. Wickland. 1989. The impact of fishing on the reef fish of Pedro Bank and Port Royal, Jamaica: A Comparison of traps surveys, 1969-73 and 1986. *Proc. Gulf Carib. Fish. Inst.* 39:340-359.

Munro, J.L. and I. R. Smith. 1984. Management strategies in multispecies complexes in artisanal fisheries. *Proc. Gulf Carib. Fish. Inst.* 36:127-141.

Munro, J. L. 1974. The mode of operation of Antillean fish traps and the relationships between ingress, escapement, catch, and soak. *J. Cons. Int. Explor. Mer.* 35 (3): 337-350.

Munro, J.L., P.H. Reeson, and V.C. Gaut. 1971. Dynamic factors affecting the performance of the Antillean fish trap. *Proc. Gulf Carib. Fish. Inst.* 23: 184-194.

Oswald, E.O. 1981. The "S" shaped fishpots of Jamaica. Unpublished Report. Fishing Technology Service, Fishery Industries Division, Food and Agriculture Organization of the United Nations, Rome, Italy, 11p.

Pearse, P.H. 1982. Approaches to economic management of fisheries. Paper presented for the Seminario Internacional Sobra la Administracion de los Pesquerias Chilenas, Santiago, Chile, July 26, 1982.

Reifsteck, D., and W. Shaul. (in progress). The Jamaican fish trap: construction.

Zar, J.H. 1974. *Biostatistical analysis*. Prentice-Hall, Inc., Englewood Cliffs, NJ. 620p.