COMPARATIVE EFFICIENCY OF DIFFERENT TYPES OF BAITING POSITIONS IN TUNA LONGLINE FISHING

DREXEL J. MARQUEZ
Senior Fishery Technologist

ABSTRACT

Three types of baiting positions for tuna longline fishing namely, horizontal, vertical and upside down, were experimented by the Bureau of Fisheries and Aquatic Resources of the Philippines, to determine the most effective type in terms of catch, bait loss and bait recovery. Analysis of the data collected by t-test at 5% significance level showed a tendency of more fish to be caught by horizontal baiting type than by vertical or upside down types and with a significantly higher bait loss and lower bait recovery.

INTRODUCTION

The capture of fish on a longline requires that the fish strike voluntarily at a relatively motionless baited hook.

This fact reveals that the catchability of fish is partly dependent on the baiting methods. As early as 1951, experiments on baiting methods, longline baits and other fishing techniques, designed to improve on the gear efficiency, have been conducted by the Pacific Oceanic Fishery Investigation, but until now, little has been known on the effects of bait positions on the capture of tuna.

This paper attempts to analyze the data collected during experiment on different baiting positions conducted by the Bureau of Fisheries and Aquatic Resources. Comparison of the different baiting positions are concentrated mainly on the results of their catch, bait loss and recovery during actual fishing.

FISHING GEAR AND BAIT

The research vessel, M/V Lumba-lumba (355 gross tons), of the Bureau of Fisheries and Aquatic Resources, was used in the experimental survey on tuna longline.

The longline gear used was a modified tuna longline. It differed from the ordinary type, mainly in the operation of the gear, but the construction was similar to those described by various authors such as Shapiro (1950), Shimada (1951), and Niska (1953). The basic unit of the gear, the basket, was composed of a 400 m mainline. Five 30 m hook droppers or branchlines were attached to the mainline at about 70 m intervals (Fig. 1). Each set was buoyed by a series of floats attached to 18.3 m floatlines to support the mainline. Usually, ordinary hooks were used, although diamond hooks were sometimes employed. Milkfish, *Chanos chanos* (Forsskal), was used as bait during the entire fishing experiment.

Murphy and Shomura (1953) described in some detail the manner in which the ordinary longline are set and retrieved. The modified tuna longline used in this experimental operation is set differently, that is, the mainlines are pre-connected to each other and properly coiled by a line piler in a storage box located at the eastern deck of the vessel. The line is automatically released and controlled by hydraulic lever brake where it passes through during setting. Branchlines and floatlines can be attached to the mainline at the desired intervals as the line is being released through the guide pipe located at the rear end of the vessel. Hauling the line is similar to the ordinary longline. In addition, the line is continuously coiled to the storage box as it is being retrieved to the line hauler and ready again for the next setting. This is done by the line piler located on top of the storage box.

METHODS

The experimental longlining was conducted in the southern waters of the Philippines between latitudes 5° and 10° during the months of November and December, 1975 and January and February, 1976. A total of 18 settings were completed during the entire experiment. A minimum of 20 and a maximum of 70 baskets were set during each longline operation. The baskets were usually set at dawn and retrieved shortly before noon resulting in a range of fishing time of about four to five hours.

The different types of baiting positions experimented (Fig. 2) positions during actual fishing. These bait positions were used simultaneously in each set of gear. The total number of baskets in each set were divided among the bait positions and each type of bait position was employed to each division of baskets. To avoid great differences in soaking time for individual positions, each division containing one type of bait position was alternately employed in each set and "returning retrieving" was used during hauling. Returning-retrieving-hauling started with the line which was set first.

During the course of the experimental fishing, detailed data were recorded as the line was hauled. Catches of each bait position were recorded as well as the number of bait lost and recovered. Species compositions of catch were also identified and the fate of each baited hook was noted, i.e., presence or absence of bait, breakage of dropper lines, and loss of fish and baits during hauling.

In the analysis of the results, the mean catch, bait loss, and bait recovery in each bait position were subjected to simple statistical test (t-test) to find significant differences between bait positions at 5% significance level.

RESULTS

Table 1 shows the total number of hooks used and catch by bait position. Due to the difficulty in controlling total number of hooks in each bait position in some sets, the total number of hooks by position slightly differed from each other.

Table 2 summarizes the total number of fish caught, bait lost and bait recovered by bait position. Table 2 shows that the horizontal type of baiting position yielded the highest total fish catch followed by vertical type while upside down type yielded the lowest. Of the 88 fish caught, horizontal type contributed 55.6%, vertical and upside down, 27.3% and 17.1%, respectively. The results of t-test analyses for the differences in catch (no. of fish/hook) is given in Table 3, which shows significantly larger number of fish caught by the horizontal position while catches of vertical and upside down show no statistical difference.

Catch by species implies some variations in the effectiveness of the bait positions (Table 4). Due to insufficient amount of fish caught, no statistical analysis was made for each species. However,

results of catch by bait position and by species show that out of 34 yellowfin tunas, 22 were caught by horizontal, seven by vertical and five by upside down. Similarly, out of 24 big-eyed tunas, 15 were caught by horizontal, five by vertical and four by upside down. In addition, it can be seen that sharks and other species such as barracuda, marlin, sailfish, swordfish, and sting ray were homogenously caught by the same bait positions.

It is evident that bait recovery is a function of bait loss during fishing, setting, and hauling. Table 2 shows that the vertical and upside down positions lost the same amount of baits while horizontal position lost a lot. Of the total 1,520 baits used for horizontal, 21.0% was lost and 75.8% was recovered, 3.2% caught fish. On the other hand, of 1,505 and 1,490 baits used for vertical and upside down positions, both lost about 10% and recovered about 89% but caught 1.6% and 1.0%, respectively. The t-test analyses for the differences in the number of bait loss and bait recovery by bait position are shown in Tables 5 and 6. The results of the t-test show that horizontal type had significantly higher bait loss and lower bait recovery compared to vertical and upside down positions, and the number of bait loss and recovery of vertical and upside down show no statistical differences.

DISCUSSION

On the basis of the present data, it appears that horizontal type is the most effective in terms of catch among the baiting positions while the catchabilities of vertical and upside down types are much lower than horizontal, and they appear to have a greater tendency to retain more baits than the former as indicated in the results of bait loss and recovery. However, these facts alone do not indicate that fish prefer to bite the bait held horizontally than vertically or upside down. Before attributing to the differences of preferable type of baiting position, bait availability by the positions during fishing and feeding behavior of fish caught must be considered.

There are two possible factors affecting the differences in catch by bait positions. First is the hook-bait relation or the position of the hook on the baitfish in relation to a possible bite. Shomura (1955) noted that fish, especially large tunas, could steal baits without being hooked, as indicated by the stomach examinations he conducted. Thus, this ability of fish would tend to decrease the fishing efficiency of the gear. A bait fish, immersed into the water, is potentially exposed to any kind of attack and degree of bite.

However, a successful hooking only occurs when the mouth of the biting fish would reach the position of the hook. In such a case, a bait held horizontally at least ½ of the bait's body should be bitten by an attacking fish for a sucessful hooking. On the other hand, in a bait held vertically or upside down, at least ⅔ should be bitten if the attacking fish comes from behind. However, it is interesting to note that most sight feeding fishes tend to bite the head first than any other part of the body (Ali, 1959).

The second is the attractivity of the bait fish held in different positions. The attractivity of the bait fish lies not only on its color but also on its natural looks under normal conditions. Magnusson (1963) noted that the catch rate of skipjack tuna increased when a live bait is chummed and decreased when a dead bait is chummed. This shows that dead baits do not provide as intense food stimuli as live swimming baits do.

The results of catch by species indicate some variations in the effectiveness of the three baiting positions. However, the catch difference by species and by bait-positions is too small to warrant statistical analysis. Therefore, no preference could be established. Moreover, bait availability by bait positions during fish and feeding behavior of fish caught should be considered in order to determine any preference. Thus, a further experiment should be made to find out the variations of catch by fish groups and by bait positions.

There are many factors that affect the loss of bait in a longline especially in the deep sea area. Hirayama (1969) pointed out that falling by dropping off from hook, shark damage and removal of bait due to wave action would result in a loss of bait and considerably affect the effectiveness of the longline gear. A similar observation reported by Shomura (1955) was that excessive loss of baits would be due to the roughness of sea condition. From the data on bait loss and recovery, it appears that an excessive loss of baits occurred in the horizontal baiting positions compared to vertical and upside down. However, it should be noted that despite the higher catch by horizontal type, catch did not affect the excessive loss of baits, since baits with catch were already excluded from the total bait loss of each position. Instead, the results indicated that a large part of the horizontal baits were lost either during setting or

hauling. The masterfisherman of the vessel proved that baits were actually lost during hauling, as a lot of them were seen falling while the branchlines were being retrieved after setting. It seems that a greater number of baits may have been pulled loosely before the hooks became visible to the observers.

SUMMARY

Three types of baiting positions of tuna longline fishing were experimented on board M/V Lumba-lumba. The results are summarized as follows:

The total catch of the three types of baiting position shows that horizontal type yielded 55.6%; vertical, 27.3%; and upside down, 17.1%.

The result of t-test shows that catch of horizontal type is statistically more significant than the catches of the two other types. Catches of vertical and upside down types show no statistical difference.

The catch by species of each baiting position indicates that horizontal type has the highest catch of yellowfin and big-eyed tuna. Sharks, on the other hand, were caught homogenously by all baiting position. However, the differences in catch by species and by bait position is too small to warrant statistical analysis, thus these differences should be taken with reservations.

Bait loss and recovery by bait position show that out of the total bait used by bait position, horizontal lost 21% and recovered 76% (3% baits with catch). On the other hand, both vertical and upside down lost and recovered 10% and 89%, respectively.

The result of t-test indicates that horizontal lost baits excessively as compared to vertical and upside down types. The vertical and upside down positions have the tendency to retain baits.

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REFERENCES

ALI, M.A.
1956 The ocular structure, retinomotor and photobehavioral responses of juvenile Pacific salmon. Canadian Jour. Zool., (37): 965-996.

HIRAYAMA, N.
1969 Studies on the fishing mechanism of tuna longline III. The difference of catch by retrieving methods. Bull. Jap. Soc. Scient. Fish., 35(7): 629-634.

MAGNUSSON, J.
1963 Tuna behaviour and physiology, a review. In: Rosa, H., Jr. (Ed.) Proceedings of the World Scientific Meeting on the Biology of Tunas and Related Species. FAO Fish. Rep., 3(6): 1057-1066.

MURPHY, G.I. and R.S. SHOMURA
1953 Longline fishing for deep swimming tunas in the Central Pacific, 1950-1951. U.S. Fish Wildl. Serv. Sci. Rep. Fish., (98): 1-47.

NISKA, E.L.
1953 Construction detail of tuna longline gear used by Pacific Oceanic Fishery Investigations. Comm. Fish. Rev., 15 (6): 1-6.

SHAPIRO, S.
1950 The Japanese longline fishery for tunas. Comm. Fish. Rev., 12(4): 1-27.

SHIMADA, B.M.
1951 Japanese tuna-mothership operations in the Western Equitorial Pacific Ocean. Comm. Fish Rev., 13(6): 1-26.

SHOMURA, R.S.
1955 A comparative study of longline baits. U.S. Fish

Table 1. Summary of the total number of hooks and catch by bait positions.

Bait Positions \ No. of sets	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
Horizontal	40 (1)	50 (0)	100 (4)	50 (0)	100 (2)	110 (2)	115 (4)	100 (3)	105 (6)	110 (3)	50 (1)	100 (4)	100 (3)	90 (6)	50 (1)	50 (0)	100 (4)	100 (5)	1,500 (49)
Vertical	30 (0)	50 (0)	75 (2)	50 (2)	110 (2)	130 (2)	100 (1)	100 (2)	105 (0)	110 (0)	50 (0)	100 (3)	100 (2)	90 (2)	55 (0)	50 (0)	100 (3)	100 (3)	1,505 (24)
Upside-down	30 (0)	50 (0)	75 (1)	50 (0)	100 (1)	110 (2)	100 (1)	100 (1)	110 (1)	120 (1)	50 (0)	100 (2)	100 (1)	95 (1)	50 (0)	50 (1)	100 (0)	100 (2)	1,490 (15)
Total	100 (1)	150 (0)	250 (7)	150 (2)	310 (5)	350 (6)	315 (6)	300 (6)	320 (7)	340 (4)	150 (1)	300 (9)	300 (6)	275 (9)	155 (1)	150 (1)	300 (7)	300 (10)	4,515 (88)

( ) Number of fish

Table 2. Summary of the total number of fish caught, bait lost and recovered by bait positions.

Bait Positions	Total no. of hooks	Total no. of fish caught	Total no. of bait lost	Total no. of bait recovered
Horizontal	1,520	49 (3.2%)	319 (21.0%)	1,152 (75.8%)
Vertical	1,595	24 (1.6%)	149 (9.9%)	1,332 (88.5%)
Upside-down	1,490	15 (1.0%)	151 (10.1%)	1,324 (88.9%)
Total	4,515	88 (1.9%)	619 (13.7%)	3,808 (84.3%)

Table 3. T-test analyses of the total catch of each bait position.

Bait Positions	Horizontal	Vertical	Upside-down
Horizontal		2.50	3.90
Vertical			1.36
Upside-down			

$t_{0.05}$ — 1.684

Table 4. Number of catch by species of each bait position.

Bait Positions	Species caught	Number
Horizontal	Yellowfin	22
	Big-eyed	15
	Shark	7
	Others	5
Vertical	Yellowfin	7
	Big-eyed	5
	Shark	6
	Others	6
Upside-down	Yellowfin	5
	Big-eyed	4
	Shark	2
	Others	4

Table 5. T-test analyses of the total bait recovery of each bait position.

Bait Positions	Horizontal	Vertical	Upside-down
Horizontal		2.67	2.91
Vertical			0.27
Upside-down			

$t_{0.05}$ — 1.684

Table 6. T-test analyses of the total bait lost of each bait position.

Bait Positions	Horizontal	Vertical	Upside-down
Horizontal		4.53	4.84
Vertical			0.30
Upside-down			

$t_{0.05}$ — 1.684

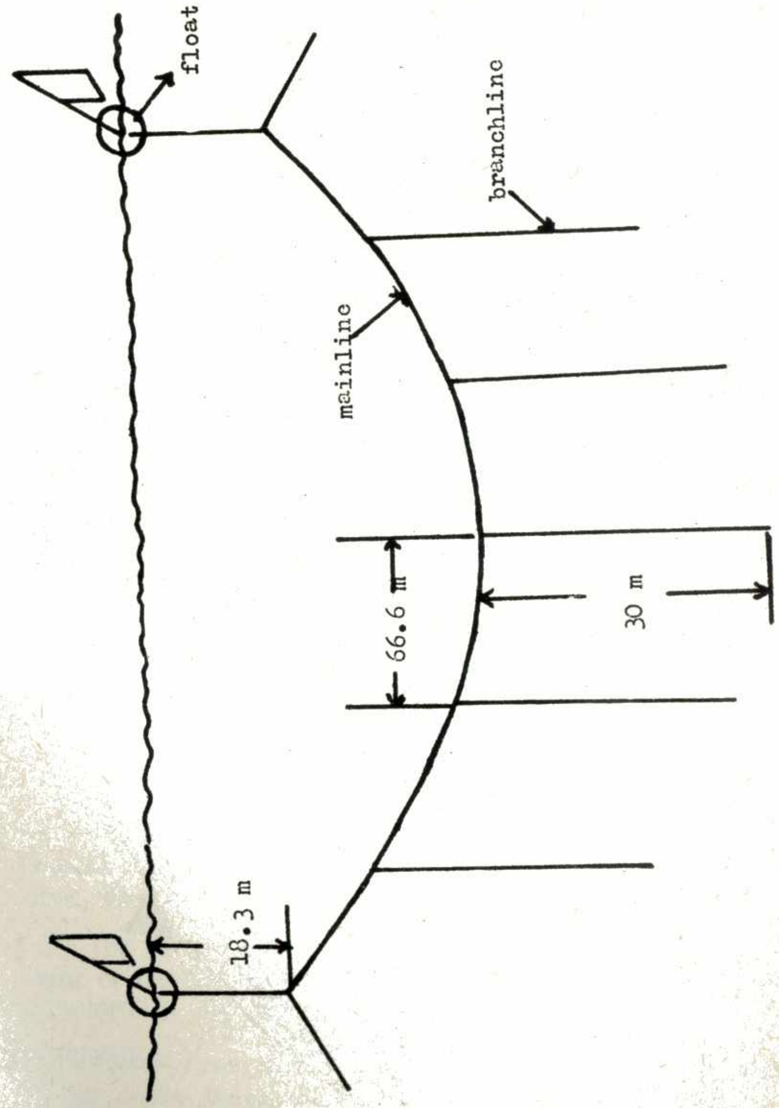

Fig. 1. Diagramatic view of a basket of BFAR tuna longline gear.

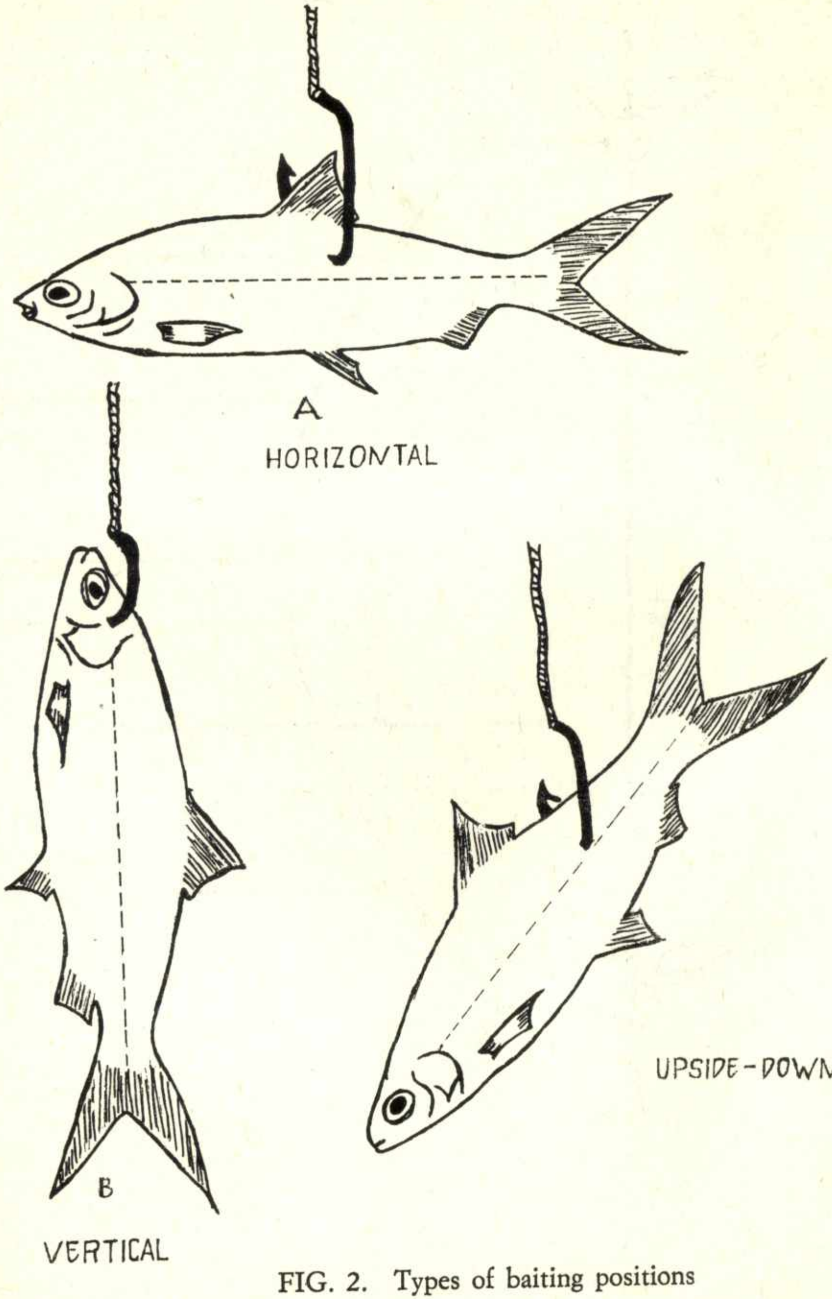

FIG. 2. Types of baiting positions