Vidyodaya J. Arts, Sci. Lett., Silver Jubilee pp. 73–84

PREDATORS OF FLYING FISH (HIRUNDICHTHYS COROMANDELENSIS) AND ITS SUITABILITY AS A BAIT FISH*

by

J. JINADASA

Abstract

The fishing season for the flying fish *Hirundichthys coromandelensis* in Sri Lanka extends from about middle of May to about beginning of August, which is their spawning season. During this season the concentrations of tuna, shark, dolphin fish and seer are the heaviest for the year in the Sri Lankan waters because these predators are extraordinarily attracted to those spawning flying fish. Therefore, flying fish could be satisfactorily used as a live bait in hand lining and trolling as well as a dead bait for trolling and long lining to catch its predators.

Introduction

A fishery for flying fish *Hirundichthys coromandelensis* is operated off the east coast of Sri Lanka and India from the middle of May upto the beginning of August each year (Jinadasa, 1971). The fish are caught by attracting them to lures made up of freshly uprooted *Theprosia purpuria* shrubs tied on to two wooden frames constructed in the form of a cross. The fishes are frenziedly attracted to these lures for spawning and are easily caught with scoop nets. During these months Sri Lanka catches each year about 400 tons of flying fish (Jinadasa, 1972) while India catches about 4,000 tons (Arora and Bennergy, 1957). There is a glut of this fish in the local Sri Lankan market during these months. But it is not particularly popular among Sri Lankans. The low demand results in low prices.

Tuna (*Thunnus albacares*), Seer (*Scomeromorus* spp), Dolphin fish (*Coryphaene hippurus*) and Sharks (*Carcharhinus* spp), which are very popular edible fish in Sri Lanka, seem to find flying fish a very attractive prey and, therefore, these predatory fish gather in numbers at the fishing grounds during the flying fish season. A natural predator-prey relationship of this sort could be successfully utilized to exploit fish with better consumer preferences. In addition, upto 1975 the bait required for Sri Lanka's tuna long line fishery was imported with the expenditure of a considerable amount of foreign

* Excerpted from the first Fisheries M. S. Thesis.

exchange. This foreign exchange could have been saved if a suitable substitute for the imported bait could be found locally. During the years 1968–1975 special trips were made by Sri Lanka Fisheries Corporations tuna boats to Penang to purchase the tuna bait. At present, partly due to high cost of imported bait, and management problems, tuna long liners are not operated by Fisheries Corporation of Sri Lanka. With suitable bait available locally, time and money could have been saved for use of these boats in tuna fishing with a resulting increase of catch and thus the valuable tuna long line fishery could have been saved.

The aim of this study was to assess the suitability of flying fish as bait for long lining, trolling and hand lining.

Material and Method

The present study was carried out from 1969 to 1972 and again from 1979 to 1980, altogether covering five fishing seasons. The species of the predators of flying fish (tuna, seer, sharks and dolphin fish) and their numbers caught daily by the flying fish fishermen around their lures on the one hand, and those caught daily by the troll fishermen operating in the vicinity of the former on the other hand, were recorded, as was also the total catch (in baskets) of flying fish. These catches were observed at the landing sites. The predators caught during the rest of the year by the troll fishermen only were recorded. The stomach contents of about 15% of all predators caught were examined in this study. The predators of flying fish are caught by the flying fish fishermen around their lures in the following manner : Each boat uses one, hundred meter monofilament nylon line to the end of which a freshly caught live flying fish is hooked mid–dorsally (the hook passing below the vertebral column) (Figure 1 A) and returned to the water. The catch is hauled in and line re-set. This continues throught the period each boat spends at the flying fish lure fishery. On each of the three fishery seasons during the 1969 to 1971 period I spent a whole day once a week in one of these flying fish fishing boats, keeping careful records of the number of operations and the number of species of predators caught and their respective numbers of fish.

The fishing of predators by the troll fishermen on the contrary is as follows : Each boat uses four, 50 to 75 meter monofilament nylon lines to the ends of each of which a decapitated flying fish is hooked at the middle (Figure 1 B) The lines are then thrown into the water and trolled, the catch is hauled in and the line re-set. Each operation is continued for about three hours per day. This operation continues before, during and after the flying fish fishery season. I have joined the troll fishermen during eight such operations and kept careful records of the number of species of predators caught by this

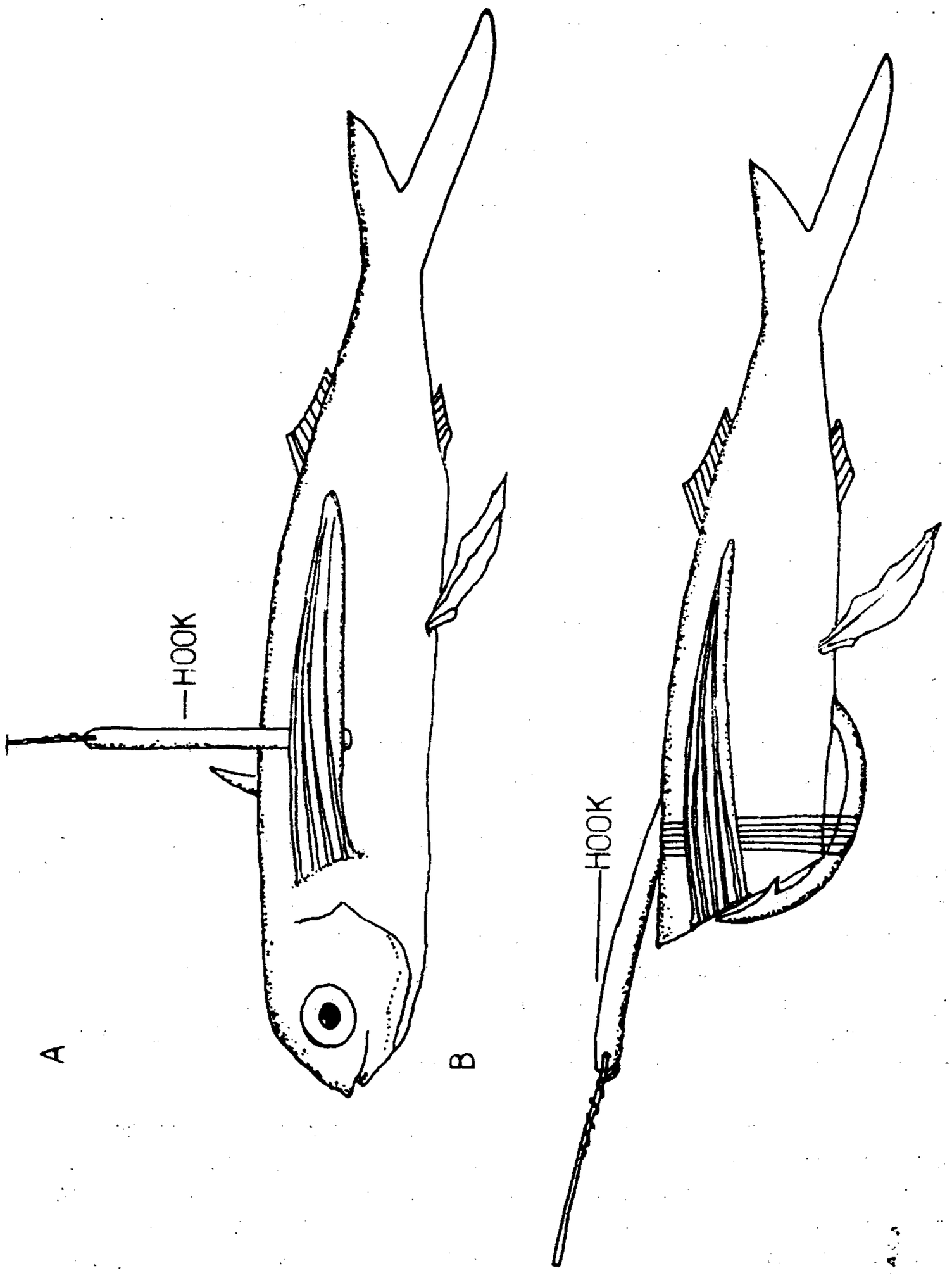

Figure 1. *A.* Live flying fish hooked mid—dorsally for hand lining.
B. Decapitated flying fish hooked for trolling.

method and the numbers of each species. In the fishing seasons of 1979 to 1980 when I did not go out to the sea with these troll fishermen I made arrangements to collect such data from them.

A tuna long liner of the Sri Lanka Fisheries Corporation normally used saury (*Colalabes saira*) as bait, but by arrangement operated four times in 1971 with a mixture of saury and flying fish as bait, and a privately owned smaller long liner (3–1/2 ton : 70 hooks) operated eight times, also in 1971 with a mixture of flying fish and chub mackeral (*Rastreliger kanagurta*) as bait. In both experiments flying fish and saury or chub mackeral were baited in alternate baskets. Single hook monofilament nylon lines were baited with dead flying fish. These were allowed to sink near the lure to a depth of abour 5 to 10 meters. The catch was hauled in and the line re-set.

Results and Discussion

The catch of both predators and flying fish per unit effort during the same time is given in (Figure 2) It shows that the flying fish catch is inversely proportional to the density of predators present in the fishing ground. This is because when the predators approach a lure the flying fish in and around it are frightened away and the whole spawning aggregate disappears. No flying fish are seen in that lure for some time. There may be one or more such incidents within a fishing day and this will result in a more or less poor catch of flying fish when the catch of predators goes up. It is obvious from this that flying fish are well favoured as food by these predators.

The catch per unit effort of flying fish by lure and predators by trolling is shown in (Figure 3). Which shows that the catch per unit effort of flying fish increased from about middle of May, reached a peak around early June, remained more or less constant until middle of July and declined around end of July. The catch per unit effort of predators followed an identical pattern but the period of increase, peak and decline were slightly delayed with respect to that of flying fish. This further proves that the density of the predators in the fishing ground is determined by the density of the prey.

The length frequency distribution of the predators that were caught are shown in (Figure 4). It shows that the predators caught belonged to a range of sizes. It would probably mean that these particular hooks with the flying fish bait may be too small and therefore insignificant for larger sized fish, or too large for smaller sized fish. The same species caught with other gear have also indicated an almost identical size indicating that fish outside the above range in sizes are not found in the fishing ground. The stomach contents of tuna, seer, shark and dolphin fish studied during and after the flying fish fishing season are presented in Table 1. It will be seen from this that

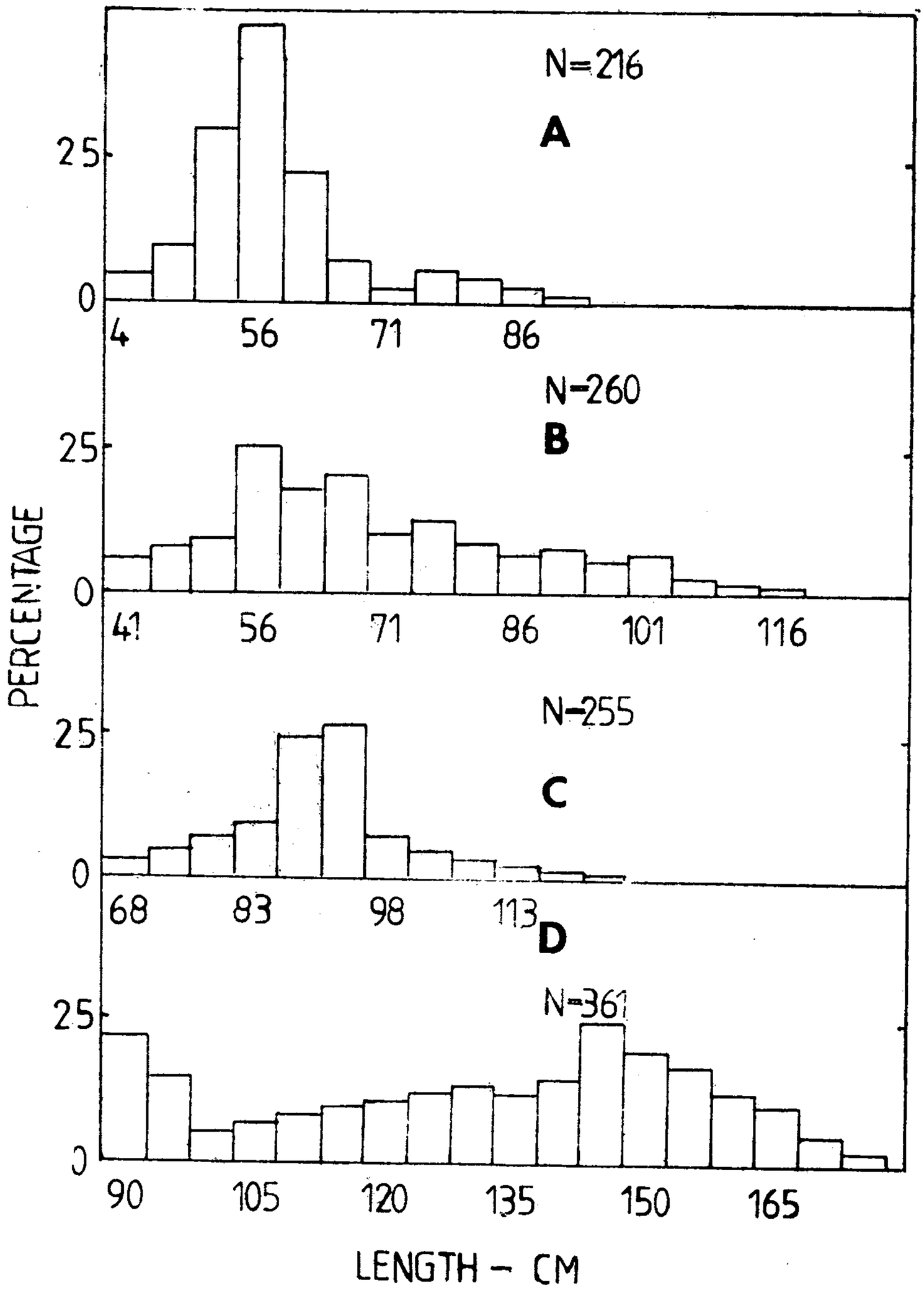

Figure 2. Negative correlation between the catch rate of prey, flying fish and catch rate of predators.

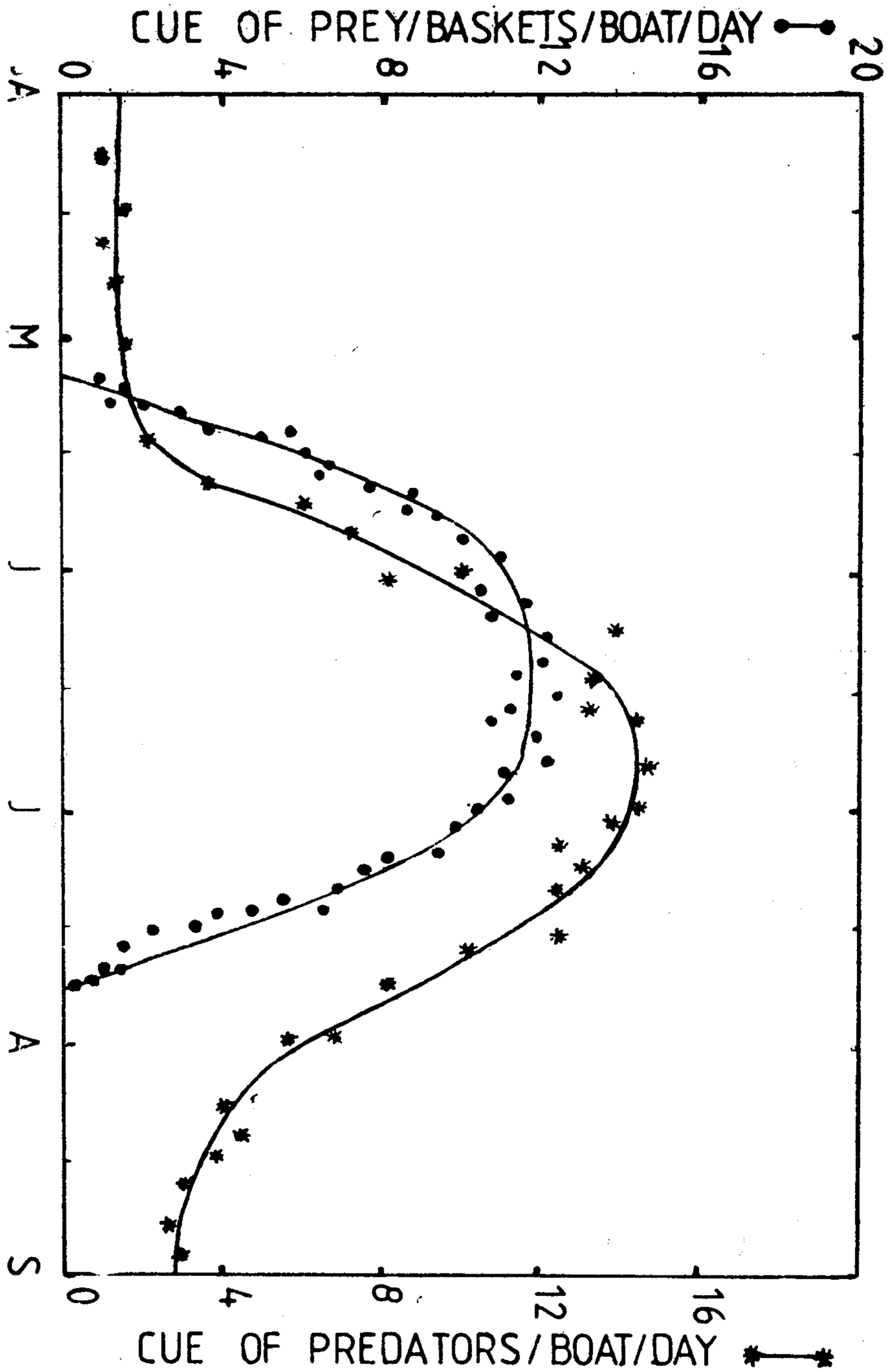

Figure 3. The catch rate of pradators and prey during the year

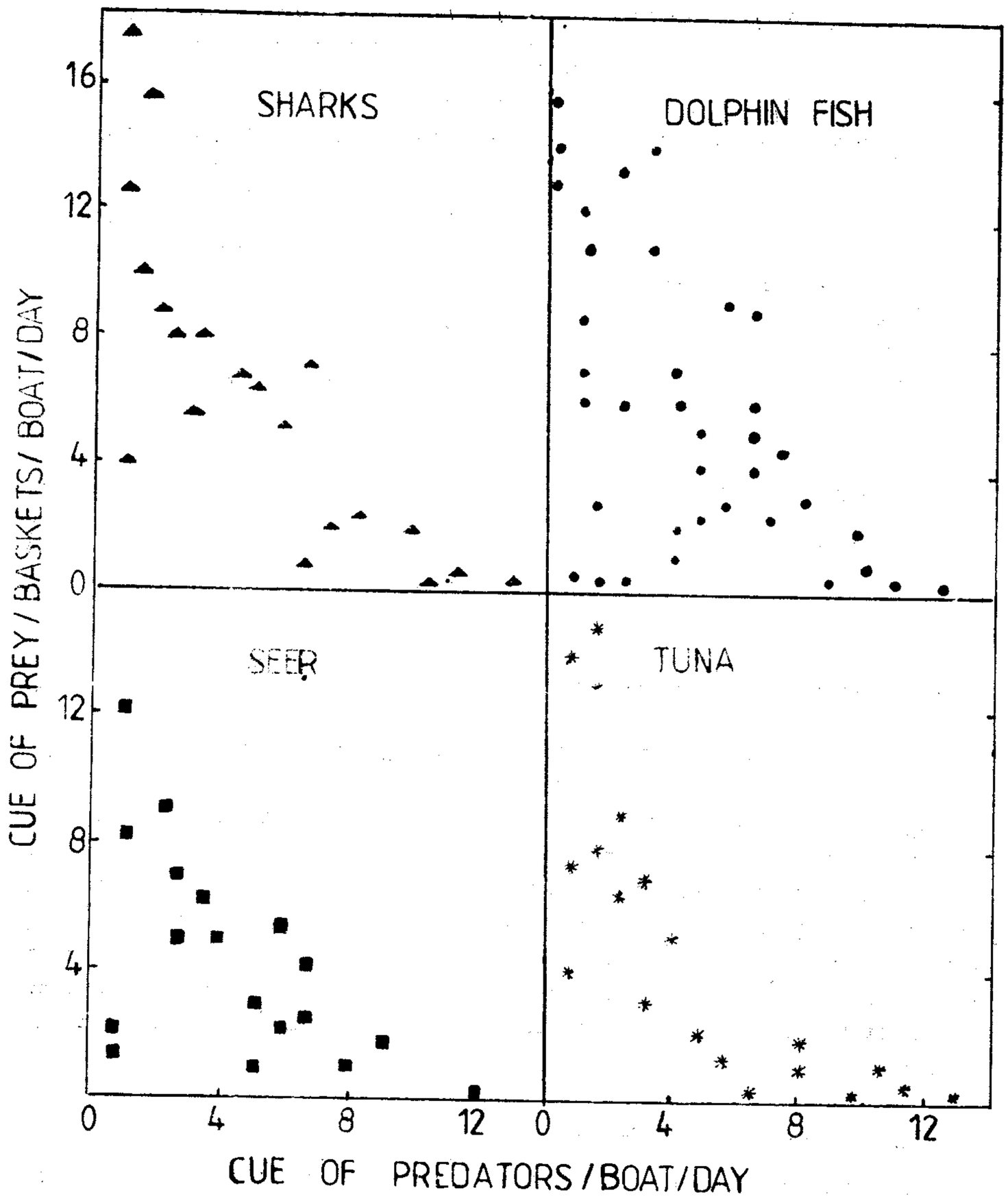

Figure 4. The length frequency distributions of predators caught.
A. Dolphin fish, B. Yellow fin tuna, C. Seer, D. Sharks.

TABLE 1

The distribution of the stomach contents (no of prey per stomach) of the predators of flying fish during and after the fishery season

Number of prey per stomach	PREDATORS			
	Yellow fin tuna	*Seer*	*Dolphin fish*	*Sharks*
N	31	47	64	227
During the flying fish fishery season				
Flying fish	6	5	8	11
Skipjack	00	00	00	1
Squids	2	3	2	6
Others	2	00	2	4
N	11	19	23	65
After the flying fish fishery season				
Fying fish	00	00	00	00
Chub mackeral	4	3	2	6
Skipjack	00	00	00	2
Squids	7	9	4	11
Mackeral tuna	2	1	2	5
Others	3	4	2	5

N, is the total number of predators examined.

more than 60% of the prey were flying fish during the fishing season, although, other species of fish like sardine, squid and mackeral are very common in the fishing ground. Eye estimation of the volume of the stomach contents seem to indicate more or less the same percentage of flying fish per predator. The stomach contents of the above predator species of fish noted after the spawning season of flying fish i.e. when the flying fish have disappeared from the fishing ground, is also shown in Table 1. It will be seen that squid and mackeral seem to be preferred to other species of fish during the latter period. All these results taken together clearly indicate a selective feeding on flying fish by predators.

Flying Fish as bait for hand line

The results of 11 hand line operations using dead flying fish as bait resulted in a catch of three dolphin fish and one shark. Other species were not caught by this gear near the lure. The hand line was operated near the flying fish lure. This could possibly mean that a single dead and motionless bait is not attractive enough for these predators when they have an aggregate of live prey around the nearby lure. However, the fact that dolphin fish and shark are attracted even to a single flying fish proves that these two species are especially attracted to flying fish.

Flying Fish as a live bait

The results of 19 line fishing operations using live flying fish as bait (Figure 1 A) are shown in Table 2. These results indicate that live flying fish could be utilised as a bait in hand lines to catch its predators. However, due to the difficulties encountered in keeping flying fish alive for more than four to five hours after capture, this method could be carried out only during the fishing season in waters close to the fishing ground. The results also indicate that dolphin fish are far more quickly attracted to and take the bait than any of the other predators. This could either be a reflection of their population density in the fishing ground or an indication that they specifically hunt for flying fish.

TABLE 2
The catch per unit effort of the predators using live Flying Fish as bait

Number of operations	Numbers caught per operation				Duration of the operation (Hours)
	Dolphin fish	Shark	Tuna	Mackeral	
6	—	2	—	—	2
4	—	—	4	—	4 1/2
2	—	—	—	2	3
7	5	—	—	1	2

Flying Fish as a trolling bait

The results of trolling conducted with flying fish as bait are presented in Table 3. An F test indicated a significant difference among the four means, ($F = 8.55, p. > 0.05$). A test was used to find the significant difference between pairs of means. A significant difference of mean catch rate between dolphin fish and all the other species of fish was observed (t value between dolphin fish, seer, shark and tuna are 4.87, 3.52 and 4.59, $p. > 0.05$), proving that of the four species of fish it attacks vigorously only flying fish and therefore, it could be caught most efficiently by trolling using flying fish as bait. These results also indicate that the flying fish is an acceptable bait for all the above species of fish, but especially so for dolphin fish.

TABLE 3
Cactch per unit effort of the predators in trolling

Operation number	Perdators caught per operation			
	Dolphin fish	Shark	Tuna	Seer
1	2	—	1	1
2	2	1	—	—
3	3	3	1	—
4	2	—	1	1
5	6	1	—	—
6	3	1	2	1
7	4	2	1	2
8	2	3	1	1
Mean per operation	3	1.37	0.875	0.75

Flying Fish as a long line bait

The results obtained for four long line operations using saury (*C. saira*) and flying fish (*H. coromandelensis*) in a tuna long liner of the Sri Lanka Fisheries Corporation and eight separate operations using mackeral (*R. kanagurta*) and flying fish in a privately owned fishing boat are shown in Table 4. The observed differences in hook rates were statistically tested using Normal Test :

$$Z = \frac{XY}{2NP\ (1\ P)}$$

Where Z = Normal distribution of coefficient.

X = Number hooked using flying fish as bait.

Y = Number hooked using saury as bait.

N = Total number of hooks used in the line.

P = Estimated probability of number hooked using any bait.

The results indicate that the hook rate of tuna although not statistically significant ($z = 1.64$, $p. = 0.05$) is only slightly higher with saury than either with flying fish or mackeral as bait and therefore, in view of the cost differential it could be used as a substitute for saury. In 1975 the cost of saury per fishing trip was Rs. 45,000.00 in foreign exchange for a fishing trip of about

TABLE 4

Number of Tuna caught by the long line using flying fish, saury and Chub mackeral as bait

Number of operations	*Bait used*	*No. of tuna caught*	*Total No. of hooks*	*Calculated t value*	*Table value of t*
1	flying fish	115			
	saury	92	4550	1.67+	1.96
1	flying fish	133			
	saury	148	6650	.9375+	
1	flying fish	91			
	saury	97	4550	0.4615+	
1	flying fish	144			
	saury	159	6650	0.9375+	
1	flying fish	3.5			
	chub Mackeral	2.8	70	0.3139+	

Statistically not significant at 5+ level.

20 fishing days as against Rs. 10,000.00 in local currency for flying fish. Furthermore, when the foreign exchange involved for the whole operation and the time lost in bait purchasing trips to Penang are both considered together, the slightly lower catch rate with flying fish as bait is more than compensated for. Considered as a whole, therefore, use of flying fish as a substitute bait would be profitable in the long run.

Up to 1975 the Sri Lanka Fisheries Corporation owned four tuna long liners and these have to be disposed of partly due to lack of a locally available bait The annual local flying fish production is about 400 metric tons or about 6.5×10^6 fish per year (Jinadasa, 1972). The bait required to operate four tuna long liners with about 2,000 hooks in each line and about 20 fishing operations per month with an operational target of about nine months a year is about 1.5×10^6 fish. Which is about one fourth the annual local flying fish production. Therefore, the local production of flying fish alone could have supplied the bait required for about 15 tuna long liners. The tuna fleet should not have been disposed of for the bait problem alone. Sivasubramanian (1970) too suggested that flying fish could satisfactorily be used as a substitute for saury. My experiments have now proved conclusively that flying fish could be certainly used almost as effectively as the imported bait, saury.

Acknowledgements

I am thankful to my research supervisor Dr K Sivasubramanian, FAO Consultant (then Research Officer, Fisheries Research Station, Colombo 3) for suggesting the problem and guiding and supervising my M.Sc research work of which this study formed a part. I am also thankful to Professor A. C. J. Weerekoon, then Head of the Department of Biological Sciences and Professor W. E. Ratnayake, the present Head of the Department of Zoology for encouragement and the correction of the manuscript for publication. Thanks are also extended to the fishermen of Back Bay, Trincomalee area for taking me in their fishing trips along with them and for helping me to operate fishing lines. The co-operation extended by the Sri Lanka Fisheries Corporation by conducting bait trials in their long liner according to my instructions is greatly appreciated.

This research was partly funded by then the National Science Council of Sri Lanka (now Natural Resources, Energy and Science Authority).

References

1. Arora, H. L. and S. K. Bennergy—1957 — Flying fish fishery along the Coromandel Coast. In Journ. Fish Vol. 4.

2. Jinadasa, J —1971 — Taxonomic Notes on a Collection of Flying Fishes from Ceylon Waters. Bull. Fish. Res. Stn. Vol. 22 Nos. 1 and 2.

3. Jinadasa, J. —1972 — Bionomics of the Flying Fish *Hirundichthys coromandelensisi* Hornell, M.Sc. Thesis, University of Sri Jayewardenepura.

4. Sivasubramanian, K.- -1970 — Developing Ceylon's Oceanic Tuna Long Line Fishery. (Manuscript report, Library, Fisheries Research Station, Colombo 3) (presently at NARA, Crow Island, Colombo 15).