J. Natn. Sci. Coun. Sri Lanka 1991 19 (2) : 107-114

FISHING GROUND FOR THE FLYING FISH *HIRUNDICHTHYS COROMANDELENSIS* (HORNELL) OFF THE EAST COAST OF SRI LANKA AND INDIA

J. JINADASA
Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.

(Date of receipt : 07 January 1991)
(Date of acceptance : 30 July 1991)

Abstract: The fishing season for the flying fish *Hirundichthys coromandelensis* (Hornell) off the east coasts of India and Sri Lanka is from mid May to mid Jyly, this fishery involves the spawning stock. The highest concentration of the fish is around the edge of the continental shelf. The size of the fish caught ranged from 18-25 cm. The fish are distributed continuously in waters off-Madras in India to off-Vakarai in Sri Lanka along the western border of Bay of Bengal. Presently this fishery is confined to two fishing areas along the eastern coast of India and Sri Lanka. However, this fishery could be developed to cover a larger area from Madras to Vakarai..

1. Introduction

A well established fishery for the flying fish *(Hirundichthys coromandelensis)* exsists off the east coast of India, extending from Madras to Point Calimer (Hornell, 1923, Arora and Banergi, 1956) and the east coast of Sri Lanka extending from Pulmoodai to Trincomalee (Jinadasa, 1971, 1972, 1982). In both countries the fishery is on the spawning stock and the fishing season extends from mid May to mid July. The spawners are attracted during day time to floating lures made out of fresh *Theprosia purpuria* shrub and are caught using scoop nets. Annually India exploits about 1800 MT (Arora and Banerji, 1956, Sivasubramanian, 1991) and Sri Lanka about 300 MT of fish from this fishery (Jinadasa, 1972). However, there is no fishery from Pulmoodai to Pt. Calimer i.e. in between the two fishing areas. Therefore, the purpose of the present study was to investigate and report as to why there is no fishery for flying fish in the above region and the boundaries of the fishing ground of this species in Sri Lankan waters.

2. Materials and Methods

About 60 fishing boats (31/2 ton, E. 26 type) operate daily from Trincomalee Back Bay. The boats leave port to fishing ground early morning between 4.00 a.m. and 6.00 a.m., and return to port with the flying fish catch between 1.00 p.m. and 7.00 p.m. Their place and mode of operation were monitored by joining one of the fishing boats weekly from 1969-1973 and monthly from 1979 to 1982. The catch is landed at about eight landing sites on the shore of the Back Bay which is less than 200 meters from the center of Trincomalee town. The catch in each boat is emptied into large cane baskets, which are carried by two people to sheds to process and pack in ice to dispatch to the rest of the Island. The number of baskets of fish in about 70% boats was counted at the time of unloading in order to estimate the total catch (TC) and the catch per unit effort (CPUE).

Each basket contained 500 fish (± 15) or about 32 kg (± 2). Based on the above, the catch per unit effort (CPUE) for this study was calculated as the number of kgs boat^{-1} day^{-1}.

A random sample of about 300 - 400 fish was then taken daily from about 15% of total number of boats operated from 1969 to 1973 during which period the author lived in Trincomalee. These fish were taken to the temporary Laboratory set up at No. 91, Church Street, Trincomalee. Their total lengths were measured to the nearest mm using a fish board. Weights were taken to the nearest gramme. Ovaries and stomachs were wrapped separately, in cheese cloth and preserved in 5% formalin solution. Such samples were taken only once a month from 1979 to 1982.

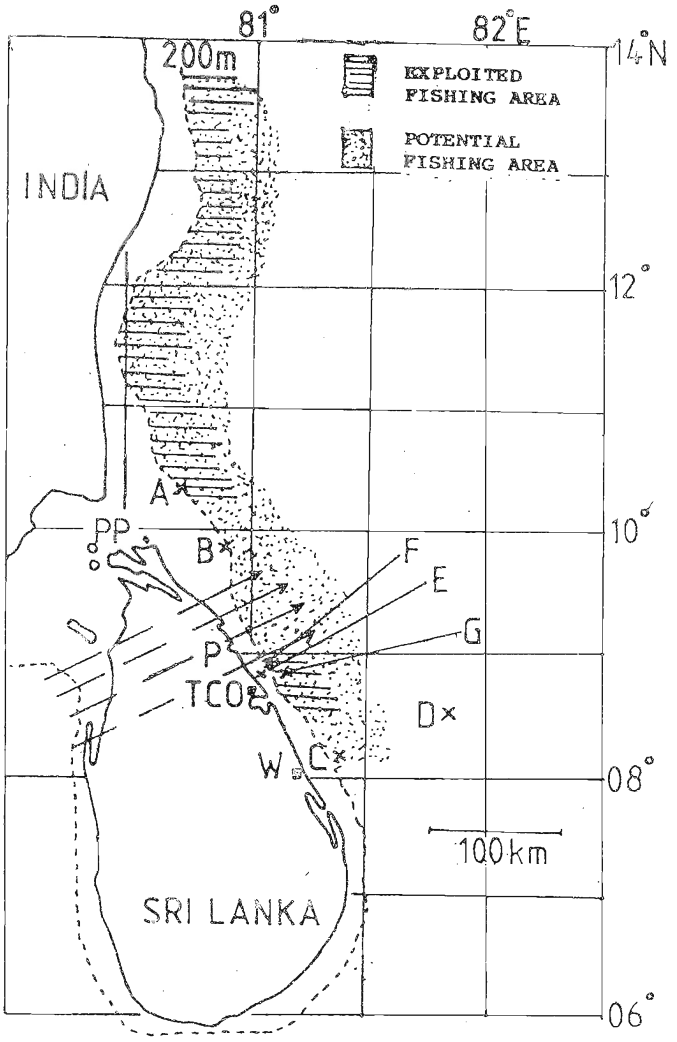

Figure 1: **Map of Sri Lanka showing the main landing site of (TCO - Trincomalee), A,B,C,D,E,F and G - exploratory fishing stations, P - Pulmoodai (a minor fish landing site), W - Vakarai (an experimental site south of Trincomalee), 200 m - edge of continental shelf, arrows show the direction of wind.**

Exploratory fishing was carried out at seven sites, namely at the edge of the continental shelf at E (8.4°N; 81.45°E) (Figure 1), about 3 km west of E at F (8.4°N and 81.5°E) where the depth was 180 mts, 3 km east of E at G (8.4°N and 81.50°E) where the depth was greater than 300 mts. Fourth site was about 150 km east of E at D (8.25°N and 82.4°E); fifth was about 50 km east of Vakarai at C (8.1°N and 81.9°E). The last two stations were located about 60 km east and north of Point Pedro at A (10.2°N and 81.4°E) and B (9.95°N and 81.45°E). Fish caught at these sites were identified, their total length and weights were measured. Exploratory fishing at A and B were conducted under the direction of Dr K. Sivasubramanian (FAO consultant).

The total catch and the duration of the fishing season from 1982 to 1986 were obtained from the records maintained by fish merchants namely, A.B. Somadasa, A.B. Mendis Silva, (north east), A.T. Sirisena (Uppuweli) and Alwis Silva.

3. Results

The observations indicated that the heavy commercial fishing off Trincomalee is carried out from about 10-15 km to about 20-30 km from the shore.

Fish caught using lures were sampled from 1969 to 1973 and 1979 to 1982 indicated the entire catch composed of only *H. coromandelensis.* However, gill nets operated for other species of fish such as *Amblygaster sirm, sardinella* sp. in the same area caught other species of flying fish namely *Cypselurus comatus, C. suttoni, C. atrisignis, C. spilopterus, C. katopteron, C. oligolepis* and *C. opisthopus* in small quantities in the region. These species are occasionally caught in the gill nets that are operated at night in the same area (Table 1). Therefore, their contribution to the fishery is very small and they have never been caught in the lures along with *H. coromandelensis.*

Table 1: Weight (kg) of species of flying fish other than *Hirundichthys coromandelensis* caught by gill-nets in the fishing ground

Species	Year						
	1969	1970	1971	1972	1973	1974	1982
Cypselurus spilopterus	140	186	159	160	143	135	172
C. suttoni	x	x	x	x	x	x	08
C. atrisignis	30	14	18	26	13	18	31
C. katopteus	x	x	x	x	x	x	x
C. comatus naresii	11	17	13	23	31	19	28
C. oligolepis	x	x	x	x	x	x	x
C. opisthopus	x	x	x	x	x	x	04

x indicates very small numbers (10)

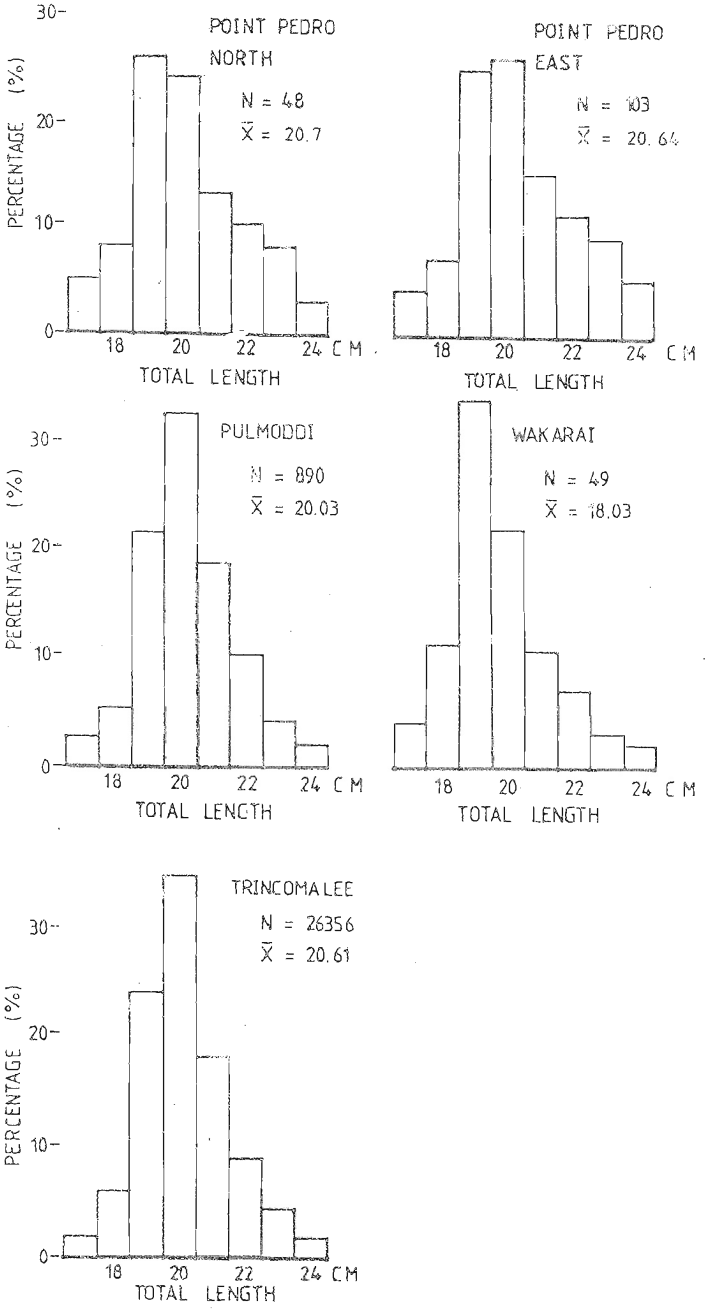

Figure 2: Length - frequency distribution of flying fish *Hirundichthys coromandelensis* caught off the east coast of Sri Lanka.

The size of *H. coromandelensis* caught ranged from about 18 to 25 cm and it was almost the same from 1969 to 1986, where the men length varied only from 20.45 cm (S.D. 2.101) to 21.20 (S.D. 2.135) and the mode remained between 20 and 21.

The exploratory fishing conducted at sites A, B, C and D also recorded only *H. coromandelensis* and its size was similar to that of the catch at the main landing sites (Figure 2). The catch per unit effort (CPUE) was highest at the edge of the continental shelf and declined to the east and west of it (Table 2). The exploratory fishing carried out at the edge of the continental shelf at sites A, B and C of the Sri Lankan fishing ground showed a mean (CPUE) of 2.7, 1.8 and 1.1 kg/hr^{-1} respectively. Experimental fishing at the edge of the continental shelf at E also gave the highest catch (Table 3). The seaweeds collected along the edge of the continental shelf on examination showed large numbers of eggs of *H. coromandelensis* deposited on them. Floating seaweed fibres and other debris in the above region and its vicinity also had heavy deposition of eggs of this species.

Table 2: The number of flying fish *H. coromandelensis* caught per hour during exploratory fishing

Station	No. of operations	No. of fish caught/hour	Mean weight hr^{-1} (kg)
North of Point Pedro	2	43	2.7
East of Point Pedro	2	28	1.8
South of Trincomalee (Vakarai)	2	17	1.1

Table 3: The weight of fish caught on and around the continental shelf during exploratory fishing

Station	No. of operations	kg/boat^{-1}/day^{-1}
Three km west of the continental shelf	4	63
Three km east of the continental shelf	4	208
On the continentalshelf	11	296

4. Discussion

The lures made out of fresh shrubs have attracted only *H. coromandelensis* because in order to facilitate spawning they seem to require objects to creep through. This has been demostrated previously by Jinadasa (1972) who observed that spawning females lay eggs on lures as much as 5-7kg/day^{-1} and while doing so they also creep in large

numbers into the lures. He had found as much as 324 fish day^{-1} trapped inside the lures, of which 80% were females. Further, eggs have also been found deposited on seaweeds. Therefore, this fish seemed to require vegetation to spawn. Synthetic fibres have been proved to be unattractive (Jinadasa, 1972). As a result of the above behavior, only spawning *H. coromandelensis* could be attracted to lures made out of fresh shrubs.

The size of the fish caught from 1969 to 1972 had clearly shown uni-modal length frequency distribution (Jinadasa, 1972). Subsequent studies up to 1986 also showed similar results. Arora and Banerji, (1956) also had obtained similar results for the fishes caught along the east coast of India. The exploratory fishing carried out in between the two fishing grounds also showed similar results (Figure 2). According to available information, the fishing seasons of both countries are the same within the last 70 years (Hornell, 1923; Arora and Banerji, 1956). Further, same species during the same season from off Point Pedro to the Vakarai has been caught by the author, indicating that the same stock extends all along the western border of Bay of Bengal.

The age determination of the spawning population sampled from 1969 to 1972 (Jinadasa, 1972) showed that the fish belonged to a single year-class and that they are all two-year old fish. Based on growth parameters, he had further shown that there were no survivors from the population of previous year. These findings confirm that each year a fresh stock of spawning fish approach the east coast of India and Sri Lanka.

The highest catch per unit effort was realised at the edge of the continental shelf because the density of fish there is higher than that of the east and the west of it. This is probably due to the fact that mature fish migrate from the oceanic waters towards coastal waters in search of a suitable substrate for spawning, during which process fish encounter seaweeds first at the edge of the continental shelf. Therefore, they aggregate there more than to the east or the west of it. As a result the catch per unit effort was highest there.

The exploratory fishing conducted at sites A, B, C and D also showed catches that could sustain a commercial fishery. However, the catch per unit effort was much less at C (off Vakarai) F and G (off Point Pedro) because the exploratory fishing was carried out by the author himself, with the help of the tamil fishermen, where as at the other places it was done by fishermen indicating that the efficiency of the fishermen also contributed to the higher catch rate. However, the total catch within the day was higher than the minimum for the season off Trincomalee. Therefore, at F and G too there is sufficient fish stock for a sustainable fishery. These findings indicate that the fishing ground is continuous from off the coast of Madras in India to Vakarai in Sri Lanka. But the continental shelf north of Pulmoodai and south of Trincomalee widens, therefore, its edge exceeds 45 km from the shore, which is too far for fishermen in small fishing crafts to reach, catch fish and return to port on the same day.

Exploratory fishing at sites A, B and C involved 36 hrs of sailing, ordinary fishing vessels which have facilities to stay out at sea for not more than 24 hrs are unable to

reach the fishing area. As a result there is no fishery north of Pulmoodai upto Point Calimer and south of Trincomalee upto Vakarai. On the oceanic side, the fish are distributed as far out as 150 km from the shore. Although the density is much less, perhaps due to shoreward migration for spawning, it is sufficient for a moderate fishery. From the work carried out in India (Hornell, 1923; Arora and Banerji, 1956) and the experimental and exploratory fishing carried out at the above stations by the author, it is evident that the fishing ground of the flying fish extends from off-Madras to Vakarai from about 3 km to about 150 km from the shore.

Boundaries of fishing grounds have been clearly identified using longitudes and latitudes. Further, their boundaries and area have also been estimated in order to calculate the total fish production per unit area (Malpas, 1926; Sivalingam and Mudcof, 1957; Munasinghe, 1969; Sivalingam, 1966; Mendis, 1965 a,b), size of shoal and area of distribution (Sivasubramanian, 1971).

Their conclusions were based on one or two observations. Further, stock assessments, demarcation of international fishing grounds such as Georges Bank and Portuguese fishing grounds in the north Atlantic ocean have been concluded using one or two observations (Honk, 1961). In Sri Lanka, Joseph (1977) has identified bait fishing grounds off Mabole and Udappuwa by carrying out one set of experiments. Further, in most cases, scientists have carried out the exploratory fishing. Therefore, off Point Pedro the author himself carried out the exploratory fishing with the help of professional tamil fishermen and the number of experiments had to be limited to two per station. Therefore, the results obtained are sufficient to indicate that the fishing ground is continuous from Madras to Vakarai. No further exploratory fishing operations can be carried out at the sites A, B or C now, or within the next 100 years from now due to ethnic problems. It has been highlighted (Jinadasa, in press) that the fisheries research in the northern and the eastern waters have been neglected except for the work done by Sivasubramanian (1966, 1969). The present information contributes further towards this observation.

5. Conclusions

The lures made out of fresh shrubs attract only 18-25 cm *H. coromandelensis*. They are concentrated at the edge of the continental shelf from off-Madras to Vakarai. All along the western border of Bay of Bengal is one fishing ground. The Sri Lankan fishing ground extends from off Vakarai to off Point Pedro. Between north of Pulmoodai and south of Trincomalee the fishing ground is about 45 km and around Trincomalee it is about 7-9 km from the shore.

References

1. ARORA, H.L. & BANERJI, S.K. (1956) Flying Fish Fishery Along the Coromandel Coast. *Indian Journal of Fisheries.* 4, 55-117

2. HONK, R. (1961) The Portuguese Fishing Industry. Atlantic Ocean Fisheries. Edited by G. Borgstrown D.Sc. and A.J. Heighway. *Fishing News Book Ltd.* England 165-191p.

3. HORNELL, J. (1923) The Flying Fish Fishery off the Coromandel Coast and the Spawning Habits of *Cypselurus*. *Madras Fish. Bull.* No. 15, 123p.

4. JINADASA, J. (1985) Predators of Flying Fish *(H. coromandalensis)* and its Suitability as a Tuna Long Line Bait Fish. *Vidyodaya Journal of Arts, Science and Letters.* Jubilee Issue. 73-84.

5. JINADASA, J. (1985) A Study of Some Oceanographic Factors off Trincomalee in Relation to Flying Fish Fishery. *Vidyodaya Journal of Arts, Science and Letters.* 9, (1&2) 15-28.

6. JINADASA, J. (1972) The Bionomics of the Flying Fish *Hirundichthys coromandelensis* Hornell. M.Sc. Thesis, 150p. University of Sri Jayewardenepura Library.

7. JINADASA, J. (1971) Taxonomic Notes on a Collection of Flying Fishes Caught in Ceylon Waters. *Bull. Fish. Res. Stn. Sri Lanka.* 22, (1 & 2) 1-16.

8. JOSEPH, B.D.L. (1977) Red Bait (Diptery Gonatus Leucogramicus Blecker) Resources in the Western Coastal Water (7-8 N) of Sri Lanka. *Bull. Fish. Res. Stn.* 27, (1 & 2) 1-9.

9. MALPAS, A.H. (1926) The Marine Biological Survey of the Littoral Waters. Ceylon Journal of Science (C) 2, 13-165.

10. MENDIS, A.S. (1968) Stern Trawling on the Wadge Bank with 235 ton. Trawlers. Proceedings : B session IPFC/C68/Sym 34.

11. MENDIS, A.S. (1965)a The Trawler Fishery. *Bull. Fish. Res. Stn. Sri Lanka* 17, (2) 268-274.

12 MENDIS, A.S. (1965)b Resources of Sri Lanka Pedro and Wadge Bank. *Bull. Fish. Res. Stn. Sri Lanka* 18, (2) 47-51.

13. MUNASINGHE, N.L.R. (1969) Seasonal Variation in the Distribution and Availability of Carangids ("Paraw and Parati") in the Wadge Bank. *Bull. Fish. Res. Stn. Sri Lanka.* 20, 191-200.

14. SIVALINGAM, S. (1966) Wadge Bank Trawler Fishery Studies. *Bull. Fish. Res. Stn. Sri Lanaka.* 19, (1-2) 41-59.

15. SIVALINGAM, S. & MEDCOF, J.C. (1957) General Features and Productivity of the Wadge Bank Trawler Fishery. *Bull. Fish. Res. Stn. Ceylon.* 6, 1-23.

16. SIVASUBRAMANIAN, K. (1991) Capture of Flying Fish. Bay of Bengal News 41, 1-20.

17. SIVASUBRAMANIAN, K. (1969) Occurence of Oriental Bonito *(S. orientalis)* in the Inshore Waters of Ceylon. *Bull. Fish. Res. Stn.* 20, 73-79.

18. SIVASUBRAMANIAN, K. (1966) Distribution and Length Weight Relationships of Tuna and Tuna Like Fishes Around Sri Lanka. *Bull. Fish. Res. Stn.* 19, 27-47.