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SOME STUDIES ON THE TRAWL FISHERY IN THE PORTUGAL BAY ON THE NORTH WESTERN COASTAL WATERS OF SRI LANKA

P. A. A. T. Jayawardane and P. Dayaratne
Marine Biological Resources Division
National Aquatic Resources Research and Development Agency
Crow Island, Mattakkuliya
Colombo 15, Sri Lanka

ABSTRACT

The present study was carried out from May 1991 to April 1993 to evaluate the trawl fishery in the Portugal Bay area of the northwestern coastal waters of Sri Lanka. The main craft types engaged in the trawl fishery are 11 t crafts and 3.5 t wooden boats. There were 17, 11 t trawlers and around 35, 3.5 t wooden boats. The estimated average catch rates for 3.5 t and 11 t crafts for the study period were 22.7 kg/haul and 73.4 kg/haul respectively.

The target species of the trawl fishery by both craft types is prawns. Prawns alone contribute 10% and the 32% of the total catch of 11 t and 3.5 t crafts that operate in the Portugal Bay area. However, the by-catch also contributes to the economy of these operations. The major finfish varieties caught are the fish belonging to the families Leiognathidae, Ariidae and Rajidae. Among these, Leiognathids seem to constitute a major portion contributing around 34% of the by-catch. Leiognathus brevirostris constitutes about 44% of the catch of the ponyfish.

The estimated annual yield from the trawl fishery obtained for the periods 1991-1992 and 1992-1993 were 662 MT and 474 MT respectively. Seasonality in the trawl fishery was observed with a peak period from September to March of each year. The environmental factors such as rainfall and phase of the moon have not affected the catch rates significantly.

INTRODUCTION

Origin of coastal trawling in Sri Lanka dates back to about hundred years. Initially nets used by local fishermen were simple square or triangular shaped bags (Lensu dela, Kathumaram dela) which were made up of natural fibres of local origin (Cotton, Hemp etc.) and traditional crafts for operations (Weerasooriya, 1977).

In Sri Lanka most of the continental shelf area has rocky bottoms and therefore trawling is limited to small scale prawn trawling on smooth muddy areas of continental shelf especially near the estuarine and coastal waters where influxing rivers bring more nutrients during the rainy seasons (Jayawardane and Dayaratne, 1992). However, according to De Bruin (1970), trawling in the estuarine waters of Sri Lanka is impracticable due to the presence of submerged logs and stakes.

Prawn trawling has been carried out over the last few decades in the Portugal Bay area, and in 1984, 15 trawlers were reported operating in this fishing ground (Jayawickrema, pers. com.). Since then number of crafts has been considerably increased mainly because of restriction of trawling in the northern and the eastern areas due to the civil disturbances. Although the trawler fishermen in the Portugal Bay area target high valued prawns, due to high economic value, a high percentage of finfish are also caught as a by-catch which mainly consists of Silverbellies (Jayawardane and Dayaratne, 1992).

With the increase in number of trawlers and also with the movement of the trawlers towards the estuary proper, there had been several conflicts between the trawler fishermen and the traditional prawn fishermen. The National Aquatic Resources Agency has conducted a short survey to investigate these conflicts in 1989 (Jayawickrema, pers. com.). However, the lack of detailed information on the commercial fishery and limited knowledge on this resource in the past have restricted the formulation of recommendations which would have been useful for the management of the resource. Therefore, present investigation was undertaken to study the trawl fishery in the Portugal Bay area with the view of formulation of recommendations for management.

This report presents the results of a detailed study of the trawler fishery, which is based on a survey carried out at the major fish-landing centre in the Kalpitiya Town, during the period May 1991 to April 1993. The monthly variation in the fishing effort, catch rates, catch variability with the environmental parameters, total catch and it's species composition were studied. The description of the type of the fishing craft, gear and area is also included.

MATERIALS AND METHODS

i. Collection of data

The trawler fishery in the Portugal Bay area was monitored during the period May 1991 to April 1993 at the major fish landing centre in the Kalpitiya Town (Figure 1). Sampling was carried out fortnightly and on each sampling day more than 20% of the trawlers operated were sampled randomly. The information such as specifications of the crafts and gear, horse power of the engines, total catch and species composition were recorded. The total number of trawlers operated on each sampling day and the number of hauls per trip of the sampled boat were also recorded in order to calculate the total effort and production for the particular month. The number of fishing days for each month was noted for each craft type separately.

The species composition of the catches was analyzed for each month separately to study the variation pattern. The values were tabulated as percentage of the total catch. Only the finfish species that contribute significantly by weight and the prawns which were of economic importance were selected for this analysis. All other finfish were grouped together.

ii. Aanalysis of data

A. Catch per unit effort (CPUE) and total production of the fishery

For the 11 t trawlers, number of trips per month varied where as 3.5 t wooden boats carried out fixed number trips per month throughout the year. The number of hauls per boat per trip also varied with the month and with the craft type. Therefore, catch in kg per haul was taken as the unit measure of the catch rate.

Total production for each month was estimated using the following formula.

Total production for the month = Average catch per haul (CPUE) x Average number of hauls per trip x Average number of trawlers operated per day x Average number of fishing trips for that month

B. Variability of the catch with the environmental parameters

The correlation between catch and lunar phase and catch and rainfall were analyzed using the Kruskal-Wallis test with tied ranks (Zar, 1984).

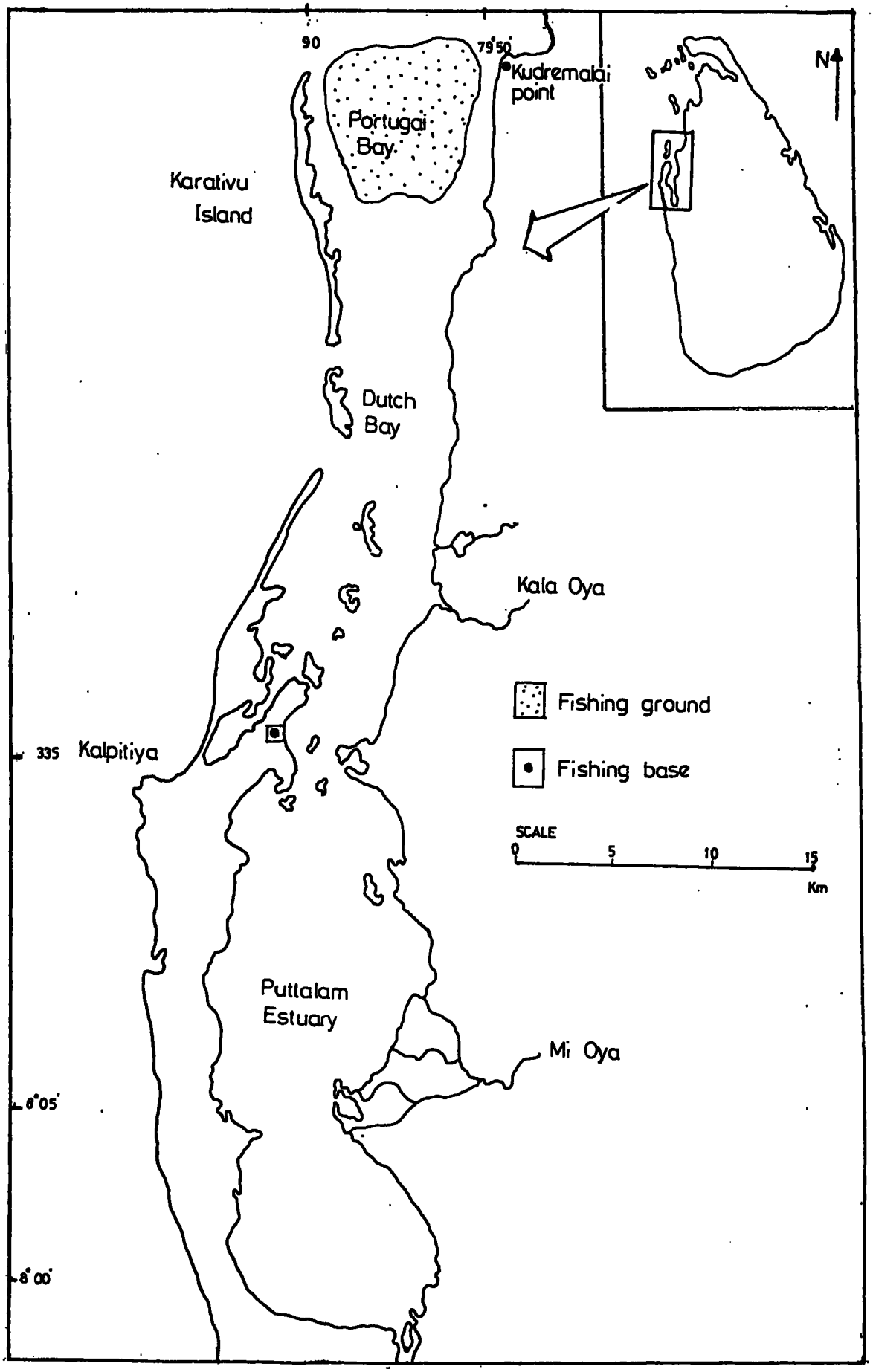

Figure 1. Geographic location of the base and the fishing ground off Kalpitiya

RESULTS

- ***Crafts and gear***

In the Portugal Bay area of the Puttalam Estuary, trawling is carried out by 11 t trawlers and 3.5 t wooden boats. There were 17, 11 t trawlers and around 35, 3.5 t wooden boats. Specifications of the crafts and the trawl nets used are given in the Table1 and 2.

The two types of crafts seem to use two different size trawl nets although the mesh size of the nets are the same in the wing, belly as well as the cod end. The 11 t trawlers use larger nets compared to those used by 3.5 t wooden boats.

For 11 t trawlers number of trips per month varied from 8 to 12 whereas for 3.5 t wooden boats it was 12 trips per month throughout the year. The number of hauls per boat per trip also varied monthly and with the craft type.

Average duration of a haul was almost 4.3 hours, for both craft types with an average trawling speed of 3.4 Knots/hour.

- ***Monthly variation in the effort***

Figure 2 shows the monthly variation in the effort of the trawler fishery. During the present study the variation pattern of fishing effort seems to follow almost similar trend for both craft types. In the 1991-1992 period, peak effort was recorded in August 1991, while in the 1992-1993 period peak effort was observed in September 1992. Generally the fishing effort seems to be declining from September to March/April. From May/June onwards, the effort shows an increasing trend until August/September.

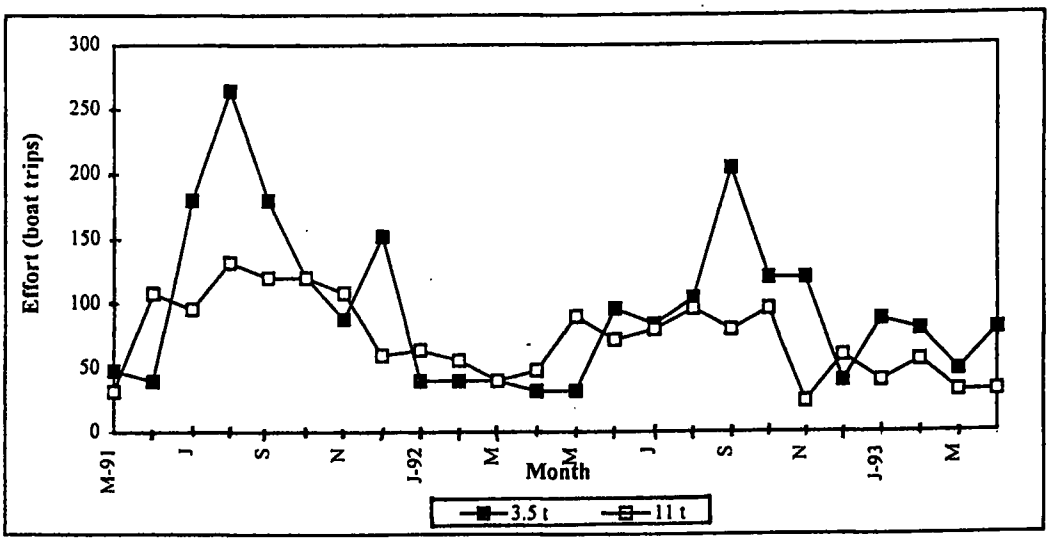

Figure 2. Monthly variation in the effort of the trawl fishery

- ***Seasonal variation in the catch per unit effort***

Seasonal variation in the catch per unit effort of the trawler fishery and the rainfall in the Puttalam area is shown in Figure 3. The variation pattern of CPUE seems to follow a similar trend for both craft types during May 1991-April 1992. However, a considerable difference in the CPUE values were observed between the craft types with large 11 t crafts generally having high catch rates during this period. There is a trend for the CPUE values of the 11 t trawlers to increase during the periods, September 1991 to March 1992

and August 1992 to February 1993, whereas catch rates of the 3.5 t wooden boats show almost 3 peaks during the present study (June to November 1991, April to August 1992 and September to December 1992). During the present study the average catch rates recorded for 3.5 t crafts and 11 t crafts for the period 1991-1992 were 23.92 kg/haul and 74.58 kg/haul respectively which were comparatively higher than that for the period 1992-1993 which were 21.5 kg/haul and 72.25 kg/haul for 3.5 t and 11 t crafts respectively.

From October to December of each year the coastal areas around Puttalam where this study was carried out, received a high rainfall due to northeast monsoons. However, the results of the Kruskal-Wallis test with tied ranks (Zar, 1984) performed for the values of CPUE of both craft types at different rainfall levels indicate that there is no significant difference between the mean values of CPUE at different rainfall levels ($P>0.05$). The summary of this test is given in Table 3.

Similarly the results of the Kruskal-wallis test with tied ranks (Zar,1984) performed on the mean CPUE values of both craft types at different phases of the moon does not indicate significant difference ($P>0.05$). A summary of this test is given in Table 4.

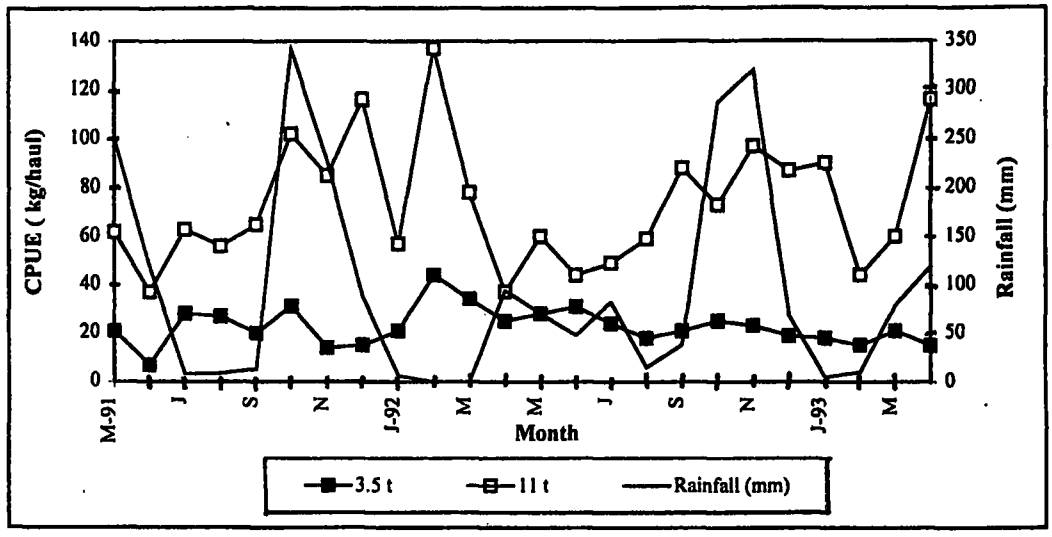

Figure 3. Seasonal variation in the catch rate and the rainfall in Puttalum

- ***Monthly variation in the total production***

Figure 4 shows the monthly variation pattern of the total production for each craft type. During the study period highest monthly production was observed in October 1991 (97.92 MT) for 11 t crafts and August, 1991 (42.77 MT) for 3.5 t crafts. The estimated annual yield from the trawler fishery obtained for the period 1991-1992 was 662 MT, which was comparatively higher than the estimated annual yield for the period 1992-1993, which was 474 MT. The variation pattern of total production seems to follow a similar trend for both craft types. Generally the period from July to February could be considered as the peak period for the fishery.

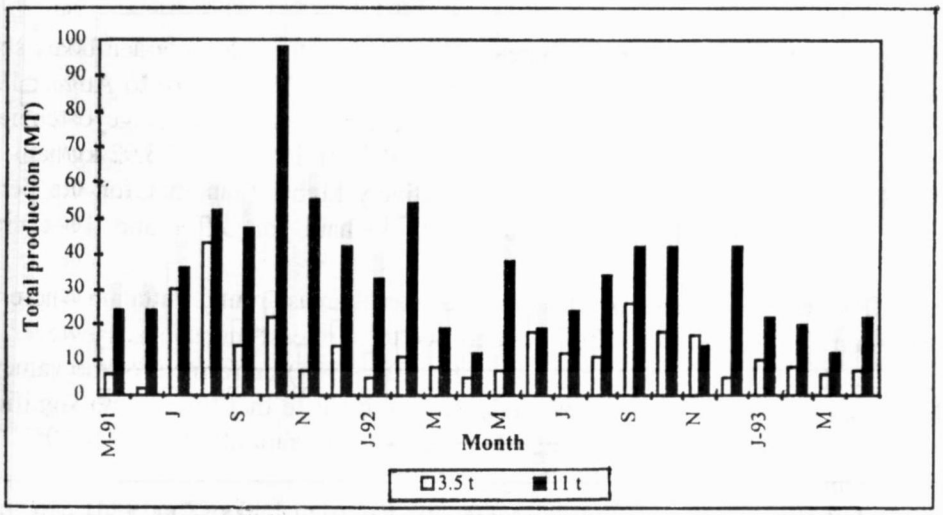

Figure 4. Monthly variation in the total production of the trawl fishery

- ***Monthly variation in the species composition of the catch***

A total of 53 fish species belonging to 26 different families were identified among the catches. Out of these, five groups viz. Prawns, Ponyfish, Catfish, Skates and Crabs were considered as important depending on their production by weight and the economic importance. In the study area trawling is primarily carried out to target prawns which fetch a high economic returns to the fishermen.

However, as seen in Figures 5 and 6 a considerable amount of by-catch which consists of a large number of finfishes were also caught. Among these, ponyfishes seem to constitute a major portion of the by-catch. It was also revealed during the present investigation that the contribution of ponyfishes to the trawler by-catch was around 34%. Out of this the *Leiognathus brevirostris* seems to constitute almost 44% of the catch of ponyfish. The contribution by other species seems to vary from month to month. On an average the by-catch of the trawler fishery (Ponyfish, Catfish, Skates, Crabs and others) in the Portugal Bay area constitute about 68% of the production in 3.5 t class boats and 90% of the total production in 11 t class boats.

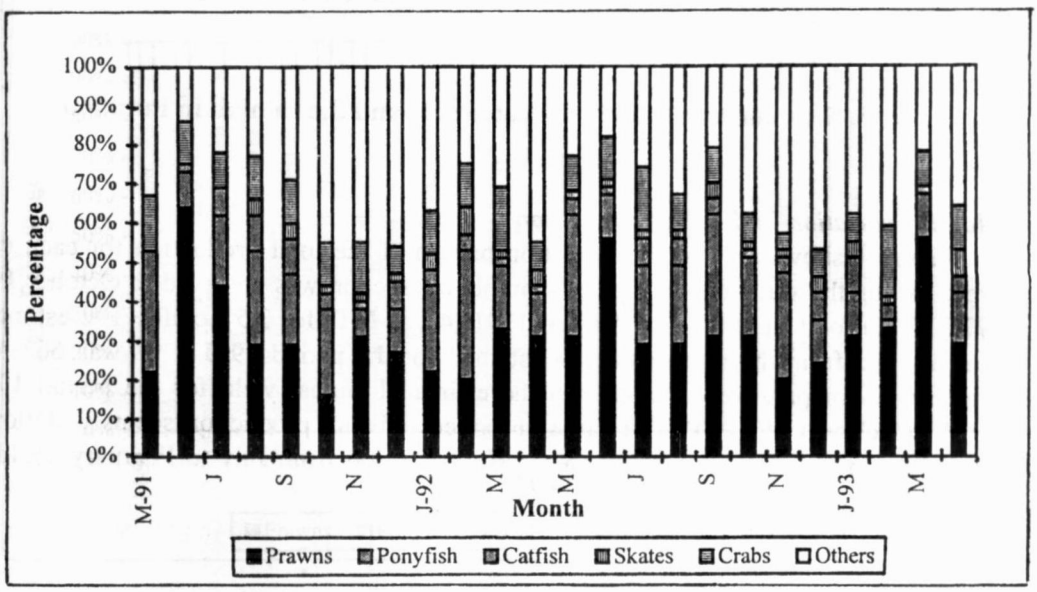

Figure 5. Monthly variation in the species composition of the catches of 3.5 trawlers

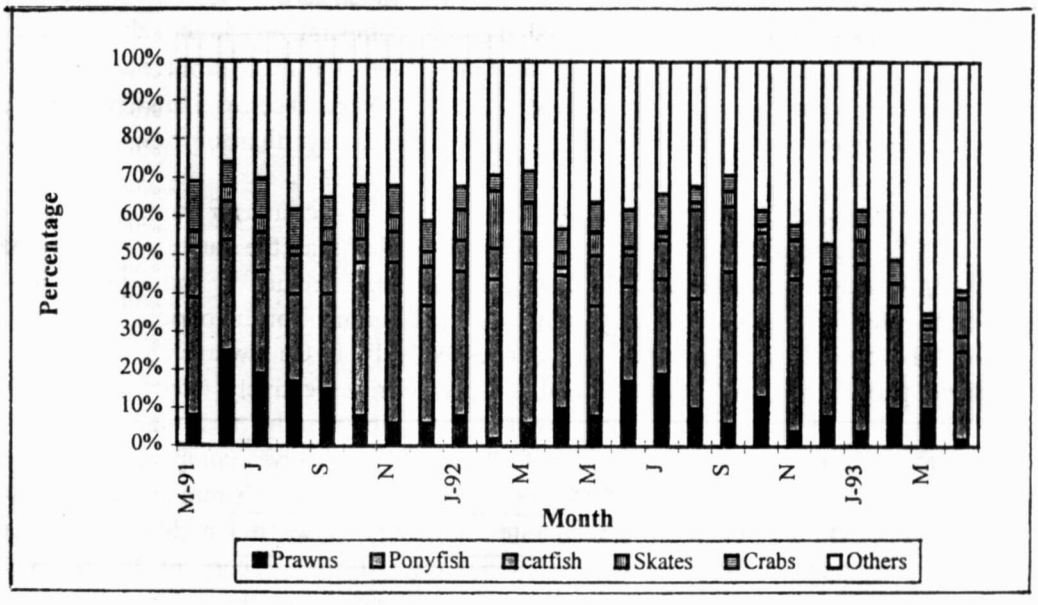

Figure 6. Monthly variation in the species composition of the catches of 11 t trawlers

DISCUSSION

The trawler fishery has a long history in Sri Lanka and Malpas (1926) gives one of the earliest records of this fishery. In earlier times both exploratory and commercial fish trawling had been tried on east coast particularly on Pedro Bank (Berg,1971). There had been a few off shore trawling grounds in the past (Wadge Bank, Pedro Bank, Palk Bay and Gulf of Mannar). However, with the declaration of the 200 mile exclusive economic zone in 1976, Sri Lanka lost access to these fishing grounds partially or completely (Joseph,1984).

The results of the present study indicate that the 11 t crafts obtain high catch rates which is due to the high efficiency of the craft and large size of the trawl net used in these crafts compared to that of 3.5 t crafts. Generally the monthly CPUE was high during the period September to February of both years. Monthly effort was also high during the same period. This indicates that the period September to February is the best fishing season for the trawler fishery.

There are two river estuaries north of Kalpitiya and South of Kalpitiya, viz Kala Oya estuary and Mi-Oya estuary, which enrich the Puttalam estuary with their outfall. During the monsoonal rains flooded rivers down pour their nutrient rich waters increasing the primary production in this region. Legare (1957) has observed a similar phenomenon in the Strait of Georgia Canada. This in turn seems to be increasing the aggregation of prawns and finfish in the Portugal Bay area during the north east monsoonal period. This may be one reason for the relatively higher values observed for CPUE during the period September to February of both years.

However, the analysis of catch figures with Kruskal-wallis non parametric test (Zar,1984) indicated that there is no statistically significant difference in CPUE with different levels of rainfall. Although there is a common understanding among fishermen that a significant difference in catch rates are observed on full moon, new moon and quarter moon days, the results of the present analysis indicate that there is no statistically significant difference between the mean CPUE values observed at different phases of the moon.

However, Venkataraman and Badrudeen (1974) observed a marked variation between the trawler landings on full moon and new moon days where the average catch rates were comparatively higher on full moon days than that on new moon days. They also record that the trawler landings from Palk Bay by day fishing were comparatively higher than that by night fishing. In addition Karunasinghe and Wijeyratne (1996) too made similar observation in the *Amblygaster sirm* fishery in the coastal waters off Negombo, Sri Lanka where the average catch rates were comparatively higher on full moon days than on new moon and quarter moon days.

The average CPUE values for the 11 t crafts and 3.5 t crafts for study period (17 Kg/hour and 5.28 Kg/hour respectively) were relatively higher than the catch rates from the other trawling grounds indicating that the Portugal Bay area is relatively more productive. Average catch rates for the trawler fishery in the seas off Negombo for the periods 1979-1980 and 1980-1981 were 2.6 kg/hour and 2.9 kg/hour respectively. In Chilaw average catch rates for the same periods were 4.0 Kg/hour and 2.5 Kg/hour respectively (Jayakody, 1984). However, it was also revealed during the present investigation that the mesh sizes of the cod end of the trawl gear used in Portugal Bay area (20 mm stretched) was comparatively larger when compared to that in Negombo and Chilaw which were 17 and 13 mm stretched mesh respectively. In addition the present catch rates have not shown much difference when compared to the catch rates from the commercial otter trawler fishery in Manila Bay, Philippines, during the periods 1960, 1961 and 1962. Average catch rates for the commercial otter trawler fishery in Manila Bay for the years 1960, 1961 and 1962 were 15.72 Kg/hour, 13.57 Kg/hour and 16.33 Kg/hour respectively (Caces-Borja et al 1972).

The total annual production from the trawl fishery in the Portugal Bay area obtained for the period 1991-1992 (662 MT) was comparatively higher than the production obtained for the period 1991-1992 which was 474 MT. This could have been due to the high fishing effort recorded in the 1991-1992 period, which would probably lead to a remarkable high production in the 1991-1992 period. Although the production from the Portugal Bay is quite low when compared to the production from the trawler fishery in the seas off Tamil Nadu, (the trawler fishery production in the seas off Tamil Nadu for the years 1971, 1972, 1973, 1974, and 1975 were 28,698 MT, 25,663 MT, 32,972 MT, 31,297 MT and 53,148 MT respectively) the production per trawl hour in the study area is comparatively higher with 0.01 MT/hour when compared to the 0.006 MT/hour in the seas off Tamil Nadu (Annam and Dharma Raja, 1981).

However, the total production estimated from the Portugal Bay area for the study period were relatively high when compared to the production from the trawler fishery in Negombo and Chilaw on the west coast. In Negombo annual production from the trawler fishery obtained for the periods 1979-1980 and 1980-1981 were 274 MT and 304 MT respectively (Jayakody,1984). In Chilaw, on the other hand annual production for the years 1979-1980 and 1980-1981 were 364 MT and 151 MT respectively (Jayakody,1984). Although the production from the trawler fishery in Negombo and Chilaw were lower than the annual production from the Portugal Bay area, percentage of high valuable prawns in the trawler catch were higher with 55 % in Chilaw and 61 % in Negombo when compared to the 16 % in the Portugal Bay area. The rest of the catches from Portugal Bay area consist mainly of finfish.

The high percentage of shellfish especially the prawns bring considerable economic revenue to the fishery. Prawns alone contribute only 10 % and 32 % of the total catch of 11 t crafts and 3.5 t crafts that operate in the Portugal Bay area. The high production of the by-catch which consisted mainly of ponyfish has less economic revenue. It was found that 33 % of the total production of 11 t boats and 18 % of the total production of 3.5 t boats come from ponyfish. In addition to the leiognathids mainly the fish belonging to the families Ariidae, Portunidae and Rajidae seem to make significant contribution to the trawler by-catch. The

appearance of other finfish species in the trawler catch varied seasonally probably depending on the migration of these species to and away from the trawling ground.

The shrimp by-catch ratio for the trawler operations in the study area was estimated at 1 : 9 for 11 t boats and 1 : 2 for 3.5 t boats. These by-catch proportions were comparatively high when compared to the shrimp: by-catch ratios from the other trawling grounds. The shrimp: by-catch ratios for the trawler fishery in Negombo and Chilaw for the period 1990-1991 were 1 : 0.23 and 1 : 1.92 respectively (Jayawickrema, 1992).

Unlike in the industrial and large scale trawler fisheries in other countries, almost all the catch from trawler operations are utilized for export and local consumption except for a few non edible varieties. Even the low value fish like ponyfish has a market value because of the high demand for fish. Therefore, the by-catch problem which is very serious in many tropical shallow water trawler fisheries is absent in this fishery.

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Table 1. Specifications of the fishing crafts

Boat type	Length of the craft	Width of the craft	H. P. of the engine	No. of people on board	Net hauling
11 t	10.4 m	2.7 m	60 - 90	3	Mechanical winch
3.5 t	8.5 m - 9.8 m	1.8 m	30	5	Hand operated

Table 2. Specifications of the trawl nets

Boat type	Length of the wing	Mesh size of the wing	Length of the belly	Mesh size of the belly	Length of the cod end	Mesh size of the cod end	Width of the opening of the wing	Width of the opening of the belly	Width of the opening of the cod end	Length of the top rope	Length of the bottom rope
11 t	10.8 m	35 mm	11.3 m	35 mm	4.8 m	20 mm	26.3 m	12.3 m	3 m	23 m	27 m
3.5 t	8.2 m	35 mm	8.1 m	35 mm	2 m	20 mm	20.3 m	9.3 m	1.5 m	20 m	24 m

Table 3

Summary of the nonparametric analysis of variance (the Kruskal-wallis test with tied ranks) for the catch per unit effort values of 3.5 t and 11 t trawlers at different levels of rainfall

Kruskal-wallis test statistic, H		Correction factor C		Corrected value of Kruskal-wallis test statistic, Hc		Level of significance	
3.5 t	11 t	3.5 t	11 t	3.5 t	11 t	3.5 t	11 t
5.82	3.05	0.99	0.9983	5.86	3.06	not significant	not significant

$X^2_{0.05,3} = 7.815$

Level of rainfall (mm)		0-99	100-199	200-299	300-399
CPUE	3.5 t	24.06	14.5	20.0	27.0
	11 t	70.0	76.5	73.3	99.5

Table 4

Summary of the nonparametric analysis of variance (the Kruskal-wallis test with tied ranks) for the catch per unit effort values of 3.5 t and 11 t trawlers at different phases of the moon

Kruskal-wallis test statistic, H		Correction factor C		Corrected value of Kruskal-wallis test statistic, Hc		Level of significance	
3.5 t	11 t	3.5 t	11 t	3.5 t	11 t	3.5 t	11 t
0.4	1.33	0.9963	0.9992	0.4015	1.33	not significant	not significant

$X^2_{0.05,2} = 5.991$

Moon phase		New moon	Quarter moon	Full moon
CPUE	3.5 t	18.56	18.68	18.78
	11 t	62.14	78.24	69.8