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PRESENT STATUS OF THE SHRIMP TRAWL FISHERY IN THE SEAS OFF NEGOMBO AND HENDALA ON THE WESTERN COASTAL WATERS OF SRI LANKA

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ABSTRACT

A study was conducted to evaluate the shrimp trawl fishery in the seas off Negombo and Hendala during the period January 1998 to December 1999. In the shallow seas off west coast trawling is conducted by two types of crafts *viz.* 3.5 t wooden boats (mechanised trawls) and traditional sail driven large dug out canoes (non-mechanised trawls). The total catch effort and the catch per unit effort showed seasonal variations. A seasonality in the trawl fishery was observed with a peak period from June/July to October/November, which apparently coincided with the south west monsoon and the inter monsoon periods of the island. The statistical analysis indicated that the catch rates of both craft types observed during the south west monsoon were significantly higher than during north east and inter monsoon periods ($P<0.05$). There is no substantial difference between the estimated mean catch rates for the two craft types for the two years study. The estimated annual fish productivity of the non-mechanised and mechanised trawls were 390 and 208 MT in 1998 and 403 and 259 MT in 1999 respectively. Penaeid shrimps formed 60-64% of the catch of the west coast trawl fishery. Trawl by-catch mainly consisted of sea crabs, sciaenids, leiognathids and *Opisthopterus tardoore*. The shrimp : by-catch ratio for the trawl operations in the study area were estimated at 1 : 0.67 for non-mechanised trawls and 1 : 0.56 for mechanised trawls. The estimated mean income per trawl operation varied from Rs. 930 to 2,960 (Mean = Rs. 1,660) for non-mechanised trawls and from Rs. 470 to 4,240 (Mean = Rs. 1,860) for mechanised trawls.

Key words : Trawl fishery, non-mechanised trawls, mechanised trawls, *P. indicus*, *M. dobsoni*

INTRODUCTION

The origin of coastal trawling in Sri Lanka dates back to about a hundred years. Initially, nets used by the local fishermen were simple square or triangular shaped bags ('Lensu dela', 'Kathumaram dela') which were made up of natural fibres (Cotton, Hemp etc.) and used traditional crafts for operations (Weerasooriya, 1977). In the sea off Sri Lanka, trawling is restricted to small scale shrimp trawling on smooth muddy areas of the continental shelf, especially near the estuarine and coastal waters (Jayawardane and Dayaratne, 1998). 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. As reported by Berg (1971) the bottom conditions in the northern and the eastern coastal waters are generally suitable for trawling where the prawn resources are restricted to soft bottoms in Palk Bay and Mullaitivu areas. According to Chestnoy (1970) huge variations in the catchability of trawls operating in Ceylon waters may have a substantial influence over the progress of commercial trawl fisheries. In addition Weerakoon (1964) also made a valuable evaluation of prawn trawling in the shallow seas off Ceylon.

Shrimp trawling has been in existence in the shallow coastal waters off west coast of Sri Lanka over the last few decades. Though a few studies have been conducted in the recent past to evaluate the shrimp trawl fisheries in the seas off Negombo and Chilaw on the west coast of Sri Lanka (Jayakody, 1984; Jayawickrema, 1992; Siddeek, 1978) the information on the shrimp trawling in the seas off Hendala (Fig. 1) is scanty.

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In recent times (1992) shrimp trawling in the seas off Chilaw was banned as a result of a dispute between the two fishing communities (traditional and trawl fishermen) sharing the same resource. Therefore, shrimp trawling is now restricted to Negombo and Hendala, in the western coastal waters of Sri Lanka. In addition trawling is the major fishing activity taking place in the shallow coastal waters off Negombo and Hendala, exploiting the parent stock of shrimps, which utilise Negombo lagoon for completion of the early phase of their complex life cycle.

During the present study the aspects of the trawl fishery studied include monthly variation in the fishing effort, catch rates, total catch, species composition and economy of the fishery. Also included are descriptions of type the of fishing crafts, gear and area of operation.

MATERIALS AND METHODS

Collection of statistics on catch and effort

A pilot survey was first conducted (along the coastal stretch between Colombo to Vennappuwa in the west coast) in order to gather basic information on the shrimp trawl fishing activities in the seas off west coast of Sri Lanka. Based on this information, a rigorous sampling scheme was formulated. For the collection of catch and effort data from the trawl fishery, 2 sampling sites were selected from a total of 4 fish landing sites scattered throughout the study area (Fig. 1). Pilot survey indicated that around 70% of the shrimp trawlers engaged in the seas off Negombo and Hendala unload their catches at the selected sampling stations. Data collection was conducted by making regular weekly field visits to the selected sampling sites during the period January 1998 to December 1999. Catch and effort data of the trawl fishery were collected separately from randomly selected crafts at each sampling site.

On each sampling day more than 30% of the total number of fishing crafts that operated at each sampling site were sampled randomly. The information on specifications of the craft and gear, details on fishing operations, the total catch and its species composition and information on the economics of the fishery was recorded. The total number of fishing craft operated at each sampling site was recorded in order to estimate the total effort for the particular month. The number of fishing days for each month was noted for each craft type.

On each sampling day around 2-3 representative shrimp samples (amounting to 10 to 20% of the total shrimp catch) were collected at sampling stations and in the laboratory shrimps were sorted in to species and sexed. The total length of each specimen (from the tip of the rostrum to the tip of the telson) was measured to the nearest 0.1 cm using a measuring board and the weight of the entire sample was determined. These were then pooled to estimate the monthly length frequency data. Finally the monthly length frequency data were pooled together to estimate the annual length frequency distributions of major shrimp species exploited by two types of trawlers.

Measurement of potential climatic factors influencing the catch rates of the shrimp trawl fishery such as average wind speed and the resultant wind direction of the study area, were obtained from the Meteorological Department of Sri Lanka. The information on wind speed and wind direction was used to predict the two monsoon seasons of the island; the south west and north east monsoon.

Information on the nature and the area of fishing operations was also collected during the study.

Analysis of statistics on catch and effort

Fishing effort and the catch per unit effort

The fishing effort is expressed as the mean number of fishing crafts operated per day with respect to each craft type. The mean catch, in kg per craft-day, was considered as the catch per unit effort with respect to each craft type based on the following observations. During the study period every fishing craft conducted approximately the same number of hauls (frequently 4 - 6) and the true fishing time is almost constant throughout the study period for each craft type. The number of fishermen involved in fishing operation is also constant (4) and they usually have only one fishing operation per day.

The impact of different factors such as fishing season and the fishing area on the shrimp yields from two craft types was evaluated using the General Linear Model.

The monthly production was estimated using the following formula: MTP = CPUE x NFC x MFD where MTP = monthly total production, CPUE = mean catch in kg per craft-day, NFC = mean number of fishing crafts operated per day and MFD = mean number of fishing days for that particular month.

Species abundance and species composition of the catches

Almost all the finfish and crustacea from the trawl catches were identified using the FAO species identification sheets (Fischer and Bianchi, 1984). The species composition of the monthly catches was also analysed to study the variation pattern. These values were tabulated as the percentage of the total catch.

RESULTS

Fishing crafts, gear and operation

In the shallow seas off Hendala and Negombo trawling is conducted by 3.5 t wooden boats (mechanised trawls) and traditional sail driven large dug out canoes (non-mechanised trawls) respectively.

The use of non-mechanised trawls occurs outside the lagoon, to a distance of around 10-15 km north of the entrance. They are operated during daytime in waters up to 12 m depth, from craft of traditional design (12 m in length), fitted with outrigger and sail. The nets are towed under sail power, although when there is insufficient wind the crew is required to row. The net used is long narrow and cone shaped, with a small cod-end about 1 m in length and a larger body of about 7 m. The width of the opening of the net was around 5.64 m. Mesh sizes of the cod end and the body of the trawl net were 15 and 20 mm respectively. No floats are used for the head rope. There are lead sinkers placed at intervals along the foot rope, and heavy stones of 30-35 kg attached at each end. The net on each side is connected to the towing ropes by bridles, of about 4.5 m, to the stones and a shorter length to the head rope. The towing of a net takes about one hour at a mean speed of 1.7 km hr^{-1} (SD = 0.18) and then it is manually hauled. The direction of the craft is then reversed and the net returned to the water. There are around 4-6 hauls during a fishing day and the mean true fishing time was estimated at 5.23 hours (SD = 1.88).

The mechanised trawls are operated from the Hamilton canal (Fig. 1) on grounds located about 15-20 km south of the entrance to Negombo lagoon. They are prohibited by regulations from fishing on the same grounds as non-mechanised trawlers. The crafts are of the 3.5 t type, 10.4 m in length, and of modern design. They are powered by inboard diesel engines of 25-40 HP. Thick bamboo poles are extended as booms either side of the craft from which the net is towed. The fishing operations and net design are otherwise similar to those with the non-mechanised trawls. The mean true fishing time for mechanised trawls was estimated at 5.54 hours (SD = 1.59) while the estimated mean towing speed was 3.43 km hr^{-1} (SD = 0.57). The nets are larger, with a cod end of about 2.5 m in length and a body of about 12-15 m. The width of the opening of the net was about 15 m. Although some craft are used throughout the year, the operations of most are confined to about 5 months centred on June/July. About two-thirds of the boats may idle in some months and a few may be used in catching fish with other gears.

Fishing effort

In 1998 the total annual fishing effort of the trawl fishery was estimated at 27,192 (total number of fishing operations) and in the following year the fishing effort increased to over 30,000 which is an increase of about 11% (Table 1). The composition of the fishing effort of the shrimp trawl fishery showed considerable variation over the two years studied with 19,338 fishing trips by non-mechanised trawls in 1998 (71% of the total effort), which increased to 20,058 fishing trips (66% of the total effort) in the following year. Where as mechanised trawls increased by 25%, from 7,854 fishing trips in 1998 (29% of the total effort) to 10,138 fishing trips in 1999, (34% of the total effort) (Table 1). The monthly variation pattern of the effort of both craft types appear to follow similar trend for both years studied (Fig. 2). Generally, the fishing effort of mechanised trawls was high during the period

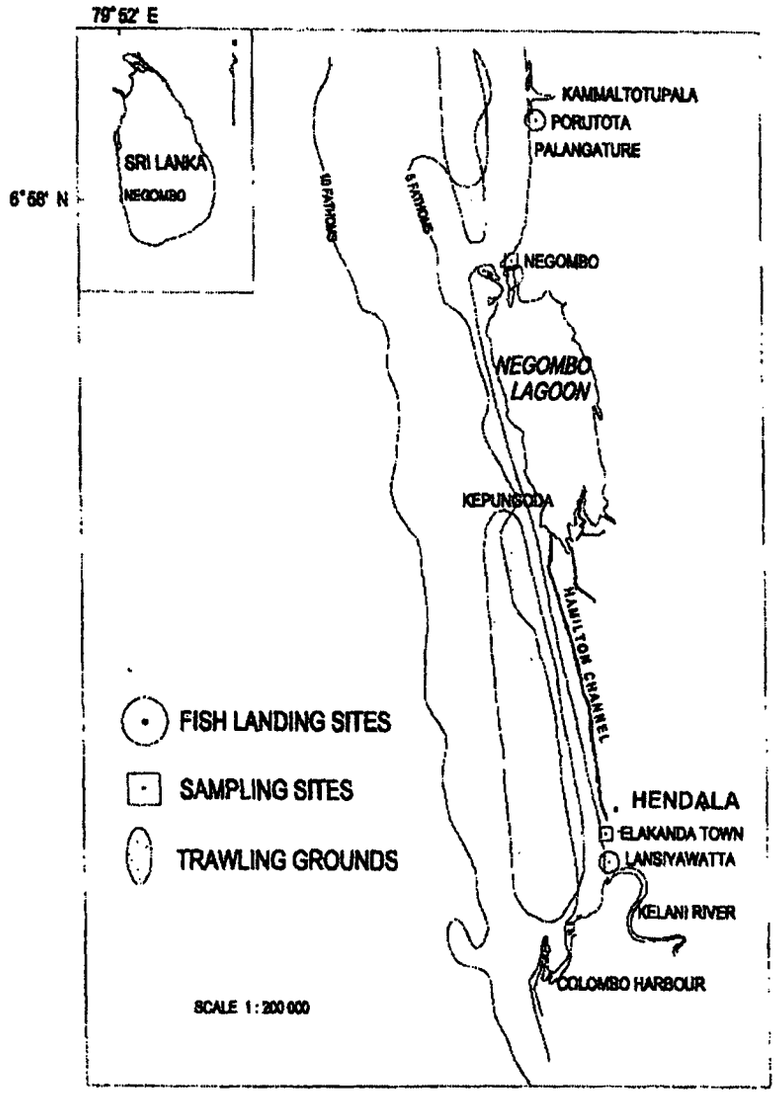


Figure 1. Map of the study area

June-July to October-November of both years. The non-mechanised trawls have shown little variation in terms of the fishing effort throughout the study.

Catch rates

The CPUE of different components of the non-mechanised trawls (shrimp, fish and total) show considerable variations and the total catch rate is influenced by the catch rate of shrimps to a great extent. The peak total and shrimp catches were recorded in January 1998 while the fish peak catches in January 1999 (Fig. 3). The mean total, shrimp and fish catch rates for the years 1998 and 1999 were estimated at 19.91, 12.49 and 7.42 kg/craft-day and 19.91, 11.33 and 8.57 kg/craft-day respectively (Table 1). The catch rates of shrimps increased from around May-June until August-September and declined again. In addition high CPUEs were also observed in November of both years. It was noted that the period of high CPUEs of shrimps apparently coincided with the south west and the onset of north east monsoon of the island resulting high winds in the west coast (Fig. 3). On the other hand the period of low catch rates in terms of shrimps coincided with the north east and the

inter monsoon period with relatively calm seas over the west coast.

Except for a few months, the total catch rate of mechanised trawls is influenced by the catch rate of shrimps to a great extent (Fig. 4). The estimated mean overall, shrimp and fish catch rates for the years 1998 and 1999 were 22.21, 12.35 and 9.86 kg/craft-day and 21.3, 11.44 and 9.87 kg/craft-day respectively. The mean CPUEs increased from May-June to November-December of both years-studied (Fig. 4). The period with high shrimp catches coincided with the period of high average wind velocity over the west coast of the island (south west monsoon). The relatively low shrimp catches were observed from December to April-May which coincided with the north east and the inter monsoon periods with calm seas over the west coast.

Catch variability with factors other than fishing effort

The statistical analysis (Table 2) indicated that there is a significant effect of sampling site on most of the indices of catch rate (total shrimps, *P. indicus* and *M. dobsoni*) ($P<0.05$). The catch rates observed during different fishing seasons (north-east monsoon, south-west monsoon and the inter monsoon) were also significantly different from each other (Table 2). Especially the catch rates observed in the south-west monsoon were significantly higher than in north-east and inter monsoon periods (Table 3) ($P<0.05$). There was an interaction between the fishing season and the sampling site, which was significant ($P<0.05$) in terms of most of the indices of the catch rate (Table 2).

Total catch

The annual catch from the non-mechanised trawls was estimated at 390 t in 1998 and 403 t in 1999, which was an increase of about 3% (Table 1). However, the shrimp catch from non-mechanised trawls was reduced slightly from 245 t in 1998 to 233 t in 1999, which was a reduction of about 5%. The increase in the total catch could probably be due to the increase in the fish catch which from 146 t in 1998 to 170 t in 1999. The estimated annual catch from mechanised trawls was 208 t in 1998 and 259 t in 1999 (Table 1). This was an increase of about 25%. Similarly the shrimp catch and the fish catch from the mechanised trawls were also increased from 129 and 78 t to 167 and 92 t respectively during the two years studied These high catches may probably be associated with the increased effort of mechanised trawls in 1999.

The variation pattern of the total production of both craft types was found to be similar throughout the study period (Fig. 5). Generally the total catch from mechanised trawls was high during the period May-June to October-November of both years which apparently coincided with the period high shrimp catches. In contrast the non-mechanised trawls have not shown a variation in terms of the total production throughout the study period.

Species composition of the catch

A total of 48 species of finfish and crustaceans belonging to 21 different families and with certain commercial importance have been identified in the catches. Almost all the fish and shellfish species caught are of marine origin. However, a few dominated the catches in terms of their weight and/or value. Of these, small shrimps, large shrimps, sea crabs, sciaenids, leiognathids and *Opisthopterus tardoore* were considered as important depending on their production by weight and the economic importance. All the other fish were grouped as "others".

In the study area trawling is primarily carried out to target shrimps which fetch a high economic return to the fishermen. Penaeid shrimps formed 60% and 64% of the catch of non-mechanised and mechanised trawls respectively. The contributions of small shrimps (mostly *Metapenaeus dobsoni* and *Parapenaeopsis coromandelica*) and large shrimps (mostly *Penaeus indicus* and *P. merguiensis*) to the total catch of non-mechanised and mechanised trawls were 58% and 2%, and 59 and 5% respectively. The other major contributors formed 23% of the catch of contributions of shrimps to the trawl catches were most substantial during the period from May-June

Table 1

Catch and effort on statistics of the shrimp trawl fishery

Fishing gear	Fishing effort (total number of operations)		CPUE in kg/craft-day						Total production (MT)					
			Shrimps		Others		Total		Shrimps		Others		Total	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
Non-mechanised trawl	19,338	20,058	12.5	11.3	7.42	8.57	19.9	19.9	245	233	146	170	390	403
Mechanised trawl	7,854	10,138	12.4	11.4	9.86	9.87	22.2	21.3	129	167	78	92	208	259
Total	**27,192**	**30,196**							**374**	**400**	**224**	**262**	**598**	**662**

until October-November (Fig. 6). In general the species composition does not show considerable variations between the two years studied.

Size composition of the shrimp catches

As trawling exploits the parent stock of the shrimps utilising Negombo lagoon as the nursery ground, a narrower length range of shrimps were caught in this fishery with fewer smaller ones. The mechanised trawls seem to exploit larger individuals of *P. indicus* and *P. merguiensis* (both males and females) compared to that of non-mechanised trawls (Figs 7 and 8). However, the above was not distinct in terms of both *M. dobsoni* and *P. coromandelica*. There is also a clear separation between the length distributions of the two sexes found in the catches of both trawl types except for *P. indicus* (Figs 7 and 8) and was more apparent in mechanised trawl catches. It was also noted that the length distributions of almost all the shrimp species found in the catches of the two trawl types are unimodal.

Economy of the fishery

The mean net daily income per trawl operation for each month was estimated separately for two types of crafts depending on the observations made at respective auction sites. During the present investigation mean net income per trawl operation varied from Rs. 930 to 2,960 (Mean = Rs.1,660) for non-mechanised trawls and from Rs. 470 to 4,240 (Mean = Rs.1,860) for mechanised trawls. There were around 24 fishing days per month and one fifth of the income is paid to each crew member. Therefore, average monthly income per owner and crew member were estimated to be about Rs. 16,650 (range Rs. 8,930 to 28,390) and 7,990 (Range Rs.4,460 to 14,190) respectively for non-mechanised trawls (ratio 2.08:1). On the other hand for mechanised trawls these were estimated to be Rs. 18,590 (range Rs. 4,540 to 40,720) and Rs.8920 (Range Rs.2,270 to 20,360) respectively (ratio 2.08:1).

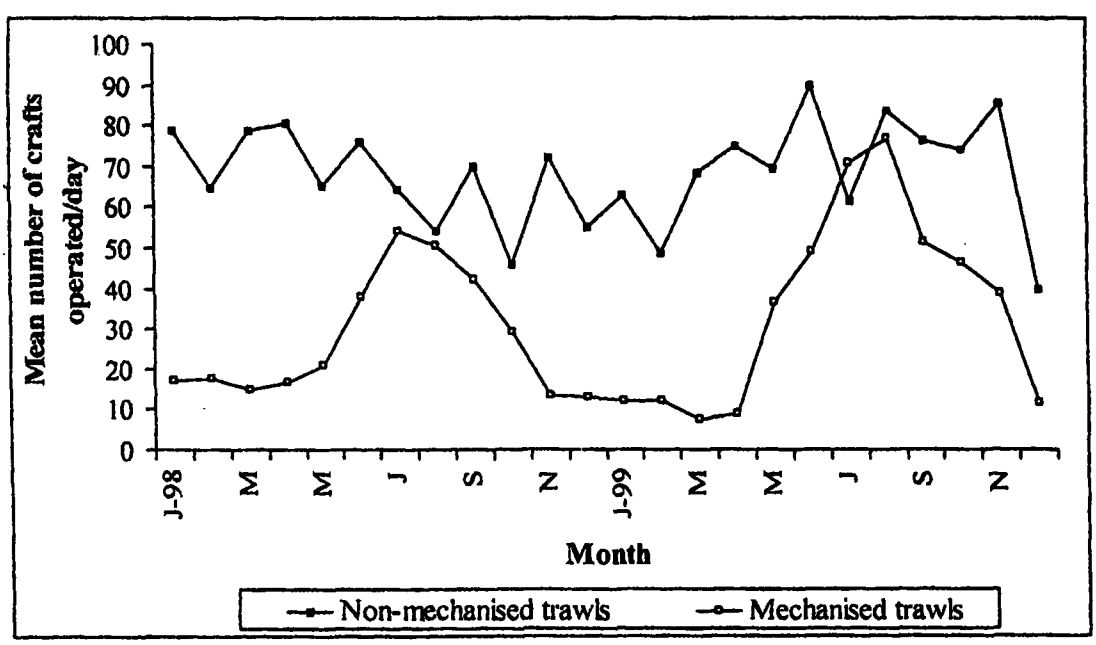


Figure 2. Monthly variation in the effort of the trawl fishery

Table 2

Summary of the GLM (general linear model) performed on the catch rates of shrimp trawl fishery

Source	Sums of squares	Degrees of of freedom	Means squares	F-value	Level of significance (P)	R squared (r^2)
Total catch rate						
Corrected model	51	5	10.2	38.28	0.000	0.11
Intercept	11625.23	1	11625.23	43629.18	0.000	
Site	0.347	1	0.35	1.3	0.25	
Season	25.32	2	12.66	47.51	0.000	
Site*Season	33	2	16.5	61.92	0.000	
Error	424.2	1592	0.27			
Total	14211.62	1598				
Corrected total	475.2	1597				
Total shrimps						
Corrected model	398.13	5	79.63	115.41	0.000	0.27
Intercept	5868.91	1	5868.91	8506.84	0.000	
Site	38.05	1	38.05	55.16	0.000	
Season	328.79	2	164.4	238.29	0.000	
Site*Season	148.75	2	74.38	107.81	0.000	
Error	1097.64	1591	0.69			
Total	9197.01	1597				
Corrected total	1495.76	1596				
P. indicus						
Corrected model	103.96	5	20.79	29.22	0.000	0.09
Intercept	3103.55	1	3103.55	4361.71	0.000	
Site	5.15	1	5.15	7.24	0.007	
Season	30.49	2	15.24	21.42	0.000	
Site*Season	66.31	2	33.15	46.59	0.000	
Error	990.47	1392	0.71			
Total	4797.25	1398				
Corrected total	1094.43	1397				
M. dobsoni						
Corrected model	387.79	5	77.56	103.91	0.000	0.25
Intercept	4 053.19	1	4053.19	5392.83	0.000	
Site	52.43	1	52.43	69.7 6	0.000	
Season	316.74	2	158.37	210.72	0.000	
Site*Season	137.83	2	68.91	91.69	0.000	
Error	1186.76	1579	0.75			
Total	7045.32	1585				
Corrected total	1574.55	1584				

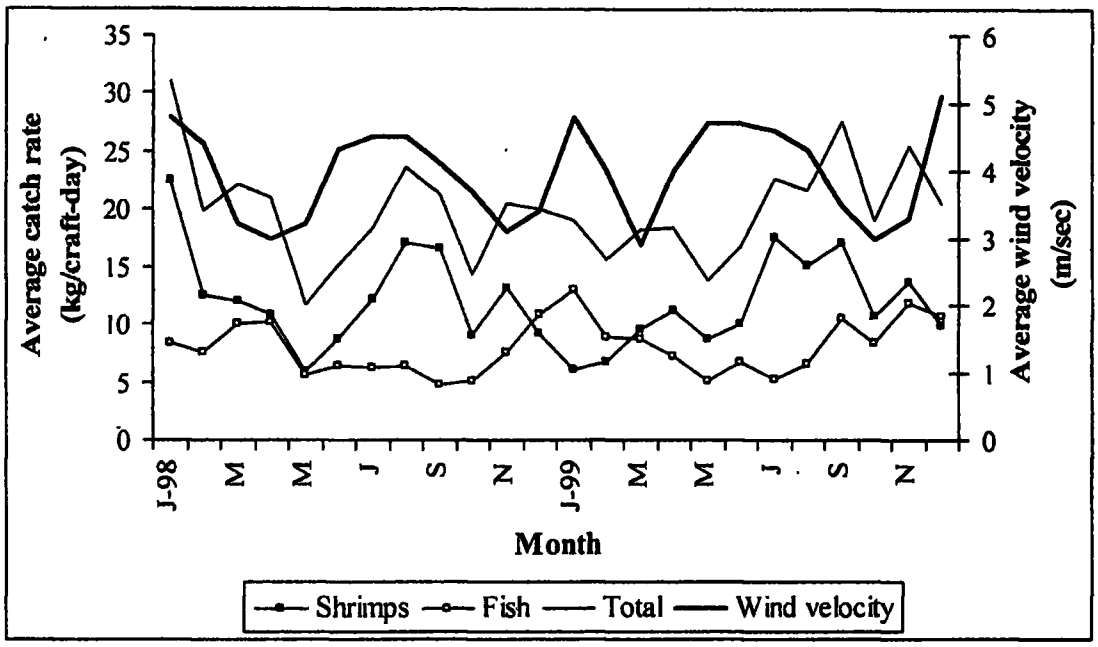


Figure 3. Monthly variation in the mean catch rates of different components of the non-mechanised trawls and the average wind velocity

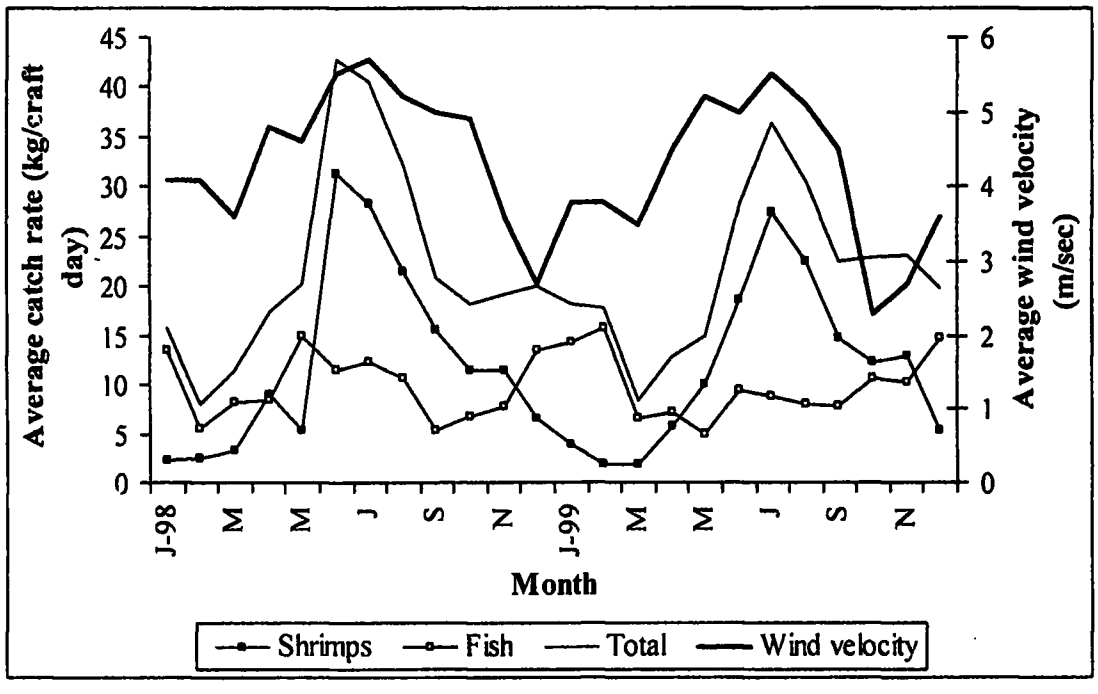


Figure 4. Monthly variation in the average catch rates of different components of the mechanised trawls and the average wind velocity

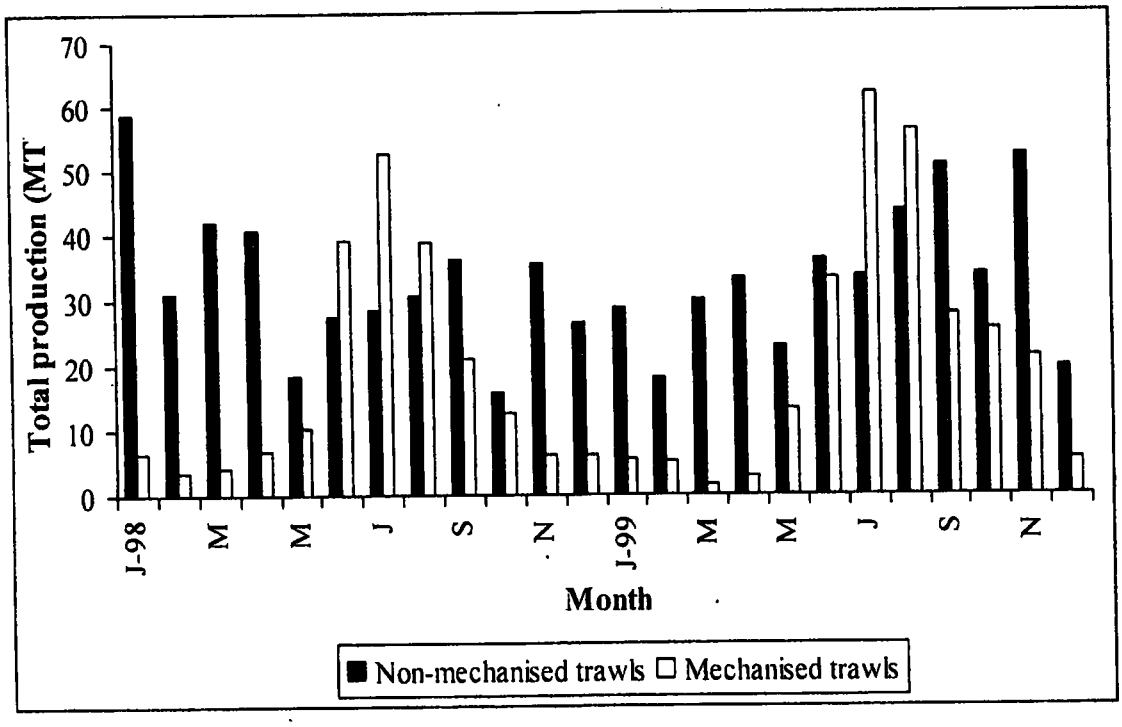
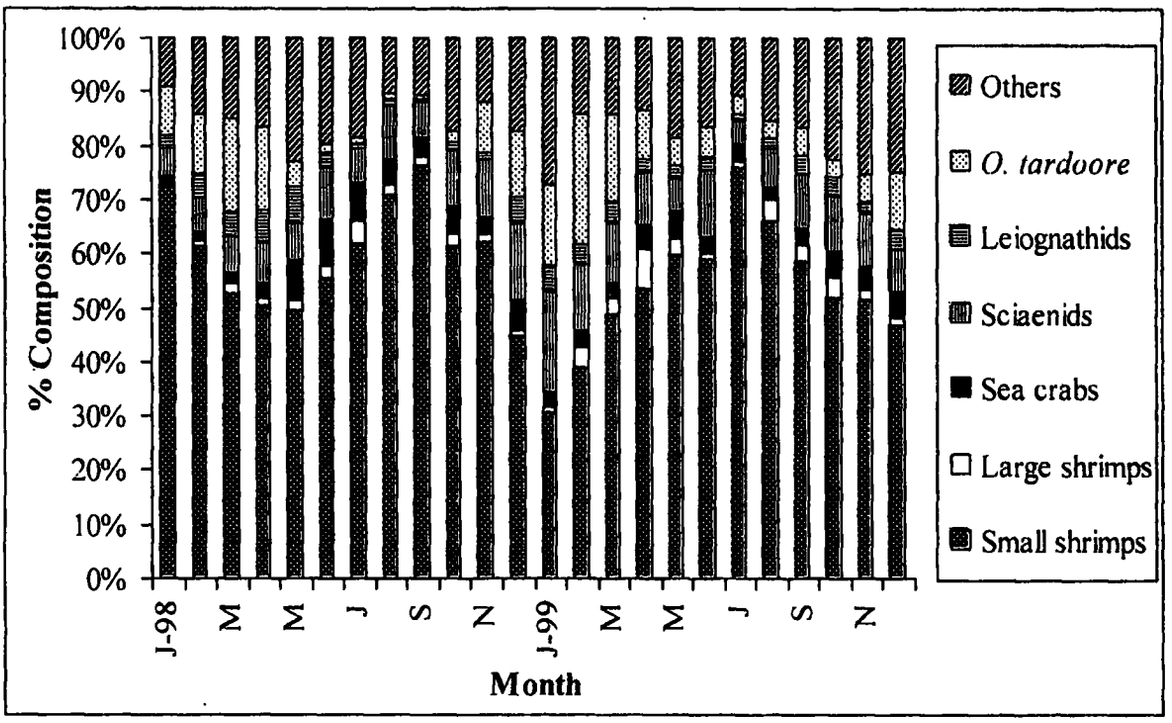


Figure 5. Monthly variation in the total production of the trawl fishery

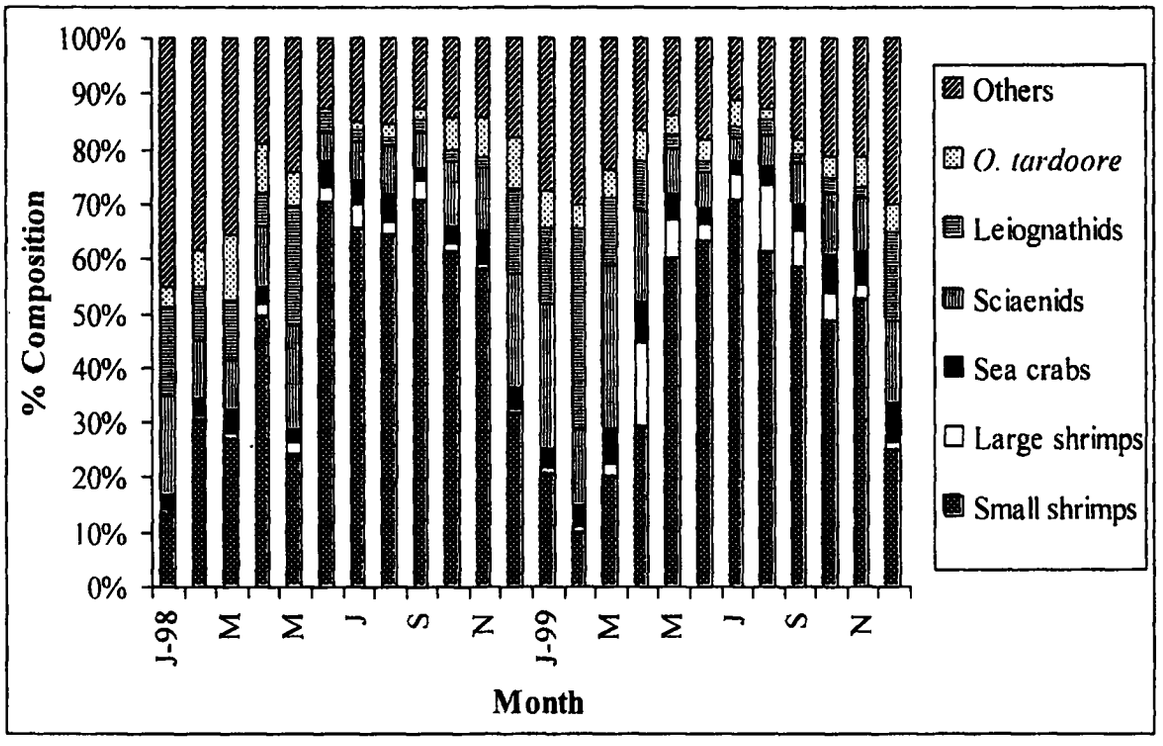
Table 3
Summary of the multiple comparisons of shrimp trawl fishery between different fishing seasons

Season 1	Mean catch rate	Season 2	Mean catch rate	Mean difference	Standard error	Level of significance
Total catch rate						
South west monsoon	24.14	North east monsoon	20.5	0.2344	0.03	0
		Inter monsoon	19.89	0.1893	0.03	0
Total shrimps						
North east monsoon	9.97	South west monsoon	16.98	-0.9891	0.05	0
		Inter monsoon	10.96	-0.4699	0.05	0
South west monsoon	16.98	Inter monsoon	10.96	0.5192	0.05	0
P. indicus						
North east monsoon	0.18	South west monsoon	0.24	-0.1512	0.06	0.03
		Inter monsoon	0.37	-0.3291	0.06	0
South west monsoon	0.24	Inter monsoon	0.37	-0.1779	0.05	0.002
M. dobsoni						
North east monsoon	7.47	South west monsoon	12.08	-0.9667	0.06	0
		Inter monsoon	7.83	-0.4438	0.06	0
South west monsoon	12.08	Inter monsoon	7.83	0.5228	0.05	0

*Catch rate (kg/boat-day)

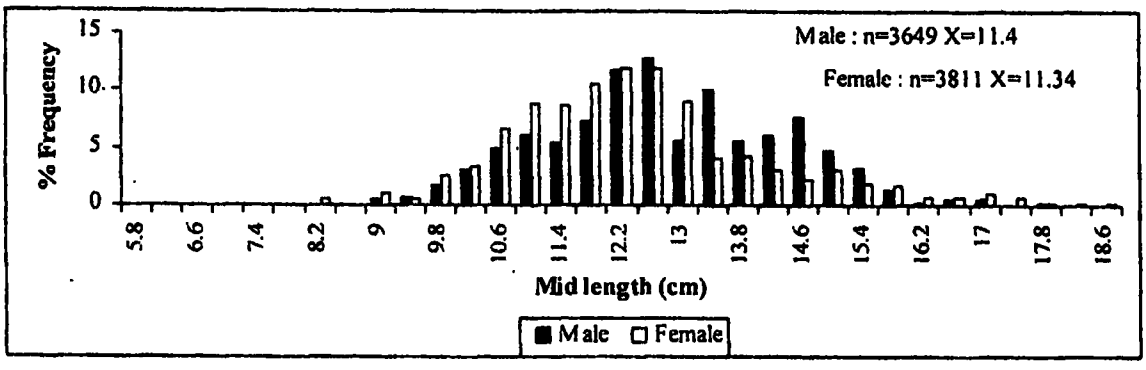


Non-mechanised trawls

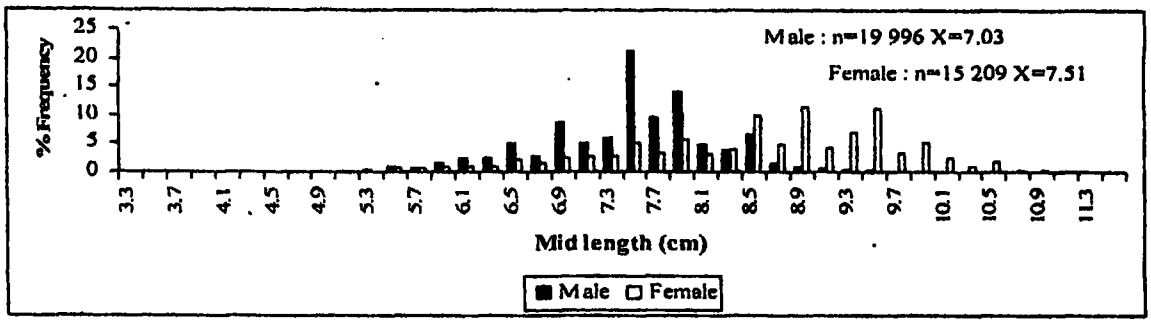


Mechanised trawls

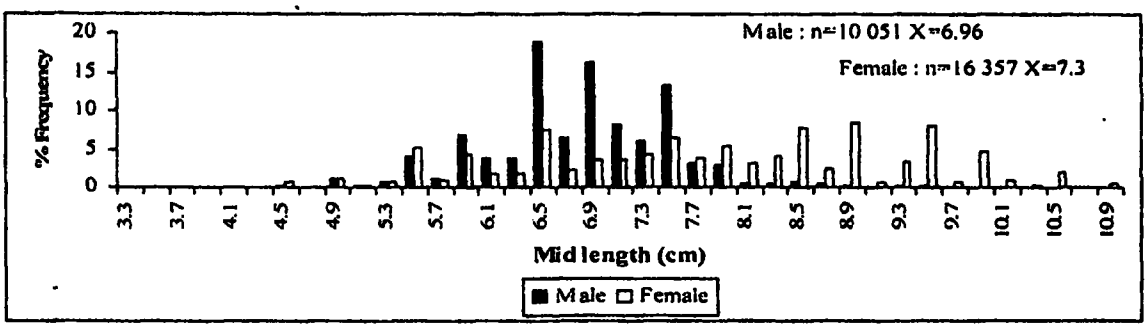
Figure 6. Monthly variation in the species composition of the catch of mechanized trawls



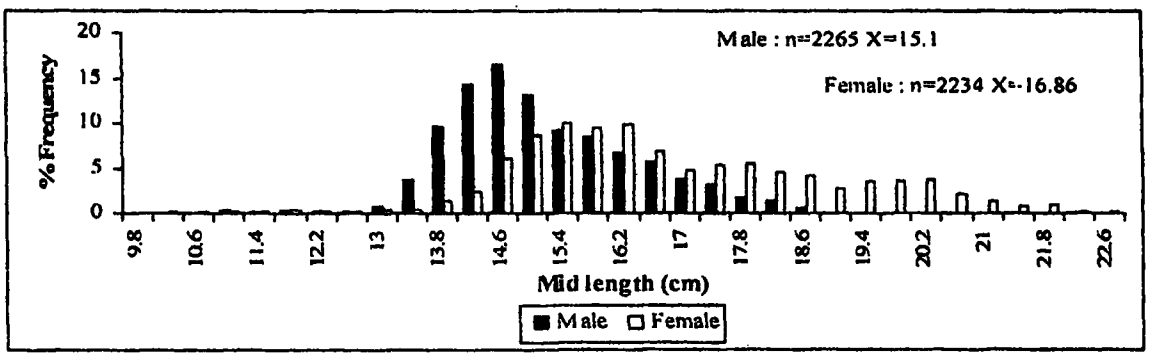
P.indicus



P.dobsoni

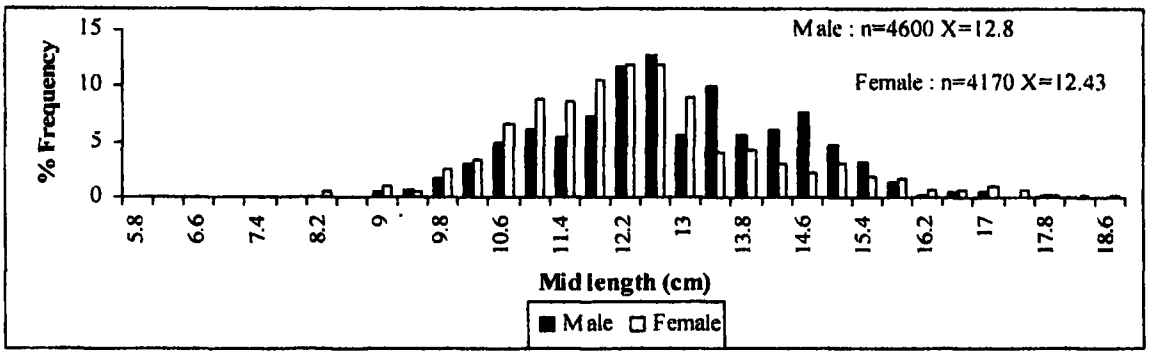


P.coromandelica

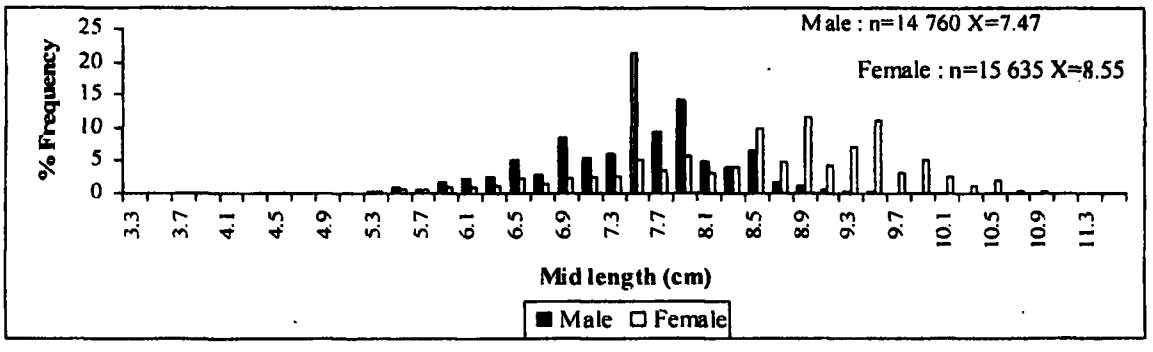


P. merguiensis

Figure 7. Length frequency distributions of the major shrimp species caught in the catches of non-mechanised trawls : n=number of individuals X=mean length



P.indicus



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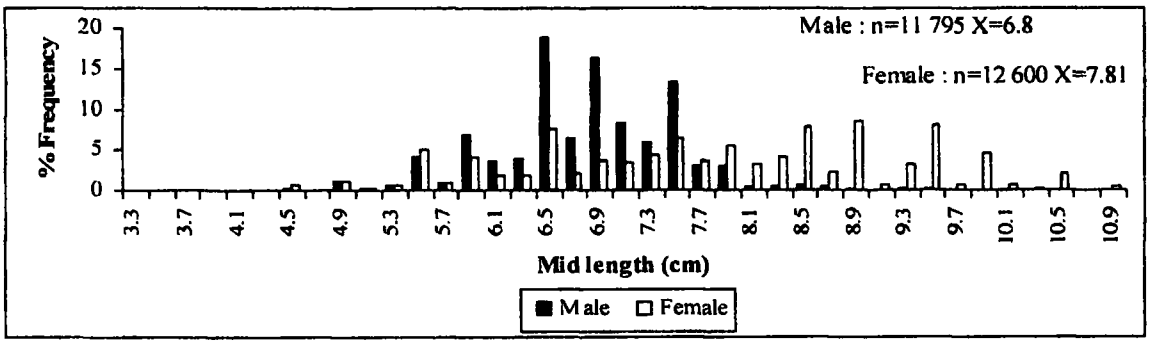
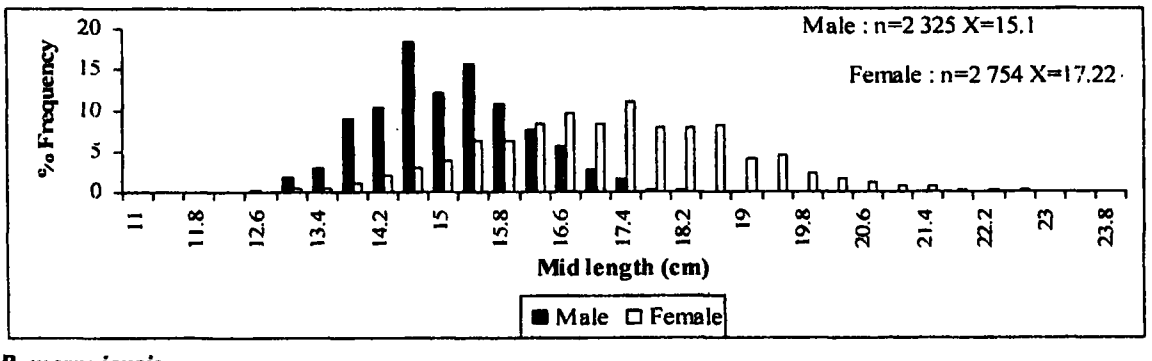


P.coromandelica



P. merguiensis

Figure 8. Length frequency distributions of the major shrimp species caught in the catches of mechanised trawls : n=number of individuals X=mean length

DISCUSSION

The trawl fishery has a long history in Sri Lanka and Malpas (1926) made one of the earliest records of this fishery. In earlier times both exploratory and commercial fish trawling had been tried in the 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 miles exclusive economic zone in 1976, Sri Lanka lost access to these fishing grounds partially or completely (Joseph, 1984).

The findings of the present study indicated that the period from May-June until August-September is the best fishing season for the shrimp trawl fishery in the seas off Negombo and Hendala, which coincid with the south-west monsoon of the island. The statistical analysis has confirmed that the south-west monsoon has a significant influence on the shrimp catches from the trawl fishery (Tables 2 & 3). The majority of penaeid shrimps possess both estuarine and the marine phases in their complex life cycles. Once the nursery life is completed in low saline lagoons, estuaries etc. they migrate back to coastal waters for reproduction (De Bruin, 1971). It is highly probable that the resultant osmotic stress due to low saline waters in the Negombo lagoon with the onset of inter-monsoon rains in April-May, induces the migration of pre-adults towards coastal areas for spawning. As penaeid shrimps form about 60-64% of the catch from the trawl fishery in this region, the high catch rates during the south west monsoon could presumably be due to the increased stock density in the trawling grounds owing to migration of shrimps to coastal areas for reproduction. The statistical analysis also provided sufficient evidence to justify that the sampling site has a great influence on the shrimp catches from the trawl fishery. This could presumably be due to the high efficiency of the mechanised crafts exploiting the southern trawling ground over the non-mechanised crafts which depend upon the existing wind force for fishing operations to a great extent. However, the modest shrimp catches from the trawling ground off Hendala (Fig. 1) could be partially explained by the reasonably high fishing effort by mechanised trawls particularly centred around June/July. In addition, loosing access to the substantial portion of the fishing ground owing to declaration of a security zone based on the Colombo harbour could presumably be the other reason for these modest catch rates.

The catch rates of the shrimp trawl fishery in the seas off Negombo and Hendala though generally low could be compared with those of other trawl fisheries around the island. The present study indicates that non-mechanised and mechanised trawls have similar catch rates averaging 3.8 and 3.93 kg/hour respectively. For the trawl fishery in the north western coastal waters of Sri Lanka Jayawardane and Dayaratne (1998) reported a higher average catch rate of 5.28 kg/hour. The estimated average catch rates for the shrimp trawl fishery in the seas off Chilaw however, for the periods 1979-80 and 1980-81 were closer to those of the north west coast at 4 and 2.5 kg/hour respectively (Jayakody, 1984). Interestingly, the present catch rates were only slightly higher than the estimated average catch rates reported by Jayakody (1984) for the non-mechanised trawls operating in the seas off Negombo for the periods 1979-80 and 1980-81 (2.6 and 2.9 kg/hour respectively). It was noted that even after about 20 years the catch rates of non-mechanised trawls remained almost unchanged even with the modest or slightly low catch rates.

The estimated annual catch from mechanised trawls was 208 t in 1998 and 259 t in 1999, an increase of around 25%. Similarly the shrimp catch and the fish catch from the mechanised trawls were also increased from 130 and 78 t to 167 and 92 t respectively over the two years studied. However, this could be attributed to the substantial increase in the fishing effort of mechanised trawls from 7,854 fishing trips in 1998 to 10,138 fishing trips in 1999 which is an increase of around 29%.

The high percentage of shrimps in catches brings substantial economic returns to the trawl fishermen in the study area. Shrimps alone contribute to 60 and 64% of the total catch of non-mechanised and mechanised trawls respectively. On the other hand the by-catch of finfish makes less

economic returns. The shrimp : by-catch ratios for the trawl operations in the study area were estimated at 1 : 0.67 for non-mechanised trawls and 1 : 0.56 for mechanised trawls. These by-catch proportions were reasonably low when compared to those from other trawling grounds. The estimated shrimp : by-catch ratio for the trawl fishery in the north western coastal waters of Sri Lanka was 1 : 2 (Jayawardane and Dayaratne, 1998) and 1 : 1.92 for the trawl fishery in Chilaw for the period 1990-1991 (Jayawickrema, 1992).

When compared the economy of non-mechanised and mechanised trawls, the former has a better performance. The estimated remuneration to the crew of mechanised trawls is low. Also the remuneration to the fishermen/owners is modest compared to the relatively high investment required to own a 3.5 t craft. These findings accord with many of the mechanised trawls being operated only during the months around June/July when the shrimps are abundant. Another factor contributing to the modest performance, is the exclusion of these crafts from the grounds adjacent to the port of Colombo. This has been applied only during recent years, and stems from the enlargement of the security zone around the commercial port.

These catches and effort data are by far the most comprehensive so far reported for the shrimp trawl fishery in the seas off west coast of Sri Lanka. They are nevertheless not without error. The catch weights are not from actual weighing, but are estimates from visual examination by the enumerators at the landing sites. The information on fishing effort was from questioning the fishermen at the time of landing, and hence reliant on the integrity of the interviews. Also, in the short time during which the catches were available for examination, it was not always possible to achieve a fully comprehensive identification of all the species. Notwithstanding, it can be reported that the fishermen appeared always fully cooperative, and the enumerators were well trained and professional.

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