Sri Lanka J. Aquat. Sci. **3** (1998): 27-41

Some Studies on the Small Meshed Artisanal Gillnet Fishery in the Shallow Coastal Waters off Chilaw, Sri Lanka

P.A.A.T. JAYAWARDANE and D.S. JAYAKODY

National Aquatic Resources Research and Development Agency
Crow Island, Mattakkuliya
Colombo 15, Sri Lanka

Abstract

Results of a study carried out on the artisanal small meshed gillnet fishery in the shallow coastal waters off Chilaw based on a survey conducted from January, 1994 to December, 1995 are presented in this paper. The fishing operations were carried out by traditional log rafts using drift gillnets of mesh size ranging from 20 mm to 51 mm stretched mesh of which the 28 mm, 30 mm and 51 mm being the most common. Fishing operations were limited up to 2 km from the shore at a mean depth of 12.07 m (SD=0.73). The total annual productions from the fishery were 332 MT and 674 MT for 1994 and 1995 respectively. Monsoonal changes appear to have some effect on this fishery. Clupeids contributed around 60% (*Sardinella* spp. 53% ; *Opisthopterus tardoore* 4% ; *Hilsa kellee* 5%) to the total catch.

Introduction

Small pelagic fish resources contribute significantly to the fish production in Sri Lanka. Forty to fifty percent of the marine fish landed in Sri Lanka are caught mainly by small meshed gillnets and beach seines (Karunasinghe & Fonseka 1985). The small meshed gillnets contribute over 80% of the production of small pelagic fish in the coastal waters of Sri Lanka (Karunasinghe & Dayaratne 1986). In the past, beach seines and non mechanized log rafts were mostly responsible for these catches. However, after introduction of small open decked 5 - 5.5 m FRP boats in the early 1960s gillnet fishery became very popular (Dayaratne 1985).

In the recent past several studies on small pelagic fish resources have been carried out in the coastal waters around Sri Lanka. These include fisheries biology of some pelagic fish species from the west coast of Sri Lanka (Dayaratne 1984), purse seining for small pelagic fish around Sri Lanka (Joseph 1975), studies of population dynamics of *A. sirm* (Dayaratne 1985; Siddeek et al. 1985), and some aspects of the fishery of *A. sirm* (Karunasinghe & Dayaratne 1986; Karunasinghe & Wijeyaratne 1991).

The present paper discusses the results of a study carried out on the artisanal small meshed gillnet fishery in the shallow coastal waters off Chilaw, Sri Lanka. The study conducted at two major fish landing centres in the Chilaw area (Chilaw and Welihena) during the period from January 1994 to December 1995. The objective of the present investigation was to study the impact of prawn trawl ban in Chilaw area on the

small scale traditional fishing activities. During the present study total production of the fishery and the variations in the fishing effort, catch rates and the species composition of the catches were studied.

Materials and Methods

Selection of sampling stations

Study area covers the coast around Chilaw from Thoduwawa to Karukupane (Fig. 1). Initially a frame survey was carried out to identify the major fish landing centres and types of the crafts and gear used in this fishery. Out of the 08 fish landing centres scattered along the study area, two major fish landing centers, Chilaw and Welihena were selected for sampling. Although detailed sampling was carried out at Chilaw and Welihena, all crafts operated at other stations were also noted and were considered in the analysis of data.

Collection of data

Catch and effort data were collected by making regular fortnightly field visits to the sampling stations during the study period. More than 20% of the fishing crafts operated on each sampling day were sampled randomly. The information such as specifications of the crafts and gear, the total catch and its species composition were recorded.

Analysis of data

Seasonal variations in the total effort, catch per unit effort and total catch

The total number of crafts operated per day was taken as the unit of measure of the effort of this fishery. These values were derived for each month by averaging total number of crafts operated on sampling days.

This was used to calculate the percentage of the crafts operated in each month at the sampling site and this was then extrapolated to obtain an estimate for the whole study area.

The total catch for a day was estimated by multiplying the total number of crafts operated on a sampling day by the average catch per craft sampled. To obtain the monthly total catch, the estimated daily total catch was multiplied by the number of fishing days in each month which was usually 23 - 25.

Due to the following observations made during the present study, the average catch per craft per day is considered as the catch per unit effort.

i. Every log raft used approximately the same number of similar size gillnet units per fishing operation.

ii. The true fishing time for every craft was almost the same i.e., 01 hour, throughout the study period.

iii. The number of fishermen involved in a fishing operation was always one and the fishermen usually carried out a single fishing operation per day.

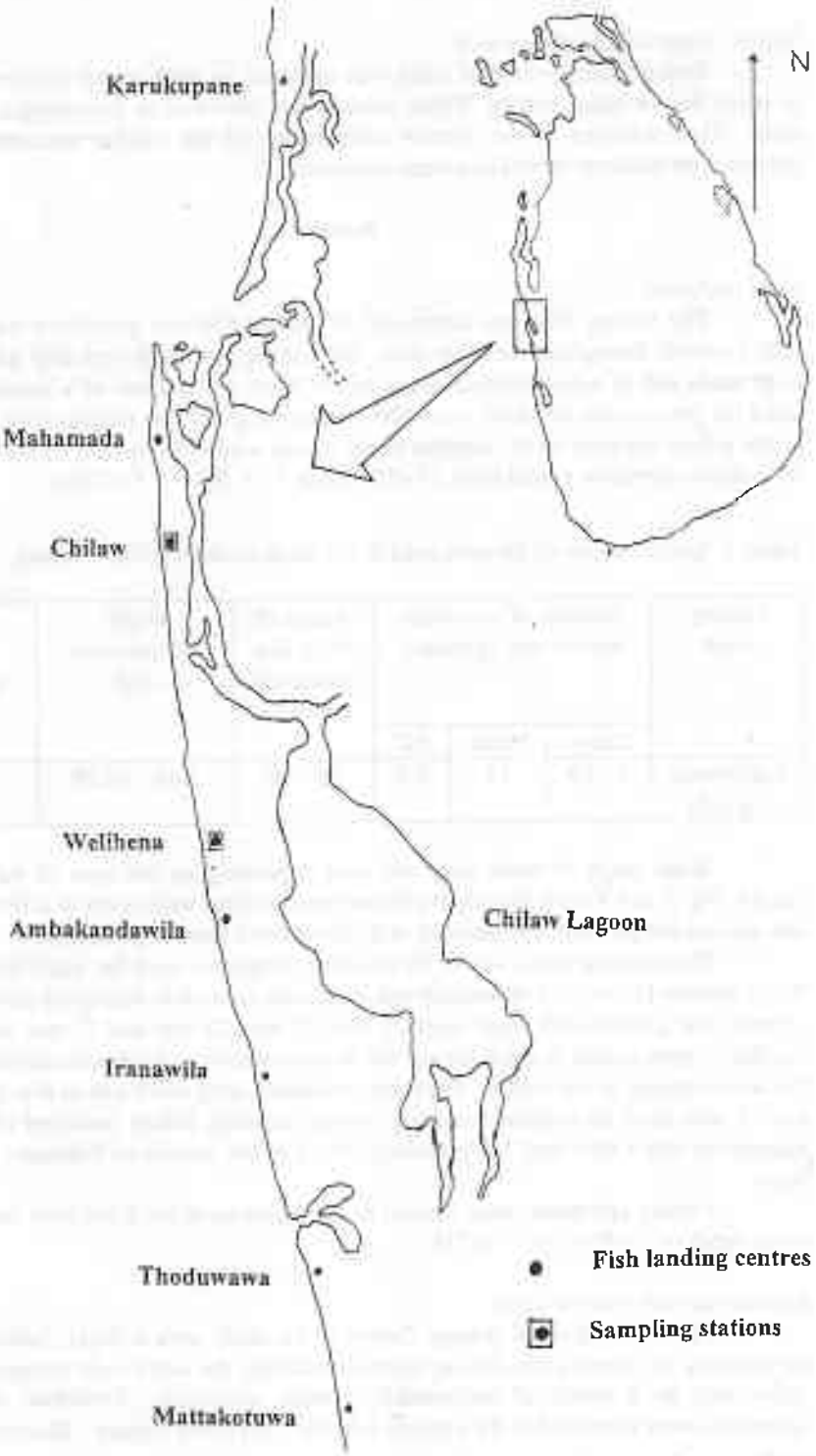


Fig. 1. Map showing fish landing centres and the sampling stations.

Species composition of the catch

Species composition of catch was analyzed for each month separately in order to study the variation pattern. These values were tabulated as percentages of the total catch. The variations in the species composition of the catches encountered in the gillnets with different mesh sizes were compared.

Results

Craft and gear

The fishing fleet was composed of around 650 non motorized traditional log rafts scattered throughout the study area. The fishing gear used were drift gillnets which were made out of nylon multi-filament twine. Each net consists of a number of equal sized net pieces each of which was 1500 meshes long and 330 meshes wide. The length of the gillnet depends on the number of net pieces used. The number of such units used for a single operation varied from 21 - 29 (Mean = 24, SD = 3.3) (Table 1).

Table 1. Specifications of the gear used in the small meshed gillnet fishery.

Fishing craft	Number of net pieces used in one operation			Range of mesh size (stretched mm)	Depth of operation (m)	Number of fishing trips/craft/day
	Range	Mean	SD			
Traditional log rafts	4 - 29	13	3.3	20 - 50	3.66 - 18.29	01

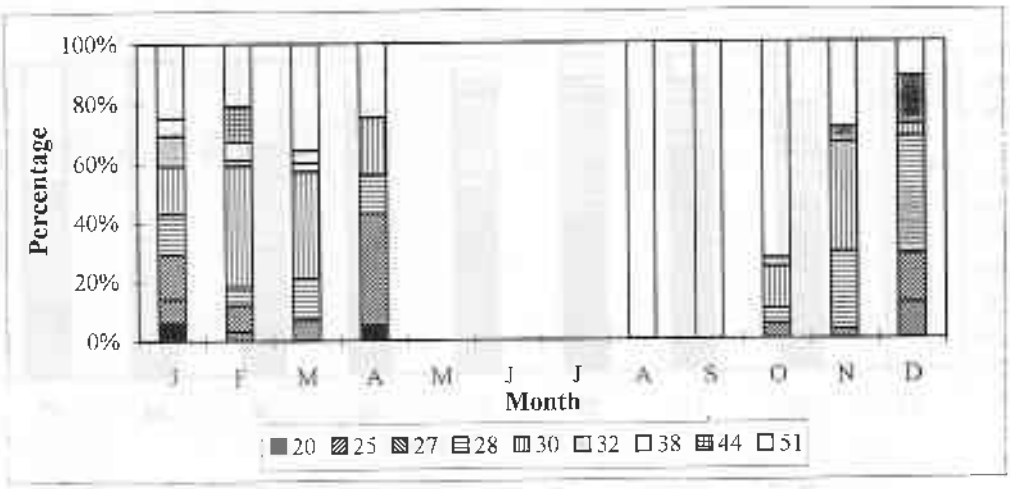
Wide range of mesh sizes are used depending on the type of the fish to be caught. Fig. 2 and 3 show the relative importance of these mesh sizes in different months and species composition encountered in different mesh sizes respectively.

The smallest mesh size of 20 mm was commonly used for small fishes such as White sardine (*Escualosa thoracata*) and anchovies especially during the period January - April. The gillnets with mesh sizes 25 mm, 27 mm, 28 mm and 32 mm were used in October - April period to catch mainly the White sardinella (*Sardinella albella*) which is the target species of the fishery. The most commonly used mesh size in this fishery is 51 mm. It was used throughout the study period targeting Indian mackerel (*Rastrelliger kanagurta*) and Kelee shad (*Hilsa kelee*) except in the months of February, March and April.

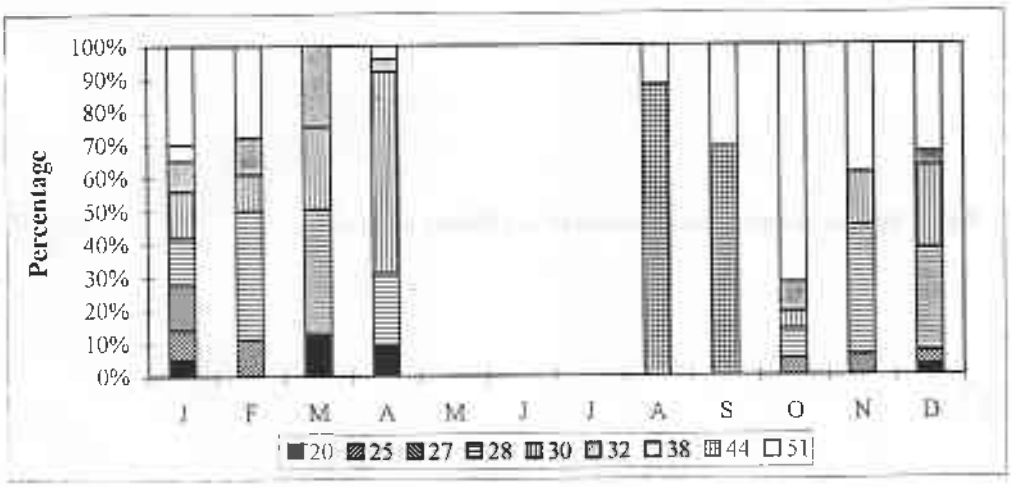
Fishing operations were limited to the region up to the 2 km from the shore at a mean depth of 12.07 m (SD = 0.73).

Monthly variation in the effort

The artisanal small pelagic fishery in the study area is highly seasonal due to the inability of carrying out fishing operations during the south west monsoonal period (May-July) as a result of unfavorable weather conditions. Therefore, the fishing operations were restricted to the periods January - April and August - December of both years.



1994-1995 period



1995-1996 period

Fig. 2. Relative importance of the different mesh sizes (mm) during the study period.

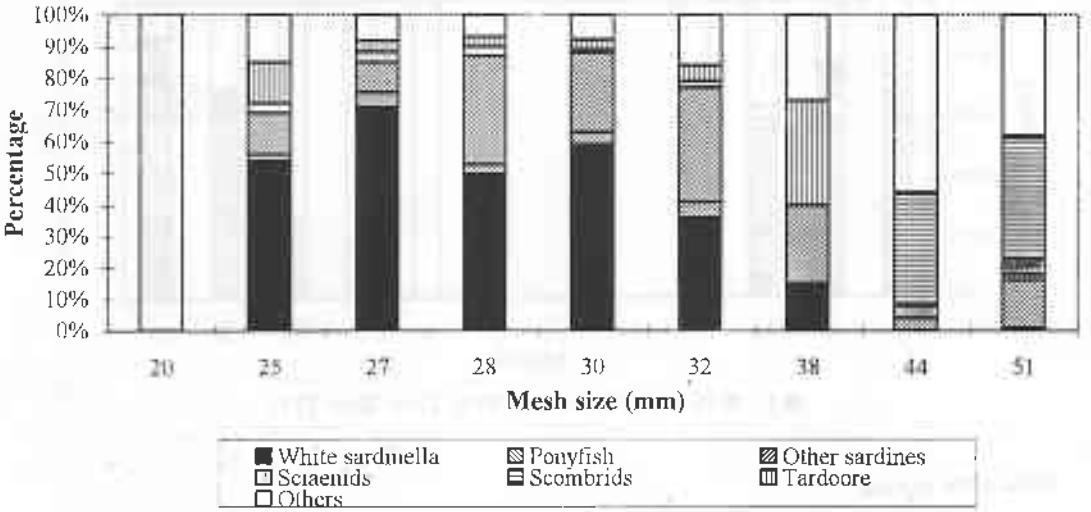


Fig. 3. Species composition encountered in different mesh sizes

The monthly variation pattern in the average number of log rafts operated per day in each month is shown in Fig. 4. It was observed that there is a tendency for an increase in effort during the period October to February. Average number of log rafts operated per day varied from 47-309 in 1994 and 30-436 in 1995. The variation pattern of the effort was the same in the two years covered during the present study.

Seasonal variation in the catch per unit effort

Fig. 5 shows the seasonal variation pattern of the catch per unit effort of the fishery. The variation pattern was found to be similar in both years. There is a trend for the CPUE values to increase during October-November and to decline to reach a minimum in January and increase again. The highest catch rate during the study period was observed in October 1995 which was 34.81 kg craft^{-1} day^{-1}. Generally from September to November and from February to April could be considered as the peak periods for the fishery.

Since the two *Sardinella* spp. (*Sardinella albella* and *Sardinella longiceps*) and *Rastrelliger kanagurta* were the species that contributed most to the total catch their seasonal variations in the catch rates were studied. Monthly variations of the CPUE of these species are shown in Fig. 6.

Each year peak catches of *S. albella* were obtained in April and October-November period while the lowest catch rates were observed in August-September and December-January periods. Catches of *S. longiceps* also follow the same pattern as *S. albella*. However, the variation pattern of the catch rates of *R. kanagurta* has shown more complex fluctuations with high catches in August-October period and almost negligible catches in January-April period which is the peak season for other two species.

Monthly variation in the total production

Fig. 7 shows the monthly variation pattern of the total production of the fishery. During the study period highest monthly catch of 209 MT was observed in December 1995. The total annual productions from this fishery were 332 MT and 674 MT for the years 1994 and 1995 respectively. The variation pattern of the total production was similar in both years studied. In terms of production the period October-February could be considered as the peak period for the fishery.

Species composition of the catches

A total of 26 fish species belonging to 11 different families were identified among the catches (Table 2). Monthly variation pattern of the species composition of the catch by weight for the study period is given in Fig. 8. Although a variety of species are caught in this fishery, Clupeids contribute a major portion of the catches. Analysis of percentage composition has shown that three species *S. albella*, *S. longiceps* and *H. kelee* contribute to about 58% of the total catch. In addition the contributions made by *R. kanagurta* and *Leiognathus spp.* to the total production which were 13 % and 7 % respectively were also found to be significant. The other fish species such as *Pellona ditchela*, *Thryssa spp.*, *Lactarius lactarius*, *Scomberomorus commerson* and *Arius spp.* although appear in the catches, do not contribute significantly to the total catch. Prawn species such as *P. indicus*, *P. merguiensis* and *M. dobsoni* were also recorded in the catches especially during the period August-October.

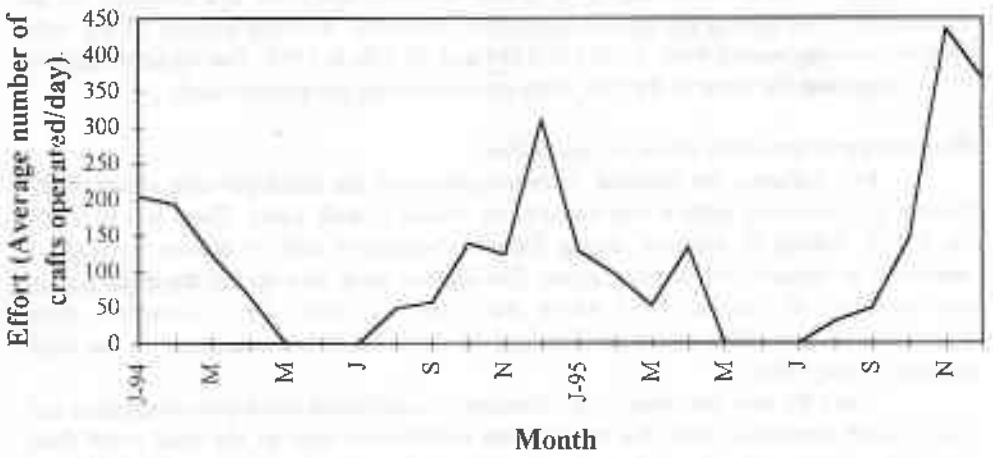


Fig. 4. Monthly variation in the effort of the small meshed gillnet fihery.

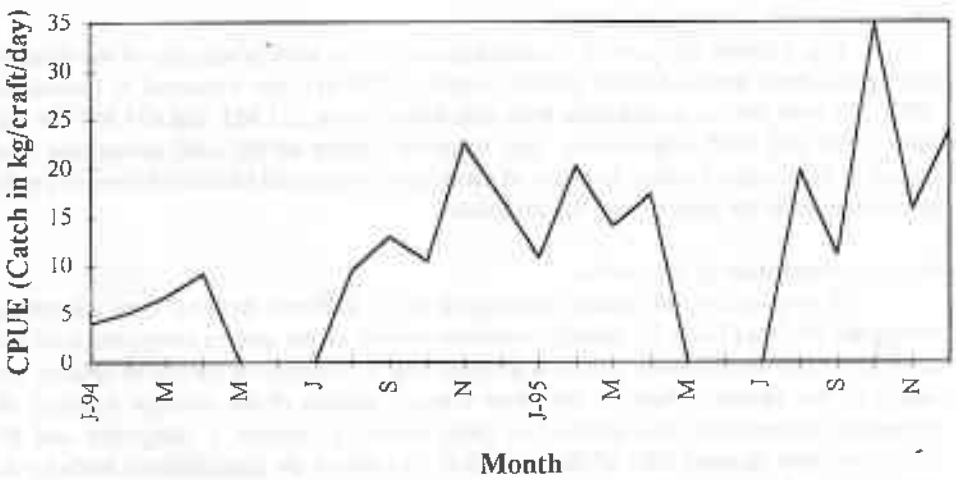


Fig. 5. Seasonal variation in the catch rate of the small meshed gillnet fishery

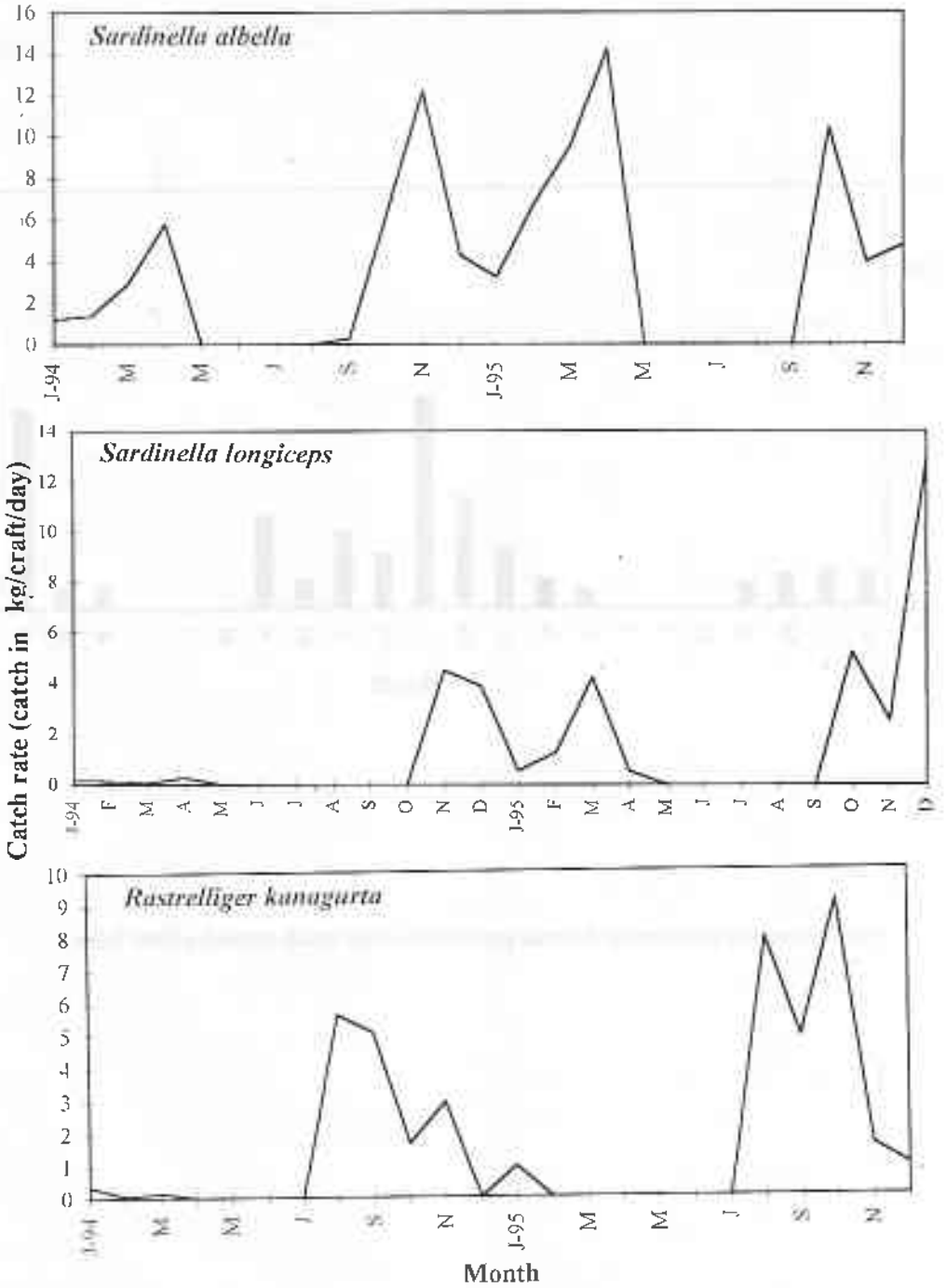


Fig. 6 Seaonal variation in the catch rates of thre major fish species seen among the catches of small meshed gillnet fishery

Table 2. List of fish species identified among the catches

Family	Scientific name	English name
Clupeidae	*Sardinella albella*	White sardinella
	Sardinella longiceps	Indian oil sardine
	Sardinella gibbosa	Goldstripe sardinella
	Hilsa kelee	Kelee shad
	Escualosa thoracata	White sardine
Pristigasteridae	*Opisthopterus tardoore*	Tardoore
	Pellona ditchela	Indian pellona
Scombridae	*Rastrelliger kanagurta*	Indian mackerel
	Scomberomorus commerson	Narrowbarred Spanish mackerel
Leiognathidae	*Leiognathus brevirostris*	Shortnose ponyfish
	Leiognathus splendens	Splendid pony
	Gazza achlamys	Naked toothpony
	Secutor insidiator	Pugnose ponyfish
Lactariidae	*Lactarius lactarius*	False trevally
Sciaenidae	*Otolithes ruber*	Tigertooth croaker
	Protonibea diacanthus	Spotted croaker
Sphyraenidae	*Sphyraena jello*	Pickhandle barracuda
Mullidae	*Upeneus bensasi*	Bensasi goatfish
Terapontidae	*Terapon jarbua*	Jarbua terapon
	Terapon puta	Smallscaled terapon
Sillaginidae	*Sillago sihama*	Silver sillago
Penaeidae	*Penaeus indicus*	Indian white shrimp
	Penaeus merguiensis	Banana prawn
	Penaeus monodon	Giant tiger prawn
	Metapenaeus dobsoni	Kadal shrimp
Portunidae	*Portunus pelagicus*	Blue swimming crab

Discussion

The seasonal variation pattern of the catch per unit appears to follow a similar trend in the both years studied. The period September-November could be considered as the peak period for the fishery and this coincides partially with the latter part of the south west monsoon. The other period with considerable amounts of catches, which is February-April, coincides with the latter part of the north east monsoon. Low catch rates were observed at the beginning of the two monsoons.

The results agree with those of Dayaratne (1985) who recorded the highest catches in small pelagic fishery in the coastal waters around Chilaw, during the period from August to October and from February to March. However, the research surveys carried out by "RV Dr. Fridtjof Nansen" has shown more complex fluctuations of the small pelagic stocks where the peak catches were observed during August-September and the lowest catches in April-June (Blindheim & Foyn 1980).

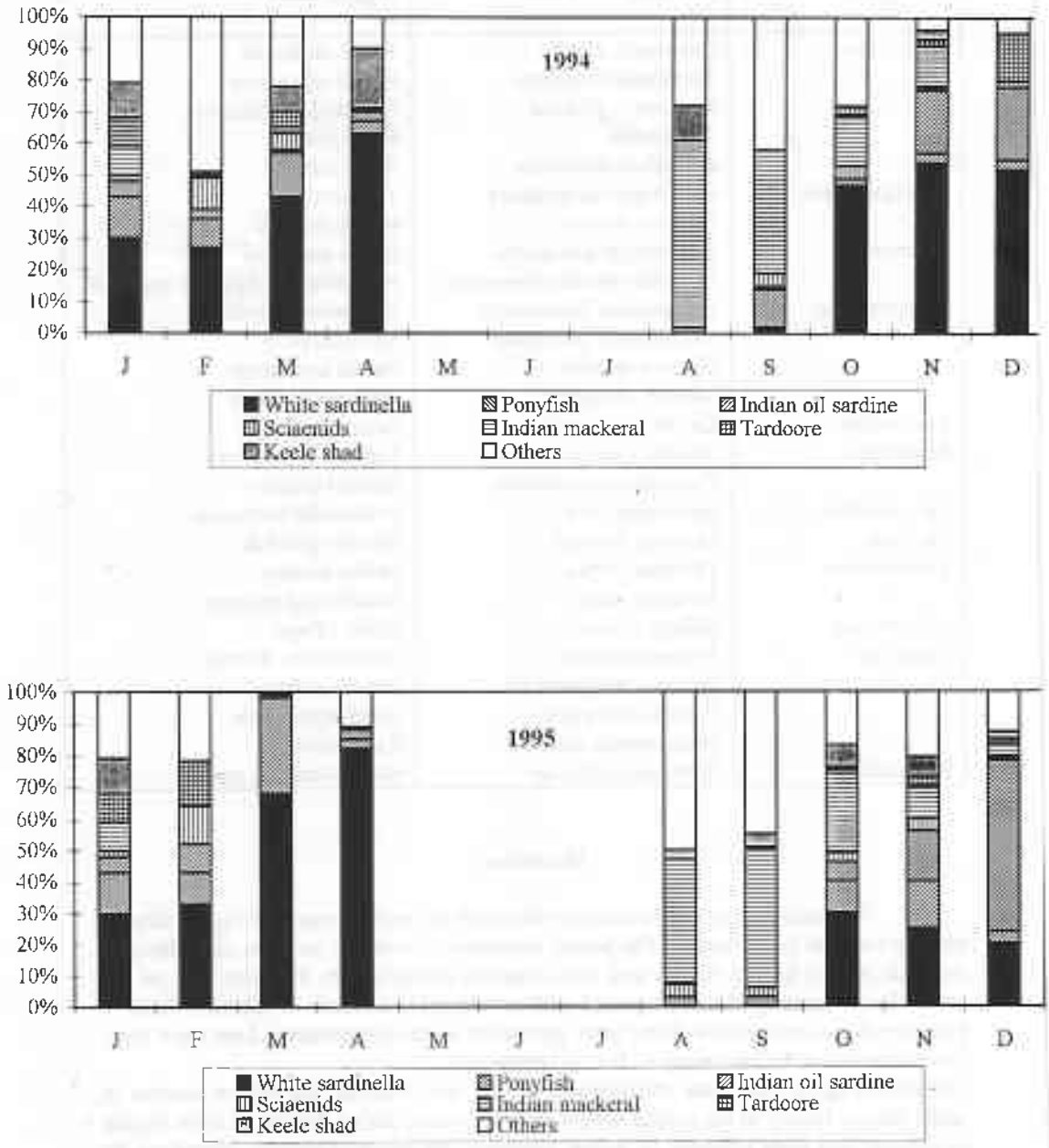


Fig. 8. Monthly variation in the percentage species composition of the catches.

Each year peak catches of two *Sardinella spp.* (*S. albella* and *S. longiceps*) were observed in October-November and March-April period and lowest catches in December-January. The comparatively low catches recorded during these months could probably be due to the spawning behaviour as the period of low catches coincides with the estimated spawning season of these sardines as recorded by Dayaratne (1983).

The variation pattern of the catch rates of *R. kanagurta* appears to differ from the other two species with the highest catches in August-November period and almost negligible catches in January-April period.

Studies conducted on the reproductive biology of *R. kanagurta* in the seas off India (Bennet 1964; Rao 1967) implies that the spawning of Indian mackerel occurs almost throughout the year except in November-January period with peaks in certain seasons. However, it is not clearly understood whether there is a relationship between the seasonality observed in the appearance of this species among the catches and the spawning behaviour since very little information is available on the reproductive biology of this species in the coastal waters around Sri Lanka.

The total annual fish production obtained from this fishery for the 1994 period was 332 MT which was almost the half of the total production obtained for the 1995 period (674 MT). This could have been due to the high mean catch rate and the effort recorded in 1995 period which lead to a remarkable high production especially in the months October, November and December of the 1995 period.

The study revealed that the two species of sardines (*S. albella* and *S. longiceps*) together contributed to around 53% of the total catch of the artisanal small pelagic fishery where the mean depth of fishing was 12.07 m (SD = 0.73). High relative abundance of these sardine species at a depths less than 20 m is frequently reported (Dayaratne 1985).

In addition to the Clupeids, finfish belonging to the families Scombridae, Leiognathidae, Lactariidae, Sciaenidae, Sphyraenidae, Mullidae, Terapontidae and Sillaginidae and the shellfish belonging to the families Penaeidae and Portunidae were recorded in the catches. This could be due to the wider continental shelf area in the north western coastal waters where more species are distributed in great abundance than in deeper waters.

The artisanal small pelagic fishery is carried out in the shallow coastal areas of the seas off Chilaw. These fishing grounds had been used for prawn trawling during the past few decades. The resource was also exploited by the traditional prawn fishermen using log rafts and trammel nets. They were also engaged in the small pelagic fishery especially in the periods where the prawn catches were low. However, after banning trawling for prawns in 1992, the resource is exclusively exploited by the traditional prawn fishermen with better economic returns.

The artisanal small pelagic fishery is mainly responsible for catches of certain varieties of small pelagic fish such as *S. albella*, *S. longiceps* and *R. kanagurta*. Although it does not seem to make significant contribution to the small pelagic fish catches from the Chilaw area, the study revealed that few thousands people in this area depend upon these traditional fishing activities for their livelihood almost throughout the year. According to the findings of the present investigation, contribution of sardines to this fishery is significant. The seasonal variation in the catch rates of these sardines could probably be due to reproductive behaviour of these fish. Therefore, detailed investigation should be conducted to study the reproductive biology and fishery of these

species. Studies on length at maturity, spawning time, spawning areas, level of maximum sustainable yield, and optimum effort seem to be most useful in fisheries point of view.

Acknowledgments

Authors wish to thank Messers H. A. R. E. Perera, M. G. K. Gunawardane, T. Upasena, H. D. Wimalasena and D. M. de Mel of National Aquatic Resources Research and Development Agency for their assistance given in the field work. Financial assistance provided by National Aquatic Resources Research and Development Agency is also gratefully acknowledged.

References

Bennet, P. S. 1964.
Seasonal abundance of small sized juvenile *Rastreliger kanagurta* at Vizhingam during 1960-1963. Indian Journal of Fisheries 11 (1&2): 391-406.

Blindheim, J. & L. Foyn 1980.
A survey of the coastal fish resources of Sri Lanka. Report No. III. Jan.-Feb. 1980, Reports on surveys with the R/V "Dr. Fridtjof Nansen", Institute of Marine Research, Bergen.

Dayaratne, N. M. P. J. 1985.
Age and growth studies of some sardines (*Sardinella spp.*) using the primary rings in otoliths. Proceedings of the 41 st Annual Sessions of the Sri Lanka Association for Advancement of Science (Abstract).

Dayaratne, P. 1983.
Age and growth studies of four *Sardinella* spp. from Sri Lanka by using primary growth rings in otoliths. M.Sc. Thesis. University of Bergen, Norway.

Dayaratne, P. 1984.
Fisheries biology of some small pelagic fish species (Clupeoides) from the west coast of Sri Lanka. Ph.D. Thesis. University of Bergen, Norway.

Dayaratne, P. 1985.
Some observations on the small meshed gillnet fishery in Negombo and Chilaw. Journal of National Aquatic Resources Agency of Sri Lanka 32: 65-81.

Joseph, B. D. L. 1975.
Purse seining for small pelagic fish around Sri Lanka. Bulletin of Fisheries Research Station, Sri Lanka 26: 31-43.

Karunasinghe, W. P. N. & P. Dayaratne 1986. Fishery and length based population studies of *Sardinella sirm* (Walbaum) from the southern coastal waters of Sri Lanka. Proceedings of the 42 nd Annual Sessions of the Sri Lanka Association for Advancement of Science (Abstract).

Karunasinghe, W. P. N. & M. Fonseka 1985.
A preliminary analysis of small mesh gillnet fishery in the inshore waters of Sri Lanka. Journal of National Aquatic Resources Agency, Sri Lanka 32: 34-45.

Karunasinghe, W. P. N. & M. J. S. Wijeyaratne 1995.
On the exploitation of trenched sardine, *Amblygaster sirm* (Walbaum) in the west coast of Sri Lanka. Journal of the National Science Council of Sri Lanka 23 (1): 1-7.

Rao, V. R. 1967.
Spawning behaviour and fecundity of the Indian mackerel *Rastrelliger kanagurta* (Cuvier) at Mangalore. Indian Journal of Fisheries 14 (1&2): 171-186.

Siddeek, M. S. M., L. Joseph, P. M. A. Jayasuriya & W. P. N. Karunasinghe 1985.
A preliminary analysis of length frequency data of *Amblygaster sirm* from Negombo Sri Lanka using ELEFAN programs. Journal of the National Aquatic Resources Agency, Sri Lanka 32: 46-56