Vidyodaya J., of Sci., (1992). Vol 4, No. 1, pp: 117 - 129

PRESENT STATUS OF THE SEINE FISHERY IN NEGOMBO LAGOON OF SRI LANKA.

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Received on : 24 - 09 - 1992

Accepted on : 16 - 03 - 1993

Abstract

Studies on the seine fishery of Negombo Lagoon in the west coast of Sri Lanka (7°10' N and 79°50' E) were carried out for a period of one year from May 1989 to April 1990. In the operation of this gear, 2 or 4 standard nets, each with a length of 32 m are used. Each net was made up of 4 or 5 vertically joined pieces of nets, with a stretched mesh size of 1.25 cm. 3 and 5 men are involved in 2 net and 4 net operations respectively. Total production from this gear was estimated to be around 36,000 kg/year. During the present study, 82 species of fish ranging in size from 2.5 cm to 130.0 cm were encountered together with 6 species of commercially important penaeid prawns. The catch and fishing effort were low from August to December. Catch per unit effort was high from February to May. Salinity and fish catch showed a significant positive correlation probably due to immigration of allochthonous marine organisms into the lagoon with increasing salinity. Fishing effort also showed a significant positive correlation with salinity. Significant difference between the catches of 4 net-piece and 5 net-piece nets was not observed ($P>0.05$). Although the catch and catch per fisherman were significantly higher in 4 net operations than in 2 net operations ($P<0.05$), significant difference in catch per net between the two operations was not observed ($P>0.05$). 2 Net operations were observed to provide more employment opportunities and better distribution of income than 4 net operations. Threat of overexploitation of the resource was observed to be high in 4 net operations.

Key words : Negombo Lagoon, Seine fishery.

1. Introduction

The Negombo Lagoon on the West coast of Sri Lanka (7° 10' N and 79° 50' E) with a surface area of 3100 ha has been identified as one of the most productive coastal environments in the tropics. Its annual fishery production has been estimated to be around 150 kg/ha (Samarakoon and van Zon 1991). As in most other tropical waters, variety of fishing gear is operated in this

lagoon. The contribution from seines to the total production of this brackish-water body has been estimated to be around 30 % (Wijeyaratne and Costa 1987 a). When compared with other types of gear operated in the lagoon which include cast nets, gill nets and brush parks, seining has been found to be the most labour intensive (Wijeyaratne and Costa 1987 b). In the management of small scale fisheries in developing countries, labour intensive gear play an important role in providing maximum social benefits since they mitigate the threat of unemployment at least to some extent (Kapetsky 1981, Panayotou 1982). Therefore, seines can be considered as an important type of gear in this highly productive ecosystem.

In the management of tropical fishery resources, catch and fishing effort statistics have become extremely important mainly because data on growth and mortality parameters of individual fish species are not available (Pauly 1984).

Present study was carried out to investigate on the catch and fishing effort of seines operated in the Negombo Lagoon as a prelude for the management of the fishery of this important gear in order to obtain the maximum social benefits.

2. Materials and Methods

The gear

The seine was 32 m in length. Height of the net varied with the number of net pieces used. Each net consistsed of 4 or 5 net pieces joined vertically with each other. Height of a net piece was approximately 1.25 m. Mesh size of the net was 1.25 cm stretched mesh. To the top and the bottom of the net, 2 net units each with a height of 10 cm were attached. Mesh size of these units was 3 cm stretched mesh. To the float line, 40 to 65 rubber or wooden floats were attached. The bottom line generally did not contain sinkers.

Operation procedure

During the operation, two standard nets were attached to each other and were hauled in shoulder deep water for about 25 minutes. The catch was collected on to the out triggered craft. Generally the net was hauled about 15 times during the operation. Usually two men were involved in hauling and one man stayed in the craft manoeuvering it. Sometimes hauling was carried out using two nets, each consisting of 2 standard nets attached to each other. In such operations where 4 standard nets were used, 4 men hauled the net and one man manoeuvered the craft.

Collection of data

Total fish catch of seines was sampled once a week from May 1989 to April 1990 at the fish landing site at Katunayake (Fig. 1). On each sampling day, total fish catch of each craft was weighed to the nearest 10 g. The fish were identified and the total lengths of the smallest and the largest specimens of each species were measured to the nearest 1 mm. Information on the size of the net, number of nets used, number of fishermen involved in the operation, number of times the net was hauled and the time spent in fishing were also recorded.

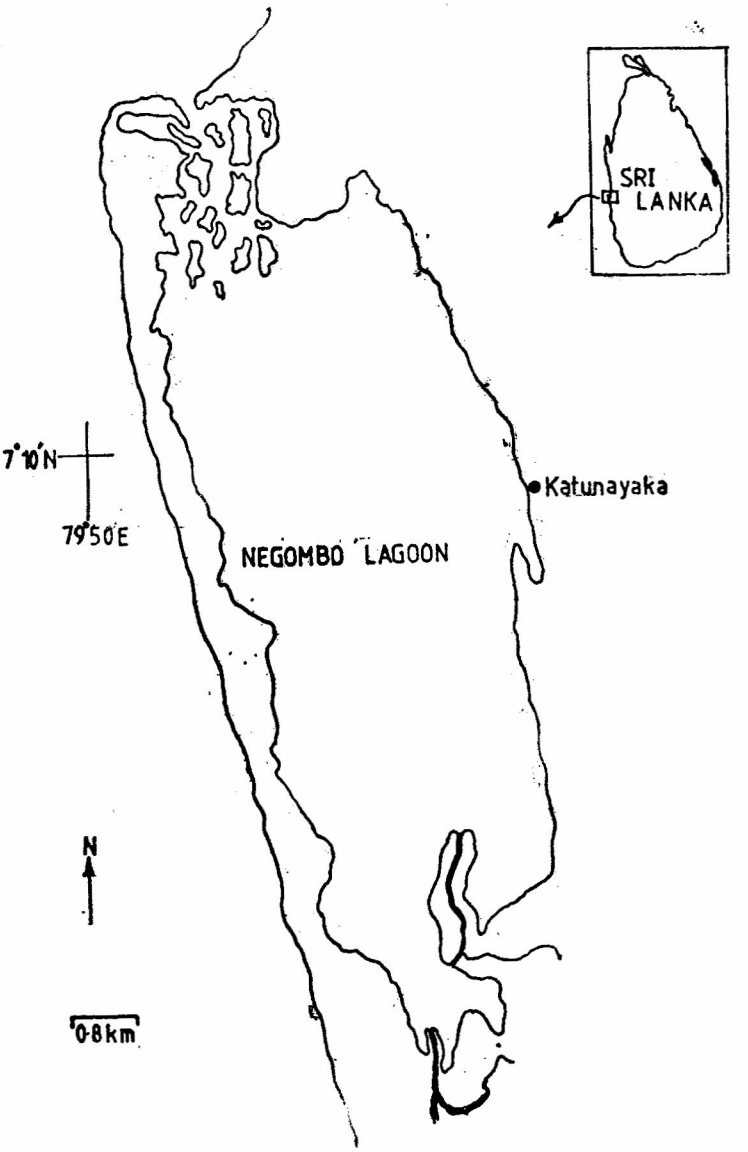

Fig. 1 Map of Negombo lagoon showing the sampling site.

On each sampling day, salinity was measured by a salinity refractometer. Rainfall data for the study period were obtained from the Meteorological Department.

Analysis of data

In the present study, fishing effort was estimated in man-hours and number of net-pieces hauled. The catch and the catch per unit effort for the operations using 2 nets, each with 4 and 5 net-pieces and for those using 4 nets, each with 5 net-pieces were calculated and were statistically compared using one way Analysis of Variance (Zar 1974).

The relationship of catch, fishing effort and catch per unit effort with environmental paramenters such as rainfall and salinity were determined by the Pearson's correlation coefficient. Correlation coefficients between fishing effort, catch and catch per unit effort were also calculated.

3. Results

Eighty two fish species belonging to 41 families were recorded during the present study. They were categorized into 3 groups, viz, allochthonous freshwater, allochthonous marine and autochthonous species and are listed in Table I. 4 Allochthonous freshwater, 58 allochthonous marine and 20 autochthonous species were recorded. The smallest species caught was a 2.5 cm long specimen of *Monodactylus argenteus*. The largest specimen recorded was a 130.0 cm long sea perch (*Lates calcarifer*) which weighed 9.1 kg.

Table I: Species of fish caught in the seines operated in Negombo Lagoon and their size range.

A: Allocthonous fishes from freshwater.

	Family	Species	Size-range (cm)
1.	Anguillidae	*Anguilla bicolor*	31.5-63.0
2.	Cichlidae	*Etroplus maculatus*	4.0-6.4
3.	Clariidae	*Clarias teysmanni*	15.1-34.5
4.	Cyprinodontidae	*Panchax panchax blochii*	3.1-4.6

B. Autocthonous fishes from brackishwater

	Family	Species	Size-range (cm)
1.	Ambassidae	*Ambassis commersoni*	5.0-9.6
		Ambassis gymnocephalus	5.6-9.7
2.	Bagridae	*Macrones gulio*	6.5-12.4
3.	Cichlidae	*Etroplus suratensis*	5.4-13.6
4.	Dorosomidae	*Nematalosa nasus*	9.1-14.5
5.	Dussumieridae	*Ehirava fluviatilis*	4.0-4.2
6.	Elopidae	*Elops machnata*	7.0-18.8
7.	Gobiidae	*Acentrogobius griseus*	5.2-7.8
		Glossogobius giuris	7.6-14.4
		Mugilogobius valigouva	4.3-6.2
8.	Megalopidae	*Megalops cyprinoides*	8.4-23.2
9.	Periophthalmidae	*Perhopithalmus koelreuteri*	5.4-8.5
10.	Tachysuridae	*Aroides dussumieri*	5.6-10.2
		Netuma thalassinus	4.3-8.4
		Osteogeneiosus militaris	6.1-18.6
		Pseudarius jella	10.3-14.5
		Tachysurus caelatus	6.8-7.9
		Tachysurus maculatus	9.0-21.0
		Tachysurus subrostratus	8.4-17.5
		Tachysurus venosus	9.6-20.3

C: Allocthonous fishes from the sea

	Family	Species	Size-range (cm)
1.	Belonidae	*Tylosurus leiurus*	34.3-41.2
2.	Carangidae	*Alectis cilioris*	12.8-16.3
		Carangoides gymnostethoides	18.3-20.4
		Caranx malabaricus	5.4-16.8
		Caranx ignobilis	5.5-15.3
		Caranx sunsun	5.4-18.1
		Gnathanodon speciosus	16.6-18.4
3.	Chanidae	*Chanos chanos*	7.5-32.1
4.	Clupeidae	*Kowala coval*	4.8-5.0
		Macrura kelee	8.0-13.4
		Sardinalla melanura	11.5-14.0
		Sardinella albella	9.6-12.0
5.	Cynoglossidae	*Cynoglossus lingua*	13.0-20.6
		Cynoglossus macrolepidotus	12.6-21.8
6.	Engraulidae	*Anchoviella commersonii*	5.0-6.2
		Thrissina baelama	4.5-6.0
		Thrissocles kammalensis	5.2-6.1

7.	Hemirhamphidae	*Hemirhamphus gaimardi*	11.0-13.1
		Hemirhamphus marginatus	13.0-21.3
8.	Lactariidae	*Lactarius lactarius*	11.0-16.4
9.	Latidae	*Lates calcarifer*	9.4-130.0
10.	Leiognathidae	*Leiognathus equulus*	6.0-9.6
		Leiognathus fasciatus	6.4-9.8
11.	Lethrinidae	*Lethrinus reticulatus*	11.8-15.4
12.	Lutianidae	*Lutianus argentimaculatus*	10.1-18.4
		Lutianus fulviflamma	5.1-13.5
13.	Mugilidae	*Liza dussumieri*	7.2-26.2
		Liza macrolepis	7.0-24.5
		Liza oligolepis	6.5-17.8
		Liza parsia	8.0-20.4
		Liza strongylocephalus	6.5-13.5
		Liza tade	7.0-26.5
		Liza waigiensis	6.5-22.0
		Mugil cephalus	7.8-40.0
		Valamugil buchanani	6.9-33.1
14.	Monodactylidae	*Monodactylus argenteus*	2.5-6.7
15.	Platycephalidae	*Thysanophrys indicus*	16.8-19.1
16.	Plotosidae	*Plotosus canius*	17.2-32.3
17.	Scatophagidae	*Scatophagus argus*	2.8-15.3
18.	Sciaenidae	*Otolithus rubra*	19.2-22.2
19.	Serranidae	*Epinephelus fario*	5.4-11.6
		Epinephelus merra	5.7-14.9
		Epinephelus tauvina	3.9-21.5
20.	Siganidae	*Siganus javus*	3.2-7.8
		Siganus oramin	4.3-10.1
		Siganus vermiculatus	4.5-23.0
21.	Sillaginidae	*Sillago sihama*	11.8-14.2
22.	Soleidae	*Brachirus orientalis*	14.0-17.8
23.	Sparidae	*Acanthopagrus berda*	5.4-10.5
		Acanthopagrus latus	10.3-17.2
24.	Sphyraenidae	*Sphyraena jello*	21.0-26.1
25.	Tetraodontidae	*Chelonodon fluviatilis*	3.7-9.4
		Chelonodon patoca	3.5-8.7
26.	Theraponidae	*Autisthes puta*	4.8-10.0
		Therapon jarbua	5.2-12.3
27.	Triacanthidae	*Triacanthus biaculeatus*	3.5-10.2
		Triacanthus brevirostris	3.7-10.6
28.	Trichiuridae	*Trichiurus savala*	22.0-38.0

Six species of prawns were also recorded in the catches. They were *Penaeus indicus, P. monodon, P. monocros, P. semisulcatus, Matapenaeus dobsoni* and *Macrobrachium rosenbergii.* Of these, *M. dobsoni* was the most abundant. *M. rosenbergii* was very rarely caught. Crab species such as *Scylla serrata* and *Portunus pelagicus* were also caught in small numbers.

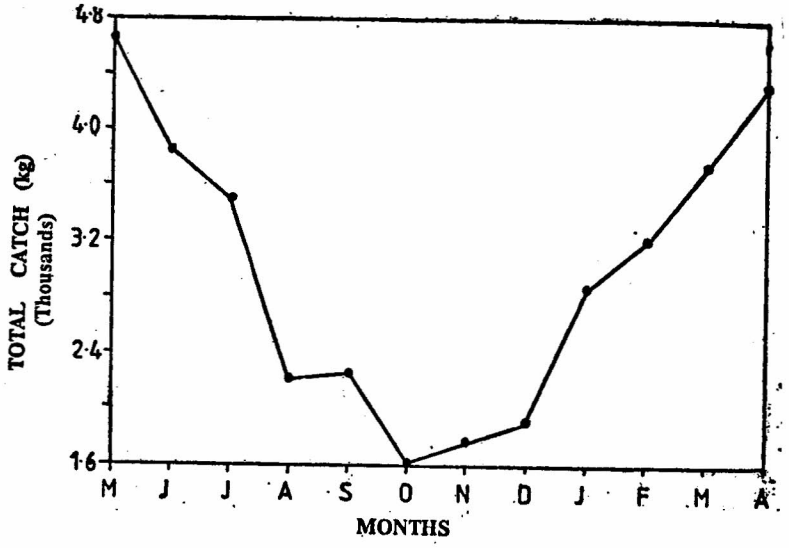

Fig. 2 Seasonal variation of monthly fish catches of the seines operated in Negombo Lagoon.

Seasonal variation pattern of the total fish catch is shown in Fig. 2. The highest catch of 4650 kg was recorded in May and the lowest catch of 1620 kg was obtained in October. A gradual decrease of the catch from May to October was evident. The catch increased from October to May.

The total yield from the seine fishery was estimated to be 35931.8 kg/year.

Seasonal variation pattern of the fishing effort is shown in Fig. 3. The fishing effort was found to be higher from March to July than in other months. The annual fishing effort was estimated to be around 51000 man-hours or 380,000 net-piece hauls.

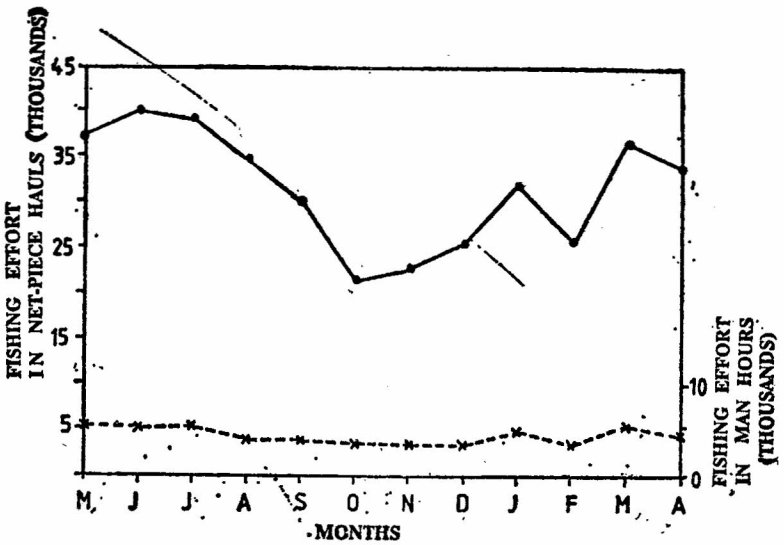

Fig. 3 Seasonal variation of the mean daily fishing effort of seines operated in Negombo Lagoon.

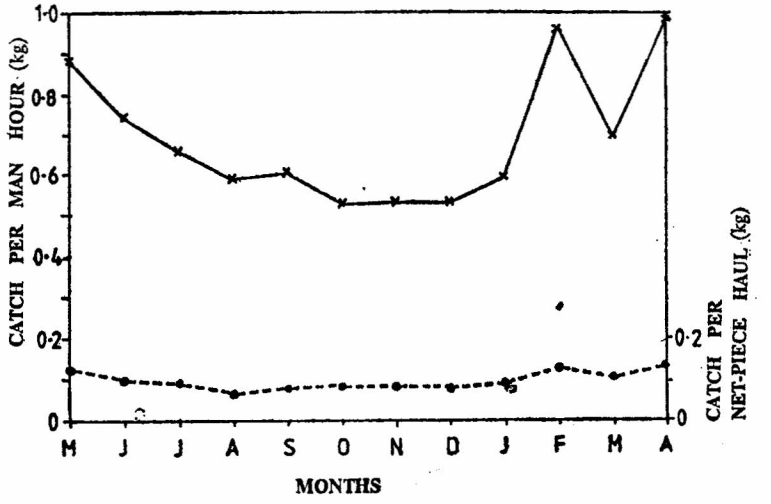

Fig. 4 Seasonal variation of the mean daily catch per unit effort of seines operated in Negombo lagoon.

Seasonal variation of the catch per unit effort (CPUE) is shown in Fig 4. CPUE was observed to be higher from February to May than in other months.

During the study period, the maximum rainfall of 600 mm was recorded in October. In January and July no rains were experienced. The values for salinity ranged from 0.2% observed in October to 3.2% observed in January.

Simple linear correlation coefficients between environmental parameters and catch-effort statistics are given in Table II. Although catch, fishing effort and CPUE were negatively correlated with rainfall, the correlation coefficients were statistically not significant ($P>0.05$). The catch and fishing effort showed a significant positive correlation with salinity ($P<0.05$). The correlation coefficients between CPUE and the parameters such as salinity and fishing effort were found to be statistically not significant ($P>0.05$)

Table II: Simple linear correlation coefficients between environmental parameters and catch-effort statistics of seines operated in Negombo lagoon.

C	=	Total catch
CPUE1	=	Catch per net-piece haul
CPUE2	=	Catch per man-hour
E1	=	Fishing effort in net-piece hauls
E2	=	Fishing effort in man-hours

PAIR OF PARAMETERS			CORRELATION COEFFICIENT	P
Rainfall	*	C	—0.45	>0.05
	*	CPUE1	—0.27	>0.05
	*	CPUE2	—0.25	>0.05
	*	E 1	—0.48	>0.05
	*	E 2	—0.49	>0.05
Salinity	*	C	+0.67	<0.05
	*	CPUE1	+0.48	>0.05
	*	CPUE2	+0.50	>0.05
	*	E 1	+0.65	<0.05
	*	E 2	+0.62	<0.05
C	*	E 1	+0.77	<0.05
	*	E 2	+0.79	<0.05
CPUE1	*	E 1	—0.29	>0.05
CPUE2	*	E 2	—0.28	>0.05

Table III: Catch and fishing effort statistics of the seines of different sizes. (Standard deviations are given within brackets).

	2 net operation (Each net with 4 net-pieces)		2 net operation (Each net with 5 net-pieces)		4 net operation (Each net with 5 net-pieces)	
Mean catch per day (kg)	12.42	(5.23)	12.05	(2.44)	32.84	(11.26)
Mean number of hauls per day	13.20	(1.82)	13.16	(1.17)	14.69	(3.32)
Mean catch per net per day (kg)	6.21	(2.61)	6.03	(1.22)	8.21	(2.82)
Mean catch per net per haul (kg)	0.47	(0.19)	0.46	(0.11)	0.59	(0.25)
No of fishermen involved in operation	3	(0.00)	3	(0.00)	5	(0.00)
Mean daily catch per fisherman (kg)	4.14	(1.74)	4.02	(0.81)	6.57	(2.25)

Catch and effort statistics for the seines of different sizes are summarized in Table III. Results of the Analyses of Variances carried out for these data are given in Table IV. Catch, catch per net and catch per net per haul were found to be not significantly different in the nets with 4 net-pieces and 5 net-pieces ($P>0.05$). However, when 4 nets are used in the operation, total catch and catch per fisherman were found to be significantly higher than those in 2 net operations ($P<0.05$). Catch per net, number of hauls per day and catch per net per haul were found to be not significantly different between 2 net operations and 4 net operations ($P0>.05$).

Table IV: Summary of the results of analysis of variance performed on daily catch and effort data of the seines of different sizes.

	SOURCE	DF	SS	MS	F	P
Mean catch						
	Factor	2	1986.5	993.3	25.97	0.000
	Error	24	917.9	38.2		
	Total	26	2904.4			
Mean catch per net						
	Factor	2	20.82	10.41	2.26	0.126
	Error	24	110.58	4.61		
	Total	26	131.40			
Catch per fisherman						
	Factor	2	29.18	14.59	6.15	0.007
	Error	24	56.90	2.37		
	Total	26	86.70			
Number of hauls						
	Factor	2	10.61	5.31	1.32	0.287
	Error	24	96.78	4.03		
	Total	26	107.39			
Catch per net per haul						
	Factor	2	0.0691	0.0345	1.15	0.333
	Error	24	0.7208	0.0300		
	Total	26	0.7899			

4. Discussion

Total number of fish species observed in the present study is higher than the number that has been recorded earlier from this estuary by De Silva and Silva (1979). Nine families, namely, Bagridae, Clariidae, Cynoglossidae, Dorosomidae, Elopidae, Hemirhamphidae, Monodactylidae, Platycephalidae, and Sillaginidae were observed in this study in addition to those recorded by De Silva and Silva (1979). However, 6 families namely Acanthuroidaee, Atherinidae, Eleotridae, Lagocephalidae, Mullidae and Plectorhychidae, which have been recorded by De Silva and Silva (1979) were not encountred in the present study. This may possibly has resulted due to the differences in the types of gear sampled in the two studies. De Silva and Silva (1979) obtained their samples from brush parks while the present study dealt with seines. Therefore, it is possible that differences in the spatial distribution and preference to a particular habitat of different species have contributed to the variations in the species composition encountered in the two studies.

Three families, viz, Lethrinidae, Monodactylidae and Platycephalidae which were observed in the present study have not been recorded by Pillai (1965) who has carried out an extensive study on brackishwater fish and fisheries of Sri Lanka.

Of the 82 fish species recorded, *Chelodon patoca* and *C. fluviatilis* are not consumed because their flesh is considered to be poisonous. Economically most valuable food fishes were *Lates calcarifer*, *Siganus spp.*, *Liza spp.*, *Mugil cephalus*, *Chanos chanos* and *Etroplus suratensis*. Small individuals of *Scatophagus argus*, *Monodactylus argenteus*, *Lates calcarifer* and *Epinephelus spp.* are important as ornamental fish and aquaculture seed. When caught, they are kept alive to be sold separately.

Total fish catch of seines estimated in the present study is higher than that recorded in 1980—82 by Wijeyaratne and Costa (1987 a). However, the total fishing effort in man-hours estimated in the present study is smaller than the value recorded in 1980—82. The reason for high catches observed in the present study may possibly be attributed to the environmental conditions. The 1980—82 period was characterized with unusually dry weather conditions. Low productivity may have resulted due to low rainfall which has minimized the surface run-off and river discharges into the lagoon which bring in large amount of nutrients responsible for high productivity.

When the seasonal variation pattern of total fish catch was considered, during 1980—82 low catches from this gear have been recorded from November to February (Wijeyaratne and Costa 1987 a). In the present study, low catches were observed from August to December. However, in 1980—82 and in the present study, high catches were recorded from April to July.

In 1980—82, total fishing effort of this gear was observed to be high from February to May and in October (Wijeyaratne and Costa 1987 b). In the present study, fishing effort was observed to be low from April to December and in February. However, in 1980—82 period and in the present study high values for fishing effort have been recorded in April and May. These results indicate that the seasonal variation patterns of catch and fishing effort of a particular fishery may vary from time to time.

High values for CPUE observed from February to May indicate that there is a possibility of increasing the fishing effort during this period. However, since the total catch and CPUE are low from August to December, it is desirable to maintain the fishing effort at a minimum level during these months.

The main reason for the significant positive correlation observed between fish catch and salinity is the increased migration of allochthonous marine species into the lagoon during the period of high salinities (McDowall, 1988).

When salinity is high, fishermen, through experience know that there is high amount of fish in the lagoon and much fishing effort is exerted during these periods. Thus, a significant positive correlation results between the fishing effort and salinity.

Statistical analysis indicates that there is no significant difference in the total catch per net between 4 net-piece nets and 5 net-piece nets. Therefore, use of nets with 5 net-pieces instead of 4, will only increase the cost of preparation of the net.

Similarly, there is no significant difference in the catch per net between the 4 net and 2 net operations. However, the total catch and catch per haul are significantly higher in 4 net operations than in 2 net operations as expected. Statistical analysis also indicates that the catch per fisherman is significantly higher in 4 net operations than in 2 net operations.

In the developing countries, management of fisheries should be aimed also at generating more employment and distribution of income (Panayotou 1982). Results of the present study indicate that 2 net operations provide more employment opportunities and a better distribution of income than 4 net operations. In addition, due to higher fish catches, threat of over exploitation of the resources is also higher in 4 net operations than in 2 net operations.

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