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STUDIES ON THE EXPLOITATION OF MINOR CYPRINIDS IN PARAKRAMA SAMUDRA, A MAN - MADE LAKE IN SRI LANKA, USING GILLNETS

by

U. S. AMARASINGHE

National Aquatic Resources Agency.

ABSTRACT

Experimental fishing trials with gillnets of 14 mm, 18 mm, 26 mm, 38 mm, 44 mm, and 52 mm stretched mesh sizes were carried out from October 1982 to July 1983 in Parakrama Samudra, an ancient man-made lake in Sri Lanka, in order to investigate the effective mesh sizes for catching small cyprinids and also to examine the spatial and seasonal variations of their relative activities. The results indicate that gillnets of 18 mm mesh size were the most efficient for catching *Amblypharyngodon melettinus* and *Rasbora daniconius* while *Puntius filamentosus*, *P. dorsalis* and *P. chola* could be effectively caught using gillnets of 38 mm mesh size. 52 mm mesh size was more effective for larger specimens of *P. dorsalis*. Fishing trials carried out during day time showed that efficient exploitation of *A. melettinus* could be done from 4.30 pm to 7.30 p.m. using gillnets of 18 mm mesh size in the off-shore areas. *P. filamentosus* and *P. dorsalis* is best exploited using 38 mm and 52 mm mesh bottom set nets during night. Catch efficiencies were higher during the seasons of low water level.

INTRODUCTION

The Sri Lankan fresh water fish fauna consists of 53 species of which more than half belong to the family Cyprinidae. Majority of these cyprinid fishes are small and are economically unimportant as food fishes. They are abundantly present in man-made reservoirs in the low country and form an important resource which still remain untapped. Costa (personal communication) in a memorandum to the Minister of Fisheries in 1979, indicated the abundance of these trash fish in the low country reservoirs and suggested that these fish should be profitably exploited as dried fish or for conversion into fish meal. As a follow-up to this suggestion, a few trials were carried out by the Fisheries Research Station in some reservoirs but they were later abandoned due to lack of research personnel. Recently however, the value of this resource has been again spotlighted (Schiemer and Hofer 1983; De Silva 1985). Schiemer and Hofer (1983) reported the abundance of small cyprinids such as *Puntius dorsalis*, *P. filamentosus*, *P. chola* and *Amblypharyngodon melettinus* in Parakrama Samudra.

Since all the reservoirs in Sri Lanka contain large populations of *Oreochromis* (Tilapia) *mossambicus* which form about 90% of the commercial catches, the exploitation of these cyprinids will have to be carried out in such a way so as not to damage the existing juvenile populations of *O. mossambicus* which would ultimately be recruited to the fishery. A series of experimental gillnet fishing trials was therefore planned and carried out in Parakrama Samudra with a view to determine which of the mesh sizes would provide the best catches of these different minor cyprinid fish species and which time of the day and year would be the most suitable for this fishery.

MATERIALS AND METHODS

The fishing trials reported in this paper were carried out in Parakrama Samudra between October 1982 and July 1983. The dimensions of experimental gillnets and the number of fishing trials carried out are given in Table 1. It was assumed that since the dimensions of gillnets of each mesh size were similar, the catch efficiencies of gillnets of each mesh size were the same. Montly fishing trials were carried out with gillnets of the mesh sizes 18 mm and 38 mm.

TABLE 1

Dimensions of experimental gillnets and the number of fishing trials.

Stretched Mesh size mm	*ply*	*Hanging ratio*	*Depth m*	*Length m*	*No. of fishing trials* *Surface*	*Bottom*
14	02	0.5	0.7	22.7	—	6
18	02	0.5	0.9	13.5	14	25
26	02	0.5	1.4	19.5	—	4
38	02	0.5	2.1	28.5	31	39
44	02	0.5	2.7	33.0	15	10
52	02	0.5	3.2	39.0	6	9

The fishing trials with gillnets of mesh sizes 14 mm and 26 mm were abandoned in April 1983 because the catches of these mesh sizes were very poor. Gillnets of 44 mm and 52 mm mesh sizes were operated monthly from April to July 1983. The results of this study are expressed as the number of individuals per net piece per hour. Most of the fishing trials were carried out in the off-shore (depth range 3-6.5 m) and littoral areas (depth range 1-2.75 m) of the northern basin of the reservoir. A few trials however, were conducted in the middle and southern basins for comparison (Fig. 1) Gillnets were set close to the surface and near the bottom of the reservoir simultaneously. Only the depths of fishing areas that exceed the height of each gillnet (Table 1) were chosen to set gillnets properly. Conseqently in this paper, the bottom and the surface areas are referred to "net-heights" of the water column from the bottom and the surface respectively. In the shallow areas, the nets that were set extended almost to the bottom. In these instances, the catches in the upper and lower halves of nets were recorded separately. No attempts were made to study the vertical distribution of fish since it is of little importance from the point of view of commercial exploitation, using gillnets. The nets were lifted at two hourly intervals during the fishing trials conducted from 10.00 am to 8.00 pm. The reason for selecting this time range for studying hourly actvitiy patterns of minor cyprinids in the reservoir is that during the preliminary observations in August 1982 when some fishing trials were carried out, these fishes were appeared to be active in the afternoon. In the night trials, nets were exposed from late in the evening to morning hours (6.00 p.m. to 6.00 a.m.). Samples of male and female *A. melettinus*, *P. filamentosus* and *P. dorsalis* were preserved in formalin for later determination of parameters such as standard length, percentage maturity etc.

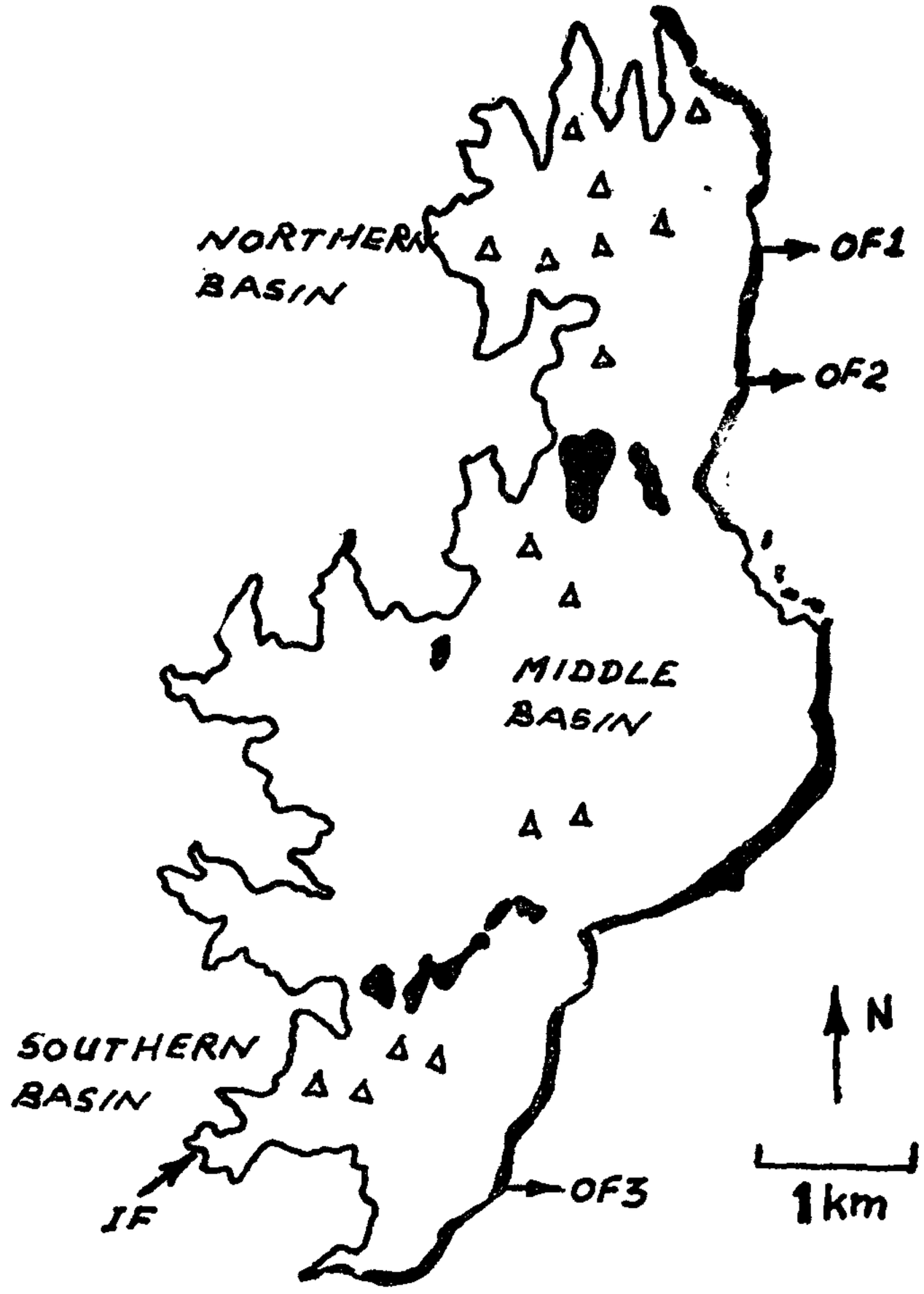

Figure 1 : Map of Parakrama Samudra. OF1, OF2, OF3 — Sluices; IF — Inflow; Triangles show the sampling stations.

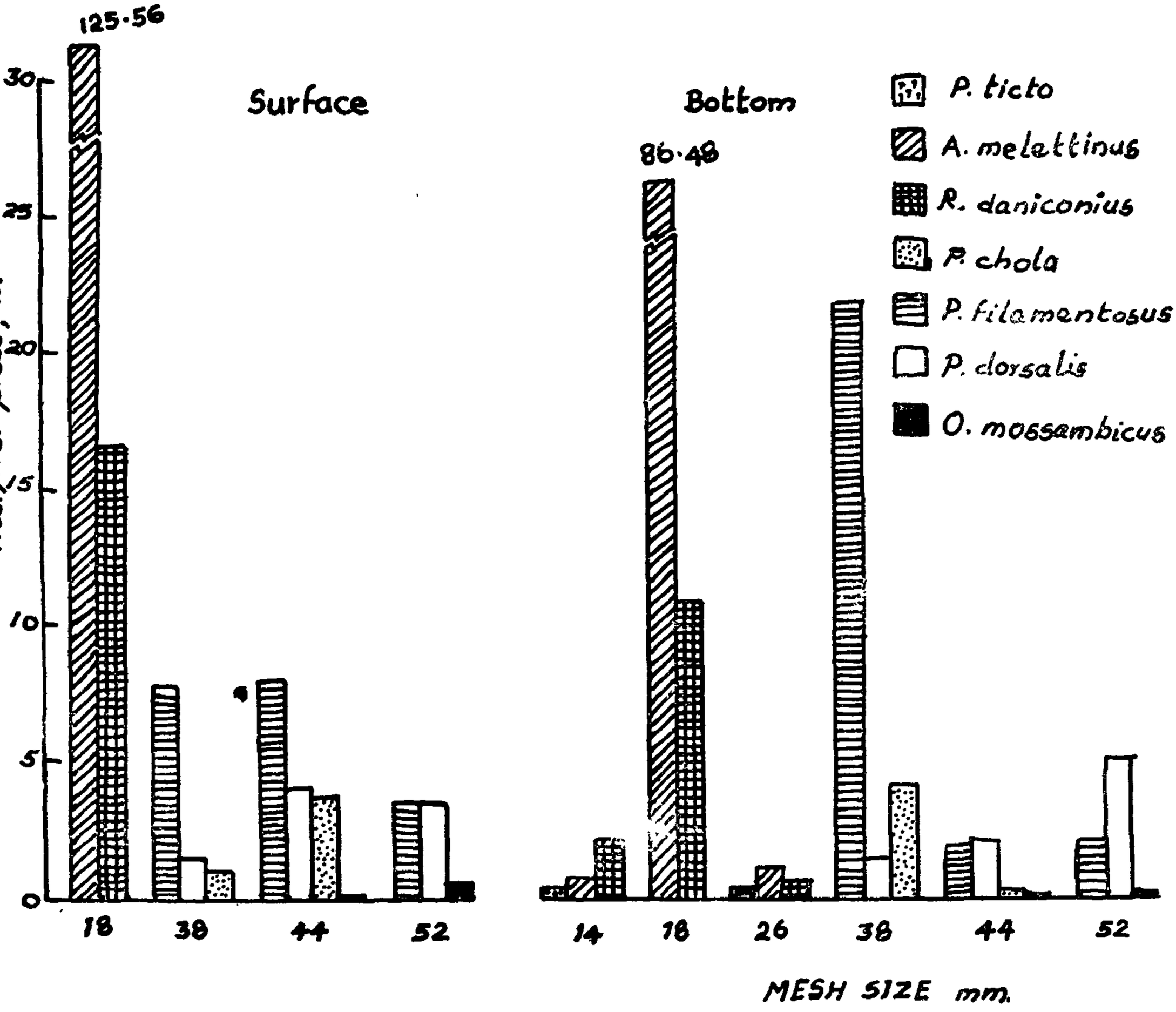

Figure 2 : Efficiencies of different mesh sizes upon different species in surface and bottom areas of the lake.

Note : Efficiencies are comparable only within each mesh size.

RESULTS

The efficiencies of catching different species of fish by nets of different mesh size in the surface and the bottom of the reservoir are shown in Fig. 2. These indicate that nets with a stretched mesh size of 18 mm is about the most effective for catching *A. mellettinus* and *Rasbora daniconius* while nets with mesh sizes of 38 mm and 52 mm effectively catch *P. filamentosus*, *P. dorsalis* and *P. chola.* The difference between the numbers of *A. melettinus* caught from the surface and the bottom of the reservoir with gillnets of 18 mm mesh size were found to be highly significant ($p < 0.001$; Table 2). Similar results were obtained for the *P. filamentosus* catches

TABLE 2

X^2 TEST TO COMPARE THE CATCHES OF *A. melettinus* CAUGHT USING NETS OF 18 mm MESH SIZE IN THE SURFACE AND THE BOTTOM AREAS

	Fishing hours	*% fishing hours*	*Observed numbers*	*Expected numbers*	X^2
Surface	55.25	49.63	3402	3591.23	
Bottom	56.08	50.37	3834	3644.77	
	111.33	100	7236	7236	19.795

using nets of 38 mm mesh size. The activity patterns of *A. melettinus* and *R. daniconius* expressed as numbers caught using 18 mm nets from 10.00 a.m. to 6.00 p.m. are shown in Figs 3a and 3b in the surface areas and in the bottom areas respectively. The numbers caught indicate that *A. melettinus* is more active in the mid-day and in the evening both in the upper and the lower parts of the water column while *R. daniconius* shows a relatively high activity in the upper part during the mid-day. The relative numbers of *P. filamentosus*, *P. dorsalis* and *P. chola* entangled in 38 mm nets from 10.00 a.m. to 8.00 p.m. in the upper and the bottom areas of the water column are shown in Figs 4a and 4b respectively. From the numbers caught, it appears

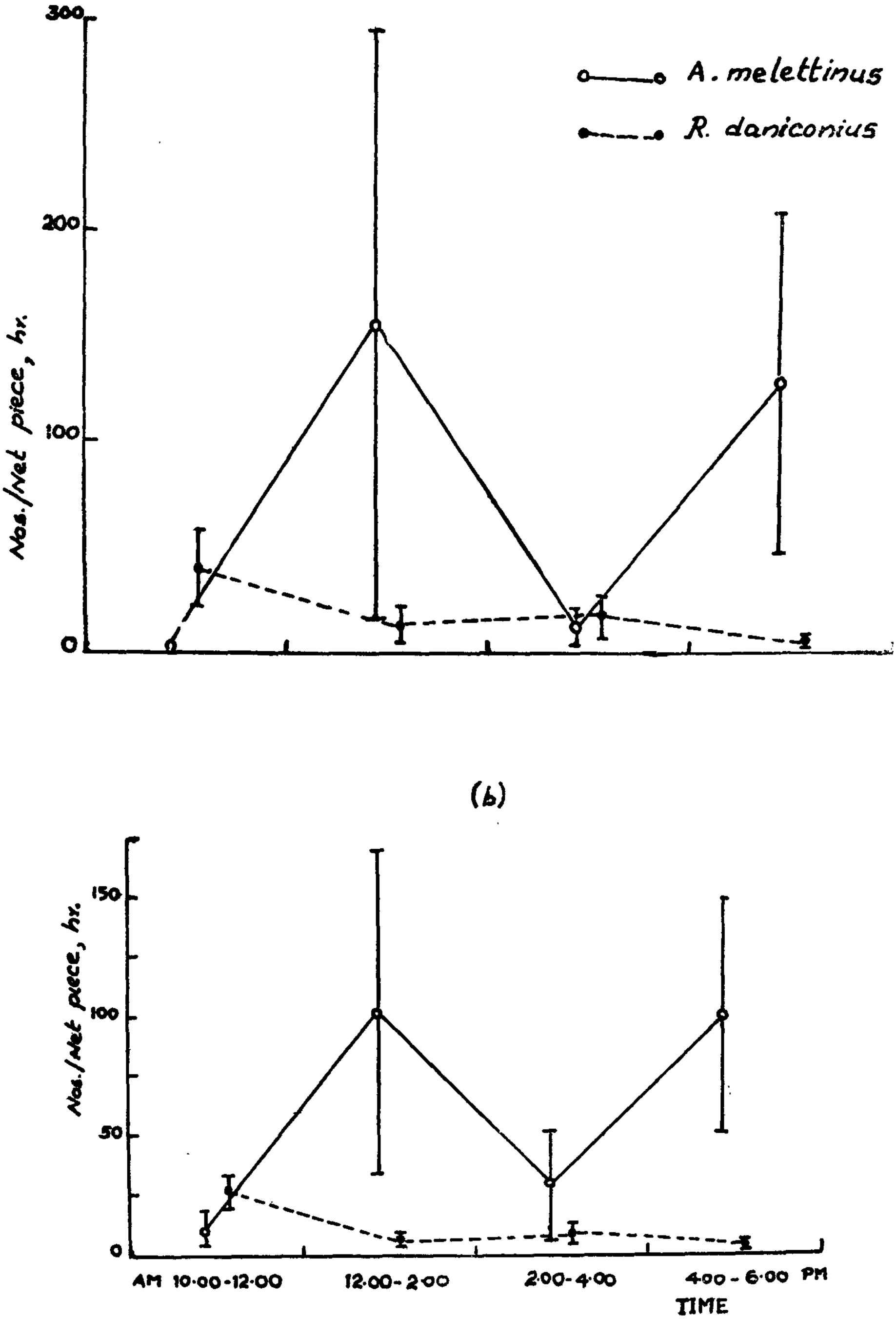

Figure 3 : The activity pattern of *A. melettinus* and *R. doniconius* in offshore areas expressed as numbers caught in 18mm mesh size nets between 10.00 a.m. and 6.00 p.m. a. surface areas; b. Bottom areas; Vertical lines -- 2SE

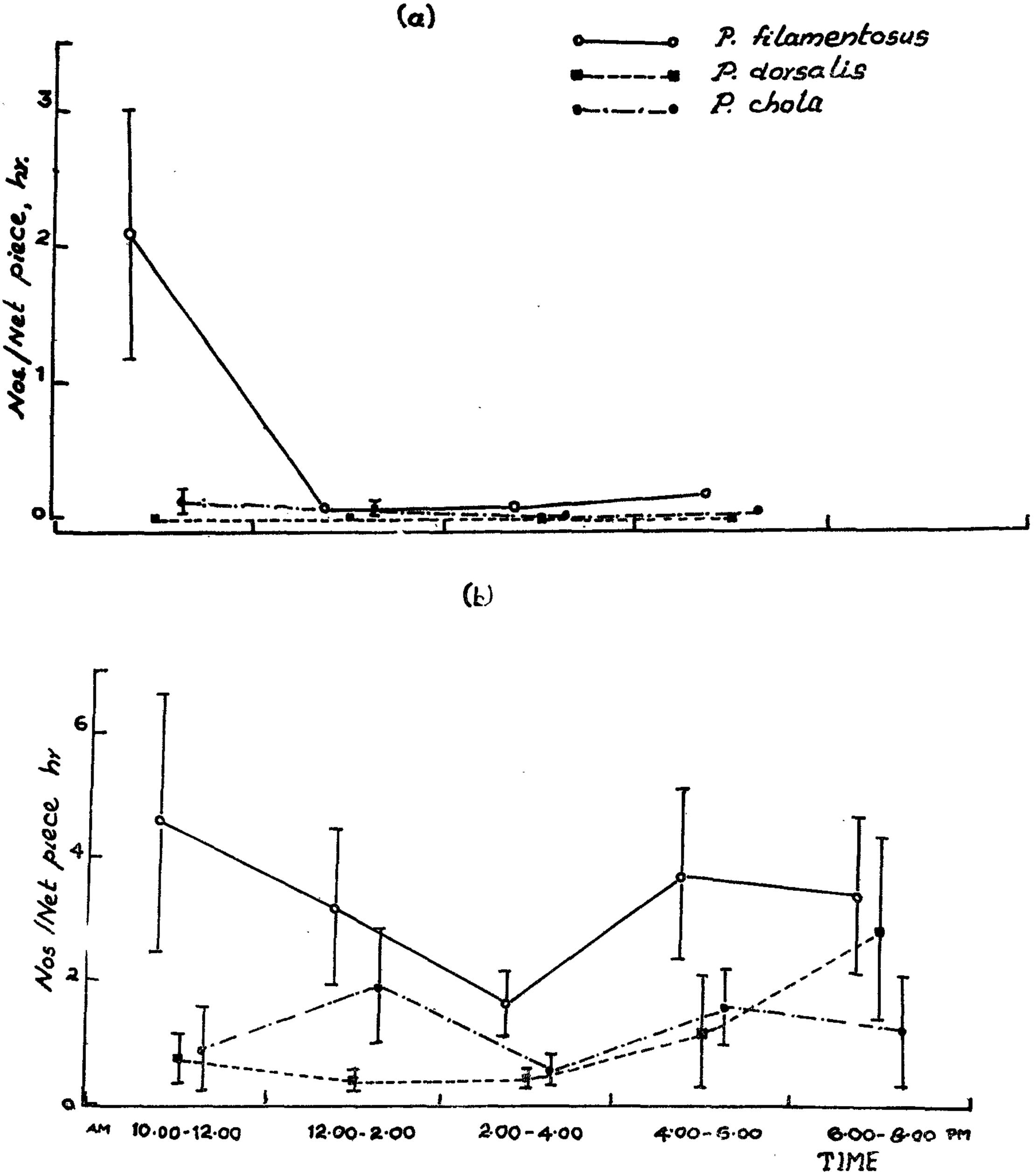

Figure 4 : The day time (10.00 a.m. — 8.00 p.m.) activity patterns of *P. filamentosus*, *P. dorsalis* and *P. chola* in offshore areas as expressed by the numbers caught using nets of 38mm mesh size. a. Surface areas; b. Bottom areas; Vertical lines — 2SE

that these three species are more active close to the bottom than in the upper parts of the water column. The peak activity of *P. filamentosus* is observed in the upper water column in the morning and in the lower water column both in the morning and in the evening. However, the *P. filamentosus* numbers caught during the morning hours were relatively low (Fig. 4a). From the results expressed in Fig. 5, it could be concluded that *P. dorsalis* is mostly active in

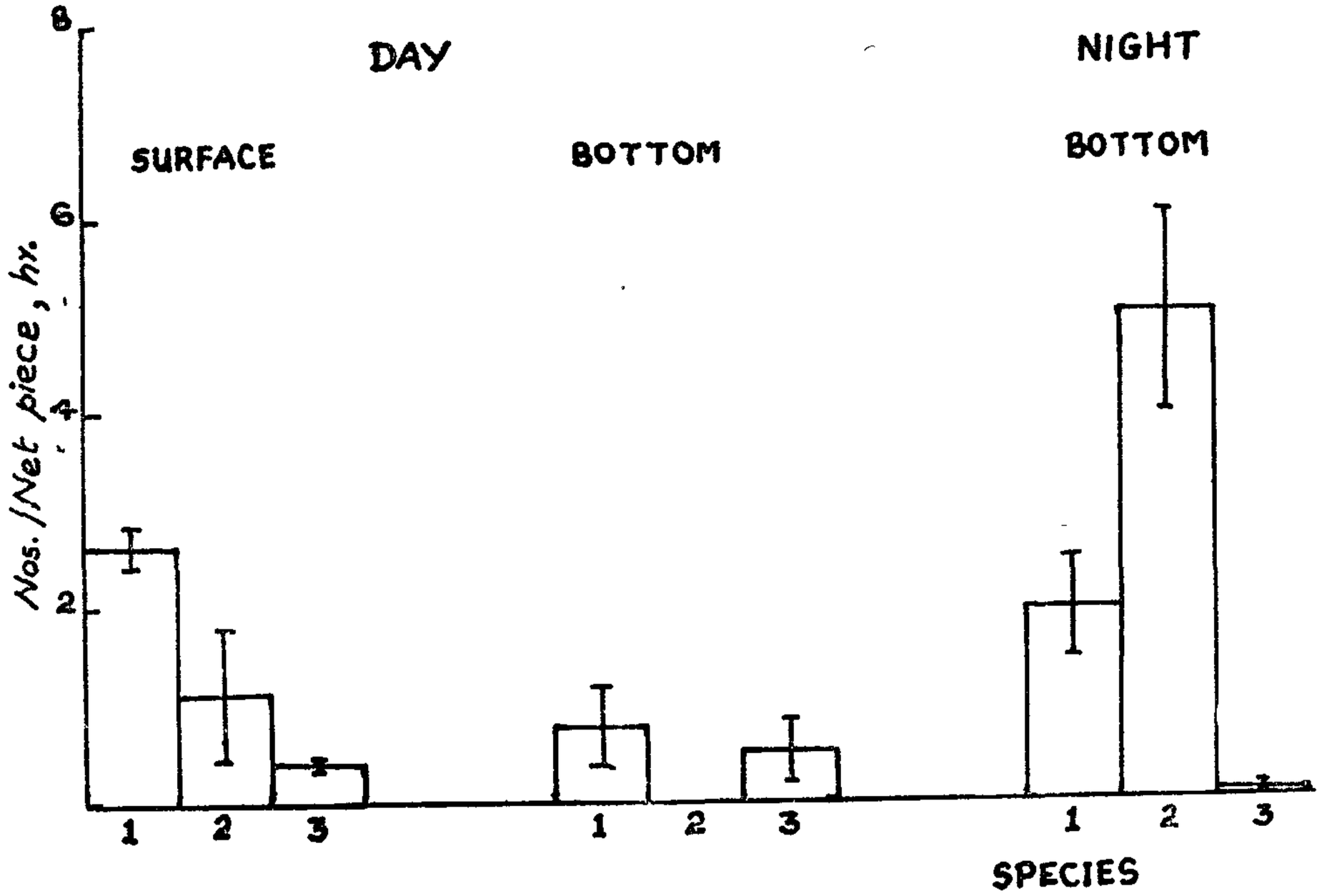

Figure 5 : Catch efficiencies of three species of fishes caught in 52mm mesh nets in off-shore areas during day time (10.00 a.m. 6.00 p.m.) and night hours. (6.00 p.m. - 6.00 a.m.) 1- *P. filamentosus;* 2- *P. dorsalis;* 3- *O. mossambicus* vertical lines – 2SE.

the lower part of the water column in the night hours (6.00 p.m. - 6.00 a.m.). Also, *P. dorsalis* caught in 38 mm mesh size showed a high activity pattern close to the bottom after 6.00 p.m. (Fig. 4b). 52 mm appears to be the best mesh size to catch these fish (Fig. 2).

Length frequency measurements expressed as percentages for mature and immature *A. melettinus*, *P. filamentosus* and for *P. dorsalis* caught in different mesh sizes are given in Figs. 6a-e. *A. mellettinus* caught in 18 mm mesh size and the other species caught in 38 mm and 52 mm mesh sizes consist of very small percentages of immature fish. Seasonal variation of the relative evening activity patterns of *A. melettinus* and *R. daniconius* within upper and lower parts of the water column are shown in Figs. 7a and 7b. Monthly fluctuations of the activity patterns of *P. filamentosus*, *P. dorsalis* and *P. chola* in the off-shore areas are also shown in Fig. 8b for the bottom layers. Monthly fluctuations of water levels in Parakrama Samudra are also incorporated in Figs. 7 and 8. From these results, it is evident that all five species are less active in the off-shore areas of the reservoir during the months of high water level.

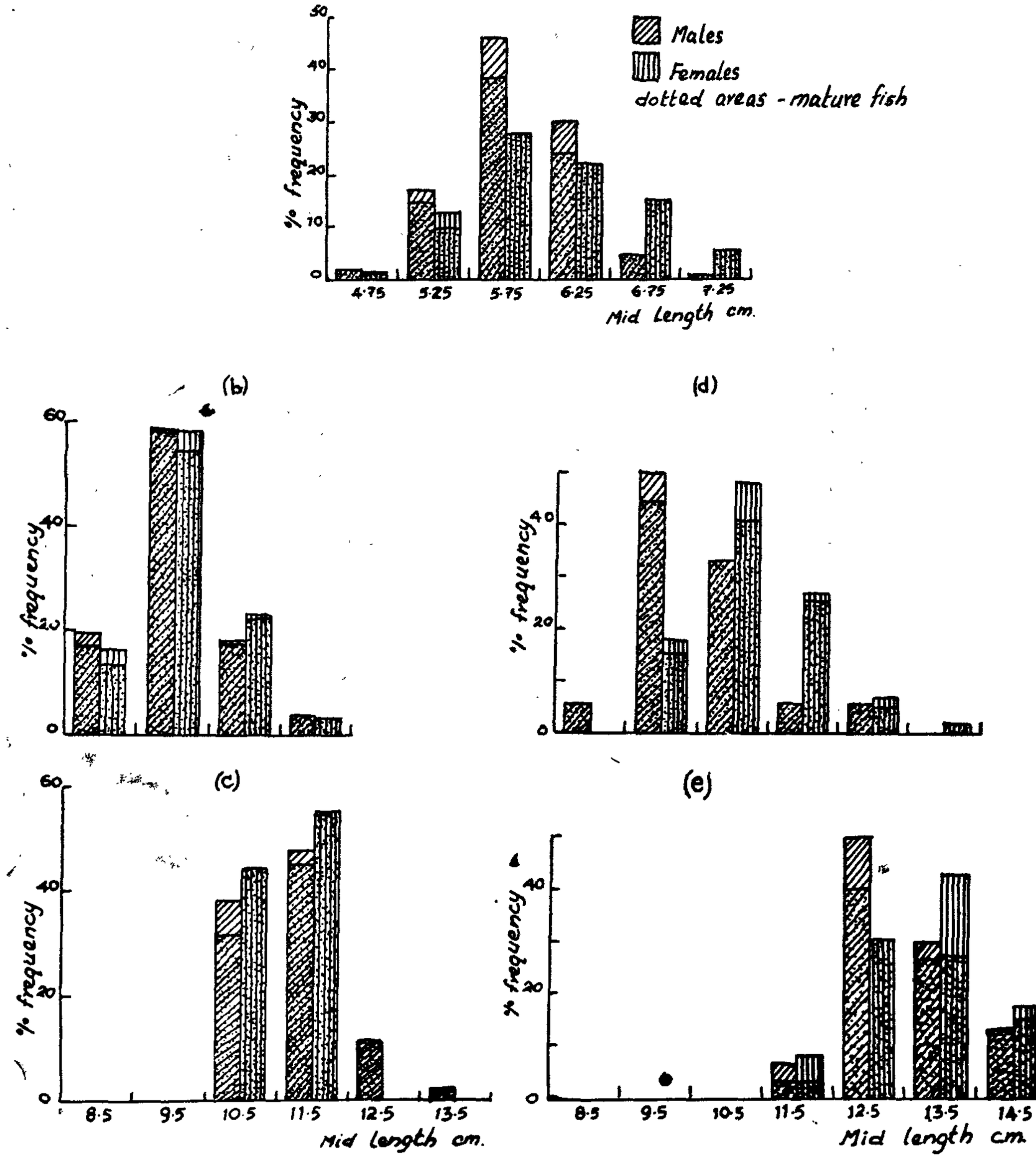

Figure 6: Percentage length (standard) frequencies of *A. melettinus*, *P. filamentosus* and *P. dorsalis* caught in different mesh sizes a. *A.melettinus* in 18mm mesh size; b. *P. filamentosus* in 38 mm mesh size; c. *P. filamentosus* in 52 mm mesh size; d. *P. dorsalis* in 38 mm mesh size; e. *P. dorsalis* in 52 mm mesh size.

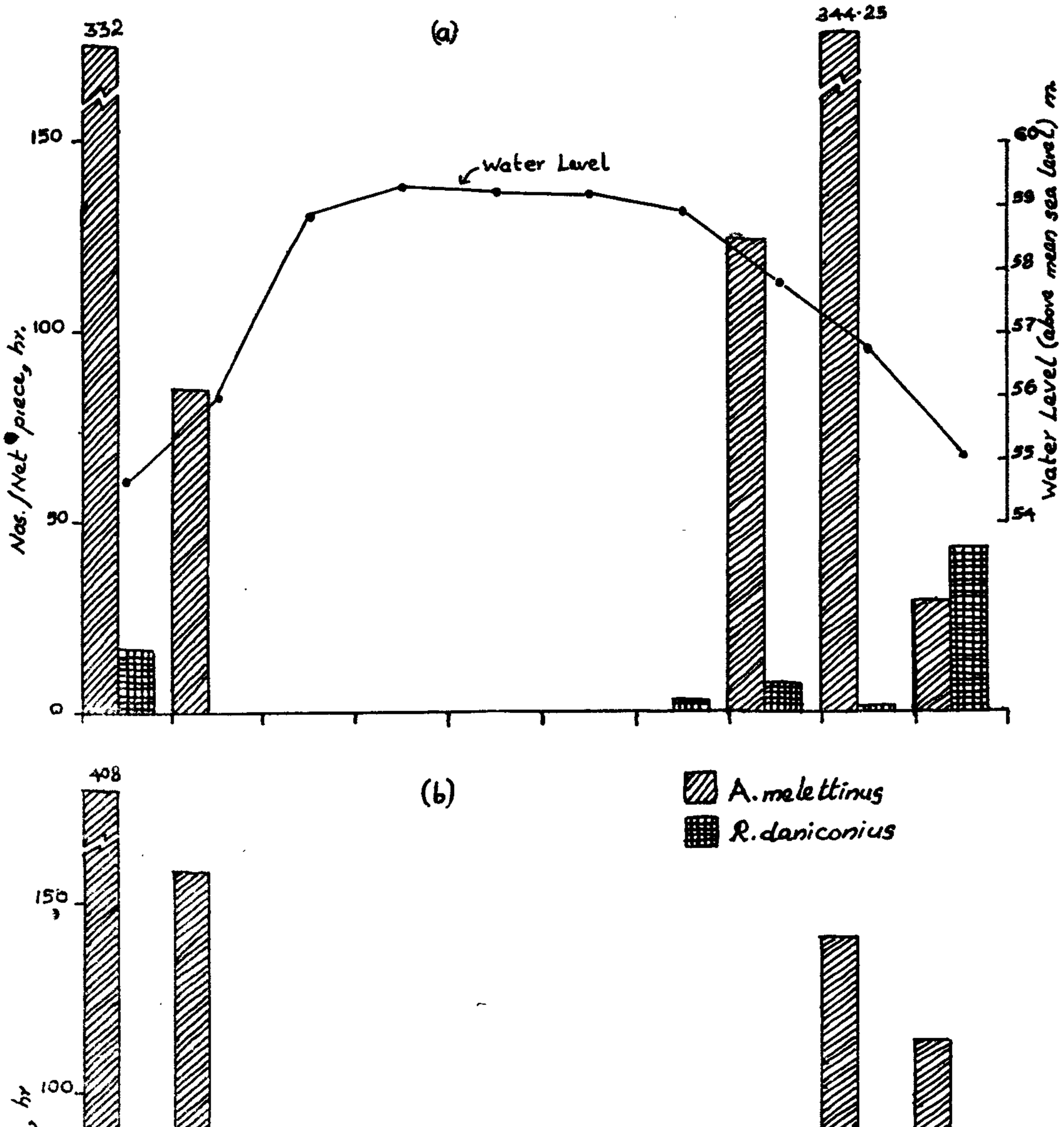

Figure 7 : Seasonal variation of relative efficiencies of *A. melettinus* and *R. daniconius* caught in 18mm gillnets hours. Water level fluctuations are also shown here. a. Surface; b. Bottom. Note : No fishing trials were carried out in February and March.

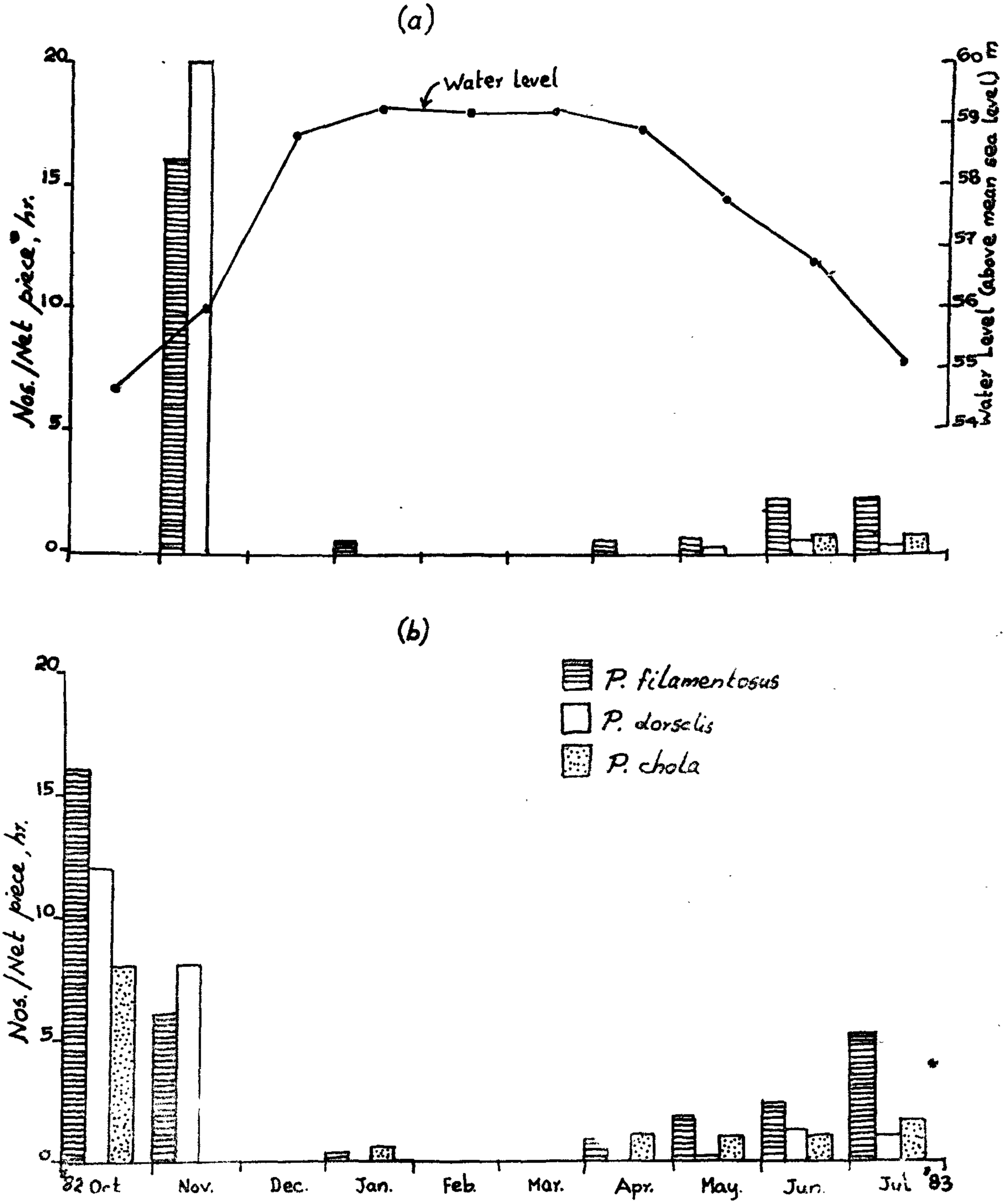

Figure 8 : Seasonal variation of relative efficiencies of *P. filamentosus P. dorsalis* and *P. chola* caught in 38mm gillnets the day time (10.00 a.m. – 6.00 p.m.). Water level fluctuations are also shown here. a. Surface; b. Bottom Note : No fishing trials were carried out in February & March.

DISCUSSION

The present study carried out in Parakrama Samudra indicates that nets of different mesh sizes could be effectively used to catch the presently unutilized small cyprinids that are abundantly present in this reservoir. This study has also provided some information on the spatial and seasonal variations of the relative activity patterns of these fishes which are pre-requisites to monitor a research programme to study their fishery potential. The relative activities of different species of cyprinids, measured as catch per unit effort (ie. individuals, net^{-1}, hour^{-1}) showed seasonal and spatial changes in the northern basin of the reservoir. A similar, but a more pronounced pattern was observed in the middle and southern basins. The relatively high activity close to the surface in the off-shore areas during the mid-day by *R. daniconius* may be due to its feeding habit. This species is predominately carnivorous (De Silva *et al.*, 1980) and has been recorded to be migrating to the surface to feed in the upper part of the water column (Schiemer and Hofer, 1983). *A. melettinus* which showed a high activity pattern in the evening close to the limnetic zone could be efficiently caught using gillnets of 18 mm mesh size.

P. filamentosus is usually more abundant in the littoral areas of the lake than in the open lake areas (Hofer and Schiemer, 1983). However. since *Oreochromis mossambicus* juveniles usually prefer shallow waters, *P. filamentosus* if fished should be in the off-shore areas using nets of 38 mm mesh size. Both *A. melettinus* and *P. filamentosus* were found to be different in the surface and the bottom waters. From Fig. 4, it appears that *P. dorsalis* and *P. chola* are obviously active in the bottom of the off-shore areas with a considerable variation in activity between 10.00 a.m. and 8.00 p.m. The reason for their high activities close to the bottom is due to their remarkably similar feeding habits (Schiemer and Hofer, 1983). From this study, it appears that the most effective mesh size for *P. filamentosus* is 38 mm while *P. dorsalis* can be caught using 38 mm mesh sizes as well as 52 mm mesh sizes.

It has been recorded that gut contents of *P. dorsalis* increase from sunset until midnight indicating that its feeding peak hours are in the night (Schiemer and Hofer, 1983). *P. dorsalis* could therefore be effectively exploited during night using gillnets of 38 mm for small specimens and 52 mm mesh size for large specimens. The activities of all these cyprinids considerably fluctuate seasonally. Their poor activities in the off-shore areas during the seasons of high water level (see Figs. 7 and 8) may possibly be due to their dispersion in a vast volume of water or due to their migration towards the inshore areas which have submerged vegetation where fish can find shelter and food. However, further investigations will be required to arrive at any conclusion on their inshore migratory behavioural patterns during the seasons of high water level. The exploitation of minor cyprinids, although present in large numbers in the littoral areas in some seasons, using gillnets will have to be differentially exploited because of the potential danger of destroying recruitment stages of *O. mossambicus* which might subsequently affect adversely on the existing commerical fishery.

Since this study is only of a preliminary nature, before suggesting a sound policy for exploitatiion of this untapped resource, it will be necessary that, further investigations will have to be carried out to determine firstly, the feeding chronology of minor cyprinids in Parakrama Samudra, secondly, their activity patterns in relation to feeding behaviour and thirdly, the optimum level of potential exploitation of these minor cyprinids in the different parts of the reservoir by conducting more diverse experimental gillnet fishing trials.

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