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MORPHOMETRY OF A MAN - MADE LAKE IN SRI LANKA : A FACTOR INFLUENCING RECRUITMENT TO CICHLID FISHERY

by

U. S. AMARASINGHE & T. UPASENA

National Aquatic Resources Agency.

ABSTRACT

Morphometry of Parakrama Samudra, a man-made lake in Sri Lanka, was studied in relation to location of nests of *Oreochromis* (*Tilapia*) *mossambicus*. Nests of *O. mossambicus*, the dominant fish species in the reservoir, occurred in the depth range 100-160 cm. Fluctuations in the water level do not interrupt nesting behaviour. Reproductive failure therefore cannot be ascribed to fluctuations in water level. The peak spawning season of *O. mossambicus* in August is followed by elevation of water level in the reservoir during December to May. During this period, a part of the jungle areas around the reservoir becomes inundated. This provides a large feeding area for the young stages, with rich supply of food. Consequently the occurrence of a peak recruitment season is evident in April/May.

INTRODUCTION

It is well known that the morphometry of a lake is an important factor influencing fish production (Fryer and Iles, 1972). In Sri Lanka, freshwater fish production is almost entirely obtained from the man-made reservoirs which differ morphometrically. Parakrama Samudra is an ancient man-made lake 2662 ha. in extent at full supply level. It sustains a commercial fishery where *Oreochromis* (*Tilapia*) *mossambicus* forms the major part of the catch. This fish provides a relatively cheap protein source for rural communities. Opinions differ on the influence of water level upon fish production in Parakrama Samudra. De Silva and Chandrasoma (1980) and De Silva (1983) stated that depletion of *O. mossambicus* was owing to inflow of water from the Mahaweli river diversion project. However, De Silva and Fernando (1980) stated that increase of *O. mossambicus* was due to increased water level because of the same river diversion project. De Silva (1985) found a relationship between the water level fluctuations in a particular year and the fish yield three years later. In this paper, morphometry of Parakrama Samudra is shown as a factor influencing recruitment to the cichlid fishery.

MATERIALS AND METHODS

Bottom topography of Parakrama Samudra was determined from July to November 1982. Depth measurements were taken at different locations each of which was mapped by bearings from at lest three land-marks using a hand compass. The water depth was expressed n meters above mean sea level. The data of present study and the other available information (Schiemer, 1983; Fernando, 1984) were used to prepare the bathymetric map of Parakrama

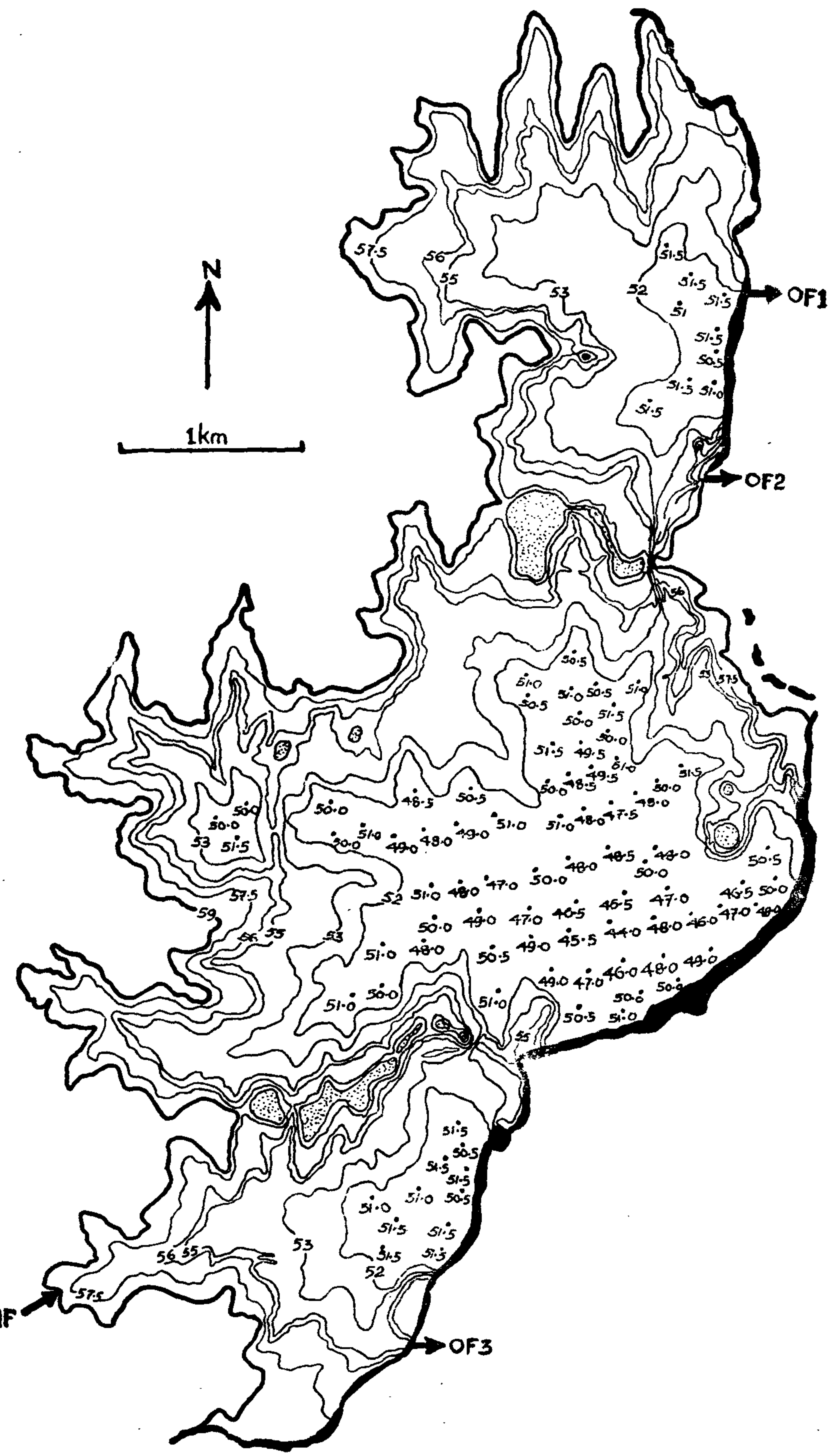

Fig. 1. Bathymetric map of Parakrama Samudra. Contour lines and other depths are in meters above mean sea level. (IF-inflow; OF1, OF2, OF3 - outlets). Contour lines were not drawn for the area of dead storage.

Samudra (Fig. 1). The nests of *O. mossambicus* were observed along a number of transects during July, August 1982 and March 1983 (Fig. 2). Water depth and the nature of bottom (i.e. muddy, sandy, rocky etc.) were also noted at locations of newly built nests (Fryer and Iles, 1972). Secchi disc depths in three basins of Parakrama Samudra during different seasons (Table 1), were obtained from various sources (Dokulil *et al.*, 1983; E. I. L. Silva, personal communication). Total length of *O. mossambicus* was determined to the nearest 5 mm from the commercial catches from June 1982 to December 1983. Monthly variations in density of

TABLE 1.

SECCHI DISC VISIBILITY IN METERS IN THREE BASINS OF PARAKRAMA SAMUDRA DURING DIFFERENT SEASONS

Date	*Northern basin*	*Middle basin*	*Southern basin*	*Source*
14.09.79	0.6	—	—	—
01.03.80	1.37	1.78	1.36	Dokulil *et al.*
07.03.80	1.20	1.95	—	(1983)
17.03.80	1.15	1.85	—	
17.11.82	1.25	0.85	0.22	E. I. L. Silva
20.01.83	1.29	—	—	(pers. comm.)

O. mossambicus expressed as individuals per net piece, per day were also determined from randomly selected boats. For this purpose, the boats which practice "beating technique", a modified gillnet fishing method (Amarasinghe and Pitcher, 1986), were excluded. More than sixty percent of the boats engaged in typical gillnet fishing were examined for 4-5 days a month. The daily water level data for Parakrama Samudra from June 1982 to December 1983 were obtained from the Irrigation Department.

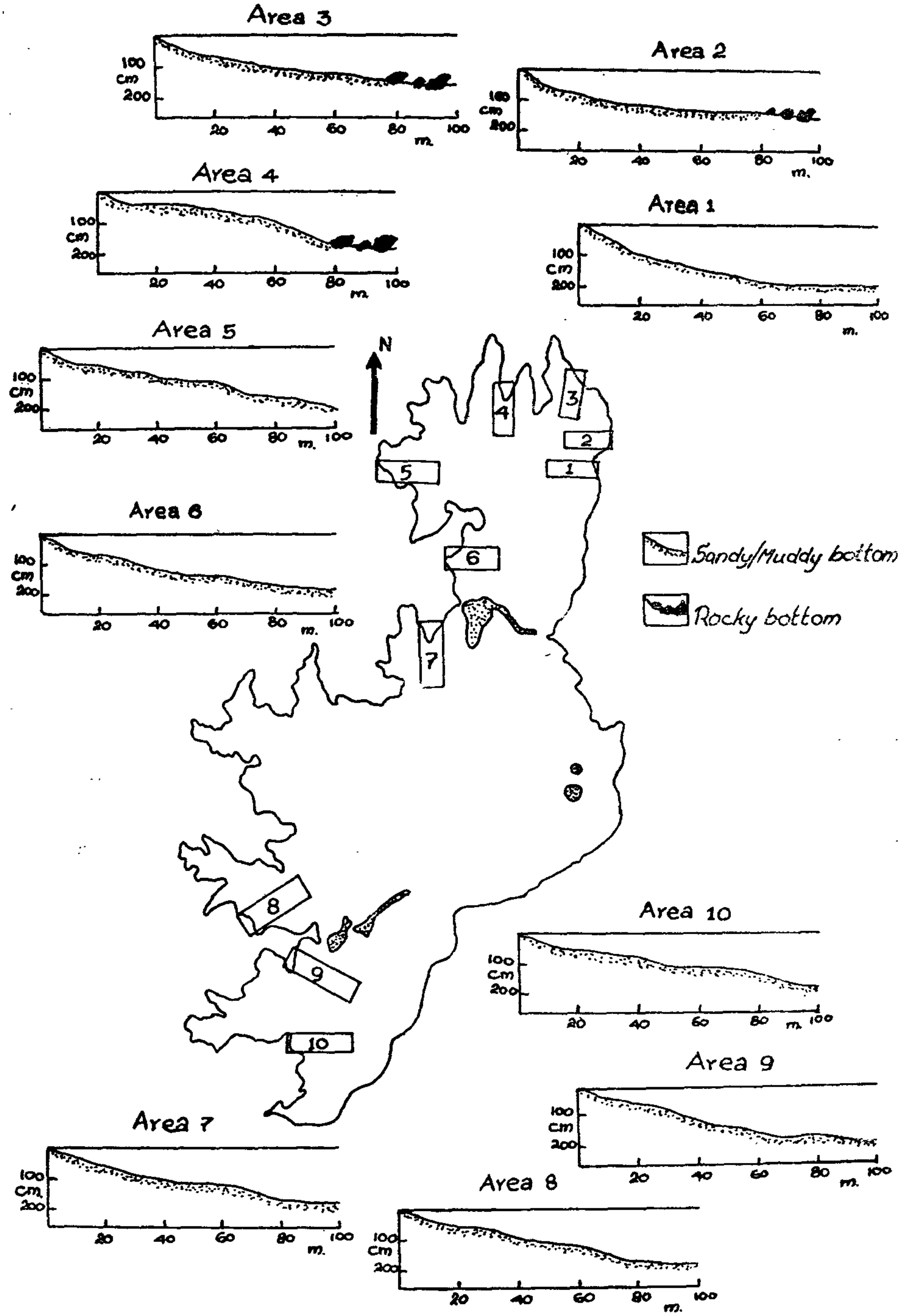

Fig. 2. Diagramatic representation of ten locations observed for the nesting sites of *O. mossambicus* and nature of the bottom.

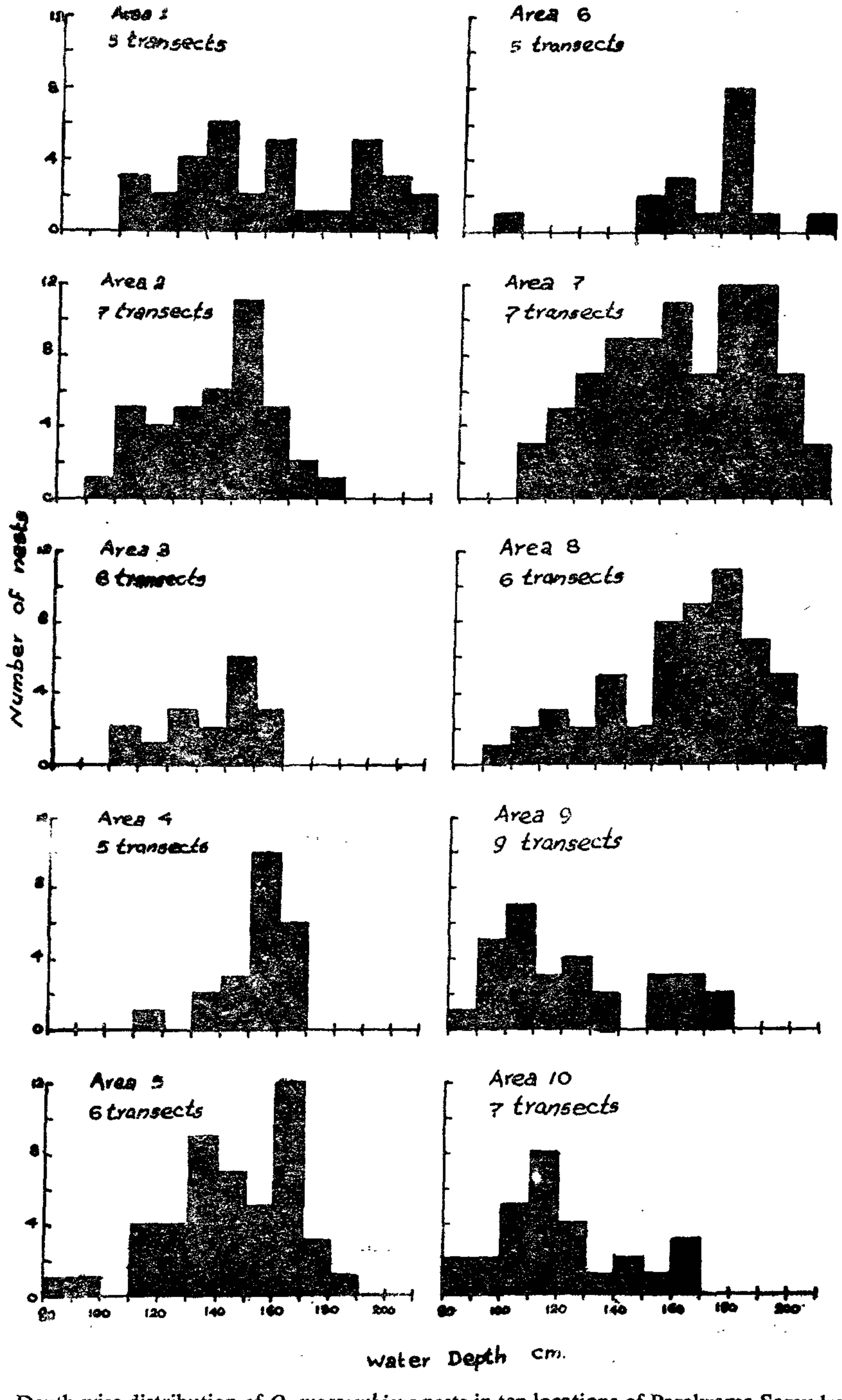

Fig. 3. Depth-wise distribution of *O. mossambicus* nests in ten locations of Parakrama Samudra. Areas 1 to 6 — Northern basin; Areas 7 & 8 Middle basin; Areas 9 & 10 — Southern basin.

RESULTS

Nature of the bottom at ten locations where nesting sites of *O. mossambicus* were observed is shown in Fig. 2. The nests were found in water deeper than 60 cm. The optimum depth for construction of nests is variable. In the northern basin, it was about 145 cm while in the middle and the southern basins, they were about 160 cm and 100 cm respectively (Fig. 3). Length frequency distribution of the commercial catches of *O. mossambicus* showed that the small individuals were abundant in April-May 1983 (Fig. 4). Changes in the density/catch efficiency of *O. mossambicus*, their monthly mean landing size and the water level fluctuations in the reservoir are shown in Fig. 5. The density or catch efficiency of *O. mossambicus* declined when the water level increased in December 1982. During the following four months, the density of *O. mossambicus* remained more or less constant while the mean landing size gradually declined. This was followed by an increase in the stock density and further declined in the mean landing size of *O. mossambicus.*

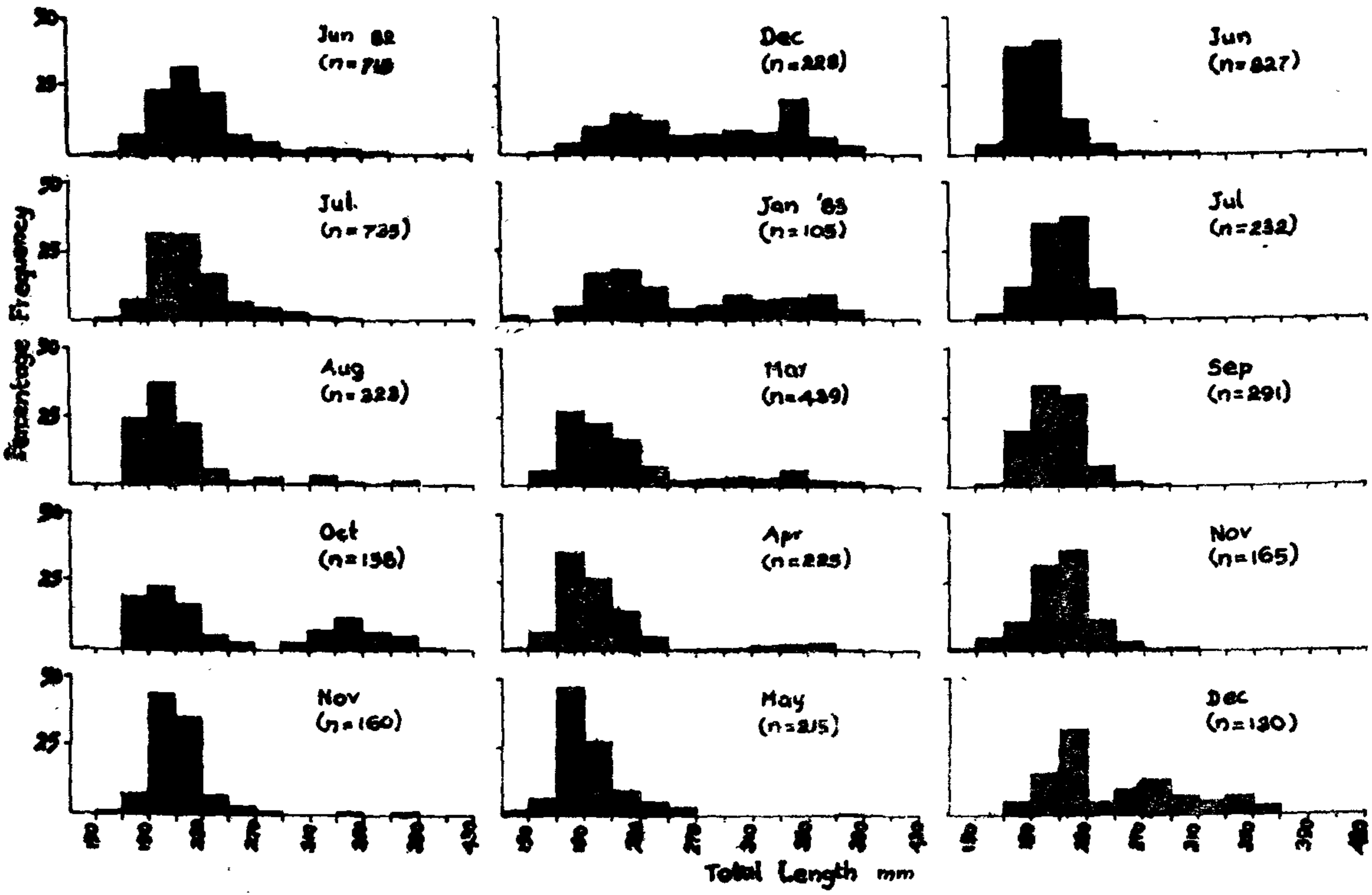

Fig. 4. Length frequency distribution of *O. mossambicus* commercial catches (June 1982-Dec. 1983). The sample size in each month is given in parentheses.

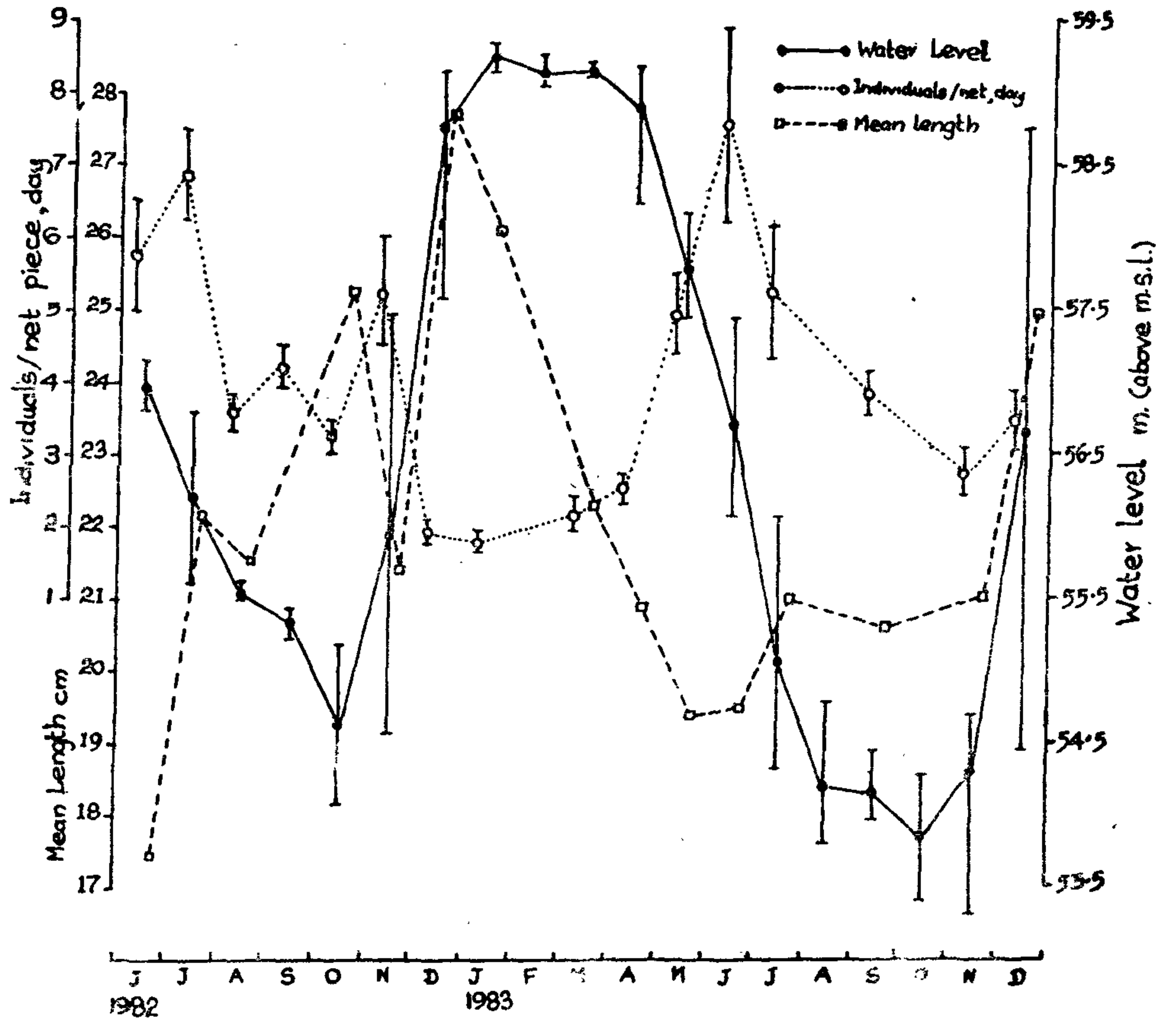

Fig. 5. Water level fluctuations (vertical lines : range), *O. mossambicus* individuals per net piece, per day (vertical lines : 2SE) & their mean landing sizes.

DISCUSSION

Parakrama Samudra consists of three basins connected by narrow channels at low water levels. The bottom of the reservoir slopes from West to East. The embankment is situated along the eastern border. Areas along the west bank are exposed as water level recedes during the dry season. Irregular shoreline particularly along the western shore causes a high index of littoral development (Schiemer, 1983).

The nesting sites of *O. mossambicus* are confined to the shallow, littoral areas around the reservoir. No nests were found in the areas with hard bottom (Figs. 2 and 3). The preferred depth varied with location. *O. mossambicus* prefers the shallow areas for construction of nests in the southern basin. Here light penetration is the lowest since turbidity is increased by silt discharged from the river (Table 1). In contrast, in the middle basin where the highest light penetration exists (Dokulil *et al.*, 1983), nest building occurs in deeper waters. Poor visibility impedes the courtship display of *O. mossambicus* (De Silva, 1985) so that the seasonal variation in turbidity (see Table 1) may govern the optimum depth of nesting sites. High turbidity due to high wind action and vise versa have been reported in Parakrama Samudra (Dokulil *et al.*, 1983). Therefore it is reasonable to expect seasonal changes in the optimum depth of nesting sites of *O. mossambicus*. Samarakoon (1983) reported that seasonality in breeding behaviour of the indigenous cichlids *Etroplus suratensis* and *E. maculatus* is influenced by turbidity.

The pattern of water level fluctuations in Parakrama Samudra (see Fig. 5) has been recorded to be similar over a long period (De Silva, 1983). Apparently, these fluctuations do not disturb the nesting behaviour of *O. mossambicus.* This may be due to the fact that, the suitable areas for nesting remain submerged for an adequate period.

When the water level of the reservoir exceeds 57.5 m (above mean sea level), the jungle areas in the west bank are covered with water. This happens every year from December to May (Fig. 5; De Silva, 1983) and permits more space, feeding grounds and refuge for the fishes. Difficulty in operating gillnets in these inundated jungle areas together with the low density of fish due to the increase in volume of water, may have lowered catch per net piece, per day during early months of this period (Fig. 5). During this time of high water level, the mean monthly landing size of *O. mossambicus* gradually declined reaching a minimum in May 1983. Nevertheless, the number of individuals caught per net piece, per day increased from April to June 1983. It may be attributed to increase of stock density due to receding water level and enlargement of stock size due to peak recruitment to the fishery.

70-90% of the fish catch in Parakrama Samudra consists of *O. mossambicus* (Amarasinghe and Pitcher, 1986). Recruitment of *O. mossambicus* to the fishery is determined by the smallest mesh size of gillnets used by fishermen. The mean of the first mode in the size distribution of fish denotes the smallest age-class in the sample (Macdonald and Pitcher, 1979). The months during which the smallest fish of 19-20 mean total length are caught (Fig. 4) will therefore correspond to periods of peak recruitment. In the present study, peak recruitment was in April/May.

O. mossambicus in Parakrama Samudra is reported to spawn throughout the year with higher intensities in August, the driest month of the year (De Silva and Chandrasoma, 1980). Peak recruitment that occurs in April/May may be a reflection of a past peak breeding season. The availability of small individuals of *O. mossambicus* in abundance in April/May (Figs. 4 and 5), is indirect evidence for this peak recruitment season. The high water level just after the peak breeding season of *O. mossambicus* provides an area with a good food supply for the young stages so that this may enhance an early recruitment to the fishery.

The other possible reasons for localization of *O. mossambicus* populations resulting low catch efficiencies during the months of high water level are that they are likely to be having depth preference with their size (Fryer and Iles, 1972), that the fishes may stay less dispersed in the inundated jungle areas and that they may be having temperature preference. Further investigations regarding these aspects will be required for a comprehensive idea about the seaonal variation in the mean landing size of *O. mossambicus* in the commercial catches.

The Sri Lankan reservoir fishery is dominated by *O. mossambicus.* Detailed and comprehensive studies for a series of reservoirs based upon nesting behaviour of *O. mossambicus* in relation to turbidity, structure and gradient of the bottom will be useful for quantification of recruitment. This will enable identification of an optimum fishing strategy and regulation of mesh size of gillnets.

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