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Ashtamudi estuary as a nursery ground for Indian oil sardine, *Sardinella longiceps* (Val.)

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Abstract

Fishery survey cruises conducted in Ashtamudi estuary, Kerala, S.India (latitude 8°45'- 9°28' N and longitude 75°28' - 77°17' E) revealed the unusual occurrence of large shoals of oil sardine, *Sardinella longiceps* (Val.) young ones contributing to the fishery in the estuary at significant levels. Exploited stock of this species in December was constituted by size ranging from 90 to 159mm with a modal size at 106mm while a remarkable shift in the length composition could be discernible in April, when 92% of the stock was constituted by individuals in the range 120-139mm with a modal length at 122mm. An attempt was also made to quantify the exploited juvenile stock of the lake during the study period, which declined significantly from 57.5 tonnes in December, 2000 to 5.4 tonnes in April, 2001. Gill nets and cast nets were found to contribute more than 60% of the total landings. The Ashtamudi estuarine system serving as a nursery ground for fingerlings of oil sardine has been highlighted.

Introduction

Ashtamudi estuary, Kerala (S.India) (latitude 8°45'- 9°28' N and longitude 75°28' - 77°17' E), is the second largest estuarine system on the south west coast of India. This estuarine system is known to support a wide array of fin fish and shell fish species mainly constituted by true estuarine species, marine migrants and fishes of limnetic origin. A recent study identified about 57 fin fish species from this estuary (Kurup and Thomas, 2001). Ashtamudi estuary is found to be serving as a nursery habitat for a true marine fish *Sardinella longiceps* (Val.), the oil sardine, and this observation draws significance in view of the fact that the estuarine phase of the fry, fingerling and juveniles of this species is quite hitherto unknown though their nomadic occurrence in some estuarine waters on the south west coast has been reported (George, 1965; Raja, 1973; Dhulkhed and Ramamurthy, 1973; Reghu, 1973; Kurup and Samuel, 1985).

A perusal of the literature indicates that unusual occurrences of very small sized oil sardines in estuaries like Kalinadi, Aghanashini, Sharavati, Chandragiri and

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Cochin back waters were due to accidental or passive immigration of young ones which lasted only for short periods. However, the present study explores the possibility of using Ashtamudi estuarine system as a nursery habitat by large shoals of oil sardine fingerlings and thus contributing to a regular fishery in par with that of other estuarine fishes.

Material and methods

The data for the present study was collected during the fishery survey cruises conducted in the Ashtamudi estuarine system during December 2000 (post-monsoon period) and April 2001 (pre-monsoon period).

The information regarding the fishery in monsoon period was collected directly from fishermen using a pre-tested questionnaire, during the fishery survey cruises.

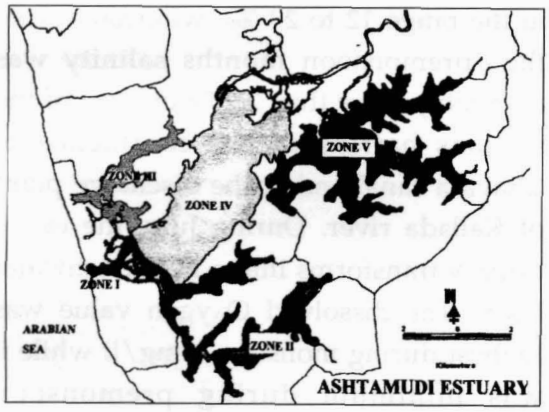

Fig.1. *Ashtamudi estuarine system showing demarcation of zones.*

For the purpose of quantification of the catch from the estuary, it was apportioned into five zones, zones 1-5 corresponding to five geographic regions widely accepted *viz.*, Southern kayal, Entrance (bar mouth), Northern Kayal, Central kayal and Eastern kayal respectively (Fig.1). The fishery survey cruises were conducted for a span of five consecutive days and the fishing activities in each zone (both day and night fishing) were observed for a continuous period of 24 hours (Kurup and Thomas, 2001). In each zone, the total number of similar types of gears engaged in fishing for *S. longiceps* were enumerated and the catches from not less than 30% of total units were directly observed giving special emphasis to weight, length composition, sex, maturity stage, hours used for fishing, etc.

The daily catch of *S. longiceps* in each gear type was thus computed by the formula following Kurup *et al.*(1993).

$$W = \frac{w}{n} \times N$$

Where W= Total estimated catch

'w = weight of the observed catch

n = number of units observed

N= Total number of similar units engaged in fishing

The daily catch so computed has been multiplied with the total number of fishing days in each month and thus, the

monthly catch was arrived at.

Total length of specimens were observed with a measuring board up to the nearest millimeter. Length frequency distribution was worked out at 10mm size classes. Details regarding occurrence, abundance, fishery, size groups appeared in the catches, etc during the remaining periods were collected from the fishermen who are regularly engaged in the fishing in the estuary. 150 fishermen were interviewed in this connection and the details were entered in to a structured questionnaire.

Various physico-chemical characteristics of water such as temperature, pH, salinity and dissolved oxygen were also recorded during the fishery survey cruises. Temperature was recorded with a sensitive mercury –in – glass centigrade thermometer while a pH meter (pH Scan) having the range from –0.1 to 15 +\- 0.2 with a resolution of 0.1 was used for measuring pH. Salinity was measured by following Mohr Knudson method (Strickland and Parson, 1972) while Dissolved Oxygen was determined by the azide modification of Winkler method (Eaton *et al*, 1995). Besides, data collected on the hydrography of Ashtamudi lake by the Centre for Earth Science Studies during premonsoon,monsoon and post monsoon periods in the same year (Nair *et al.*, 2001)as part of Ashtamudi Management plan were also used. Plankton samples were collected from one station from each zone using a truncated conical tow net (0.3m diameter) made of velon cloth having 75m mesh size. The speed of the boat and the total distance covered for each hauling were more or less kept constant. The net was towed for a period of 20 minutes, covering a distance of approximately 50m, during night hours when the tide was at the receding condition. After each haul, the planktonic samples were collected and preserved in 5% formalin and identified in the laboratory following Eaton *et al.* (1995).

Results

Surface water temperature ranged between 28-31^{0}C. The highest pH recorded was 8.6 from zone 1 in April while the lowest of 7 was in zone 5 in December. The average salinity recorded during the monsoon was 4.13 ‰. During the post monsoon months the salinity was in the range 12 to 29 ‰ whereas during the premonsoon months salinity was invariably more than 25 ‰ in most of the stations barring at the confluence of Chavara canal and at the discharge point of Kallada river. During July, the entire estuary transforms into a near freshwater body. The dissolved Oxygen value was highest during monsoon (6mg/l) while it was minimum during premonsoon (0.32mg/l). Among the phytoplankters *Coscinodiscus, Chaetoceros, Navicula, Pleurosigma, Triceratium, Thalassionema,*

Biddulphia and *Oedogonium*, were found as very common while the zooplankters were represented by Cladocerans, Copepods, prawn larvae, Polychaetes and Chaetognaths.

As part of the survey conducted during December 2000, large shoals of *Sardinella longiceps* were found exceedingly common in the estuary and their large scale movement was clearly visible even in the surface waters. Many instances could be recorded in respect of their entry on to the shore or boat jetties due to any sort of disturbances caused in the surface waters. Almost all samples collected were juveniles. Laboratory analyses revealed that most of them belonged to stage II, in which the gonads occupied almost half of the abdominal cavity.

Percentage length frequency distributions of *S. longiceps* in the exploited fishery during December, 2000 and April 2001, are shown in Fig.2. The exploited stock in December was constituted by size group ranging from 90-159mm size classes with a modal size at 106mm. Furthermore, about 71% of the fishery was constituted by size groups in the range 100 -120mm.On the contrary, a remarkable shift in the length composition could be discernible in the exploited stock observed in April,2001. About 92% of the stock belonged to a size range of 120-139mm with a modal length at 122mm and the minimum and maximum sizes recorded were 122mm to 154mm respectively. Interestingly, size groups 90-99 to 120-129mm which represented the major fishery during December, 2000 could no longer be observed in the catch.

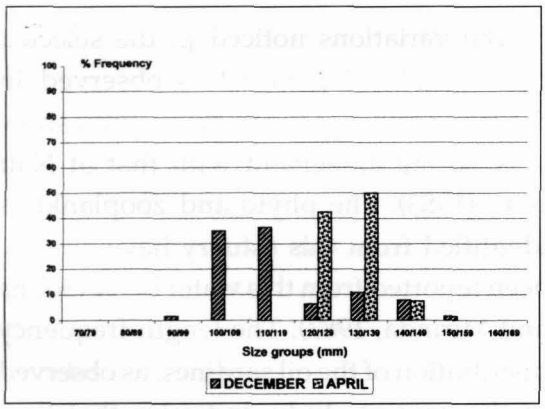

Fig.2. *% Length frequency distribution of Sardinella longiceps exploited from Ashtamudi lake during December, 2000 and April, 2001*

In both December and April, it appeared that juveniles and subadults of *S. longiceps* contributed a significant quantity in the exploited fishery resources of the Ashtamudi estuary with 57.5 tonnes in the former and 5.4 tonnes in the latter months respectively. The zone wise estimated landings of this species in both the months are presented in Fig.3a and 3b. It could be seen that bulk of the landings of *S. longiceps* in December was exploited from zone 4 (56.4 tonnes) while Zone 1 to 3 accounted only for a marginal fishery to the tune of less than one tonne whereas in zone 5, virtually no fishery could be encountered. On the contrary, in

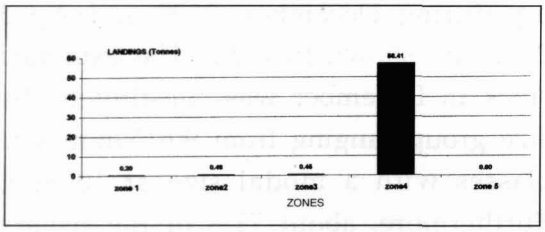

Fig.3.a. *Zone wise landings of S. longiceps in Ashtamudi lake during December, 2000.*

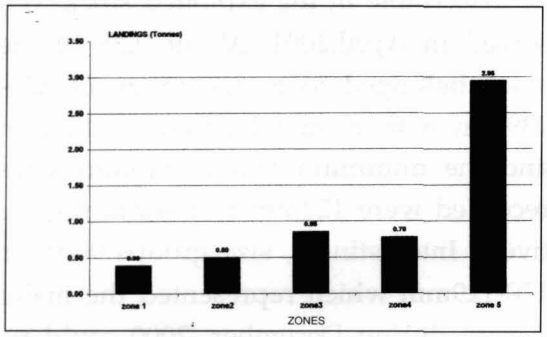

Fig.3b. *Zone wise landings of S. longiceps in Ashtamudi lake during April, 2001*

April, heavy landings could be recorded from Zone 5 which accounted for about 50% of total landings from this water body whereas the fishery in all other zones were marginal. Gear wise percentage exploitation of *S. longiceps* in the two months are depicted in Fig.4. It is pertinent to note that only a few types of gears were engaged for the fishery such as gill nets ("Neettu vala", "Chala vala"), Cast nets ("Veechu vala") and Seines ("Koru vala", Chemmeen vala") while only incidental catches could be registered in fixed gears such as stake net and Chinese net. Major landing could be reckoned from gill nets

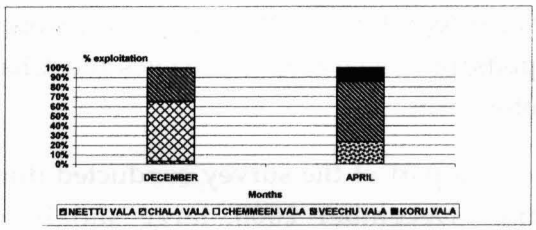

Fig.4. *Gear wise percentage exploitation of S. longiceps in Ashtamudi lake during December and April.*

and cast nets. In December, highest landing could be recorded from gill net *chalavala* (62.05%) while Cast net contributed only 34.08% of the total catch. On the contrary, in April, it was cast net which accounted for highest landings (62.5%) while gill net "neettuvala" and Seine "Koruvala" contributed to 23.26 and 14.21% respectively.

Discussion

The variations noticed in the selected hydrographical parameters observed in the lake as part of the present study show very strong agreement with that of Nair *et al.* (1983). The phyto and zooplankters identified from this estuary have already been reported from this water body (Sobha and Mirinda, 1987). The length frequency distribution of the oil sardines, as observed in the present study, indicates that they belong to less than one year class. The evident shift in the modal sizes after four

months of the initial observation (106 mm in December and 122 mm in April) revealed the presence of a resident population in the estuary and its growth which would in turn might have effected a shift in the size to higher groups. Available literature on the occurrence of young oil sardines in estuarine systems recorded sizes ranging from 39-53 mm in August (Reghu, 1973), 40-94 mm in September (Dhulkhed and Ramamurthy, 1973) and 81-125 mm in October (Raja, 1973). However, there is no report on the prevalence of a regular fishery in any of the water bodies constituted by juveniles. Though a shift in modal sizes could be observed, no perceptible advancement in maturation commensurate with size class progression was recorded in the samples collected in April. This may be due to the influence of estuarine conditions prevailing in this water body which are totally different from that of marine habitats where this species usually attains sexual maturation(Nair, 1960).

Dhulkhed and Ramamurthy (1973) reported the occurrence of this species in Chandragiri estuary and expressed the possibility of their nomadic entry into many other estuaries on the south west coast of India. According to Raja (1973) the occurrence of young oil sardine in Kalinadi estuary could be a passive incursion with shoals of oil sardine entering the rivers when tides came, only to return with ebb tide. In such cases, the juveniles constituted very small fishery that endured only for a short period. The present observation on *S. longiceps* from Ashtamudi estuary is not comparable with that of the above as it was found very abundant in this water body for a period of 8-12 months and appeared in different stages from fry to subadults commencing from September onwards. Moreover, the remarkable shift in their modal size group in the exploited stock during April also manifests the possibility of the growth of the resident population and attainment of higher size groups.

Though many reports are available pertaining to sporadic occurrences of small sized juveniles of this species in many estuaries in the south west coast of India (Raja, 1973; George, 1965; Reghu, 1973; Dhulkhed and Ramamurthy, 1973), their permanent stay and growth in the estuary by foraging the food available in this new habitat and subsequent recruitment to the estuarine fishery is hitherto unknown. The fry and fingerlings might have acclimatized to the low saline conditions prevalent in the estuary during the monsoon months while during the post and pre-monsoon periods, the estuary offered favourable hydrographical conditions preferred by the stock of oil sardine (Nair, 1960). The results of the hydrographical and plankton study revealed that Ashtamudy estuary is endowed with both

the favourite food materials and desired physico-chemical parameters preferred by *S. longiceps*. It appears that *S. longiceps* might have utilized Ashtamudi estuary as its nursery ground as this water body is endowed with all the favourable factors required for the growth and survival of this species.

Based on the market surveys, it could also be understood that there is less consumer acceptance of oil sardines caught from the estuary owing to their inferior taste when compared to its counterpart exploited from inshore waters. This could be attributed to a wide array of features such as lack of fat deposition due to the arrest of maturation process, difference in salinity profile, in the place of inhabitation, proximity to mud due to low water depth when compared to the pelagic realm of sea, etc.

It can reasonably be inferred that oil sardine might have entered in to the Ashtamudi estuary during the month of July-August as fry and fingerling stages from the inshore waters of Quilon. Previous reports also suggest that fry and fingerling of oil sardine are capable of tolerating low salinity ranges as low as 2.96 ppt. (Reghu, 1973). Oil sardines recorded a heavy landing during 2000 along Kerala coast with a catch of 2.41 lakh tonnes (Anon, 2001) and therefore, there are every possibility in having severe competition for food and space for the individuals inhabiting along the inshore waters. The unusual immigration undertaken by the fry and fingerling into estuary as evident from their preponderance in the estuary might be for the sake of avoiding the home ground where they are prone to stiff competition for food and space. The fry and fingerlings, upon their arrival in the estuary, might have got acclimatised to the estuarine conditions and found it congenial to utilize these productive grounds as their feeding grounds. After monsoon subsidence, there is a sharp increase in salinity gradient of the estuary due to poor river run off and thus high salinity prevails in the estuary during post monsoon and pre-monsoon periods (Nair *et al.*, 2001). A perceptible decline in the typical estuarine detritus feeding fishes could be observed during the study period (Kurup and Thomas, 2001) and this may be due to the scarcity of detritus in the estuary. Oil sardine might have foraged the rich phytoplankton population available in the lake and consequently there may not be chance for their death and decay, thus adversely affecting the detritus formation in the estuary. The present findings generate unique interest by unravelling the possibility of utilizing a tropical estuarine system as a nursery ground by a typical marine species, *S. longiceps* which so far is known to complete its life cycle only in marine habitat and its estuarine phase is quite unknown

hitherto. This species usually spawns in the near shore waters at about 15 km away from sea shore at a depth of 30m (Balan, 1984). The peak spawning period is reported to be during June to August, though the season extends from May to November. Bensam (1968) reported that the juveniles of this species register a very rapid growth before they are 12 months old. Many reports are also available that the juveniles measuring 100 mm are one year old and those between 100-150mm length are in the second year (Sekharan, 1965; Prabhu and Dhulkhed, 1967; Sekharan and Dhulkhed, 1967).

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