

Ecology of Indian Estuaries-XI. A Preliminary Survey of the Fishery Resources of the Ashtamudi Estuarine System

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The fish fauna of the Ashtamudi, the second largest estuarine system in Kerala ($8^{\circ}53' - 9^{\circ}02'$ N Lat. and $76^{\circ}31' - 76^{\circ}41'$ E Long.) is listed. 97 species belonging to 39 families have been recorded, of which 69 are commercially important contributing to the fisheries of the Ashtamudi Estuary. Mulletts, cichlids and the glassy perchlets are the most abundant groups and contribute appreciably to the landings. Results revealed that the estuarine system supports a good capture fishery which is seasonal. Majority of the fish fauna in the estuary are marine elements recruited from the adjoining Arabian Sea. An inventory of the craft and gear employed is presented and the sources of pollution in the estuarine system are described, aquacultural prospects of this area are discussed.

The brackish water environment represents an unified ecosystem of high fertility, supporting a rich natural fishery which is of considerable significance in the rural economy of developing countries (Tampi, 1973). A substantial part of the Indian fisheries is contributed by the estuaries, backwaters, coastal creeks and large brackish water tracts bordering the coast of India (Panikkar, 1974).

The backwaters of Kerala comprise a system of interconnected lagoons, bays and swamps penetrating the main land. The total area of Kerala backwaters is about 500 km². Rough estimates show that fish landings from the Kerala backwaters amount to 14,000–17,000 tons per year (George & Sebastian, 1970). A proper understanding of the fish fauna, their seasonal abundance, habits and habitats are of great importance for the effective utilization of this valuable ecosystem and to plan out developmental programmes. However, very little information is available on the brackish water fish fauna and fisheries of India except from selected backwaters namely, the Vembanad Backwaters (Shetty, 1965), Chilka Lake (Jhingran, 1969; Jhingran & Natarajan, 1973) and the Hooghly-Matlah estuarine system (Gopalakrishnan, 1973). Ashtamudi, the second largest estuarine system

in Kerala is an important fishing centre and contributes considerably to the inland fisheries of the State. However, no scientific attempt has hitherto been made to collect information on the fish fauna, fisheries and general ecology of this estuarine system. Therefore studies were initiated with a view to filling up this lacuna and this paper reports a preliminary account of the fish fauna of the estuary.

The environment

Ashtamudi with an area of about 32 km² lies between latitude $8^{\circ}53'$ and $9^{\circ}02'$ N and longitude $76^{\circ}31'$ and $76^{\circ}41'$ E (Fig. 1). It has eight major creeks known by different names. The Kallada River originating from the Western Ghats empties into the estuary at Arinalloor after traversing for about 120 km. The estuary has a permanent connection with the adjoining Arabian Sea at Neendakara which is an important fishing harbour. The salt penetration is evident up to Uppukootu, a place several km upstream.

The estuarine system is divided into 4 zones as follows (Fig. 1): (1) *Marine zone* (Neendakara zone)-lies adjoining the mouth of the estuary. Neendakara, one of the important fish landing centres along the

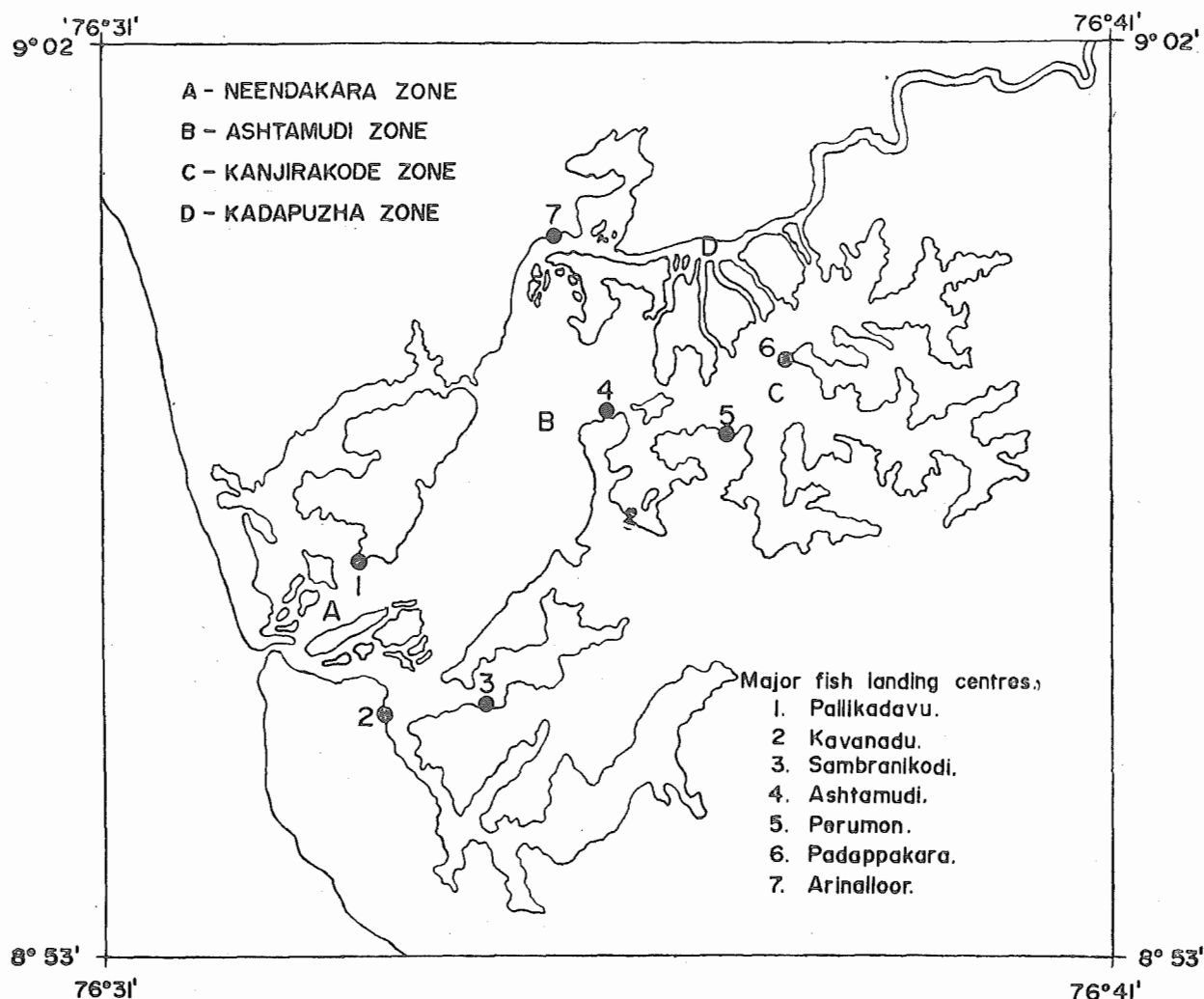


Fig. 1. Map of the Ashtamudi estuarine system showing the major fish landing centres.

west coast is situated in this zone, (2) *Brackish water zone- I* (Ashtamudi zone)- occupies the central portion of the estuary, (3) *Brackish water zone- II* (Kanjirakode zone)- represents the interior most part of the estuary and (4) *Tidal river zone* (Kadapuzha zone)- representing the lower reaches of the Kallada River. This zone is heavily polluted by the Punalur Paper Mill effluents.

Materials and Methods

An inventory of fishing craft and gear used by the fishermen in the Ashtamudi Estuary has been prepared on the basis of detailed field survey and interviews with fishermen. Fish samples were collected at random from fishermen in the estuary and from the major landing centres along the

banks (Fig. 1) during the fortnightly visits to the various zones. Identification was carried out following Day (1877-78), Weber & de Beaufort (1913-1953), Munro (1955, 1967), Whitehead (1972), Fischer & Whitehead (1974) and Collette (1981). Regular fortnightly surface and bottom water temperature and salinity were recorded from 4 stations-Neendakara, Ashtamudi, Kanjirakode and Kadapuzha representing each zone during February 1980 to January 1981.

Observations

(a) Fishing craft

The fishing craft employed in the Ashtamudi Estuary are the traditional dug-out canoes scooped out of large logs of Aini, Mango and Chini wood varying from 3 to 8 m

in length and plank built boats (Kettuvallam)

(b) *Fishing gear and techniques*

The nets used in the estuary are of 4 types (1) seine nets, (2) cast nets, (3) Chinese dip nets and (4) drag nets. Of these, cast nets and seine nets are commonly used and the latter is a typical gear for fishing in lakes. Seine nets used in the estuary are known by different names such as "Koru vala", "Ariku vala" and "Taruthi vala". They are mainly used for prawn fishing. Anchovies, chandids and gobiids are also fished using this net. Based on the size of meshes the seine nets are divided into two types (i) "Adukku vala" with smaller mesh size and (2) "Thelian vala" with larger meshes. "Veezu vala" is the cast nets used in the estuary. Two types of cast nets are in operation namely, those with a central line and those without a central line. The latter is employed in shallow regions with rough bottom and the fishermen dives in after casting in order to haul the net and is locally known as "Kallum vala." Cast nets with central line are of two types based on mesh size. (1) "Paravu vala" - with large mesh (Mulletts, cichlids and cat fishes are commonly caught in this net) (2) "Thekkan vala"- with smaller mesh and is used for prawn, leiognathids, gerrids, chandids and theraponids. A group of fishermen operating cast nets are called "Paduthikar" and is quite common in the estuary. The advantage of this type of fishing is that it can cover a relatively large area and also reduces the chance of fish escaping. "Charivu vala" is the well known drag net and can be used only in the shallow regions. This net destroys a large number of young ones of *Etroplus suratensis* the most commercially important fish in the estuary. Stationary dip nets installed on wooden frames popularly known as "Cheena vala" (Chinese dip net) are also used. Light is used as a lure. About 200 chinese nets are in operation and most of them are confined to the Ashtamudi zone of the estuary. Long line with natural baits are also employed to catch cat fish, serranids and crabs.

Lure fishing

One of the most interesting and successful fishing methods observed in the Ashtamudi Estuary is the lure fishing locally known as

"Othukke vala" and is common both at the Ashtamudi and Kanjirakode zones. In this method a lure is used to concentrate the fish. The lure consists of a large heap of branches of trees immersed in the water column by stone weights and is known as "Thoope." The "Thoope" is allowed to remain as such without any disturbance for about 5-10 days. When mature it serves as an artificial shelter for the fish by giving food and protection. Fishermen using this method are very cunning and when the lure has fully matured, net is spread around it. After removing the lure to some extent, the net is gradually brought closer and hauled. *Etroplus suratensis*, mullets, *Scatophagus argus* and serranids are the major fishes caught by this method. This method is similar to the 'brushwood fishery' described by Brandt (1964).

Scare line fishing

This is restricted to the shallow regions and is common at the marine zone. This method has already been reported from the Kayamkulam Lake (Gopinath, 1952). The principle made use of in this method is to concentrate the fishes by scaring with noise. On a long rope the tender fronds of the coconut palm are attached at close intervals and is known as "virali." It is dragged through the water and the noise that it creates frightens the fish. The frightened fishes swim madly and are then caught by cast net. Mulletts are the dominant group fished by this method. Gerrids and theraponids are also caught in limited numbers.

Besides these, temporary barriers/netting are also in use at the Neendakara region (near the barmouth) for prawn fishing during the prawn season.

An understanding of the fishing gear employed in a water body is a pre-requisite for the proper management of the fisheries. Although in the Ashtamudi Estuary many different forms of gear have been employed, cast nets and seine nets are by far the most common and contribute substantially to the total catch. Lure fishing and scare line fishing seem to be the most successful method for commercial operations for mullets and *Etroplus suratensis*. Chinese dip nets are also quite effective and these have the advantage that they can be operated even during

the rough weather conditions. From the fisheries point of view, "Charivu vala" seems to be the only harmful net which destroys a large number of young ones of commercially important groups such as cichlids and prawns.

Results and Discussion

In Kerala, the backwaters support a rich fishery. The Ashtamudi Estuary itself has a good resource of fin fishes, prawns, crabs

and clams and provides livelihood to thousands of people. 97 species of fishes belonging to 39 families have been collected. A classified list of species along with their distribution in different zones of the estuary is presented in Table 1. Of the 39 families 16 are represented by single members and family *Gobiidae* has the highest representation (10 species). Families such as *Clupeidae*, *Engraulidae*, *Cyprinidae*, *Hemiramphidae*, *Mugilidae*, *Carangidae*, *Lutjanidae*, *Gerridae* and *Leiognathidae* have fair representation.

Table 1. A classified list of the fish fauna of the Ashtamudi estuarine system

Fish fauna	Marine zone	Brackish water zones		Tidal river zone	Habitat (as per Munro 1955)
	Neenda-kara	Ashta-mudi	Kanjira-kode	Kada-puzha	
1	2	3	4	5	6
I Family - Megalopidae					
1. <i>Megalops cyprinoides</i> (Broussonet)*	+				E
II Family - Clupeidae					
Sub-family - Dussumieriinae					
2. <i>Dussumieria acuta</i> (Val.)*	+	+	+		M
Sub-family - Clupeinae					
3. <i>Sardinella fimbriata</i> (Val.)*	+	+	+		M
4. <i>Sardinella</i> sp.*			+		M
Sub-family - Pellonulinae					
5. <i>Ehirava fluviatilis</i> Deraniyagala				+	E,R
Sub-family - Dorosomatinae					
6. <i>Anadontostoma chacunda</i> (Ham. Buch.)*		+	+		M
III Family - Engraulidae**					
Sub-family - Engraulinae					
7. <i>Stolephorus indicus</i> (Van Hasselt)*	+	+	+	+	M
8. <i>S. commersonii</i> Lacepede*	+	+	+	+	M
9. <i>Thryssa malabarica</i> (Bloch)*	+				M
10. <i>T. mystax</i> (Schneider)*	+			+	M
11. <i>T. hamiltonii</i> (Gray)*		+			M
IV Family - Cyprinidae					
12. <i>Rasbora daniconius</i> (Ham. Buch.)*				+	R
13. <i>Danio aequipinnatus</i> (McClelland)				+	R
14. <i>Puntius filamentosus</i> (Val.)*				+	R
15. <i>P. amphibius</i> (Val.)*				+	R
16. <i>P. sarana</i> (Ham. Buch.)*				+	R
17. <i>P. vittatus</i> Day				+	R
V Family - Siluridae					
18. <i>Callichrous</i> sp.				+	R
VI Family - Tachysuridae**					
19. <i>Tachysurus maculatus</i> (Thunberg)*		+	+		E,R
20. <i>T. subrostratus</i> (Val.)*		+	+		M,E,R
VII Family - Belonide					
21. <i>Xenentodon cancila</i> (Ham. Buch.)*				+	R
22. <i>Tylosurus strongylurus</i> (Van Hasselt*)			+		M,E

	1	2	3	4	5	6
VIII Family - Hemirhamphidae						
23. <i>Zenarchopterus dispar</i> (Val.)*				+		E,R
24. <i>Z. buffonis</i> (Cuv. & Val.)*				+		M,E
25. <i>Hyporhamphus xanthopterus</i> (Val.)*			+	+		M,E
26. <i>Hy. limbatus</i> *			+	+		M,E
IX Family - Syngnathidae						
27. <i>Dorichthys cunculus</i> (Ham. Buch.)					+	E,R
X Family - Cyprinodontidae						
28. <i>Panchax lineatus</i> (Steindachner)			+			E,R
XI Family - Sphyrænidae						
29. <i>Sphyræna jello</i> Cuvier*			+	+		M
XII Family - Mugilidae**						
30. <i>Mugil cephalus</i> Linneaus*		+	+	+		M,E,R
31. <i>Osteomugil cunnesius</i> (Val.)*		+	+	+	+	M,E
32. <i>Liza macrolepis</i> (Smith)*		+	+	+	+	M,E
33. <i>L. parsia</i> (Ham.)*		+	+	+		M,E
34. <i>Valamugil seheli</i> (Forskal)*			+			M
35. <i>V. buechanani</i> (Bleeker)*		+	+			M,E,R
XIII Family - Atherinidae						
36. <i>Pranesus duodecimalis</i> (Val.)*			+	+		M,E
XIV Family - Channidae						
37. <i>Channa punctata</i> (Bloch)*					+	R
38. <i>C. striata</i> (Bloch)*					+	R
XV Family - Centropomidae**						
39. <i>Chanda commersonii</i> (Cuv. & Val.)*		+	+	+	+	E,R
40. <i>C. gymnocephalus</i> (Lac.)*		+	+	+	+	M,E,R
XVI Family - Serranidae						
41. <i>Epinepheles tauvina</i> (Forskal)*			+			M
42. <i>Epinepheles</i> sp.*			+			
XVII Family - Theraponidae**						
43. <i>Therapon jarbua</i> (Forskal)*			+			M,E
44. <i>Pelates quadrilineatus</i> (Bloch)			+			E
45. <i>Autisthes puta</i> (Cuv.)			+	+		M,E
XVIII Family - Apogonidae						
46. <i>Apogon thermalis</i> Cuvier			+			M,E,R
XIX Family - Sillaginidae**						
47. <i>Sillago sihama</i> (Forskal)*		+	+	+		M,E
XX Family - Carangidae*						
48. <i>Selar mate</i> (Cuv.)*			+	+		M
49. <i>Carangoides praesteus</i> (Bennet)*		+		+		M
50. <i>Caranx ignobilis</i> (Forskal)*		+	+	+		M
51. <i>Chorinemus</i> sp.*				+		
XXI Family - Lutjanidae						
52. <i>Lutjanus fulviflamma</i> (Forskal)*		+	+	+		M,E,R
53. <i>L. johni</i> (Bloch)*		+				M
54. <i>L. russelli</i> (Bleeker)*			+			M
55. <i>L. aregentimaculatus</i> (Forskal)*			+		+	M,E
XXII Family - Gerridae**						
56. <i>Gerres oyena</i> (Forskal)*			+	+	+	M
57. <i>G. oblongus</i> (Cuv.)*			+	+		M
58. <i>G. abbreviatus</i> (Bleeker)*			+	+		M
59. <i>Gerreomorpha setifer</i> (Ham.)*			+		+	E
60. <i>Pertica filamentosa</i> (Cuv.)*		+				M

	1	2	3	4	5	6
XXIII Family - Leiognathidae**						
61. <i>Leiognathus equulus</i> (Forskal)*	+			+		M,E,R
62. <i>L. lineolatus</i> (Val.)*	+		+	+		M
63. <i>L. splendens</i> (Cuv.)*	+		+			M
64. <i>Secutor ruconius</i> (Ham.)*	+					M
65. <i>S. insidiator</i> (Bloch)*	+					M
XXIV Family - Lethrinidae						
66. <i>Lethrinus</i> sp.*	+					
XXV Family - Pomadasysidae						
67. <i>Pomadasys hasta</i> (Bloch)*			+	+		M
XXVI Family - Cichlidae**						
68. <i>Etroplus suratensis</i> (Bloch)*			+	+	+	E,R
69. <i>E. maculatus</i> (Bloch)*			+	+	+	E,R
XXVII Family - Pomacentridae						
70. <i>Pomacentrus cyanomos</i> Bleeker			+			M
XXVIII Family - Siganidae						
71. <i>Siganus oramin</i> (Bloch & Schneider)	+	+				M
72. <i>S. javus</i> (Linnaeus)	+			+		M
XXIX Family - Anabantidae						
73. <i>Anabas testudineus</i> (Bloch)*					+	R
XXX Family - Eleotridae						
74. <i>Eleotris fusca</i> (Schneider)			+			E,R
XXXI Family - Gobiidae						
75. <i>Glossogobius giuris</i> (Ham. Buch.)*				+	+	M,E,R
76. <i>G. biocellatus</i> (Cuv. & Val.)			+			M
77. <i>Acentrogobius reichei</i> (Bleeker)			+			M
78. <i>A. caninus</i> (Val.)			+			M
79. <i>A. cyanomos</i> (Bleeker)			+			
80. <i>A. chlorostigmatoides</i> (Bleeker)			+			
81. <i>Acentrogobius</i> sp.	+					
82. <i>Oligolepis acutipennis</i> (Cuv. & Val.)	+	+		+	+	M,E
83. <i>Oxyurichthys tentacularis</i> (Cuv. & Val.)	+	+				M
84. <i>O. microlepis</i> (Bleeker).			+			M
XXXII Family - Taenoididae						
85. <i>Odontamblyopus rubicundus</i> (Ham. Buch.)			+			
86. <i>Brachyamblyopus urolepis</i> (Bleeker)	+					
87. <i>Brachyamblyopus</i> sp.	+					
XXXIII Family - Trypauchenidae						
88. <i>Trypauchen vagina</i>				+		M
XXXIV Family - Platycephalidae						
89. <i>Thysanophrys indicus</i> (Linn.)*			+	+		M
XXXV Family - Bothidae						
90. <i>Pseudorhombus triocellatus</i> (Bloch)*	+	+				M
XXXVI Family - Soleidae**						
91. <i>Synaptura commersonii</i> (Swainson)*	+					M
92. <i>Brachiurus orientalis</i> (Bloch)*	+	+				M
XXXVII Family - Cynoglossidae**						
93. <i>Cynoglossus lida</i> (Bleeker)*	+	+				M
94. <i>C. lingua</i> Ham. Buch*	+					M,E
XXXVIII Family - Triacanthidae						
95. <i>Triacanthus brevirostris</i> Schelegel			+			M

	1	2	3	4	5	6
XXXIX Family – Tetradontidae						
96. <i>Arothron hispidus</i> (Lacepede)				+		M
97. <i>Chelonodon patoca</i> (Ham. Buch)				+		M,E

† – present

* – Commercially important species (Jhingran, 1975)

** – Families substantially contributing to fisheries

M – Marine

E – Estuarine

R – Riverine

The fauna of a brackish water system is generally composed of marine and freshwater organisms which can adapt to waters of different and varying salinities and truly resident estuarine species (Jhingran & Gopalakrishnan, 1973). Among the 97 species nearly 50% (42 species) are typically marine and 11 are typically freshwater (Table 1). Only 3, namely, *Megalops cyprinoides*, *Pelates quadrilineatus* and *Gerreomorpha setifer* are truly estuarine. Others are transient forms inhabiting estuarine and riverine (9 species), marine and estuarine (15 species) and marine, estuarine and riverine (8 species) habitats (as per Munro, 1955). Thus it is clear that in the Ashtamudi Estuary majority of the fish fauna have been recruited from the adjoining Arabian Sea and the fisheries mainly depend on the ingress from the sea.

Of the 97 species recorded 69 are commercially important (as per Jhingran 1975) and among the 39 families 12 contribute substantially to the fisheries (Table 1). The pearl spot (*Etroplus suratensis*) and the mullets are the most abundant forms having considerable market value and contribute appreciably to the landings. None of the commercially important groups which contribute to the major catches belong to the truly estuarine habitat and the fishery is highly seasonal since it depends on the recruitment from the sea. *Etroplus* spp. and *Chanda* spp. are available all round the year. Mulletts are most abundant during December–January. Among the mullet species, *Osteomugil cunnesius* is the most common form and *M. cephalus*, *Liza parsia* and *L. macrolepis* also contribute considerably to the fishery. Gobiids locally known as “Koozhali” are seasonal with a peak fishing season during April – June. Anchovies (Chooda)

are also seasonal and are landed in large quantities during July – October. Economically less important groups such as gobiids, anchovies, chandids, leiognathids, gerrids and theraponids constitute a rich raw material which can be utilised for the production of fish meal, fish protein concentrate etc. In the Ashtamudi Estuary, the fin fish fishery is generally poor during August–October. The estuary has a rich prawn resource and the season lasts for about 6–7 months (May–November) with a peak in August–October. During this period most of the fishermen otherwise engaged in normal fishing are found to concentrate on prawn fishing. This seems to be the reason for the low fin fish landing during this period.

Surface water temperature varied between 27.2 and 33.0°C at Neendakara, 26.0 and 35.0°C at Ashtamudi, 27.0 and 35.5°C at Kanjirakode and 26.4 and 32.5°C at Kadapuzha while that of bottom between 27.0 and 33.0°C, 28.0 and 34.5°C, 28.2 and 33.5°C and 26.4°C and 33.5°C respectively.

Salinity distribution showed a wide range of fluctuation, in the surface water from 8.33 to 34.30‰ at Neendakara, 3.80 to 30.35‰, at Ashtamudi, 2.74 to 27.86‰ at Kanjirakode and 0.12 to 6.35‰ at Kadapuzha and in the bottom water between 13.30 and 35.05‰, 11.08 and 32.97‰, 11.58 and 31.62‰, and 0.30 and 28.91‰ respectively. The seasonal variations in salinity are shown in Fig. 2.

The physico-chemical features in an estuarine environment especially salinity vary widely and play a significant role in the distribution of the estuarine fauna. Salinity distribution in the Ashtamudi Estuary showed a well defined seasonal pattern (Fig. 2). The

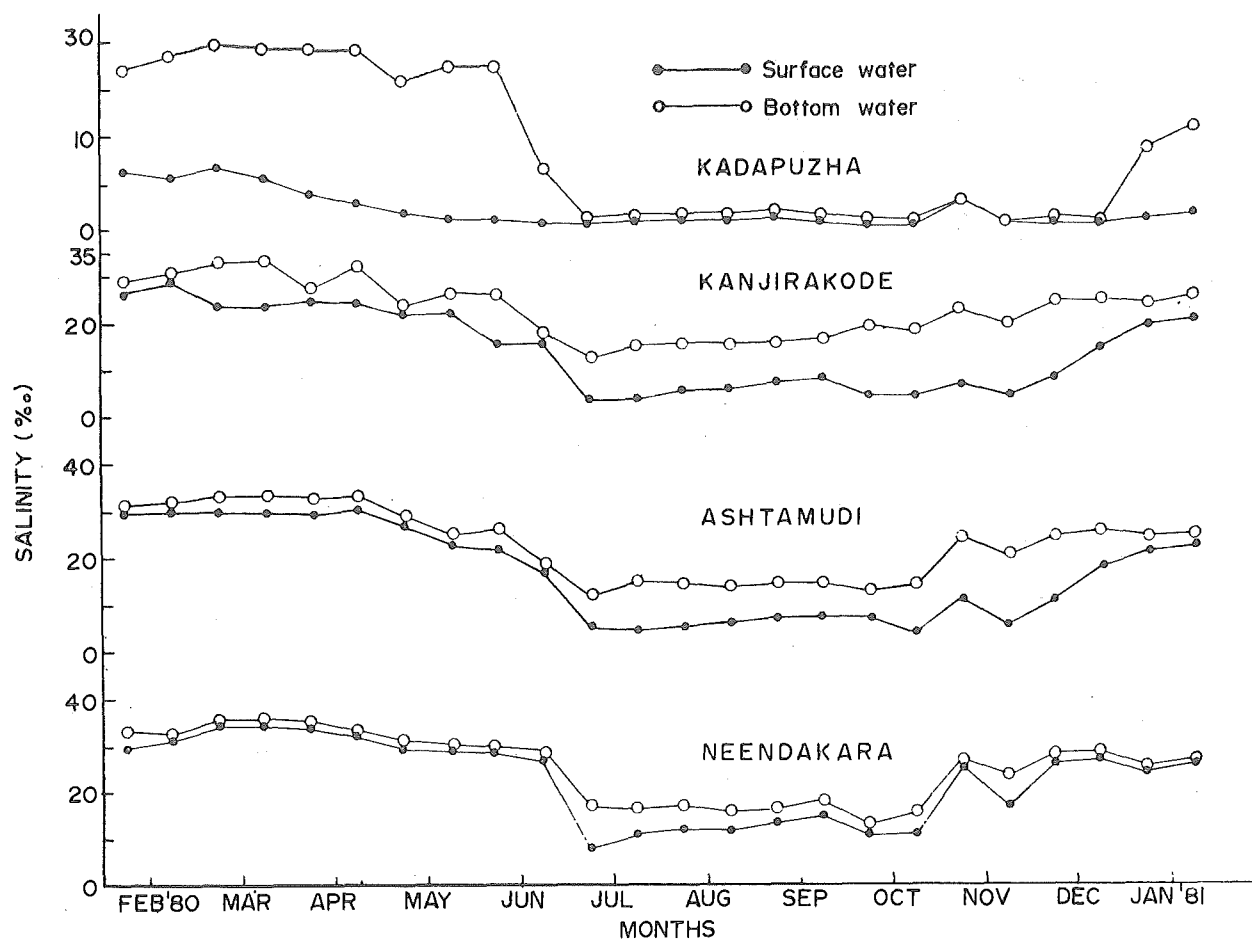


Fig. 2. Fortnightly variations in salinity at the Ashtamudi estuarine system during 1980-'81

estuary remains as an extension of the adjoining sea during January to May without much difference in surface and bottom waters except at the river zone (Kadapuzha zone) where a distinct vertical stratification is noticeable with a surface layer of less saline water. With the advent of the monsoon a decline in salinity is noticeable and the estuary remains more brackish during June–December. The tidal effect is prominent even at Kadapuzha, a station located several km upstream on the Kallada River and the bottom water here recorded a maximum salinity of 28.91‰. Exclusively marine species, namely, *Stolephorus indicus*, *S. commersonii*, *Thryssa mystax* and *Gerres oyena* caught from the tidal river zone have been found to ascend to this zone during periods of saline water penetration. All the recorded freshwater species are fished from the lower reaches of the Kallada River. According to Panikkar (1969) the populations of the estuarine fauna

along the west coast suffer from partial or complete destruction during the south-west monsoon period followed by repopulation by marine species during the post-monsoon season.

Besides this capture fishery, the Ashtamudi offers considerable scope for culture fishery. The estuary has been found to be highly productive (Nair *et al.*, 1983) and has a rich deposition of organic detritus brought by the inflowing river. Moreover this area is a relatively calm environment and acts as breeding and nursery zones for a number of species. The high productivity of estuaries which affords a plentiful supply of microvegetation essential for supporting many of the post-larvae make this an ideal habitat where the growing young ones can graze uninterruptedly without fear from the larger predators and have better chances of survival and growth (Tampi, 1973). The Ashtamudi Estuary has good potential for

prawn, mullet and *Etroplus suratensis* fry and the extensive shallow regions are most suitable for aquaculture. Conversion of these shallow regions into fish culture farms and proper stocking of the available natural fish and prawn seeds would increase the fish production considerably.

Although the Ashtamudi Estuary has a good capture fishery as well as great scope for culture fishery, this estuarine system is getting increasingly polluted from different sources. Effluents from the Punalur Paper Mills, The Lakshmi Starch Factory, The Alind and the Ceramic Industry situated on the shores of this estuarine system are the major sources of pollution. Besides these, retting of coconut husks, sewage disposal, organic wastes from the fish landing and sea food processing centres, and oil spillage from fishing boats at Neendakara have substantially contributed to polluting this productive estuarine system. Proper regulation and control measures against pollution would enable to preserve this system which provides employment to thousands of people and contribute considerably to the revenue of the state. With increasing volume of waste material and the introduction of new and persistent chemicals in industries, the stress on the estuarine ecosystem in many parts of the world has reached a point where it is unable to absorb the additional stress without damage (Ganapathi, 1975). Thus any deleterious effects of pollution would affect not only the fisheries of this estuarine system but also the inshore fisheries of the adjoining sea.

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