Indian J. Fish., **52**(2) : 179-187, Apr.-June, 2005

Fish/prawn seed resources and hydrography in the surf and backwater at Cochin

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ABSTRACT

The present study deals with the seasonal variation of hydrographic parameters and fish and prawn seed and juvenile resources in the intertidal surf zone of the sea and the adjoining backwater at Cochin based on regular monitoring of monthly data for 1996-2001. Hydrographic parameters in general, showed fluctuations within the seasons, from season to season and year to year. Nitrite and nitrate values were more in the backwater, while phosphate concentration did not show much variation between the surf zone and the backwater (except June). Phytoplankton productivity indicated trimodal pattern of distribution with the peaks recorded during February, June and September in the surf zone and during February, August and November in the backwater. In the surf zone, plankton samples indicated the abundance of fish larvae during southwest monsoon season (719 nos./100m^3) and in the backwater during premonsoon period (997 nos./100m^3) corresponding to the highest mean values of primary production recorded in the surf zone and backwater. Decapod larvae comprised mostly of *Metapenaeus dobsoni* in the surf zone and backwater. Mean values indicated the abundance of decapod larvae in the surf zone at Cochin. In the Cochin backwater, distribution of fish juveniles varied from season to season and year to year in relation to fluctuation of the rainfall and salinity.

Introduction

It is well known that the seeds of coastal fishes and prawns occur in abundance in the nearshore areas along the coast and the adjoining estuarine systems serve as the nursery grounds for these larval resources. Although extensive studies have been made on the hydrographic features, primary production and secondary production of the inshore waters (5-50 metres) off Cochin and the adjacent Cochin backwater, very little information is available on the hydrographic features of the intertidal surf zone and on the seed and juvenile resources of fishes and prawns from the surf zone and the adjoining backwater at Cochin. In recent years, the environmental changes, occurring due to irregularity and failure of monsoon winds and rainfall and coastal pollution have affected the distribution and abundance of the coastal flora and fauna. This study deals with the hydrographic features and seasonal

fluctuation and abundance of fish and prawn seed and juvenile resources in the intertidal surf zone and the adjoining backwater at Cochin, based on regular monthly data collected during 1996-2001.

Materials and methods

Monthly data were collected from the surface during high tide between 0900 and 1100 hours on hydrographic parameters, primary productivity and fish and decapod larvae (from the plankton samples), from three stations in the shallow intertidal surf zone (less than 1 m depth) of the sea (Fort Cochin, Manassery and Kannamaly) at Cochin and one station in the Cochin backwater at Thevara. In addition, monthly samples on the juveniles of fishes and prawns were collected from two local landing centres of the Cochin backwater (Pachalam and Thevara) and analysed for their species composition and numerical abundance. From the fish samples thus collected, adults were separated. Among the penaeid prawn samples, *Metapenaeus dobsoni* and *M. monoceros* measuring below 45 mm and *Penaeus indicus* (also called as *Fenneropenaeus indicus*) measuring below 50 mm (including rostrum) were considered as juveniles. However, among nonpenaeids, since it was difficult to separate the juveniles from the adults, sizes falling below 30 mm alone were considered as juveniles.

Monthly rainfall data were collected from the 'Daily Weather Reports' of the Indian Meteorological Department for Cochin during 1996-2001 and processed for the three seasons of the year. Hydrographic data included surface water temperature, salinity, dissolved oxygen, phosphate, nitrite and nitrate, adopting standard methods. Primary productivity was determined by light and dark bottle oxygen technique (Strickland and Parsons, 1972). Due to bacterial interferance in the L-I values, 80% of gross primary production (G.P.P) was considered as net primary production (N.P.P.) for uniformity (Selvaraj, 2000). Plankton samples were collected by filtering 1000 litres (1 m^3) of water manually (using a plastic bucket) through plankton net (0.4 mm mesh size), from these four shallow stations along the shore and preserved in 5 % formalin. The samples were analysed for numerical counts of fish larvae and decapod larvae and the values were extrapolated for 100 m^3 water.

The monthly data were treated seperately and processed for premonsoon (February - May), southwest monsoon (June - September) and postmonsoon (October - January) seasons to study the seasonal variation and abundance.

Results and discussion

The results obtained based on the monthly mean values (averages of six years data) of surface water temperature, salinity and dissolved oxygen for the surf zone (Cochin) and the Cochin backwater are depicted in Fig. 1 and those of phosphate, nitrite and nitrate concentrations and gross primary productivity are illustrated in Fig. 2, for their seasonal variation and abundance. Yearwise fluctuations of these parameters are presented seasonwise alongwith seasonal rainfall data in Figs. 3 & 4 and the consolidated mean values of hydrographic parameters are given in Table 1.

The results obtained on the seasonal variation and numerical abundance of fish larvae are presented in Table 2 and those of decapod larvae are given in Table 3. The data on the seasonal fluctuation and relative

abundance of fish and prawn juveniles during 1996-2001(based on numerical counts) are presented year wise in Figs. 5, 6 & 7 for the premonsoon, southwest monsoon and post-monsoon periods respectively, and their consolidated mean values for the three seasons (average of the six years) in Table 4.

Annual rainfall at Cochin ranged from 246 cm (in 2000) to 340 cm (in 1997) during 1996-2001. Monthly distribution of surface water temperature and salinity showed almost the same trend with relatively higher temperature and low salinity recorded in the backwater throughout the year. Water temperature and salinity showed decline during June-August by the influence of southwest monsoon rainfall and salinity indicated a decline in October due to northeast monsoon effect (Fig. 1). Distribution of dissolved oxygen showed close relationship in the surf zone and backwater and did not show any remarkable variation with seasons. In general, premonsoon months showed relatively stable environment in the surf zone and the Cochin backwater.

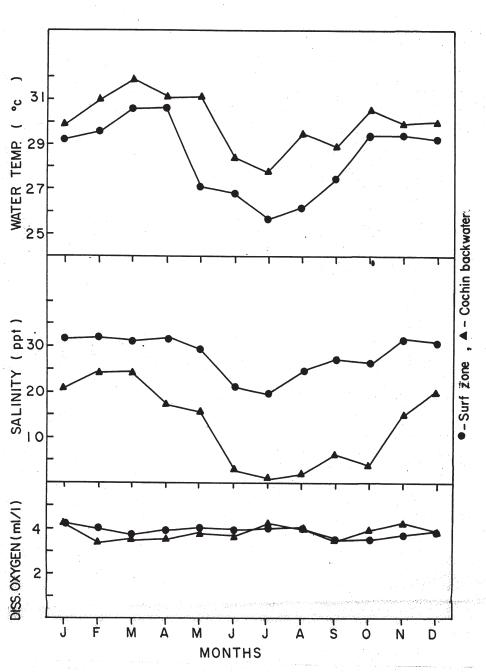

Fig. 1. Monthly variations of surface water temperature, salinity and dissolved oxygen (mean values of 1996 - 2001)

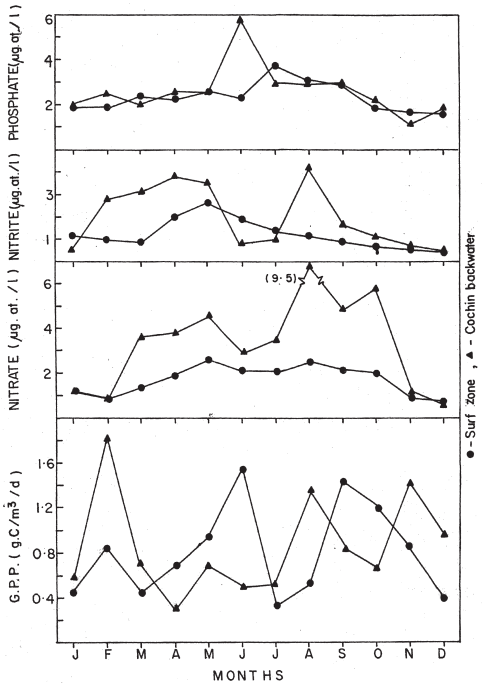

Fig. 2. Monthly variations of phosphate, nitrite, nitrate and primary productivity (mean values of 1996 - 2001).

Among nutrients, distribution of phosphate did not show much variation between the surf zone and backwater except an increase noticed in the backwater during June. Nitrite and nitrate concentrations in general were more in the backwater than in the surf zone (Fig. 2) This indicated that the enrichment of nutrients in the intertidal zone was mostly through *in situ*. production through

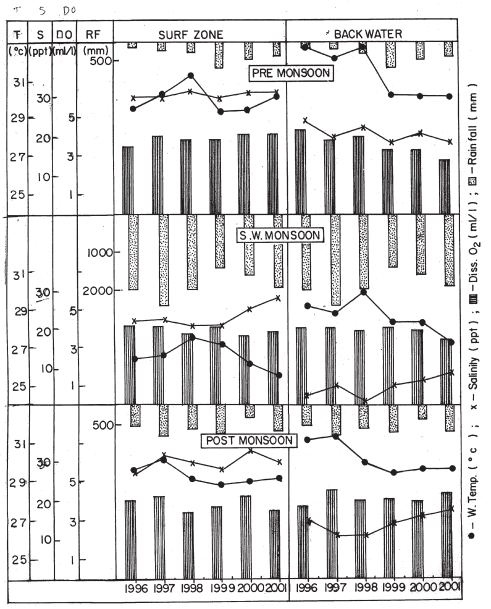

Fig. 3. Yearwise fluctuation of rainfall (mm), surface water tempetarure (°C), salinity (ppt) and dissolved oxygen (ml/l).

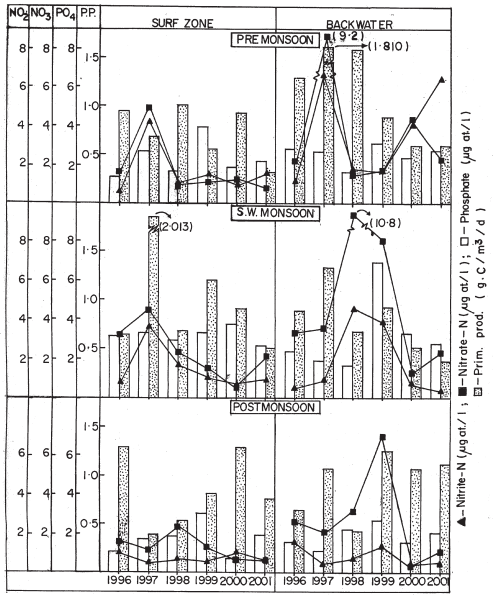

Fig. 4. Yearwise fluctuation of nitrite, nitrate and phosphate concentrations (mg at./l) and primary productivity (g.C/m3/d).

biogeochemical processes in the estuarine environment during premonsoon months and through land drainage and fresh water flow during monsoon. The presence of phosphate and nitrate in all the months in the surf zone and backwater with higher values of primary productivity confirmed that these nutrients do not act as the limiting factor for primary production in the surf zone of the sea and in the Cochin backwater. The role of nutrients and their seasonal variation in the Cochin backwater have been discussed

TABLE 1: *Seasonwise mean values of hydrographic parameters during 1996-2001 (average of six years data)*

Parameters	Premonsoon		Southwest monsoon		Postmonsoon		Annual average	
	Surf	B.W.	Surf	B.W.	Surf	B.W.	Surf	B.W.
Water Temp. (°C)	30.0	31.3	26.5	28.6	29.4	30.2	28.6	30.0
Salinity (ppt)	31.3	21.0	23.3	5.0	30.2	14.2	28.3	13.4
Dissolved Oxygen (ml/l)	3.89	3.57	3.89	3.85	3.81	4.09	3.86	3.84
Phosphate (mg at./l)	2.23	2.49	3.13	3.08	1.75	1.79	2.37	2.45
Nitrite (mg at./l)	1.61	3.58	1.48	1.76	0.73	0.80	1.27	2.05
Nitrate(mg at./l)	1.72	3.49	2.33	4.85	1.24	2.65	1.76	3.66
G.P.P. (g.C/m^3/d)	0.740	1.123	0.989	0.782	0.833	0.920	0.854	0.942
N.P.P. (g.C/m^3/d)	0.592	0.898	0.791	0.626	0.666	0.736	0.683	0.754

TABLE. 2: *Seasonal variation and abundance of fish larvae (mean values in nos./100 m³ water)*

Year	Premonsoon season		S.W. monsoon season		Postmonsoon season	
	Surf	B.W.	Surf	B.W.	Surf	B.W.
1996	225	0	1150	2300	358	0
1997	833	1175	133	67	67	33
1998	333	0	512	200	245	387
1999	350	N.D.	1567	N.D.	622	N.D.
2000	175	N.D.	172	N.D.	558	200
2001	156	2813	778	533	100	450
Mean	345	997	719	775	325	214

TABLE. 3: *Seasonwise abundance of decapod larvae (mean values in nos./100 m³ water)*

Year	Premonsoon season		S.W. monsoon season		Postmonsoon season	
	Surf	B.W.	Surf	B.W.	Surf	B.W.
1996	200	550	2294	1925	92	650
1997	908	100	1222	300	67	0
1998	575	275	225	75	255	67
1999	167	N.D.	550	N.D.	378	N.D.
2000	325	N.D.	67	N.D.	134	200
2001	1433	1900	344	100	600	0
Mean	601	706	784	600	254	183

N.D. No data

in detail by Sankaranarayanan and Qasim (1969).

Hydrographic parameters in general, showed fluctuation within the seasons(Figs. 1 & 2), from season to season and year to year in the surf zone and back water (Figs. 3 & 4). Statistical analysis showed significant difference in water temperature and salinity over the seasons with lowering of tempertature and salinity during the southwest monsoon. There was not much variation during premonsoon and postmonsoon seasons in the surf zone while in the Cochin backwater, the salinity showed significant variation in all the three seasons. However, dissolved oxygen did not show any significant difference over the three seasons. In the surf zone, nitrite and nitrate values did not show significant variation over the seasons, and in the backwater, phosphate, nitrite and nitrate values did not show significant variations over the seasons. Statistically, there was no significant variation in primary productivity over the seasons.

Phytoplankton productivity showed trimodal pattern of distribution with the peaks recorded during February, June and September in the surf zone and during February, August and November in the Cochin backwater (Fig. 2). This agrees with the work of Qasim *et al.* (1974); Sumitra *et al.* (1974) in the nearshore waters at Manassery

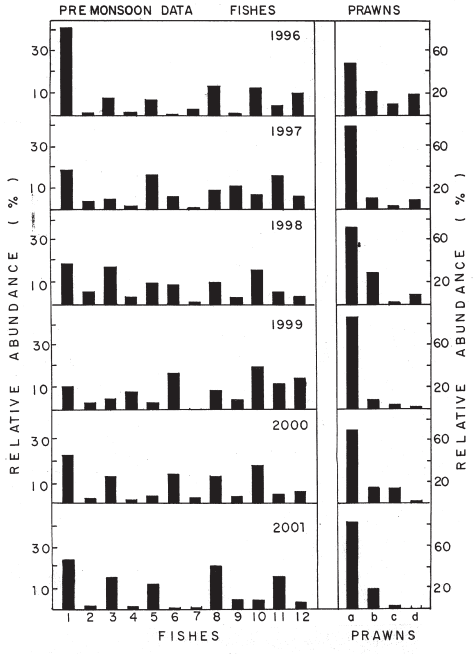

Fig. 5. Yearwise fluctuation and relative abundance of fish and prawn juveniles in the Cochin backwater during premonsoon season. Refer Table 4 for the names of fish species (1-12) and prawn species (a-d).

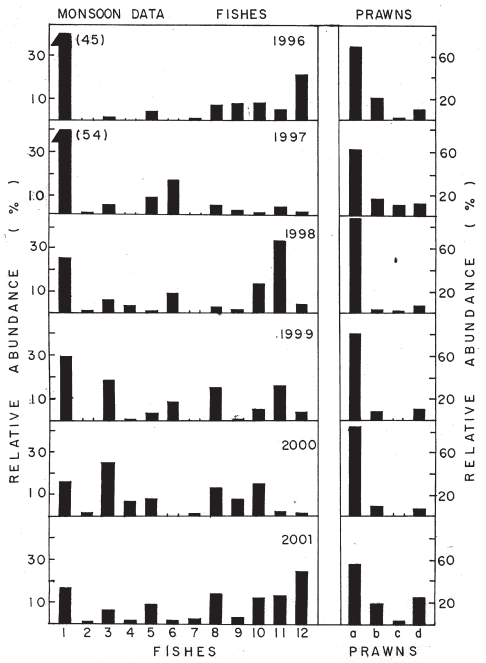

Fig. 6. Yearwise flucutation and relative abundance of fish and prawn juveniles in the Cochin backwater during southwest monsoon season. Refer Table 4 for the names of fish species (1-12) and prawn species (a-d).

(Cochin) and Gowda *et al.* (2001) in the Nethravathi estuary (Mangalore) in the Southwest coast of India, but in different months. The peaks observed during monsoon and postmonsoon months showed very high production (more than 1.2 g.C/m^3/d). Madhupratap *et al.* (1994) have also stated that primary productivity in the coastal surface waters reaches more than 1 g.C/m^3/d during bloom formation. Gross primary productivity showed the highest mean value of 1.123 g.C/m^3/d in the Cochin backwater during premonsoon period and 0.989g.C/m^3/d in the surf zone during southwest monsoon season (Table 1). The increase in primary productivity value observed in the backwater during premonsoon was chiefly due to the blooming of phytoplankton during February in 1997 and 1998 (Fig. 4). Among the hydrographic parameters, salinity alone indicated positive correlation with primary production in the backwater.

Fish larvae in the zooplankton samples of the surf zone showed abundance during southwest monsoon period (719 nos./100m^3) and in the Cochin backwater during premonsoon months (997 nos./ 100 m^3) corresponding to the increase in phytoplankton productivity. According to Davidraj and Ramamirtham (1981), the fish eggs and larval numbers in the zooplankton samples showed an

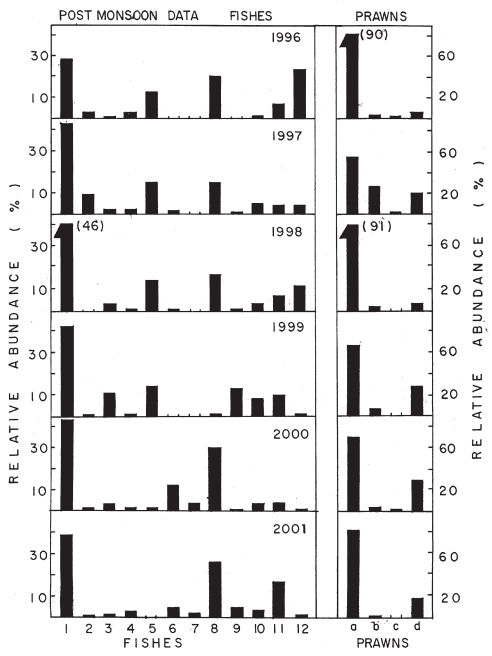

Fig. 7. Yearwise flucutation and relative abundance of fish and prawn juveniles in the Cochin backwater during postmonsoon season. Refer Table 4 for the names of fish species (1-12) and prawn species (a-d)

increasing trend in the premonsoon months with their abundance recorded during monsoon period in the shelf waters.

The composition of fish seed present in the Cochin backwater during 1974 - 76 as reported by Rengarajan and Davidraj (1979) consisted of gobiids, *Ambassis* spp. and clupeids in the order of abundance. In the present study, fish larvae were dominated by *Ambassis* spp. throughout the year in the surf zone and backwater. Except the mullet fry recorded during the onset of south west monsoon (May - June) and northeast monsoon (October - November) period, larvae of other cultivable fishes were not observed. Rengarajan and Davidraj (1979) have recorded few milk fish larvae in the plankton samples of the Cochin backwater during postmonsoon months. The absence of these larvae in the present samples collected in the shallow water along the shore might be due to either limited efficiency of the method employed for sampling or it could be due to preference of different habitats (other than the shallow waters) by these larvae in the backwater system.

Decapod larvae in the zooplankton samples were represented by prawn larvae of *M. dobsoni, M. monoceros* and *P. indicus* and zoea stages of crab larvae in the surf zone and backwater of which *M. dobsoni* larvae were relatively more as reported by Silas *et. al*. (1989). Mean numbers indicated the abundance of decapod larvae in the surf zone during southwest monsoon (784 nos. /100 m^3) in the backwater and during premonsoon season (706nos./100 m^3). In general, postmonsoon period showed relatively low numbers of fish larvae (Table 2) and decapod larvae (Table 3). The results indicated that fish larvae were relatively more in the Cochin backwater and decapod larvae in the surf zone of the sea at Cochin. It has been observed that in the surf zone of the Moplah Bay (North Kerala), the relative abundance of decapod larvae and fish larvae in the zooplankton samples were 14.7 and 2.45 % respectively during 1991-1992 (Selvaraj and Molly varghese, 1999) indicating the abundance of decapod larvae in the surf zone.

In Cochin backwater, 52 species of juvenile fishes were recorded during 1996-2001, of which about ten species showed their presence significantly. Among those species, juveniles of *Ambassis gymnocephalus* dominated in all the three seasons (Table 4).

TABLE 4: *Seasonal variation and Relative abundance (%) of juvenile fishes and prawns in the Cochin backwater during 1996-2001*

		Premonsoon	Southwest monsoon	Postmonsoon	Annual average
	Fishes				
1.	*Ambassis* spp.	22.4	31.2	40.1	31.2
2.	*Caranx* spp.	2.5	0.7	2.4	1.9
3.	*Etroplus* spp.	10.0	10.4	3.4	7.9
4.	*Gerres* spp.	2.4	2.0	1.7	2.0
5.	*Gobius* spp.	8.3	5.5	9.4	7.7
6.	*Johnius* spp.	7.3	6.0	3.1	5.5
7.	*Kowala* spp.	1.1	0.6	0.8	0.8
8.	*Leiognathus* spp.	12.4	9.6	18.0	13.3
9.	*Liza* spp.	4.0	3.7	3.3	3.7
10.	*Stolephorus* spp.	13.0	9.1	3.7	8.6
11.	*Thrissocles* spp.	9.7	12.5	7.7	10.0
12.	Others	6.9	8.7	6.4	7.4
	Prawns				
a.	*M.dobsoni*	72.7	73.4	75.3	73.8
b.	*M.monoceros*	15.6	12.6	6.9	11.7
c.	*P.indicus*	5.5	2.3	0.2	2.7
d.	Non-penaeids	6.2	11.7	17.6	11.8

Seasonal variation and abundance of fish and prawn juveniles showed fluctuation from year to year and from season to season in relation to fluctuations in the rainfall and salinity in the backwater (Figs. 5-7). Quantitative assessment of the juvenile fishery resources could not be made in the present study. Consolidated mean values indicated that juveniles of fishes were dominated by *Ambassis* spp. (31.2%), *Leiognathus* spp. (13.3%), *Thrissocles* spp. (10.0%), *Stolephorus* sp. (8.6%), *Etroplus* spp. (7.9%), *Gobius* spp. (7.7%), *Johnius* sp. (5.5%), *Liza* spp. (3.7%), *Gerres* spp. (2.0%), *Caranx* sp. (1.9%) and others (7.4%). Among these common groups, dominant species that contributed to the juvenile fishery of the backwater were *Ambassis gymnocephalus, Leiognathus brevirostris, Thrissocles malabaricus, T. mystax, Stolephorus macrops, Etroplus maculatus, E. suratensis, Glossogobius giurus, Johnius osseus, Liza parsia, Gerres abreviatus, Caranx kalla and Kowala coval*. Among the other groups of juveniles of important fish species which showed their seasonal occurrence (each 0.5 - 1.0%) in the samples of the Cochin backwater were *Secutor insidiator* and *Therapon jarbua* during premonsoon months; *Gobius microlepis* during southwest monsoon months; Hemiramphids in September; *Siganus* sp. during December - January; and *Lutjanus* sp., *Polynemus* sp., *Sillago sihama* and *Sphyraena* sp. during peak summer months (April - May).

Among prawn juveniles, *M. dobsoni* contributed in general more than 70% in the three seasons with their abundance recorded during postmonsoon period (75.3%). Juveniles of *M. monoceros* (15.6%) and *P.indicus* (5.5%) were relatively more during premonsoon season and non-penaeids during postmonsoon season (17.6%) in the Cochin backwater (Table 4). Among those juveniles of respective species, early juveniles(20-30 mm) of *M.dobsoni* formed 36-38% during April - September, *M. monoceros* (40.7%) during July - September and that of *P. indicus* were considerably more in the backwater close to the commencement of southwest monsoon season, which might indicate their peak period of recruitment to the coastal fisheries.

Acknowledgements

The authors are grateful to Dr. M. Devaraj, former Director, CMFRI for suggesting this research topic and encouragement; Dr. Mohan Joseph Modayil, Director, CMFRI for facilities and guidance; Dr. M. Rajagopalan, for suggestions in the manuscript; Dr. Somy Kuriakose, for statistical analysis; K. Solaman for assistance in the field work.

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Date of Receipt : 17-10-2003
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