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Shrimp fishery by stake nets in Cochin barmouth area with special reference to *Metapenaeus monoceros* (Fabricius)

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ABSTRACT

A general account on the shrimp fishery of Cochin backwaters based on stake net catch landed at Thoppumpady and Vypeen during January – December 1991 is given. Total shrimp catch and effort expended were more at Vypeen due to its proximity to the bar mouth. January – May period was observed to be the peak season for the shrimp fishery. Juveniles of *Metapenaeus dobsoni, Penaeus indicus* and *M. monoceros* were the contributors to the shrimp fishery in the order of abundance. Biological characteristics of *M. monoceros* were studied in detail. Size range of this species in the fishery was 56-120 mm and the catch was dominated by males and females in the length range of 71-90 mm and 66-90 mm respectively. Preference of darker nights of the new moon phase for egression to the sea by *M. monoceros* for further growth and maturation was felt from the present data.

Introduction

The backwater fishery resources of Kerala are of high magnitude and support a rich fishery. The fishery wealth is composed of several species of fishes, crustaceans and molluscs belonging prominently to the marine habit. The resources survey made in 1991 by Agency for Development of Aquaculture Kerala (ADAK) showed that the total area of backwaters in Kerala as per revenue records was 65137 hectares. The landings of commercially important fish and shrimps from the backwaters are about 15-21 thousand tonnes per annum with an average of 18 thousand t (Sanjeevaghosh, 1993).

Shetty (1965) made detailed observations on the fish and fisheries of Vembanad backwaters. George and Suseelan (1982) gave an account on the distribution of shrimps in Vembanad Estuary in relation to salinity. Kurup *et al.* (1993) conducted monthly surveys during 1988-89 in the Vembanad lake and estimated the annual yield of fishes and crustaceans as 7202 t. A detailed account on the shrimp fishery of Cochin Backwaters with special reference to the stake net catches was given by Menon

and Raman (1961). Manissery and Rao (2000) gave a brief account on the shrimp fishery at Thevara in Cochin backwaters during 1996-99. The extensive estuarine systems combined with backwaters serve as nursery grounds for commercially important shrimps. The muddy bottom containing large amounts of animal and plant detritus provide optimum conditions for growth. The juvenile shrimps then emigrate to the sea for further growth, maturation and spawning. At present there is a lacunae in our knowledge on the recent account on the shrimp fishery in the Cochin backwaters. Hence observations on shrimp fishery in general and fisheries biology of *M. monoceros* in particular from Cochin backwaters were made and given here in detail.

Materials and methods

Two important fish landing centres viz. Thoppumpady which is about 2 km from bar mouth on the southern side and Vypeen (about 500m from bar mouth on the northern side) were selected for observation of stake net fishery of Cochin backwaters during January – December, 1991. Stake nets were selected for observation of shrimp fishery, as bulk of the shrimp catch from this backwater was landed by these nets and they were operated regularly. Eventhough these nets were operated in different places in Cochin backwaters, the catch was landed at selected centres alone, to facilitate the traders to purchase the catch, which in turn enabled to get the catch details accurately as well as to collect the shrimp samples for biological studies regularly. The details on catch and effort were collected by visiting these two centres regularly, once in a week and random sample of about 1 kg of *M. monoceros* was collected every fortnight for biological studies. Using the raising factor N/n , where 'N' is the number of units landed on the day, and 'n' is the units observed, total weight of resource on the sampling day was estimated on the basis of sampling units. The monthly estimates were obtained by raising the estimated resource on the observation day to the number of fishing days in the month. The catch per unit effort (cpue) is the shrimp catch of one stake net for one day of operation. The collected samples of *M. monoceros* was separated sex-wise and details on total length (from the tip of the rostrum to the tip of telson), carapace length, total weight and tail weight were taken for males and females separately.

Craft and gear

The Cochin backwaters forming the northern extension of the Vembanad Lake support a very good juvenile shrimp fishery during the greater part of the year. The important fishing gears operated to exploit the fishes and crustaceans in the backwaters were of stake nets (Oonni or Kutti vala), dip nets (cheena vala or kampa vala), gill nets and cast nets. As stake nets were operated mainly to catch shrimps in the Cochin backwaters, fishery of these nets alone, were monitored for the present studies. The description of a stake net and mode of operation were given by Menon and Raman (1961) and Kurian and Sebastian (1976). The design of the stake net in detail along with economics of stake nets operation in the backwaters of Kerala were given by Hridayanathan and Pauly (1993). The stake nets were operated four days prior to new moon and full moon and continued till the fifth day after the moon's phase.

Results

The total shrimp catch landed by stake nets at Thoppumpady during 1991 amounted to 61.26 t with cpue of 3.24

TABLE 1: *Monthwise details on catch, CPUE (kg), effort and species composition of shrimps in stake net for the year 1991 at Thoppumpady.*

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	All months
Estimated unit operation	1871	2134	2790	2400	1800	1720	240	600	543	1710	1519	1575	18902
Total prawn catch	8341	14126	9882	6708	8013	2586	101	539	1447	1872	1697	5947	61259
CPUE	4.46	6.62	3.54	2.80	4.45	1.50	0.42	0.90	2.66	1.10	1.12	3.78	3.24
M. monoceros	165	947	324	348	207	152	5	16	22	45	133	54	2418
CPUE	0.09	0.44	0.12	0.15	0.12	0.09	0.02	0.03	0.04	0.03	0.09	0.03	0.13
%	1.98	6.70	3.28	5.19	2.58	5.88	4.95	2.97	1.52	2.40	7.84	0.91	3.95
M. dobsoni	7523	12346	8892	5704	5922	1668	36	488	1421	1773	1402	5866	53041
CPUE	4.02	5.79	3.18	2.38	3.29	0.97	0.15	0.81	2.62	1.04	0.92	3.73	2.81
%	90.19	87.41	89.98	85.03	73.90	64.50	35.64	90.54	98.29	94.72	82.62	98.64	86.58
P. indicus	653	820	639	652	1884	766	60	32	2	18	162	27	5715
CPUE	0.35	0.38	0.23	0.27	1.05	0.44	0.25	0.05	-	0.01	0.11	0.02	0.30
%	7.83	5.80	6.47	9.72	23.51	29.62	59.41	5.94	0.14	0.96	9.54	0.45	9.33
M. affinis	-	-	-	-	-	-	-	3	24	36	-	-	41
CPUE	-	-	-	-	-	-	-	0.01	-	0.02	-	-	-
%	-	-	-	-	-	-	-	0.56	0.14	1.92	-	-	0.07
P. semisulcatus	-	13	27	4	-	-	-	-	-	-	-	-	44
CPUE	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
%	-	0.09	0.27	0.06	-	-	-	-	-	-	-	-	0.07

kg. The details on the catch and effort and species composition of shrimps are shown in Table 1. The estimated unit operation of stake nets in this centre in 1991 was 18902. January-May was found to be the peak fishing season for shrimps when more than three fourth of the catch (47070 kg; 76.84%) was caught and the average catch per unit effort during these five months was 4.28 kg. Due to favourable ebb tides in January-February period the nets were operated twice a day, in the evening as well as in the early morning. Heavy rains from first week of June '91 resulted in strong outflow of water from the backwaters to the sea. During this period the stake nets were operated in the early mornings without depending on the ebb tides. From second half of June, till November '91 only a few nets were operated and that too for restricted days due to decrease in the catch of shrimps as well as fishes. From September '91, the shrimp catch started improving and in the month of December the shrimp catch amounted to 5947 kg with CPUE of 3.78 kg. The maximum shrimp catch (14126 kg) and CPUE (6.62 kg) were recorded in the month of February'91. The shrimp catch was very poor during July-August, which coincided with peak monsoon. During fishing season between 50 and 125 stake nets per day landed their catch at Thoppumpady. The shrimp catch in 1991 mainly consisted, juveniles of the

following three species viz. *Metapenaeus dobsoni, Penaeus indicus* and *M. monoceros* in the order of abundance with percentage composition of 86.58, 9.33 and 3.95 respectively. *P. semisulcatus* and *M. affinis* were encountered sporadically in the catch during February-April and August-October respectively.

The estimated landings of *M. monoceros* by stake nets at Thoppumpady for the year 1991 was 2418 kg with CPUE of 0.13 kg. The productive season of fishery for this species was January-June when 88.63 % (2143 kg) of the annual catch was harvested with CPUE of 0.17 kg. The monsoon settled down from June and very poor fishery for this species was noticed during July-December '91. Thus *M. monoceros* formed one of the important contributors to the shrimp fishery at Thoppumpady region.

Between 250 and 300 stake nets operate regularly at Cochin backwaters region near the bar mouth and land their catch at Vypeen centre. The number of days of net operation is always more at Vypeen centre due to better outflow of water during low tides when compared with other fishing centres of Cochin backwaters. It was observed further, that when juvenile fishes constitute the main catch, the stake nets are operated even during high tides. During January-February 1991, the stake nets were operated during ebb tide in the early morning as well as in the evening. In the month of June, due to heavy rains there was a good outflow of water from estuary and the nets were operated twice a day. The details on the shrimp fishery at Vypeen are given in Table.2. The estimated shrimp landings at Vypeen amounted to 222 t in 1991 with an average annual CPUE of 2.84 kg. The peak season of the shrimp fishery was January-May '91 when 68.55 % (152.25 t) of the annual catch was recorded with catch rate of 4.13 kg. The maximum shrimp catch (53.16 t) and CPUE (7.64 kg) were recorded in the month of February. *M. dobsoni* was the most dominant species which constituted 75.35 % (167.34 t) of the annual shrimp catch with CPUE of 2.14 kg. *P. indicus* (12.67%) and *M. monoceros* (11.92 %) were the other important contributors to the shrimp fishery at Vypeen. The annual landings of *P. indicus* was 28.15 t with CPUE of 0.36 kg. January-July duration was the peak fishing season for this species when 95.27% (26.82 t) of the annual catch was landed. The highest catch (6.12 t) and CPUE (0.88 kg) were recorded in February '91.

The total catch of *M. monoceros* during 1991 was 26.47 t with CPUE of 0.34 kg. The peak fishing season for this species was January-April, when 76.13 % (20.15 t) of annual landings were recorded with average CPUE of 0.68 kg. The catch was moderate during October-November when 3.67 t of *M. monoceros* was caught which amounted to 13.87 % of annual catch. During monsoon period (June-September'91) the catch of *M. monoceros* decreased to 924 kg, with the CPUE of 0.04 kg. The highest catch (7.44 t) and CPUE (1.07 kg) were recorded in the month of February '91.

A relationship between shrimp catch and phases of moon was generally observed during 1991. Hence an attempt was made to learn whether any differences exist between the newmoon and full moon phases in the movement of juvenile *M. monoceros* from Cochin backwaters, which can be deduced from the variations in catch rates during these phases. As the peak fishing season for this species in the stake nets fishery was

TABLE2: *Monthwise details on catch, CPUE (kg), effort and species composition of shrimps in stake net at Vypeen centre for the year 1991.*

Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	All months
Estimated unit operation	8004	6960	7200	7544	7200	10000	5400	4322	3915	5594	6780	5220	78139
Total prwn catch(kg)	29815	53160	15840	34627	18804	9280	3162	3247	10827	28861	5601	8866	222090
CPUE	3.72	7.64	2.20	4.59	2.61	0.93	0.59	0.75	2.77	5.16	0.83	1.70	2.84
M. monoceros	5149	7440	1980	5582	744	420	87	168	249	1510	2157	984	26470
CPUE	0.64	1.07	0.27	0.74	0.10	0.04	0.02	0.04	0.07	0.27	0.32	0.19	0.34
%	17.27	14.00	12.50	16.12	3.96	4.53	2.75	5.17	2.30	5.23	38.51	11.10	11.92
M. dobsoni	22678	39480	12240	25650	13428	2750	108	2470	10337	27095	3263	7838	167337
CPUE	2.83	5.67	1.70	3.40	1.87	0.28	0.02	0.57	2.64	4.84	0.48	1.50	2.14
%	76.06	74.27	77.27	74.08	71.41	29.63	3.42	76.07	95.47	93.88	58.26	88.40	75.35
P. indicus	1988	6120	1620	3395	4632	6110	2952	609	241	256	181	44	28148
CPUE	0.25	0.88	0.23	0.45	0.64	0.61	0.55	0.14	0.06	0.05	0.03	0.01	0.36
%	6.67	11.51	10.23	9.80	24.63	65.84	93.36	18.76	2.23	0.89	3.23	0.50	12.67
M. affinis	-	-	-	-	-	-	15	-	-	-	-	-	15
CPUE	-	-	-	-	-	-	-	-	-	-	-	-	-
%	-	-	-	-	-	-	0.47	-	-	-	-	-	0.01
P. semisulcatus	-	120	-	-	-	-	-	-	-	-	-	-	120
CPUE	-	0.02	-	-	-	-	-	-	-	-	-	-	-
%	-	0.22	-	-	-	-	-	-	-	-	-	-	0.05

TABLE 3: *Catch per unit effort of* M. monoceros *(kg) in stake net fishery at Thoppumpady during different phases of moon with CPUE of total prawns (kg) in parenthesis*

Months	Catch per unit effort		Number of units observed	Number of total days observed
	Newmoon Phase	Full moon Phase		
April '91	1.21 (20.01)	0.69 (16.11)	6 (16.11)	15
May ' 91	0.67 (24.18)	0.59 (13.76)	6	14

January-May '91, continuous observations were made on the landings of six stake net units at Thoppumpady during full and new moon phases of April and May'91. The catch details are shown in Table 3.

During the darker nights of new moon phase in April '91, the juvenile brown shrimps moved to the sea from the Cochin backwaters in greater numbers which was indicated by the higher catch rate of 1.21 kg. In the full moon phase

during the brighter nights in the same month, the CPUE of *M. monoceros* reduced by 43 % to 0.69 kg. However, in May 91, the same trend of movement during darker nights to the sea by juvenile *M. monoceros* was there but not so significant as in April (CPUE of 0.67 kg in new moon phase, and 0.59 kg during full moon phase). The above observations suggested preference of darkness by *M. monoceros* for egression to the sea for further growth and maturation. Increase in the catch of brown shrimp during new moon phase may probably due to higher force of receding water. The maximum catch was noticed on different days in the new and full moon phases and there was no relationship between catch rate and any particular day in the new moon or full moon phase.

The monthly length distribution (at 5 mm intervals) in percentage frequency for females and males of *M. monoceros* in the stake net fishery at Thoppumpady is presented in Table 4. Length distribution in most of the months was multimodal, which indicated the post-larval recruitment to the Cochin backwaters at different intervals.

Females of 56-120 mm and males of 56-115 mm in total length represented *M. monoceros* catch in the stake nets in Cochin backwaters in 1991. Bulk of the catch (96.60%) was contributed by those measuring between 61 and 95 mm. There were two dominant modal groups in 66-70 and 76-80 mm for females and one predominant group in 76-80 mm for males in the stake net fishery in 1991. The number of monthly modes varied between one and three for both sexes. The lowest size group of the population at 56-65 mm occurred more during February-March and October-November periods. Larger shrimps measuring between 96 and 120 mm in total length were encountered mainly during peak summer months (April - May) as well as in the first fortnight of June when good outflow from backwaters resulted due to heavy monsoon rains. Female *M. monoceros* outnumbered males in the stake net catch during January-July period and in November and formed 53.83 % in the annual catch.

Discussion

Peak season of the penaeid shrimp fishery in Cochin backwaters was January-May. The shrimp catch was dominated by *M. dobsoni* and the other contributors were *P. indicus* and *M. monoceros*. Kurup *et al*. (1993) observed preponderance of penaeids during January-June based on their studies on exploited fishery resources of Vembanad lake during 1988-89 and recorded similar species composition in shrimp catch.

The productive season for *M. monoceros* in Cochin backwaters was January-June, which agrees well with the observations on this species made by George (1974) and George and Suseelan (1982) in the same backwater system. *M. monoceros* was one of the important contributors to the shrimp fishery of Cochin backwaters forming third in abundance in the stake net fishery. This observation coincided with the earlier studies on the distribution and abundance of shrimp seeds in Cochin backwater system which showed that *M. monoceros* was third in abundance with density of 6/m^2 (Sosamma Easo and Mathew, 1989). The catch rate of this species in the stake net fishery at Vypeen was better than the Thoppumpady centre. This can be attributed to stronger tidal outflow due to proximity of Vypeen to Cochin bar mouth. The percentage composition of this species in the total shrimp landings of the stake net fishery

TABLE 4: *Length frequency (%) of* M. monoceros *from Thoppumpady region of Cochin backwaters in 1991.*

M.L. in mm	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec		Annual	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
58		-	2.7	1.7	1.9			0.8													3.5	1.1		1.0	1.0	1.1
63			7.5	10.3	8.2	6.0	0.8	4.4									0.6		7.0	5.0	7.9	4.9	2.1	1.0	5.0	5.9
68	20.8	5.4	28.3	9.4	5.4	2.8	4.5	6.4	1.0	1.0	2.6			9.3				0.5	10.5	1.3	13.3	17.6	1.0	8.5	15.3	6.9
73	11.4	30.6	16.7	33.7	7.0	12.3	8.2	16.3	1.0	13.2	0.6		3.2			1.7	1.2	1.0	19.3	16.5	24.0	29.9	12.92	20.3	11.9	23.5
78	30.9	40.6	24.2	33.6	27.7	33.9	20.5	24.5	9.7	5.8	11.0	22.3		18.5	8.6	18.2	20.6	0.5	12.3	38.0	15.5	32.0	19.18	32.7	22.1	29.8
83	22.9	15.3	19.1	11.1	18.4	25.9	27.1	21.4	16.3	19.9	22.6	24.6	11.1	16.6	23.8	32.6	20.6	16.8	26.3	24.0	24.4	13.4	31.89	30.9	21.1	17.3
88	10.0	5.4	2.5		32.8	12.7	24.6	13.0	35.9	42.5	14.8	27.7	15.9	22.2	39.6	37.2	32.7	32.7	8.8	13.9	9.4	1.1	15.8	5.6	15.2	9.6
93	2.0				0.5	6.4	8.6	5.9	24.8	15.3	21.3	22.2	34.9	11.1	15.3	8.6	23.1	40.8	8.8	1.3	1.0		14.78		5.0	4.4
98	2.0						2.2	4.6	8.0	1.0	16.2	3.2	27.0	13.0	8.3	1.7	1.2	7.7			1.0		2.3		2.1	0.9
103							1.5	2.4	2.1	1.3	6.5		7.9	9.3	4.4										0.7	0.4
108									1.2		1.9								7.0						0.3	
113							1.2	1.1			1.9														0.3	0.2
118											0.6															

was 11.92 at Vypeen and 3.95% at Thoppumpady. Menon and Raman (1961) based on their observations on the stake net fishery in Cochin backwaters stated that the shrimp catch at Azhikal situated nearer to Cochin harbour was better than Thevara (which is six miles away from harbour) and attributed this trend to nearness of Azhikal to harbour entrance and greater strength of tidal currents. Similar observation on the shrimp fishery of Cochin backwaters was made by Kuttyamma and Antony (1975).

Catch of *M. monoceros* was found to be better during darker nights of new moon phase which indicated positively, the nocturnal nature of the brown shrimp and its preference of darkness for egression to the sea. Subrahmanyam (1965) also stated that *M. monoceros* was nocturnal in movement and the number of emigrants was generally higher during new moon period than during full moon in the Godavari estuarine system. However Menon and Raman (1961) noticed highest catch of shrimps in the stake net fishery of Cochin backwaters on new or full moon day or on the following two days and concluded that brighter and darker fortnights did not influence the catch. Juveniles of *M. monoceros* in the size range of 56-120 mm contributed to the brown shrimp catch in the stake net fishery. Predominance of females over the males in the *M. monoceros* catch was noticed during the period of observation.

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