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DISTRIBUTION OF SEX RATIOS OF PENAEID PRAWNS IN THE TRAWL FISHERY OFF COCHIN*

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ABSTRACT

Sex ratio data of four species of penaeid prawns *Metapenaeus dobsoni*, *Penaeus indicus*, *Parapeneopsis stylifera* and *Metapenaeus affinis* in the trawl fishery catches of Cochin for 1962 and 1963 are analysed statistically and it is found that in the former three species the distributions of the sexes are significantly different from what could be accounted for by binomial theory and in *Metapenaeus affinis* alone the sexes are more or less evenly distributed throughout the year. It is suggested that the differential sex ratios in the fishing grounds may be brought about by the segregated sex movements for breeding.

IN sex ratio studies in which monthly samples are collected and analysed for sex ratio estimation, different monthly samples may give different estimates of sex ratio. It is possible that either the sex ratios are distributed according to the binomial theory and the apparent difference in the monthly sex ratios are due to sampling fluctuations or the sex ratios are not distributed according to the binomial theory due to an actual change in the concentration of the sexes.

Sex ratios of the four species of penaeid prawns, *viz.*, *Metapenaeus dobsoni*, *Metapenaeus affinis*, *Penaeus indicus* and *Parapeneopsis stylifera* in the commercial trawl fishery in Cochin area for the years 1962 and 1963 have been analysed in order to determine whether or not they were distributed binomially. Tables I *a* to *d* give the sex ratios of the different species during the different months of off-shore catches. From the tables it is evident that the ratio of males vary considerably in different months in most of the species. To test if the variation in the monthly sex ratios could be expected from binomial theory or not, x^2-statistics given below was calculated:

$$x^2 = \frac{\sum\left(\frac{x_i^2}{n_i}\right) - \frac{(\Sigma x_i)^2}{\Sigma n_i}}{pq}$$

where x_i is the number of males in the "i"-th month, n_i is the total number of observations in the "i"-th month, $p = \Sigma x_i / \Sigma n_i$ (Cochran, 1954) and $q = (1-p)$. The x^2 values of each species with the associated degrees of freedom are given in Table II separately for 1962 and 1963. Significance tests at a probability level of 0·01 show that the variations in sex ratios in different months in the case of the three species *M. dobsoni*, *P. stylifera* and *P. indicus* were significantly different from what could be accounted for by binomial distribution. But the variation in monthly sex ratios in the case of *M. affinis* was not found to be significantly different from the expected binomial ratios.

If the sex ratios are distributed according to the binomial theory, the estimate of variance of sample estimate of the sex ratio is given by $v(p) = pq/n$, where p is the sample estimate of male ratio, $q = 1 - p$ measuring the estimate of female ratio and 'n' the sample size. This formula is not valid if the distribution is not binomial, unless individual prawns are sampled at random. In actual practice cluster sampling is resorted to. In this case Cochran (1953) has given the following formula for estimation of variance of p.

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TABLE I

Showing the sex ratios of the different species for 1962 and 1963

Months	1962			1963		
	Sample size	Males	Ratio	Sample size	Males	Ratio
		(a) M. dobsoni				
January ..	993	428	0·43	1,047	519	0·49
February ..	1,057	466	0·44	1,222	432	0·35
March ..	1,743	553	0·32	997	389	0·39
April ..	919	416	0·45	1,009	385	0·38
May ..	1,127	536	0·48	1,069	456	0·43
June ..	846	553	0·65	50	39	0·78
November ..	271	150	0·55	167	98	0·59
December ..	390	247	0·63	196	94	0·48
		(b) M. affinis				
January ..	205	109	0·53	287	132	0·46
February ..	200	103	0·51	331	187	0·56
March ..	323	178	0·55	297	131	0·44
April ..	55	18	0·33	384	204	0·53
May ..	545	265	0·49	377	189	0·50
June ..	285	152	0·53	97	41	0·42
September ..	1	1	1·00	..	..	..
October ..	442	217	0·49	15	7	0·47
November ..	446	223	0·50	97	49	0·50
December ..	635	324	0·51	44	27	0·61
		(c) P. stylifera				
January ...	33	9	0·27	41	17	0·41
February ..	43	8	0·19	29	16	0·55
March ..	108	47	0·43	141	65	0·46
April ...	49	25	0·51	251	32	0·13
May ...	401	174	0·43	31	13	0·42
June ...	818	423	0·52	24	10	0·42
September ..	515	238	0·46	..	..	...
October ..	778	419	0·54	125	80	0·64
November ..	574	348	0·61	177	118	0·67
December ..	326	170	0·52	18	14	0·78
		(d) P. indicus				
January ...	247	144	0·58	82	50	0·61
February ...	115	82	0·71	46	30	0·65
March ..	40	22	0·55	15	6	0·40
April ..	2	1	0·50	143	71	0·49
May ..	9	5	0·55	84	28	0·33
June ..	18	9	0·50	...	...	...
October ..	2	2	1·00	..	...	...
November ..	5	1	0·20	..	..	..
December ..	153	117	0·76	8	2	0·25

TABLE II

Showing the values of x^2 for different species for 1962 and 1963

Species	1962			1963		
	Degree of freedom	Value of x^2	Significant or not	Degree of freedom	Value of x^2	Significant or not
M. dobsoni ..	7	333·519	Significant	7	110·740	Significant
M. affinis ..	9	14·892	Non-significant	8	17·752	Non-significant
P. stylifera ..	9	66·082	Significant	8	29·566	Significant
P. indicus ..	8	22·273	Significant	5	20·118	Significant

$$v'(p) = \frac{1}{k(k-1)\bar{n}^2} (\Sigma x_i^2 + p^2 \Sigma n_i^2 - 2p \Sigma x_i n_i)$$

where k is the number of clusters sampled. Table III gives the value of $v(p)$ and $v'(p)$ in the case of all the species studied.

TABLE III

Showing the values of v (p) *and* v' (p) *for different species for 1962 and 1963*

Species	1962		1963	
	$v(p)$	$v'(p)$	$v(p)$	$v'(p)$
M. dobsoni ..	0·0000338	0·001967	0·0000423	0·000574
M. affinis ..	0·0000798	0·00077	0·0001295	0·000338
P. stylifera ..	0·0000686	0·000451	0·000295	0·001305
P. indicus ..	0·0003859	0·005584	0·000661	0·006130

For all the species it is found that $v'(p)$ is greater than $v(p)$. This shows that the two sexes are distributed in greater patchiness in different months than expected by binomial theory.

x^2 tests have shown that the same sex ratio is not maintained throughout the fishing season in the case of the three species *M. dobsoni, P. stylifera* and *P. indicus*. Menon (1957) studying the inshore prawn fishery of Cochin area observed the occurrence of difference in the sex ratios of all these species as well as *M. affinis* especially in the larger size groups. It is possible that the difference in sex ratios observed may be due to an actual change brought about byinshore-off shore movements of these prawns as suggested by Menon (*op. cit.*). A close examination of Table I *a* will reveal that in the case of *M. dobsoni* the ratio of males is high in the fishing grounds in the months June and November–December. In other words females are less abundant here during these months. According to George (1962) these are the months of peak breeding season for this species in this area. Hence it is possible that this difference in sex ratio may be due to the movement of females in larger numbers to deeper waters for spawning. In the other species *P. stylifera* and *P. indicus* also the differential sex ratio can be explained to be due to breeding movements. In *P. stylifera* the female ratio is less in the exploited ground, as can be seen from Table I *c*, in October to December which is the peak breeding season of this species on the Malabar Coast as observed by Menon (1953). In the case of *P. indicus* the peak breeding months in Cochin area is November–December and February (George, 1962) when females are noticed to be less in the trawl catches (Table I *d*). However, it is interesting to note that in the case of *M. affinis* alone the x^2 value is non-significant thereby indicating that this species does not appear to segregate by sex in the trawling area. This apparent difference in this particular species may be due to the fact that the breeding of this species does not take place anywhere near the present area exploited by the trawl fishery, so that segregated movements for breeding does not take place in this ground. The insignificant number of post-larvae of this species in comparison to the others entering the backwaters near the fishing area further strengthen this point of view.

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