

ON THE SEX PROPORTIONS AND MATURITY TRENDS IN *CYNOGLOSSUS SEMIFASCIATUS* DAY ON THE WEST COAST DURING 1980-81¹

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Twenty-seven samples of *C. semifasciatus* were analysed in all for sex and maturity trends from Calicut, Cannanore, Mangalore and Malpe during the period February 1980 to January 1981, the samples being preserved and transported to Bangalore and worked out there. Two additional samples were also collected from Cochin during January 1982 and examined similarly. The Cochin samples of January 1982 resembled the Calicut samples of January 1981 in the general maturity trends of the females (only this sex being analysed for stages of maturity in this work); only the early immature and the advanced spent as well as spent recovering stages occurred in these samples, the intermediate stages (III to VI) being completely absent.

In the pooled data of the other centres no immature juveniles in stage I occurred in the first and second quarters of the year while they were dominant in the fourth quarter; the latter occurrence indicated that the main spawning had taken place at the last phase of the third quarter and early in the fourth quarter in the area, as found in past at Calicut. Spawning and post-spawning stages (VI and recovering II) were completely absent in the second quarter but occurred in the first and fourth quarters. While stage VII was more frequent in the fourth quarter, stage II (recovering) was more frequent in the first quarter.

INTRODUCTION

Some detailed work was done in the past on the sex proportions and maturity trends in *Cynoglossus semifasciatus* Day at Calicut (Seshappa and Bhimachar 1955); some further information is also available for some years on these trends in a summary way for both Calicut and Mangalore in the Annual Reports of the Central Marine Fisheries Research Institute published in the various volumes of the *Indian Journal of Fisheries*. No detailed information is available for Cannanore, but a single sample studied from Moplah bay,

Cannanore (Seshappa 1978) dealt with 28 individuals collected on 14-12-1968, these including 14 females (9 of these being in stages III and above and others in stages I and II). Seshappa (1980) has given an account of the sex proportions and maturity trends in *C. bilineatus* (Lacepede) and *C. macrolepidotus* (Bleeker) at Calicut.

27 samples of *C. semifasciatus* were collected and examined between February 1980 and January 1981 (inclusive) from four selected centres of the west coast for a study of the population variations in the species in time and space; along with the selected morphometric and meristic characters that were studied in these samples the sexes were determined and maturity stages also recorded for all the females. Malpe, Mangalore, Cannanore and Calicut were the sampling centres; but the

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findings on two samples from Cochin harbour available in January 1982 are also given at the end.

While as many as 15 samples were available from Calicut, only six samples were obtained from Mangalore, five from Cannanore and only one sample from Malpe.

METHODS

The mode of collection, preservation and transport of the samples to Bangalore has been given elsewhere (Seshappa and Chakrapani, in press). The sexes were determined in the preserved specimens after cutting open the abdomen and careful examination of the gonads with the necessary microscopic examination (only the females being taken up for determining the maturity stages). The key followed for designating the various stages was the one given by Seshappa and Bhimachar (1955).

RESULTS

The dates of collection of the samples at the different places, the gears used and the total numbers of the two sexes in each sample are given in table 1. Table 2 shows the month-wise frequency and percentages of the different stages among the females of *C. semifasciatus* examined during the period. The following are the main features of the maturity trends noticed:

(a) *Malpe*: There are 18 females in the single sample examined; among these 77.78% are in stage V and three are in still higher stages of maturity while only one individual is in stage I (i.e. below V). The very high percentage of the pre-spawning advanced maturity stages is not quite normal at Calicut and they are not noticed here in April when only 7.02% are found in stage V; but in

Mangalore 26.09% of the females are found in stage V; while no samples are available from Cannanore in March and April, 18.18% of the females are in stage V there, in May. Probably spawners occurred in good numbers even upto the commencement of the southwest monsoon all along the west coast in 1980; the occurrence of large numbers of stage V fish at Malpe is particularly noteworthy for March.

(b) *Mangalore*: Samples were available from this centre only during February, March and May. February showed all the maturity stages from I to VII (and spent recovering stage II also), this last bracketted stage being dominant and forming 40.9% of the total females (stage V with 22.73% being the second dominant). Stages above V were absent in March and May (except for one specimen in March in stage VII). The dominant stages in March and May were IV and III with 41.30% and 50.70% of the total females respectively. Stages II and V were the main maturity stages seen in both the months.

(c) *Cannanore*: While five samples were available from this centre, only the months of May, October and December were represented; stages III to V were seen in May with stage III dominating (60.61%) while all the 13 females of October were in stage IV; in December stages IV to VI were absent and stage VII (spent) was dominant with 40% of the females in it, while stages I to III were also present with stage I dominating the series (22.5%); these represented the new recruits that formed a distinct size group at the lower end of the series, the older fish being represented by stages VII and II (spent recovering).

(d) *Calicut*: April and May represented the premonsoon period in the samples of this place; stages above V were absent in both these months and the other stages ranged from II to V. Stage IV was dominant in April (59.65%) and stage V in May (53.49%).

TABLE 1

DETAILS OF DIFFERENT SAMPLES OF *C. semifasciatus* TAKEN FROM DIFFERENT CENTRES DURING 1980-81 ALONG WITH THE GEARS USED AND THE NUMBERS OF THE TWO SEXES (TWO SAMPLES FROM COCHIN TAKEN IN JANUARY 1982 ARE ALSO INCLUDED IN THE TABLE AT THE END)

Dates	Places	Total males	Total females	Gears used
23-2-1980	Mangalore	25	22	Trawl net
14-3-1980	"	45	19	"
15-3-1980	Malpe	28	18	"
28-3-1980	Mangalore	24	27	"
23-4-1980	Calicut	27	26	"
30-4-1980	"	19	30	"
5-5-1980	Mangalore	29	25	Trawl net?
8-5-1980	Cannanore	39	14	Trawl net
10-5-1980	Calicut	33	22	"
15-5-1980	Mangalore	30	22	Trawl net?
22-5-1980	"	27	24	"
25-5-1980	Calicut	28	22	Trawl net?
28-5-1980	Cannanore	32	19	"
6-10-1980	near Cannanore	22	13	Not known
21-10-1980	Calicut	22	32	Gillnet (<i>ayilachalavala</i>)
23-10-1980	"	29	26	Seine net (<i>Pattenkollivala</i>)
30-10-1980	"	19	32	"
31-10-1980	"	27	24	Gillnet (<i>ayilachalavala</i>)
28-11-1980	"	22	28	Seine net (<i>Pattenkollivala</i>)
1-12-1980	"	34	18	Trawl net
13-12-1980 (i)	Calicut	30	25	"
(ii)	"	26	27	Seine net (<i>Pattenkollivala</i>)
14-12-1980	Cannanore	33	19	Trawl net
28-12-1980	"	31	21	"
29-12-1980	Calicut	19	33	"
15-1-1981	"	32	24	"
28-1-1981	"	30	23	"
Cochin samples of January 1982				
8-1-1982	Cochin Harbour	28	37	Shrimp trawl?
13-1-1982	"	48	20	Shrimp trawl

The latter stage formed only 7.02% in April while stage IV formed 18.6% in May and a good proportion of the females had moved over from IV to V in this interval. October had unusually included a few juveniles of a new brood in stage I (3.51%), the range of other stages being mainly III to V with a single specimen each in stage VII and stage II (recovering spent); the dominant stage in October

was IV (40.35%). The maturity stages of this month indicate that not only had spawning started already in the neighbourhood but also a few juveniles had entered the catches unusually early in the season. In November there was only one sample and all the fish in it were juveniles in stages I and II with stage I forming 82.14%. In December all stages were represented with the minimum of one each in

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TABLE 2

MONTHLY TOTAL FREQUENCY AND PERCENTAGE DISTRIBUTION OF DIFFERENT MATURITY STAGES IN *C. semifasciatus*, FEBRUARY 1980 TO JANUARY 1981. (FIGURES IN BRACKETS ARE PERCENTAGES)

Months	I	II (Virgins)	Maturity III	stages VI	V	VI	VII	II (Recovering)	Totals
I. MANGALORE									
February	0	3 (13.64)	1 (4.55)	2 (9.09)	5 (22.73)	1 (4.55)	1 (4.55)	9 (40.91)	22
March	0	13 (28.26)	1 (2.17)	19 (41.30)	12 (26.09)	0	1 (2.17)	0	46
May	0	2 (2.82)	36 (50.70)	27 (38.03)	6 (8.45)	0	0	0	71
II. MALPE									
March	0	1 (5.56)	0	0	14 (77.78)	2 (11.11)	1 (5.56)	0	18
III. CANNANORE									
May	0	0	20 (60.61)	7 (21.21)	6 (18.18)	0	0	0	33
October	0	0	0	13 (100%)	0	0	0	0	13
December	9 (22.50)	7 (17.50)	1 (2.50)	0	0	0	16 (40.00)	7 (17.50)	40
IV. CALICUT									
April	0	8 (14.14)	11 (19.30)	34 (59.65)	4 (7.02)	0	0	0	57
May	0	1 (2.33)	11 (25.58)	8 (18.60)	23 (53.49)	0	0	0	43
October	4 (3.51)	0	23 (20.18)	46 (40.35)	39 (34.21)	0	1 (0.88)	1 (0.88)	114
November	23 (82.14)	5 (17.86)	0	0	0	0	0	0	28
December	40 (38.83)	34 (33.01)	8 (7.77)	3 (2.91)	1 (0.97)	1 (0.97)	9 (8.74)	7 (6.80)	103
January 1981	3 (6.25)	4 (8.33)	0	0	0	0	10 (21.83)	31 (64.58)	48

stages V and VI and a maximum of 38.83% and 33.01% respectively in stages I and II; the frequency of the different stages declined after II and rose again (to 9% and 7% respectively) in stages VII and recovering II. In January, only stages I and II (6.25% and

8.33%), and VII and recovering II (21.83% and 64.58%) occurred.

X²-ANALYSIS (TABLE 4)

The degree of disparity or otherwise of the monthly sex ratios for the different centres

were tested by means of the X^2 -analysis (Snedecor and Cochran 1968). For Calicut this analysis for the different months and also for the totals of the entire period showed non-significant differences ($X^2=0.1161$ to 1.2308 for different months and 0.0158 for the annual totals, P being more than 0.05 and non-significant).

For Cannanore, the May values showed a X^2 -value of 7.2835 with P less than 0.01 and significant, while in the other two months the difference was non-significant. The year's total at Cannanore showed a X^2 -value of 10.3724 with P at about 0.001 and highly significant.

For Mangalore, the monthly distribution as well as the total sex distribution showed X^2 -values ranging from 0.0957 to 2.6348 with P more than 0.05 and insignificant. For Malpe, represented by a single sample, the X^2 -value was low ($=1.0870$) with P more than 0.05 and non-significant.

Thus, only the samples of Cannanore showed an uneven distribution of the two sexes this standing out in the May totals as well as the annual totals. It is difficult to assign any reason clearly for the significant departure noticed here. But marked segregation of the sexes in individual samples and local populations may be noticed during October-November, but this being uncommon later, and particularly as late as May following (Seshappa and Bhimachar 1955). The disproportionate distribution of the sexes is usually connected with the spawning period, out-of-the-season spawning being also sometimes noticed at Calicut during recent years. It is just possible that some such phenomenon may have been responsible for the above disparity at Cannanore; as samples have been available only for the three months of May, October and December, the totals of the year only reflect the condition of the dominant one of these months. While nothing can be said on this definitely in the

absence of the samples for the June-September period, it can still be said with some confidence that there is perhaps no consistent difference between or within the other centres to indicate any clear possibilities of stock differences.

REMARKS

According to data published earlier for Calicut (Seshappa and Bhimachar 1955) in all the years of normal sole fishery, the shoaling starts immediately after the southwest monsoon is over, and the fish has the gonads in an advanced condition of stages IV-V of maturity by October; small juveniles of the new brood join the catches within 2-3 weeks of this and the December fishery usually consists of a large percentage of juveniles of the year (though these are usually discarded in the sea by the fishermen); spawning goes on continuously or intermittently right through the fourth quarter of the Calendar year and through the first quarter of the following year also. The new recruits entering the grounds in intermittent batches vary in numbers from time to time and are all immature, stage III of maturity appearing only in the second quarter of the year in the fish of the new brood. The gonads grow further and reach advanced pre-spawning stages by the following October-November months (after the passage of the fish through the southwest monsoon away from the inshore grounds, with a scattered distribution).

During the years before the introduction of regular trawling in the inshore waters, the phenomenon of "*Manthayilakam*" or massive shoaling up of the fish in the surface waters during September and October after the heavy rains are over, used to be noticed regularly, the fish moving away from the inshore grounds for spawning after this. It has been reported

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(V. Balan, CMFR Institute, pers. communication) that this "*Manthayilakam*" is hardly noticeable these days after the introduction of trawling, the normal fishery of the October-November period also being not steadily intense (with some quantities being landed all round the year except during the monsoon months when the trawlers are also idle). Perhaps as an adaptive adjustment to these conditions the biological cycle seems to be getting modified to some extent in that out-of-the-season spawning is also noticed occasionally in some years in the monsoon months. The intensive and more or less continuous fishing perhaps provides for better growth with reduction in population strength and early maturity of the pre-monsoon populations of the fish; it has been noticed frequently in recent years that sizes larger than reported by Seshappa and Bhimachar (1955) are seen in the pre-monsoon samples of the Malabar sole at Calicut, these being still members of the "O" year class only.

It is interesting to examine the pooled quarterly data of the present work (table 3) in the light of the above observations. No samples were available for the third quarter of the year as usual, and it will be noticed that no juveniles of stage I occurred in the first and second quarters of the year though they formed the dominant group (25.50%) in the fourth quarter. This is a clear indication that the main spawning has taken place as usual either at the end of the third quarter or early in the fourth quarter. Another interesting point clearly noticed is that the spawning and post-spawning stages (i.e. stage VI to recovering stage II) are completely absent in the second quarter, while they are present in the first and fourth quarters; stage VII (spent) is more frequent in the fourth quarter (8.72%) while stage II (recovering spent) fish are more frequent in the first quarter (10.47%).

TABLE 3

POOLED QUARTERLY TOTAL FREQUENCY AND PERCENTAGE DISTRIBUTION OF THE DIFFERENT MATURITY STAGES IN FEMALE *C. semifasciatus*, DURING 1980.
(FIGURES IN BRACKETS ARE PERCENTAGES)

Stages	Quarters			
	January-March	April-June	July-September	October-December
I	0	0	No data	76(25.50)
II (Virgins)	17 (19.77)	11 (5.39)	„	46(15.44)
III	2 (2.33)	78 (38.24)	„	32(10.74)
IV	21 (24.42)	76 (37.25)	„	62(20.81)
V	31 (36.05)	39 (19.12)	„	40(13.42)
VI	3 (3.49)	0	„	1 (0.24)
VII	3 (3.49)	0	„	26 (8.72)
II (Recovering)	9 (10.47)	0	„	15 (5.03)
Totals:	86	204	Nil	298

TWO SAMPLES FROM COCHIN HARBOUR

Two samples of *C. semifasciatus* were available during January 1982, one on 8-1-1982 and the other on 13-1-1982. These are being treated separately from the rest as they were collected one year after the other samples treated above in this paper and hence considered unsuitable to be combined with those samples. The following are sex proportions and maturity trends noticed at Cochin in the above mentioned material:

Sample dates	Total males	Different		Maturity III	stages among females					Total Females
		I	II (Virgin)		IV	V	VI	VII	II (Rec.)	
Jan. 8	37	2 (7.14%)	11 (30.29%)	0	0	0	0	1 (3.57%)	14 (50%)	28
Jan. 13	48	4 (20%)	8 (40%)	0	0	0	0	0	8 (40%)	20

TABLE 4

MONTHLY SEX-DISTRIBUTION IN *C. semifasciatus* AT FOUR CENTRES DURING FEBRUARY 1980 to JANUARY 1981, ALONG WITH X^2 -VALUES

Months	Calicut		Cannanore		Mangalore		Malpe	
	Males	Females	Males	Females	Males	Females	Males	Females
February	—	—	—	—	25	22	—	—
March	—	—	—	—	69	46	28	18
April	46	56	—	—	—	—	—	—
May	60	44	71	33	86	71	—	—
October	97	114	22	13	—	—	—	—
November	22	28	—	—	—	—	—	—
December	109	103	64	40	—	—	—	—
January 1981	62	47	—	—	—	—	—	—
Totals:	396	392	157	86	180	139	28	18
X^2 :	0.0158		10.3724		2.6348		1.0870	
P:	>0.05		0.001		>0.05		>0.05	
R:	NS		SS		NS		NS	

Abbreviations:- X^2 = Chi-square; P = Probability level; R = result i.e. whether significant or otherwise; NS = non-significant; SS = highly significant.

In both the samples, the maturing and mature (or ripe) females are completely absent and only the spent recovering and immature fish are noticed in the samples. A single specimen in stage VII (spent) was found on 8-1-82, this being absent on 13-1-82 when all the larger females (equalling 40% of the total) were

recovering spent individuals. The dominant maturity stages on both the occasions were found to be II (virgin) and recovering II. This situation is closely comparable to the same occurring at Calicut in January 1981, the details of the latter being as follows:

Sample dates	Total males	Different		Maturity III	stages among females					Total Females
		I	II		IV	V	VI	VII	II (Rec.)	
Jan. 15	32	3 (12.5%)	0	0	0	0	0	9 (37.50%)	12 (50.00%)	24
Jan. 28	30	0	4 (17.39%)	0	0	0	0	1 (4.35%)	18 (78.26%)	23

In the totals of January in the above centres during the two different years, it is found that the intermediate maturity stages III to VI are completely absent and the only stages represented are I and II among the smaller sizes and VII and recovering II among the larger sizes of the fish; soles of the last mentioned stage are most dominant at both the places during the period relevant to them here.

CONCLUSION

The seasonal maturity trends among the females of *C. semifasciatus* follow generally the same pattern as described for the species at Calicut (Seshappa and Bhimachar 1955) with a few differences. The spawning season also appears to have been roughly the same as at Calicut in the earlier years. While individual samples showed some apparent disparity now and then between the numbers of the two sexes, X^2 -analysis showed that the differences

are not statistically significant when studied among monthly and annual totals except at Cannanore where a significant difference is seen during one particular month, this showing out in the annual totals also.

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