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OBSERVATIONS ON SOME ASPECTS OF BIOLOGY OF THE CROAKERS *JOHNIUS (JOHNIEOPS) DUSSUMIERI* (CUVIER) AND *JOHNIUS (JOHNIUS) CARUTTA* BLOCH FROM KAKINADA

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ABSTRACT

Observations on some aspects of biology of *Johnius dussumieri* and *J. carutta* are made from trawler catches of Kakinada. It is shown that *J. dussumieri* spawns during March-August period. This species attains first maturity at a total length of 110 mm. There is a predominance of females in larger length groups. The length-weight relationship of *J. dussumieri* follows the equation log w = −4.84511 + 2.96347 log L. The fluctuations in relative condition factor seem to be related to gonad cycle.

Individuals of *J. carutta* attain first maturity at a total length of 155 mm. This species is a fractional spawner releasing the ripe ova in two spawning acts during the single spawning season which appears to extend from January to June. In this species also, as in *J. dussumieri*, there is a predominance of females in larger lengths. The length-weight relationship in *J. carutta* is calculated to be log W = −5.43389 + 3.23343 log L.

INTRODUCTION

AMONG the demersal catches landed by the small trawlers at Kakinada, sciaenids rank second in abundance being next to prawns and among the fish catch these fishes rank first (Muthu *et al.*, 1977). In regard to the species abundance, *Johnius dussumieri* and *J. carutta* are among the important species in the sciaenid catches off Kakinada. Considerable information is available on the biology of sciaenid fishes from different regions on the Indian Coasts but there is no information on the biology of *Johnius dussumieri*** and excepting the work of Rao (1967) on the spawning, there is no information on the biology of *J. carutta* from India. An attempt is, therefore, made to present the details of some aspects of biology of these two species from Kakinada on the basis of the data collected from the small trawlers during January 1975-December 1977.

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** The species referred to as *Johnius dussumieri* by Sawant (1963) and Devadoss (1973) is referrable to either *Johnius elongatus* or *Johnieops macrorhynus* Mohan (Mohan, 1975).

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MATERIAL AND METHODS

The material for the present study was obtained at weekly intervals from the private trawler landings at the Kakinada Fishing Harbour. On each observation day, random samples of all species of sciaenids were collected from 4-5 boats for studies on species composition and different aspects of biology. The pooled samples were brought to the laboratory and data on length, weight, sex and stages of maturation were taken on fresh specimens of important species and gonads were preserved in 4% formalin for detailed studies. Since the sciaenid fishery is a multispecies one (about 17 species at Kakinada), the samples collected (each about 2-3 kg) consist of different species. Another feature of sciaenid fishery at Kakinada is that none of the species occurs throughout

the year in the catches (CMFRI, 1976). Consequently, relatively few numbers of each species could be examined each month and hence the data of corresponding months of the three-year period were pooled for purpose of the present study.

The colour and general appearance of the gonads were noted in fresh condition and ova diameter measurements were taken from preserved ovaries. In taking the diameter measurements the procedure of Clark (1934) was followed. In each ovary about 300 ova were measured at a magnification where each micrometer division is equal to 0.014 mm. For classification of maturation stages, the procedure followed earlier for *Atrobucca nibe* (Murty, 1981) was employed. The spawning season is determined on the basis of data of females only.

The length-weight relationship was calculated by the method of least squares using the formula $W = a\ L^n$ or $\log W = \log a + n \log L$, where W = weight in grams, L = length in mm, a = a constant and n = exponent. The relative condition factor (Kn) was calculated using the formula $Kn = W/\hat{W}$ (Le Cren, 1951), where W = observed individual weight and $\hat{W}$ = weight calculated from the length - weight relationship for each length.

Biology of *Johnius (Johnieops) dussumieri*

Maturation and Spawning

The study is based on 326 specimens (176 females and 150 males) ranging from 81 to 168 mm total length.

For determining the minimum length at first maturity, maturing, ripening and ripe (stages III-V) females and mature males were taken into account. The percentage frequency distribution of these individuals in different length groups in relation to immature fish are presented in Fig. 1. Specimens of 100 mm and above only showed mature gonads. It may

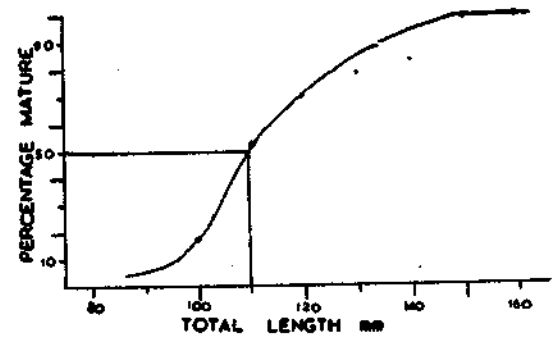

Fig. 1. Percentage frequency distribution of mature individuals in different length groups of *J. dussumieri*.

be seen from the figure that there is a progressive increase of mature fish along with increase in length. All individuals above 150 mm are mature. The data show that 50% of fish are mature (Fig. 1) at a length of about 110 mm.

The ova diameter frequency distribution in ovaries in stages III, IV and V of maturation is presented in Fig. 2. It is seen that there are two modes (a, b) in the diameter frequency distribution in all three stages. In stage III, the mode (b) at 13–15 md group consists of early maturing translucent ova, whereas the other mode (*a*) at 25–27 md group consists of opaque ova. In stage IV these modes have shifted to 22–24 md and 43–45 md groups respectively. While some of the ova in mode '*b*' are translucent, all the ova in mode '*a*' are opaque and are separate from the capsules. In stage V (Ripe), these modes have further shifted to 28–30 md and 49–51 md groups. While the ova in the mode *b* are all opaque, those in the mode *a* are translucent with vacuolated yolk and with a distinct oil globule ranging in diameter from 8 to 11 md.

The process of maturation and ripening indicated that the ova at mode '*a*' in stage III

attained a growth of 24 md by the time the ovary reached ripe stage (V) and that the ova in mode '*b*' in stage III attained a growth of 15 md, by the time the ovary became ripe. The ova diameter frequency distribution in different stages of maturation indicates that the ova may be released in two spawning acts.

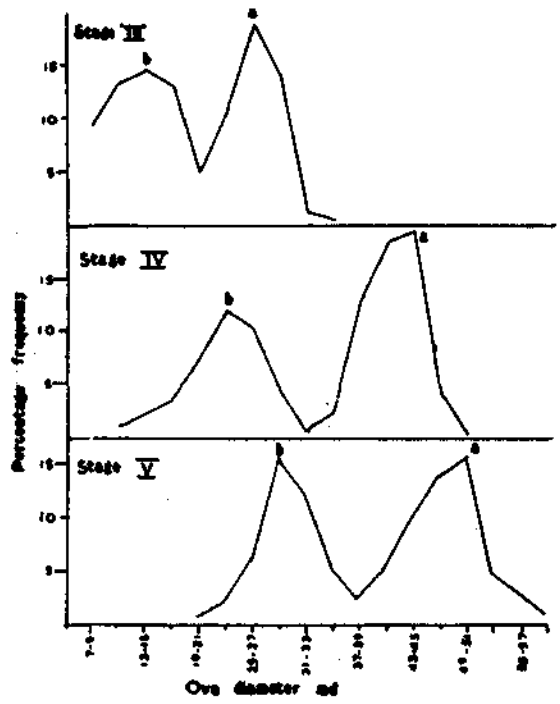

Fig. 2. Ova diameter frequency distribution in ovaries of different stages of maturation in *J. dussumieri*.

Table 1 shows the percentage frequency distribution of maturation stages in females in different months. It may be seen that ripe females (st. V) occurred during March–June period with greater abundance in May. Females in prespawning stage (st. IV) occurred during February-July period with peak in June. March-August is, therefore, considered to be the spawning season of *J. dussumieri* at Kakinada. The details of sex ratio in different months are presented in Table 2. It may be seen that females dominated males during February–July (except April) and November. The sex ratio in different lengths is given in Table 3; males dominated females upto a length of 119 mm whereas in all larger lengths females dominated.

Length-weight relationship

The data of 144 females ranging from 81 to 168 mm total length and from 6 to 59 g weight and 132 males ranging from 85 to 168 mm TL and from 7 to 61 g weight were used to calculate the length-weight relationship. The relationships for males and females were calculated separately and equations are:

$$\text{Males: } \log W = -4.67244 + 2.88164 \log L; \ (r = 0.96)$$

$$\text{Females: } \log W = -5.06076 + 3.06496 \log L; \ (r = 0.95)$$

The regression coefficients of sexes were compared by analysis of covariance following Snedecor and Cochran (1967). Since there is no significant difference both in the slopes and in the elevations (Table 4), the data of sexes were pooled and a common relationship calculated which can be expressed by the equation:

$$\log W = -4.84511 + 2.96347 \log L; \ (r = 0.95)$$

Relative condition factor

The values of relative condition factor (Kn) calculated separately for each fish were added up and the mean for each month calculated. It is seen from Fig. 3 that the Kn value is minimum in June and maximum in September. It is also noted that the Kn values during March–July period are low. As in the case of *Atrobucca nibe* (Murty, 1981), in this species also, majority of fish (84%) had either evorted or empty stomachs and hence the possibility of food intake influencing Kn values could not be ascertained.

TABLE 1. *Percentage frequency distribution of different maturation stages in females of* J. dussumieri *in different months*

Months	N	Stages of maturation				
		I	II	III	IV	V
January	13	—	100.0	—	—	—
February	17	—	5.9	82.4	11.7	—
March	38	—	—	73.7	23.7	2.6
April	26	—	19.2	46.1	30.8	3.9
May	45	—	2.2	24.4	26.7	46.7
June	10	—	—	30.0	60.0	10.0
July	6	—	50.0	16.7	33.3	—
August	15	26.7	60.0	13.3	—	—
September	3	—	100.0	—	—	—
October		— No data —				
November	5	100.0	—	—	—	—
December	14	35.7	64.3	—	—	—

TABLE 2. *Percentage sex ratio in different months in* J. dussumieri *and* J. carutta (P:150)

Months	*J. dussumieri*		*J. carutta*	
	N	Male : Female	N	Male : Female
January	29	25.2 : 44.8	82	50.0 : 50.0
February	29	20.7 : 79.3	45	51.1 : 48.9
March	32	37.5 : 62.5	62	41.9 : 58.1
April	57	54.4 : 45.6		No data
May	88	48.9 : 51.1	2	50.0 : 50.0
June	14	28.6 : 71.4		No data
July	6	33.3 : 66.7	10	90.0 : 10.0
August	31	58.1 : 41.9	94	56.4 : 43.6
September	5	40.0 : 60.0	22	36.4 : 63.6
October	No data		24	45.8 : 54.2
November	6	16.7 : 83.3	13	23.1 : 76.9
December	29	51.7 : 48.3	51	33.3 : 66.7

TABLE 3. *Percentage sex ratio in different length groups in* J. dussumieri *and* J. carutta

Length groups (mm)	*J. dussumieri*		*J. carutta*	
	N	Male : Female	N	Male : Female
80– 89	3	66.7 : 33.3	2	50.0 : 50.0
90– 99	4	75.0 : 25.0	2	100.0 : —
100–109	35	62.9 : 37.1	8	100.0 : —
110–119	64	56.3 : 43.7	24	58.3 : 41.7
120–129	89	39.3 : 60.7	57	56.1 : 43.9
130–139	78	43.6 : 56.4	62	56.5 : 43.5
140–149	31	32.3 : 67.7	65	41.5 : 58.5
150–159	11	45.5 : 54.5	74	43.2 : 56.8
160–169	11	27.3 : 72.7	48	37.5 : 62.5
170–179	—	—	41	51.2 : 48.8
180–189	—	—	33	33.3 : 66.7
190–199	—	—	11	9.1 : 90.9
200–209	—	—	1	100.0 : —
210–219	—	—	3	— : 100.0

For purpose of comparison of Kn values of different lengths, data of April and May only were considered because it is desirable for such comparison that data are collected during a reasonably short period (Lagler, 1952), so that the possibility of different factors (eg. maturation, fat deposition etc.) affecting Kn values in different months or seasons can be eliminated. The months April and May are selected because most of the length groups are represented in these two months.

Fig. 3. Relative condition factor of *J. dussumieri* in different months.

Kn value is maximum in 80 mm group (Fig. 4). After that length there is a fall in the Kn value and it reached a peak at 110 mm group. As shown earlier, *J. dussumieri* matures first at a length of 110 mm. Again the Kn values showed a fall and increased gradually till 140 mm. It is possible that majority of the individuals mature for the second time when they are 140 mm.

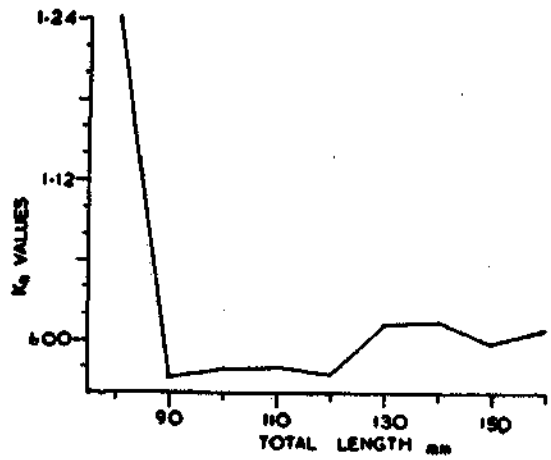

Fig. 4. Relative condition factor of *J. dussumieri* in different length groups.

Biology of *Johnius (Johnius) carutta*

Maturation and spawning

The study is based on 403 specimens (190 males and 213 females) ranging from 84 to 215 mm TL.

Females of stages III–V of maturation and mature males were considered for the purpose of determining size at first maturity. The percentage frequency distribution of these fishes in relation to immature fish in different length groups are presented in Fig. 5. There is a gradual increase of mature specimens till 190 mm and, above this length all are mature. Since 50% of the individuals were mature at 155 mm, this length is taken as the minimum length at first maturity. The ova diameter frequency distribution in ovaries of stages III,

IV and Va of maturation are presented in Fig. 6. There are two modes one at 15–16 md and

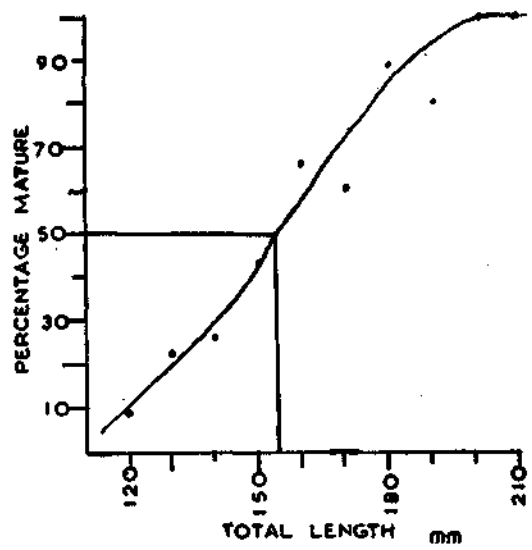

Fig. 5. Percentage frequency distribution of mature fishes in different length groups of *J. carutta*.

the other at 25–26 md group in the diameter frequency distribution of ovary in stage III.

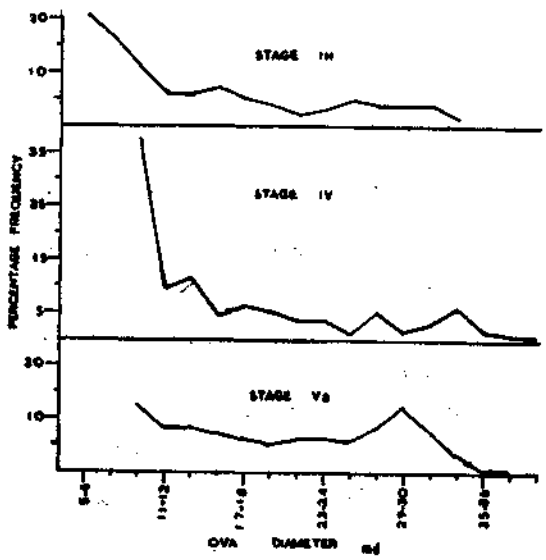

Fig. 6. Ova diameter frequency distribution in ovaries of different stages of maturation in *J. carutta*.

While the first mode consists of immature translucent ova, the second mode consists mostly of opaque ova. In stage IV, in addition to the immature and early maturing ova, there are two modes at 27–28 md and 33–34 md groups in the mature ova. The latter mode (at 33–34 md) may be the result of faster growth of a group of ova forming a mode at 25–26 md group in stage III. Fishes with fully ripe, stage V ovaries were not encountered in the samples. In stage Va (partially spawned) there is only one mode at 29–30 md groups in the diameter frequency distribution of mature ova. Though some of the larger ova were translucent (ripe ova) with an oil globule, majority of them were opaque. In this connection, it may be stated that stage Va ovary does not occupy the entire length of body cavity indicating that some ova were already released.

The fact that there are two modes in the diameter frequency distribution of mature ova in stage IV ovary and that there is only one mode in mature group of ova in the ovary of stage Va, indicate that *J. carutta* is a fractional spawner releasing ripe ova in two batches during the single spawning season. The absence of a second mode in the frequency distribution of mature ova in stage Va ovary, unlike in that of stage IV and the presence of a few ripe ova in stage Va ovary, support this conclusion. Rao (1967) observed a similar situation in mature ovaries and stated that only one batch of mature ova was likely to be released in the 'ensuing spawning season.' His data clearly show that mature individuals occur during November–March period which indicated a single spawning season and the second batch of ova in mature ovaries may not remain till next spawning season since they were already mature.

The frequency distribution of maturation stages in females is presented in Table 5. It is seen that mature individuals (stage IV) occurred from January to May and partially spawned

individuals during January. During July–December period only immature and maturing individuals occurred. It thus appears that *J. carutta* spawns off Kakinada during January–June period. According to Rao (1967) this species spawns off Visakhapatnam during January–April period.

The details of se ratio in different months are presented in Table 2. It is observed that the sexes aie distributed more or less in 1:1 ratio during January–May period; incidentally, this happens to be the spawning season for this species. During July–August there is a predominance of males and during September–

TABLE 4. *Analysis of Covariance to test the significance of differences/between regression lines of sexes in the length-weight relationship of* J. dussumieri

Sources of variation	Deviation from regression		
	df	sum of squares	Mean squares
due to regression within sexes	272	0.68029	0.00250
difference between regression coefficients	1	0.00621	0.00621
residuals due to regression-pooled within	273	0.68650	0.00252
difference between adjusted means	1	0.00090	0.00090
Total	274	0.68740	
Comparison of slopes	F = 2.484, df 1,272 NS		
Comparison of elevation	F = 0.357, df 1,273 NS		

TABLE 5. *Percentage frequency distribution of different maturation stages in females of* J. carutta *in different months* (P:152)

Months	N	Stages of maturation				
		I	II	III	IV	Va
January	40	5.0	77.5	5.0	7.5	5.0
February	23	—	13.0	74.0	13.0	—
March	36	—	—	80.0	19.5	—
April			No data			
May	1	—	—	—	100.0	—
June			No data			
July	1	100.0	—	—	—	—
August	41	53.7	46.3	—	—	—
September	14	—	100.0	—	—	—
October	13	38.5	61.5	—	—	—
November	10	80.0	20.0	—	—	—
December	34	11.8	76.5	11.8	—	—

TABLE 6. *Analysis of covariance to test the significance of differences/between regression lines of sexes in the length-weight relationship of* J. carutta (P:153)

Sources of variation	Deviation from regression		
	df	sum of squares	Mean squares
Due to regression within sexes	350	0.34203	0.00098
difference between regression coefficients	1	0.00013	0.00013
residuals due to regression-pooled within	351	0.34216	0.00097
difference between adjusted means	1	0.00061	0.00061
Total	352	0.34277	
Comparison of slopes	F = 0.133 df 1,350 NS		
Comparison of elevation	F = 0.629 df 1,351 NS		

December period, there is a predominance of females. The sex ratio in different length groups is given in Table 3. It is seen that upto a length of 139 mm there is predominance of males and after this length females dominated.

Males: $\log W = -5.41602 + 3.22584 \log L$; $(r = 0.99)$

Females: $\log W = -5.46190 + 3.24570 \log L$; $(r = 0.99)$

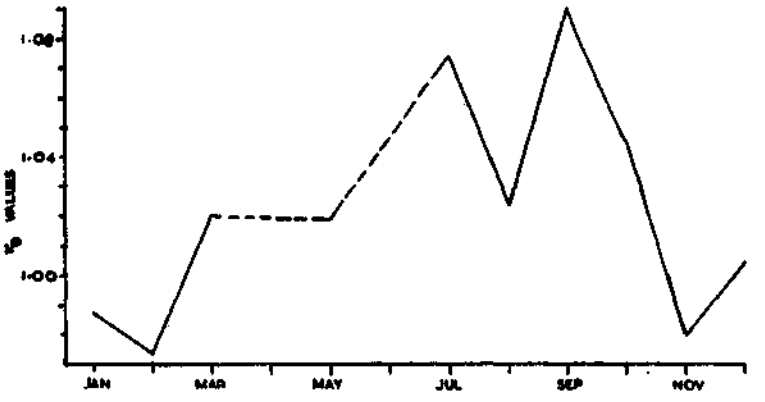

Fig. 7. Relative condition factor of *J. carutta* in different months.

Length-weight relationship

The data of 163 males ranging from 86 to 200 mm length and 5 to 94 g weight and 191 females ranging from 84 to 216 mm length and 6 to 133 g weight were used to calculate the length-weight relationship. The equations were obtained separately for sexes and they are:

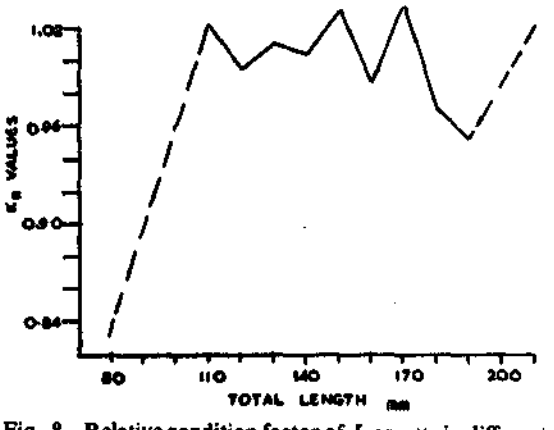

Fig. 8. Relative condition factor of *J. carutta* in different length groups.

The regression coefficients of sexes were compared by Analysis of Covariance. The results (Table 6) show that there is no significant difference both in slopes and elevations. Hence, data of sexes were pooled and a common relationship was calculated:

$$\log W = -5.43389 + 3.23343 \log L.; \quad (r = 0.99)$$

Relative condition factor

The values of Kn during different months are presented in Fig. 7. It is seen that the values during January-March and May were low. It has been shown earlier that the spawning season for this species is January-June and the low Kn values during this period (no data for April and June) may be associated with spawning. It was observed that there was building up of fat in the body cavity during July-October period and the high Kn values during these months may be associated with this.

For reasons cited elsewhere in this paper, the Kn values in different length groups during November and December 1976 were taken to compare the values of different lengths (Fig. 8) because most of the length groups occurred during these two months. Though the fluctuations in Kn values in different lengths do not clearly show any relationship with spawning, it may be noted that high Kn values occurred in 150–159, 170–179 and 210–219 mm length groups.

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