INTRAOVARIAN STUDIES AND FECUNDITY IN *NEMIPTERUS JAPONICUS* (BLOCH)

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ABSTRACT

Fecundity in *Nemipterus japonicus* (Bloch) varied from 10.5 to 80.8 thou-size. Among the four equations tested, the linear relationship between length and sands in fish ranging in size from 13.0 to 20.9 cm, and increased with increasing fecundity was closer than the rest. It was also found that the fish bred twice a year, once in December-February and then in June-July. The spawning was short and sharp.

INTRODUCTION

Threadfin bream *Nemipterus japonicus* is an important fishery along the Andhra-Orissa coasts, sometimes forming as high as 13.8% of the total catches (Krishnamoorthi 1973a). Krishnamoorthi (1971, 1973b, 1974) studied different aspect of its biology. The present account deals with the fecundity and maturity of *N. japonicus*.

MATERIAL AND METHOD

The present investigation is based on preserved material consisting of 38 ovaries from fish ranging in size from 130 to 209 mm collected by Dr. B. Krishnamoorthi during November-February period of the year 1965-66 from the catches of the Government of India trawlers at Visakhapatnam. Biological details, such as length of the fish, stages of maturity etc., had been recorded by him.

The total number of ova in each ovary was determined from four portions, two in each lobe. The weight of each portion as well as that of the ovary were recorded with the help of a chemical balance to an accuracy of 1 mg. The number of matured and fully matured ova counted from the portions was then raised to the total weight of the ovary which gave the fecundity of the fish.

Ova-diameter measurements were made under a microscope fitted with an ocular micrometer. The procedures adopted were basically similar to those suggested by Hickling and Rutenberg (1936) and De Jong (1940). About 1000 ova selected at random were measured from each ovary as suggested by Prabhu

(1955, 1956). The diameters of ova less than 10 micrometer division were not counted as they were numerous; neither have they been shown in the figures. In order to avoid the longest or shortest diameter in measuring the ova, the method adopted by earlier workers (Clark 1925 and 1934, De Jong 1940, Prabhu 1956) was followed. The entire range in size of the ova was then divided into several 2-micrometer-division groups and the percentage numbers of ova in each size group was calculated and plotted. The degree of formation of yolk in maturing and mature ova was taken as a guide in judging the stages of maturity in intraovarian eggs.

MATURITY

Stages of ova

The matured ovaries contained ova of all stages of maturity. The following classification of ova was found convenient for the present study.

Stage I (immature ova): Ova transparent, possessing a distinct nucleus and a protoplasmic layer devoid of any yolk deposition. The size of ova varied from 1 to 5 micrometer divisions (1 micrometer division = 0.016 mm).

Stage II (maturing ova): Small ova, still transparent, in which yolk deposition has started. A central semitransparent portion can be made out. The diameters of the ova vary from 6 to 12 micrometer divisions.

Stage III (maturing ova): Small ova with centre fully yolked and opaque, but the periphery still stransparent. The diameters vary from 12 to 15 micrometer divisions.

Stage IV (mature ova): Opaque and fully yolked but still contained within the follicles. The size ranges from 16 to 25 micrometer divisions.

Stage V (fully matured): These are large, free, partly transparent eggs which have burst from follicles, the diameter range being 26 to 38 micrometer division.

Stage VI (Ripe): These are also free and large eggs but fully transparent with deposition of one or more drops of oil globules and ready for liberation. The size ranged from 40 to 55 micrometer divisions.

Stages of ovary

A scale of seven stages of maturity similar to the one recommended by the International Council for the Exploration of the Sea was followed for classifying the ovary of *N. japonicus*.

Stage I: Small slender ovary, eggs transparent and not visible to the naked eye.

Stage II: Slightly enlarged ovary, eggs transparent not visible to the naked eye.

Stage III: Advanced stage eggs are just visible to the naked eye. Eggs not completely opaque.

Stage IV: Most advanced eggs have become completely opaque. The diameters of the largest eggs are 30 micrometer divisions.

Stage V: Ovary large. Most advanced eggs have become partly transparent. The maximum diameter of the most advanced eggs are 40 micrometer divisions, with a mode at 30 micrometer divisions.

Stage VI: Ovary greatly enlarged. Eggs fully transparent; the maximum diameter of the most advanced eggs are 55 micrometer division, with a mode at 40 micrometer division; ready to be shed.

Stage VII: Spent ovary, flabby and contracted.

In Fig. 3 A, B and C are shown frequency curves of ova examined from ovaries in IV, V and VI stages of maturity respectively. In A there are two modes a and b at 24-25 and 16-17 micrometer divisions, respectively, and the ova are in the respective stages IV and III. In B also there are two modes a and b at 30-31 and 20-21 micrometer divisions, respectively. In other words mode a has progressed from 24-25 micrometer division in A to 30-31 micrometer division in B and mode b has progressed from 16-17 micrometer division

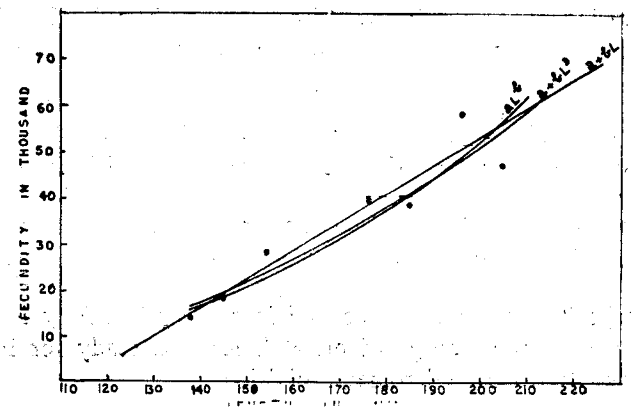

FIG. 1. Relation between fecundity and length in *N. japonicus*.

in A to 20-21 micrometer division in B. The ova at mode a are in V stage and at b in IV stage. The two modes a and b can be traced at 40-41 and 20-21 micrometer division in C i. e., mode a has progressed to 40-41 micrometer division from 30-31 micrometer division in B and mode b has no progression, but half way through to maturity. The ova at a and b are in stages VI and IV, respectively. Fig. 3 D represents frequency polygon of ova from a spent ovary. The mode a is faintly represented indicating that the ova are shed. The remaining few ova are likely to the absorbed. Mode b continues to be represented at 20-21 micrometer division. In Fig. 3 E is shown the frequency curve of ova pooled from the ovaries of 35 fish considered for the study. Here also can be seen two modes, a and b. From the rate of progression of mode a as well as from the position of mode b, it appears that ova at mode b may take another

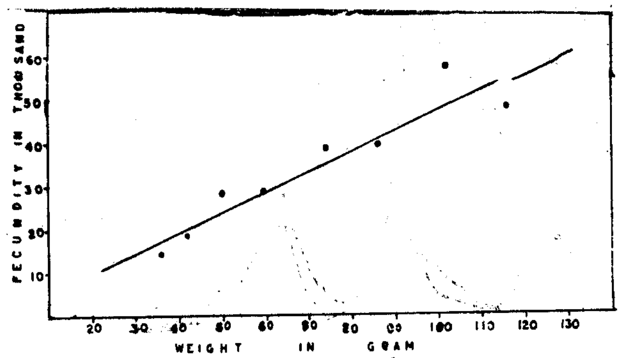

FIG. 2. Relation between fecundity and weight in *N. japonicus.*

3 months to become fully matured and ready for spawning. As ovaries with matured and fully matured ova as well as spent ovaries were recorded during December-February, and also as the modes are sharply differentiated from one another, it appears that the fish breeds over a short and definite period from December to February. Since about 3 months time is necessary for the second mode to become ready for spawning, it appears that the fish may breed for a second time in June-July period. Krishnamoorthi (1971) has reported that the fish breeds over a short period of three months commencing from November. The second breeding period was not reported by him, possibly, for lack of material during June-July period (see Fig. 5 and Table 2).

FECUNDITY

The average fecundity, average number of ova per gram weight of the body and number of ova per gram weight of ovary in respect of each group of fish are given in Table 1. In general, an increase not only in the average fecundity but also in the number of ova per gram weight of the body with the increasing size of the fish is seen. When these values are plotted (Fig. 1), it appears that the relation between fecundity and length could be shown approximately as a straight line or as a curve with help of the formulae (Clark 1934, Simpson 1951, Lehman 1953, Macgregor 1957, Kandler and Dutt 1958) given below:

$$\text{(i)} \quad F = a + bL = f(L); \quad \text{(ii)} \quad F = aL^b = f(L^b); \quad \text{(iii)} \quad F = a + bL^3 = f(L^3)$$

Where F and L are fecundity and length of the fish and a and b two constants.

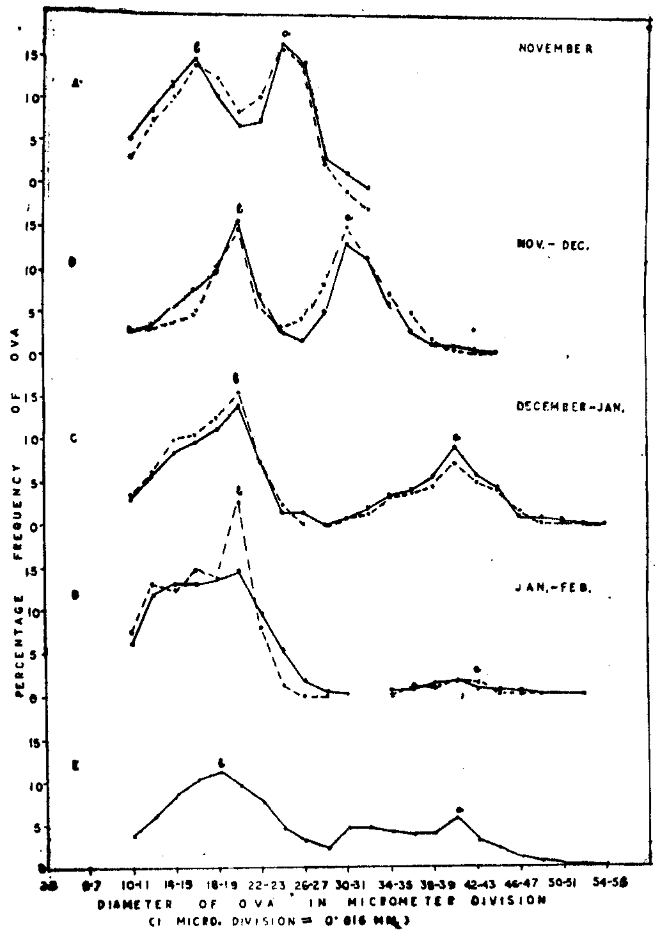

FIG. 3. Ova-diameter-frequency polygon of *N. japonicus* from: A — ovary of stage IV recorded in November (dotted line, of a single ovary and continuous, the average of 7 ovaries); B — ovary of stage V, in November-December (dotted line, of a single ovary, and continuous, average of 10); C — ovary of stage VI, in December-January (dotted line, of a single ovary, and continuous, average of 16); D — spent ovaries, in January-February (dotted line, of a single ovary, and continuous, average of 2); E — the pooled data of all the 35 ovaries.

In can also be seen that a linear relationship is possible between the observed fecundity and the weight of fish which could be expressed by a formula of the type $F = a+bW$, where F = fecundity; W = weight of the fish and a and b are two constants (Fig. 2).

The respective worked out equations were as follows:—

(i) $F = 133 + 476.29\ W$

(ii) $F = -64144 + 574.62\ L$

(iii) $F = 0.002110\ L.^{3.2156}$

When transformed logarithmically —

$\text{Log } F = —\ 2.6757 + 3.2156 \log L$

(iv) $F = 731 + 0.006336\ L^3$

TABLE 1. *Average fecundity counts at various length ranges.*

Frequency	Length range in mm	Average length of the fish in mm	Average weight of the fish in g	Average weight of ovary in g	Average no. of ova in thousands (Total)	No. of ova per g-wt. of body	No. of ova per g-wt. of ovary
3	130-139	138	26	1.483	13.9	382	9,343
4	140-149	145	42	1.685	18.1	432	10,741
6	150-159	154	50	2.807	28.2	567	10,038
4	160-169	164	59	2.869	27.8	466	9,673
4	170-179	176	74	3.941	38.7	523	9,823
4	180-189	185	86	3.785	37.9	439	10,003
4	190-199	176	101	5.791	58.4	577	10,008
3	200-209	205	116	4.897	47.2	407	9,645

TABLE 2. *Relation between fecundity in thousand and length respectively weight—Mean values for centimetre group observed and calculated, and differences between them.*

Frequency	Length range in mm	Average length in mm	Average weight in g	Average no. of eggs in thousands	Calculated no. of eggs, differences (obs. - Calc.)							
					f (L)	diff.	f(L^b)	diff.	f(L^3)	diff.	f(W)	diff.
3	130-139	138	36	13.9	15.2	-1.3	16.0	-2.1	17.4	-3.5	17.3	-3.4
4	140-149	145	42	18.1	19.2	-1.1	18.8	-0.7	20.0	-1.9	20.1	-2.0
6	150-159	154	50	28.2	24.3	3.8	22.8	5.3	23.9	4.3	23.9	4.2
4	160-169	164	59	27.8	30.1	-2.3	27.9	-0.1	28.6	-0.9	28.7	-0.9
4	170-179	176	74	38.7	37.0	1.7	35.0	3.6	35.3	3.4	35.5	3.3
4	180-189	185	86	37.9	42.1	-4.3	41.2	-3.3	41.1	-3.2	41.1	-3.2
4	190-199	196	101	58.4	48.5	9.9	49.6	8.8	48.4	9.9	48.2	10.1
3	200-209	205	116	47.2	53.6	-6.4	57.0	-9.8	55.3	-8.1	55.3	-8.1

The validity of the above four formulae were tested by working out the following values (Table 2). The greater the values the lesser the validity of the formula.

1. Mean square division:

$$\frac{(\text{y obs.} - \text{y calc.})^2}{n - 1}$$

2. Mean deviation, in %

$$\pm \frac{100\,n \sqrt{\frac{\Sigma(\text{y oba.} - \text{y calc})^2}{n-1}}}{\Sigma(\text{y calc.})}$$

3. x^2 ie, sum of the square of deviation divided by calculated values:

$$\sum \frac{(\text{y obs.} - \text{y calc})^2}{\text{y calc.}}$$

The calculated values more or less agree with the abserved ones. The values of the mean square deivation, mean deviation, in % and x^2 values are least for the linear equation F = a+bL. Obviously the linear relation is more valid for expressing the relation between length and fecundity.

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