MATURITY AND SPAWNING OF THE ANCHOVY, *THRISSINA BAELAMA* (FORSKAL) FROM THE ANDAMAN SEA

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ABSTRACT

The occurrence of mature and spent specimens of *Thrissina baelama* in different size groups indicated that the fish matures at an average length of 117 mm (TL). This is supported by the results obtained from the study of ponderal index. While the immature females showed a more or less direct relationship between 'Kn' values and feeding activity, the mature females showed some deviations during certain months. The study of ova diameters has shown that the species spawns twice in a year. Spawning appears to be of short duration and the whole stock of mature ova measuring 0.57-0.84 mm in diameter are extruded during the spawning. Two spawning seasons in a year were observed and these coincided with the two monsoons, during July-August and late November-January. Fecundity ranged between 1171 and 3356 ova in a fish size range of 110-127mm. Logarithmic regressions described the relationship between fecundity and weight of fish and fecundity and weight of ovary.

INTRODUCTION

Thrissina baelama (Forskal), locally known as 'kori', constitutes one of the commercially important fisheries of the Andaman waters. *T. baelama*, the only species in the genus *Thrissina*, enjoys a wide distribution and is recorded from almost every part of the Indo-Pacific region (Whitehead, 1967). Although the different aspects of biology of anchovies of *Thrissocles* species have been dealt with by several workers (Venkataraman, 1956; Dharmamba, 1959; Masurekar and Rege, 1960 and Rao, 1964) information regarding the biology of *T. baelama* is very meagre (Sadasivan, 1953). In view of this, a detailed study on various aspects of the biology of this species was initiated in 1968 at Port Blair and the present account relates to its maturity and spawning.

MATERIAL AND METHODS

The material for the study was obtained from the main fish disposal centre at Port Blair. Random samples of commercial catches, mostly from the cast-net landings, were utilised in this study. The different stages of maturity were classified according to the scale given by the International Council for the Exploration of Sea. Ovaries were preserved in 5% formalin and further analysis of intraovarian

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eggs and fecundity was made when sufficiently hardened. Ova diameter measurements of intraovarian eggs were made according to the methods recommended by Clark (1934) and Palekar and Karandikar (1952).

A total of 18 ovaries, 2-3 ovaries in each maturity stage including spent ones, was selected for the ova-diameter study. A sample study of ova taken from anterior, middle and posterior regions of a few ovaries in advanced stages of maturity indicated a more or less uniform pattern of distribution in different parts of both the lobes and hence in further studies 1000 ova from middle portion of each ovary were measured by means of an occular micrometer scale at a magnification giving a value of 16.8μ to each micrometer division (m.d.). Ova smaller than 5 m.d. were not measured. Ova diameters from ovaries of the same state of maturity were combined and grouped into size intervals of 2 m.d. and the pooled data were used in plotting the graph.

Mature ovaries (stage IV-V) were considered for fecundity studies. After removing the surface moisture, approximately 2/3 portion of the ovary from the middle region was removed and weighed to the nearest milligram. All the mature ova visible to the naked eye and measuring roughly above 30 m.d. in the weighed piece were counted. From the number of mature ova obtained from the portion of ovary of known weight, the fecundity of a fish was computed.

Size at First Maturity

The size of *T. baelama* at first maturity was determined by analysing 1022 specimens of which 584 were females and 438 were males. The percentage occurrence of female fish in various stages of maturity at length interval of 5 mm was calculated and given in Table 1. Those in stage I were considered as immature,

TABLE 1. *Percentage occurrence of females of* T. baelama *in different stages of maturity in various size groups*

Size group (mm)	No. of females	Maturity stages						
		I	II	III	IV	V	VI	Spent
65 — 69	1	100.0	—	—	—	—	—	—
70 — 74	—	—	—	—	—	—	—	—
75 — 79	2	100.0	—	—	—	—	—	—
80 — 84	5	80.0	20.0	—	—	—	—	—
85 — 89	18	83.3	16.7	—	—	—	—	—
90 — 94	26	53.8	30.8	15.4	—	—	—	—
95 — 99	73	49.3	21.9	20.6	5.5	2.7	—	—
100 — 104	91	45.0	23.1	11.0	13.2	7.7	—	—
105 — 109	112	29.5	19.6	16.1	18.7	14.3	0.9	0.9
110 — 114	92	12.0	21.7	26.1	25.0	9.8	2.2	3.2
115 — 119	104	8.7	10.6	11.5	29.8	22.1	2.9	14.4
120 — 124	48	—	—	4.2	12.5	25.0	27.1	31.2
125 — 129	12	—	—	—	50.0	25.0	16.6	8.4
130 — 134	2	—	—	—	—	—	—	100.0

stages II and III as maturing and stage IV and above as mature. All the specimens above 125 mm were found in either mature or spent condition. Since 55% were mature in 115-119 mm size group it can be concluded that fifty percent maturity is attained when the fish grows to a length of 117 mm (mean).

The smallest male with mature gonads measured 98 mm. The percentage occurrence of mature males increased from 100-104 mm size group (14.4%); 21.3% in 105-109 mm size group and 35.9% at a mean length of 112 mm. As seen in females, more than fifty per cent of males were mature in 115-119 mm size group and beyond this size all fish were mature. Since spent fish were recorded for the first time in both sexes in 105-109 mm size group it can be presumed that the minimum size at first maturity is about 107 mm.

Ponderal Index

A total of 1022 specimens ranging 57-132 mm in total length and 1.5-17.5 gm in weight was treated for 'K' value determination by employing the formula $K=100\ W/L^3$ where, W is the weight of fish in grams and L the length of fish in centimetres. When the average values of 'K' at different lengths were plotted separately for male and female fish there was no significant variation in the point of inflexion on the curve between these two sexes. Hence, both the sexes have been treated together for this study. In Fig. 1 the average values of 'K' are plotted

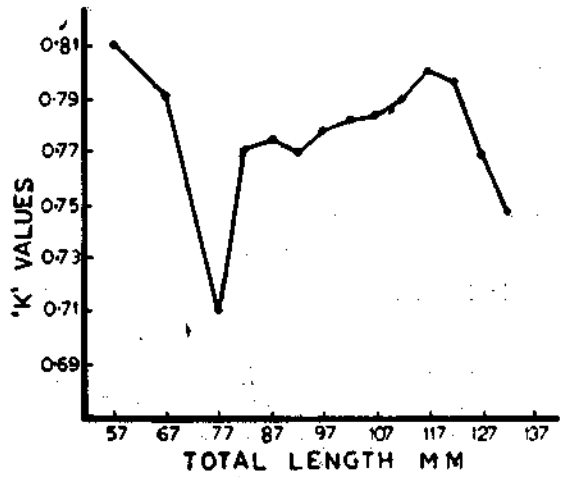

Fig. 1. Ponderal index at different lengths of *T. baelama*.

against the mid-point of corresponding size groups. The values were very high in the small-sized fish. After the fall in value at 77 mm a steady rise was noticed from 87 mm to 117 mm reaching a peak condition at 117 mm. Thereafter, the fall in 'K' is steep. This point of inflexion can be considered to be the size at which the species attained maturity.

Seasonal variations in relative condition

A total of 211 mature and 373 immature females collected during 1968-70 was studied to determine the seasonal variations in the relative condition in relation to the feeding intensity of the fish. Since the number of mature males collected was comparatively small and their size range also limited, the condition of females alone was studied.

The curves of the 'Kn' values and the intensity of feeding in immature females showed a more or less direct relationship (Fig. 2). It can be inferred that the seasonal fluctuations in the relative condition of immature females are influenced by the feeding activity of fish to some extent.

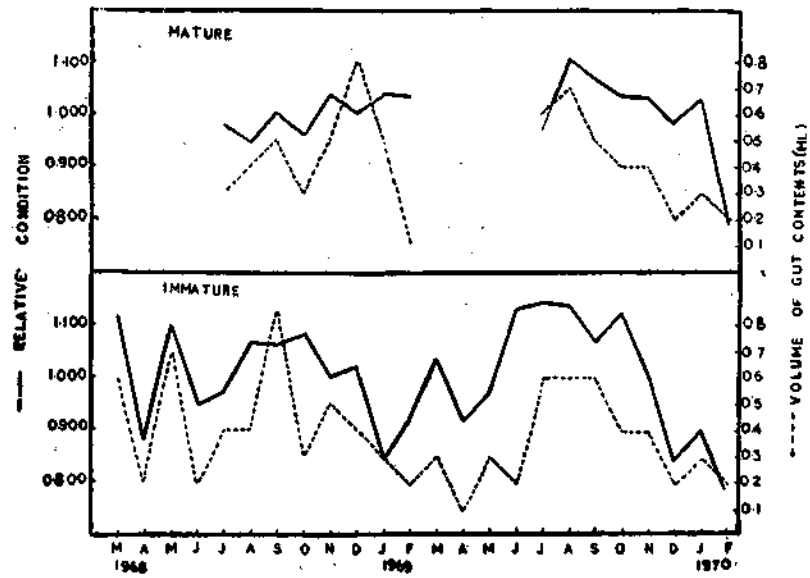

FIG. 2. Variations in the relative condition factor and feeding intensity in *T. baelama*.

Mature specimens were not available for study during March-June in both the years. A striking correlation between the seasonal cycles in the relative condition and the feeding intensity was noticed in mature females during the period from July 1969 to February 1970. The peak condition in August 1969 may be associated with the better feeding of fish and the fall in February 1970 was probably due to poor feeding activity. However, in the previous season 1968-69 the distribution of 'Kn' values was different from the pattern of feeding intensity in certain months. Although the feeding intensity was very high in December 1968 a fall in 'Kn' value was noticed in this month. Further, in January-February 1969 the condition was high when there was a steep fall in feeding intensity. It indicates that sometimes factors other than feeding may be responsible for the variations in the condition of mature females.

Ova Development

It has been emphasized by many workers that the analysis of the ovaries of earlier stages, besides the fully mature and spent ovaries, is necessary for proper understanding of the course of maturation of the oocytes in the ovary. Fig. 3 gives the frequency curves of ova diameter measurements of ovaries in different stages of maturity. In stage I the ova are small measuring up to a maximum of 15 m.d. In stage II a distinct mode appeared at 15-16 m.d. indicating the separation of a batch of eggs from the general egg stock for maturation. Further development of this maturing batch of ova can be seen as the ovaries approach stage III, where the mode 'a' has shifted to 21-22 m.d. There is another small mode 'b' consisting of immature group of eggs at 11-12 m.d. which indicates that there is a smultaneous maturation of a second batch of ova beginning from this stage. These two successive batches of ova separated from one another and undergoing matuiation can be seen in stage IV. Here, the mature group of ova is represented by a prominent mode 'a' at 29-30 m.d. and separated from maturing ova noticed at 13-14 m.d. In stage V the mature ova of mode 'a' has progressed to 37-38 m.d. and the second

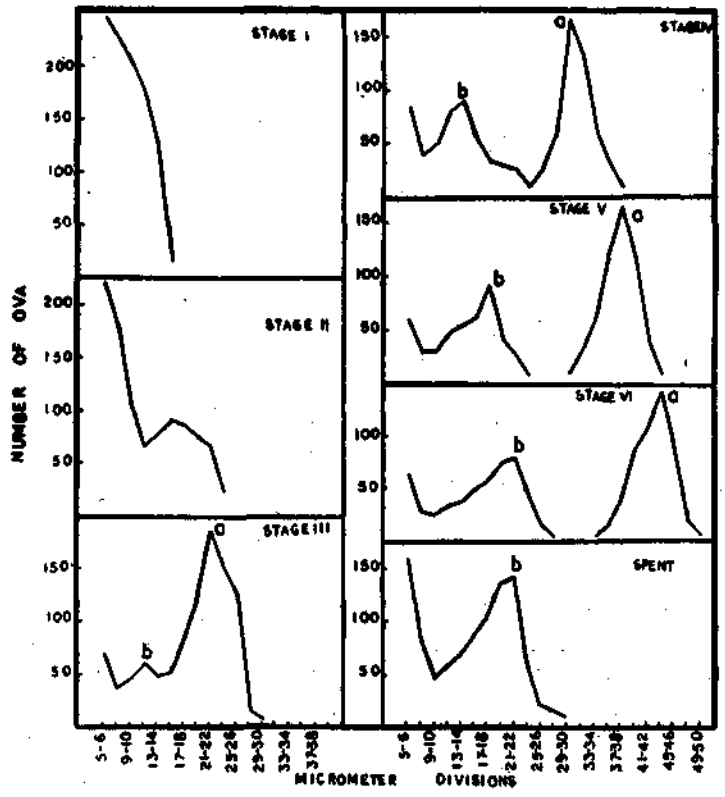

FIG. 3. Ova diameter frequency polygons of *T. baelama*.

mode 'b' was noticed at 17-18 m.d which has undergone more or less half the process of maturation and separated completely from the former. Further progress of this mature ova can be noticed with a modal shift in stage VI. The diameters of ova under mode 'a' vary from 0.57 to 0.84 mm and these can be expected to be liberated during the ensuing spawning season. The maturing group of eggs range in size from 0.15 to 0.47 mm with a mode at 0.36 mm. Since the maturing group is clearly demarcated and situated about half way between the immature and mature groups of eggs, it is unlikely that these will be liberated in the same season along with the first batch of eggs. This is further confirmed by the ova diameter frequency polygon of a spent ovary, wherein all the mature eggs have beeen extruded and only the group of maturing ova under mode 'b' is noticed. The eggs, therefore, form the stock of eggs for a subsequent spawning and the fish may spawn a second time in a year. As the ova diameter frequency polygons of the mature ovaries show a single well-differentiated group of mature ova it may be inferred that the individual fish spawns during a short and definite period.

Spawning Seasons

Although the mature fish were seen throughout the year, a large number of mature females with advanced stage of ovary was noticed only during a restricted period of July-August and again December-January coinciding with the two monsoon seasons. The occurrence of fish in oozing condition and spent individuals in the catches as noticed in these two periods indicate that spawning takes place during these months. This is further supported by the seasonal variations of the gonadosomatic index calculated separately for mature females which showed low values during these periods.

Sex Ratio

The sex ratios of the samples appeared to be unequal. In 1968-69, out of 499 fish, 203 were males and 296 females and in 1969-70 out of 523 specimens, 237 were males and 286 females. The sex ratio during each month in two years showed much variation. Females formed a high percentage in most of the months during 1968-69 except May and June 1968. In 1969-70, females dominated from July 1969 to January 1970.

An analysis of the occurrence of the males and females in different size groups (Table 2) indicated that there were more males than females among the smaller sizes measuring below 99 mm but among the bigger fish measuring above 100 mm the percentage of females dominated males. Females were more abundant (82.5%-100%) particularly from the size group 115-119 mm onwards which may probably be attributed to the migration of this group towards inshore waters after attaining sexual maturity. The occurrence of such mature fish in relatively high percentages was noticed during July-August and November-January in the commercial catches coinciding with the spawning period of the fish.

TABLE 2. *Sex ratio in* T. baclama *at different size groups*

Size group in mm	No. of fish	Males %	Females %
55— 59	1	100.0	—
60— 64	—	—	—
65— 69	1	—	100.0
70— 74	—	—	—
75— 79	4	50.0	50.0
80— 84	14	64.3	35.7
85— 89	42	64.3	35.7
90— 94	89	70.8	29.2
95— 99	148	50.7	49.3
100—104	174	47.7	52.3
105—109	206	45.6	54.4
110—114	146	36.9	63.1
115—119	126	17.5	82.5
120—124	57	15.8	84.2
125—129	12	—	100.0
130—134	2	—	100.0

FECUNDITY

Fecundity was determined in 20 mature specimens (stages IV and V) ranging in size 110-127 mm. The range of fecundity was found to be 1171-3356 with a mean of 2068. Although the number of eggs generally increased with the size of the fish, it has been noticed that the fecundity of individual fish of the same length vary considerably. A logarithmic regression relation was found between fecundity and weight of fish which is expressed as Log F=2.2877 + 0.9033 Log W, where F is the number of ova and W is the weight of fish in grams. The relation had a perfect correlation with 'r'=0.9074. Similar logarithmic regression relation was obtained between fecundity and weight of the ovary expressed by the equation Log F=1. 1379+0.8089 Log W, where F and W represent the number of ova produced and weight of the ovary respectively. The coefficient of correlation was found to be 0.9016.

DISCUSSION

Masurekar and Rege (1960) in their studies on *Thrissocles hamiltonii* have found the average size at first maturity between 14.6 to 15.5 c n. In *Thrissina baelama* above 55% of females were mature at an average length of 117 mm in addition to the occurrence of spent specimens in considerable percentage at this size. This shows that *T. baeluma* attains maturity at a lesser size than *T. hamiltonii*.

Gopalakrishnayya (1963) stated that the variations in 'Kn' may be attributed to changes in feeding intensity in immature fish, while in mature fish to spawning. In *T. baelama*, among immature females a more or less close relationship was found between the 'Kn' values and feeding intensity, whereas in mature females, besides feeding, other factors may also bring about changes in the relative condition.

Masurekar and Rege (1960) found that *T. hamiltonii* has two short spawning periods, indicated by a distinct stock of mature ova, sharply differentiated from the general stock consisting of maturing and immature eggs. Based on such pattern of polygons Dharmamba (1959) concluded that *T. mystax* may spawn twice in a year. The present observations that spawning in *T. baelama* is restricted to definite short periods, and the individual fish spawns twice during a year agree with the findings of the above authors.

Sadasivan (1953) concluded on the basis of limited evidences, that in most of the clupeids of Andaman waters, including *T. baelama*, the breeding season appeared to correspond with the advent of the southwest monsoon. The present study has indicated that *T. baelama* spawns twice in a year, during July-August and again from late November to January coinciding with the south-west and north-east monsoons.

Fecundity studies on *Thrissocles* spp. are very meagre. Masurekar and Rege (1960) estimated the fecundity of *T. hamiltonii* as ranging from 12495 to 23060 in fish varying from 15.0-17.3 cm. Their limited data also revealed that fecundity was proportional to the length of fish. However, in *T. baelama* although a general increase in fecundity was noticed with an increase in size of fish, considerable variations between individuals of the same size were found.

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