MATURITY AND SPAWNING OF THE SPOTTED HERRING, *HERKLOTSICHTHYS PUNCTATUS* (RUPPELL) FROM THE ANDAMAN SEA

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ABSTRACT

Herklotsichthys punctatus has been found to attain sexual maturity at an average size of 125 mm total length in the Andaman waters. Observations on the seasonal progression of ova indicated the sharp biannual spawning habit of the fish. The percentage occurrence of mature fish, fluctuations of the relative ovary weight during different months and ova diameter frequency indicated that spawning occurs first in May-June and again in October-November. Fecundity has been found to vary from 6,530 to 10,690 in specimens ranging 115-144 mm total length.

INTRODUCTION

The spotted herring, *Herklotsichthys punctatus*, makes a significant contribution to the clupeid landings in the Andaman Islands and occurs throughout the year. A study on the biology and fishery of this species was initiated at Port Blair in 1965. The present paper deals with the maturity and spawning of this species in the Andaman waters.

MATERIAL AND METHODS

Samples, each consisting of 10-15 fishes, were collected twice a week from the commercial catches of different fish landing centres around Port Blair. Data on fish length, weight, sex, maturation (on the I.C.E.S. scale), and the length and weight of ovary were recorded. The ovaries were preserved in 5% formalin and no appreciable shrinkage of the ova was noticed due to preservation even after several weeks. Ova diameter studies were made from samples taken from the middle region of both the ovaries. For the study of growth of ova the method adopted by Prabhu (1956) was followed. Eleven ovaries, in five different stages of maturity, were selected for the study of spawning periodicity and the diameters of 1000 ova from each ovary were measured, using an ocular micrometer. Each micrometer division (m.d.) was equal to 16.8μ. Ova measuring 5 m.d. and above only were measured. Fecundity was estimated by counting the total number of mature ova in a sample of known weight

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and by raising the number by the factor expressing the ratio between weight of the sample and total weight of the ovary.

OBSERVATIONS

Size at maturity

The percentage occurrence of female fishes of different maturity stages in various size groups was calculated to determine the length of *H. punctatus* at first maturity. Females of maturity stages I - V were available for study during 1965-67. Fish belonging to stages I and II have been grouped as immature, stage III as maturing and stages IV and V as mature. It can be seen from Table I that all the female fish

TABLE 1. *Percentage occurrence of females of* H. punctatus *in different stages of maturity in each 5 mm group*

Size group mm	No. of fish	Stages of maturity I	II	III	IV	V
65 - 69	6	100.0	..	..	..	..
70 - 74	7	100.0	..	..	..	..
75 - 79	16	100.0	..	..	..	..
80 - 84	14	100.0	..	..	..	..
85 - 89	15	86.7	13.3	..	..	..
90 - 94	13	84.6	7.7	7.7	..	..
95 - 99	16	75.0	18.7	6.3	..	..
100 - 104	18	61.1	27.9	5.5	5.5	..
105 - 109	42	14.3	35.7	21.4	26.2	2.4
110 - 114	57	10.5	31.6	26.3	24.6	7.0
115 - 119	73	1.4	16.8	45.2	28.8	8.2
120 - 124	70	2.9	11.4	42.8	32.9	10.0
125 - 129	38	..	13.2	21.0	47.4	18.4
130 - 134	48	..	16.7	10.4	50.0	22.9
135 - 139	54	..	13.0	13.0	27.7	46.3
140 - 144	17	..	..	..	58.8	41.2
145 - 149	2	..	..	..	..	100.0

up to 90 mm were in the immature stage and a high percentage of females remained immature up to 110-114 mm size. Maturing fish appeared from 92 mm (mid point) onwards. The percentage of maturing individuals in 115-124 mm size group was fairly high (42.8% — 45.2%). The occurrence of mature fish gradually increased from 100-104 mm size group. A length of 125 mm can be taken as the size at 50% maturity, since in 120-124 mm group the mature group is 43%, and in the next group it is 66%.

Ponderal index

The condition factor or the ponderal index was calculated separately for each size group and for all length groups combined, by using the formula $K=W/L^3$, where K=condition factor, W=weight of the fish in grams and L=length of the fish in

millimeters. A total of 487 fish in the length range of 65—145 mm was examined for this purpose. From the pattern of curve of 'K' values presented in Fig. 1, it may

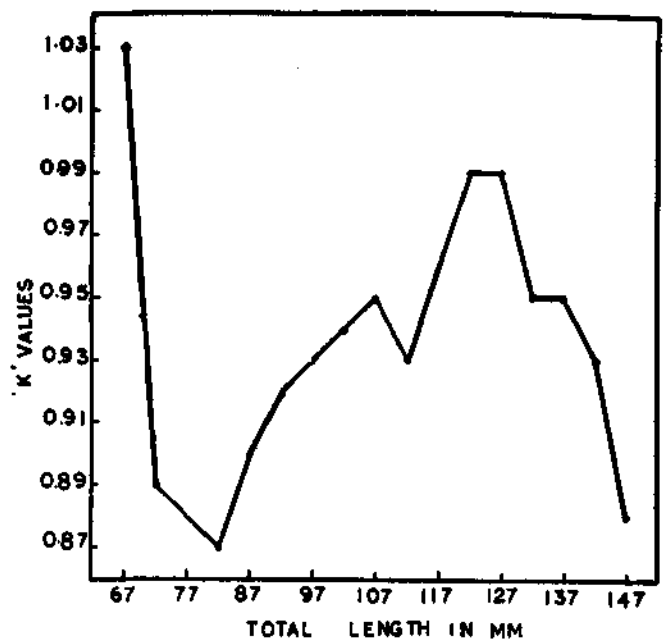

FIG. 1 The average 'ponderal index' (K) at different lengths of *H. punctatus*.

be inferred that the fish matures at an average length of 125 mm at which point a steep fall in the values takes place.

Ova diametre frequency

Fig. 2 gives the ova diameter frequency polygon drawn from the data on nine ovaries in stages II - V obtained at the approach of the spawning season. In the ovary of stage II (Fig. 2, A) the small immature eggs constituting the general egg stock form a high percentage and the withdrawal for maturation is clearly seen through three successive batches of eggs represented by three modes at 11-12 m.d., 15-16 m.d. and a well-distinguished group at 21-22 m.d. respectively. Further development of these batches of egges is seen in stage III (Fig. 2, B). The mode 'a' has shifted to 25—26 m.d. while modes 'b' and 'c' have advanced to 17-18 m.d. and 13-14 m.d. respectively. Fig. 2(C) shows the frequency polygon of ova in stage IV of maturity. The diameter of the mature eggs varies from 24 to 38 m.d. with a prominent mode at 29-30 m.d. In addition to this group of ova, there are intermediate stages of maturing ova as seen in mode 'b' at 19-20 m.d. and mode 'c' at 15-16 m.d. The ova at mode 'a' are well defined from the rest of the stock of eggs and these from the first batch of ova to be spawned. Fig. 2(D) gives the frequency curve of ova in stage V of maturity, where most of the mature eggs have become ripe with a modal diameter of 39-40 m.d.

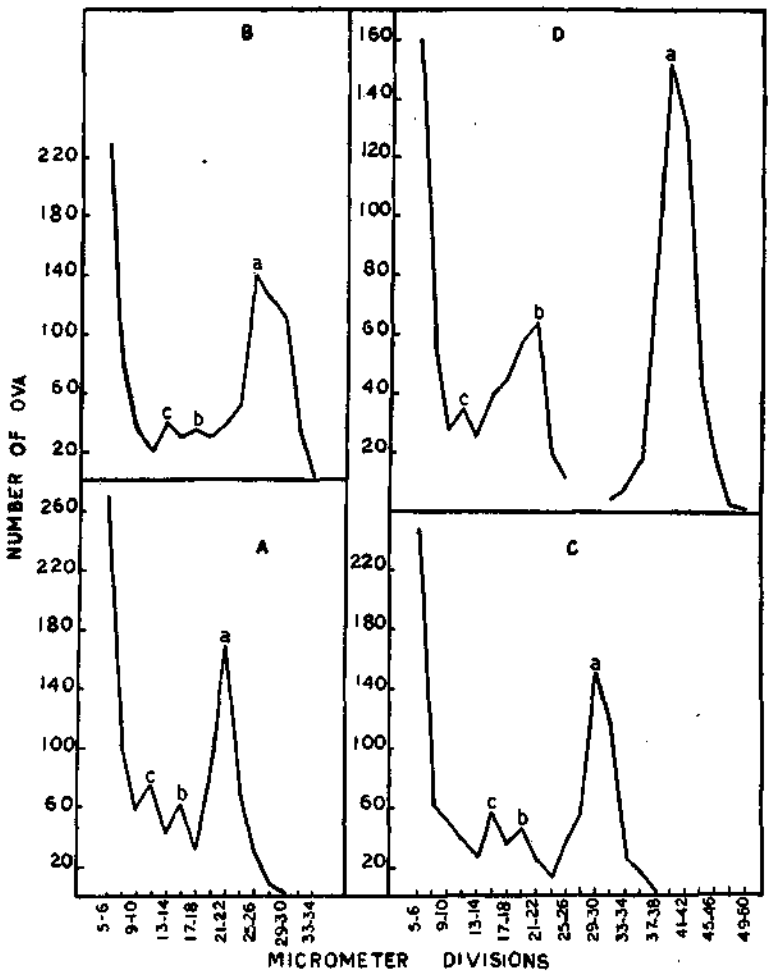

FIG. 2 Ova-diameter distribution in different stages of ovary of *H. punctatus*.

As they are sharply differentiated from the rest of the eggs it could be said that these eggs are almost ready to be liberated during the ensuing spawning season. The mode 'b' at 21-22 m.d. is the maximum modal length at the fish size of 115 mm and, according to the progression of modes, it reaches a maximum size of 39-40 m.d. as the fish grew by 24 mm in length, i.e., at the size of 139 m.m. Based on the observations on the length frequency of this species made by the author, it could be said that it would take about 4—5 months for the fish to gain an average growth of 24 mm. By the time the mature ova at mode 'a' are released the next successive group of ova at mode 'b' with further development during the growth of fish may occupy its place thus indicating the possibility of a second spawning.

Spawning period

Table 2 gives the percentage occurrence of mature females during 1965-67. Mature individuals in stages IV and V were noticed in the commercial catches in appreciable percentages during March-April and again in August-September. Hence

TABLE 2. *Percentage occurrence of mature females of* H. punctatus *during 1965-67*

Months	1965		1966		1967	
	No. of females	Mature fish (%)	No. of females	Mature fish (%)	No. of females	Mature fish (%)
January			21	19.1	17	47.1
February			33	12.1	16	31.2
March			41	34.1	30	50.0
April			5	40.0	10	50.0
May			10	0.0	12	8.3
June			21	14.3	3	0.0
July			21	38.1	25	44.0
August			22	72.3	31	90.3
September			21	85.7	31	80.6
October	16	58.3	25	48.0	22	31.8
November	15	0.0	5	0.0	9	33.3
December	19	10.5	15	33.3	10	40.0

it can be presumed that the spawning season of the fish may be about May-June and October-November. Fishes in oozing condition could not be collected in any part of the year, which suggests that the fish after attaining sexual maturity may move out of the inshore fishing grounds for spawning.

Gonado-somatic index

The relative ovary weight or the gonado-somatic index was calculated for individual fish by employing the formula, the ovary weight x 10^3/fish weight. A total of 506 specimens was examined for this purpose. The variations in average gonado-somatic index of mature fish were analysed to find its relation to spawning (Fig. 3). Two minima were noted, one in May-June and another in October-November, which agree with the spawning periods mentioned earlier.

Fecundity

The fecundity estimates were based on 19 specimens of *H. punctatus* ranging in size 115-144 mm in total length. Only the ovaries in advanced stages of maturity (stages IV and V) which have not spawned before were selected for this study. The potential stock of eggs varied from 6,530 in a fish of 115 mm total length to 10,690 in a fish of 139 mm length with an average of 8,353.

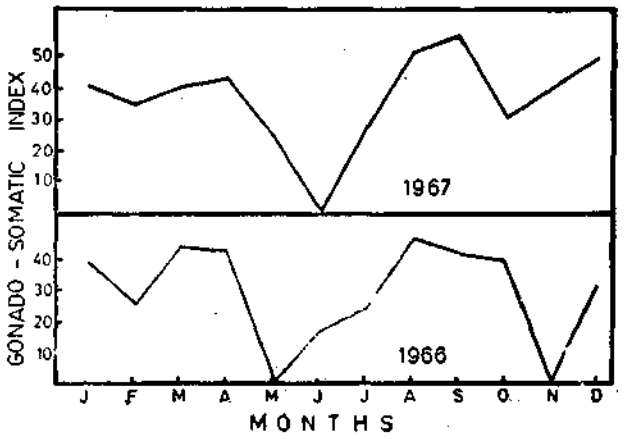

FIG. 3 Distribution of monthly average values of gonado-somatic index in *H. punctatus* during 1966-67.

The relationship between the fecundity and length of fish was found to be—log Y=2.045+O. 8999 log X, where Y is the number of ova in thousands and X is the total length of fish in millimetres. The relationship obtained between weight of the fish and fecundity was—log Y=2.196+O.7452 log X, where Y is the number of ova in thousands and X the weight of fish in grams, with a correlation cofficient (r) of O.8527. Fecundity and weight of ovary showed the relation—log Y=2.357+O.5122 log X, where Y represents the number of ova in thousands and X denotes the weight of ovary in grams, with a correlation coefficient (r) of 0.870.

DISCUSSION

In fishes where spawning takes place more than once a year, in addition to the batch of eggs in mature condition, another batch of maturing eggs will be distinctly represented in the frequency curve of intra-ovarian eggs. De Jong (1940) has observed in *Clupea fimbriata* and a few other species, a second batch of eggs getting differentiated from the general egg stock before the first group of eggs reach peak maturity. He concluded that after the first spawning is over, the ovary may contain, besides the general immature egg stock, a second batch of rather large eggs half-way to maturity which may be spawned in due course. Based on the occurrence of more than two distinct modes in ova diameter measurements of the mature ova in *Hilsa ilisha* Mathur (1964) concuded that the fish spawns twice in a year. In *H. Punctatus*, the occurrence of a distinct second mode, more or less in the middle of the total size range of the intra-ovarian eggs, clearly indicated the possibility of a second spawning in the same year. The time interval between two spawnings may not be long since the yolk formation has already commenced in these eggs. As the mature ova are completely separated from the rest of the egg stock it may be stated that the spawning may be of a short duration. The occurrence of mature females showing two peaks in a year, i.e., in March-April and August-September, and the disappearance of the fully

mature fishes in the following months from the fishing ground, as noticed consecutively for two years, probably indicate the biannual spawning habit of this species, once in May-June and again in October-November with an approximate time lapse of about 4—5 months.

Mathur (1964) and Saigal (1964) noticed a sudden fall in the relative ovary weight and associated it with the spawning season of the fish. In *H. Punctatus* the gonado-somatic index, showed two declines in a year, clearly indicating two spawnings coinciding with the onset of the two monsoons. Sadasivan (1953), on the basis of limited evidence, has stated that *Clupea (H) bulan* spawns in the colder months after north-east monsoon. He has observed that, for most of the other clupeids of Andaman waters, the breeding season appeared to correspond with the advent of the South-west monsoon. As there was no difference in the frequency distribution of ova among different individuals in the same stage of maturity, it may be inferred that similar spawning periodicity existed between individuals of *H. punctatus*, as observed in *S. gibbosa* (Dharmamba, 1959).

Generally it has been found that the number of eggs increased with the size of the fish. It has also been observed that the fecundity of individual fish of the same length varied considerably. Jhingran (1961) has shown that in *Setipinna phasa* the relation between fecundity and fish length is linear and he found a proportional increase in fecundity with increase in length and weight of fish. Mathur (1964) observed that egg production in *Hilsa ilisha* was somewhat more highly correlated with weight than with length of fish. The fecundity studies in *H. punctuatus* revealed a close relationship with weight of the ovary rather than with the length and weight of the fish.

Varghese (1961) and Balan (1963) have correlated fluctuations in ponderal index with the attainment of maturity in *Coilia borneensis* and in *Leiognathus bindus* respectively. In *H. punctatus* the 'K' values, after attainng a maximm at 125 mm, fall abruptly and this can be associated with the attainment of sexual maturity.

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