# MATURITY AND SPAWNING PERIOD OF *THRISSOCLES PURAVA* (HAM.) AS DETERMINED BY OVA-DIAMETER MEASUREMENTS

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## Introduction

In our studies on the maturity of fishes in Bombay waters, it was noted that the occurrence of *Thrissocles purava* was in two periods, from late January to April and from late August to October, and that the ovaries of specimens obtained in these months were in mature, spent and maturing condition. During these periods the post-larval forms of this fish were also encountered in the plankton.* In the remaining months of the year a few young and immature specimens were caught in inshore waters. This prompted us to examine this species more carefully in order to arrive at some definite conclusion regarding its maturity and breeding season.

*Thrissocles purava* is a small-sized fish attaining a maximum length of 270 mm. and weighing about 140 gm. The average commercial size is about 230 mm. weighing about 85 gm. It is known locally as "Kateri", on account of the presence of a number of small bony spines in its skeleton. This fish is generally consumed by the lower middle class and poor people.

* 3rd "Progress Report on 'Investigation of fish eggs & fish larvæ from Bombay waters' 1946-47," I.C.A.R., Fisheries Scheme, New Delhi.

## MATERIAL AND METHODS

A representative collection of varied sizes was obtained twice or thrice a week from fish markets where fishes were brought from the neighbouring fishing centres. After bringing the fish to the laboratory, the specimens were cleaned and their total body-length and weight were taken. The fish were then cut open ventrally and the general appearance and the extent of the ovary in the abdomen were noted. The ovaries were taken cut carefully and weighed. A small portion of the ovary was teased on a slide and examined under the microscope and the different stages of ova were noted. The ovaries were subsequently fixed in 10% formalin and allowed to harden for several days before the ova-diameters were measured. A record was maintained of the locality of the fish caught, their length and weight, the size and weight of the ovary and the state of maturity, in a tabular form throughout the period of this investigation (1947–48).

*Measurement of ova-diameters.*—At least three or four ovary samples from maturing and mature specimens, were taken for measurement of ova-diameters. The anterior, the middle, and the posterior portions of the preserved ovaries were examined. The distribution of ova of various sizes was found to be uniform throughout the entire mass of the ovary. As no appreciable shrinkage was noticed in the preserved material, the latter could be conveniently used for the purpose. The ova-diameters were measured by means of a micrometer eye-piece at a magnification which gave a value of $16{\cdot}9\,\mu$ to each micrometer unit. For the estimation of the size-frequency percentages of ova, about 300 ova from each ovary sample of maturing and mature fish were measured. The diameter counts were arranged into different groups and their corresponding percentages were calculated.

*Enumeration of mature ova.*—The enumeration of mature ova produced for a single spawning was done by what is known as *specific-gravity-bottle method.* The procedure adopted was as follows:—

(1) Weight of the specific gravity bottle.. .. .. W

(2) Weight of the specific gravity bottle filled with water .. $W_1$

(3) Weight of the specific gravity bottle filled with mature ova .. .. .. .. .. .. $W_2$

(4) Weight of the specific gravity bottle filled with mature ova and water .. .. .. .. $W_3$

$\therefore$ (5) Weight of water (in sp. gr. bottle) .. .. .. $(W_1-W)$

(6) Weight of water not occupying the volume of mature ova .. .. .. .. .. $(W_3-W_2)$

∴ (7) Weight of water occupying the volume of mature ova .. .. .. $(W_1-W) - (W_3-W_2)$

(8) = Volume of water displaced by the ova.

= Volume of the mature ova.

Since, volume of one mature ovum = $4/3\pi r^3$.

Total number of mature ova =

$$= \frac{\text{total volume of mature ova}}{\text{volume of one mature ovum}}$$

$$= \frac{(W_1 - W) - (W_3 - W_2)}{4/3\pi r^3}$$

From the formula, the total number of mature ova present in the entire ovaries of the mature fish was calculated.

## Growth of Ovary from Immature to Mature Stage

Before describing the successive changes in the ovary, it is advisable to state precisely the meaning of the terms immature and mature. It must be remembered that the term immature may mean a young fish which had never spawned before, or it may also refer to older fish which, on account of the immature condition of the ovary, can still be called immature. The term mature may be applied to a fish becoming mature for the first time, or to a fish attaining maturity subsequent to the first spawning.

In the present description, the term immature is applied to a fish containing immature ovaries, with ova smaller than 0·45 mm. A maturing fish has its ova ranging from 0·45 mm. to 0·76 mm.; while a mature fish has them from 0·92 mm. to 1·26 mm. in diameter.

*Immature fish and its ova.*—As stated previously, the immature specimens were encountered in very small numbers in the inshore catches. They measured about 140–50 mm. on an average. The ovaries of an immature fish are in the form of two longitudinal cream-coloured strips attached to the ventral side of the air-bladder, and extend over $\frac{1}{3}$ to $\frac{1}{2}$ the length of abdomen. The right ovary is relatively smaller than the left one. They measure from 20 to 30 mm. in length and weigh from 0·5 gm. to 1·5 gm.

The ova contained in these ovaries are primarily in the immature condition. They measure from 0·08 mm. to 0·44 mm. in diameter. Of these the smaller ones with a diameter varying from 0·08 to 0·33 mm. appear as quite transparent, spherical cells, containing a distinct nucleus. In-between hese ova which form the bulk of the ovary, there may also be found, a few

larger ova which exhibit a tendency towards yolk formation. In these larger immature ova, whose diameters vary from 0·33 to 0·44 mm. a thin layer of very minute yolk granules is being gradually developed along the periphery of the cell wall, which marks the initial step in the deposition of yolk in an immature ovum. By reason of the presence of these developing yolk granules these ova present a more or less semi-transparent appearance. The presence of such semi-transparent ova in the immature ovary is indicative of its gradual development towards the maturing stage.

*Maturing fish, its ovaries and ova.*—Maturing females were noted in fairly large numbers during the periods of the occurrence of the species. In specimens measuring from 174 mm. to 244 mm. and weighing from 41 gm. to 89 gm. the ovary length varied from 40 mm. to 64 mm. and its weight from 2 to 5·8 gm.

The maturing ovaries contain two types of ova, namely the immature ones described above and the maturing. The diameters of the latter vary from 0·45 to 0·76 mm. Of these, the ova smaller than 0·50 mm. in diameter are partially opaque, being more opaque at the periphery than in the central zone. Ova with a diameter varying from 0·50 to 0·76 mm. represent the typical maturing ova, by virtue of their being densely packed with yolk granules and are therefore highly opaque in appearance.

*Mature fish, its ovaries and ova.*—A mature fish is easily recognisable by its distended abdomen, due to the extensive growth of the ovaries. Mature specimens measured from 188 mm. to 240 mm. in length and weighed between 51 gm. and 94 gm. Their ovaries varied from 55 mm. to 75 mm. in length, and from 12 gm. to 15·5 gm. in weight. A single mature fish, 270 mm. long and weighing 140 gm., was encountered only once. Its ovaries, 75 mm. long, weighed as much as 20 gm.

An examination of the mature ovary under the microscope shows the presence of two types of ova: mature and immature, the latter forming but a small amount of the bulk of the ovary. A mature ovum is spherical in shape with a diameter varying from 0·92 mm. to 1·26 mm. It is transparent in appearance and the yolk is in the vacuolated condition. The oil globules are absent in the ovum of this species.

*Spent fish.*—As stated previously, the mature and the spent fish occur simultaneously in large numbers from February to April and from August to October. These two periods obviously represent the spawning seasons of this species. The spent ovaries, weighing 1·2 to 4·2 gm. are flaccid, wrinkled and slightly reddish in appearance. Empty follicles from which

mature ova have been extruded, are found in plenty in these spent ovaries. After going through the process of degeneration of the empty follicles, the spent ovaries become reorganised. With the addition of a fresh crop of immature ova, the old ones already present in them begin to grow into the maturing stage in due course. Such specimens with maturing ovaries are frequently met with in each season. They are in the process of preparing a new crop of mature ova for the next spawning season which would follow after about six months.

## The Total Number of Mature Ova Produced for a Single Spawning

The enumeration of ova was done with specific-gravity-bottle method, and the total number of ova produced for one spawning was found to vary with the size of the fish, there being usually more ova in a larger specimen. The size of the fish and the total number of mature ova produced are given below:—

| Size of fish | Number of mature ova |
|---|---|
| 170 mm. .. | .. 5,842 |
| 187 mm. .. | .. 11,896 |
| 192 mm. .. | .. 15,175 |
| 205 mm. .. | .. 17,457 |
| 207 mm. .. | .. 19,490 |
| 212 mm. .. | .. 21,721 |
| 222 mm. .. | .. 22,485 |
| 237 mm. .. | .. 23,878 |

## Size-Frequency Percentages of Ova from Mature Fish

In the description of the mature ovary it has been pointed out that the mature ovary contains two types of ova: immature and mature. In order to determine the proportion of each type, the size-frequency percentages of immature and mature ova were recorded in a tabular form and also shown graphically. The isolation of these groups by the total absence of the maturing ova is clearly seen in Table I and Figs. 1, 2. An analysis of the size-frequency percentage data in Table I brings to light the following important points.

(i) The percentage of immature ova varies between 30% to 50%.

(ii) The percentage of mature ova is from 50% to 70%.

Figs. 1 and 2 clearly indicate the percentage distribution of ova in mature ovaries and also show two distinct modal points in each of them. The first modal point varies from 0·21 mm. to 0·38 mm In the majority

TABLE I

*Size-Frequency Percentages of Ova in the Mature Ovaries* (1947–48)

| Diameter ranges of ova in millimeters | Ova percentages | | | | | |
|---|---|---|---|---|---|---|
| | August | September | October | February | March | April |
| 0·17–0·26 .. | 10·4 | 4·0 | 12·7 | 11·2 | 8·8 | 10·2 |
| 0·26–0·34 .. | 9·3 | 27·0 | 13·5 | 11·6 | 9·0 | 29·5 |
| 0·34–0·43 .. | 28·7 | 6·0 | 13·0 | 5·6 | 23·1 | 3·0 |
| 0·43–0·51 .. | 3·8 | 5·6 | 3·3 | 0·0 | 0·8 | 0·0 |
| 0·51–0·59 .. | 0 | 0 | 0 | 0 | 0 | 0 |
| 0·59–0·68 .. | 0 | 0 | 0 | 0 | 0 | 0 |
| 0·68–0·76 .. | 0 | 0 | 0 | 0 | 0 | 0 |
| 0·76–0·85 .. | 0 | 0 | 0 | 0 | 0 | 0 |
| 0·85–0·93 .. | 0·0 | 4·8 | 8·3 | 1·2 | 1·3 | 1·0 |
| 0·93–1·02 .. | 0·3 | 33·3 | 27·8 | 36·2 | 37·2 | 21·4 |
| 1·02–1·10 .. | 1·7 | 18·5 | 16·2 | 34·1 | 19·7 | 34·6 |
| 1·10–1·19 .. | 35·9 | 0·8 | 5·2 | 0·0 | 0·0 | 0·3 |
| 1·19–1·27 .. | 9·9 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 |

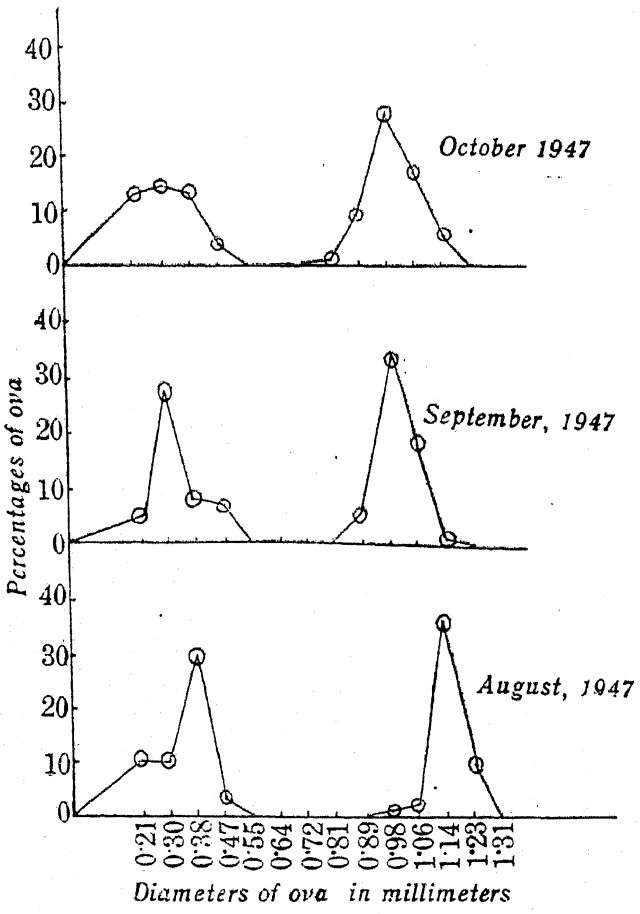


FIG. 1. Diameters of ova in millimeters.

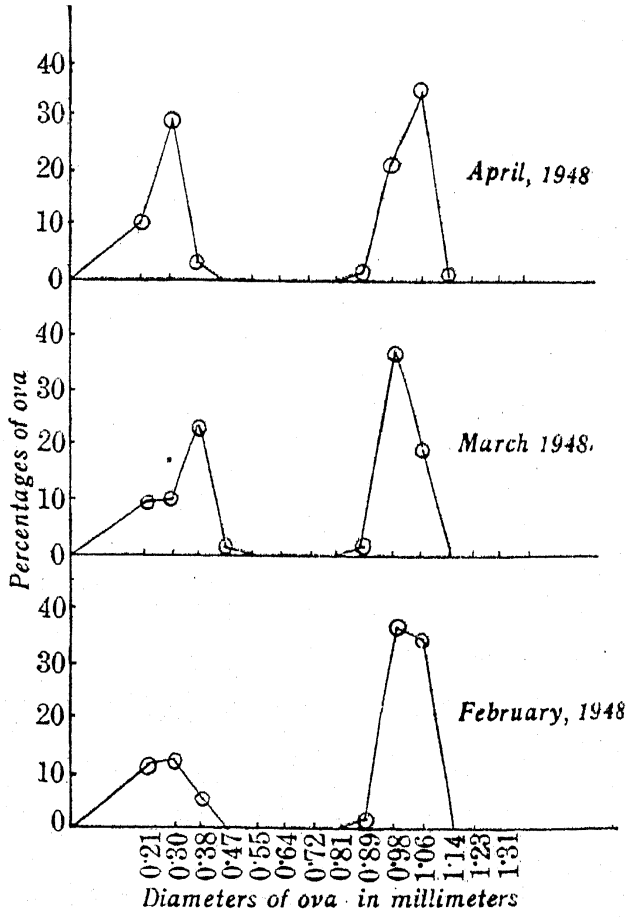


FIG. 2. Diameters of ova in millimeters.

of polygons, it remains at 0·30 mm. It represents the group of *immature* ova, which ranges from below 0·21 mm. to 0·49 mm. The second modal point varies from 0·98 mm. to 1·14 mm. In the majority of polygons, it represents the group of *mature* ova, which generally begins at 0·92 mm. and extends as far as 1·26 mm. These polygons bring to light two notable features of this fish:—

(i) The complete separation of the mature ova group from the immature one.

(ii) The complete absence of the maturing ova in the mature ovary.

## Spawning of *Thrissocles purava*

It has been stated at the outset that this species is known to occur in Bombay waters mainly during two periods of the year: once from late January to April and again from late August to October. At other times the adult fish moves elsewhere from the Bombay shores.

During the periods of its occurrence in Bombay waters, the adults are found in plenty in maturing, mature and spent condition of their ovaries, while only a small percentage, with immature ovaries is known to visit the shores. On analysis of the available material, the percentage of the adult females in each stage of maturity, during the period under investigation, is given in Table II.

Table II

*Percentage of Females in Each Stage of Maturity*

| Stage of Maturity | (1947–48) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Aug. | Sept. | Oct. | Jan. | Feb. | Mar. | Apr. |
| Immature .. | 15 | 7·7 | 6·1 | 10 | 11·1 | 6·4 | 0 |
| Maturing .. | 50 | 15·4 | 15·3 | 90 | 33·3 | 32·3 | 0 |
| Mature .. | 35 | 61·5 | 52 | 0 | 38·9 | 41·9 | 75 |
| Spent .. | 0 | 15·4 | 26·5 | 0 | 16·4 | 19·4 | 25 |

The figures given above point out the following noteworthy features in respect of the spawning activity of the species:—

(i) Mature and spent specimens occur plentifully during late August to October and from February to April.

(ii) The peak spawning occurs during September–October and February–April months.

(iii) The percentage of the spent females shows an increase at the close of the spawning season.

(iv) The percentage of the maturing females is fairly large during the spawning period.

(v) The percentage of the immature females is very low during the two periods of occurrence of this species.

It will be seen from the above that the simultaneous occurrence of the mature and spent specimens during August–October and February–April periods, indicates that the fish spawns at that time and that it visits the Bombay shores for that purpose.

## DURATION AND FREQUENCY OF SPAWNING

From the knowledge of the structure of the mature ovary and the nature of the catch during the spawning periods, there is some evidence to indicate that the spawning of *Thrissocles purava* is of a short duration and that it spawns only once during the season. The fact that the mature ovaries contain only two types of ova namely mature and immature (Table I) and that these two groups are completely separated from each other (Figs. 1, 2), suggests according to Rutenberg and Hickling (1936), a discontinuous growth of ova and therefore a short spawning period. Further the plentiful occurrence of mature fish coupled with the increasing proportion of spent females during the spawning seasons, indicates, according to Walford (1932), that the individual fish may have only one spawning during each season.

## FATE OF THE MATURING OVA

The fish after spawning remains in the inshore waters and leaves the shore at the close of the spawning season, with its ovaries in the maturing stage. The maturing fish which continued to appear throughout the spawning period, cannot be expected to mature during that season as can be seen from the size-frequency percentage data in Table III.

The data in Table III are represented by polygons in Fig. 3. A study of the polygons indicates two distinct modal points in each. The first is located at 0·21 mm. and represents the group of *immature* ova, which extends as far as 0·45 mm. The second modal point is located at 0·55 mm. and represents the group of *maturing* ova, whose upper limit extends as far as 0·68 mm.

It must be made clear that the readings in Table III represent only a sample of maturing ovaries obtained during the spawning seasons. They seem to corroborate the view that the maturing specimens which are present

TABLE III

*Size-Frequency Percentages of Ova in the Maturing Ovaries*

| Diameter ranges of ova in millimeters | Percentages of ova in different seasons | |
|---|---|---|
| | 21-10-1947 | 20-4-1948 |
| 0·17–0·26 | 15·3 | 25·2 |
| 0·26–0·34 | 12·8 | 20·6 |
| 0·34–0·43 | 3·8 | 5·6 |
| 0·43–0·51 | 2·9 | 9·6 |
| 0·51–0·59 | 40·9 | 36·8 |
| 0·59–0·68 | 24·3 | 2·8 |

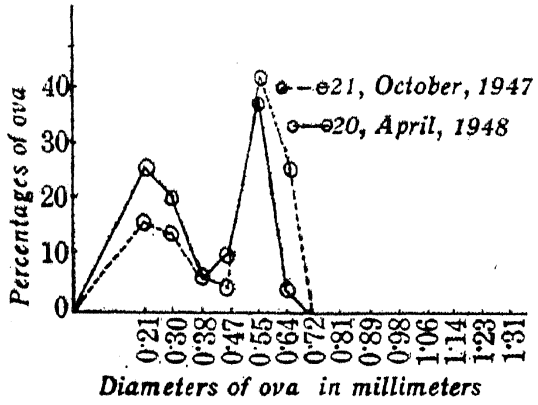


FIG. 3. Diameters of ova in millimeters.

in fairly large numbers in the seasonal catches, are not likely to mature in the same season, as they contain only the small maturing ova varying from 0·45 mm.–0·64 mm. It appears quite possible, however, that this (maturing) stock, which disappears from the local habitat at the close of the season, becomes mature and then returns to Bombay waters during the next season for spawning. Since the time interval between two successive spawnings is about six months, the latter seems to be the minimum period required for the growth and rematuration of ova after each spawning.

## SIZE AT FIRST MATURITY

The data employed for the determination of minimum size at maturity are based on 360 fish obtained from Sassoon Docks and Dadar fish market. Since the study relates to female fish, the conclusions drawn apply to that sex only. The simultaneous presence of mature and spent specimens in

the catch obviously indicate that they were the individuals involved in spawning activity during the season; and hence only such specimens were taken into consideration for determination of size at first maturity.

The number and percentage of mature and spent fish grouped by 5 millimeter length classes are given in Table IV. The data are shown by histograms in Fig. 4. They indicate that,—no mature fish were found with a

TABLE IV

*Number and Percentage of Mature and Spent Females* (Thrissocles purava) *in each 5 Millimeter Length*

| Total length in millimeters | Total fish examined | Number mature and spent | Per cent. mature and spent |
|---|---|---|---|
| 150–154 .. | 6 | .. | .. |
| 155–159 .. | 2 | .. | .. |
| 160–164 .. | 9 | 2 | 22·2 |
| 165–169 .. | 3 | 1 | 33·3 |
| 170–174 .. | 5 | 5 | 100·0 |
| 175–179 .. | 15 | 8 | 53·3 |
| 180–184 .. | 36 | 30 | 88·4 |
| 185–189 .. | 59 | 45 | 76·2 |
| 190–194 .. | 18 | 18 | 100·0 |
| 195–199 .. | 13 | 8 | 61·5 |
| 200–204 .. | 43 | 27 | 62·8 |
| 205–209 .. | 27 | 27 | 100·0 |
| 210–214 .. | 45 | 42 | 93·3 |
| 215–219 .. | 15 | 15 | 100·0 |
| 220–224 .. | 16 | 8 | 50·0 |
| 225–229 .. | 9 | 00 | 00 |
| 230–234 .. | 4 | 00 | 00 |
| 235–239 .. | 24 | 9 | 37·5 |
| 240–244 .. | 8 | 4 | 50·0 |
| 245–249 .. | 0 | 0 | 0 |
| 250–254 .. | 2 | 2 | 00·0 |
| 255–259 .. | .. | .. | .. |
| 260–264 .. | .. | .. | .. |
| 265–269 .. | .. | .. | .. |
| 270–274 .. | 1 | 1 | 100·0 |

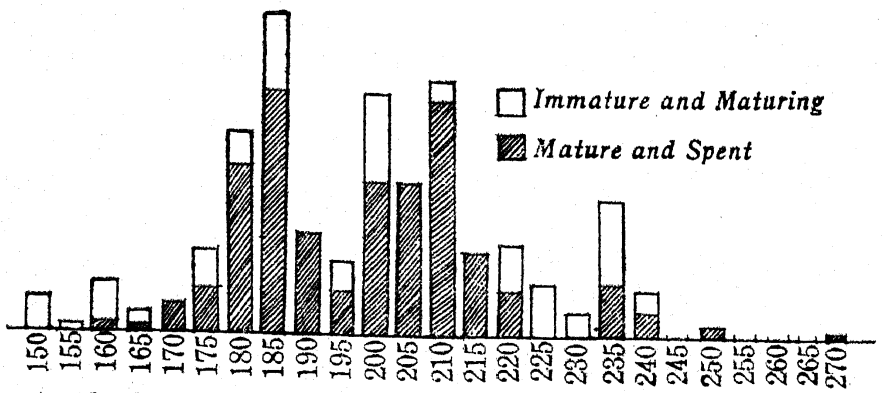


FIG. 4. Number of mature and spent females (*Thrissocles purava*) in each 5 millimeters of length.

length less than 160 mm.; = 22·2 per cent. of the females was mature between 160–64 mm.; —33·3 per cent. between 165–69 mm. and a major per cent. was mature in practically all the length classes above 170 mm. It may therefore be stated with some degree of precision that the female *Thrissocles purava* mature at an average length of 170 mm.

## Summary

The peak period of occurrence of *Thrissocles purava* (Ham.) in Bombay waters is in two seasons, namely February-April and August–October. The mature, spent and maturing fish are caught in inshore waters in these periods. The post-larval forms are also encountered in the plankton samples taken in these months. During the remaining months a few young, immature specimens are available in small numbers.

The range of diameters of immature, maturing and mature ova is from 0·08 mm. to 0·44 mm.; 0·45 mm. to 0·76 mm. and 0·92 mm. to 1·26 mm. respectively.

The mature ovaries of this species are found to contain only two groups of ova, namely mature and immature.

The spawning season, as determined by the ova diameter measurements and the structure of the mature ovary, is found to be the same as the peak period of occurrence of this species in inshore waters. Relatively high percentages of mature and spent females during this period further supports the view that the species visits the Bombay shores mainly for spawning.

The spawning period for individual fish is of a short duration and there is only one spawning a season. The minimum period required for the rematuration of the spent ovaries is about six months.

The size at first maturity is found to be about 170 mm.

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