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# REPRODUCTIVE BIOLOGY AND LENGTH-WEIGHT RELATIONSHIP OF *THRYSSA DUSSUMIERI* (VAL ENCIENNES) OF THE PAKISTAN COAST

S. M. SHAMSUL HODA

*Institute of Marine Biology,*
*Karachi University, Karachi, Pakistan*

ABSTRACT

The occurrence of mature specimens of *Thryssa dussumieri* (Val.) in different size groups indicates that the fish matures at 125-130 mm in total length, which is supported by the results obtained from the study of maturity stages, gonado-somatic index and relative condition. Coefficient of regression describes the relationship between the total length of fish and length and breadth of gonads, and between fish weight and gonadial weight. The logarithmic relationship between fecundity and total length, body weight and ovary weight has been established. Frequency distribution of ova suggests that the spawning period is twice i.e. March and August-September in a season. Separate equations for describing length-weight relationship of males and females are justified.

## INTRODUCTION

THE anchovies form an important fishery along the Pakistan Coast and are widely used as trash fish. They are also consumed by poor and middle class men. The previous knowledge of the different aspects of the biology of *Thryssa* sp. is available from Indian waters (Palekar and Karandikar, 1951 ; Venkataraman, 1956 ; Dharmamba, 1959 ; Masurekar and Rage, 1960 ; Rao, 1964 ; Marichamy, 1970) but no work is known from the Pakistan Coast till date. Therefore the present investigation is undertaken with a view to determining the reproductive biology and length-weight relationship of *T. dussumieri*.

The author is deeply indebted to Prof. Muzammil Ahmed, the acting Director of the Institute of Marine Biology, University of Karachi, for his keen interest and encouragement during the course of this investigation.

## MATERIAL AND METHODS

Material for this study was collected during the period between January and December, 1977 from the commercial landings at West Wharf, Karachi from the Pakistan Coast. Gonads were removed and fixed in 10% neutral formalin. The ova were measured by the method adopted by Clark (1934). Sexual stages were marked according to the scale adopted by International Council for the Exploration of the sea (Wood, 1930). GSI (Gonado-somatic index) was determined with gonad weight recorded as percentage of the body weight including gonad. Length-weight relationship and condition were calculated by the method of LeCren (1951). Fecundity was made by counting the ova in a portion of known weight and then calculating the total number from the total weight of the ovary.

## RESULTS

### *Breeding*

Females were slightly more numerous than males and a sex ratio of 1.22 : 1.00 between females (191) and males (156) was obtained. The same sex ratio was found in different months (Table 1) and different size classes (Table 2) of the fish. Based on size groups, the males were predominant up to 120 mm and in the range of 120 mm and in the range of 120 to 140 mm the females were predominant.

TABLE 1. *Number of males and females in the monthly samples*

| Months | Number of males | Number of females | Sex ratio | Confidence limit |
|---|---|---|---|---|
| January .. .. | 22 | 28 | 1 : 1.27 | 0.440-0.137 |
| February.. .. | 10 | 16 | 1 : 1.60 | 0.197-0.572 |
| March .. .. | 42 | 38 | 1 : 0.90 | 0.416-0.634 |
| April .. .. | 6 | 9 | 1 : 1.50 | 0.152-0.552 |
| May .. .. | 21 | 15 | 1 : 0.70 | 0.422-0.744 |
| June .. .. | 2 | 4 | 1 : 2.00 | 0.439-0.711 |
| July .. .. | 9 | 17 | 1 : 1.89 | 0.163-0.529 |
| August .. .. | 6 | 7 | 1 : 1.67 | 0.152-0.648 |
| September .. | 5 | 19 | 1 : 3.80 | 0.046-0.371 |
| October .. .. | 16 | 15 | 1 : 0.94 | 0.340-0.692 |
| November .. | 11 | 13 | 1 : 1.18 | 0.251-0.343 |
| December .. | 6 | 10 | 1 : 1.67 | 0.116-0.345 |
| Total .. | 156 | 191 | 1 : 1.22 | 0.398—0.502 |

The cycle of maturation of gonads was followed through the period of investigation based on their general appearance. The following I-VII stages of maturation have been defined. The fishes in running condition were rarely met in this study. Spent fish were not common.

STAGE I (Immature) : Ovaries small, whitish, almost transparent, soft, slightly cylindrical (left lobe larger than right one), oviduct long and thin, extend less than half of the length of the body cavity, GSI 0.091-1.028. Testes small, thin strip, whitish, opaque, asymmetrical (left lobe larger than right one), a fairly long thin was deferens faintly distinguished, extend less than half the length of body cavity GSI 0.062-0.634.

STAGE II (Developing): Ovaries whitish, yolk-laden ova visible, asymmetrical as before, oviduct a little reduced (Fig. 1 top), GSI 1.052-2.375. Testes whitish, more elongated and thicker than before, asymmetrical, duly transparent, vas deferens distinct but slightly reduced, extend more than half the length of the body cavity, GSI 0.560-1.221.

STAGE III (Maturing): Ovaries opaque, oviduct much reduced, blood vessels spread over the surface, granular appearance, occupy nearly 2/3 of the body cavity, GSI 0.224-2.581. Testes more elongated than before, blood vessels marked, slightly wrinkled, occupy about 2/3 of the length of body cavity, vas deferens widens but much reduced, GSI 1.664-2.393.

TABLE 2. *Number of males and females in different size classes*

| Size class mm | Number of males | Number of females | Sex ratio | Confidence limit |
|---|---|---|---|---|
| 60 .. .. | 1 | × | 1 : | × |
| 70 .. .. | × | × | × | × |
| 80 .. .. | 4 | 1 | 1 : 0.23] | 1.151-0.449 |
| 90 .. .. | 13 | 12 | 1 : 0.92 | 0.324-0.716 |
| 100 .. .. | 49 | 36 | 1 : 0.73 | 0.472-0.682 |
| 110 .. .. | 68 | 60 | 1 : 0.88 | 0.445-0.618 |
| 120 .. .. | 17 | 61 | 1 : 3.59 | 0.126-0.310 |
| 130 .. .. | 3 | 21 | 1 : 7.0 | 0.007-0.310 |
| 140 .. .. | 1 | × | × | × |
| Total .. | 156 | 191 | 1 : 1.22 | 0.398-0.502 |

STAGE IV (Mature): Ovaries opaque, large granular appearance, oviduct indistinct, occupy nearly 3/4 of the length of body cavity (Fig. 1 bottom), GSI 3.063-3.858. Testes enlarged and quite massive, occupy nearly 3/4 of the length of body cavity (Fig. 2), GSI 2.634-4.160.

STAGE V (Mature): Ovaries large and extended, tunica breaks easily at a pressure, ova large and transparent, occupy the entire length of body cavity, GSI 2.877-5.639. Testes more extensive than previous stage, occupy almost the entire length of body cavity, viscous fluid oozes out from cut surface, GSI 4.146-6.339.

STAGE VI (Mature): Ovaries extensive, ova extruded on slight pressure, GSI 5.275-6.415. Testes same as before, the outer margins slightly folded down, milt expressed by a moderate pressure or from the cut ends, GSI 5.414-7.859.

STAGE VII (Spent): Ovaries shrunken and flaccid, testes also shrunken no milt expressed on pressure.

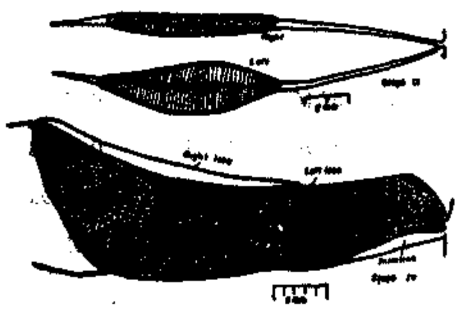

Fig. 1. Ovary of *Thryssa dussumieri*. Top—stage II (lobes separated); Bottom—Stage IV (left lobe, lateral view).

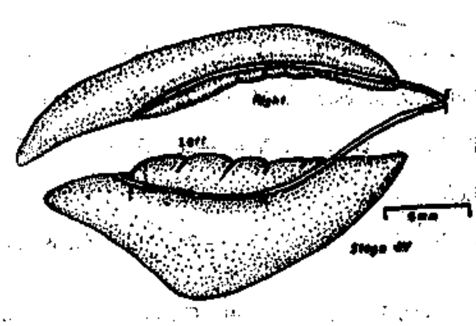

Fig. 2. Testes of *T. dussumieri*. Stage IV (lobes separated).

## *Size and weight*

The fish 90-140 mm in total length and 123 in number were grouped into 10 at 5 mm size range, and the mean values of length and breadth of the gonads were calculated for each group. In order to know how the size of the gonads in males and females are related to the length of the fish, the relationships between the length and breadth of the gonads and the total length of the fish are established by the method of least square (Table 3). Such relationships can not be correctly expressed by the equations as 'F' tests show high significant values. This suggests disproportionate growth of the length and breadth of the gonads in relation to the length of the fish, which is probably due to the maturation and spawning. It appears from the Table 3 that the growth rate in the breadth of the left lobes of the gonads is faster than those of the right lobes; the growth in the breadth of ovaries and testes appears to be related to the maturation and spawning events. The growth rate in the length of either lobes of ovaries and testes are almost equal. Regression lines and the intercepts on the length axis at nearly 84-86 and 79-83 mm for males and females respectively (Figs. 3-6) presumably suggest the length at which morphological differentiation of the gonads is made. The ovaries appear before testes. Further it may be inferred from the equation that for every 5 mm increase in length of fish, the length and breadth of both lobes of gonads increase approximately equal to the values of the regression coefficient or 'slope' of the regression line.

TABLE 3. *The equations for the regression lines to show the relationships between the fish length and gonadial length and breadth in* T. dussumieri (*X = Fish length*, Y = *Gonadial length or breadth*).

| Linear equation | | F (1, 8) | r | S.E. of reg. coeff. |
|---|---|---|---|---|
| TOTAL LENGTH OF FISH—GONADIAL LENGTH | | | | |
| Left lobe of testes : Y = —28.3125 + 0.451 X | .. | 167.16 | 0.97684 | 0.03493 |
| Right „ „ „ : Y = —28.6479 + 0.455 X | .. | 132.76 | 0.97117 | 0.03[illegible] |
| Left „ „ ovary : Y = —25.1661 + 0.3968 X | .. | 37.16 | 0.90712 | 0.06493 |
| Right „ „ „ : Y = —25.9319 + 0.3899 X | .. | 42.71 | 0.91773 | 0.05950 |
| TOTAL LENGTH OF FISH—GONADIAL BREADTH | | | | |
| Left lobe of testes : Y = —9.9817 + 0.162 X | .. | 115.08 | 0.9669 | 0.01509 |
| Right „ „ „ : Y = —4.1020 + 0.077 X | .. | 175.96 | 0.9760 | 0.00577 |
| Left Lobe of ovary : Y = —8.1001 + 0.125 X | .. | 32.28 | 0.8952 | 0.02192 |
| Right „ „ „ : Y = —6.2378 + 0.086 X | .. | 102.47 | 0.9631 | 0.00844 |

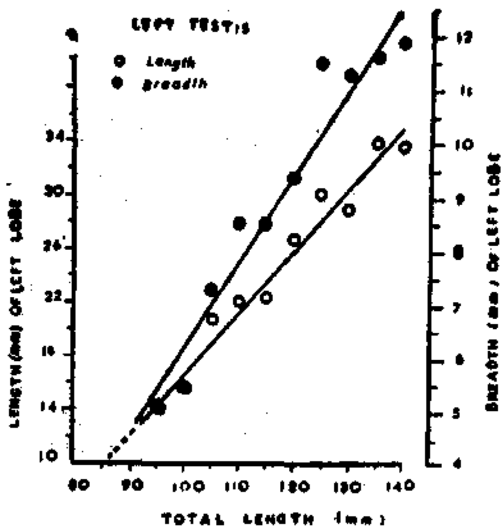

Fig. 3. Relationship between total length and left and right lobes of left testis.

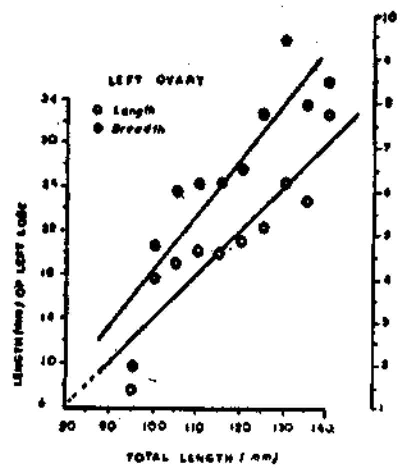

Fig. 4. Relationship between total length and left and right lobes of left ovary.

The logarithmic relationship between fish weight (mg) and gonadial weight (mg) has been calculated and is found to be,

$$\text{Log } W_{ov} = -3.464092 + 1.465653 \ \text{Log } W_{fw} \quad (r = 0.5849589, n = 32)$$

$$\text{Log } W_{ts} = -3.819348 + 1.543216 \ \text{Log } W_{fw} \quad (r = 0.6987068, n = 39)$$

( ov = ovary, ts = testes, fw = fish weight)

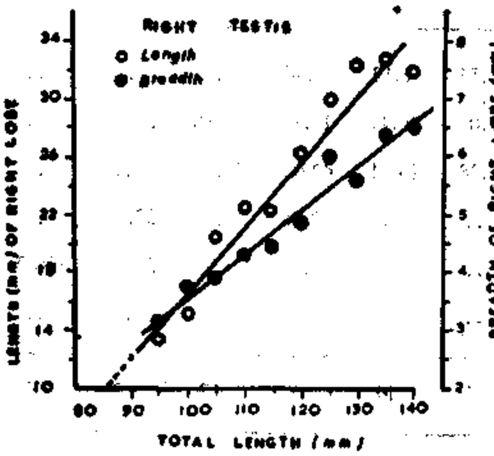


Fig. 5. Relationship between total length and left and right lobes of right testis.

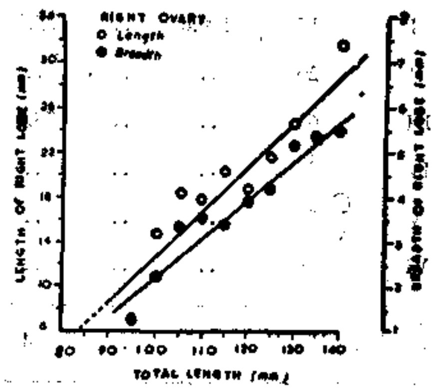


Fig. 6. Relationship between total length and left and right lobes of right ovary.

The relationship has been graphically depicted in figures 7 and 8. The difference in the regression lines of fish weight and gonadial weight has been tested by 'F' test which is not significant at 95 % significant level. The 'F' value being non-significant the slopes of the regression lines do not show real difference. Therefore, by pooling all data a general relationship has been obtained :

$$\text{Log } W_{gonad} = -3.623 + 1.499 \text{ Log } W_{fish} \ (r=0.7666, \text{S.E. of 'b'} = 0.170614$$

*Size at first maturity*

Those fish in stage I were considered as immature, stage II and III as maturing and stage IV-VI as mature. Their percentage were computed for each 10 mm length groups. The percentage of immature individuals diminished with increase in length. Since 58% were mature in 120-130 mm size it can be concluded that nearly 60% maturity is attained when the fish grows to a mean length of 125 mm (Table 4), and 6.12-22.02 % males and 25% females were found mature at 100-110 mm length. It can be presumed that the minimum size at first maturity is an average of 105 mm and the maximum size is an average of 125 mm in both sexes of *T. dussumieri*.

TABLE 4. *Percentage occurrence of* Thryssa dussumieri *in different stages of maturity in various size groups*

| Maturity stage | Number of individuals | Male | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 60-70 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 |
| I | 15 | 100.0 | .. | 25.0 | 61.54 | 6.12 | 2.94 | .. | .. | .. |
| II | 26 | .. | .. | .. | 23.08 | 20.41 | 16.18 | 5.88 | 33.33 | .. |
| III | 63 | .. | .. | 75.0 | 15.38 | 46.94 | 42.65 | 35.29 | .. | .. |
| IV | 22 | .. | .. | .. | .. | 6.12 | 22.06 | 17.65 | 33.33 | .. |
| V | 21 | .. | .. | .. | .. | 18.37 | 11.76 | 11.76 | 33.33 | 100.0 |
| VI | 9 | .. | .. | .. | .. | 2.04 | 4.41 | 29.41 | .. | .. |
| Total .. | 156 | 1 | .. | 4 | 3 | 49 | 68 | 17 | 3 | 1 |

| Maturity stage | Number of individuals | Female | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 |
| I | 12 | .. | 100.0 | 46.15 | 11.11 | 1.67 | .. | .. | .. |
| II | 49 | .. | .. | 38.46 | 38.89 | 31.67 | 15.0 | 9.52 | .. |
| III | 52 | .. | .. | 15.32 | 25.0 | 30.0 | 26.67 | 33.33 | .. |
| IV | 49 | .. | .. | .. | 25.0 | 25.0 | 33.33 | 23.81 | .. |
| V | 22 | .. | .. | .. | .. | 10.0 | 18.33 | 23.81 | .. |
| VI | 7 | .. | .. | .. | .. | 1.67 | 6.67 | 9.52 | .. |
| Total .. | 191 | .. | 1 | 13 | 36 | 60 | 60 | 21 | .. |

*Ova diameter*

Figure 9 represents ova diameter frequency curves of different maturity stages based on the measurements of ova from ovaries of 15 fish ranging in size from 106 to 139 mm. Ova diameters from ovaries of the same stage of maturity were combined, averaged and pooled into 2 micrometer division groups for plotting frequencies. Ova less than 3 micrometer divisions (1 m.d.=0.017 mm) were not taken into account.

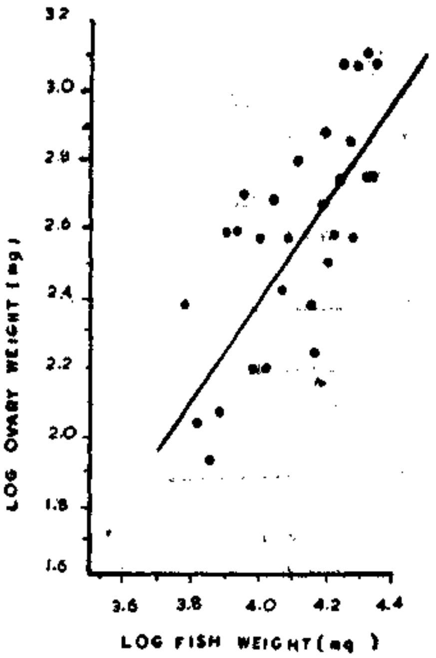


Fig. 7. Logarithmic relationship between fish weight and ovary weight.

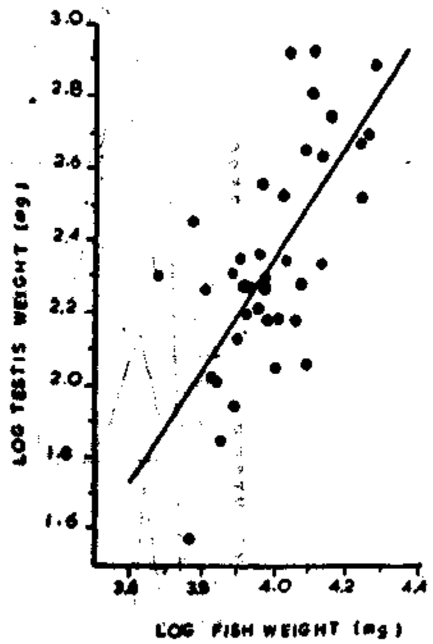


Fig. 8. Logarithmic relationship between fish weight and testes weight.

In stage I about 61% ova measure 5-6 m.d. whereas in stage II the batch of immature ova are getting separated from the general stock with a mode 'a' at 17-18 m.d. As the ovary passed the stage III a second batch of ova are differentiated with a mode 'b' at 11-12 m.d. The ova of mode 'a' has now grown to 27-28 m.d. In stage IV three modes are marked, the mode 'a' has grown to 35-36 m.d. and mode 'b' has attained 15-16 m.d. A third mode 'c' at 7-8 m.d. is discernible. These three batches of ova pass through stage V and in stage VI they attain 43-44 m.d., 27-28, and 13-14 m.d. respectively. Modes at 'a' and 'b' ensure progressive development of ova which ultimately partake in the spawning activity. The ova at mode 'a' are larger than those of 'b' and 'c', and two batches of ova are not likely to be shed simultaneously. They are shed in batches one after another with an interval of time. Thus it can be said that the spawning is twice a year in *T. dussumieri* and that the spawning period for individual fish is of longer duration.

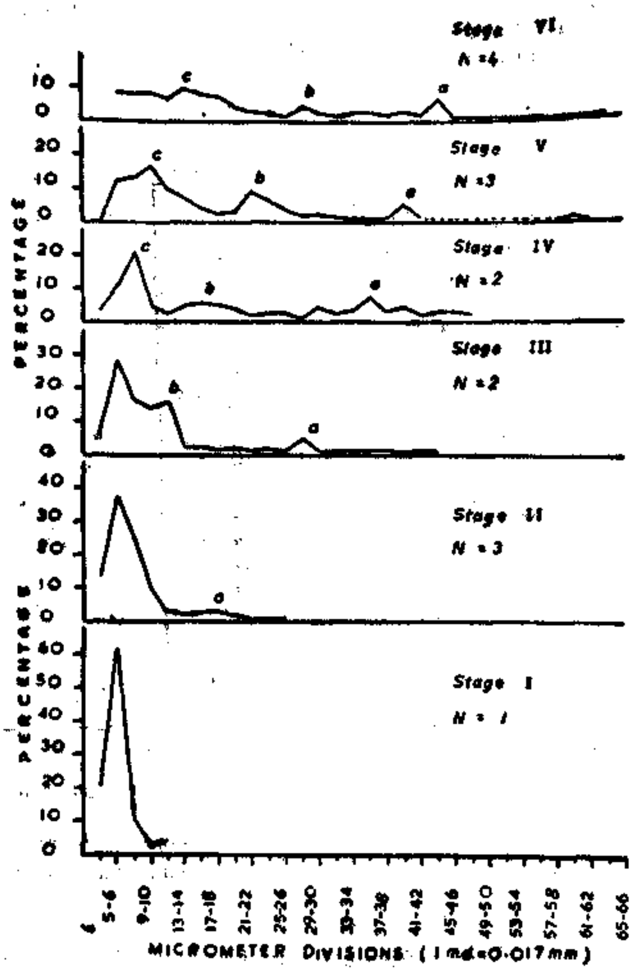


Fig. 9. Frequency polygons of ova diameter.

## *Fecundity*

For this study, 29 specimens of *T. dussumieri* varying in size from 106 to 139 mm in stages of maturity IV-VI were made use of. The equations of regression coefficient between total length (L), weight of the fish (Wf), weight of the ovary (Wov) and fecundity (Y) are given in Table 5.

TABLE 5. *Regression equations for fecundity and length, weight of fish and weight of the ovary (rov = right ovary, lov = left ovary)*

| Equation | | | | r | S.E. of reg. coeff. |
|---|---|---|---|---|---|
| Log Y | .. | −6.1698327 | 4.6480 Log L | 0.695737 | 0.9235097 |
| Log Y | .. | 2.140151 | 1.2515 Log $W_f$ | 0.701332 | 0.0542853 |
| Log Y | .. | 1.38200 | 0.7598 Log $W_{ov}$ | 0.552600 | 0.2388795 |
| Log Y | .. | 2.84438 | 0.3205 Log $W_{rov}$ | 0.243740 | 0.2317621 |
| Log Y | .. | 1.91879 | 0.4941 Log $W_{lov}$ | 0.49404 | 0.1665699 |

The relationship has been graphically shown in Fig. 10-12. Figure 10 shows that the number of ova destined to be spawned varied widely in a fish of nearly the same length. It is estimated that the number of ova from specimens of the same length varies about 1/3 of the earlier values. Such discrepancies in the estimated number of ova in varied proportions at different lengths indicates that the ova in this species are shed in several batches. The coefficient of correlation between total length and total weight of the fish and fecundity is quite distinct (i.e. 0.7) suggesting

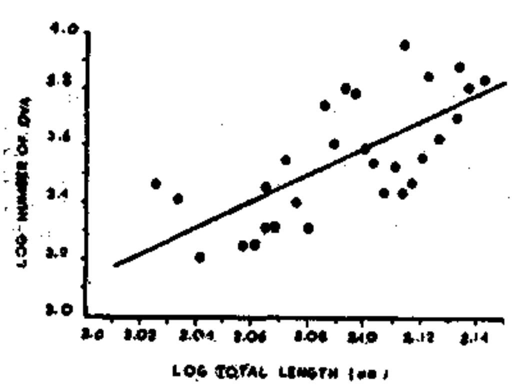


Fig. 10. Logarithmic relationship between total length and number of ova.

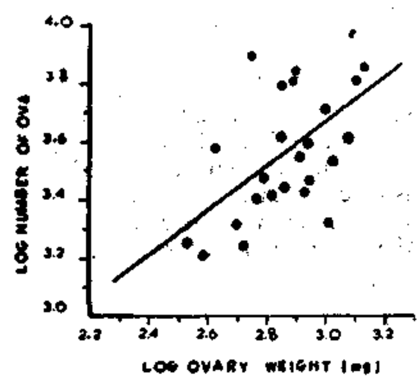


Fig. 11. Logarithmic relationship between ovary weight and number of ova.

that the number of ova is determined by the length and weight of the fish. The constant 'b' is higher (0.491496) in the left lobe of the ovary than the right one (0.3026556) which indicates that the number of ova in the left lobe is greater than that of the right one. The fecundity ranged from 1585 to 7945 in a fish ranging from 106 to 139 mm in total length. A preliminary examination of the ovary revealed that there is no significant variation in the number and mean ova diameter from anetrior, central and posterior parts of an individual ovary.

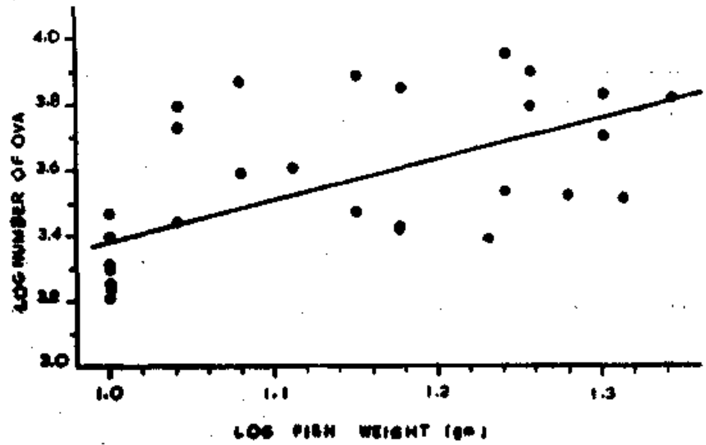


Fig. 12. Logarithmic relationship between fish weight and number of ova.

*GSI* (*Gonado-somatic index*)

GSI indicates the state of gonadial development and breeding time and were calculated month and size wise. They show high and low values in either sex (Figs. 13, 14). High values in March and August-September suggest maturity of gonads during these months. Therefore it can be inferred that the spawning of *T. dussumieri* is twice a year. The value of GSI increases at 130 mm in total length for either sex, in males the value decreases afterwards but in females it remains the same indicating the presence of mature eggs.

*Length-frequency distribution*

The length of *T. dussumieri* under investigation varied between 80 and 146 mm in total length. The length-frequency distribution in figure 15 indicates that a larger portion of the fish greater than 115 mm weie encountered during December, January, March-June. Juveniles less than 110 mm are present in February, July, August and November. In August and April percentage of individuals greater than 125 mm are encountered. The Fig. 15 also shows the presence of distinct size groups contributing to the bulk of fishery every month. The percentage of individuals greater than 125 mm in December may be attributed to the errors in random sampling.

*Length-weight relationship*

Length-weight relationship of 156 males and 191 females has been calculated and is expressed in the following equations :

Males : Log W= −4.6920+2.76956 Log L. (r=0.84499, S.E. of reg. coeff. =0.141245)

Females : Log W= −5.6884+3.26159 Log L. (r=0.91792, S.E. of reg. coeff. =0.102546).

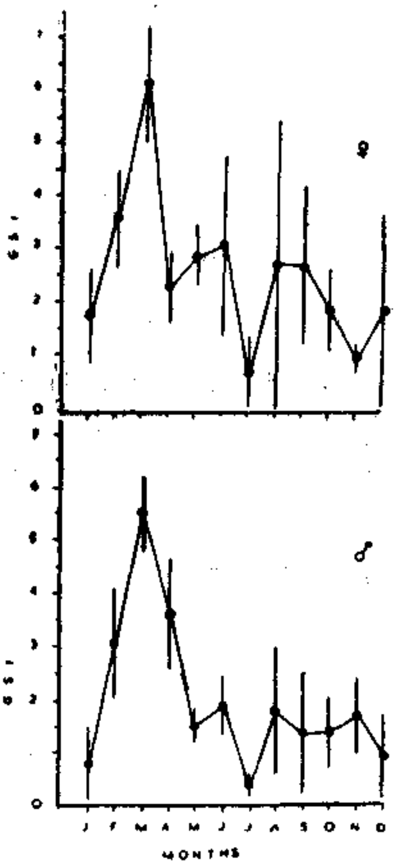

Fig. 13. Monthly fluctuations in the mean values of GSI (Gonado-somatic index). Vertical bars indicate 95% confidence interval.

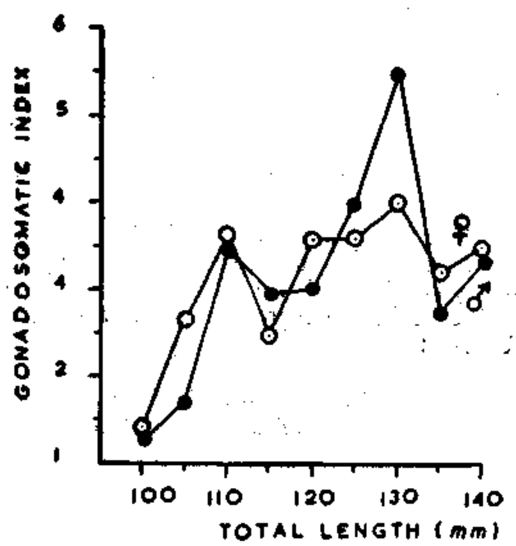


Fig. 14. Mean Gonado-somatic index values at different lengths.

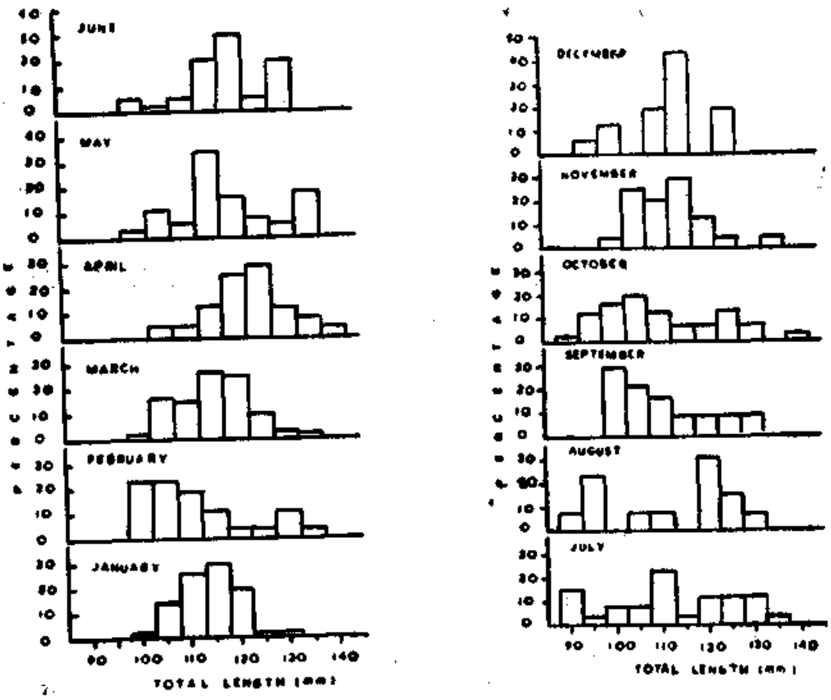


Fig. 15. Length-frequency distribution in different months.

The S.E. is slightly lower in females than in males which indicates that in males the different weights are more frequently met for a given length than in females. Analysis of covariance (Snedecor and Cochran, 1967) was made for testing the difference in the regression lines in the length-weight relationship of males and females :

TABLE 6. *Analysis of covariance for difference in the regression lines of the length-weight relationship for males and females*

| | d.f. | | | | Reg. coeff. | d.f. | SS | MS |
|---|---|---|---|---|---|---|---|---|
| Within— | | | | | | | | |
| Males .. | 155 | 0.238460 | 0.660430 | 2.561730 | 2.76956 | 154 | 0.73263 | 0.004757 |
| Females .. | 190 | 0.297910 | 0.971660 | 3.761230 | 3.26159 | 189 | 0.59207 | 0.003133 |
| Pooled within— | | | | | | 343 | 1.32469 | 0.003862 |
| Common .. | 345 | 0.536370 | 1.632090 | 6.322960 | 3.04284 | 344 | 1.35677 | 0.003944 |
| | Difference between slopes | | | | | 1 | 0.03207 | 0.032073 |

$\Sigma x^2$, $\Sigma xy$, $\Sigma y^2$ are corrected sums of squares and products, x and y have usual meanings. Comparison of slopes F=0.032073/0.003862=8.3047437 (d.f. 1,343). The 'F' value being significant the slopes of the regression lines of males and females show differences. Therefore two different regression lines for males and females are justified for length-weight relationship.

*Relative condition*

The mean relative condition through the various months of the year is presented in Fig. 16 and in relation to size in Fig. 17. March and August-September are followed by a fall in subsequent months. Since a fall is indicative of the onset of spawning, March and August mark the time of breeding. The peaks at 110 and 130 mm in either sex indicate minimum and maximum size of maturity. A rise from 125 to 130 mm in Fig. 17 may be attributed to the size when the spawning occurs in *T. dussumieri*.

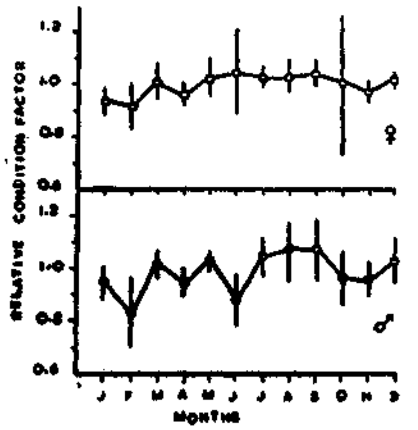


Fig. 16. Monthly fluctuations in the mean values of relative condition. Vertical bars indicate 95% confidence interval.

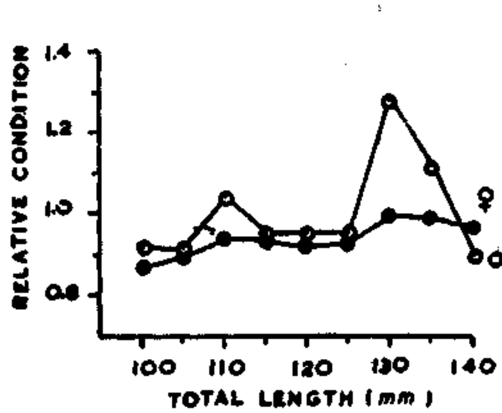


Fig. 17. Mean relative condition values at different lengths.

The fatness covering the gonads changes seasonally. Fat is laid down between the peritoneum and dorsal musculature. It begins to accumulate shortly after spawning in April and September and remains until December and January. The disappearance of the fat bodies coincides with the ripening of the gonads in February-March and August-September.

## Discussion

Marichamy (1970) indicated that in *Thrissina baelama* (Forsskal) there were more males than females below 90 mm and more females than males above 100 mm, the percentage of females dominated males. This happened during July-August and November-January which coincide with their spawning period. In the present study of *T. dussumieri* the occurrence of mature fish is considerably high percentage at 120-130 mm was noticed in March-April and August-September coinciding with the spawning time. The sex ratio figures might suggest that differential fishing could occur in *T. dussumieri*.

Rao (1963) remarked that the growth in the breadth of gonads is related to the maturation and spawning events and not to the length of the fish, *Pseudosciaena diacanthus* (Lacépède). This observation tallies with the present studies on the growth of gonads in *T. dussumieri*. Further the relation between fish length and breadth of the gonads is not proportional due to maturation events.

Average size at first maturity in *T. hamiltonii* is 146-155 mm (Masurekar and Rege, 1960), in *T. purava* 170 mm (Venkataraman, 1956) and in *T. baelama* 117 mm (Marichamy, 1970). In *T. dussumieri* nearly 60% maturity is attained at 125 mm in both sexes. This indicates that *T. dussumieri* attains maturity at a lesser size than *T. hamiltonii* and a little greater than *T. baelama*.

Gonado-somatic index has been used by many investigators (Masterman, 1913b; Olsen and Marriman, 1946) to assess the degree of ripeness of ovary. LerCen (1951) stressed the superiority of the relative condition factor over the condition factor. It is interesting to find that seasonal GSI and relative condition factor indicate almost similar trends suggesting the breeding time in March and August-September. It has also been noted that the inflection points at 105-110 and 125-130 mm in both GSI and relative condition factor confirm the observation of their first maturity and breeding length respectively.

Marichamy (1970) stated that the fecundity studies on *Thrissocles* were very meagre. It is 5842-23878 in 170-237 mm in total length of *T. purava* (Palekar and Karandikar, 1952), 12495-23060 in 150-173 mm in total length of *T. hamiltonii* (Masurekar and Rege, 1960) and 1171-3356 in 110-127 mm in total length of *T. baelama* (Marichamy, 1970). Fecundity in *T. dussumieri* is found to be 1585-7943 in 106-139 mm in total length. The number of ova from the right life is less than that of the left lobe. Fecundity is increased in proportion to 4.648 power of the length. In many fishes the fecundity has been reported to increase either at a rate of 3 times to that of the length or more as reported in haddock (Hodder, 1963), *Sardinella longiceps* (Balan, 1965) and *Notopterus notopterus* (Parameswaran and Sinha, 1966). The number of ova from specimens of nearly the same length varied considerably indicating that the ova are shed in several batches in *T. dussumieri*. Kagwade (1970) arrived at similar conclusions in *Polynema heptadactylus* Cuvier and Valenciennes.

Dharmamba (1959) investigated the spawning habits of some clupeoids based on ova diameter measurements and pointed out that the spawning period of *T. dussumieri* is a prolonged one extending from February-March to August-September with the individual spawning twice in each season. The present study is in with her findings. In the process of progressive development of ova as revealed in ova-diameter frequency polygons based on ovaries of 15 specimens, three modes i.e. 0.221, 0.459 and 0.731 mm are marked in stage VI in this study against three modes i.e. 0.24, 0.432 and 0.56 mm in stage 'D' of Dharmamba, (1959) findings based on ovaries of 5 specimens.

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