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Observations on the fecundity of the cyprinid *Rasbora daniconius* (Hamilton)

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Abstract. The present paper reports the fecundity(F) of *Rasbora daniconius* in relation to the total body length (L), total body weight (W) and gonad weight (G) of the fish. Catch data indicated a predominance of females during the months of July–August which is the breeding season of this species. The collected fish in the length range of 7·7–11·7 cm bore a linear relationship with their weights. The fecundity of the fish ranged from 580 to 11040 eggs fish^{-1}. Fecundity exhibited a linear relationship with L, G and W. By subjecting the data to multiple regression analyses, a new and convenient method of best predictions of F in *R. daniconius* in relation to L alone has been developed.

Keywords. Cyprinid ; gonad weight ; *Rasbora daniconius* ; correlation ; fecundity; spawning ; reproduction ; maturity.

1. Introduction

Studies on fecundity of culturable fishes provide information for successful application of the knowledge in the management and exploitation of the resource (Bagenal 1967). With reference to forage fishes which are predators of the fry and young of culturable fishes (Jhingran 1977), the fecundity data would be useful in separating their stock from the stock of culturable fishes (Farren 1938).

During preliminary observations on the cyprinid forage fish, *Rasbora daniconius*, a marked variation in fecundity, in different habitats was noted (Nagendran and Katre 1977). These authors also indicated the necessity for determining more accurate relationship between fecundity and other variables (body length, body weight and gonad weight) of the fish collected from a single habitat. Therefore, an attempt has been made to correlate the fecundity of this species with the above variables, to evaluate the dependance of fecundity on these parameters.

2. Material and methods

Rasbora daniconius (Hamilton) is a commonly occurring cyprinid forage fish in the freshwaters of India (Day 1878) and is known to breed during monsoon seasons (Muddanna 1971). Hence the present study was carried out during July/August 1977, the monsoon months at Bangalore, Karnataka. Fish were collected randomly from the Benniganahalli tank (near Bangalore) by operating a cast net. After recording the total lengths and total weights, the fish were preserved in 5% formalin for further analysis. Fecundity estimates were made by the standard method detailed in the IBP Handbook on Fish production in freshwaters (Bagenal 1978). For determining the weight of the eggs, a known number of eggs were weighed in a monopan electric balance and the average value taken. The diameter of the egg was measured at its widest region using a calibrated ocular micrometer.

Computer programs were developed for calculating the relationship between fecundity and other variables (body length, body weight and gonad weight).

3. Results and discussion

3.1. *Preliminary observations*

The presence of gravid ovaries in all the collected specimens confirms that *Rasbora daniconius* breeds during monsoons. Variations in the size of ova within each ovary were observed. The diameter of the ova ranged from 0·7068 to 1·1780 mm egg^{-1}, while their weights fell in the range of 94·117–514·286 $\mu g\ egg^{-1}$. Perhaps this indicates that the fish spawns more than once during a breeding season (Nagendran and Katre 1977).

Surprisingly, all the fiftyfive specimens of *R. daniconius* were found to be females. Relative abundance of females in comparison to males in the catch statistics during the breeding season has been reported for another cyprinid fish, *Labeo fimbriatus* (Bhatnagar 1972). During the spawning season, the females of *R. daniconius* perhaps become heavy, due to the bulkier ovaries and get trapped easily, when a medium sized cast net is operated. Further, it is said that during the spawning season females become lethargic and hence get caught more easily than the males which are more agile and comparatively slender (Bhatnagar 1972).

3.2. *Analyses*

R. daniconius collected during the present study had a length range of 7·7–11·7 cm while their weights ranged from 4·5 to 16·5 g. The scattergram of total weights (g) of the fish plotted against the total lengths (cm) exhibited a linear relationship suggesting the applicability of linear regression analysis (figure 1). This relationship can be represented by the linear regression equation

$$W = \bar{w} + R_{WL}(L - \bar{l})$$

Where, $\bar{w}$ = average weight of the fish, $\bar{l}$ = average length of the fish and R_{WL} = 2·9 g per unit length of the fish. R_{WL} is the regression co-efficient (regression of W on L evaluated using the data from graph (figure 1).

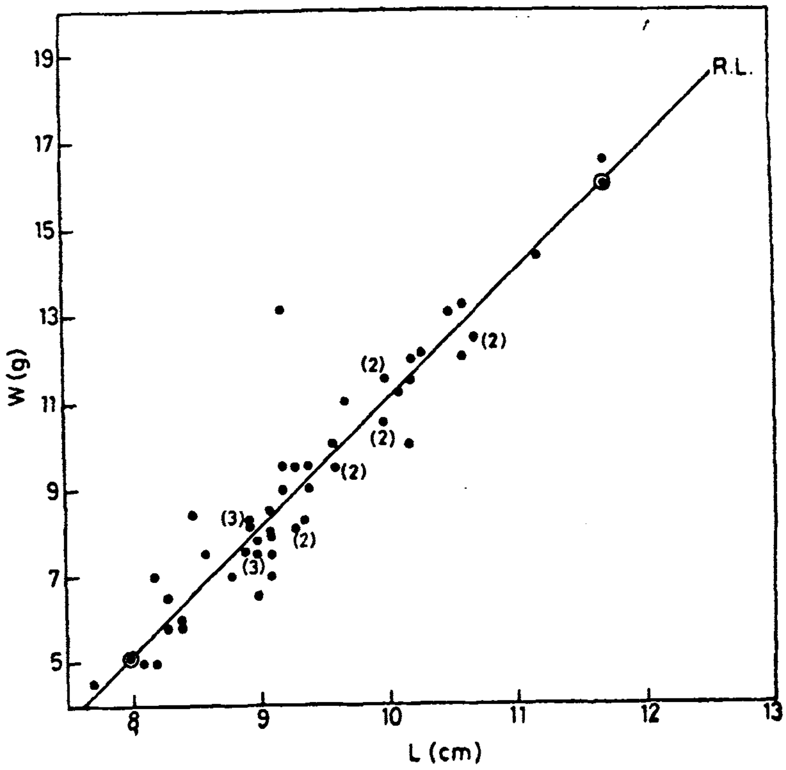

Figure 1. *Rasbora daniconius* : Scatter diagram and the regression line (RL) for the length-weight relationship. Numbers in parantheses are the number of females of the same length.

The high correlation between L and W indicated in table 1 further confirms this linear relationship. LeCren (1951) pointed out that generally the weight of the fish is a function of the cube of its length. However, such a generalization is not applicable in the present context, as the experimental fish represent only the gravid females of the species and a direct linear relationship obtained presently is justified.

The ovaries of *R. daniconius* weighed on an average 24·27% of the average body weight. This value is comparable to the value of 18·30% indicated for the same species, collected from another local freshwater tank (Nagendran and Katre 1977). Hence, an ovarian weight range of 18–25% of the body weight may indicate the presence of mature ovaries in *R. daniconius*. The value of absolute fecundity (total number of gravid eggs per female) for *R. daniconius* ranged from 580–11040, while the number of eggs per gram weight of the ovary ranged from 1600 to 3952.

Individuals of *R. daniconius* having a more or less similar ovarian weight, exhibited considerable variations in their fecundity. The estimated value of the fecundity factor (number of eggs per gram weight of the fish) was 630 ± 203 which is close to the value of 679 ± 108 reported earlier for the same species (Nagendran and Katre 1977). The large variation from the mean value may be due to several factors viz., age of fish, the spawning season (in relation to spawning periodicities

Table 1. Regression and Correlation coefficients. The average values of total length (L), total Weight (W), Gonad Weight (G), and Fecundity (F) of *Rasbora daniconius* are : $\bar{l} = 9\cdot2909$, $\bar{w} = 8\cdot9073$, $\bar{g} = 2\cdot2545$, $\bar{f} = 5670\cdot6000$.

Depend. variable	Concomitant variables	'B'-Regression coefficient(s)	Correlation coefficient(s)
L	W	0·3032	0·9425
W	L	2·9295	
L	G	0·6001	0·7819
G	L	1·0190	
W	G	2·0765	0·8706
G	W	0·3650	
L	F	1832·6942	0·6212
W	F	698·4757	0·7358
G	F	2027·9426	0·8957
F	G, W	— 172·4723 (G)*	—0·2000
		2386·0841 (W)*	0·7656
F	L, G	— 601·5122 (G)*	0·8447
		2388·8825 (L)*	—0·2800
		— 885·3566 (G, W)*	—
F	L, W, G	135·5661 (G, L)*	—
		2277·6995 (W, L)*	—
F	L (reduced)	1811·7343	—

* Parameter(s) in parantheses is (are) kept constant for evaluation.

per fish) as well as the population density of the fish. During the present study the size (mm) or weight (μg) of the eggs of *R. daniconius* did not exhibit any relationship either to the length or weight or the fecundity of the fish. However, in contrast it has been reported that amongst Atlantic salmon, more fecund and larger ones produce larger eggs (Pope *et al* 1961).

The scattergrams of fecundity (F) against body length (L), body weight including the gonad weight (W) and gonad weight (G) (figures 2a, b, c) indicate linear relationships between these variables. A linear relationship between L and F is known to exist in fishes which seldom grow to more than a few inches in length (Qasim and Qayyum 1963). Fecundity estimates are usually correlated with the weight of the fish since it might be supposed that weight is more closely connected with the "condition" of a fish than its length (Bagenal 1967). While a similar linear relationship between F and W has been shown in *Tandanus tandanus* (Davis 1977), *Labeo fimbriatus* (Bhatnagar 1972) and *Puntius sarana* (Sinha 1975), a nonlinear relationship has been indicated for the Atlantic salmon (Pope, Mills and Shearer 1961) and *Osteogeneiosus militaris* (Pantulu 1963). Yuen (1955) has reported that a curvilinear relationship exists between F and W in the big eye tuna. The linear relationship between the gonad weight (G) and the fecundity (F) in *Rasbora daniconius* indicates that the number of eggs in the ovaries increases in proportion to the gonad weight. A similar linear relationship between F and G has been also reported for *Labeo fimbriatus* (Bhatnagar 1972), *Polynemus paradiseus*

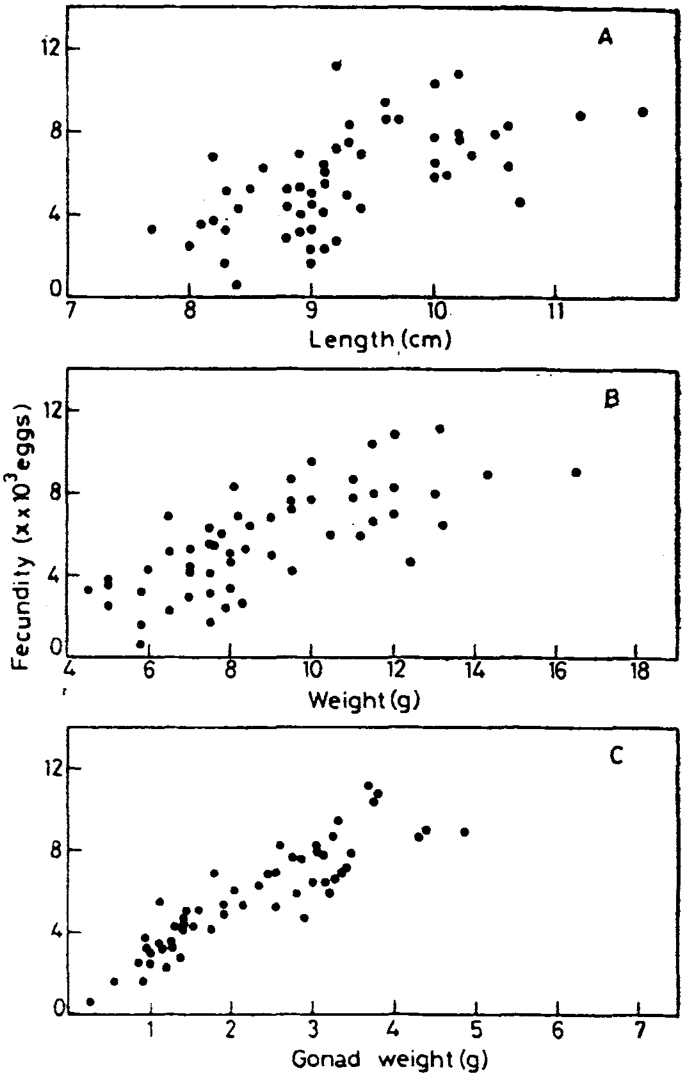

Figure 2. *Rasbora daniconius*: Scattergrams showing the relationships between fecundity and L, W and G.

(Gupta 1968), *Ophicephalus punctatus*, *Callichrous pabda* and *Mystus vittatus* (Qasim and Qayyum 1963).

Regression of F on L, W and G was evaluated following the standard methods detailed in Steel and Torrie (1960). Since the scattergrams of F against L, W and G (figures 2a, b, c) did not indicate a nonlinearity over the range of experimental values, a linear regression analysis was adopted. The regression coefficients given in table 1 indicate that the correlation between G and F is high as compared to the correlation either between W and F or between L and F. The regression of G on F remained approximately constant irrespective of the other concomitant

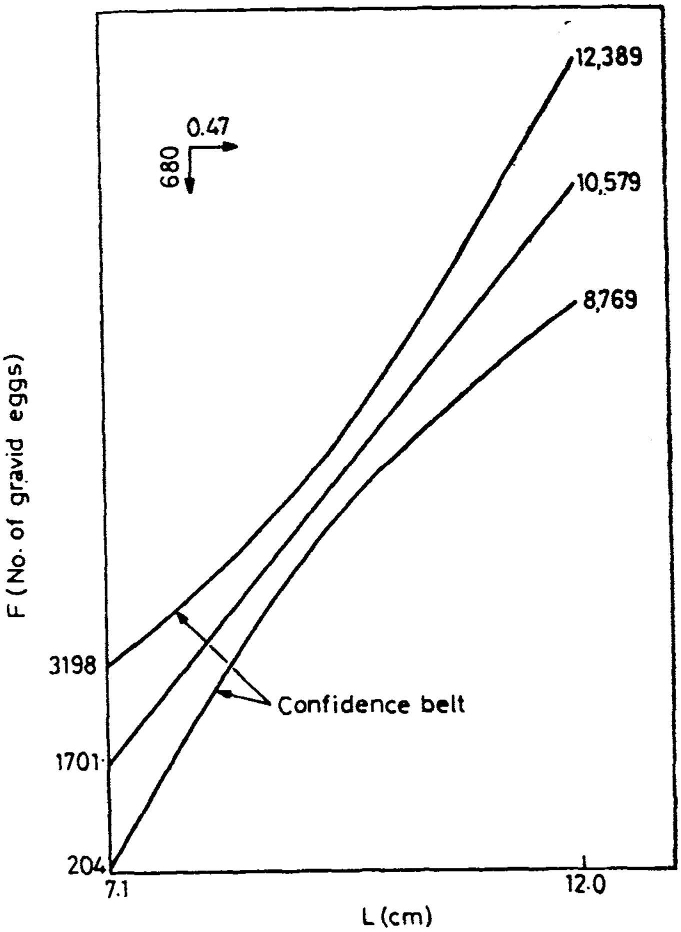

Figure 3. *Rasbora daniconius*: Regression estimation of F with respect to L. The regression line with 95% confidence belt is indicated.

variable(s) chosen. This indicates that for predictions of fecundity G is the most appropriate variable. The experimental determination of G is not only laborious but is also impracticable in field predictions of F, without sacrificing the fish (Bhatt, Dalal and Abidi 1977). However, for an accurate prediction of F, the effects of all the variables need to be considered. The [analysis carried out suggested the following approximations:

(i) The linearity between L and W implied the sufficiency of knowing either L or W.

(ii) From table 1 it is seen B_{FG}/L, B_{FG}/W, $B_{FG}/L, W$ are equal within 5% level. This suggests that the effect of G on F can be taken as a constant factor in the prediction of F.

These observations allow the possibility of determining F knowing L alone. In terms of L a general regression equation for F can be given as

$$F = \bar{f} + B'_{F \cdot L}(L - \bar{l}) \pm \epsilon,$$

where, $\bar{f}$ = average fecundity of the fish, and 'ϵ' is a correction factor which takes into account the dispersion in L about its mean value, and is given by $\epsilon = 2 \cdot 01 \times 1066 \cdot 6940\ [0 \cdot 0189 + (L - \bar{l})^2 \times 0 \cdot 0259]^{1/2}$ (figure 3).

The values of the various factors appearing in the regression equation can be obtained from table 1. The correction factor depends on the confidence belt chosen, the standard deviation and the sample size. The parameter $B'_{F \cdot L}$ is the modified regression coefficient of F on L, which incorporates into it the effects of not considering W and G as the other concomitant variables. The evaluation of $B'_{F \cdot L}$ was done using the Gauss–Doolittle matrix reduction technique on the F-correlation matrix (Steel and Torrie 1960). The evaluated $B'_{F \cdot L}$ value for this study was 1811·7343 (table 1).

From the above statistical analysis it is apparent that the best predictions of F in *Rasbora daniconius* is in relation to L. This method is offered as an investigative tool which may be tested further on other species.

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