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Fecundity of mahaseer *Tor putitora* (Ham.)

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Abstract. Fecundity of Kumaun high altitude mahaseer *Tor putitora* was studied by both gravimetric and volumetric count methods. The fecundity ranged from 7076 to 18525 in total length range from 33·90 to 51·70 cm. It was found that the fecundity has straight line relationships with total length, body weight, ovary length, ovary weight and ovary volume separately. These relationships are expressed by standard formulae separately for both gravimetric and volumetric counts of eggs. The number of eggs increased more with per centimeter of the total length than per gram body weight of the fish. The fecundity increased with higher year classes. It was also observed that the female fish mature after 3 years of age.

Keywords. Fecundity ; mahaseer ; *Tor putitora* ; high altitude ; Bhimtal.

1. Introduction

Fecundity of fish is an important aspect of fish biology and ecology due to its direct relation to fish production and fisheries. Studies on fecundity of high altitude lake Mahaseer, *Tor putitora* are still not available in literature; while Mahaseer of a few other regions were studied by Desai (1973) on *Tor tor* from Narbada; and Chaturvedi (1976) on *T. tor* of Udaipur lake. Bhatnagar (1964) studied only the spawning of *T. putitora* from Bhakhara reservoir by periodicity of ova diameter. However, detailed studies on the fecundity of *T. tor* and the spawning habits of *T. putitora* from high altitude lake Bhimtal were recently made by the present author (Pathani 1979).

Considerable studies on the fecundity of fish have been done in recent years in India and abroad (Das 1964, 1967; Mathur 1964; Swee and McCrimmon 1966; Jhingran 1968; Savant and Bal 1969; Sheri and Power 1969; Bhargava 1970; Lear 1970; Rao 1971; Jyoti and Malhotra 1972; Parmeswaran *et al* 1972; Varghese 1973, 1976; Stauffer 1976; Pathak and Jhingran 1977; Panek and Cofield 1978; Rao *et al* 1979).

2. Materials and methods

The fish were collected from high altitude lake, Bhimtal during spawning season (May to September) by gill netting and angling. Various body measurements of fish were recorded. The fecundity was recorded by gravimetric (F_{gr}) (round marks and continuous line) and volumetric (F_{vol}) (cross marks and dotted line) count methods. The smallest egg diameter 0·705 mm was considered to count. A large number of fish were examined for fecundity studied but only 32 of them were found suitable. Various relationships were obtained by the formula: $F = a + b \times$ body measurements (where F = fecundity, Tl = total length, Fw = fish weight, Ol = ovary length, Ow = ovary weight and Ov = ovary volume; r = correlation coefficient; and a and b constants, separately).

3. Observations

The total length of these fish ranged from 33·90 to 51·70 cm and the fecundity ranged from 7107 to 18486 by gravimetric count; and 7076 to 18525 by volumetric count methods.

3.1. *Ovary of the fish*

The ripe ovary occupied most of the body cavity, compressing the alimentary canal and causing poor feeding. Both the lobes of the mature ovary are generally equal in length and weight; but in a few specimens they were unequal in size and weight. Therefore, three samples from each lobe of the ovary were taken for the study to avoid counting errors. The mature ovary of *T. putitora* contains large yellowish light orange coloured eggs. These eggs were not spread uniformly, and could be divided into four categories according to their size which ranged from 0·705 to 2·866 mm in diameter.

3.2. *Body relationships with fecundity*

The following relationships of fecundity with body measurements were observed in the present investigations.

3.2a. *Between total length and fecundity* : The log of fecundity when plotted against the log of total length of the fish, indicated a straight line relationship between these two (figure 1). The following formulas were established for estimating fecundity.

$$F_{gr} = 257{\cdot}00 + 27{\cdot}48\ Tl, \text{ and } r = 0{\cdot}5847746.$$

$$F_{vol} = -902{\cdot}18 + 30{\cdot}41\ Tl, \text{ and } r = 0{\cdot}675102.$$

3.2b. *Between fish weight and fecundity* : The weight of *T. putitora* specimens studied ranged from 302·00 to 1280·00 g. The log of fecundity of fish was plotted against log of fish weight in a scattered diagram, and a linear relation-

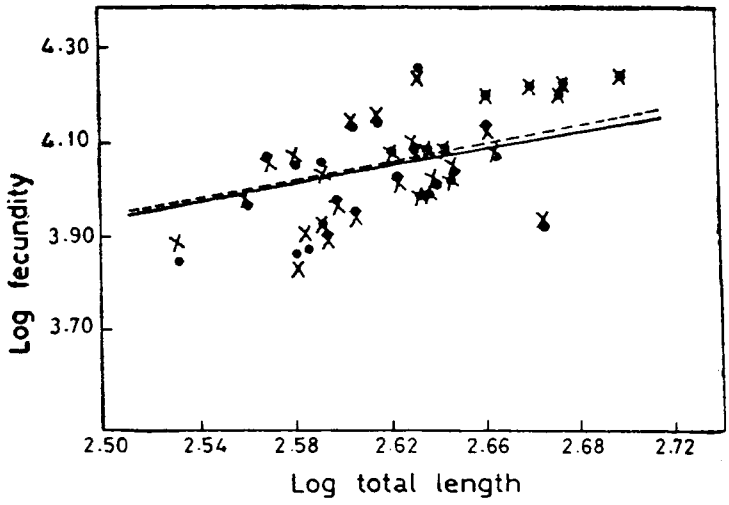

Figure 1. Relationship between fecundity and total length of *T. putitora*.

ship was established between the two variables (figure 2). The relationship according to standard formula was obtained as follows:

$$F_{gr} = 6110{\cdot}31 + 8{\cdot}005\ Fw, \text{ and } r = 0{\cdot}505916.$$

$$F_{vol} = 5284{\cdot}93 + 9{\cdot}27\ Fw, \text{ and } r = 0{\cdot}575864.$$

3.2c. *Between ovary length and fecundity* : The length of ovary ranged from 86 to 160 mm. The number of ova and the length of ovary are obviously related to each other. To study the relationship between fecundity and ovary length, the data on log values were plotted (figure 3), which indicated a linear relationship between these two variables and can be expressed as:

$$F_{gr} = -8762{\cdot}0 + 154{\cdot}86\ Ol, \text{ and } r = 0{\cdot}5847746.$$

$$F_{vol} = -9740{\cdot}0 + 162{\cdot}40\ Ol, \text{ and } r = 0{\cdot}675102.$$

3.2d. *Between ovary weight and fecundity* : The ovary weight ranged from 28 to 78 g. Fecundity by both gravimetric and volumetric count methods is presented in figure 4. This shows a straight line relationship between these two variables which can be expressed as

$$F_{gr} = 6106{\cdot}01 + 111{\cdot}69\ Ow, \text{ and } r = 0{\cdot}5493979.$$

$$F_{vol} = 4645{\cdot}10 + 141{\cdot}32\ Ov, \text{ and } r = 0{\cdot}7405168.$$

3.2e. *Between ovary volume and fecundity* : The volume of ovary ranged from 28 to 78 ml. By gravimetric and volumetric counts methods also a straight lin relationship was obtained between ovary volume and the fecundity (figure 5).

$$F_{gr} = 5182{\cdot}22 + 123{\cdot}32\ Ov, \text{ and } r = 0{\cdot}6215328.$$

$$F_{vol} = 4645{\cdot}10 + 141{\cdot}32\ Ov, \text{ and } r = 0{\cdot}7405168.$$

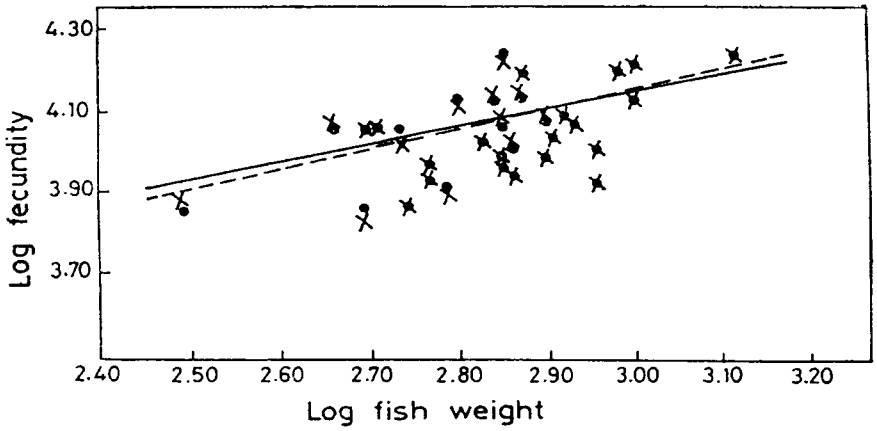

Figure 2. Relationship between fecundity and fish weight of *T. putitora*.

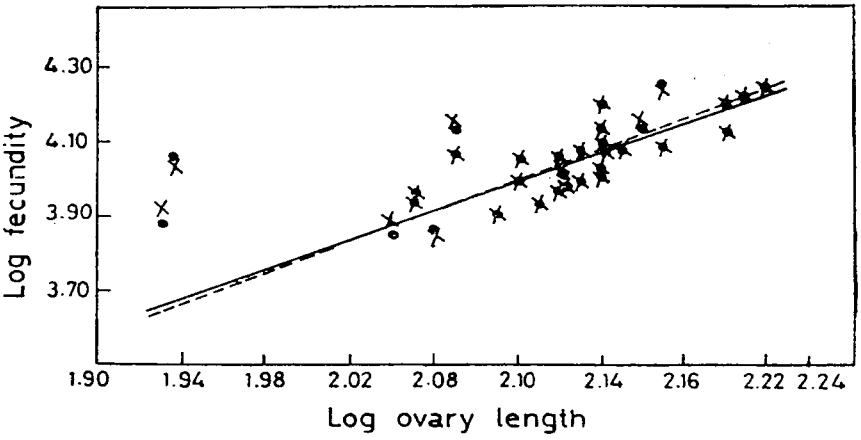

Figure 3. Relationship between fecundity and ovary length of *T. putitora*.

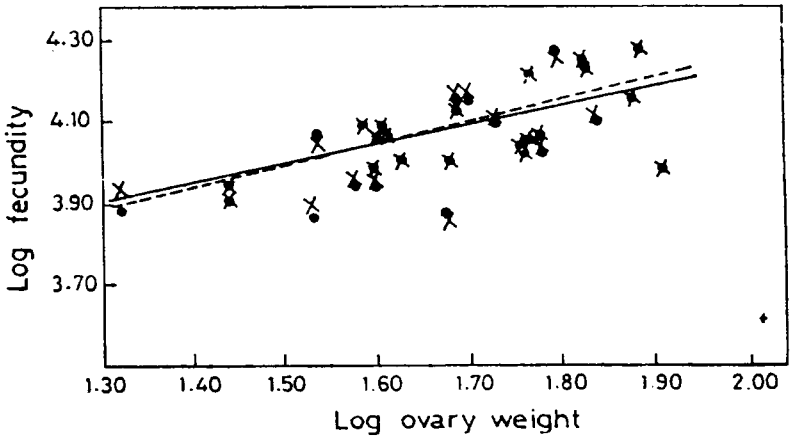

Figure 4. Relationship between fecundity and ovary weight of *T. putitora*.

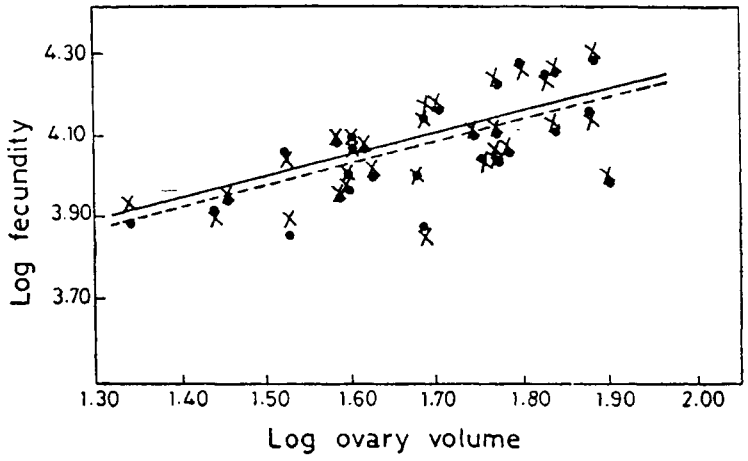

Figure 5. Relationship between fecundity and ovary volume of *T. putitora.*

3.3. *Age and fecundity*

There is always a correlation between age and fecundity in fish. It has also been found that the number of ova increases with age of mahaseer. Only three year classes, viz. 3 (7076–11823), 4 (9080–14632) and 5 (10019–18528) were studied and no fish was matured or gravid before three years of age. The present study also shows fluctuations in the fecundity in the same year classes.

4. Discussion

Thomas (1893) reported that loose eggs in the mature ovary of mahaseer indicate the ripeness of the ovary. In the present studies, the ovary of mature fish contained large yellowish light orange coloured eggs in *T. putitora.* Contrary to the observation of Thomas (*op. cit.*), the ripe eggs do not lie loose in the ovary until they approach the oviduct. Four groups of eggs of different sizes (0·705–2·866 mm diameter) and colours (cream opaque to yellowish light orange) are present interspersed in the ripe ovary of the fish which persist throughout the breeding season (May to September, Pathani 1979). Bhatnagar (1964) recorded batches of different sized eggs in the ovary of *T. putitora* collected from Bhakhara reservoir. Rai (1967) reported different sized and coloured eggs in mature *T. tor.* The colour of eggs in many fishes was also recorded by Das (1964) and Qayyum and Qasim (1964). The unequal lobes of ovary were also described by Desai (1973) in *T. tor* of Narbada. In *T. putitora* the fecundity was calculated by both gravimetric and volumetric count methods which showed slight variations. But the results from volumetric method for counting the eggs were more consistent than the gravimetric count method as reported by Pathani (1979) and Burrows (1951).

In the present study five linear relationships of fecundity with body measurements were recorded and similar relationships of fecundity with various body

measurements were also studied by others (Swarup 1962; Jhingran 1968; Savant and Bal 1969; Lear 1970; Varghese 1973, 1976; Rao *et al* 1979). It was observed that the fecundity increased with higher year classes with slight variations in the same year classes of mahaseer (Rao 1974; Jyoti and Malhotra 1972; Sheri and Power 1969; Swee and McCrimmon 1966 in other fishes). Lehman (1953) showed that there is direct proportion increase in fecundity with size, weight and age in an American shad. Thus, the present findings agree with those of earlier workers.

Kesteven (1942) and Desai (1973) reported straight line relationships of fecundity with fish length, fish weight and ovary weight separately having scattered diagrams. David (1963) showed an emperical formula between log fecundity and log ovary weight in *Mystus gulio* as in the present study. But Simpson (1951) reported that the fecundity in Plaice is related to the cube of fish length. A curvilinear relationship between fecundity and body measurements with significant low values of *r* in *Cyprinus carpio* was established by Parmeswaran *et al* (1972) and also by Hodder (1963) in Grand haddock. Low values of coefficient of condition (*r*) are not uncommon. Rounsefell (1957) reported these values of 0·57 and 0·56 in length-fecundity and weight-fecundity regression, respectively in sockeye slamon. Islam and Talbot (1968) also reported low *r* values in length-fecundity (0·499) and weight-fecundity (0·580) in hilsa of Indus river. Pathak and Jhingran (1977) also reported a straight line relationship between fecundity and total length and also between fecundity and fish weight in *Labeo calbasu* ; Panek and Coefield (1978) stated that the log of fecundity with length and weight, respectively in *Lepomis* sp. is also a straight line relationship, similar to the present study. In the present study, it was found that the eggs per centimeter total length of fish are higher (average 278·01 eggs/cm) than eggs per g fish weight (average 18·90 eggs/g) as also in *Barilius bendelisis* reported by Bisht and Upadhyay (1979).

It was also observed that *T. putitora* (female) of Kumaun lake Bhimtal matures only after three years or more of age (determined by scales, operculum, vertebrae and otoliths in a separate contribution); and these ripe fish only were investigated for the fecundity studies. No gravid female fish of two years old was found mature in the lake. However, Parmeswaran *et al* (1972) found that *Cyprinus carpio* matures only after six to eight months in plain waters of India; and Khan and Jhingran (1975) also described gravid *Labeo rohita* only after two years of age in plains waters. It is presumed that the environmental factors (temperature and food etc.) will be responsible for late maturity and low fecundity of fish in the lake as also reported by Pathani and Das (1978) in Kumaun fishes and Nikolsky (1963) in Russian fishes. It may, therefore, be concluded that *T. putitora* of high altitude Kumaun lakes matures late due to low temperature and low food, facts not recorded for the fish in any other waters of India.

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