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Fecundity of Two herring fishes in the Thanlwin River Mouth Waters

Khaing Myat Myat Htwe

Abstract

Two herring fishes (*Tenualosa ilisha* and *Tenualosa. toli*) were collected from the two study areas: Kyaikkhami (for both species) and Kyauktan Village in Mawlamyine (for only *T. ilisha*). Their systematic position, distinct morphological characters, FAO names, local name, meristic counts, were presented. Fecundity for both species were also recorded in the study. Fecundity per ovarian weight obtained from *T. ilisha* (river stock) were ranging from 2,247 to 19, 270 ova and *T. toli* (marine stock) were ranging from 1930 to 5, 660 ova per ovarian weight. In *T. ilisha* and *T: toli*, the relationships between fecundity and different variables (body length, body weight, ovarian length, ovarian weight and ovarian volume) showed positive correlation. In this finding *T. toli* was more dominant species than *T. ilisha* in study area.

Key words: Morphology, fecundity, *T. ilisha, T. toli,* relationships.

Introduction

In the fishery sectors in Mon State, the herring fisheries sector contributes the highest production. These species have a great commercial value and received special attention to scientists all over the world on various aspects such as their biology and abundance. The herring fishes belong to the family Clupeidae. This family includes around 200 species. They are characterized by a small head and a bright silvery, sleek body. They are widely found in coastal shallow waters and swim in groups, which are referred as schooling, and are anadromous species. Generally, they move in groups in the same direction to the shore, to spawn and then disperse after spawning. Herring fishes are also known as forage fish, as they are near the base of food chain and serve as the foods for the predators. Herring fishes thrive on minute organisms like planktons, crustaceans and fish larvae. Phytoplanktons are the main source of food for the young ones, while the adults feed on both phytoplanktons, and zooplanktons like copepods and other small crustaceans, and fish larvae. Herring fishes are commonly known as plankton-filtered feeders (Internet sources).

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Day (1878), Whitehead (1985) and Munroe (1999) stated that these two species were migratory and anadromous species. *T. ilisha* was considered as an anadromous fish and its feeding ground was in the sea and spawning grounds along considerable stretch of the lower or middle reaches of the river (Kalayar Win Maung, 2007). Dutt (1966) stated that T. *toli* inhabits fast flowing, turbid estuaries and adjacent coastal waters and schooling in coastal water, euryhaline and perhaps anadromous, and migrating up stream to breed (as cited in Kalayar Win Maung 2007). But, Blaber *et al.* (2001) stated that spawning of it takes places in the middle reaches of estuaries. During the study period, *T. toli* was not recroded from the river by field observation and this was confirmed by the informations from local fishermen who stated that this species was never caught from the Thanlwin River. Kalayar Win Maung (2007) reported that *T. toli* was not recorded in the river. Therefore, the present study agreed with the statement of Blaber *et al.* (2004) and Kalayar Win Maung (2007).

T. ilisha (hilsa shad) is locally known as, "Nga Tha Lauk" in Myanmar. Blaber *et al.* (2001) and Kalayar Win Maung (2007) stated that *T. ilisha* is the most widespread species found from north Sumatra in the east to Kuwait in the west and forms the basis of important fisheries in Bangladesh, India, Myanmar, Pakistan and Kuwait. *T.toli* is also known as, "Nga Tha Lauk Yauk Pha" in Myanmar and recorded to occur in the estuaries and adjacent coastal areas of India to Java and to the South China Sea. This species distributes along the coastal waters of countries in the Bay of Bengal Large Marine Ecosystem (BOBLME) region such as India, Sri Lanka, Bangladesh, Myanmar, Malaysia, Thailand and Indonesia except for Maldives (Preston, 2004). It is also present in Cambodian Mekong near the Vietnam border (Dutt, 1966).

The two species differ from each other in morphological characters. They have immense economical and commercial importance for humans. Native people favour these fishes for the taste and delicacy. In India, the hilsa/India shad (*Tenualosa ilisha*) has been announced as the State Fish by the Government of West Bengal (Saw Aung Ye Htut Lwin *et al.,* 2010). In Myanmar, these two species are recorded in the list of Myanmar top ten commercial fishes as well as top 5 exportable species (Sann Aung, 2003). Therefore, fishing pressure has increased and the decline of their stocks has been noted.

The knowledge of fecundity and spawning season of fish helps to manage and maintain such fishery and they can be used for planning fishing tactics (El–Ganaing, 1992; Osman *et al.*, 2011). Besides, fecundity is an important biological characteristic which is used, in conjunction with information on egg and larvae abundance and age structure, to estimate the biomass and spawning potential of fish populations and to predict changes in population size under varying age specific mortality regime. Moreover, fecundity estimates have also been used, along with other biological characters, as indicators of stock differentiation (Kelly *et al.*, 1985). The present study was a part of a detailed investigation on the morphology, systematic position and fecundity estimation of herring fishes in the Thalwin River Mouth Waters.

Materials and Methods

Study areas and study periods

Fish depots in Kyaikkhami (Lat.16° 03′N , Long. 97° 33′ E) and Kyauktan Village in Mawlamyine (Lat. 16° 26′N, Long. 97° 37′ E), were selected for sample collecting (Fig. 1). Sample fishes were mainly collected during their respective breeding times (October-November for *T. ilisha* and July-August and November-December for *T. toli*).

Identification and classification

Day (1878), Munro (1955), F.A.O species identification sheets (1974), Jayaran (1981), Whitehead (1985), Talwar and Jhingran (1991), De Bruin *et al.* (1995), Munroe (1999), were used for identification and classification of the species.

Estimation of fecundity

In fecundity estimation, *T. ilisha* collected from Kyauktan Village as a river stock and only *T. toli* from Kyaikkhami as a marine stock, were used. For fecundity determination, a total of 10-12 ovigerous females ranging from 28 – 50 cm Total Length (TL) in size and 185.0-1387.8g in weight of both species were examined to determine the fecundity of each species. The ovaries were weighed into gram after removing the excess tissues and measured the total ovarian volume (milliliter) and ovarian length (centimetre). As the ova of different diameters were distributed throughout the ovaries, approximately 10 gm of ova from each region (interior, middle and posterior) of the ovaries were taken out and preserved in 4% formaldehyde solution for a period of not more than a week to count the numbers of egg later.

And then, one gram of ovary was taken out from each of preserved portion of ovaries after removing excess moisture by using blotting paper. The ova were visible to the naked eye and counted from each pieces of the ovary. The fecundity per ovarian weight was estimated by using the following formula as proposed by Somvanshi (1985):

$$F = W\,(Na + Nm + Np) / (Wa + Wm + Wp)$$

where, W = the weight of the ovaries of the fish.

Wa, Wm, Wp = the respective weight of each piece of ovaries

Na + Nm + Np = the respective number of ova from each piece of ovaries

The fecundity (F) was estimated in relation to the total body length (L) in cm, fish weight (W) in grams, ovarian (gonad) length (GL) in cm, ovarian weight (GW) in grams and ovarian volume (GV) in ml.

The relationships between fecundity and different variables were expressed as power curve in the form of $F=aL^b$.

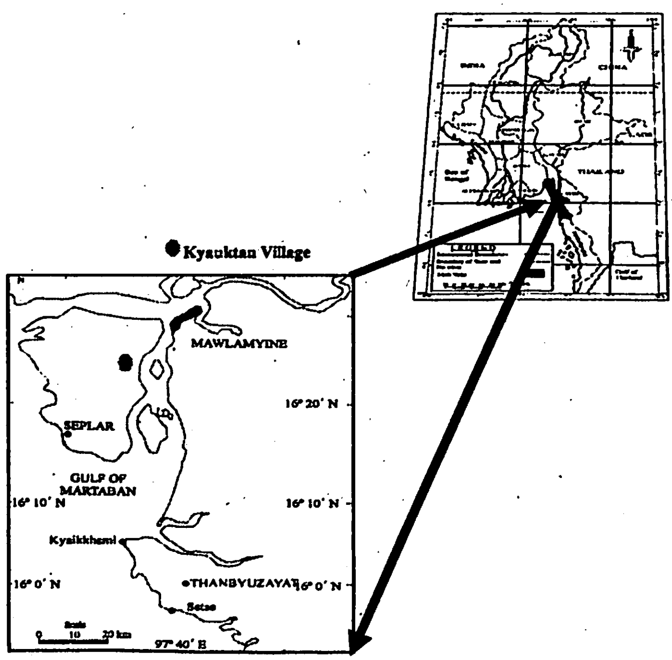
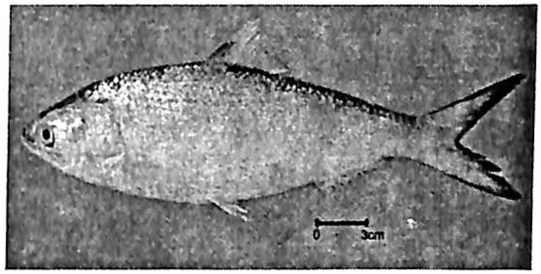


Fig. I. Map showing the study areas

Results

Systematic position



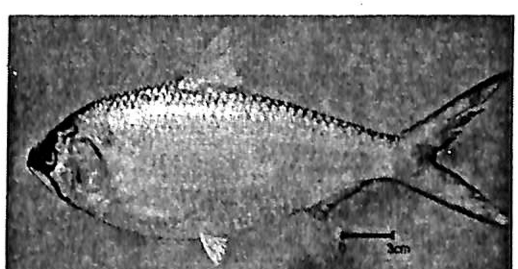
Kingdom	Animalia
Phylum	Chordata
Class	Actinopterygii
Order	Clupeiformes
Family	Clupeidae
Subfamily	Alosinae
Genus	*Tenualosa*
Species	*ilisha*

Tenualosa ilisha **(Hamilton-Buchanan, 1822)**

FAO name	: Hilsa shad.
Local name	: Nga-Tha-Lauk.
Meristic counts	: D. 18-20; P.14; V.7; A. 18-21; C. 24-28; B.6.
Size	: Maximum to 60 cm, common to 30-45 cm.

Distinctive characters : Brilliant silvery, dark bluewish green on dorsal; a series of small spots along flanks in immature but present or absent spots in the adults; abdomen keel and serrated, with 18 pre-ventral scutes and 14 post ventral scutes. Head is nearly equal in length of the tail; Mouth is terminal, no teeth on both jaws; a distinct median notch present in the upper jaw. Eyes are large, with yellowish iris. Lateral line absent.

Systematic position



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Order	Clupeiformes
Family	Clupeidae
Subfamily	Alosinae
Genus	*Tenualosa*
Species	*toli*

Tenualosa toli **(Valenciennes, 1847)**

FAO name : Toli shad.

Local name : Nga-Tha-Lauk-Yaukpha.

Meristic counts : D. 17; P.13-14; V.7-8; A. 19-20; C. 24-26; B.6.

Size : Maximum to 60 cm, common to 25-40 cm.

Distinctive characters : Silvery in colour; a diffuse dark spot present on shoulder; abdomen keel and serrated, with 17 pre-ventral scutes and 13 post-ventral scutes. Head is shorter than the tail; Mouth is terminal, with no teeth on both jaws; a distinct notch present at the centre of the upper jaw. Eyes are large and with reddish iris. Lateral line absent.

Fecundity of two herring fishes

Number of eggs per ovarian weight and total number of eggs related to respective total body length, body weight, ovarian length, ovarian weight and ovarian volume of *T. ilisha* and *T. toli* were represented in Table 1 and Table 2 respectively.

Table 1. Total body length, body weight, ovarian length, ovarian weight, ovarian volume and number of eggs per ovarian weight and total number of eggs of *T. ilisha.*

Sr. No.	Total body length (cm)	Total body weight (g)	Ovarian length (cm)	Ovarian weight (g)	Ovarian volume (ml)	No. of eggs per ovarian weight	Total number of eggs
1	30.0	285.5	11.0	30.0	35.0	7,732.1	231,964.2
2	30.0	395.0	12.0	35.0	40.0	6,810.0	238,350.0
3	31.0	340.0	12.0	58.0	50.0	6,350.0	368,300.0
4	32.5	370.0	11.0	37.0	32.5	19,270.0	712,990.0
5	33.4	350.5	11.5	41.0	60.0	5,318.3	218,051.5
6	37.2	620.0	14.0	100.0	90.0	4,897.0	489,700.0
7	38.5	445.5	14.0	52.5	55.0	2,246.7	117,950.2
8	38.5	650.0	15.0	60.0	60.5	10,815.0	648,900.0
9	41.5	680.0	16.0	110.0	150.0	5,281.7	580,983.7
10	41.5	685.5	16.0	110.0	150.0	5,275.0	580,250.0
11	44.0	1200.0	16.5	150.0	160.0	3,110.0	466,500.0
12	44.0	1306.1	17.5	160.0	165.0	3,959.4	633,499.2

Table 2. Total body length, body weight, ovarian length, ovarian weight, ovarian volume and number of eggs per ovarian weight and total number of eggs of *T. toli.*

Sr. No.	Total body length (cm)	Total body weight (g)	Ovarian length (cm)	Ovarian weight (g)	Ovarian volume (ml)	No. of eggs per ovarian weight	Total number of eggs
1	28.0	185.0	11.5	35.5	31.5	5,425.0	192,587.5
2	30.0	285.0	12.0	35.0	40.0	5,225.0	182,875.0
3	41.0	600.0	16.0	90.0	85.0	2,119.3	190,737.0
4	43.0	790.0	16.2	73.0	68.0	4,663.3	340,420.9
5	43.7	730.0	17.5	120.0	115.0	1,930.0	231,600.0
6	45.5	920.0	17.0	110.0	105.0	2,588.0	284,680.0
7	45.9	1142.9	17.5	130.6	115.0	3,580.0	467,548.0
8	45.5	1140.5	17.0	129.5	110.0	3,210.0	415,695.0
9	48.0	1145.5	17.8	135.0	120.0	5,610.0	757,350.0
10	48.5	1387.8	18.0	204.1	125.0	5,660.0	1,155,206.0

Relationship between fecundity and different variables of *T. ilisha*

Fecundity and fish length

The relationship between fecundity and fish length showed the equation as $F = 1066.6L^{1.6397}$, with the correlation coefficient $r = 0.42$. The number of ova increased at a rate of 1.6397 times to the length of fish (Fig. 2-A).

Fecundity and fish weight

Fecundity had been shown a better correlation with fish weight than fish length. The number of ova increased at a rate of 0.6185 times to the fish weight, with correlation coefficient $r = 0.54$. The relation was observed as $F = 7901.6W^{0.6185}$ (Fig. 2-B).

Fecundity and gonad length (ovarian length)

The relationship between fecundity and gonad length had shown the equation as $F = 8610.9GL^{1.4555}$. This equation revealed that the better correlation between fecundity and gonad length than fish length. The number of ova increased at the rate of 1.4555 times to the gonad length, with correlation coefficient $r = 0.43$ (Fig. 2-C).

Fecundity and gonad weight (ovarian weight)

The fecundity and gonad weight relationship could be represented as $F = 44636GW^{0.5143}$. According to the equation, the number of ova increased at a rate of 0.5143 times to the gonad weight and noted a better correlation, with a correlation coefficient r = 0.53 (Fig. 2-D). The number of ova produced were closely related to the weight of gonad.

Fecundity and gonad volume (ovarian volume)

The relationship between fecundity and gonad volume could be expressed as $F = 66950GV^{0.4094}$ and the number of ova increased at a rate of 0.4094 times to the gonad volume, with a correlation coefficient r = 0.45. (Fig. 2-E).

Relationship between fecundity and different variables of *T.toli* Fecundity and fish length

Fecundity data was analysed in relation to fish length was presented in (Fig. 3-A). This relationship could be expressed as $F= 82.509L^{2.2434}$. The equation revealed that the correlation was good, with correlation coefficient r = 0.69. It might be said that the egg production was closely correlated with the fish length.

Fecundity and fish weight

Fecundity and fish weight relationship, presented in (Fig. 3-B), showed the equation as $F= 2923.9W^{0.727}$. According to this equation, it was a better correlation, with a correlation coefficient r = 0.77.

Fecundity and gonad length (ovarian length)

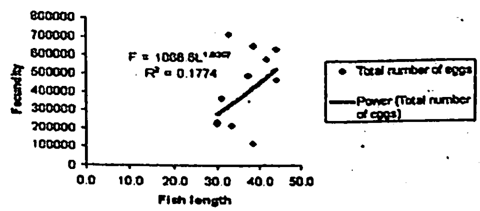
Fecundity and gonad length relationship could be expressed in equation as, $F = 375.55GL^{2.4706}$. This equation indicated that there was a good correlation between the two variables, with correlation coefficient r= 0.65 (Fig. 3-C).

Fecundity and gonad weight (ovarian weight)

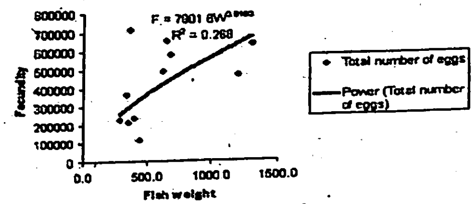
This relationship was observed as a good correlation and could be expressed as the equation, $F = 8367.2GW^{0.8214}$, with a correlation coefficient r = 0.76 (Fig. 3-D).

Fecundity and gonad volume (ovarian volume)

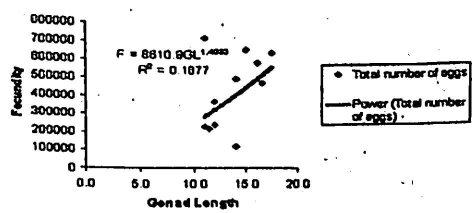
Fig. 3-E showed the relationship between fecundity and gonad volume. This relationship could be expressed in the form of an equation, $F = 9135GV^{0.8221}$. It might be concluded that there was a good correlation between two variables, with correlation coefficient $r = 0.65$.



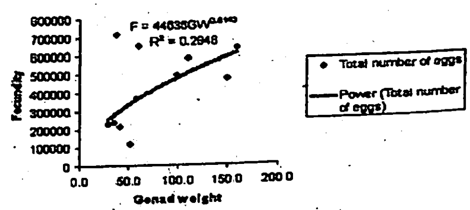
A. Fecundity-Fish length



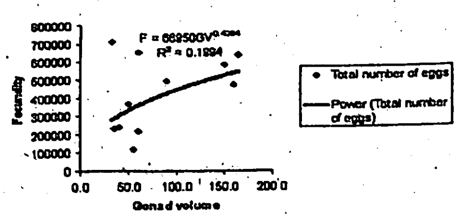
B. Fecundity-Fish weight



C. Fecundity-Gonad length

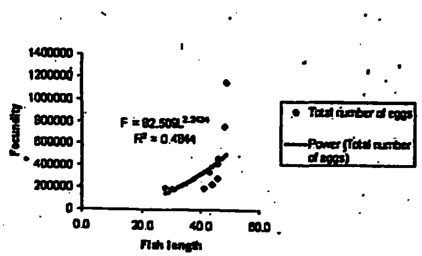


D. Fecundity-Gonad weight

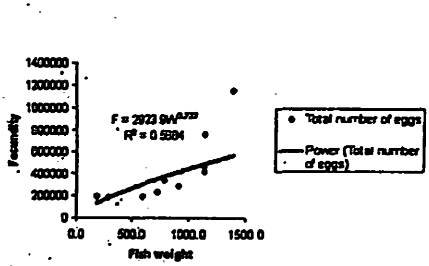


E. Fecundity-Gonad volume

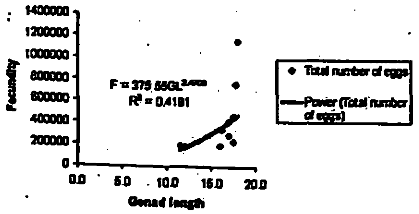
Fig. 2. Relationships between fecundity and different variables of *T. ilisha*.



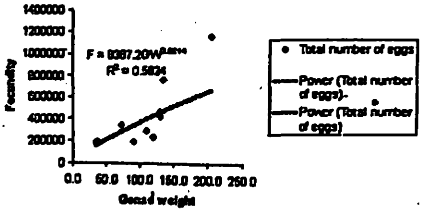
A. Fecundity-Fish length



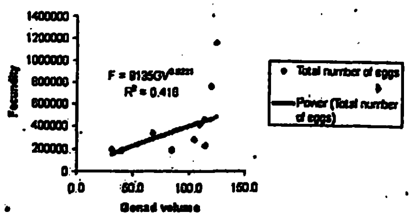
B. Fecundity-Fish weight



C. Fecundity-Gonad length



D. Fecundity-Gonad weight



E. Fecundity-Gonad volume

Fig. 3. Relationships between Fecundity and different variables of *T.toli.*

Discussion

In Myanmar coastal waters, generally, the two species of herring fishes (*Tenualosa ilisha* and *T. toli*) are found to be dominant (Hla Win *et al.*, 2008). Between these two species *T. toli* was not recorded from the river during the study period and it may be strictly marine form. Only one species, *T. ilisha* was found to occur along the river as it is known to be a migratory species.

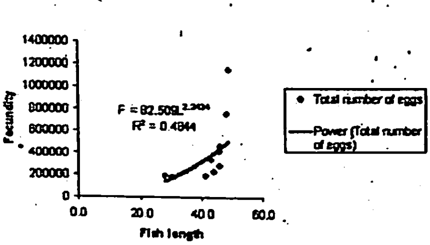
In fecundity estimation, mature female of *T. ilisha* from river stock and that of *T. toli* from marine stock, total length ranging from 28 cm to 50 cm for both species were examined. It was showed that the fecundity for *T. ilisha* varied for 117, 950 to 712, 990 in absolute number of eggs and 2, 247 to 19, 270 per ovarian weight. According to Hassan (1953), De (1980) reported that the fecundity of *T. ilisha* varied from 828 to 7, 888 per gram of ovary weight of the fish. The previous estimations of the fecundity were: from 250, 000 to 1, 600, 000; from 289, 000 to 1, 168, 622; from 400, 000 to 1, 200, 000, and from 316, 316 to 1,840, 179 per female. Panhwar (2010) reported that the fecundity in *T. ilisha* was 87, 267 to 614, 482 in the female ranging from 210 to 350 mm in total length. Qureshi (1968 a) stated that the fecundity of *T. ilisha* from the river Indus was reported to vary between 80, 000 and 2, 000, 000 eggs but the size range was not mentioned. Qureshi (1968 b) also stated that the number of ova varied from 85,000 to 2, 000, 000 while the length of these fishes ranged from 17.5 to 48.3 cm TL. In the present study, fecundity of *T. toli* varied from 182875 to 1, 155, 206 in total absolute number of eggs and 1930 to 5, 660 per ovarian weight.

In general, fecundity increased as body weight/length increased. Or it might be due to natural phenomenon that the ova (eggs) tend to gradually decrease in number as time goes by (Table. 3). The older the ova (eggs) the smaller the number (Phenomenon of natural selection).

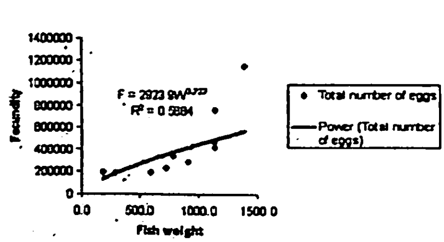
Table. 3. Average body length, body weight, ovarian length, ovarian weight, ovarian volume and number of eggs per ovary weight of *T. ilisha* and *T. toli* (Mean ± SD) during breeding season.

Species	Body length (cm)	Body weight (g)	Ovarian length (cm)	Ovarian weight (g)	Ovarian volume (ml)	no. of egg/ovarian weight	no. of fish examined
T. ilisha	36.84 ± 5.31	610.68 ± 333.22	13.88 ± 2.33	78.63 ± 45.74	87.33 ± 53.14	6755.43 ± 4528.04	12
T. toli	41.91 ± 7.17	832.67 ± 393.08	16.05 ± 2.36	106.27 ± 50.76	91.45 ± 34.01	4001.06 ± 1488.29	10

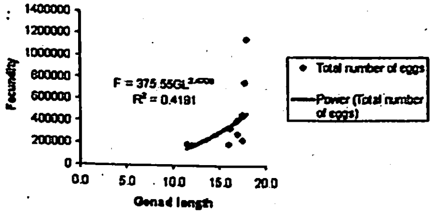
Within a given species, fecundity may vary as a result of different adaptations to environmental habits. Even within a stock, fecundity is known to vary annually, and can undergo long-term changes (Horwood *et al.*, 1986; Rijnsdorp, 1991; Kjesbu *et al.*, 1998; Mura *et al.*, 2003) and has been shown to be proportional to fish size and condition. Changes in environmental factors such as temperature, may affect condition by influencing fish behavirour and metabolism, as well as food availability (Mura *et al.*, 2003). Generally, larger fish produce more eggs, both in absolute and in relative terms to body mass.



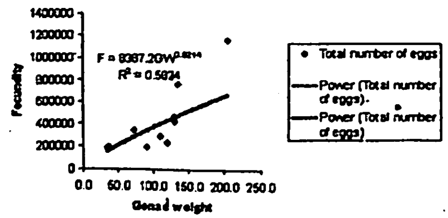
A. Fecundity-Fish length



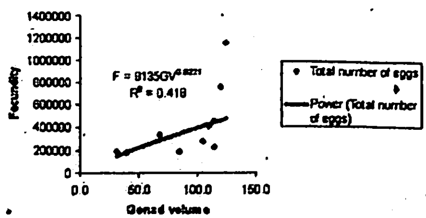
B. Fecundity-Fish weight



C. Fecundity-Gonad length



D. Fecundity-Gonad weight



E. Fecundity-Gonad volume

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Species	Body length (cm)	Body weight (g)	Ovarian length (cm)	Ovarian weight (g)	Ovarian volume (ml)	no. of egg/ovarian weight	no. of fish examined
T. ilisha	36.84 ± 5.31	610.68 ± 333.22	13.88 ± 2.33	78.63 ± 45.74	87.33 ± 53.14	6755.43 ± 4528.04	12
T. toli	41.91 ± 7.17	832.67 ± 393.08	16.05 ± 2.36	106.27 ± 50.76	91.45 ± 34.01	4001.06 ± 1488.29	10

Within a given species, fecundity may vary as a result of different adaptations to environmental habits. Even within a stock, fecundity is known to vary annually, and can undergo long-term changes (Horwood *et al.*, 1986; Rijnsdorp, 1991; Kjesbu *et al.*, 1998; Mura *et al.*, 2003) and has been shown to be proportional to fish size and condition. Changes in environmental factors such as temperature, may affect condition by influencing fish behavirour and metabolism, as well as food availability (Mura *et al.*, 2003). Generally, larger fish produce more eggs, both in absolute and in relative terms to body mass.

Fish size and condition are key parameters to properly assess fecundity at the population level (Mura *et al.*, 2003).

In the relationships between fecundity and different variables, the result showed that there were positive correlations in all variables. According to their correlations in *T. ilisha* (r = 0.42, r = 0.54, r = 0.43, r = 0.53, r = 0.45) and *T. toli* (r = 0.69, r = 0.77, r = 0.65, r = 0.76, r = 0.65), it may be said that *T. toli* is a better species than *T. ilisha*. Therefore, the present findings recommended that *T. toli* was a dominant species than in *T. ilisha* in study area.

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