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Reproductive Aspects of *Puntius ticto* from Dafri Lake, Badin, Sindh, Southern Pakistan

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Abstract

Reproductive aspects of *Puntius ticto* were studied from Dafri Lake, District Badin.. The Sampling was carried out from February 2015 to November 2015 and fresh fish specimens were brought to the Fisheries Science Laboratory, Department of Fresh Water Biology and Fisheries, in Ice Box for further analysis. Each fish was measured for total length (cm) and total weight (g) separately for male and female. The fish were dissected and their gonads were removed and weighed, the same were used for fecundity analysis. Fecundity was estimated by gravimetric method. Gonado-Somatic Index (GSI) was analyzed with the formula GSI= (GW × 100)/BW. Egg size was measured under binocular microscope. In total 256 specimens (combined sex) were analyzed for the study, there were 105 male and 151 female individuals, making a female and male percentage 58.98 % and 41.015 %, respectively. The total length and weight of male *P. ticto* ranged between 4.0 -9.4 cm and 3.8-12.3 g, respectively, whereas the length and weight of female *P. ticto* ranged between 5.4-10.2 cm and 5.2-15.2 g, respectively. Female analyzed during study were larger than male. Maximum values of Gonado-Somatic Index were observed in August (6.32) followed by a decline then after, indicating a single spawning season. Fecundity of *P. ticto* ranged between 433.5-2625.5, with average values of 1363.7±614.99. Correlation between fecundity and body parameters (Total length, Total weight and Gonadal weight) extracted higher R^2 values with total weight of fish. Information on reproductive biology of *P. ticto* will be helpful for developing and application of breeding and conservation strategies of this species.

Keywords: *Puntius ticto*, Reproduction, Fecundity, Sexual dimorphism

Introduction

Species in genus *Puntius* are also referred as small indigenous species (SIS), which were abundantly available in all kind of freshwater bodies including rivers, streams, ponds and floodplains in South Asia (Mahanty *et al.*, 2014). Small fishes play vital role in aquatic food chain as well as food for human being due to rich micronutrients and protein contents (Mahanty *et al.* 2014). *Puntius* species play important role in freshwater ecosystem being the food of carnivorous and piscivorous fishes (Soomro *et al.* 2012).*Puntius ticto* (Hamilton 1822) is freshwater to brackish water subtropical fish species in Order Cyprini formes and Family Cyprinidae (Hossain *et al.* 2012). *P. ticto* is commonly known as "ticto-barb" or "two-spot" and fire-fin barb, while locally known as Popri. This species is also popular as aquarium fish (Froese & Pauly 2011; Hossain *et al.*, 2012). In recent years sharp decline in the populations of fishes in genus *Puntius* is

observed by fisheries biologist and fishermen in different water bodies of Sindh (personal observation). Studies on life history traits and population dynamics play vital role in the aquaculture, management and conservation of fish species (Hossain *et al.* 2008; Siddik *et al.* 2013).

The knowledge about reproductive biology of fish gives important information to be used in the policy for the capture fisheries and also culture of the species therefore, this information is significantly important in fisheries science (Dinh *et al.,* 2021; Fontoura *et al.,* 2009; Teichert *et al.,* 2014).

Reproductive season of the species can vary from one habitat to another and from one geographical region to another aimed to difference in temperature, photoperiod and hydrological conditions. Endocrine hormones which are stimulated by environmental conditions such as photoperiod and temperature control and sustain the reproductive cycle of fish (Bhattacharya, 1992). Gondadosomatic Index is the standard tool for estimating the reproductive season of a fish used by many researchers (Soomro *et al.,* 2012; Soomro *et al.,* 2015; Solomon *et al.,* 2018).

Fecundity is the most important biological aspect that helps to understand production capacity of species required for fisheries management, production and aquaculture (Doha and Hye, 1970). The number of egg in ripen ovary of fish during the spawning season is called the fecundity ((Nikolsky, 1963; Hossain, 2012). Fecundity can help to understand the disparity between different populations.

Current study aims to clear the sexual dimorphism, reproductive season and reproductive potential (fecundity) of *P. ticto.* The information of present study will be useful for the conservation of the declining species.

Materials and Methods

The fish sampling at Dafri lake was carried out from February to November 2015 by overnight fixation of gill net (mesh size 1.0 inch) with floats and sinkers. All the samples of *Puntius ticto* were sorted out and shifted to ice box for the transportation to the laboratory of Fisheries Science at Department of Fresh Water Biology and Fisheries, University of Sindh at the earliest to avoid any deterioration of the specimen. Samples were examined for sexual dimorphism, total length (cm) total weight (g), Gonadal weight, egg size and fecundity.

The fish specimens and gonads were weighed by digital balance model SF-400 nearest to 0.1g. The data for all individual specimens were recorded separately.

To enumerate the reproductive season of fish monthly Gonado-Somatic Index (GSI) was calculated. GSI is considered as best calculation to estimate monthly change in the reproductive activities of fish. Gonado-Somatic Index was measured by following formula,

GSI = average gonadal weight ×100/average body weight

Fecundity was calculated by gravimetric method. Ovary was weighed and three sub samples, each from anterior, middle and posterior portion of ovary were taken and weighed separately. The number of each portion was counted separately under binocular microscope (Nikon ECLIPSE E200). Average of all sections in single ovary were calculated, the calculated values were applied to following formula.

$F=GW\times average\ of\ sub\ samples/$ subsample weight (Yelden & Avsar 2000).

Where F= Fecundity,

GW = Gonad weight (g)

For measurements of egg size ovaries were washed with the distilled water and eggs were separated on the slide for further analysis. The slide was put under the trinocular microscope and outlines of eggs were drawn using drawing tube fix with microscope. A line of 1.0 mm was also drawn using stage micrometer on same magnification for egg size measurement. The egg size was measured and an average was taken on monthly basis.

Results and Discussions

In total 256 specimen of *P. ticto* were used for the study constituting 151 female and 105 male. The female were 58.98 % and the percentage and the male population was 41.015%, respectively. A male-female ratio was calculated as 1.0:1.44.

The total length of male *P. ticto* ranged between 4.0 -9.4 cm and female *P. ticto* ranged between 4-10.2 cm. The total weight of male *P. ticto* ranged between 3.8-12.3 and female *P. ticto* varied between 5.2-15.2 g **(Table 1).**

The size of smallest mature female at sexual maturity was 5.3 cm, the minimum size of the egg-bearing female seen during the study can be used to assess the size of an aquatic animal at sexual maturity, and many researchers have previously employed these techniques (Soomro *et al.* 2011; Qambrani *et al.* 2015).

Male-female ratio was 1.0:1.44, with female dominance over males. Sex ratio is the well-established feature in the evolutionary biology and

in biological science (Fisher, 1993). Many studies show that females outnumber males numerically. For example, Soomro *et al.* (2012) found that females outnumber males in *Eutropiichthys vacha* from the Indus River. In Manchar Lake, the female population of *Glossogobius giuris* was likewise shown to be dominant over the male population (Qambrani *et al.* 2015).

Table 1. Descriptive statistics of length (cm) and Weight (g) of *P. ticto* for male, female and combine sex.

Sex	No.	Length (cm)		Weight (g)		R^2
		Min -Max	Average	Min-Max	Average	
Male	105	4.0-9.4	7.81±1.15	3.8-12.3	8.2±1.94	0.598
Female	151	5.4-10.2	8.18±0.98	5.2-15.2	8.77±1.83	0.637
Combine	256	4.0-10.2	7.96±1.9	3.8-15.2	8.26±1.97	0.564

The dominance of female population over males is influenced by a variety of factors including habitat differences, food availability, environmental factors and fish physiology. Differences in sex ratio could also be due to differences in fishing techniques. The disparity in sex ratios can also be attributed to the environmental factors (Fryxell *et al.*, 2015).

Sexual Dimorphism

P. ticto displays pronounced sexual dimorphism, which can be observed both during and outside of the reproductive season. Males had more colorful scales and fins than females while females were having darker fins and scales. Female *P. ticto* has silvery fins with pale coloration. Male fish have blackish or darker patches on their dorsal and pectoral fins whereas female fins and bodies are lighter (Figure 1). External sexual dimorphism is critical for understanding the reproductive biology of any fish (Qambrani *et al.* 2015). These distinctions can be useful in both field work and aquaculture of specific species.

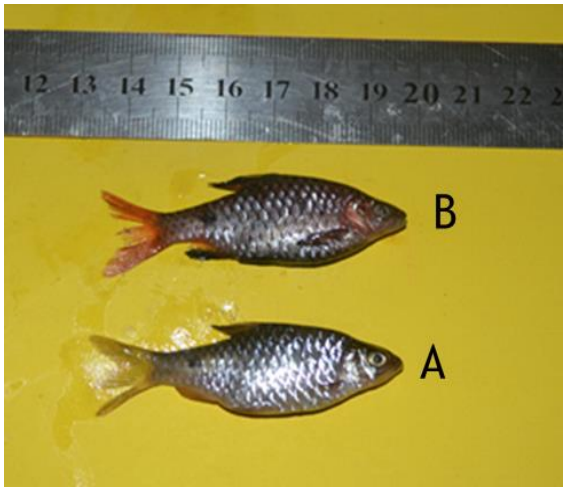

Figure 1.Sexual dimorphism of *Puntius ticto* with distinct difference in color pattern of (A) Female and (B) Male

Gonado-Somatic Index

Gonado-Somatic Index of *P. ticto* began to appear in March (0.9) and showed increase progressively onwards till August. The GSI values recorded from April to August are (2.6, 4.14, 4.34, 5.25, and 6.32). Later on GSI showed regressive trend from September onwards and reached to lowest point in October (3.61). As a result, the fish has only one spawning season, with the month of August being the peak activity (spawning) month due to highest GSI (6.32) (Fig. 2).

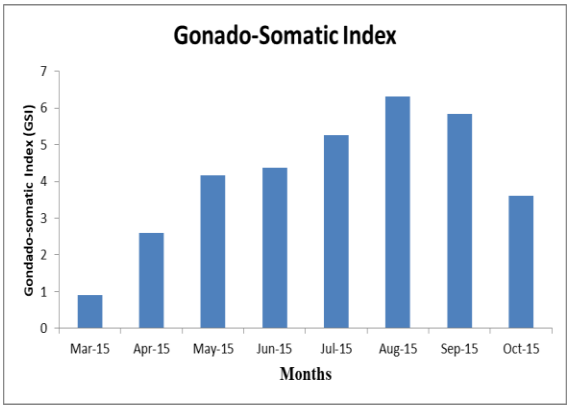

Figure 2. Monthly variation in the Gonado-Somatic Index (GSI) of female Puntius ticto from Dafri Lake, District Badin.

To the best of our knowledge this is the first report on reproduction season of *P. ticto* from Pakistan or elsewhere therefore, there is no available study to compare the reproductive or Gonado-Somatic Index of the species. However, highest GSI values of another species in genus *Puntius*, *Puntius sophore* were recorded during July from Bangladesh (Kohinoor et al, 2005).

Egg size

As ovaries started ripen in March with measurable egg size. The gradual increase in egg size is recorded from March to August (0.31, 0.51, 0.61, 0.727, 0.77 and 0.83).

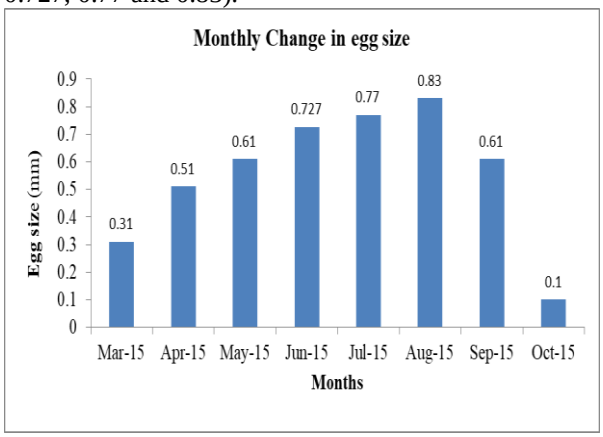

Figure 3. Monthly variation in egg size (average) of *Puntius ticto* from Dafri Lake, District Badin

The egg size measured in September and October was 0.61 and 0.1, respectively. It was found that increase or decrease in egg size was followed by changes in Gonado-Somatic Index.

Fecundity

Twenty six females were examined for fecundity. The lowest fecundity of *P. ticto* observed in our study was 433.5 in the fish with total length of 5.3 cm. On the other hand, highest fecundity was recorded 2625.5 in fish with total length of 10.2 cm and a weight range 6.8-16.5. The average of fecundity was calculated as 1363.7±614.99 **(Table 2).** Another study reported fecundity of *P. ticto* 1611 to 4130 in Ganges River, Bangladesh (Hossain *et al.* 2012) from the fish of length range 9.10-10.80. The fecundity reported from Ganges River is higher than our findings. Variations in fecundity of the same species in various environments are not an unusual happening (Roy *et al.* 2014). Food availability, fish stock, developmental stages, and other environmental factors can all contribute to such differences (Qambrani *et al.* 2015; Roy *et al.* 2014: Gupta and Srivastav, 2001). Length range of specimen used by Hossain et al 2012 is also smaller than the current study (5.3-10.2 cm). Therefore, this can be concluded that comparatively high range in length of fish used for fecundity estimation gave much variation in fecundity values of *P. ticto* from Dafri Lake.

Regression analysis was used to determine the bivariate relationship between body parameters. The most significant value of the coefficient of determination (R^2 = 0.84) was calculated by regressing total weight and fecundity, followed by regressing between gonadal weight with fecundity (R^2 = 0.776) and total length (cm) with fecundity (R^2 = 0.74) (Fig. 4).

Many researchers have established that weight variables (Total weight and Gonadal weight) are accurately correlated with fecundity (Hossain *et al.* 2012). A variety of characteristics can have an impact on fish fecundity. In the current study fecundity was correlated with total length (cm) total weight (g) and gonadal weight (g) of fish whereas, total weight has appeared to be the most significant variable to effect the fecundity of *P. ticto.*

According to Hossain *et al.* (2012), body weight of *P. ticto* is a better indicator of fecundity than the rest of the morphological criteria, which support the findings of current study, suggesting that total weight (g) is the best indicator of fecundity.

In neighboring countries (India, Bangladesh) *P. ticto* populations has declined and in Pakistan also it has also disappearing from freshwater habitats (personal observation). Current research provides a foundation for establishing *P. ticto* conservation approach based on induced breeding and artificial propagation.

Conclusion and recommendations

The species has single spawning season. Current study provides first information on reproductive aspects of *P. ticto* included size at sexual maturity, fecundity, Gonado-Somatic Index and

Table 2. Descriptive statistics of total length (cm), total weight (g), gonadal weight (g) and fecundity of *Puntius ticto* from Dafri lake, Badin.

Total Length (cm)		Total Weight (g)		Gonadal weight (g)		Fecundity	
Average ± STD	**Min-Max**	**Average ± STD**	**Min-Max**	**Average ± STD**	**Min-Max**	**Average ± STD**	**Min-Max**
8.69±1.017	5.3-10.2	10.3±2.68	6.8-16.5	10.23±0.27	0.5-2.1	1363.7±614.99	433.5-2625.5
Min. = Minimum; Max = Maximum; STD= Standard deviation							

fecundity from Pakistan. This information will contribute for fisheries management and conservation of the species.

It is recommended that the conservation of this species should be carried out through induced spawning based on the information on reproductive biology given in this article.

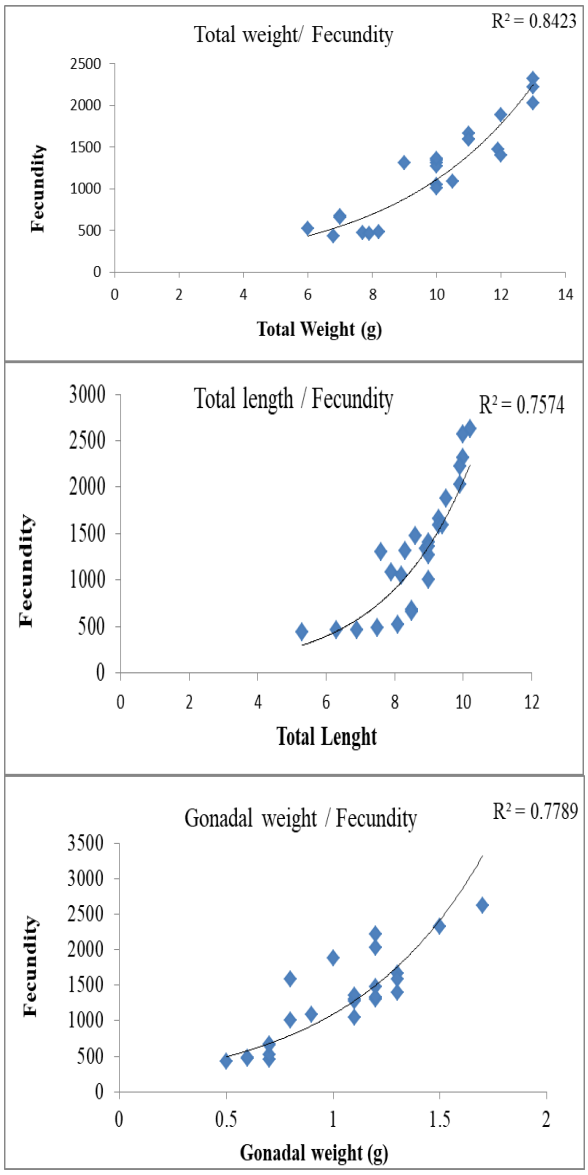

Figure 4. Regression of fecundity with Total length, Total weight and Gonadal-weight of *Puntius ticto* from Dafri Lake, District Badin.

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