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BIOLOGICAL ASPECTS OF MOUNTAIN CARP *LABEO DYOCHEILUS* (MCCLELLAND), FROM DAU DAM, THANA AHMED KHAN, SINDH, PAKISTAN

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A B S T R A C T

Labeo dyocheilus is commonly recognized as "Hill Stream", found in different Asian countries such as Afghanistan, Butan, India, and Pakistan with habitat of rivers, channels, stream, and mountain torrents. Sex ratio, breeding season, length at first maturity fecundity and reproductive season of *L. dyocheilus* were studied. Fish specimen was collected from Dau Dam, Thano Ahmed khan District Jamshoro Sindh Pakistan during February to November 2015 by use of gill net (Fish caching method). Samples comprised 341 individuals (164 male and 177 female) for calculating the (length-weight) relationship and reproductive attributes of the species. The female population slightly outnumbered male population with a ratio of 1.0:1.07. Fecundity analysis was based on 107 female (average fecundity 1856.77, fecundity varied from 2881 to 61146. The value of coefficient of determination r^2 generated by regression between Gonadal weight-fecundity was 0.83.total weight-fecundity gave r^2 0.62.Total length-fecundity gave r^2 was 0.67. Gonadal weight-fecundity gave r^2 0.8375 Confirmed to the general pattern of reproduction, where gonadal weight has substantial impact on fecundity. Gonado-somatic Index peaked in July and declined gradually till October, suggesting that reproductive activities of the species peak during hot summer / monsoon season. The present study provides the baseline information about reproductive biology of cultured or harvested fishes will be helpful for management.

Keywords: *Labeo dyocheilus* (McClelland), Sex ratio, Spawning season -Fecundity relationship.

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INTRODUCTION

Labeo dyocheilus (McClelland1839) is generally known as "Hill Stream carp", is carp in family "Cyprinidae" and "order Cypriniformes". It inhabits in lakes, rivers, canals, watercourse, and dikes and in streams (Leghari *et al*. 2020). It was reported from ten Asian motherlands including Afghanistan, Bangladesh, Butan, Cambodia, India, Laos, Myanmar, Nepal, Pakistan, and Thailand (Froese and Pauly, 2018). This fish is regarded as vulnerable species in India (Dubey, 1994; Lakra et al., 2010; Prasad, 1994). Reproduction is a process that ensures species existence, survival, conservation and is a vital stage in the creation of new species through genetic recombination (Muchlisin, 2014). Additionally, reproduction helps save organisms from extinction (Muchlisin et al., 2004). Growth is an .inherit individually characteristic in all living organisms according to natural phenomena as time passed. Growth is always increasing with length or weight both. The study of length-weight relationship of fishes is a basic tool for measuring the production, development, supplying, thickness, maturity, output of a specific territory (Verma, 2013). The successful reproduction process depend upon regular gonadal progress and it advantageous by environmental conditions (temperature + Photoperiod) both factors are most important for monitoring, mostly fishes reproductive activities are seasonal (Lam, 1983; Shankar and Kulkarni, 2007). Awareness about "reproductive biology" of fishes is significant for fisheries management,

both in culture and capture fisheries. The proportion of gonad weight relative to body weight is called the Gonado-somatic index (GSI). This study provide key information of various reproductive features of *L. dyocheilus* such as sexual maturity, sex ratio, seasonality of breeding, fecundity.

MATERIALS AND METHODS

Study Area

Dau Dam is one of partly burrowed Dam situated at the base hills of "Kithar range" it is "4 ^{s}km" away from Thana Ahmed khan. This aquatic reservoir obtains water from "River torrents" of the khirthar range, although water standing whole the year.

Data Collection

The samples of *L. dyocheilus* were collected from different sites of Dau Dam, Thano Ahmed Khan during (February 2015 to November 2015. Procedure of Gill net (Fish caching method) was applied for overnight to catch the fish. At early morning the mesh was checked, fish were handpicked from net, which were shifted to the research laboratory at Department of Freshwater Biology and Fisheries, University of Sindh, and preserved in ice box.

All the samples of collected fish were washed by distilled water and after and measured for Total length (TL), total weight (TW) and gonadal weight (GW), with the sizing board to the nearest 0.1 cm. The fish specimens and the gonads were weighed by digital balance model SF-400. To define the appropriateness of development of fish least square method was used (Zar, 1984). Relationship between the total length and Total weight were also established through least square method applying the same calculation given below.

$\log W = \log a + b \log L$ via least square linear

Where W= weight of fish (g), a= body constant, L= total length (cm) and b= growth exponent).

The average monthly values of gonadal and body weight was used to determine the GSI. The mature eggs were counted under dissecting microscope and for the fecundity estimation we followed gravimetric method prescribed by (Lagler *et al*., 1977).

Gondado-somatic Index (GSI) was calculated by following formula:

$$\text{GSI} = \text{Gonad weight x}100$$

Fecundity was estimated by following formula

$$F=GW1\times averageofsubsamples$$

Where F= Fecundity, = each 1g sample GW = Gonad weight g.

RESULTS

The study of length-weight relationship was conducted to determine the growth status of *L. dyocheilus* in Dau dam. A total of 341 individuals (164 male and 177 female) were collected to calculate the length-weight relationship for calculating the length-weight association (Table 1). The female fish population was greater as compared to male population with a ratio of 1.0:1.07. The length and weight of female was observed between 11.7- 24.5 and 18-180, whereas, male length and weight ranged were observed between 12.5-20.2 and 18-110.3, respectively (Table 1). The coefficient of determination R^2 values for combine, male and female populations were generated as 0.9039, 0.826 and 0.923, depicting the powerful association between length and weight, and significant results (Table 2). The values of slope coefficient (*b)* calculated for male, female and combine populations were 2.36 and 2.79 and 2.8, respectively (Table 2).

Table 1. Descriptive statistics of different body parameters i.e. total length (cm), total weight (g) of *Labeo dyocheilus* from Dau dam, Thana Ahmed Khan, Sindh.

Sex	No.	Length range		Weight range	
		Min-Max	AVE±STD	Min-Max	AVE±STD
Combine	341	11.7-24.5	16.48±2.30	18-180	56.15±26.95
Males	164	12.5-20.2	15.48±1.48	18-110.3	44.98±19.58
Females	177	11.7-24.5	17.68±2.69	18-180	66.89-28.91

Table 2. Length-weight regression parameters (a, b and R2) of Labeo dyocheilus from Dau Dam.

Sex	Regression parameters							R^2
	a	*Lower 95%*	Upper 95%	*b*	Lower 95%	Upper 95%	P-Value	
Combine	-1.683	-1.970	-1.396	2.800	2.577	3.037	4.81776E-12	0.903
Males	-1.063	-2.086	-0.040	2.369	1.528	3.210	0.000287014	0.826
Females	-1.668	-1.969	-1.368	2.790	2.551	3.032	8.88101E-12	0.923

Sexual Diamorphism

In genus *Labeo* fish no any distinct visible sexual dimorphism have been observed, However slight morphological variation were observed, male were found with brighter shade of scale and fins and female were observed with gloomier fins and scales (Figure 1A and B).

Sex Ratio

The total 164 male entities and 177 female individuals were used for the reproduction, the percentage of male and female *L. dyocheilus* was 51.90 % and 48.094 %, respectively. The female and male sex ratio was 1.00-1.07. There was slight supremacy of female population over male.

Figure1. Sexual dimorphism of Labeo diyocheilus, with distinct difference in color pattern of (A) male and (B) Female.

Size at Sexual Maturity

The minimum length of carrying eggs 11.7 cm of mature female, it indicating minimum size at sexual maturity (Table 1).

Reproductive Season

Monthly change in the gonado-somatic Index (GSI) is a major tool in fish biology to detect the reproductive season of a fish. Onset of GSI was observed in April (coincided with appearance of eggs), which gradually jumped up till July, later on gradual decrease in GSI was noticed, which went to zero with no single female with mature eggs in the samples in November.

Based on the GSI graph its can be depicted that reproductive season of *L. dyocheilius* starts in April, it peaks in July and declines in October (Figure 2).

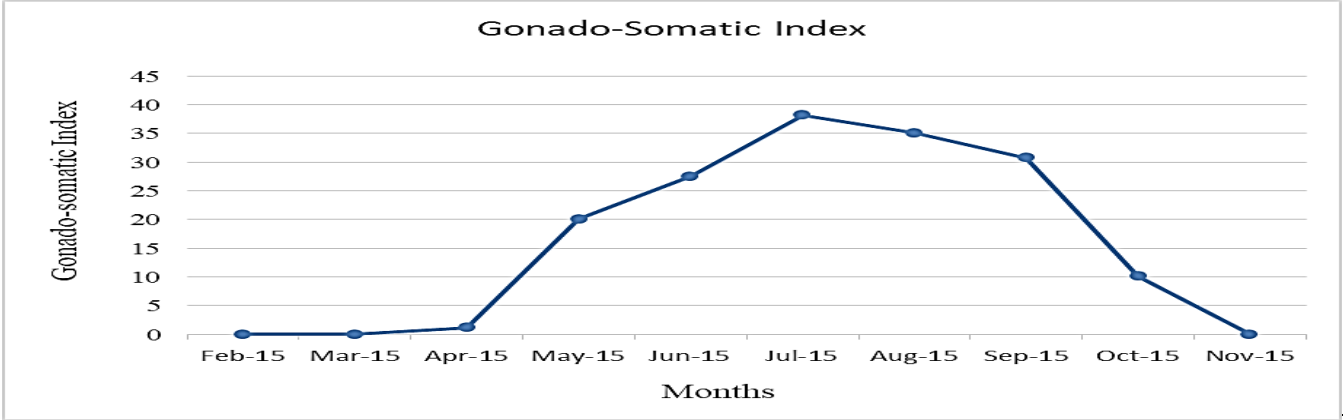

Figure 2. Gondao-Somatic Index of (female) Labeo dyocheilus calculated from Dau dam.

Fecundity is generative prospective of the species. Higher fertility is an adaptive biological strategy to avoid any loss of cohort due to conceivable transience risks. Species with low risk of mortality can have relatively lower fecundities. 9. Based on 107 female fishes the fecundity was analyzed with average fecundity of

1856.77, the minimum and maximum fecundity was observed as 2881-61146. Minimum fecundity was recorded 2881 from the fish with total length 11.7 cm, and maximum fecundity was recorded 61146 from the fish with total length of 24.5 cm (Table 3).

Fecundity was correlated with different body parameters including Gonadal-weight, total weight and total length through regression equations by plotting the fecundity at Y-axis as a dependent variable. The value of coefficient of determination r^2 generated by regression between Gonadal weight-fecundity was 0.83 (Figure 3). The *r2* for total weight-fecundity was calculated as 0.62, for total length-fecundity was 0.67 and for gonadal weight-fecundity *r2* was estimated as 0.8375 (Figure 3). The general patterns of reproduction confirmed that the gonadal weight has substantial impact on fecundity.

Table 3. Descriptive statistics of total length (cm), total weight (g), gonadal weight (g) and fecundity.

Counts	Total length (cm)	Total weight (g)	Gonadal weight (g)	Fecundity
Average ±STD	17.68±2.69	68.73±29.58	22.85±9.65	18567.77±12699.94
Min-max	11.7-24.5	18-180	8.5-42.9	2881.5-61146

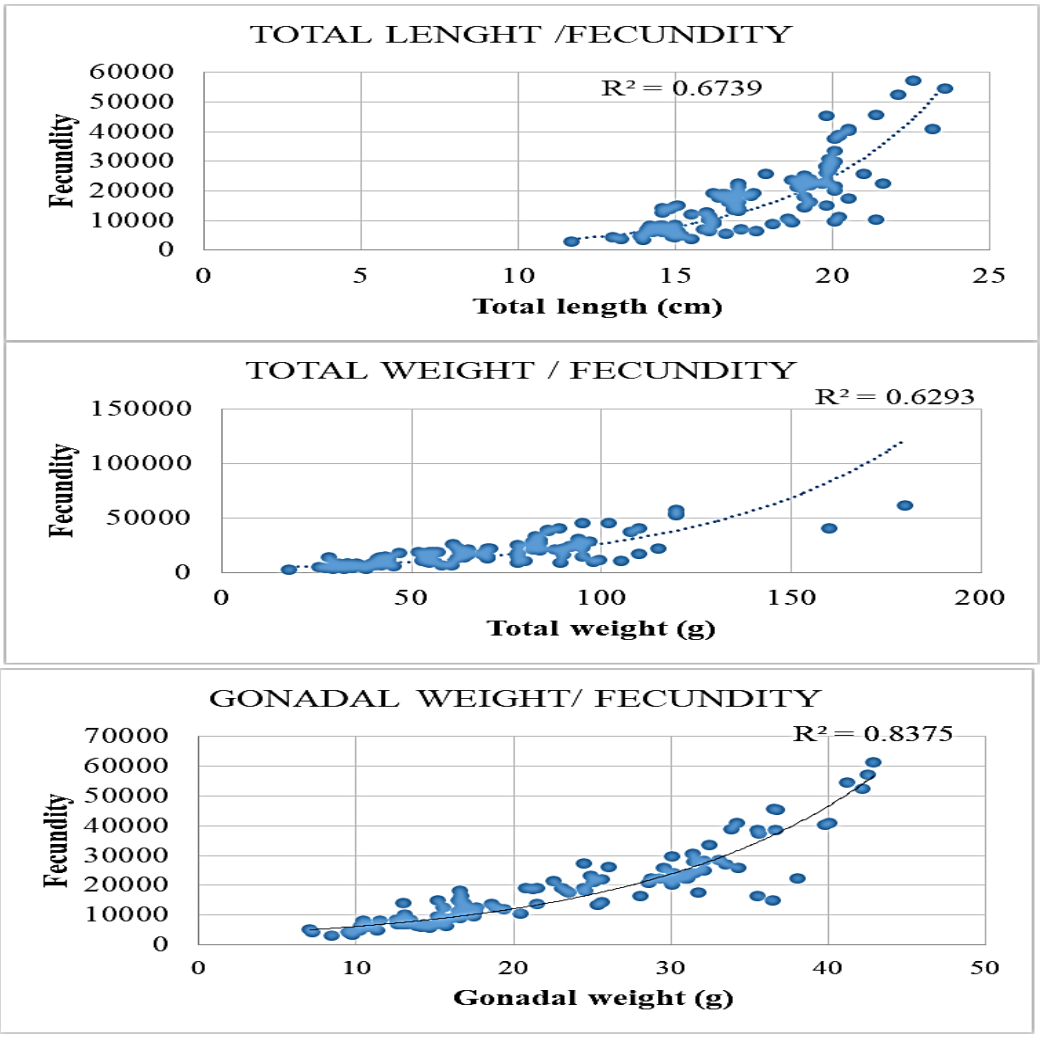

Figure 3. Regression analysis between total length, total weight and gonadal weight with fecundity of *Labeo dyocheilus*.

DISCUSSION

There was no any prominent sign of sexual dimorphism, on the contrary a distinct variation in the shades of scales and fins were observed in *L. diyocheilus.* Determining physical distinctions between both sexes is supportive tool in the field of fisheries, which aids in the study of fish

reproductive biology and life history features (Qambrani *et al.* 2015; Kinato *et al*. 2007).

The number of specimen used for present investigation was 341; the number of male and female population was 164 and 177, sequentially. The male to female sex ratio of *L. dyochelius* drew as 1.0:1.07, sequentially. In fishes numerical supremacy of female over male has been observed frequently, which is also considered as recurrent phenomenon, which is a typical finding in fisheries biology. Several researchers have shown that the female population outnumbers the male population in aquatic environments for several fish species in Sindh, Pakistan (Soomro et al. 2007; Soomro *et al*., 2012; Qambrani *et al*. 2015), and elsewhere.

It is a common observation in fisheries biology that female is dominant over male, many researchers reported this natural phenomena in *Eutropiichthyes vacha* female population dominated over male in Indus River (Soomro *et al*., 2012). Female *Puntius serana* was dominant over the male from "Lake Kolleru, Andhra Pardesh" (Sriramachandra Murty, 1975). Size of *L. dyocheilus* extended from 11.7 to 24.5 cm, previously its size range at Nai Gaj was recorded as 15-27 (Leghari *et al*. 2020), size range variation between both habitats are slight which can be attributed to the same geographical region as well as environmental conditions, Nai Gaj and Dau Dam both originate from Khirthar mountain torrents, Comparatively higher length (39.2 cm) was recorded from Kamuan, Hamaliyan region These Length variances among the both inhabitants can be accredited to habitat difference, availability of food and fish catching methods. The significance of coefficient *b* for relationship male-female and combine population of *L. dyocheilus* was intended as (2.36, 2.79 and 2.8), respectively, these measurements showed the negative allomatric growth in fish, same results were recorded in previous studies for same species in Nai Gaj mountain torrents (Leghari, *et al*. 2020) and for catfishes too (Leghari *et al*. 2022). The values of b is less than 3.0, indicating that the rates at which body length is increasing is not equivalent to the rate at which body weight is rising. This shift could be the consequence of several of variables that impact fish growth, such as the time of year, habitat, gonadal maturation, sex, gut being full, physical well-being, and preservation methods (Soomro et al. 2007; Hossain et al. 2006; Tesch, 1971). Although in other researchers have same finding of the *b* values representing of negative allometric growth, those were within the suggested range 2.5-3.5 (Froese, 2006; Jatoi et al., 2013). Therefore this can be concluded that the growth of fish follows the cube law.

Gonado-somatic record peaked in July and gradually decrease till October, related tendency of generative period was described for *Labeo gonius* in Brahmputra (Chowdhary and Shahid, 2018). It is considered that the peak of the reproductive cycle corresponds with the time when the GSI is at its highest. In the absence of firsthand observations, it is thought to be the best indicator of a species' shifts in reproductive activity over the year (Stoumbodi *et al*., 1993; Cardinale *et al*. 1998).The species showed normal trends of reproductive season as other carps in the region (Bahuguna, 2012; Chowdhary and Shahid, 2018). In the current study fecundity of *L. dyocheilus* was found between 2881 to 61146. Previously the fertility of *L. dyocheilus* was recorded as 3,218 to 31,524 from Kamaun, Himaliya India (Chowdhary and Shahid, 2018). It was determined that the species has more generative potential at Dau dam, than Himalayan region. Regression of fecundity with "total length, total weight and gonadal weight" recommended that fecundity increase with increase in "gonadal weight". Related consequences were detected by (Chowdhary and Shahid, 2018) for *Labeo gonius* (Dobriyal, 1988; Soomro et al., 2012).

CONCLUSION

The current study of length-weight, and fecundity-gonadal relationship was conducted to determine the growth status of *L. dyocheilus* in Dau dam Thano Ahmed Khan, district Jamshoro Sindh Pakistan. According to aspect reproduction biology fecundity is the reproductive potential of the species. Complex fertility is an adaptive natural approach to escape any damage of cohort due to conceivable mortality risks. Species with low danger of mortality can have reasonably lower fertilities. Present study suggests that elevated fecundities were obtained with increasing gonadal weight.

AUTHOR'S CONTRIBUTION

Rehman Ibrahim has conducted the field work and experimental work, Anila Naz Soomro designed the experiment and lead the main write-up, Sadaf Tabbasum Qureshi assisted in experiments, Aziz Ahmed help in sorting the data, Aiman Amour analyzed data, Mutahr Channa formatted the article.

CONFLICT OF INTEREST

The authors have declared no conflicts of interest in publishing this work

REFERENCES

Bahuguna, P., 2012. Observation on the reproductive

capacity of wild major carp Labeo dyocheilus from Kumaun Himalaya, India. Essence J 3, 1-7.

Chowdhary, S.T., Shahid, I., 2018. Maturity and breeding of Labeo gonius (Ham.) from Brahmaputra. Journal of Biosphere 7, 44-54.

Dobriyal, A.K., 1988. Fecundity of the Chinese silver carpHypophthalmichthys molitrix (Val.) from Gujartal Fish Farm, Jaunpur, UP. Proceedings: Animal Sciences 97, 169-173.

Dubey, G., 1994. Endangered, vulnerable and rare fishes of west coast river system of India. NATURE CONSERVATORS, MUZAFFARNAGAR(INDIA). 77-95.

Froese, R., 2006. Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. Journal of applied ichthyology 22, 241-253.

Jatoi, S., Baloch, W., Soomro, A., Gachal, G., 2013. Length-weight relationship of the silurid catfish Sperata seenghala Sykes 1839 (Bagridae) from Indus River, Sindh, Pakistan. Sindh University Research Journal-SURJ (Science Series) 45.

Lagler, K.F., Bardach, J.E., Miller, R.R., Passino, D., 1977. Ichthyology. John Willey and Sons. Inc. New York 505.

Lakra, W.S., Sarkar, U., Gopalakrishnan, A., Kathirvelpandian, A., 2010. Threatened freshwater fishes of India. National Bureau of Fish Genetic Resources.

Lam, T., 1983. 2 Environmental influences on gonadal activity in fish, Fish physiology. Elsevier, pp. 65-116.

Muchlisin, Z., Hashim, R., Chong, A., 2004. Preliminary study on the cryopreservation of tropical bagrid catfish (Mystus nemurus) spermatozoa; the effect of extender and cryoprotectant on the motility after short-term storage. Theriogenology 62, 25-34.

Muchlisin, Z.A., 2014. A general overview on some aspects of fish reproduction. Aceh International Journal of Science and Technology 3, 43-52.

Prasad, P., 1994. Status paper on endangered, vulnerable and rare fish species of Bihar. NATURE CONSERVATORS, MUZAFFARNAGAR(INDIA). 25-29.

Shankar, D., Kulkarni, R., 2007. Tissue cholesterol and serum cortisol level during different reproductive phases of the female freshwater fish Notopterus notopterus (Pallas). Journal of environmental biology 28, 137-139.

Soomro, A.N., Baloch, W.A., Jafri, S.I.H., Burdi, G.H., Fulanda, B., 2012. Reproduction and feeding habits of the River Catfish Eutropiichthys vacha (Hamilton, 1822)(Siluriformes, Schilbidae) in an impacted habitat: Kotri hydrodam, River Indus, Pakistan. Our Nature 10, 269-280.

Sriramachandra Murty, V., 1975. Studies on maturation, spawning, fecundity and sex ratio in Barbus (Puntius) sarana (Hamilton-Buchanan) from Lake Kolleru, Andhra Pradesh.

Verma, R., 2013. Maturation and spawning biology of a hill stream major carp Labeo dyocheilus (McClelland, 1839) from central himalaya, India. International Journal of Advanced Fisheries and Aquatic Science 1, 39-48.

Zar, J., 1984. Simple linear regression. Biostatistical analysis 4, 324-359.