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MORPHOLOGICAL SIGNS OF SEXUAL MATURITY AND REPRODUCTION IN BLACK FISH (SCHIZOTHORAX INTERMEDIUS)

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Abstract: This study examined the stages of sexual maturation and the morphological characteristics of the reproductive season in black fish in the area of Shomurot Charvok village and the Chashma shrine, located in the Nurota district of the Navoi region. During the research, the gonads of male and female individuals were evaluated morphologically.

Keywords:zygote, ontogenesis, embryonic, gastrulation, organogenesis, fry, gonads, GSI, reproduction, visual, histological.

Introduction Reproduction is a physiological process that is the only factor ensuring the survival of a species. Studying the behavior of a species during its reproductive period is essential not only for understanding its biological characteristics but also for effectively managing and conserving the population during spawning.

As in all bony fish, in black fish as well, the fusion of gametes occurs outside the female's body through external fertilization in water [1,2,3]. The subsequent development of a mature embryo from the externally fertilized egg also occurs in the aquatic environment. That is, the embryonic stages of ontogenesis—zygote formation, cleavage, gastrulation, and organogenesis—occur independently of the mother's body [5,6]. Consequently, not all eggs get fertilized, and a large proportion of hatched fry fall prey to other animals. To compensate, natural selection maintains the species through the high fecundity of these externally fertilizing and externally developing fish species [9].

Literature Review The liver plays an important role in providing the energy required for the reproduction of gametes in female fish. The energy needed for oocyte growth is derived from the liver (Colonello et al., 2007) [18]. Most of the oocyte mass accumulates due to vitellogenin synthesized in the liver (Lubzens et al., 2010) [18]. Additionally, environmental factors such as water temperature and photoperiod influence gonad development and sexual maturity in fish (Wootton, 1990) [15,18].

Fecundity refers to the number of mature eggs produced during one reproductive season. Understanding fecundity is crucial for estimating fish stock size, analyzing population changes, and developing strategies to increase fish productivity. However, studies by Gushing (1968) and Mann (1984) have shown that fecundity varies within species depending on geographical location [18].

Fish of the Schizothorax genus are typically found in clear mountain rivers and streams, which increases the risk of their eggs and fry being destroyed. Due to innate parental instincts, these fish lay their eggs between rocks and among tree roots to protect them [12,13,14].

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In Syrdarya water bodies, male black fish reach sexual maturity at the age of 2–3 years and a body length of 12–15 cm; females mature at 3–4 years with the same length [7,17].

The spawning season lasts from April to August. The extended reproductive period of black fish is linked to a limited natural food base for fry. To efficiently utilize scarce food sources, the spawning period is prolonged—this is considered an important ecological feature of the species. [19,20].

Observations in the Chorvoq reservoir of the Navalisoy region showed that black fish arrive in small groups (40–50 individuals) to spawn. Most spawning fish had a body length of 23.0–38.0 cm, with a few larger individuals reaching 40.0–50.0 cm. Black fish spawn in the morning in gravelly areas 1.0–1.5 meters deep. The eggs develop between or under rocks [4,17].

The toxicity of black fish eggs is a rare ecological adaptation aimed at protecting them from predation. In some locations, especially in the Nurota springs, local residents unaware of this toxicity consumed the fish before the spawning period and became ill, leading to the belief that these fish are “sacred” [11,17].

Absolute fecundity in black fish ranges from 6,600 to 74,000 eggs in individuals with a body length of 30–51.5 cm. The sex ratio coefficient ranges from 5.43% to 17.5% [17].

International Literature Review During a review of relevant international literature, we studied the article by Iqra Farooq Wani, Fa Shan, and Mh Balkhi, which analyzed the gonadosomatic index (GSI), fecundity, and reproductive behavior of Schizothorax niger Heckel living in Dal Lake in Kashmir. The study emphasized that the spawning season and periodicity in Schizothorax species vary with environmental conditions, including:Himachal Pradesh: March to June (Thingran, 1982) , Kumaon waters: July to December (Bisht, 1974) Garhwal Himalayas: July to September (Misra, 1982) [16]

Research Methodology The ordinary black fish (Schizothorax intermedius) is a typical representative of the mountain-Asian faunal complex. Members of this group inhabit the ichthyofauna of the Tien Shan mountain and foothill river systems, including tributaries and upper streams of the Syrdarya and Kashkadarya rivers.

Understanding the reproductive biology of black fish is vital for conservation and the development of artificial breeding programs. Thus, this study aimed to investigate the stages of sexual maturity and reproductive characteristics of the species. The research was conducted on April 13, 2025, on samples collected from Shomurot Charvok village and the Chashma shrine in Nurota district, Navoi region. Each fish was analyzed using 30 different metrics, including body weight, length, maximum and minimum body height, and then categorized by sex.

Gonad development stages were assessed using:

Visual methods (color, shape, and size of gonads),

Morphological methods (gonads were extracted and weighed; their ratio to body mass was calculated),

Histological methods (gonad tissue samples were examined microscopically to determine gamete shape and maturity stage) [8].

Analysis and Results

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The findings indicated that the reproductive season of this species mainly occurs from March to May [10].The gonadosomatic index (GSI) was calculated using the following formula (V.R. Desai, 1970):

$$GSI=\left(\frac{\text{gonad weight (g)}}{\text{Total body weight (g)}}\right)100$$

1-Table Gonadosomatic Index Values

	N 1	N 2	N 3	N 4	N 5
Total length of the fish (including caudal fin) – Lab	265	244	266	185	217
Standard length of the fish (excluding caudal fin) – ad	223	205	224	155	182
"Fish weight – g"	188	120	183	70	99
Greatest vertical body depth (maximum body height) – gh	47	39	45	36	34
Least body depth (minimum vertical body height) – iR	21	14	20	15	13
Sex and gonadal maturity stage	♂4	♀4	♂4	♂2	♂4
Weight of the gonads (in grams) – g	17	7	11	7	15
Gonadosomatic index (GSI)	9,042	5,833	6,010	10,0	15,151

1-Figure Sample of black fish used for analysis

2-Figure Laboratory analysis of black fish gonads

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Conclusion The GSI value increases as the gonads approach full maturity and peaks during spawning. After egg-laying, the GSI drops sharply. Generally, female fish tend to have higher GSI values than males.

It can be concluded that the absolute and relative fecundity of black fish increases with age, body length, and weight. Although black fish grow most rapidly during their first year, their growth rate slows significantly from the second year onward.

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