



Original article

STUDY OF CONDITION FACTORS AND ORGAN INDICES OF SOME COMMERCIAL FISHES OF AGAIE - LAPAI RESERVOIR, NIGER STATE, NIGERIA

***¹Ibrahim, B. U., ¹Yunusa, A., ²Auta, J., ³Balogu, D. O. and ⁴Usman, M.**

¹Department of Biological Sciences, Faculty of Natural Sciences, Ibrahim Badamasi Babangida University, Lapai, Nigeria

²Department of Biology, Faculty of Life Sciences, Ahmadu Bello University, Zaria, Nigeria

³Department of Food Science and Technology, Faculty of Applied Sciences and Technology, Ibrahim Badamasi Babangida University, Lapai, Nigeria

⁴Department of Biological Sciences, Faculty of Science, AlHikmah University, Ilorin, Nigeria

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ABSTRACT

Condition factor designated as K is an important tool in fish biology and aquaculture, which indicates the well-being of fish, and also determines the conduciveness of the environment for survival. This study examined the condition factor and organ indices of some commercial fishes of Agaie - Lapai Reservoir, Niger State. Twenty-five (25) samples each of *Clarias gariepinus*, *Auchenoglanis occidentalis* and *Bagrus bayad* were collected and used for this study. The condition factors of *A. occidentalis* was 0.04 with mean Total Length (25.59cm), *C. gariepinus* was 0.04 with mean Total Length (25.88cm) and *B. bayad* was 0.04 with mean Total Length (27.70cm), being less than 1 showed that the fishes are not in good condition in the reservoir. Mean monthly condition factor did not differ significantly ($p>0.05$) and showed that these fishes were not in good condition. There was low level of energy reserve based on mean hepatosomatic index of *A. occidentalis* (0.70), *C. gariepinus* (0.90) and for *B. bayad* (0.76). Mean spleen somatic index of *A. occidentalis* (0.08), *C. gariepinus* (0.08) and *B. bayad* (0.07) showed decreased spleen size due to low red blood cell produced or stored. Low mean cardiosomatic index of *A. occidentalis* (0.07), *C. gariepinus* (0.08) and *B. bayad* (0.09) depicted small heart size. Low mean gonadosomatic index of *Auchenoglanis occidentalis* (0.14), *Clarias gariepinus* (3.49) and *Bagrus bayad* (0.16) showed that gonads were small and not matured.

Keywords: Condition Factor, organ indices, Commercial Fishes, Lapai-Agaie Reservoir

***Corresponding Author's email:** ibrahimsayuti@yahoo.com

INTRODUCTION

Fishes are vertebrate animals that are commonly found in water and have contributed greatly to the livelihood of most Nigerians. This includes the provision of high-quality protein, income generation, and job creation. There exist a relationship between growth and organ indices of fishes and this differs in habitat, geographical locations and type of species, which is influenced by biotic and other environmental factors (1).

Condition factor designated as K is an important tool in fish biology and aquaculture. It examines the well - being of fish and also determines the conduciveness of the environment for survival. K is also useful to monitor feeding intensity, age and rates of growth of an organism such as fish (2). However, it is influenced by both living (biotic) and non - living (abiotic) factors such as sex, food availability, season, stress and water quality parameters (3).

Organ indices are important biological parameters that are usually used to assess the general health of fish on individual and population level. This parameter can be described as the ratio of organs to body weights. Examples of such organs include liver, gonads, spleen and heart. Their size and weights are related to the overall length and weight of fish and also indicate the general status of fish health.

Clarias gariepinus (mud catfish), *Auchenoglanis occidentalis* (bottle nose giraffe) and *Bagrus bayad* (bagrid fish)

are commercial fishes found in fishers catches with wide distribution at landing sites in Lapai - Agaie Reservoir. Studies of some aspects of the biology of these fishes have been carried out in several water bodies. This includes the works of (4), (5) and (6). However, over the years there is lack of information relating condition factor and gonad indices of these important fishes in the reservoir. This makes their conservation and management in the reservoir challenging. *Clarias gariepinus*, *Auchenoglanis occidentalis* and *Bagrus bayad* are among the major fishes that have contributed greatly over the years to the sustenance of fisheries of Lapai - Agaie Reservoir. Therefore, knowledge on biological parameters such as, condition factor and organ indices are very important in their conservation and management.

The aim of this study is to determine the well - being, gonad indices and evaluate the general health status of the fishes in the reservoir.

MATERIALS AND METHODS

Description of the Study Area

Lapai - Agaie Reservoir is an important water body in Niger State. It is located on Latitude 9°39' N and Longitude 6°33' E. It is a small water body, which has a mean depth of 6.1 meters. The primary aim of constructing the reservoir is for portable drinking water supply to the community and also for irrigation purposes.

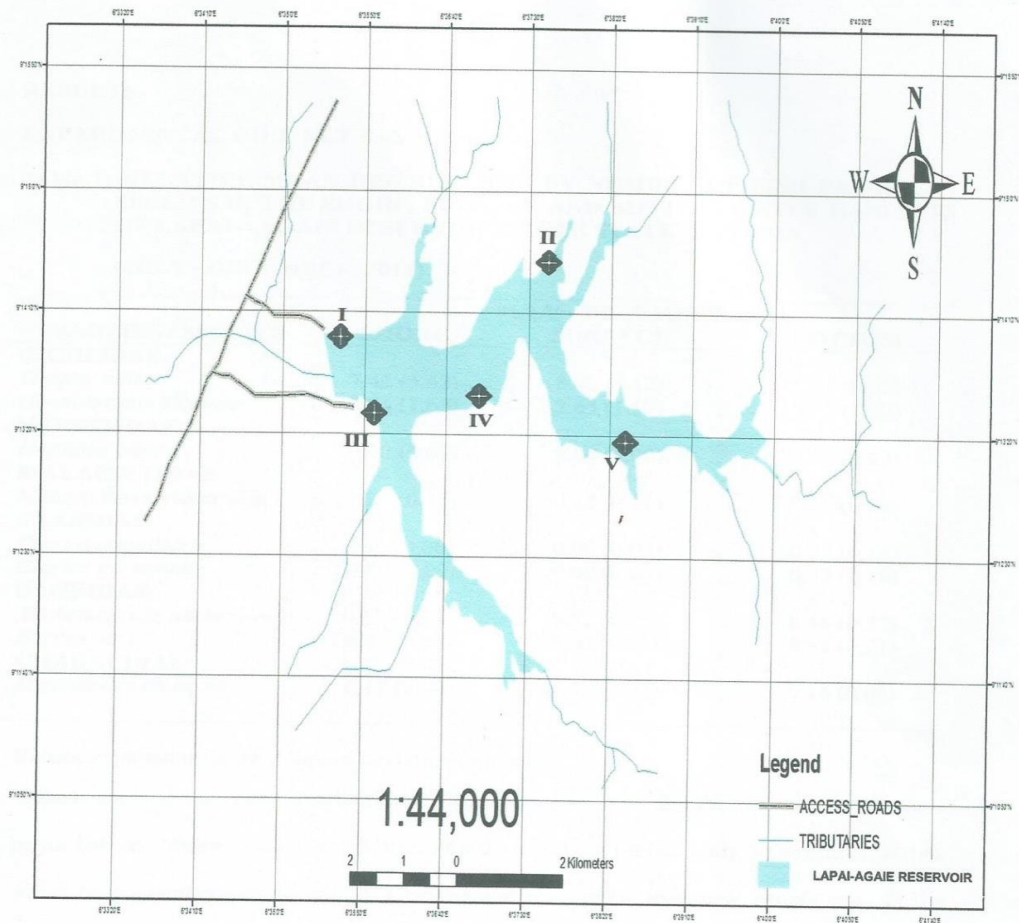


Figure 1: Map of Lapai – Agaie Reservoir, Niger State, Nigeria

Source: Niger State Water Board, Minna.

Sample Identification, Collection and Transportation

Clarias gariepinus, *Auchenoglanis occidentalis* and *Bagrus bayad* were identified at landing site based on their distinctive features using guides according to (7). Twenty-five fresh samples each of these fishes were obtained from fishers catches at landing sites on the reservoir. The collection was done at random to make sure different sizes are represented.

Samples collected were kept in ice - chest box to maintain freshness then transported to Biology Laboratory at Ibrahim Badamasi Babangida University main campus, Lapai, Niger State, where analysis was carried out. This was done for a period of five (5) months between March, 2021 and July, 2021.

Measurement of fish samples

Standard length, total length and weight of each fish sample was measured and taken

accordingly. This was done using measuring board (cm) for lengths and weighing balance for weight in grams (g).

Determination of Condition Factor (K)

Condition factor designated as (K) was calculated for each fish species according to the formula by (8) as follows:

$$K = \frac{100W}{L^3}$$

Where,

K = Condition factor

W = Body weight (in grams)

L = Length (in cm)

Organ Indices Determination

Each sample of fish was dissected from the anterior portion to the head region. The gonad, liver and heart of each sample were removed, the weights taken and then recorded. This was done for the entire fishes collected.

Organ indices, which include Hepatosomatic index (liver), Spleensomatic, Cardiosomatic index (CSI) and Gonadosomatic index (gonad) of each fish sample were calculated as follows:

$$\text{Hepatosomatic index (HIS): } HIS = \frac{\text{Liver weight (g)}}{\text{Fish weight}} \times 100$$

$$\text{Spleensomatic index (SSI): } = \frac{\text{Spleen weight (g)}}{\text{Fish weight}} \times 100$$

$$\text{Cardiosomatic index (CSI): } CSI = \frac{\text{Heart weight (g)}}{\text{Fish weight}} \times 100$$

$$\text{Gonadosomatic index (GSI): } GSI = \frac{\text{Gonad weight (g)}}{\text{Fish weight}} \times 100 \dots \dots \dots (8)$$

Data Analysis

Descriptive statistics was used to compute minimum and maximum values, means and standard deviation (SD) from the data collected. Analysis of variance (ANOVA) was used to test for significant differences at 95% confidence limit of the data collected. The new Duncan Multiple Range Test (NDMRT) was carried out to rank means where necessary. Special Package for Social Sciences (SPSS) version 20 and Microsoft Excel (2013) were used as statistical packages.

RESULTS

The various body measurements and condition factor of *Auchenoglanis*

occidentalis, *Clarias gariepinus* and *Bagrus bayad* is shown in Table 1. There were variations in these parameters during the period of study.

Means standard (cm) and total lengths (cm) of *A. occidentalis* was 19.94 and 24.59 respectively while mean weight (g) was 6.04. That of *C. gariepinus* were 22.07 and 25.88 and that of mean weight was 5.00. *B. bayad* had standard length (cm) mean of 22.78, total length (cm) of mean of 27.70 while mean weight (g) was 6.04.

The mean condition factors of *A. occidentalis*, *C. gariepinus* and *B. bayad* were 0.07, 0.04 and 0.04 were less than 1.

Table 1: Mean condition factor of some commercial fishes in Agaie-Lapai Reservoir, Niger State, Nigeria from March to July 2021.

Parameter	<i>Auchenoglanis occidentalis</i>	<i>Clarias gariepinus</i>	<i>Bagrus bayad</i>
	Mean ± SD	Mean ± SD	Mean ± SD
Standard Length	19.94 ± 2.43	22.07 ± 6.03	22.78 ± 3.10
Total Length (cm)	24.59 ± 2.59	25.88 ± 5.50	27.70 ± 3.40
Weight (g)	6.04 ± 2.07	5.00 ± 2.71	6.04 ± 2.07
Condition Factor (K)	0.07±0.01	0.40±0.04	0.04±0.004

The mean monthly condition factor of *Auchenoglanis occidentalis*, *Clarias gariepinus* and *Bagrus bayad* from Agaie-Lapai Reservoir is represented in Figure 2. There were no much variations in condition factors during the period of study.

Monthly mean condition factor of *A. occidentalis* of April and May was the

same (0.10) while June and July also had 0.07 each. *C. gariepinus* had 0.04 as mean value in April, May and June while July had 0.07. May (0.05) was higher than April, June and July each with 0.04. Condition factors were less than 1 across months.

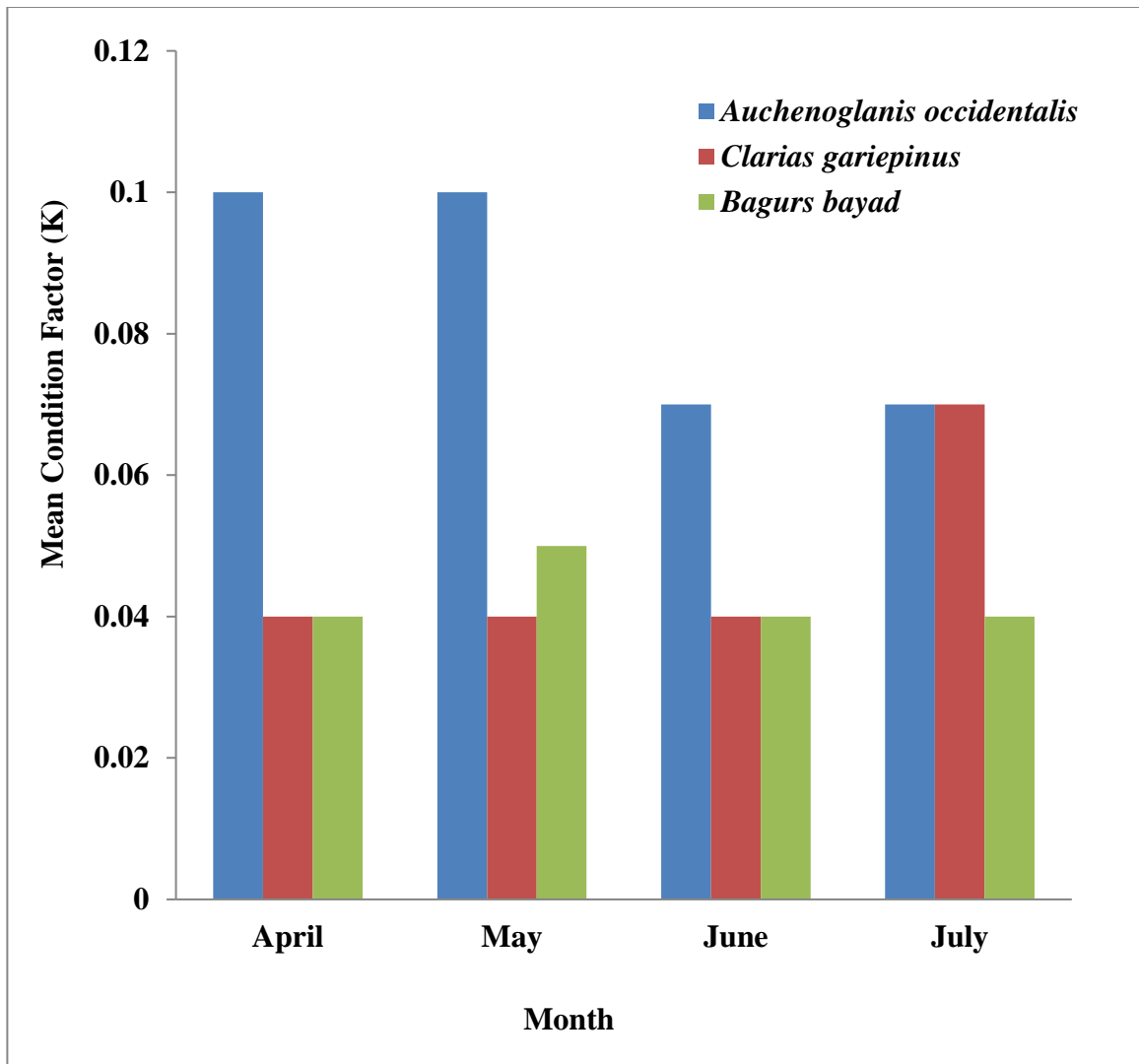


Fig. 2: monthly condition factor of some commercial fishes of Agaie - Lapai Reservoir, Niger State, Nigeria.

The mean organ indices of *A. occidentalis*, *C. gariepinus* and *Bagrus bayad* in Agaie -

Lapai Reservoir, Niger State is shown in Table 2. There were variations in the gonad indices during the period of study. The mean Hepatosomatic, spleen, cardiosomatic and gonadosomatic indexes

of 0.70g, 0.08g, 0.07g and 0.14 g were recorded in *A. occidentalis*, with that of *C. gariepinus* as 0.90g, 0.08g, 0.07g and 3.49 g respectively. That of *B. bayad* was 0.76g, 0.07g, 0.09g and 0.16 g respectively.

Table 2: Mean organ indices of *Auchenoglanis occidentalis* in Agaie - Lapai Reservoir, Niger State, Nigeria

Parameter	<i>Auchenoglanis occidentalis</i>	<i>Clarias gariepinus</i>	<i>Bagrus bayad</i>
	Mean \pm SD	Mean \pm SD	Mean \pm SD
Hepatosomatic index	0.70 \pm 0.30	0.90 \pm 0.38	0.76 \pm 0.14
Spleensomatic index	0.08 \pm 0.03	0.08 \pm 0.02	0.07 \pm 0.02
Cardio somatic index	0.07 \pm 0.02	0.08 \pm 0.02	0.09 \pm 0.14
Gonadosomatic index	0.14 \pm 0.05	3.49 \pm 1.91	0.16 \pm 0.07

DISCUSSION

Condition factor (K) is an important parameter that determines the well-being or health status of fish as it relates to the conduciveness of the immediate environment. The values in this study for *A. Auchenoglanis* (0.04), *C. gariepinus* (0.03) and *B. bayad* (0.03) showed that these fishes are not in good condition because K value is less than 1. (4) reported mean condition factor of 2.27 for *A. occidentalis*, 1.32 for *C. gariepinus* and 1.29 for *B. bayad* (9). This could be due to difference in season, water quality, availability of food and reproductive activities amongst others. Condition factor according to (10) is influenced by sex, age and maturity. (11) also reported condition factor for mature fresh water fish to be in the range of 2.9 to 4.8. This could also signify that these fishes are not mature.

Monthly Condition factors also showed that all the fishes were not in good condition. A fish is said to be in good condition when the K - value is equal or higher than 1. There was no significant difference ($P > 0.05$) in this parameter across months. This implies that the environment throughout these months did

not improve to favour the survival of these fishes. This could be due to season or period of sampling and fish sizes to mention but a few. Better condition factors have been reported in bigger fishes than smaller ones, which could be due to better foraging ability and conversion of stored in adults or due to heavier gonads (4).

Hepatosomatic index (HIS) is a parameter that determines the health state of the liver. It is usually used as an indicator of energy reserve in the liver (12). The values for *A. occidentalis* (0.70), *C. gariepinus* (0.90) and for *B. bayad* (0.76), indicated low level of energy reserved in these fishes. This could be due to the high metabolism level, unfavorable nature of the environment of fishes are not in good health.

The mean spleensomatic index of *A. occidentalis* (0.08), *C. gariepinus* (0.08) and *B. bayad* (0.07) were quite small during the period of study. In fish, the spleen produce and store red blood cells. Therefore acute stress could lead to rapid release of red blood cells from the spleen to the circulatory system (13), which results in decreased spleen size (14) and

also the state of the environment especially if it is polluted. This could be the reason for such observation in this study.

Cardiosomatic index (CSI) is also an important parameter in knowing the health of fish. The mean cardiosomatic index, which is the ratio of heart weight to that of fish weight of *A. occidentalis* (0.07), *C. gariepinus* (0.08) and *B. bayad* (0.09) recorded during this study, could be due to environmental changes and other activities, such as breeding, searching for food to mention but a few. Gonad Indices are very important indicators that also tell about the general health status of organisms in a given environment including fish. Most of the vital organs usually used to assess this include the liver (Hepatosomatic), spleensomatic, heart (Cardiosomatic) and gonad (Gonadosomatic). The gonadosomatic index (GSI) is known as the ratio of the weight of gonads relative to total body weight. This is one of the indices in monitoring changes in nutritional and energy status of fish. According to (15) GSI has been widely used to evaluate reproduction timing. The mean GSI values of *Auchenoglanis occidentalis* (0.14), *Clarias gariepinus* (3.49) and *Bagrus bayad* (0.16) were small compared with the report of (5) that reported GSI of *C. gariepinus* and *B. bayad* as 4.50g and 2.64 respectively. This could be due to stage of maturity or gonad sizes of these fishes. (16) did report that GSI tallies with the level of maturation of fish, hence it peaks at full maturity and its high decrease shows the beginning of spawning.

CONCLUSION

Mean condition factors (K) of *A. occidentalis*, *C. gariepinus* and *B. bayad*

were less than 1, which showed un-conduciveness of the environment to the survival of these fishes.

Monthly mean condition factor of *A. occidentalis*, *C. gariepinus* and *B. bayad* were the same in some months and different in others.

There was influence of the environment in the hepatosomatic, spleensomatic, cardiosomatic and gonadosomatic indexes of *Auchenoglanis occidentalis*, *C. gariepinus* and *B. bayad* that resulted to low energy reserve level, changes in heart and spleen sizes.

RECOMMENDATIONS

Similar work should be done for the remaining months in order to have a comprehensive information on the subject matter in the reservoir. There is need to determine the water quality of the water and other activities, which have contributed to the un-favourable condition of these fishes. Aspects of biology of these fishes need to be carried out, which will assist greatly in their successful conservation and management in the reservoir

REFERENCES

1. Paugy, D., Leveque, C. and Teugels, G.G. (2003). The Fresh and Brackish water Fishes of West Africa, Volume I, Institute of Research and Development Editions. Collection Faune et Flore tropicales 40, Paris. 457p.
2. Ndimele, P. E., Kumolu-Johnson, C. A., Aladetohun, N. F. and Ayorinde, O. A. (2010). Length-weight relationship, condition factor and dietary composition of *Sarotherodon melanotheron* in Ologe Lagoon, Lagos, Nigeria. *Agriculture and Biology Journal of North America*, 4:584 – 590.
3. Khallaf, E., Galal, M. and Athuman, M. (2003). The biology of *Oreochromis*

- niloticus* in a polluted canal. *Ecotoxicology*, 12:405 – 416.
4. Shinkafi, B. A. and Ipinjolu, J. K. (2010). Morphometric relationships and relative condition factor of *Auchenoglanis occidentalis* (Cuvier and Valenciennes) from River Rima, North-Western Nigeria. *Journal of Fisheries International*, 5(4):61-66.
 5. Shola, G. S., Victoria, O. A., Musa, A. T. and Victor, T. O. (2017). Gonad somatic index and feeding habit of selected fish species of Lake Kalgwaiin Jigawa State, Nigeria. *Fish and Ocean Opj.*, 4(2): 555631. DOI:10.19080/OFOAJ.2017.04.55563 1.
 6. Jimoh, O. A., Raimi, C. O., Adebayo, E. T., Balogun, A. T., Akomolede O. O., Salami, S. R. and Awoniyi, O. O. (2021). Relationship between body measurement and gonadosomatic index of *Clarias gariepinus* and *Heterobranchus longifilis* broodstocks. *International Journal of Fisheries and Aquaculture Research*, 7 (1): 1-10.
 7. Idodo-Umeh, G. (2003). Freshwater fisheries of Northern Nigeria. (Taxonomy, Ecological Notes, Diet and Utilization). ISBN 9788052-01-0 insert the publisher.
 8. Pauly, D. (1984). Fish population dynamics in tropical waters: a manual for use with programmable calculators, *ICLARM Studies and Reviews*, 8, 325.
 9. Nwabueze, A. A. and Garba, A. A. (2015). Growth pattern and Condition factor of *Bagrus bayad* from two Rivers in Southern Nigeria. *Global Journal of Bio-science and Biotechnology*, (4): 330-334.
 10. Anyanwu, P.E., Okoro, B.C., Anyanwu, A.O., Matanmi, M.A., Ebonwu, B.I., Ayanbu - Cookey, I.K., Hamzat, M. D., Ihumekpen, F. and Afolabi, S. E. (2007) Length - weight relationship, condition factor and sex ratio of African mud catfish (*Clarias gariepinus*) reared in indoor water re-circulatory system tanks. *Arch Journal of Biological Sciences*, 2 (7): 780-783.
 11. Bagenal, T. (1978). *Method for assessment of fish production in Fresh water*. IBP Handbook No. 3. Blackwell Scientific Publications. Oxford London. 78pp.
 12. Cerda, J. B., Calman, G., Lafleur Jr, G. J. and Limesand, S. (1996). Pattern of vitellogenesis and follicle maturational competence during the ovarian follicular cycle of *Fundulus heteroclitus*. *General and comparative endocrinology*, 103(1):24- 35.
 13. Fange, R., and Nilsson, S. (1985). The fish spleen: structure and function. *Experientia*, 41: 152-158.
 14. Yamamoto, K. (1989). Contraction of spleen in three Perciformes and two Tetraodontiformes during severe exercise. *Comparative Biochemistry and Physiology*, 94A: 633-644.
 15. Lowerre-Barbieri, S. K., Henderson, N., Llopiz, J., Walters, S. and Bickford, J. (2021). Defining a spawning population. *Marina Ecology Progress Series*, 105-142.
 16. Mishra, S. and Saksena, D. N. (2012). Gonadosomatic index and fecundity of an Indian major carp *Labeo calbasu* in Gohad reservoir. *The Bioscan*, 7(1): 43-46.