Original Research Article

Estimation of Length-Weight and Condition Factor of Indian Major Carps and selected indigenous fish species in Chandrakesharreservoir, Dewas (M.P.), India

Abstract

This paper investigates the length-weight and condition factor of Indian major carps and selected indigenous fish species in Chandrakeshar Reservoir, located in Dewas, Madhya Pradesh, India during January, 2021 to December, 2023 throughout different seasons. The study aims to contribute valuable insights into the growth patterns and overall health status of these fish populations in the reservoir. A comprehensive survey was conducted to collect length and weight data from various individuals representing major carps, including *Catlacatla*, *Labeorohita*, and *Cirrhinusmrigala*, along with indigenous species prevalent in the region. The length-weight relationships for each species were determined using established methodologies, providing essential parameters for growth assessments. Concurrently, the condition factor (K) of fish well-being and habitat suitability, was calculated to evaluate the overall health and adaptability of the fish in the Chandrakeshar Reservoir. Results provides the basic information regarding fish productivity which may be suitable for better management of Indian major carps and indigenous fishes in Chandrakesharreservoir.

Keywords

Length-Weight, Condition Factor, Indian Major Carps, Indigenous Fish Species, Chandrakeshar Reservoir.

Introduction

The length-weight study is an approach that is widely applied in fisheries management as it provides information on stock condition [1]. Length-weight (LW) of fishes is important in fisheries and fish biology because they allow estimation of the average weight of the fish of a given length group by establishing a mathematical relation between them [2, 3]. The length-weight analysis proves to be a valuable method, offering insights into the reproductive history, well-being, spatial distribution of diverse ecologically distinct species, and enabling historical comparisons across various populations. Aquatic ecosystems play a pivotal role in sustaining biodiversity and

providing essential resources for human communities worldwide. Chandrakeshar Reservoir, nestled in the heart of Dewas, Madhya Pradesh, India, stands as a crucial component of this intricate network, fostering a diverse array of fish species. Among these inhabitants are the Indian Major Carps and various indigenous species, whose ecological roles and population dynamics are integral to the reservoir's overall health. Understanding the intricate relationships within these aquatic communities is imperative for effective fisheries management and the conservation of biodiversity. The Length-Weight (LW) and Condition Factor (CF) serve as valuable indicators, offering insights into the reproductive history, health conditions, and spatial distribution of fish populations. This comprehensive study endeavours to unravel the mysteries surrounding the LW and CF of Indian Major Carps and select indigenous fish species in Chandrakeshar Reservoir. The Indian Major Carps, comprising species such as *Catlacatla, Labeorohita*, and *Cirrhinusmrigala*, hold immense economic and cultural significance in the region. Simultaneously, the indigenous fish species such as *Securiculagora, Ompakpabda, Puntiussophore, Systomussarana* and *Xenontodoncancilla*etc., contribute to the reservoir's ecological balance, reflecting the resilience and adaptability of local aquatic life. By exploring the nuances of their Length-Weight and Condition Factor, we aim to decipher the intricate tapestry of their existence within this aquatic ecosystem.

The significance of this study extends beyond the reservoir's boundaries, providing valuable insights into the broader field of fisheries science. Therefore, the outcomes of this study of Chandrakeshar reservoir will furnish fundamental data that holds significance for stock assessment and fisheries management of the studied species. Additionally, these findings will serve as valuable benchmarks for comparing Length-Weight (LW) with those observed in other ecosystems.

Materials and methods

The Chandrakeshar Reservoir, situated in Dewas, Madhya Pradesh, spans the geographic coordinates of approximately latitude is 22˚37’00” N and longitude are 76˚2’30’’E. Covering an expansive surface area of around 110 km2, characterized by a mean depth of 12 meters, a maximum depth of 18.90 meters, and a maximum drawdown of 5 meters, Chandrakeshar Reservoir stands as a vital aquatic habitat in the region. The dam on Chandrakeshar River, a tributary of the Narmada River, serves a

multi-faceted purpose. Primarily constructed for irrigation to benefit nearby villages, the dam also plays a crucial role in providing water for drinking purposes. Additionally, local fishermen utilize the water for fish culture, further enhancing the reservoir's significance in supporting both agricultural and aquatic livelihoods in the region.

Fish samples were collected by using various fish nets viz; cast nets and gill nets with the help of local fishermen from a selected site. The fisher folks operating in this reservoir deploy surface and bottom set gill nets using various mesh sizes including 2,3, 4 & 5 cm. Collected fish fauna was instantly fixed in 10% formaldehyde. Ichthyofauna was identified with the help of keys [4, 5, 6]. Total length (cm) of each fish was taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin using a measuring board. Body weight was measured to the nearest gram using an Electronic Digital Balance. The Fulton's (1904) condition factor formula [$K = (W/L^3) \times 100$] was applied to assess the health condition of the fish populations. Results include Length-Weight Relationship parameters for each species, Condition Factor values indicating health status, and spatial distribution maps illustrating the presence of different species across the reservoir throughout 2021-23 in pre-monsoon, post-monsoon and winter seasons.

Result and discussion:

In this study, a comprehensive examination was conducted on a total of 22 fish species belonging to 7 families, namely Bagridae, Clariidae, Ambassidae, Channidae, Cyprinidae, Notopteridae, and Heteropneustidae, as illustrated in table 1 and table 2. The analysis encompassed all species, totalling 421 individuals distributed across the seven families. The age sizes of the fish exhibited significant variation, ranging from young to adult stages, each characterized by distinct growth rates. The length-weight distributions of fishes in the Chandrakeshar reservoir exhibited significant variations in fish sizes, suggesting efficient sampling with gill nets. The careful selection of mesh sizes in the nets played a role in capturing fish with lengths ranging from 1.6 to 90.0 cm and weights spanning from 0.1 to 11000g. With an average length ranging from 41.2 to 90 cm and an average weight spanning 65.6 to 11000g, *Catlacatla* demonstrates robust growth. The calculated Condition Factor (K) stands at 2.12. Exhibiting an average length of 32.2 to 59.4 cm and an average weight of 45.8 to 2600g, *Cirrhinusmrigala* showcases a diverse size range. The calculated K is 1.43. Since Fulton’s condition

factor, K is a measurement involving the length and weight for a particular fish, therefore it could be influenced by the same factors as LW. Barnham and Baxter (1998) proposed that if the K value is 1.00, the condition of the fish is poor, long and thin. The condition scale ranges from 1.6 for an excellent, trophy-class fish. A score of 1.4 indicates a good, well-proportioned fish, while 1.2 represents a fair fish acceptable to many anglers. This species, with an average length between 23.8 and 42.4 cm and an average weight ranging from 33.1 to 3600g, demonstrates a balanced growth pattern. The calculated K is 5.18. The overall average K value for Indian Major Carps is 2.91 which supports to the other studies [7, 8].

The study examined various indigenous fish species in Chandrakeshar Reservoir, showing a length range of 4.5 to 31 cm and a weight range of 17.75 to 283.3g, *Notopterusnotopterus* demonstrates adaptability [9]. The calculated K is 2.53. With a length range of 1.6 to 8.9 cm and a weight range of 5.25 to 10.9g, *Chandanama* exhibits a compact size. The calculated K is 3.80. This species, with a length range of 6.8 to 15.4 cm and a weight range of 11.1 to 756.8g, signifies diverse growth. The calculated K is 28.17. The overall average K value for Indigenous fish species is 5.91. This study supports to the other scientists who carried out the worked [10, 11].

Puntiussarana and *Puntiussophore* demonstrated healthy conditions, each with distinctive length-weight relationships and condition factors (K=2.79 and 2.97, respectively). *Labeocalbasu*exhibited robust growth with a K value of 3.66. *Labeobata* demonstrated excellent growth, boasting a condition factor of 5.29. *Cyprinuscarpio* showed diverse growth patterns with a substantial K value of 19.48. The results provide a comprehensive understanding of the growth dynamics and overall health of these indigenous fish species, contributing valuable data for fisheries management and conservation initiatives in the region, many factors could contribute to the differences of growth of fish such as differences of habitat, fish activities, food habits and seasonal growth rates [12, 13].

Conclusion

This study's findings indicate that the Chandrakeshar reservoir is a thriving aquatic environment, offering a habitat for a diverse range of freshwater fishes. This extensive study on the Length-Weight and Condition Factor of Indian Major Carps and Indigenous fish species across different seasons, the research not only sheds light on the growth patterns and health status of fish populations but also underscores the

resilience and adaptability of these species in a dynamic environment. The study showcases the diverse roles played by Indian Major Carps and indigenous species in maintaining ecological balance within Chandrakeshar reservoir.

The positive outcomes of this research extend beyond the reservoir's confines. The calculated average condition factors (K) of 2.91 for Indian Major Carps and 5.91 for Indigenous fish species reflect robust health and habitat suitability [14, 15]. These findings not only facilitate improved fisheries management in Chandrakeshar reservoir but also serve as a beacon for sustainable practices in aquatic ecosystems. The study stands as a testament to the intricate relationships within these aquatic communities, emphasizing the importance of informed decision-making for the conservation of biodiversity.

References:

1. Bagenal, T.B. &Tesch, F.W. 1978. Age and growth. In Methods for Assessment of Fish Production in Fresh Waters. 3rd ed., edited by Bagenal, T.B. Oxford: *Blackwell Scientific Publications*. pp. 101-136.
2. Sarkar, U.K., Deepak P.K., and Negi, R.S., (2008). Length-weight relationship of clown knifefish*Chitalachitala* (Hamilton 1822) from the Ganga basin, *India. J. Appl. Ichthyol.*, 25, 232-233.
3. Mir, J.I., Shabir, R. and Mir, F.A. (2012). Length-Weight Relationship and Condition Factor of Schizopygecurvifrons (Heckel, 1838) from River Jhelum, Kashmir, India. *World Journal of Fish and Marine Sciences*, 4 (3): 325-329.
4. Jayaram KC. The fresh water fishes of India, region. *Narendra Publication House*. Delhi 110006 (India). 1999.
5. Shrivastava GJ. A text book of fishes. VishwaVidyalayaPrakashan, Varanasi. 2007.
6. Talwar PK, Jhingran AG. Inland fishes of India and adjacent countries. Oxford and *IBH Publishing Co. Pvt. Ltd*., New Delhi 1991, 1-322.
7. Hossain, M. Y. 2010. Morphometric relationships of lengthweight and length-length of four cyprinid small indigenous fish species from the Padma River (NW Bangladesh). *Turk. J. Fish. Aquat. Sci*., 10: 131-134. DOI: 10.4194/ trjfas.2010.0118.

8. Jatoi, S., Baloch, W. A., Soomro, A. N. and Gachal, G. S. 2013. Length-weight relationship of the silurid catfish Sperataseenghala Sykes 1839 (Bagridae) from Indus River, Sindh, *Pakistan. Sindh. Univ. Res. J.*, 45(4): 661-664.

9. Karrar, A. M. H. M., Elkareem, M. M. E. A. and Ali, A. K. S. 2016. Length-weight relationship and condition factor of Nile tilapia [*Oreochromisniloticus* (Trewavas)] from White Nile, Sudan. *Environ. Nat. Res. Int. J.*, 1(1): 77-84.
10. Oscoz, J., Campos F. and Escala, M. C. 2005. Weight-length relationships of some fish species of the Iberian Peninsula. *J. Appl. Ichthyol*., 21(1): 73-74. https://doi.org/10.1111/ j.1439-0426.2004.00587. x.
11. Pauly, D., Gayanilo, Jr., F. C. 1997. ABee: An alternative approach to estimating the parameters of a length-weight relationship from length-frequency samples and their bulk weights. International Centre for Living Aquatic Resources Management, Manila, Philippines.
12. Lowe-McConnell R.H. 1987. In: M.M. Isa, C.S. Rawi, R. Rosla, S.A.M. Shah, A.S.R. Shah (Eds.). Length-weight relationships of freshwater fish species in Kerian River Basin and Pedu Lake. Research Journal of Fisheries and Hydrobiology 5(1): 1-8.
13. Mizuno N., Furtado J.I. 1982. In: M.M. Isa, C.S. Rawi, R. Rosla, S.A.M. Shah, A.S.R. Shah (Eds.). Length-weight relationships of freshwater fish species in Kerian River Basin and Pedu Lake. Research Journal of Fisheries and Hydrobiology 5(1): 1-8.
14. Sharma S, Mudgal LK, Sharma, Anjana, Sharma A. Fish diversity of YashwantSagar reservoir, Indore, (M.P.). Him. J.Env. Zool 2004;18(2).
15. Vyas V, Vishwakarma KS. Study on species diversity and assemblage of fish fauna of Jamner River: A Tributary of river Narmada. International. Journal of Theoretical & Applied Sciences 2014;5(2):84-89.

Table 1. Descriptive statistics and estimated parameters of length-weight relationship of Indian major carps from Chandrakeshar Reservoir during January, 2021 to December, 2023.

S. No	Scientific Name IMC	Order/ Family	No.of fish measured	Length(cm)		Avg	Weight(g)		Avg	Value of K [K = (W/L³) × 100]
				Min	Max		Min	Max		
1.	*Catlacatla*	Cypriniformes/cyprinidae	35	41.2	90	65.6	1000	11000	6000	2.12
2.	*Cirrhinusmrigala*	Cypriniformes/cyprinidae	18	32.2	59.4	45.8	160	2600	1380	1.43
3.	*Labeorohita*	Cypriniformes/cyprinidae	30	23.8	42.4	33.1	160	3600	1880	5.18
Average K value of IMC										2.91

Table 2. Descriptive statistics and estimated parameters of length-weight relationship of indigenous fishes from Chandrakeshar Reservoir during January, 2021 to December, 2023.

S. No	Scientific Name of Indigenous fishes	Order/ Family	No. of fish measured	Length (cm)		Avg	Weight(g)		Avg	Value of K [K = (W/L³) × 100]
				Min	Max		Min	Max		
1	*Notopterusnotopterus*	Osteoglossiformes/notopteridae	22	4.5	31	17.75	0.79	283.3	142.04	2.53
2	*Rasboradaniconius*	Cypriniformes/cyprinidae	18	3.8	11.4	7.6	0.3	20.4	10.35	2.35
3	*Puntiussarana*	Cypriniformes/cyprinidae	16	4.2	10.8	7.5	0.8	22.8	11.8	2.79
4	*Puntiussophore*	Cypriniformes/cyprinidae	20	3.4	10.5	6.95	0.5	19.5	10	2.97
5	*Labeocalbasu*	Cypriniformes/cyprinidae	16	4.8	48.5	26.65	2	1387.2	694.6	3.66
6	*Labeogonius*	Cypriniformes/cyprinidae	13	150	420	285	20	850	435	0.00
7	*Labeobata*	Cypriniformes/ Cyprinidae	22	11.5	27.2	19.35	17	750	383.5	5.29
8	*Labeofimbriatus*	Cypriniformes/ Cyprinidae	16	10.3	25.6	17.95	23	560	291.5	5.04
9	*Cyprinuscarpio*	Cypriniformes/cyprinidae	23	8.6	29.5	19.05	13.6	2680.8	1347.2	19.48
13	*Cirrhinusreba*	Cypriniformes/ Cyprinidae	20	8.9	22.4	15.65	12.5	490.8	251.65	6.56
14	*Mystuscavasius*	Siluriformes/Bagridae	16	4.2	12.6	8.4	1.2	26.4	13.8	2.32
	Channa punctata	Anabantiformes/Channidae	23	3.6	23.1	13.35	0.5	135.9	68.2	2.86

15	*Mystusseenghala*	Siluriformes/Bagridae	15	5.6	56.6	31.1	4.6	1657.8	831.2	2.76
16	*Heteropneustesfossillis*	Siluriformes/heteropnuestidae	20	3.9	18.6	11.25	1.9	230.4	116.15	8.15
17	*Clariasbatrachus*	Siluriformes/clariidae	18	6.8	15.4	11.1	13.8	756.8	385.3	28.17
18	*Chandanama*	Perciformes/ambassidae	30	1.6	8.9	5.25	0.1	10.9	5.5	3.80
19	*Chandaranga*	Perciformes/ambassidae	30	2.2	6.7	4.45	0.1	2.9	1.5	1.70
Average K value of Indigenous fish species										5.91

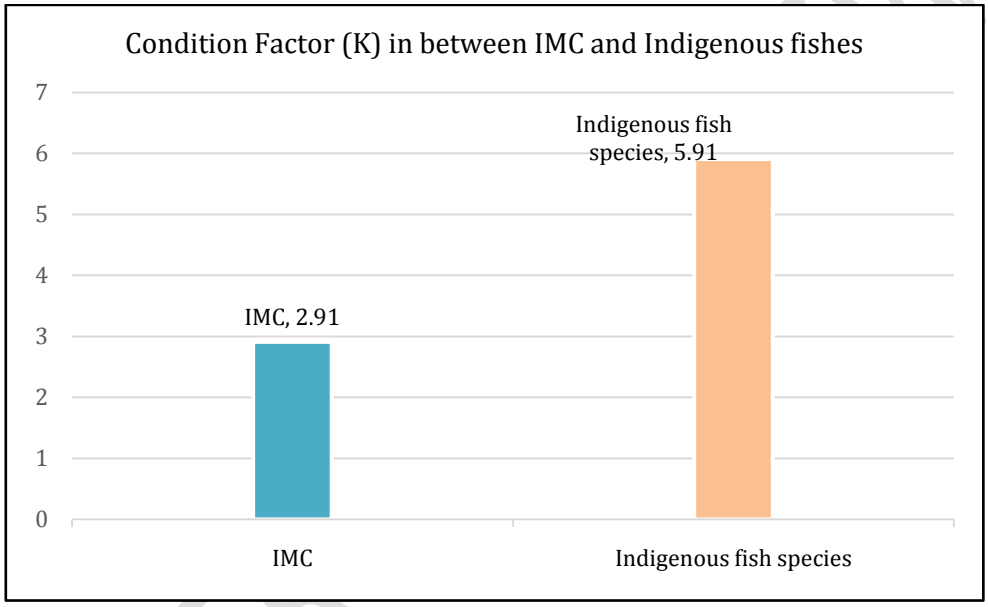

Fig. 1. Statistical analysis of condition factor (K) in between IMC and indigenous fishes of Chandrakeshar reservoir.