Length-Weight Relationship and Condition Factor of African Big Barb *Labeobarbus intermedius* (Rüppell, 1836) in Ethiopian Freshwater Bodies: A Review

Agumassie Tesfahun, Mathewos Temesgen, L. Prabhadevi
Department of Biology, Ambo University, Ethiopia

Corresponding author Email: agumase2012@yahoo.com

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**Abstract**

The investigations on length-weight relationship and condition factor of the African big barb *Labeobarbus intermedius* (Rüppell, 1836) in Ethiopian water bodies have shown varied pattern including nearly isometric (b ≈ 3), negative (b < 3) and positive (b > 3) allometric. The Fulton condition factor (K) of *L. intermedius* is high (1.73) in Lake Ziway, however, declined in most rivers and lakes and also exhibits seasonal variation. Fish had a better body condition (2.73) during wet season in Angereb and Sanja Rivers. There is variation in condition factor with respect to sex in which females had better body condition (1.88) in Lake Ziway. The length-weight relationship and condition factor of *L. intermedius* is correlated with availability of food and water quality parameters justifying the need for effective management of this fish stock for conservation and continued fishing.

**Keywords** Fulton Condition Factor; Length-weight; *L. intermedius*

1 Background

The African big barb *Labeobarbus intermedius* is a widely distributed fish species in Northern Kenya and in most parts of Ethiopian drainage basin (Dadebo et al., 2013). It is widely distributed in the rift valley basin, Abay basin and Baro-Akobo basin part of Ethiopia, of which Lake Tana harbors the largest number of big barb species (Vijverberg et al., 2012; Awoke, 2015). It is one of the most commercially important fish species in the country (LFDP4, 1997; Bjorklis, 2004; Desta et al., 2006). The total annual yield of *L. intermedius* from the total inland water bodies is estimated to be about 365 tons per year (LFDP, 1997). However, recently *L. intermedius* catch from rift valley lakes (Lake Hawassa and Lake Koka) declined and reported to be unsafe for human consumption due to high mercury concentration (Mengesha, 2009). The decline of the fish species due to overfishing and parasitic infection has result the less accessibility of the fish on the local markets (Desta et al., 2006; Mengesha, 2009; Dadebo et al., 2013).

Length-weight relationship (LWR) is one of the most important biological tools in fishery management. It is used to estimate the average weight at which a fish can attain the given length (Lawson et al., 2013). Relationship between the two also indicates the wellbeing of fishes (Hamid et al., 2015). The difference in LWR is based on the inherited body shape and condition of individual fish. Condition factor shows the degree of wellbeing of fishes in their habitat, which is expressed by coefficient of body condition. It is a measure of various biological and ecological factors with regard to their feeding conditions (Nehemia et al., 2012). High values of condition factor indicate better body condition. However it is affected by stress, sex, season, availability of food and the quality of water where it grows (Ighwela et al., 2011).

The study of length-weight relationship and condition factor of freshwater fish species is a subject of continuous research as it is a basis for the development of a successful management program on fish capture and culture (Shalloof et al., 2009) in wild and controlled environments. In addition, the information is vital for management of the fish taken from different habitat types, feeding habits and species interaction under culture systems. The length-weight relationship and condition factor of *L. intermedius* have been reported from several water bodies (Admasu and Dadebo, 1997; Tesfaye, 2006; Anteneh, 2007; Berie, 2007; Gebremedhin et al., 2012; Dadebo et al., 2013).
Wakjira, 2013; Engdaw, 2014; Gebremedhin and Mengist, 2014; Awoke et al., 2015; Teshome et al., 2015; Abera, 2016; Melaku et al., 2017; Temesgen, 2017). However, there is no compiled information on the length-weight relationship and condition factor of *L. intermedius* in different Ethiopian water bodies. Therefore, this review paper is aimed to assess the length-weight relationship and condition factor of the African big barb *Labeobarbus intermedius* in Ethiopian water bodies.

2 Materials and Methods

Data sources were collected from June, 2017 through November, 2017. A range of literature sources were used for this review including journal articles, books and book chapters, workshop proceedings, FAO reports, bulletins, legal documents, and unpublished reports including PhD dissertations. The documents were collected from University libraries and Ethiopian Ministry of Livestock and fishery, from individual researchers, and from the Internet data bases.

2.1 Some biological parameters of *L. intermedius* in lentic and lotic systems

2.1.1 Length-weight relationship

The length-weight relationship indicates the wellbeing of fishes (Hamid et al., 2015). Fish can attain either isometric, negative allometric or positive allometric growth in its life (Nehemia et al., 2012). Isometric growth (b=3) is the type of growth when all the body parts grow at an approximately the same rate as the fish grows. The isometric growth pattern was reported from Lake Tana and tributaries of Blue Nile (Tesfaye, 2006; Gebremedhin et al., 2012; Gebremedhin and Mengist, 2014; Engdaw, 2014; Awoke et al., 2015) (Figure 1). Negative allometric growth (b<3) is the type of growth in which fish become slender as it increases in weight. *Labeobarbus intermedius* caught from Lake Langano, Gilgel Gibe reservoir and some tributaries of White Nile (Wakjira, 2013; Abera, 2016; Melaku et al., 2017; Temesgen, 2017) (Figure 1) such negative pattern. Positive allometric growth (b>3) in which fish become relatively deeper-bodied as it increases in length (Riedel et al., 2007) has been found in Gelgel Beles and koka reservoir population (Dadebo et al., 2013; Berie, 2007) (Figure 1). According to Bagenal and Tesch (1978) the differences in regression coefficient b (growth parameters) might be due to seasonal fluctuations in water quality parameters, food availability, feeding rate, gonad development and spawning period. The nearly isometric growth pattern in most common for this species are in both riverine and lacustrine environments (Figure 1).

![Figure 1 Regression coefficient (b) values of *L. intermedius*](image)

2.1.2 Fulton Condition Factor (FCF)

Condition factor expresses the degree of wellbeing of fishes in their habitat. On the other hand it is a measure of various biological and ecological factors with regard to their feeding conditions (Nehemia et al., 2012). Food availability in the water bodies are influenced by the changes in the water chemistry due to variations in the atmosphere and the surrounding environments (Pothoven et al., 2001). The condition factor of *L. intermedius*
showed variations among the populations in the rivers and reservoirs. It was comparatively high (1.14, 1.1, 1.05) respectively in Angereb (Tesfaye, 2006) in Beles and Sanja Rivers (Berie, 2007) than Gilgel Beles (0.99) (Dadebo et al., 2013) and Nile River (0.99) (Awoke et al., 2015). Higher condition is associated with high energy content, adequate food availability, reproductive potential and favorable environmental conditions. Relatively higher condition factors were reported from Lake Ziway (1.73) (Abera, 2016), in Lake Langeno (1.33) (Temesgen, 2017), Arno-Garno River (1.3), Aveya River (1.22) (Gebremedhin et al., 2012), (Wakjira, 2013) Geba and Sor Rivers (1.21) (Melaku et al., 2017) and Gilgel Gibe Reservoir (1.18) (Gebremedhin and Mengist, 2014) (Figure 2). The condition factor from Lake Koka was (1.0) (Dadebo et al., 2013) lower than Lake Ziway and Lake Langeno (Figure 2).

Ighwela et al. (2011) stated that seasonal fluctuations in food quantity and quality, water level, flow rate and temperature affect the condition factor of fishes. The mean Fulton condition factor of this species was greater in dry season (1.1) than wet (0.9) in Lake Koka (Dadebo et al., 2013) period. Similar seasonality was observed in Arno-Garno River (Gebremedhin et al., 2012) however, the values were higher (1.39 in dry season) (1.28 wet season) than Lake Koka. Comparatively high condition factor values during wet season than dry season were observed in Angereb and Sanja Rivers (Tesfaye, 2006), Aveya River (Gebremedhin and Mengist, 2014), Gilgel Gibe Reservoir (Wakjira, 2013). The condition factor of the species did not varied very much between the seasons in Geba and Sor Rivers (Melaku et al., 2017), Beles and Gilgel Beles (Berie, 2007) and in Nile River (Awoke et al., 2015) (Figure 3).
The body condition of fish is affected during peak spawning season the energy requirement for egg development in females and sperm production in males (Ighwela et al., 2011; Gebremedhin et al., 2012). Based on this male fishes were found in better condition (1.36) than females (1.28) in Arno-Garno River (Gebremedhin et al., 2012).

However, females were in better condition in Beles River (Berie, 2007) Aveya River (Gebremedhin and Mengist, 2014) (Figure 4). In Lake Ziway, female fishes showed the highest mean condition factor (1.88) than males (1.52) (Abera, 2016). Whereas in Lake Koka (Dadebo et al., 2013) the condition factor did not vary considerably among the sexes. Such a condition was reported from Nile River (Awoke et al., 2015) and Gilgel Beles River (Berie, 2007). It leads to conclude that high condition index of fish is associated with the amount of energy (fat) content, type of food available, reproductive potential and favorable environmental conditions (Paukert and Rogers, 2004).

Figure 4 Fulton Condition Factor (Mean) male and female *L. intermedius*

**3 Conclusion**

Growth pattern of fish varied in the different water bodies however, comparatively good condition factor was found in the fishes collected from Lake Ziway and Lake Langano than those observed from the rivers. The body condition of fish also varied with seasons and sex in the water bodies considered. Therefore, proper management of aquatic ecosystems is vital for sustainable fish stock utilization in the country.

**Authors’ contributions**

Agumassie Tesfahun and Mathewos Temesgen have compiled the data and prepared the manuscript. Dr. Prabhadevi has edited and contributed in the finalization of the manuscript. All authors read and approved the final manuscript.

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