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Length-weight relationship of invasive Mozambique Tilapia, *Oreochromis mossambicus* (Peters, 1852) from Veli estuary, Kerala, India

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ABSTRACT

The length-weight relationship (LWR) was investigated for *Oreochromis mossambicus* from the Veli estuary. A total of 532 fish (243 males and 289 females) were collected from the landing centre. LWR estimated by the least square method showed 'b' values significantly lesser than the isometric value of 3 (males – 2.524, females – 2.776, combined – 2.682). The low determination coefficients (r^2) suggest a negative allometric growth pattern for the fish. The study indicates the need for further in-depth investigations on the population dynamics of fish groups of the estuary for proper fishery management.

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O. mossambicus, Veli estuary, Length-weight measurement, Allometric

1. Introduction

Length-weight relationships (LWRs) are important parameters to study fish biology and fishery management. LWR is influenced by various environmental and climatic factors like temperature, feeding and breeding niches, sex, etc. (Nallathambi *et al.*, 2019). These parameters are widely used to assess growth and biomass from length data (Garcia *et al.*, 1998; Renjith *et al.*, 2020). The Mozambique tilapia, *Oreochromis mossambicus*, is native to rivers of central and southern Africa (Trewavas, 1982). Still, owing to its suitability as an aquaculture species, it is widely distributed worldwide. But of late, invasive populations of *O. mossambicus* have been reported to cause environmental and ecological problems in many countries (Canonico *et al.*, 2005), and the species is listed in the Global Invasive Species Database (2020) as being one of the top 100 invasive alien species on the planet. The fish was introduced to India during the early 1950s for stocking in reservoirs and lakes of Southern India to ensure food security for people (Sugunan, 1995), and since then, it has become one of the major components of the inland fishery catch of India. The present study aims to assess the LWR of *O. mossambicus* in the Veli estuary, an important urban water body of Kerala, India.

2. Materials and Methods

2.1. Study area

The Veli estuary, situated between 8°25′ and 8°35′ N and 76°50′ and76°58′ E, in Thiruvananthapuram, Kerala, is one of the smallest estuaries along the southwest coast of India. It is a shallow temporary estuary, with a mean depth of 2-3 m and a total area of 0.853 sq. km (Regi, 2014), which remains separated from the Arabian Sea by a sand bar. The estuary and its backwaters form a major source of inland fisheries and provide livelihood for fishermen families in the locality.

2.2. Length-weight measurements

Samples of *O. mossambicus* were collected monthly from April 2013 to March 2014 from the landing center near the estuary. A total of 532 fish samples (243 males and 289 females) were collected. The specimens were preserved in ice and brought to the laboratory. The total length (TL) and standard length (SL) of the fish samples were measured using a string and ruler and also digital calipers (0.1 cm precision). Total body weight (TW) was measured using a digital weighing balance of 0.01 g accuracy. The sex of the fish samples was determined by dissecting through the vent and observing the gonads.

LWR was estimated separately for male, female and combined fish groups using the equation $W = a L^b$ (Le Cren, 1951; Froese, 2006), after logarithmic transformation to $\log W = \log a + b \log L$, where W is the total weight (g), L is the total length (cm), 'a' and 'b' the intercept and the slope of the regression coefficient respectively.

Statistical analyses were performed using the software package IBM-SPSS Statistics.

3. Results and Discussion

The TL and TW of the *O. mossambicus* specimens collected from Veli estuary ranged from 59 to 267 mm and 9 to 262 g in males and 97 to 257 mm and 16 to 250 g in females, respectively. The LWR calculated using the method of least squares for male and female *O. mossambicus* separately and for combined sexes is shown in Table 1. The plots with empirical values of TL against their respective TW obtained smooth curves (Fig. 1-3).

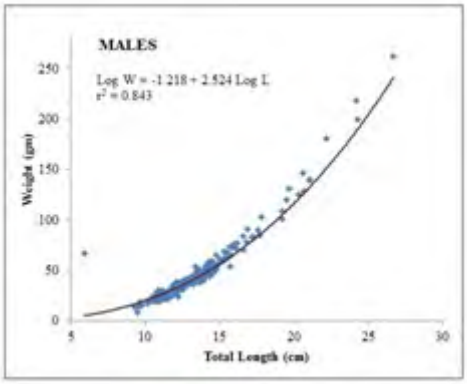

Fig. 1. Length-weight relationship of *O. mossambicus* (males)

Table 1. Sex-wise length-weight relationship of *O. mossambicus*

Sex groups	No. of specimens	Length-weight relationship	
Males	243	$W = 0.060534L^{2.524}$	Log W = -1.218 + 2.524 Log L
Females	289	$W = 0.033037L^{2.776}$	Log W = -1.481 + 2.776 Log L
Combined	532	$W = 0.041305L^{2.682}$	Log W = -1.384 + 2.682 Log L

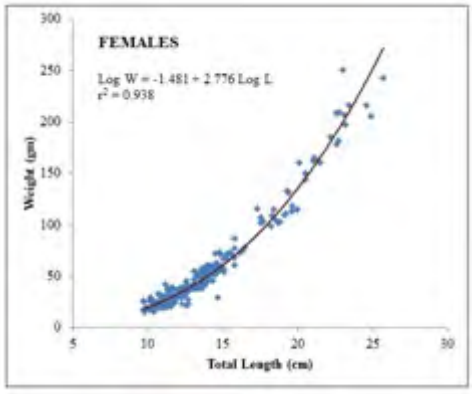

Fig. 2. Length-weight relationship of *O. mossambicus* (females)

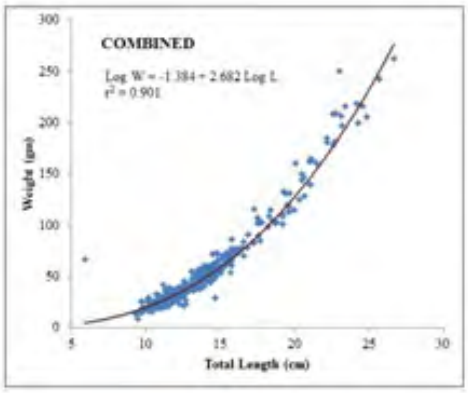

Fig. 3. Length-weight relationship of *O. mossambicus* (combined)

The allometric coefficients ('b' values) of the male, female and combined fish groups were in the expected range of 2.5 to 3.5 (Froese, 2006). The highest 'b' value was observed for females, followed by sexes combined and the male fishes. The higher 'b' value of 2.776 indicates that the female fishes gain weight faster in relation to the length than males and combined sexes (2.524 and 2.682, respectively). This can be attributed to the studies that female fishes are heavier than males of the same lengths, probably because of the difference in fatness and gonadal development (Le Cren, 1951). The 'b' values usually range from 2.5 to 4.0 for many fish species (Pervin and Mortuza, 2008). Student's t-test indicated that the observed 'b' values for all sex groups of *O. mossambicus* deviated significantly from the isometric value of 3, tending towards negative allometric growth, indicating that the fish tends to become more slender as it increases in weight (Riedel *et al*., 2007). Differences in 'b' values and its variations from the isometric value can also arise due to variations in habitat, gonadal maturity and preservation techniques, among others (Wooton 1990; Ambily and Bijoy Nandan, 2010), and also to evolutionary selection (Kharat *et al*. 2008). The 'b' value of *O. mossambicus* varies from habitat to habitat (Jayaraj, 2000; Hatikakoty and Biswas, 2004; Subha, 2011). This could be attributed to the nature of growth, which depends on environmental factors. The negative allometric growth pattern in fish has also been related to food supply problems and fish density in the water (Murphy *et al*., 1991).

The determination coefficient (r^2) values showed the best fit for females (0.938), followed by combined sexes (0.901) and male fishes (0.843). The low r^2 values estimated for *O. mossambicus* suggest its disproportionate growth (Renjith *et al.*, 2020), which should be taken into consideration as it has emerged as the dominant fish group and forms the major component that determines the trophic structure of the Veli estuary.

4. Conclusion

Over three decades, *O. mossambicus* has emerged as the dominant fish group in the Veli estuary (Regi, 2014). Despite the ecological ill-effects it imposes on other indigenous fish groups, *O. mossambicus*is the main component of the fishery of the estuary, which supports the livelihood of local fishermen. In this context, the negative allometric growth pattern exhibited by the *O. mossambicus* population of Veli estuary during this study raises a concern, considering the habitat is found conducible for the optimum fish growth. Further in-depth study of the population dynamics of the fish groups in the estuary needs to be undertaken to design a framework for sustainable management of fishery in the estuary.

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