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Length–weight relationships of four fish species from Fatala estuary, Guinea, West Africa

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Abstract :

This study provides length-weight relationships (LWR) that had not yet been reported for four fish species belonging to four different families: Chrysichthys johnelsi Daget, 1959, Cynoglossus senegalensis (Kaup, 1858), Citharichthys stampflii (Steindachner, 1894) and Pseudotolithus typus, Bleeker, 1863. Data were collected in the Fatala estuary, republic of Guinea, each month between January 1993 and March 1994, using alternately a purse seine net (length 250 m, height 20 m, 14 mm side mesh) and gillnets (side mesh sizes of 10, 12.5, 15, 15.5, 20, 22.5, 25, 30, 35 and 40 mm). For each fish specimen, fork or total length and total weight were measured with precision to 0.1 cm and 0.1 g respectively. A wider size range, compared to the size range available in FishBase, was obtained for Pseudotolithus typus. The present study also provides a new maximum total length for Citharichthys stampflii. The determination coefficient (r^2) between length and total body weight ranged between 0.958 in Citharichthys stampflii and 0.989 in Cynoglossus senegalensis. The allometric coefficient b varied from 2.9552 (Chrysichthys johnelsi) to 3.7288 (Citharichthys stampflii). The value of LWRs for the four fish species should assist fisheries scientists and managers to complement their further studies of population parameters to improve management decisions in Fatala estuary and, more widely, in West Africa.

Keywords : Fatala estuary, fish species, Guinea, length–weight relationships

INTRODUCTION

Fisheries management and research often require the use of biometric relationships to transform field data into appropriate indices (Ecoutin & Albaret, 2003). Among them, length-weight relationships (LWR) are useful for weight prediction and estimation of fish biomass from length data collected by visual census as an indication for fish stock assessment (Carlander, 1969; Froese & Pauly, 2021). This is particulary relevant in data-poor species and stocks where new studies are of great importance to improve species-specific estimates and increase the reliability of on-line databases (Froese et al., 2014). Consequently, the present study provides length-weight relationships for four fish species from the Fatala estuary to assist in future conservation and management.

MATERIALS AND METHODS

The Fatala estuary is located in the republic of Guinea between 10.0° and 10.3° North and between 14.0° and 14.25° West (Simier et al., 2019). It is subject to a humid tropical climate of the sub-Guinean type characterized by an alternating dry season from November to May and a rainy season culminating in July. Rainfall is very high (around 3500 $mm.year^{-1}$), and the hydrological maximum occurs in August-September (Simier & Ecoutin, 2017). The estuarine zone is limited 60 km upstream by a rocky sill where both the dynamic tide and the salt tide stop. The sampling plan set 7 locations located in the estuary, respectively at 3, 10, 17, 24, 33, 39 and 46 km from the mouth, plus one at sea, in the extension of the mouth. Two fishing methods were used alternately each month between 24/01/1993 and 22/03/1994 to describe the variations in the fish population in a complementary way (Baran, 1995). The first one was a purse seine (length 250 m, height 20 m, 14 mm side mesh); two fishing hauls were made per location, one in the channel, the other as close to the bank as possible (minimum water height 2 m) (Simier & Ecoutin, 2017). The second one, gillnets, was used for better sampling of the riparian habitat. Sampling was carried out using batteries of gillnets set at night, parallel to the bank. Each set consisted of ten nets mounted at 50%, with dimensions of 25 m x 2 m in fishing. The white knotted multifilament nets had mesh sizes of 10, 12.5, 15, 15.5, 20, 22.5, 25, 30, 35 and 40 mm respectively. Four sites were set, common to the purse seine sampling, located respectively at 3, 17, 33 and 46 km from the mouth. For each site, 4 replicates were defined, corresponding to two successive nights of fishing on each bank of the river (Simier & Ecoutin, 2017). A total of 212 purse seine fishing hauls were carried out and 952 gillnets were set, corresponding to 96 batteries.

Fish were identified to the species level, measured to the nearest mm (fork length for fish with a forked caudal fin, total length for species with a pointed caudal fin) (Baran, 1995), and weighed to the nearest g. All data are available in PPEAO database (Simier et al., 2019). Linear regressions of log(W) *vs.* log(L), where W is total weight in g, L is total or fork length in cm, were calculated to obtain the length-weight relationship of the form $W = aL^b$ (Froese, 2006) where log(a) is the intercept and b is the slope of the regression. Length and weight data were first plotted to identify outliers, the most extreme of which were finally excluded from the analyses.

RESULTS

Sample size, length and weight ranges and parameters of the LWR equations with 95%

confidence limits and values of the determination coefficient (r^2) were computed for the four species and reported in Table 1. Length-weight relationships for all species were highly significant (Table 1; $P < 0.01$). All fish species had the allometric coefficient b in the LWR equations between 2.9552 (*Chrysichthys johnelsi*) and 3.7288 (*Citharichthys stampflii*). The coefficient of determination (r^2) between length and weight varied from 0.958 (*Citharichthys stampflii*, n=51) to 0.989 (*Cynoglossus senegalensis*, n=28*).*

DISCUSSION

Length-weight data from purse seine sampling in the Fatala estuary had been included in a global study on LWR of species from estuaries and lagoons in West Africa by Ecoutin & Albaret (2003). The present work focused on historical data from the Fatala estuary with much more individuals thanks to additional data from gillnets sampling. Due to their importance, the study of historical data provides results that allow comparisons or modelling of the biogeographical life cycle of fish species and fish stocks. The slope values (b) of LWRs fell within the expected range of 2.5-3.5 as expected by Carlander (1969) and Froese (2006) for all species except *Citharichthys stampflii*. A new maximum total length was presented for *Citharichthys stampflii.* The size range of *Pseudotolithus typus* obtained in this study was larger than that reported in FishBase. Therefore, our study provides a significant baseline study on the LWRs of four fish species from Fatala estuary. These results are useful for further studies or for other key parameters needed for fisheries management (Gonçalves et al., 1997; Fromentin & Fonteneau, 2001; Moutopoulos & Stergiou, 2002; De La Cruz Agüero et al., 2011; Saberi et al., 2017). The results presented here are reliable and can enrich length-weight relationships and maximum lengths in FishBase (Froese & Pauly, 2021).

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Data availability statement: Data are available at http://ppeao.ird.fr or upon request to ppeao@ird.fr

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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Table 1. Synthesis of studies on length–weight relationship (LWR) of four fish species from the Fatala estuary in Guinea. Abbreviations: n, sample size; Max, maximum; Min, minimum; a and b, parameters of LWR; CL, confidence limits; r^2, coefficient of determination. Species: [f], fork length; [t], Total length. Lmax fishbase, maximum length in Fishbase.

Species	n	Length (cm)	Weight (g)	Relationship parameters			Lmax Fishbase
		Min-Max	Min-Max	a (95%CL)	b (95%CL)	r^2	
Claroteidae							
Chrysichthys johnelsi [f] Daget, 1959	67	7.5-33.4	4-430	0.013 (0.010-0.016)	2.9552 (2.8713-3.0392)	0.987	33
Cynoglossidae							
Cynoglossus senegalensis [t] (Kaup, 1858)	28	14.5-63.5	9-805	0.002 (0.001-0.003)	3.1322 (3.0009-3.2634)	0.989	66.5
Cyclopsettidae							
Citharichthys stampflii [t] (Steindachner, 1894)	51	5.8-19.0	1-73	0.001 (0.001-0.002)	3.7288 (3.5044-3.9533)	0.958	16
Sciaenidae							
Pseudotolithus typus [t] Bleeker, 1863	54	27.3-84.2	115-3500	0.005 (0.003-0.008)	3.0642 (2.9310-3.1974)	0.976	140