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

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## 26 **Summary**

27 This study provides length-weight relationships (LWR) that had not yet been reported for  
28 four fish species belonging to four different families: *Chrysichthys johnelsi* Daget, 1959,  
29 *Cynoglossus senegalensis* (Kaup, 1858), *Citharichthys stampflii* (Steindachner, 1894) and  
30 *Pseudotolithus typus*, Bleeker, 1863. Data were collected in the Fatala estuary, republic of  
31 Guinea, each month between January 1993 and March 1994, using alternately a purse seine  
32 net (length 250 m, height 20 m, 14 mm side mesh) and gillnets (side mesh sizes of 10, 12.5,  
33 15, 15.5, 20, 22.5, 25, 30, 35 and 40 mm). For each fish specimen, fork or total length and  
34 total weight were measured with precision to 0.1 cm and 0.1 g respectively. A wider size  
35 range, compared to the size range available in FishBase, was obtained for *Pseudotolithus*  
36 *typus*. The present study also provides a new maximum total length for *Citharichthys*  
37 *stampflii*. The determination coefficient ( $r^2$ ) between length and total body weight ranged  
38 between 0.958 in *Citharichthys stampflii* and 0.989 in *Cynoglossus senegalensis*. The  
39 allometric coefficient  $b$  varied from 2.9552 (*Chrysichthys johnelsi*) to 3.7288 (*Citharichthys*  
40 *stampflii*). The value of LWRs for the four fish species should assist fisheries scientists and  
41 managers to complement their further studies of population parameters to improve  
42 management decisions in Fatala estuary and, more widely, in West Africa.

43  
44 **Key words:** Length–weight relationships, fish species, Fatala estuary, Guinea

45

47 **INTRODUCTION**

48 Fisheries management and research often require the use of biometric relationships to  
49 transform field data into appropriate indices (Ecoutin & Albaret, 2003). Among them, length-  
50 weight relationships (LWR) are useful for weight prediction and estimation of fish biomass  
51 from length data collected by visual census as an indication for fish stock assessment  
52 (Carlander, 1969; Froese, 2006). This is particularly relevant in data-poor species and stocks  
53 where new studies are of great importance to improve species-specific estimates and increase  
54 the reliability of on-line databases (Froese et al., 2014). Consequently, the present study  
55 provides length-weight relationships for four fish species from the Fatala estuary to assist in  
56 future conservation and management.

57 **MATERIALS AND METHODS**

58 The Fatala estuary is located in the republic of Guinea between 10.0° and 10.3° North and  
59 between 14.0° and 14.25° West (Simier et al., 2019). It is subject to a humid tropical climate  
60 of the sub-Guinean type characterized by an alternating dry season from November to May  
61 and a rainy season culminating in July. Rainfall is very high (around 3500 mm.year<sup>-1</sup>), and  
62 the hydrological maximum occurs in August-September (Simier & Ecoutin, 2017). The  
63 estuarine zone is limited 60 km upstream by a rocky sill where both the dynamic tide and the  
64 salt tide stop. The sampling plan set 7 locations located in the estuary, respectively at 3, 10,  
65 17, 24, 33, 39 and 46 km from the mouth, plus one at sea, in the extension of the mouth. Two  
66 fishing methods were used alternately each month between 24/01/1993 and 22/03/1994 to  
67 describe the variations in the fish population in a complementary way (Baran, 1995). The first  
68 one was a purse seine (length 250 m, height 20 m, 14 mm side mesh); two fishing hauls were  
69 made per location, one in the channel, the other as close to the bank as possible (minimum  
70 water height 2 m) (Simier & Ecoutin, 2017). The second one, gillnets, was used for better  
71 sampling of the riparian habitat. Sampling was carried out using batteries of gillnets set at  
72 night, parallel to the bank. Each set consisted of ten nets mounted at 50%, with dimensions of  
73 25 m x 2 m in fishing. The white knotted multifilament nets had mesh sizes of 10, 12.5, 15,  
74 15.5, 20, 22.5, 25, 30, 35 and 40 mm respectively. Four sites were set, common to the purse  
75 seine sampling, located respectively at 3, 17, 33 and 46 km from the mouth. For each site, 4  
76 replicates were defined, corresponding to two successive nights of fishing on each bank of  
77 the river (Simier & Ecoutin, 2017). A total of 212 purse seine fishing hauls were carried out  
78 and 952 gillnets were set, corresponding to 96 batteries.

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

87 **RESULTS**

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

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

## 95 DISCUSSION

96 Length-weight data from purse seine sampling in the Fatala estuary had been included in a  
97 global study on LWR of species from estuaries and lagoons in West Africa by Ecoutin &  
98 Albaret (2003). The present work focused on historical data from the Fatala estuary with  
99 much more individuals thanks to additional data from gillnets sampling. Due to their  
100 importance, the study of historical data provides results that allow comparisons or modelling  
101 of the biogeographical life cycle of fish species and fish stocks. The slope values ( $b$ ) of  
102 LWRs fell within the expected range of 2.5-3.5 as expected by Carlander (1969) and Froese  
103 (2006) for all species except *Citharichthys stampflii*. A new maximum total length was  
104 presented for *Citharichthys stampflii*. The size range of *Pseudotolithus typus* obtained in this  
105 study was larger than that reported in FishBase. Therefore, our study provides a significant  
106 baseline study on the LWRs of four fish species from Fatala estuary. These results are useful  
107 for further studies or for other key parameters needed for fisheries management (Gonçalves et  
108 al., 1997; Fromentin & Fonteneau, 2001; Moutopoulos & Stergiou, 2002; De La Cruz Agüero  
109 et al., 2011; Saberi et al., 2017). The results presented here are reliable and can enrich length-  
110 weight relationships and maximum lengths in FishBase (Froese & Pauly, 2021).

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117 fieldwork and in the laboratory, at that time.

118 **Data availability statement:** Data are available at <http://ppeao.ird.fr> or upon request to  
119 [ppeao@ird.fr](mailto:ppeao@ird.fr)

## 120 CONFLICT OF INTEREST

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

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166

167 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,  
 168 maximum; Min, minimum; a and b, parameters of LWR; CL, confidence limits;  $r^2$ , coefficient of determination. Species: <sup>f</sup>, fork length; <sup>t</sup>, Total length. Lmax  
 169 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)	$r^2$	
<b>Claroteidae</b>							
<i>Chrysichthys johnelsi</i> <sup>f</sup> Daget, 1959	67	7.5-33.4	4-430	0.013 (0.010-0.016)	2.9552 (2.8713-3.0392)	0.987	33
<b>Cynoglossidae</b>							
<i>Cynoglossus senegalensis</i> <sup>t</sup> (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
<b>Cyclopsettidae</b>							
<i>Citharichthys stampflii</i> <sup>t</sup> (Steindachner, 1894)	51	5.8-19.0	1-73	0.001 (0.001-0.002)	3.7288 (3.5044-3.9533)	0.958	16
<b>Sciaenidae</b>							
<i>Pseudotolithus typus</i> <sup>t</sup> Bleeker, 1863	54	27.3-84.2	115-3500	0.005 (0.003-0.008)	3.0642 (2.9310-3.1974)	0.976	140

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