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Length-weight relationships of *Sarotherodon melanotheron melanotheron* (Pisces: Cichlidae) in Benin (West Africa)

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Abstract

Length-weight relationship is of great importance in fishery assessments and biomass estimation. The present study reports length-weight relationships for six populations of *Sarotherodon melanotheron melanotheron* (Pisces, Cichlidae) captured in fresh and brackish waters in Benin (Lagoon of Porto-Novo, Lake Nokoue, Coastal Lagoon, Lake Aheme, Lake Toho and Dam SUCOBE). Nine hundred (900) individuals of *S. melanotheron melanotheron* were analyzed. The results are very important to the management and conservation of the specie in Benin.

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Introduction

Length-weight relationship (LWR) is of great importance in fishery assessments (Krause *et al*., 1998; Haimovici and Velasco, 2000; *Jennings et al*., 2000; Øvredal and Totland, 2002; Ecoutin *et al*., 2005; Froese, 2006 ; Samat *et al*., 2008).

These relationships are often used to estimate biomass from length observations (Andrade and Camos, 2002) and to convert growth-in- length equations to growth-in-weight for use in stock assessment models (Pauly, 1993), and for life history and morphological comparisons between different fish species or populations (Weatherley and Gill, 1987; Petrakis and Stergiou, 1995; Gonçalves *et al*., 1997).

Nevertheless, it is important to inform about length-weight relationships in the most productive brackish and freshwater body in Benin.

S. melanotheron melanotheron commonly called "Black shin tilapia" is one of the most fish caught, especially in the south Benin (Niyonkuru, 2007). It is present in the brackish waters of the Lake Nokoué, the Lagoon of Porto-Novo, the coastal Lagoon and the Lake Ahémé, but also in fresh waters of the Lake Toho (south-west of the country) and the Dam of SUCOBE in Save (center of the country).

This study aimed to estimate the growth performance of *Sarotherodon melanotheron melanotheron* in Benin waters, which in principle are different in terms of resources and habitat characteristics.

Material and methods

The length-weight relationship (LWR) of *Sarotherodon melanotheron melanotheron* was determined from individuals collected from six different water bodies of Benin. This is the lagoon of Porto-Novo, the Lake Nokoué, the coastal lagoon and the Lake Ahémé containing brackish water, and the Lake Toho and the Dam of SUCOBE containing fresh water (Fig. 1). They were collected from fishermen using various gears from July to September 2011. The fish are then treated in the field or brought back to the laboratory in the ice. Body weight (W) and total length (L) were recorded for each individual of *S. melanotheron melanotheron*, using a sensitive scale (Type AHAUS, 0.1 g). A sample of 50 individuals of *S. melanotheron melanotheron* is taken monthly in the six water bodies.

The length–weight relationships were estimated using the equation: $W = aTL^b$, where W is the body weight (g), TL is the total length (cm), a is exponent describing of the rate of change of weight weight with length and b is the weight at unit length (Samat, 2008). Log-log plots were generated to remove outliers (Froese, 2006), and 95% confidence limits for anti-log a and b were calculated for males, females and the grouped sex. The t-test was performed to confirm whether the b departed from the isometric value 3 (Sokal and Rohlf, 1987). The data obtained were processed statistically using Statview (version 5.1) software. Different means were compared between localities using Anova test with a factor.

Results and discussion

A total of 900 individuals of *S. melanotheron melanotheron* were analyzed within six (6) water bodies studied. All Length Weight regressions were significant ($P < 0.01$), with the coefficient of determination (r^2) ranging from 0.95 to 0.99**.** Slopes (b values) of the length weight relationship ranged from 2.55 for females of Lagoon of Porto-Novo to 2.77 for females in Coastal lagoon (Table 1). These values are within the limits (2.5 and 3.5) reported by Froese (2006) for most fishes**.**

According to Tesch (1971), the LWR may change according to fish, sex, maturity, season and even time of day (because of changes in stomach fullness); thus, the length–weight parameters presented here may be considered as average values.

The slope b provides valuable information on fish growth, being isometric when $b = 3$, positive allometry when $b > 3$ and negative allometry when $b < 3$ (Morey *et al*., 2003).

Table 1. Descriptive statistics and estimate parameters of length-weight relationship for *S. melanotheron melanotheron* from six water bodies (n, sample size; Min, minimum; Max, maximum; SD, standard deviation; a, intercept; b, slope; CI, Confidence interval; r^2, determination coefficient).

Water Body	Sex	n	Length (TL)		Weight (W)		Equation parameters				r^2
			Mean± SD	Min-Max	Mean± SD	Min – Max	a	CI of a	b	CI of b	
L. Djègbadji	F	92	11,1±2,2	6,5-17,5	31,7±18,2	7,0-73,4	0,038	0,031 to 0,046	2,76	2,68 to 2,84	0,99
	M	58	10,9±6,8	6,8-15,8	29,4±15,4	5,9-106,3	0,051	0,037 to 0,071	2,73	2,58 to 2,87	0,99
	Grouped sex	150	11,0±2,2	6,5-17,5	30,8±17,2	5,9-106,3	0,041	0,036 to 0,050	2,75	2,64 to 2,85	0,99
L. Ahémé	F	82	13,8±2,2	6,2-20,1	49,4±22,2	9,0-139,0	0,034	0,026 to 0,044	2,77	2,67 to 2,87	0,98
	M	68	13,8±2,0	7,8-19,6	48,9±18,0	13,0-117,0	0,041	0,031 to 0,056	2,69	2,58 to 2,81	0,97
	Grouped sex	150	13,8±2,1	6,2-20,1	49,2±20,4	9,0-139,0	0,037	0,030 to 0,045	2,74	2,66 to 2,81	0,98
L. Nokoué	F	98	11,5±3,0	7,3-20,1	34,8±24,7	7,2-129,3	0,037	0,031 to 0,044	2,73	2,66 to 2,80	0,99
	M	52	12,2±2,6	7,5-17,1	38,6±21,6	10,0-90,7	0,041	0,030 to 0,057	2,69	2,57 to 2,83	0,99
	Grouped sex	150	11,7±2,9	7,3-20,1	35,9±23,9	7,2-129,3	0,038	0,033 to 0,044	2,72	2,66 to 2,78	0,99
L. Porto	F	87	16,7±2,7	11,6-23,6	95,3±49,7	32,0-271,6	0,038	0,025 to 0,056	2,76	2,58 to 2,94	0,98
	M	63	16,7±1,7	12,4-19,5	92,1±28,7	39,0-156,0	0,045	0,028 to 0,073	2,69	2,43 to 2,94	0,97
	Grouped sex	150	16,7±2,3	5,8-23,6	93,9±42,2	32,0-271,6	0,046	0,030 to 0,070	2,73	2,59 to 2,88	0,98
Dam. SUCOBE	F	66	15,4±1,8	11,0-19,3	80,3±25,4	34,0-165,0	0,061	0,039 to 0,098	2,61	2,44 to 2,78	0,97
	M	84	15,5±2,1	11,6-22,4	80,6±30,7	33,0-191,0	0,037	0,038 to 0,087	2,62	2,48 to 2,78	0,97
	Grouped sex	150	15,4±2,0	11,0-22,4	80,5±28,5	33,0-191,0	0,059	0,044 to 0,081	2,62	2,51 to 2,73	0,97
L. Toho	F	80	11,1±2,7	6,1-16,5	31,2±18,9	5,0-82,0	0,055	0,026 to 0,117	2,55	2,23 to 2,87	0,95
	M	70	12,3±2,6	5,8-16,9	41,5±19,5	5,5-104,0	0,058	0,028 to 0,049	2,75	2,63 to 2,86	0,99
	Grouped sex	150	11,7±2,7	5,8-16,9	36,0±19,9	5,0-104,0	0,044	0,028 to 0,069	2,66	2,47 to 2,86	0,96

The LWR of all water bodies indicated negative allometric growth. All regression coefficient (b) of *S. melanotheron melanotheron* was significantly different from 3. This negative allometric is statistically similar to those obtained by Niyonkuru and Lalèyè (2012) in Lake Nokoué and Ahémé (respectively b = 2,85 and b =2,87), Ecoutin and Albaret (2003) in the lagoon Ebrié (b = 2.78) and the lagoon Sine Saloum (b = 2.81), Ayoade and Ikulala (2007) in Eleiyele Lake (b = 2,8) and those obtained by Ouattara and Alexandra (2009) in the Lake Dam Ayamé (b = 2.92). These results are different from those found by Lalèyè (2006) for the same species in Ouémé River where "b" values (3.07) were not significantly different to 3. Isometric growth indicates that the body increases in all dimensions in the same proportion to growth, whereas negative allometry indicates that the body becomes more rotound as it increases in length, and negative allometry indicates a slimmer body (Jobling, 2008).

Conclusion

The results are very interesting when comparing *S. melanotheron* populations. The study constitutes a basis for identifying a successful strain of the species to advice on fish farming in Benin.

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