Submitted: 19 Jul. 2020
Accepted: 2 Nov. 2020
Editor: R. Causse

Length-weight relationships of 19 fish species from two tropical artificial reservoirs (Manantali and Selingue) in Mali, West Africa

by

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Résumé. – Relations taille-poids chez 19 espèces de poissons de deux réservoirs artificiels tropicaux (Manantali et Selingue) au Mali, en Afrique de l'Ouest.

Les relations longueur-poids (RLP) ont été estimées pour 19 espèces de poissons échantillonnées dans deux lacs artificiels (Manantali et Sélingué) au Mali : *Brycinus leuciscus, B. macrolepidotus, B. nurse, Chrysichthys auratus, C. nigrodigitatus, Coptodon zillii, Distichodus brevipinnis, D. rostratus, Hemichromis fasciatus, Hydrocynus forskahlii, Labeo coubie, L. senegalensis, Lates niloticus, Mormyrus rume, Sarotherodon galilaeus, Schilbe intermedius, S. mystus, Synodontis schall, S. sorex*. Les poissons ont été collectés entre juin 2002 et octobre 2003 au cours de trois campagnes de pêche expérimentale utilisant des filets maillants déployés pendant la nuit. Tous les poissons ont été mesurés (longueur totale) au mm près et pesés au g près (poids total). Les coefficients de détermination (r^2) étaient pour la plupart élevés (> 0,9). Les valeurs du coefficient d'allométrie b étaient comprises entre 2,651 (*Chrysichthys auratus*) et 3,270 (*Brycinus leuciscus*). Cette étude fournit de nouvelles informations sur les relations longueur-poids de deux espèces de poissons qui ont été publiées mais ne sont pas encore renseignées dans Fishbase *(Distichodus brevipinnis* et *Mormyrus rume)*.

Key words. – Length-weight relationship – Freshwater fishes – Artificial reservoir – Mali.

A major constraint to science-based fish stock management in West Africa is the lack of reliable data on target stocks. This especially holds true for inland fisheries, such as those that operate in reservoirs (Abobi and Wolff, 2019).

Data provided from length-weight relationship of fish are useful for a number of purposes, such as biology, population dynamics and stock valuation. Such data are particularly valuable for data-poor stocks (Kantoussan *et al*., 2009; Andersen and Beyer 2015). Several studies have been carried out on length-weight relationships of freshwater species in West Africa (King (1996) on different freshwater bodies (both lotic and lentic system) in Nigeria; Ezenwaji (2004) and Nwani (2006) on the Anambra River, Southeastern in Nigeria; Inyang and Ezenwaji (2004) on six-armed, medium-sized Agulu Lake, Nigeria; Ecoutin *et al*. (2005) on the lower, middle and upper part of the Gambia estuary, Gambia; Lalèyè (2006) on the Oueme River, Benin; Konan *et al*. (2007) on five rivers (Bia, Soumié, Eholié, Ehania and Noé), Southeast of Ivory Coast; Odedeyi *et al*. (2007) on the Ose River, Nigeria; Imam *et al*. (2010) on the Wasai Reservoir in Kano, Nigeria; Ikongbeh *et al*. (2012) on Lake Akata, Benue state, Nigeria; Niyonkuru and Lalèyè (2012) on Lakes Nokoué and Ahémé, Benin; Abobi and Ekau (2013) on the lower reaches of White Volta River (Yapei), Ghana; Alhassan *et al*. (2014) on the Bontanga Reservoir, Ghana; Koffi *et al*. (2014) on the Taabo Electric Dam, Ivory Coast) but none examined the fish in Malian reservoirs.

The main objective of this study is to provide length-weight relationships of the major freshwater fish species inhabiting the Manantali and Selingue reservoirs in Mali.

MATERIALS AND METHODS

The two studied sites are artificial reservoirs. Selingue Reservoir, created in 1980, is 80 km in length, with a width between 3 and 8 km, a maximum depth of 23.8 m, average depth of 5.4 m and an area of 409 km² (Anne *et al*., 1994; van der Knaap, 1994). Manantali Reservoir, which was filled in 1987, is 80 km long, with a width varying from 6 to 8 km, a maximum surface area of 457 km², maximum depth of 55 m, and mean depth of 23.8 m (Anne *et al*., 1994; van der Knaap, 1994) (Fig. 1).

Fish were collected between June 2002 and October 2003 during three experimental fishing campaigns: i) a first campaign, during low water period, was conducted from 10 to 14 June 2002 on Selingue Reservoir and from 19 to 22 June 2002 on Manantali Reservoir; ii) a second campaign, also during the low water period, was conducted from 9 to 16 April 2003 on Manantali Reservoir and from 22 to 29 April on Selingue Reservoir; iii) a last campaign was conducted at the end of the rainy season, from 1 to 6 October 2003 on Manantali Reservoir and from 10 to 15 October on Selingue Reservoir. For the campaign in June 2002, fish were captured using vertical gillnets with mesh size of 10, 12.5, 15, 17.5, 20, 25, 30, 35, 40, 50, 60, 70 and 80 mm, while the two other campaigns used monofilament gillnet panels with mesh sizes of 10, 15, 22.5, 45, and 80 mm knot to knot. Each panel of a given mesh size was 25 m length and 3 m high (Laë *et al*., 2004; Coll *et al*., 2007; Simier *et al*., 2019).

Total lengths of individual fish were measured to the nearest mm and total fresh weight to the nearest g. Parameters of the weight-length relationships were estimated by the least-squares method applied to log-transformed data for males and females together as:

$$\log(W) = \log(a) + b \log(L),$$

where W = total fresh weight (g), L = total length (cm), a = intercept, and b = slope of the linear regression.

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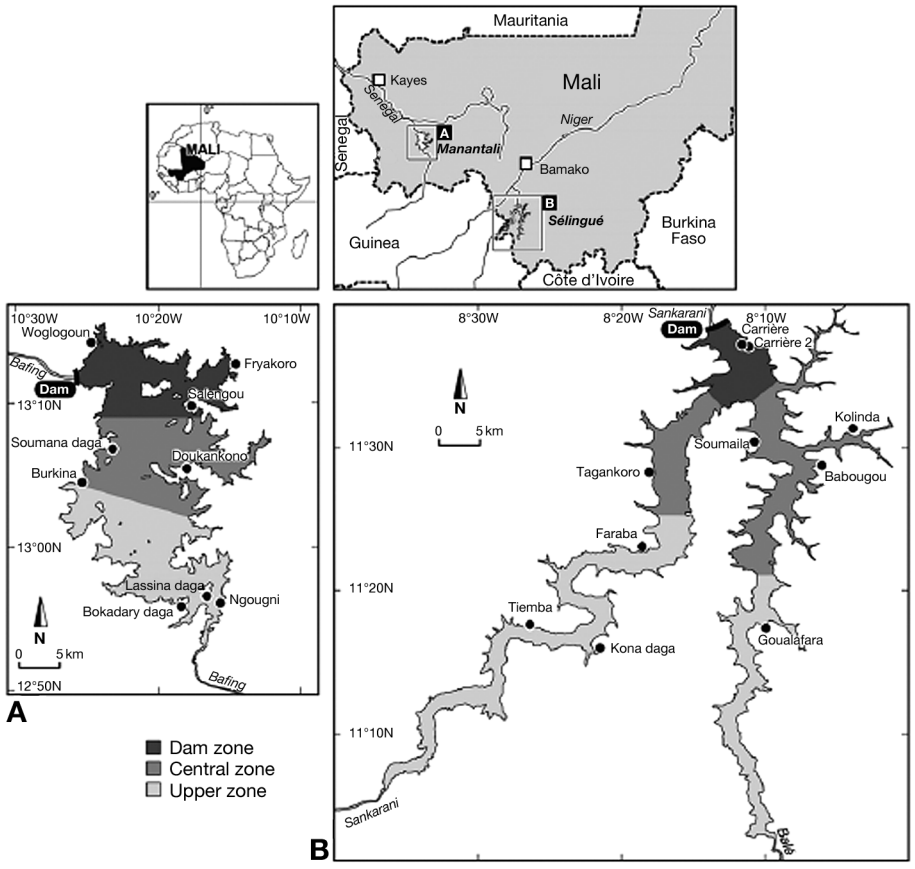

Figure 1. – Situation map (top) and detailed map (bottom) of the two Malian lakes studied: (**A**) Manantali, (**B**) Sélingué.

Among the catches, only species represented by at least 10 individuals were included in the analyses. The 95% confidence intervals of a and b were calculated using the "confint" function of the stats package in R (R Core Team, 2020).

RESULTS

Six species from five different families, accounting for 958 individuals and 18 species from 8 different families accounting for 1428 individuals, were selected for the LWR analysis in Manantali and Selingue reservoirs, respectively. For each species, sample size, minimum and maximum length, minimum and maximum weight, a and b values with their 95% confidence intervals and the coefficient of determination (r^2) are given in table I. The number of individuals by species varied from 21 to 646 for Manantali Reservoir and from 10 to 406 for Selingue Reservoir. Coefficients of determination (r^2) ranged from 0.902 (*Schilbe intermedius)* to 0.999 (*Mormyrus rume)* and b values ranged between 2.651 (*Chrysichthys auratus*) and 3.270 (*Brycinus leuciscus*). *Distichodus brevipinnis* and *Mormyrus rume* have been studied in Anambra River and Ose River (Nigeria), and in Bontanga Reservoir (Ghana).

DISCUSSION

With determination coefficient (r^2) values that range from 0.90 to 0.99, the relationships between the total length and body weight are highly significant. Several studies on length-weight relationships of freshwater fishes have shown similar results in West African reservoirs (King, 1996; Imam *et al*., 2010; Ikongbeh *et al*., 2012; Lederoun *et al*., 2018), estuaries (Ecoutin *et al*., 2005; Ndiaye *et al*., 2015), rivers (Entsua-Mensah *et al*., 1995; Ezenwaji, 2004; Lalèyè, 2006; Abobi and Ekau, 2013; Lederoun *et al*., 2016), and lagoons (Fafioye and Oluajo, 2005; Abohweyere and Williams, 2008; Kumolu-Johnson and Ndimele, 2010). However, prior to our study, length-weight relationships for *Distichodus brevipinnis* and *Mormyrus rume* have been published for Anambra River, Nigeria (Ezenwaji, 2004; Nwani, 2006), Ose River, Nigeria (Odedeyi *et al*., 2007) and Bontanga Reservoir, Ghana (Alhassan *et al*., 2014), but are not yet available in Fishbase (Froese and Pauly, 2020).

According to Carlander (1969), b values may range from 2.5 to 3.5. The results of our study confirmed this, since the b values obtained ranged between 2.651 (*Chrysichthys auratus*) and 3.270 (*Brycinus leuciscus*). The high value of b close to 3 for *Hydrocynus forskahlii* (3.011), *Lates niloticus* (3.018), *Synodontis schall* (3.101) in Manantali and *Brycinus leuciscus* (3.270), *B. nurse* (3.204), *Hemichromis fasciatus* (3.144), *Distichodus rostratus* (3.146), *Synodontis schall* (3.120), *Mormyrus rume* (3.175), *Schilbe intermedius* (3.269), *S. mystus* (3.195) in Selingue reservoirs can be explained by food availability and good quality of environment (Le Cren, 1951; Cushing and Horwood, 1994; Arslan *et al*., 2004, Rahman *et al*., 2008).

These results, like many other fish length-weight relationship studies in West Africa, may be useful for future research, as well as for the management of freshwater species of Malian reservoirs.

Acknowledgements. – This research was supported by the RAP Research Program of the IRD in Dakar (Senegal). The authors would like to thank the Malian investigators in Manantali and Selingue reservoirs, Mali. We

Table I. – Length-weight relationship (LWR) of the fish species of the Manantali and Selingue artificial reservoirs in Mali. n, sample size; Max, maximum; Min, minimum; a and b, parameters of LWR; CL, confidence limits; r^2, coefficient of determination.

Reservoir	Family	Species	n	Total length (cm)	Weight (g)	Relationship parameters		
				Min-Max	Min-Max	a	b	r^2
Manantali	Alestidae	*Brycinus nurse* (Rüppell, 1832)	94	11.2-25.4	16-186	0.014 (0.012-0.017)	2.918 (2.864-2.973)	0.992
		Hydrocynus forskahlii (Cuvier, 1819)	646	9.4-45.2	5-598	0.006 (0.005-0.006)	3.011 (2.991-3.031)	0.993
	Cichlidae	*Coptodon zillii* (Gervais, 1848)	21	8.3-22.8	11-221	0.019 (0.011-0.035)	2.954 (2.728-3.180)	0.975
	Claroteidae	*Chrysichthys auratus* (Geoffroy Saint-Hilaire, 1809)	143	8.1-19.5	5-62	0.009 (0.008-0.011)	2.960 (2.894-3.027)	0.982
	Latidae	*Lates niloticus* (Linnaeus, 1758)	27	7.5-39.0	4-697	0.009 (0.008-0.012)	3.018 (2.957-3.079)	0.998
	Mochokidae	*Synodontis schall* (Bloch & Schneider, 1801)	27	12.5-40.0	17-584	0.006 (0.005-0.008)	3.101 (3.014-3.188)	0.995
Selingue	Alestidae	*Brycinus leuciscus* (Günther, 1867)	406	6.6-13.3	3-30	0.007 (0.006-0.009)	3.270 (3.170-3.370)	0.912
		Brycinus macrolepidotus Valenciennes, 1850	30	7.6-27.1	5-171	0.012 (0.008-0.018)	2.878 (2.727-3.029)	0.982
		Brycinus nurse (Rüppell, 1832)	134	7.5-20.8	3-102	0.007 (0.006-0.008)	3.204 (3.128-3.280)	0.981
		Hydrocynus forskahlii (Cuvier, 1819)	55	10.6-37.5	8-297	0.008 (0.007-0.009)	2.906 (2.861-2.951)	0.997
	Cichlidae	*Coptodon zillii* (Gervais, 1848)	17	5.7-20.4	3-150	0.017 (0.012-0.025)	2.995 (2.833-3.156)	0.991
		Hemichromis fasciatus Peters, 1857	113	6.2-17.0	4-86	0.010 (0.008-0.013)	3.144 (3.041-3.248)	0.970
		Sarotherodon galilaeus (Linnaeus, 1758)	76	8.3-20.9	10-191	0.022 (0.014-0.035)	2.953 (2.767-3.140)	0.931
	Claroteidae	*Chrysichthys auratus* (Geoffroy Saint-Hilaire, 1809)	53	6.4-20.5	3-56	0.018 (0.012-0.025)	2.651 (2.503-2.799)	0.962
		Chrysichthys nigrodigitatus (Lacepède, 1803)	33	5.0-30.7	1-173	0.008 (0.006-0.011)	2.840 (2.743-2.938)	0.991
	Cyprinidae	*Labeo coubie* Rüppell, 1832	85	8.2-30.9	6-288	0.012 (0.009-0.015)	2.911 (2.802-3.019)	0.972
		Labeo senegalensis Valenciennes, 1842	56	8.7-25.8	5-126	0.010 (0.008-0.012)	2.921 (2.853-2.989)	0.993
	Distichodontidae	*Distichodus brevipinnis* Günther, 1864	40	7.7-37.6	4-459	0.011 (0.009-0.014)	2.929 (2.827-3.031)	0.989
		Distichodus rostratus Günther, 1864	18	7.6-12.3	4-19	0.007 (0.003-0.017)	3.146 (2.752-3.540)	0.947
	Mochokidae	*Synodontis schall* (Bloch & Schneider, 1801)	10	11.0-26.4	10-166	0.007 (0.003- 0.016)	3.120 (2.797-3.442)	0.984
		Synodontis sorex Günther, 1864	26	6.7-12.5	2-11	0.008 (0.005-0.015)	2.802 (2.538-3.066)	0.952
	Mormyridae	*Mormyrus rume* Valenciennes, 1847	11	14.3-66.2	16-1815	0.003 (0.003-0.004)	3.165 (3.083-3.248)	0.999
	Schilbeidae	*Schilbe intermedius* Rüppell, 1832	17	8.0-17.0	2-32	0.003 (0.001-0.013)	3.269 (2.675-3.863)	0.902
		Schilbe mystus (Linnaeus, 1758)	248	6.0-29.6	1-163	0.003 (0.003-0.004)	3.195 (3.124-3.266)	0.969

also thank two anonymous reviewers for their comments.

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