Length-weight relationships for 36 freshwater fish species from two tropical reservoirs: Ayamé I and Buyo, Côte d'Ivoire

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Received 18-VII-2011. Corrected 14-IV-2012. Accepted 16-V-2012.

Abstract: Nowadays, the successful management of small scale fisheries requires the use of biometric data collected in the field, in order to transform them into suitable indicators. The present study describes the length-weight relationships for 36 freshwater fish species from two tropical reservoirs Ayame I and Buyo, in Côte d'Ivoire. The main objective of the study was to provide a length weight key for a wide range of freshwater fish species from these tropical reservoirs exploited by the inland fisheries. The samplings were carried out at Buyo from July 1997 to August 1998, and from August 2004 to July 2005 in Ayame I. Fish specimens were collected from catches of artisanal fisheries using gill-nets, cast-nets, beach seines and bamboo traps. After landings, samples were identified, total weight for each specimen was recorded to the nearest gram and standard length was measured to the nearest millimetre. A total of 12 724 individuals belonging to 15 families and 24 genera were obtained in this study. The results indicated that the family with the highest number of species was Cichlidae with eight species. Six families were recorded with only one species per family. The value of the exponent b in the length weight relationships ($W=aL^b$) ranged from 2.173 for *Marcusenius furcidens* to 3.472 for *Polypterus endlicheri* and the median of b was 2.756. The modal value of the exponent b equal to 2.70 indicates that most of the fish species in Ayame I and Buyo Reservoirs have negative allometric growth. The length weight parameters of the three species, *Lates niloticus, Synodontis koensis* and *S. punctifer* are described for the first time in these regions. The present length-weight key for 36 freshwater fish species could be used as a valuable tool for fishery managers, in order to improve the inland fisheries statistics largely based on hydropower reservoirs in Côte d'Ivoire. Rev. Biol. Trop. 60 (4): 1847-1856. Epub 2012 December 01.

Key words: length weight relationship, freshwater fish, tropical reservoirs, Côte d'Ivoire, West Africa.

The impoundment of hydropower reservoirs in Côte d'Ivoire has allowed the development of inland fisheries, mostly in the large reservoirs of Ayame I, Kossou and Buyo (Da Costa *et al.* 2002). Officially, inland fisheries catches estimated at 18 000 tons are composed by Cichlidae (*Oreochromis niloticus*, *Sarotherodon* spp, *Tilapia* spp.), Osteoglossidae (*Heterotis niloticus*), Claroteidae (*Chrysichthys* spp.) which represent more than 88% of the landings (FAO 2008). Moreover, two species, *Oreochromis niloticus* (Linnaeus, 1758) and *Heterotis niloticus* (Cuvier, 1829), which contribute to the most of the commercial catches, are introduced species (Moreau *et al.* 1988). Paugy *et al.* (1994) and Gourene *et al.* (1999) have identified 83 and 36 fish species in the reservoirs Buyo and Ayamé I, respectively.

Inland fisheries in Côte d'Ivoire are exclusively artisanal and fishers operate various

gears depending on the season, the investment level, the fishing areas and the species targeted. These gears are gillnets, cast nets, long-lines, beach seines and various kinds of traps (Reizer 1968). Besides, reservoirs fisheries are characterized by the cohabitation of autochthonous population and non indigenous fishermen coming from the neighboring country of Mali. As of 1998, fishing activities in Ayame I were operated by the indigenous inhabitants of the reservoir district, after the eviction of the non indigenous fishermen (Tah *et al.* 2009). Regarding Buyo Reservoir, since September 2002 after the civil war event, a large part of this area has resulted inaccessible by fisheries managers. Consequently, no reliable data on fisheries statistics are available since.

According to Ecoutin & Albaret (2003), the management of small scale fisheries requires the use of biometric relationships. Among them, the length-weight relationships (LWR) are widely presented by authors as useful tools with several applications in domains of fisheries sciences, population dynamics, ecology and stocks assessments (Petrakis & Stergiou 1995, Santos *et al*. 2002). Knowledge of LWR allows, in a given geographic zone, the estimation of the average weight at given length (Ferreira *et al.* 2008). Moreover, this tool may provide important information concerning morphometric comparison between species and populations (King 1996, Gonçalves *et al.* 1997) and life history comparisons between regions (Weatherley & Gill 1987).

Studies on fish population biology have been carried out in these two reservoirs since their impoundment. Most of these studies focused mainly on fish fauna, biological and population parameters of some commercially important fish species (Traore 1996, Kone & Teugels 1999, Tah *et al.* 2010). However, none actually considered the length-weight parameters of fish species exploited by inland fisheries from the man- made reservoirs. Therefore, the aim of the present study is to avoid this deficiency and provide a length-weight key for a wide range of freshwater fish species.

MATERIAL AND METHODS

Study areas: Two reservoirs were surveyed in this study. Ayamé I is located in the South-East (05°30' - 06°00' N and 03°00' - 03°05' W) and Buyo in South-West (6°20' - 07°03' N and 06°50' - 07°4' W) (Fig. 1). For both reservoir areas, the climate characterized by an equatorial transition zone, with two rainy seasons separated by a short dry period from August to September, and a more pronounced one from December to March. The oldest hydroelectric reservoir is Ayamé I; it was built in 1959 on the Bia River, and has an average surface of 135km^2 (Laë 1997); the artificial reservoir is 80km long and 27km wide (at the maximum water level). The second hydroelectric reservoir of Buyo is the most recent dam and was built on the river Sassandra in 1980; it has a main channel total length of 100km and a wide varying from 200m to 10km, with an average surface of 920km^2 (Traore 1996).

Data collection and analysis: Samplings were carried out in a monthly basis in four landings sites at Buyo Reservoir during July, August, September and December 1997, and March and June 1998; and at three landing sites in Ayame I, between August 2004 and July 2005 (Fig. 1). Fish species were collected directly from the artisanal fishermen catch, that use gill nets of various mesh sizes (15 to 60mm stretched mesh), beach seines, bamboo traps and cast nets. The most frequently encountered fishing gears on both reservoirs were gillnets that are used throughout the year. Gillnets are usually set during the afternoon at about 16:00 h (GMT) and lifted the following morning at about 07:00 h (GMT). Large and medium-sized mesh gillnets mainly targeted high-valued large size species of Cichlid. Beach seines with 14mm mesh size and a length of 300m on average are activated mostly during the early part of the rainy seasons, when the water level rises. Bamboo traps and cast nets targeting *Chrysichthys* spp. are operated during the greater rainy season (March-July).

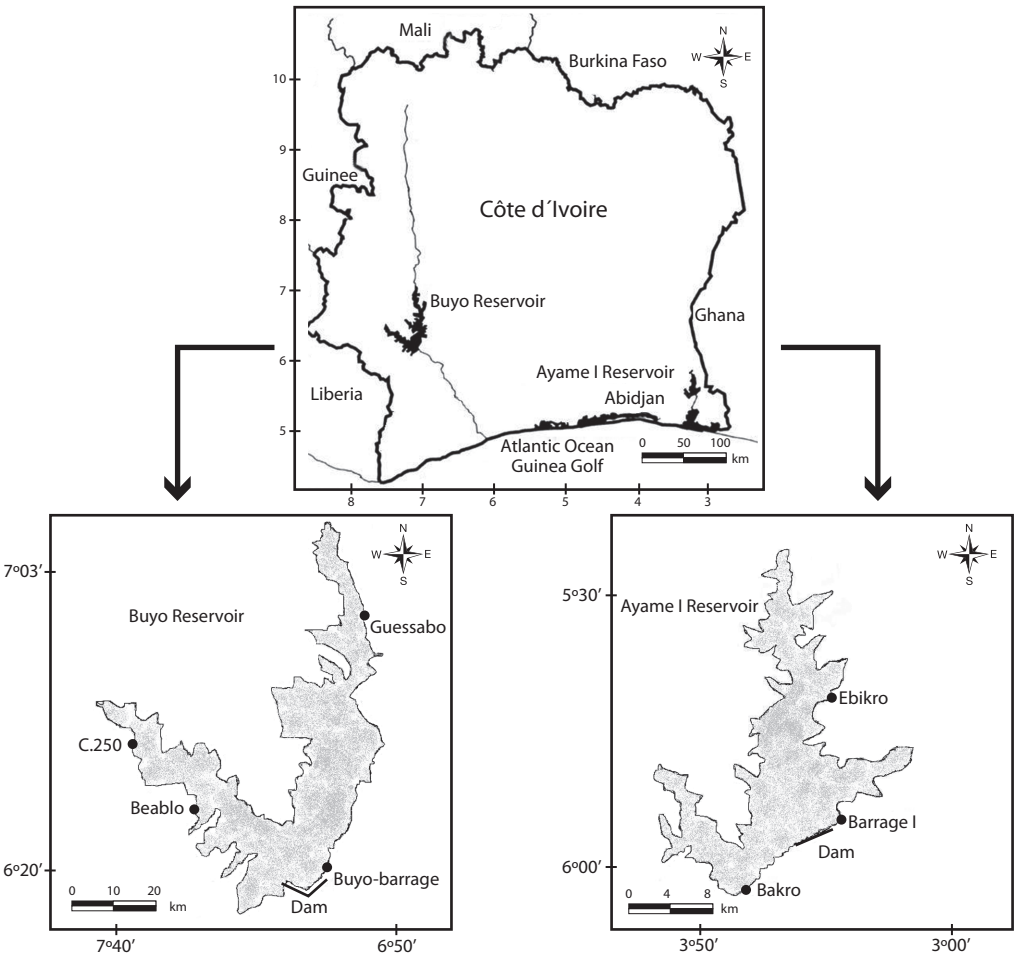

Fig. 1. Resevoirs Ayame I and Buyo in Côte d'Ivoire (●=Sampling sites).

At Buyo Reservoir between 1997 and 1998, like at Ayame I Reservoir between 2004 and 2005, measurements were made *in situ* by the research team. Standard length for each fish was measured to the nearest millimetre using a measuring board ichtyometer (STANLEY Model CE-M 10-0594). Body weight was recorded with a precision balance to the nearest gram (OHAUS Model CT 6000). Species identification was based on Lévêque *et al.* (1990, 1992) and Paugy *et al.* (2003) keys. For each reservoir, data from all landing sites were pooled together. As mentioned by Lalèye (2006) and Konan *et al.* (2007), only species presenting a sample size higher than 10 individuals were taken into account. Taxonomic orders of fish species in this work is based in Nelson (2006) classification.

The LWR of fish was estimated by using the equation: $W=a\ L^b$, where W=weight in grams (g), L=standard length in centimetres (cm), *a* is a scaling constant and *b* is the allometric growth coefficient. After logarithmic transformation of this relation ($\log10\ W=\log10\ a + b\ \log10\ L$), parameters (*a)* and (*b)* were determined via least squares linear regression (Zar 1999). The 95% confidence limits for *b* (CL 95%) were computed using the equation:

CL= b ±(1.96 x SE) where SE is the standard error of b. In order to check if the value of b was significantly different from 3, the Student's t-test was conducted as expressed by the equation according to Sokal & Rohlf (1987): ts=(b-3)/SE, where ts is the t-test value, b the slope and SE the standard error of the slope b. The value of b gives information on the kind of growth of fish: The growth is isometric if b=3 and the growth is allometric if b≠3 (negative allometric if b<3 and positive allometric if b>3). All the statistical analyses were considered at significance level of 5% ($p<0.05$).

RESULTS

The mean water level and temperature monthly fluctuations for the period of 1997-1998 for Buyo, and of 2004-2005 for Ayame I, are illustrated in figure 2; these data were provided by the operator of the hydroelectric energy (Compagnie Ivoirienne d'Electricité). The maximum water level reached 200.15m at Buyo in November 1997, and 90.5m at Ayame I in December 2004; while the minimum water levels were recorded at 192.6m in July 1997, and 85.32m in August 2004, respectively. The

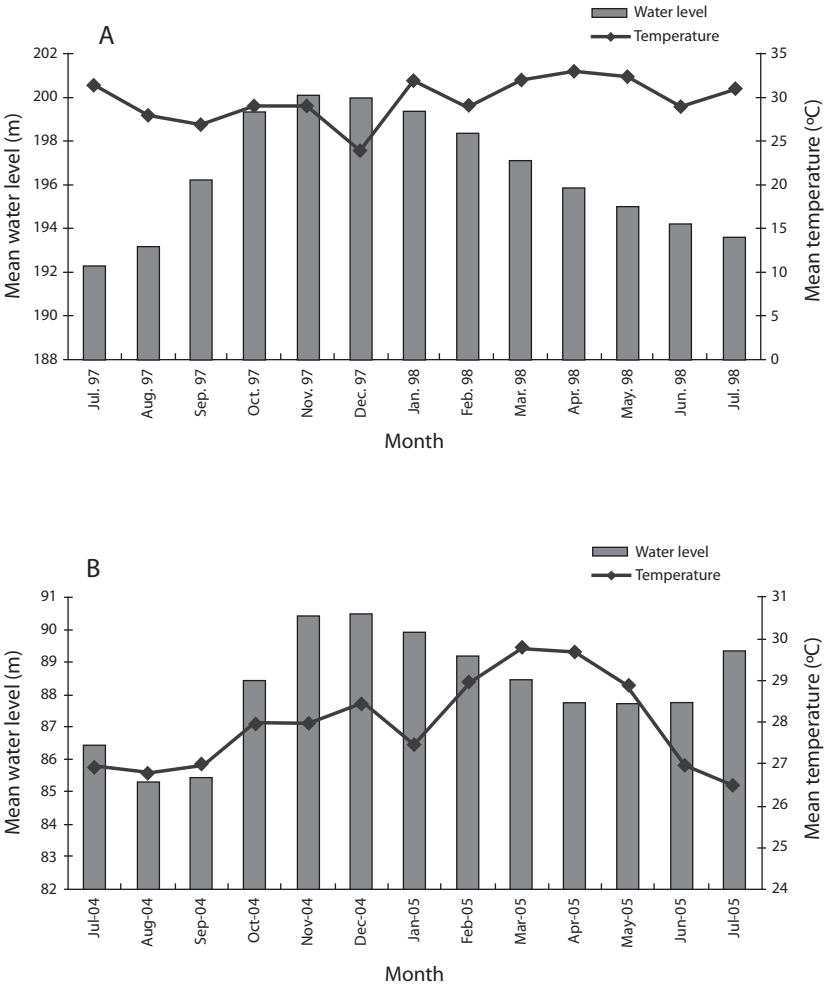

Fig. 2. Monthly variations of mean water level and mean temperature of Buyo (A) and Ayame I (B) Reservoirs during the periods (1997-1998) and (2004-2005).

lowest water temperature values of 24°C and 26.5°C were observed at Buyo in December 1997, and at Ayame I in July 2005, respectively; while the highest temperature values were recorded at Buyo with 33°C in April 1998, and 29.8°C in Ayame I in March 2005.

A total of 49 data sets (24 from Ayamé I and 25 from Buyo) were obtained and the LWR could be estimated. The 36 freshwater fish species found belong to 15 families and 24 genera (Tables 1 and 2). Cichlidae resulted the family with the highest number of species with eight species: *Chromidotilapia guentheri, Hemichromis bimaculatus H. fasciatus, Oreochromis niloticus, Sarotherodon galileaus, S. melanotheron, Tilapia busumana* and *T. zillii*. Only one species per family was recorded for Polypteridae, Osteoglossidae, Hepsetidae, Distichodontidae, Malapteruridea Channidae and Centropomidae. And the other families had two or four species each.

Table 1 shows the 13 fish species collected in both reservoirs; and table 2 shows the 23 species collected either in Buyo or Ayame I reservoirs. A total of 12 724 individuals were used in the present study (Tables 1 and 2). The samples ranged from 14 individuals for *Alestes baremoze* in Buyo Reservoir to 2 016 individuals for *Sarotherodon melanotheron* in Ayamé I Reservoir. The sizes of the collected fish specimens ranged from 4cm (*Oreochromis niloticus*) to 122.5cm (*Heterobranchus isopterus*), and the intervals of size classes varied from 2.2cm (*Hemichromis bimaculatus* at Ayame I) to 114.7cm (*H. isopterus* at Buyo).

The determination coefficient (r^2) values, calculated for the 49 LWRs, varied from 0.70 in *Petrocephalus bovei* (Mormyridae) to 0.99 in *Polypterus endlicheri* (Polypterudae). Besides, 57% of the LWRs had r^2 values higher than 0.90, 37% had r^2 values between 0.80-0.90, while 8% had r^2 values lower than 0.80.

The estimates of *b* ranged from 2.173 for *Marcusenius furcidens* to 3.472 for *Polypterus endlicheri* with a mean value of 2.771 (SD=0.256). The median and mode values of *b* were 2.756 and 2.70 (Fig. 3).

The kind of growth, determined by Student's *t*-test, revealed that six species, *Distichodus rostratus, Labeo coubie, Chrysichthys nigrodigitatus, Synodontis schall* at Buyo, and *Clarias anguillaris* and *Synodontis schall* at Ayame I, showed isometric growth (b=3). For the other species, *b* was significantly (Student t–test: $p<0.05$) different from 3. Seven species of this category (four from Buyo and three from Ayamé I) showed positive allometric growth (b>3) and the 36 last ones a negative allometric growth (b<3). It should be pointed out that four species, *Hepsetus odoe*, *Chrysichthys nigrodigitatus*, *Parachanna obscura* and *Hemichromis bimaculatus* studied in the both reservoirs showed different growth type according to the reservoir (Table 2).

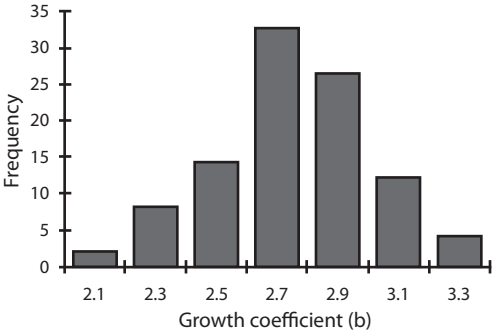

Fig. 3. Frequency distribution of the allometric growth coefficients for 36 freshwater fish species from two tropical man-made lakes, Ayame I and Buyo (Côte d Ivoire; West Africa).

DISCUSSION

The range of *b* values (2.173-3.472) in our study is similar to the values (2.458-3.473) recorded by Ecoutin & Albaret (2003), which studied the length-weight relationships of 52 species of West African lagoons and estuaries. It is also similar to the *b* values (2.213-3.729) obtained in Konan *et al.* (2007), which studied the length-weight relationships of 57 fish species in the coastal rivers of South-Eastern

TABLE 1
Descriptive statistics and LWR parameters for 13 selected freshwater fish species collected in both reservoirs Buyo and Ayame I

Family/Species	Reservoirs	N	Length (cm)		Weight (g)		Parameters of length-weight relationships					Growth
			Min.	Max.	Min.	Max.	a	b	SE (b)	95% CL of (b)	r^2	
OSTEOGLOSSIDAE												
Heterotis niloticus	Ayamé I	98	10.5	70	18	3200	0.022	2.557	0.119	2.320-2.793	0.968	A-
H. niloticus	Buyo	222	13.3	89	39	7500	0.017	2.678	0.115	2.450-2.905	0.931	A-
MORMYRIDAE												
Marcusenius ussheri	Ayamé I	473	7.5	35	7	469	0.025	2.499	0.024	2.422-2.985	0.883	A-
M. ussheri	Buyo	281	6	32	5	386	0.013	2.756	0.02	2.716-2.795	0.827	A-
Mormyrus rume	Ayamé I	43	19	67	60	1570	0.013	2.704	0.139	2.559-2.856	0.947	A-
M. rume	Buyo	288	8	78	13	4700	0.02	2.509	0.079	2.354-2.663	0.834	A-
HEPSETIDAE												
Hepsetus odoe	Ayamé I	182	9.8	31	11	462	0.005	3.166	0.041	3.084-3.247	0.973	A+
H. odoe	Buyo	39	9	26	26	410	0.026	2.481	0.108	2.611-2.700	0.874	A-
ALESTIIDAE												
Brycinus macrolepidotus	Ayamé I	192	6	24	10	364	0.016	2.779	0.033	2.711-2.844	0.952	A-
B. macrolepidotus	Buyo	47	5.5	29	5	617	0.0189	2.704	0.024	2.655-2.752	0.921	A-
CLAROTEIDAE												
Chrysichthys nigrodigitatus	Ayamé I	223	7.5	38	9	1200	0.036	2.712	0.051	2.611-2.812	0.968	A-
C. nigrodigitatus	Buyo	36	14.5	44.5	90	2200	0.009	3.023	0.215	2.582-3.463	0.963	I
SCHILBEIDAE												
Schilbe mandibularis	Ayamé I	954	6.4	21	5	124	0.249	2.489	0.010	2.485-2.492	0.800	A-
S. mandibularis	Buyo	314	7	28	4	256	0.01	2.844	0.015	2.813-2.874	0.822	A-
MOCHOKIDAE												
Synodontis bastiani	Ayamé I	252	11.5	20.9	40	197	0.016	2.754	0.011	2.731-2.776	0.803	A-
S. bastiani	Buyo	128	7.5	22	8	300	0.012	2.894	0.04	2.814-2.973	0.926	A-
S. schall	Ayamé I	89	11	19.2	39	220	0.010	3.004	0.023	2.958-3?049	0.881	I
S. schall	Buyo	93	8	23	16	397	0.01	2.961	0.048	2.865-3.056	0.845	I
CHANNIDAE												
Parachanna obscura	Ayamé I	39	18	34	92	526	0.012	2.919	0.074	2.674-2.975	0.955	A-
P. obscura	Buyo	85	13.5	35	26	771	0.004	3.208	0.103	3.00-3.414	0.917	A+
CICHLIDAE												
Hemichromis bimaculatus	Ayamé I	32	5.6	7.8	7	18	0.053	2.337	0.014	2.306-2.367	0.786	A-
H. bimaculatus	Buyo	194	5	9.7	4	40	0.01	3.076	0.006	3.062-3.089	0.72	A+
H. fasciatus	Ayamé I	149	5.4	19	6	261	0.019	2.744	0.051	2.642-2.845	0.904	A-
H. fasciatus	Buyo	238	4.5	21	5	245	0.001	2.798	0.012	2.773-2.822	0.829	A-
Oreochromis niloticus	Ayamé I	1006	8	27.5	18	639	0.024	2.693	0.014	2.666-2.719	0.941	A-
O. niloticus	Buyo	650	4	33	15	977	0.021	2.759	0.024	2.710-2.807	0.952	A-

N: sample size; Min: minimum; Max: maximum; b: allometric growth coefficient; SE: standard error; CL: confidence limits; r^2: determination coefficient; I: isometric growth; A+: positive allometric growth; A-: negative allometric growth.
In bold species with different growth type according to the reservoir (*Hepsetus odoe*, *Chrysichthys nigrodigitatus*, *Parachanna obscura* and *Hemichromis bimaculatus*).

TABLE 2
Descriptive statistics and LWR parameters for the 23 freshwater fish species collected either in Buyo or Ayame I reservoirs

Family/Species	Reservoirs	N	Length (cm)		Weight (g)		Parameters of length-weight relationships					Growth
			Min.	Max.	Min.	Max.	a	b	SE (b)	95% C.I. of (b)	r^2	
POLYPTERIDAE												
Polypterus endlicheri	Buyo	22	23	65.5	279	3400	0.001	3.472	0.183	3.088-3.855	0.992	A+
MORMYRIDAE												
Marcusenius furcidens	Ayamé I	83	12.3	26	42	224	0.053	2.173	0.041	2.450-2.547	0.812	A-
Mormyrops anguilloides	Ayamé I	134	15.5	62	41	1850	0.012	2.708	0.075	2.090-2.255	0.873	A-
Petrocephalus bovei	Buyo	36	6.7	11.5	4	30	0.007	3.091	0.02	3.049-3.132	0.704	A+
ALESTIIDAE												
Aleste baremoze	Buyo	15	14.5	23.5	41	178	0.009	2.907	0.066	2.764-3.059	0.948	A-
Brycinus imberi	Ayamé I	1011	5.4	15	6	83	0.020	2.690	0.005	2.658-2.679	0.878	A-
B. nurse	Ayamé I	432	5.7	15	9	86	0.011	2.937	0.012	2.913-2.960	0.919	A-
DISTICHODONTIDAE												
Distichodus rostratus	Buyo	87	10.7	47	25	2700	0.012	2.894	0.094	2.706-3.081	0.943	I
CYPRINIDAE												
Labeo coubie	Buyo	197	7	50	8	1983	0.014	2.836	0.096	2.647-3.024	0.93	I
L. parvus	Ayamé I	75	10.5	22.5	30	352	0.007	3.128	0.034	3.060-3.191	0.938	A+
CLAROTEIDAE												
Chrysichthys maurus	Ayamé I	140	9	45	17	1301	0.018	2.705	0.043	2.618-2.789	0.926	A-
SCHILBEIDAE												
Schilbe intermedius	Buyo	134	8	17.5	5	155	0.009	2.914	0.017	2.879-2.948	0.723	A-
CLARIIDAE												
Clarias anguillaris	Ayamé I	92	11.5	90	19	9000	0.011	2.807	0.118	2.570-3.041	0.968	I
Heterobranchus isopterus	Buyo	137	7.8	122.5	13	25000	0/020	2.6	0.125	2.353-2.846	0.898	A-
MALAPTERURIDAE												
Malapterurus electricus	Buyo	101	11	39	41	1200	0.024	2.595	0.055	2.485-2.706	0.908	A-
MOCHOKIDAE												
Synodontis koensis	Buyo	207	5.5	14	5	100	0.015	2.779	0.01	2.757-2.800	0.831	A-
S. punctifer	Buyo	71	6	28	4	210	0.018	2.675	0.047	2.580-2.769	0.921	A-
CENTROPOMIDAE												
Lates niloticus	Buyo	210	5.5	97	12	20000	0.027	2.521	0.0669	2.421-2.684	0.824	A-
CICHLIDAE												
Chromidotilapia guentheri	Ayamé I	14	6.5	10.4	13	36	0.053	2.222	0.049	2.125-2.34	0.880	A-
Sarotherodon galileaus	Buyo	259	7	29	15	859	0.022	2.742	0.041	2.660-2823	0.949	A-
S. melanotheron	Ayamé I	2021	6.5	22.6	9	495	0.019	2.812	0.010	2.791-2.832	0.944	A-
Tilapia busumana	Ayamé I	55	6.9	12.9	16	95	0.017	2.845	0.025	2.794-2.897	0.916	A-
T. zillii	Ayamé I	32	7.6	21.5	16	489	0.008	3.150	0.075	2.994-3.303	0.964	A+

N: sample size; Min: minimum; Max: maximum; b: allometric growth coefficient; SE: standard error; CL: confidence limits; r^2: determination coefficient; I: isometric growth; A+: positive allometric growth; A -: negative allometric growth.

Côte d'Ivoire. According to Bagenal & Tesch (1978), the range of the parameter *b* usually encountered in fishes is within the expected range of (2-4). This is in accordance with the range of *b* for the 49 LWRs from the present study. Moreover, the modal value of *b* equal to 2.70, can suggest, that the «cube law» (Froese 2006) cannot be applied to most of the fish species in the Ayame I and Buyo reservoirs.

On the 30 species appearing both in this study and those obtained by Konan *et al.* (2007), only 10 species (*Heterotis niloticus, Mormyrops anguilloides*, *Brycinus imberi, Labeo coubie, L. parvus, Chrysichthys maurus, Clarias anguillaris, Synodontis bastiani, Oreochromis niloticus* and *Sarotherodon melanotheron*) have similar *b* values. For the other 20 species, several factors such as sampling procedure (sample size and length range) (Ecoutin & Albaret 2003) sexual dimorphism (Artigues *et al.* 2003), water quality or food availability on fish growth (Henderson 2005) could explain this variation in *b* values.

No values of *b* for the six species of *Alestes baremoze Distichodus rostratus*, *Sarotherodon galileaus*, *Lates niloticus, Synodontis koensis* and *S. punctifer* were reported by Konan *et al.* (2007). However, LWRs data on three species were published in Fishbase (Froese & Pauly, 2010) for this region: *Alestes baremoze* (Daget & Iltis 1965), *Distichodus rostratus* and *Sarotherodon galileaus* (Bauchot & Bauchot 1978). Concerning the last three fish species of *Lates niloticus, Synodontis koensis* and *S. punctifer* no previous data on length-weight relationships were available in FishBase (Froese & Pauly 2010) for this region and our results provide the first references on LWRs for them.

Inland fishery statistics in Côte d'Ivoire mostly consist of rough estimates of total catch for all species, exploitation indices (e.g., number of canoes, fishermen) and, at best, average length or weight for some species of commercial importance. Therefore, the present length-weight key for 36 freshwater fish species could be used as an useful tool for more effective management of these fisheries. Certainly, this key can facilitate fisheries biologists to derive weight estimates for un-weighed but measured fish, and assist them in estimating the biomass of captured fish species. Besides, new data on length-weight relationships were recorded for three fish species in this region. According to that, this study represents an additional contribution to the available LWRs for the region.

ACKNOWLEDGMENTS

The present work was fully supported by Laboratory of Hydrobiology (University of Cocody, Abidjan) and Ministry of Animal Resources and the Halieutic Production of Côte d'Ivoire.

RESUMEN

Hoy en día, el manejo exitoso de pesquerías a pequeña escala requiere el uso de datos biométricos recolectados en campo, y así poder transformarlos en indicadores aplicables. El presente estudio describe la relación longitud-peso para 36 especies de peces de agua dulce encontrados en dos embalses hidroeléctricos tropicales en Ayame I y Buyo, en Costa de Marfil. El principal objetivo del estudio es proveer una clave de longitud-peso para una amplia variedad de peces de agua dulce provenientes de estos dos embalses, los cuales son explotados por pesquerías locales. El muestreo fue llevado a cabo en Buyo durante los meses de Julio 1997 a Agosto 1998, y en Ayame I de Agosto 2004 a Julio 2005. Los especímenes fueron tomados de trampas colocadas por pesqueros artesanales, utilizando redes de enmalle, atarraya, red de cerco y trampas de bambú. Los especímenes fueron identificados, pesados hasta el gramo más cercano y la longitud fue medida hasta el milímetro más cercano. Un total de 12 724 individuos pertenecientes a 15 familias y 24 géneros fueron obtenidos en este estudio. Los resultados muestran que la familia con más número de especies fue Cichlidae con 8 especies. En seis familias se obtuvo únicamente una especie. El valor del exponente b en la relación longitud-peso ($w=al^b$) estuvo dentro del rango de 2.173 para *Marcusenius furcidens*, de 3.472 en *Polypterus endlicheri*, y la media de b fue 2.756. El valor modal del exponente b igual a 2.70 indica que la mayoría de especies de peces en las reservas Ayame I y Buyo tienen crecimiento alométrico negativo. Los parámetros longitud-peso de tres especies, *Lates niloticus*, *Synodontis koensis* and *S. punctifer* son descritos por primera vez en estas localidades. La clave longitud-peso presentada para 36 especies de peces puede ser utilizada como una herramienta valiosa para administradores pesqueros, y así mejorar

ampliamente las estadísticas de las pesquerías basadas en embalses hidroeléctricos en Costa de Marfil.

Palabras clave: relación longitud-peso, peces de agua dulce, embalses tropicales, Costa de Marfil, Africa del Oeste.

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