Original Research Article

Length-Weight Relationship and condition factor of twenty fish species in Ebrie lagoon (Aghien-Potou sectors Abidjan, Côte d'Ivoire)

.

ABSTRACT

Aims: This study investigated Length-weight relationships and condition factors of fish species in Ebrie Lagoon (Aghien-Potou sector, Côte d'Ivoire)
Place and Duration of Study: Ebrie Lagoon (Aghien-potou sector) from April 2019 to March 2020.
Methodology: study was conducted during 3 to 4 days continuously in Ebrie Lagoon (Aghien-Potou Sector). Furthermore, monthly fish samples were collected from commercial fishing area at random using gillnets, cast nets, traps, hooks and beach seines.
Results: All Length-Weight regressions were highly significant with the coefficient of determination (r^2) ranging from 0.61 in *Schilbe mandibularis* to 0.90 in *Monodactylus sebae* and *Chrysichthys maurus*. An isometric growth was observed for most of species except three of them namely *Ethmalosa fimbriata*, *Pseudotolithus elongatus,* and *polydactylus quadrifilis*. The k values varied from 0.19±0.001 in *S. melanotheron* to 6.10±0.3 in *Monodactylus sebae.* The values of b and k denote that the Ebrie lagoon could provide a favourable environment and suitable habitat for the growth of those fish species.
Conclusion: The study provides basic information on length-weight parameters for twenty major fish species collected from Ebrie lagoon (Aghien-Potou sector). Three species namely *Ethmalosa fimbriata*, *Pseudotolithus elongatus* and *Polydactylus quadrifilis* exhibited a trend of positive growth whereas seventeen fish species showed isometric growth. The condition factor k was superior to 1 for 75% of the fish species and inferior to 1 for 25 % of the fish species. These growth trends denote that the lagoon could provide a favourable environment and suitable habitat for the growth of those fish species. Thus it would be interesting to create a protected area near the lagoon in order to ensure the protection of fish species.

Keywords: Length-Weight Relationship, Condition factor, Fish, Lagoon, Côte d'Ivoire, West Africa

1. INTRODUCTION

In coastal areas, fish is the major source of animal proteins and provides essential nutrients including the micronutrients of high bioavaibility which are found in limiting amounts in the diet [1]

Length-weight relationship is an essential tool in biology, physiology, ecology and stock assessment of fishes [2]. This relation provides useful information on fish species within a given geographic region [3]. Length-weight relationships (LWRs) provide useful information for fishery management for both applied and basic purposes [4]. In addition, LWR information is necessary to estimate the biomass from length-frequency data [5] and is useful for between-region comparisons of life histories of certain species [6].

The condition factor of fishes is the most important biological parameter which provides information on condition of fish species and the entire community and is of high significance for management and conservation of natural populations [7]. Moreover, the condition factor estimates the general well-being of the individual and is frequently used in several cases such as the comparison of two more co-specific populations living in similar or different conditions of food or density; the observation of increase or decrease in feeding activity or population changes possibly due to modification in food resources.

Despite the usefulness of both Length-Weight Relationship and the condition factor in fisheries management little is known about the Length-Weight Relationship and condition factor of fish species in Ebrie Lagoon (Aghien-Potou sector). The purpose of the present study was to provide basic information on the Length-Weight Relationship parameters of twenty fish species in Aghien-Potou sector caught by artisanal fisheries and assess the condition factor for each species.

2. MATERIAL AND METHODS

2.1. Study area

The Ebrie Lagoon system with an area of 566 km², extends in the east on 125 km along the littoral of Côte d'Ivoire. It comprises the Ebrié Lagoon itself (523 km²) and the Aghien-Potou lagoon system (43 km²). Located between 5°15-5°27 N and 3°43-3°56 W [8] (Fig. 1), the Aghien-Potou lagoon system extends on 72 km from perimeter and 32 km length from the median axis [8] (figure 1). In Potou lagoon, the influence of the intrusion salt works is sensitive in dry season (from January to May),

while remaining moderate (< 9), and the water being soft from May to December [9]. The climate of the study zone is an equatorial type characterized by four seasons including one high dry season from December to March, a high rainy season from April to July, a small dry season from August to September and a small rainy season from October to November. It is a zone where interannual precipitations rank above 1500 mm. This zone contains a significant hydrographic network, composed of the Bete, Djibi and Me rivers. The Bete and Djibi rivers emerge directly in the Aghien Lagoon whereas me river emerges in the natural channel connecting the Aghien lagoon to the lagoon Potou [10]. The Potou Lagoon is characterized by low depths (< 3 m). The most significant depths are recorded on the level of the channels connecting the Aghien lagoons and Potou (5 to 7 m) on the one hand and the Potou sector (7 m) with the remainder of the Ebrie Lagoon on the second hand [11].

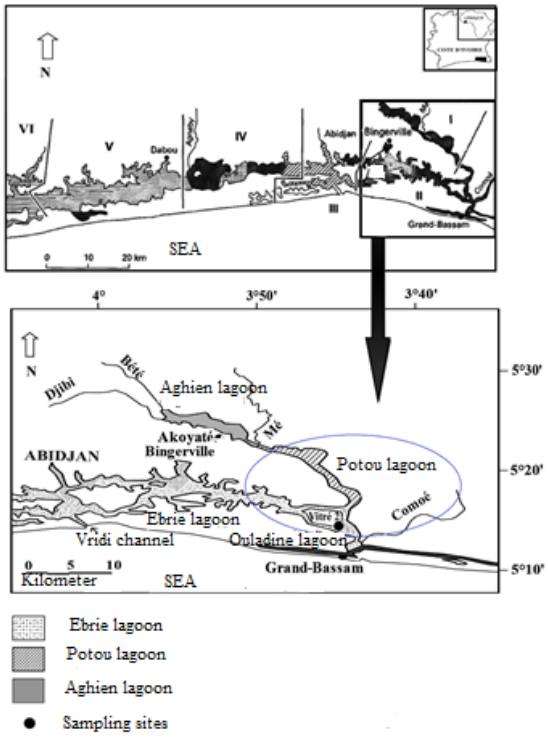

Fig 1: Map of Ebrie Lagoon showing sampling zone (Aghien-Potou Secto

2.2 Data collection and analysis

A monthly study was conducted during 3 to 4 days continuously in Ebrié Lagoon (Aghien-Potou Sector). Furthermore, monthly fish samples were collected from commercial fishing area at random using gillnets, cast nets, traps, hooks and beach seines. Fishermen were chosen by random and fishes in their catches were analysed.

Each specimen was identified to the species level by using [12] manual. Then each individual collected was measured for its standard length (LS) to the nearest 0.1 cm by using a fish measuring board. The fish specimens were individually weighed to the nearest 0.01g using an electronic weighing balance model FEL-500S. Parameters of the length-weight relationship of identified fish species were estimated using the equation:

$W = aSL^b$ [13] (1)

Where, W= weight of fish (g), L= length of fish (cm), a= y-intercept or the initial growth coefficient and b= Slope of the growth coefficient

Parameters (a) and (b) were determined after logarithmic transformation of (1) via least squares linear regression [14].

$\log W = \log a + b \log SL$ (2)

The 95% confidence limits for b (CL 95%) were computed using the equation:

$CL = b \pm (1.96 \times SE)$

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 [15]: 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 type of growth of fish: The growth is isometric if b=3 and the growth is allometric if b≠3 (negative allometric if b inferior to 3 and positive allometric if b is superior to 3). All the statistical analysis were considered at significance level of 5% ($p<0.05$). The condition factor was estimated by the formula:

Condition factor (kc) = $100 W / LS^3$ [16]

Where, W is the weight of fish 'g), LS is the standard length of fish (cm)

3. Results

The length-weight relationships results of each species with several descriptive statistics are summarized in Table 1. A total of 16157 specimens belonging to 13 families and 18 genera were collected in the present study. The family with the highest species number four (04) species was Cichlidae (*Tylochromis jentinki, Coptodon guineensis, Hemichromis fasciatus and Sarotherodon melanotheron*), while three (03) species were recorded by Claroteidae (*Chrysichthys nigrodigitatus, C. auratus, C. maurus*). Two species were recorded by Clupeidae (*Pellonula leonensis, Ethmalosa fimbriata*), Mugilidae (*Mugil cephalus, Liza falcipinnis*) while the other families were represented by one species each. The sample size for the fish species were ranged from 41 in *Hemichromis fasciatus* to 2662 in *Coptodon guineensis* while the value of b was ranged from 2.67 in *Monodactylus sebae* (Monodactylidae) to 3.85 in *Ethmalosa fimbriata* (Clupeidae). The values of correlation coefficient (r^2) varied from 0.61 in *Chrysichthys maurus* (Claroteidae) to 0.99 in *Sphyraena afra*. This value (r^2) was high for several species.

The condition factor (k) for twenty fish species in Ebrie lagoon (Aghien-Potou sector) is presented in Table 1. The highest value of k for the fish species was 6.10±0.31 in *Monodactylus sebae* whereas the lowest value was 0.19±0.001 in *Sarotherodon melanotheron.* 75% of fish species showed a value of k > 1 while 25 % of fish species showed a value of < 1.

4. Discussion

The range of value of b (2.67-3.85) obtained in the present study was within the expected limits (2-4) reported by [17] for most fish species. This range of b values recorded in the work is similar to the values (2.26-3.94) recorded by [18] which studied the Length-weight relationships for 18 fish species in Grand-Lahou lagoon (Côte d'Ivoire). It is also similar to the b values (2.229-3.911) obtained in [19] which studied the length-weight relationship of 30 fish species in Aby lagoon (Côte d'Ivoire). The 95% confidence interval of b for about 80% of the fish species ranged from 2.5 to 3.4. This is within the expected range of 2.5 < b < 3.5 [18]. The value of b for *Ethmalosa fimbriata* in this study is different from that reported by [20] for Grand-Lahou lagoon. In addition, the variation in b values might be correlated with many factors such as food availability, season and sex [21, 22]. The higher b value in *Ethmalosa fimbriata*, *Schilbe mandibularis*, *Pomadasys jubelini, Pseudotolithus*

elongatus and *Hemichromis fasciatus* in Ebrie lagoon showed that it provided a more favourable environment for this fish species. So Ebrie Lagoon (Aghien-Potou sector) seems to be a very healthy environment for some fish species. The coefficient of determination (r^2) for length-weight relationships was high for some species which indicated that for those species the length increased with increase in weight of the fish. This was in agreement with previous studies [19].

Fulton's condition factor (k) reflects through its variations, information on the physiological state of the fish in relation to its welfare. A closer examination of the condition factors revealed that 75% (16 out of 20) of the fish species had their k superior to 1 (k > 1). Only 25% had k values < 1. [23] proposed that if the k value is 1.00, the condition of the fish is poor, long and thin. A 1.20 value of k indicates that the fish is of moderate condition and acceptable to many anglers. A good and well-proportional fish would have a k value that is approximately 1.40. Based on this criterion, the majority of sampled fishes in Ebrie Lagoon (Aghien-Potou sector) were in good condition.

Table I: Length-weight relationship of twenty fish species collected from Ebrie Lagoon (Aghien-Potou sector)

Species	N	a	b	95% of CI of b	r^2	k	Mean length (cm)	Mean weight (g)	GT
Clupeidae									
Pellonula leonensis Boulenger, 1916	98	0.183	2.85	2.83-2.86	0.66	1.48±0.04	8.96±1.78	13.56±8.91	I
Ethmalosa fimbriata (Bowdich, 1825)	2471	0.103	3.85	3.85-3.87	0.78	4.22±0.50	11.78±1.71	186.53±64.93	A+
Claroteidae									
Chrysichthys nigrodigitatus (Lacepède, 1803)	1382	0.180	2.91	2.78-3.03	0.81	1.65±0.04	22.29±1.71	266.5±217	I
Chrysichthys maurus (Valencienne, 1839)	1137	0.134	2.98	2.83-3.12	0.90	1.67±0.01	25.23±8.96	428.08±388	I
Chrysichthys auratus (Geoffroy Saint-Hilaire, 1808)	51	0.169	2.98	2.86-3.09	0.78	1.56±0.04	14.84±2.37	58.07±25.41	I
Schilbeidae									
Schilbe mandibularis (Günther, 1871)	514	0.086	3.17	3.11-3.27	0.61	0.59±0.02	17.68±3.51	43.99±30.47	I

Clariidae *Clarias güentheri* Pfeffer, 1896	71	0.192	2.76	2.69-2.82	0.80	1.08±0.03	22.98±3.32	144.39±60.78	I
Haemulidae *Pomadasys jubelini* (Cuvier, 1830)	158	0.122	3.12	2.95-3.29	0.85	1.16±0.02	19.45±3.44	99.23±48.39	I
Sciaenidae *Pseudotolithus elongatus* (Bowdich, 1825)	125	0.038	3.21	3.20-3.21	0.80	1.10±0.04	21.92±3.83	12.95±6.78	A+
Monodactylidae *Monodactylus sebae* (Cuvier, 1829)	46	0.419	2.67	2.37-2.96	0.90	6.10±0.31	11.97±1.84	112.01±43.45	I
Cichlidae *Tylochromis jentinki* (Steindachner, 1894)	1276	0.159	3.04	2.86-3.19	0.79	1.67±0.008	22.03±2.68	212.3±93.80	I
Coptodon guineensis (Günther, 1862)	2662	0.260	2.84	2.76-2.91	0.86	2.88±0.07	19.74±3.082	247.09±103.90	I
Hemichromis fasciatus Peters, 1852	41	0.095	3.25	3.21-3.28	0.91	0.89±0.04	19.17±2.91	76.56±42.62	I
Sarotherodon melanotheron Ruppel, 1852	2345	0.421	3.64	3.60-3.67	0.89	0.19±0.001	19.90±2.99	1779.71±901.52	A+
Mugilidae *Mugil cephalus* Limnaeus, 1758	96	0.156	3.012	2.85-3.16	0.79	1.44±0.04	23.88±5.01	244.65±167.31	I
Liza falcipinnis (Valencienne, 1836)	49	0.143	2.98	2.90-3.05	0.73	1.11±0.001	18.75±2.15	79.25±30.15	I
Elopidae *Elops lacerta*	2494	0.105	3.09	3.08-3.09	0.68	0.73±0.009	20.22±3.58	70.20±34.85	I
Sphyraenidae *Sphyraena afra* Peters, 1844	80	0.197	2.75	2.48-3.01	0.90	0.97±0.03	35.24±4.95	454.67±172.35	I
Polynemidae *Polydactylus quadrifilis* (Cuvier, 1829)	737	0.119	3.09	3.06-3.11	0.85	1.020±0.030	24.71±11.21	267.27±102.25	A+
Cynoglossidae *Cynoglossus senegalensis* (Kaup, 1858)	327	0.071	3.029	2.73-3.32	0.68	2.54±0.001	35.40±4.18	121.29±40.11	I

N: sample size; a and b regression coefficient; Cl: confidence interval r^2: correlation coefficient: k: condition factor; GT : Growth type ; I : isometric growth, A+ : positive allometric

5. Conclusion

The study provides basic information on length-weight parameters for twenty major fish species collected from Ebrie Lagoon (Aghien-Potou sector). Three species namely *Ethmalosa fimbriata*, *Pseudotolithus elongatus* and *Polydactylus quadrifilis* exhibited a trend of positive growth whereas seventeen fish species showed isometric growth.

The condition factor k was superior to 1 for 75% of the fish species and inferior to 1 for 25 % of the fish species. These growth trends denote that the lagoon could provide a favourable environment and suitable habitat for the growth of those fish species. Thus it would be interesting to create a protected area near the lagoon in order to ensure the protection of fish species.

References

1 Tilami SK, Sampels S. Nutritional value of fish: Lipids, Proteins, vitamins and Minerals. Fisheries Sciences and Aquaculture. 2017; 26(2):1-13.

2 Bolognini L, F. Domenichetti, Grati F, Polidori P, Scarcella G, Fabi G. Weight-Length Relationships for 20 Fish Species in the Adriatic Sea, Turk. J. Fish. Aquat. Sci. 2013; 13: 555-560.

3 Aura MC, Munga CN, Kimani EN, Manyala JO, Musa S. (2011). Length-weight relationships for nine deep sea species off the Kenyan coast. Pan American Journal of Aquatic Sciences.2011; 6: 188-192

4 Xiong W, Zhu XW, Xie D, Pan CH. 2018. Length–weight relationships of eight fish species from mangroves of Guangdong, China. J. Appl. Ichthyol. 2018; 33: 1240-1241.

5 Froese R, Tsikliras A.C, Stergiou KI. Editorial note on weight-length relations of fishes. Acta Ichthyol. Piscat. 2011; 41: 261–26

6 Moutopoulos DK, Stergiou KL. Weight-length and length-length relationships for 40 fish species of the Angean Sea (Hellas). J. Appl. Ichthyol. 2002; 18: 200-203.

7 Muchlisin ZA, Musman M, Azizah MNS. Length-weight relationships and condition factors of two threatened fishes, Rasbora tawarensis and Poropuntius tawarensis, endemic to Lake Laut Tawar, Aceh Province, Indan. J. Appl. Ichthyol. 2010; 26(6): 949-953.

8 Tastet JP, Guiral D. Géologie et sédimentologie. In: JR. Durand, P. Dufour, D. Guiral et SGAF. Zabi (Eds.). Environnement et ressources aquatiques de Côte d'Ivoire, tome 2. ORSTOM, Paris. 1999;35-57.

9 Guiral D. Chantraine JM. Hypothèses sur l'origine des mortalités observées en lagune Ebrié en 1979. Document Scientifique. Centre de Recherches Océanographique Abidjan. 1983; 12(2):6 1-95.

10 Traoré A, Soro G, Konan E, Kouadio B, Bamba S, Oga MS, Soro N. Biemi J. Evaluation des paramètres physiques, chimiques et bactériologiques des eaux d'une lagune tropicale en période d'étiage: la lagune Aghien. International Journal Biological Chemistry Sciences. 2012; 6 (6): 7048-7058

11 N'Guessan K, Tra Bi F.H, Koné MW. Etude ethnopharmacologique de plantes antipaludiques utilisées en médecine traditionnelle chez les Abbey et Krobou d'Agboville (Côte d'Ivoire) Ethnopharmacologia. 2009; (44):42-50.

12 Paugy D, Lévêque C, Teugels GG. The Fresh and Brackish water Fishes of West Africa, Volume I, Institute of Research and Development Editions. Collection Faune et Flore tropicales 40, Paris. 2003; 457p

13 Ricker WE. Linear regressions in fisheries research. J. Fish. Res. Board Can. 1973; 30(3): 409-434.

14 Zar JH. 1984. Biostatistical Analysis. Prentice Hall, New Jersey. 1999; pp: 718

15 Sokal R. Rohlf, F. Introduction to Biostatistics, 2nd Edn. Freeman Publication, New York. 1987; pp: 887.

16 Pauly D. Some simple methods for the assessment of tropical fish stocks. FAO Fisheries Tech. Pap., FAO. Rome.1983; 234: 52.

17 Tesch FW. Age and Growth. In: Ricker, W.E. (Ed.), Methods for Assessment of Fish Production in Freshwaters. IBP Handbook 3. Blackwell Scientific Publications, Oxford, UK.1971; pp: 93-123.

18 Coulibaly B, Bamba M, Tah L, Kouamelan EP, Koné T. Length-weight relationships of 18 fish species in Grand-Lahou lagoon Sout-west Côte d'Ivoire. International Journal of Fisheries and Aquatic Studies. 2018; 6 (6): 372-376.

19 Koffi BK, Berté S, Koné T. Length-Weight Relationships of 30 Fish Species in Aby Lagoon, Southeastern (Côte d'Ivoire). Current Research Journal of Biological Sciences. 2014; 6 (4): 173-178

20 Carlander KD. Handbook of Freshwater Fishery Biology, Vol. 1, the Iowa State University Press, Ames, IA. 1969; pp: 752.

21 Yilmaz S, Yazıcıoğlu O, Erbaşaran M, Esen S, Zengin M, Polat N. **Length-**weight relationship and relative condition factor of white bream**, Blicca** bjoerkna (L., 1758), from Lake Ladik, Turkey. J. Black Sea/Medit. Environ. 2012; 18(3): 380-387

22 Ali RAS, Elawad AN, Khalifa MM, El-Mor M. Length–weight relationship and condition factor of Liza ramada from Eastern coast of Libya Int. J. Fish. Aqua. Res. 2016; 2(2): 1-9

23 Barnham C, Baxter A. Condition factor, K, for Salmonid Fish, Fisheries Notes, ISSN 1998 ; pp. 1440–2254.