International Journal of Forest, Animal and Fisheries Research (IJFAF)
ISSN: 2456-8791
[Vol-7, Issue-1, Jan-Feb, 2023]
Issue DOI: https://dx.doi.org/10.22161/ijfaf.7.1
Article DOI: https://dx.doi.org/10.22161/ijfaf.7.1.1

Assessment of size structures, length-weight models and condition factors of Eleotridae (Pisces: Perciformes: Gobiodei) from the coastal waters of Benin (West Africa)

Sonon Péjanos Stanislas, Sidi Imorou Rachad, Arame Hamidou, Adjibade Kayodé Nambil, Adite Alphonse*

Laboratory of Ecology and Aquatic Ecosystem Management (LEMEA), Departement of Zoology, Faculty of Sciences and Technics, Université d'Abomey-Calavi, BP: 526 Cotonou, Benin.
*Corresponding author

Received: 19 Dec 2022; Received in revised form: 21 Jan 2023; Accepted: 02 Feb 2023; Available online: 10 Feb 2023

***Abstract*— *The Eleotridae is one of the fish family widely distributed in the Benin coastal waters where the species constitute an important component of artisanal fisheries. The current study evaluates length frequency distributions, length-weight models and condition factors of Eleotrid fishes in order to assess their wellbeing in the degrading coastal waters of Benin. Fish samplings were made during eighteen (18) consecutive months and morphometric data were recorded and analyzed using SPSS computer software. Larger Eleotrids were Eleotris vittata, E. senegalensis, E. daganensis and Bostrychus africanus while Dormitator lebretonis, the most abundant species displayed small sizes (standard length) ranging between 1.2 - 11.30 cm. Overall, all the species showed unimodal size distributions except Eleotris daganensis that exhibited a bimodal size distribution in Lake Nokoué. Length-weight models showed allometric growth with slopes b ranging between 2.4725 and 3.7296 along with significant correlation coefficients (r) varying between 0.7695 and 0.9965. Condition factors (K) varied significantly across the four (4) coastal waters and ranged between 0.79 (Dormitator lebretonis) and 3.60 (Eleotris daganensis). The sustainable exploitation of Eleotrid fishes in the Benin coastal waters requires a holistic approach of ecosystem management including ecological follow-up, habitat restauration and species valorization.*

***Keywords*— Allometry, Coastal waters, Condition factor, Eleotridae, Management, Southern Benin.**

I. INTRODUCTION

Also called sleeper gobies, the Eleotrids are important fisheries component in the Western African coastal waters where about 6 genera and 13 species were recorded (FAO, 1981; Leveque et al., 1992; Atobalete and Ugwumba, 2011). In addition, some species are used not only in aquaculture but also as ornemental fish in aquarium. In the coastal waters of Southern Benin, Eleotrids are considered as one of the formost fish of high economic and commercial importance. Recent fisheries surveys by Sonon et al. (2021) at the Benin coastal waters revealed five Eleotrid species that accounted for about 12.28% of the artisanal catches (Adite, 2013). The meat of these species is very appreciate by consumers and in particular, the species *Dormitator lebretonis* is widely used for sauce seasoning in replacement of shrimps that have become scarce and very expensive. Unfortunately, due to habitat degradation and fragmentation, the stock and catches of Eleotrids are being decreasing, and increasingly more small-sized fishes are often harvested (Babatounde, 2015).

Notwithstanding its fisheries importance and habitat disturbances, little is known about the growth factors of the Eleotrid dwelling the Benin coastal waters. In particular, data on size structures, length-weight models (LWR) and condition factors (K) are scant. As stated by fisheries ecologists, length-weight relationships and condition coefficients provide valuable informations on fish population, ecosystem health and productivity (Ecoutin et al., 2005; Samat et al., 2008). Length and weight data can notably provide important clues to climatic and environmental changes, and the change in human subsistence practices (Pauly, 1984; Luff, and Bailey, 2000). As reported by Abowei (2009) and Gbaguidi & Adite (2016), both length-weight models and condition coefficients are measures of the feeding intensity and physiological states of fishes. Particularly, LWR and K affect fecundity, spawning, growth and mortality and evaluate the well-being of the fishes (Tesch, 1971; Bagenal, 1978; Beyer, 1987; Froese, 1998). These growth factor are strongly influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem (Abowei, 2010). Hence, LWR and K could be used as indicators to evaluate the productivity and the "ecological health"of aquatic ecosystems (Deekae and Abowei, 2010). As results, both community indices appear to be useful instruments for decision in fisheries management (Tesch, 1971; Oni et al., 1983; Schreck and Moyle, 1990; Abowei, 2009).

In this study, we assessed the size structures, weight-length relationships and conditions factors of Eleotridae fishes from four (4) coastal lagoons (Lake Nokoué, Coastal Lagoon, Lake Ahémé and lagoon of Porto-Novo) in Southern Benin. This information are badly needed not only for the monitoring and conservation of Eleotrid fishes but also for aquaculture valorization of numerous swamps of Southern Benin.

II. MATERIALS AND METHODS

***Study area*:** The study location is the coastal waters of Southern Benin (Fig. 1) constituted of four (4) lagoons, Lake Nokoué (140 km^2**)**, Porto-Novo Lagoon (35 km^2), Coastal Lagoon (55 km^2) and Lake Ahémé (80 km^2). Located between 6°20′ and 6°30′N, and between 2°20′ and 2°35′E Lake Nokoué is a polyhaline water with salinity varying between 0.2-40 ‰, water temperature between 27.5- 31.1°C, dept between 25-345.5 cm, transparency between 25-98.5 cm, pH between 5.8-7.55 and dissolved oxygen ranging between 0.55-8.9 mg/l (Sonon et al., 2021). Porto-Novo Lagoon is located between 6°25′and 6°30′N and between 2°30′and 2°38E and communicates with Lake Nokoué to the west through Totchè canal. Salinities in Porto-Novo Lagoon range between 0.11-18 ‰, water temperature between 26.8-31.5°C, depth between 88.5-485.3 cm, transparency between 45.3-113.5 cm, pH between 6.2-8.55 and dissolved oxygen between 0.85-8.2 mg/l. The Coastal Lagoon extended from Togbin village to Grand-Popo city with salinities varying between 0.15-30‰ , water temperature between 27.1-31.5 °C, depth between 22-385 cm, transparency between 22-92.2 cm, pH between 6.5-8.5 and dissolved oxygen between 0.82-9.8 mg/l. Lake Ahémé is located between 6.20° and 6.40°N and between 1.55° and 2°E and linked southward with the Coastal Lagoon via Aho channel (Lalèyè & Moreau, 2004). This brackish water communicates in his North with the Couffo River and also with the Mono River that cause the rise of Lake Ahémé. Salinities of Lake Ahémé varied between 0.12-22‰, water temperature between 27.5-30.8°C, depth between 72.5- 478 cm, transparency between 78.9-129.7 cm, pH between 6.1-7.8 and dissolved oxygen between 0.85-9.7 mg/l.

The study area showed a sub-equatorial climate with two wet seasons (April-July; mid-September-October) and two dry seasons (December-March; August-mid-September), with floodings occuring August - November. Aquatic plants include *Ecchornia crassipes* (water hyacinth), *Raphia gigantea, Rhizophora racemosa, Avicennia africana* and *Acrostichum aureum*. In addition to marshy meadows and mangroves forests, there were at some sites, some fruit plantations including mango trees, orange trees, coconut trees etc.

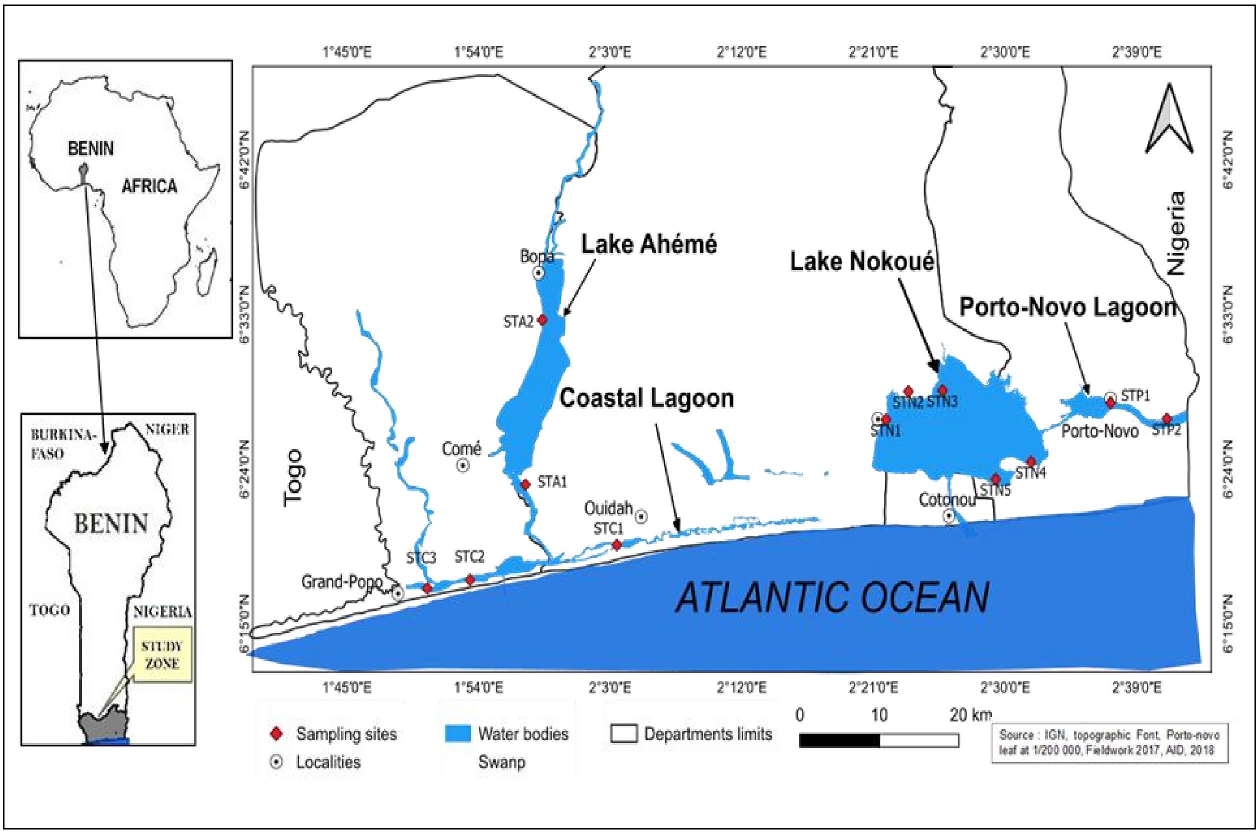

Fig. 1: Map showing coastal waters (Southern Benin) and the twelve study locations. STN= Sites of Lake Nokoué, STP= Sites of Porto-Novo Lagoon, STC= Sites of Coastal Lagoon, STA= Sites of Lake Ahémé.

Fish sampling: Eleotridae samplings were done on the four (4) coastal waters of Bénin, Lake Nokoué (5 sites), Lagoon of Porto-Novo (2 sites), Coastal Lagoon (3 sites) and Lake Ahémé (2 sites) (Figure 1). Geographical coordinates of each sampling site were recorded using a GPS receiver (Garmin Dakota 10). Two habitats, the "open water", exempt of vegetation and "aquatic vegetation" were considered in each sampling site. Also, in Lake Nokoué, a system of traditionnal aquaculture/fisheries ("Acadja" habitat) made of park of branches has been sampled. "Acadja" is massively used in artisanal fisheries in Benin coastal waters.

Eleotrid collections were made monthly using castnets, seines, gillnets and traps (Adite et al., 2017). Also, samplings were done in artisanal captures of local fishermen to add species that were not caught during experimental samplings (Hauber, 2011). During the eighteen (18) consecutive months of sampling in the coastal waters, a total of 7225 Eleotrid individuals were collected. After collection, the fish individuals were identified in situ using references such as Leveque et al. (1992) and Pezold *et al.* (2002) on freshwater and brackish fishes of West Africa. The samples were then conveyed in thermos cool boxes to the laboratory. Individual fishes were measured for total length (TL) and standard length (SL) to the nearest 1.0 mm with a fish measuring board, and weighed to the nearest 0.01 gram with an electronic balance. Individual fishes were then preserved in 10% formalin and latter in 70% alcohol for further biological observations.

Data analysis: Morphometric data (total length, standard length, weight) of Eleotrid fishes were recorded in Excel and SPSS (Morgan et al., 2001) spreadsheets. Size structures were examined by generating standard length (SL) frequency histograms of each species. Length-weight models were examined for species with sample size ≥20 individuals following the power function of Le Cren's (1951):

$$W = aSL^b$$

along with its logarithmic-transformed linear model:

$$LogW = Loga + b\ LogSL$$

where SL is the fish standard length, W is the fish individual weight, a is the intercept, and b, the allometry coefficient (Le Cren, 1951). One-way analysis of variance (ANOVA) was used to test significance of the regression. The wellbing each Eleotrid species was assessed using condition factor (K) following Tesch (1978) model:

$$K= W/SL^{b} \times 100$$

where K is the condition factor, W, the fish individual weight (g), SL, the standard length (cm), and b, the allometry coefficient. In addition, spatial and seasonal variations (flood, dry, wet) of K were examined by coastal water: the values of K were submitted to ANOVA using SPSS software version 21 (Morgan et al., 2001).

III. RESULTS

***Size structures*:** Among the five (5) Eleotrid species inventoried in the four (4) coastal waters, four (4) species exhibited relatively large sizes (Table 1). These were *Eleotris vittata* with SL ranging between 3-17cm in Lake Nokoué, 2.8-18cm in Lagoon of Porto-Novo, 1.4-19cm in Coastal Lagoon and 1.6-21cm in Lake Ahémé, *Eleotris senegalensis* with SL between 4.7-14.5cm in Lake Nokoué, 2.5-16.5cm in Lagoon of Porto-Novo, 4-12.33cm in Coastal Lagoon and 10.5-11.3cm in Lake Ahémé, *Eleotris daganensis* with SL between 4.3-16cm in Lake Nokoué, 5-17cm in Lagoon of Porto-Novo, 1.5-9.4cm in Coastal Lagoon and 5.9-13 in Lake Ahémé and *Bostrychus africanus* showing SL between 9-15cm in Lake Nokoué, 8.5-14cm in Lagoon of Porto-Novo, 8.6-13cm in Coastal Lagoon. In contrast, *Dormitator lebretonis*, the most abundant species displayed small sizes with standard length (SL) ranging between 1.5-9.6cm in. Lake Nokoué, 2-96cm in Lagoon of Porto-Novo, 1.2-7.8cm in Coastal Lagoon and 6.5-11.30 cm in Lake Ahémé (Table 1). The highest SL mean (4.27cm ± 1.22) of *D. lebretonis* was recorded in Lagoon of Porto-Novo, that of *E. vittata* (9.32 cm ± 2.57) was recorded in Lake Ahémé, those of *E. senegalensis* (10.9cm ±0.23), and *E. daganensis* (9.31cm ± 2.32) were recorded in Lake Ahémé and that of *B. africanus* (11.2cm ± 0.65) was recorded in Lake Nokoué. One-way ANOVA indicated that each of the five (5) Eleotrids exhibited significant ($P \leq 0.01$) variations of SL across the 4 coastal waters. Indeed, statistics for *D. lebretonis* gave $F_{3,4848} = 21.42$, $P = 0.002$; *E. vittata* : $F_{3,1647} = 18.21$, $P = 0.001$; *E. daganensis* : $F_{3,301} = 16.25$, $P = 0.002$; *E. senegalensis* : $F_{3,240} = 13.92$, $P = 0.001$; *B. africanus* : $F_{2,241} = 17.26$, $P = 0.002$. In general, all the species showed unimodal size distributions (Fig. 2,3,5 & 6) except *E. daganensis* (Fig. 4) that exhibited a bimodal size distribution in Lake Nokoué.

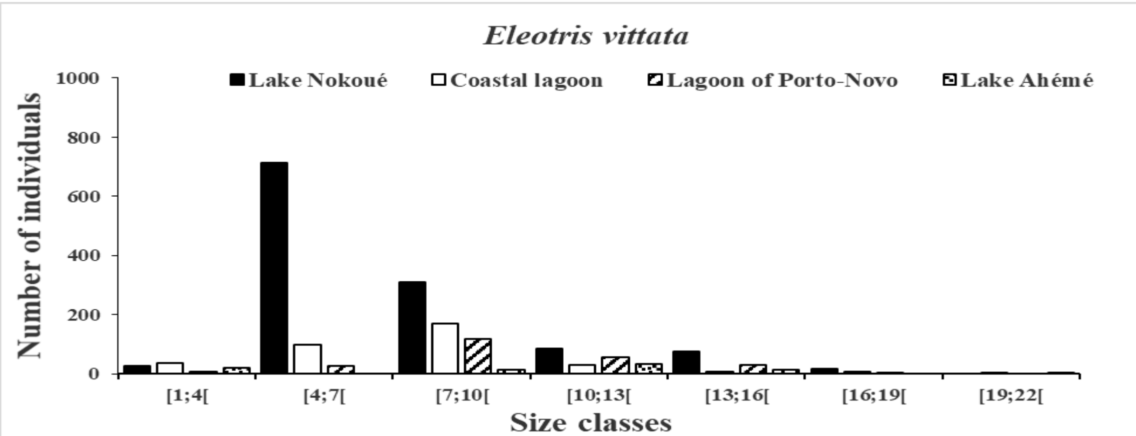

Fig. 2: Size structure of Eleotris vittata from the four (4) coastal waters (Lake Nokoué, Coastal Lagoon, Lagoon of Porto-Novo and Lake Ahémé) of Southern Benin.

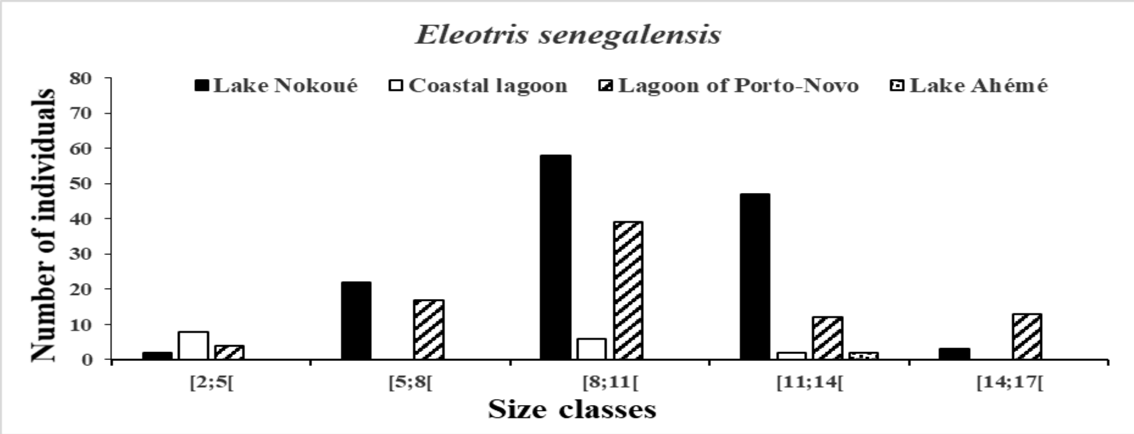

Fig. 3: Size structure of Eleotris senegalensis from the four (4) coastal waters (Lake Nokoué,Coastal Lagoon, Lagoon of Porto-Novo and Lake Ahémé) of Southern Benin.

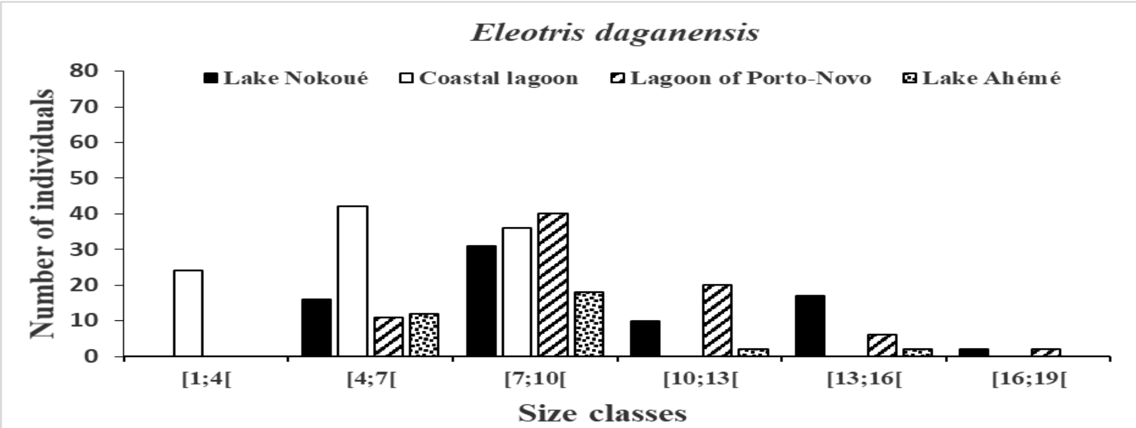

Fig. 4: Size structure of Eleotris daganensis from the four (4) coastal waters (Lake Nokoué, Coastal Lagoon, Lagoon of Porto-Novo and Lake Ahémé) of Southern Benin.

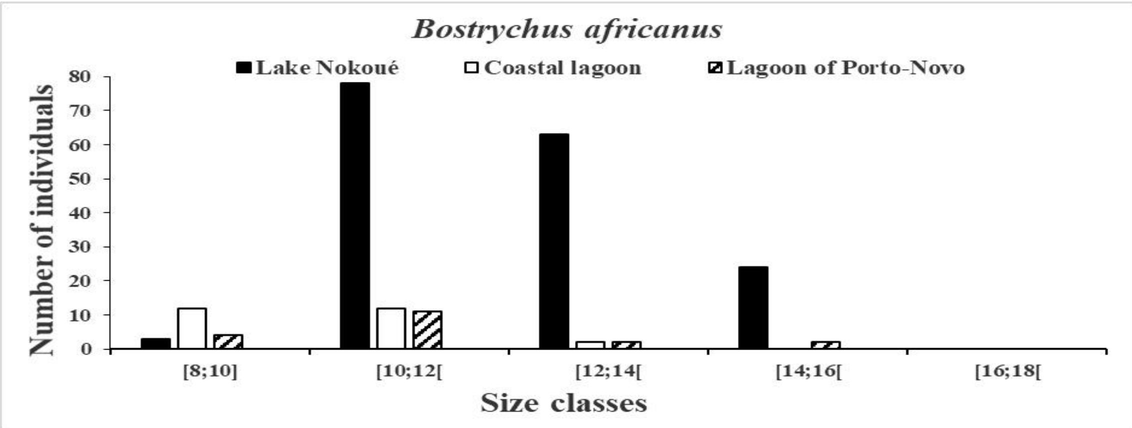

Fig. 5: Size structure of Bostrychus africanus from the four (4) coastal waters (Lake Nokoué, Coastal Lagoon, Lagoon of Porto-Novo and Lake Ahémé) of Southern Benin.

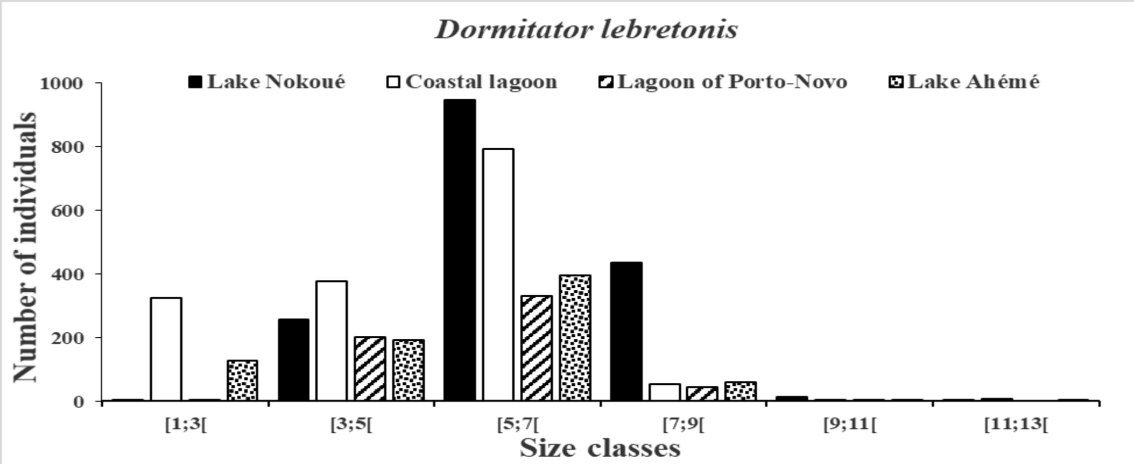

Fig. 6: Size structure of Dormitator lebretonis from the four (4) coastal waters (Lake Nokoué, Coastal Lagoon, Lagoon of Porto-Novo and Lake Ahémé) of Southern Benin.

Length-weight relationships: The matrix of length-weight regression equations of the 5 species at the 4 coastal waters with associated correlation coefficients (*r*), allometric coefficients (*b*) and constants a are presented in Table 1. In Lake Nokoué, except *B. africanus* that showed a negative allometric coefficient *b*=2.90, all the remaining four (4) Eleotrids exhibited significant positive allometric growth (*b*>3; *P*<0.05) with *E. senegalensis* displaying the highest *b*=3.28. In Porto-Novo Lagoon the four (4) Eleotrids, *D. lebretonis*, *E.vittata, E. senegalensis* and *E. daganensis* exhibited significant negative allometric growth (*b*<3; *P*<0.05) with *E. vittata* showing the highest value of *b*=2.94. Eleotrids of the Coastal Lagoon and Lake Ahémé showed significant positive (*b*>3; *P*<0.05) allometric and isometric growth. Slope *b* of squeakers in the Coastal Lagoon ranged between 3.01 (*E. vittata*) and 3.28 (*D. lebretonis*) and those of Eleotrids in Lake Ahémé varied between 3.09 (*E. vittata*) and 3.73 (*E. daganensis*). Because of the lower abundance (N = 19), of *B. africanus* in Porto-Novo Lagoon, the regression of this species in this ecosystem have not been done. It was also the case of *E. senegalensis* in the Coastal Lagoon (N = 16) and in Lake Ahémé (N = 2). Associated correlation coefficients (r^2) ranged between 0.86 (*B. africanus*) and 0.99 (*E. daganensis*) in Lake Nokoué, 0.92 (*E. senegalensis*) and 0.98 (*E. daganensis*) in Porto-Novo Lagoon, 0.96 (*B. africanus*) and 0.99 (*E. vittata*) in the Coastal Lagoon and between 0.98 (*E. daganensis*) and 0.99 (*E. vittata*) in Lake Ahémé. Seasonaly, during the wet, flood and dry seasons, all the eleotrid species exhibited positive allometric growth (*b*>3, p<0.05) with higherst value of *b*=3.22 recorded for *E. daganensis* in Coastal Lagoon during dry season (Table 2). In contrast, all eleotrid species showed negative allometric growth in lagoon of Porto-Novo during all the season. Length weight relationship of differents eleotrids was also studied considering the habitats (Table 3). In general, "open water" and "aquatic vegetation" habitats showed positive allometric growth (b>3, p<0.05) for all the eleotrids species in Lake Nokoué, Coastal Lagoon and Lake Ahémé respectively with highest value of *b*=3.18 recorded for *D. lebretonis* in aquatic vegetation. In Porto-Novo Lagoon, all these eleotrids species exhibited negative allometric growth with the highest *b*=2.95 recorded in aquatic vegetation habitat.

Table 1. Length-weight models of eleotrid species collected from April 2017 to September 2018 in the four (4) coastal waters of Southern Benin.

Sites	Species	N	SL Interval (cm)	Weight Interval (g)	Length-Weight Relationships				
					a	b	r^2	Growth	T-test
Lake Nokoué	*Dormitator lebretonis*	1911	1.5-9.6	0.4-14.84	0.02	3.15	0.92	A^+	*P*=0.00
	Eleotris vittata	984	3-17	0.5-191	0.01	3.18	0.96	A^+	*P*=0.00
	Eleotris daganensis	87	4.3-16	3-163.16	0.02	3.22	0.99	A^+	*P*=0.00
	Eleotris senegalensis	139	4.7-14.5	2.1-130.2	0.01	3.28	0.98	A^+	*P*=0.00
	Bostrychus africanus	140	9-15.4	11.64-63.26	0.03	2.90	0.86	A^-	*P*=0.00
Porto-Novo Lagoon	*Dormitator lebretonis*	578	2-9.6	0.44-17.5	0.04	2.76	0.93	A^-	*P*=0.00
	Eleotris vittata	238	2.8-18	0.76-182.34	0.03	2.94	0.96	A^-	*P*=0.00
	Eleotris daganensis	79	5-17	2-119.7	0.04	2.85	0.98	A^-	*P*=0.00
	Eleotris senegalensis	84	2.5- 16.5	2.16-139.06	0.10	2.47	0.92	A^-	*P*=0.00
	*Bostrychus africanus**	19	8.5-14	15.32-57.68	-	-	-	-	-
Coastal Lagoon	*Dormitator lebretonis*	1556	1.2- 7.8	0.35-14.44	0.01	3.28	0.97	A^+	*P*=0.00
	Eleotris vittata	346	1.4- 19	2.4-22	0.02	3.01	0.99	I	*P*=0.90
	Eleotris daganensis	102	1.5-9.4	0.1-21.04	0.02	3.14	0.98	A^+	*P*=0.00
	*Eleotris senegalensis**	16	4-12.3	2.06-77.62	-	-	-	-	-
	Bostrychus africanus	26	8.6-13	15.16-57.94	0.02	3.23	0.96	A^+	*P*=0.00
Lake Ahémé	*Dormitator lebretonis*	804	6.5-11.30	3.4-13.44	0.02	3.17	0.98	A^+	*P*=0.00
	Eleotris vittata	80	1.6-21	0.18-140.4	0.02	3.09	0.99	A^+	*P*=0.00
	Eleotris daganensis	34	5.9-13	2.8-68.18	0.01	3.73	0.98	A^+	*P*=0.00
	*Eleotris senegalensis**	2	10.5-11.3	32.44-36.44	-	-	-	-	-

*Length-weight regression equations were not performed for species with sample size < 20

A^-: Negative allometric growth; A^+: Positive allometric growth; I: Isometric growth

Table 2. Seasonal length-weight models of eleotrid fishes collected from April 2017 to September 2018 in the four (4) coastal waters of Southern Benin.

Sites	**Species**	**Dry**				**Wet**				**Flood**			
		a	b	r^2	Growth	a	b	r^2	Growth	a	b	r^2	Growth
Lake Nokoué	*Dormitator lebretonis*	0.02	3.18	0.97	A+*	0.02	3.11	0.92	A+*	0.01	3.08	0.91	A+*
	Eleotris vittata	0.03	3.09	0.92	A+*	0.03	3.10	0.98	A+*	0.01	3.02	0.98	A+*
	Eleotris daganensis	-	-	-	-	0.02	3.02	0.99	A+*	0.01	3.12	0.97	A+*
	Eleotris senegalensis	0.02	3.12	0.89	A+*	0.02	3.08	0.95	A+*	0.01	3.05	0.93	A+*
	Bostrychus africanus	0.04	2.84	0.93	A-*	0.03	2.82	0.94	A-*	0.03	3.01	0.91	A+*
Porto-Novo Lagoon	*Dormitator lebretonis*	0.04	2.82	0.94	A-*	0.03	2.89	0.92	A-*	0.04	2.75	0.93	A-*
	Eleotris vittata	0.03	2.92	0.91	A-*	0.03	2.79	0.96	A-*	0.03	2.82	0.92	A-*
	Eleotris daganensis	-	-	-	-	0.03	2.95	0.92	A-*	0.04	2.85	0.99	A-*
	Eleotris senegalensis	-	-	-	-	0.09	2.87	0.95	A-*	0.39	2.89	0.98	A-*
	Bostrychus africanus	-	-	-	-	-	-	-	-	0.01	2.19	-	-
Coastal Lagoon	*Dormitator lebretonis*	0.01	3.02	0.91	A+*	0.01	3.18	0.92	A+*	0.01	2.19	0.92	A+*
	Eleotris vittata	0.02	3.01	0.98	I**	0.02	3.01	0.99	I**	0.02	3.02	0.98	A+*
	Eleotris daganensis	0.01	3.22	0.87	A+*	0.02	3.14	0.98	A+*	0.02	3.08	0.91	A+*
	Eleotris senegalensis	-	-	-	-	-	-	-	-	-	-	-	-
	Bostrychus africanus	-	-	-	-	-	-	-	-	-	-	-	-
Lake Ahémé	*Dormitator lebretonis*	0.02	3.02	0.93	A+*	0.02	3.17	0.98	A+*	0.02	3.06	0.91	A+*
	Eleotris vittata	-	-	-	-	0.02	3.09	0.99	A+*	0.01	3.07	0.95	A+*
	Eleotris daganensis	-	-	-	-	-	-	-	-	0.01	3.22	0.94	A+*
	*Eleotris senegalensis****	-	-	-	-	-	-	-	-	-	-	-	-

* Significant at P<0.001 ; ** Insignificant (P>0.05) A^-: Negative allometric growth A^+: Positive allometric growth I: Isometric growth

*** Because sample size of *Eleotris senegalensis* is N=2 < 20 individuals, length-weight regression equations were not performed.

Table 3. Length-weight relationships models by habitat type of eleotrid fishes collected from April 2017 to September 2018 in the four (4) coastal waters of Southern Benin.

Sites	Species	Open Water				Aquatic Vegetation				Acadjavi			
		a	b	r^2	Growth	a	b	r^2	Growth	a	b	r^2	Growth
Lake Nokoué	*Dormitator lebretonis*	0.01	3 .18	0.97	A+*	0.08	3.11	0.92	A+*	0.02	3.11	0.92	A+*
	Eleotris vittata	0.03	3.09	0.92	A+*	0.04	3.10	0.98	A+*	0.01	3.21	0.91	A+*
	Eleotris daganensis	-	-	-	-	0.01	3.02	0.98	A+*	0.02	3.23	0.93	A+*
	Eleotris senegalensis	0.02	3.12	0.89	A+*	0.02	3.08	0.95	A+*	0.02	3.12	0.92	A+*
	Bostrychus africanus	0.03	2.84	0.93	A-*	0.03	2.82	0.94	A-*	0.02	3.15	0.91	A+*
Porto-Novo Lagoon	*Dormitator lebretonis*	0.04	2.82	0.94	A-*	0.03	2.89	0.93	A-*	-	-	-	-
	Eleotris vittata	0.03	2.93	0.91	A-*	0.03	2.79	0.96	A-*	-	-	-	-
	Eleotris daganensis	-	-	-	-	0.02	2.95	0.92	A-*	-	-	-	-
	Eleotris senegalensis	-	-	-	-	0.09	2.87	0.95	A-*	-	-	-	-
	Bostrychus africanus	-	-	-	-	-	-	-	-	-	-	-	-
Coastal Lagoon	*Dormitator lebretonis*	0.01	3.02	0.91	A+*	0.01	3.18	0.92	A+*	-	-	-	-
	Eleotris vittata	0.02	3.01	0.98	I**	0.02	3.02	0.99	I**	-	-	-	-
	Eleotris daganensis	0.01	3.18	0.87	A+*	0.02	3.14	0.98	A+*	-	-	-	-
	Eleotris senegalensis	-	-	-	-	-	-	-	-	-	-	-	-
	Bostrychus africanus	-	-	-	-	-	-	-	-	-	-	-	-
Lake Ahémé	*Dormitator lebretonis*	0.02	3.06	0.94	A+*	0.02	3.17	0.98	A+*	-	-	-	-
	Eleotris vittata	-	-	-	-	0.02	3.08	0.99	A+*	-	-	-	-
	*Eleotris daganensis****	-	-	-	-	-	-	-	-	-	-	-	-
	*Eleotris senegalensis****	-	-	-	-	-	-	-	-	-	-	-	-

* Significant at *P*<0.001 ; ** Insignificant (*P*>0.05) A^-: Negative allometric growth A^+: Positive allometric growth I: Isometric growth

*** Because sample sizes of *Eleotris daganensis* and *Eleotris senegalensis* were < 20 individuals, length-weight regression equations were not performed during dry, wet and flood seasons.

Condition factors: Significant ($F_{3,7224}$ = 243.658; P=0.001) spatial variations of Eleotrid condition factors (K) were recorded across the four (4) coastal waters examined. Overall, K ranged between 0.7 (*D. lebretonis*) and 3.6 (*E. daganensis*). In lake Nokoué, *E. vittata* exhibited the highest condition factor (K = 3.2) whereas *D. lebretonis* showed the lowest value (K = 0.7). In contrast, in Porto-Novo Lagoon, *D. lebretonis* displayed the highest value of K = 2.99 while *E. senegalensis* showed the lowest value (K=1.06). Also, in the Coastal Lagoon, condition factor peaked for *D. lebretonis* with K = 3 while *B. africanus* exhibited the lowest K=0.77. In Lake Ahémé, *E. daganensis* exhibited the highest K=3.6, whereas the lowest value was recorded for *D. lebretonis* (K=0.79) (Table 4).With regards to habitats, all five (5) squeakers showed their highest condition factors in aquatic vegetation with the highest mean K= 5.60 ± 0.6 recorded for *B. africanus* in Lake Nokoué (Table. 5). Likewise, the Eleotrids species showed seasonal variations (P<0.05) of the condition factors (Table. 6). Indeed, the first most abundant Eleotrid, *D. lebretonis*, showed significant (P<0.000) seasonal variations of (K) in Lake Nokoué ($F_{2,1910}$=4712.96; P=0.000), Porto-Novo Lagoon ($F_{2,577}$=49.22; P=0.000), Coastal Lagoon ($F_{2,1555}$=2669.52; P=0.000) and Lake Ahémé ($F_{2,803}$=186,72; P=0.000). Similar trends were recorded for E. vittata, the second most prominent Eleotrid, with $F_{2,983}$=103.30; P=0.000 for Lake Nokoué, $F_{2,237}$=316.032; P=0.000 for Porto-Novo Lagoon, $F_{2,345}$=65,62; P=0.000 for Coastal Lagoon and $F_{2,79}$=16.34; P=0.000 for Lake Ahémé. In particular, *E. vittata, E. daganensis* and *E. senegalensis* showed respectively their highest mean K, 5.52±1.68 (Porto-Novo Lagoon), 3.6±2.05 (Coastal Lagoon) and 1.42±0.26 (Porto-Novo Lagoon) in the dry season. Inversely, the highest mean condition factors of *D. lebretonis* (K= 2.95±0.68) were recorded during the flooding period in Lake Ahémé and that for *B. africanus* (K = 2.60 ± 0.6) were recorded in Lake Nokoue during the wet season.

Table 4. Variations of condition factors (K±SD) of eleotrid fish species collected in coastal waters of Southern Benin from April 2017 to September 2018.

	Lake Nokoué		Lagoon of Porto-Novo		Coastal Lagoon		Lake Ahémé	
Species	**Sample size**	**K**	**Sample size**	**K**	**Sample size**	**K**	**Sample size**	**K**
Dormitator lebretonis	1911	0.7[a]	578	2.99[b]	1556	3[b]	804	0.79[a]
Eleotris vittata	984	3.2[c]	238	2.39[b]	346	2.54[b]	80	1.34[a]
Eleotris daganensis	87	1.15[ab]	79	1.29[b]	102	1.04[a]	34	3.6[c]
Eleotris senegalensis	139	0.77[a]	84	1.06[b]	16	1.17[b]	2	-
Bostrychus africanus	140	2.52[c]	19	1.14[b]	26	0.77[a]	0	-

[abc] mean with differents letters are statistically different (*P*<0.05)

Table 5. Spatial variations of condition factors (K±SD) of eleotrid fishes collected by habitats type in coastal waters of Southern Benin from April 2017 to September 2018.

Species	**K ±SD**			
	Coastal waters	**Open Water**	**Aquatic Vegetation**	**"Acadjavi"**
Dormitator lebretonis	Lake Nokoué	0.86 ± 0.65 [b]	1.31 ± 0.42 [a]	1.12 ± 0.33 [a]
	Porto-Novo Lagoon	1.11 ±1.46 [a]	2.68 ±0.75 [b]	-
	Coastal lagoon	1.41 ± 0.22 [a]	1.84 ± 0.65 [b]	-
	Lake Ahémé	0.68 ± 0.41 [a]	1.32 ± 0.65 [b]	-

Eleotris vittata	Lake Nokoué	1.22 ± 0.23 ^{a}	2.24 ± 2.21 ^{b}	1.85 ± 0.42 ^{a}
	Porto-Novo Lagoon	2.35 ± 1.75 ^{a}	3.97 ± 0.13 ^{b}	-
	Coastal lagoon	1.02 ± 0.31 ^{a}	2.35 ± 0.22 ^{b}	-
	Lake Ahémé	0.84 ± 0.28 ^{a}	1.67 ± 0.31 ^{b}	-
Eleotris daganensis	Lake Nokoué	1.32 ± 0.29^{a}	2.22± 0.31^{b}	1.72 ± 0.35^{a}
	Porto-Novo Lagoon	1.81 ± 0.15 ^{a}	2.65±0.09 ^{b}	-
	Coastal Lagoon	2.42 ±1.23 ^{a}	3.82± 0.28 ^{b}	-
	Lake Ahémé	1.27 ± 0.32 ^{a}	1.67±0.12 ^{a}	-
Eleotris senegalensis	Lake Nokoué	0.79 ± 0.19 ^{a}	1.36 ± 0.24 ^{b}	1.23 ± 0.22 ^{b}
	Porto-Novo Lagoon	1.42 ± 0.35 ^{a}	2.34±0.12 ^{b}	-
	Coastal Lagoon	1.35 ± 0.42 ^{a}	2.20±0.19 ^{b}	-
	Lake Ahémé	-	-	-
Bostrychus africanus	Lake Nokoué	3.78 ± 0.66 ^{b}	5.60 ± 0.6 ^{c}	1.25 ± 0.35 ^{a}
	Porto-Novo Lagoon	2.21 ±0.07 ^{a}	3.08 ±1.28 ^{b}	-
	Coastal lagoon	2.25 ± 0.89 ^{a}	3.32 ± 1.57 ^{b}	-
	Lake Ahémé	-	-	-

^{abc} mean with differents letters are statistically different (*P*<0.05)

Table 6. Seasonal variations of condition factors (K±SD) of eleotrid fishes collected in the coastal waters of Southern Benin from April 2017 to September 2018.

Species		**K ±SD**		
	Sites	**Dry**	**Wet**	**Flood**
Dormitator lebretonis	Lake Nokoué	2.06 ± 0.54 ^{b}	0.62 ± 0.15 ^{a}	0.63 ± 0.15 ^{a}
	Porto-Novo Lagoon	2.03 ± 1.36 ^{b}	1.68 ± 0.65 ^{a}	1.24 ± 0.22 ^{a}
	Coastal Lagoon	0.71 ± 0.08	0.74 ± 0.19	0.9 ± 0.19
	Lake Ahémé	0.86 ± 0.39 ^{a}	0.66 ± 0.37 ^{a}	2.95 ± 0.68 ^{b}
Eleotris vittata	Lake Nokoué	1.29^{a} ± 0.89	3.36^{b} ± 2.18	3.66^{b} ± 2.47
	Porto-Novo Lagoon	5.52 ± 1.68 ^{c}	0.86 ± 0.11 ^{a}	1.04 ± 0.25 ^{b}
	Coastal Lagoon	0.92^{a} ± 0.23	-	4.29^{b} ± 0.47
	Lake Ahémé	1.14 ± 0.21 ^{b}	0.67± 0.12 ^{a}	1.05 ± 0.10 ^{b}
Eleotris daganensis	Lake Nokoué	-	1.15± 0.26	1.16 ± 0.25
	Porto-Novo Lagoon	0.58 ± 0.06 ^{a}	0.4 ± 0.05 ^{a}	1.08 ± 0.11 ^{b}
	Coastal Lagoon	3.6 ± 2.05	-	-
	Lake Ahémé	1.27 ± 0.19 ^{b}	0.67 ± 0.10 ^{a}	0.89 ± 0.51 ^{ab}
Eleotris senegalensis	Lake Nokoué	-	1.08 ± 0.24	0.81 ± 0.16
	Porto-Novo Lagoon	1.42^{b} ± 0.26	0.74 ± 0.05 ^{a}	0.66 ± 0.15 ^{a}
	Coastal Lagoon	3.6 ± 2.05	-	-

	Lake Ahémé	-	-	-
Bostrychus africanus	Lake Nokoué	-	2.60 ± 0.6	2.43 ± 0.58
	Porto-Novo Lagoon	1.21 ± 0.07	1.08 ± 1.28	-
	Coastal Lagoon	-	-	0.71 ± 0.02

abc Mean with differents letters are statistically different (*P*<0.05)

IV. DISCUSSIONS

Though of modest abundances, the fishes of Eleotridae family are important fisheries components of the Benin coastal waters that are currently under severe degradation pressure with impacts on community structure. In this study, the high variability of Eleotrid sizes across the four (4) coastal waters examined is the result of anthropogenic disturbances such as mangrove destruction, domestic waste dumpings, overfishing, floating plant proliferation that affect size structures, length-weight relationships and condition factors (K). In the current survey, the maximum standard length (SLm=11.30 cm) recorded in Lake Ahémé for the dominant species *D. lebretonis* is similar to that reported by Babatounde et al. (2015) in the Coastal Lagoon where the maximum standard length of this species was SLm=11.17cm. Inversely, the SLm recorded for *D. lebretonis* in this investigation is higher than that (SLm=7.8 cm) reported by Hazoume (2017) in the Sô river. Also, in the lower Mono of Benin and Togo, Adité and Fiogbé (2013) reported lower value SLm = 5.8 cm for *D. lebretonis*. According to Leveque (1992), in the Western Africa, the SL of *D. lebretonis* does not exceed 12 cm. However, in Equador, Rivera et al. (2005) reported a species, *Dormitator latifrons* whose maximum standard length were much higher and reached SLm=27cm. The SLm =15.4 cm recorded for *B. africanus* (Lake Nokoué), the less abundant species was lower than that reported by Udo and Akpan (2000) in the Qua iboe estuary in Nigeria (SLm=17.7 cm). Inversely, the maximum size recorded for *E. senegalensis* (SLm=16.5 cm recorded in Lagoon of Porto-Novo) was lower than that (SLm=22cm) reported by Konan et al. (2007) in the coastal rivers in South Eastern of Ivory Coast. The maximum standard length of *E. vittata* (SLm=21 cm) recorded in Lake Ahémé in the current study was also lower than that recorded by Ekpo et al. (2015) in the lower Cross River in Nigeria with SLm=110.30 cm. Overall, the overfishing, the differential abundances of preys available for these species and the conditions of their habitats may explain the spatial variabilities of the growth patterns displayed (Adité and Winemiller, 1997; Laleyè et al., 2003; Adite et al., 2017). These spatial variabilities in fish sizes were also the results of habitat fragmentations due mainly to change in water quality and the level of habitat degradation. In general, standard length (SL) frequency histograms established for the Eleotrids species exhibited an unimodal size distribution for all five (5) species inventoried in the four (4) lagoons studied except *E. daganensis* in Lake Nokoué.

In this fisheries survey, the Eleotridae examined showed a high variability in length-weight models with slopes (b) varying between 2.47 and 3.72 .Overall, the student T-test indicated that the five (5) species inventoried exhibited an allometric growth except *E. vittata* in the Coastal Lagoon where this species showed an isometric growth. *D. lebretonis* and *E. daganensis* showed significant (b>3; P<0.05) positive allometric growth in Lake Nokoué, Coastal lagoon and Lake Ahémé indicating that the fishes become more runded as they grew (Gbaguidi et al. 2016; Hazoume et al., 2017). Inversely these two species exhibited significant (b<3; P<0.05) negative allometric growth in lagoon of Porto-Novo indicating that these species become slender as they grew (Sidi Imorou et al., 2020; Nambil et al., 2020). Likewise, *E. vittata* showed significant (b<3; P<0.05) negative allometric growth in Lake Nokoué and Lake Ahémé, two coastal waters of critical ecological health (Sossoukpe et al., 2016). This negative allometric grow trends could be attributed to the multiple degradation factors such as the exploitation of mangroves, the dumping of domestic wastes and overfishing. The significant (b=3; P<0.05) isometric growth exhibited by *E. vittata* in the Coastal Lagoon indicated a relatively high wellbeing, probably because of suitable habitat conditions coupled with an efficient predation strategy. As reported by Adite et al. (2017) and Lederoun et al. (2018), habitat conditions and stochasticity, food resource availabilities and fish species tolerance to critical habitat factors could favor the differential growth pattern recorded. In general, length-weight relationships displayed high coefficients of correlation (r) ranging between 0.8696 (*B. africanus*) and 0.9876 (*E. daganensis*) in Lake Nokoué, 0.9226 (*E. senegalensis*) and 0.9797 (*E. daganensis*) in lagoon of Porto-Novo, 0.9643 (*B. africanus*) and 0.9923 (*E. vittata*) in Coastal Lagoon and between 0.9771 (*E. daganensis*) and 0.9967 (*E. vittata*) in Lake Ahémé.

In this survey condition factors (K) of eleotrids from the coastal waters were relatively low and significantly ($P<0.05$) varied with species and ecosystems and ranged between 0.7 (*D. lebretonis*) and 3.6 (*E. daganensis*). *Eleotris vittata* exhibited the highest conditions factors (K=3.2) in Lake Nokoué where Eleotrid fishes were prominent, whereas *D. lebretonis* showed the highest value of K=2.99 in Lagoon of Porto-Novo, the less degraded coastal water. Nevertheless, in this survey, the condition factor (K) of most species were greater than 1 indicating a relatively good condition and wellbeing of the eleotrids and globally reflects a relatively high tolerance of these species to critical environmental conditions (Ujjania et al., 2012).

In this study, the condition factor recorded for *D. lebretonis* in the Coastal Lagoon is higher than that reported by Babatounde et al. (2015) in this lagoon where the condition coefficient (K) was 1.4. Likewise, in the current study, values of K for *E. vittata* in all the coastal waters were higher than that reported by Ekpo et al. (2015) in the lower Cross River of Nigeria where K was 1.2. Probably, levels of environmental disturbances, differential habitat conditions and food resource availabilities may explain spatial variabilities of Eleotrid wellbeing (Sidi Imorou et al., 2019). Indeed, the aquatic vegetation is characterized by a high availability of food resources (detritus, invertebrates, insects etc.) and consequently exhibited higher values of K for all the species in the four (4) coastal waters. For example, in lagoon of Porto-Novo, *D. lebretonis*, *E. vittata* and *E. senegalensis* showed their highest values of K in aquatic vegetation with K= 2.68, K= 3.97 and K= 2.34, respectively. Also, higher values of condition factors in *E. daganensis* and *B. africanus* were recorded in aquatic vegetation of Coastal Lagoon and Lake Nokoué with K=3.82 and K=5.60, respectively. In particular, in aquatic vegetation, the decomposition of dead plants boosts the proliferation of aquatic insects and other invertebrates that constitute the main food resources for Eleotrids (Nordlie, 1981). The seasonal variations of K recorded are probably the consequence of differential hydrological regime of each coastal water that are associated with temporary habitats such as inunded floodplains and wetlands. Overall, combined factors such as seasons, habitat conditions, food availability, ontogeny and sexual stage of maturation could affect the level of K and the wellbeing of the fishes (Richter, 2007; Abowei, 2009).

V. CONCLUSION

The five sleeper gobies, *Eleotris vittata, Eleotris senegalensis, Eleotris daganensis, Bostrychus africanus* and *Dormitator lebretonis* inventoried are well distributed in Lake Nokoué, Porto-Novo Lagoon, Coastal Lagoon and Lake Ahémé and constitute an important fisheries component of the Benin coastal waters. Overall, Eleotrid assemblages showed positive allometric growth and isometric growth in Lake Nokoué, Coastal Lagoon and Lake Ahémé. Nevertheless, in Porto-Novo Lagoon all 5 species displayed negative allometric growth indicating a reduced wellbeing of the sleeper gobies in this habitat. Condition factors (K) were low to moderate and reflect the relatively high tolerance of Eleotrids to habitat disturbances. Sustainable exploitation and valorization of the sleeper gobies require a holistic management scheme of the species in the degrading Benin coastal waters.

REFERENCES

[1] Adite, A. and Winemiller, K.O. (1997). Trophic ecology and ecomorphology of fish assemblages in coastal lakes of Benin, West Africa. Ecoscience, 4, 6-23. http://doi.org/10.1080/11956860.1997.11682371

[2] Adite, A. and Fiogbe, E.D. (2013). Fish biodiversity and community structure of the ecotonal zone of the Mono River in Benin and Togo (West Africa). International Journal of Current Research, 5(12), 3876-3885.

[3] Adite, A., Tossavi, C.E. and Kakpo, D.B.E. (2017). Biodiversity, length-weight patterns and condition

factors of cichlid fishes (Perciformes: Cichlidae) in brackish water and freshwater lakes of the Mono River, Southern Benin, West Africa, International Journal of Fauna and Biological Studies, 4, 26-34.

[4] Adjibade, K.N., Adite, A., Arame, H., Chikou, A. and Abou, Y. (2020). Aspects of life-history strategy of Marcusenius senegalensis (Pisces: Osteoglossiformes: Mormyridae; Steindachner, 1870) from Niger River in Northern Benin. International Journal of Forest, Animal and Fisheries Research, 4,1-12. http://doi.org/10.22161/ijfaf.4.1.1.

[5] Abowei, J.F.N. (2009). The abundance, condition factor and lenght – weight relationship of *Cynoglossus senegalensis* (Kaup, 1858) from Nkoro River Niger Delta, Nigeria. Advanced Journal of Food Sciences and Technology, 1, 56-61.

[6] Abowei, J.F.N. (2010). Some Population Parameters of *Distichodus rostratus* (Gunther, 1864) from the Fresh Water Reaches of Lower Nun River, Niger Delta, Nigeria. Advance Journal of Food Science and Technology, 2(2), 84-90.

[7] Atobatele, O.E. and Ugwumba, A.O. (2011). Condition factor and diet of *Chrysichthys nigrodigitatus* and *Chrysichthys auratus* (Siluriformes: Bagridae) from Aiba Reservoir, Iwo, Nigeria. International Journal of Tropical Biology, 59 (3), 1233-1244.

[8] Babatounde, A. (2015). Eléments d'écologie et de biologie de *Dormitator lebretonis* (Eleotridae) à la lagune côtière du Bénin. M.Sc. Thesis, Faculty of Siences and Technics, University of Abomey-Calavi.

[9] Bagenal, T.B. (1978). Aspects of fish fecundity in ecology of freshwater fish production, Gerking, Blackwell Scientific Publications, Oxford.

[10] Beyer, J.E. (1987). On length- weight relationship, computing the mean weight of the fish of a given length class. Fish Byte, 5, 11-13.

[11] Deekae, S.N. and Abowei, J.F.N. (2010). *Macrobrachium Macrobrachion* (Herklots. 1851). Length Weight Relationship and Fulton's Condition Factor in Luubara creek. Ogoni Land. Niger Delta. Nigeria. International Journal of Animal and Veterinary Advances, 2, 155-162.

[12] Ecoutin, J.M. and Albert, J.J. (2003). Length -weight relationship of 52 fish species from West African estuaries and lagoons. Cybium, 27, 3-9.

[13] Ekpo, E.I., Essien-Ibok, M.A. and Effiong, E.E. (2015). Biology of bigmouth sleeper, *Eleotris vittata* (Dumaèril, 1861) (Pisces ; Eleotridae) in the lower Cross River, Nigeria. International Journal of Fisheries and Aquatic Studies, 3(2), 346-352.

[14] Froese, R. (1998). Length- weight relationship for 18 less-studied fish species. Journal of applied Ichthyology, 14, 117-118.

[15] Gbaguidi, H.M.A.G. and Adite, A. (2016). Abundance, length-weight relationships and Fulton's condition factor of the freshwater cichlid *Sarotherodon galilaeus* (Pisces: Teleostei: Perciformes) from a sand-dragged man-made lake of Southern Benin, West Africa. Journal of Biodiversity and Environmental Sciences, 8 (5), 75-87.

[16] Hauber, M.E. (2011). Description and Improvement of the 'Whedo'- Aquaculture - System in Malanville (North of Benin). Dissertation Zur Erlangung Des. Naturwissenschaftlichen Doktorgrades Der Bayerischen Julius-Maximilians-Universtität Würzburg.

[17] Hazoume, R.U.S. (2017). Diversité, organisation trophique et exploitation des poissons de la rivière Sô au Benin (Afrique de l'Ouest). PhD Thesis, University of Abomey-Calavi, Benin.

[18] Konan, K.F., Ouattara, A.; Ouatara, M. and Gourène, G. (2007). Weight-length relationship of 57 fish species of the coastal rivers in South-Eastern of ivory coast. Ribarstvo, 65, 49-60.

[19] Lalèyè, P.A., Niyonkuru, C., Moreau, J. and Teugels, G.G. (2003). Spacial and seasonal distribution of the ichthyofauna of Lake Nokoué, Benin, West Africa. African journal of aquatic science, 28(2) 151-161. http://doi.org/10.2989/16085910309503779

[20] Laleye, P.A. ; Chikou, A., Philippart, J.C. ; Teugels, G. and Vandewalles, P. (2004). Etude de la diversité ichtyologique du bassin du fleuve Ouémé au Bénin (Afrique de l'Ouest), Cybium, 28(4) , 329-339.

[21] Le Cren, E.D. (1951). The length- weight relationship and seasonal cycle in gonadal weight and condition in the perch (*Perca fluviatilis*). Journal of Animal Ecology, 20, 201–219. Https : //doi: org/10. 2307/1540.

[22] Lederoun, D., lalèyè, P., Vreven, E. and Vandewalle, P. (2016). Length-weight relatioships and condition factors of 30 actinopterygian fish from the Mono-basin (Benin and Togo, West Africa). International Journal of Biological and Chemical Sciences, 4: 1017-1029.

[23] Lévêque, C., Paugy, D. and Teugels, G.G. (1992). Faune des poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest, Paris: ORSTOM.

[24] Lévêque, C. (1994). Biodiversité des poissons africains. *In*: Diversité biologique des poissons des eaux douces et saumâtres d'Afrique. Synthèses géographiques (Teugels G.G., Guegan J.F. & Albaret J.J., eds). Annales du Musée Royal d'Afrique Centrale, Sciences Zoologiques, Tervuren, No. 275. pp : 7-16. http://doi.org/10.2307/1446700

[25] Luff, R., Bailey, A. and Geoff, C. (2000). Analysis of incremental growth structures and size changes in african catfish *Synodontis schall* (schall) from tell el Amarna, Middle Egypt. Journal of Archaeological Sciences, 27(9): 82-135. http://doi.org/10.1006/jasc.1999.0519

[26] Morgan, G.A., Grieggo, O.V. and Gloeckner, G.W. (2001). SPSS for Windows: An introduction to use and

interpretation in research. Lawrence Erlbaum Associates Publishers, Mahwah, New Jersey, 214 p.

[27] Nordlie, F.G. (1978). Niche specificities of eleotrid fishes in a tropical estuary. Revista de Biologia Tropical, 27: 35-50.

[28] Pauly, D. and Munro, J.L. (1984). Once more on the comparison of growth in fish and invertebrates. ICLARM Fishbyte, 3: 2-21.

[29] Pezold, F. and Cage, B. (2001). A review of the spinycheek sleepers, genus *eleotris* (Teleostei; Eleotridae) of the western hemisphere with comparison to the west African species. Tulane Studies in zoology and botany, 32:12.

[30] Rivera, R.C., Benítez, G.A. and Girón, J.H. (2005). Conversión alimenticia en engordas puras y mixtas de Popoyote(*Dormitator latifrons,* Richardson) en estanques de cemento. Revista Aquatic,23:45-52. http://www.revistaaquatic.com/aquatic/art.asp?t=p&c=192.

[31] Richter, T.J. (2007). Development and evaluation of standard weight equations for bridgelip suckers and large scale suckers. North American Journal of Fisheries Management, 27(3): 936-939. http://doi.org/10.47886/978091323584

[32] Samat, A., Shukor, M.N., Mazlan, A.G., Arshad, A. and Fatimah, M.Y. (2008). Length-weight relationdhip and condition factor or *Pterygoplichthys pardalis* (Pisces: Loricariidae) in Malaysia Peninsula. Research journal of fisheries and Hydrobiology, 3(2): 48-53.

[33] Schreck, C.B. and Moyle, P.B. (1990). Methods for Fish Biology. American Fisheries Society,Bethesa, Maryland, 704 p.

[34] Sidi Imorou, R., Adite, A., Adjibade, N.K., Arame, H., Sonon, P. and Abou, Y. (2019). Fish biodiversity and community structure of Okpara stream, Oueme River, Benin, West Africa: Risk of high predation and food-web alteration. Journal of Biodiversity and Environmental Sciences, 14(6): 272-289.

[35] Sonon, P.S. Sossoukpe, E. Adite, A. Gbankoto, A. and Abou, Y. (2021). Diversity and community characteristics of Eleotridae (Pisces: Actinopterygii: Perciformes) from the coastal waters of Benin (West Africa). In press.

[36] Sossoukpe, E., Djidohokpin, G. and Fiogbe, E.D. (2016). Demographic parameters and exploitation rate of sardinela maderensis (Pisces: Lowe 1838) in the nearshore zaters of Benin (West Africa) and their implication for management and conservation. International journal of Fisheries and Aquatic Studies, 4: 165-171.

[37] Tesch, F.W. (1971). Age and Growth. In: Methods for Assessment of Fish Production in Fresh Waters, 2nd edn. W. E. Ricker (Ed.). International Biological Programme, Oxford and Edinburgh, pp. 97-130.

[38] Udo, M.T. and Akpan, A.W. (2005). Intersexual an spatial heteroreneity in trophic attributes of the sleeper. *Bostrychus africanus* (Eleotridae) in the Qua Iboe estuary, Department of Zoology, University of Uyo, Nigeria, 235 p.