LENGTH-WEIGHT RELATIONSHIP, GROWTH RATE AND CONDITION FACTORS OF FISH SPECIES OF OGUN COASTER WATER, NIGERIA

ABSTRACT

Sustainable exploitation of freshwater fish species for commercial value is sacrosanct for fishery to continuously play its role in Nigeria socio-economic growth and development. Five commercially available fish species (*Oreochromis niloticus, Elops saurus, Raiamas senegalensis, Monodactylus sebae and Gobionellus oceanicus*) in Ogun coastal water, Iwopin, Ogun State, Nigeria were appraised for the length-weight relationship, growth rate and condition factors. Fifty samples of each fish species were collected from fishermen at the landing sites weekly between January and April, 2023. Length-weight indices showed *Elops saurus, H. niloticus* and *R. senegalensis*. Condition factor recorded in the fish species of *E. saurus, R senegalensis, H. bebe* and *G. oceanicus* were not significantly different to each other, but showed negative allometric growth. Conclusively, the study provided length-weight relationships for *Oreochromis niloticus, Elops saurus, Raiamas senegalensis, Monodactylus sebae and Gobionellus oceanicus* exhibited different growth patterns, and showed a strong association between length and weight of the fishes. Furthermore, the study will be useful for fishery biologist for sustainable fishery management.

Keywords; Allometric growth, Fish, *Oreochromis niloticus*, Total length

INTRODUCTION

The study of the biology of some fish species with preference to length-weight relationship (LWR) and condition factor (k) is an important aspect in fish biology. Growth is the change in absolute weight (energy content) or length of fish over time (Bake *et al.,* 2013) and also as a function of fish size (Akombo and Araoye, 2011). Growth can be any changes in size or

part of body, regardless of whether the change is positive or negative, temporary or long-lasting (Nordgarden *et al*., 2003). Abowei and George (2009) reported that Length-weight relationship (LWR) in fish is the growth index which is an important management tool used in estimating the average weight at a given length growth. LWR is of great importance in fishery assessments (Ayoade and Ikulala, 2007) which provides knowledge on the fish stock, age, life span, mortality, growth and reproduction (Kumar and Narayan, 2014).

Condition factor is the degree of well-being of the fish (Faradonbeh *et al.,* 2015) in their habitat as coefficient of condition such as stress, sex, season, availability of feeds, water quality (Khallaf *et al*., 2003; Haruna *et al.,* 2015) and as a useful index for monitoring physiological conditions and growth rates in fish (Ujjania *et al.,* 2012). Fisheries remain a reliable agricultural part that contributed significantly to the nation's Gross Domestic Product which can be measured and considered as fundamental components for human feeding and employment (Ricker, 2004). Studies on fish biology and ecology are important in fishery management and conservation (Atama e*t al.,* 2013), while the difference and variability morphomeristic characters provide information on genetic improvement of fish species (Akombo and Araoye, 2011) for proper exploitation and management.

Various studies (Fafioye and Olubanjo, 2005; Abowei, 2007; Agboola and Anetekhai, 2008; Abowei, 2009; Kumolu-Johnson and Ndimele, 2010; Atama *et al.*, 2013; Bolarinwa and Popoola, 2013; Fafioye *et al.*, 2018; Osho and Usman, 2019; Oladunjoye *et al.*, 2022) have been carried-out on the LWR and condition factors of fishes in Nigeria. However, scanty information exists on LWRs of different fish species in the Ogun State Coastal Water, which necessitate the study to assess the water viability through fish growth pattern and well-being. The results will assist in decision making and fisheries management and conservation. The aim of the research is

to establish the length-weight relationship, growth rate and condition factor of *Oreochromis niloticus, Elops saurus, Raiamas senegalensis, Gobionellus oceanicus* and *Hyperopisus bebe* in Ogun Coastal Water, Iwopin, Ogun State, Nigeria.

MATERIALS AND METHODS

Description of Study Site

This study was carried out on Ogun Coastal Water, Iwopin, Ogun State, Southwest, Nigeria (Figure 1). It is situated between 4° 23' 59.99" E and 6° 28' 59.99" N which was bounded in the East by Lekki Lagoon and South by Bight of Benin. The Lagoon covers an area of 26km^2 (Famoofo and Abdul, 2020). Fishing activities are carried out with motorised and non- motorized canoes which include gillnet, seine net, cast net, non-return valve trap sand brush park fish aggregator, bamboo trap among others. Hydrologically, the water body falls into the western littoral area with semi-diurnal offshore tides.

Samples Collection

Fifty (50) fish species were collected and rapidly labeled and packed in white plastic bucket containing ice blocks to prevent post-harvest spoilage. Total lengths (±0.01cm) of the fish species were taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin using a measuring board in centimeters (cm). The body weights of the fish were measured with a top loading Metler balance as suggested by Fafioye and Olubanjo (2005) and Oladunjoye *et al.* (2022) and recorded to the nearest (±0.01) gram. The sex (male or female) of each of the sample was recorded for all the fish species by the presence of secondary sexual papillae located behind the anus.

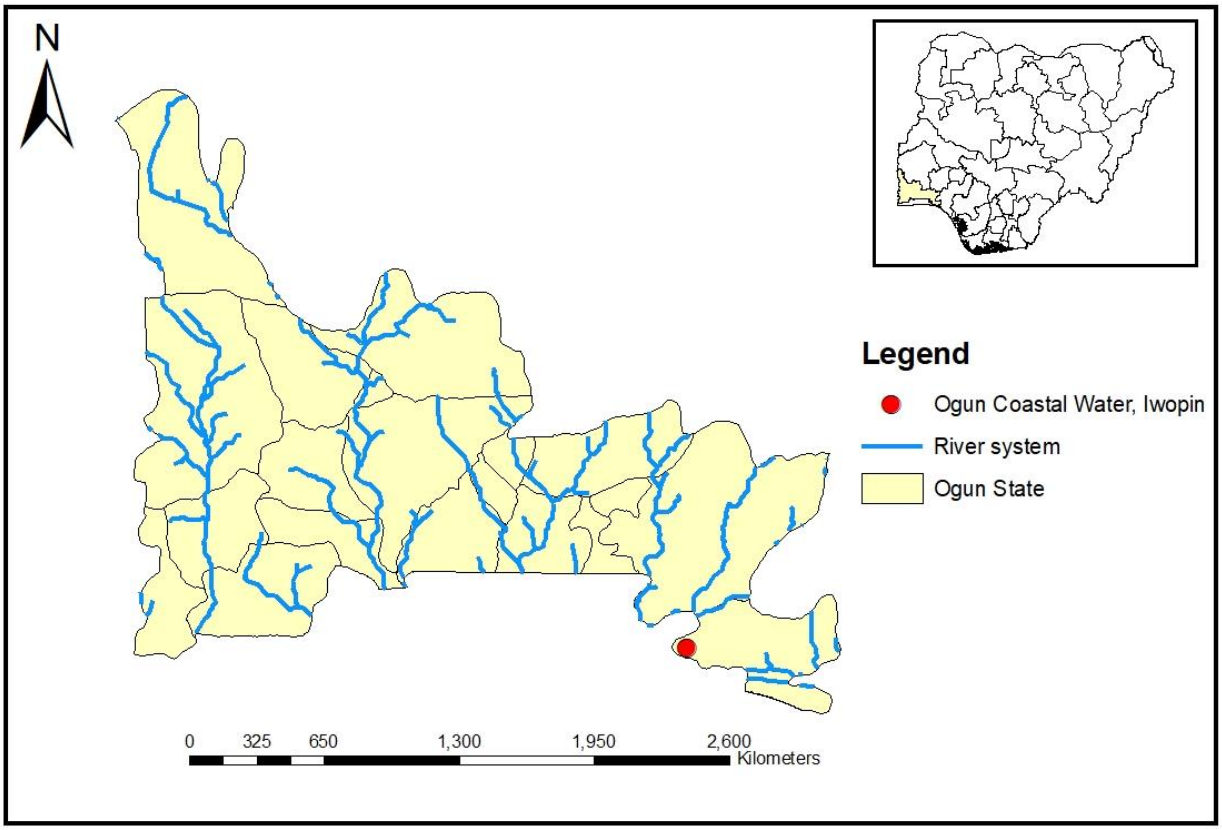

Figure 1: Map of Ogun Coastal Water, Iwopin, Ogun State, Nigeria

Determination of length-weight relationship, growth rate and condition factor

The LWR was estimated using the equation opined by Pauly (1983), Froese (1998) and Froese *et al.* (2019)

$W = aL^b$

Where; W - weight of fish in (g),

L - Total length (TL) of fish in (cm),

a – (constant) describe the rate of change of weight with length (intercept)

b - weight at unit length (slope).

The equation was log transformed to estimate the parameters 'a' and 'b' (Oliva-Paterna *et al*., 2009)

Log W - Log *a* + *b* Log L

a and *b* values were obtained from a linear regression of the LWRs of fish. The squared correlation (r^2), which is the extent of reliability was computed. Meanwhile, the value of *b* gives information on the kind of growth pattern of fish: the growth is isometric if $b = 3$ and allometric if $b \neq 3$. Therefore, if $b > 3$, it is positive allometric pattern or negative allometric if < 3 (Nehemia *et al.,* 2012). The condition factor which shows the degree of well-being of the fish in their habitat was determined by using the equation, $K = 100W/ L^b$ (Gomiero and Braga, 2005). Where by K = condition factor; W = the weight of the fish in gram (g); L = the total length of the fish in centimeters (cm); and b = the value obtained from the length-weight equation.

Statistical Analysis

Data obtained were subjected to statistical analyses using SPSS version 20.0 (IBM Corp, 2011). Mean values of condition factors, body weight, total length and standard length were compared using ANOVA. Results were presented as Mean±Standard deviation, while Post-hoc tests were done using the Student-Newman-Keuls (SNK). P value less than 0.05 was considered to be statistically significant. The *b* value was estimated for each fish species and tested for significant difference from 3 at 95% confidence limit.

RESULTS

Length-weight relationship of *O. niloticus, E. saurus, R. senegalensis, G. oceanicus* and *H. bebe* fish species in Ogun Coastal Water, Iwopin, Ogun State is presented in Table 1. Mean body weight was significantly higher in *O. niloticus* than the other fish species, while the total length and standard length were significantly higher in *H. bebe*. The length-weight relationship recorded in the *E. saurus* was strong ($r = 0.550$), but not significant ($p = 0.15$), while *O. niloticus, R. senegalensis, H. bebe* and *G. oceanicus* were very strong and significant (Table 1).

The condition factors of O. *niloticus, E. saurus, R. senegalensis, G. oceanicus and H. bebe* fish species in Ogun coastal water, Iwopin, Ogun state Nigeria is presented in Table 2. Condition factor was significantly higher in *O. niloticus* than other fish species, while *E. saurus, R. senegalensis, H. bebe* and *G. oceanicus* condition factors were not significantly different. The growth pattern and exponential equation of fish species in Ogun Coastal Water, Iwopin, Ogun State shows negative allometric growth type (Table 2).

Table 1: Length-weight relationship of fish species in Ogun Coastal Water, Ogun State, Nigeria

Fish Species	TL (cm)	SL (cm)	Weight (g)	A	b	R	R^2	p -value
Oreochromis niloticus	26.73±2.79[b]	21.17±2.41[b]	354.17±77.39[a]	14.73	0.03	0.941	0.885	0.01*
Elops saurus	15.54±3.13[c]	11.00±3.37[c]	21.80±5.81[c]	6.82	0.40	0.742	0.550	0.15
Raiamas senegalensis	13.80±3.42[c]	11.06±2.62[c]	18.20±3.77[c]	2.29	0.88	0.974	0.948	0.01*
Hyperopisus bebe	36.20±1.15[a]	30.94±1.20[a]	245.00±80.64[b]	32.84	0.01	0.962	0.925	0.01*
Gobionellus oceanicus	17.00±4.76[c]	12.68±4.60[c]	20.40±4.45[c]	4.51	1.05	0.986	0.973	0.01*

[abc]Means (±Standard deviation) in the same column having similar superscripts are not significantly different ($p > 0.05$)

Keys;
R^2 - Coefficient of determination
R - Correlation co-efficient
a - Rate of change of weight with length (intercept)
b - Weight at unit length (slope)

Table 2: Condition factor and growth pattern of fish species of Ogun Coastal Water, Ogun State

Fish Species	Condition factor	*b*	Growth Type	Exponential Equation
Oreochromis niloticus	1.85±0.25[a]	0.03	Negative Allometric	$Wt = 14.73(TL)^{0.04}$
Elops saurus	0.68±0.46[b]	0.40	Negative Allometric	$Wt = 6.92(TL)^{0.4}$
Raiamas senegalensis	0.82±0.43[b]	0.88	Negative Allometric	$Wt = 2.29(TL)^{0.88}$
Hyperopisus bebe	0.51±0.12[b]	0.01	Negative Allometric	$Wt = 32.84(TL)^{0.01}$
Gobionellus oceanicus	0.51±0.27[b]	1.05	Negative Allometric	$Wt = 4.51(TL)^{1.05}$

[abc]Means (±Standard deviation) in the same column having similar superscripts are not significantly different ($p > 0.05$)

Keys;
Wt - Body weight
TL - Total length
b - weight at unit length (slope)

DISCUSSION

The LWR of the fish species in Ogun coastal water are growth values which ranges from 0.01 - 1.05 and far below Fafioye and Olubanjo (2005) findings which document 2.790 and 2.880 for *Clarias garienpinus* in Epe Lagoon. However, the fishes show negative allometric growth pattern in line with Fafioye and Olubanjo (2005) and Oladunjoye *et al.* (2022) findings on *Clarias gariepinus* exposed to quarry particles. Meanwhile, the study did not conform to the reports of Abowei and Ezekiel (2013), Ezekiel and Abowei (2014), Olarenwaju *et al.* (2017) and Fafioye *et al.* (2018) which documented positive allometric growth pattern in fish species of different rivers.

These variations (*b* values) may be attributed to the ecological conditions of the habitats or variation in the physiology of fish in both sex and season (Hossain *et al.*, 2006; 2009), feeding rate, gonad development and growth pattern (Hossain *et al.*, 2011). In addition, it can be as a result of differences in habitat (Oladunjoye *et al.*, 2022), season (Ibrahim, 2012), stomach fullness, gonad maturity, sex, health and preservation techniques of the fish species (Oliva-Paterna *et al.*, 2009; Sarkar and Sarkar, 2013). The use of length-weight relationship to determine the growth rate and condition factor is not limited to finfishes, rather, it applied to shellfishes (Kumari *et al.*, 2013; Fafioye *et al.*, 2018).

The LWR correlation value (0.742 - 0.986) obtained was far above what was reported by Fafioye (2009), while it correlates with Arimoro and Meye (2007) findings. Therefore, there is a strong correlation that exists between the length and weight of the fish species which was similar to Adeyemi (2010; 2011) report on fish species of Idah, River Niger. The TL and weight observed was between 13.80±3.42 - 36.20±1.15 and 18.20±3.77 - 354.17±77 falls within and below the ranges documented by Olanrewaju *et al.* (2017) findings respectively.

The condition factor of the fish species of Ogun coastal water documented (0.51±12 - 1.85±0.25) was far below Olanrewaju *et al.* (2017) and Lawal (2019) reports which recorded 2.04±1.76 for *H. niloticus* and 1.97±1.98 for *R. senegalensis*. The results indicated that fish species in the water are not doing well as opined and suggested by Ezekiel and Abowei (2013) and contrary to Abdul (2009) and Abowei *et al.* (2009) findings which might be due to the season, place of collection or environmental factors. Negative allometric growth pattern in fish species have been earlier reported in similar findings reported by Adeyemi *et al.* (2009) and Midhat *et al.* (2012).

Conclusively, the study provided information on the length-weight relationships of *Oreochromis niloticus, Elops saurus, Raiamas senegalensis, Hyperopisus bebe and Gobionellus oceanicus* which is baseline knowledge for fisheries sustainability and managements. Fish species of Ogun coastal water Nigeria are not in good condition which might affect fisheries resources and production. There is need for adequate provision or regulations on fishes of the river water to foster sustainable fisheries production and managements.

REFERENCES

Abdul WO. (2009). Stock assessment of Tilapia in the freshwater ecotype of Ogun estuary,

Abowei JFN. (2007). The morphology, abundance, condition factor and length-weight relationship of *Ethmalosa fimbriata* (Bowdish, 1825) from Nkoro River, Niger Delta, Nigeria. *Advance Journal of Food Science and Technology*, 1(1), 51-56.

Abowei JFN. (2009). The Condition Factor, Length-Weight Relationship and Abundance of *Elops seneganensis* (Regan, 1909) from Nkoro River, Niger Delta, Nigeria. Advance Journal of Food Science and Technology, 2(1): 16 – 21.

Abowei JFN and George ADI. (2009) A study of the length - weight relationship and condition factor of *Callinectes amicola* (De Rochebrune, 1883) from Okpoka Creek, Niger Delta, Nigeria. *Int. J. Anim. Vet. Adv.*, 1(2): 66 - 72.

Abowei JFN and Ezekiel EN. (2013). The length-weight relationship and condition factor of *Chrysichthys nigrodigitatus* (Lacepède, 1803) from Amassoma River flood plains. *Sci Agri.*, 3: 30-37.

Adeyemi SO. (2010). Length-weight, length-length relationship and condition factor of *Synodontis resupinatus* at Idah Area of River Niger, Nigeria. PAT, 6: 85 - 90.

Adeyemi SO. (2011). Fishery ecology of Gbedikere Lake, Kogi State, Nigeria. Lambert Academic Publishing, USA.

Adeyemi SO, Bankole NO, Adikwu IA, Akombo PM. (2009). Age, Growth and Mortality of some commercially important fish species in Gbadikere Lake, Kogi State, Nigeria. *Int. J. of Lakes and Rivers Res.*, 2 (1): 63 – 69

Agboola JI and Anetekhai MA. (2008). Length–weight relationships of some fresh and brackish water fishes in Badagry creek, Nigeria. *Journal of Applied Ichthyology*, 24(5): 623 - 625.

Akombo P and Araoye PA. (2011). Morphometric measurements and growth patterns of four species of the genus Synodontis (Cuvier, 1816) from Lower Benue River, Makurdi, Nigeria. *International Journal of fisheries and Aquaculture*, 3(15), 263 - 270.

and macroinvertebrates of Gbediker Lake Bassa, Kogi State, Nigeria. *International Journal of Lakes and River* 2: 37–44.

Arimoro FO and Meye JA. (2007). Some Aspects of the biology of *Macrobrachium dux* (Lenz, 1910) (Crustacea: Decapoda: Natantia) in River Orogodo, Niger Delta, Nigeria. *Acta Biologica Colombia*, 12(1): 111 - 122.

Atama CI, Okeke OC, Ekeh FN, Ezenwaji NE, Onah IE, Ivoke N and Eyo JE. (2013). Length-weight relationship and condition factor of six cichlid (Cichilidae: Perciformis) species of Anambra River, Nigeria. *Journal of fisheries and aquaculture*, 4(2): 82 - 93

Ayoade AA and Ikulala AO. (2007). Length weight relationship, condition factor and stomach contents of *Hemichromis bimaculatus, Serotherodon melanotheron and Tilapia guetheri* (perciformes: Cichilidae) in Eleyele Lake, Southwestern Nigeria.

Bake GG, Adejumo TM and Sadiku SOE. (2013). Growth performance and Nutrient utilization of Nile Tilapia (*Oreochromis niloticus*) Fed toasted Flamboyant seed meal (Delonix regia).

Bolarinwa JB and Popoola Q. (2013). Length-weight relationships of some economic fishes of Ibeshe waterside, Lagos lagoon, Nigeria. *Journal of Aquaculture Research and Development*, *5*(1):

Ezekiel EN and Abowei JFN. (2013). Length-weight relationship and condition factor of *Heterotis niloticus* from Amassoma flood plain, Niger Delta, Nigeria. *App. Sci. Report.*, 4: 164 - 172.

Ezekiel EN and Abowei JFN. (2014). A study of length-weight relationship and condition factor of *Hepsetus odoe* (Bloch, 1794) from Amassoma flood plains. Ann. Bio. Sci. 2: 10 - 17.

Fafioye OO and Olubanjo OA. (2005). Length-weight relationships of five fish species in Epe Lagoon, Nigeria. *Afr. J. Biotechnol.*, 4: 749 - 751.

Fafioye OO. (2009). Length-weight relationships of five fish species in Epe Lagoon, Nigeria. *Afr. J. Biotechnol.*, 5: 457 - 481

Fafioye OO, Asiru RA and Oladunjoye RY. (2018). Length-Weight Relationship, Abundance and Sex Ratio of the Giant River Prawn *Macrobrachium vollenhovenii* (Herklots, 1857) From River Osun, Southwestern Nigeria. *Journal of Aquaculture Research and Development*, 9 (10): 1-5. https://doi.org/10.4172/2155-9546.1000554

Famoofo OO and Abdul WO. (2020). Biometry, condition factors and length-weight relationships of sixteen fish species in Iwopin fresh-water ecotype of Lekki Lagoon, Ogun State, Southwest, Nigeria. *Heliyon*, 6(1), e02957.

Faradonbeh MZ, Eagderi S and Ghojoghi F. (2015). Length-weight relationship and condition factor of seven fish species of Totkabon River (southern Caspian Sea basin), Guilan, Iran. *International Journal of Aquatic Biology*, *3*(3): 172 - 176.

Froese R. (1998). Length-weight relationship for fish species. *Journal of Applied Ichthyol.*, 14: 117 – 118.

Froese R, Winker H, Coro G, Demirel N, Tsikliras AC, Dimarchopoulou D, and Pauly D. (2019). On the pile-up effect and priors for Linf and M/K: response to a comment by Hordyk et al. on "A new approach for estimating stock status from length frequency data". *ICES Journal of Marine Science*, *76*(2): 461 - 465.

Gomiero LM and Braga FMS. (2005). The condition factor of fishes from two river basins in Sao Paulo State, Southeast of Brazil. *Acta Scientiarum.* 27: 73 - 78.

Haruna MA, Bichi AH, Abubakar S and Danba EP. (2015). Some aspects of the biology of *Tilapia zilli* in Kanye Dam, Kabo Local Government, Kano State, Nigeria. *International Journal of Agriculture, Forestry and Fisheries, 3*(2), 32-36.

Hossain MY, Ahmed ZF, Leunda PM, Jasmine S, Oscoz J, Miranda R and Ohtomi J. (2006). Condition, length-weight and length-length relationships of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, Southwestern Bangladesh. *Journal of Applied Ichthyology,* 22(4): 304 - 307.

Hossain MY, Jasmine S, Ibrahim AHM, Ahmed ZF, Rahman MM and Ohtomi J. (2009). Length- weight and length-length relationships of 10 small fish species from the Ganges, Bangladesh. *Journal of Applied Ichthyology,* 25(1): 117 - 119.

Hossain MY, Rahman M, Fulanda B, Jewel MAS, Ahamed F and Ohtomi J. (2011). Length-weight relationships of five threatened fish species from the Jamuna (Brahmaputra River tributary) River, Northern Bangladesh, *Journal of Applied Ichthyology,* 28(2): 275 – 277.

IBM Corporation (2011). IBM SPSS statistics for Windows, version 20.0. Armonk, NY:IBM Corp.

Ibrahim MM. (2012). Variation in parasite infracommunies of *Tilapia zillii* in relation to some biotic and abiotic factors. *Int. J. Zool. Res*., 8(2): 59 - 70.

Khallaf EA, Galal M and Authman M. (2003). The biology of *Oreochromis niloticus* in a polluted canal. *Ecotoxicology*, *12*(5), 405 - 416.

Kumar G and Narayan B. (2014). Length-weight relationship, condition factor and fecundity of African snakehead *Parachanna obscura* from the Anambra River, South East, Nigeria. *Croatian Journal of Fisheries*, 77(2), 99 - 105.

Kumari P, Kumar M, Reddy CRK and Jha B. (2013). Algal lipids, fatty acids and sterols. In *Functional ingredients from algae for foods and nutraceuticals* (pp. 87-134). Woodhead Publishing.

Kumolu-Johnson CA and Ndimele PE. (2010). Length-weight relationships and condition factors of twenty-one fish species in Ologe Lagoon, Lagos, Nigeria. *Asian Journal of Agricultural Sciences*, 2(4): 174 - 179.

Lawal MO. (2019). *Nigrodigitatus* (Lacépède) in Epe Lagoon, Nigeria. *African Journal of Biotechnology,* 9: 7955 - 7960.

Midhat AEK, Mohammed MNA and Seham AI. (2012). Environmental studies on *Synodontis schall* (Bloch and Schneider, 1801), (Pisces: Mochokidae) in the river Nile at Gizza sector, Egypt: Biological aspects of population dynamics. *Journal of Fisheries and Aquatic*, 7: 104 - 133.

Nehemia A, Maganira JD and Rumisha C. (2012). Length-Weight relationship and condition factor of tilapia species grown in marine and fresh water ponds. *Agric. Biol. J. N. Am.*, 3(3): 117 – 124.

Nordgarden U, Oppedal F, Taranger GL, Hemre GI and Hansen T. (2003). Seasonally changing metabolism in Atlantic salmon (*Salmo salar* L.) Growth and feed conversion ratio. *Aquaculture Nutrition*, 9(5): 287 - 293.

Oladunjoye RY, Adeleke MT, Asiru RA, Bankole ST, Kuku RO and Lordson AU. (2022). Lenght-weight Relationship, Growth Rate and Condition factor of *Clarias gariepinus* (Burchell, 1822) Juveniles exposed to quarry particles. *Journal of innovative Research in Life Sciences,* 5 (1): 11 - 18

Olarenwaju AEK, Oyetunji OT and Ogunlase RT. (2017). Abundance and Length-Weight Relationship of Freshwater Gastropods in River Eleyele, Ibadan, Oyo State.

Oliva-Paterna FJ, Torralva M and Carvalho ED. (2009). Length–weight relationships for 20 species collected in the Jurumirim reservoir (Paranapanema Basin, Brazil). *Journal of Applied Ichthyology*, *25*(3): 360 - 371.

Osho FE and Usman RA. (2019). Length-weight relationship, condition factor and fecundity of African snakehead *Parachanna obscura* from the Anambra River, South East Nigeria. *Croatian Journal of Fisheries*, 77(2): 99 - 105.

Pauly D. (1983). Some simple methods for the assessment of tropical fish stocks. FAO. Fisheries Techn.Pap. (234) FAO, Rome.

Ricker WK. (2004). Computation and interpretation of biological statistics of fish population. *Fish Res. Biol. Canada Bulletin,* 191.

Sarkar M and Sarkar B. (2013). An economic manufacturing quantity model with probabilistic deterioration in a production system. *Economic Modelling*, 31: 245 - 252.

Ujjania NC, Kohli MPS and Sharma LL. (2012). Length-weight relationship and condition factors of Indian major carps (*C. catla, L. rohita* and *C. mrigala*) in Mahi Bajaj Sagar, India. *Research Journal of Biology,* 2 (1): 30 – 36.