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Oyeniyi Muyiwa Emmanuel
Department of Fisheries and Aquaculture, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Nigeria

Solomon Shola Gabriel
Department of Fisheries and Aquaculture, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Nigeria

Ayuba Victoria Offuene
Department of Fisheries and Aquaculture, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Nigeria

Corresponding Author:
Oyeniyi Muyiwa Emmanuel
Department of Fisheries and Aquaculture, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Nigeria

Some somatic indices of *Clarotes laticeps* from lower river Benue, Makurdi, Nigeria

Oyeniyi Muyiwa Emmanuel, Solomon Shola Gabriel and Ayuba Victoria Offuene

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Abstract
The condition factor, Gonado-somatic index and Hepatosomatic index of *Clarotes laticeps* from Lower River Benue were determined using 157 samples from the catches of the fishermen within Abinsi and Wadata Axis of the river in Makurdi, Nigeria. The highest condition factor and hepato-somatic index of 1.2956±0.07 and 4.1799±0.49 respectively were recorded in January while the highest gonado-somatic index of 0.9725±0.12 was recorded in August. The least condition factor, gonado-somatic index and hepato-somatic index of 0.9995±0.04, 0.2738±0.03 and 1.4227±0.23 were recorded in August, December and September respectively. It was also observed that both the male and female *Clarotes laticeps* from Lower River Benue are in good condition at 1.22±0.03 while the female had higher Gonado-somatic index and hepato-somatic index (0.3830±0.02 and 2.94±0.22 respectively) than male with 0.2664±0.37 and 2.78±0.21 respectively. There were significant differences in the parameters across the months of sampling but relatively insignificant between the sexes. The correlation coefficients shows significant inverse relationship between the condition factor and both the gonado-somatic index and hepato-somatic index but significant direct relationship between the gonado-somatic index and the hepato-somatic index. It was concluded that *Clarotes laticeps* in Lower River Benue is in good condition.

Keywords: *Clarotes laticeps*, condition, gonad, index, somatic

Introduction

Fish leaves in an environment that is highly predisposed to various forms of factors that affect their well being. Such factors may include food availability, pollution and predation. Thus, the need to regularly examine the variations in the indices of health and wellbeing of the various species of fish in different bodies of water.

Analyses of Condition Factor, Hepatosomatic index and Gonadosomatic index of fish could offer information on the general health condition of the organisms. Somatic (body) conditions that are often used in fish biology during field research are the Hepatosomatic index to identify possible liver diseases, the Gonadosomatic index to determine the reproductive development and the condition factor to assess the general condition of fish (Van der Oost *et al.*, 2003) [34]. This is because they are inexpensive, non-lethal alternatives to proximate analysis of tissues (Craig *et al.*, 2005) [8]. Also, Ekanem (2000) [10] and Allison *et al.* (2008) [3] has affirmed that condition factor and gonadosomatic index are two reliable somatic indices that can be used to determine the spawning periods in tropical fishes.

Condition factor is an index of the degree of fatness or well being of a species which may be used to determine the reproductive time of fish without sacrificing the fish (Haruna and Bichi, 2005; Arellano-Martinez and Ceballosvazquez, 2001) [19, 4]. A high condition factor reflects good environmental quality; while a low condition factor reflects poor environmental quality. Condition factors of different tropical fish species based on size, sex, maturity stages as well as seasons have been investigated and reported by different authors such as Saliu (2001) [30] and Lizama *et al.* (2002) [28].

Knowledge on reproductive biology of fish is essential for evaluating the commercial potentialities of its stock, life history, culture practice and management of its fishery (Islam *et al.*, 2012) [2]. Reproductive potential of a population is one of the basic exigencies to designate the individuals of that population in respect to their gonadal conditions (Akter *et al.*, 2012) [2]. One of the most reliable methods of the determination of the reproductive potentials of fish is the examination of the Gonado-Somatic Index.

Gonado-Somatic Index (GSI) is the ratio of gonad weight to body weight used to estimate reproductive condition. Reproduction is the most critical stage in the life cycle of a species, which determines its survival. GSI is generally indicative of reproductive success (and general water quality).

Hepatosomatic Index (HSI) is defined as the ratio of liver weight to body weight. It provides an indication on status of energy reserve in an animal. In a poor environment, fish usually have a smaller liver (with less energy reserved in the liver). HSI has been reported to decrease in fish exposed to high concentrations of cadmium and zinc. The liver also serves as the main and important detoxifying organ in fish that is essential for both the metabolism and the excretion of toxic substances in the body (van Dyk *et al*., 2007) [35] and several categories of hepatocellular pathology are now regarded as reliable biomarkers of toxic injury and representative of biological endpoints of contaminant exposure (Stentiford *et al*., 2003; Feist *et al*., 2004; ICES, 2006) [32, 14].

Clarotes laticeps is a freshwater, ray-finned (Actinopterygii) fish and a member of the family Claroteidae that inhabits water column and bottom (demersal) waters of swamps, streams, rivers and lakes (Idodo-Umeh, 2003) [22]. It is mostly found in African water bodies such as Rivers Niger, Benue, Nile and Lakes Volta and Chad (Baensch and Riehl, 1991; Eccles, 1992) [7, 9]. It is a seasonal fish but found in abundance in the rainy season, feeding on crustaceans, insects, mollusks and small fish (Idodo-Umeh, 2003; Azeroual *et al*., 2010) [5, 22]. Juveniles of *Clarotes laticeps* are usually common in the catches of artisanal fishermen around Benue River from December (Eccles, 1992) [9] and this marks the beginning of the recruitment process in the fishery. A specimen of *Clarotes laticeps* weighing up to 10kg and having up to 80cm standard length has been reported by Ita (1984) [24] and Lewis (1974) [27].

Despite been a commercial fish, *Clarotes laticeps* has a status of Least Concerned (LC) and Harmless to human on the International Union of Conservation of Nature (IUCN) Red List (Azeroual *et al*., 2010; IUCN, 2014) [5]. It has a phylogenetic Diversity Index (PD_{50}) of 0.7500 of which the normal range is usually from 0.5 (low) to 2.0 (high) (Faith *et al*., 2004) [12].

Materials and Methods

Study Locations, Sample Collection and Identification

One hundred and fifty seven (157) Samples of *Clarotes laticeps* were collected from Wadata landing site in Makurdi, Benue state as well as from the catches of the fishermen operating between Abinsi and Wadata axis of Lower River Benue in Makurdi, Benue State.

Samples were collected on monthly basis from August, 2014 to January, 2015 from the catches of fishermen using Traps, Cast Nets as well as Hooks and Line in River Benue. The samples were transported to the laboratory in plastic containers with open tops.

Identification of fish samples was carried out using fish identification guides by Froese and Pauly (2015) [15], Babatunde and Raji (2014) [6] and Idodo Umeh (2004).

Laboratory analysis were carried out at the General Purpose Laboratory of the Department of Fisheries and Aquaculture, University of Agriculture, Makurdi, Benue State.

Experimental Procedures

The various weights and length measurements involved were taken using Electronic balance (Model HC-D) and graded meter rule respectively while the experiments involved in the research were carried out according to the procedures stated below.

Determination of Gonado-Somatic Index (GSI)

Determination of maturity stages of gonads of fish by visual examination using maturity keys lacks precision because it relies upon subjective judgment.

The Gonado-Somatic Index was measured as follows:

$$GSI = \frac{Gonad\ Weight\ (g)}{Total\ Body\ Weight\ (g)}\ X\ 100$$

(Schaefer and Orange 1956) [31].

Determination of Hepatosomatic Index (HIS)

The fish liver were carefully detached from the gut of the fish and weighed to the nearest 0.01g.

The Hepatosomatic index was then determined using the following formular;

$$HSI = \frac{Liver\ Weight\ (g)}{Total\ Body\ Weight\ (g)}\ X\ 100$$

Determination of Condition Factor

The condition factor which shows the degree of well-being of the fish in their habitat was determined by using the equation:

$$K = \frac{100W}{L^3}$$

(Gomiero and Braga, 2005) [18].

Where by "K" is the Condition Factor

"W" is the Total Body Weight of the fish in gram (g)

"L" is the Total Length of the fish in centimeters (cm)

Results

Table 1 shows the mean condition indices of *Clarotes laticeps* from Lower River Benue. The maximum mean condition factor of 1.1805±0.09 and minimum of 0.9995±0.04 were recorded in October and August respectively, ranging from 0.60 to 2.45. Maximum mean Gonadosomatic Index of 0.9725±0.12 and minimum of 0.2738±0.03 were recorded in August and December respectively with a range of 0.04-1.53. The Hepatosomatic Index had the highest value of 4.1799±0.49 and lowest value of 1.4227±0.23 in January and September respectively, ranging from 0.77 to 14.30.

Table 2 shows the mean condition indices of the two sexes of *Clarotes laticeps* from Lower River Benue. Both the male and female show the same level of wellness, having condition factor of 1.22±0.03 while the female has the highest Gonadosomatic and Hepatosomatic indices of 0.3830±*0*.02 and 2.94±0.22 respectively.

Table 3 shows the correlation coefficients of some selected parameters of Clarotes laticeps from Lower River Benue. Significant positive correlation exists between month and sex, month and condition factor, month and hepato-somatic index, total length and total body weight, sex and gonado-somatic index as well as hepato-somatic index and gonado-somatic index. However, significant negative correlation exists between month and total length, month and total body

weight, month and gonado-somatic index, sex and total body weight, total length and condition factor, total length and hepato-somatic index, total body weight and hepato-somatic index, condition factor and Hepatosomatic index as well as condition factor and gonado-somatic index.

Table 1: Condition Factor, Gonado-somatic Index and Hepato-somatic Index of *Clarotes laticeps* from Lower River Benue

Month	Parameters			
	Condition Factor		Gonado-Somatic Index	Hepato-Somatic Index
August	Maximum	1.13	1.53	2.57
	Minimum	0.90	0.70	1.53
	Mean	0.9995±0.04[a]	0.9725±0.12[c]	2.2309±0.16[ab]
September	Maximum	1.30	0.74	2.14
	Minimum	0.99	0.39	0.77
	Mean	1.1650±0.05[ab]	0.5861±0.06[b]	1.4227±0.23[a]
October	Maximum	1.68	1.37	2.11
	Minimum	0.82	0.24	1.27
	Mean	1.1805±0.09[ab]	0.5675±0.13[b]	1.7578±0.10[a]
November	Maximum	2.030	0.71	2.93
	Minimum	0.75	0.04	1.00
	Mean	1.1771±0.03[ab]	0.3028±0.02[a]	1.9582±0.06[a]
December	Maximum	2.45	1.14	14.30
	Minimum	0.60	0.07	1.40
	Mean	1.2747±0.04[b]	0.2738±0.03[a]	3.7159±0.31[bc]
January	Maximum	1.88	0.58	7.54
	Minimum	0.77	0.10	2.05
	Mean	1.2956±0.07[b]	0.2788±0.04[a]	4.1799±0.49[c]

*means in the same column carrying different superscripts are significantly different

Table 2: Condition Factor, Gonado-somatic and Hepato-Somatic Index of the Sexes of *Clarotes laticeps* from Lower River Benue

Sex		Wellness Factor		
		Condition Factor	Gonadosomatic Index	Hepatosomatic Index
Male	Minimum	0.75	0.04	0.77
	Maximum	2.12	1.53	8.52
	Mean	1.22±0.04[a]	0.2664±0.37[a]	2.78±0.21[a]
Female	Minimum	0.60	0.16	1.21
	Maximum	2.45	1.37	14.30
	Mean	1.22±0.03[a]	0.3830±0.02[b]	2.94±0.22[a]

*means in the same column with different superscripts are significantly different

Table 3: Correlation between Month, Sex, Total Length, Total Body Weight, Gonado-Somatic Index, Hepatosomatic Index and Condition Factor of *Clarotes laticeps* from Lower River Benue

	Month	Sex	Total Length	Total Body Weight	Condition Factor	Hepato-Somatic Index	Gonado-Somatic Index
Month	1						
Sex	0.168*	1					
Total Length	-0.506*	0.056	1				
Total Body Weight	-0.430*	-0.018	0.862*	1			
Condition Factor	0.209*	0.002	-0.199*	0.094	1		
Hepato-Somatic Index	0.391*	0.041	-0.680*	-0.545*	-0.201*	1	
Gonado-Somatic Index	-0.518*	0.229*	-0.027	-0.016	-0.263*	0.211*	1

*Correlation is significant at 0.05 "P" level

Discussion

The highest condition factor was recorded in January while the least was recorded in August. Also, a nearly increasing trend in the condition factor was observed from September to January. The high condition factor in January could have resulted from a lot of factors among which is less pollution from run-offs into the river. This was because there was no rainfall at this period which could have brought different impurities from different non-point pollution sources into the river.

Also, in the months of December and January were the least Gonadosomatic Indices recorded which signifies low or no reproductive activities in the community of *Clarotes laticeps* in Lower River Benue. This could have had effect on the condition factor of the species as the condition factor of fish increases during the period when the fish is not involved in any reproductive activities. This could also be confirmed in the month of August when the least condition factor and the highest Gonadosomatic Index were recorded. It could therefore be inferred that *Clarotes laticeps* from Lower River Benue breed around the months of August and September as the Gonadosomatic Indices recorded in these months are closer to one (1) while the month of January could be described as the off breeding month. This knowledge of the Gonadosomatic index favours *Clarotes laticeps* as an aquaculture candidate as stressed by Ghanbahadur and Ghanbahadur (2012) [16]. The declining trend of observed in the gonadosomattic index of this species shows that it does not breed from the month of September to January. These months could be described as the post spawning and preparatory phases of breeding in the fish as pointed out by Quyyam and Quasim (1961) [29] as

well as Ghanbahadur and Ghanbahadur (2012) [16] in their observations on the Gonadosomatic indices of *Ophiocephalus puntatus* and *Cyprinus carpio*. However, the sharp decline observed in this study between the month of August and September gives an indication that August might have marked the end of spawning period in *Clarotes laticeps* in Lower River Benue. This is similar to the findings of Ekokotu and Olele (2014) [11] who observed the condition factor and the Gonadosomatic index of *Clarotes laticeps* in Lower River Niger to reach the peak values of 2.81 and 11.86 respectively in August but dropped to 2.05 and 0.75, respectively, in October. However, the suspected breeding season in this study can only be said to fall within the breeding period of April to November stated by Azeroual *et al.*, (2010) [5].

Also, as seen in the Hepatosomatic Indices recorded in the months of sampling, the fish were able to store more food in the increasing trend from the month of September towards the month of January, with the highest Hepatosomatic Index recorded in January. This can be explained in line with the findings of Lenhardt *et al.* (2009) [26] who discovered seasonal variation in the Hepatosomatic index of Sterlet (*Acipenser ruthenus)*, ranging between 1.14 and 6.67 due to variation in food availability throughout the year and as confirmed by Yang and Baumann (2006) [36] who stated that Hepatosomatic index depends on seasonal cycle that affects food availability. Availability of more food for storage could have resulted from less utilisation of food on other activities such as reproduction because reproduction in animals has been seen as one of the metabolic activities that takes higher percentage of energy. Another factor that could be responsible for the variation in the Hepatosomatic index of the fish is pollution and stress as shown by Ada (2013) [1] while monitoring the Gonado-hepato-somatic index of *Oreochromis niloticus* exposed to some herbicides as well as Tilak *et al.* (2007) [33].

The inverse relationship observed between the Gonadosomatic index and the Hepatosomatic index of *Clarotes laticeps* was earlier pointed out by Gomex-Marquez *et al.* (2003) [17] when it was noted that hepatosomatic index has an inverse relationship with gonadosomatic index in *Oreochromis niloticus.*

The equal mean condition factors observed between the male and female Clarotes laticeps shows that food and other environmental conditions are all available to the male and female equally. Also, higher Gonadosomatic Index shows that the female gets ripped sexually earlier than the male counterpart. This is in conformity with the findings of Fawole and Arawono (2000) [13] who observed the gonadosomatic index of *Sarotherodon galilaeus* in Ile-Ife, Nigeria to be 0.33± 0.21 for males and 1.88±1.01 for females.

The higher Hepatosomatic Index observed in the female also buttress the fact that the female need to store more food to cater for the energy needed for development of eggs and ovulation.

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