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Seasonal Abundance, Morphometric Measurements and Growth Patterns in Frill Fin Goby, *Bathygobius soporator* from Badagry Creek, Lagos, Nigeria

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ABSTRACT

Present study was conducted on Frill fin goby (*Bathygobius soporator*) to provide information on its abundance, morphometric measurements and growth patterns in Badagry creek, Lagos, Nigeria. A total of 506 individuals were caught from the creek between January 2008 and January 2009. They were caught with gill nets and non-return barrier traps. Biometric and morphometric data were obtained from the fish. Abundance of the fish was in favour of low rainfall and high salinity. Four hundred and seventy males and five females were encountered in the study, giving 1 male: 0.0106 female ratio. The morphometric data included eye diameter, which varied between 3-9(4.98±0.43) mm, head length ranged from 16-60 (39.15±4.9) mm and body depth, 20-70 (27.15±4.46) mm. The fish measured between 60 and 252 (131.21±17.68) mm total length, weighing 2.7 and 291.9 g b.wt, respectively. The populations of the species showed variations in their morphometric measurements which were not differ significantly ($p \geq 0.05$), indicating that the fish population may not be genetically diversified. These insignificant variations may be related to the geography, ecology and human activities of the creek. The fingerlings measured between 60-99 mm TL; juveniles, 100-149 mm TL and adults, 150 to 252 mm TL, representing 18.58, 55.14 and 26.28% of the population, respectively. The LWR was Log W = Log-1.56+1.43 Log L ($r = 0.66$) representing a negative allometric growth relationship. The condition factor for the fish was less than 2.890 g cm^{-3}. This study therefore provides information on the biologic aspects of *B. soporator* as baseline data for its ecology, management and conservation in Badagry creek.

Key words: Allometry, condition factor, growth exponential, intertidal area, salinity

INTRODUCTION

Frill fin goby (*Bathygobius soporator*) is a member of the family Gobiidae, the largest family of marine, brackish and freshwater fishes (Alfred-Ockiya, 2000) occurring worldwide in tropical and temperate regions. The family comprises over 212 genera such as *Boleophthalmus, Gobius, Periophthalmus, Periophthalmadon, Scartelaos* and *Brachygobius* and 2000 species. Hoese (1998) and Berra (2001) identified subfamilies: Oxudercinae, Amblyopinae, Sicydiinae, Gobionellinae and Gobiinae. The *B. soporator* is demersal and non-migratory species inhabiting the depth between 0-16 m. Nguyen and Nguyen (2006) recognized coral reef as their special habitat. To many, the species is considered a small, relatively unimportant goby especially in the tropical waters (including lagoons, creeks and estuarine). Aspects of the biology of this species were documented by Tavolga (1954, 1956).

Occurrence of *B. soporator* in tidal pools in coastal regions and oceanic islands on both sides of the Atlantic was reported by Lima *et al.* (2005). A notable adaptation to the benthic way of life is the development of a sucker formed by uniting the pelvic fins so as to enable it to cling to a substratum (Akihito *et al.*, 2000) and feed on benthic invertebrates, eggs and zooplankton. They live in environments with enormous variations in salinity, oxygen content, turbidity and temperature (Rantin *et al.*, 1998). Galindo and Moreira (2009) in their study made use of erythrocytes of the *B. soporator* as genotoxicity biomarkers.

Importance of frill fin goby, *B. soporator* in the fisheries of Badagry creek and its environs can not be underestimated especially its roles in the coastal food chains and ecology of this important water body. The species forms part of delicacies for the inhabitants of Badagry creek and Lagos environs. It sells for as much as \$20 kg^{-1} and serves as baits for capture fisheries. For these reasons, fishing pressure is being exerted on its fisheries in this water body. Therefore, an immediate action is needed for its management and conservation to avoid its possible extinction.

Several reviews are available on the ecology, fishes and fisheries of many creeks and lagoons in Lagos, Nigeria. Reviews on fisheries and non related fish species that abound in the Badagry creek include Solarin and Kusemiju (1991), Lawal-Are and Kusemiju (2000), Chukwu and Kuton (2001), Lawal -Are (2001), Ajado and Edokpayi (2003), Akintola (2007), Lawson *et al.* (2010) and Soyinka *et al.* (2010). Fishes and fisheries of the neighbouring Ologe and Iyagbe lagoons were documented in Kumolu-Johnson (2004), Onyema (2008), Kumolu-Johnson and Ndimele (2010), Lawson and Aguda (2010) and Ndimele and Jimoh (2011). Some recent reviews on fishes and fisheries of the adjacent Lagos lagoon include Ayoola and Kuton (2009), Uwadiae *et al.* (2009), Adeyemo *et al.* (2010) and Lawson and Jimoh (2010). Aspects of the biology of mudskipper, *Periophthalmus papilio* (a cryptobenthic relative of *B. soporator*) in Lagos lagoon were documented in Emmanuel (2008), Lawson (2010 a,b,c; 2011a, b). *B. soporator* was reported by Carbajal-Fajardo *et al.* (2009) as one of the icthyofauna species of Camaronera lagoon in Mexico.

Information on *B. soporator* in Nigerian waters is very scant probably because of its consideration as a relatively unimportant fish by some workers. Of recent fishing pressure from overfishing activity on fishes that are considered of relative importance. Their annual yields from both artisanal and offshore fisheries have greatly reduced, attention of the populace has shifted toward hurting for frill fin goby as food in Lagos and Niger Delta region. Therefore, there are needs to conserve and manage this species. These can not be achieved without first understanding its biology and ecology. These and coupled with the fact of dearth of information on this species, authors therefore in this study provide information on its biologic aspects in Badagry creek to provide baseline data for carrying out further studies on this economically emerging fish species.

MATERIALS AND METHODS

This study was conducted in Badagry creek, Lagos, Nigeria between January 2008 and January 2009.

Description of Badagry creek: Badagry creek (Fig. 1) is one of the aquatic habitats in Lagos, Nigeria. It is endowed with deltaic distributaries, floodplains and mangrove swamps. The creek runs across the boundaries of Federal Republic of Nigeria and Republic of Benin. It directly connects with Nigeria's 960 km of coastline bordering the Atlantic Ocean in the Gulf of Guinea, a maritime area of 46,500 km^2 with depth of up to 50 m and an Exclusive Economic Zone of 210,900 km^2 (World Resources, 1990). It lies within longitude 2°42'E and 3°42'E and stretches between latitude

6°22'N and 6°42'N. It is of importance to artisanal and commercial fisheries, transportation, recreation and domestic purposes. Sources of water into the creek include Lagune de Porto-Novo (in Republic of Benin); Rivers Yelwa and Owo; Ologe and Lagos lagoons (Nigeria).

The creek is surrounded by marshy ground, which is permanently white mangrove forest. The dominant plants are *Rhizophora racemosa, Drepanocarpus lunatus, Avecennia nitida, Dalbergia ecastaphyllum, Typha australis* and *Phoneix reclinata*. The sedges include: *Cyperus articulatus, Paspalum vaginatum* and *Cyperus papyrus*. The prominent ferns are *Achrosticum* sp., *Marsilead* sp., *Cylosorus* sp. and *Ceratopleris* sp. Palms are mainly *Pandanus candelabrum* and *Raphia hookeri*. It has several species of fishes, some abound in large number and serves as breeding and feeding grounds for some of them. The fresh water fishes include Tilapias (*Oreochromis niloticus*, *Tilapia melanotheron* and *T. zillii*) and Catfishes (*Clarias* and *Chrysichthys* sp). Marine fish species are Mullets (*Mugil* and *Liza* sp), Ten pounder (*Elops lacerta*), Clupeids (*Ilisha Africana* and *Ethmalosa fimbriata*) and Sciaenids (*Pseudotolithus typus* and *P. senegalensis*). The indigenous species are mudskipper (*Periophthalmus papilio*) and gobiids (*Bathygobius soporator*). Common shellfishes include *Cardisoma armatum*, *Callinectes amnicola*, *Goniopsis pelli* and *Macrobranchium vollenhovenii* (Lawal-Are and Kusemiju, 2001; Ajado and Dokpayi, 2003; Akintola, 2007; Agboola and Anetekhai, 2008; Agboola *et al*., 2008; Lawson *et al*., 2010; Soyinka *et al*., 2010).

Due to seasonal distribution of rainfall, Badagry creek experiences seasonal flooding which introduces a lot of detritus and pollutants from the land. The lagoon presently serves as a major drainage channel receiving domestic wastes as well as industrial effluents from Agbara industrial Estate in Ogun state via Ologe lagoon.

The sampling stations in the study included Badagry, Iworo, Obele, Gbanko, Ibiye and Oto Awori (Fig. 1).

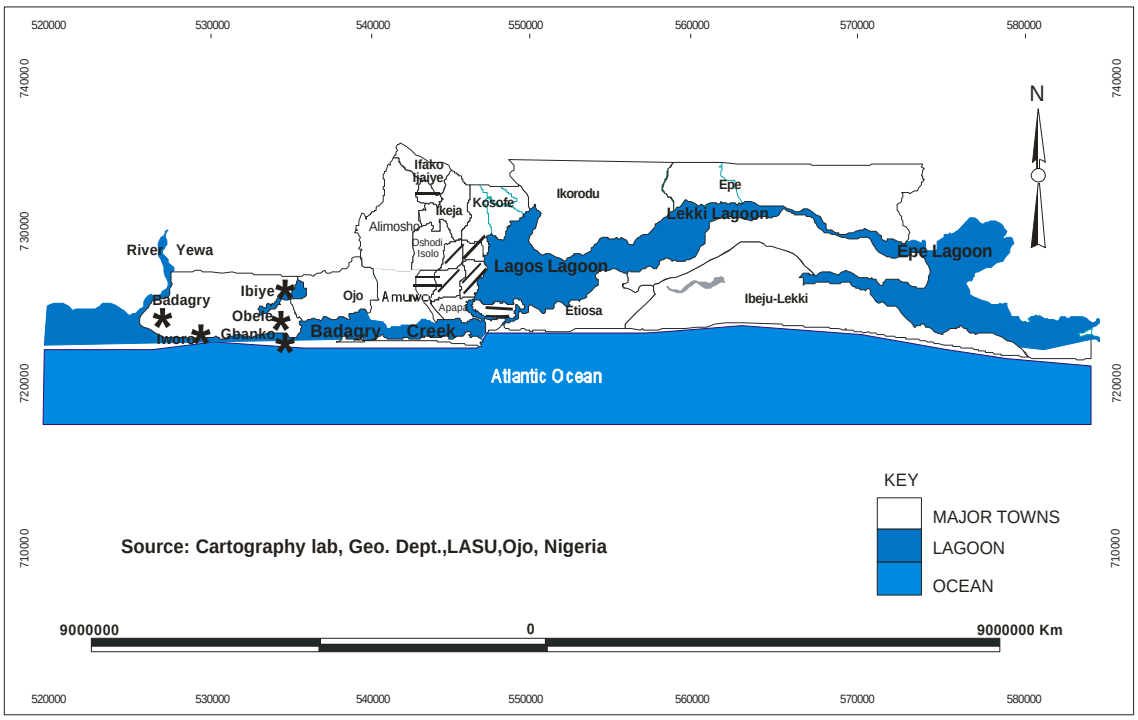

Fig. 1: Map of Lagos showing the Badagry creek complex (sampling stations*)

Field activities: Water samples were collected fortnightly in the sterilized reagent bottles from the sampling sites in Fig. 1. Water temperature and salinity were determined in the field with mercury-in-glass thermometer and refractometer, respectively. Data on rainfall for Badagry area of Lagos, Nigeria was obtained from Nigerian Meteorological (NIMET) Department, Ministry of Aviation, Oshodi, Lagos, Nigeria. These parameters were considered important limiting factors when discussing the abundance of fish in aquatic habitat.

In all a total of 506 specimens of *B. soporator* were collected from inter and sub tidal areas of Badagry, Iworo, Obele, Gbanko, Ibiye and Oto Awori between January 2008 and January 2009. Fish specimens were caught with gill nets of 18-45 mm mesh sizes from depth not exceeding 25 m and non-return barrier traps from depths of 0-5 m. Diurnal collections of the fish specimens were carried out with assistance of motorized fishermen. The total fish catch per day was recorded. The specimens were preserved in 9% formaldehyde solution in the field before transported to laboratory for further investigations.

Laboratory Procedures and data collection: The biometric data on the sex, body weight (BW) and total length (TL) measurements were recorded for the specimens.

The morphometric data on eye diameter (ED), head length (HL) and body depth (BD) measurements were also carried out on the specimens to determine taxonomic variations among the populations of this fish in Badagry creek. The measurements were carried out with the specimens facing left. ED was taken as a measurement of the eye orbit; HL, as a distance between the snout and a point directly behind the operculum and BD represented the deepest part of the body (a vertical distance between a dorsal fin base and the ventral fin base). TL was a distance from the snout to the tip of caudal or tail fin. ED, HL BD and TL measurements were in nearest 1 mm and BW in nearest 0.01 g.

The specimens were opened at the chest of ventral position with scissors. The gonads were carefully removed from the body with forceps; naked eye and microscopic examinations determined sexes. Ratios of the numbers of males to females were subjected to Chi-square (χ^2) test:

$$\chi^2 = \Sigma (O-E)^2/E$$

where, O is number observed and E is number expected.

Length frequency distribution: In this study the length frequency distribution was divided into 60-69, 70-79, 80-89, 90-99, 100-109, 110-119, 120-129, ……, 250-259 mm TL class intervals. Ages of the fish were extrapolated from the size modal distribution that was obtained from the analysis of the length frequency data of the fish following Pauly (1987) method. Specimens below 99 mm were classified as fingerlings, those between 100-149 mm as juveniles and those that measured from 150 to 259 mm TL as adults.

Length-Weight Relationships (LWR): The growth exponential 'a' and 'b' of length-weight relationships ($W = a L^b$) were estimated by least squares regression method and transformed into a linear form by logarithms transformation:

$$\text{Log } W = \text{Log } a + b \text{ Log } L$$

where, W is body weight (g), L is total length (mm), a and b are the coefficients of the functional regression between W and L.

The confidential intervals of 95% were calculated for b to see if it was statistically different.

Condition factors, "K": K for individual fish was based on the equation (Le-Cren, 1951):

$$K = 100.W/L^3$$

where, W is fish body weight (g) and L is fish total length (mm)

RESULTS

Seasonal abundance of *B. soporator*: A total of 506 specimens were caught from Badagry creek between January 2008 and January 2009. The percentages of abundance varied between 3.78 in June and 18.9% in April. No fish was caught from July to November.

Water temperature in Badagry creek during the period of this study ranged from 25.1 in August to 28.6 in September with mean value of 27.59±0.91°C (Table 1). Monthly variations in water temperature were recorded, but did not significantly different ($p>0.05$) to determine the clear patterns of distribution of this fish in the creek.

The lowest salinity value of 0.2‰ was obtained in June and July; the highest value of 16.8‰ was recorded in April. The mean was 6.42±0.67‰. Lower salinities (0.2-1.30‰) were recorded between July and November when this fish was absent from the creek. At higher salinities between 2.25 (December) and 16.8 ‰(April), the species was caught in various percentages, the catches were 18.9 and 16.02%, respectively. Abundance of this species in the Badagry creek was salinity dependent (Table 1).

Data on rainfall (Table 1) indicated 6 months of wet and 6 month of dry seasons in Lagos area. Rainfall varied between 40 in January 2008 and 336 in June with mean value of 129.08±92.34 mm. The wet month commenced from May (215 mm) and ended in October (222 mm) with light shower or less rain in August (69 mm). Dry month commenced from November (77 mm) and stopped in April (115 mm) with a peak of harmattan period in January 2008 when rainfall was 40 mm. The rainfalls for wet and dry seasons were 69-336 (201±88.38) and 40-115 (67.43±30.61) mm, respectively, however, during these periods 15.42 and 84.58% of fish were caught, respectively. Abundance of this species in Badagry creek was dependent of rainfall.

The sex distribution patterns of the fish in this study in Table 2 showed that 470 males and 5 females were caught from the creek, representing 98.95 and 1.05% of the catch, respectively. The overall ratio was 1 male to 0.0106 female in favour of males. The Chi-square test revealed a significant departure from an expected and theoretical 1 male: 1 female ratio ($\chi^2 > \chi^2_{1, 0.05} = 3.84$). Differences in sex ratios were highly significant throughout the study period.

In this study population of *B. soporator* was categorized into 3 size groups (Table 3). Fingerlings were those that measured between 60-99 (85.29±9.45) mm TL and weighed 2.5-18.0 (8.54±2.8) g, juveniles, 100-149 (125.17±13.63) mm TL, weighing between 10.0 and 57.0 (27.82±10.09) g. Adults were 150 to 252 (168.97±18.83) mm long and 13.7 to 291.9 (72.93±37.43) g body weight. The populations of fingerlings, juveniles and adults were 18.58, 55.14 and 26.28%, respectively. Fingerlings were absent in May and June, but most abundant

Table 1: The seasonal abundance of *B. soporator* from Badagry creek

Year	Month	Abundance (%) N = 506	Temperature (°C)	Salinity (‰)	Rainfall (mm)
2008	January	51(10.08)	27.0	12.50	40
2008	February	115(22.73)	27.9	14.60	57
2008	March	45(8.89)	28.3	15.50	100
2008	April	89(17.59)	28.0	16.80	115
2008	May	21(4.15)	27.4	6.30	215
2008	June	57(11.27)	28.1	0.20	336
2008	July	0.00	28.3	0.20	150
2008	August	0.00	25.1	0.40	69
2008	September	0.00	28.6	0.80	214
2008	October	0.00	28.2	1.25	222
2008	November	0.00	27.2	1.30	77
2008	December	105(20.75)	27.3	2.25	41
2009	January	23(4.55)	27.3	11.30	42

N = Sample size (506 individuals)

Table 2: Sex distribution patterns in *B. soporator* from Badagry creek

Year	Month	Sample size N = 475	No. of males	No. of females	Sex ratio* Males: females
2008	January	51	51	0	1:0.00
2008	February	110	110	0	1:0:00
2008	March	44	43	1	1:0.02
2008	April	87	87	0	1:0.00
2008	May	21	21	0	1:0.00
2008	June	53	52	1	1:0.02
2008	July	0	0	0	0.00
2008	August	0	0	0	0.00
2008	September	0	0	0	0.00
2008	October	0	0	0	0.00
2008	November	0	0	0	0.00
2008	December	87	84	3	1:0.04
2009	January	22	22	0	1:0.00
Total		475	470 (98.95%)	5 (1.05%)	1:0.0106

*Differences in sex ratios were highly significant ($p<0.05$)

Table 3: Size distribution patterns in *B. soporator*

Year	Month	Sample size N = 560	Fingerlings (60-99) mm TL	Juveniles (100-149) mm TL	Adults (150-252) mm TL
2008	January	51(10.08)	5 (0.99)	36 (7.12)	10 (1.98)
2008	February	115 (22.73)	20 (3.95)	71 (14.03)	24 (4.74)
2008	March	45 (8.89)	14 (2.77)	26 (5.14)	5 (0.99)
2008	April	89 (17.59)	4 (0.71)	42 (8.3)	43 (8.5)
2008	May	21(4.15)	0.00	10 (1.98)	11(2.17)
2008	June	57(11.27)	0.00	25 (4.94)	32 (6.32))
2008	July	0.00	0.00	0.00	0.00
2008	August	0.00	0.00	0.00	0.00
2008	September	0.00	0.00	0.00	0.00
2008	October	0.00	0.00	0.00	0.00
2008	November	0.00	0.00	0.00	0.00
2008	December	105 (20.75)	44 (8.7)0	55 (10.87)	6 (1.19))
2009	January	23 (4.55)	7 (1.38)	14 (2.77)	2 (0.4)
Total		506.00	94 (18.58%)	279 (55.14%)	133 (26.28%)

Figures in brackets represent percentages

(8.7%) in December 2008, juveniles and adults were most abundant in February (14.03%) and April (8.5%), respectively. No specimen was caught between July and November.

The morphometric measurements in *B. soporator*: The morphometric and body proportional measurements of *B. soporator* in Table 4 showed that eye diameter varied between 3-9 mm with mean value of 4.98±0.43 mm, head length ranged from 16-60 (39.15±4.9) mm and body depth, 20-70 (27.15±4.46) mm. The fish measured between 60 and 252 (131.21±17.68) mm long. The overall mean ratios of BD in TL, HL in TL and ED in HL were 6.31±1.32, 4.23±1.08 and 5.65±1.63, respectively. Although there were variations in morphometric and body proportional measurements in this species, however these were not significantly different ($p>0.05$) enough to deduce taxonomic differences in this fish from Badagry creek.

Growth patterns in *B. soporator*

Length frequency distributions: The length frequency histograms in *B. soporator* are presented in Fig. 2. Twenty class intervals were derived from the histograms. The intervals ranged from 64.5 to 254.5 mm TL. The cohort intervals of between 64.5 and 94.5 mm represented fingerlings, those from 104.5 to 174.5 comprised the juveniles, while 184.5-254.5 were the adult fish. The histograms showed a uni-modal distribution of length with modal class at 124.5 representing 1^+ age group of the fish population in Badagry creek.

Table 4: Summary of morphometric measurements in *B. soporator* from Badagry creek

	Range		
Morphometric feature	Min.	Max.	Mean±SE
Eye diameter (ED)*	3	9	4.98±0.43
Head length (HL)*	16	60	39.15±4.90
Body depth (BD)*	20	70	27.15±4.46
Total length (TL)*	60	252	131.21±17.68
TL/BD proportion	6	7	6.31±1.32
TL/HL proportion	3	5	4.23±1.08
HL/ED proportion	4	6	5.65±1.63

*Measurements in millimeters

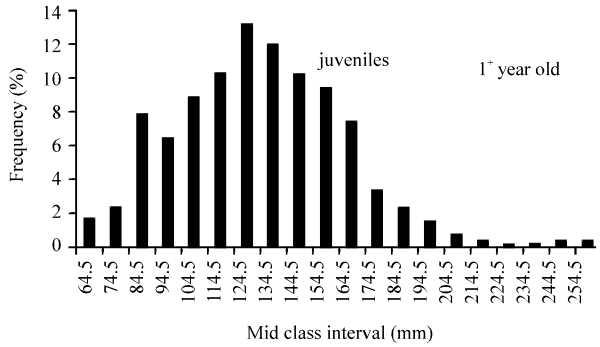

Fig. 2: Histograms of length frequency distributions in *B. soporator* from Badagry creek, Lagos

Length-weight relationships: In Badagry creek the total length of the specimens ranged from 60.0-252.0 (128.97±31.90) mm and weighed between 2.5-291.9 (36.10±3.09) g body weights, respectively. Logarithm transformation of the relationship between TL and BW measurements is presented in Fig. 3 and expresses as:

$$\text{Log W} = \text{Log } -1.56 + 1.43 \text{ Log L } (r = 0.66)$$

The growth exponential value of b =1.43 was a negative allometry growth and a departure from the expected value of 3.0 for isometric growth. There was a corresponding increase in fish body weight with increased total length measurements as indicated by r = 0.66.

Condition factor (K): The condition factor in *B. soporator* from Badagry creek is presented in Table 5. The values ranged from 0.01 in April to 2.20 g cm^{-3} in January 2008. The lowest mean of 1.27±0.27 g cm^{-3} and highest mean of 1.52±0.16 g cm^{-3} were recorded in March and June, respectively.

Table 5: The monthly condition factor (K) in *B. soporator* from Badagry creek

			Range*		
Year	Month	Sample size	Min.	Max.	Mean±S.D*
2008	January	51	0.68	2.20	1.43±0.27
2008	February	115	0.77	1.98	1.40±0.18
2008	March	45	0.35	1.97	1.27±0.27
2008	April	89	0.01	1.82	1.34±0.30
2008	May	21	1.09	1.88	1.39±0.20
2008	June	57	1.20	1.85	1.52±0.16
2008	July	0	0.00	0.00	0.00
2008	August	0	0.00	0.00	0.00
2008	September	0	0.00	0.00	0.00
2008	October	0	0.00	0.00	0.00
2008	November	0	0.00	0.00	0.00
2008	December	105	0.84	1.66	1.32±0.14
2009	January	23	1.18	1.56	1.32±0.09

*Values in g cm^{-3}

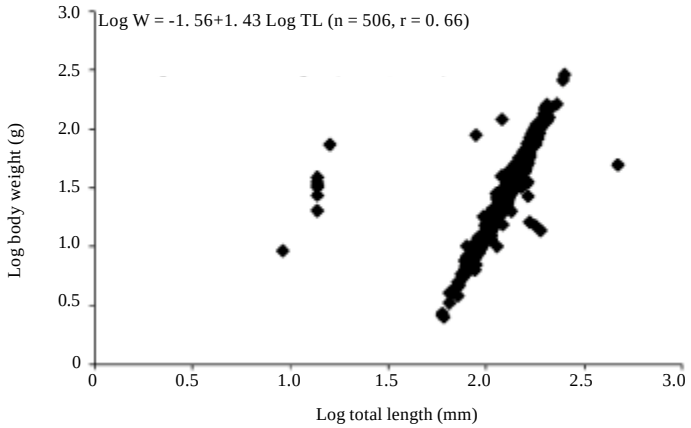

Fig. 3: Log length-log weight relationship in *B. soporator* from Badagry creek, Lagos

DISCUSSION

In this study abundance of Frill fin goby, *Bathygobius soporator* in Badagry creek was greatly determined by water quality parameters such as temperature, rainfall and salinity. This finding was strongly supported by Morton (1989), Lowe-McConnell (1991) and Blaber (1997) who described the mangrove forests as very unstable habitats where parameters such as temperature, salinity and dissolved oxygen fluctuate greatly. According to them these parameters will have great impact on occurrence, distribution, metabolism and physiology of its organisms.

Water temperature ranged from 25.1 to 28.6 (27.59±0.91)°C in Badagry creek between January 2008 and January 2009. These variations were typical temperatures of tropical and subtropical waters where occurrences of *B. soporator* were reported in abundance. The tropical to subtropical range in water temperature suggests that the species prefers warm, coastal waters. In support of this, Tavolga (1950a, b) reported successful breeding and rearing of the larvae of *B. soporator* in captivity at temperatures of 24 to 29°C, the temperatures that were similar to what were obtained in this study. To our knowledge, occurrence of this species has never been reported in cold waters.

In Badagry creek, this species occurred in large number at salinities between 0.2 and 16.8 (6.42±0.67)‰. This is an indication that the species is a euryhaline fish that is able to tolerate wide range or regime of salinity. This probably might have contributed to its hardness in Badagry creek. This finding is not contrary to report of Tavolga (1950b) who described the species as a "hardy species that accustomed to large changes in salinity". However, Ross and Rhode (2004) mentioned *B. soporator* as rare species in tidal freshwater. Its laboratory culture studies revealed a retarded embryological development in seawater diluted to about 18 ppt (Tavolga, 1950a). The distribution of the species in the present study showed that it is mostly confined to brackish water salinities.

In the present study there were six months of wet (June to November) and six months of dry (December-May) seasons. Rainfall has adverse effect on the abundance of this fish in Badagry creek. This is because more specimens were caught in dry than wet seasons. The percentages of abundance were 15.42% for wet and 84.58% for dry periods. Of these fingerlings, juveniles and adults constituted 18.58, 55.14 and 26.28% occurring throughout the year except for July, August, September, October and November 2008 when there was a rise in water level. This probably suggests that wet season does not favour occurrence of this species. Rainfall reduces water salinity due to dilution effect as currently observed in this study. The species was reported to be an intertidal resident species with homing behavior. Maugé (1986) confirmed their availability in pools, while Robins and Ray (1986) noted their abundance in rocky tide pools and along water edge and as well as in lagoons, creeks and estuaries by Miller (1990). Many intertidal fish are able to withstand environmental changes, show morphological, physiological and behavioural adaptations which enable them to survive and reproduce in a habitat subject to regular change like what is found in the mangrove forest (Lewis, 1970; Bridges, 1993; Gilbson, 1996).

In this study, the population was in favour of males. A sex ratio of 1 male to 0.0106 female (Table 2) was a departure from the expected and theoretical 1 male: 1 female. Similar reports were documented in some non related fishes. For example, sex ratios in favour of males during the spawning period were documented in *Elops lacerta* (Ugwumba, 1984; Lawson and Aguda, 2010) and *Chrysichthys walkeri* (Kusemiju, 1976) in some West African lagoons. The reasons probably may be:

- Ecological or genetical factors or both. Females were suspected to leave the spawning grounds more rapidly than the male counterparts (Ozcan and Balik, 2009). Males according to (Nikolsky, 1963) usually predominate in the young fish because they mature earlier but live less long. This is in support of an average age of one year old fish obtained from this study
- Sex reversal where some females reversed or change to male was suspected to have occurred at a stage in the life history of this fish

Sex ratio where large number of males is available to very few females may not be too well as reproductive strategy of this species in Badagry creek. This assertion as an additional reason probably might account for its not all year presence in this creek.

Sex ratios in favour of females were documented in *Ethmalosa fimbriata* (Fagade and Olaniyan, 1972; Blay and Eyeson, 1982) and *Mugil cephalus* (Lawson, 1991; Lawson and Jimoh, 2010). However, sex ratio of 1 male : 1 female was reported by Fagade (1969) and Lawson (1998) on Tilapia and mudskipper, *Periophthalmus papilio,* respectively in some Nigerian waters.

The fish was as small as 60 and as long as 252.0 (128.97±31.90) mm and weighing between 2.5-291.9 (36.10±3.09) g in Badagry creek. This confirms reports on gobies as relatively small fish. According to Herald (1961) some varied between 5 and 10 cm long; some may exceed 50 cm (Jordan, 1905). Maugé (1986) reported the maximum size of 150 mm TL. The average size reported by Robins and Ray (1986) was 7.5 cm. However, the specimens collected from the Bahamas ranged in length from 2.0 to 8.8 cm (Tavolga, 1950a). We suggest in this report that the size differences probably may be due to reasons of ecology, geology or genetic or all. The size of this fish is of great significance as prey species for commercially important fishes like cod, haddock, sea bass, flat fish and tuna.

Variations in the morphometric measurements of *B. soporator* were noted in Badagry creek. The measurements included: ED (3-6), HL (16-60), BD (20-70) and TL (60-252) mm. These are contrary to ED (4-8), HL (22-43), BD (15-33) and TL (140-190) mm that were documented in Lawson *et al.* (2010) for a related cryptic fish, mudskipper, *Periophthalmus papilio* from the adjacent Lagos lagoon. *P. papilio* was formerly grouped in family Gobiidae along with *B. soporator*. These variations based on the stated methodology did not show any taxonomic difference among the populations of *B. soporator* to deduce the presence of a related species. The fish probably may be the only species in the creek.

Proportions of the fish body depth and head length in total length of this species were 6.31 and 4.23, respectively while that of eye diameter in head length was 5.65. Data obtained from this work may serve as template in systematic study and taxonomy of this and non-related fish species in our waters.

The maximum age of this species from the modal progression of length frequency histograms was a year. This was in agreement with report of Hoese (1998) who stated that "*B. soporator* develops very quickly and probably live no longer than one year in the tropic". Availability of food and environmental factors may affect the lifespan of this fish.

In this study, LWR was Log W = Log -1.56 + 1.43 Log L (r = 0.66). The allometric growth value of b = 1.43 obtained from LWRs was an indication of poor growth exhibited by this species in Badagry creek. This is an indication that the fish was too light for its size. There was positive correlation (r = 0.66) between the body weight and total length measurements of the fish. There was increased body weight with increased total length. Similar reports were documented on several fish species in Nigerian waters. Growth is isometric and perfect when b = 3.0, it is described as very

good when it is greater than 3. The poor value of b = 1.43 was recorded in this study. This might responsible for its pointed body profile. LWRs are a useful tool for fisheries research, because they allow the conversion of growth in length equation to growth equation for use in stock assessment model. They allow for the estimation of biomass and condition of the fish. They are useful tools for regional comparison of life histories of certain species (Goncalves *et al*., 1997; Diaz *et al*., 2000; Montoupolos and Stergious, 2000).

The mean condition factor (K) between 1.27±0.27g cm^{-3} in March and 1.52±0.16 g cm^{-3} in the June postulated a high degree in the well being of the fish as well as high gonadal maturation. The variations of K in the fish according to King (1995) may be indicative of food abundance, adaptation to the environment and gonadal development. Low K was described by Braga and Gennari-Filho (1990) as a period when accumulated fat is in use for spawning. A high value indicates a period of increased rate of feeding, followed by a gradual increase in accumulated fat suggesting a preparation for a new reproductive period. K has been closely linked with reproductive cycle of fish by Fagade and Olaniyan (1972), Ugwumba (1990) and Aboaba (1993).

In furtherance to this work, we have embarked on a research programme at molecular level of analysis (e.g., Randomly Amplified Polymorphic DNA (RAPD) primers, RAPD markers) which may provide better or more precise results on genetic and morphological diversities among the populations of this fish in Badagry creek, Nigeria.

In this study we provide information on seasonal abundance, morphometric measurements and sex ratios in frill fin goby, *Bathygobius soporator* from Badagry creek, Lagos, Nigeria. Our information will serve as baseline data for carrying out further studies on its ecology, management and conservation not only in Badagry creek but other Nigerian waters where this species abounds.

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