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Dietary Composition and Biometric Characteristics of the Giant African Threadfin, Polydactylus quadrifilis (Cuvier, 1829) from, Nigeria

Oluboba T.F. Adejumobi K.O. Fakayode O.S. Oluwakayode O.O. Ebohon J.O. Edah .B
Nigerian Institute for Oceanography and Marine Research, Victoria Island, Lagos, Nigeria

Abstract
The giant African threadfin, *Polydactylus quadrifilis* (Cuvier, 1829) is a commercially important marine and brackish water fish. The dietary composition, feeding intensity, growth pattern and condition factor of the fish from Lagos Lagoon, Nigeria was investigated for a period of six months to provide additional information toward the development of fisheries in Lagos Lagoon system. A total of eighty eight fish samples were purchased from Artisanal fisherman using cast net along side with other fish species from Lagos Lagoon between January and June 2014.The regression coefficient "b" exhibit positive allometric growth in Lagos Lagoon. The value of exponent "b" was found to be 3.14 and condition factor (k) of the fish was 1.44 respectively, which was an indication that the fish were thriving very well in the Lagoon. During the study period 94% fish showed active feeding; 12.5% stomachs were found full, 21.6% stomachs were three-quarter full, 20.5% stomachs were half full, 39.8% stomachs were quarter full and 5.7% stomachs were empty. The fish fed on varieties food items such as shrimp, fish and crab with 56.9, 36.9 and 6.3 percent in average respectively. The presence of crab and shrimp was attestation to its carnivorous tendency, while occurrence of bony fish was an indication of its piscivorous habit. Variations in the Index of Relative Importance (IRI %) and GII among the prey groups showed that shrimp were the most important component in the Giant African threadfin.
Keywords: *Polydactylusquadrifilis,* diet, length-weight relationship, condition factor

Introduction

Giant African threadfin, *Polydactylusquadrifilis* (Cuvier, 1829) belongs to the family Polynemidae (shiny nose or threadfin) which occur in marine and brackish waters and they contributed significantly to estuarine and creek fisheries and some of representatives have been found in tidal rivers. The threadfin family contains three species, all in three different genera in Nigerian waters namely: *Galeoidesdecadactylus*, *Pentanemusquinquarius* and *Polydactylusquadrifilis* (giant African threadfin). Giant African threadfin is the largest species in the family Polynemidae and they are important to commercial fisheries as a food fish, popular among.

The Lagos Lagoon and its coast was the study area for this project. The Nigerian coastline is between longitude 02° 53′ to 08° 14′ E and latitude 06° 21 ′ to 03° 55 ′ N, covering a distance of 85 km and lies in between the Gulf of Guinea. Lagos coast is a narrow coastal shelf and lies between 14, 816 km and 27,780 km with a total area of 41,000 km^2. It is a marine environment and salinity is a major limiting factor to the growth of some organisms in the Lagos coast. It has supported decades of small scale fisheries which have shown sign of continuous decline (Solarin, 1998).

Owing to the dynamics of river inflow and seawater incursion, the Lagos Lagoon experiences brackish condition that is more discernible in the dry season. In the wet season, the increased river inflow creates freshwater and low brackish conditions in various parts of the lagoon. The harmattan, a short season of dry, dusty North-East Trade winds are experienced sometimes between November and January in the region reducing visibility and lowering temperatures (Onyema*et al.*, 2003). It stretches over 257km from Cotonou, Republic of Benin to western end of the Niger delta and covers an area of 295km2 (FAO, 1969) with a depth of 1.2m and maximum depth of 2m located between 6^o 26' - 37'N; 3^o 23' - 4^o 20'E). The lagoon opening forms an extensive harbour which serves as a major outlet of fresh water from the lagoon system during rainy season; it is opened throughout the year and exposed to semi-diurnal tides. The tide range is low less than 1.0 in the lagoon (Oyenekan, 1992).

Diets of *P. quadrifilis* consist of shrimps, smaller fish, crabs, polychaete worms, and other benthic invertebrates (Motomura, 2004). The food and feeding habits of fishes is variable throughout the year due to seasonal changes in temperature and water quality, which are responsible for food production in aquatic habitat.

Different methods are use in the studies of stomach contents analysis of fishes but no simple classification of feeding systems is completely satisfactory. The frequency of occurrence and numerical methods of estimating the relative importance of food items in the diets of fish have some short-comings (Gümüş*et al.*, 2002). Specifically, the frequency of occurrence method tends to magnify the relative importance of small food items while numerical method under states the relative importance of large food biomass which may be the main diet of the fish. New methods of estimating the relative importance of food items in the diet of fish species which employs or combines more than one parameter have been develop (Lima – junior and Goitein, 2001).

Geometric Index of importance (GII) has some advantages over other commonly used indices for measuring the relative importance of food items in the diet of fish species because it has a mathematical foundation based on geometry, enabling the use of more than one quantitative parameter (Assis, 1995). It is easy to compute, each parameter involved is weighed equally and food items are ranked according to their overall importance in the stomachGumus(2002) compared Geometric Index of Importance (GII) and Index of Relative Importance (IRI) and concluded that GII is more suitable for measuring the relative importance of food items in the diet of fish species because the discrimination strength of GII make the relative importance of food items more visible and interpretable.

Knowledge of length-weight and condition factor (K) of fishes is important in the study of fisheries biology. The condition factor in fish serves as an indicator of physiological state of the fish in relation to its wellbeing and also provides information when comparing two populations living in certain feeding density, climate and other conditions (Weatherly and Gills, 1987). Thus, condition factor is important in understanding the life cycle of fish species and it contributes to adequate management of these species, hence, maintaining the equilibrium in the ecosystem (Imam *et al*., 2010). This study aimed at dietary composition, feeding intensity, growth pattern and condition factor of the fish analyses of *Polydactylusquadrifilis*, from Lagos Lagoon, Nigeria. It will therefore provide necessary baseline data and information toward the development of fisheries in Lagos lagoon system.

Materials and Methods

Sample collection

Samples of *Polydactylusquadrifilis*were purchased along side with other fish species from the Lagos Lagoon by artisanal fishermen using cast net. A total of 88 specimens of the giant African threadfins were collected monthly between January and June 2014. The specimens were preserved in a frozen ice chest at the point of collection and immediately transferred to the deep freezer at -4^{o}C in the transferred to Marine Biology section laboratory.

Laboratory Analysis

In the laboratory, total length (TL) and body weight (BW) of the fish were recorded.
TL was measured to the nearest 1cm andBW to the nearest 0.1 g body weight.
The length-weight relationship (LWR) between fish total length (TL) and body weight (BW) was presented in a linear form by logarithms transformation as:
Log W = Log a + b Log L……. (Parsons,1988).
The parameters ‘b’ and |r| were estimated from the least square regression method.
The condition factor (K) was estimated to determine the state of well being of the fish from equation:

$$K = \frac{100W}{L^3}$$ ---------- (Le Cren, 1951)

Where, W = body weight in g; L = total length in mm.

Stomach contents have been used by many researchers to establish the food and feeding habits of fish (Kusemiju, 1975; Hyslops, 1980; Adetayo and Kusemiju, 1994; Lemos *et al.*, 2001).

The stomach contents were analyzed to establish the diet composition of the fish by making incision from the anus through the throat to reveal the alimentary canal. The Fullness of stomach was determined as 0/4 for empty stomach, ¼ for quarter full, 2/4 for half full, ¾ for three quarter full and 4/4 for full stomach and recorded specially, for all the samples, the vacuity rate (the proportion of empty stomach) was determined. The stomach contents sample were viewed and identified under dissecting microscope, each prey item was identified and the number of individuals of each type of prey was recorded. Percentage composition by number (%N), percent frequency of occurrence (%F) and percent composition by point (%P) (Hyslop 1980; Bowen 1996; (Ugwumba and Ugwumba 2007).

%N = 100x Ni/n where; Ni is total number of prey of a particular taxon, n is the total number of all prey identified. %O = 100 x Oi/n where; Oi is number of stomachs containing a particular prey taxon (frequency of occurrence); n is total number of stomachs with any prey. %P = 100x Pi/n where; Pi is the total number of points of the particular food items, n = Total number of points of points of all food items.

Index Relative Importance (IRI) was calculated with the formula (% N + % P) x %Oi as described by Pinkas*et al*., (1971) and subsequently used by Smith (1995). To facilitate diet comparison among species IRI was standardized to % IRI (Cortes, 1997). GII was calculated with the formula:

$$GII = (\%N + \%P + \%O) / \sqrt{3}.$$

RESULTS

Length-weight relationships (LWR): The total length (TL) measurements of *Polydactylusquadrifilis*varied between 13 and 30.3 cm (19.3 ±3.3) cm TL and weighed 12.7 – 193 g (50.0 ±32.9) g BW, respectively.
The log transformation of the LWR is expressed in Fig. 1 as:

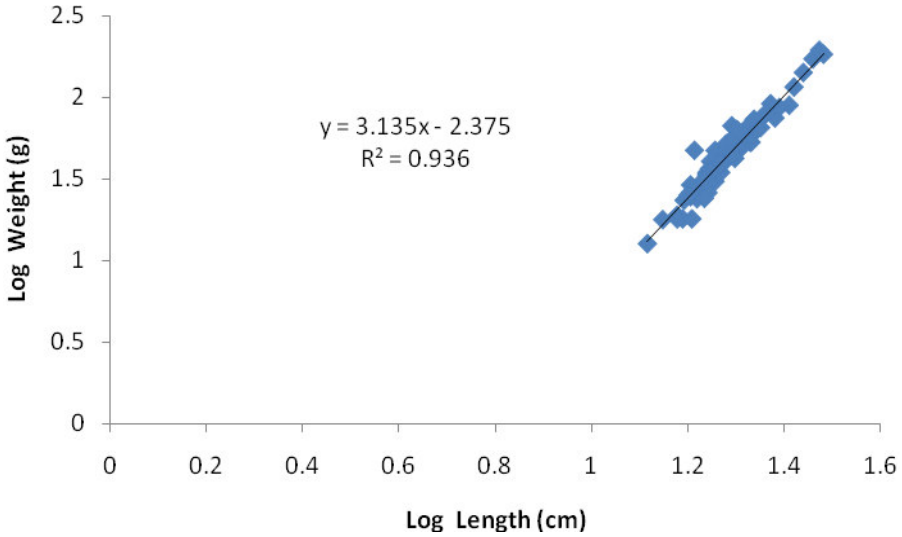

Fig 1: Length - weight relationship of *P. quadrifilis*from Lagos Lagoon
Log W=-2.38+3.14 Log L (n=88, r= 0.94)
The growth exponential values of b= 3.14 was a positive allometric growth for the fish and regression coefficient (r) values 0.94 which shows high correlation. There was increase in L with a corresponding increase in W. the growth exponential 'b' and 'r' was better.
Condition factor (K): The condition factor of the specimen is greater than 1 (1.44) which shows that the fish were in good condition during the collection of the samples.
Feeding intensity: The feeding intensity determined based on the stomachs contents of all the samples, during the study period 94% fish showed active feeding and the overall vacuity index (VI) of *P. quadrifilis*was 5.7%; 12.5% of the stomachs were found full, 21.6% stomachs were three-quarter full, 20.5% were half full, 39.8% were quarter full and 5.7% were empty (figure 2) and table 1 shows percentage of monthly feeding intensity of *P. quadrifilis*from Lagos Lagoon.

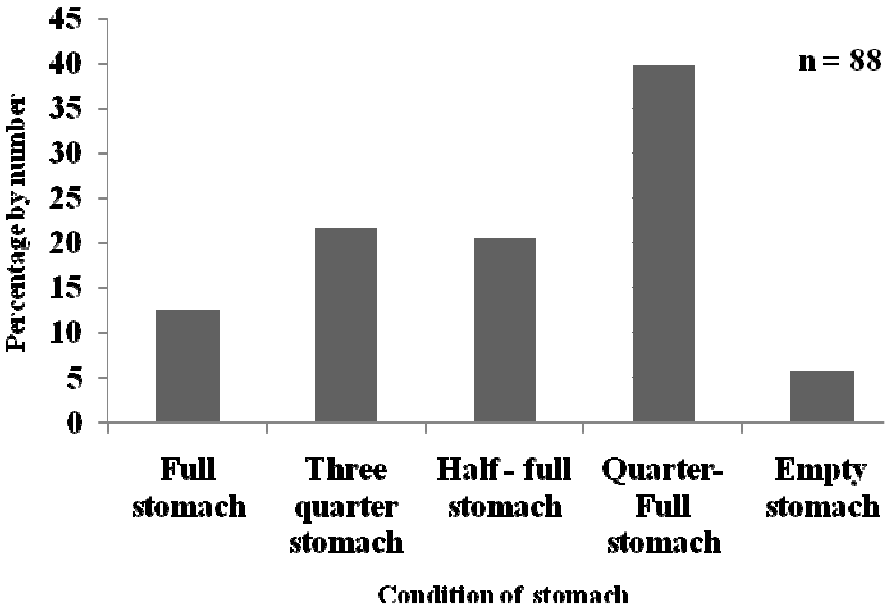

Figure 2: Variations in the conditions (fullness) of stomach of *P. quadrifilis*from Lagos Lagoon

The diet composition of fish shows little diversity. The stomach contents of *P. quadrifilis*from Lagos Lagoon consist of fish, shrimps, crab, debris and unidentified food groups.

Table 1: Percentage of monthly feeding intensity of *Polydactylusquadrifilis*

Months	Stomach examined	4/4 Full	3/4Full	2/4 Full	1/4Full	0/4Empty
January, 2014	29	3.5	20.7	27.6	48.3	-
February, 2014	19	26.3	26.3	15.8	31.6	-
March, 2014	22	9.1	22.7	13.6	36.4	18.2
April, 2014	6	-	-	5	0	-
May, 2014	-	-	-	-	-	
June, 2014	12	25	25	8.3	33.3	8.3

A total of 635 prey individuals were identified (Table 2). Table 3 shows the percentage composition by number (%N), percent frequency of occurrence (%F) and percent composition by point and the two compounds index (i.e. IRI and GII), shrimp were the most important component in the diet of *P. quadrifilis* with IRI% of 70.7, Fish were second in importance, IRI% of 24.8%, followed by crab, IRI% of 2.5%. Besides debris IRI% of 2.1% was minor prey (Table 3 shows the GII of each prey.

Table 2: List of the species identified monthly in the stomach of *P. quadrifilis*

Food items	Jan	Feb	March	April	May	June	Total
Shrimp	84	84	29	73	-	91	361
Crab	21	12	3	-	-	4	40
Fish	7	111	26	89	-	1	234
Total							635

Table 3: Summary of stomach analyses used primary and compound index

Food items	% N	% P	% O	% IRI	GII
Shrimps	56.9	62.8	27.1	70.7	86.4
Crab	6.3	9.9	7.0	2.5	13.6
Fish	36.9	25.0	21.6	24.8	49.1
Debris	-	2.2	44.2	2.1	27.3
Total	100	100	100	100	

Discussion

The knowledge of the food and feeding habits of fishes provide answers to practical problems which arise in relation to human exploitations. Length- weight relationship reflected the usual trend of increase in length with a corresponding increase in weight. The specimens have equal proportion of increase in weight with increase in length. The value of the correlation coefficient b" describes the pattern of the growth. If the value of b is 3, then the fish is said to have isometric growth. Values other than 3 shows that the fish exhibited allometric growth. It may be a positive or negative allometric growth depending on whether the value of b is significantly greater than or less than 3.In this study the size of *P. quadrifilis*varied between 13 and 30.3 cm (19.3 ± 3.3) cm TL and weighed 12.7 – 193 g (50.0 ±32.9) g BW, respectively. Lawson and Olagundoye (2011) reported that the size of *P. quadrifilis* in Ologe Lagoon varied between 90 and 490 (199.572±56.862) mm TL and weighed 6-950 g W, respectively, the size range is indication of availability of juvenile and adult *P. quadrifilis*in the Lagoon and that the Lagoon is a breeding or spawning ground for reproduction, while adults is an indication that *P. quadrifilis* migrate to Lagos coast.

In Lagos Lagoon, the growth exponential value of b for P. quadrifilis was 3.14. The parameter "b" has a very significant biological meaning. It indicates the rate of weight gain in relation to growth in length. "b" equals to 3, means the isometric growth. "b" value greater than 3, signifies a positive allometric growth meaning the weight of the fish is much compare with its length. A value of "b" lesser than 3 indicates a negative allometric growth, the fish becomes lighter for its length as it grows. The b values of length weight relations are known to vary with age, maturity and sex (Dulcic&Kraljevic, 1996); geographic location, environmental condition, season, stomach fullness, disease and parasite loads (Le Cren, 1951; Ricker, 1975; Bagenal&Tesch, 1978; Erkoyuncu, 1995). The correlation values of r = 0.94 was indication of a strong relationship between total length and body weight measurements of the fish. There was an increase in body weight with corresponding increase in total length.

The condition factor was greater than with K value of 1.44, which shows that the fish is in good condition. The k values recorded in Ologe Lagoon for *P. quadrifilis* by Lawson and Olagundoye (2011) were less than 1, the high k values obtained in this study could be attributed to food or season. Variation in values of K according to King (1995) may be indicative of food abundance, adaptation to environment and gonadal development of fish.

The feeding intensity was high during the period of study; the vacuity index of 5.7% revealed in this

study is an indication of high feeding intensity in *P. quadrifilis*. This shows that it is an opportunistic feeder, it feeds almost continuously throughout the day. The highly feeding intensity is also a reflection of the abundance of requisite food resources, both from authocthonous and allocthonous sources.

The diet composition of *P. quadrifilis* in Lagos Lagoon comprised invertebrate such as crabs and shrimp, and their presence was attestation to its carnivorous tendency, while occurrence of bony fish was an indication of its piscivorous habit. Lawson and Olagundoye (2011) also reported copepod, crab, shrimps and fish as part of diet composition of *P. quadrifilis* in Ologe Lagoon.

Variations in the Index of Relative Importance (IRI %) and GII among the prey groups showed that shrimp were the most important component in the Giant African threadfin food. Good understanding of the biology of fish species especially diet composition, growth patterns and condition factor enhances their management and yield in culture. Furthermore, this study apart from contributing to the knowledge of biology of giant African threadfin, *P. quadrifilis* will stimulate further research on the biology and culture of these species. It will also assist in the management and conservation of fish and fisheries of Lagos Lagoon, Lagos, Nigeria.

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