Morphology, Fecundity and diet of *Galeoides decadactylus* (Pisces: Polynemidae) (Bloch, 1795) off Nigerian coast

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Abstract: *Galeoides decadactylus* (Bloch) is one of the three species of the family polynemidae commonly called the threadfins, found in warm tropical surface water of the Atlantic on the continental shelf of West Africa. They are important in the trawl fisheries of Nigeria. The specimens used for this study were collected off Nigerian coast from Lagos to Calabar between December, 2003 and November, 2004. In this study the length-frequency distribution, length - weight relationship, condition factor, sex ratio, fecundity, food and feeding habits of *Galeoides decadactylus* were examined. Measurements recorded for each fish were standard length (SL) and total length (TL) to the nearest 1mm and weight to the nearest 0.1g. Sexes of fish were determined by visual and microscopic examination of the gonads. Fecundity was estimated from the ripe ovaries (stage v) by the gravimetric method. The Gonadotropic Index (GI) and the Condition Factor (K) were calculated. Food items were quantified by two methods, the numerical and frequency of occurrence methods. The total length of 259 specimens examined ranged between 12.0cm and 28.3cm (standard length 9.9cm to 20.8cm). Specimens exhibited negative allometric growth. The condition factor increased with individual size. Females had a slightly higher condition factor than males. The sex ratio was 1:0.46 (male:female). The number of eggs per female ranged between 58 001 and 279 279. There was a negative correlation between log-fecundity and log-weight than between log-fecundity and log length. The major food items were crustaceans, molluscs, pisces and annelids. There were no distinctions in the feeding habits of the species in relation to size. The fish was euryphagus species and highly fecund.
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Key words: *Galeoides decadactylus*, fecundity, allometric growth, condition factor, euryphagus.

INTRODUCTION

Galeoides decadactylus is one of the three species of the family polynemidae found in warm tropical surface water of the Atlantic on the continental shelf of West Africa. It is usually distinguished by its lower portion of the pectoral fin detached to form nine or ten short free rays (Schneider 1990).

G. decadactylus is a moderately elongated fish, slightly compressed with the standard length about three times longer than the body depth. It has an inferior mouth with a fleshy translucent blunt snout. It occurs in shallow coastal waters, also in estuaries (Schneider 1990). It is a carnivorous fish feeding on variety of crustaceans such as shrimps and crab parts. It is of great importance as protein source for man and coastal tribes all over the world (Kusemiju and Osibona 1998). The threadfins are important in the trawl fisheries of Nigeria in which two of the genera *Galeoides* and *Pentanemus* form 10% and 20% respectively of the total catch landings (Longhurst 1964).

Fecundity has been defined by Bagenal (1968) cited by Osibona and Kusemiju (1998) as the number of ripe eggs in the female gonad prior to the next spawning period. Knowledge of fecundity is paramount to the understanding of population dynamic (Kelly et al 1996). They reported further that fecundity was correlated to fish weight. However, Nagasaki (1958) and Osibona and Kusemiju (1998) reported close correlation between fecundity and body weight than between fecundity and length although there could be weight loss during period of egg maturation. Despite the importance to the fisheries economics of African Seaboard Countries of the two species (*G. decadactylus* and *Pentanemus quiquarius*), very little information on their biology is available. Other information include preliminary studies on growth rates in fish from Sierra Leone area (Longhurst 1962, 1963b), their escapement from trawls in the same fishery (Longhurst 1959, 1960a) their elementary chemical composition (Watts 1958) and the growth and fecundity of *P. quinquarius* off Aiyetoro coast (Kusemiju and Osibona 1998).

The main objectives were to examine the growth pattern, fecundity, food and feeding habits of this species as a complement to the already existing information on the biology of this fishery resource in West Africa.

MATERIALS AND METHODS

The specimens used for this study were collected between December, 2003 and November, 2004 with beam trawl (M.V. Massey, a 13.2m long inshore trawler with a 125hp caterpillar engine). The trawl net of 3 inches (7.62cm) wing and 2 inches (5.08 cm) cod end was used. Specimens were preserved in adequate ice block from the point of collection to the laboratory. They were labeled and then transferred into the freezer pending further analysis. Fish samples were thawed in the open air in the laboratory and body wiped

dry. Measurements recorded for each fish were standard length (SL) and total length (TL) to the nearest 01cm and weight to the nearest 0.1g. Sexes of fish were determined by visual and microscopic examination of the gonads. The unsexed fishes (juveniles and young adults) were regarded as immature. The gonadal maturity stages classification was adopted after Kelly *et al.* (1996). Mature ovaries were removed, weighed and then preserved in Gilson's fluid.

Fecundity: Fecundity was estimated from the ripe ovaries (stage v) by the gravimetric method after Kelly *et al*. (1996). The potential individual fecundity (FPI) was calculated according to the equation:

$$FPI = \sum_{n=1}^{n=5} \left[W_{susp} \times \left(\frac{C_n}{W_n} \right) \right] \times \left(Wsum/W_{sub} \right)$$

where W_{susp} is total suspension weight (sucrose + eggs); (n is average egg count of the nth 0.5ml sample; W_n is weight of the nth 0.5ml sample; W_{sum} is total weight of eggs in the Ovary and W_{sub} is weight of eggs in the suspension.

Gonadotropic index: The Gonadotropic Index (GI) was calculated using the formula:

$$G.I = \frac{\text{Ovary weight}}{\text{Fish weight}} \times 100$$

given by Sturm (1978).

Stomach content: The stomach contents were analyzed to establish the food habits of the fish. Since the fish were frozen immediately after catching their stomach contents were representative of their last meals. Food items were quantified by two methods, the numerical and frequency of occurrence methods (Hyslop 1980; Costal et al. 1992). In the numerical method the number of each food item was expressed as the percentage of the total number of food items found in the stomachs while in the frequency of occurrence method, the occurrence of food items was expressed as the percentage of the total number of stomach containing food.

Length-Weight relationship: The length-weight relationships for each sex and the combined sexes were calculated using the equation.

Log weight = log a + b log length.

Where a and b are regression constants.

Condition factor: The condition factor was calculated for the males, females and combined sexes using the condition factor method of Bannister (1976):

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

Where K = condition factor, L = total length (mm) and W = weight in grams.

In order to test whether b – values obtained in the linear regressions were significantly different from the isometric value (3), a t – test ($H0 \neq b = 3$) with a confidence level of 99 % ($P < 0.01$) was applied, expressed by the following equation (Sokal and Rolif 1987).

RESULTS

Length-frequency lengths of 259 specimens examined ranged from 12.0cm to 28.3cm (standard length 9.9cm to 20.8cm). The length frequency distribution of *G. decaqdactylus* showed a Unimodel size distribution (Figure 1). This result indicated that *G. decadactylus* attained one size group of total length ranging from 12.5 to 20.1cm and mean 16.1cm.

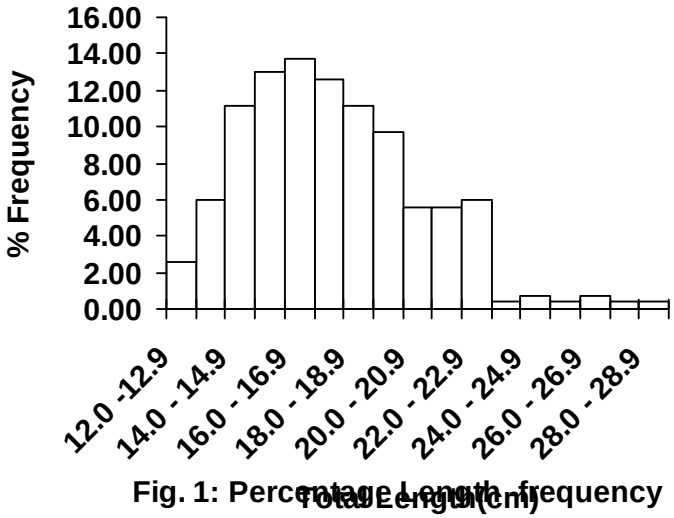

Fig. 1: Percentage Length-frequency distribution of *G. decadactylus* off Nigerian coast

Length-weight relationship of *G. decadactylus*

The total lengths of *G. decadactylus* off Nigerian Coast ranged from 12.0cm to 28.3cm (standard length 9.9 – 20.8cm) while the weights ranged from 18.6g to 230.5g. The log length – log weight relationship for this species is as shown in Fig. 2. The length-weight relationship regardless of sex or year class reflected the general increase of weight with increasing length.

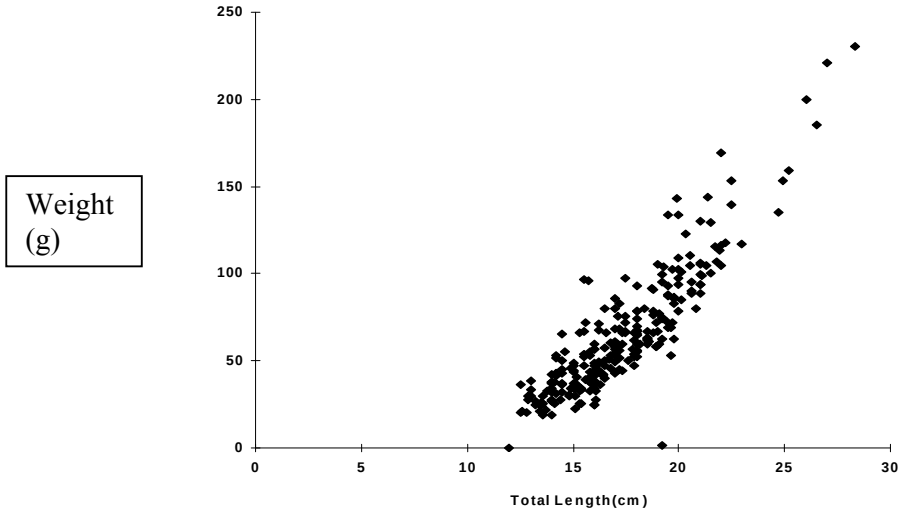

Fig. 2: Length - Weight relationship of (combined sexes) *G. decadactylus* off Nigerian coast.

The exponential relationship of the log length and log weight for both combined and individual sexes are shown in Table 1.

TABLE 1**:** Length-weight relationship of *G. decadactylus*

TL (cm)	Individual	Length-weight relationship	N	r	t	p
12.9 – 27.0	Male	Log W = Log-1.6480 + 2.7568 Log L	178	0.867	– 2.0391	<0.01
13.5 – 28.3	Female	Log W = Log-1.8643 + 2.9295 Log L	81	0.843	– 0.335	<0.01
12.9 – 28.3	Sexes combined	Log W = Log-1.6948 + 2.7962 Log L	259	0.868	– 1.728	<0.01

N = number of individual species, r = coefficient, t = absolute value of the t comparing calculated slope to 3, p = significant different.

The b values obtained were: 2.7568, 2.9295and 2.8211 for male, females and combined sexes.

In order to confirm whether b-values obtained in the linear regressions were significantly different from the isometric value (3), a t-test (Ho ≠ b =3) with a confidence level of ≠ 75% ($\alpha < 0.01$) was applied, expressed by the following equation (Sokal and Rolif 1987).

$$t_s = \frac{b - 3}{s_b}$$

Where t_s is the t test value, b the slope and s_b the standard error of the slope (b).

Condition factor The size and sex variation in condition factors are presented in Table 2 and the values varied from 1.49 to 3.96. Female specimens had higher condition factors than males. The K-value however increases with increase in fish size for both male and female specimens and for the combined sexes.

Table 2: Condition factor in relation to sex and size of *G. decadactylus* off Nigerian Coast.

Total Length /Size Group(cm)	Number of Specimen	Range of K-factor	Mean of K-factor
		Male	
12.0 – 20.9	172	149 - 3.23	2.36
21.0 – 29.9	6	2.19 - 3.76	2.17
		Female	
12.0 – 20.9	59	1.69 - 3.41	2.40
21.0 – 29.9	22	2.08 - 3.96	3.02
		Combined sexes	
12.0 – 20.9	231	1.49 - 3.41	2.45
21.0 – 29.9	28	2.08 - 3.96	3.02

Fecundity of *G. decadactylus*

The number of eggs in the ovary ranged between 58 001 for a 175mm total length fish to 279 277 for a 220mm total length fish with a mean fecundity of 168 639. Logarithm – transformed length or weight/ fecundity (Figs. 3 and 4), data gave the following equations:

Log F = Log 7.3109 + 1.7526 Log L
(n = 10, r = 0.2272)

Log F = Log 5.4213 + 0.1900 Log W
(n = 10, r = -0.0508).

Eggs in matured ovaries were of different diameters. T he egg diameter ranged between 227 μm and 317μm increasing with maturation of the ovaries. The ripe and ripe-running eggs were pale and deep yellow respectively.

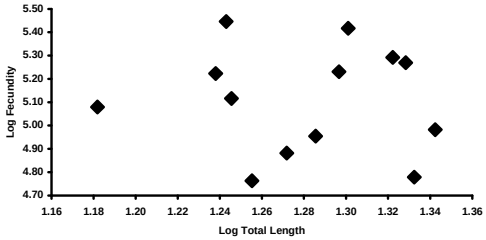

Fig. 3. The relationship between Log fecundity and Log total length of *G. decadactylus* off Nigerian Coast.

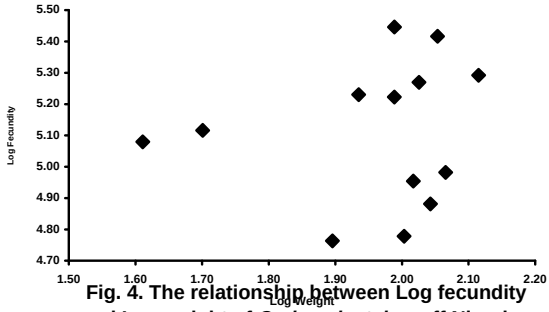

Fig. 4. The relationship between Log fecundity and Log weight of *G. decadactylus* off Nigerian Coast.

Gonadotropic Index (G.I): The gonadotropic indices of this species ranged from 0.91% to 9.57%. The mean value obtained was 5.24%.

Food and feeding habits of *G. decadactylus***:** The stomach contents of 259 *G. decadactylus* were examined. 94 (36.15%) had empty stomachs. A summary of the food items is presented in Table 3 and Fig. 5.

TABLE 3: Summary of food items of *G. decadactylus*

Food Items	Frequency of Occurrence		Numerical Method	
	Number	Percentage	Number	Percentage
Crustacea				
Penaeus notialis	154	24.76	382	14.19
Palaemon hastatus	109	17.52	217	8.06
Crab	72	11.58	139	5.16
Calanoids	18	2.89	1740	64.65
Cladocera	1	0.16	40	1.48
Pisces				
Fish parts	50	8.04	56	2.08
Fish eggs	1	0.16	9	0.33
Annelida				
Nereis sp	28	4.50	50	1.85
Molluscs				
Neritina sp	8	1.29	26	0.96
Aloidis trigona	12	1.93	32	1.18
Sand grains	3	0.48	-	-
Unidentified mass	166	26.69	-	-

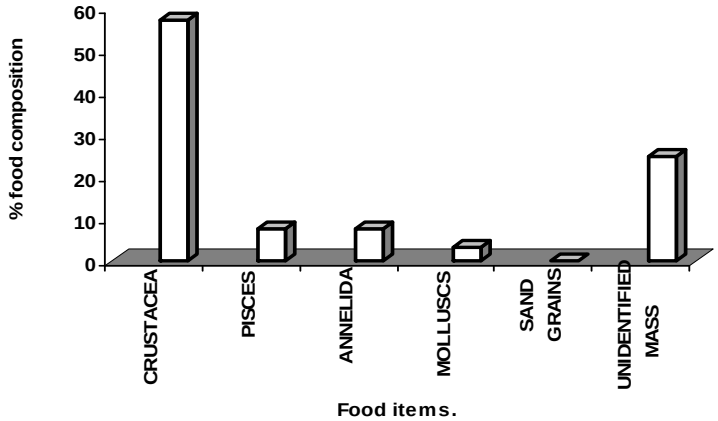

Fig. 5. Summary of food items of *G. decadactylus*.

Food in relation to size of *G. decadactylus***:** The specimens were divided into two size groups to facilitate a comparison of their food habit. The first size group (12.0 -20.9cm) comprised mostly of small sized fishes while 21.0cm to 28.3cm group consisted of mature fishes. The summary of the percentage composition of the two size categories were represented in Table 4 and Figure 6, Table 5 and Figure 7.

TABLE 4: Food in relation to size, 12.0 – 20.9cm of *G.decadactylus***.**

Food Items	Frequency of Occurrence		Numerical Method	
	Number	Percentage	Number	Percentage
Crustacea				
Penaeus notialis	122	24.40	289	13.20
Palaemon hastatus	85	11.00	170	7.76
Crabs	55	3.20	108	4.93
Calanoids	16	3.34	1510	68.98
Cladocera	-	-	-	-
Pisces				
Fish parts	28	5.60	43	1.96
Fish eggs	21	4.20	9	0.41
Annelida				
Nereis sp	21	4.20	33	1.50
Molluscs				
Neritina sp	8	1.60	25	1.14
Aloidis trigona	8	1.60	2	0.09
Sand grain	3	0.60	-	-
Unidentified mass	133	26.60	-	-

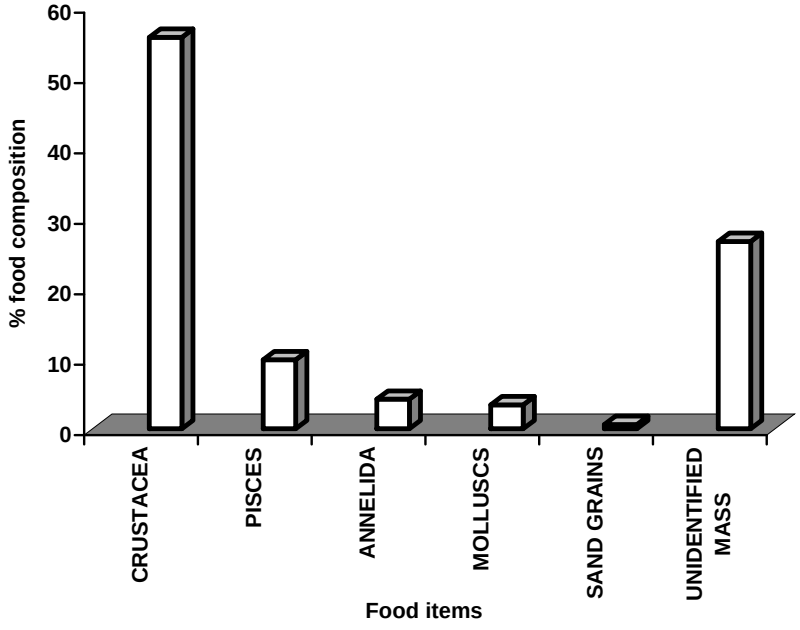

Fig.6. Food in relation to size 12.0 – 20.9 cm of *G. decadactylus*.

TABLE 5: Food in relation to size, 210 – 283mm of *G.decadactylus*

Food Items	Frequency of Occurrence		Numerical Method	
	Number	Percentage	Number	Percentage
Crustacea				
Penaeus notialis	32	23.88	93	19.21
Palaemon hastatus	24	17.91	47	9.71
Crabs	17	12.68	31	6.40
Calanoids	3	2.23	230	47.52
Cladocera	1	0.74	40	8.26
Pisces				
Fish parts	10	7.46	13	2.68
Fish eggs	-	-	-	-
Annelida				
Nereis sp	10	7.46	17	3.51
Molluscs				
Neritina sp	4	2.98	12	2.47
Aloidis trigona	-	-	1	0.20
Sand grain	-	-	-	-
Unidentified mass	33	24.62	-	-

Fig.7. Food in relation to size 21.0 – 28.3 cm of *G. decadactylus*.

Both size groups fed on the same type of food, crustaceans being the most important, however larger food items were more important in the diet of the large size group. The larger sized of *P. notialis, P. hastatus*, and crabs were more important in the diet of the large size group, the small size group fed on pre-adult and juveniles of the crustaceans and calanoids.

DISCUSSION

The length-frequency distribution of *G. decadactylus* showed that the fish exhibited unimodal distribution, which is one age group off Nigerian Coast. The frequency distribution study is one of the methods used for determining age of fishes. The method has been successfully used by Fagade and Olaniyan (1972) to age the bonga fish, *Ethmalosa fimbriata* in which three age groups were reported off Lagos coast. Kusemiju and Osibona (1998) reported a unimodal distribution in *Pentanemus quinquarius* off Aiyetoro coast.

The logarithmic plot of weight against length indicated a linear relationship. This relationship indicates that an increase in length leads to increase in weight. The correlation coefficients (r) were very high between the lengths and weights in *G. decadactylus* for both sexes, indicating a moderately strong relationship between the variables. The values of the regression coefficient (b) for the males, females and combined sexes were less than 3 showing that *G. decadactylus* had a negative allometric growth since the P-values is less than 0.01 this is a statistically significant relationship between Log weight and log length at 99% confidence level, for *G. decadactylus*. It was also confirmed that the b-values obtained for the specimens were significantly different from the isometric value (3).

The mean condition factor increased as the fish size increases. Female specimens had higher condition factors than males. The condition factor values are useful in comparing the healthiness of fish from different habitats or to indicate the sustainability of the environment in which the fish are caught. Kusemiju and Osibona (1998) also reported that the mean condition factor increased as the fish length increased in *P. quinquarius* off Aiyetoro coast.

There was negative relationship between the logarithm of fecundity and length/weight. There was, however, a different correlations between log fecundity/weight (r = -0.0508) and log fecundity / length (r = -0.2272). In this study, specimens of the same length or weight had variable fecundity. This was also reported by Kusemiju and Osibona (1998) on other species of the threadfin, *P. quinquarius*. This meant that the fecundity was variable irrespective of the weight or length of *G. decadactylus*. The variable in the fecundity may be as a result of differential feeding success (Bagenal 1978) and the size of the female parents (Fryer and Iles 1972).

Longhurst (1965) reported that 16.8% of the *G. decadatylus* examined were hermaphrodites with a suggestion that the fish exhibited protandrous sex change but in this study there was no hermaphrodites observed. There were occurrences of ripe and ripe running fishes throughout the study periods showing that the fish spawned throughout the periods. High values of the gonadotrophic indices in December indicated a peak spawning season, however minor spawning peak occurred in January. Ugbor (1984) reported that high values of the gonadotropic indices occurred in December and minor spawning peak in May. The fecundity ranged from 58 000 to 279 277 per female. This species had high fecundity compared to other species which attained similar lengths at sexual maturity. The large number gives room for eggs and fry that may be lost as a result of exposure to high mortality arising from environmental perturbation and predation (Ikomi and Jessa 2003).

The overall sex ratio was 1:0.46. The study showed that males specimens were significantly more abundant than the females a deviation from the expected 1:1 (male:female). This agreed with Ugbor (1984) where it was reported that males were significantly more abundant than females in the same species off Lagos coast.

The food items in the stomachs of *G. decadactylus* suggested that it is euryphagus (i.e. feeding on a wide range of organisms). The specimens of *G. decadactylus* had a high number of empty stomachs, 94 specimens (36.15%). This agreed with Longhurst (1960b) that high percentage of empty stomach (69.6%) was reported for offshore fishes and 39.0% for estuarine population of fishes. The high proportion of empty stomach observed was associated with seasonal variation of food or with feeding regimes.The species was observed to feed on varieties of active and sedentary benthic animals. Occurrence of detritus in the form of sand was also observed. This also indicated that the species is demersal and bottom feeder in addition to its inferior mouth location (Holden and Reed 1991). The diet constituted mainly of crustaceans, Pisces, annelids and molluscs. Crustaceans (*P. notialis*, crabs, calanoids and cladocera) were the most important diet of the species. These except calanoids and cladocera were in agreement with what was reported by Longhurst (1957) and Onyia (1973) on the same species. A comparison of the food of the species with food fed on by other member of the Scianid Community such as *Brachydeuterus auritus* and *Vomer sepinnis* showed that all fed on varied crustacean as reported by Marcus (1986). This also reduces inter specific competition among the species.

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