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GROWTH PATTERN AND PROXIMATE COMPOSITION OF FIVE CARTILAGINOUS FISH SPECIES FROM LAGOS LAGOON AND ITS COAST

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ABSTRACT

Length - weight relationship, as well as the nutritive values of some selected species of cartilaginous fishes were examined from the Lagos lagoon and its environs which lies within latitude 6° 26'–6° 37' N and longitude 3° 23'-4° 20' E. The following five cartilaginous fishes; Raja miraletus, Dasyatis margarita, Squalus megalops, Sphyrna couardi and Rhinobatos albomaculatus* were used for the study and a *total of fifty-four fish samples were collected for four months between May and August. Length and weight measurements were taken, and the proximate composition of the fish was analyzed using standard AOAC methods. Results for most of the fishes revealed negative allometric growth (b< 3). The sex ratio (Male: Female) were 1:1.16; 1:1.28; 1:1.15; 1:1.30; and 1:10 for Raja Miraletus; Dasyatis Margarita; Squalus Megalops; Sphyrna Couardi; and Rhinobatos Albomaculatus respectively. The proximate analysis revealed that Raja miraletus, Squalus megalops, Rhinobatos albomaculatus, Sphyrna couardi, Raja miraletus and Sphyrna couardi have the highest values of crude protein, carbohydrates, moisture content, ether extract, crude fibre and ash content at 25.85%, 4.88%, 66.17%, 3.08%, 4.76% and 2.35% respectively. The fishes belong to the high protein–low–fat category and can be recommended in human diets to prevent protein deficiencies.

Key words: Growth pattern, Proximate composition, Cartilaginous, Lagoon and Fish

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INTRODUCTION

The length-weight relationship of fishes is paramount in fisheries sciences and management and studies in this aspect have been carried out since the late 19th century (Garcia-Ayala et al. 2014). When Length and weight measurements, together with data on the age of fish are assessed, they can provide information on the following: fish stock, age maturity, life span, mortality, growth, and reproduction (Kumar *et al*., 2014). It has also been used for calculating body condition index and for analyzing between-region morphological and life-history disparities in fish biology and fisheries assessment (Gonçalves et al**,** 2007, Sani, *et al*.,2010, and Erguden, et al ,2009) The condition factor obtained from the length-weight data is used to evaluate the well-being of fish (Zamani, *et al.*, 2015). The condition factor indicates the fitness and general well-being of the fish. It reflects the interaction between biotic and abiotic factors in the physiological conditions of fish and their welfare (Getso *et al.*, 2017, and Keyombe *et al.***,** 2017). The sex ratio supplies information about the reproductive

potential and stock size of the fish population (Stratoudakis, et al, 2006).

Proximate composition generally comprises the estimation of moisture, protein, fat, and ash contents of the fresh fish body. The percentage composition of these constituents accounts for about 96-98 % of the total tissue constituents in fish (Nowsad, 2007). The chemical composition of fish flesh is regarded as a dependable predictor of the quality, physiological state, habitat, and nutritional value of the fish. It is important to provide data on the proximate composition of fish since it serves as one of the major protein sources in human nutrition (Mohanty *et al.*, 2014). The Chondrichthyes are cartilaginous fishes represented by sharks, skates, rays and most primitive living jawed aquatic vertebrates. They occupy a wide range of habitats which includes freshwater riverine and lake systems, inshore estuaries and lagoons, coastal waters, the open sea, and the deep ocean. Most of them are predatory, while some are scavengers and some are suction or filter feeders especially some of the largest. The predatory ones are found close to or at the top of the marine food chain, thus they are small in numbers and are not as abundant and available as bony fishes and the available ones can be a good source of protein for human consumption. Studies have been carried out on the LWR of bony fish species in the Nigerian waters (Olatunde, 2020) but there is a paucity of information about the nutritive value and length-weight relationships of cartilaginous fishes in the coastal waters of Nigeria. The study was therefore carried out to determine the length-weight relationship and proximate composition of these fishes.

MATERIALS AND METHODS

Study Area

The Lagos Lagoon is one of the several lagoons in West Africa, a brackish coastal lagoon, which lies within latitude 6° 26'–6° 37' N and longitude 3° 23'-4° 20' E and it stretches for 257km from the Benin Republic to the West and Niger Delta to the East and consists of nine lagoons namely, Badagry, Ologe, Yewa, Iyagbe, Lagos, Kuramo, Mahin, Lekki and Epe Lagoon as shown in Figure 1.

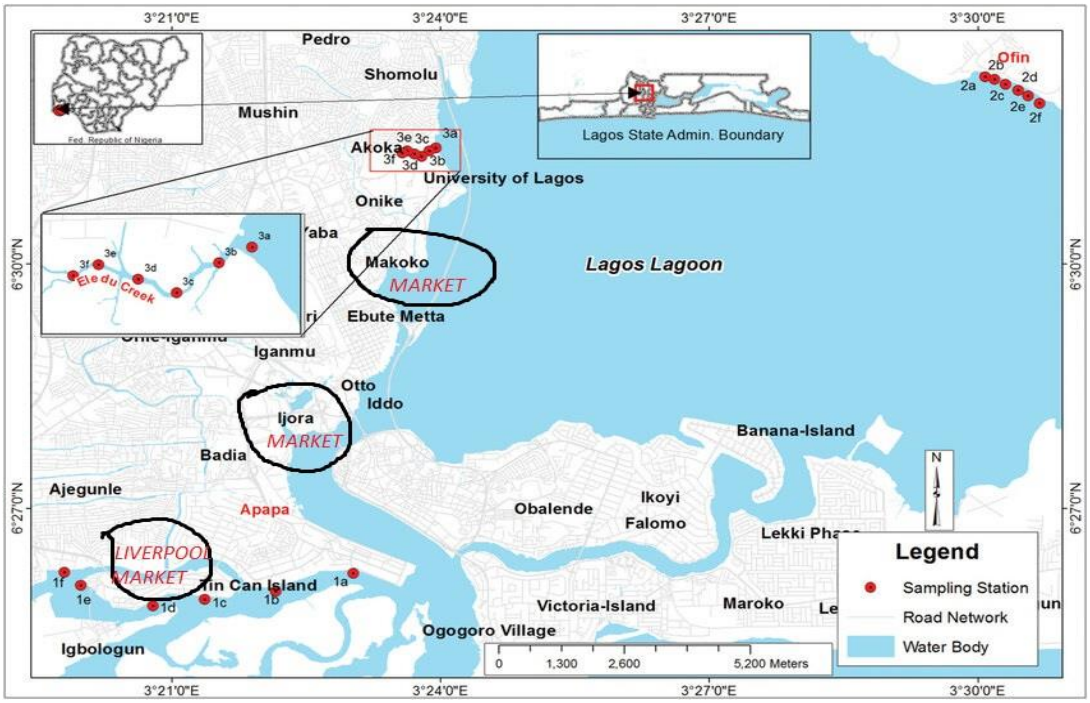

Figure 1. Map of Lagos Lagoon

Fish Sample Collection

The cartilaginous fish species were collected based on the species available from three commercial landing sites namely Makoko fish market, Liverpool fish market, and Ijora fish market as indicated in Figure 1. The sampling was done during the wet season. A total of 54 fish samples (all the species consist of eleven samples except Squalus megalops with ten samples) were obtained during this period which consisted of five different species of cartilaginous fishes. The species were *Dasyatis margarita* (sting ray), *Raja miraletus* (brown ray), *Squalus megalops* (dogfish shark), *Sphyrna couardi* (hammerhead shark), and *Rhinobatos albomaculatus* (White spotted guitarfish). The fish species were collected randomly to represent the population. The fish samples were labeled for easy identification and kept in the freezer at a temperature of -20 ºC before analysis to be thawed for use.

Morphometric Measurement

The fish specimen was removed from the freezer and thawed. Total length and standard-length measurements were measured to the nearest cm using a measuring board and the weight was measured to the nearest gram using a weighing scale. The relationship between the length (L) and weight (W) of the fish is expressed as thus;

$W = aL^b$ …… 1

Where W= weight of the fish in g, L is the standard length of the fish in cm, a =Regression constant, and b = Regression coefficient

The equation was linearised by a logarithmic transformation to give

$Log\ W = Log\ a + b\ Log\ L$…… 2

The length-weight relationship was determined graphically using the above equation.

The condition factor (K) was obtained from the following equation

$K = 100\ \frac{W}{L^b}$ …… 3

Where W = Weight of the fish in g, L = Total length in cm, b = regression coefficient

***Sex Ratio*:** The sex ratio was calculated by dividing the total number of males by the total number of females. The chi-square (χ^2) was used to evaluate the significant differences between the population of the male to the female. Using the formula

$X^2 = \sum \frac{O-E}{E}$ …… 4

Where; χ^2 = Chi-square test, O = observed values and E = expected values

Proximate analysis

The proximate composition of the fish samples was done using the procedure of AOAC (1995). This method was used to evaluate the crude protein, ash, ether extract, crude fiber, and moisture content of the samples.

Statistical analysis

Data obtained were analyzed using a one-way analysis of variance test (ANOVA) and the Duncan multiple range test was used to separate the means value using the statistical analysis system package (SAS, 2005).

RESULTS

The total length of the species used in this study ranged from 12.1 cm - 43.4cm for *Raja miraletus*, 38.0 cm -86.5cm for *Dasyatis margarita*,33.5cm -85.3 cm for *Squalus megalops*,48 cm - 59.5cmfor Sphyrna couardi,64.5 cm -64.8 cm for *Rhinobatos albomaculatus* and the weight ranged from 50.0 -400.0 g for *Raja miraletus*, 85.0-876.0 g for *Dasyatis magarita*,100 .0g -3200.0g for *Squalus megalops*, 500.0g -1000.0 g for *Sphyrna couardi*, 900.0g -1000.0g for *Rhinobatos albomaculatu* as shown in Table 1.

Table 1: Morphometric Measurement of Five Cartilaginous Fish Species

Fish species	*Range of Weight (g)*	*Total length Range (cm)*	*Range of Standard length (cm)*	*Range of Disc length (cm)*
Raja miraletus	50- 400	12- 43.4	11- 45	6.0- 21.6
Dasyatis margarita	102 - 876	38- 86.5	35- 89-	13.5- 27.7
Sphyrna couardi	610- 1000	48- 59.5	47.5- 58	45- 62-
Squalus megalops	611- 1000	48- 59.5	32.4- 84.5	38- 70-
Rhinobatos albomaculatus	900- 1000	64.5- 64.8	60- 80	24.4- 24.7

Meanwhile, Figure 2 (a-e) show the length-weight relationship for male *Raja miraletus*, *Dasyatus margarita*, *Squalus megalops*, *Sphyrna couardi*, and *Rhinobatus albomaculutus* at R^2 of 0.31, 0.85, 1.00, 1.00, 1.00 and 1.00 respectively.

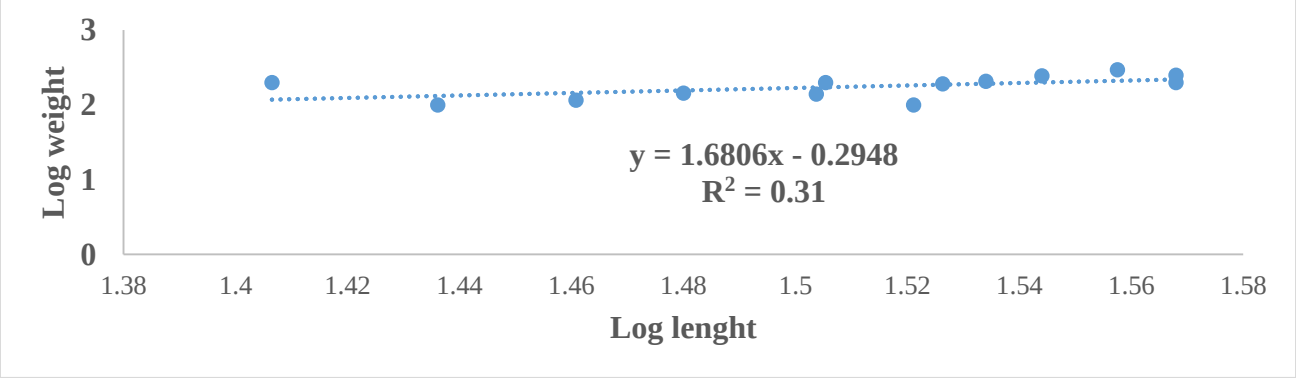

Fig 2a: Length – Weight Relationship for Raja miraletus (Male).

Fig 2 b: Length -Weight Relationship of Dasyatis margarita (Male).

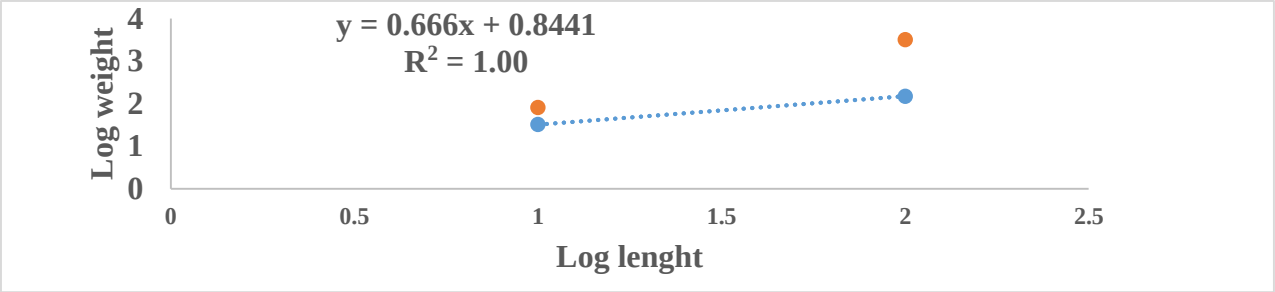

Fig 2 c: Length -Weight Relationship of Squalus megalops (Male).

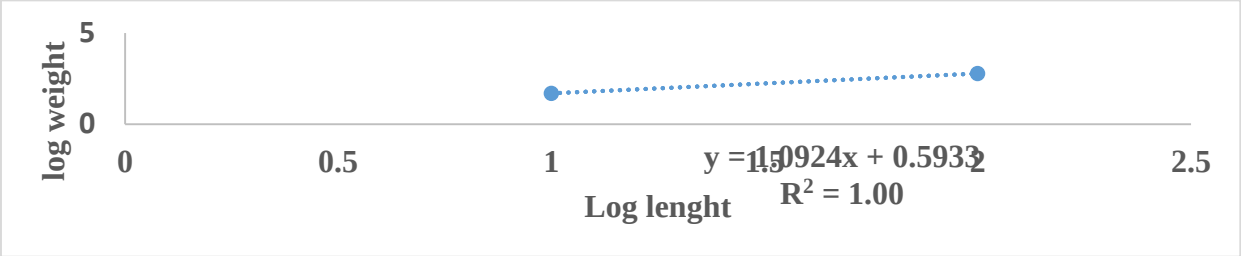

Fig 2 d: Length -weight relationship of Sphyrna couardi (Male)

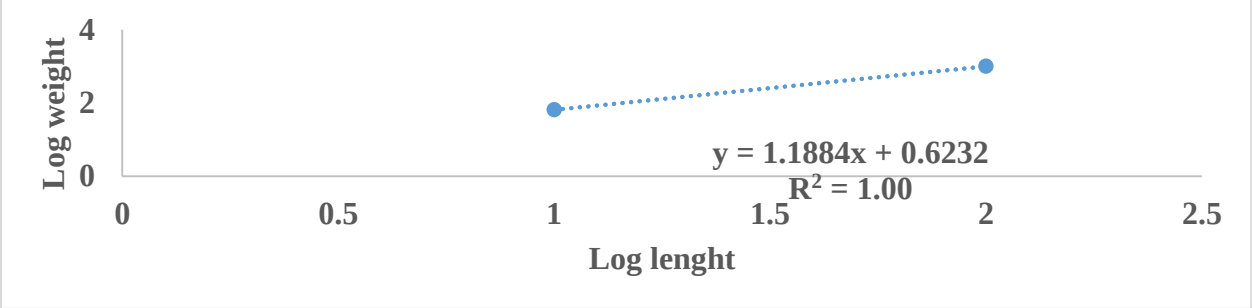

Fig 2 e: Length weight relationship of Rhinobatos albomaculatus (Male).

Figure 3 (a- e) show the length-weight relationship for female *Raja miraletus, Dasyatus margarita, Squalus megalops, Sphyrna couardi,* and *Rhinobatus albomaculutus* at R^2 of 0.48, 0.27, 1.00, 0.64, and 1.00 respectively.

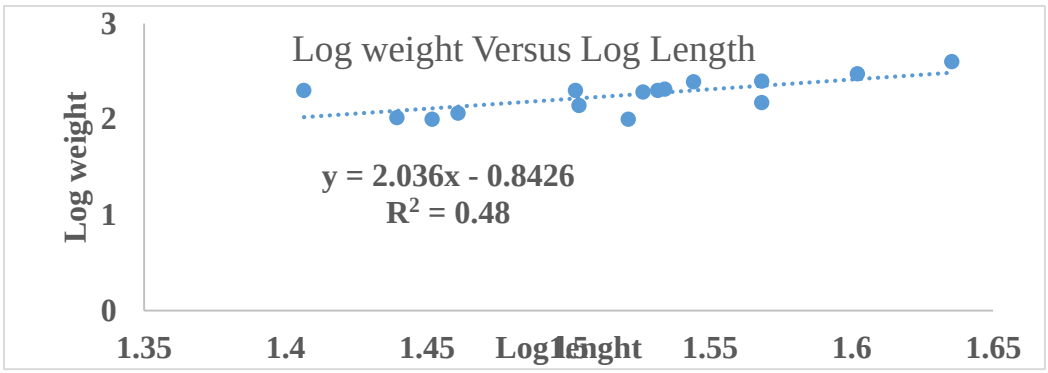

Fig 3 a : Length -Weight Relationship of Raja miraletus (female).

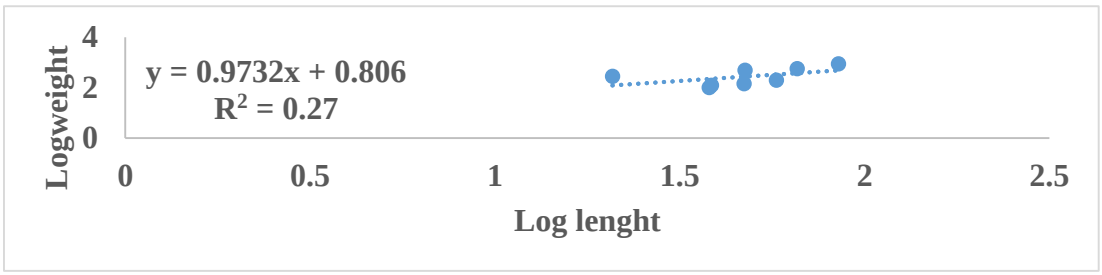

Fig. 3 b: Length -weight relationship of Dasyatis margarita (female) from Lagos lagoon and its coast

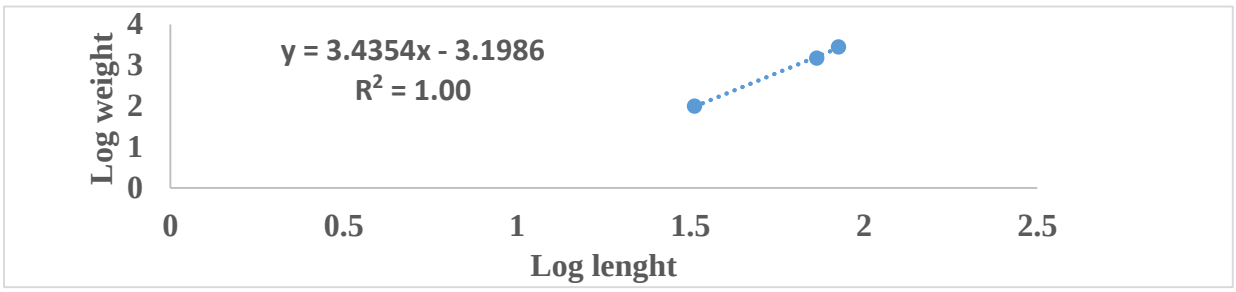

Fig. 3 c: Length -weight relationship of Squalus megalops (female) from Lagos lagoon and its coast

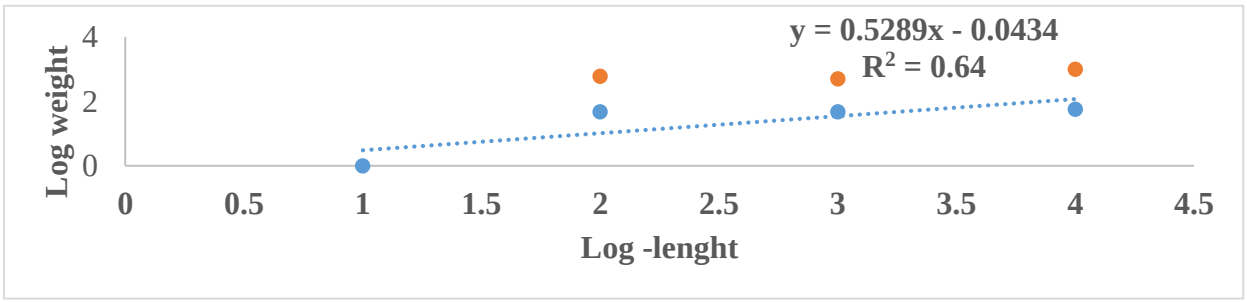

Fig. 3 d: Length -Weight Relationship of Sphyrna couardi (Female).

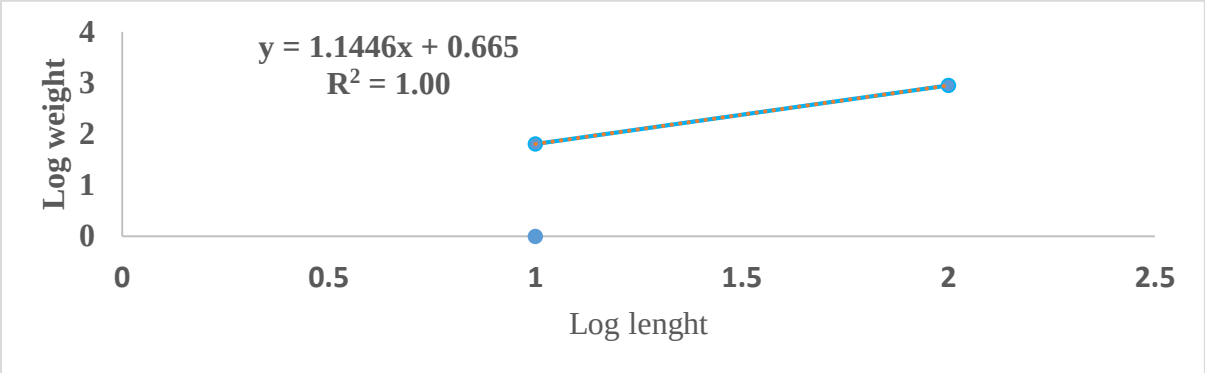

Fig. 3 e. Length -Weight Relationship of Rhinobatos albomaculatus (Female).

Figure 4 (a- e) show the length-weight relationship for Combined sexes for *Raja miraletus, Dasyatus margarita, Squalus megalops, Sphyrna couardi*, and *Rhinobatus albomaculutus* at R^2 of 0.68, 0.33, 0.98, 0.52 and 1.00 respectively. The condition factor which describes the wellness of the fish ranged from 0.46 -2.82 for combined sexes for *Raja miraletus*, 0.10 -0.19 for *Dasyatis margarita*,0.36 – 0.51 for *Squalus megalops*, 0.47 -0.49 for *Sphyrna couardi*,0.33 -0.37 for *Rhinobatos albomaculatus*. The regression plot value of these fishes revealed that the b values for both male and female *Raja miraletus* is 1.68 and 2.03 and for the combined sexes it is 1.63, for *Dasyatis magarita* , the male and female b values are 2.31 and 0.97 while the value for both sexes is 1.10. For *Squalus megalops*, the b value for male and female is 0.66 and 3.43, and for both sexes is 3.32, For *Sphyrna couardi* ,the b values for the male and female are 1.09 and 0.52 and for both sexes is 0.34. *Rhinobatos albomaculatus* b values for males and females are 1.88 and 1.14 respectively and for the combined sexes the b value is 1.14. The sex ratio for *Raja miraletus* (male /female) was 1: 1.16, for *Dasyatis magarita*, 1:1.28, for *Squalus megalops*, 1:1.5, *Sphyrna couardi* 1:3 and *Rhinobatos albomaculatus* 1:1 and the Chi-Square test revealed a non-significant difference (p.> 0.05)

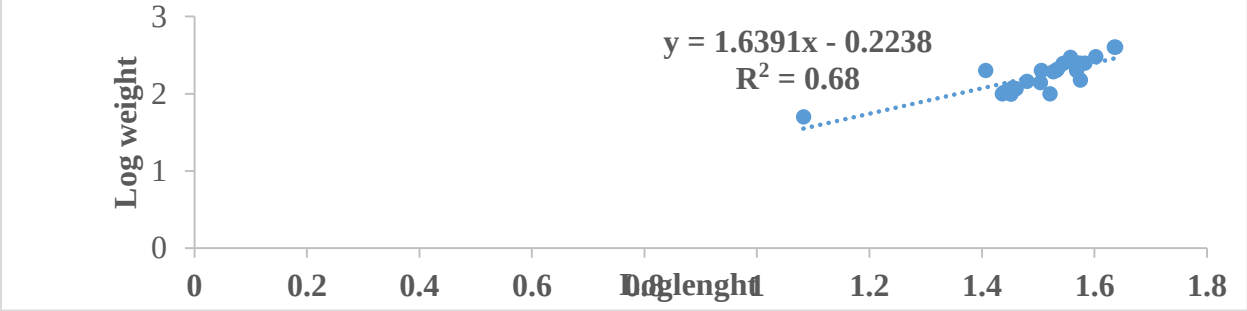

Fig. 4 a. Length – Weight Relationship of Raja miraletus (Combined Sexes).

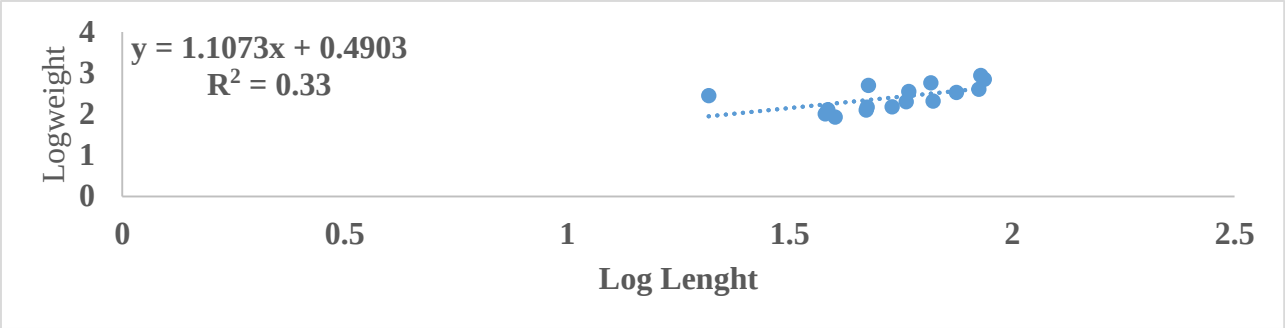

Fig. 4 b: Length – Weight Relationship of Dasyatis margarita (combined sexes).

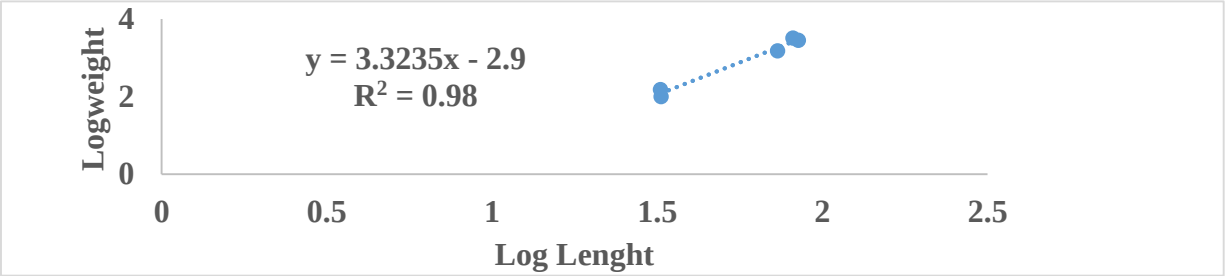

Fig. 4 c Length -Weight Relationship of Squalus megalops (Combined Sexes) from Lagos lagoon and its coast

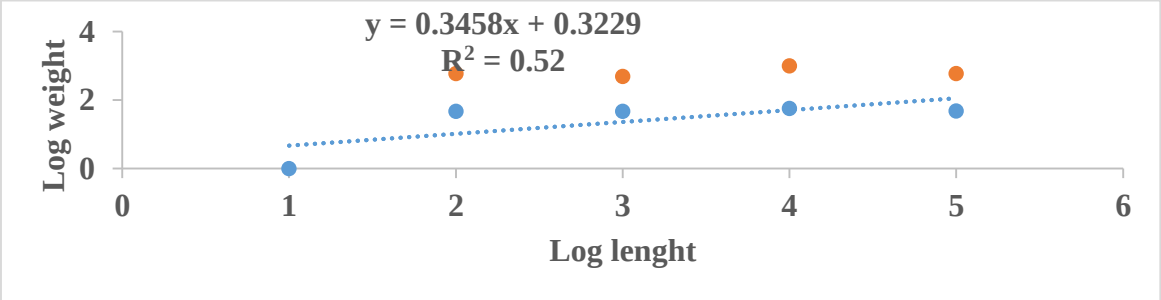

Fig. 4 d. Length -Weight Relationship of Sphyrna couardi (Combined Sexes).

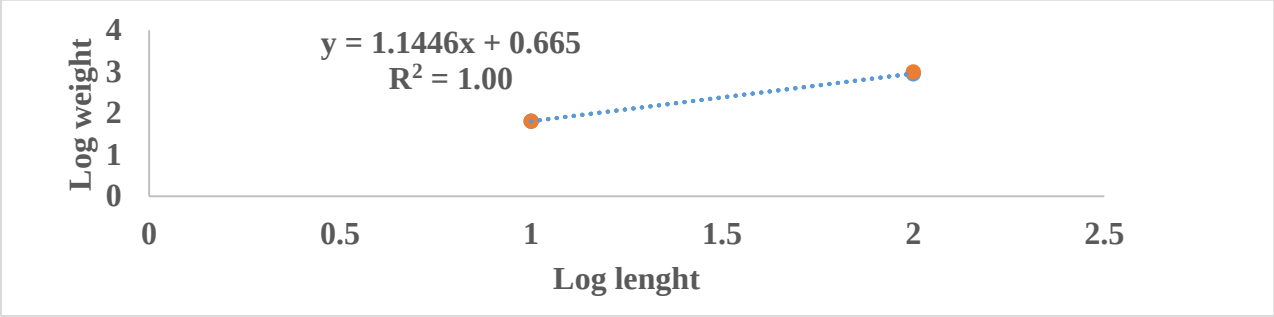

Fig. 4 e. Length Weight Relationship of Rhinobatos albomaculatus (Combined Sexes).

The proximate composition for the five cartilaginous fishes is given in Table 2. *Raja miraletus* had the highest protein content (25.85%) among the five cartilaginous fishes examined in this study while *Rhinobatos albomaculatus* had the least protein content (24.33%). *Squalus megalops* had the highest carbohydrate content (4.88%)

with *Rhinobatos albomaculatus* having the least carbohydrate content (3.92%). For ether extract *Sphyrna couardi* had the highest value of 3.08% with *Rhinobatos albomaculatus* having the least value of 1.45%. *Sphyrna couardi* had the highest ash content of 2.35% amongst the five fish species with *Raja miraletus* having the lowest value of 0.36%. The crude fiber content was highest in *Raja miraletus* (4.76%) while *Sphyrna couardi* had the least value of 1.78%. The highest moisture content was found in *Rhinobatos albomaculatus* (66.17%) and the least moisture content was found in *Raja miraletus* with a value of 61.94%.

Table 2. Proximate Composition of Five Cartilaginous Fishes

Fish Species	CHO	CP	EE	MOI	ASH	CF
Raja miraletus	4.75^{b}	25.85^{a}	2.34^{b}	61.94^{e}	0.36^{c}	4.76^{a}
Dasyatis magarita	4.19^{d}	25.13^{b}	1.69^{d}	64.36^{d}	1.17^{b}	4.10^{b}
Sphyrna couardi	4.64^{c}	25.13^{b}	3.08^{a}	63.06^{d}	2.35^{a}	1.78^{d}
Squalus megalops	4.88^{a}	24.33^{d}	1.75^{c}	64.75^{b}	1.56^{b}	2.71^{c}
Rhinobatos albomaculatus	3.92^{e}	24.83^{e}	1.45^{e}	66.17^{a}	1.29^{b}	2.34^{cd}
SEM	0.10	0.13	0.16	0.39	0.19	039

Means on the same column with different superscripts are significantly different (p< 0.05) from each other. SEM – Standard error of means, CHO- carbohydrate, CP -crude protein, EE-ether extract, MOI- moisture, CF- crude fibre.

DISCUSSION

The b values in the length-weight relationship for the fishes examined in this study reveal that Raja miraletus, Dasyatis margarita, Sphyrna couardi, and *Rhinobatos albomaculatus* male and female exhibited negative allometric growth and combined sexes also revealed negative allometric growth pattern while Squalus megalops male showed negative allomeric growth, the female exhibited positive allometric growth and the combined sexes showed positive allometric growth pattern. The differences seen in the b values obtained for these fishes could be a result of many factors like the area and season in which fish samples are collected, number of fish samples examined, habitat, extent of gut fullness, maturity of the gonads, fish condition as well as differences in the length of the fish specimens caught (Sani et al 2010). The sex ratio of the fishes used in this study shows no significant difference between the male and the female fish species at p>0.05. This is similar to the sex ratio obtained by Oliveira et al (2012) for five marine fishes from Brazil.

Fishes are normally grouped as lean (< 5 percent), moderately fat (5 -10 percent), and fat (> 10 percent) depending on their fat content (Kari, et al, 2022), and the standard proximate composition of fish protein is between 15-23% on wet basis. The cartilaginous fishes examined in this study belong to the high protein (24-26%) – low-fat category (<5%) and can be classified as lean fish. Emmanuel, et al (2011), reported that *Clarias gariepinus* and Tarpon atlanticus belonged to the high protein -low-fat category which is in line with the protein–fat content range of the fishes used in this study. Their high protein content may be due to the high protein content in the fish's diet The carbohydrate content in this study was found to be less than 5% and is in agreement with the carbohydrate values (1.48-4.54%) which is less than 5% obtained by Babalola et al, (2011) for five commercial fish species (*Trachurus trachurus, Sardinella aurita, Micropoonias furniereri, Scomber scombrus, Clarias gariepinus*) in Nigeria. Moisture content values of fishes obtained in this study (61.93- 66.17%) were lower than the values obtained by Olagunju, et al (2012) which (65- 74.9%) on the nutrient composition of Tilapia zilli,

Hemisynodontis membranacea,
Clupea herengus and Scomber scombrus. The observed range of ash content (0.36-2.35%) is higher than the ones obtained by Olagunju, et al (2012). This indicates that these fish species are good sources of mineral content.

CONCLUSION

The findings in this study revealed negative allometric growth for these cartilaginous fishes and these can be a result of some factors that affect length-weight relationships. The proximate composition revealed high protein, low-fat content, and a good source of ash content in these fishes and they can be recommended as a rich source of nutrients in the human diet. These fish species can be used in human diets to avoid excessive consumption of saturated fats and help prevent protein deficiencies.

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