Length-Weight Relationships and Food Preference of Two Coastal Marine Fishes, *Galeoides decadactylus* (Polynemidae) and *Sphyraena sphyraena* (Sphyraenidae) off Cape Coast, Ghana

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Abstract

The food and feeding habits of most commercially important marine fish species in Ghana had not been studied. The aim of the paper was to study the diet spectrum of two coastal fishes of Ghana; *Galeoides decadactylus* (Polynemidae) Bloch, 1795 and *Sphyraena sphyraena* (Sphyraenidae) Linnaeus, 1758, both of tropical fish species. Fish samples were obtained in 2011 from sandy beaches near Cape Coast township in the Central Region of Ghana, noted for beach seining. Length-weight measurements were taken from well-preserved fish specimens from which stomachs were extracted for the analysis of the food contents, using frequency of occurrence, numerical and gravimetric methods, as well as index of relative importance. The length-frequency analysis showed a size distribution with a modal size of 11.0–13.9 cm for both species. The length-weight relationships for both fish species showed strong correlation between the weight and length with correlation coefficient (r^2) and exponent *b* for *Galeoides decadactylus* as 0.9869 and 2.9893, and that for *Sphyraena sphyraena* as 0.9861 and 2.9094, respectively. Juvenile shrimp and fish fry formed the bulk of the food items in the stomachs of the two fish species. Juvenile shrimps occurred in 77.18% of the stomachs observed for *G. decadactylus* and accounted for 80.20% of the total number of the food items whilst comprising 63.14% of the weight of food consumed. That of *S. sphyraena* was, respectively, 66.7% by frequency, 87.0% by numbers and 96.3% by weight. Juvenile shrimp had the highest IRI in the diet of *G. decadactylus* whereas in *S. sphyraena* fish fry recorded the highest IRI. Literature evidence showed that the diet spectrum and aspects of growth of the two fish species reported elsewhere in the tropics were comparable to that off the coast of Cape Coast despite the differences in geographical location. The findings in this study will contribute to the knowledge gap on the diet of most commercially important fish species in Ghanaian waters.

Introduction

Galeoides decadactylus (Polynemidae) and *Sphyraena sphyraena* (Sphyraenidae) are both tropical and subtropical fish species (Nelson, 2006) found in the Atlantic, Pacific and Indian Oceans. In West Africa, the distribution of the species is from Morocco to Angola. They are also found in Algeria and Namibia (Motomura, 2004).

The common practice in studying fish feeding habitat is to determine the diet of the fish species by an analysis of stomach contents. Stomach content analyses, using the various methods such as frequency of occurrence, numerical, volumetric and gravimetric methods, were highlighted by Hyslop (1980). Longhurst (1957) made a detailed survey of the food and feeding habits of the fish species in Sierra Leone estuarine waters. Blay (1996) reported on an experimental work on the feeding biology of *Porogobius schlegelii* in Fosu lagoon, where

percentage frequency of occurrence method was employed to determined composition of various food contents such as copepods, ostracods, fish scales and fish fry. Again, according to Blay *et al*. (2006), juveniles of *Pseudotolithus senegalensis* and *Brachydeuterus auritus* off Cape Coast, Ghana, were stenophagous and resource partitioning was suggested between the two species.

Aggrey-Fynn & Obodai (2009) studied the diet analysis of two sympatric species of *Balistes* in the western Gulf of Guinea, where again stomach contents of the two species suggested that there was a habitat overlap. Also, Okyere *et al*. (2011) studied the food habits of a number of wetland fishes linked to the Kakum estuary which is connected to Cape Coast waters, and the food spectrum showed overlaps in grey mullets species and *Porogobius schlegelii*. In coastal waters of Ghana, only a handful of marine fish species of economic importance had been studied to understand their food and feeding habits. Therefore, the aim of this paper is to enhance the knowledge on the diet spectrum of some coastal fishes of Ghana.

Materials and methods

Study area

The study area is a sandy beach which is located about 1 km west of Cape Coast relic township in the Central Region of Ghana (approximately 5°6' N, 1°16' W) (Fig. 1). It is an historic town noted for artisanal fishery. The site is selected primarily due to

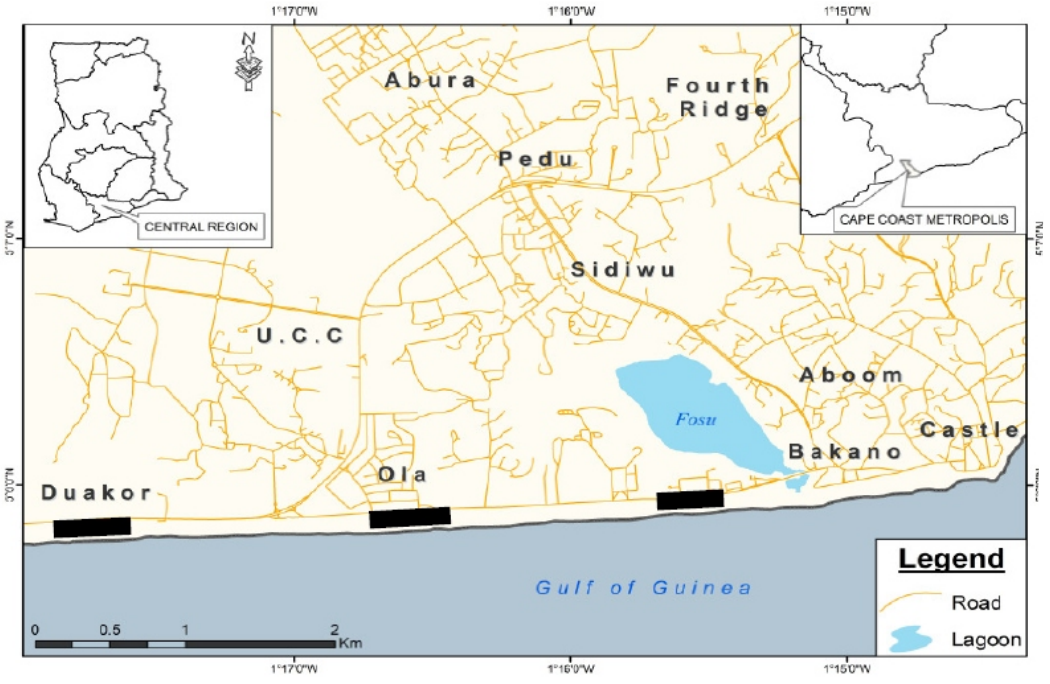

Fig. 1. Map of study area showing the beaches (black thick blocks) in Cape Coast where fish samples from beach seine were taken

predominance of beach seine operations in the area. The fish species that are landed in the area include juveniles of various small and large pelagics and demersals that are common in the Gulf of Guinea (Mensah & Quaatey, 2002; Mehl *et al*., 2004, 2005; Nunoo *et al*., 2007; Aggrey-Fynn & Sackey-Mensah, 2012). The study was conducted in 2011 covering part of the wet and dry seasons.

Fish samples were obtained fresh from beach seining and preserved in 10% formaldehyde solution for analysis. The length and weight measurements were taken to the nearest 0.1 cm and 0.01 g, respectively. Length-frequency distribution and length-weight relationships with the R^2 and *b* values of the two species were obtained using statistica package. The stomachs of the specimen were then preserved and labeled appropriately for the analysis of the contents by frequency of occurrence, numerical and gravimetric methods after Hyslop (1980). The food items were identified as far as possible, to the family level, using identification manuals by Newell & Newell, 1977; Ruppert & Barnes, 1994 and Gibbons, 2000. The index of relative importance (IRI) which incorporates percentage by number (N), gravimetric (G) and frequency of occurrence (F) was calculated as follows:

IRI = (%N + %G) ´ %F (Hyslop, 1980) .... (1)

Results

A total of 101 and 75 specimens of *Galeoides decadactylus* and *Sphyraena sphyraena* were examined, respectively. The samples of the two fish species were grouped into seven classes with a class range of 2.9 cm for both species. The size range for *G. decadactylus* was 5.3–24.4 cm whereas that of *S. sphyraena* was 7.2–26.1 cm. Both species showed a uni-modal size distribution of 11.0–13.9 cm (Fig. 2 and 3).

Fig. 4 and 5 show the total length-weight relationships of *G.decadactylus* as:

$W = 0.011\ L^{2.9802}$ ..... (2)

whilst that of *S. sphyraena* as:

$W = 0.0067\ L^{2.9094}$ ..... (3)

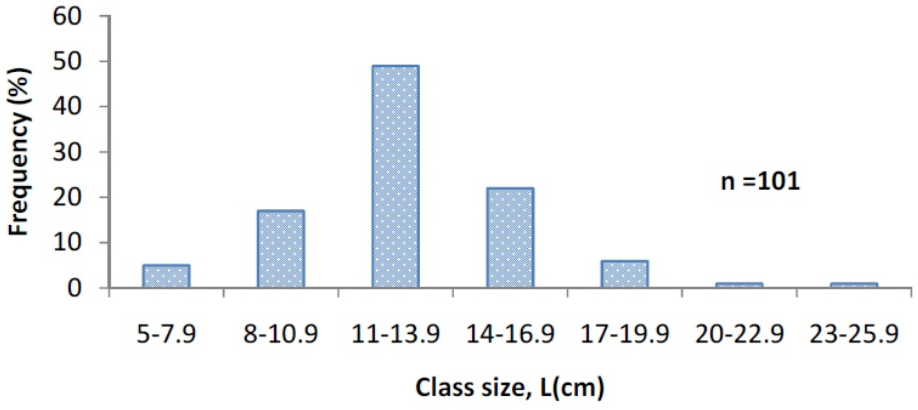

Fig. 2. Length-frequency distribution of *G. decadactylus* obtained from Cape Coast coastal waters

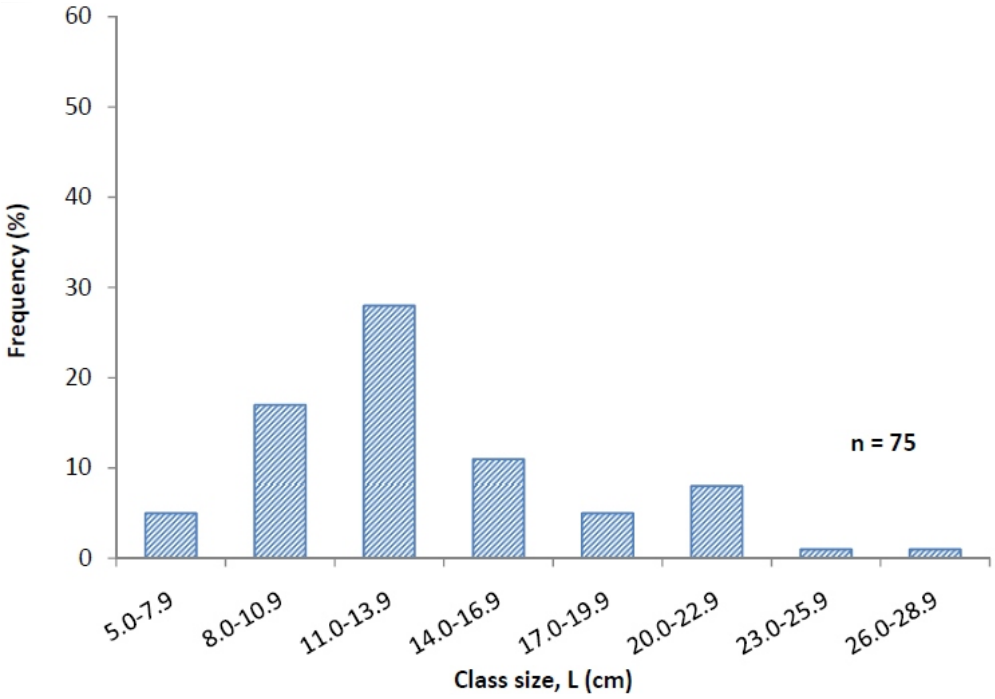

Fig. 3. Length-frequency distribution of *S. sphyraena* obtained from Cape Coast coastal waters

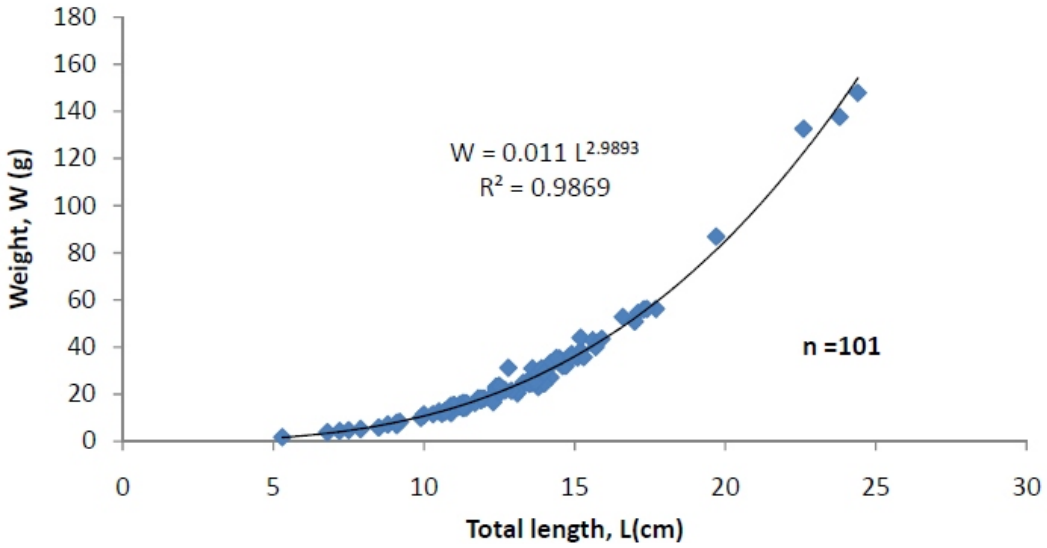

Fig. 4. Length-weigth relationship of *G. decadactylus* obtained from Cape Coast coastal waters

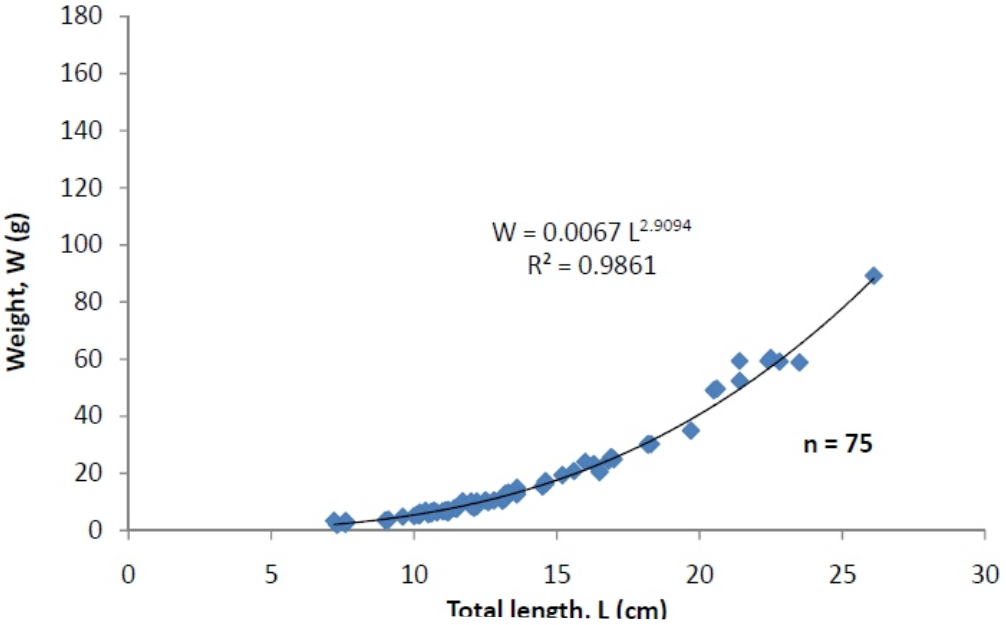

Fig. 5. Length-weight relationship of *S. sphyraena* obtained from Cape Coast coastal waters

respectively, where W denotes body weight of fish and L denotes total length of fish. The graphs show strong correlation between the weight and length of both fish species as R^2 was 0.9869 and 0.9861 for *G. decadactylus* and *S. sphyraena,* respectively. The exponent *b* for *G. decadactylus* and *S. sphyraena* is 2.9893 and 2.9094, respectively (Fig. 4 and 5), showing that weight increases positively with an increasing length.

The stomach contents of the two species composed mainly of juvenile shrimp and fish fry with *G. decadactylus* additionally feeding on squid (cephalopod) and worm. Sand particles were also found in the stomachs of the two fish species (Fig. 6 and 7). Some of the food items were found to be partly digested, which was quite difficult to identify in some stomachs of *G. decadactylus* (Fig. 6). The percentage frequency of occurrence, numerical and gravimetric of each food item found in the stomachs of the two fish species are shown in Fig. 6 and 7.

The main food item of *G. decadactylus* was juvenile shrimp, which occurred in 77.18% of the stomachs observed and accounted for 80.20% of the total number of the food items whilst comprising 63.14% of the weight of food consumed. The *S. sphyraena* also fed mainly on fish fry which occurred in 66.7% of the stomachs observed and accounted for 87.0% of the total number of food items while comprising 96.3% of the weight of food consumed.

The index of relative importance (IRI) of the various food items in the stomach of *G. decadactylus* and *S. sphyraena* are shown in

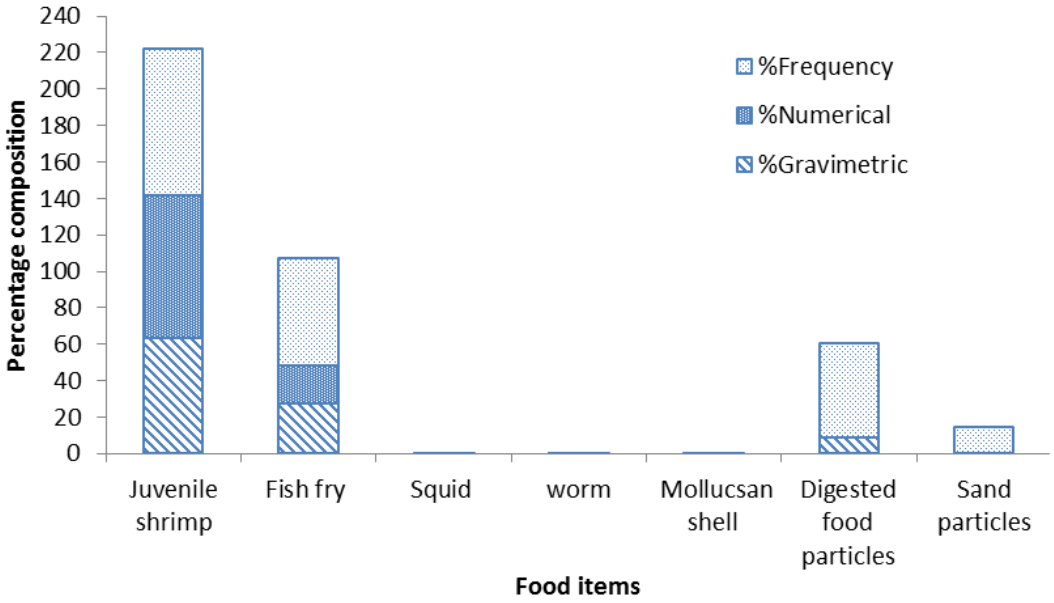

Fig. 6. Percentage frequency of occurrence, numerical and gravimetric compositions of food items in the stomach of *G. decadactylus* in coastal waters of Cape Coast

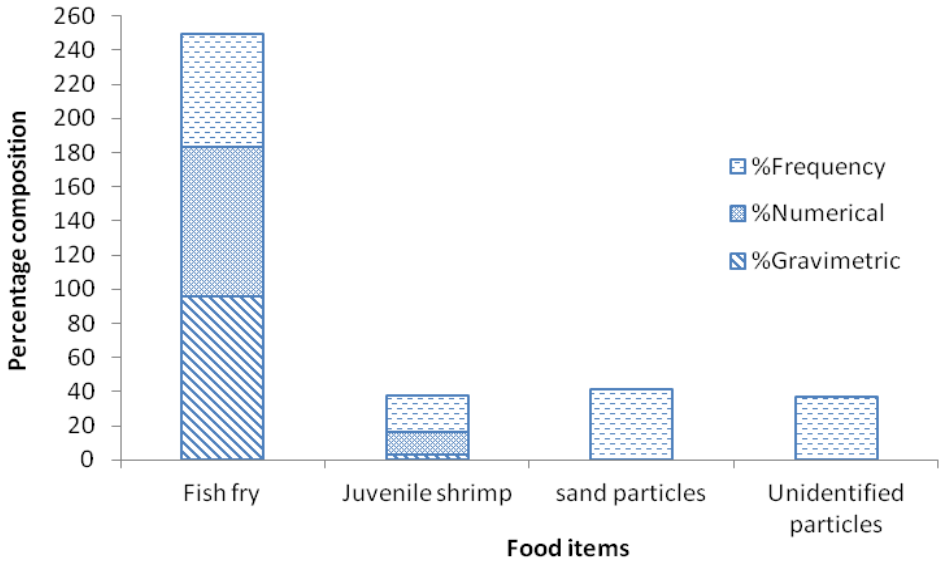

Fig. 7. Percentage frequency of occurrence, numerical and gravimetric compositions of food items in the stomach of *S. sphyraena* in coastal waters of Cape Coast

Table 1. Juvenile shrimp had the highest IRI in the diet of *G. decadactylus* whereas in *S. sphyraena* fish fry recorded the highest IRI. Juvenile shrimp and fish fry form the bulk of the food of the fishes.

TABLE 1

Index of relative importance of food items in the stomach of G. decadatylus and S. sphyraena in coastal waters of Cape Coast

Food item	*Index of relative importance, IRI*	
	G. decadactylus	*S. sphyraena*
Juvenile shrimp	11372.36	519.36
Fish fry	2827.53	15545.36
Squid	0.51	
Molluscan shell	0.24	
Worm	0.0495	

Discussion

Dietary analysis of an organism using stomach content analysis is more accurate if the sample size is large (Hyslop, 1980). Sample sizes for both species were relatively small and this could be attributed to the fact that the species had low occurrence in the beach seine landings at the time of sampling. However, the analysis of the stomach content showed that the main food item of the two fish species, *G. decadactylus* and *S. sphyraena,* are shrimps and fish fry, respectively, and this was supported by the highest index of relative importance, IRI value each of the food item attained in the diet of the two fish species. These food items are very important in the diet of the two species as they form the bulk of their food resources. The stomach content results (Table 1) suggest that each fish species has specialised in feeding more on one particular food item in the same habitat. There is, therefore, an indication of a possible ecological segregation in the food resources of *G. decadactylus* and *S. sphyraena*, as such competition among the species is reduced (Emmanuel *et al.*, 2010).

In addition, *S. sphyraena* from this study fed on a narrow range of food items (Fig. 7), hence, it can be referred to as stenophagous fish species, whereas *G. decadactylus* appeared to have a wider food spectrum, and, therefore, can be referred to as euryphagous. However, aside juvenile shrimp and fish fry, which had a very high IRI in *G. decadactylus*, the IRI of the rest of the food items (such as squid, worm and molluscan shell) were so small, suggesting their presence were not so important in the diet of the species. It might have happened that these items were impulsively ingested because their presence in the food items were again reported by Longhurst (1957). The smaller sample size used in this study could also have accounted for the smaller IRI recorded for those food items in *G. decadactylus*. Occurrence of sand in the diet of the two coastal fishes might connote the shallowness of their habitat even though *G. decadactylus* is demersal and bottom feeder (Holden & Reed, 1991). Again, the fishes might have, however, ingested the sand whilst being hauled ashore.

Emmanuel *et al.* (2010) showed that *G. decadactylus* found off Nigerian coast feeds on a variety of crustaceans and molluscs. This study, on the contrary, found only one food item in the diet of *G. decadactylus* to belong to the class Crustacea. All the other groups mentioned by Emmanuel *et al.* (2010), which constitute the food items in the stomach of *G. decadactylus* fully correspond

to that found in this study. The report from Longhurst (1957) shows that *G. decadactylus* has a wider range of food items relative to the findings in this study. This will probably be due to different study areas and what was available for the fish species to feed on since it is an opportunistic feeder (Onyia, 1973). Earlier works by Sinha (1987), Carpenter & Nkem (2001), Barreinros *et al.* (2002), Porter & Motta (2004) and Hosseini *et al.* (2009) confirm that *S. sphyraena* feeds mainly on fish. Sinha (1987) reported that *S. sphyraena* is a fish eater, which uses its sharp visual power and strong olfactory senses to find its prey. Barreinros *et al.* (2002) discussed the feeding habit of *S. sphyraena* in Azores Island and found that the diet constituted 82.2% of Blue Jack mackerel, *Trachurus picturatus.* Hosseini *et al.* (2009) also found the main food of *S. sphyraena* in Bushehr Province waters to be two types of fishes, *Liza subviridis* and *Tenualoza illisia.* A comparative study done by Bachok *et al*. (2004) on the diet composition and feeding habit of demersal fishes in Terengganu in the West Coast of Peninsular suggests that members of the genus *Sphyraena* are fish eaters.

Majority of sizes that occurred in the samples ranged from 11.0 to 13.9 cm (TL) for both *G. decadactylus* and *S. sphyraena*. Comparing the recorded size range to the size at first maturity of the fishes as 21.0–28.3 cm (TL) for *G. decadactylus* (Emmanuel *et al.,* 2010) and 26 cm for *S. sphyraena* (Chemmam-Abdelkader & Ezzeddine, 2011), it is obvious that most of the fishes that are landed at the study site are juveniles, and this calls for management plans as this may affect recruitment of adult to the fish stock and possibly future collapse of the fishery. In the report of Emmanuel *et al.* (2010) on *G. decadactylus,* the sizes that dominated ranged from 12.5–20.1 cm (TL) which differs from that in this study. In his report, most of the specimens were adults and this might imply that recruitment of fish cohorts is enhanced. The length-weight relationships of *G. decadactylus* and *S. sphyraena* were a curvilinear, described by the power equations, $W = 0.011L^{2.9893}$ and $W = 0.0067L^{2.9094}$, respectively (Fig. 4 and 5).

There is high correlation between length and weight of both fish species with R^2 value of 0.9869 for *G. decadactylus* and 0.9861 for *S. sphyraena.* This implies that weight increases with increasing size of the fish. Both species had exponents (*b*), which were statistically significant to 3.0 which showed possible isometric growth in the fish species. Studies done off the coast of Nigeria by Emmanuel *et al.* (2010) reported a *b* value of 2.7962 for *G. decadactylus*. The difference in *b* values might be related to different geographical areas with different environmental conditions. Thus, the diet spectrum and aspects of growth of the two fish species off Cape Coast in Ghana are comparable to the studies done elsewhere in the tropics on the same species. The findings in this study will contribute to the knowledge gap on the diet studies of most commercially important fish species in Ghanaian waters, hence, in the Gulf of Guinea.

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