University of Benghazi, Faculty of Science,
Zoology Department

Some biological aspects of the invasive fish *Fistularia commersonii*(Ruppell 1838) population in the coast off Benghazi, Libya

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DEDECATION

This thesis is dedicated to:

My family for her support to me during my study…………

Greating to my mother who without her I can not achievable any thing in my life………….

Everyone help me in my research………..

ACKNOWLEDGMENT

In the beginning, my great appreciation to Allah for his blessing and his help to complete this study.

This research would not have been achievable without the support of numerous people. Many thanks to my supervisor Dr. Houssein Elbaraasi who proposed this research to me and without his timeless effort, patience and help this thesis would not be complete.

I would like to thank saad Alyamani who collect the samples for this study my, also I thank my family for their support.

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1. INTRODUCTION

Although the Suez Canal was constructed to provide an easier trade route for Europeans to India and the Far East, it actually initiated an ecological disturbance between two entirely different bodies of water; the Red Sea and the Mediterranean. From that time on various marine species were introduced into the Mediterranean Sea, this introduction was termed Lessepsian migration after the engineer Ferdinand de Lesseps (Por 1978, 1990).

at least 24 species of fishes have passed from the red sea to Mediterranean sea since the suez canal was opened in 1869 records of another 26 species collected in the Mediterranean and alleged to be of Red sea origin are shown to be based on misidentification or probable errors in determining the source of material.

There are no reliable records of Mediterranean species penetrating into the reds sea. Nearly all of the 24 species are confined to shallow coastal waters and have migrated mostly northward along the Asiatic coast. One is known from the Mediterranean coast Egypt only, nine are not recorded farther north than Israel, 13 are known as far as the Anatolian coast of Turkey, and seven have reached the Aegean sea. The extremes in westward migration so far recorded are parexocoetus mento from the Gulf of sidra and leiognathus klunzingeri from the neighborhood of lampedusa(Ben-Tuvia 1966).

Several red sea species were observed in the Mediterranean for first time within the last 10 years. The decrease in salinity of the Bitter lakes, which are part of the suez canal, may have facilitated recent immigration.

While red sea species constitue only 9% of the fish fauna of the Mediterranean coast of Isreal, their ecological importance is fairly great since 18 species are among the more common in this are, and nine are commercially exploited(Ben-Tuvia 1966).

The bluespotted cornet fish, *Fistularia commersonii* (Ruppell, 1862), is an excellent example of the fish species participating in the migration process from the Red Sea. The first report of *Fistularia commersonii* was in 2000, off the coast of Israel (Golani 2000). Since this first report, *Fistularia commersonii* has become a relatively common fish in Mediterranean Sea.

Fistularia commersonii is abenthopelag species with tropical and sub-tropical distribution (Froese and Pauly 2010). It lives either solitary or in schools (Fischer and Bianchi 1984, Nakamura *et al*. 2003, Karachle *et al*. 2004, Froese and Pauly 2007). It occurs in many different habitats, ranging from rocky bottoms and reef to muddy and sandy ones to seagrass meadows to mixed environments (Bilecenoglu *et al*. 2002, Corsini *et al*. 2002, Azzurro *et al*. 2004, Pais *et al*. 2007, Garibaldi and Orsi-Relini 2008, Kara and Oudjane 2009, Psomadakis *et al*. 2009).

Reproductive season of *Fistularia commersonii* in the Mediterranean spanned at least six months, from May to October. The reproduction of *Fistularia commersonii* in its exotic environment is characterized by a prolonged reproductive season, a multiple spawning pattern, and good condition during reproduction. (Golani *et al*. 2007, Bariche *et al*. 2013).

In the Mediterranean the diet composition of *Fistularia commersonii* has rarely been studied. The bluespotted cornet fish as primarily piscivorous but supplements its diet with squids and shrimps (Golani 2000). It is carnivorous, seeking food over reefs and seagrass beds, as well as benthic fish and occasionally shrimps (Corsini *et al*. 2002). It feeds on bottom living, water column dwelling local fishes such as *Atherina* sp. and native populations of economic importance mainly S*picara smaris* and M*ullus surmulentus* (Corsini *et al*. 2002). It also feeds predominantly on fish and other foods with several kinds of crustaceans. The prey families identified are grouped as either pelagic fish or bottom-dwelling reef fish. Some of the families are the same as those identified in the Mediterranean e.g: Gobiidae, Clupeidae, Mullidae. (Takeuchi *et al*. 2001).

The *Fistularia commersonii* is ventrally flattened and it has a long whip-like tail filament, being green dorsally and grading to silvery white ventrally, with two blue stripes or rows of blue spots on the back. It reaches a maximum length of 160 cm and maximum weight of 4kg, with the most frequent length being that 100cm. the body is extremely elongated, the head (consisting of a long, tubular snout) constitutes more than one-third of the total body length, ending in small mouth. Dorsal and anal fins are posterior in position, opposite to each other. The caudal fin is forked, with two very elongated and filament middle rays. The skin is smooth, without bony plates along the midline of the back. (Deidun and Germana 2011).

1.1 OBJECTIVES:

The goal of the this study is to provide essential information on population structure of *Fistularia commersonii* in the Libyan coast off Benghazi during an one year of research, However, The specific objectives of this study are to:

1. Determine the sex ratios for the species in the Libyan coast (southern Mediterranean),
2. Show general descriptive statistics and the status of this species during one year of study,
3. Explain the length-frequencies distribution,
4. Calculate the weight-length relationships
5. Give basic information about its reproductive seasons in Libyan coast, and
6. Investigate its monthly variation in food composition.

2. LITERATURE REVIEW

2.1. Biological invasions:

The Mediterranean sea is a semi-enclosed, deep (average depth 1.45km, max. Depth 5.5km), oligotrophic, concentration basin with high density water production. It communicates the west with the Atlantic ocean, the Northeast with the Black sea and the southeast with the Red sea. It is composed by two major interacting sub-basins, the western and eastern Mediterranean. The Mediterranean region is a climate transition area, tightly related to the global climate variability. Within the last two decades, more and more scientific evidences are indicating that environmental changes are occurring at all scales with profound impacts on among others Mediterranean basins and coasts. Because the European climate (including the Mediterranean) is under the influence of both subtopic and arctic regimes, the evolution of physical parameters (i.e temperature, salinity) in response to global warming is adjusting to the regional climate and circulation (EastMed 2010).

Today, the 82% of alien biota introduced into the eastern Mediterranean, are of Indo- Pacific origin, mainly of Indian Ocean and Red Sea derivation, because this basin is close to the Red Sea and connected to it via the Suez Canal, while the Atlantic influx is limited due to great distance of the main way of connection. Furthermore, all means of transport enable alien species to reach new habitats where they may become invasive (Corsini-Foka 2010).

Waterways and Shipping: for several centuries, humans have connected river systems by canals and cut land bridges to enable shorter shipping routes. Today, particularly Europe has a well-developed waterway system. This interconnection offer to organisms unique opportunities to cross biogeographically borders by reaching the next drainage system, sea or ocean. The Suez Canal enables hundreds of species to migrate from one sea to the other. Shipping offers unique opportunities for hitchhikers and stowaways to be transported and distributed globally. As cargo, ships used soil and stones as ballast. in combination with the soil and dirt in the ship itself, and the possibilities which cargo and containers offer in general foe stowaways, maritime transport enable many species to reach far-distant coasts (Por 1978, Gallil 2000).

As hull fouling, the planktonic larvae of many sessile species regularly colonize the hull of ships and boats. This hull fouling of ships is characterized by crustaceans and bivalves, and may involve more than 100 species.

As in ballast water, this ballast water and its sediment load transport thousands of marine species from uptake to discharge points. This includes virtually any species of plankton or higher organisms, including their planktonic larvae(Gollash 2002).

Biological invasions in marine habitats represent a recognized worldwide threat to the integrity of native communities, to economy and even to human health. Invasive species are believed to accelerate the decline of native populations already under environmental stress, leading to population losses and extinctions on a local scale(Ricciardi 2004) , but not globally (Gurevitch and Padilla 2004). The extent of the impact has been so severe that invasive species are regarded as the second biggest cause of biodiversity loss after habitat destruction (Breithaupt 2003). Constituting one of the four greatest threats to the world`s oceans on local, regional and global scales (Imo 2000-2004).

Invasive species have an impact on, 1. Biodiversity by impacting on native species ecosystems either directly (affecting hydrology, nutrient cycling, and other processes, mainly by the so-called ecosystem, engineers), or indirectly by changing the whole ecosystem structure and functioning (introduced species often consume or prey on native ones, overgrow them, compete with them, attack them, or hybridise with them). 2. Socioeconomics, new incursions of marine alien species continue and some existing species are extending their range. By doing so, they can be detrimentally affect the socioeconomic values of an area by impacting on fisheries and aquaculture, health and sanitation, and infrastructure and building (Streftaris 2006).

2.2. Lessepsian migration"abiogeographic phenomenon:

Francis Dov Por first used the term "lessespian Migration" in 1969when describing the unidirectional migration of species of the Red Sea to the Mediterranean via the Suez Canal, as a uniquely evident phenomenon in modern biogeography. The phenomenon does not represent the direction of species movement from one aquatic province to the other alone, but also refers to the "successful" biotic advance from the Red Sea to the Eastern Mediterranean . The word migration in this context strictly refers to the passing of Red Sea species through the Suez Canal and their successful settling in the Eastern Mediterranean only. Lastly "Lessepsian Migration" may also represent a reference in time when the Eastern Mediterranean had entered into a new phase with the opening of the Suez Canal" in 1869 (Por 1978).

In general there are several causes that have determined the successful settling of Lessepsian migrants in the Mediterranean Sea. First, is the fact that the Mediterranean Sea is relatively low in species diversity in comparison to the extremely competitive conditions found in the Red Sea (Por, 1978). For this many of the ecological niches are partially or not filled at all, making competition quite an easy task (Por1978). The second reason is related to the tropical water temperatures, which demonstrates habitat suitability (Boudouresque1999). Thirdly the fact that the fish has reached the Mediterranean is an indication of the species pre-adaptation to harsher habitat conditions. finally canal might cause a mixing great zoogeographic importance, also the direction of flow of water takes place from Red Sea northwards, since the mean sea level is 30-40cm higher than at the Mediterranean canal outlet for most of the year (Boubouresque 1999).

These factors are important but not enough to understand why some species are successful or more successful than others. Observations of many taxa have shown that some species a high tendency to disperse and colonize areas while other closely related species with similar ecological requirements do not. These observations are defined by number of fish families with several species of which only a few have established populations in the Mediterranean (Goren and Dor, 1994).

In studying the immigration of fishes through the Suez Canal, three zoo-ecological areas must be taken into consideration: 1. The northern red sea, 2. The eastern Mediterranean, 3. The Suez Canal itself in which many marine animals from the two neighboring areas have found a permanent habitat (Steinitz 1968). The prevailing hydrographic conditions differ in these three areas, although the salinities and summer temperatures are to some extent similar (Morcos1967, 1970, El-saby 1968, Oren1970, Oren and Hornung1972). Temperature and salinity are the main a biotic factors influencing the distribution of organisms over large zoogeographical areas. Often they also have a decisive influence on the ecological distribution of species in various biotopes of an area.

The process of immigration is highly selective, common species of the home seas are not necessarily successful immigrants in a new region, similar effects have been shown to occur in many forms of colonization (Mac Arthur and Wilson

1967). The adaptation of a species to a new area requires adjustment of its reproductive processes, especially with regard to the correct timing of spawning in order to ensure suitable physical and ecological conditions for the development and survival of the young stages. It is evident that the direction of immigration is mainly from the red sea into the Mediterranean (Steinitz 1968).

Thirty-six red sea or cosmopolitan species can be regarded as Suez Canal immigration. Twelve of them were found within the last 12year. Evidently immigration is a continuous process, and over time the probability of suitable species of fishes entering the Suez Canal and colonizing the new region increases. Time also plays an essential role in the biological processes of adaptation of the species to the modified conditions of life. More resistant species, endowed with greater plasticity of genetic characters, can form local "races" within environment (Kosswig1974).

About 80 Lessepsian fish species were documented in the Mediterranean so far (Bariche, 2010; Golani, 2010; Bariche, 2011, Sakinan and Orek 2011, Salameh *et al*. 2011,Bariche and Heemstra 2012), 18 of them were recorded, already, from the Libyan coasts (Shakman, and Kinzelbach. 2007), including *F. commersonii*.

2.3. Historic of *Fistularia commersonii*:

The bluespotted cornetfish, *Fistularia commersonii* (Ruppell, 1838) originally distributed in the Indian and Pacific Ocean (Fritzsche 1976, Froese and Pauly, 2010), is today one of the most successful invaders of the Mediterranean Sea (Streftaris and Zenetos, 2006) and European waters (DAISIE 2008). Twelve years ago, in January2000, this species was recorded for the first time along the Mediterranean coasts of Israel, entering from the Red sea via the Suez Canal (Golani2000). Since then, it has spread rapidly all over the Mediterranean, across the eastern (Bilecenoglu *et al*. 2002; Cosini *et al*. 2002; Karachle *et al*. 2004), central (Azzuro *et al*. 2004; Ben-Souissi *et al*. 2004) and western sectors of the basin (Garibaldi and Orsi Relini, 2008; Kara and Oudjane, 2009). In 2007 it reached the Alboran sea (Sanchez-Tocino *et al*. 2007), which is the farthest a lessepsian fish migrant has ever been recorded from its entry point (Golani *et al*. 2002).

It was recorded in 2002 from the strait of Sicily (Fiorentino *et al*. 2004; Azzurro *et al*. 2004) in the following year it was recorded from the Gulf of Castellammare in the southern Tyrrhenian sea in November 2003(Pipitone *et al*.2004), about one year later, in October 2004 it was observed in the North Tyrrhenian, along the coast of Monte Argentario (Micarelli *et al*. 2006). It seems to have established populations along the central Tyrrhenian coasts soon after(Micarell *et al*. 2006, Ligas *et al*. 2007, Psomadakis *et al*. 2009). In 2005, it was recorded from the off the east coast of Sardinia, near Arbatax (Pais *et al* . 2007); from Tunisia and from the Adriatic Sea and Ligurian Sea in 2008 (Dulčić *et al*. 2008; Garibaldi and Orsi Relini, 2008). In recent years and covers a vast geographical area, being recorded from Turkey (Bilecenoglu *et al*. 2002), Rhodes(Corsini *et al*. .2002), north Aegean (Karachle *et al*.2004), Montenegro (Joksimovic *et al*. 2008), Malta (Cini, 2006) and from Benghazi, Libya (Elbaraasi and Elsalini, 2009).

2.4. Feeding habits:

This fish develops a variety of techniques for capturing prey, such as ambushing, stalking and chasing, because prey fishes exhibit a wide range of behavioral and morphological adaptation for avoiding capture (Keenleyside1979, Gerking 1994). Thus, diversification in foraging behavior in piscivores will be more remarkable than in fish of other tropic levels (Hixon, 1991, Gerking, 1994).

Fishes of this family are reported to be stalking predators that suddenly attack prey fish after approaching them closely (Hobson, 1968, Parrish, 1993).

They also exhibit associative foraging with other fish species or other animals such as octopus (Hobson 1968, Diamant and Shpigel, 1985).

In shallow reefs of a variety of tropical and subtropical regions, Fistulariidae fishes prey on a wide variety of fish species.

The small cornetfish feeds only on reef fish that captured after stalking (where the fish slowly approaches the prey and then suddenly attack). The stalking is done either solitarily or in foraging association. Large fish feeds on both types of fishes by stalking and/or chasing (where the fish chases the prey using its high mobility and attacks), either solitarily or in foraging association.

In the Mediterranean the diet composition of *Fistularia commersonii* has rarely been studied. Golani(2000) stated the blue-spotted cornet fish as primarily piscivorous but supplements its diet with squids and shrimps. A further study by Corsini *et al*. 2002 documented the preference of 37 specimens of *Fistularia commersonii* from Rhodes Island marine area. Corsini *et al*. 2002 also considered the cornetfish as carnivorous, seeking food over reefs and seagrass beds, as well as benthic fish and occasionally shrimps. The results showed that off the Rhodes Island *Fistularia commersonii* fed on bottom living, water column dwelling local fishes such as *Atherina* sp. and native populations of economic important mainly *Spicara smaris* and *Mullus surmulenus.*

Fistularia commersonii is known as a piscivorous fish that prefers to swim between reefs and seagrass as well as shallow sandy shores where it may feed on fishes and shrimps. It is characterized by a stalking feeding behavior during which it pursues its prey on a low profile before it attacks and ingests its prey whole. Many observations show that it predates its prey by schooling. Parrish (1993) observed such a behavioural mechanism to be an adaptation for evading, confusing and reducing the efficiency of predators. It is also thought of as a hydrodynamic and foraging function, where the group attacks tend to result in higher capture success rates.

It should be noted though that they do not only feed on fish prey. Corsini, Kondilatos and Economidis have studied the food preference of *Fistularia commersonii* during the year 2002. Their study showed that it feeds on several commercial native populations, which are of economic importance. They include *Spicara smaris*(L.) and *Mullus surmuletus* L. (Corsini 2002).

Fistularia commersonii is an opportunist feeding on prey from different coastal habitats and depths; explaining its success in establishment in the Mediterranean Sea. Furthermore, it seems to prefer families of commercial importance such as Athrinidae and Centracanthidae (Parrish 1993).

2.5. A general definition of Piscivores fish:

When studying their ecology, piscivorous fish are seen to occupy large phylogenetic and geographic territories. They are also found in many habitats occupying the top of the aquatic food web. Furthermore piscivorous fish generally achieve the largest body size within fish communities, represented by some of the largest species (elasmobranches, tunas, billfishes) that cause great impacts on their communities through predation. Due to their large body size they are among the valuable harvestable and sometimes endangered species in many of the world's fisheries. Piscivorous fish are also seen to compete with humans over commercially important resource species (Christensen, 1996).

By definition a piscivorous fish, similar to carnivorous fish primarily consumes fish prey (Hart and Reynolds, 2002) and as a group come second in proportion to those that feed on benthic invertebrates. They are situated in a variety of freshwater, estuarine, and marine systems (tropical and temperate ecosystem). Piscivrous fish were categorized into primary and secondary piscivorous. The primaries (specialized) become piscivorous within the first few months of life, whereas the secondary become fish-eaters much later. He further suggested that the shift to piscivory is attributed to a mechanism, which allows the fish to maintain enough energetic efficiency as it grows. They are also species said to be opportunists and vary their feeding habits according to their surrounding prey types (Hart and Reynolds 2002). Piscivorous have three feeding behaviours; luring, stalking and chasing.

Dörner *et al*.(2003) analyzed and compared the feeding behavior of large perch in two lakes of different state and food availability. Perch constitutes the piscivorous fish community in most European temperate lakes, and is generally considered to be important as a predator in lakes with a high water transparency. The importance of this piscivores fish lies in its ability to control fish abundance and thus play a vital role in structuring the fish community. Perch is also described as opportunistic feeders using all food components available. The study compared the seasonal patterns of the feeding behavior of perch in two lakes in order to recognize similarities and differences. The study confirmed that perch seasonally changes its diet composition. Invertebrates and juvenile fish prey were the main food components of large perch of both populations. Mean lengths of prey fish were consistently smaller than those in situ. The prey fish availability was an important factor determining the feeding behavior of large perch.

Another study conducted by Stewart and Jones (2001) examines how the diet of piscivorous fish responds to fluctuations in the abundance of their prey. This study focused on two species of rock-cod and monitored their diet in two different habitats on the northern Great Barrier Reef, Australia, over a 2year period. The study monitored the abundance and family composition of their prey at the same time. Dietary information was largely collected from regurgitated samples. Results of the study identified prey fish of the family, Apogonidae, followed by Pomacentridae and Clupeidae, as the dominating diet of both species of rock-cod. Fluctuations in prey abundance and patterns of prey selection caused dietary composition to vary both temporally and spatially. The piscivores rock cods preferred to prey on mid-water schooling prey belonging to the families Clupeidae and to a lesser extent Caesionidae over other families. Laboratory experiments supported the hypothesis the prey selection were dependant on prey behaviour. Feeding rates of both species of rock-cod varies between seasons, showing a preference on small recruit sized fish in the summer. The study showed little variation in feeding rates between habitats. They concluded that their observation of how the feeding ecology of predatory fish responded to variation in prey abundance provide potential mechanisms for how predation may affect the community structure of coral reef fishes(Stewart and Jones 2001).

2.6. *Fistularia commersonii* ; A piscivorous Lessepsian fish:

Fistularia commersonii is of Indo-Pacific origin and is found also in the eastern pacific on the vicinities of Bahia Magdalena, Islas Encantadas, Baja California and Punta Lobos, Sonora, Mexico to Archipielago de las Perlas, Panama(Fritzche 1976). It is also seen to occur along reefs and sandy shores.

Its name was given by Ruppell (1835-1838) who wanted to name it *Fistularia immaculate* (which means fish that is spotlessly clean) but could not since he realized that the specimen was covered with blue-spots on its back. There exist two species groups in the genus *Fistularia*. The first group includes *F. petimba* and *F.corneta* which have a row of elongate bony plates along the middle of the back, reddish in color and are found at depths along continental margins (Fritzsche 1976).

The second group consists of *F. commersonii* and *F. tabacaria*. These two species lack the elongate bony plates along their back and are reef and coral dwellers with blue spots along the back. Furthermore *Fistularia comersonii* better known in Arabic as Qasaba (straw in English), is defined to have a compressed and elongated body. Its small mouth is found at the end of a long, relatively hard tubular snout and has extremely small teeth. Specimens are usually seen in several colors ranging from uniform green and brownish dorsal shadings to silvery-white from the bottom. Furthermore it has a pair of blue or green lines, rows of blue spots and fin that has a pinkish color (Khalaf 1997). *Fistularia commersonii* is also known as a piscivorous fish that prefers to swim to reefs and sea grass as well as shallow sandy shores where it may feed on fishes and shrimps. It is characterized by a stalking feeding behavior during which it pursues its prey on a low profile before it attacks and ingests its prey whole. Many observations show that it predates its prey by schooling. Parrish 1993, observed such a behavioural mechanism to be an adaptation for evading, confusing and reducing the efficiency of predators. It is also thought of as a hydrodynamic and foraging function, where the group attacks tend to get higher capture success rates (Stewart and Jones 2001).

3. MATERIAL AND METHODS

3.1. Study area and samples collection:

The bluespotted cornetfish, *Fistularia commersonii* Samples (Figure 1) were collected by commercial fishing vessels by fishermen along the coast of Benghazi by trammel nets, Libya (Figure 2). A total of 189 individuals were sampled monthly from November 2012 to October 2013, taking into account the lack of samples in some months. Fish Samples, after that, were transferred in ice to the Aquaculture and Fisheries laboratory, Zoology Department, Benghazi University.

Figure 1. Samples of the bluespotted cornetfish, *Fistularia commersonii.*

Figure 2. Map showing the location of sampling *F. commersonii* in the coast off Benghazi, Libya

Figure 3. Length measurements for bluespotted cornetfish, *Fistularia commersonii*

3.2. In The Laboratory:

For each fish, the total length (TL) and Standard length (SL) were measured to the nearest centimeter (Figure 3) and total body weight (BW) to 0.1 gr. Sex for each individual were determined by removing the gonads. The weight of the gonad (Wg) was to the 0.01 gr. Spawning season was determined in using the monthly change of gonado-somatic index (GSI) (Cailliet et al. 1986).

The feeding habit was studied by analysis of food content in the digestive tube by recording the degree of stomach fullness. The stomachs were visually classified as gorged, full, ¾ full, ½ full, ¼ full, trace and empty depending upon the degree of fullness and the amount of food contained in them (Pillay 1925).

Furthermore, the stomachs were dissected out (Figure 4) and the food was preserved in 5% formaldehyde for further study. Fishes with stomachs gorged, full, ¾ full were considered as active feeders, ½ full as moderate feeders and ¼ full and trace full stomachs as poor feeders following the method used by Rao and Rao 2002, Hyslop 1980.

Figure 4. Digestive system and gonads in *Fistularia commersonii*.

3.3. Statistical analysis and data calculation:

Total length and weight of fish during the year was analysed using ANOVA followed by Tukey's Multiple Comparison test. The normality was tested for length frequency distributions using frequency distribution test.

The sex ratio is given as males : females (M:F), The chi-square (X^2) was used to verify the significant differences between the sex ratio of the species within the population that commonly expected 1:1 sex ratio (Sokal and Jamesrohlf, 1987).

The length weight relationships (LWR) were calculated using the equation of Ricker (1973):

$$W= a L$$

Where W= weight (g), L= total length (cm), the parameters *a* and *b* were calculated by functional regression, as was the coefficient of determination (R^2). The *b* value for each species was tested by *t*-test at the 0.05 significance level to verify that it was significantly different from the isometric growth (*b*= 3) (Sokal and Jamesrohlf, 1987).

The condition factor (K) was calculated by the formula:

$$K= 100w/ L^3 \qquad \text{(Pauly, 1983)}$$

Where W= Weight (g), L= Total length (cm).

The Gonado-somatic index (GSI) was calculated by:

$$\text{Gonad weight/Body weight} \times 100$$

All the statistical analysis and calculations were done by GraphPad 5.0 software and Microsoft Excel programs.

4. RESULTS:

4.1. Sex ratio:

A total of 189 specimens of *Fistularia commersonii* were collected throughout the year. The largest number of collected samples was in June (n=107), while the smallest collected samples was in September (n=3). It was determined (Table 1) that 14% of the samples were males (n=2), 57% females (n=4) in April; 57% males (n= 26), 33% females (n=15) in May; 55% males (n=59), 43% females (n=43) in June; 64% males (n=9), 35% females (n=5) August; 66% males (n=2), 33% females (n=1) in September; and 61% males (n=8), 38% females (n=5) in November. The sex ratio of males to females was 0.5:1 in April, 1.73:1 in May, 1.37:1 in June, 1.8: in August, 2:1 in September, and 1.6:1 in November (Table 1) and the analysis showed that in April, May and September the ratio of males and females differ significantly (P=1.03, P=0.45 and P=0.20, respectively), While in June, August and November the differences was statistically insignificant (P<0.05).

Table 1. Variations in sex ratio of *F. commersonii* collected from the coast off Benghazi, Libya.

Months	Total number	Immature	Males	Females	Ratio M:F	P
April	7	1	2	4	0.5:1	1.03
May	45	4	26	15	1.73:1	0.45
June	107	5	59	43	1.37:1	0.03*
August	14		9	5	1.8:1	0.004*
September	3		2	1	2:1	0.20
November	13		8	5	1.6:1	0.01*

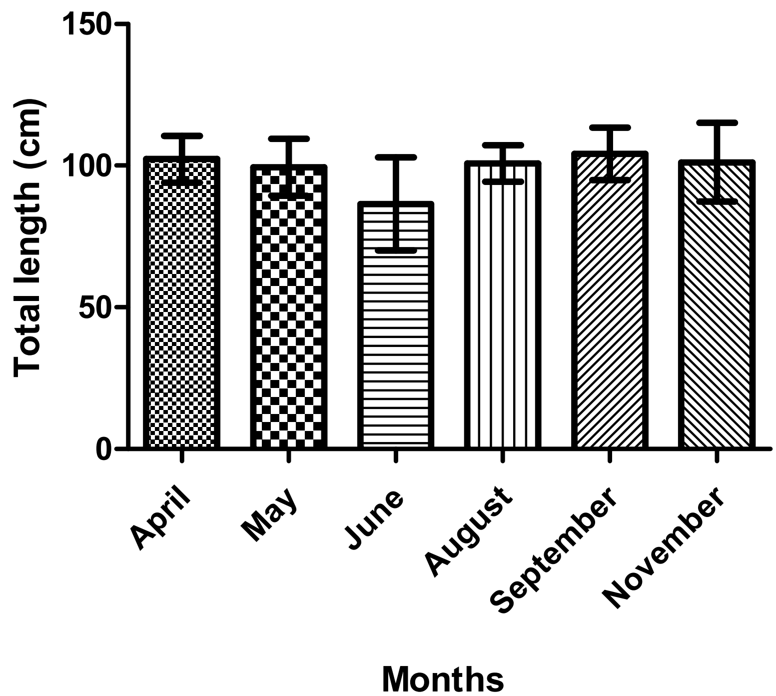
*did not show any significant differences P<0.05. *P: probability from* χ^2*-test.*

4.2. Length, weight and Condition factor (K) of *Fistularia commersonii*:

Since there was no significant difference in most parameters between male and female bluespotted cornetfish, therefore data of results for the sexes were combined.

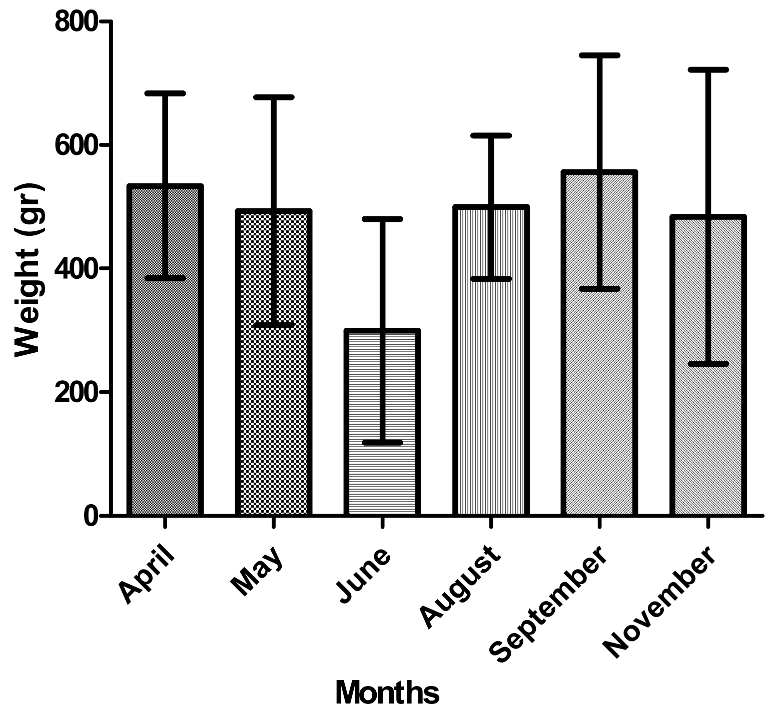
Total length (TL) of bluespotted cornetfish (Figure 5) collected during this study ranged from 90.0 to 115.0 cm (n=7) in April with mean TL of 102.4 ±8.244 cm (mean±SD), from 76.70 to 124.5 cm (n=45) in May with mean of 99.41±10.01 cm, from 55.0 to 198.5 cm (n=107) in June with mean of 86.47±16.41 cm, from 84.0 to 110.0 cm (n=14) in August, with mean of 100.8±6.513 cm, from 93.0 to 109.5 cm (n=3) in September with mean of 104.2±9.238 cm, and ranged from 82.0 to 128.0 cm (n=13) in November with mean TL of 101.2±13.96 cm (Figure 5). The statistical analysis, however, showed that there was no significant difference ($P<0.05$) within the months except May vs June, June vs August and June vs November which showed a significant differences ($P>0.05$), according to ANOVA followed by Tukey's Multiple Comparison test.

Figure 5. Mean monthly total length (TL) of *Fistularia commersonii* collected from the coast off Benghazi, Libya.



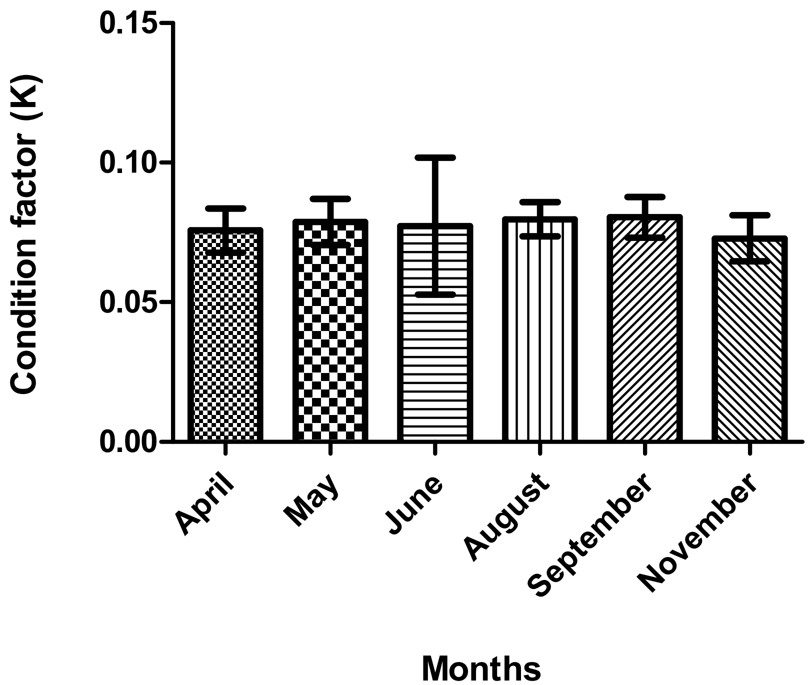
Weight of bluespotted cornetfish (Figure 6) collected during this study ranged from 390 to 768 g (n=7) in April, from 179 to 1032 g (n=45) in May, from 56 to 954 g (n=107) in June, from 292 to 709 g (n=14) in August, from 340 to 690 g (n=3) in September, and ranged from 219 to 1033 g (n=13) in November. Furthermore, the mean weight of fish collected in April was 534±150 g (mean±SD), 493±184 g in May, 299±181 g in June, 499±116 g in August, 556±189 g in September, and 484±238 g in November (Figure 6). The statistical analysis showed that there was no significant difference ($P<0.05$) within the months except April vs June, May vs June, June vs August, and June vs November which showed a significant differences ($P>0.05$), according to ANOVA followed by Tukey's Multiple Comparison test.

Figure 6. Mean monthly Weight of *Fistularia commersonii* collected from the coast off Benghazi, Libya.



The monthly calculated values of Condition factor (K) of bluespotted cornetfish off the coast of Benghazi are shown in Figure 7. However, the mean value of K in April was 0.07±0.01, in May was 0.07±0.01, in June was 0.07±0.02, in August was 0.07±0.01, in September was 0.08±0.01, and finally in November was 0.07±0.01 (Figure 7). Furthermore, the statistical analysis showed that there was no significant difference ($P<0.05$) for K values between the samples within the studied months this was done by ANOVA followed by Tukey's Multiple Comparison test.

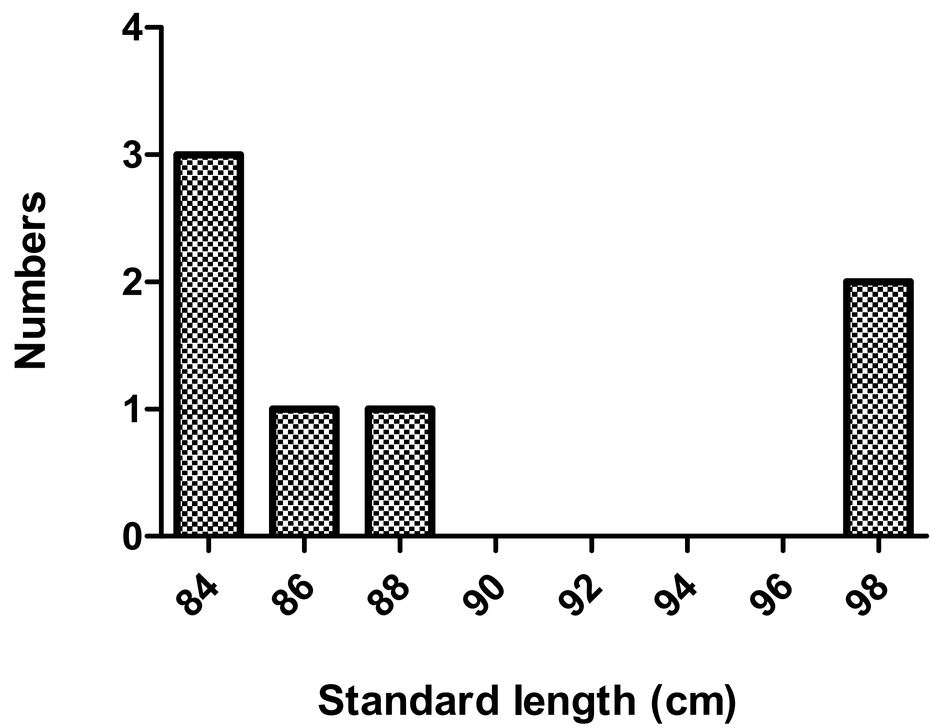
Figure 7. The Condition factor (K) of *Fistularia commersonii* collected from the coast of Benghazi, Libya.



4.3. Standard length frequency distribution:

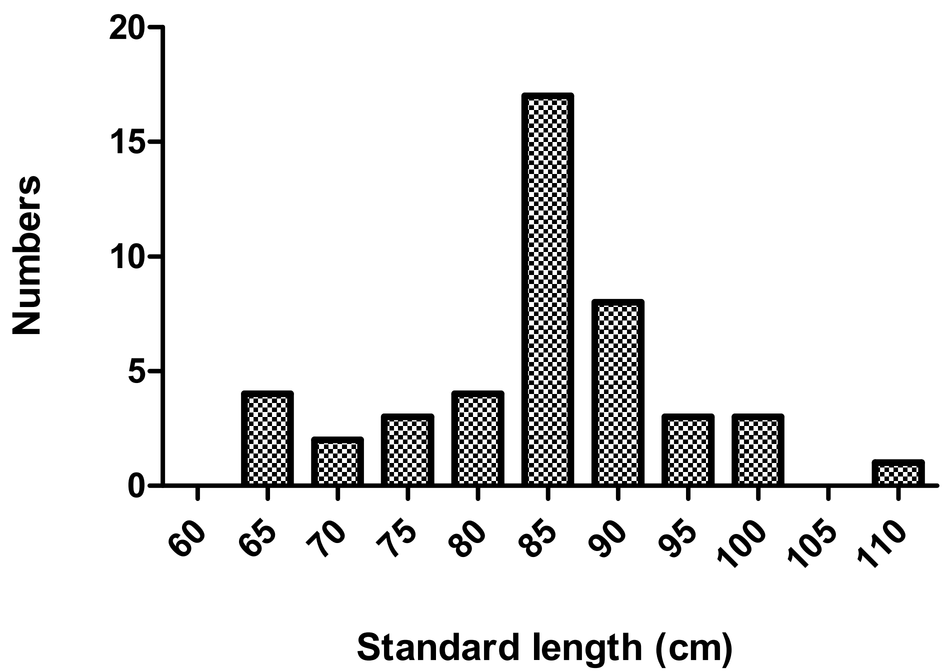
Standard length frequency distribution of bluespotted cornetfish in April showed that fish size ranged within 84 cm was 3fish, 86 cm was 1 fish, 88 cm was 1 fish and 98 cm 2 fish Figure 8. However, the statistical analysis showed that the distributions for total individuals were not normally distributed (P<0.05).

Figure 8. Standard length frequency distribution of *Fistularia commersonii* collected in April.



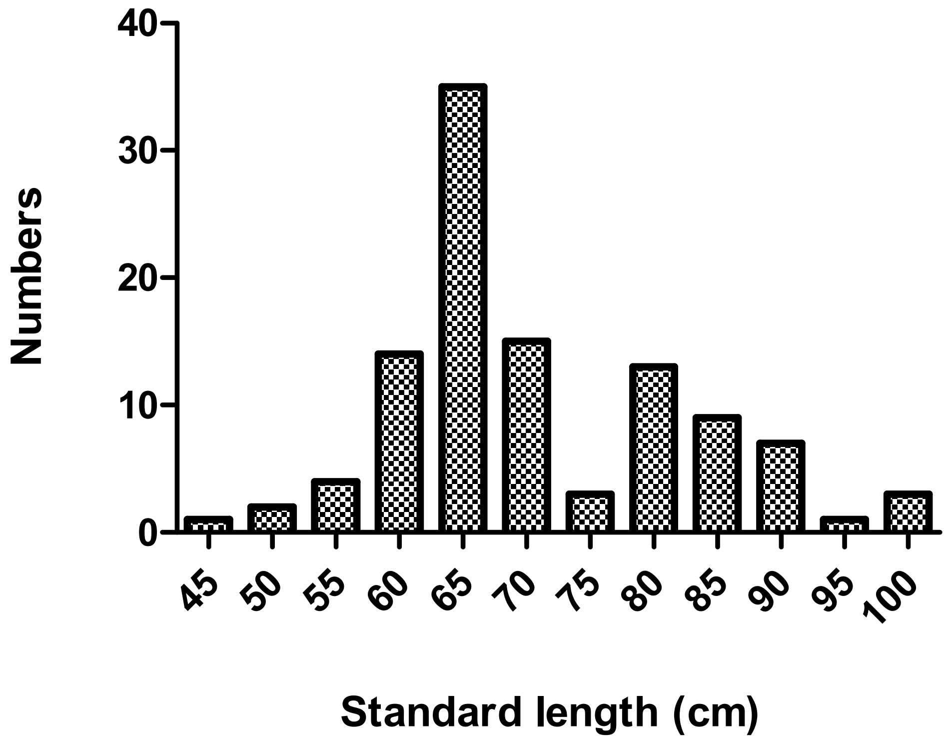
In May, fish size ranged within 65 cm was 4 fish, 70 cm was 2 fish, 75 cm was 3 fish, 80 cm 4 fish, 85 cm 17 fish which is the highest group, 90 cm was 7 fish, 95 cm was 2 fish, 100 cm was 2 fish and 110 cm was only 1fish Figure 9. However, the statistical analysis showed that the distributions for total individuals were normally distributed (P>0.05).

Figure 9. Standard length frequency distribution of *Fistularia commersonii* collected in May.



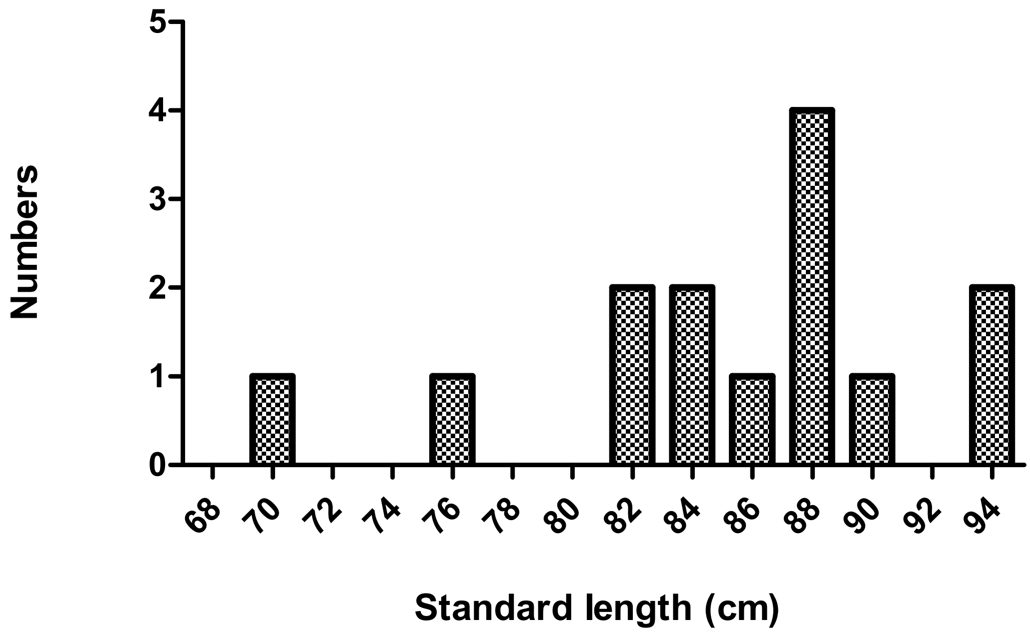
In June, Standard length frequency distribution showed that fish size ranged within 45 cm size group was 1 fish; 50 cm was 2 fish, 55 cm 4 fish, 60 cm was 12 fish, 65 cm was 36 fish, 70 cm was 13 fish, 75 cm was 3 fish, 80 cm was 11 fish, 85 cm 9 fish, 90 cm was 8 fish, 95 cm was 1 fish, and 100 cm size group was 3 fish (Figure 10). However, the statistical analysis showed that the distributions for total individuals were normally distributed (P>0.05).

Figure 10. Standard length frequency distribution of *Fistularia commersonii* collected in June.



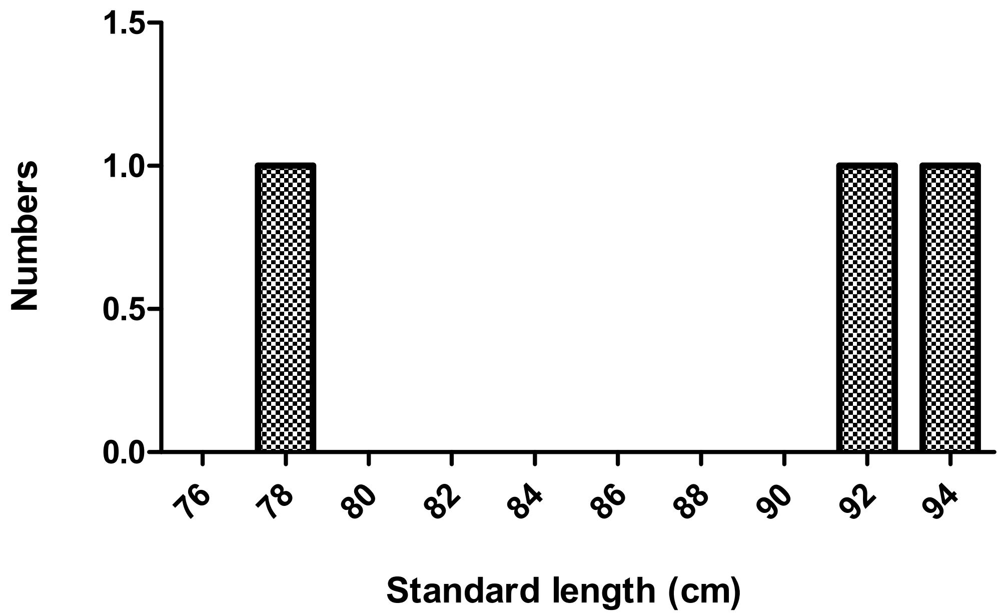
In August, Standard length frequency distribution showed that fish size ranged within 70 cm size group was 1 fish; 76 cm was 1 fish, 82 cm 2 fish, 84 cm was 2 fish, 86 cm was 1 fish, 88 cm was 4 fish, 90 cm was 1 fish, and 94 cm size group was only 2 fish (Figure 11). However, the statistical analysis showed that the distributions for total individuals were not normally distributed (P<0.05).

Figure 11. Standard length frequency distribution of *Fistularia commersonii* collected in August.



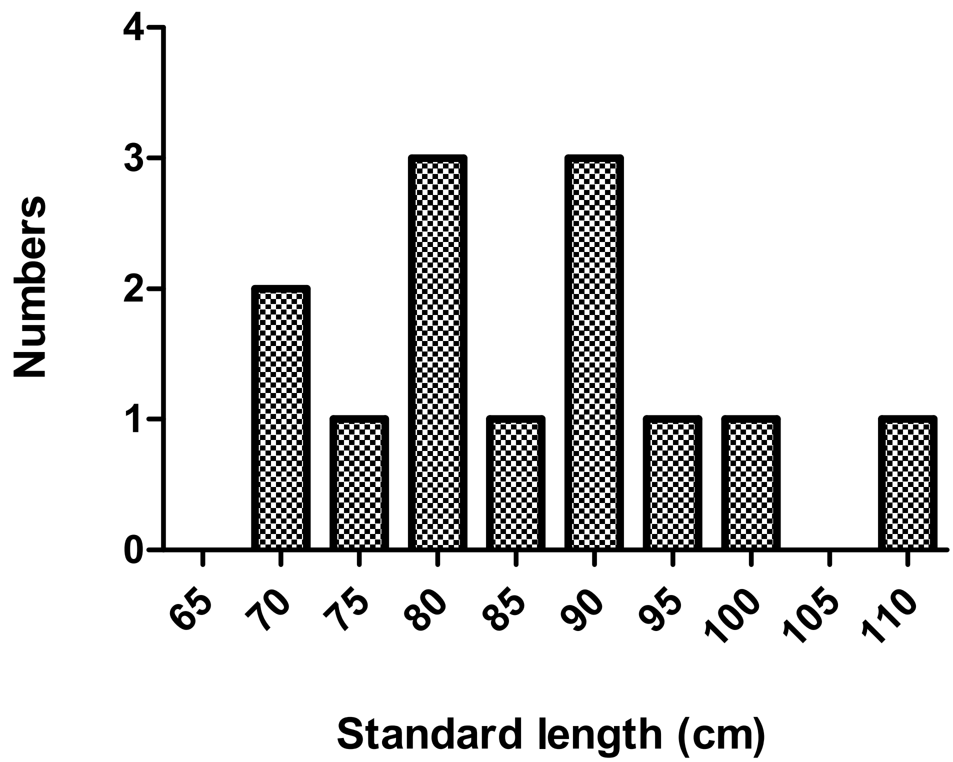
In September, Standard length frequency distribution showed that fish size ranged within 78 cm size group was 1 fish; 92 cm 1 fish, and 94 cm size group was only 1 fish too (Figure 12). However, the statistical analysis showed that the distributions for total individuals were not normally distributed ($P<0.05$).

Figure 12. Standard length frequency distribution of *Fistularia commersonii* collected in September.



In November, Standard length frequency distribution showed that fish size ranged within 70 cm size group was 2 fish; 75 cm was 1 fish, 80 cm 3 fish, 85 cm was 1 fish, 90 cm was 3 fish, 95 cm was 1 fish, 100 cm was 1 fish, and 110 cm size group was only 1 fish (Figure 11). However, the statistical analysis showed that the distributions for total individuals were not normally distributed (P<0.05).

Figure 13. Standard length frequency distribution of *Fistularia commersonii* collected in November.



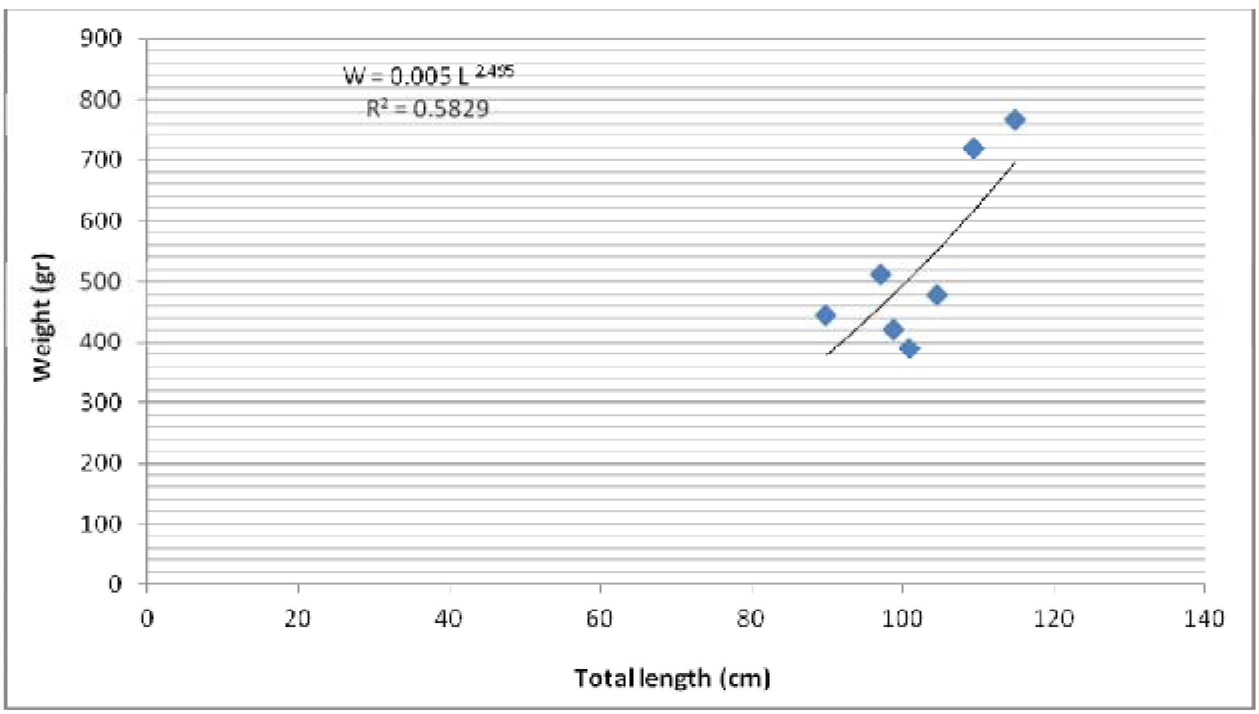
4.4. Length-weight relationships (LWR):

The relationship between total length and weight of both sexes of *Fistularia commersonii* for April obtained by a parabolic equation of Ricker (1973) which expressed as follows:

$$W= 0.005 L^{2.50}$$

Such relationship is shown in Figures 14. The coefficient of determination (R^2) were $R^2 = 0.60$.

Figure 14. Length-weight relationship of *Fistularia commersonii* in April.

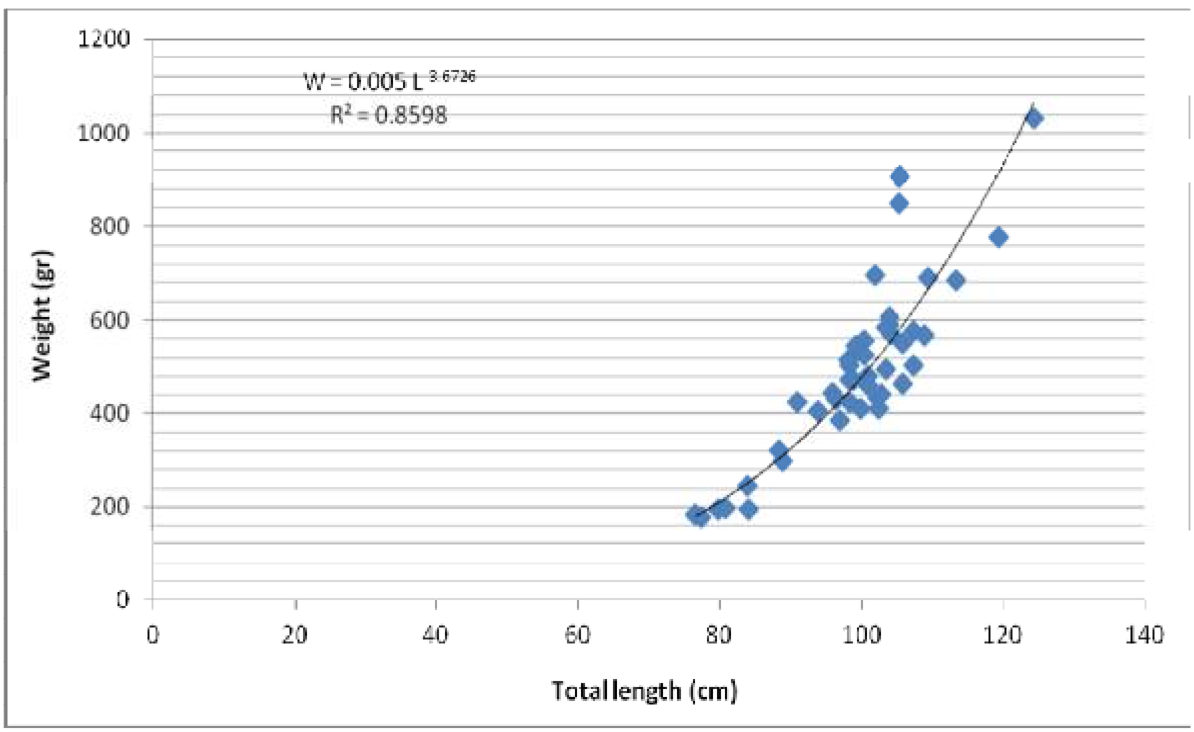


The length weight relationship of *Fistularia commersonii* for May obtained by a parabolic equation as follows:

$$W = 0.005\ L^{3.67}$$

Such relationship is shown in Figures 15. The coefficient of determination (R^2) were $R^2 = 0.86$.

Figure 15. Length-weight relationship of *Fistularia commersonii* in May.

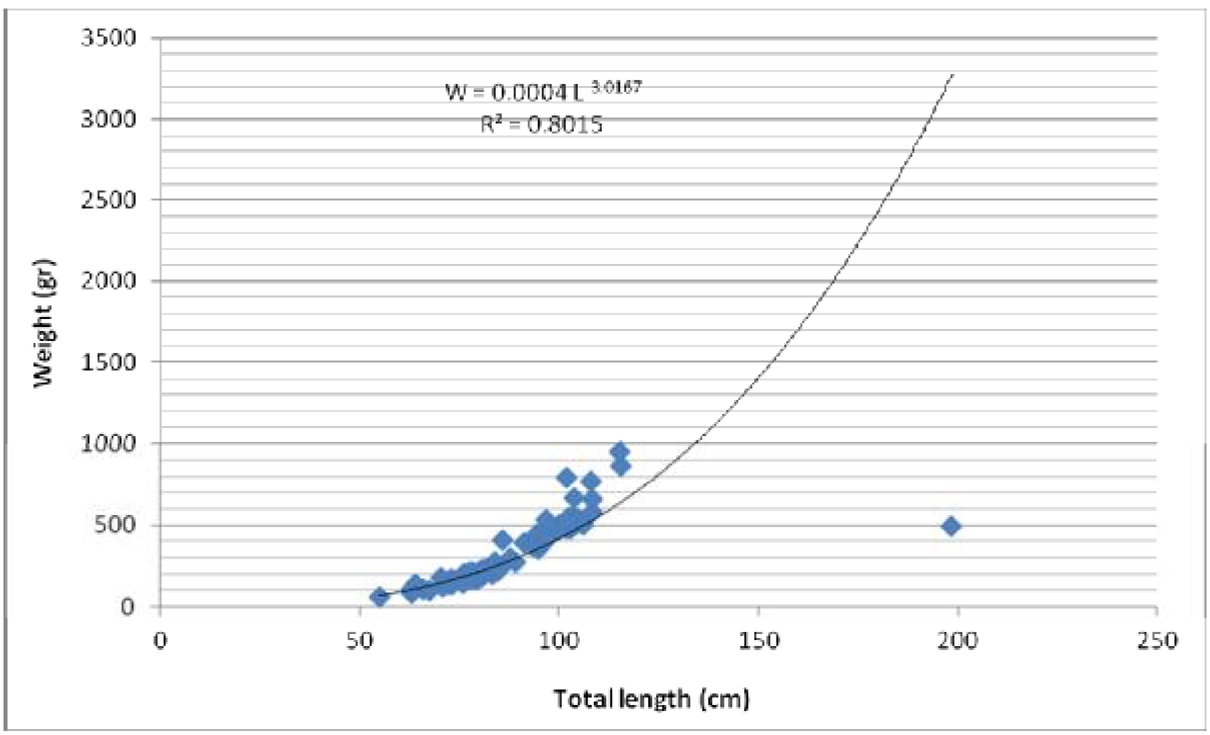


The length weight relationship of *Fistularia commersonii* for June obtained by a parabolic equation as follows:

$$W= 0.0004\ L^{3.01}$$

Such relationship is shown in Figures 16. The coefficient of determination (R^2) were R^2 = 0.80.

Figure 16. Length-weight relationship of *Fistularia commersonii* in June.

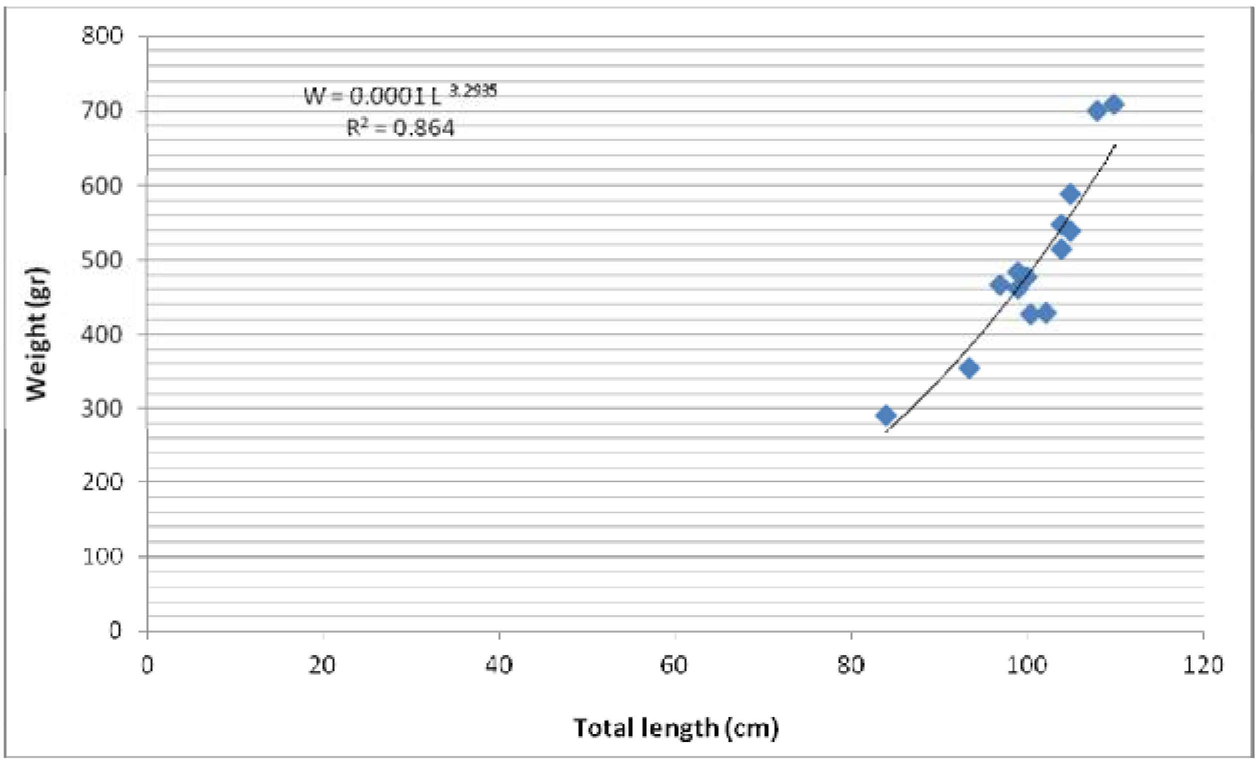


The length weight relationship of *Fistularia commersonii* for August obtained by a parabolic equation as follows:

$$W= 0.0001\ L^{3.30}$$

Such relationship is shown in Figures 17. The coefficient of determination (R^2) were $R^2 = 0.86$.

Figure 17. Length-weight relationship of *Fistularia commersonii* in August.

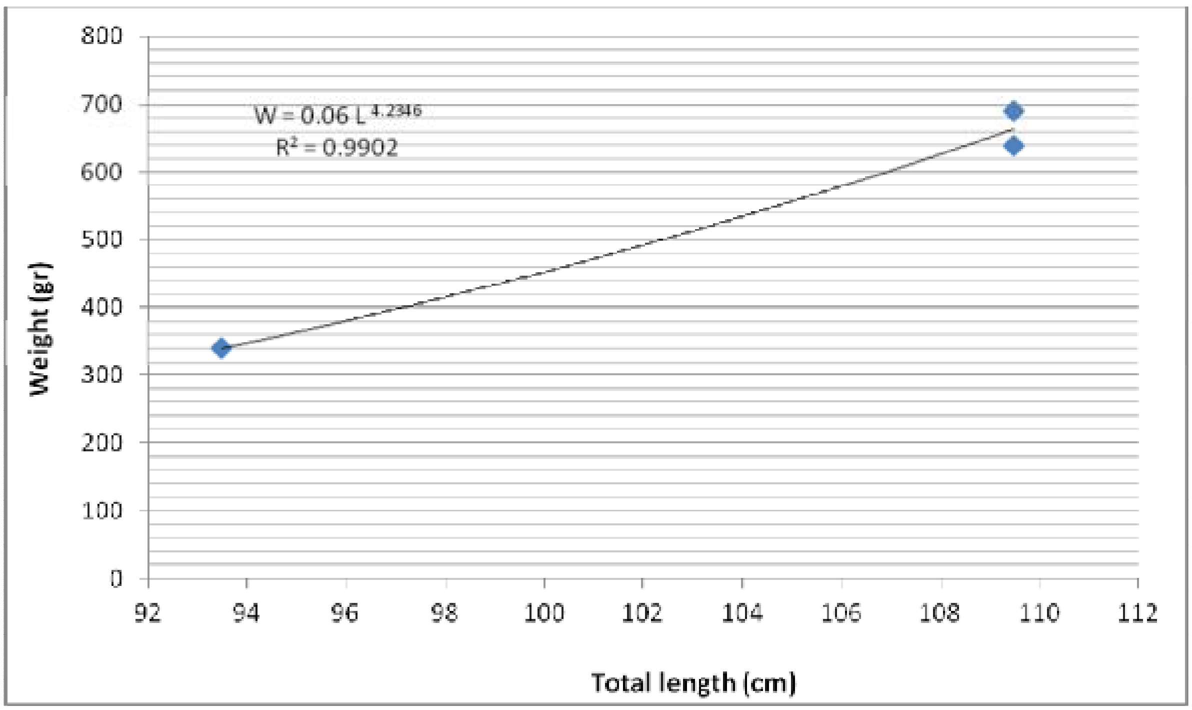


The length weight relationship of *Fistularia commersonii* for September obtained by a parabolic equation as follows:

$$W= 0.06\ L^{4.2}$$

Such relationship is shown in Figures 18. The coefficient of determination (R^2) were $R^2 = 0.99$.

Figure 18. Length-weight relationship of *Fistularia commersonii* in September.

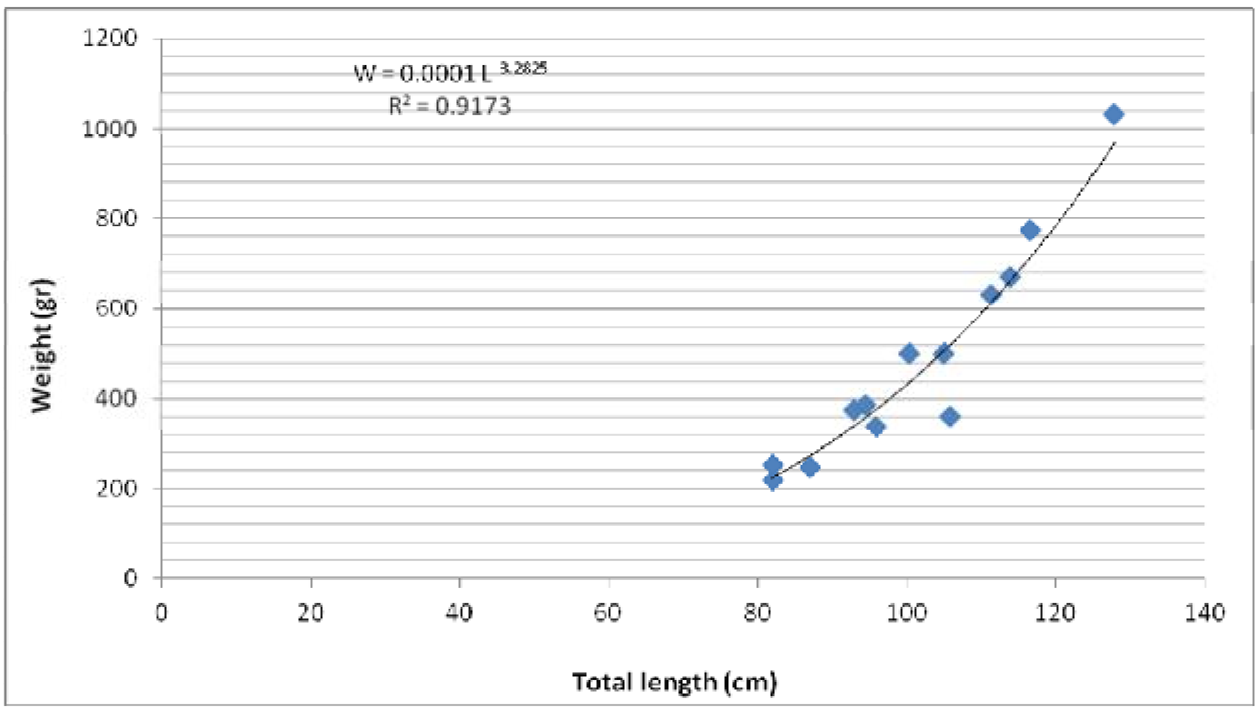


The length weight relationship of *Fistularia commersonii* for November obtained by a parabolic equation as follows:

$$W= 0.0001\ L^{3.28}$$

Such relationship is shown in Figures 19. The coefficient of determination (R^2) were $R^2 = 0.91$.

Figure 19. Length-weight relationship of *Fistularia commersonii* in November.



4.5. Gonadosomatic index (GSI):

The monthly GSI of male and female are given in Figures 19, 20. The mean monthly GSI in male fluctuated between 0.40 in April to 1.50 in September and in female from 0.80 in June to 6.00 in August. The values of GSI increased in August and September showing two distinct peaks in September for males and August for females.

Figure 19. Monthly GSI (mean±SD) values of Male *Fistularia commersonii* in the coast off Benghazi, Libya.

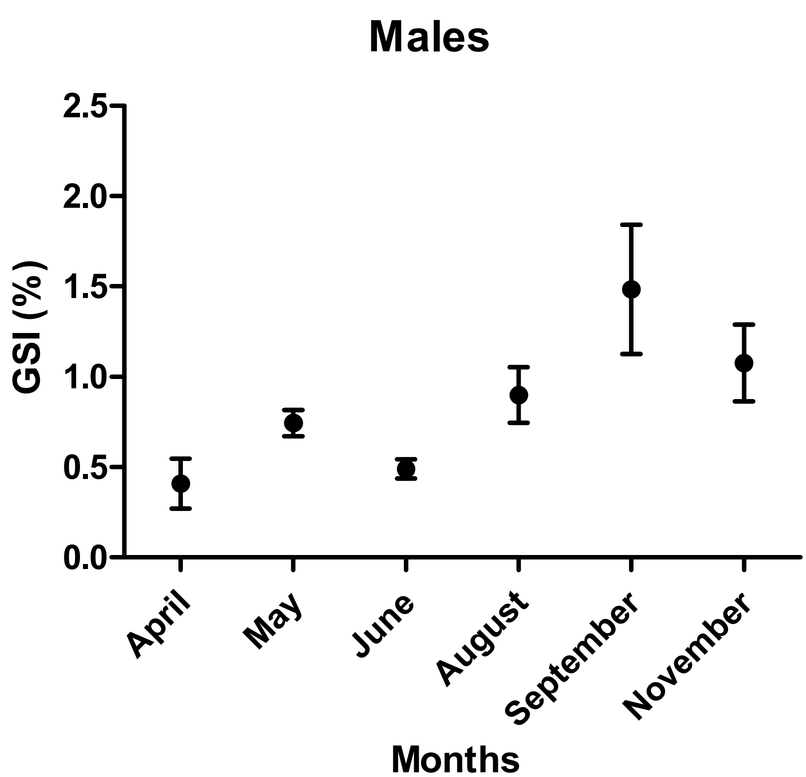
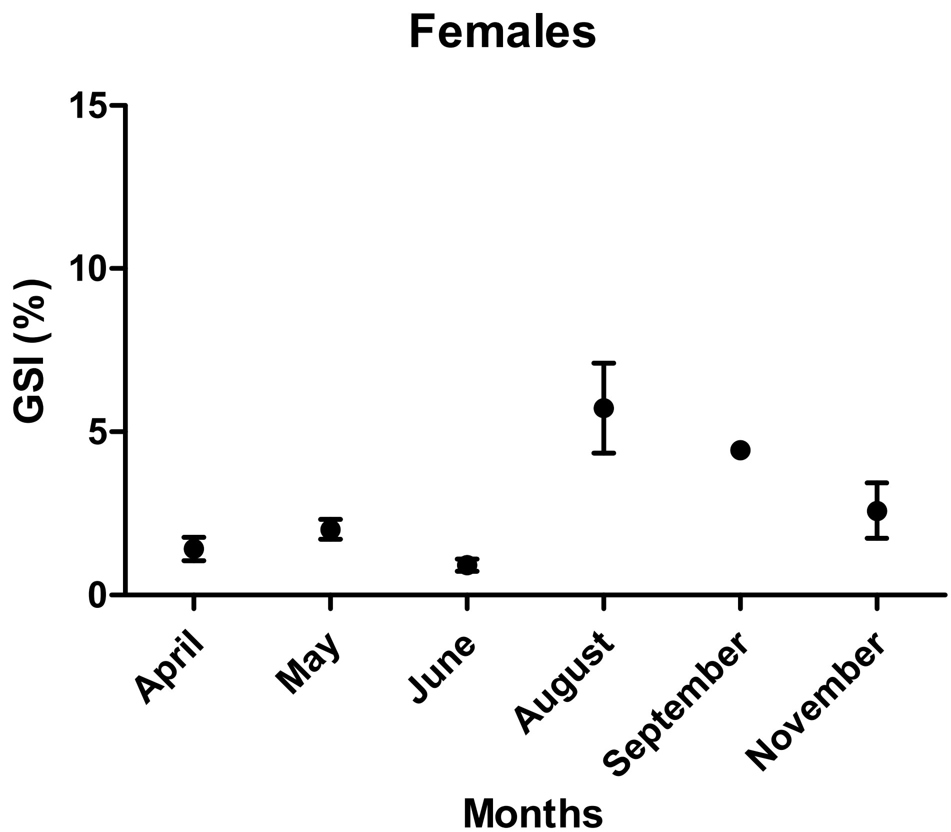


Figure 20. Monthly GSI (mean±SD) values of Female *Fistularia commersonii* in the coast off Benghazi, Libya.

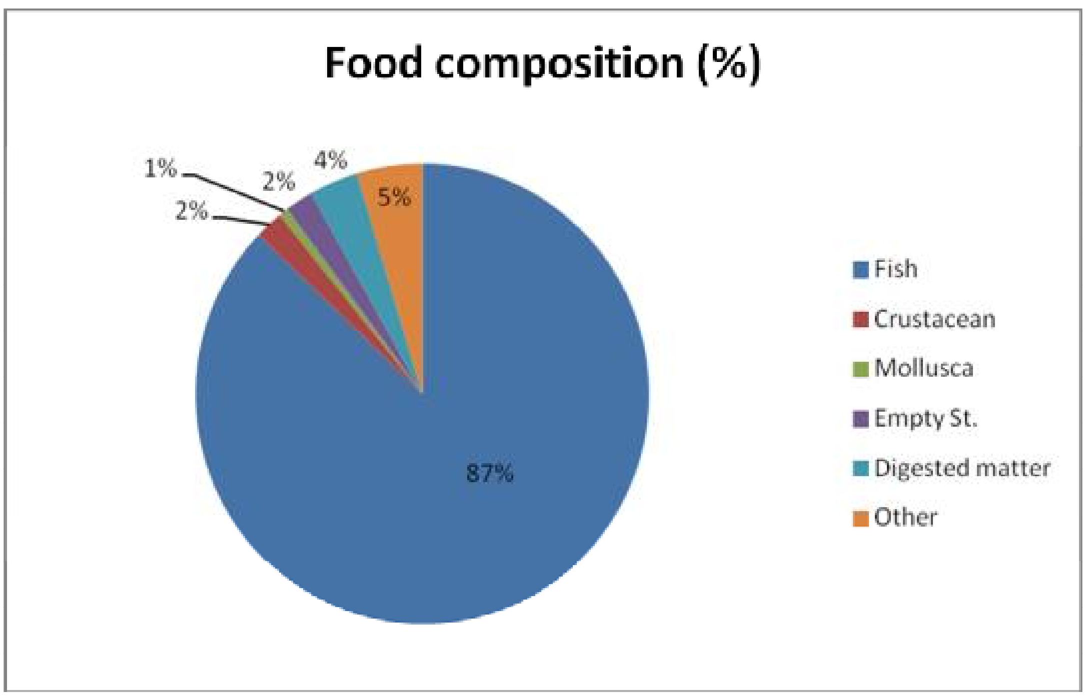


4.6. Monthly variation in Food composition:

The various food items recorded from the stomach of the bluespotted cornetfish during the study period are presented in Figure 21. Generally, the food items found in the examined stomachs were grouped into six categories namely fish, crustacean, mollusca, empty stomach, digested matter, and other.

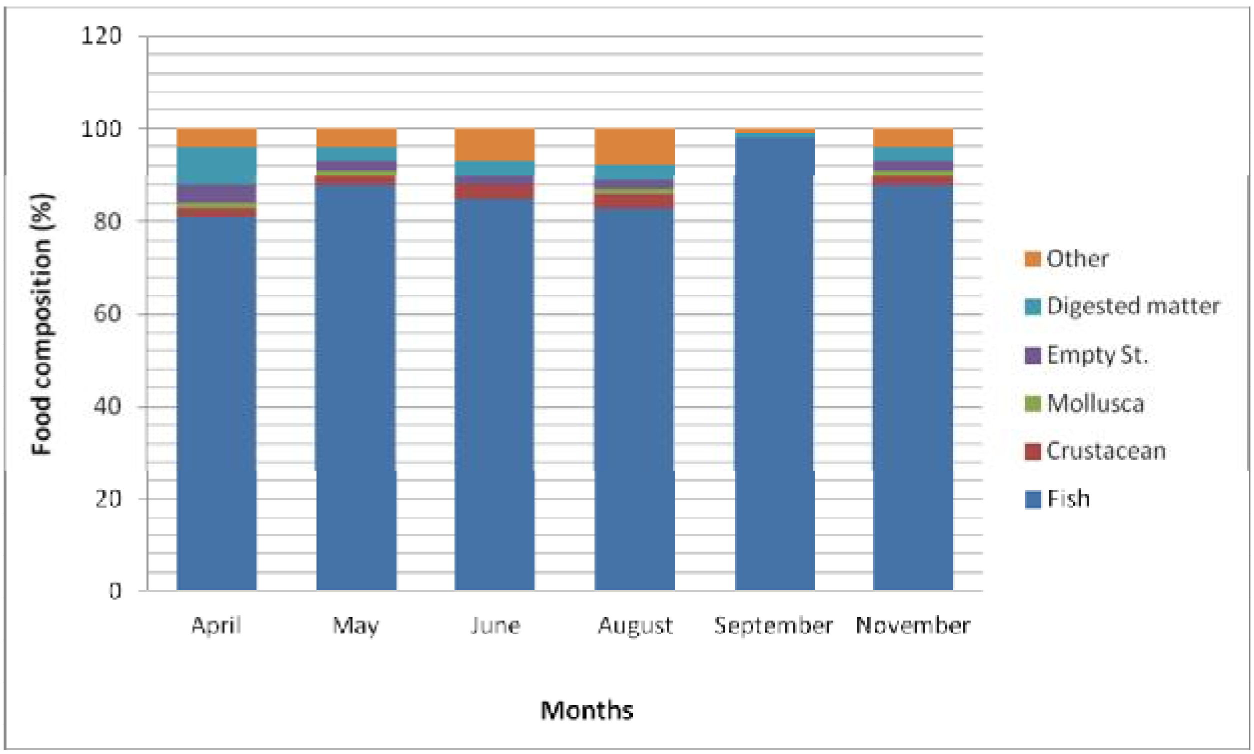
The first group found in large quantities was Fish (87%) of total food composition. Thus, it forms the major food items in the stomach. However, other matter (which include sand grains, and unidentified matter was 5% of total food composition followed by digested matter (4%), crustacean (2%), mollusc (1%) and empty stomach (2%).

Figure 21. The average percentage of main food items in the stomach of *Fistularia commersonii* in the coast off Benghazi, Libya.



The variation in percentage composition of food items in *Fistularia commersonii* during different months are shown in Figure 22. It revealed that percentage composition of different food items varied in different months according to their availability and preference of fish. However, fish was the main food composition for all months (Figure 23). Furthermore, In April, fish was 81% of total food composition, crustacean was 2%, mollusca was 1%, empty stomach was 4%, digested matter 8%, and other was 4%.

Figure 22. Monthly variation of food composition of *Fistularia commersonii* in the coast off Benghazi, Libya.



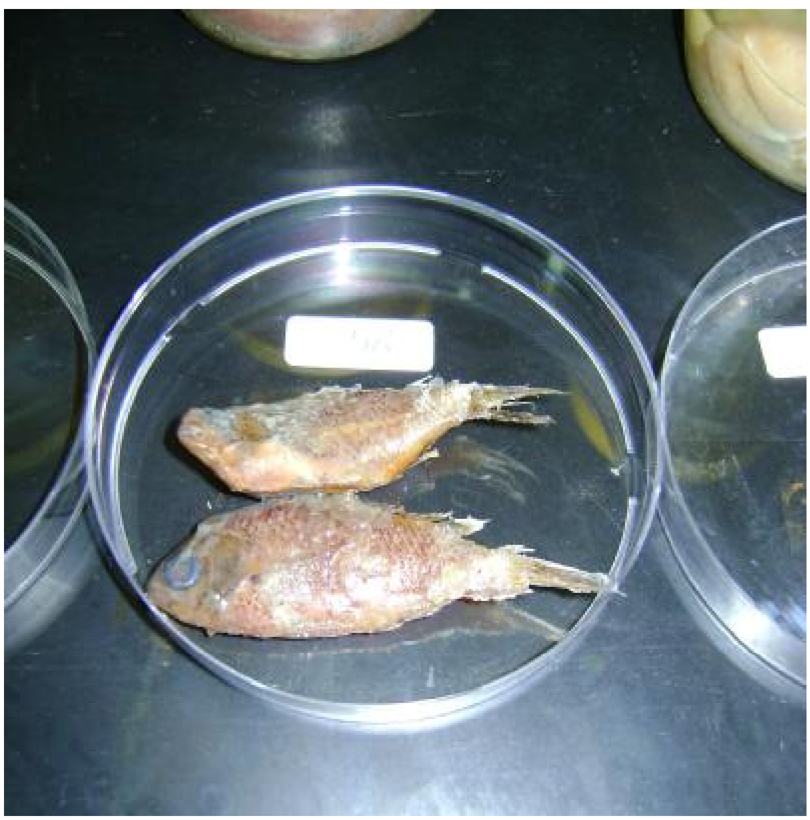
In May, , fish was 88% of total food composition, crustacean was 2%, mollusca was 1%, empty stomach was 2%, digested matter 3%, and other was 4%. In June, fish was 85% of total food composition, crustacean was 3%, mollusca was 0%, empty stomach was 2%, digested matter 3%, and other was 7%. In August, fish was 83% of total food composition, crustacean was 3%, mollusca was 1%, empty stomach was 2%, digested matter 3%, and other was 8%. In September, fish was 98% of total food composition, crustacean was 0%, mollusca was 0%, empty stomach was 0%, digested matter 1%, and other was 1%. In November, fish was 88% of total food composition, crustacean was 2%, mollusca was 1%, empty stomach was 2%, digested matter 3%, and other was 4%.

Figure 23. Some samples of Fishes (A-D), crustacean (E), and mollusca (F) found in the stomach of *Fistularia commersonii* in the coast off Benghazi, Libya.

A.

B.

C.



D.

E.

F.

5. DISCUSSIONS

Sex ratio investigation in fish is very important to understanding the relationship between fishes and their environment also to describing fish population status (Oliveira *et al*., 2012). However, it may influence by several factors such as reproductive behavior, food availability and environmental conditions and genetic factors like sex chromosomes. Sex ratio results may vary from species to species, or even in the same population at different times of the year (Baroiller *et al*., 2009).

Environmental conditions and seasonal changes are expected to be quite variable during the year which influences on sex ratios in most of the aquatic organisms including fish. Furthermore, it could have effect on the sex equilibrium states in the fish populations, as has been found in some fishes where the influence temperature on sex ratios differs along a latitudinal gradient (Lagomarsino and Conover, 1993, Pen *et al*., 2010). Therefore, studying the sex ratio between populations might be of great help to further increase our knowledge of the evolution of sex-determining mechanisms. Hence, sex ratio indicates the proportion of male and female in the population and is expected to be 1:1 in nature, any differences from this ratio may indicate the dominance of one sex over the other (Bal and Rao, 1984). In the present study, the bluespotted cornetfish *F. commersonii* sex ratio of males to females was 0.5:1 in April, 1.7:1 in May, 1.37:1 in June, 1.8:1 in August, 2:1 in September, and 1.6:1 in November (Table 1). However, males were dominance over females in all studied months except in April. Bariche and Kajajian (2012) reported that the overall sex ratio of *F. commersonii* did not differ from the hypothesized 1:1 ratio, which indicated a well-balanced population in the eastern Mediterranean.

Total length (TL) of bluespotted cornetfish in the present study ranged from 90.0 to 115.0 cm (n=7) in April with mean TL of 102.4 ±8.244 cm (mean±SD), from 76.70 to 124.5 cm (n=45) in May with mean of 99.41±10.01 cm, from 55.0 to 198.5 cm (n=107) in June with mean of 86.47±16.41 cm, from 84.0 to 110.0 cm (n=14) in August, with mean of 100.8±6.513 cm, from 93.0 to 109.5 cm (n=3) in September with mean of 104.2±9.238 cm, and ranged from 82.0 to 128.0 cm (n=13) in November with mean TL of 101.2±13.96 cm (Figure 5). However, The largest individual examined (198.1 cm, TL) is in line with maximum sizes recorded from the Mediterranean in previous studies (Kalogirou *et al.*, 2007; Bariche *et al.*, 2009, Bariche and Kajajian 2012), and is probably very close to the maximum size in the Mediterranean Sea. A substantially larger size (160 cm) has been reported from the Indo-Pacific, indicating that the species might grow larger in its native tropical area (Fritzsche and Schneider, 1995). The species might have encountered some limiting factors in the Mediterranean Sea such as water temperature which effect on its size.

The condition of fishes is influences by the gonadal development, feeding activity and several other factors (Doddamani *et al.,* 2001). In the present investigation, comparing K bluespotted cornetfish collected from Benghazi. The mean value of K in April was 0.07±0.01, in May was 0.07±0.01, in June was 0.07±0.02, in August was 0.07±0.01, in September was 0.08±0.01, and finally in November was 0.07±0.01 (Figure 7). There were no significant differences in condition factor during the year, which may explain that the population off Benghazi coast living in same conditions food availability.

Length-frequency distribution could be attributed to variation in environmental conditions. The highest number of the standard length was within 65 cm in June, and the lowest number was with 45 cm in June. Length-frequency distributions were not normally distributed for all individuals grouped together except for May and June. Possible causes behind this deviation from normality are unclear and could be due to some hidden sampling biases (Bariche *et. al*. 2012). Based on the sampling method used it is expected that the size classes collected in this study are not representative of the size structure of *F. commersonii* in Benghazi.

The parameters of length-weight relationship for fish species are used for fisheries management and fish biology, however in this study we compare the LWR of bluespotted cornetfish during the year to find out the growth performance in the population. Values of exponent *b* provide information on fish growth indicating the type of growth; isometric (b=3.0), positive allometric (b>3.0) or negative allometric (b<3.0).The results showed that the exponent *b* ranged from 2.50 in April to 4.2 in September. The exponent *b* however, was 3.67 in May, 3.01 in June, 3.30 in August and 3.28 in November. In general, the value of *b* of the length-weight relationship was within the expected range of 2.5-3.5 (Dulcic and Glamuzina, 2006) except in September which was n=3 . Furthermore, the present study indicates a negative allometric growth for the cornetfish of April, a positive allometric growth for May, August, September and November, and isometric growth for June (b=3). Thus, isometric growth indicates that the body increases in all dimensions in the same proportion during growth, whereas positive allometry indicates that the body becomes more rotund as it increases in length, and negative allometry indicates a slimmer body (Erguden and Goksu, 2009).

The parameters of LWR in fish are affected by factors such as, environmental conditions, gonad maturity stages, sex, stomach fullness, health condition, season, population and differences within species (Koutrakis and Tsikliras, 2003).

The information on the LWR of bluespotted cornetfish presented in this study could contribute to the management of natural stocks of these fish species which are ecologically important. Additionally, the difference in LWR may be attributed to gonadal development where weights of gonads of females are higher than those of males leading to gaining more weight by female. Dulcic and Karaljevic, (1996) also stated that the estimated parameters of LWR might differ among seasons and years primarily due to physicochemical characteristics of the environment, sex and maturity stages of a given species. It has been stated that the variation of *b* is not significant unlike *a*, which may even vary daily (Goncalves *et al.,* 1997).

The coefficients of determination R^2 indicate the degree of association between length and weight of the fish. The high values of coefficients in both sexes revealed that there is perfect relationship between the two variables in this species.

Comparing with GSI values, it is inferred that during August and September the GSI was high in female and relatively lower in male. That may indicate higher spawning activity of female at the time of sampling leading to aggregation of females in the spawning ground. Bariche *et al*. (2012) reported that the fluctuation of the GSI, for bluespotted cornet fish in the coast of Lebanon, highlighted only one peak in July-August with no further recrudescence in November or December. It is therefore possible that some individuals undergo a late maturity within the annual cycle or even a second spawning period if conditions are favourable. This has been observed in other multiple spawners (Marino et al. 2001. Moore *et al*. 2007).

The length of the intestine of the fish depends upon the feeding habits. Carnivores fishes normally have short and more or less straight intestine. This is because the meat gets digested more easily, wherein herbivores fishes the intestine is long and highly coiled because the vegetable food items take more time for digestion (Al.Hussaini 1949, Bond 1996, Moyle and Cech 2000). In the present species the alimentary canal is short; hence the stomach that only considered in this study. The methods employed for the quantitative and qualitative analysis of stomach contents do not give a complete picture of dietary importance when they singly used. However, when used in combination, such as numerical or frequency occurrence and volumetric or gravimetric, better results are achieved (Kalogirou *et al*. 2007). The analysis of stomach content of bluespotted cornetfish from Benghazi coast revealed that this species consume a variety of bony fish as food items in this region. Furthermore, the first group found in large quantities was Fish (87%) of total food composition. Thus, it forms the major food items in the stomach. However, other matter (which includes sand grains, and unidentified matter) was 5% of total food composition followed by digested matter (4%), crustacean (2%), mollusc (1%) and empty stomach (2%). Differences in the dominance of different food categories can be attributed to their availability and the habitat where the fish lived at a particular time. Occurrence of crustacean and molluscs even in small percentage is perhaps due to the abundant of them during this period. They also indicate a bottom feeding tendency. Occurrence of sand grains throughout the study period with relatively low quantities indicates that sand may be taken accidentally (Kalogirou *et al*. 2007).

6. SUMMARY

Fistularia commersonii is one of the Red Sea species participating in the migration process from the Red Sea to Mediterranean Sea. It is the fastest and furthest spreading alien fish species, it feeds on several commercial native populations.

Aim of this study was to know some biological aspects of the invasive fish *Fistularia commersonii* population in the coast off Benghazi, Libya.

A total of 189 specimens were collected throughout a year,7 specimens in April, 45 specimens in May, 107 in June, 14 specimens in August, 3 specimens in September and 13 specimens in November. in this the study the following morphometrics measurement were taken: (Total length TL, Standard length SL, Head length HL, Weight, Gutted weight), also internal organs were measured(weight of liver, weight of gonads, length of stomach, weight of stomach).

Result of sex ratio of males to females showed that proportion of male was higher than female in May, June, August, September and November, while proportion of male was lower than female in April.

For mean of total length and weight, there was no significant difference in most parameters between male and female bluespotted cornetfish, therefore data of results for the sexes were combined.in April_102.4 ±8.244 cm_,534±150 g,_in may99.41±10.01 cm, 299±181 g, in June 86.47±16.41 cm, 299±181 g, in August 100.8±6.513 cm, 499±116 g, in September 104.2±9.238 cm,, 556±189 g, and in November 101.2±13.96 cm, 484±238 g.

The statistical analysis for mean of total length, showed that there was no significant difference ($P<0.05$) within the months except May vs June, June vs August and June vs November which showed a significant differences ($P>0.05$), for mean of weight there was no significant difference ($P<0.05$) within the months except April vs June, May vs June, June vs August, and June vs November which showed a significant differences ($P>0.05$).

The monthly GSI of male and female ,The mean monthly GSI in male fluctuated between 0.40 in April to 1.50 in September and in female from 0.80 in June to 6.00 in August. The values of GSI increased in August and September showing two distinct peaks in September for males and August for females.

This study may also indicate that fistularia commersonii feeds on prey from different habitats and depths.

We can presume that this species like others has been successful due to competitive superiority and pre-adaptation of the tropical Indo-Pacific fish over the Mediterranean species and also by the existence of unsaturated niches.

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الخلاصة

Fistularia commersonii احد الأسماك البحر الأحمر الغازية التي تغزوا البحر المتوسط عبر قناة السويس, وهي أسرع الأسماك الغازية انتشارا, ولها تأثير علي مجتمعات الأسماك المحلية في البحر المتوسط, حيث تتغذي علي الأسماك المحلية ذات الأهمية الإقتصادية.

الغرض من هذه الدراسة معرفة تركيب مجتمعات *Fistularia commersonii* علي ساحل بنغازي وبعض الخصائص البيولوجية لهذه المجتمعات.

تم تجميع 189 عينة خلال أشهر السنة, حيث تم تجميع 7 عينات خلال شهر ابريل, 45 عينة في شهر مايو, 107 عينات في شهرجونيو, 14 عينة في شهر أغسطس, 3 عينات خلال شهر سبتمبر, و 13 عينة في شهر نوفمبر . وتم اخذ بعض القياسات الشكلية للسمكة (طول الكلي للسمكة, الطول المعياري, طول الرأس, وزن السمكة,وزن السمكة بعد نزع الأحشاء). كم تم أخذ قياسات الأعضاء الداخلية (وزن الكلي, وزن الأعضاء التناسلية, طول المعدة, وزن المعدة قبل وبعد تفريغ محتواها, وزن المحتوي).

أظهرت النتائج ان نسبة الذكور أعلي من نسبة الإناث في شهر مايو, جونيو, أغسطس, سبتمبر, نوفمبر,بينما نسبة الذكور كانت أقل من نسبة الإناث في شهر أبريل.

اما بالنسبة لمتوسط الأطوال و الاوزان ,لا توجد فروق معنوية بين الذكور و الإناث, لهذا السبب بيانات النتائج كلا الجنسين دمجت. فكانت في شهر ابريل متوسط الطول 102.4 ±8.244 cm ومتوسط الأوزان 534±150 g ,في مايو 99.41±10.01 cm, 299±181 g ,في جونيو 86.47±16.41 cm , 299±181 g وفي اغسطس 100.8±6.513 cm, 499±116 g وفي سبتمبر 104.2±9.238 cm, 556±189 g وفي شهر نوفمبر 101.2±13.96 cm, 484±238 g.

إحصائيا لا توجد فروق معنوية بين متوسط الأطوال بين الأشهر باستثناء ما بين مايو و جونيو, وجونيو وأغسطس, وما بين جونيو ونوفمبر هناك فرق معنوي(P>0.05).أما بالنسبة للأوزان لا توجد فروق معنوية باستثناء ما بين ابريل وجونيو,ومايو وجونيو,وجونيو واغسطس,وما بين جونيو ونوفمبر هناك فرق معنوي (P>0.05).

اما بالنسبة للنضوج الجنسي,المتوسط الشهري بالنسبة للذكور في ابريل يتقلب ما بين 0.40 إلي 1.50في سبمتبر ,أما بالنسبة للإناث من 0.80 في جونيو إلي 6.00 في أغسطس,حجم الأعضاء التناسلية للذكور تصل إلي أكبر حجم في سبتمبر,أما بالنسبة للإناث فهي أكبر ما تكون في أغسطس.

هذه الدراسة قد تشير إلي أن هذا النوع من الأسماك يتغذي علي الفرائس في بيئات وأعماق مختلفة.

ونحن نستنتج أن الذي أدي إلي نجاح معيشة هذا النوع من الأسماك في البحر المتوسط هو بسبب التكيف والتفوق التنافسي ونتيجة وجود بيئات ملائمة غير مشبعة.

جامعة بنغازي، كلية العلوم،

قسم علم الحيوان

دراسة بعض الخصائص البيولوجية في تجمعات السمكة الغازية *Fistularia* commersonii(Ruppell 1838) على ساحل بنغازي، ليبيا

رسالة مقدمة كجزء من متطلبات درجة الإجازة العالية (الماجستير) في علم الحيوان

مقدمة من: أسماء الهادي بشير

إشراف د. حسين محمد البرعصي

2014 م