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Some aspects of reproductive biology of *Alepes djedaba* (Teleostei: Carangidae) in the Arabian Gulf

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Abstract

Reproductive biology and biological parameters of *Alepes djedaba*, family Carangidae from the Arabian Gulf, Kingdom of Saudia Arabia show that the spawning season lasted from January to June, with a spawning peak in May for males and June for females. The sex ratio (males to females) was 1: 1.36. The size at onset of sexual maturity was 17.6 cm for males and 18.1 cm for females. Hepatosomatic index reached its maximum values in December, February and May. The Fullness index of the stomach revealed that the rate of feeding was high in the months from December to March, after which it decreased gradually. The equation of the length weight relationship showed a slight negative allometry (b = 2.9). Monthly variations in condition factor showed that it increased from October to January. These findings bring additional biological relevance to the species under study in the Arabian Gulf

Keywords: Carangidae, *Alepes djedaba*, reproductive biology, length weight relationship, fullness index.

1. Introduction

Carangidae is a marine fish family which is found in the Atlantic, Indian and Pacific oceans. Most species of this family are fast swimming predatory fishes that hunt in the waters above reefs and in the open sea, some dig in the sea floor for invertebrates. *A. djedaba* is one of the species involved in the Lessepsian migration through the Suez Canal and inhabits the east coast of the Mediterranean sea around Lebanon and Egypt (Taskavak & Bilecenoglu, 2001). Kuthalingam (1955) reported that *A. djedaba* is a migratory species.

Alepes djedaba is one of family Carangidae, its common name is shrimp scad as it has a common body profile of a scad , usually found on inshore reefs and sandy substrates. The name *Alepes djedaba* was proposed by Gushiken (1983) in an extensive review of the Carangidae of Japan, identifying a number of morphological features associating it with *Alepes*. *A. djedaba* is known to inhabit the Red sea (Adam, 1966). According to Carpenter *et al*. (1997), *A. djedaba* is considered as a living marine resource in the eastern Saudia Arabia. It is one of the larger scads, growing to 40 cm, but more often seen around 25 cm (Iwatsuki& kimura, 1996).

A. djedaba is a commercial fish in most countries. Van der Elst and Peter (1988), stated that this species is considered a good fish for eating. Davidson (2004), also recorded that the flesh of this species is of good quality and some regions regard various species of *Alepes* as hjgh quality and market them fresh or dry and salt.

According to Venkataramani and Natarajan (1984), reproductive features of most species of *Alepes* are badly known. The present study is a trial to reveal the biological facts on the reproduction of *A. djedaba*

2. Materials and methods

Random samples of 490 individual of *A. djedaba* were monthly collected from the commercial landed catch along the Arabian Gulf, Kingdom of Saudia Arabia. The total length of fish sampled ranged between 17 and 32 cm with gutted weights varied from 60 to 410 gm.

2.1. Spawning season

Gonadosomatic index (G.S.I.) was used to determine the spawning season according to Schaefer and Orange (1959), G.S.I. = (gonad weight / gutted weight) x 100.
The gonad and gutted weights were recorded in (gm) for each fish and the monthly variations in gonadosomatic index were determined for males and females.

Maturity stages were determined for each fish according to Nikolsky (1963) as follows;

Stage (I), immature: The testis and ovary are thread- like.

Stage (II), maturing: The testis is pale pink in color and transparent. The ovary is regular straight, creamy to rosy pink and occupies lesser than one third of the body cavity.

Stage (III), mature: The testis looks like a narrow ribbon, white in color and opaque. It appears just under the kidneys and occupies the whole body cavity. The ovary is rose to faint pink in color with orange tint and is more or less of equal diameter and extends through 1/2 of the body cavity.

Stage (IV), prespawning: The testis is dirty white in color, ribbon like throughout its length and opaque. The diameter of the gonad has increased. The ovary is round, yellow to orange in color, compact and occupies the whole length of the body cavity. Large ova can be detected by the naked eye.

Stage (V), spawning: The test is still ribbon like and milky white in color, upon pressing on the belly of the fish, milt gets out from the genital opening. The ovary is reddish orange, round filled with ripe yellowish eggs. Eggs could be released with a gentle pressing on the belly.

Stage (VI), post spawning: The testis is flaccid and dirty white in color, some residual milt is still in the gonad. The ovary is shrunken loose, folded and flaccid, dark violet in color; transparent with few large ova could be detected.

2.2. Sex ratio

The sex ratio was calculated as the ratio between the total number of males to total number of females for the whole sample.

2,2,1. Length at onset of sexual maturity

The estimation of length at sexual maturity (L_{50}) was calculated according to the formula:
Ln (P/ 1-P) = a+ bL (Gunderson, 1977) where:
P: is the proportion of mature individuals in each length interval.
L: is the mean length.
a and b are constants.

2.3. Hepatosomatic Index (H.S.I.)

The hepatosomatic index was calculated for each fish as the percentage ratio of liver weight to gutted weight. Monthly variations in H.S.I. were determined.

2.4. Fullness index (FI)

The fullness index was determined as the percentage ratio of the weight of stomach content to the gutted weight of the fish body.

2.5. Length- weight relationship and condition factor

Length weight relationship was estimated for the combined sexes of the whole sample by using the power equation of Le Cren (1951), $W = aL^b$

Where, W: is the gutted weight in gm, L: is the total length in cm, a& b are constants. There were no significant differences in the exponent "b" between males and females (P= 0.05), therefore we used the combined sexes.

The condition factor "K" was calculated for the whole sample following the equation of Hile (1936),

$K= (W / L^3) \times 100$.

3. Results

Monthly variations in gonadosomatic index(G.S.I.) are shown in (Figure1), it is clear that the mean value of G.S.I. for both males and females increased from January to June. It reached its maximum value in May for males and in June for females. The G.S.I. decreased suddenly in July after which a gradual decrease occurred from August to October, with a marked little increase in November for both sexes.

The monthly variations in G.S.I. took the same trend in both males and females. This shows that the spawning season of *A. djedaba* lasted from January to June.

Monthly variations in sexual maturity stages were determined for both males (Figure 2) and females (Figure 3). From these figures, it is clear that stage IV appeared from January to June and stage V(ripe) was observed in the two sexes in May and June. Stage VI was observed in males in June, July and August and in females in July, August, September and November.

These results show that both males and females have a prolonged spawning season with a peak in May and June.

From 490 fish examined, samples 208 were males and 282 were females, so the overall sex ratio of males to females *A.djedaba* was 1: 1.36 showing a predominance of females.

The size at onset of sexual maturity was calculated according to the equation of (Gunderson, 1977). From this equation, it appears that the length at which 50% of the individuals were sexually mature was 17.6 cm for males and 18.1 cm for females.

Monthly variations in hepatosomatic index (H.S.I.) were calculated for the combined sexes (Figure 4). The mean values of H.S.I. reached their maximum in December (2.15), February (2.25) and May (2.15). The least value was noticed in August (1.28).

Monthly variations in fullness index (F.I.) was shown in (Figure 5), from this figure it is clear that *A. djedaba* has a slightly high rate of feeding in the months from December to March, then this rate gradually decreased.

The length weight relationship for *A. djedaba* is represented in (Figure 6) and expressed by the following equation: $w = 0.0159\ L^{2.9}$ $R^2 = 0.93$

This equation shows that the value of "b" shows slight negative allometry (2.9). Monthly variations in condition factor (k) (Figure 7), show a little increase in the mean value in October, November, December and January. Then a decrease in July, August and September was noticed. It reached its lowest value in September.

Variations in the mean value of condition factor with length group (Figure 8) show that the maximum value of "K" (1.85) was observed at length group 19 cm, then it decreased gradually with increasing total length.

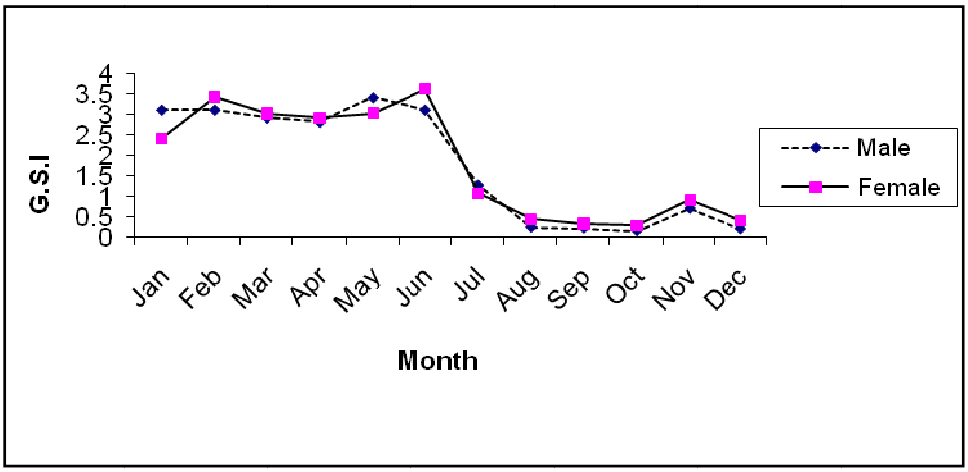

Figure 1. Monthly variations in gonadosomatic index (G.S.I) for males and females *A. djedaba.*

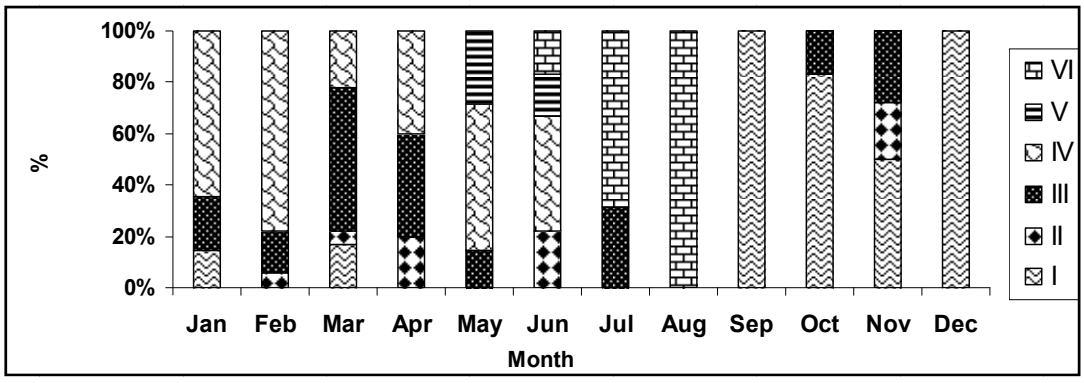

Figure 2. Monthly distribution of maturity stages for male *A. djedaba.*

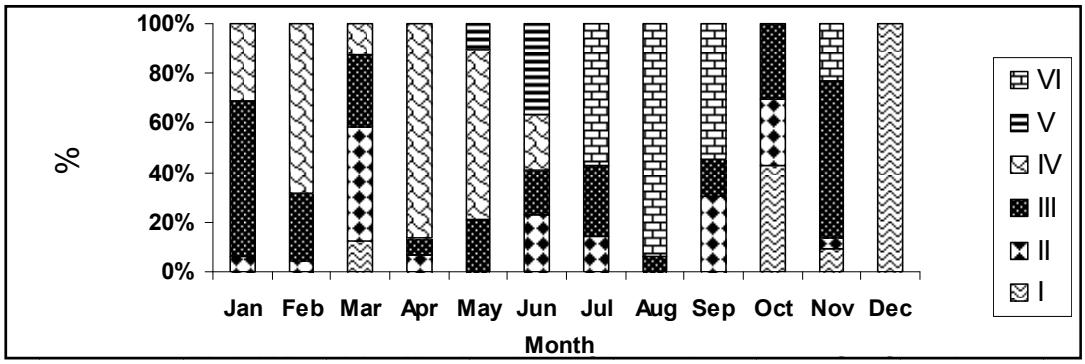

Figure 3. Monthly distribution of maturity stages for female *A. djedaba*

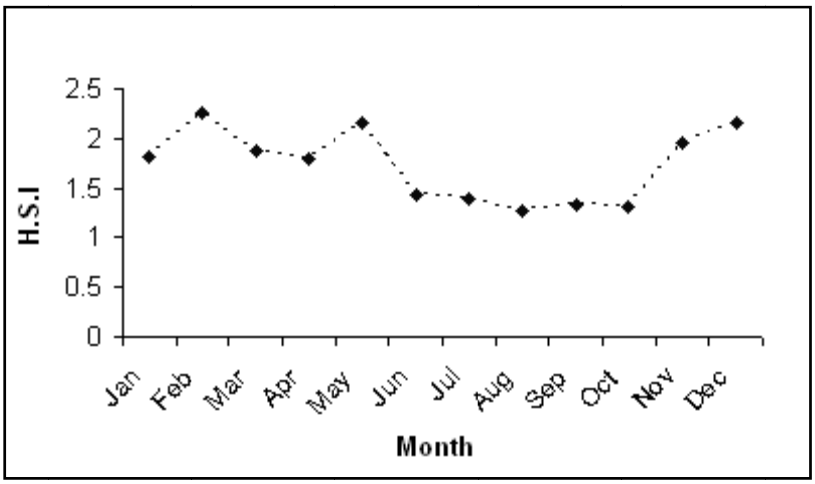

Figure 4. monthly variations in hepatosomatic index (H.S.I) for *A. djedaba.*

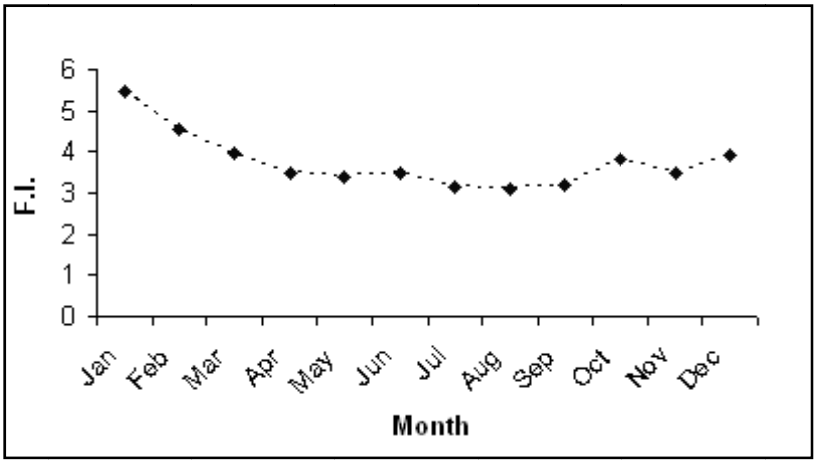

Figure 5. Monthly variations in fullness index (F.I.) for *A. djedaba.*

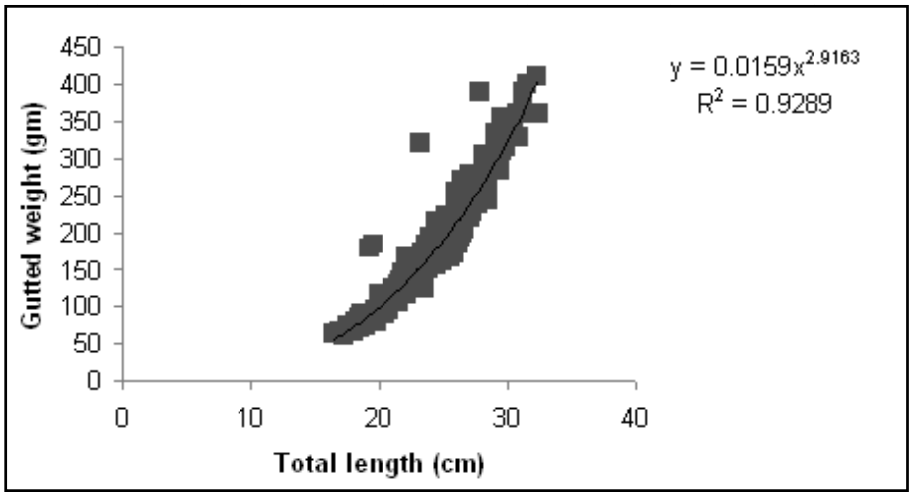

Figure 6. Length weight relationship for *A. djedaba.*

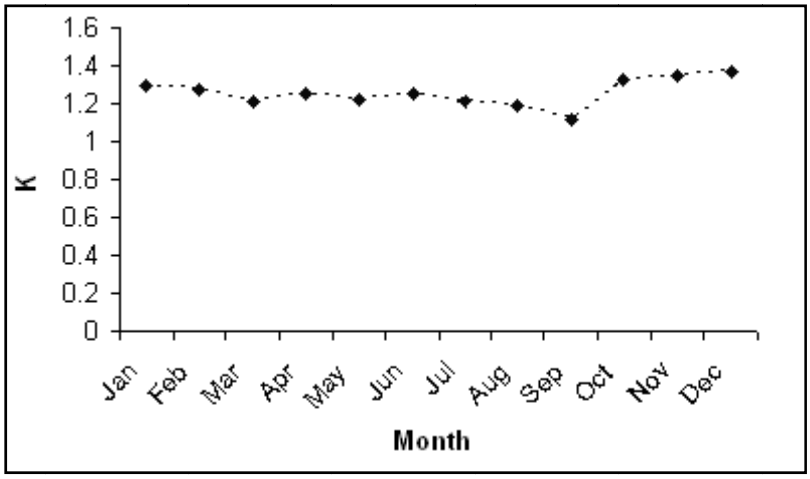

Figure 7. Monthly variations in condition factor (K) for *A. djedaba.*

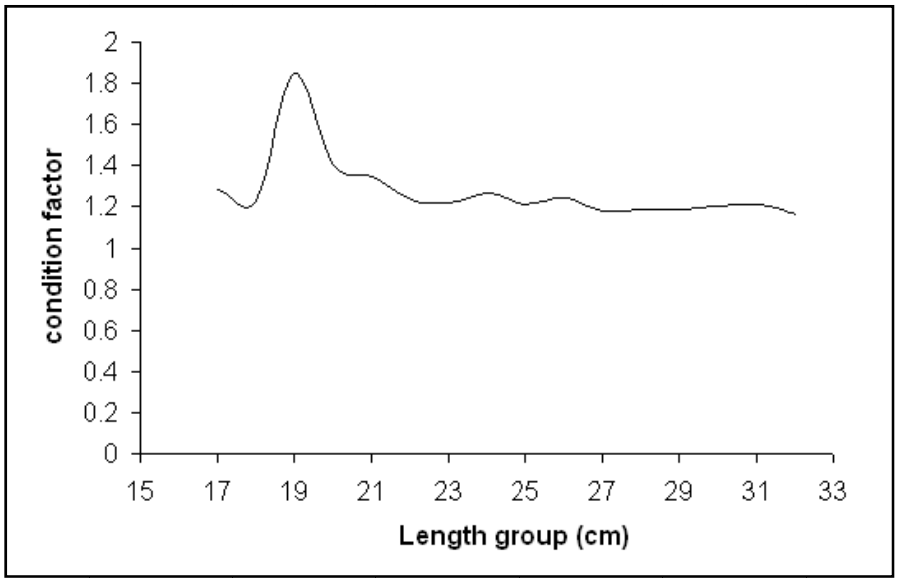

Figure 8. Variations in condition factor with length group in *A. djedaba.*

4. Discussion

Study of sexual cycle of *A.djedaba* shows that the spawning season lasts from January to June. These results show that the species understudy is a prolonged spawner. Venkataramani and Natarajan (1984), stated that the reproduction of most species of *Alepes* is unstudied, except for *A. kleinii*. This species spawns on a single event over a period of a few months, releasing small transparent pelagic eggs. The last authors reported that natural spawning behavior in the genus *Alepes* needs further studies.

The study of Sivakami (1990), on the ova diameter of *A. djedaba* from Cochin revealed the presence of batches of mature and maturing ova probably released in two batches during June to November. Van der Elst & Peter (1988), proposed that the spawning of the last species occurred in shallow coastal waters. Afonso *et al*. (2008) studied another species from Carangidae *Pseudocaranx dentex* in Azores, central north Atlantic, the spawning season of this species lasted from June to September. It undergoes the maturation process throughout late winter and spring and becomes reproductively active in June with a spawning peak in August and recedes in September. The last authors reported that *P. dentex* is an annual spawner that most probably release gametes in multiple events during summer. Rowling & Raines (2000) as well as Farmer *et al.* (2005) showed that *P. dentex* is a partial spawner and stated that the maturation accompanied the increase in temperature in spring.

The peaks of spawning in the species under the present study in May and June could also be related to the summer increase in temperature. Bye (1984) and Stacey (1984) reported that environmental factors such as photoperiod, temperature, salinity and stress are known to influence activities in both sexes of a fish species.

The sex ratio of males to females in *A.djedaba* was 1: 1.36; this means that the females predominate males. This phenomenon of prevailing females over males is common among fish species in different families. Manooch (1976), found that the ratio of males to females in *Pagrus pagrus* was 1: 1.9 and 1: 1.33 in different years. Pajuelo and Lorenzo (1996) found this ratio in the same species 1:3.3. Al Abdulhadi and Osman (2009) found that the overall sex ratio of *Rhabdosargus haffara* (males to females was 1: 1.68.

The size at first sexual maturity in the present study was 17.6 cm total length for males and 18.1 cm for females. This size was recorded for the same species by Carpenter & Volker (2001) as 17 cm fork length and by Sivakami (1990) as 18- 18.9 cm. The present study also shows that males reach sexual maturity earlier than females. This result is known in other fish species (Wootton, 1990; Zaki *et al*., 1995; Osman, 2000 and Al Abdulhadi and Osman, 2009).

Hepatosomatic index is defined as the ratio of liver weight to body weight. It provides an indication on status of energy reserve in an animal. The present study of monthly variations in H.S.I. reveals that this value increased from November to May, which includes the spawning season. The least value of H.S.I. was in August; the post spawning season.

Monthly variations in fullness index were calculated in order to follow the annual rate of feeding and its relation with the spawning season. An increase in the rate of feeding was noticed from December to March, after which the rate of feeding decreased. As is shown before, the peak of spawning of that species occurred in May and June, so that we can say that the species understudy increased its feeding before entering the spawning period to use the energy from

this food in producing the gonadal products, then it decreased its feeding rate during and after spawning. These findings are in accordance with Sivakami (1990), in studying *A. djedaba* from Cochin who observed higher percentage occurrence of empty stomachs and lower volume of food consumed during the breeding season, an indication of reduced feeding activity during that period.

Length and weight data are standard results of fish sampling for the biology of a fish species. Ponderal growth in this study shows slight negative allometry, with "b" value (2.9) in the length weight relationship. This is in accordance with Taskavak and Bilercenoglu (2001), who found the value of "b= 2.8" for *A. djedaba*. On the other hand, Sivakami (1990), studied the length weight relationship of the species understudy and obtained a value of "b= 3.14", which means positive allometry. Afonso *et al.* (2008) in their studying *Pseudocaranx dentex* (Carangidae) recorded that there were no differences in the maturation or length weight relationships between sexes. This is in accordance with the present study, where no difference in length weight relationship was noted between males and females.

The condition factor (k) has been widely used to express the suitability of an environment to a certain fish species. It is an important indicator of the degree of well being and relative robustness of the fish population. The value of (k) varies with fish length, weight, season and state of maturity (Lagler, 1956). A higher condition factor reflects good environmental quality, while a low condition factor reflects poor environmental quality. Monthly variations in the value of (k) showed a decrease in the months from July to September that is after completing the spawning season as the fish became exhausted.

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