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Reproductive Biology of Lizard Fish, *Saurida tumbil* (Forskal) in the Jizan Region of the Red Sea

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ABSTRACT. The reproductive biology of lizard fish *Saurida tumbil* in the Jizan region of the Red Sea was studied during 1986. Females outnumbered males and attained larger size than males. Among young individuals males were more numerous than females, while in older age groups the females were more numerous. There is no significant difference in length-weight relationship between the sexes. The equation for the two sexes are found to be

$$\log w = -\log 1.954 + 2.958 \log L$$

The smallest size at first maturity was 11 cm for males and 13 cm for females. About 50% of the females were mature at a length of 19 cm.

The spawning of males and females extended throughout the year. The greatest amount of spawning was observed during winter. Gonado-carcass ratio of females was high from October to May. Spawning is often concentrated at the time of the year when prevailing winds or currents are at their weakest. Monthly variations in the visceral carcass ratio and relative condition were analysed for both sexes in relation to spawning activity. This species is carnivorous and feeds mainly on fish.

Introduction

The spawning time and its relation to environmental factors in tropical fish have been reviewed by many authors (Munro *et al.*, 1973; Erdman, 1976; Johannes, 1978; Fursa, 1979). There are various methods to measure the spawning time of fish, one of which involves estimation by the frequency of occurrence of the eggs and larvae of fish in the sea whilst the other is based on frequency of ripe fish in the catch (Fursa, 1979).

Some work has been carried out on the various aspects of the biology of *S. tumbil*. In the Indian waters Rao (1984) studied the length-weight relationship. However, Budnichenko and Nor (1978) and Budnichenko and Dimitrova (1980) described growth and reproductive biology of the *S. tumbil* in the Arabian sea. Recently, Euzen (1989) and Mathews and Samuel (1989) studied the feeding habitats and population dynamics of the same species in Kuwait waters. During an earlier study in the Jizan area, the lizard fish *Saurida tumbil* (Forskal) was found to be one of the most regularly occurring and abundant species throughout the year (Oakley and Bakhsh, 1989). In spite of these studies, similar work in the Red Sea is lacking. Therefore, the aim of this paper is to provide some basic information on the reproduction of lizard fish close to Jizan and Farasan Island. The various aspects covered include sex-ratio, length-weight relationship, length at first maturity, spawning pattern.

Material and Methods

Biological studies were carried out on lizard fish, *Saurida tumbil*, from the coastal waters of Jizan, southern Red Sea. Fish samples were collected during 1986 by experimental trawl fishing with mesh size of 60-70 mm and from commercial fishing trawlers (40-50 mm) of the Saudi Arabia Fisheries Company (SFC). Details of the hauls made and the area trawled are given in Oakley and Bakhsh (1988, 1989).

In the laboratory, total length and carcass weight (*i.e.* total weight less gonad, viscera and food content) were measured. Monthly fluctuations in the gonad/carcass ratio (GCR) for both sexes were estimated. The GCR was calculated as follows :

$$GCR = [\text{gonad weight}]/[\text{carcass weight}] \times 100$$

The visceral/carcass ratio (VCR) was calculated in

similar manner to GCR. Condition factor K_n was calculated as follows :

$$K_n = W/w$$

where W represent the observed carcass weight, and w the calculated carcass weight from the weight relationship equation. The fish carcass weights were used to eliminate any possible influence of different factors (gonads, visceral and food content) on K_n value. The individual K_n values were grouped according to sex and month of the year.

Preference for food was estimated as frequency of occurrence by calculating the number of stomach containing a states prey as a percent of the total number of stomachs examined. Food items were identified to the lowest taxon as possible.

Results

Sex-ratio

Out of 631 fish sampled, 226 males and 405 females were identified giving the ratio of males to females 1:1.79. A Chi-squared test showed a significant departure from 1:1 ratio ($P < .01$). Sex ratio was not steady throughout the year. Data in Fig. (1) showed that a high percentage of females were caught from January to April, but from May to July the males were dominant. Between August to December, females again dominated, except during the month of October. Sex ratios varied considerably with length (Fig. 2). Male percentage was higher in small size groups, from 13-19 cm, whereas female percentage increased progressively from 20 to 30 cm. Fish more than 30 cm were all female.

Length-weight relationship

A total of 247 specimens of *S. tumbil* (158 females, 89 males) ranging in size from 12 to 33 cm, were used to determine the length-weight relationship. Double logarithmic regression analysis was applied using the following formula :

$$\text{Log } w = \log a + b \log L$$

where w = carcass weight, L = total length (cm), a, and b are constants. The relationship was calculated separately for each sex and the equations obtained were as follows :

male; $\text{Log } w = (-1.987) + 2.982 \log L$

female; $\text{Log } w = (-1.906) + 2.924 \log L$

The slope and intercepts were compared statistically and were found to be insignificant ($P > 0.05$). Hence the length weight data of male and female fish were pooled together and the equation for the length weight relationship for both sexes was calculated as follows :

$$\log w = (-1.954) + 2.958 \log L$$

Sexual maturity stages

For sexual maturity studies, female *S. tumbil* were grouped into 3 stages, immature, ripe, and resting. Males were grouped into 2 stages, immature and ripe

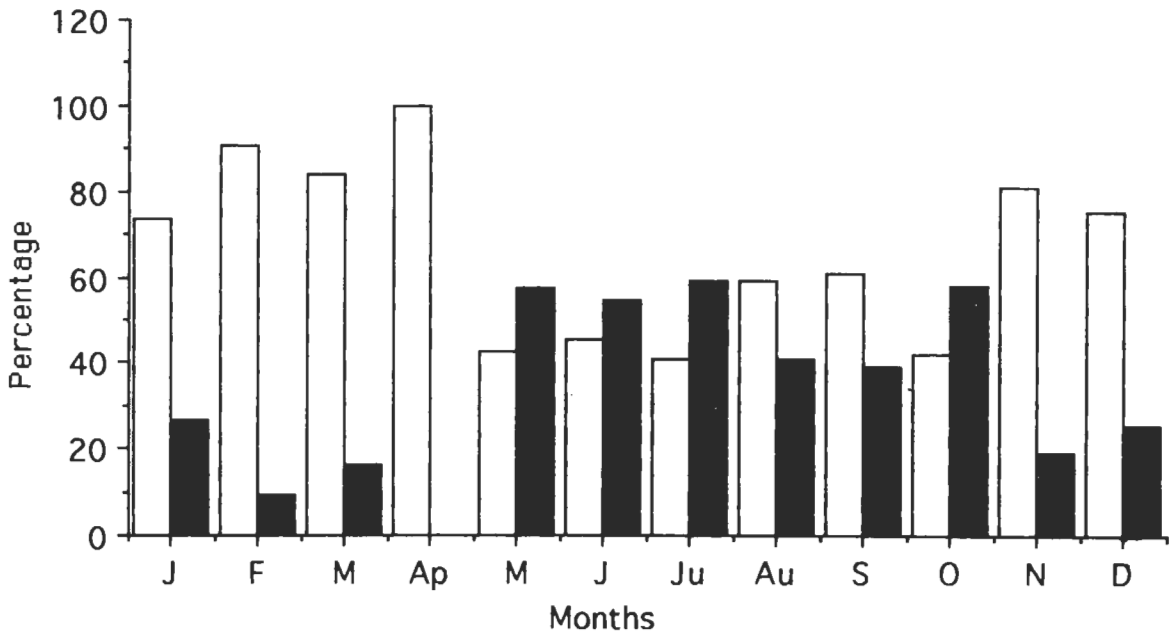

FIG. 1. Monthly variation in sex-ratio of *S. tumbil* during 1986.

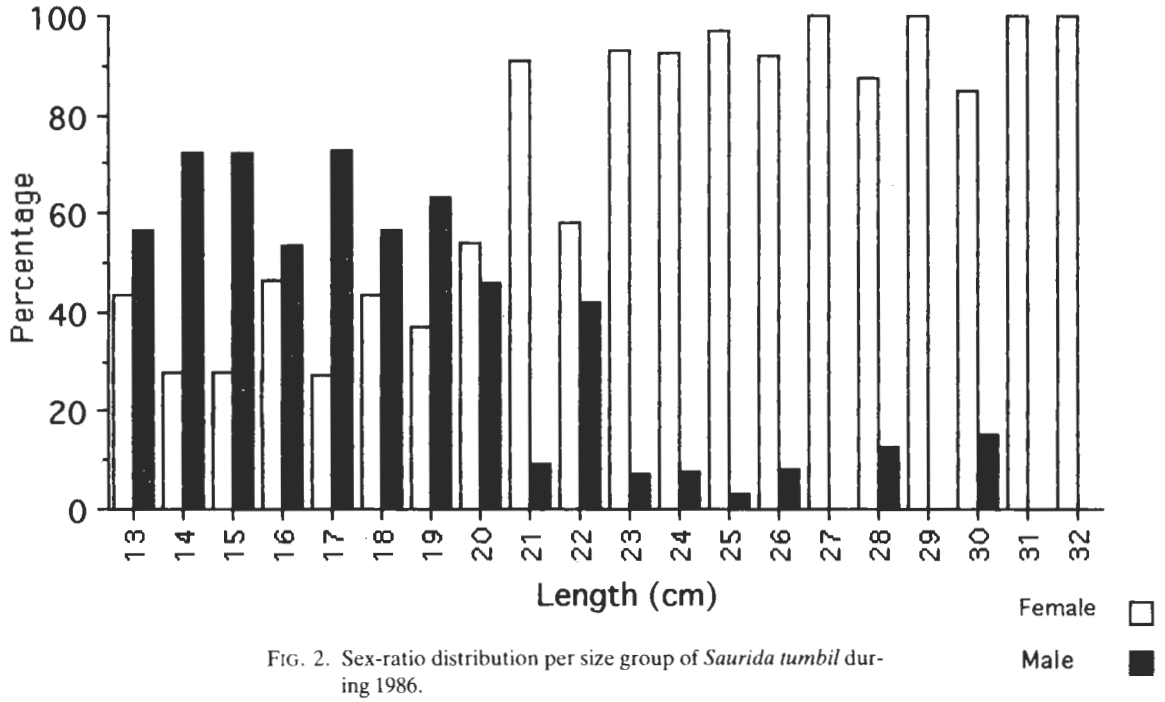

FIG. 2. Sex-ratio distribution per size group of *Saurida tumbil* during 1986.

because a resting stage was not detected for the male population. For each month, each stage was expressed as a percent of the total female or male population (Fig. 3, 4).

A high percentage of ripe females was found throughout the year except from June to September. Resting stages occurred in a low percentage during most of the year but disappeared from September to December and February (Fig. 3). Immature females occurred throughout the year. Immature and ripe males showed considerable monthly fluctuations throughout the year (Fig. 4).

Length of First Maturity

Mature males first appeared at 11 cm while females reached this stage at a larger size of 13 cm; both were

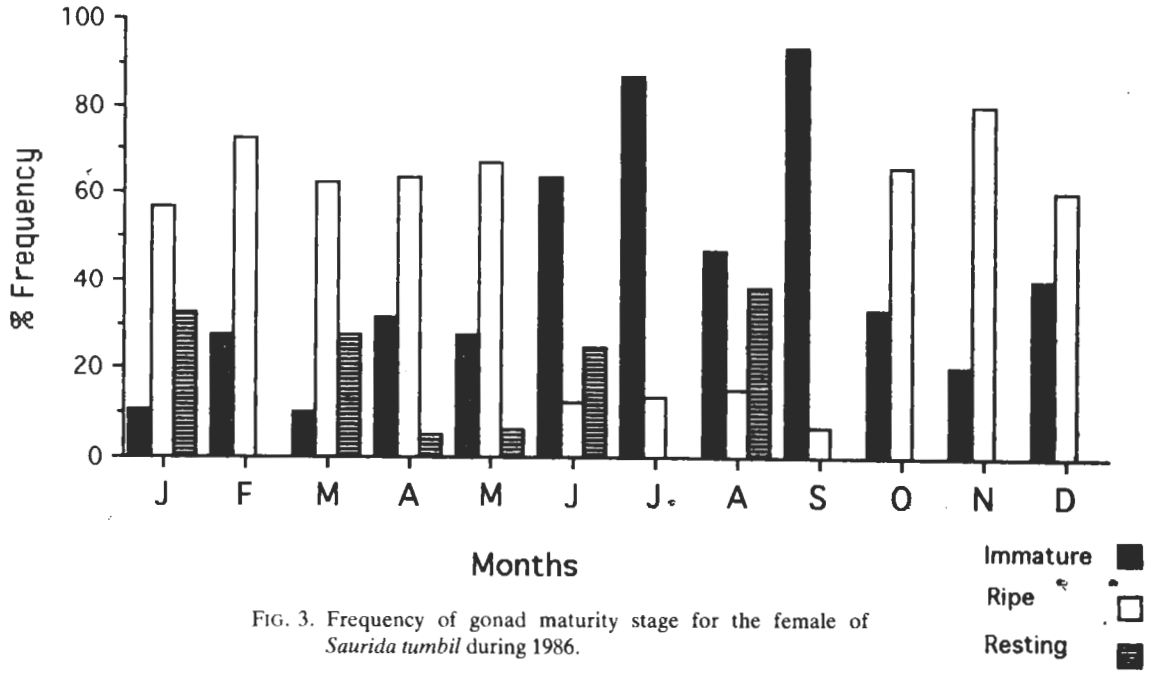

FIG. 3. Frequency of gonad maturity stage for the female of *Saurida tumbil* during 1986.

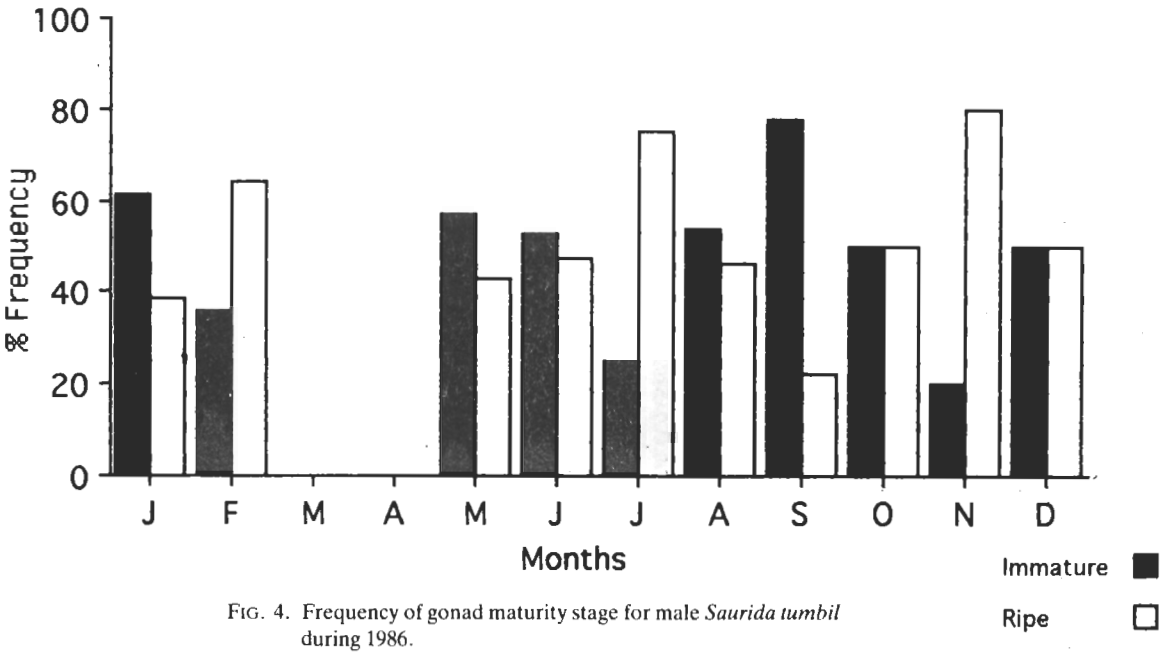

FIG. 4. Frequency of gonad maturity stage for male *Saurida tumbil* during 1986.

collected during summer, June to October. For females 50% were mature at length 19 cm. All males were found to be mature at a size of 24 cm and females by 29 cm.

Gonado Carcass Ratio (GCR)

The relationships between GCR and season are given in Fig. 5 and 6 for both sexes. In females the peak GCR extended from October until the following May (Fig. 5). The highest average GCR was observed from February to May. The GCR sharply declined during June to September and started to peak from October. The average GCR of males was lower than females. The GCR of males reached the highest average in May and then declined towards September. The average value increased from October to February but values for March and April were not found in the samples.

Visceral Carcass Ratio (VCR)

The relationship between VCR and season for both sexes is given in Fig. 7 and 8. In females, the mean av-

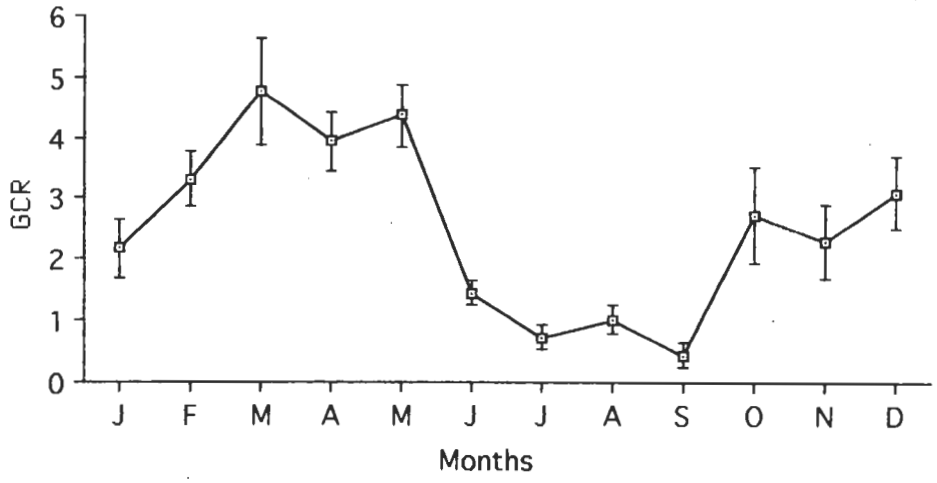

FIG. 5. Seasonal variation in gonado-carcass ratio (GCR) of female *Saurida tumbil* during 1986. Vertical bars represent S.E.

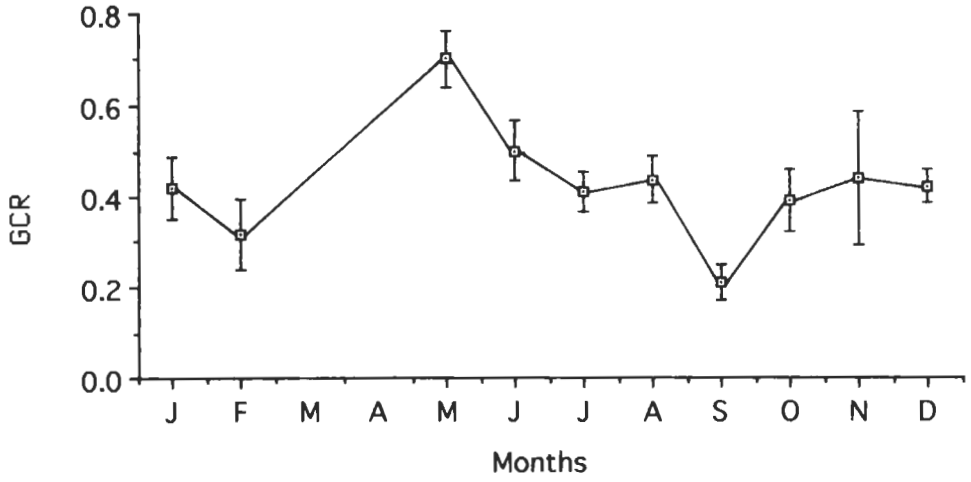

FIG. 6. Seasonal variation in gonado-carcass ratio (GSR) of male *Saurida tumbil* during 1986. Vertical bar represent S.E.

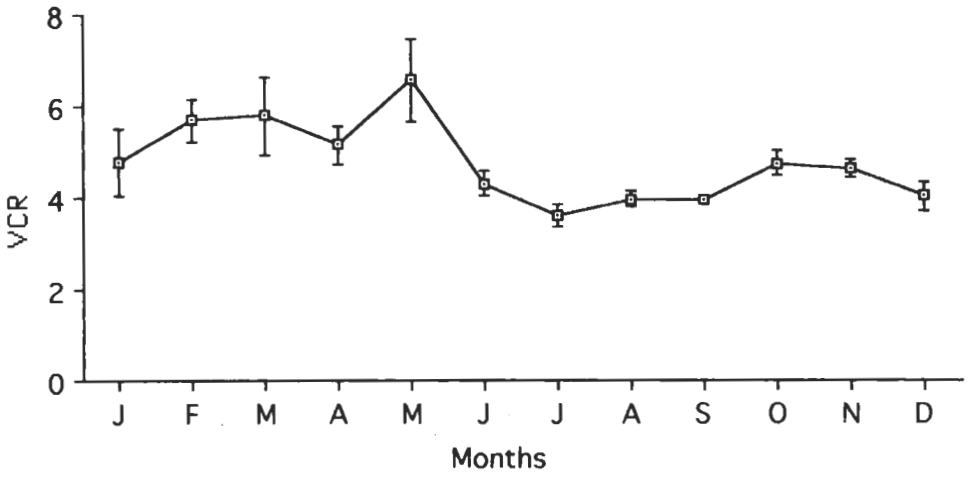

FIG. 7. Seasonal variation in visceral-carcass ratio (VCR) of female *Saurida tumbil* during 1986. Vertical bars represent (S.E.).

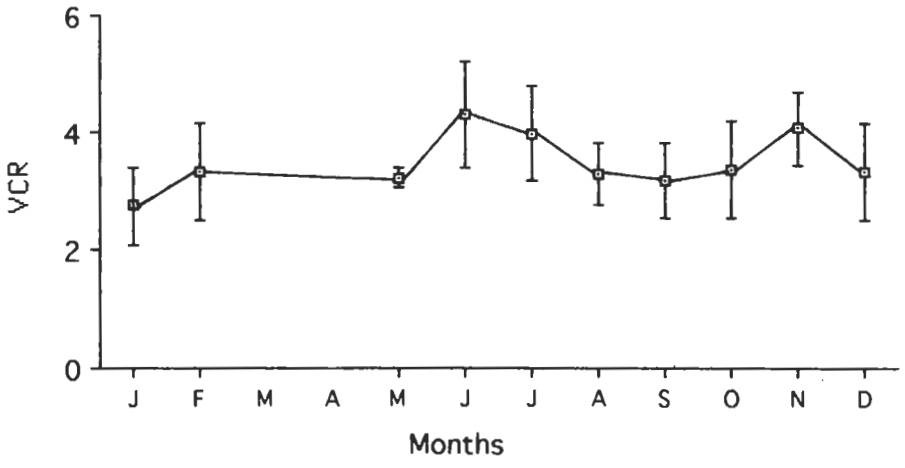

FIG. 8. Seasonal variation in visceral-carcass ratio (VCR) of male *Saurida tumbil* during 1986. Vertical bar represent S.E.

erage of VCR was higher than that of males and showed a different pattern. The VCR of females was higher from January to May, but was lower from June to December. In males, the VCR average varied slowly throughout the year. The peak average was recorded in June and November (Fig. 8).

Condition Factor (K_n)

The monthly average of relative condition factor (K_n) for the males and females are presented in Fig. 9 and 10. It was noticed that seasonal variation in K_n followed a similar pattern in both sexes. K_n was highest during February and decreased gradually until July, then started to increase in August.

Food

Specimens collected during 1986 were used for analysis of food. Table (1) lists the species found in the stomachs of *S. tumbil* based on examination of 362 specimens ranging in size from 12-33 cm. The principal food item of lizard fish is fish, particularly lizard fish and sardine. It was eating smaller size specimens of its own species or genera like *Saurida undosquamis*. Lizard fish and sardine occurrence were 70% and 22% respectively. Three other fish species were also frequent in stomachs, *Nemipteridae* (*N. japonicus* 10%), *Carangidae* (*Atule mate* 3%) and *Scombridae* (*Rasterelliger kanagurta* 7%). The chief invertebrate prey were periacid shrimps and the molluscs (mainly squid) which constituted 11% and 8% respectively. The shrimp species identified were *Penaeus semisulcatus* and *Metapenaeus monocerus*. There was very little variation in diet with length but small fish seemed to prefer fish fry. Analysis of this data indicated that there was no marked constant tendency for larger lizard to select larger prey. Lizard fish can eat larger

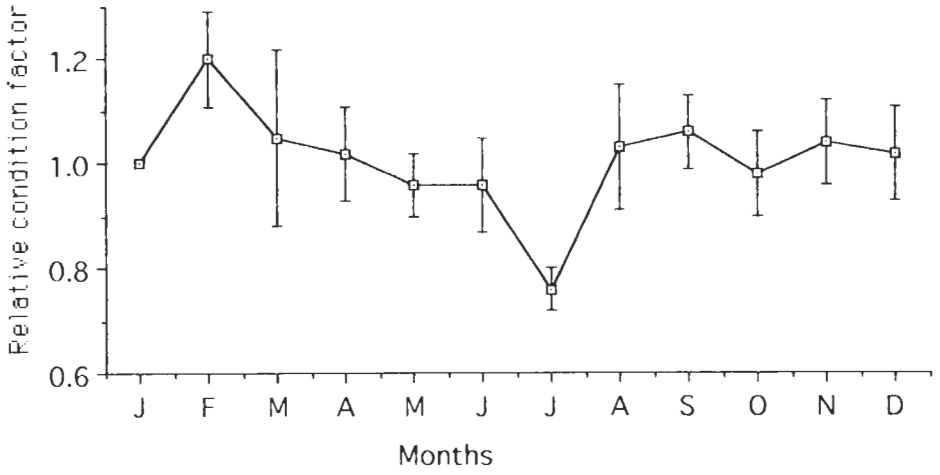

FIG. 9. Seasonal variation in the relative condition factor of female *Saurida tumbil* during 1986. Vertical bar represent S.E.

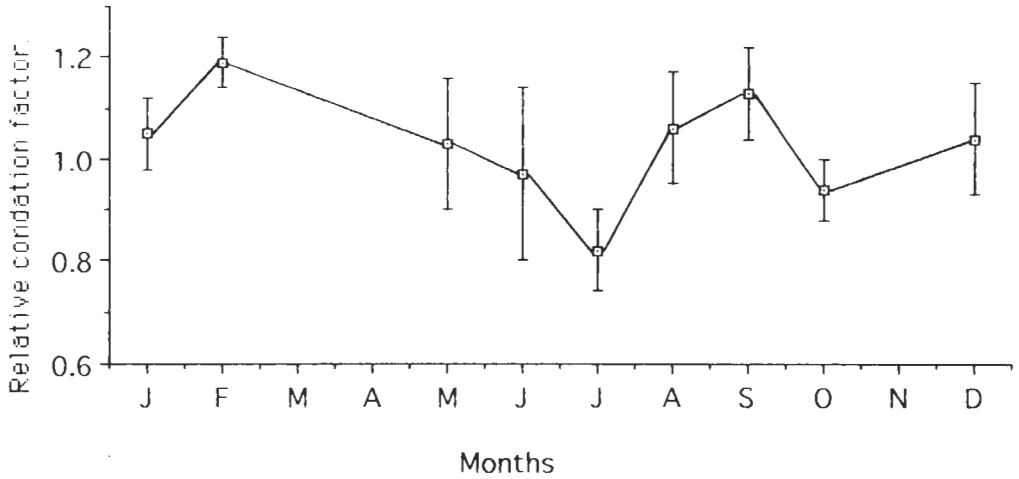

FIG. 10. Seasonal variation in the relative condition factor of male *Saurida tumbil* during 1986.

TABLE 1. Analysis of the stomach contents of *S. tumbil* in Jizan area during 1986.

Food items	Occurrence %
Penaeidas :	
Shrimp	11
Mollusca :	
Squid	8
Scombridae :	
Rasterelliger kanagurata	7
Nemipteridae :	
Nemipterus japonicus	10
Synodontidae :	
Saurida tumbil	60
Saurida undosquamis	10
Carangidae :	
Atule mate	3
Decapterus	2
Caranx	1
Teraponidae :	
Terapon puta	1
Clupeidae :	
Sardina	22
Gobidae	1
Bothidae	1
Unidentified fish	27

prey; in some instances the stomach was so distended that prey items were visible through the wall.

Discussion

Sex composition of *Saurida tumbil* populations has been studied by earlier investigators (Budnichenko and Nor, 1978; Budnichenko and Dimitrova, 1980). In the Arabian Sea, overall the males predominate over females; the young males of *S. tumbil* were larger in number than females, although in older age groups the females were more dominant (Budnichenko and Nor, 1978; Budnichenko and Dimitrova, 1980). But in the present study, the sex ratio was (1:1.7) in favour of females. It was again observed that males were dominant in size 13-19 cm, while females were dominant over a size of 23 cm. The males were more abundant than females during summer (May to July). This could be to facilitate and ensure successful fertilization of females. The situation was different during the rest of year, when females exceeded the males. This may be due to the movement of females toward the shore for spawning.

The first male *S. tumbil* attained maturity at a smaller size (11 cm) than the females (13 cm). In Indian waters, Rao (1984) observed that nearly 50% of the females are mature in the size group 28-30 cm whereas, in the present study, nearly 50% of the females were mature in size group 19-20 cm.

Differences in length-weight relationship between sexes in lizard fish are known. Rao (1983) found that there is significant difference in the regression between the sexes in *S. tumbil* in Indian waters. In the present study, there was no significant difference in the regression between the sexes. In Indian waters, Rao (1983) found that the power term is greater than 3 for females (3.20) and males (3.29). Near Kuwaiti waters, in the Arabian Gulf, the slope was 3.08 for *S. tumbil* (Mathews and Samuel, 1989). In the present study, the slope for females is 2.92 and for males is 2.98. Both authors used total weight for estimating length-weight relationship, whereas carcass weight was used here.

It is recognized that the spawning season of marine fish is characteristically longer at lower latitudes (Qasim, 1955; Munro *et al.*, 1973). Erdman (1976), in a review of the spawning patterns of Caribbean fishes, found many marine species which spawn the year-round, with seasonal peaks occurring once or twice at year. Fewer species showed limited and well-defined spawning periods. In the eastern part of the Arabian Sea, Fursa (1979) also showed that most species have prolonged spawning whereas, in some species, spawning is confined to restricted periods but others are year-round. In this respect, it would appear that the spawning pattern of *S. tumbil* is similar to that of other tropical fishes. In Indian waters, Rao (1984) found that spawning occurred from October to March, whereas along the west coast of India it occurred from September to January (Weber, 1976). In the eastern part of the Arabian Sea, the spawning extended from October to February (Fursa, 1979). Also, Budnichenko and Dimitrova (1980) found that in the Arabian Sea *S. tumbil* exhibits year-round spawning, with a peak during the winter monsoon period. The results of the present study indicate that females have protracted spawning extending from October to May. The spawning season of males occurred throughout the year. This is probably to ensure fertilization of eggs. This long spawning for both sexes is supported by sexual maturity stage and GCR.

Some factors may confuse the general pattern of spawning between the GCR and stage of maturity since *S. tumbil* are fractional spawners (Budnichenko and Dimitrova, 1980). Delahunty and De Vlaming (1980) stated that gonadal weight may not be accurate measure of the gonadal activity. If the population of fish being studied is asynchronous in their gonadal development or are fractional, spawners gonadal weight can vary to a large degree. Therefore, the use of change in gonadal/carcass ratio may be used only as an

indicator of the timing of the breeding cycle.

Spawning of tropical fish has been correlated with the two monsoon trade winds (Low McConnel, 1979; Qasim, 1973; Fursa, 1979) but, a few authors emphasized that spawning can occur during calm conditions (Johannes, 1978; Wourms and Bayne, 1973). Johannes (1978) reported that the collective spawning peak in 13 out of 18 locations in the tropics occurs at a time of the year when prevailing current or winds are weakest. Wourms and Bayne (1973) noted that the full peak in reproductive activity of the Indian Ocean brotulid, *Dinematichthys ilucoeteoides,* corresponds to a period of calm season between the monsoons. In the present study, the peak spawning occurred in the calm period from October to May during the winter monsoon. We also noted that *Nemipterus japonicus* spawn from November to May in the Jizan area (Bakhsh, 1996). In the eastern part of the Arabian Sea, Fursa (1979) observed spawning of *S. tumbil* in the winter monsoon period (October-February).

Some comments are required on the seasonal variation of VCR and K_n in mature lizard fish. The VCR was lowest from June to December and may be due to passage of stored nutrients from the liver to gonad as well as their use in catabolism. The K_n decreased from February to July whereas VCR was highest from January to May. This may be due to feeding but also to translocation of material to liver from other parts of the body especially muscle. The peak value of K_n from August to January is associated with accumulation of fat. It may suggest that spawning make inroads into the liver reserves, which may no longer be maintained at the expense of the carcass. This heavy reproductive energy expenditure may mean that females need a higher energy supply.

The male gonad weight was less than the female gonad. These differences in magnitude between the sexes in the lizard must have considerable influence on the pattern of energy use. This is obvious, where K_n and VCR did not varied much throughout the year.

The main diet of *S. tumbil,* in this investigation, consisted mainly of fish, squid and shrimp. Similar results were reported by Euzen (1989) in the waters of Kuwait. However, clupeidae (*Ilisha indica*) was the dominant food item in Euzen's (1989) study but the most important prey items in the diet of our sample was *S. tumbil.* Euzen (1989) studied the food content of two species of *S. tumbil* and *S. undosquamis*. He found that they eat Theraponidae (*Helotes sexlineatus*), Cynoglossidae (*Cynoglossus macrolepidotus*), Nemipteridae (*Nemipterus japonicus* and *N. tolu*), Leiognathidae spp, Clupeidae (*Ilisha indica*), Carangidae (*Caranx leptolepis*). These were not present in our samples. This indicated that the food items are less abundant in the Jizan area.

The general impression of the feeding habits obtained from the analysis of the stomach contents is that this demersal fish feeds mainly on forms inhabiting the surface of the substratum or swimming just above it, because there was no trace of mud in the stomach, even though the fish were caught on a mud-bottom. The lizard fishes are known to be 'sit and wait' predators (Yeh *et al.*, 1977; Randall, 1983). Euzen (1989) stated that *Saurida* spp. are benthic–living fish and indicated that *Saurida* spp. is mainly a pelagic feeders.

During our analysis of data, it was found that some empty stomachs occurred throughout the year, but there is no obvious variation with season. Empty stomachs averaged 30%, whereas Euzen (1989) found a high percentage (52.7%) of empty stomachs in *Saurida* spp. samples.

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I would like to thank the Faculty of Marine Science, King Abdulaziz University for providing laboratory facilities and finances for this study. The Saudi Fisheries Company was generous in providing fish samples. The Ministry of Agriculture and Fisheries kindly allowed me the use of the R.V. Ibn Majed. Thanks are also due to Dr. S.G. Oakley, A. Salamah and other staff of the Faculty of Marine Science for their assistance in various ways. Many thanks to Mr. Ahmad Azzoghd for typing this manuscript.

References

Bakhsh, A.A. (1996) The biology of thread bream *Nemipterus japonicus* (Bloch) from the Jizan Region of the Red Sea. *J. KAU: Mar. Sci.*, **7**: 179-189.

Budnichenko, V.A. and **Nor, L.A.** (1978) Some characteristics of the growth of *Saurida undosquamis* and *Saurida tumbil.* Pisces synodontidae in the Arabian Sea. *VOPR ikbtiol.* **18**(5): 844-849.

——— and **Dimitrova, O.S.** (1980) Reproductive biology of *Saurida undosquamis* and *Saurida tumbil* synodontidae in the Arabian Sea. *VOPR iktiol,* **19**(5): 860-867.

Delahunty, D. and **De Vlaming, V.L.** (1980) Seasonal relationships of ovary weight, liver weight and fat stores with body weight in the goldfish *Carassias auratus. J. Fish. Biol.* **16:** 5-13.

Erdman, D.S. (1976) Spawning patterns of fish from Northeastern Caribbean. *Symposium on Progress in the Caribbean and Adjacent Regions. FAO Fish. Rep.* **200:** 145-170.

Euzen, O. (1989) Food habits and diet composition of some fishes of Kuwait. Presented at: *The Eighth shrimp and fin fisheries management workshop. Kuwait Bull. Mar. Sci.*, **10:** 65-85.

Fursa, A.I. (1979) On the seasonal nature of the spawning of fishes in the eastern part of the Arabian Sea. *J. Ichthyio.* **19:** 66-74.

Johannes, R.E. (1978) Reproductive strategies of coastal marine fishes in the tropics. *Env. Biol. Fish.* **3:** 65-84.

Low-McConnel, R.H. (1979) Ecological aspects of seasonality in fish of tropical water. in: **Miller, P.J.** (ed.), *Fish phenology; anabolic adaptiveness in teleost,* pp. 219-237, *Sym. Zool. Soc. Lond.* No. **44.**

Mathews, C.P. and **Samuel, M.** (1989) Multi-species dynamic pool assessment of shrimp by catch in Kuwait. Presented at: *The Eighth shrimp and fin fisheries management workshop. Kuwait Bull. Mar. Sci.* **10:** 147-168.

Munro, J.L., Gaut, V.C., Thompson, R. and **Reeson, P.H.** (1973) The spawning season of the Caribbean reef fishes. *J. Fish. Biol.* **5:** 69-84.

Oakley, S.G. and **Bakhsh, A.A.** (1988) The trawl fishery for shrimp and fin fish in the Jizan region of the Red Sea. *Proc. Saudi Biol. Soc.* **11:** 177-190.

———— and ———— (1989) Growth and mortality of the yellow tail Jack, *Atule mate* in the Red Sea. Presented at: *The Eighth shrimp and fin fisheries management workshop. Kuwait Bull. Mar. Sci.* **10:** 131-134.

Qasim, S.Z. (1955) Time and duration of spawning season of teleosts in relation to their distribution. *J. Cons. Internat. Explor. Mer.* **21:** 144-155.

———— (1973) An appraisal of the studies on maturation and spawning in marine teleosts from the Indian water. *Indian J. Fish.* **20,** No. 1.

Randall, J.E. (1983) *Red Sea Reef Fishes.* London, Immel Publishing.

Rao, K.V.S. (1983) Length-weight relationship in *Saurida tumbil* and *Saurida undosquamis* and relative condition in *Sauridae tumbil. Indian J. Fish* **30:** 296-305.

Weber, W. (1976) The influence of hydrographic features on the spawning time of tropical fish. In: **Tiews, K.** (ed.), *Fisheries Resources Management in Southeast Asia, pp. 269-281.* German Foundation for International Development, Berlin.

Wourms, J.P. and **Bayne, O.** (1973) Development of the viviparous brotulid fish *Dinematichthys ilucoeteoides. Copeia,* **1:** 32-40.

Yeh, Shean Y.A., Lin Lai Hang and **Chang Liu Hsi** (1977) Age and growth of lizard fish *Saurida tumbil* (Bloch) in the East China Sea and Gulf of Tonkin. *Acta Oceanographica Taiwanica,* **7:** 134-145.

بيولوجية التكاثر للسمكة السحلية *Saurida tumbil* في منطقة جيزان في البحر الأحمر

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المستخلص: تمت دراسة بيولوجية التكاثر لسمكة السحلية *Saurida tumbil* في منطقة جيزان في البحر الأحمر عام ١٩٨٦م، وقد وجد أن الإناث أكبر حجماً وأكثر عدداً من الذكور في الأطوار البالغة أما في الأطوار اليافعة فالذكور أكثر تعدادا من الإناث. ولا توجد علاقة إحصائية بين الوزن والطول لكلا الجنسين، وبالتالي تم توحيد معادلتهما لتصبح كالآتي:

$$\text{Logw} = -\log 1.954 + 2.958 \log L$$

وقد وجد أن أصغر طول عند النضج الجنسي كان ١١سم للذكور، ١٣سم للإناث، وأن حوالي ٥٠٪ من الإناث نضجت عند طول ١٩سم وأن التزاوج لكلا الجنسين يمتد طوال العام، بينما تبلغ ذروته في الشتاء وقد كان التزاوج يتركز خلال الفترة من السنة التي تكون فيها الرياح السائدة أو التيارات في أضعف حالاتها. . . . كما تمت دراسة التغيرات الشهرية لنسبة الامعاء إلى الوزن ومعدل الحالة لكلا الجنسين وعلاقتهما بالنشاط التزاوجي.

وهذا النوع يمتاز بكونه من آكلات اللحوم ويتغذى بشكل رئيسي على الأسماك.