World Journal of Fish and Marine Sciences 4 (4): 400-406, 2012
ISSN 2078-4589

DOI: 10.5829/idosi.wjfms.2012.04.04.62191

Studies on the Reproductive Biology of the Female *Saurida tumbil* in the Persian Gulf (Bushehr Province, Iran)

[1]S.A. Taghavi Motlagh, [1]A. Vahabnezhad, [2]M.J. Shabani, [2]M.A. Nazari and [3]M. Hakimelahi

[1]Iranian Fisheries Research Organization, P.O. Box: 14155-6116 Tehran, Iran
[2]Iran Shrimp Research Center, P.O. Box: 1374 Bushehr, Iran
[3]Iranian National Institute for Oceanography, P.O. B.ox: 1411813389 Tehran, Iran

Abstract: Studies were conducted on the changes occurring in the ovaries of female *Saurida tumbil* in the Persian Gulf (Bushehr Province) from October 2010 to September 2011. The mean length at first maturity (Lm 50%) for females was 29.5 Cm. The sex ratio was M: F = 1:4.6 which was significantly (P<0.05) different among samples. Gonadal samples were taken monthly from the females stained with Haemotoxylin and Eosin (H and E) stain and samples were studied by light microscope. Different stages of oocyte development (chromatin nucleolar stage, perinucleolar stage, cortical alveoli stage, Vitellogenesis stage and hydration, ovulation stage and degeneration stage) were surveyed. Monthly distribution of GSI values demonstrated that the main peak of GSI was in June and then it decreased gradually in the following months and again increased in September. The results of gonad development stages show that, *S. tumbil* is synchronous spawner. The length weight relationship for this species were estimated as $W= 0.0112FL^{2.977}$.

Key words: *Saurida tumbil* % Gonad % Sex Ratio % Development % Length at First Maturity

INTRODUCTION

Saurida tumbil (Synodontidae) commonly known as Lizard Fish is most dominant among the two species of Saurida reported from in Persian Gulf, Iranian shores. The Lizard fishes are a group of fishes widely distributed of Red Sea and East coast of Africa (except Kenya), including Madagascar to the Persian Gulf [1]. Furthermore, they made up an important part in trawl survey in the Persian Gulf. The mean total catch of Lizard fishes in Bushehr province was about 446 tons in ten years ago. According to the fishery statistics obtained from the fisheries department office of the Ministry of Agriculture in Iran in 1998, family Synodontidae is represented in the trawl survey conducted in the Persian Gulf by two species, *Saurida tumbil and Saurida undosquamis*. Fig. 1 shows the catch rates and estimated total catches for *S. tumbil* species harvested in the Persian Gulf. Landing data from 1997 to 2007 shows significant changes as the end 1977s catch's rates had slightly increasing trend onwards and around 2002s, catches began to increase until 2006, rapid and large declines were observed in the 2008s until 2009s that were less than 10% of total catch.

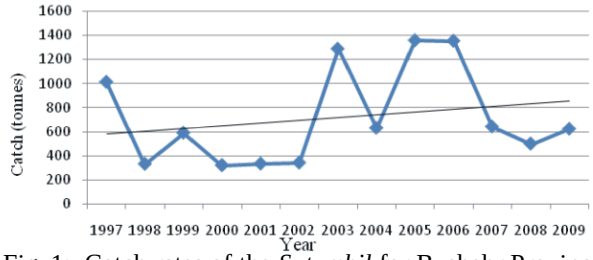

Fig. 1: Catch rates of the *S. tumbil* for Bushehr Province in the period 1997-2009

The biology and dynamics of *S. tumbil* have been studied in different localities [2-11] but no such studies have been recorded the Persian Gulf areas. Therefore, the aim of this study is to provide some basic information about the reproduction of *S. tumbil* in this area. The biological aspects of *S. tumbil* included in the present study are, sex-ratio, length-weight relationship, spawning pattern and length at first maturity.

MATERIALS AND METHODS

Sample Collection: In total, 358 individual fish were collected monthly regularly and directly from artisanal

Corresponding Author: Taghavi Motlagh, Iranian Fisheries Research Organization, P.O. Box: 14155-6116 Tehran, Iran.

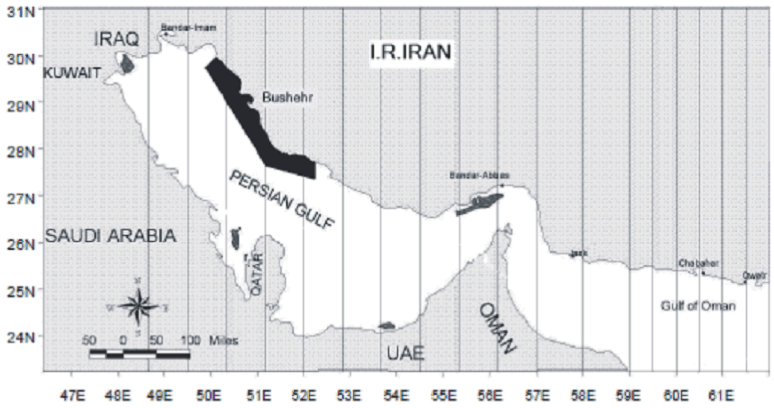

Fig. 2: Map of the Persian Gulf and Oman Sea showing the location of Bushehr Province

fishermen at landing station of South part of Iran, Persian Gulf (Bushehr Province) from October 2010 to September 2011. The fishes were captured by trawl (Fig. 2).

Biological Data Collection: Fork length (FL) of individual fish was taken to the nearest cm and total weight (TW) to the nearest 0.01kg. The gonads of each fish that could be sexed macroscopically were removed and weighed to the nearest 0.01 g. Each gonad was allocated to a maturity stage, based on the scheme of [12], yet in the case of females, has taken into account the histological characteristics of the ovaries. The spawning period was established from the analysis of three variables [13]:

- Percentage frequency of the maturity stages;
- Gonadosomatic index

$$GSI = (GNW/BW)*100$$

- Hepatosomatic index

$$HSI = (LW/GW)*100.$$

Fork length of all individuals was used to estimate the size at first maturity. These are defined as the sizes (FL) at which 50 % of all fish sampled are at the relevant maturity stage (III, IV and V) [14]. Using length interval of 2 cm the proportions of each maturity stage were estimated and the data fitted to a logistic curve [14].

The relationship between length (FL) and weight (TW) for 320 female Individuals was estimated using linear regression analysis. To linearalize the power curve ($W = aL^b$) that best described this relationship, both variables were transformed using Lnx. The line of the best fit for the linear relationship was described by [15]:

$$Ln\ TW = Lna + bLnFL.$$

Histological Analysis: Ovaries of 320 individuals were removed from females collected monthly from September 2010 to August 2011. Ovaries were placed in Bouin's solution for 48hrs and transferred to 70% ethanol. After fixation, the gonad tissues were dehydrated and embedded in paraffin and sections (5 µm thick) were stained with Mayer's haemalum and Young's Eosin balances [16]. The proportion of female to male was determined and the result was tested by Chi-square method.

RESULT

Development of Sexual Cells: Six consecutive oogenesis phases have been identified as a result of histological analysis. These phases were chromatin nucleolar phase, perinucleolar phase, Vesicle (cortical alveoli) stage, Yolk Granules or Vitellogenesis stage and hydration, ovulation stage and Degeneration stage respectively.

Chromatin Nucleolar Phase: Primary oocytes had a dark and a large nucleus along with a very large nucleolus and a lightly stained fine cytoplasm. Each oocyte was surrounded by several flat shaped follicle cells (Fig. 3a).

Perinucleolar Phase: The size of oocytes increased with growth of ovary. Compare to stage I, cytoplasm was stained less with haemotoxylin. The number of nucleoli increased. Nucleoli were located on the membrane of nucleus (Fig. 3b).

Vesicle (Cortical Alveoli) Phase: The oocytes at this stage were in the process of vacuolization (cortical alveolar system) and primary yolk production. Cortical

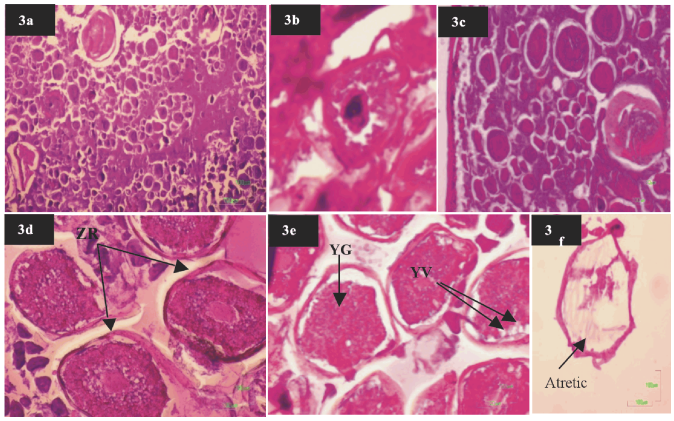

Fig. 3: (A) Ovary in chromatin nucleolar phase, (B) Ovary in perinucleolus phase, (C) Ovary in cortical alveolar phase, (D) Ovary in vitellogenic phase, (E) Ovary in mature phase and (F) Atretic follicle
YG - Yolk globule, YV- Yolk vesicle, ZR- zona radiate and Nu, nucleus

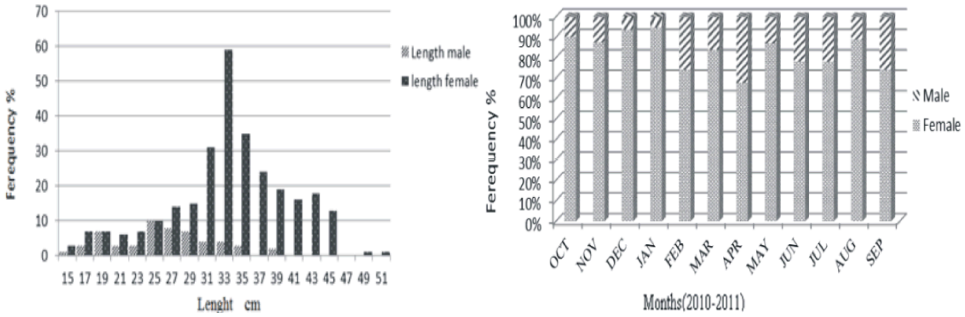

Fig. 4: Temporal distribution by sex and Sex-ratio distribution per size group of *S. tumbil* during 2010-2011

alveoli were initially appeared circumferential in cytoplasm. In comparison with peripheral vacuoles, there were the larger vacuoles around the nucleus existed. Zona radiata was first observed as a thin layer between the oocyte and follicular cells (Fig. 3c).

Vitellogenesis Stage: The Oocytes could be observed by naked eye, were deep yellow in color. By further growth, the diameter of vacuoles increased but their numbers decreased at the late stage IV. The most perennial phase of oogenesis is the vitellogenic phase. This stage is characteristics with the vitellin granules around the nucleus. Granules were smaller and fewer at the beginning, whereas they became larger and numerous parallel with the oocyte development. As a consequence of this increase in number and volume of granules, alveoli were pushed towards the oocyte wall (Fig. 3d).

Ovulation Phase: While nucleus migrated towards the oocyte wall (animal pole), nucleus membrane was broken up and nucleoli scattered in the cytoplasm. Chorion made an invagination (animal invagination) towards the oocyte center. Vitellin granules spread around the cytoplasm and chorion reached to its maximum thickness. Oocytes in maturation phase were seen in the middle of March and this has progressed to the end of September (Fig. 3e).

Degeneration Phase: As a result of ovulation, granulosa and theca cells containing follicular wall and Atretic follicles were observed within the ovaries (Fig. 3f).

Sex Ratio: The sex ratio of the 358 specimens of *S. tumbil* collected during the study period, were estimated 4.6:1 females to males, respectively ($c2=1.962$, $P<0.05$). in general the number of males were significantly lower than females during the study periods (Fig. 4).

Size structure is shown with the significant difference in sex ratio. Data in Fig. 4 is indicated that high numbers of male individuals were caught during April and September, but the number of females dominated during the year of sampling. Most male caught were in small size, in contrast larger individuals were female. Almost all fishes more than 39cm in Fork length were females.

Table 1: Monthly distribution of different maturity stages of Female *S. tumbil* in Bushehr Province

Month	No. of fish	Immature	Mature	Nearly Ripe	Ripe	Spawning	Spent
Oct.	28	0%	25%	14%	22%	18%	21%
Nov.	28	11%	57%	18%	11%	3%	0%
Dec.	29	21%	79%	0%	0%	0%	0%
Jan.	26	4%	62%	4%	4%	15%	11%
Feb.	23	0%	18%	00%	4%	0%	78%
Mar.	26	0%	11%	0%	8%	8%	73%
Apr.	21	14%	5%	0%	62%	19%	0%
May.	27	0%	0%	0%	7%	27%	66%
Jun.	25	0%	0%	0%	0%	4%	96%
Jul.	32	63%	9%	0%	0%	0%	28%
Aug.	32	28%	30%	0%	9%	10%	23%
Sep.	23	0%	4%	0%	13%	26%	57%

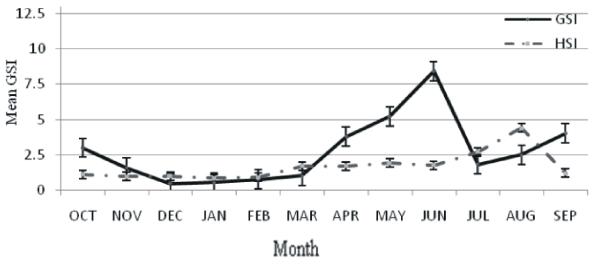

Fig. 5: Monthly variation of gonadosomatic index (GSI) and hepatosomatic (HSI) in female *S. tumbile* throughout the period from October 2010 to September 2011

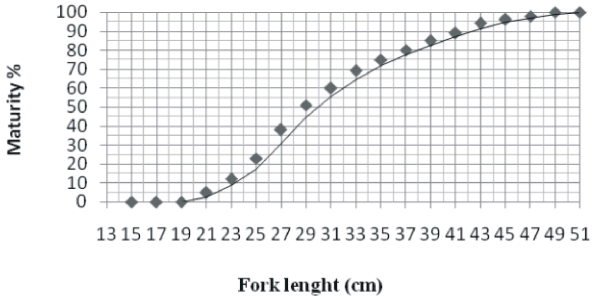

Fig. 6: The percentage distribution of mature *S. tumbile* female with size

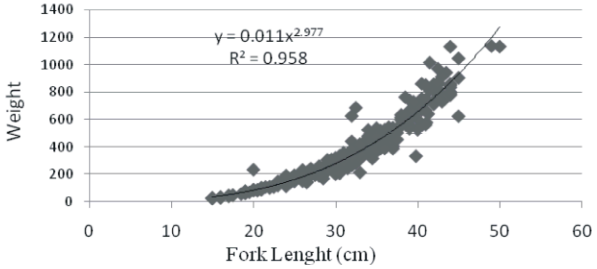

Fig. 7: Length-weight relationship curve for *S. tumbile* during 2010-2011

Monthly Distribution of Maturity Stages: The percentage distribution of different maturity stages of Female *S. tumbil* is given in Table (1). It is obvious that the immature (stage, I) and mature stages (stage, II) were recorded during the whole year with the highest percentage during December, January and August. Nearly ripe (stage, III) stage was recorded during October to January with the highest percentage during the November and then decreased due to the ripening of the gonads. The ripe stage (stage IV) was recorded throughout the most of the year with the maximum during April and October. As the same spawning stage (stage, V) was recorded during the year with the peak from May and September. The highest number of fish with spent ovary (stage, VI) was observed in most of the months.

Gonadosomatic Index (GSI): The relationships between Gonadosomatic index and Hepatosomatic index with season for females are given in Fig. 5. The GSI curve assessment during 12 months sampling period indicated two peaks, with the highest average being started from March ended in July and smaller one from July and drop done in October, it is apparently clear that *S. tumbil* population at the Iranian southern coastal water have a prolonged spawning season. The HSI presented irregular trend during the annual cycle.

Length of First Maturity: Length at first maturity (Lm_{50}) is the length at which 50 % of the fish are matured, was found to be 29.5 cm. Figure 6 showing the selectivity curve of % mature females as a function of size. It is to be noted that the only females at stage III and above were considered matured.

Length-Weight Relationship: The linear regression analysis of the length-weight data allowed the estimation of the constants, a and b of the length-weight relationship represented by the equation $W= 0.0112FL^{2.977}$ with a regression coefficient $R^2= 0.96$ (Figure 7). Where W is the total weight in g and L is the Fork length in cm (Fig. 7).

DISCUSSION

In some samples in the present study, gonads at different sizes were observed especially in females. Testicles were lobular type whereas ovaries were saccular type in samples evaluated in the present study.

The mean of the sex ratio was 1:4.6 (M: F) respectively, this sex ratio was similar with other studies [18, 17]. There are some factors that can influence sex ratio; the other factor is food availability [12]. According to Nikolsky [12] reported that when food is abundant, females predominate, with the situation inverting in regions where food is limited. Feeding activity, in this case, would be influencing metabolism through hormonal activity, resulting in changes in production of individuals of a given sex. Some research has reported that females require better environmental conditions than males, suffering in their development when environmental conditions deteriorate.

Gonadosomatic index is a main item to give a background about the spawning season of species. Monthly distribution of GSI values demonstrated that the main peak of GSI is in June and then it decreases gradually in the following months and again increased in September. Monthly variation of gonadosomatic index throughout the fishing period demonstrated that the spawning period of *S. tumbil* is long. The result of this study, According to Abbaszadeh, *et al.* [18] studies, the main GSI occurs not only during December and June but also year around.

The present study indicates that the spawning activity of *S. tumbil* covers nearly all the year with two main peaks of spawning at July and October. Based on gonad development and variation of oocyte size in the ovary, Lizard fish can be classified as a group synchronous spawner with having two distinct clutches of oocyte existing concurrently with each clutch at a different developmental stage [20], although the GSI is a suitable index to provide information about annual trends in the reproductive activity that also was congruent with other studies [18, 19, 20].

In the present study, overall the females predominate over males; the young males of *S. tumbil* were less in number than females, in addition in older age groups the females were more dominant, While both of male and female were similar in mean weight. In both sexes which may be a mechanism for population regulation, as consequence could be facilitated and ensure successful fertilization of females [21]. The Situation didn't different throughout the year, when females exceeded the males; this may be due to the movement of females toward the shore for spawning [19].

The length at first sexual maturity Lm_{50} of female demonstrated that fish at length under 29.5 cm have immature gonads but at this length, gonad Begins maturation process and developing in maturity stages. The other studies, Abbaszadeh [18] recorded length of 27cm in the Iranian coast of the Persian Gulf and Faltas [22] recorded a range of (16-22 cm) for the same species in the Egyptian Mediterranean waters also Latife and Shenoda [23] recorded (16-18 cm) in the Gulf of Suez. This was indicated through studies, which were taken in other regions in the same species such as Budnichenko and Dimitrova, 1979 [24] noted (17-18 cm) in the Persian Gulf. Rao [25] recorded (14-26 cm) total length in the Indian waters. Given the distance among the areas, these differences might be due to inherent genetic differences among the populations, effects of temperature, turbidity or other environmental factors could be driving the differences [26]. In this study, the smallest length recorded in the catch was 15 cm, which wasn't smaller than the Lm_{50}, leads to the suggestion that the exploited *S. tumbil* females is protected.

The b parameter values in the weight-length model, $W= aL^b$ are 3.9 for the *S. tumbil*, showing isometric growth [27]. The amount of a compared with corresponding values for this species in other regions [11, 26] and [28] indicated that can be suitable environment in south coastal waters of Iran. The reasons for the b parameter values in the different regions are related to seasonal fluctuations in environmental parameters, physiological conditions of the fish at the time of collection, sex, gonadal development and nutritive conditions in the environment of fish [29]. In conclusion, Gonadosomatic index (GSI) of *S. tumbil* female revealed clear two peaks in July and October, indicating to have a prolonged spawning season and matured fishes were detected throughout the year. The *S. tumbil* was classified as a group synchronous spawner.

In calculation, the female was predominant in the population. With awareness of a result of this research, is revealed except pollution and over fishing, there is any Serious Threat for the stock of lizard fish in the south coastal waters of Iran, but only major issue is that if male size differed from of females during the year, it causes to modify the stock sexual composition in the future.

ACKNOWLEDGMENT

The present study was carried out within the framework of the research project "Determination of the ecological relationship among economic fishes in the coastal area of the Persian Gulf" funded by Iranian Fisheries Research Organization (IFRO) and Iran National Science Foundation. Special thanks for presentation of material and spiritual supportive aids and services for this national project and all colleagues that helped during field work.

REFERENCES

1. Russell, B.C. and W. Houston, 1989. Offshore fishes of the Arafura Sea. Beagle, 6(1): 69-84.
2. El-Ganainy, A.A., 1992. Biological studies on lizard fishes *Saurida imdosquamis* (Pisces, Synodontidae) from the Gulf of Suez. M. Sc. Thesis, Fuclty Sci., Ain Shams University. Cairo. Egypt.
3. El-Ganainy, A.A., 1997. Population dynamics of lizard fishes (Synodontidae) from the Red Sea. Ph.D. Thesis, Faculty Science. Suez Canal University, Ismailia. Egypt.
4. El Ganainy, A.A., 2003. Assessment of the lizard fish *Saurida undosouamis* (Richardson) fishery in the Gulf of Suez, red Sea. Bull. Nat. Inst. Oceanog and Fish. ARE, 29: 1-13.
5. El-Ganainy, A.A., 2004. Biological characteristic and fishery assessment of the lizard fishes *Saurida imdosquamis* from the Red Sea, Egypt. Egypt Journal of Aquatic Biology and Fish, 8(2): 93-113.
6. Golani, D., 1993. The biology of the Red Sea migrant, *Saurida undosquamis* in the Mediterranean and comparison with the indigenous confamilial *Synodus saurus* (Teleostei: Synodontidae). Hydrobiologia, 271(2): 109-117.
7. Abdallah, M., 2002. Length-weight relationship of fishes caught by trawl off Alexandria. Egypt. Naga ICLARM Q., 25(1): 19-20.
8. El-Greisy, Z.A., 2005. Reproductive biology and histology of female brushtooth Lizardfish *Saurida undosquamis* (Richardson), Family: Synodontidae, from the Mediterranean Coast of Egypt. Egyptian Journal of Aquatic Research, 31, pp: 19
9. Boonwanich, T., 1991. Population dynamics of *Saurida elongata* and S. undosquamis (Synodontidae) in the Southern Gulf of Thailand. ICLARM Fish Byte, 9(1): 23-27.
10. Erzini, K., 1991. Growth. In: K. Erzini and M. Castro, (Eds.), Microcomputer applications in fisheries. The University of Rhode Island, Kingston, pp: 36-59.
11. Federizon, R., 1993. Using vital statistics and survey catch composition data for tropical multispecies fish stock assessment: application to the demersal resources of the central Philippines. Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven. Ph.D. Dissertation, pp: 201.
12. Nikolsky, G.V., 1963. The ecology of fishes. 6th Edition. London, Academic Press, pp: 353.
13. West, G., 1990. Methods of assessing ovarian development in fishes: a review. Aust. Journal of Mar. Freshwater. Research, 41: 199-222.
14. Pope, J.A., A.R. Marggets, J.M. Hamley and E.F. Akyuz, 1983. Manual of methods for fish stock assessment. Pt. 3. Selectivity of fishing gear. FAO Fishery Technical, Rome, pp: 41.
15. Pauly, D., 1983a. Length-converted catch curves. A powerful tool for fisheries research in the tropics. Part 1. ICLARM Fishbyte, 1(2): 9-13.
16. Winsor, L., 1994. Tissue processing. In: A.E. Woods and E.C. Ellis, (Eds.), In Laboratory Histopathology: a Complete Reference, Edinburgh: Churchill Livingston, Section, 4(2): 1-44.
17. Redding, J.M. and R. Patino, 1993. Reproductive Physiology. In The Physiology of Fishes Edited by: Evan DH. Boca Raton, Florida: CRC Press Inc., pp: 503-534.
18. Abbaszadeh, A., Y. Keyvani, N. Mahbobi Soofiani and A. Falahati Marvast, 2010. Biology of the female Lizardfish, *Saurida tumbil* reproductive from the Persian Gulf (Bushehr province). Journal of Fisheries, 4(1): 16.
19. Bakhsh, A.A., 1996. Reproductive Biology of Lizard Fish, *Saurida tumbil* (Forskal) in the Jizan Region of the Red Sea. 1. KA U: Mar. Sci., Special/ssue: Symp. On Red Sea Mar. En viron. Jeddah, 7: 169.
20. Magdy, M., A.M. El-Halfawy, A. Amal and M. Ramadan, 2007. Growth and Reproduction of Female Brushtooth Lizard fish *Saurida undosquamis* (Richardson) from the Gulf of Suez, Egypt. Journal of Fisheries and Aquatic Sci., 24(1-2): 143-148.
21. Fagade, S.O., A.A. Adebisi and A.N. Atanda. 1984. The breeding cycle of *Sarethorodon galilaeus* in the I.I.T.A. Lake, Ibadan, Nigeria. Arch. Hydrobiol, 100(4): 493-500.
22. Faltas, S.N., 1993. Studies on the fishery biology of lizard fish (Family: Synodontidae) in the Egyptian Mediterranean waters, Ph.D. Thesis, Faculty of Science, Alex. Univ., Egypt, pp: 305.

23. Latife, A.A. and T.S. Shenouda, 1973. Studies on *Saurida undosquamis* (Richardson) from the Gulf of Suez. Monthly peculiarities of gonads. Bull. Inst. Oceanogr. Fish, 3: 295-335.
24. Budnichenko, V.A. and O.S. Dimitrova, 1979. Reproductive biology of *Saurida undosquamis* and *Saurida tumbil* (pisces, synodontidae) in the Arabian Sea Journal Ichthyology, 19(5): 860-867.
25. Rao, K.V.S., 1983. Maturation and spawning of lizard fishes (*Saurida* spp.) from North Western part of Bay of Bengal. Indian Journal of Fish, 30(1): 27-45.
26. Taghavi Motlagh, S.A., J. Seyfabadi, A. Vahabnezhad, M. Ghodrati Shojaei and M. Hakimelahi, 2010. Some reproduction characteristics and weight-length relationships of the spangled emperor, *Lethrinus nebulous* (Lethrinidae) of the South Coastal of Iran (Persian Gulf and Oman Sea). Turkish Journal of Fisheries and Aquatic Sci., 10: 221-227.
27. King, M., 1995. Fisheries Biology, Assessment and Management. Fishing News Book, London, pp: 342.
28. Ahmad, A.T.B., M.M. Isa, M.S. Ismail and S. Yusof, 2003. Status of demersal fishery resources of Malaysia, pp: 83-135. In: G. Silvestre, L. Garces, I. Stobutzki, M. Ahmed, R.A. Valmonte-Santos, C. Luna, L. Lachica-Aliño, P. Munro, V. Christensen and D. Pauly, (eds.) Assessment, management and future directions for coastal fisheries in Asian countries. World Fish Center Conference Proceedings, pp: 6-7.
29. Biswas, S.P., 1993. Manual of methods in fish biology, South Asian Publishers, New Delhi, pp: 157.