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Study on the biology of the small scaled terapon *Terapon puta* (Cuvier, 1829) from Bardawil Lagoon, North Sinai, Egypt

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ABSTRACT

This work aims to investigate some biological aspects as length-weight, age composition, sex ratio, Gonado-Somatic Index (GSI) and fecundity of the small- scaled *Terapon puta* (Cuvier, 1829) in Bardawil Lagoon, North Sinai, Egypt. The study was carried out during the period from May 2017 to January 2018. The results revealed that the total body weight relative to the total body length is positive isometric, b = 3.0209. The length at first capture was 11.9 cm, and the length groups 12-12.9 cm have predominated the fish population (17.8%). Four age groups were detected, and the age composition of *T. puta* indicated that individuals belonging to age group I dominate the fish population (38.6% of the total collected individuals). The overall sex ratio indicated that the females *T. puta* were dominant throughout all the months except in November. The lowest values of GSI of *T. puta* were recorded in November and December while its highest values recorded in June. The length at first mature (L_{50}) was determined as 13.2 and 13.7 cm for males and females respectively. The fecundity increase with increasing the total body length with correlation coefficient ($r^2 = 0.89$). To facilitate the management of modern fisheries of this species , the recommendation should be directed to equal length at first capture by the length at first mature and not less than 13.8 cm to give the females to spawn even once to keep stock of the fish in Bardawil Lagoon.

INTRODUCTION

Small- scaled terapon, *Terapon puta* (Cuvier,1829), is considered an important commercial fish in the Indo-West Pacific, North Indian Ocean and the Indo-Australian Archipelago. It is a Lessepsian migrant, and now is prevalent in the Mediterranean Sea (Golani *et al*., 2002). This species belongs to Order: Perciformes and Family: Terapontidae. This family includes 16 genera and about 48 fish species (Nelson ,2006). The species of this family are frequent in the marine coastal, brackish and fresh water. Ben-Tuvia (1976) mentioned that, *T. puta* found in Mediterranean recorded first in Bardawil Lagoon, northern Sinai, Egypt. Vari (1978) and Yoshida, *et al*., (2013) documented that the *T. puta* is found in inshore waters, sometimes entering brackish and fresh waters and mangrove areas. It is also found in Widespread in the Indo-Pacific from East Africa north of Zanzibar, Red Sea and Persian Gulf to New Guinea and Vanuatu, and north to the Philippines. Although the broad distribution of this species along the indo-pacific waters, modest information on its biological character has been reported by Ben-Tuvia (1986) in Bardawil Lagoon, Egypt; Paxton *et al*. (1989) in Australia studied the general biology of *T.*

puta; Alwany and Hassan (2008) studied the relationship between otoliths size and the fish body size of *T. puta* from the Gulf of Suez, Egypt. Many scientists have studied the length- weight relationship of *Terapon puta* such as (Karna and Panda, 2012 in Chilika Lagoon, Odisha (India); Ahmed and Benzer, 2015 in Karachi Fish Harbour ; Nandikeswari , 2016 in Pondicherry coast, India ; Rizkalla *et al*., 2016; Sabrah *et al.*, 2016 ; Abu El-Nasr and El-Drawany, 2017 in Lake Timsah Egypt and Kassem , 2017 in Bardawil Lagoon, Egypt,) .

The reproductive cycle of fishes is closely tied to the environmental changes particularly temperature, photoperiod and food supply(Bagenal ,1978). The length at first maturity and gonado somatic index and sex ratio of *Terapon puta* was estimated by many authors(Nandikeswari and Anandan, 2013; Nandikeswari *et al*., 2013; Nandikeswari 2016 , Sabrah *et al.*, 2016; Rizkalla *et al* ., 2016 and Kassem, 2017).

The objective of the present research is to shed light on some biological features of the *Terapon puta*. Using such information is essential for the management and the good accuracy of the fishing in Bardawil Lagoon.

MATERIALS AND METHODS

The study was carried out in the Bardawil Lagoon (Fig. 1)**.** The lagoon is separated from the Mediterranean Sea by a sandy bar with two narrow inlets. It is considered as a natural depression with a depth of 1-3 m.

Monthly random samples of *Terapon puta* were collected from the different landing sites of the Bardawil Lagoon, North Sinai. The sampling period occurred during the fishing season from May to December, 2017 and January 2018.

Fig. 1: Sattelite image of Bardawil Lagoon

Length distribution and length at first capture:

In the laboratory, total fish length and total weight for 1106 specimens were determined to the nearest 0.1 cm and 0.1 gm respectively. Estimated distribution length by length frequency for length groups and estimating length at first capture (L_c) was taken as corresponding to the cumulative length probability at 50% (Pauly ,1987).

Length-weight relationship:

The relationship between length and weight was described by the potential equation:

$W = a L^b$ (Ricker , 1975), where W is the total weight (gm), and L is the total length (cm), a and b are constants. The condition factor was calculated monthly by formula:

$K = (W * 100) / L^3$ (Hile ,1936), Where: K = condition factor W = weight in gram and L = length in centimeter.

Age determination:

Most of the authors preferred to use scales for the age determination. In the present study, it was difficult to collect scales, since the scales of *T. puta* are small and loosely embedded structures with hardly visible annual marks. Therefore in the present study, otoliths were used for the age determination. Otoliths were cleaned by 8 % HCl, and then dried. The otoliths were cleared in a mixture of 50 % ethyl alcohol and 50% glycerin and they were examined using microscope. The opaque and transparent rings were counted from the nucleus to the margin along the longest axis of the otolith. One opaque zone together with one transparent zone was considered to be an annual increment. Each annual increment represents one year of the fish age (El-Ganainy ,1992). The number of fish in each age group was calculated, and then the proportion of the different age groups of the fish in the catch was used to calculate the age composition of *T. puta*.

Reproduction:

Length, weight, sex, stage of maturity and fecundity of individual fish samples were recorded. Ovaries were removed and preserved in 10 % formalin for further studies. After the gonads had been extracted, the specimens were sexed with naked eye and by microscope in young specimens. The gonads (Fig. 2) after being removed were weighed to the nearest 0.01 gm. In order to determine the spawning season, the Gonado Somatic Indices (GSI) were calculated monthly by equation of Albertine-Berhaut (1973) as follows:

GSI = Gonad Weight / Body Weight *100.

Fig. 2: Gonads of *Terapon puta* from Bardawil Lagoon during 2017- 2018.

The length and age at first maturity (L_{m50}) was determined by examination of gonads to determine the sex and the stage of maturity, where 50% of fish reach their sexual maturity was estimated by fitting the maturation curve between the percentage maturities of fish corresponding to each length class interval.

Fecundity:

Absolute fecundity ($F_{abs.}$) is defined as the number of mature eggs in the ovaries during the spawning season. 40 mature ovaries of adult females were used of length ranged from 11.5 to 18.9 cm. The gonads were removed, weighed to the nearest 0.01g and placed in glass bottle with 10 % formalin. Then, the gonads were washed

and dried. Subsamples were taken from different parts of the ovaries and weighted to obtain the net eggs weight. The subsamples weighted (1gm), and eggs were well mixed, and placed on slide which was divided into squares. The eggs in twenty squares were counted under the microscope. The mean number and the total number of eggs in the subsample were counted. Then, the total fecundity (F) was calculated as given by Yeldan and Avsar (2000) :

F = Gonad Weight * Egg Number in the Subsample / weight of subsample

The relative fecundity (F_{rel}) was calculated as: $F_{rel} = F_{abs}$ / (Body length or body weight*)*. The relationship between the total length (L) and fecundity using the least square method was recorded.

RESULTS

Length distribution:

A total of 1106 specimens of *Terapon puta* were obtained from the Bardawil Lagoon from May to December, 2017 and January 2018. Total length ranged from 5.3 to 18.9 cm and the observed total weight from 2.5 to 68 g. Length frequency of *T. puta* (Figure 3) showed that the length group (12-12.9cm) was the most frequent, since it constitute 17.8% of the catch, whereas the length group (5-5.9 cm) were lowest since it represented 0.5% in the catch. Length at first capture (L_c) was 11.9cm as shown in Figure (4).

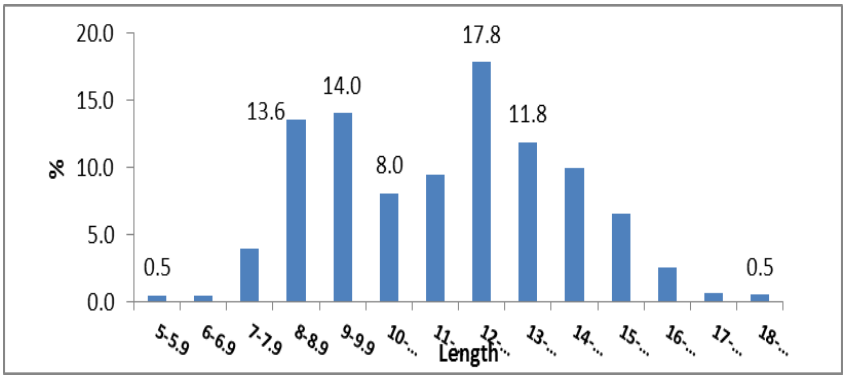

Fig. 3: Length frequency distribution of *T. puta* from Bardawil Lagoon during 2017- 2018.

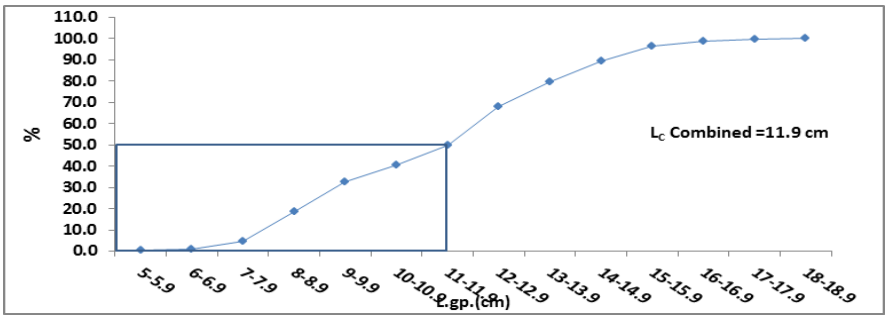

Fig. 4: Length at first capture of *T. puta* from Bardawil Lagoon during 2017- 2018.

Length-weight relationship:

The length – weight relationship was described by the power equation as: $W = 0.0117\ L^{2.9472}$ ($R^2 = 0.9369$), $W = 0.0062\ L^{3.1886}$ ($R^2 = 0.9712$) and $W = 0.0097\ L^{3.0209}$ ($R^2 = 0.959$) for males, females and combined sexes respectively (Figs.5, 6 and 7).

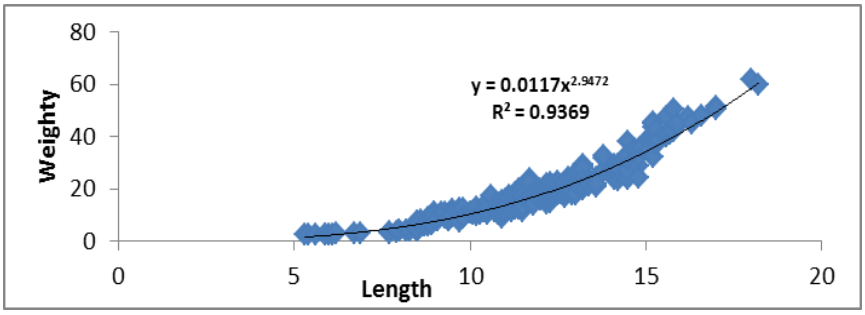

Fig. 5: L - Wt relationship of males for *T. puta* in Bardawil Lagoon during 2017- 2018.

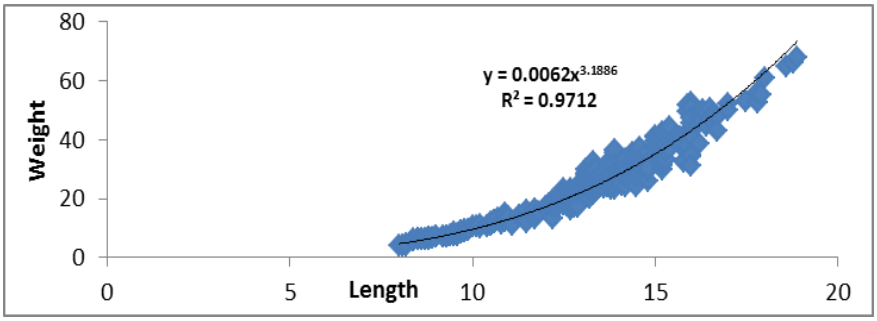

Fig. 6: L - Wt relationship of females for *T. puta* in Bardawil Lagoon during 2017- 2018.

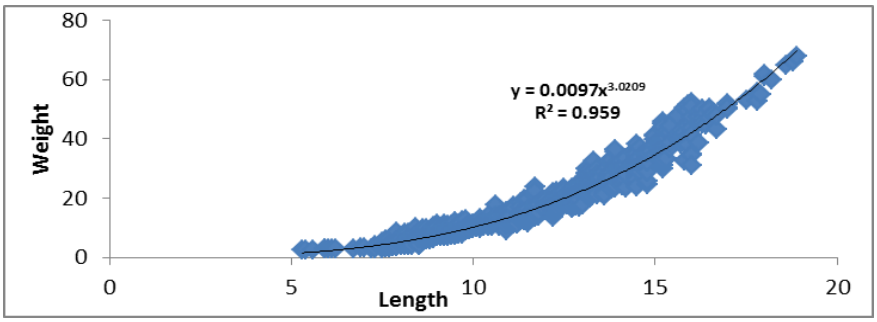

Fig. 7: L - Wt. relationship of combined sexes for *T. puta* in Bardawil Lagoon during 2017- 2018.

Condition Factor:

The mean condition factors of males, females and combined sexes of *Terapon puta* were nearly similar to each other. Condition Factor varied from 0.98 to 1.46 in all individuals. Lower condition factor values (K) were recorded in August for males and combined sexes while in September for the females. The highest values were recorded in December for males and females , while the highest value of combined sexes were recorded in November (Fig. 8).

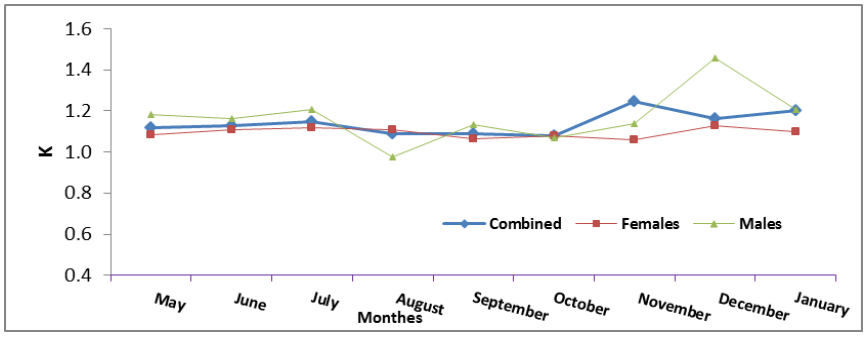

Fig. 8: Monthly variation in condition factor (K) of combined sexes, females and males of *T. puta* in Bardawil Lagoon during 2017- 2018.

Age composition:

The results show that, four age groups were recorded. The age composition of *T. puta* from Bardawil Lagoon reveals the predominance of age group (I) in the catch, since it compose 38.3%, followed by the age group II (23.1). Age group IV was the least frequent, since it composes 7.3 % of the total age groups, Figure (9).

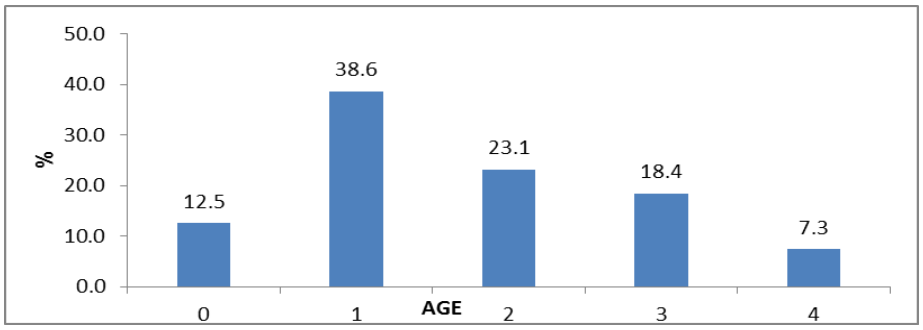

Fig. 9: Age composition of *T. puta* from Bardawil Lagoon during 2017- 2018.

Sex ratio:

The sex ratio of *T. puta* collected in this study was1: 1.7(313 males to 518 females). It was observed that the two sexes did not distribute in the same proportion during different months. Females predominated during all months except in November, since it constitutes more than 60 % of the collected sample during the period of study (Table 1).

Table 1: Monthly variations in sex ratio of *T. puta* in Bardawil Lagoon during 2017- 2018.

Month	Females		Males		sex ratio
	No.	%	No.	%	M/F
May ٢٠١٧	76	65.5	40	34.5	1-1.9
June	151	67.4	73	32.6	1-2.1
July	44	69.8	19	30.2	1-2.3
August	52	57.8	38	42.2	1-1.4
September	31	59.6	21	40.4	1-1.5
October	35	54.7	29	45.3	1-1.2
November	34	46.6	39	53.4	1-0.9
December	26	60.5	17	39.5	1-1.5
January 2018	69	65.1	37	34.9	1-1.9
	518	62.3	313	37.7	1-1.7

It was noticed that females were outnumbered males for all length groups except length group (11-11.9) (Fig. 10).

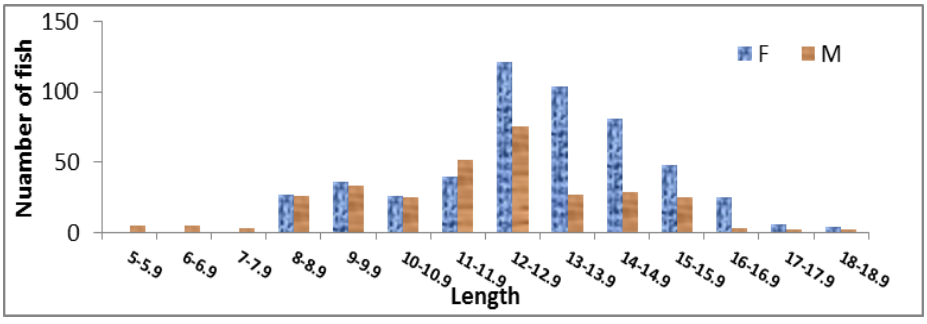

Fig. 10: Sex ratio according to different length groups of *T. puta* in Bardawil Lagoon during 2017-2018.

Gonado-Somatic Index (GSI):

The monthly changes in males and females GSI of *T. puta* were represented in Fig. 11. GSI of males of *T. puta* was lower than females. The lowest value of GSI of males (1.0) was recorded in December, then increase slightly in January. The

maximum value of GSI of male was recorded in June GSI (4.3). GSI of females showed a similar pattern as males. It attained the lowest value (1.0) in November and reached the highest value in June (7.6). This means that the reproduction season of *T. puta* in Bardawil Lagoon is from May to July (summer spawner).

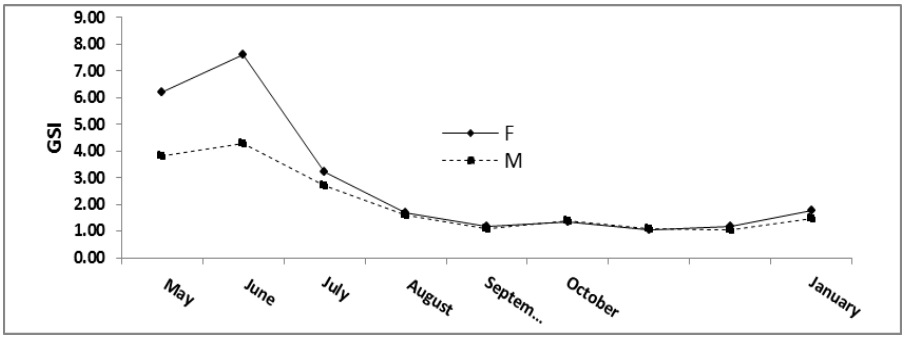

Fig. 11: Monthly changes in Gonado Somatic Index (GSI) of males (M) and females (F) of *T. puta* in Bardawil Lagoon during 2017- 2018.

Length at first sexual maturity:

The immature and mature fish for each length group was analyzed to determine the length at first mature (L_m). All males and females with a total length higher than 12 cm are mature. The length at first mature (L_{50}) was determined as 13.2 and 13.7 cm for males and females respectively (Fig. 12).

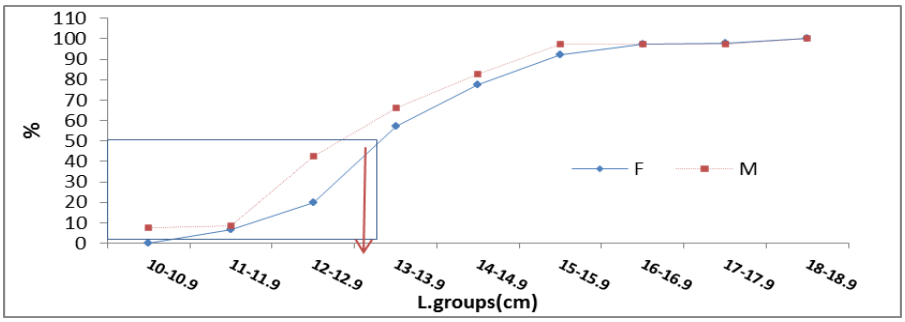

Fig. 12: Length at first maturity (L_m) of males and females of *T. puta* in Bardawil Lagoon during 2017-2018.

Fecundity:

The relation between fecundity (absolute and relative) and total length and body weight of *T. puta* were illustrated in Table (2). The number of eggs gradually increased by increasing fish length, since fish of 11.5 cm produces about 89571.4 eggs, reaching maximum number of about 202761 eggs for a fish length 18.9 cm.

Table 2: Total fish length, absolute and relative fecundity of *T. puta* in Bardawil Lagoon during 2017-2018.

L. groups(cm)	No	Ave. L	Absolute fecundity		Relative Fecundity
			Fecundity	Calculated F.	(*F*/*L*)
11-11.9	1	11.5	89571.4	99111.17	7788.8
12-12.9	5	12.8	110628.6	117030.8	8642.9
13-13.9	10	13.3	128004.8	123477.1	9660.7
14-14.9	5	14.4	143276.2	140803.7	9935.9
15-15.9	11	15.4	158019.5	156214.6	10248.9
16-16.9	3	16.3	171791.7	169755.9	10561.0
17-17.9	1	17.9	188125.0	196928.7	10509.8
18-18.9	4	18.6	202761.9	208571.7	10915.8
	40				

The relative fecundity gradually increased from 7788.8 to 10915 eggs per cm .The relation between fecundity and size & weight was illustrated in Figs. 13 and 14. The

absolute fecundity was increased with a total length and described by power equation $F = a L^b$ as: $F = 2239.4 L^{1.5518}$, ($R^2 = 0.8873$).

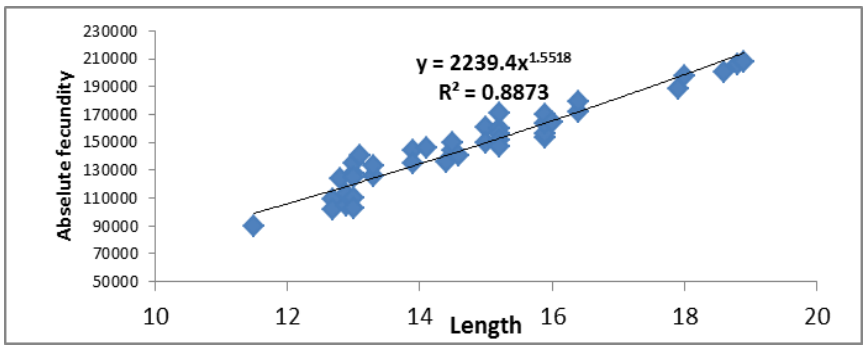

Fig. 13: Relationship between total length and absolute fecundity of *T. puta* from Bardawil Lagoon during 2017- 2018.

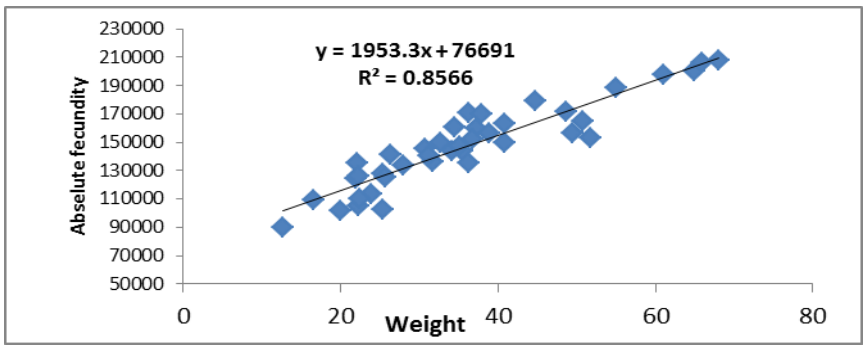

Fig. 14: Relationship between body weight (g) and absolute fecundity of *T. puta* from Bardawil Lagoon during 2017- 2018.

DISCUSSION

This study presents some biological aspects on the small scaled terapon *Terapon puta* (Cuvier, 1829) from Bardawil Lagoon, North Sinai, Egypt. In the present study, the total body length of *T. puta* ranged between 5.3 to 18.9 cm and the total body weight varied from 2.5 to 68.0 gm. Vari (2001) reported that the maximum length of *T. puta*, from the western central Pacific was 15 cm, while Edelist (2012) stated that the total body length of *T. puta*, from the southeastern Mediterranean Sea ranges from 7.3-14 cm and the maximum total body weight is 28.5 gm. On the other hand, Nandikeswari and Anandan (2013) pointed out that the total body length of *T. puta* from Nallavadu Coast Ranges from 13.4-21.9 cm and the total body weight varies from 30-78 gm. Also, Rizkalla *et al*., (2016) stated that the total body length of *T. puta*, from Lake Timsah Egypt ranged from 5.6 to 15.2 cm and the total body weight varied from 5.08 to 41.65 gm. This variability may be due to the difference in the environmental conditions such as: habitat, food abundance and temperature, or the differences in mesh size of the fishing gears.

The length-weight relationship is very crucial in estimating the standing stock biomass and discusses the development history of fish population from various regions (Petrakis and Stergiou, 1995). It is an important fishery management tool and it is very beneficial for cultivators and fisheries managers to determine the growth of the species (Nandikeswari *et al*., 2014). The data obtained from the length-weight relationship equation showed an isometric growth in which b = 3.0209. This means

that any increase in size of the studied fish accompanied by increasing in its weight. Olurin and Aderibigbe (2006) mentioned that fish are said to exhibit isometric growth when length increases in equal proportions with body weight for constant specific gravity. The regression co-efficient for isometric growth is '3' and values greater or lesser than '3' indicate allometric growth. The power "b" in this study is nearly agreement with previous studies in the Lake Timsah, (Egypt), since b = 3.0240; Abu El-Nasr and El-Drawany, (2017). On the other hand, these results were higher that recorded by Sabrah *et al.,* (2016) and Kassem(2017), since they found that, the values of (b) equals 2.72 and 2.775 for *T. puta* in Great Bitter Lake and Bardawil Lagoon respectively. Length-weight relationship differs for the same species in different localities according to the environmental conditions, such as temperature and abundance of food (Tesch ,1968). Condition Factor of the studied species varied from 0.98 to 1.46 in all individuals. Ahmed and Benzer (2015) reported that condition factor of *Terapon puta* in Karachi Fish Harbour, Turkey varied from 1.57 to 2.97 in all individual. Nandikeswari *et. al.*, (2017) reported that condition factor of males and females *T. puta* from Puducherry waters, India ranged from 0.739- 1.640 and 0.742-1.432 respectively. These differences may be attributed to the difference in ecological conditions.

Age is one parameter necessary to assess population dynamics and the state of exploited resources (Allain and Lorance,2000). The small scaled fish is not long lived, since this paper showed that the maximum age of *Terapon puta* was IV years. Sabra *et al.,* (2016) mentioned that 3, 1 and 2 years old recorded for *Terapon puta* in Bitter Lake, Suze Bay and Lake Timsah, Egypt respectively.

In the present study, the sex ratio of males to females of *T. puta* 1:1.7 .These results agree with Rizkalla, *et al.* (2016) in Lake Timsah, Egypt (1:1.2), Miu *et al.,* (1990) from Tamshui River (1:1.8) and Kassem (2017) from Brdawil Lagoon (١:1.57). The predominance of females may be attributed to the male fertilizing efficiency as recorded by Salama (1996) or to the fact that females consume more energy for environmental adaptation than males for the reproduction(Liang *et al*., 2005) or males may not commonly inhabit the depth zone, where the majority of fishing efforts for this species is concentrated(Abaszadeh *et al.*, 2013).

The most suitable method of determining the reproductive cycle of fishes is to observe the seasonal changes in their gonads(Karlou-Riga and Economidis ,1997). The present study revealed that the reproduction season of *T. puta* in Bardawil Lagoon extends from May to July (summer spawner). Niamaimandi *et al*., (2016) reported that the Spawning period of *Terapon puta* in in Bushehr coastal waters (Persian Gulf) occurred from late of summer to autumn.

The knowledge on length at maturity and spawning season detects when and at which length the fish should be protected and therefore it is important for the proper management and conservation of fish stocks(Hunter *et al*., 1992). In the present study, the length at first maturity (L_m) of *Terapon puta* was 13.2 and 13.7 cm for male and female respectively. L_{m50} is an important trait of life history necessary for success of fishery management, fundamental to establishment of the means that avoid exploitation of young specimens and consequential reduction of spawning stock (Penha and Mateus ,2007). It seems that there is also differentiation in maturity between the two sexes. Most of the male reached maturity smaller and younger than female which explains the greater duration of life of the female that mature later (Nikolsky, 1969). Nandikeswari *et al.,* (2014 a) reported that the gonad weight is considered the best indicator of the fecundity of the aforementioned fish species, while the total body length occupies the subsequent rank. Moreover, Bagenal (1967)

concluded that in some teleost fishes, explained the higher engagement of the absolute fecundity with the total body length than with the total body weight, to the stability of the fish length and the variability of its weight.

Fecundity and spawning habits are among the important aspects of the biology of fishes which must be understood to clarify the fluctuation of the level of population as well as to make efforts to increase the amount of fish harvest(Das *et al*., 1989) and also determination of fecundity and the development of sexual maturity is a essential to fishery science(Brown *et al*. 2003). In the present study, it was noted that, the values of the absolute fecundity of *T. puta* increase proportionally with the fish total body length and total body weight. These observations coincide with those reported by Nandikeswari and Anandan(2013) for *T. puta* from Nallavadu coast. The absolute fecundity of *T. puta* in the present study were between 89571 to 202761 eggs in fish ranged between 11.5 to 18.9 cm total body length and 15.7 to 68 gm total body weight .These results were lowest than results obtained for the same species studied by Nandikeswari and Anandan (2013), in which the fecundity ranges from 20002 to 123042 eggs in fish between 13.4 to 21.9 cm total body length and 30 to 78 g total body weight in Nallavadu coast, India. Kassem (2017) reported that, the absolute fecundity of *T. puta* ranged from 94133 to 300000 eggs in fish between 11.6 to 17.3 cm total body length and 20 to 54 g total body weight in Bardwil Lagoon Egypt. Latif and Shenouda (1973) found that the fecundity varies not only in the different species, but also in the same species in the different years or different environmental conditions.

CONCLUSION

The length – weight relationship of *Terapon puta* in Bardawil Lagoon exhibits an isometric growth. Condition Factor varied from 0.98 to 1.46 in all individuals. Females predominated during all months, since it constitutes more than 60 % of the collected sample during the period of study. *Terapon puta* in Bardawil Lagoon is a summer spawner, and the female attains its maturity at 13.7 cm of total length. Regulations should also be directed to equal length at first capture by the length at first mature and not less than 13.8 cm to give the females to spawn even once to keep stock of the fish in Bardawil Lagoon.

REFERENCES

Abaszadeh, A.; Keivany, Y.; Soofiani, N. M. and Falahatimarvast, A. (2013). Reproductive biology of the greater lizardfish, *Saurida tumbil* (Bloch, 1795), in Bushehr coastal waters of Iran. Turk. J. Zool., 37: 717-722.

Abu El-Nasr, T. M. and El-Drawany, M. A. (2017). Some Biological Studies on *Terapon puta* (Cuvier, 1829) in the Lake Timsah, Egypt 1-Age, Growth and Mortality of *Terapon puta* (Spinycheek Grunter). Merit Research Journal of Agricultural Science and Soil Sciences (ISSN: 2350-2274) Vol. 5(6) : 108-114.

Ahmed, Q. and Benzer, S. (2015). Length-Weight Relationship in *Terapon puta* (Cuvier, 1829) Collected from Karachi Fish Harbour. Journal of Applied Environmental and Biological Sciences. J. Appl. Environ. Biol. Sci. 5(10): 1-5.

Albertine-Berhaut, J. (1973) . Biologie de stades juveniles de téleostéens mugilidae *Mugil auratus* Risso 1810, *Mugil capito* Cuvier 1829, et *Mugil salines* Risso 1810: I. Régime alimentaire. Aquaculture 2: 251–266.

Allain, V. and Lorance, P. (2000). Age estimation and growth of some deep sea fish from the northeast Atlantic ocean. Cybium, 24(3), 7-16.

Alwany, M. A. and Hassan, E.M. (2008). Otolith morphology and body size relationships for selected fishes in Suez Canal and Gulf of Suez. Catrina J. 2008; 3:55-63.

Bagenal, T. B. (1967). A short review of fish fecundity. In: ″The Biological Basis of Freshwater Fish Production″. Gerking, S. D. (ed.).Blackwell Sci. Pub., Oxford, England. Pp.: 89-111.

Bagenal, T. B. (1978). Aspects of fish fecundity, In: Gerking, S. D. (ed). Methods of Assessment of Ecology of Freshwater Fish Production. Blackwell, London, , 75-101.

Ben-Tuvia, A. (1976). Occurrence of Red Sea fishes *Herklotsichthys punctatus*, *Autisthes puta* and *Rhonciscus stridens* in the eastern Mediterranean. Israel Journal of Zoology, 25: 212-213.

Ben-Tuvia, A. (1986). Teraponidae. In: Fishes of the North-Eastern Atlantic and the Mediterranean. Whitehead, P. J. P., M. L. Bauchot, J.C. Hureau, J. Nielsen and E. Tortonese (Eds.). UNESCO, Paris, France. 797-799.

Brown, P.; Sivakumaran K. P.; Stoessel, D; Giles, A.; Green, C. and Walker, T. (2003). Carp Population Biology in Victoria. Report Marine and Freshwater Resources Institute, Department of Primary Industries, Snobs Creek, Victoria; 56:202.

Das, M. ; Dewan S. and Debnath S. C. (1989). Studies on fecundity of *Heteropneustes fossilis* (Bloch) in a mini pond of Bangladesh Agricultural University, Mymensingh. Bangladesh Journal of Agricultural Sciences, 16:1-6.

Edelist, D. (2012). New length-weight relationships and Lmax values for fishes from the southeastern Mediterranean Sea. J. Appl. Ichthyol., 30(3): 521-526.

El-Ganainy, A. A., (1992). Biological Studies on lizard fishes, *Saurida undosquamis* (Pisces: Synodontidae) from the Gulf of Suez. M.Sc. thesis, Fac. Sci, Ain Shams Univ., Cairo, Egypt.

Golani, D. ; Orsi-Relini, L. ; Massuti, E. and Quignard, J. P. (2002). CIESM Atlas of Exotic Species in the Mediterranean. Vol. 1. Fishes. Briand, F. (ed.). CIESM Pub., Monaco.256 pp.

Hile, R. (1936). Age and growth of the Cisco, *Leucichthys artedi* (Le Sueur), in the lakes of the Northeastern highlands, Wisconsin. Bull. Bur. Fish. U. S., 48(19): 211-317.

Hunter, J. R.; Macewicz, B. J.; Lo, N.C and Kimbrell, C. A. (1992). Fecundity, spawning and maturity of female Dover sole *Microstomus pacificus*, with an evaluation of assumption and precision. Fishery Bulletin; 90:101-128.

Karlou-Riga, C. and Economidis, P. S. (1997). Spawning frequency and batch fecundity of horse mackerel, *Trachurus trachurus* (L.), in the Saronikos Gulf (Greece). Journal of Applied Ichthyology, 13:97-104.

Karna, S. K. and Panda, S. (2012). Length-Weight Relationship (LWR) of 20 fish Species in Chilika Lagoon, Odisha (India). Asian J. Exp. Biol. Sci. 3(1).

Kassem, S. A. (2017) .Biological and dynamical studies on the small scaled terapon stock (family: terapontidae) in Bardawil Lagoon. M.Sc, Fac. Envir. Agric. Sci. Arish Univ.

Latif, A. F. A. and Shenouda, T. H. S. (1973). Studies on *Saurida undosquamis* (Richardson) from the Gulf of Suez. Bull. Inst. Oceanogr. Fish. 3:183-202.

Liang, S. H.; Wu, H. P. and Shieh, B. S. (2005).Size structure, reproductive phenology and sex ratio of an exotic armored catfish (*Liposarcus multiradiatus*) in the Kaoping River of southern Taiwan. Zool. Stud., 44(2): 252-259.

Miu, T. C.; Lee, S. C. and Tzeng, W. N. (1990).Reproductive biology of *Terapon jarbua* from the Estuary of Tamshui River. J. Fish. Soc. Taiwan, 17(1): 9-20.

Nandikeswari, R. (2016). Size at first maturity and maturity stages of *Terapon puta* (Cuvier, 1829) from Pondicherry coast, India. International Journal of Fisheries and Aquatic Studies 4(2): 452-454.

Nandikeswari, R. and Anandan, V. (2013). Analysis on Gonadosomatic Index and Fecundity of *Terapon Puta* from Nallavadu Coast Pondicherry. Int. J. Sci. Res. Pub. V.3(2):1:4.

Nandikeswari, R.; Sambasivam, M. and Anandan, V. (2013). Study on sex ratio of *Terapon puta* (Cuvier, 1829) from Puducherry Coast, India. Journal of Environmental Science, Computer Science and Engineering & Technology. 2(4): 1396-1400.

Nandikeswari, R.; Sambasivam, M. and Anandan, V. (2014 a).Estimation of fecundity and gonadosomatic index of *Terapon jarbua* from Puducherry coast, India. Int. J. Biol. Vet. Agric. Food Eng., 8(1): 61-65.

Nandikeswari, R. ; Sambasivam, M. and Anandan, V. (2014 b). Length-weight relationship of *Terapon jarbua* (Forsskal, 1775) from Puducherry waters. Int. J. Biol. Biomol. Agric. Food Biotechnol., 8(3): 277-281.

Nandikeswari, R. ; Sambasivam, M. and Mohan, P. M. (2017).Comparative study on condition factors of *Terapon jarbua* and *Terapon puta* from Puducherry waters.Indian J.Geo marine Sci.,46(2) : 245- 249.

Nelson, J. S. (2006). Fishes of the World.4th edition. John Wiley & Sons Inc., New York.

Niamaimandi, N.; Shabankareh, H. M. and Ansari, F. (2016). Feeding and spawning seasons of small-scaled Terapon (*Terapon puta*) in Bushehr coastal waters (Persian Gulf).J.Anim. Biol.9: 71- 79.

Nikolsky, G.V. (1969). Theory of fish population dynamics as the biological background for rational exploitation and management of fishery resources, Oliver & Boyd, Edinburgh.

Olurin, K. B. and Aderibigbe, O.A. (2006). Length-Weight Relationship and Condition Factor of Pond Reared Juvenile *Oreochromis niloticus.* World Journal of Zoology 1 (2): 82-85.

Pauly, D. (1987). Length-Based Methods in Fisheries Research. ICLARM Conference Proceedings 13:7-34.

Paxton, J. R.; Hoese, D.F.; Allen, G.R. and Hanley, J.E. (1989). Zoological Catalogue of Australia: Pisces: Petromyzontidae to Carangidae. (Zoological Catalogue of Australia Series). CSIRO Publishing, Australia, ISBN-13: 978-0644094306. 1989, 7: 665.

Penha, J. M. F. and Mateus, L.A.F. (2007). Sustainable harvest of two large predatory Catfish in the Cuiabá river basin, northern Pantanal, Brazil. Brazilian Journal of Biology; 67(1):81-89.

Petrakis, O. and Stergiou, K. I. (1995). Weight-length relationships for 33 fish species in Greek waters. Fish. Res., 21: 465-469.

Ricker, W. E. (1975). Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Canada, 191:382 p.

Rizkalla, W. ; El-Shabaka, H. A.; El-Ganiany A. A.; Abd El Rahman, F.A. and El-Naggar, M. M. (2016). Reproductive biology of the small-scaled terapon,

Terapon puta (Cuvier, 1829), from Lake Timsah, Egypt. Egypt. J. Aquat. Biol. & Fish., 20(3): 1 – 14.

Sabrah, M. M.; Mohamedein, L. I. ; El-Sawy, M. A. and Abou El-Naga, E. H. (2016). Biological Characteristics in Approaching to Biochemical and Heavy Metals of Edible Fish *Terapon puta*, Cuvier, 1829 from Different Fishing Sites along the Suez Canal, Egypt. J. Fisheries and Aquatic Sci. 11 (2): 147-162.

Salama, M. E. (1996). Effects of sex ratio and feed quality on mass production of Nile tilapia, *Oreochromis niloticus* (L.), fry. Aquacult. Res., 27(8): 581-585.

Tesch, F.W. (1968). Age and Growth in Methods for Assessment of Fishes Production. In: W.E. Ricer (Ed.), in methods for assessment of fish production in Freshwater, IBP Handbook, Blackwell Science Publication, London: 93-123.

Vari, R. P. (1978). The Terapon perches (Percoidei, Teraponidae) : a cladistics analysis and taxonomic revision. Bull. Am. Mus. Natl. Hist., 159(5):175-340.

Vari, R.P. (2001). Terapontidae. In: The Living Marine Resources of the Western Central Pacific (Carpenter K.E. & Niem V.H., eds), pp. 3305-3316. Rome: FAO.

Yeldan, H. and Avşar , D. (2000). A preliminary study on the reproduction of rabbit fish, *Siganus rivulatus* (Forsskål, 1775), in the northeastern Mediterranean. Turk. J. Zool. 24: 173-182.

Yoshida, T.; Motomura, H.; Musikasinthorn, P. and Matsuura , K. (2013). Fishes of Northern Gulf of Thailand. National Museum of Nature and Science, Tsukuba, Research Institute for Humanity and Nature, Kyoto. Kagoshima University Museum. , Kagoshima., Japan. pp. 239.

ARABIC SUMMARY

دراسة بيولوجية على أسماك الشخرم *Terapon puta* (Cuvier, 1829) في بحيرة البردويل شمال سيناء- مصر

عطيه على عمر العياط ، و كريمان احمد شوقى شلوف
المعهد القومى لعلوم البحار والمصايد

يهدف هذا البحث إلى استكشاف بعض الجوانب البيولوجية لأسماك الشخرم (*Terapon puta* (Cuvier, 1829) في بحيرة البردويل شمال سيناء – مصر. تمت الدراسة خلال الفترة من مايو ٢٠١٧ حتى يناير ٢٠١٨. أظهرت النتائج أن نمو إجمالي وزن الجسم بالنسبة لطول الجسم الكلي متماثل حيث (b = 3.0209). كان الطول عند بداية الصيد ١١.٩ سم وقد ساد المصيد المجموعة الطولية (١٢- ١٢.٩ سم) بنسبة ١٧.٨٪ . فى هذه الدراسة تم تسجيل أربع فئات عمرية، بينت التركيبة العمرية لأسماك الشخرم أن الأفراد الذين ينتمون إلى الفئة العمرية الأولى قد سادوا بنسبة ٣٨.٦ ٪ من مجموع الأفراد الذين تم جمعهم. وأشارت النسبة الإجمالية بين الجنسين إلى أن الإناث كانت مهيمنة طوال جميع الشهور باستثناء شهر نوفمبر من العام. كانت القيم المتوسطة لدليل المناسل صغيرة في نوفمبر وديسمبر ، في حين أنها إرتفعت تدريجيا لتصل إلى أعلى القيم في يونيو. كشفت دراسة الخصوبة لأسماك الشخرم أن الخصوبة المطلقة الملاحظة تزيد مع زيادة طول الجسم مع معامل الارتباط (r^2 = 0.89) ، وبالتالي ، كان طول الجسم الكلي أفضل مؤشر على خصوبة اسماك الشخرم . نوصى بزيادة الطول عند بداية الصيد ليتساوى مع الطول عند بداية النضج الجنسي ولا يقل عن ١٣.٨ سم لإعطاء الإناث فرصة للتفريخ ولو مرة واحدة للحفاظ على مخزون الأسماك في بحيرة البردويل.