Reproductive biology of the small-scaled terapon, *Terapon puta* (Cuvier, 1829), from Lake Timsah, Egypt

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ABSTRACT

The reproductive biology of the small-scaled terapon, *Terapon puta* (Cuvier, 1829), from Lake Timsah, Ismailia Governorate, Egypt, has been studied during the period from June 2011 to May 2014. The results revealed that the growth of the total body weight relative to the total body length is negative allometric (b = 2.4954). Moreover, the collected fishes were divided into three age groups from one to three years. The age composition of *T. puta* catch indicated that individuals belonging to age group two have predominated the fish population (90.53% of the total collected individuals). The overall sex ratio indicated that the females *T. puta* were dominant throughout all the seasons of the year. The average values of the gonadosomatic index of *T. puta* were small in winter (the pre-spawning season) for both sexes, while they gradually increased in spring and summer to reach highest values in summer. The values of GSI then decreased gradually to reach minimal values in autumn (the post-spawning season) for both sexes. The aforementioned data indicates that *T. puta* has a long spawning season that starts in early spring and ends in late summer. Moreover, the study of the fecundity of *T. puta* revealed that the highest significant relationship was found between the logarithmic values of both mean total body weight, and mean observed absolute fecundity, with highest correlation coefficient (r^2=0.999), consequently, the total body weight was the best indicator of the fecundity of *T. puta*. The recommendation of the present study is to prevent fishing of *T. puta* in Lake Timsah during the spawning season, which extends from April to August, or use nets with wider meshes in order to protect the spawning biomass of *T. puta* resources.

Keywords: *Terapon puta*, fecundity, gonadosomatic index, allometric growth, otolith, sex ratio.

INTRODUCTION

The 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.

Holden and Raitt (1974) stated that knowledge of the fecundity of a species is an important factor in fish stock management and it is used to calculate the reproductive potential of a stock and the survival from egg to recruitment.

Miu *et al.* (1990) stated that the sex ratio of *Terapon jarbua*, from Tamshui River is in favor of the females and the overall sex ratio of females to males is 1.8:1. On the other hand, Nandikeswari *et al.* (2013) observed that males *T. puta*, from Puducherry (Pondicherry) coast are dominant in the population and the overall sex

ratio of females to males is 1:1.06. In addition, Nandikeswari *et al.* (2014 a) reported that the males *Terapon jarbua*, from Pondicherry coast outnumber the females and the overall sex ratio of females to males is 1:1.28. Moreover, Vicentini and Araujo (2003) pointed out that the sex ratio constitutes basic information necessary for the assessment of the potential of fish reproduction and the stock size estimation in fish population.

Taskavak and Bilecenoglu (2001) stated that the growth in weight relative to length in *Pelates quadrilineatus*, from the eastern Mediterranean Sea, is isometric. However, Edelist (2012) and Isa *et al.* (2012) observed a negative allometric growth in *T. puta*, from the southeastern Mediterranean Sea and *Terapon jarbua*, from the Merbok estuary, respectively.

Nandikeswari and Anandan (2013), in *T. puta*, from Nallavadu coast and Nandikeswari *et al.* (2014 a), in *Terapon jarbua*, from Pondicherry coast, found that a highly significant relationship between the logarithmic values of both the fecundity and the gonad weight. So, the gonad weight is considered as the best indicator of the fecundity.

Therefore, the present study was planned to gain more information about the biological aspects of *T. puta* during the different seasons of the year that will help in the management and improvement of its fishery.

MATERIALS AND METHODS

1- Sampling:

A total number of 441 specimens of female and male *Terapon puta* (Cuvier, 1829) (Perciformes: Terapontidae) were collected seasonally and obtained alive from the fishermen operating by trammel nets in Lake Timsah in Ismailia governorate (Fig. 1). In the present work, the specimens were collected during three consecutive years from June 2011 to May 2014 targeting the accuracy of the obtained data.

Fig. 1: Photograph of Lake Timsah in Ismailia.

2- The length-weight relationship:

The length of each fish was measured to the nearest 0.1 cm, while the body weight was measured to the nearest 0.1 gm. Moreover, the relationship between the length and the weight of *T. puta* was analyzed. The statistical relationship between these parameters was established using the formula of Le Cren (1951):

$$W = a\,L^b$$

Where, W: is the fish total body weight in gm.

      L: is the fish total body length in cm.

      a: is a constant (intercept) which varies for any given species.

      b: is the growth exponent (slope).

3-The age and growth:

  i- The 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. Before aging, 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 Optika 4083 P3 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 were considered to be an annual increment. Each annual increment represents one year of the fish age (El-Ganainy, 1992).

  ii- The age composition:

The number of fish in each age group was calculated, then the proportion of the different age groups of the fish in the catch was used to calculate the age composition of *T. puta*.

4- The sex ratio:

Each specimen was dissected and the gonads were removed. The sex of each specimen was identified by examination of the gonads. The proportion of the two sexes relative to one another was used to calculate the sex ratio.

5- The gonadosomatic index:

The gonadosomatic index (GSI) was calculated according to Strum (1978) as follows: $\text{GSI} = \dfrac{\text{weight of gonad}}{\text{Total body weight}} \times 100$

6- The fecundity:

In the present study, analysis of 29 mature female ovaries was carried out. The ovaries were preserved in 10% neutral formalin; the two ovaries were then weighed. It was found convenient to take the central region of each ovary as a representative sub-sample for the fecundity. A sub-sample of about 0.1 to 0.2 gm from each ovary was weighed to the nearest 0.001 gm and then crumbled in a large petri-dish containing glycerol. The number of the mature ova that are likely to be spawned in each sub-sample was counted. Two terms are applied in studying the fish fecundity, namely: the absolute fecundity which is the total number of mature oocytes in the ovary and the relative fecundity which is the total number of oocytes per unit of fish length or weight (Nikolsky, 1963). The absolute and relative fecundities can be calculated using the following equations:

The absolute fecundity $= \dfrac{\text{Ovary weight} \times \text{number of oocytes in the sub} - \text{sample}}{\text{weight of ovary sub} - \text{sample}}$

The relative fecundity $= \dfrac{\text{Absolute fecundity}}{\text{total body length or weight}}$

The statistical analysis:

Microsoft Office Excel in the personal computer (PC) windows (2010) was used and the analysis of variance (ANOVA) test is included in the regression analysis and was used to test whether the calculated regression line was significant or not.

RESULTS

1- The length-weight relationship:

The total body length of the specimens ranged from 5.6 to 15.2 cm with an average of 11.282 ± 1.2512 cm, while the total body weight varied from 5.08 to 41.65 gm, with an average of 19.261 ± 5.5376 gm. The length-weight equation of Le Cren (1951) computed was:

$$W = 0.0442 \ L^{2.4954}$$

ANOVA by: ($r^2 = 0.9012$, No $= 441$, $SE_a = 0.0954$, $SE_b = 0.0394$).

The average of the observed and calculated total body weights are represented in Table (1) and graphically represented in Figure (2). The agreement between the observed and calculated total body weights is evident from the curve, where the smooth curve represents the calculated weights and the dots represent the observed ones. The growth of total body weight relative to total body length was negative allometric (b= 2.4954; 95% CI: 2.41789-2.5729). A high degree of correlation was found between the logarithms of the total body weight and length, (Fig. 3), which indicated that an equation of the type $W = a \ L^b$ fits the data well. The derived logarithmic form for Le Cren equation was as follows:

$$Log \ W = -1.3542 + 2.4954 \ Log \ L \ (r^2 = 0.9012)$$

Table 1: Average observed and calculated total body weights for each total body length of *T. puta* from Lake Timsah.

Total body length (cm)		Fish No.	Total body weight (gm)		
Range observed	Average observed		Range observed	Average observed	Calculated
5.0-5.9	5.70	2	5.0-5.5	5.45	3.40
6.0-6.9	6.65	6	5.0-6	5.72	4.99
7.0-7.9	7.51	7	5.0-6.9	6.31	5.88
8.0-8.9	8.57	3	7.0-8.5	7.5	9.41
9.0-9.9	9.45	19	9.7-14.2	11.14	12.01
10.0-10.9	10.55	75	11.7-19.3	15.56	15.81
11.0-11.9	11.37	221	14.0-25.5	19.22	19.05
12.0-12.9	12.32	85	18.3-31.0	23.44	23.28
13.0-13.9	13.28	16	28.0-37.0	31.10	28.07
14.0-14.9	14.35	4	31.0-40.5	36.59	34.06
15.0-15.9	15.07	3	38.7-41.6	39.84	38.48

Fig. (2): Total body length-total body weight relationship of *T. puta* from Lake Timsah.
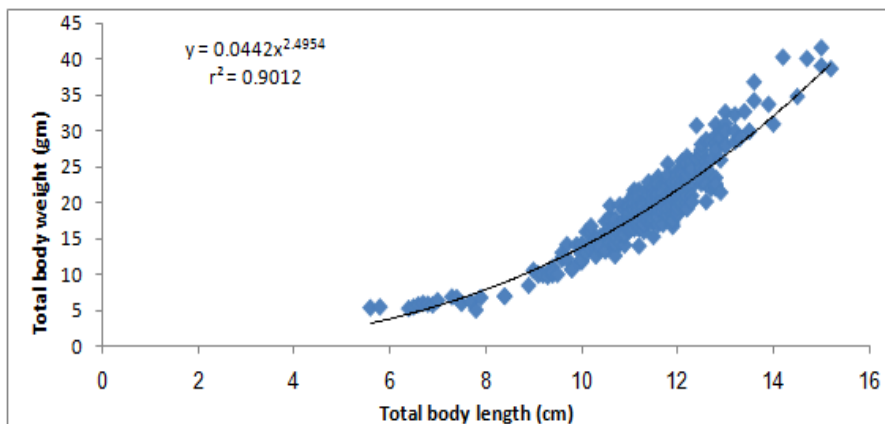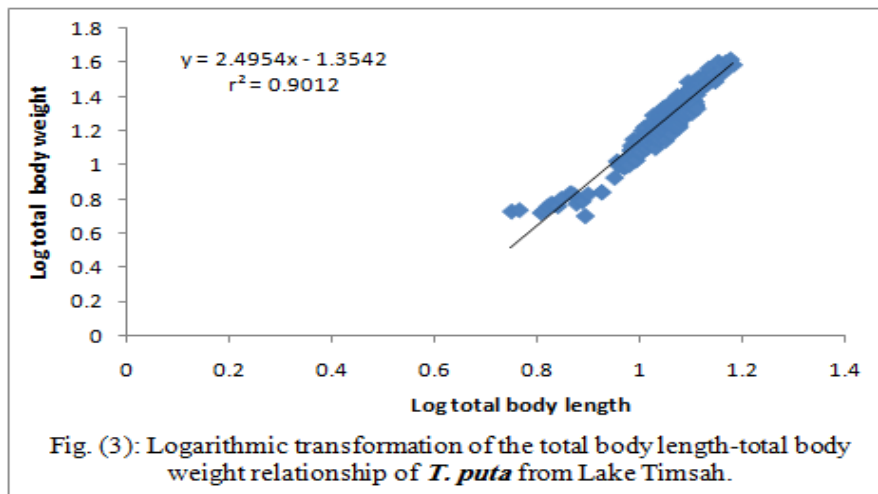
Fig. (3): Logarithmic transformation of the total body length-total body weight relationship of *T. puta* from Lake Timsah.

2- The age and growth:
i- The age determination:

The otolith of *T. puta* is elliptic in shape, with a rostrum (Rs) and slightly irregular margin (Mr). It is composed of a central nucleus (N) which is surrounded by a number of concentric rings of different radii, forming opaque and translucent zones. One opaque zone (Oq.z) together with a translucent zone (Tr.z) represents an annual ring. Each annual ring accounts for a year of the fish age (Fig. 4).

In the present study, three age groups from I to III years were encountered. The mean observed lengths at the different age groups are 8.71, 12.62 and 14.81 cm, respectively, (Table 2) and this indicates a rapid growth in the 1st year of life as the fish attains more than 50 % of its maximum size, whereas in the following years the rate of growth of the different age groups slows down.
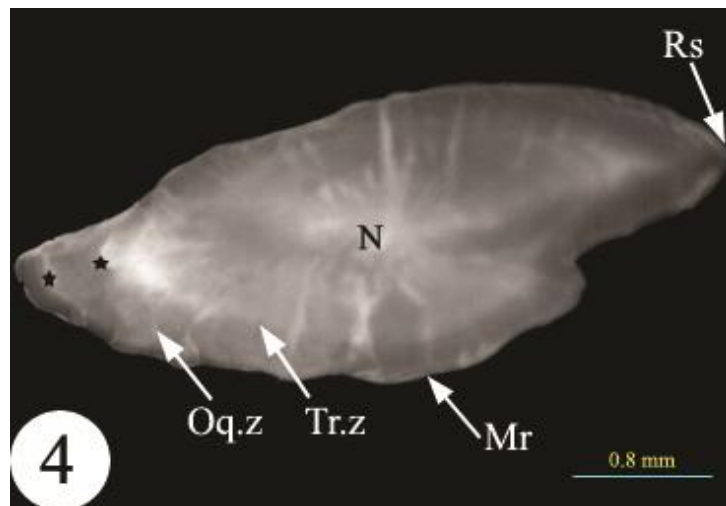

Fig. 4: Photomicrograph of an otolith of *T. puta* from Lake Timsah belonging age group two. Asterisk: annual ring.

Table 2: The mean observed lengths and standard deviation of different age groups of *T. puta* from Lake Timsah.

Age group	Number of fish	Observed length range (cm)	Mean observed length (cm)	S.D
I	24	7.1-9.8	8.71	0.589
II	392	9.5-13.8	12.62	0.321
III	17	12.9-15.1	14.81	0.258

ii- The age composition:

The study of the age composition of *T. puta* from Lake Timsah reveals the predominance of age group (II) in the catch (90.53% of the individuals). The fishes of age groups (I) and (III) are both represented by small percentages of 5.54 and 3.93 %, respectively, (Table 3 and Fig. 5).

Table 3: The age composition of *T. puta* from Lake Timsah.

Age group	Number of fish	% composition
I	24	5.54
II	392	90.53
III	17	3.93

Fig. (5): Age composition of *T. puta* from Lake Timsah.
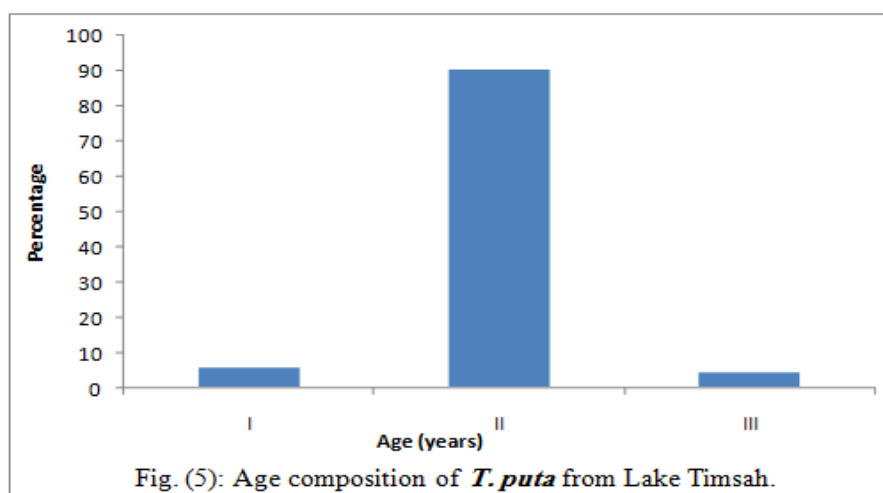
3- The sex ratio:

The both sexes of *T. puta* are not present in the same proportion throughout the different seasons of the year. The females are dominant during all the seasons of the year and show the highest percentage in Spring with a value of 63.38 %.The overall sex ratio of females to males during the study period was 1.3:1, respectively, (Table 4 and Fig. 6).

Table 4: Seasonal sex ratio of *T. puta* from Lake Timsah.

Season	Females		Males	
	No.	%	No.	%
Summer	130	53.5	113	46.5
Autumn	49	56.32	38	43.68
Winter	23	57.5	17	42.5
Spring	45	63.38	26	36.62

Fig. (6): Seasonal sex ratio of *T. puta* from lake Timsah.
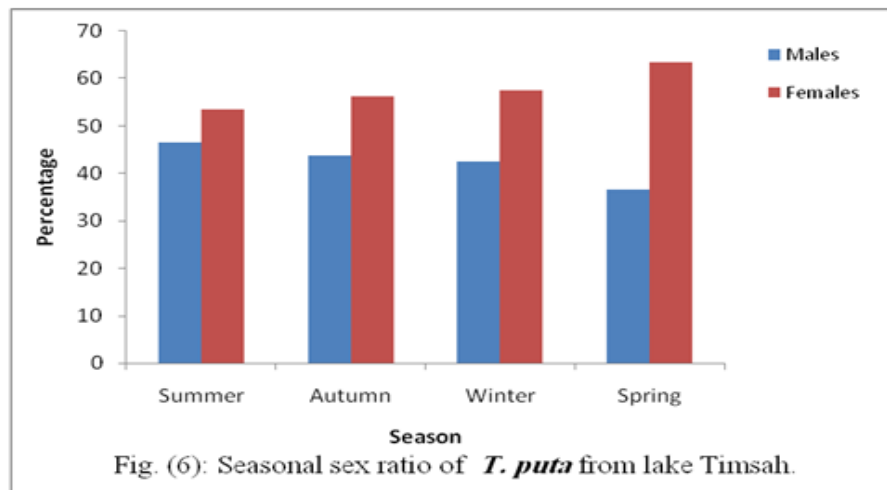
4- The gonadosomatic index:

The average values of gonadosomatic index were small in Winter for both sexes (1.389 for females and 0.337 for males) which is considered as the pre-spawning season and then they increased sharply in Spring and Summer and reached the highest values of 5.356 for females and 3.308 for males in Summer, where the spawning activity was highly observed for both sexes. The values of GSI decreased gradually till they reach the minimal values in Autumn for both sexes (0.974 for females and 0.291 for males) which is considered as the post-spawning season for both sexes (Tab. 5) and (Fig. 7). The aforementioned data reveals that *T. puta* has a prolonged spawning season starting from early Spring till late Summer.

Table 5: Seasonal variation in gonadosomatic index of females and males *T. puta* from Lake Timsah.

Season	No. of females	Females GSI	S.D	No. of males	Males GSI	S.D
Winter	23	1.389	0.447	17	0.338	0.384
Spring	45	3.589	1.863	10	3.00	2.836
Summer	130	5.356	1.692	113	3.308	1.795
Autumn	49	0.974	0.780	38	0.291	0.536

Fig. (7): Seasonal variation of gonadosomaic index of females and males *T. puta* from Lake Timsah.
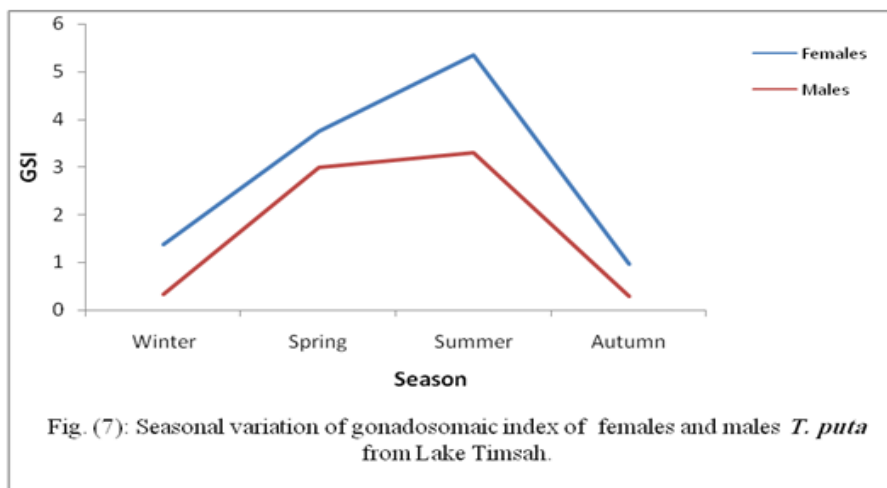
5- The fecundity:

The relationship between the absolute fecundity and total body length or total body weight was then estimated. To find out the best correlation coefficients between the absolute fecundity and total body length and between the absolute fecundity and total body weight, four mathematical plots were tested. These plots are: arithmetic-

arithmetic, arithmetic-log, log-arithmetic and log-log. The correlation coefficient "r^2" and the values of the intercept "a" and the regression coefficient "b" for the different plots are given in Table (6).

a- The relationship between the absolute fecundity and the fish total body length:

It is clear from Table (7) and Figure (8) that the egg production of *T. puta* increases with the increase in fish total body length. Thus, the mean observed absolute fecundity of *T. puta* ranges between 20437and 45272.83 eggs for fish with the mean total body length ranging from 9.9 to 12.35cm. Moreover, the mean relative fecundity of *T. puta* increases with the increase in fish mean total body length and ranges from 2064.34 to 3665.82 eggs per each cm.

It is clear from Table (6) that the relationship between the fish total body length and log observed absolute fecundity has the highest correlation coefficient (r^2 = 0.994). This relationship is a linear relationship and is represented by the following equation:

$$Log\ F = a + b\ (L)$$

Where, F: is the calculated absolute fecundity.

L: is the total body length.
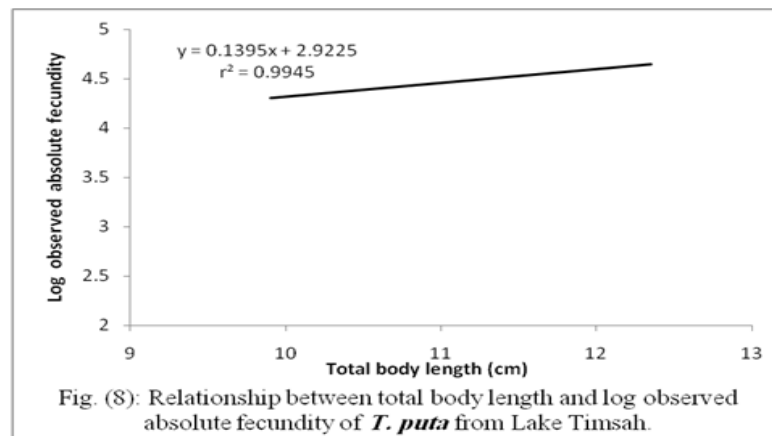
$$Log\ F = 2.9224 + 0.1396\ (L)$$

The graphical representation of this relationship is illustrated in Figure (8).

Table 6: The correlation coefficients, the values of the intercepts and the regression coefficients of the relationships between absolute fecundity and total body length (L), and absolute fecundity and total body weight (W) of *T. puta* from Lake Timsah.

	F			Log F		
	r^2	a	b	r^2	a	b
L (cm)	0.9656	-80054.1	10002.14	0.9945	2.9224	0.1396
Log L	0.9536	-233870	253719.3	0.989	0.7629	3.5527
W (gm)	0.999	-15689.3	2461.888	0.996	3.8951	0.03085
Log W	0.992	-116240	115703	0.999	2.6251	1.4576

Table 7: Mean observed, calculated absolute and relative fecundity of *T. puta* in relation to the fish total body length.

Total body length interval (cm)	Mean total body length	Number of fish	Mean observed absolute fecundity	Mean calculated absolute fecundity	Mean relative fecundity F/L
9.0-9.9	9.9	1	20437	20157.65	2064.34
10.0-10.9	10.59	9	25046.56	25163.09	2365.11
11.0-11.9	11.47	13	32221.92	33389.66	2809.23
12.0-12.9	12.35	6	45272.83	44305.74	3665.82

Fig. (8): Relationship between total body length and log observed absolute fecundity of *T. puta* from Lake Timsah.

b- The relationship between the absolute fecundity and the fish total body weight:

It is clear from Table (8) and Figure (9) that the values of absolute and relative fecundities increase with the increase in fish total body weight. The values of the mean observed absolute fecundity range from 25190.12 to 46508 eggs for fish with the mean body weight ranging from 16.54 to 25.19 gm, while the values of the mean relative fecundity range from 1522.98 to 1846.28 eggs per each gm.

The weights of the 29 fishes selected for fecundity studies were grouped in classes of 5 gm interval. The fecundity data obtained were plotted against the mean total body weight of *T. puta.* Table (6) shows that the highest estimated correlation coefficient is ($r^2 = 0.999$) for the relationship between the logarithmic values of both the fish mean total body weight and the mean observed absolute fecundity. This relationship is a linear relationship and is represented by the following equation:

$$Log F = a + b (log W)$$

Where, F: is the calculated absolute fecundity
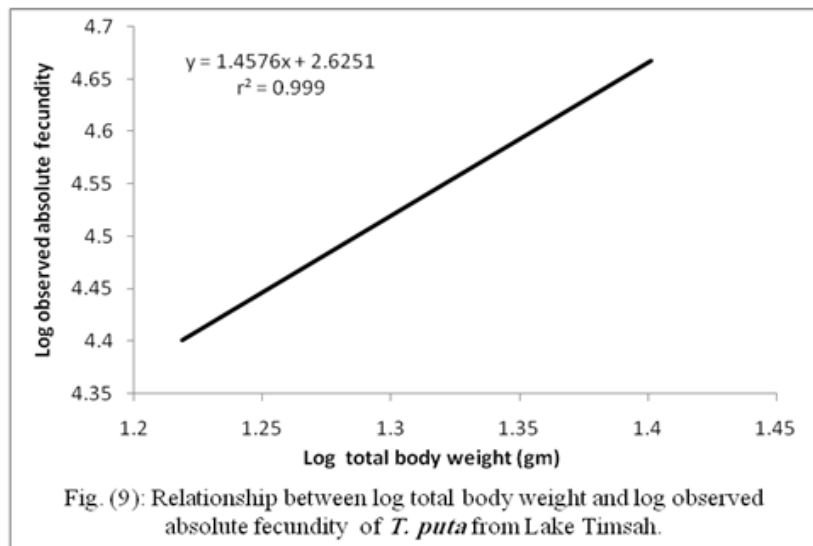
W: is the total body weight.

$$Log F = 2.6251 + 1.476 (log W)$$

This relationship is graphically represented in Figure (9).

Table 8: Mean observed, calculated absolute and relative fecundity of *T. puta* in relation to the fish total body weight.

Total body weight range (gm)	Mean total body weight	Number of fish	Mean observed absolute fecundity	Mean calculated absolute fecundity	Mean relative fecundity F/W
14.0-18.9	16.54	17	25190.12	25190.53	1522.98
19.0-23.9	21.15	9	3637.44	36047.27	1703.89
24.0-28.9	25.19	3	46508	46508.27	1846.28

Fig. (9): Relationship between log total body weight and log observed absolute fecundity of *T. puta* from Lake Timsah.

DISCUSSION

In the present study, the total body length of *T. puta* ranged between 5.6 to 15.2 cm and the total body weight varied from 5.08 to 41.65 gm. Vari (2001) reported that the maximum length of *T. puta*, from the western central Pacific is 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. This variability may be due to the difference in the environmental conditions such as: habitat, food abundance and temperature.

The length-weight relationship is very crucial in estimating the standing stock biomass and comparing the development history of fish population from different regions (Petrakis and Stergiou, 1995). It is an important fishery management tool and it is very useful for cultivators and fisheries managers to ascertain the growth of the species (Nandikeswari *et al*., 2014 b). Length- weight regressions have been used frequently to estimate weight from length because direct weight measurement can be time consuming in the field (Sinovcic *et al.*, 2004). Length-weight relationship differs for the same species in different localities according to the environmental conditions, such as temperature and abundance of food. Table (9) summarizes the results of the length-weight relationships for *T. puta* and the related fish species in different localities.

Table 9: Summary of the recorded length-weight constants and r^2 of *Pelates quadrilineatus, Terapon jarbua* and *Terapon puta* in different localities.

Fish species	Locality	a	b	r^2	Authors
Pelates quadrlineatus	Eastern Mediterranean Sea	0.00000148	2.958	0.97	**Taskavak and Bilecenoglu (2001)**
Terapon jarbua	Korangi- Phitti Creek area (northern Arabian Sea)	- 1.914	3.091	0.969	**Hussain*et al*. (2010)**
Terapon jarbua	Beibu Gulf (northern South China Sea)	0.00493	2.76	0.990	**Wang *et al*. (2011)**
Terapon jarbua	Merbok estuary Kedah	0.0197	2.9279	0.9565	**Isa *et al*. (2012)**
Terapon jarbua	The wider Gulf of Aden	0.0288	2.99	0.96	**Lavergne *et al*. (2013)**
Terapon puta	Southeastern Mediterranean Sea	0.0151	2.91	0.979	**Edelist (2012)**
Terapon puta	Lake Timsah	0.0442	2.4954	0.9012	The present study

In the present study, the calculated value of "b" is 2.4954 indicating that the growth of weight relative to length is negative allometric. These observations coincide with those recorded in *T. jarbua*, from Beibu Gulf (Wang *et al*., 2011), *T. puta*, from the southeastern Mediterranean Sea (Edelist, 2012) and *T. jarbua*, from Merbok estuary, Kedah (Isa *et al*., 2012). However, they disagree with those recorded in *Pelates quadrilineatus* (Taskavak and Bilecenoglu, 2001) and *T. jarbua* (Lavergne *et al*., 2013) in which the length-weight relationship is nearly isometric. On the other hand, the length-weight relationship of *T. jarbua*, from Korangi-Phitti Creek area (northern Arabian Sea) (Hussain *et al*., 2010) shows positive allometric growth. The value of "b" gives information on the kind of growth of the fish. The growth is isometric if "b" = 3 and allometric if "b" ≠ 3 (negative if "b" "<3 and positive if "b">3) (Ricker, 1973).

In the present study, otoliths are considered to be the most suitable structure for the aging of *T. puta*. The otolith of *T. puta* is elliptic in shape, with a rostrum and slightly irregular margin. These observations contradict with those of Alwany and

Hassan (2008) who stated that the otolith of *T. puta*, from Suez Canal and Gulf of Suez is oval in shape, with entire margin and lacks a rostrum. Otoliths are considered to be the most reliable aging structure in some fish species (Staples, 1971 and Khan *et al.*, 2011). The suitability of otoliths for age determination is supported by the fact that they do not show reabsorption and their growth is acellular rather by calcification (Secor *et al.*, 1995). Moreover, they are metabolically inert, thus do not reflect physiological changes that occur throughout the life of fish (Phelps *et al.*, 2007).

The present study is the first attempt to determine the age and growth of *T. puta* in Lake Timsah. Three age groups from I to III years are encountered. The mean observed lengths at the different age groups are 8.71, 12.62 and 14.81 cm, respectively. Apparently, no literature related to the age of this species was found.

The overall sex ratio of females to males *T. puta* is 1.2:1 indicating that the females are predominant during all seasons of the year. Similar observation was recorded in *Terapon jarbua*, from Tamshui River (Miu *et al.*, 1990) in which the female to male sex ratio is 1.8:1. The predominance of females may be attributed to the male fertilizing efficiency (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).On the other hand, Nandikeswari *et al.* (2013 and 2014 a) observed that males of *T. puta* and *Terapon jarbua*, from Puducherry (Pondicherry) coast, are dominant in the population and the overall sex ratio of females to males is 1:1.06 and 1:1.28, respectively. The variability of sex ratio in fishes may be due to their selective natural and fishing mortalities between sexes; or by the segregation of the sexes through various periods of the year, including segregation resulting from sex difference in age and size at maturity (Smith, 1956).

Knowledge of the spawning season of fish species gives an indication for the appropriate time for the closure of the fishery so as to protect the spawning stock biomass. It is noteworthy of mentioning that *T. puta*, from Lake Timsah has a prolonged spawning season that extends from early Spring till late Summer. This result coincides with that of Nandikeswari and Anandan (2013) who reported that *T. puta*, from Nallavadu coast has a prolonged spawning season extending from March till October. Conversely, it contradicts with that of Ben-Tuvia (1986) who stated that *T. puta*, from Bardawil Lagoon and the Mediterranean coast of Sinai has a single spawning season that occurs in Summer.

In the present study, it is noted that 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 for *T. puta*, from Nallavadu coast (Nandikeswari and Anandan, 2013) and *Terapon jarbua*, respectively, from Pondicherry coast (Nandikeswari *et al.*, 2014 a). Generally, the fecundity varies not only in the different species, but also in the same species in the different years or different environmental conditions (Latif and Shenouda, 1973). The observed absolute fecundity of *T. puta* ranges between 20437and 45272.83 eggs for fish with the mean total body length ranging from 9.9 to 12.35cm. However, it ranges from 25190.12 to 46508 eggs for fish with the mean body weight ranging from 16.54 to 25.19 gm. Higher absolute fecundity values were recorded for the same fish species, from Nallavadu coast (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 gm total body weight.

It is noteworthy of mentioning that the highest significant relationship is found between the logarithmic values of both the mean observed absolute fecundity and the mean total body weight, with the highest correlation coefficient (r^2=0.999). The total body weight is, consequently, the best indicator of the fecundity of *T. puta*. These observations coincide with those reported in *Carassius auratus*, from Rajshahi, Bangladesh (Amin *et al*., 2013) and in *Pterophyllum scalare*, from the same locality (Mazumder *et al*., 2013). However, Nandikeswari and Anandan (2013), in *T. puta* from Nallavadu coast, and Nandikeswari *et al.* (2014 a), in *Terapon jarbua* from Pondicherry coast, 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), in some teleost fishes, explained the higher correlation 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.

The recommendation of the present study is to prevent fishing of *T. puta* in Lake Timsah during the spawning season, which extends from April to August, or use nets with wider meshes in order to protect the spawning biomass of *T. puta* resources.

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ACKNOWLEGMENT

ARABIC SUMMARY

دراسات بيولوجية على أسماك التيرابون بوتا فى بحيرة التمساح

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يهدف البحث الحالى إلى دراسة بعض الصفات البيولوجية لأسماك التيرابون بوتا في بحيرة التمساح بمحافظة الإسماعيلية، بمصر في الفترة الزمنية من شهر يونيو 2011 و حتى شهر مايو 2014. و لقد خلصت النتائج إلى أن العلاقة بين وزن جسم السمكة و طولها سلبي التنامي حيث يبلغ معامل قياس التنامي 0,24954.

و قد تم تقسيم العينات المجمعة إلى ثلاث فئات عمرية و هي عام و عامين و 3 أعوام. كما أشارت الدراسة العمرية لسمكة التيرابون بوتا إلى أن ما يعادل 90,53% من إجمالي العينات التي تم جمعها تقع في المجموعة العمرية الثانية. و أوضحت الدراسة أن نسبة الإناث قد فاقت نسبة الذكور بمقياس 1,3:1. كما تبين وجود تباين موسمي في قيمة دليل المناسل الجسدي لسمكة "التيرابون بوتا" ، حيث يكون صغيرا في كلا الجنسين في فصل الشتاء (موسم ما قبل التبويض) و تزداد هذه القيمة تدريجيا في فصلي الربيع و الصيف حيث تصل أقصى مداها في فصل الصيف الذي يعد موسما ذو نشاط تبويضي عال. بينما تتناقص قيمة دليل المناسل الجسدي تدريجيا و تصل إلى أدنى مستوى لها في فصل الخريف (موسم ما بعد التبويض).

و قد خلصت النتائج الحالية إلى أن لأسماك التيرابون بوتا فترة تبويض طويلة تبدأ من أوائل فصل الربيع و تنتهي في أواخر فصل الصيف. و قد أوضحت الدراسة الحالية أن العلاقة بين الخصوبة المطلقة لسمكة التيرابون بوتا و إجمالي وزن الجسم ذات دلالة إحصائية عالية بين القيم اللوغارتمية لكليهما مع أعلى معامل إرتباط و الذي يساوي 0,999 و من ثم يعتبر إجمالي وزن الجسم أفضل مؤشر لخصوبة سمكة التيرابون بوتا.