Fecundity and Gondosomatic Index (GSI) of Common Pandora, *Pagellus erythrinus* (Linnaeus, 1758), Inhabiting Telmatha Coast Eastern Benghazi, Libya

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Abstract: This study was conducted to investigate the biology of Common Pandora in Tellmatha coast. Species of (*Pagellus erythrinus* L., 1758) were caught in Tellmatha using longline during the period from April 2017 to August 2017. A total of 80 mature female specimens were examined for fecundity and gonadosomatic index study. The fecundity of the fish ranged from 1177.7 to 5818.18 eggs with an average value of 3512.09 eggs. The relationship between fecundity and gonad weight was most significant (r= 0.9775) than that of fecundity with other factors. The relations between fecundity and total length and body weight are linear. The regression equation are i) $Log_{10}F=4.6248+2.1379Log_{10}TL$, ii) $Log_{10}F=2.7203+1.4081Log_{10}TW$, iii) $Log_{10} F= 0.5063+3.8624 Log_{10} Gw$ r = 0.8818. The spawning period started in June and continued until October. This data shows that the stock of the Common pandora of Tellmatha coast is being exploited in the limit. It would be desirable to take measures to protect the spawning stock and recruits, for example by introducing a closed season or various changes in fishing patterns.

Keywords: Common pandora (*Pagellus erythrinus*), Gonads, Fecundity and Gonadosomatic index.

INTRODUCTION

The common pandora, *Pagellus erythrinus* (Linnaeus, 1758), which belongs to the family *Sparidae*, is a valuable species for aquaculture and fisheries. The species has a relatively wide distribution, inhabiting the Black and Mediterranean seas and from Norway to Angola (Bauchot and Hureau, 1986). The depth range of the common pandora varies generally between 20-100 m and 320 m down in various habitats (Bouchot, 1987; Ozaydın, 1997; Tosunoğlu, Akyol, Metin, Tokaç, & Ünsal, 1997), Stergiou and (Hoşsucu & Çakır, 2003; Stergiou & Moutopoulos, 2001) have all conducted studies on population characteristics of the species inhabiting the Aegean Sea. Depending on size, common pandora is widely distributed from shallow coastal waters to 300 m depth. (Livadas, 1989; Mytilinéou, 1989; Orsi Relini &

Romeo, 1985; J. Pajuelo & Lorenzo, 1998; Papaconstantinou, Mytilineou, & Panos, 1988; Somarakis & Machias, 2002; Vassilopoulou, Mytilineou, & Papaconstantinou, 1986 ;Spedicato *et al,* 2002). Furthermore, (Relini and Romeo 1985) have researched the biological characteristics of the species from different seas. (Valdés et al., 2004) reported that the common pandora is a suitable species for aquaculture in the Mediterranean and that the correct determination of the species spawning period is also very important.

The common pandora is of commercial importance and has been captured by gill or trammel nets, longline, and trawl in İzmir Bay. This *Sparidae* is well known and appreciated also in the Japanese markets which have been importing large quantities of

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Mediterranean pandora for many years (To-miyama, 1974). The result is that this *Spari-dae* is currently severely overfished in several Mediterranean countries (Ghorbel, 1996; J. M. G. Pajuelo, Nespereira, & Mata, 1996). Signs of overexploitation of the species standing stock have been reported in diverse Mediterranean geographical sub-areas (GSAs) (Abella, Colloca, Sartor, & Mannini, 2010; Gurbet, Akyol, & Yalcin, 2012; Jarboui, Ghorbel, & Bouain, 1998; Mehanna, 2011; Vassilopoulou et al., 1986). The current conservation legislation on fisheries sets the minimum size limit for this species at 150 mm TL (EU Regulation 1967/2006). Also in Algerian waters, this length is the same (J.O.R.A.D.P, 2004; Valdés et al., 2004), and they reported that the common pandora is a suitable species for aquaculture in the Mediterranean and that the correct determination of the species spawning period is also very important.

Spawning period, sex-ratio, GSI, length at first maturity and length-weight relationship were studied in different regions such as Aegean sea (Hoşsucu & Çakır, 2003; Metİn, İlkyaz, Soykan, & Kinacigil, 2011). The main objective of this study was to determine spawning period, fecundity, and gonadosomatic index of the Common Pandora in Tellmatha Libyan Sea. The findings were compared with previous studies and discussed from the perspective of a sustainable fisheries policy.

To date, there is no information published on the biology of this Sparid in Tellmatha coast. Nevertheless, a number of studies were conducted, for instance (Motaref, 2014) in Ain El-Ghazala Gulf of eastern Libya.

MATERIALS AND METHODS

A total of 80 common pandora samples were collected by bottom trawl (mesh:40mm) from Tellmatha Coast (32°4253.86′N; 20°56′47.01E) (Figure 1), between depths of 30 and 100 m by R/V Egesüf (26.8 m length, 463 HP engine and 110 gross weight) from April 2017 to August 2017. A commercial bottom trawl was used for sampling. The cod-end used featured a knotless diamond shape and was made of polyamide (PA) material with 22 mm stretched mesh size netting. Fish samples were brought to the laboratory and total length (L) was measured to the nearest millimeter in the natural body position. Total weight (W) and gonad weight (Wg) was measured to the nearest 0.01 g, and sex was recorded.

The spawning period was established with monthly variations of the gonadosomatic index (GSI) from the equation GSI = [Wg / (W − Wg)] × 100, where Wg is the gonad weight (g), and W is the total weight (g) of fish (Ricker, 1975).
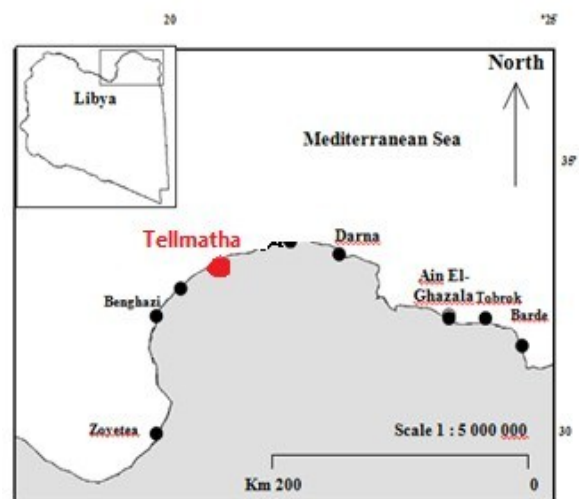

Figure (1). Sampling area.

Statistical analysis: The relationship between each paired parameters was calculated by using regression

RESULTS AND DISCUSSION

Fifty gravid females were collected randomly for the study of fecundity of *P. erythrinus*. Data showed that a fish with a mean total length of 22.4 cm and a mean total weight of

135.40 g produces 3512.09 eggs in an average (table1).

Table: (1). Mean fecundity counts of various length ranges of *P. erythrinus*

Class interval	Total length (cm)	Body weight (g)	Gonad weight (g)	Fecundity
16.0-18.0	18	72.245	0. 63	1177.7
18.0-20.0	19.6	90.72	2.19	2997.44
20.0-22.0	21	122.65	3.03	3420.63
22.0-24.0	23.4	138.79	3.75	3635.32
24.0-26.0	24.8	168.64	4.68	4023.25
26.0-28.0	27.5	219.34	6.51	5818.18
Average	22.4	135.40	3.495	3512.09

The highest fecundity 5818.18 was observed in a fish having a total length of 27.5 with a total body weight of 219.34 g, and the minimum fecundity 1177.7eggs was found in a fish with a total length of 18 cm and a total body weight of 72.24 g. This study revealed that older fish were more fecund than younger fish.

The correlation coefficient, regression equation, and the significance of fecundity correlation with total length, body weight and ovary weight of *P. erythrinus* are given in Table 2.

Table: (2). Correlation coefficient, values of regression coefficient, values of intercept of correlation with total length, body weight, and gonad weight.

Relationships	Correlation coefficient	Value of regression(b)	Values of intercept(a)
Fecundity(F) and Total length(TL)	0.8909	24487	90587
Fecundity(F)and Total weight(TW)	0.9126	13676	3550.2
Fecundity(F)and gonad weight(GW)	0.9775	2301.2	3845.1

Correlation coefficient reveals that the variation of fecundity with ovary weight is highly correlated (r=0.9549) than that of total length (r= 0.7906) and body weight(r=0.9126). Similar finding was also observed for *liza parsia* by (Rheman, Islam, Shah, Mondal, & Alam, 2002) *P. erythrinus* by Ben Smida and Hdhri (2014).
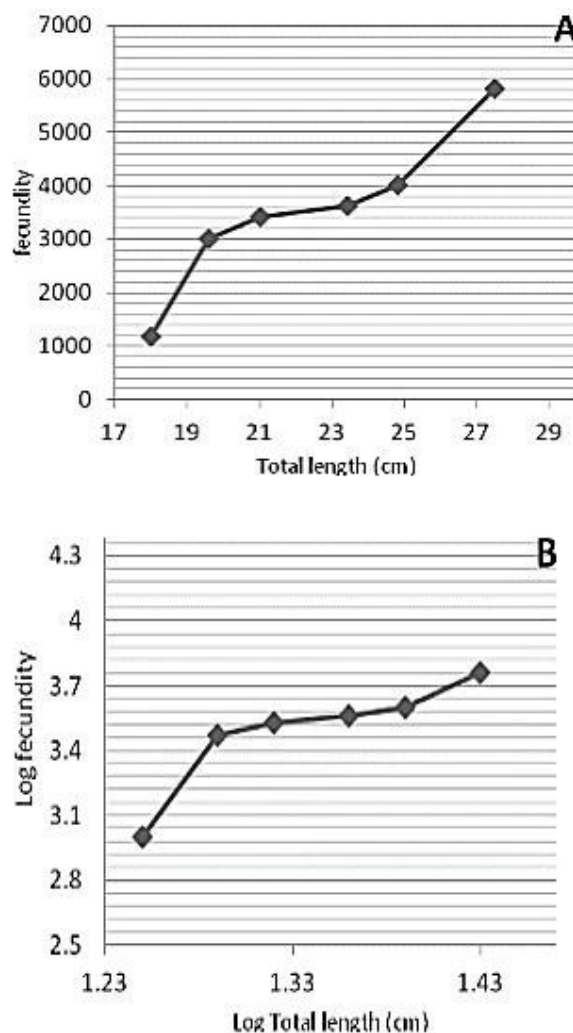
Figure(2). The Relationship between Total length and Fecundity of *P. erythrinus* A). anti-log and B). log.

The fecundity in relation to different parameter Fecundity (F) and total length (TL) relationship: (Fig. 2 a, b) Shows the total length and fecundity relationship in anti-log and log forms respectively. The study revealed the following equations:

F= 90578-24487 TL   r=0.8909

Log_{10} F= 4.62818+2.1379 Log_{10} TL   r = 0.7917

Or, F=0.2659 TL $^{3.0303}$

Where,   F= Fecundity, TL= Total Length.

Fecundity and total body weight relationship: The relationship between the fecundity and body weight of *P. erythrinus* are of linear type (Fig.3 a, b). The relationship of fecundity against body weight produced a regression, which can be stated as follows:

F= 3550.2-13676TL   r=0.9126
Log_{10} F= 2.7203+1.481 Log_{10} Tw r = 0.8176
Or, F=9.3567 Tw $^{1.2037}$
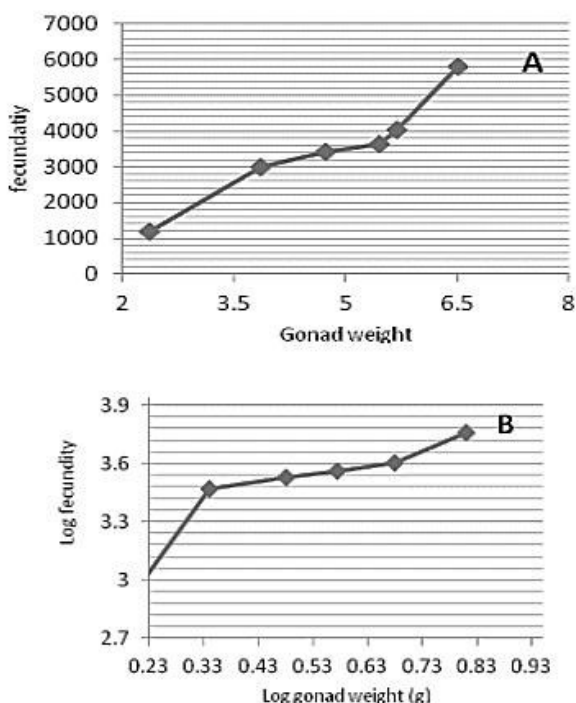Where,   F= Fecundity, TW= Total weight.

Figure (3). Relationship between Body weight and Fecundity of P. erythrinus a). Anti-log and B) log

Fecundity and gonad weight relationship: The scatter diagram of fecundity and ovary weight suggested a linear relationship between the variables (Fig. 4A) It could be seen from Fig. 4B that a straight line through the origin would fit the point well showing the direct proportion between the number of eggs and gonad weight of the fish. Similar findings were also observed by earlier studies

(Rheman et al., 2002) on *Liza parsia*.

F= 1723.3 -1728 GW   r=0.9775
Log_{10} F= 0.5063+3.8624 Log_{10} Gw   r = 0.8958
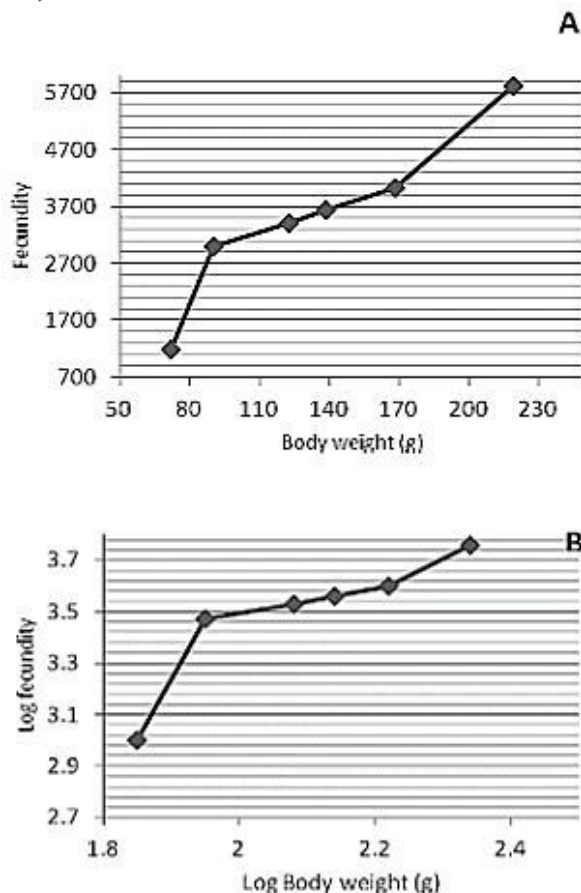Or, F=1634 Gw $^{0.6455}$

Figure (4). Relationship between Gonad weight and fecundity of *P.erythrinus* , A). anti-Log and B).Log.

Gonadosomatic index: Gonadosomatic index indicates gonadal development and maturity of fish. It increases with the maturation of fish and declines abruptly thereafter (parameswarn et al., 1974). The gonadosomatic index varied between 2.26 to 3.89, it also produced two highest peaks in July (2.38) and the lowest was in April (1.07). (Fig .5), (Table 3).

Table (3). Month-wise gonadosomatic index of *P. erythrinus*. females

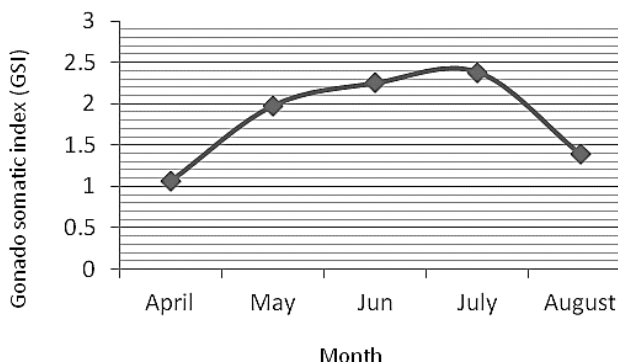| Month	Total length	Total weight	Gonad weight	Mean *GSI
April	14.5-23.5	34.51- 195.2	0.4– 2.86 1.49	0.591– 4.230 1.07
May	19- 27.5	81.08- 219.34	0.6 – 4.5 2.5	0.925– 3.211 1.98
June	18.5- 26.0	85.24- 242.59	0.9 – 6.8 2.75	1.23– 3.258 2.25
July	24.3- 29.1	115.36- 323.69	1.3 – 6.8 2.95	2.263– 3.894 2.38
August	18.2- 28.2	78.66-388.9	0.6 – 2.20 1.21	0.36– 2.20 1.39

*GSI =Gonadosomatic Index

Figure (5). Monthly fluctuation in the gonadosomatic index of the berried *P. erythrinus*.

Therefore, the fish spawn for several months with two spawning peaks. Similar findings were also observed by (Mahdi, Talet, & Boutiba, 2018) in western Algeria. The evolution of mean GSI for males and females shows similar patterns. The monthly values of GSI ranged between 0.13 and 3.80 in females and from 0.11 and 2.38 in males. From May to July the mean values reached the highest values, a second peak was observed in October. Those values were low from November to April. In different areas of Mediterranean Sea such as: Bay of Monastir (Valdés et al., 2004); (Ben Smida., 2014); (Mahdi et al., 2018), Gulf of Tunis (Zarrad, Cherif, Gharbi, Jarboui, & Missaoui, 2010), Gulf of Gabès (Ghorbel, 1996), Southern Portugal (Coelho *et al.,* 2010), and Canary Islands (J. Pajuelo & Lorenzo, 1998), the Common pandora have the same behavior and generally spawns in spring/summer, a second spawning period in autumn has also been reported by some authors (Dieuzeide et al. 1955; Ghorbel & Ktari 1982; (Vassilopoulou & Papaconstantinou, 1990). In the relationship between the fecundity and gondosomatic index (GSI) (fig.6), the GSI values increase with the maturation and fecundity of fish.

The GSI values of females were usually higher than those of males. The highest values occurred in August for females and in September for males, and spawning periods are noted. The peaks in April, August, and October show that the spawning period of this species is long (April-October) Ünsal, 1984; Özaydın, 1997 (Hoşsucu & Çakır, 2003; Mahdi et al., 2018). Spawning occurs between May-September according to many studies (Larrañeta 1964; Girardin and Quignard, 1985;(Livadas, 1989; J. Pajuelo & Lorenzo, 1998; Papaconstantinou et al., 1988). This information might be helpful for the proper management of *P. erythrinus*.
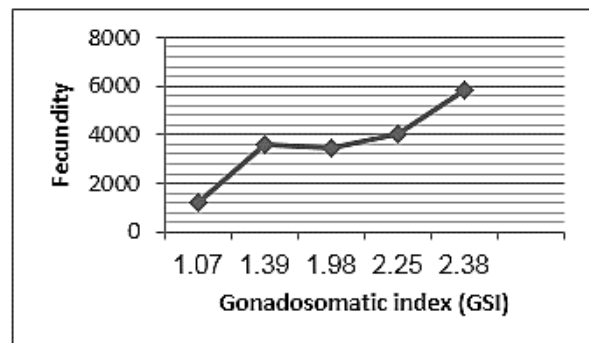

Figure (6). Relationship between Gonadosomatic index and fecundity of *P.erythrinus*

CONCLUSION

At the light of this first data about the reproductive cycle of *P.erythrinus* in Tellmatha cost in eastern Libya, we conclude that there is a significant difference between males and females *P.erythrinus* with a predominance of females. The spawning period extends from May to July with a second peak in October.

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الخصوبة ومعامل الدليل المنسلي لسمكة المرجان الأحمر(Linnaeus, 1758) *Pagellus erythrinus* , المستوطنة على ساحل طلميثة شرق بنغازي

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قسم علوم البحار، كلية العلوم، جامعة عمر المختار، البيضاء، ليبيا

المستخلص: هذه الدراسة اجريت للتعرف على خصوبة ومعامل الدليل المنسلي لأسماك المرجان الأحمر *Pagellus erythrinus* حيث تم صيد الأسماك من خلال الصيد التقليدي بمرفأ طلميثة شرق بنغازي باستخدام الخيط الطويل للصيد، خلال الفترة من أبريل 2017 إلى أغسطس 2018 م، تم فحص حوالي 80 أنثى من سمك المرجان الأحمر. تراوحت خصوبة السمكة من 1177.7 إلى 5818.18 بيضة بمتوسط قيمة 3512.09 بيضة. العلاقة بين الخصوبة ووزن الغدد التناسلية كانت أكثر أهمية (0.9775 = r) من العلاقة بين الخصوبة وعوامل أخرى. تكون العلاقات بين الخصوبة والطول الكلي ووزن الجسم خطية. بحيث كانت معادلة الانحدار كالتالي: Log10F = 2.7203 + (ii Log10F = 4.6248 + 2.1379Log10TL (i 1.4081Log10TW iii Log10 F = 0.5063 + 3.8624 Log10 Gw r = 0.8818) بدأت فترة التكاثر في يونيو واستمرت حتى أكتوبر. توضح هذه البيانات أن المخزون من سمكة المرجان الأحمر في ساحل طلميثة يتم استغلاله في الحد الأقصى وبذلك نوصي باتخاذ تدابير لحماية مخزون وضع البيض وصغار الأسماك لهذا النوع، على سبيل المثال عن طريق إدخال موسم مغلق أو إحداث تغييرات مختلفة في أنماط الصيد.

الكلمات المفتاحية: المرجان الأحمر، الغدد التناسلية، الخصوبة، معامل الدليل المنسلي.

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