REPRODUCTIVE DYNAMIC OF THE COMMON PANDORA *PAGELLUS ERYTHRINUS* (L., 1758) FROM EL-KALA COASTLINE (ALGERIAN EAST COAST)

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(Received 29th Aug 2024; accepted 9th Dec 2024)

Abstract. Monthly samples of *Pagellus erythrinus* were collected on the El-Kala coast (eastern Algeria) from March 2023 to February 2024, as part of a study to analyze the main reproductive parameters of this demersal species, including sex ratio, gonado-somatic and hepatosomatic indices, size at first sexual maturity and seasonal variations in these indices. A total of 383 specimens were examined, including 199 males, 183 females and 1 undetermined individual, with length varying from 11 to 23.5 cm. The study revealed an overall male/female sex ratio of 1.09, which remained constant throughout the year ($\chi^2 = 0.67$; $P > 0.05$), although fluctuations were observed in certain months. Males dominated in August and October, while females were more abundant in January and February. The breeding season was identified as May to August, with a second minor peak in October, based on gonado-somatic and hepatosomatic indices. Finally, the study determined that the size at which 50% of individuals were sexually mature was 15.51 cm for males and 15.38 cm for females. These results are essential for understanding the reproductive dynamics of *P. erythrinus* and provide essential information for the sustainable management and conservation of fisheries for this important fish resource along the Algerian east coast.
Keywords: *Sparidae, P. erythrinus, sex-ratio, spawning period, size at first sexual maturity, Algeria*

Introduction

The common pandora *Pagellus erythrinus* (Linnaeus, 1758) is a demersal fish of the Sparidae family, widely present in the Mediterranean, the Black Sea and the eastern Atlantic, from Norway to the southern coast of Angola (Fisher et al., 1987; Froese and Pauly, 2014). This species frequents various types of seabed to a depth of 320 m, but is particularly abundant between 20 and 100 m depth (Bauchot, 1987) and is caught both by trawling and by artisanal fishing. Tt is hermaphroditic (Ghorbel, 1996; Pajuelo and Lorenzo, 1998), this species breeds in the Mediterranean between early spring and late summer (Mytilinéou, 1989; Ghorbel, 1996; Zarrad et al., 2010; Mahdi et al., 2018), its breeding period being conditioned by hydrological factors, notably a water temperature of between 19 and 21°C (Fischer et al., 1987).

In Algeria, *P. erythrinus* is highly prized on the market, due to its high commercial value and consumer appeal. With fish production reaching around 450 tons (MPPH, 2023), it has a significant economic potential. In addition, this species is considered a promising candidate for the diversification of aquaculture, thanks to its ability to be breed in captivity (Valdes et al., 2004; Klaoudatos et al., 2004; Micale et al., 2006). A

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2301_16211633

thorough understanding of their reproductive biology is therefore essential for effective management of these fishery resources (Campana and Thorrold, 2001). In general, fish display a wide diversity of reproductive strategies and associated traits (Basilone et al., 2006) such as reproductive system, number of partners, sex roles, spawning season, size at first maturity, fecundity, among others. All these processes can be modified depending on the area where the fish live (Nikolsky, 1963). Various methods are used to assess the reproductive status of fish, such as microscopic and macroscopic classification of gonads, analysis of oocyte size distributions, measurement of sex steroids and calculation of gonadal indices (Lowerre-Barbieri et al., 2011). Several studies carried out in different regions of the Atlantic and the Mediterranean have been devoted to these various aspects, notably in the Canary Islands (Pajuelo and Lorenzo, 1998), Portugal (Santos et al., 1995; Coelho et al., 2010), Spain (Valdés et al., 2004), Turkey (Hossuçu and Cakır, 2003; Metin et al., 2011), Greece (Mytilinéou, 1989), Lebanon (Lteif et al., 2020), Libya (Saleh, 2018; Elmadjedeb et al., 2019) and Tunisia (Zarrad et al., 2010; Fassatoui and Romdhane, 2010; Ben Smida and Hadhri, 2014).

Although *P. erythrinus* is present along Algerian coasts, studies on its reproductive biology remain limited, with the exception of the one conducted by Mahdi et al. (2018) on the west coast of Algeria. Therefore, this study focuses on the reproductive analysis of the common pandora caught in the waters of the Algerian east coast (El-Kala coastline), based on the estimation of various reproductive indices. In the current work, we emphasize evolution of the gonadosomatic and hepatosomatic indices, the condition factor, breeding period, as well as the first size of sexual maturity and the sex ratio of the species.

Given the ecological similarities between Algerian waters and those of neighboring countries, where the spawning period extends from spring to summer, we hypothesize that *P. erythrinus* reproduction in the El Kala littoral follows similar seasonal patterns, with peaks in reproductive activity during these periods. We also postulate that gonado-somatic and hepato-somatic indices will increase significantly during these periods, reflecting increased reproductive intensity, and that condition factor K will peak before or during this period. These hypotheses provide a framework for exploring spatio-temporal variations in reproductive parameters and for comparing the results obtained with those reported in other Mediterranean regions, thus contributing to a better understanding of the reproductive biology of this species in a local context.

Materials and methods

Study area

This work was carried out at the El-Kala bay which is located between the two Caps Rosa in the West (36° 57′ 03″ N - 8° 14′ 35″ E) and Segleb in the East (the Tunisian border) (36° 56′ 45″ N - 8° 36′ 57″ E). The continental shelf is relatively narrow in the East and widens in the West; the -20 m and -100 m isobaths are; Indeed; located at 7 km to the east and reach 30 km to the West (*Fig. 1*). The coastal marine area of El-Kala is part of El Kala National Park and was recognized as natural biosphere reserve by UNESCO on 17 December 1990 (Sarri et al., 2014).

Sampling

Random samples were collected from commercial landings in El-Kala city. From March 2023 to February 2024, a total of 383 specimens of *P. erythrinus* were monthly

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collected, of which 199 males (11-22 cm in TL and 7.03-151.4 g in TW) and 183 females (11-23.5 cm in TL and 22-164.3 g in TW). In laboratory and for each specimen, we measured the total length (TL, 1 mm), total weight (TW, 0.1 g), eviscerated weight (EW, 0.1 g), gonad weight (GW, 0.01 g) and liver weight (LW, 0.01 g). Sex and gonadal maturity stages was identified macroscopically using Fantodji scale (1987).

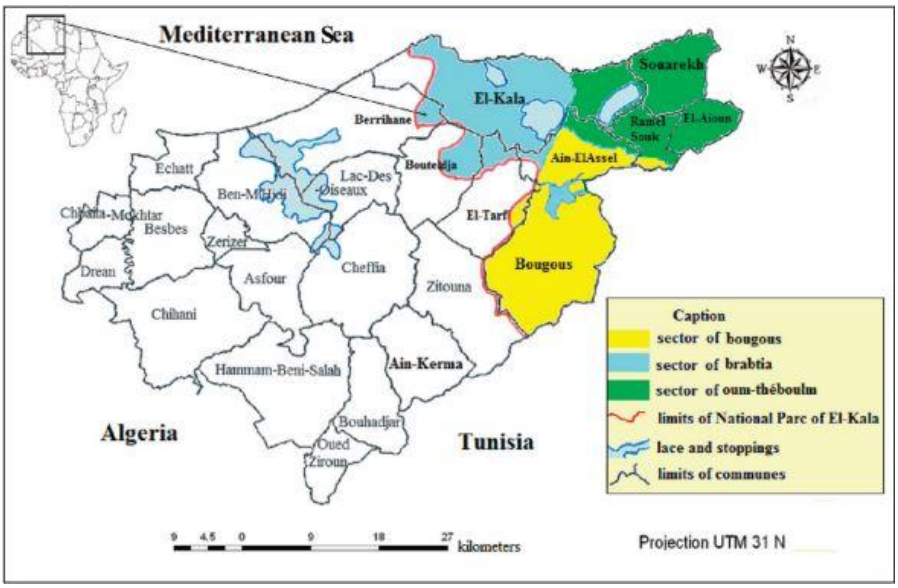

Figure 1. *Location of the sampling area (Northeast Algeria) (in Sarri et al., 2014)*

Sex ratio

The sex ratio of the common pandora was calculated monthly, seasonally, overall and according to the size of individuals, as follow:

$$SR = M/F \quad \text{(Eq.1)}$$

M: number of males; F: number of females.

By 1 cm length class intervals, the sex ratio was calculated and compared using the Chi-square test (χ^2) (Dagnelie, 1975). The latter is calculated to test the null hypothesis.

Ho: sex ratio = 50%. The null hypothesis is rejected at the significance level $\alpha = 0.05$ when χ^2_{obs} is greater than or equal to the theoretical value ($\chi^2_{1-\alpha}$) of the distribution of (χ^2) at the value 1 degree of freedom. This test is only valid for numbers of males or females greater than 5.

Spawning season

Monthly analysis of gonadosomatic index *(GSI)* was calculated in order to determine the spawning season of the species, according to the following equation:

$$GSI = (GW/EW) \times 100 \quad \text{(Eq.2)}$$

GW: gonad weight; EW: eviscerated weight.

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The monthly variation of hepatosomatic index (*HSI*) and condition factor (*K*) were also calculated:

$$HSI = (LW/EW) \times 100 \quad \text{(Eq.3)}$$

$$K = (EW/TL^b) \times 100 \quad \text{(Eq.4)}$$

LW: liver weight; EW: eviscerated weight; TL: total length; b: is the slope of the length-weight relationship and equal to 3.

Using a one-way ANOVA test, the monthly means of GSI, HSI and K were compared and a multiple sample comparison of means two by two (Newman-Keuls test, SNK) was completed according to Dagnélie (1975) and this for both males and females. There is a significant difference when the letters (a, b, c, d) shown on the graphic are different. There is no significant difference when the letters are similar, indicating that the average values are equal. Statistical analyses were performed with Minitab® Statistical Software (Version 18.1) and a significant level of 0.05 was accepted.

Length at first maturity (L50)

The L_{50} (length at which 50% of the fish had become mature) was estimated for males and females, it was computed from proportion of mature individuals (stages III, IV and V) and proportion of mature individuals by length class intervals (1 cm), using a sigmoid model with Microcal Origin Software (version 2024b. OriginLab Corporation, Northampton, MA, USA).

Results

Length-frequency distribution

Among 383 individuals collected during an annual cycle, 199 specimens are males (52.09%), 188 females (47.91%) and 1 unsexed specimen. The total length was ranged between 11 to 23.5 cm (*Fig. 2*). Overall, the percentage of males and females is close between the two sexes and by size class, except between 19-20 cm and 22-23 cm where males dominate (71.43% and 100%, respectively) and females dominate between 22-23 cm (100%) (*Fig. 2*).

Sex ratio

The overall sex ratio was constant or in balance (SR = 1.09, $\chi^2 = 0.67$; $P > 0.05$), except in August, October and Summer when males dominate (SR = 4.50, 3.29 and 2.23; $\chi^2 = 4.45$, 8.53 and 10.27, respectively; $P < 0.05$), January, February and Winter in favor of females (SR = 0.51, 0.59 and 0.65; $\chi^2 = 7.12$, 4.45 and 7.14, respectively; $P < 0.05$) (*Figs. 3* and *4*).

The sex ratio by length classes between the two sexes was constant where males and females were equal ($0 \leq \chi^2 \leq 2.57$; $P > 0.05$) (*Table 1*).

Gonadosomatic index (GSI)

A one-way ANOVA applied to mean values of GSI indicated their significant heterogeneity for males ($F = 3.64$, $p < 0.001$) and females ($F = 4.03$, $p < 0.001$). Similar

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patterns were observed in the evolution of mean monthly values of GSI between males and females (*Fig. 5*). The highest GSI value reached between April and September, with a maximum in July (males: 1%, females: 1.1%) and a minimum in February for males (0.3%) and in December for females (0.29%). A second peak of GSI was recorded in October for the both sexes (males: 0.79%, females: 0.71%). The monthly evolution of GSI and the results of a one-way ANOVA test, suggested that the reproduction season extended from April to September with second peak in October in the study area. According to Newman-Keuls test, which was applied to compare means two to two, we notice that the average values obtained from May to October differed from each other and were significantly higher than those of the remaining months for both sexes.

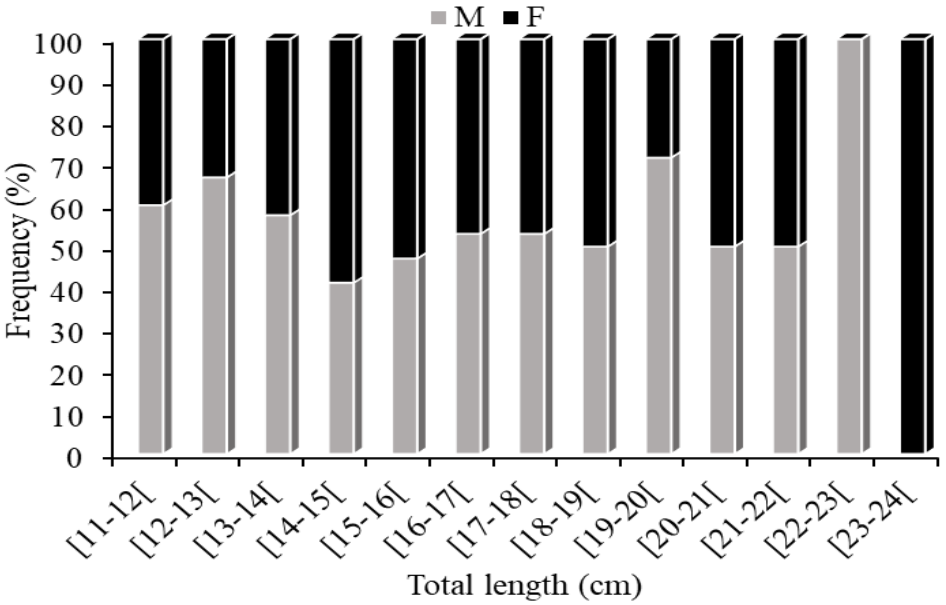

Figure 2. *Length frequency distribution males and females of P. erythrinus in El-Kala coasts (M: males, F: females)*

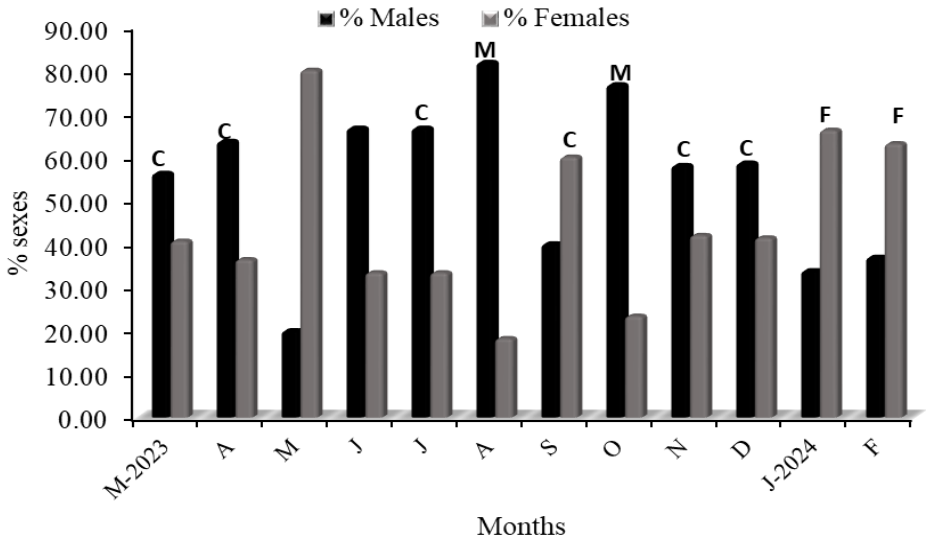

Figure 3. *Monthly variation of the sex ratio of Pagellus erythrinus from El-Kala Coastline (F: in favor of females, M: in favor of males, C: constant)*

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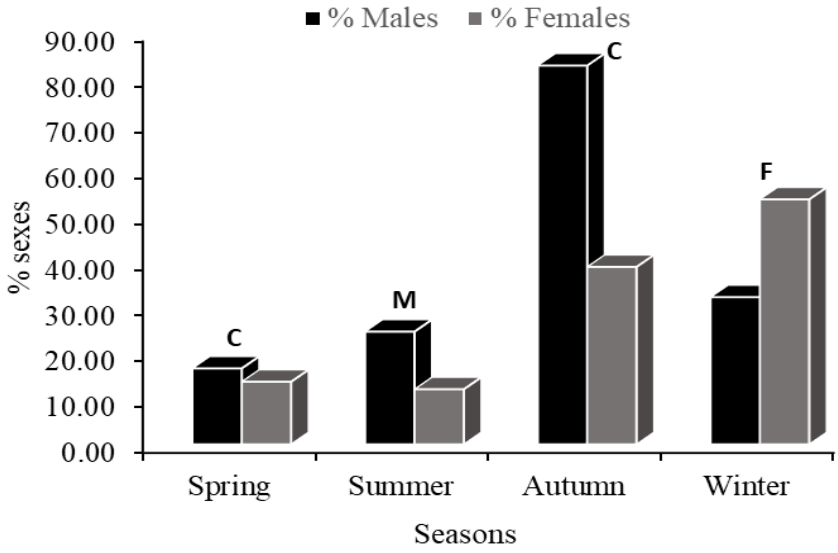

Figure 4. *seasonal variation of the sex ratio of Pagellus erythrinus from El-Kala Coastline (F: in favor of females, M: in favor of males, C: constant)*

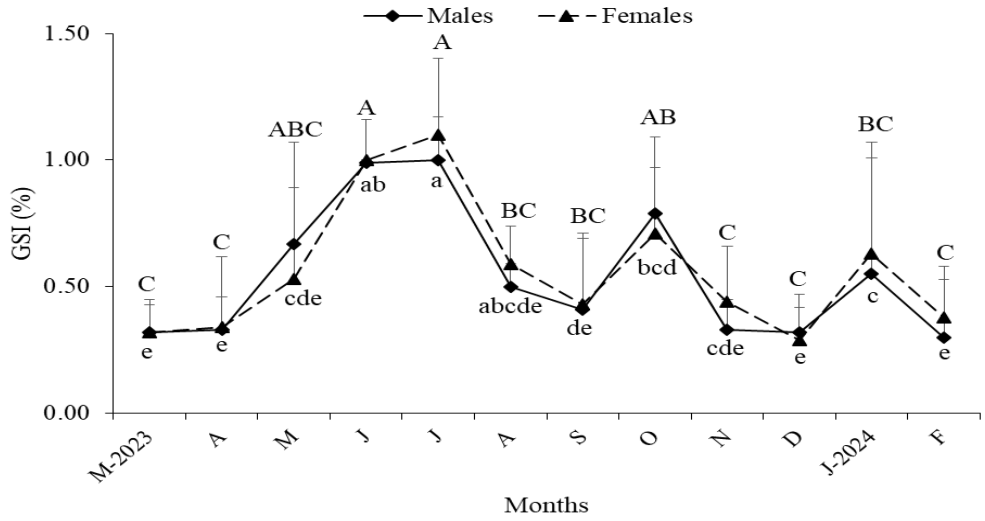

Figure 5. *Monthly evolution of Gonado-Somatic Index (mean ± SD) of P. erythrinus for males and females from the north-eastern Algeria. The different letters indicate significant differences between sampling months (capital letters for males and lowercase for females)*

Hepatosomatic index (HSI)

Figure 6 displays Monthly evolution of hepatosomatic index of common pandora in El-Kala coasts. The application of the statistical test one-way ANOVA, showed the significant heterogeneity for both sexes (males: $F = 4.03$, females: $F = 6.2$, $p < 0.001$). From March to July, the HSI mean values increased gradually and reached its maximum value for both sexes in July (males: 1.52%, Females: 1.4%). Then it decreased gradually to a minimum value in September for males (0.41%) and in March for females (0.38%). The highest value of *HSI* coincided with that of the *GSI* in males and females (at June, July and October) (*Fig. 6*). Variations in the hepatosomatic index reflect energy storage for reproduction (Hoar, 1969).

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Table 1. *Sex ratio variations according to the size of the individuals of P. erythrinus in the east Algerian coast*

Size classes	M	F	SR%	χ^2	*P*
[11-12[	6	4	1.50	0.40	
[12-13[	14	7	2.00	2.33	
[13-14[	19	14	1.36	0.76	
[14-15[	19	27	0.70	1.39	
[15-16[	41	46	0.89	0.29	
[16-17[	43	38	1.13	0.31	
[17-18[	26	23	1.13	0.18	NS
[18-19[	15	15	1.00	0.00	
[19-20[	10	4	2.50	2.57	
[20-21[	3	3	/	/	
[21-22[	1	1	/	/	
[22-23[	2	0	/	/	
[23-24[	0	1	/	/	

NS: non-significant difference; SR: sex ratio; M: males; F: females

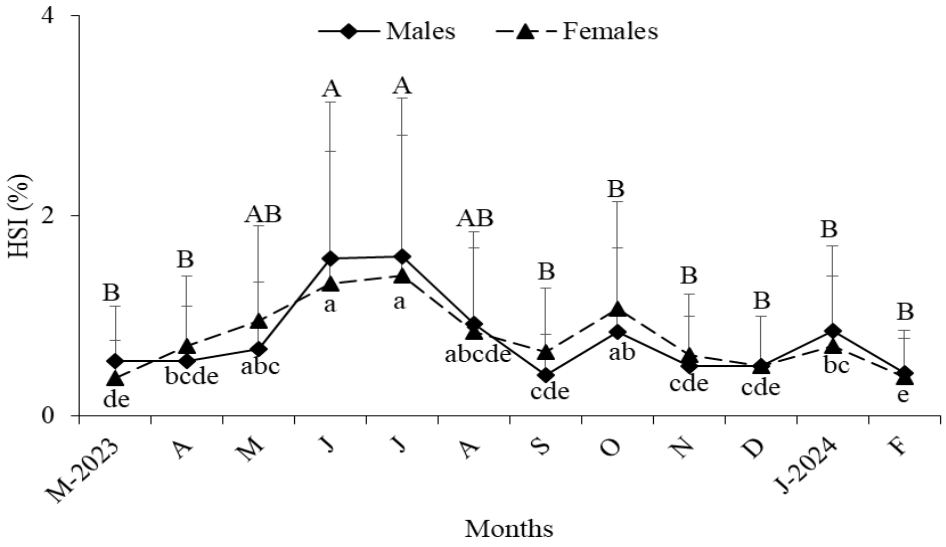

Figure 6. *Monthly evolution of Hepato-Somatic Index (mean ± SD) of P. erythrinus for males and females from the north-eastern Algeria. The different letters indicate significant differences between sampling months (capital letters for males and lowercase for females)*

Condition factor (K)

In the case of K, it oscillated between 1.1 and 1.53 for both sexes, the minimum is recorded in May for males (1.1%) and in March for females (1.18%), while the maximum values were obtained in November for males (1.46%) and in June for females (1.53%) (*Fig. 7*). The one-way ANOVA test revealed no difference for males ($F = 1.62$, $p > 0.05$) and significant difference for females ($F = 4.23$, $p < 0.001$).

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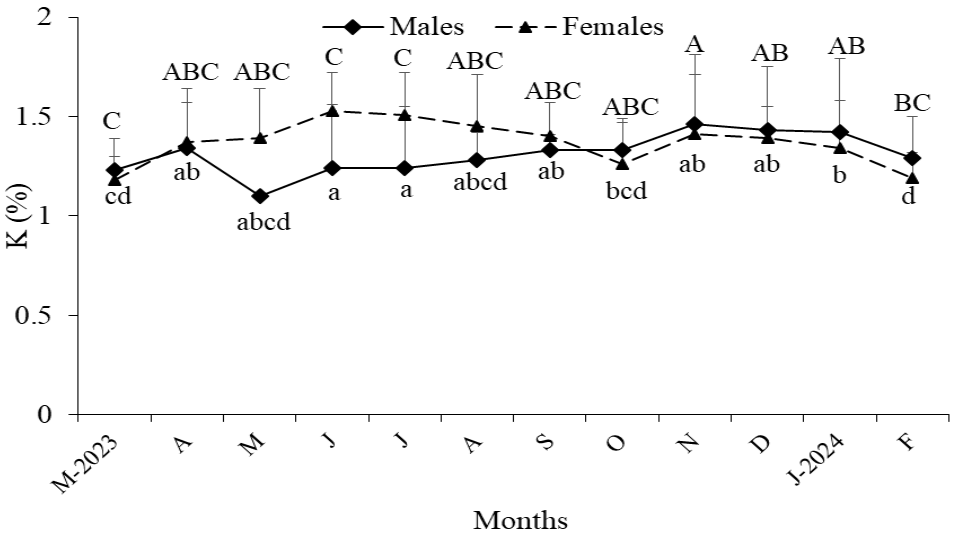

Figure 7. *Monthly evolution of the condition factor (K) of P. erythrinus for males and females from the north-eastern Algeria. The different letters indicate significant differences between sampling months (capital letters for males and lowercase for females)*

Length at first maturity (L50)

During the study period, the size at which 50% of individuals were mature was reached at 15.51 cm for males and 15.39 cm for females, with no significant difference between the two sexes (*t*-test = 0.99, $p > 0.05$) (*Fig. 8*).

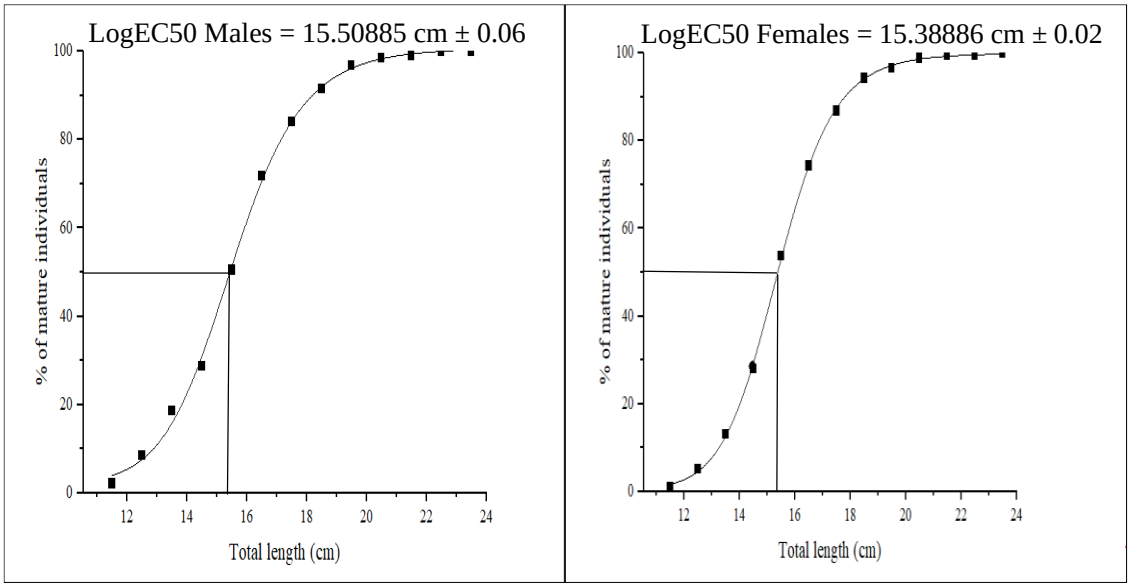

Figure 8. *Length at first maturity (L_{50} ± SD) of P. erythrinus for males and females from the north-eastern Algeria*

Discussion

This work is the first in the east coast of Algeria and especially in El-Kala bay, which treats the reproduction aspects of *P. erythrinus.* The maximum total length recorded for

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this species was reported by Busalacchi et al. (2014) in the Southern Tyrrhenian Sea (48 cm), in Southern Portugal by Coelho et al. (2010) (44.8 cm), along the Lebanese coast by Lteif et al. (2020) (40 cm), West of Algeria by Mahdi et al. (2018) (38 cm), in the Golf of Tunis by Zarrad et al. (2010) (28.5 cm), in Monastir bay, Tunisia by Ben Smida et al. (2014) (27 cm) and in the Central Aegean Sea by Metin et al. (2011) (27.8 cm). All these sizes are greater than what was recorded in this study (23.5 cm). On the other hand, Mehanna (2022) reported a maximum total length equal to 22.9 cm in Egyptian coasts. These differences may be due to several parameters as the fishing gear used and the mesh size of the nets selected, depth of fishing and also biotic and abiotic conditions.

The overall sex ratio was constant between males and females in the study area. According to Nikolsky (1963), this ratio is generally close to 1:1 for the majority of species. However, all studies carried out previously for this species in the Mediterranean Sea showed the predominance of females (Hossucu and Cakir, 2003; Zarrad et al., 2010; Metin et al., 2011; Ben Smida and Hadhri, 2014; Busalacchi et al., 2014; Mahdi et al., 2018; Elmajedeb et al., 2019; Lteif et al., 2020; Mehanna, 2022). Concerning the monthly variation of the sex ratio, it was in favor of males in August and October, and then females dominated in January and February, while statistic test did not reveal any difference according to length groups, where the sex ratio of males to females were equal. According to Mahdi et al. (2018) on Western Algerian coast, females dominated for six months and stable for the rest of the year. Elmajedeb et al. (2019) in the coast of Libya mentioned the dominance of females throughout the year except in April. In Egypt, Mehanna (2022) reported also that females dominated all the year except in June where males were dominant. These Differences in sex ratio can be attributed to various factors:

- Errors due to sampling, in particular to the selective action of fishing gear artisanal, difficult in our case to evaluate precisely. They can be at the origin of the domination of certain size classes over others, and of one sex over the other.
- Also the behavior of both sexes towards fishing gear.
- The quality and quantity of food available in the environment are among the causes essential to the fluctuation of the sex ratio within the sampled population during the study period, particularly during the reproductive period. Albaret (1977) cited the case of *Thunnus albacares* caught with longlines and in which the dominance of males could be explained by the fact that females "bite" less on the hook.

The highest value of GSI was recorded in July in the study area, just as Mahdi et al. (2018) for Western coasts of Algeria and Ben Smida and Hadhri (2018) for females in Tunisia. In other areas, the maxima of this indice was recorded in April (Elmajedeb and al., 2019) in Lybia, May (Metin et al., 2011; Mehanna et al., 2022) in Aegean Sea and Egypt, respectively and in June (Lteif et al., 2020) in Lybia. We observed that HSI and GSI values had similar pattern evolution and theirs peaks coincided (Jully and October) for both sexes such as Mahdi et al. (2018) on Oran Bay in West Algeria, which indicates an energetic transfer of reserves to the gonads and might be used in the energetic requirements of spawning. *P. erythrinus* is a lean fish that stores its lipid reserves in the liver. Based on these results, we assume that the breeding period of common pandora of El-Kala coast extended from April to September and a second peak was observed in the study area on October. The same behavior was noted in other

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localities of Mediterranean Sea as Gulf of Tunis (Zarrad et al., 2010), Bay of Monastir (Ben Smida and Hadhri, 2014), Benghazi, Lybia (Saleh, 2018; Elmajedeb et al., 2019), Oran Bay, West Algeria (Mahdi et al., 2018), Lebanese coast (Lteif et al., 2020) and Egyptian coast (Mehanna, 2022), where the spawning season extends between spring and summer (*Table 2*). According to Saleh (2018), Mahdi et al. (2018) and Elmajedeb et al. (2019), a second spawning period was recorded in October, which confirms our results. The lowest value of condition factor K was recorded at the beginning of reproduction period for males (May) and just before spawning for females (March), while the maxima was displayed just after the breeding period for males (November) and in June for females.

Table 2. *Length at first maturity (L50) and spawning period in several areas*

Authors	Length at first maturity (cm)		Spawning period	Area
	Males	Females		
Southern Mediterranean				
Present study	15.51	15.39	April-September (2nd peak in October)	El-Kala bay (East Algerian)
Mehanna, 2022	14.8	14.2	March-August	Egypt
Lteif et al., 2020	16.38 (sex combined)		March-June (Spring)	Lebanese coast, Eastern Mediterranean
Elmajedeb et al., 2019	22.34	21.36	Last spring-early summer (2nd peak in October)	Benghazi, Lybia
Mahdi et al., 2018	12.5	/	May-July (2nd peak in October)	Oran bay (West Algeria)
Saleh, 2018	/	/	May-July (2nd peak in October)	Eastern Benghazi, Lybia
Ben Smida and Hadhri, 2014	16.75	15.32	May-August	Bay of Monastir, Tunisia
Zarrad et al., 2010	15.8	14.6	April-October	Gulf of Tunis
Northern Mediterranean				
Bussalacchi et al., 2014	17	15.7	Spring-Summer	South of Tyrrhenian Sea (Central Mediterranean)
Metin et al., 2011	15.08	11.3	May-September	Aegean Sea, Turkey (Eastern Mediterranean)
Tsikliras et al., 2010	/	/	June-August	Adriatic Sea (Central Mediterranean)
Hossucu and Cakir, 2003	/	13 (FL)	April-October	Gulf of Edremit (North Aegean sea)
Somarakis and Machias, 2002	16.42	15.47	Spring-Summer	Cretan Shelf
Eastern Atlantic				
Coelho et al., 2010	17.29	17.58	March-July	South Portugal
Pajuelo and Lorenzo, 1998	23.2	17.4	April-September	Canary Islands
Santos et al., 1995	18.03	17.35	May-August	South Portugal

FL: fork length

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DOI: http://dx.doi.org/10.15666/aeer/2301_16211633

In the current study, the L50 obtained was equal to 15.51 and 15.39 cm for males and females, respectively, and was intermediate between those recorded in other research in Mediterranean Sea, which were ranged from 12.5 to 22.34 cm for males and from 11.3 to 21.36 cm for females (Somarakis and Machias, 2002; Hossucu and Cakir, 2003; Tsikliras et al., 2010; Zarrad et al., 2010; Metin et al., 2011; Ben Smida and Hadhri, 2014; Bussalacchi et al., 2014; Mahdi et al., 2018; Elmajedeb et al., 2019; Lteif et al., 2020 and Mehanna, 2022) (*Table 2*). On the other hand, it is lower than those reported in the Atlantic and which fluctuated between 17.29 to 23.2 cm for males and from 17.35 to 17.58 for females (Santos et al., 1995; Pajuelo and Lorenzo, 1998; Coelho et al., 2010). It can be concluded that the size at first sexual maturity of the *P. erythrinus* population tends to increase from the Mediterranean towards the Atlantic, which can be explained by the differences in environmental conditions, ecological factors and food availability (qualitatively and quantitatively) (Metin et al., 2011).

Conclusion

Understanding reproductive biology is necessary for fisheries assessment and management because it provides crucial information on stock recruitment status, which ultimately determines the fishery's exploitation status.

The few biological studies on *P. erythrinus* on southern Mediterranean coasts, and especially their absence on Algerian coasts, allowed us to study the reproduction of this species, as this parameter has crucial importance for stock assessment and would be needed for better management of the natural stocks of common pandora in the southern Mediterranean. At the light of this first data on reproductive dynamics of *P. erythrinus* in Eastern coasts of Algeria (El-Kala bay) and the fact that in this country, the minimum landing size of common pandora is equal to 15 cm TL (M.P.R.H., 2004) corresponding to current regulations in the Mediterranean, it may be suggested to increase the minimum length limits to 17 cm, especially since the size of first sexual maturity is reached around 15.5 cm in total length to allow individuals to reproduce at least once during their life and prohibit fishing for this species between April and September in order to ensure a sustainable fishing and stock renewal. Detailed study concerned gear selectivity of trawl should be done to find the proper mesh size which conserve the stock of common pandora, especially with global warming and changes in environmental conditions which affect directly the physiology of species and their reproductive cycles.

REFERENCES

[1] Albaret, J. J. (1977): La reproduction de l'albacore (*Thunnus albacares*) dans le golfe de Guinée. – Cah. ORSTOM. sér. Océaonogr. 15(4): 389-419.

[2] Basilone, G., Guisande, C., Patti, B., Mazzola, S., Cuttitta, A., Bonanno, A., Vergara, A. R., Maneiro, I. (2006): Effect of habitat conditions on reproduction of the European anchovy (*Engraulis encrasicolus*) in Strait of Sicily. – Fisheries Oceanography 15: 271-280.

[3] Bauchot, M. L. (1987): Poissons osseux. – In: Fischer, W., Bauchot, M. L., Schneider, M. (eds.) Fiches FAO d'identification pour les besoins de la pêche. (rev. 1). Méditerranée et mer Noire. Zone de pêche 37. FAO, Rome 2, pp. 891-1421.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2301_16211633

[4] Ben Smida, M. A., Hadhri, N. (2014): Reproductive Cycle and size at first sexual maturity of common pandora *Pagellus erythrinus* (sparidae) from the Bay of Monastir (Tunisia, central Mediterranean). – Annales, Series Historia Naturalis 24(1): 31-40.

[5] Busalacchi, B., Bottari, T., Giordano, D., Profeta, A., Rinelli, P. (2014): Distribution and biological features of the common pandora, *Pagellus erythrinus* (Linnaeus, 1758) in the southern Tyrrhenian Sea (Central Mediterranean). – Helgoland Marine Research 68: 491-501. http//:dx.doi.org/10.1007/s10152-014-0404-5.

[6] Campana, S. E., Thorrold, S. R. (2001): Otoliths, increments, and elements: keys to a comprehensive understanding of fish populations? – Canadian Journal of Fisheries and Aquatic Sciences 58: 30-38.

[7] Coelho, R., Bentes, L., Correia, C., Gonçalves, J. M. S., Lino, P. G., Monteiro, P., Erzini, K. (2010): Life history of the common pandora, *Pagellus erythrinus* (Linnaeus, 1758) (Actinopterygii: Sparidae) from southern Portugal. – Brazilian Journal of Oceanography 58: 233-245.

[8] Dagnélie, P. (1975): Théorie et méthodes statistiques, Applications agronomiques. Vol 2 Les méthodes de l'inférence statistique. – 2e edit. Presses Agronomiques de Gembloux, Gembloux.

[9] Elmajedeb, A., Elbaraasi, H., Altomi, F., Jenjan, H. (2019): Some aspects of reproductive biology of common pandora (*Pagellus Erthrinus*) collected from the Coast off Benghazi, Libya. – Oceanography and Fisheries Open Access Journal 10(1): 555-778. http//:dx.doi.org/10.19080/OFOAJ.2019.10.555778.

[10] Fantodji, A. (1987): Biologie et Physiologie de la reproduction des Pomadasys jubelini (Cuvier) (Poissons Téléostéens) des lagunes et mer de Côte d'Ivoire. – Thèse Océanographie biologique, Faculté des Sciences et Techniques, Université Nationale de Côte d'Ivoire.

[11] Fassatoui, C., Romdhane, M. S. (2010): Genetic variability between age classes in the common Pandora (*Pagellus erythrinus*, Sparidae) from the north Tunisian coast. – Bulletin de l'Institut National des Sciences et Technologies de la Mer, Salammbô 37: 1-12 (in French).

[12] Fisher, W., Schenieder, M., Bauchot, M. L. (1987): FAO Species Identification Sheets for Fishery Purposes (Révision 1). – Méditerranée et Mer Noire. Zone de Pêche 37. FAO, Rome 2: 762-1529 (in French).

[13] Froese, R., Pauly, D. (2014): *Pagellus erythrinus*. – FishBase Editors World Wide Web Electronic Publication. http://www.fishbase.fr.

[14] Ghorbel, M., Jarboui, O., Bradai, M. N., Bouain, A. (1996): Détermination de la taille de la première maturité sexuelle par une fonction logistique chez *Limanda limanda*, *Pagellus erythrinus* et *Scorpaena porcus*. – Bull. Inst. Natn Scien. Tech. Océanogr. Pêche Salammbô 3: 24-27.

[15] Hoar, W. S. (1969): Reproduction. – In: Hoar, W. S., Randall, D. J. (eds.) Fish Physiology. Vol. III. Reproduction and Growth; Bioluminescence, Pigments and Poisons. Academic Press, New York, pp. 1-72.

[16] Hossucu, B., Cakir, D. T. (2003): Some parameters about population biology of the common Pandora (*Pagellus erythrinus* L., 1758) (Sparidae) in Edremit Bay (Turkey). – Ege University Journal of Fisheries and Aquatic Sciences 20: 329-336. http//:dx.doi.org/ 10.12714/egejfas.2003.20.3.500015 7078.g.

[17] Klaoudatos, S. D., Iakovopoulos, G., Klaoudatos, D. S. (2004): *Pagellus erythrinus* (common pandora): a promising candidate species for enlarging the diversity of aquaculture production. – Aquaculture International 12: 299-320.

[18] Lowerre-Barbieri, S. K., Brown-Peterson, N. J., Murua, H., Tomkiewicz, J., Wyanski, D. M., Saborido-Rey, F. (2011): Emerging issues and methodological advances in fisheries reproductive biology. – Marine and Coastal Fisheries: Dynamics, Management and Ecosystem Science 3: 32-51.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2301_16211633

[19] Lteif, M., Jemaa, S., Mouawad, R., Khalaf, G., Lelli, S., Fakhri, M. (2020): Population biology of the common pandora, *Pagellus erythrinus* (Linnaeus, 1758) along the Lebanese coast, eastern Mediterranean. – Egyptian Journal of Aquatic Research 46(1): 57-62. http://dx.doi.org/10.1016/j.ejar.2020.01.002.
[20] MPRH (2004): Collection of regulatory texts, Fisheries and Aquacultures, Volume 1. Official printing office: les vergers, Bir-Mourad Rais, Algiers (in French).
[21] MPPH (2023): Annual Statistical Report of the Ministry of Fisheries and Aquatic Productions for 2023 (in French). – MPPH.
[22] Mahdi, H., Bensahla Talet, L., Boutiba, Z. (2018): Reproductive biology of the common pandora *Pagellus erythrinus* (Linnaeus, 1758) of Oran Bay (Algerian West Coasts). – Turkish Journal of Fisheries and Aquatic Sciences 18: 1-7. http://dx.doi.org/10.4194/1303-2712-v18_1_01.
[23] Mehanna, F. (2022): Age, growth and reproductive dynamics of the common pandora, Pagellus erythrinus from GFCM-GSA 26, Mediterranean Sea, Egypt. – Iranian Journal of Ichthyology 9(1): 32-42. https://doi.org/10.22034/iji.v9i1.857.
[24] Metin, G., Ilkyaz, A. T., Soykan, O., Kinacigil, H. T. (2011): Biological characteristics of the common pandora, *Pagellus erythrinus* (Linnaeus, 1758), in the central Aegean Sea. – Turkish Journal of Zoology 35(3): 307-31. http://dx.doi.org.3906/zoo-0904-4.
[25] Micale, V., Garaffo, M., Genovese, L., Spedicato, M. T., Muglia, U. (2006): The ontogeny of the alimentary tract during larval development in common pandora *Pagellus erythrinus* L. – Aquaculture 251(2-4): 354-365.
[26] Mytilineou, C. (1989): Données biologiques sur le pageot, *Pagellus erythrinus*, des côtes orientales de la Grèce centrale. – FAO Fish. Rep. 412: 77-82.
[27] Nikolsky, G. V. (1963): The Ecology of Fishes. – Academic Press, London.
[28] Pajuelo, J. G., Lorenzo, J. M. (1998): Population biology of the common pandora *Pagellus erythrinus* (Pisces: Sparidae) off the Canary Islands. – Fisheries Research 36: 75-86.
[29] Saleh, H. M. (2018): Fecundity and Gondosomatic Index (GSI) of Common Pandora, *Pagellus erythrinus* (Linnaeus, 1758), Inhabiting Telmatha Coast Eastern Benghazi, Libya. – Al-Mukhtar Journal of Sciences 33(4): 362-373. https://doi.org/10.54172/mjsc.v33i4.311.
[30] Santos, M. N., Monteiro, C. C., Erzini, K. (1995): Aspects of the biology and gillnet selectivity of the axillary seabream (*Pagellus acarne*, Risso) and common pandora (*Pagellus erythrinus*, Linnaeus) from the Algarve (South Portugal). – Fisheries Research 23: 223-236.
[31] Sarri, D., Djellouli, Y., Allatou, D. (2014): Biological diversity of the National Park of El-Kala (Algeria), valorization and protection. – Biodiversity Journal 5(4): 525-532.
[32] Valdes, P., Garcia-Alcazar, A., Abdel, I., Arizcun, M., Suarez, C., Abellan, E. (2004): Seasonal changes on gonadosomatic index and maturation stages in common pandora *Pagellus erythrinus* (L.). – Aquaculture International 12: 333-343. http:// dx.doi.org/10.1023/B:AQUI.0000042136.91952.9^{e}.
[33] Zarrad, R., Cherif, M., Gharbi, H., Jarboui, O., Missaoui, H. (2010): Reproductive cycle and sex reversal of *Pagellus erythrinus* (Linnaeus, 1758) in the gulf of Tunis (central Mediterranean). – Bulletin de l'Institut National des Sciences et Technologies de la Mer Salammbô 37: 13-20 (in French).

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2301_16211633