REPRODUCTIVE BIOLOGY OF EUROPEAN SEA BASS, *Dicentrarchus Labrax* (F. MORONIDAE) FROM BARDAWIL LAGOON, NORTH SINAI, EGYPT

Kariman A. Sh. Shalloof and Attia A. O. El- Aiatt

Fisheries Biology Laboratory, National Institute of Oceanography and Fisheries, Egypt.

Correspondence Author: attiamr@yahoo.com

Received 21/ 5/ 2019 *Accepted 18/ 6/ 2019*

Abstract

This paper deals with information about reproductive biology of Europen sea bass, *Dicentrarchus labrax* from Bardawil Lagoon, North Sinai, Egypt. Monthly random samples of *D. labrax* were collected from the commercial catch in different landing sites of the Bardawil Lagoon during one fishing season from May 2015 to January 2016. Sex ratio, Length at first maturity (L_m), Gonado Somatic index (GSI) and fecundity (absolute and relative) has been studied. Sex ratio showed that the females (F) outnumbered the males (M) (1M: 1.6 F) during the whole period of study. GSI was found to be greatest during the month of November to January and reached its highest value in December, referring that *D. labrax* winter spawner one time per year. L_m was determined as 30.8 and 29.2 cm for females and males respectively. Absolute fecundity was increased with the fish size and describe by the power equation, $F= 8.951\ L^{2.8501}$ ($R^2 = 0.9661$). The length at first capture (L_c) was estimated to be 27.8. It is essential to maximize length at first capture larger than length at first sexual maturity (> 30.0 cm) .This can be achieved by widening the mesh size used to catch D. *labrax* to permit the females to breed and recruit into the fisheries ground.

Key words: Bardawil Lagoon*; Dicentrarchus labrax,* L_m; L_c; Reproductive biology

INTRODUCTION

Studies on reproductive biology of fish are important needed and a vital requirement to plan a better maintenance and management strategies of fishery resources (Brewer *et al*., 2008; Grandcourt *et al*., 2009 and Muchlisin *et al*., 2010), examination of principal life-history information and for analyzing the influence of environmental variability on the dynamics of fish populations

(Schlosser, 1990). Information on reproduction biology is also useful to select the candidate of fish target from the wild for diversification of fish species in aquaculture industry. The reproduction behaviors are important to be studied in relation to know the population dynamic of fishes and their spawning seasons (Muchlisin, 2014).The Knowledge of the spawning period combined with data on spawning, maturity and fecundity may be very valuable for fisheries management (Tsikliras *et al.*, 2010).

European seabass *Dicentrarchus labrax* is a marine demersal fish and a member of the Moronidae family. This pelagic fish is widespread across the Mediterranean Sea and the east Atlantic Ocean, from Senegal to Norway. Named the 'sea wolf', these fish are known for their violent feeding behavior. Seabasses are euryhaline, and afford enormous range of salinities, from marine environments to freshwater (Pickett and Pawson, 1994 and Frtsch *et al.*, 2006). It is an important species in the Egyptian coasts of Mediterranean Sea especially in Bardawil Lagoon, and it the main demersal target of hand lines, long lines and trolling fisheries operating. Sea bass, *D. labrax* is an economic species and reaches high prices in the market and are much appreciated nationally.

Few studies have been published on the reproductive biology of European Seabass in Bardawil Lagoon, so, this study aimed to investigate the reproductive biology of *D. labrax* to suggest fisheries management of this vital species.

MATERIALS AND METHODS

Area of study:

Lake Bardawil is a shallow, hyper saline lagoon, located in the north of Sinai southern east the Mediterranean Sea. Its coordinate is about 31º 10` N 33 º 12` E. It extends for about 80 km with a maximum width 20 km and a maximum depth of 3 m.

Samples collection:

Monthly random samples of Sea bass, *D. labrax* were collected from the commercial catch in different landing sites of the Bardawil Lagoon during the fishing season from May 2015 to January 2016. In the laboratory, mean total fish length and mean total weight for 1643 specimens were measured to the nearest 0.1 cm and 0.1 g, respectively. Fish specimens were dissected to determine its sex and maturity stages. The gonads were weighed to the nearest 0.01 g and the ovaries were preserved in 10% formalin for subsequent examinations.

Maturity stages were adopted based on the morphological changes that take place in the gonads during maturity development (Nickolsky, 1963). Gonado-Somatic Index (GSI) was calculated by equation of (Albertine-Berhaut 1973) as follows:

GSI = (Gonad Weight / Body Weight) *100.

To estimate the length at first maturity(L_m), the total body length was plotted against the frequency percentage of mature individuals during the spawning season, and then the length at 50% consider as the length at first maturity (Sendecor, 1956). The absolute fecundity ($F_{abs.}$) is defined as the number of mature eggs in the ovaries during the spawning season. Number of 36 mature ovaries was used to determine fish fecundity. Mature ovaries washed, dried and weighted.

Then the ovarian tissue was removed and the net eggs weight was obtained. Eggs were well mixed, and three subsamples were weighted and counted under the microscope. Total fecundity was calculated as:

F = Gonad Weight * Egg Number in the Subsample / weight of subsample , (Yeldan and Avsar, 2000). The relative fecundity (F_{rel}) was calculated as : $F_{rel} = F_{abs}$ / (Body Length or Body weight).

RESULTS AND DISCUSSION

Fish reproductive biology (onset and duration of spawning, sex ratio, maturity stages, length- (L_m) and age (t_m) at first maturity, and fecundity) is important in fisheries research, stock assessment, and management. It may be useful in research planning, data analysis and presentation (Tsikliras *et al.*, 2013).

The population characteristics of fishes, and in particular those concerning their reproduction, are very important inputs in the assessment and management of fish stocks (Froese, 2006).

Sex ratio is an important stock characteristic for fisheries management because, a population parameters , it is included in several models that are used for the evaluation of spawning stock biomass and overall population fecundity (Marshall *et al.*, 2006) and is also between the factors defining the reproductive potential of a stock (Jakobsen *et al.*, 2009).

The results of the study have revealed that females dominance over male, but males have shown earlier maturity than female. The sex ratio of *D. labrax* was 1: 1.6, where males represented by 208 individuals and females represented by 327 individuals). Table (1) shows that the two sexes did not distributed in the same proportion during different months. Females predominated during all months, since it constitutes more than 61.1 % of the collected sample during the period of study.

Table 1. Monthly variations in sex ratio of *D. labrax* in Bardawil Lagoon during 2015-2016.

Month	No. of fish	Females		Males		Sex ratio
		No.	%	No.	%	M / F
May 2015	61	39	63.9	22	36.1	1-1.8
Jun. 2015	103	56	54.4	47	45.6	1-1.2
Jul. 2015	53	27	50.9	26	49.1	1-1.03
Aug. 2015	57	34	59.6	23	40.4	1-1.5
Sep. 2015	52	31	59.6	21	40.4	1-1.5
Oct. 2015	58	39	67.2	19	32.8	1-2.1
Nov. 2015	57	33	57.9	24	42.1	1-1.4
Dec. 2015	51	34	66.7	17	33.3	1-2
Jan. 2016	43	34	79.1	9	20.9	1-3.8
Total	535	327	61.1	208	38.9	1-1.6

Regarding the variation of sex ratio with fish length, it has been found that females' individuals were predominate males' individuals for all length groups except for length groups (19-19.9, 21-21.9, 26-26.9, 27-27.9, 31-31.9, 34-34.9 and 36.36.9) (Fig. 1).

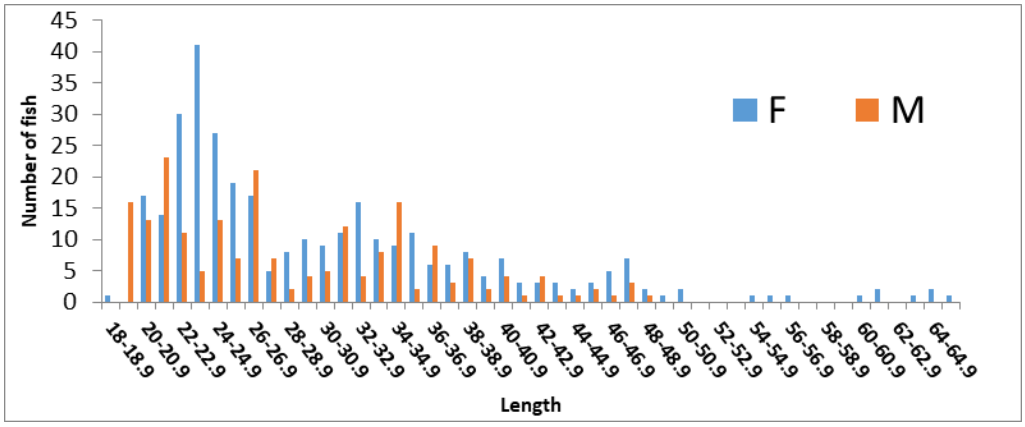

Fig. 1. Sex ratio by length groups of *D. labrax* in Bardwil lagoon during period of study.

Fig. 2 presents the monthly changes in males and females GSI of *D. labrax*. GSI values of males were lower than females. The lowest value of GSI of males (M) (0.67) was recorded in May, when it started to increase slightly from September, October, and November and the top of January GSI was (13.31). Values of GSI of females (F) showed a similar pattern of the

males. It attained the lowest value (0.71) in May and increase slightly reached the highest value in December (15.35). This means that *D. labrax* in Bardawil Lagoon is a winter spawner.

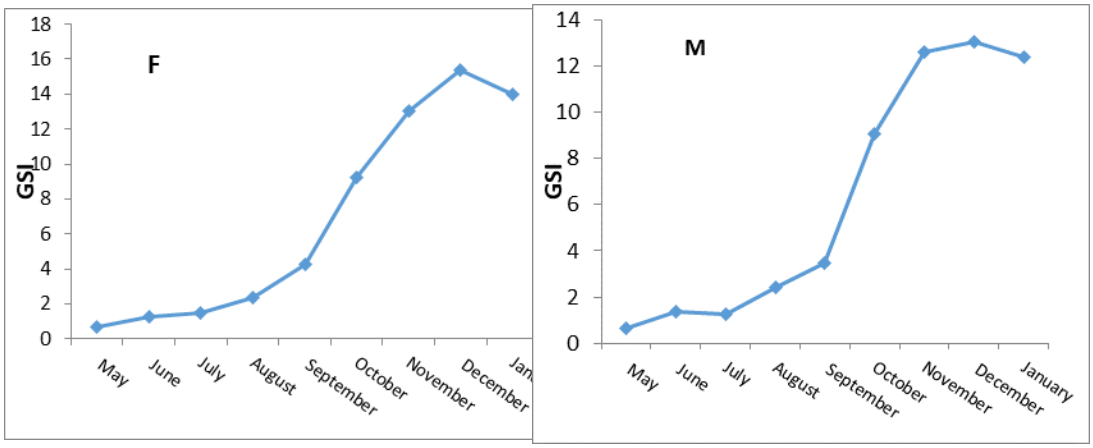

Fig. 2. Monthly changes in (GSI) of females (F) and males (M) of *D. labrax* in Bardawil Lagoon, 2015- 2016.

These findings agree with Fahim *et al*. (2016). They demonstrated that females of *D. labrax* from the Egyptian Mediterranean water have a long spawning season extending from January to late March, with a high peak in February. Females Seabass have a group synchronous type of ovary and spawning occurs once a year, during 1–2 months in the winter season , Bruslé and Roblin (1984).The variance in the GSI values among stocks of the same species and sex and of similar body size (*Atherina boyer, Aphanius fasciatus, Dicentrarchus labrax,* and *Siganus rivulatus*) could be the result of sampling differences and gear selectivity or of reproductive effort alternations to regional conditions that could have come out from increased fishing mortality and / or other disturbance (Tsikliras *et al.*, 2010). Spawning strategies including the spawning duration vary with geographical location (ICES, 2005).

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 30.0 cm are mature. The length at first mature (L_{50}) was determined as 30.8 and 29.2 cm for females and males respectively, Fig. 3. In the present study, all males and females with a total length higher than 30.0 cm

are mature. The length at first mature (L_{50}) was determined as 30.8 and 29.2 cm for females and males respectively. The total length which the females attains 60% of maturity was 28 cm. Maturation occurs at around 35 cm for males aged between 3 and 6 years (Pawson & Pickett 1996) and the latest stock assessment suggests females mature around 40 cm (40.65 cm) (ICES 2013b), aged between 4 and 7 years. Ripe adult (> 42cm) female bass around England and Wales have been found from January until May or June, and ripe adult male bass (> 34cm) from December until June.

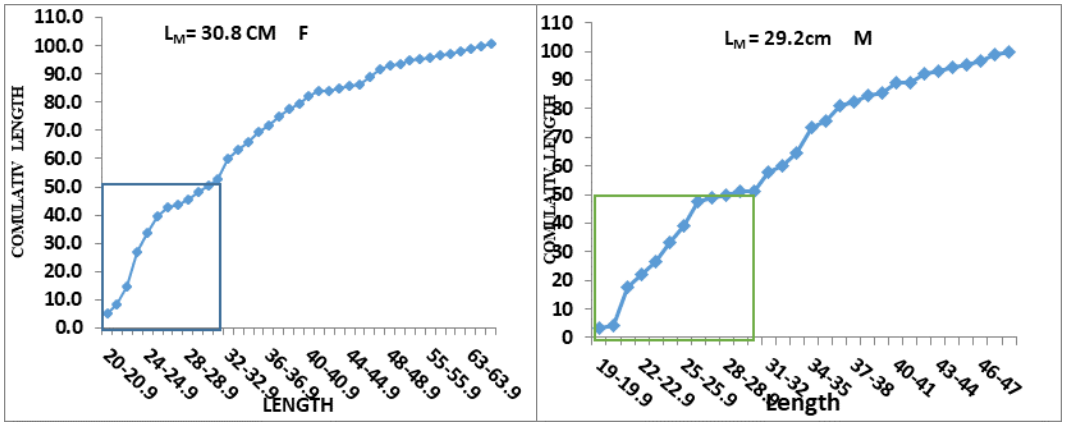

Fig. 3. Length at first maturity of female and male *D. labrax* in Bardawil Lagoon.

The length at first capture (L_c) was estimated to be 27.8 cm as recorded by El-Aiatt *et al.*, 2019 It is essential to maximize length at first capture larger than length at first sexual maturity (> 30.0 cm) .This can be achieved by widening the mesh size used to catch D. *labrax* to to permit the females to breed and recruit into the fisheries ground.

The fecundity is essential for studies of population dynamic and life history of fish (Kapoor and Khanna, 2004). In generally fecundity is defined as the number of ripening eggs found in the female just prior to spawning .The annual population fecundity is the number of eggs that all the females in a population spawn in a breeding season (Bagenal, 1978).

The relation between fecundity (absolute and relative) with body size (total length) and body weight of *D. labrax* were calculated. The results found that the number of eggs gradually increased by increasing fish length or weight,

since fish of 30.7 cm (321.4 g) bears about 207236.8 eggs, reaching maximum of about 1424800 eggs for a fish length 65 cm, (2641 g.). The absolute fecundity- total length relationship (Fig. 4) was represented by power equation as following: $F = 8.951\ L^{2.8501}$ ($R^2 = 0.9661$).

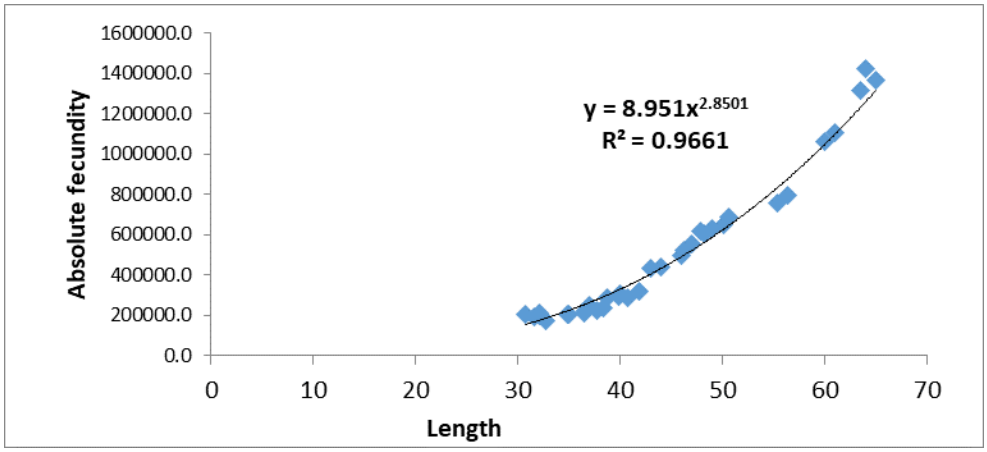

Fig. 4. Relationship between total length and absolute fecundity of *D. labrax*.

The absolute fecundity ranged from 0.2×10^6 to 1.2×10^6 eggs for total length ranged from 29 to 50 cm, also the absolute fecundity ranged from 0.3×10^6 to 1.02×10^6 eggs for weight ranged from 600 to 1700 gm (Fahim *et al.*, 2016).

The relative fecundity gradually increased from 5365.7 to 22262.5 eggs per cm. Fecundity of *D. labrax* increased with the body weight gets heavier (Fig. 5) and represented by the following linear regression:

$F = 10443 + 525.1\ W$ ($R^2 = 0.9991$).

Spawning season lasts for two-three months, between December and March. A female will spawn between one to a few batches of eggs a season. Total eggs spawned can reach 300,000 eggs per one kg of body weight. (Javier Sánchez Vázquez and Munoz-Cueto, 2014). European sea bass is a gonochoristic species. Females spawn in winter in the Mediterranean Sea (December to March) and up to June in the Atlantic Ocean. They present a high fecundity (on average 200 000 eggs / kg of female), start to reproduce over 2 kg and can reach 6 to 7 years in the wild (Froese and Pauly, 2006). Intense fishing activity and the removal of larger individuals may reduce the reproductive

potential of a stock (Sadovy 2001 and Conover and Munch 2002).These differences may be due to the differences in sampling size and differences in ecological conditions.

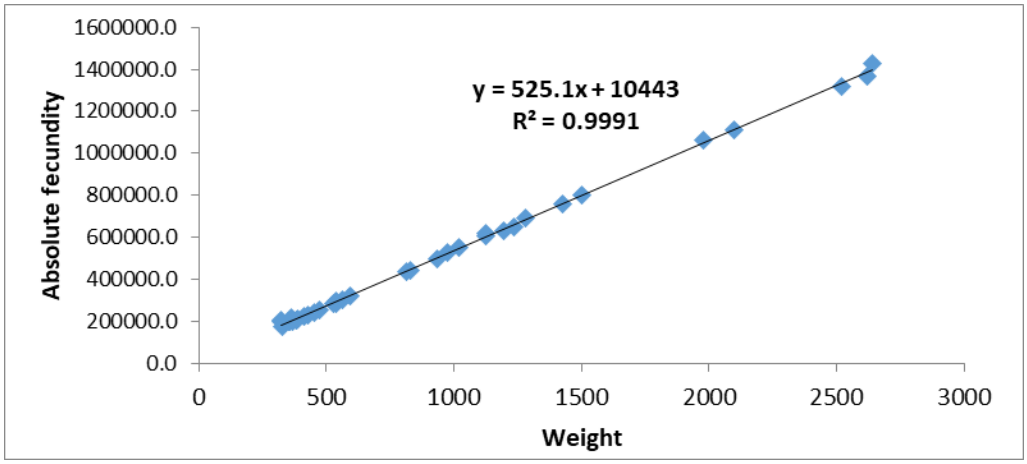

Fig. 5. Relationship between body weight (g) and absolute fecundity of *D. labrax*.

CONCLUSION

We concluded that female's dominance over male (1M: 1.6 F). It has been found that *D. labrax* in Bardawil Lagoon is a winter spawner. The data obtained show that the length at first mature (L_{50}) was determined as 30.8 and 29.2 cm for females and males respectively. Fecundity gradually increased by increasing fish length or weight.

REFERENCE

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. DOI: 10.1016/0044-8486(73)90158-0.

Bagenal, T.B., 1978. Aspects of fish fecundity. In: Gerking, S.D (ed.). Ecology of freshwater fish production. Blackwell Scientific Publications, Oxford.

Brewer, S.K.; C.F. Rabeni and D.M. Papoulias, 2008. Comparing histology and gonadosomatic index for determining spawning condition of small-bodied riverine fishes. Ecology of Freshwater Fish, 17: 54–58.

Bruslé, J. and C. Roblin, 1984. Sexualité du loup *Dicentrarchus labrax* en condition d'élevage controlé. In L'Aquaculture du Bar et des Sparidés. pp. 4–33. Edited by G. Barnabé and R. Billard. INRA, Paris.

Conover, D.O. and S.B. Munch, 2002. Sustaining fisheries yields over evolutionary time scales. Science, 297:94–96.

El-Aiatt, A.A.O.; K.A.Sh. Shalloof and M.M. Saber, 2019. Bio-economic studies on the catch of Bardawil lagoon, North Sinai, Egypt. Egyp. J. Aqat. Res.45 (1): 59- 65.

Fahim, R.M.; S.S. Assem; E.A. Omar and T.M. Srour, 2016. Reproductive biology and histological characteristics of the European Seabass, *Dicentrarchus labrax* (Linnaeus, 1758) females from the Egyptian Mediterranean water. Medit. Aqua. J., 8: 107-121.

Fritsch, M.; Y. Morizur; E. Lambert; F. Bonhomme and B. Guinand, 2006. Assessment of sea bass (*Dicentrarchus labrax*, L.) stock delimitation in the Bay of Biscay and the English Channel based on mark-recapture and genetic data, 83: 123-132.

Froese, R. and D. Pauly, 2006. Fish base. www.fishbase.org.

Grandcourt, E.M.; T.Z. Al-Abdessalaam, F. Francis, A.T. Al-Shamsi and S.A. Hartmann, 2009. Reproductive biology and implications for management of the orange-spotted grouper *Epinephelus coioides* in the southern Arabian Gulf. Journal of Fish Biology, 74: 820-841.

ICES, 2005. Spawning and life history information for North Atlantic cod stocks. ICES Coop. Res. Rep., 274:1–152.

ICES, 2013b. ICES WGCSE Report. Annex 2: Stock Annexe 10.1.

Jakobsen, T.; M.J. Fogarty; B.A. Megrey and E. Moksness, 2009. Fish reproductive biology: implications for assessment and management. Blackwell, UK, 426 p.

Javier Sánchez Vázquez, F. and Munoz-Cueto, J.A., 2014. Biology of European Sea Bass. FL. CRC Press. 436 pp. ISBN 9781466599451 - CAT# K20947.

Kapoor, B.G. and B. Khanna, 2004. Ichthyology handbook. Springer-Verlag, Berlin.

Marshall, C.T.; C.L. Needle; A. Thorsn; O.S. Kjesbu and N.A. Yaragina, 2006. Systematic bias in estimates of reproductive potential of an atlantic cod (Gadus morhua) stock: implications for stock–recruit theory and management .Can. J. Fish Aquat. Sci., 63:980–994.

MayerMuchlisin, Z.A., 2014. A General Overview on Some Aspects of Fish Reproduction. Aceh Int. J. Sci. Technol., 3 (1): 43-52.

Muchlisin, Z.A., 2014. A General Overview on Some Aspects of Fish Reproduction. Aceh In t. J. Sci. Technol., 3 (1): 43-52.

Muchlisin, Z.A.; M. Musman and M.N. Siti-Azizah, 2010. Spawning seasons of *Rasbora tawarensis* in Lake Laut Tawar, Aceh Province, Indonesia. Reproductive Biology and Endocrinology, 8: 49.

Nikolsky, G.V., 1963. The Ecology of fishes. Academic Press, London and New York. 352p.

Pawson, M.G.; G.D. Pickett, 1996. The Annual Pattern of Condition and Maturity in Bass, *Dicentrarchus Labrax*, in Waters Around England and Wales. J Mar Biol Assoc United Kingdom, 76:107.

Pickett, G.D. and M.G. Pawson, 1994. Sea Bass biology, Explotation and conservation. Fish and Fisheries Series. London: Chapman & Hall.

Sadovy, Y., 2001. The threat of fishing to highly fecund fishes .J Fish Biol, 59 (Suppl A):90–108.

Schlosser, I.J., 1990. Environmental variation, life -history attributes, and community structure in stream fishes: implications for environmental management and assessment. Environmental Management, 15: 621–628. *(5)* (PDF) A General Overview on Some Aspects of Fish Reproduction. Available from: https://www.researchgate.net/publication/307763087_A_General_Overview_on_Some_Aspects_of_Fish_Reproduction [accessed Jun 08 2019]. – 1131.

Sendecor, G.W., 1956. Statistical methods. Iowa State College Press, 5th ed. 534p.

Tsikliras, A.C.; E. Antonopoulou, and K.I. Stergiou, 2010. Spawning period of Mediterranean marine fishes. Rev Fish Biol Fisheries, 20: 499–538.

Tsikliras, A.C.; K.I. Stergiou; R. Froese, 2013. Editorial note on reproductive biology of fishes. Acta. Ichthyol. Piscat., 43 (1): 1–5.

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

بيولوجية التكاثر لأسماك القاروص فى بحيرة البردويل– شمال سيناء – مصر

كريمان أحمد شوقى شلوف ، عطية على عمر العياط

معمل بيولوجيا المصايد – المعهد القومى لعلوم البحار والمصايد – مصر.

الملخـــص العربـــى

يتناول هذا البحث معلومات حول بيولوجية التكاثر لأسماك القاروص *Dicentrarchus labrax* من بحيرة بردويل ، شمال سيناء ، مصر. تم جمع عينات عشوائية شهرية من اسماك القاروص *D. labrax* من المصيد التجاري في مواقع الإنزال المختلفة فى بحيرة البردويل خلال موسم صيد واحد من مايو ٢٠١٥ إلى يناير ٢٠١٦. تم تحديد النسبة الجنسية ، الطول عند النضج الجنسى الأول (L_m) ، دليل الكفاءة المناسل (GSI) كما تمت دراسة الخصوبة. أظهرت النسبة الجنسية تفوق عدد الإناث (F) عن عدد الذكور M (1M: 1.6 F) خلال فترة الدراسة. سجلت أعلى قيم لدليل الكفاءة المناسل GSI خلال شهر نوفمبر إلى يناير ووصلت إلى أعلى قيمة لها في ديسمبر ، وذلك يعنى أن أسماك القاروص شتوية التفريخ والذى يتم مرة واحدة في السنة. تم تحديد L_m الطول الذى يتم عنده نضج السمكة جنسياً لأول مرة وهو 30.8 و ٢٩.٢ سم للإناث والذكور على التوالي. لوحظ زيادة الخصوبة المطلقة مع الزيادة فى حجم الأسماك وتم وصف تلك العلاقة بالمعادلة الأسية ، ($R^2 = 0.9661$ & $F = 8.951\ L^{2.8501}$). كان قياس الطول عند الالتقاط الأول (L_c) يقدر بـــ ٢٧.٨. لذا نوصى بزيادة الطول عند الالتقاط لأول مرة ليكون أكبر من الطول عند النضج الجنسي الأول (> ٣٠.٠ سم)، ويمكن تحقيق ذلك من خلال توسيع فتحات الشباك المستخدمة لصيد *D. labrax* وذلك للسماح للإناث بالتفريخ.