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ESTIMATING SOME BIOLOGICAL PARAMETERS AND YIELD PER RECRUIT FOR FISHERY MANAGEMENT OF SPOTTED SEA BASS *Dicentrarchus punctatus* IN BARDAWIL LAGOON EGYPT

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ABSTRACT

The present study aimed to assess some biological parameters and yield per recruit for fishery management of spotted sea bass *Dicentrarchus punctatus* in Bardawil lagoon, Egypt. For this purpose, 3286 specimens of *D. punctatus* were collected during two fishing seasons between January 2020 and December 2021. The total length (TL)of the samples ranged from 10.1 to 34.7 cm, and the weights ranged from 9 to 368.4 g. The maximum life span was five years length range of 12.3 – 28.29 cm TL. The parameters of the von Bertalanffy growth function were $K = 0.2371$ year^{-1}, $L\infty = 37.36$ cm and $t_0 = -0.7505$ years^{-1} during 2020-2021. The rates of total mortality (Z), natural mortality (M) and fishing mortality (F) were 0.9107, 0.3121 and 0.5986 year^{-1} during the period of study. Exploitation rate E was 0.66 indicating that the population of this species is being heavily exploited. The estimated total length at first capture L_c was 17.6 cm during both 2020 and 2021. When the fishing effort is stable at 0.5986, the yield per recruit was 44.2 at the length at first capture 17.6 cm and the age at first capture 1.94 years. With increasing the length at first capture until 22.0 cm, the yield per recruit was reached 47.6. Any increase in the length of the fish, was accompanied with a decrease in the yield per recruit. To manage the spotted sea bass *Dicentrarchus punctatus* biologically, should be decrease value of exploitation rate by increasing of the length at first capture (>17.6 cm). or decreasing of fishing effort.

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INTRODUCTION

Sea basses (*Dicentrarchus labrax* and Spotted Sea bass *D. punctatus*) are common in the Mediterranean Sea, the Black Sea and along the Eastern Atlantic coasts from Great Britain to Senegal. These species found in marine to slightly brackish environments such as coastal lagoons and estuarine areas. They are euryhaline and eurythermal species, meaning they have tolerances for wide salinity and temperature fluctuations **(Moretti *et al.*, 1999).** Sea basses are predators, consuming small fish and a large variety of invertebrates. The feeding behaviour is related to size; juveniles feed mainly on small crustaceans (Amphipoda, Mysidacea and Isopoda) and small fish like Atherina and Gobius. In fish larger than 20 cm, shrimps and crabs being to be common preys **(Mehanna, 2006).**

Fishers in North Sinai depend heavily on the Bardawil lagoon for their livelihood. It is well-known that Bardawil lagoon-fisheries are predominantly multi-species and multi-gears fisheries, with a high economic importance on their fishing communities. Fishers in the lagoon use different type of gears including illegal ones. Gill net, trammel net and crab gill net are the main fishing gears used by artisanal fishers in Bardawil lagoon. Trammel nets are quite commonly used among fishermen

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in Bardawil lagoon since they are less costly. Among fishing gear, gill nets considered to be highly fish size selective and important for fisheries management and the environment **(Ilkyaz, 2005)**.

The relation between body weight and length is a simple but essential in a fishery management **(Chien-Chung, 1999**). This relation represents one of the most studied biological characters of fish biology. It is known that weight of a fish increases as a function of its length. Length-weight relationship is an essential biological parameter needed to appreciate the suitability of the environment for any fish (**Moussa, 2003**). Length–weight relationships for fish used extensively to provide information on the condition of fish, their isometric or allometric growth, in the analysis of onto genic changes, to compare life histories of fish species between regions as well as other aspects of fish population dynamics. In fisheries biology, length–weight relationships are useful for the conversion of growth-in-length equations to growth-in-weight, for use in stock assessment models and to estimate stock biomass from limited sample sizes **(Binohlan and Pauly, 1998**; **Koutrakis and Tsikliras, 2003; Ecoutin *et al*., 2005).**

The objective of the present study was to determine some biological parameters of Spotted Sea bass *Dicentrarchus punctatus* in Bardawil lagoon as basic parameters for its management.

MATERIALS AND METHODS

Bardawil Lagoon is a shallow, hyper saline lagoon, located in the north of Sinai southern east the Mediterranean Sea. Its coordinate is about 31^{o} 10 N 33^{o} 1ǵ E. It extends for about 80 km with a maximum width of 20 km and a maximum depth of 3 m (Fig. 1) **(El-Aiatt *et al*., 2019)**. Fish samples Spotted of Sea bass *Dicentrarchus punctatus* were taken randomly for biological studies during the fishing seasons 2020 and 2021. The following measurements recorded for each fish specimen: 1-Total length of the fish (cm). 2- Total weight of the fish (g.). For age determination, 1014 and 1036 scale samples were examined during fishing seasons 2020 and 2021, respectively. Scales removed from the left side of each fish behind the tip of the pectoral fin **(Paul, 1968).** The scales were then examined by a projector for age determination with 33 x magnification. The total radius of the scale of the longer axis as well as the distance from the focus of the scale to successive annuli measured to the nearest 0.1. The relationship between average total length and average scales radius was calculated. The lengths at previous ages were back calculated from scale measurements using Lee's equation as: **Lee (1920**) $L_n=[(s_n/S) *(L-a)] +a$, Where L_n = is length of fish at age "n", S_n = is magnified scale radius to "n "annulus, S=is magnified total scale radius, L= observed length and a = constant representing the intercept

The relationship between total length and body weight of the Spotted Sea bass *Dicentrarchus punctatus* specimens expressed by the following equation: $W = a L^{b}$ **(Le Cren, 1951)**, where W=total weight, L = length, and (a, b) = constants whose values estimated by the least square method. The length at recruitment (Lr) was determined as the smallest fish of Spotted Sea bass in the catch. The length at first capture (Lc); the length at which 50% of Spotted Sea bass retained in the gear estimated by the analysis of catch curve using the method of **(Pauly 1984)**.

Three methods, **Chapman and Robinson (1960), Beverton and Holt (1957)** and the Powell Wetherall method **(Powell, 1979) d**iscussed in **Wetherall *et al.* (1987**) were used to obtaine total mortality (Z).

Fig. 1. Bardawil lagoon, North Sinai Egypt

The natural mortality coefficient (M) estimated by three methods. 1- **Jensen (1996**) M= 1.5K where k is constant of von Bertlanfy.; 2-**Alverson and Carney (1975)** formula as $M = 3 \times K/[\exp (T_{max} * 0.38 * K)– 1]$ Where $T_{max} =3/k$ and k is constant of von Bertlanfy and 3-**Ursin (1967**) formula as $M=W^{-1/3}$ where W is mean weight of total samples. The fishing mortality coefficient estimated by subtracting the value of natural mortality coefficient from the value of total mortality coefficient as follows: F = Z – M and the exploitation ratio estimated by the formula suggested by **Gulland (1971)** as E= F/Z.

The method of **Gulland, (1969)** used to predict the yield per recruit as follows:

$Y/R =F\times e^{-M (Tc-Tr)}\times W\infty\times[(1/Z) – (3S/Z + K) + (3S2 /Z + 2K) – (S3 /Z + 3K)]$,

Where $S =e^{-k(Tc -T0)}$. Where L∞, K and t0 Bertalanfy, 1938 growth parameter, Tc is age at first capture, Tr is age at recruitment, W∞ is asymptotic body weight, F is fishing mortality, M is a natural mortality and Z (total mortality) = F+M.

Biomass per recruit (B/R) was obtained by **Beverton and Holt (1957)** equation as B / R = Y / R / F where "F" is the fishing mortality. The effects of age and length at first capture on yield per recruit at the present value of fishing mortality and at different fishing mortality values were calculated using **(Gulland, 1969)** model.

RESULTS

A total of 3286 specimens of Spotted Sea bass *Dicentrarchus punctatus* obtained from the Bardawil Lagoon from January 2020 to December 2021. Total length ranged from 10.1 to 34.7 cm and the observed total weight from 9.5 to 368.4 g. The fish total length ranged from 10.1 to 30.0 cm and the observed total weight ranged from 9.5 to 277.3 g. during fishing season of 2020 and the fish total length ranged from 11.5 to 34.7 cm and the observed total weight ranged from 15.4 to 368.4 g. during fishing season 2021.

The length-weight relationship described by the power equation of combined sexes in seasons 2020 and 2021 separately and both 2020 and 20021 (Fig. 2).

The back-calculated lengths at the end of each year of life for combined sexes of *D. punctatus* during fishing seasons 2020, 2021 separately and both 2020 and 2021 were 12.45, 17.81, 21.29, 24.4, 26.57 during season 2020 and 12.35, 18.01, 22.12, 25.07, 28.29 during season 2021 and 12.3, 17.9, 21.6, 24.7, 27.7 cm during January to December 2021 for1st, 2nd, 3rd 4th and 5th years of life, respectively (Fig. 3).

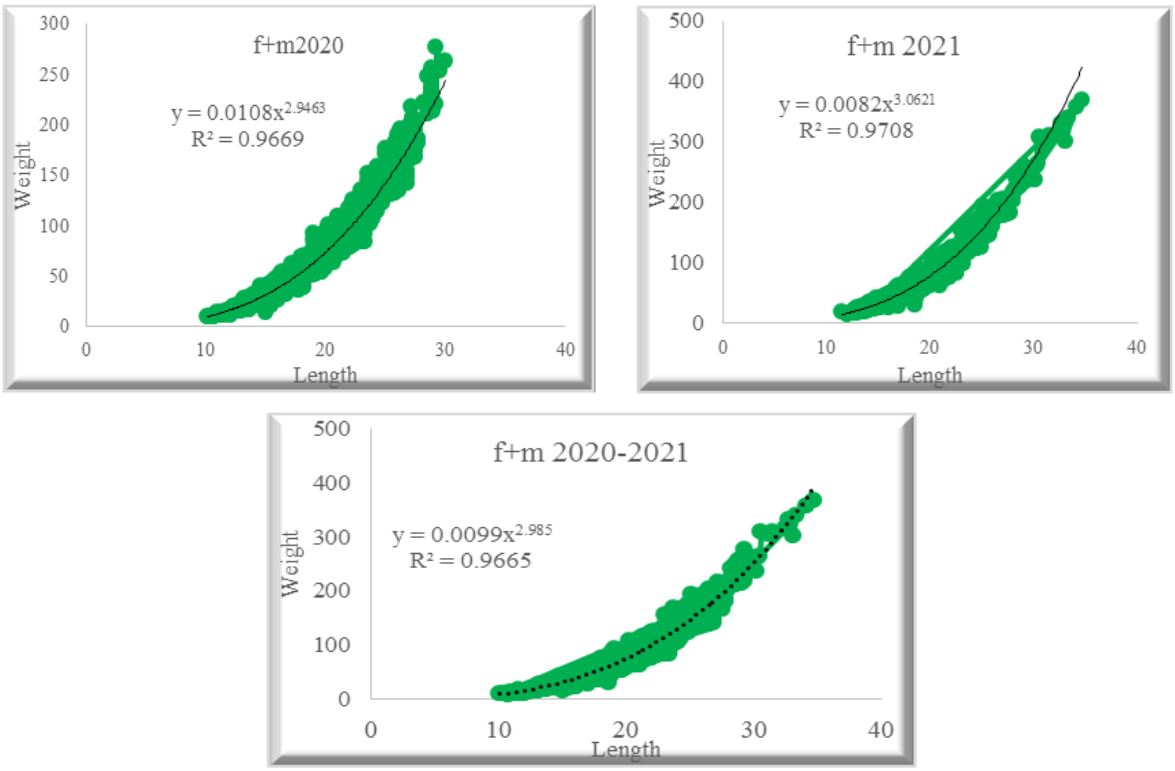


Fig. 2. Length-weight relationship (F+M) of *D. punctatus* in Bardawil Lagoon during fishing seasons 2020, 2021 and from January 2020 to December 2021

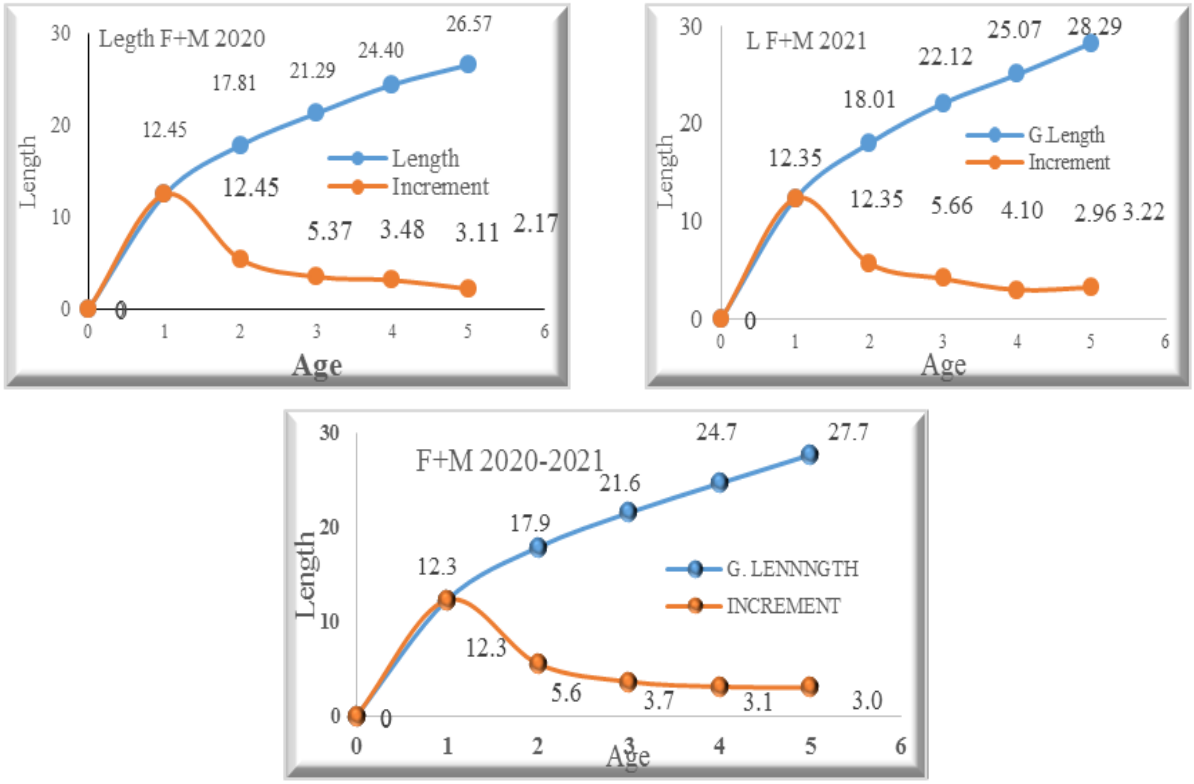


Fig. 3. Growth and annual increment in length (F+M) of D. *punctatus*, during fishing seasons 2020, 2021 and from January 2020 to December 2021

Back-calculated weight at the end of each year of life for combined sexes of *D. punctatus* were 18.18, 52.3, 88.47, 132.19, 169.87 g. during season 2020, 18.07, 57.35, 107.50, 156.86, 228.56g. during season 2021 and 17.8, 54.4, 94.9, 142.0 and 200.6 g. during January 2020 to December 2021 for 1^{st}, 2^{nd}, 3^{rd} 4^{th}, and 5^{th} year of life, respectively (Fig. 4).

Theoretical growth in length and weight of combined sexes of *D. punctatus* in Bardawil lagoon during fishing seasons 2020 ,2021 and all from January 2020 to December 2021 by **Von Bertalanffy (1938)** growth equation for length and weight and fitting the **Ford (1933)** and **Walford (1946)** plot (Table 1). Constants of Von Bertalanffy's growth equation (L_∞, K, t_o and $W\infty$) by using **Ford (1933)** and **Walford (1946)** method was (32.55 cm, 0.3025, -0.6196 and 309.01 g), (38.42 cm, 0.2285, -0.7686 and 583.22 g) and (37.36 cm, 0.2371, -0.7505 and W=488.96 g during 2020; 2021 and both 2020-2021, respectively.

Length at recruitment (Lr) of *D. punctatus* from Bardawil lagoon was 10.1, 11.5 and 10.1cm of combined sexes during fishing seasons 2020, 2021 separately and both 2020-2021. These lengths considered as the estimates of the length at recruitment. The resultant curve derived from the catch curve provided an estimate of L_c at 18.0, 17.4 and 17.6 cm of combined sexes during fishing seasons 2020, 2021 separately and both 2020-2021 (Fig. 5).

The total mortality coefficient Z of *D. punctatus* estimated using three different methods and the results summarized in (Table 2). The average were 0.8369, 0.9750 and 0.9107 during fishing seasons 2020, 2021 separately and both 2020-2021.

Natural mortality (M) estimated using three different methods, the results summarized in Table 2 and the average were 0.3752, 0.3041 and 0.3121 during fishing seasons 2020, 2021 separately and both 2020-2021.

Fishing mortality F of *D. punctatus* was estimated by the difference between total mortality (Z) and natural mortality(M). Exploitation rate (E) was 0.55, 0.69 and 0.66 during fishing seasons 2020, 2021 separately and both 2020-2021, respectively.

Table 3 illustrates the parameters used for the estimation of yield per recruit of combined sex.

Our finding from Table 4 and Fig. 6, show that curves starts at the origin where the yield per recruit is zero when fishing mortality is zero. Then the yield per recruit increases rapidly as the fishing mortality increase. In the present study the fishing mortality was 0.5986 the yield per recruit reached 44.1525 and a maximum value of yield per recruit is reached 44.1554 at fishing mortality 0.61 yr^{-1}, after which the yield per recruit decreases with further increase in fishing mortality.

When the fishing effort is stable at 0.5986 and increasing the length at first capture (LC) and the age at first capture (T_c), we find that the yield per recruit increases to reach the maximum value of yield per recruit at the length of 22.0 cm and the age of 3.0 years and after that the yield per recruit decreases (Table 5 and Figs. 7 and 8).

DISCUSSION

In the present study, (b) value of spotted Sea bass, *D. punctatus* was about 3.0621 and 2.985 during fishing seasons 2021and both 2020-2021, respectively. This indicating that, the growth in weight for Spotted Sea bass *D. punctatus* in Bardawil lagoon is an isometric (The weight follows the cube of length). These results different from that obtained by **Mehanna (2006)** since she reported that the value of b was 2.94. In fishing season 2020, (b) value of depending length upon weight of *D. punctatus* was about 2.9463 indicating that, the growth in weight for Spotted Sea bass *D. punctatus* in Bardawil lagoon is negative allometric (The weight did not follows the cube of length).

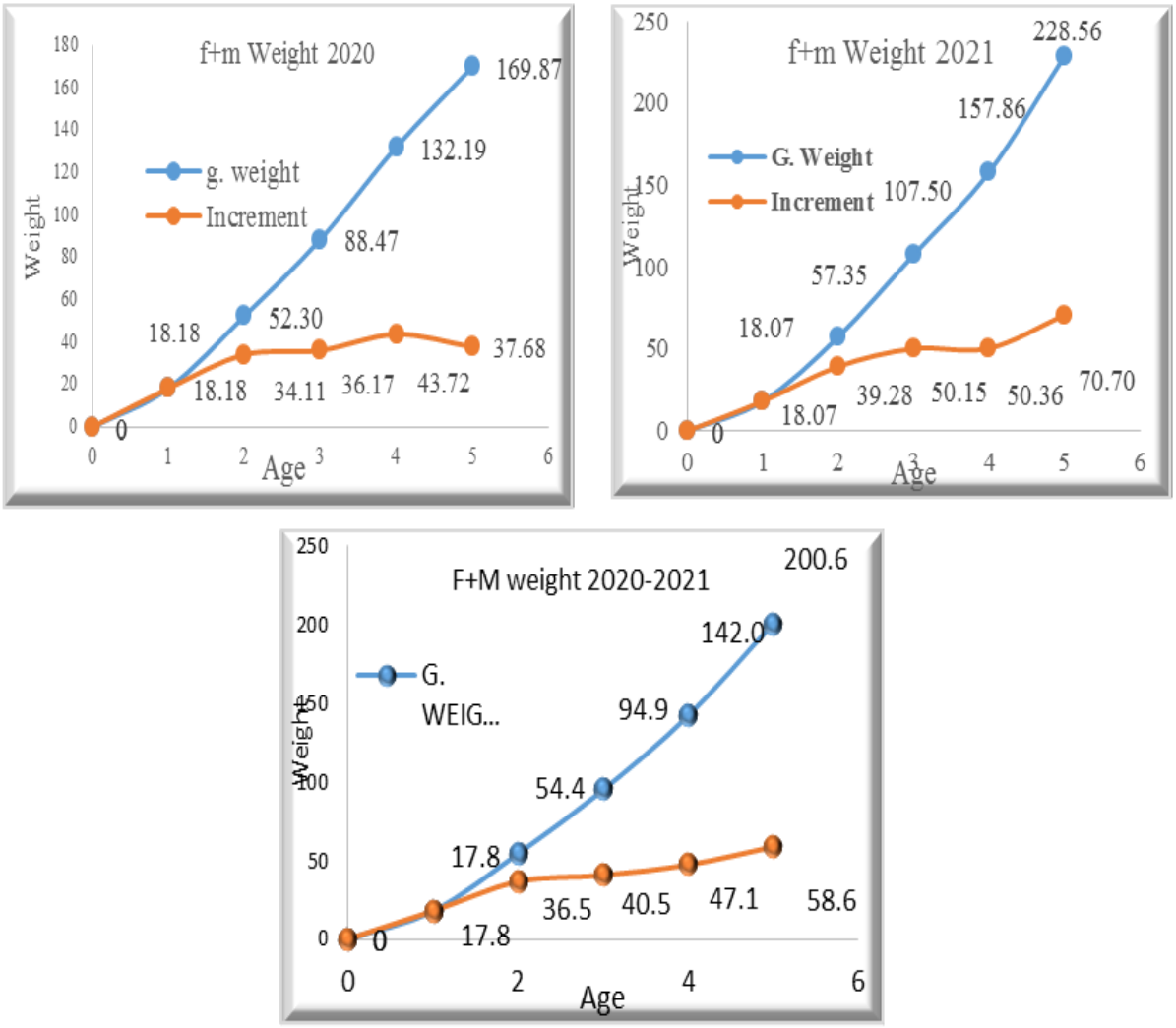


Fig. 4. Back–calculation weight at the end of different years of life (F+M) of *D. punctatus* in Bardawil Lagoon during seasons 2020, 2021 separately and from January 2020 to December 2021

Table 1. Theoretical growth in length and weight of *D. punctatus* in Bardawil lagoon

2020		$Lt = 32.55(1 - e^{-0.3025 (t + 0.6196)})$
2021	length	$Lt = 38.42(1 - e^{-0.2285 (t + 0.7686)})$
Both 2020-2021		$Lt = 37.36 (1 - e^{-0.2371 (t + 0.7505)})$
2020		$Wt = 309.01 [(1 - e^{-0.3025 (t +0.6196)}]^{2.9463}$
2021	weight	$Wt = 583.22 [(1 - e^{-0.2285 (t +0.7686)}]^{3.0621}$
Both 2020-2021		$Wt = 488.96 [(1 - e^{-.2371 (t + 0.7505)}]^{2.985}$

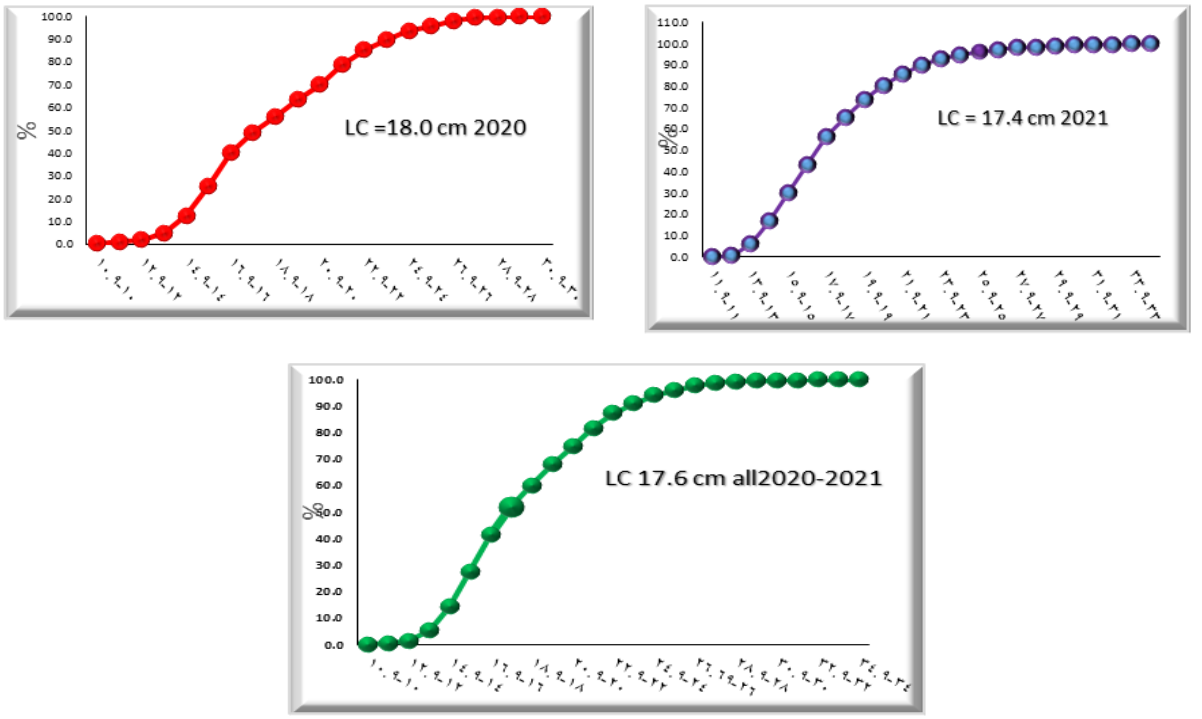


Fig. 5. L_C of combined sexes of *D. punctatus* in Bardawil lagoon during fishing seasons 2020, 2021 separately and both 2020-2021

Table 2. Estimation of Z, M, F and E by different methods for *D. punctatus* in Bardawil lagoon during different fishing seasons 2020, 2021 separately and both 2020-2021

Total mortality (Z)			
Methods	**2020**	**2021**	**All 2020-2021**
Chapman and Robinson (1960) :-	0.9481	1.0056	0.9732
Beverton and Holt (1956), Z-equation based on length data	0.8651	1.1478	0.9959
The Powell-Wetherall method **Powell (1979)**, discussed in **Wetherall *et al.* (1987)**	0.6975	0.7715	0.7629
Mean total mortality	0.8369	0.9750	0.9107
Natural mortality (M)			
Ursin (1967)	0.2452	0.2472	0.24605
Alverson and Carney (1975)	0.4266	0.3224	0.33447
Jensen (1996)	0.4537	0.3428	0.35567
Average	0.3752	0.3041	0.3121
Fishing mortality (F)			
	0.6958	0.6709	0.5986
Exploitation rate (E)			
	0.55	0.69	0.66

Table 3. Different parameters used to calculate yield per recruit (combined sex) of *D. punctatus* collected from Bardawil lagoon in both two fishing seasons 2020- 2021

	The parameters	All 2020-2021
1	Length infinity L∞	37.36
2	Weight infinity W∞	488.9566
3	Growth constant K	0.2371
4	Natural mortality M	0.3121
5	Fishing mortality F	0.5986
6	Total mortality Z	0.9107
7	Mean age at recruitment Tr	0.5787
8	Mean age at first capture Tc	1.9357
9	Mean length at first capture Lc (cm)	17.6
10	Mean length at recruitment Lr (cm)	10.1
11	Theoretical age at length zero To	-0.7505
12	Mean length L`	18.4607
13	Exploitation rate E	0.66
14	Number sample	3286

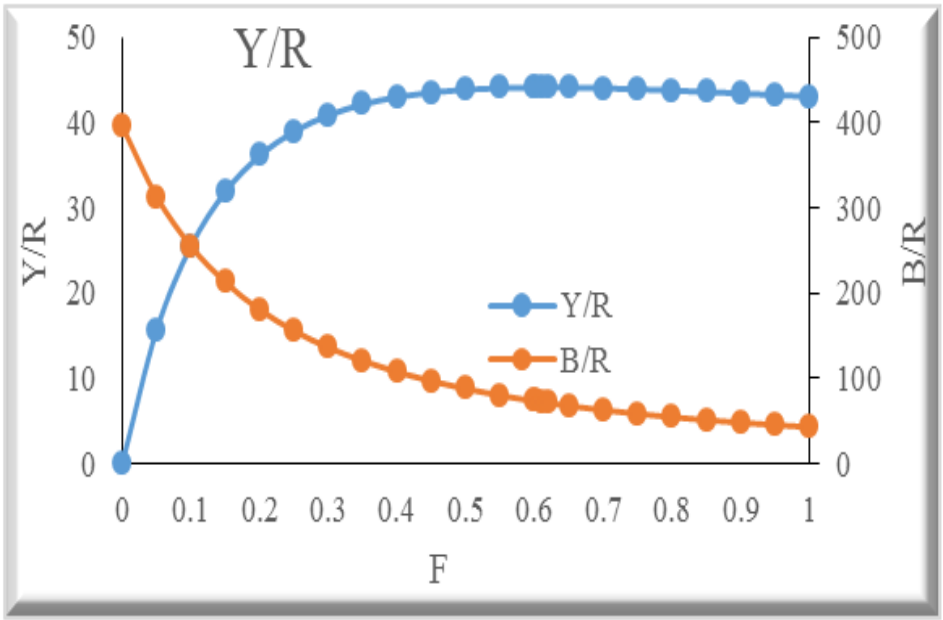


Fig. 6. The yield per recruit as a function of different fishing mortality of combined sexes of *D. punctatus* collected from Bardawil lagoon during both fishing seasons 2020- 2021

Table. 4. Yield per recruit (Y/R) of combined sexes a function of different fishing mortality of *D. punctatus* collected from Bardawil lagoon in both fishing seasons 2020- 2021

Fishing mortality	Y/R by Gulland Formula	B/Y
0	0	396.2
0.05	15.674	313.485
0.1	25.535	255.349
0.15	31.928	212.856
0.2	36.161	180.804
0.25	38.998	155.992
0.3	40.909	136.365
0.35	42.193	120.550
0.4	43.042	107.604
0.45	43.586	96.858
0.5	43.915	87.830
0.55	44.089	80.163
0.5986	44.1525	73.760
0.6	44.1530	73.588
0.61	44.1554	72.386
0.62	44.1547	71.217
0.65	44.137	67.903
0.7	44.063	62.948
0.75	43.949	58.598
0.8	43.805	54.757

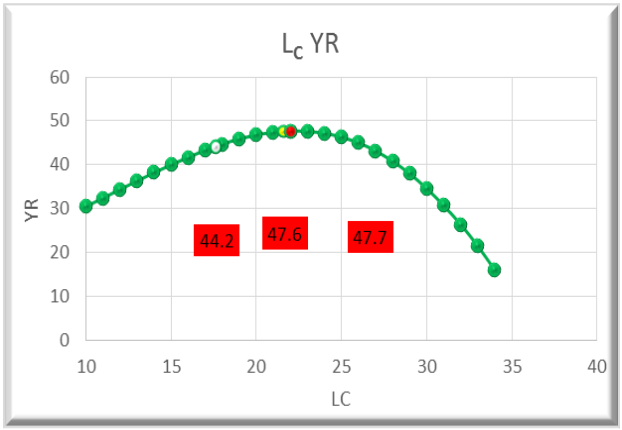


Fig. 7. Y/R of *D. punctatus* during 2020-2021 a function of different length at first capture in Bardawil lagoon

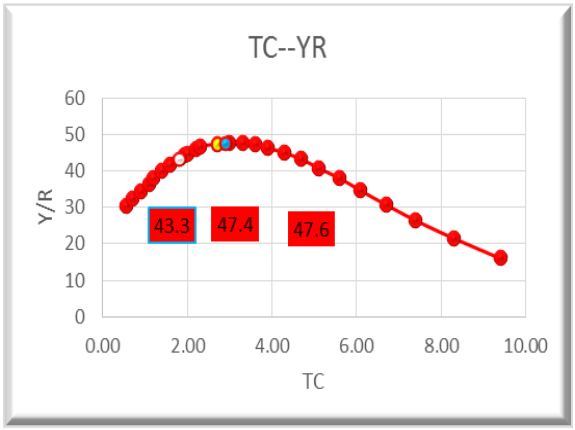
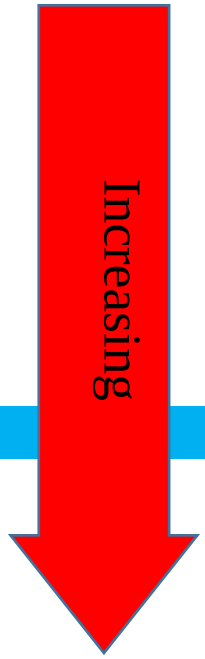
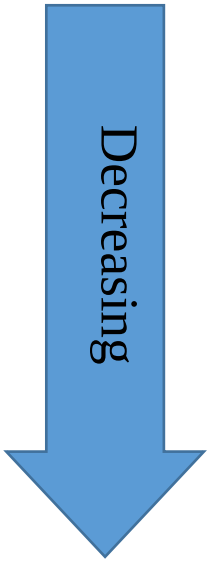


Fig. 8. Y/R of *D. punctatus* during 2020-2021 a function of different age at first capture in Bardawil lagoon

Table. 5. Y/R of *D. punctatus* during 2020- 2021 a function of different age and length at the first capture in Bardawil lagoon

T_C	L_C	YR
0.56	10	**30.5**
0.70	11	**32.4**
0.90	12	**34.4**
1.10	13	**36.3**
1.20	14	**38.2**
1.4	15	**40**
1.6	16	**41.7**
1.8	17	**43.3**
1.94	17.6	**44.2**
2	18	**44.7**
2.2	19	**45.9**
2.3	20	**46.8**
2.7	21	**47.4**
2.89	21.6	**47.6**
3	22	**47.7**
3.3	23	**47.6**
3.6	24	**47.2**
3.9	25	**46.3**
4.3	26	**45**
4.7	27	**43.2**
5.1	28	**40.8**
5.6	29	**38**
6.1	30	**34.6**
6.7	31	**30.7**
7.4	32	**26.4**
8.3	33	**21.5**
9.4	34	**16**





The decrease in weight may be influenced by feeding intensity and unsuitability of environmental factors such as salinity of water. These changes will lead to deviation from the isometric growth pattern. **Enin (1994)** mentioned that the parameter b is equal to 3 at isometric growth, when it is less or greater than 3 it is allometric. **Bagenal and Tesch (1978)** mentioned that length-weight relationship is a practical index of the condition of fish and varies over the year according to factors such as food availability, feeding rate, gonad development and spawning period. The values of (b) used to compare the condition of the fish **(El-Sedafy, 1971)**. The value of (b) lying between 1.34 and 3.68 for the different fish stocks **(Hile, 1936**) and ranged between 2.5 and 4 **(Hunt and Jones, 1972).** In the present study b value in fishing season 2020 (2.9463) agree with **Mehanna and Farouk (2021)** they found that, the b=2.9448 for *D. punctatus* in Bardawil lagoon. But the b value for *D. punctatus* in the present study during fishing season 2021 (3.0621) was better than that obtained by **Mehanna and Farouk (2021).** The variation may be due to different stages in ontogenetic development, as well as differences in condition, length, age, sex and gonadal development (**Nikolsky, 1963)**. Geographic location and some environmental conditions such as temperature, organic matter, quality of food, time of capture, stomach fullness, disease, parasitic loads and the water system in which the fish live can also affect weight at- age estimates (**Bagenal and Tesch, 1978; Bilgin *et al*., 2006).**

Rosa *et al.* (2006) and Mcllwain *et al*. (2005) mentioned that the differences in length-weight relationships and growth parameters are due to age, sex, maturity and sampling period for the same species

In the present study, the back-calculation length at the end for combined sexes of different years of spotted sea bass *D. punctatus* in Bardawil lagoon during 2020 fishing season was 12.45, 17.81, 21.29, 24.40 and 26.57 cm at age's 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, and 5^{th} years, respectively and during fishing season 2021 was 12.36, 18.01, 22.12, 25.07 and 28.29 cm at 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, and 5^{th}, respectively. These values during both fishing seasons 2020-2021 were 12.3, 17.9, 21.6, 24.7 and 27.7 cm at 1^{st}, ^{2nd,} 3^{rd}, 4^{th}, and 5^{th} ages, respectively. This result was different with **Mehanna (2006)** where they found that, the Back – calculation length at the end of different years of Spotted Sea bass *D. punctatus* in Bardawil lagoon was 20.11, 27.35, 31.67 and 34.05 cm at age's 1^{st}, 2^{nd}, 3^{rd}, and 4^{th}, respectively.

The increasing of weight is very important than increasing of length for fishermen, where the landings are recorded as a weight. The growth in weight of combined sexes was 18.18, 52.30, 88.74, 132.19 and 169.87 g at the end of 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, and 5^{th} years of life, respectively during fishing season 2020 and during fishing season 2021 was 18.07, 57.35, 107.05, 157.86 and 228.56 g at the end of 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} years of life respectively. Also, the growth in weight of combined sexes was 17.8, 54.4, 94.9, 142.0 and 200.6 g at the end of 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, and 5^{th} years of life respectively during all 2020-2021. This result was different with **Mehanna (2006)** where she found that, the Back – calculation length at the end of different years of Spotted Sea bass *D. punctatus* in Bardawil lagoon was 20.11, 27.35, 31.67 and 34.05 cm at age's 1^{st}, 2^{nd}, 3^{rd}, and 4^{th}, respectively and the back calculated weight were 76.49, 189.18, 291.18 and 360.66, g. for ages 1^{st}, 2^{nd}, 3^{rd}, and 4^{th} years respectively.

The highest annual increment in study occurred at first year of life, while a noticeable decrease was observed in the second year, reaching its minimal value during the fifth year of life. This result was identifying by previous studies in the same lagoon.

The Constant of Von Bertlanffy equations and different equations for theoretical growth in length and weight of combined sexes of *D. punctatus* in Bardawil Lagoon during 2020, 2021 and both 2020-2021 in Table 6.

In the present results, the L_∞ was very similar to the results presented by **Mehanna (2006)**, but the T_0 and k were different for the same species in Bardawil Lagoon. The results by **Mehanna (2006)**, for the same species in Bardawil Lagoon in the following equations

For growth in length $L_t=37.48\ [1^{-e\ -0.58\ (t\ +0.23)}]$

For growth in weight $Wt. = 478.30\ [1 - e^{-0.58\ (t\ +0.23)}]^{2.9448}$

The total mortality coefficient Z of combined sexes was estimated as 0.8369, 0.9750 and 0.9107 year-1 during season 2020, 2021 and both 2020-2021 respectively. The natural mortality coefficient M was 0.3752, 0.3041 and 0.3121 $year^{-1}$ during fishing seasons 2020, 2021 and both 2020-2021 respectively, while the fishing mortality coefficient F was 0.4617, 0.6709 and 0.5986 year-1 during fishing seasons 2020, 2021 and both 2020-2021 respectively. Exploitation rate (E) computed as 0.55, 0.69 and 0.66 during fishing season 2020, 2021 and all 2020-2021 respectively.

Mehanna (2006), estimated the exploitation rate of spotted bass in Bardawil lagoon 0.7, and our results ranged from 0.55 to 0.69.

Gulland (1971) suggested that the optimum exploitation rate for any exploited fish stock is about 0.5, at F_{opt} = M. More recent, **Pauly (1987**) proposed a lower optimum F that equals to 0.4 M. In the present study, F was higher than the 2 values of F_{opt} given by **Gulland (1971) and Pauly (1987)** indicating that the stock of *D. punctatus* in Bardawil Lagoon is heavily exploited.

The increase of the present fishing mortality coefficient (F = 0.5986) to F_{max} (F = 0.61) would be associated with negligible increase in the yield per recruit (44.1554–44.1525=0. 0029).). This means that, increase of fishing mortality coefficient by about 1.9 % from 0.5986 to 0.61 [(0.61 – 0.5986)/0.0.5986]×100=1.9% would be increase the yield per recruit by only 0.007% since [(44.1554 - 44.1525)/ 44.1525] × 100 = 0.007%. This shows that we are at the critical point, and any increase in the fishing mortality is not followed by an increase in the yield per recruit.

On the other hand, when the fishing effort is stable at 0.5986, the yield per recruit was 44.2 at the length at first capture 17.6 cm and the age at first capture 1.94 years. With the increase in the length at first capture until it was equal to the length at first maturity 21.6 cm and the age at first maturity 2.89 years, the yield per recruit was reached 47.6, and then with any increase in the length of the fish, a decrease in the yield per recruit.

Also,**she** showed that the plot of relative yield per recruit Y'/R and relative biomass per-recruit (B'/R) of *D. punctatus* from Bardawil fishery against exploitation rate E gives a maximum (Y'/R) at E= 0.58. Also, **Mehanna (2006**), found that the exploitation level which maintains the spawning stock biomass at 50% of the virgin spawning biomass E0.5 was estimated as 0.35.

Mehanna (2006) showed that when we raised the length at first capture to 18.75 cm ($Lc/L\infty$=0.5), the yield per recruit increased by about 19% and when it raised to the length at first sexual maturity, the yield per recruit increased by about 53%. The same trend was noticed for biomass per recruit, when we raised the length at first capture to 18.75 cm, the biomass per recruit increased by about 20.2% and when it was raised to the length at first sexual maturity, the Biomass per recruit increased by about 66.7%.

Table 6. Constant of Von Bertlanffy equations and different equations for theoretical growth in length and weight of (combined sexes) of *D. punctatus* in Bardawil Lagoon during 2020, 2021 separately and both 2020-2021

Sexes	Constants of Von Bertlanffy	Ford- Walford Method	Von Bertalanffy equations
		2020	
♀♂	**L∞**	**32.55**	$Lt = 30.55(1 - e^{-0.3025(t + 0.6291)})$
	K	**0.3025**	
	To	**-0.6291**	$Wt = 609.01[(1^{-e^{-0.3025(t+0.6291)}}]^{2.9463}$
	W∞	**309.01**	
		2021	
♀♂	**L∞**	**38.42**	$Lt = 38.42(1 - e^{-0.2285(t + 0.7773)})$
	K	**0.2285**	
	To	**-0.7773**	$Wt = 583.22[(1^{-e^{-0.2285(t+0.7773)}}]3.0621$
	W∞	**583.22**	
		2020-2021	
♀♂	**L∞**	**37.36**	$Lt = 37.36(1^{-e-0.2371(t + 0.7505)})$
	K	**0.2371**	
	To	**-0.7505**	$Wt = 488.96[(1 - e^{-.2371(t + 0.7505)}]^{2.985}$
	W∞	**488.96**	

It can be concluded that the *D. punctatus* stock in the Bardawil fishery is in a situation of overexploitation, and to sustain this valuable fishery resource some management regulations, including reduction of the present level of exploitation and increasing the length at first capture should be applied.

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الملخص العربي

تقدير بعض القياسات البيولوجية والامداد لإدارة مصايد أسماك القاروص النقط *Dicentrarchus punctatus* في بحيرة البردويل مصر

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تهدف الدراسة الحالية إلى تقييم بعض المتغيرات البيولوجية والإنتاجية لكل امداد لإدارة مصايد أسماك النقط *Dicentrarchus punctatus* في بحيرة البردويل، مصر. لهذا الغرض، تم جمع 3286 عينة من *D. punctatus* خلال موسمي صيد بين يناير 2020 وديسمبر 2021. تراوح الطول الإجمالي للعينات من 10.1 إلى 34.7 سم، وتراوحت الأوزان من 9 إلى 368.4 جم. كان الحد الأقصى للعمر خمس سنوات يتراوح بين 12.3 - 28.29 سم طول كلى. كانت قياسات النمو Von Bertlanffy خلال الفترة من 2020 الى 2021 هي (k= 0.2371 سنه $^{-1}$ L∞ =37.36 سم t0 =- 0.7505 سنه $^{-1}$). كانت معدلات النفوق الكلى والنفوق الطبيعي والنفوق بالصيد 0.9107 و0.3121 و0.5986 سنه $^{-1}$ خلال الفترة من 2020 إلى 2021 على التوالي. تشير نتائج هذه الدراسة أن معدل الاستغلال كان 0.66 خلال الفترة من 2020 إلى 2021 تشير النتائج إلى أن معدل الاستغلال لهذه الأسماك مرتفع. كان الطول الكلى عند بداية الصيد 17.6 سم خلال الفترة من 2020 إلى 2021. عندما يكون جهد الصيد مستقرًا عند 0.5986، يكون المحصول لكل امداد 44.2 عند الطول عند بداية الصيد 17.6 سم والعمر عند بداية الصيد 1.94 سنة ومع زيادة الطول عند بداية الصيد حتى 22.0 سم يصل الامداد إلى 47.6، ثم مع أي زيادة في طول السمكة، ينخفض الامداد. لإدارة مصايد أسماك النقط *D. punctatus* بيولوجيًا، يجب تقليل قيمة معدل الاستغلال عن طريق زيادة الطول عند بداية الصيد (< 17.6 سم). أو تقليل جهد الصيد.

الكلمات الاسترشادية: القاروص النقط، بحيرة البردويل، الوفيات، معدل الاستغلال، الإنتاجية لكل امداد.

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