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Fisheries status of the bogue *Boops boops* (Linnaeus, 1758) in Algerian East Coast (Western Mediterranean Sea)

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ABSTRACT

This study is the first that deals with the stock status of the bogue *Boops boops* (Linnaeus, 1758) in the Eastern Algerian coast (Western Mediterranean). It aims is to estimate the important parameters needed to evaluate the dynamics of the stock of this species which is economically important resource in Algeria. The FiSAT II software has been used for data analysis. The total length and weight of the fishes sampled ranged from 10.1 to 30.9 cm and from 13.47 to 268.15 g, respectively. The longevity has been estimated at 5 years. The parameters of von Bertalanffy growth curve were $L\infty = 32.03$ cm, $K = 0.28$ yr^{-1}, $t_o = -1.13$ years and $\phi' = 2.45$. The length-weight relationships was described by parameters a = 0.016 and b = 2.815, reflecting a trend towards negative allometric growth. The total mortality (Z), natural (M) and fishing (F) mortalities were 1.03, 0.37 and 0.66 yr^{-1}, respectively. The current exploitation rate (E) of the species was 0.64. The relative yield per recruit analysis (Y'/R) from the Beverton-Holt showed that the current level of exploitation is significantly higher than E_{max} and $E_{0.5}$ (0.54 and 0.32 respectively), indicating that the population is overexploited and suffers from fishing pressure. For sustainable management of this resource, the current exploitation rate should be reduced by 50%.

INTRODUCTION

The bogue, *Boops boops* (Linnaeus, 1758) is a marine species, gregarious of the sparidae family. Demersal to semi-pelagic, it is widespread in the Mediterranean and East Atlantic (FAO, 2019). On the Algerian coasts, it is one of the most common sparidae (Djabali *et al*., 1993; Derbal and Kara, 2001) Fished essentially with pelagic trawl and purse seine with slide, the bogue is often caught in association with other pelagic species, it thus occupies the 4th place after sardine (59%), round sardinella (22%) and saurel (7%), and thus represents 3% of the catch, according to General Directorate for Fisheries and Aquaculture (DGPA, 2018). Between 2010 and 2017, Algerian average annual fish production was estimated at 100,000 tons, mainly pelagic fish, which accounted for 80% of catches (DGPA, 2018).

In 2017, Algeria participated in the FAO's CopeMed II project; Mediterranean Fisheries Cooperation Project; whose main purpose was to strengthen scientific collaboration between the countries of the Western Mediterranean for sustainable fisheries management (CopeMed II, 2017). This project came after several alarm signals, drawn by different organizations, notably the FAO which following the study made on the state of the world's fisheries which had reported that in 2015, the Mediterranean with the Black Sea had displayed, the highest percentage (62.2%) of unsustainable stocks (FAO, 2018). In many parts of the Atlantic and Mediterranean, several studies have already been undertaken on the ecology and biology of this species (Valle *et al*., 2003; Mendes *et al*., 2004; Khemiri *et al*., 2005; Charif *et al*., 2008; Ghailen *et al*., 2010; Kara and Bayhan, 2015; Layachi *et al*., 2015), few works on their fisheries except Allam (2003) and Monteiro *et al*. (2006).

In Algeria, few studies have been done on *B. boops*, among them, we quote Derbal and Kara (2008) on the diet; Ramdane *et al*. (2013) on parasitology; Kherraz *et al*. (2016) on age and growth and Amira *et al*. (2019) on reproduction, data on the exploitation of stocks remain rare with the exception of the works of Benina *et al*. (2014) at the Algerian center. Given these findings and due the lack of data on the assessment of fisheries, we believe it is important to undertake a study on the population dynamics of *B. boops* in the eastern zone of the Algerian littoral. This study aims to estimate the biological and demographic parameters necessary for future development and sustainable management plans for this species.

MATERIALS AND METHODS

Study area and sample collection

This study focused on the Northeast coast of Algeria (Fig. 1) between Cap Takouch 37°04’04’’N – 07° 83’03’’E and Ain B’Har 36°56’45’’N – 8°36’57’’E.

Samples of a total of 1434 individuals of both sexes were collected monthly during commercial landings in the three fishing ports of Chetaïbi, Annaba and El Kala between January and December 2018. For each specimen, the total length “TL” was measured to the nearest 0.1 cm while total weight “TW” was recorded to the nearest 0.01 g.

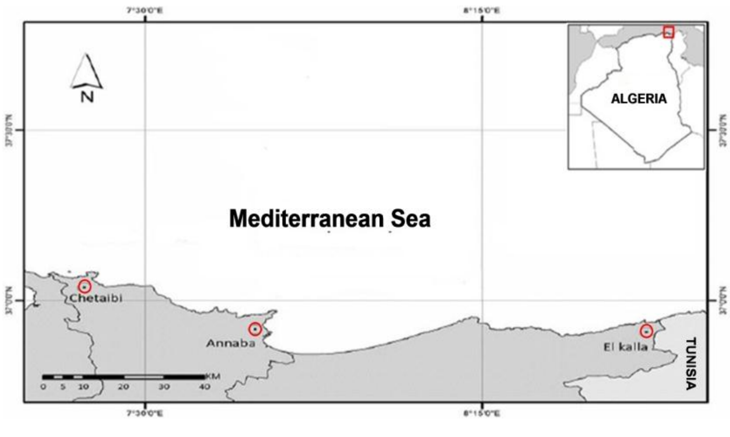

Fig. 1: A map of the Northeast coast of Algeria showing the three sampling locations

Age and growth

Bhattacharya’s method (1967) fitted in FiSAT II was used to split the age groups from the length frequency data (Gayanilo *et al*., 1995).

The description of fish growth was done by the von Bertalanffy linear growth equation (VBGF): $TL = L\infty\,[1 - e^{-k(t-t_0)}]$, requires the use of three parameters. The asymptotic length ($L\infty$) that would be reached at infinite theoretical age; the growth coefficient (K) characterizing the speed with which the fish grows towards its asymptotic size and the theoretical age (t_0) for which the length is zero. L∞ and K were estimated using ELEFAN-I (Pauly and David, 1981) module incorporated into the FiSAT software, where a K scan routine was conducted to assess a reliable estimate of the K value. As for, it was obtained from Pauly's equation (1979): $Log_{10}(-t_0) = -0.3922 – 0.2752\times Log_{10} L\infty - 1.0381 \times Log_{10} K$

The reliability of these growth parameters was tested by the equation of Pauly and Munro (1984): $\phi' = Log_{10} K + 2 Log_{10} L\infty$

Length weight relationship

Length weight relationship was evaluated using the equation of Ricker (1973): $TW = a TL^b$

Where a is constant and b is the slope, these two parameters are estimated by the least square method.

Mortality and Exploitation Rates

Total mortality coefficient (Z) was estimated by using the length converted catch curve (Pauly, 1984). Natural mortality coefficient (M) was estimated by two methods; the equation of Pauly (1980):

$Log_{10} M = - 0.0066 \times 0.279 \times Log_{10} L\infty + 0.6543 \times Log_{10} K + 0.4634 \times Log_{10} T$

Where T is mean annual temperature, estimated in study area at 18 °C (Ouali *et al*., 2018) and the equation of Djabali *et al*. (1994):

$Log_{10} M = 0.0278 – 0.1172 \times Log_{10} L\infty + 0.5092 \times Log_{10} K$ (based on growth parameters and mortality of 56 Mediterranean fish stocks, k and L∞ are the constants of the von Bertalanffy equation). Fishing mortality coefficient "F" was estimated using the relationship of Pauly (1980): F = Z – M. The exploitation rate (E) was obtained by the relationship of Gulland (1971): E = F / Z = F / (F + M).

The stock is in equilibrium when E = 0.5, it is under-exploited when E < 0.5 and is overexploited when E > 0.5 (Gulland, 1971 in Pauly, 1985).

Length at first capture (L_{c50})

The ascending left side of the length converted catch curve incorporated in FiSAT II tool is used to estimate the probability at first capture L_{c50} (Pauly, 1984).

Virtual Population Analysis (VPA)

The length-structured Virtual Population Analysis (VPA) was carried based on previously produced information (L∞, K, t_0, M, F, a and b) and cohort analysis in accordance with the FAO FiSAT-II program (Gayanilo *et al*., 2005).

Relative yield per recruit (Y'/R) and relative biomass per recruit (B'/R)

The relative yield-per-recruit (Y'/R) and relative biomass-per-recruit (B'/R) were estimated by using the knife-edge method of Beverton and Holt (1966) as modified by Pauly and Soriano (1986) and incorporated in FiSAT software.

From the analysis, the maximum allowable limit of exploitation (E_{max}) giving maximum relative yield-per-recruit (MSY =Maximum Sustainable Yield) , $E_{0.1}$, the exploitation rate at which the marginal increase in relative yield-per-recruit, is 10% of its virgin stock and $E_{0.5}$, the exploitation rate corresponding to 50% of the unexploited relative biomass per- recruit (B/R) (TRP=target reference point), have been calculated. Also yield contours which characterize yield isopleth were plotted to identify the impact on yield based on changes in exploitation rate (E_{max}) and critical length ratio ($L_{c50}/L\infty$).

RESULTS

Age and growth

The method of Bhattacharya (1967), allowed us to cinded the sample of *B. boops* of both sexes into 5 cohorts grouped around the lengths of 14.42; 17.43; 20.58; 24.51 and 29.38 cm (Table 1).

The ages 1 and 2 were most present in the catches with 37.48 and 41.42 % respectively. The minimum catch has been observed in individuals of 5 years (0.86 %).

Table 1: Age-length Key of *B. boops* obtained by Bhattacharya's method.

Species	Ages (years)	Mean total lengths (cm)	Effective N	Effective %	Separation Index	Growth rates
	1	14.42	650	37.48	n.a.	-
	2	17.43	720	41.42	2.72	3.01
B. boops	3	20.58	319	18.40	2.92	3.15
	4	24.51	30	1.73	2.43	3.93
	5	29.38	15	0.86	3.25	4.87

Notes: N − number of fish; n.a − not affiched.

The Asymptotic length ($L\infty$), the growth coefficient (K) and theoretical age at length 0 (t_0) were 32.03 cm, 0.28 yr^{-1} and-0.58 respectively (Fig. 2). So, the Von Bertanlaffy equation was $Lt=32.03\ (1-e^{-0.28\ (t+0.58)})$ with a growth performance index of ϕ' =2.46.

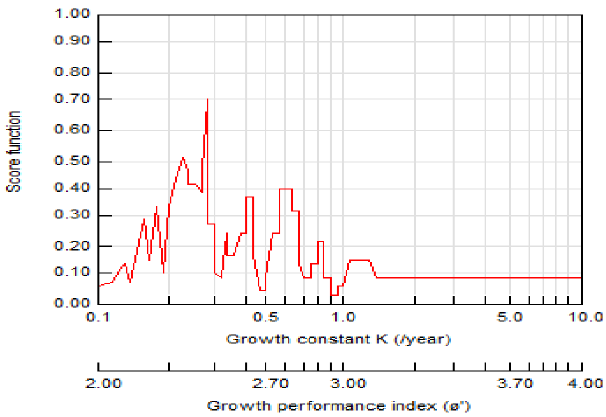

Fig. 2: ELEFAN I K-scan routine FiSAT II output for *B.boops* from the Algerian east coast.

Length weight relationship

The total length measurements of *B.boops* ranged from 10.1 to 30.9 cm and the total weight varied from 13.47 to 268.15 g. Consequently the length-weight equation was $W = 0.0016\ L^{2.815}$ (R^2=0.928).

The value of b reflected the negative allometric growth (Fig. 3).

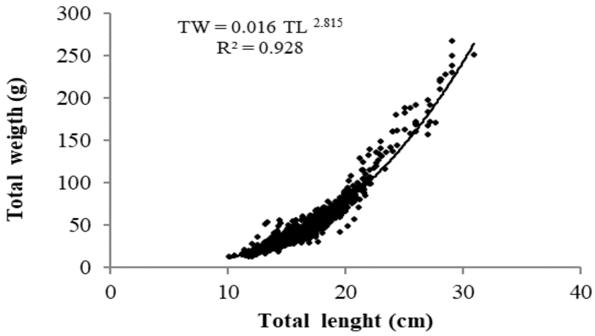

Fig. 3: Length-weight relationship of *B. boops* from the Algerian east coast.

Mortality and Exploitation Rates

Total mortality coefficient (Z) was estimated at 1.03 yr^{-1}, the natural mortality (M) was estimated at 0.62 yr^{-1}, according to the empirical model of Pauly (1980), while that calculated by the equation of Djabali *et al*. (1994) was estimated at 0.37 yr^{-1}. The fishing mortality (F) estimated at 0.66 yr^{-1}, was obtained using the Z value and the M estimate obtained from the Djabali *et al*. (1994). The current exploitation rate (E) was estimated at 0.64 (Fig. 4).

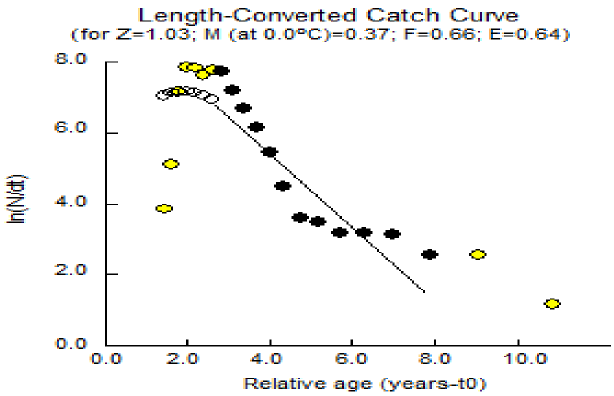

Fig. 4: Length-converted catch curve of *B. boops* from the Algerian east coast.

Length at first capture (L_{c50})

The probability of capture gives estimates of $L_{25\%}$, $L_{50\%}$ and $L_{75\%}$ at 9.71; 10.74 and 11.49 cm respectively. Therefore, the length at first capture (L_{c50}) was estimated at 10.74 cm for *B. boops* (Fig. 5).

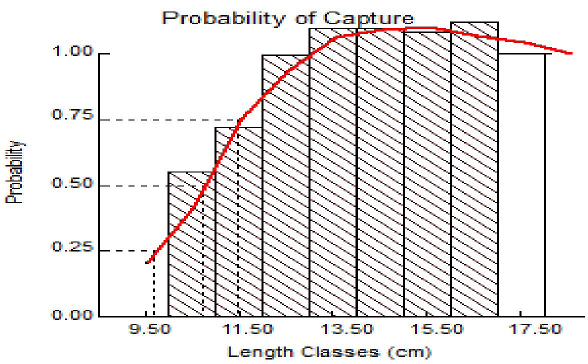

Fig. 5: Length at first capture of *B.boops* from the Algerian east coast.

Virtual population analysis (VPA)

VPA results revealed that fishing mortality affects all size classes of *B. boops* and that the majority of this species were caught between 13 and 18 cm, with a peak fishing mortality (F) of 1.32 yr^{-1} observed at mid-length 17.5 cm (Fig. 6). The terminal fishing mortality was 1.38 per year.

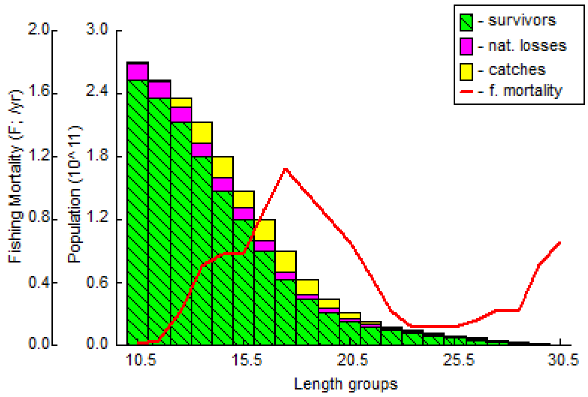

Fig. 6: Length-structured Virtual Population Analysis VPA of *B.boops* from the Algerian east coast.

Relative yield per recruit (Y'/R) and relative biomass per recruit (B'/R)

Estimates of the relative yield-per-recruit (Y'/R) and relative biomass-per-recruit (B'/R) using the Knife-edge option (Fig. 7) were $E_{0.1}$ = 0.46, $E_{0.5}$ = 0.32 and E_{max} = 0.54. The results indicate that the $E_{0.5}$ (TRP), and E_{max} (MSY) values are below the current exploitation rate (0.64).

For the yield isopleths, they place the *B. boops* fishery in quadrant D (Pauly and Soriano, 1986), based on the interception of L_c (L_{c50} / $L\infty$ = 0.335) and E (0.64) (Fig. 8).

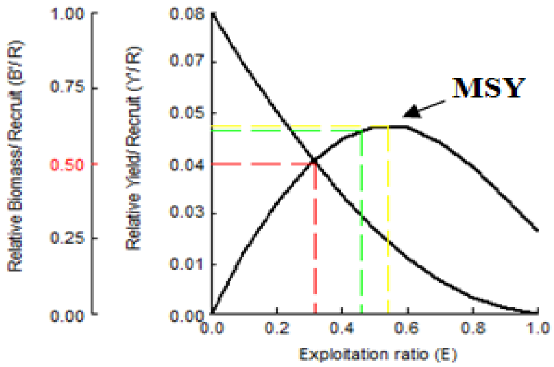

Fig. 7: Relative yield per recruit and biomass per recruit: $E_{0.5}$ (red), $E_{0.1}$(green) and E_{max} (yellow).

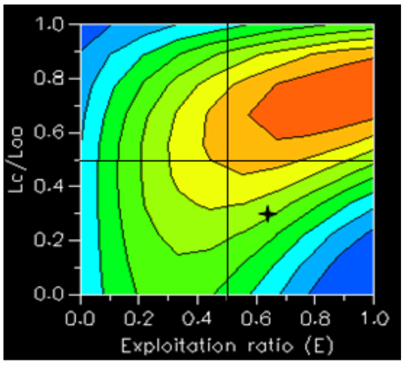

Fig. 8: Yield Isopleth diagram of *B.boops* from the Algerian east coast.

DISCUSSION

The knowledge of age and growth is a fundamental aspect necessary for the establishment of fisheries management policy (Cailliet *et al*., 2006). In this study, the total length of *B. boops* caught in the Algerian east coast ranged from 10.1 to 30.9 cm and the maximum lifespan was 5 years with a quantitative dominance of ages 1 and 2. The size range of our specimens differs from the results obtained by other studies (Table 2), as for their life span (5 years), which is consistent with those obtained by Allam (2003); Benina (2015) and Kara and Bayhan (2015), close to those of El-Haweet *et al*. (2005), El-Okda (2008) and differs from those of Khemiri *et al*. (2005) and Monteiro *et al*. (2006) (Table 2). The difference in the results obtained would probably be due to the sampling protocol used by each author, the study method as well as the sample size (Bariche, 2005).

Table 2: The growth parameters of *B. boops* in different geographical areas.

Areas	Size limits (cm)	T_{max} (y)	Method	L∞ (cm)	K (1/y)	t_0 (y)	ϕ'	Sex	a	b	Authors
Aegean Sea (Turkey)	11.3-27.9	5	O	30.79 29.87	0.23 0.24	-0.900 -0.980	2.37 2.34	F M	0.0050	3.237(+)	Kara and Bayhan (2015)
Middle Aegean (Turkey)	11 - 23.8	-		29.58	0.26	-1.142	2.37	C	0.0050	3.251(+)	Soykan *et al.*(2015)
Algarve (southern Portugal)	7.4-30.5	11	O	28.06	0.22	-1.420	2.24	C	0.0009.	3.01(=)	Monteiro *et al.*(2006)
Nazaré to St André (Portugal)	16.6-34.6	-		-	-	-	-	C	0.0074	3.084 (=)	Mendes *et al.* (2004)
East coast of Spain	9.7-16.7 (SL)	-		-	-	-	-	C	0.0161	2.812 (-)	Valle *et al.* (2003)
Alexandria (Egypt)	10.5-22.4	5	S	31.70	0.15	-1.780	2.19	C	-2.1548	3.103(+)	Allam (2003)
Saloum Bay (Egypt)	7-24	6 6	S B	31.90 29.70	0.15 0.25	-1.131 -0.701	2.18 2.34	C C	- -	- -	El-Haweet *et al.(*2005)
Alexandria (Egypt)	9.59-17.07	4	O	30.11	0.15	-1.508	2.14	C	-	-	El-Okda (2008)
Morocco (Mediterranean)	6-28	-		30.00	0.41	-0.300	2.54	C	-0.0067	2.906(=)	Layachi *et al.*(2015)
North Tunisia Gulf of Tunis East Tunisia South Tunisia	6.1- 26 (FL)	9	O	28.67 24.30 26.70 23.50	0.20 0.23 0.22 0.21	-1.410 -1.650 -1.430 -1.980	2.22 2.13 2.20 2.06	C	-	-	Khemiri *et al.* (2005)
Gulf of Tunis (Tunisia)	12-26	-	-	-	-	-	-	C	0.0070	3.060(=)	Charif *et al.* (2008)
Gulf of Gabes (Tunisia)	12.6 - 22.6	-	-	-	-	-	-	C	0.0102	3.034(=)	Ghailen *et al.*(2010)
East of Algeria (Bejaia)	-	-	-	27.50 27.00	0.28 0.24	-1.200 -1.530	2.32 2.24	F M	0.0150 0.0130	2.776(-) 2.816(-)	Ramdane *et al.* (2013)
Algerian Center	9-29	5	B	29.66	0.33	0	2.46	C	0.0160	2.798(-)	Benina *et al.* (2014)
Western Algeria	11.2- 32.3 9 - 26	-		34.13 26.78	0.26 0.38	- 1.500 - 0.750	2.48 2.43	F M	0.0120 0.0130	2.889(-) 2.863(-)	Kherraz *et al.* (2016)
Eastern of Algeria	10.1 - 30.9	5	B	32.03	0.28	- 0.580	2.46	C	0.0016	2.815(-)	Present study

Notes: O − Otoliths; B − Bhattacharya; S − Scales; T_{max}− maximum recorded age (y); M− male; F− female; C− total population; (+) positive allometry; (-) negative allometry; (=) isometric allometry.

However Allam (2003); Benina (2015) and Kara and Bayhan (2015), those authors used Bhattacharya method, Scales and Otoliths respectively with sample sizes equal to 1372; 421 and 932 individuals respectively were different, and had found ages similar to ours. This similarity may be related to the geographical location of the study areas (Mediterranean Sea) and the fact that they undergo almost the same climatic conditions (Dulvy *et al*., 2008). The quantitative dominance of ages 1 and 2 indicates that overexploitation of the species can be observed, Kara and Bayhan (2015) explains the presence in our capture of this range of size by the non-selectivity of the fishing gear used, effectively our samples are fished essentially by pelagic trawl and purse seine, these techniques are not very selective and they are capable of catching all sizes of fish.

The von Bertalanffy growth parameters ($L\infty$; K and to), basic input data in various models used to manage exploited fish stocks, were 32.03 cm; 0.28 yr^{-1} and -0.58 respectively. These values were relatively different from other researchers' estimates (Table 2). The likely reasons for these differences could be the difference between the maximum lengths observed in the catches (Table 2) or the sampling methods and the techniques used in the calculations by the different authors at different times and localities. Thus, the variability of growth would be related to geographical distribution (Overholtz, 2002; Andersen and Brander, 2009), changes in environmental conditions (Perry *et al*., 2005; Cheung *et al*., 2009), climatic effects and fishing effort (Perry *et al*., 2005; Dulvy *et al*., 2008).

The growth performance index estimate ($\phi' = 2.46$) showed agreement with the results of Benina *et al*. (2014) and Kherraz *et al*. (2016) (Table 2). However, this value has slight differences with those obtained by other authors in the Mediterranean and Atlantic (Table 2). Rahman *et al*. (2016) estimate that the growth performance of species tends to change with the environment but also with the number of species sampled, as well as the size of the largest individual.

The length-weight relationship for *B. boops* in the eastern Algerian coast, showed a negative allometric growth (b = 2.815). Table 2 shows, on the one hand, a concordance between the results of the present study and those found in Algeria. And on the other hand a divergence with the other results found in the Mediterranean and Atlantic. Regional disparity in results may be due to environmental and biological conditions such as seasons, feeding behavior, competition, maturity, sex, and age (Sparre *et al*., 1989; Mommsen, 1998).

The coefficients of total mortality (Z); natural mortality (M) according to Djabali *et al*. (1994) and *B. Boops* fishing mortality (F) of this study were estimated at 1.03; 0.37 and 0.66 $year^{-1}$ respectively. The current exploitation rate (E) was estimated at 0.64.

According to pauly (1980), the natural mortality is related to the K growth parameter and correlated with the average annual temperature of the fish habitat (T °), this equation can lead to errors (Sparre and Venema, 1996) because, if during the year, the ambient water heats, the natural mortality rises and vice versa. Hence the choice of the method of Djabali *et al*. (1994), that considers not the temperature of the environment and is better adapted to the study of Mediterranean fishes.

Based on our results, it is evident that fishing mortality (F = 0.66) is higher than natural mortality (M = 0.37), suggesting a level of exploitation (E) greater than 0.5, the first indicator factor of overfishing. Our results are in harmony with those obtained by all the authors who worked on *B. boops* mortality (Table 3). The bogues are therefore more vulnerable to fishing gear than naturally victims of the sea.

Table 3: Various mortality and Exploitation rates estimated for *B. boops* from different locations.

Areas	**Sex**	**Z (y^{-1})**	**M (y^{-1})**	**F (y^{-1})**	**E**	**Authors**
Middle Aegean (Turkey)	C	1.173	0.148	1.025	0.874	Soykan *et al*.(2015)
Algarve (southern Portugal)	C	1.04	0.33	0.71	0.68	Monteiro *et al*.(2006)
Alexandria (Egypt)	C	1.283	0.458	0.824	0.464	Allam (2003)
Algerian Center	C	1.02	0.36	0.66	0.65	Benina *et al*.(2014)
East of Algeria	C	1.03	0.37	0.66	0.64	Present study

C− total population.

The estimate of length at the first capture (L_{c50} = 10.74 cm) was found to be below the minimum landing size of 15 cm (MPRH, 2012).

This observation could be linked to the mesh size of the fishing gear used for the catch of *B. boops* and seems to confirm the explanation given by Kara and Bayhan in 2015 concerning the non-selectivity of the latter (trawls and seines).

The L_{c50} of the present study is smaller than that determined in the Egyptian sector of the Mediterranean by Allam in 2003 (L_{c50} = 14.15 cm), and in southern Portugal (southern Portugal) in the Atlantic by Monteiro *et al.* in 2006 (L_{c50} = 19 cm). The discrepancy in estimates would be related to environmental factors and long-term fishing pressure (Tsikliras and Anthonopoulou, 2006).

The results of the VPA have shown that small fish are exposed to high exploitation; the greatest fishing effort is exerted on size ranges between 13 and 18 cm. This situation prevents the stock from benefiting from a good renewal by recruitment and thus, can induce very large decreases in biomass, by changing demographic structures (Gascuel, 2008).

The relative yield per recruit (Y'/R) and the relative biomass per recruit (B'/R), determined according to $L_{c50}/L\infty$ (0.335) and M/K (1.321), revealed exploitation ratios ($E_{0.1}$ = 0.48); ($E_{0.5}$ = 0.32) and (E_{max} = 0.54) lower than the current exploitation rate (E = 0.64).This corroborates the earlier assertion that the *B.boops* stock in this study is overfished.

The interception of $L_{c50}/L\infty$ and the current exploitation rate of yield isopleths places the *B.boops* fishery in quadrant D, which means that in terms of relative yield per recruit, the catch of the bogue in the waters of the eastern Algerian coast touch small fish at a high level of fishing effort (Pauly and Soriano, 1986).

As a result, the implementation of rational management measures to avoid a possible collapse is necessary. Increasing the mesh size and reducing the fishing effort from 0.64 to 0.32 (50%) would make it possible to conserve and regulate this fishery in a sustainable manner.

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ARABIC SUMMARY

حالة مصايد السمكة *Boops boops* (Linnaeus, 1758) في الساحل الشرقي الجزائري (غرب البحر الأبيض المتوسط)

دها ل امينة طانيا [١،٢،*] ، رشدي منيرة [١] ، تحري مرجاء [١،٢] ، نديرة بن شيخ [٢] ، آسيا دياف [٢] ، عبدالله برهان جبار [٢]

١- قسم علوم البحار كلية علوم الطبيعة و الحياة جامعة شادلي بن جديد، ص ب ٧٣ ، ٣٦٠٠٠ الطارف ، الجزائر

٢- مخبر الأحياء البيئية البحرية والساحلية ، قسم البحرية العلوم ، كلية علوم الطبيعة والحياة ، جامعة باجي مختار ٢٣٠٠٠ عنابة، الجزائر ، 12 ، ص ب

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هذه الدراسة هي الأولى التي تتناول تقييم مخزون سمكة *Boops Boops* (Linnaeus,1758) في الجزء الشرقي من الساحل الجزائري (غرب البحر الأبيض المتوسط). يهدف إلى تقدير العوامل الهامة اللازمة لتقييم ديناميكية مخزون هذا النوع من الأسماك ذات الأهمية الاقتصادية في الجزائر. تم استخدام برنامج FiSAT II لتحليل البيانات. تراوح الطول والوزن الكلي للأسماك التي تم أخذ عينات منها من ١٠.١ إلى ٣٠.٩ سم ومن ١٣.٤٧ إلى ٢٦٨.١٥ غرام على التوالي. وقد تم تقدير مدى العمر ٥ سنوات. كانت معاملات منحنى النمو von Bertalanffy $L\infty$ =32.03 سم، K= 0.28/ سنة، to =- ١.١٣ و ϕ' = 2.45 . تم وصف علاقات الطول بالوزن من خلال معاملان a = 0.016 و b =2.815، مما يعكس الاتجاه نحو نمو التباين السلبي. وكان معدل النفوق الكلي (Z) ، معدل النفوق الطبيعي (M) و معدل النفوق الصيد (F) 0.37, 1.03 و ٠.٦٦ سنة$^{-1}$ على التوالي. وكان معدل الاستغلال الحالي (E) =٠.٦٤. أظهر تحليل العائد النسبي (Y'/R) من Beverton-Holt أن المستوى الحالي للاستغلال أعلى بكثير من مستوى E_{max} و $E_{0.5}$ (0.54 و٠.٣٢ على التوالي) مما يشير إلى أن الأسماك قد تم استغلالهم بشكل مفرط و يعانون من ضغط الصيد. من أجل الإدارة المستدامة لمصايد الأسماك هذه، ينبغي تخفيض معدل الاستغلال الحالي بنسبة ٥٠ ٪.