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Age and Growth of the Grass goby *Zosterisessor ophiocephalus* Pallas, 1811 in the Gulf of Gabes (Tunisia, Central Mediterranean)

Ferid HAJJI*, Amira OUANNES-GHORBEL, Mohamed GHORBEL and Othman JARBOUI

Institut National des Sciences et Technologies de la Mer (Centre de Sfax), BP 1035, 3018 Sfax, Tunisie

****Corresponding author, e-mail: ferid.hajji@yahoo.fr***

Zosterisessor ophiocephalus *is currently an important component of the eastern Mediterranean inshore fisheries. In Tunisia it was recorded for the first time in the Gulf of Gabes in 1993, where it is now an important fished species. In this study age and growth parameters were determined in the Gulf of Gabes (southeast of Tunisia) based on otolith analysis of 824 specimens caught between September 2006 and August 2007. Monthly changes in marginal increments, determined from alternation of macroscopic opaque and translucent bands, of* Zosterisessor ophiocephalus *sagittae were examined. These results allowed us the estimation of the approximate age to the appearance of each annulus. The observed age was 6 years old for both sexes. Von Bertalanffy parameters based on length at age data were* $TL_\infty = 24.83 \pm 1.69$ *cm,* $K = 0.19 \pm 0.03$ *year*$^{-1}$ *and* $t_0 = -0.91 \pm 0.12$ *for males and* $TL_\infty = 24.13 \pm 1.17$ *cm,* $K = 0.20 \pm 0.02$ *year*$^{-1}$ *and* $t_0 = -0.80 \pm 0.09$ *for females. The length-weight relationship for both sexes of* Zosterisessor ophiocephalus *is* $Wt = 0.021\ TL^{2.789}$. *The size at which 50% of females and males matured was respectively 12.65 cm and 13.91 cm total length (TL). The age at which 50% of females and males matured was respectively 2.9 and 3.5 years.*

Key words: age, growth, *Zosterisessor ophiocephalus,* Gulf of Gabes, Tunisia, Mediterranean Sea

INTRODUCTION

The grass goby, *Zosterisessor ophiocephalus* (Pallas, 1811) is a demersal fish species belonging to the Gobiidae family. This is a Mediterranean endemic species whose distribution is mainly confined to the upper Adriatic Sea, the Black Sea, and the Sea of Azov (MILLER, 1986). It is a cavity nester species, living on soft-bottoms in shallow brackish water, closely linked with seagrass meadows (*Zostera* spp), down to 100 m depth (AZOUZ, 1974). Currently, it is the most abundant gobiid caught off southern coast of Tunisia (BRADAI *et al*., 2004). In Tunisia it is also present in lagoons of Ichkeul (CHAOUACHI & BEN HASSINE, 1998; MENIF, 2000), Ghar El Melh and EL Bibene (MENIF, 2000). Several studies on biological feature of grass goby have been conducted in Mediterranean as well as in other seas around the world (DOLGII, 1962; PATZNER *et al*., 1991; OTA *et al*., 1996; PRIVILEGGI *et al*., 1997; SCAGGIANTE *et al*., 1999; PASTRES *et al*., 2002; AKYOL,

2003; MALAVASI *et al*., 2003; SCAGGIANTE *et al*., 2004; RICCATO *et al*., 2004; HAJJI *et al*., 2010; HAJJI *et al*., 2011; FRANCO *et al*., 2012). These studies treated mainly the growth parameters, the reproduction strategy, the ecology and the feeding habits. Fish age estimation by means of otoliths has a long tradition (MILLER, 1961; CAMPANA & NEILSON, 1985; JEPSEN *et al.,* 1999; CAMPANA, 2001). The deposition of organic and inorganic layers resulting in the formation of macroscopic translucent and opaque rings and microscopic zonations (MORALES-NIN, 2000). Validation of annuli periodicity could be obtained by analyzing the marginal increment (KARLOU-RIGA, 2000; KERSTAN, 2000; MASUDA *et al*., 2000) or by the analysis of otolith edge (CAZORLA, 2000; LABROPOULOU & PAPACONSTANTINOU, 2000), the age assignment of a fish being a function not only of annulus count, but of edge type in relation to date of collection and assigned birth date (CAMPANA, 2001). The marginal increment analysis verifies the annual deposition of otolith margins (opaque or translucent) throughout a year and explains the timing of the annulus formation. The main goal of the present study is to extend the current knowledge on the age and growth of grass goby to the Central Mediterranean Sea, using a validated otolith ageing method. This information will allow the age composition of the catches to be determined, which is important input parameter for stock assessment techniques and will provide an insight about the life-history of this species.

MATERIAL AND METHODS

Sampling

The Gulf of Gabes is a large neckline situated on the south coastline of Tunisia (BURROLET *et al*., 1979), spreading for about 750 km from Cape Kapoudia (35th parallel) to the Tunisian-Libyan borders (Fig. 1). Fish samples were collected weekly from September 2006 to August 2007. Fishes were caught off the coast of the Gulf of Gabes (depths down to 50 m), by artisanal fishing fleets, using different fishing gears (seine nets, gill nets, fyke nets). In the laboratory a total of 824 specimens were measured to the nearest centimeter for total length (TL) and weighed to the nearest 0.01 gram for total weight (W). Measurement and count of the annual rings were made for 352 females and 472 males. The minimum and the maximum TL of specimens of which their otoliths had been examined were, 10.5 and 20.2 cm respectively. The sex was recorded by macroscopic examination of sexually dimorphic urogenital papilla and gonads. The dissection allows the confirmation of sex and determination of the degree of sexual maturity. Gonads were macroscopically staged according to the gonad development classification for gobies with a five-point scale of maturity (MILLER, 1961).

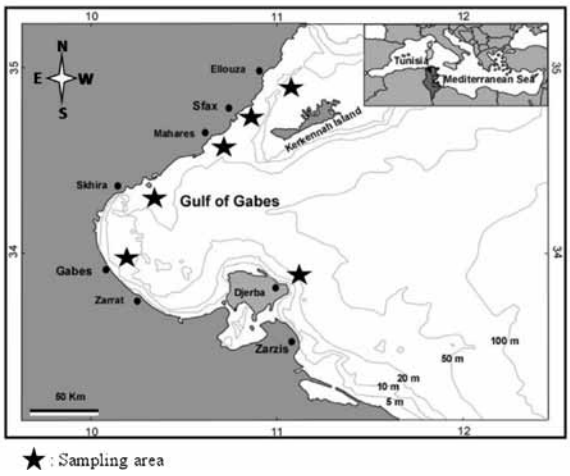

Fig.1. Sampling areas of Zosterisessor ophiocephalus in the Gulf of Gabes (Southern Tunisia)

Otolith preparation and age determination

The sagittal otoliths of each fish were removed, cleaned, and stored dry in envelopes for subsequent age determination. All otoliths were examined whole, immersed in alcohol and against a dark background, under a compound microscope using reflected light. The otoliths were measured along the radius going from the focus to the dorsal ridge; the nucleus and annual growth ring dimensions were determined in micrometer units (Fig. 2). The marginal increment was determined monthly and variation through the year indicates the period of annulus deposition. Age readings for each individual

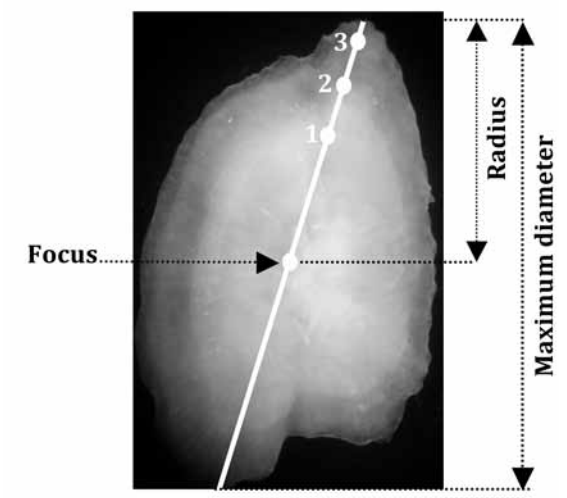

Fig.2. Annulation pattern and age determination of Zosterisessor ophiocephalus based on the sagitta otolith reading

were assessed in age groups taking into consideration the annual formation, the total number of rings, the capture date and April-May as the theoretical birth date (HAJJI *et al.*, 2011). Ages were assigned based on counts of alternating opaque and translucent zones along the axis from core to the rostral tip. Otoliths were read twice and only coincident readings were accepted. Otoliths with excessive vateritic growth, deformation and indistinct annulus character were excluded from the age analysis. The periodicity and timing of annulus formation was validated by marginal increment analysis (MIA) (MASUDA *et al.,* 2000). MIA is based on following the progression of the rings formed on the edge of otolith throughout the year. A plot of the monthly percentage of otoliths with opaque and translucent margins will point out the annulus formation period. If one maximum per year will be found for opaque and translucent zones, then it can be considered that only one annulus is deposited throughout the year. The period at which the percentage of opaque margin reached its maximum indicates that fish is in a period of fast growth (MORALES-NIN, 2000).

Growth parameters

The marginal increment index was calculated using the formula: IM = 100 x (Rc-Rn)/Rn

Where Rn is the radius of the last growth ring and Rc is the maximum otolith radius.

Total length was back calculated for each ring with the formula (LEE, 1920):

$$TLi = a + [(TL - a)\ Ri / Rc] \qquad (3)$$

Where TLi predicted total length of the fish corresponding to age or ring i in cm, a- ordinate in the origin of the equation TL = a + b Rc, TL- observed total length of the fish in cm, Ri- radius of the ring calculated as the average value observed in ring i, and Rc- maximum otolith radius.

The Von Bertalanffy growth equation was fitted to the observed length at age data of the resulting age length key using a nonlinear estimation method for females, males and for grouped sexes. The FISHPARM program (PRAGER et al., 1987) was used to estimate the parameters of the Von Bertalanffy growth equation:

$$TL_t = TL_\infty (1 - e^{-K (t-t0)})$$

where TL_t is the total length at age t; TL_∞ is the asymptotic length; K is the growth coefficient; t is age of the fish and t_0 is the hypothetical age at zero length.

Since TL_∞ is the asymptotic length and the maximal age t_{max} correspond to 95% of TL_∞ (GULLAND, 1969).

$t_{max} = t_{95\%}\ TL_\infty = t_0 - 1/k\ [Log\ (TL_\infty - 0.95\ TL_\infty)]$; and therefore $t_{max} = t_0 - 1/k\ Log\ 0.05$.

The mean size and age at maturity were calculated from the percentage of mature females an males in each size class (1 cm TL intervals) or age class (1 year interval) using the formula of DE MASTER (1978), as adapted by FOX (1994):

$$\alpha = \sum_{x=0}^{w} (x)[f(x) - f(x-1)]$$

where α is the mean size or age of maturity, *x* is size in cm or the age in years, *f(x)* is the proportion of females or males mature at size or age *x*, and *w* is the maximum size or age in the sample.

The growth in mass was also described by the same model.

$$W_t = W_\infty (1 - e^{-K (t-t_0)})^b$$

where W_t is the total mass at time t, W_∞ is the maximum theoretical mass of species and b is the power constant of the length mass relationships. Finally, the growth performance index ($\Phi' = 2 \log TL\infty + \log K$) (MUNRO & PAULY, 1983) was used to compare the growth of *Z. ophiocephalus* with other Mediterranean and Black Sea Gobius species.

Length-weight relationship and otolith growth

The relationships between total length and weight were determined by fitting the data to the commonly used equation; $W = aTL^b$ (RICKER, 1975), where TL is the total length (cm), W is the total weight (g), a and b are constants. Regression analysis was employed on data for males and females separately and for combined sex after linearization by log-transformation to satisfy assumptions of normality. Analysis of covariance was performed to determine if there were significant differences in the weight-at-length relationships between sexes (ZAR, 1996).

RESULTS

Length frequency distribution

During this study 824 specimens were sampled. Total length ranged from 10.50 to 20.20 cm. The largest male registered in this study measured 20.20 cm TL, the largest female measured 19.80 cm TL (Table 1). The bulk of samples presented a distinctive peak at 14 cm for combined sex (Fig. 3). Mean total length was greater for males than for females (Table 1), and all differences were not statistically significant (ANOVA, $P > 0.05$).

Length-weight relationships

The length-weight relationships were calculated separately for all fish and both sexes (Table 2). The length-weight relationships of both sexes separately are represented graphically in Fig. 4. The length-weight relationships were:

Table 1. The total number of fish (N), mean ± standard deviation (Mean ± SD), minimum (Min), maximum (Max) and, mode of total length (cm) for Zosterisessor ophiocephlus in the Gulf of Gabes for all fish and for each sex

Total Length (cm)			
	All fish	Females	Males
N	824	352	472
Min	10.50	10.50	10.50
Max	20.20	19.80	20.20
Mean ± SD	14.41 ± 0.11	13.84 ± 0.15	14.83 ± 0.14
Mode	14.20	13.30	14.10

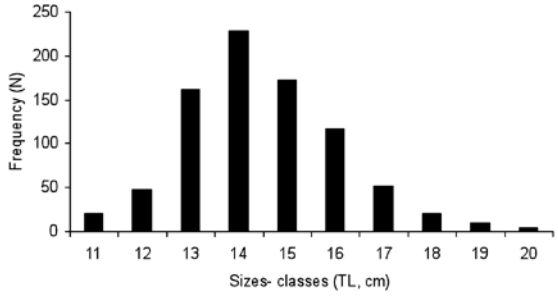

Fig.3. Length-frequency distribution of Zosterisessor ophiocephalus in the Gulf of Gabes

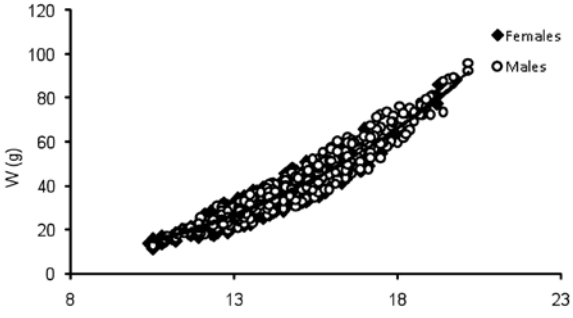

Fig.4. Length-weight relationships of males and females of Zosterisessor ophiocephalus in the Gulf of Gabes

$W = 0.025 \times TL^{2.73}$ for females ($R^2 = 0.90$, N = 352);

$W = 0.020 \times TL^{2.81}$ for males ($R^2 = 0.91$, N = 471).

There was no statistically significant slope of the length-weight regressions between sexes (ANOVA, $P > 0.05$); thus the TL-W relationships for combined sexes was expressed as:

$W = 0.020 \times TL^{2.81}$ ($R^2 = 0.91$, N = 824).

The b value was significantly lower than the theoretical value of 3 for females (t-test, t =

Table 2. Length-weight relationships and size ranges of sampled individuals of Zosterisessor ophiocephalus in the Gulf of Gabes

Sex	N	Size range (cm)	a	b	R^2	t_{obs}	Significance	Allometry
All fish	824	10.50-20.20	0.020	2.81	0.91	7.52	P < 0.05	negative
Females	352	10.50-19.80	0.025	2.73	0.90	6.61	P < 0.05	negative
Males	472	10.50-20.20	0.020	2.81	0.91	5.55	P < 0.05	negative

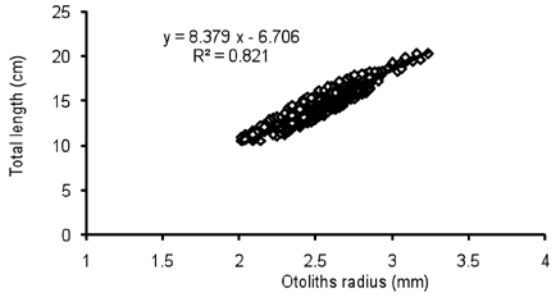

Fig.5. Linear regression relationship between total length and otolith radius of Zosterisessor ophiocephalus of the Gulf of Gabes

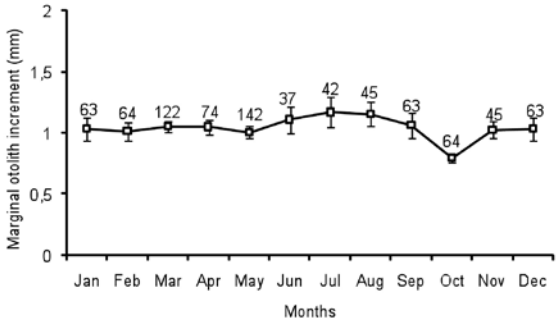

Fig.6. Mean monthly marginal increments of otoliths for Zosterisessor ophiocephalus of the Gulf of Gabes. Error bars = ± standard error with number of individuals above

Table 3. Age- length key of 824 individuals of Zosterisessor ophiocephalus from the Gulf of Gabes

Class length (mm)	Age group						
	I	II	III	IV	V	VI	N
<110	3						3
111 - 120	5	33					38
121 - 130		117					117
131 - 140		41	157				198
141 - 150			208				208
151 - 160			69	71			140
161 - 170				70			70
171 - 180				29			29
181 - 190				2	10		12
191- 200					7		7
> 201						2	2
n	8	191	434	172	17	2	824
Mean total length (cm)	10.95	12.55	14.13	16.36	18.85	20.2	14.41
s.d	0.3	0.08	0.05	0.10	0.24	0.10	0.07

Table 4. Back calculated total lengths by age group for females, males and combined sex of Zosterisessor ophiocephalus from the Gulf of Gabes. C.I., the confidence interval; GI (%)., the growth increment (%)

			Age class					
Age (years)		N	I	II	III	IV	V	VI
Combined sex								
	1	8	5.59					
	2	191	5.39	8.82				
	3	422	5.43	8.8	11.35			
	4	172	5.54	8.91	11.48	13.98		
	5	17	5.72	9.03	11.6	14.06	16.35	
	6	14	5.58	8.92	11.51	13.89	15.55	17.22
Mean			5.54	8.9	11.49	13.98	15.95	17.22
C.I.			0.10	0.08	0.10	0.10	0.78	
GI (%)				46.49	25.38	19.58	13.18	7.64
Males								
	1	6	5.78					
	2	117	5.63	9.03				
	3	180	5.65	8.92	11.35			
	4	41	5.79	9.03	11.48	13.84		
	5	6	6.21	9.42	11.88	14.37	16.52	
	6	2	5.77	9.12	11.69	14.03	15.66	17.29
Mean			5.81	9.1	11.6	14.08	16.09	17.29
C.I.			0.17	0.17	0.23	0.30	0.84	
GI (%)				44.24	24.09	19.31	13.33	7.22
Females								
	1	2	5.64					
	2	74	5.42	8.78				
	3	242	5.48	8.89	11.44			
	4	131	5.57	8.97	11.56	14.06		
	5	11	5.66	9.02	11.62	14.02	16.33	
	6	12	5.39	8.73	11.35	13.75	15.45	17.15
Mean			5.53	8.88	11.49	13.95	15.89	17.15
C.I.			0.09	0.11	0.12	0.19	0.86	
GI (%)				46.52	25.65	19.3	13.01	7.63

6.61, $P < 0.05$), for males (t-test, $t = 5.55$, $P < 0.05$) and for all individuals (t-test, $t = 7.52$, $P < 0.05$) (Table 2) which means a negative allometric growth pattern ($P < 0.05$).

Relationships between total length and otolith radius

For the calculation of the fish total length and otolith radius relationship (TL /Rc) the data from 824 individuals were used and the linear equation:

Table 5. Estimates of Von Bertallanffy growth parameters L∞, W∞, k and t0 for females, males, and sexes combined of Zosterisessor ophiocephalus in the Gulf of Gabes

Sexes	TL_∞ (cm)	W_∞ (g)	K ($year^{-1}$)	t_0 (year)
Females	24.13±1.17	157.83	0.20±0.02	-0.80±0.09
Males	24.83±1.69	150.88	0.19±0.03	-0.91±0.12
Combined sexes	24.49 ±1.32	155.58	0.20±0.02	-0.81±0.09

Table 6. Von Bertalanffy growth parameters (TL∞ and K) and growth performance indexes (Φ') for Gobius species

Species	TL_∞	K	Φ'	Source
Z. ophiocephalus males	248.3	0.19	4.069	This study
Z. ophiocephalus females	241.3	0.20	4.066	This study
G. vittatus males	50.1	1.18	3.47	KOVAČIĆ, 2006
G. vittatus females	51.0	1.02	3.42	KOVAČIĆ, 2006
G. roulei males	90.6	0.21	3.23	KOVAČIĆ, 2001
G. roulei females	80.0	0.22	3.15	KOVAČIĆ, 2001
G. paganellus	127.7	0.89	4.16	AZEVEDO & SIMAS, 2000
G. bucchichi males	115.5	0.35	3.67	SASAL *et al.*, 1996
G. bucchichi females	101.3	0.40	3.61	SASAL *et al.*, 1996
G. niger males	185.2	0.30	4.01	FABI & GIANETTI, 1985
G. niger females	168.6	0.19	3.73	FABI & GIANETTI, 1985

Ln (TL) = 8.379 (R) – 6.706 (R2 = 0.821) was obtained. Given a strong linear correlation between the total length and otolith radius (Fig. 5), radius measurements were used to back calculate the total length of previous ages. The mean marginal increment index (IM) trend for gathered age group started to increase in May, reaching a maximum value in July. A small decrease of its value is observed from August to September. In October, the IM showed a clear drop and subsequently in November begins to increase. Based on the above, it was assumed that one translucent opaque zone was deposit on the otolith each year in October (Fig. 6).

Age and growth

Since the spawning of *Z. ophiocepalus* in Tunisian coast is taking place in April-May (HAJJI *et al.*, 2011), we can assume that the first ring is formed on otoliths 6 months after spawning. Consequently, the different classes of age of grass goby were subdivided among age groups. The length-age key of all individuals by age class and length class is presented in Table 3. Given the strong linear correlation between the total length and otolith radius, radius measurements

Fig.7. Von Bertalanffy growth curves for Zosterisessor ophiocephalus by length at age data

were used to back calculate the total lengths for the first six years of life by age group for males, females and combined sex are presented in Table 4. The oldest males were estimated to be 6 years old (17.29 cm TL), and the oldest females also 6 years old (17.15 cm TL). The age structure shows that the specimens ranged between 1 and 6 years of age and between 5.53 and 17.29 cm TL (Table 4). Estimated parameters of Von Bertalanffy growth model were mention in Table 5. The Von Bertallanffy growth curve fitted by length-at-age data for all individuals is shown in Figure 7.

Age at first maturity

Based on observations of 352 females and 472 males, the size at first maturity was estimated to be 12.65 ± 0.44 cm for females and 13.91 ± 0.40 cm for males (HAJJI, 2012). The smallest mature female and male were 9.5 and 10.5 cm TL, respectively. The age at first maturity was estimated to be 2.9 years for females and 3.5 years for males.

DISCUSSION

Specimens of the grass goby *Z. ophiocephalus* fished in the Gulf of Gabes have a range from 10.50 to 20.20 cm TL for combined sex. In the central basin of the Venetian Lagoon, GRANZOTTO *et al.*, 2010 found that fish length ranged between 10.1 and 23.0 cm (TL). In the Varna (Black Sea) DOLGII (1962) found that the observed extreme size was 24 cm TL in the same way MILLER (1986) found that for the population of Varna (Black Sea) the extreme size was 24.5 TL cm. The fish of the study area (Gulf of Gabes) are known to be relatively smaller than those living in Atlantic or in other Mediterranean marine areas (GHORBEL *et al*., 1999). BOHELERT (1985) has reported that the otolith size reflects the age of the fish controlled by metabolic processes. Therefore the differences in seasonal growth rates of the fish can influence otolith growth rate and annuli deposition (GAULDIE *et al.*, 1995). Value of the parameter *b* in the length-weight relationship characterizes an isometric growth when equal to 3 (RICKER, 1975). In the present study, the values of *b* for *Z. ophiocephalus* showed a negative allometry in the growth of females and males. The same result was found by MENIF (2000), for the population of *Z. ophiocephalus* in the Lagoon of Ghar Melh (Tunisia). According to DULČIĆ & KRALJEVIĆ (1996), the estimated parameters of length-weight relationships may differ among seasons and years primarily due to physico-chemical characteristics of the environment, sex and maturity stage of a given species.

Growth increments were clearly identified and interpreted when reading sagittal otoliths of *Z. ophiocephalus*. The use of otoliths for age determination proved straightforward because they exhibited seasonal increments with different opacities surrounding a white opaque core. Owing to translucency, observation of the whole otolith provided an easy age reading, without having to prepare thin sections. The marginal increment analysis revealed that for *Z. ophiocephalus* one annulus was formed per year. The thinnest marginal increments were reached in October, when the seawater temperatures decreased. So, growth during spawning season (April) was not different than other time of year, and no decline in growth due to expenditure of energy to spawn was found. On the other hand in the central basin of the Venetian Lagoon GRANZOTTO *et al.* (2010) found that the thinnest marginal increments were reached in July. Otoliths of *Z. ophiocephalus* show the common ring pattern of temperate teleost fishes with one opaque mark and one translucent mark formed each year corresponding to rapid and to slow growth, respectively. Seasonal growth cycles might be related to a complex control by environmental and endogenous factors (BECKMAN & WILSON, 1995). The physiological changes are produced mainly by influence of temperature, food supply and reproductive cycle (PANNELLA, 1980). Six age classes, from settlers (age 1) to 6 years old, were determined by otolith readings. Maximum age for both sexes by counting annual rings was found to be 6 years in the present study. In other localities *Z. ophiocephalus* has

a maximum age of 5 years (BAUCHOT & PRAS, 1980; MILLER, 1986; MENIF, 2000). Asymptotic length values from our study differ from those estimated by other authors for the different Gobius species (Table 6). It is known that there is a general trend for the fish species with high values of TL_∞ to have lower values of K and vice versa. The growth coefficient is highly variable among different studies for the different Gobius species (*k = 0.19-1.18*) (Table 6). Therefore, similarly to the present results, in all previously published research with the exception of the study KOVAČIĆ (2006), males reached a longer length than females (Table 6). The growth performance index (Φ') yielded little information because it showed high variability within the same species in different research projects, overlap of values among different Gobius species, and considerable similarity in values between sexes of the same species (Table 6). Among Gobius, the longevity of *Z. ophiocephalus* was closer to that *Gobius vittatus*, *Gobius niger* and *Gobius bucchichi,* namely 2-5 years (SASAL *et al*., 1996; SILVA & GORDO, 1997). Other species of this genus, according to published data, live longer: *Gobius cobitis*, 10 years (GIBSON, 1970); *Gobius paganellus*, 7-10 years (MILLER, 1961; DUNNE, 1978) and estimated longevity (95% of TL_∞) 3.9 years (AZEVEDO & SIMAS, 2000); *Gobius roulei,* 7 years (KOVAČIĆ, 2001). The results of the present study indicate that age of first maturity is attained at 2.9 and 3.5 years, respectively for females and males. This is confirmed by previous studies regarding the grass goby in other Mediterranean areas (Black Sea, Tuzlov estuaries and Bulgarian waters; DOLGII, 1962; GEORGHIEV, 1966), reported they reach sexual maturity at the second or third year of life. By contrast, studies report the alternative mating tactics adopted by the young (0+), less-competitive males of the species in the Venice lagoon (MAZZOLDI *et al*., 2000; TORRICELLI *et al*., 2000; FRANCO *et al*., 2012).

CONCLUSIONS

The growth pattern of grass goby population of the Gulf of Gabes presented in this paper provides several key biological parameters. The maximum age encountered in our samples was estimated at 6 years for both sexes. For males and females the growth coefficient (k) was respectively 0.19 and 0.20 $years^{-1}$. The maximal lengths of males and females in this study were 20.20 and 19.80 cm, respectively. Results from this research will provide a starting point to develop a management plan for the grass goby in the Gulf of Gabes. Further investigations are necessary to quantify the impact of the existing regulations on the population dynamics and recruitment patterns of this species in the region.

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Starost i rast glavoča travaša *Zosterisessor ophiocephalus* Pallas, 1811 u zaljevu Gabes (Tunis, središnji Mediteran)

Ferid HAJJI*, Amira OUANNES-GHORBEL, Mohamed GHORBEL i Othman JARBOUI

Nacionalni institut znanosti i tehnologije mora, Centar u Sfax-u, BP 1035, 3018 Sfax, Tunis

**Kontakt adresa, e-mail: ferid.hajji@yahoo.fr*

SAŽETAK

Zosterisessor ophiocephalus je trenutno važna komponenta priobalnog ribolova istočnog Mediterana. U Tunisu je prvi put zabilježen u zaljevu Gabes 1993. godine, gdje je sada važna ribolovna vrsta. U ovoj studiji određivani su parametri starosti i rasta u zaljevu Gabes (jugoistočno od Tunisa) na temelju analize otolita 824 primjerka, ulovljenih između rujna 2006. i kolovoza 2007. godine. Starost je utvrđena na temelju fosilnih naraštajnih prstenova na otolitima (sagitta) vrste *Zosterisessor ophiocephalus*. Ovi rezultati su nam omogućili procjenu približne starosti pojavom svakog prstena kruga /annulus. Utvrđene su najstarije jednike koje su imale 6 godina za oba spola. Von Bertalenffy-jevi parametri zasnovani na podatcima o duljini pri određenoj starosti bili su; $TL_{\infty} = 24,83 \pm 1,69$ cm, $K = 0,19 \pm 0,03$ godina^{-1} i $t_0 = - 0,91 \pm 0,12$ za mužjake i $TL_{\infty} = 24,13 \pm 1,17$ cm, $K = 0,20 \pm 0,02$ godina^{-1} i $t_0 = - 0,80 \pm 0,09$ za ženke. Dužinsko-maseni odnos za oba spola vrste *Zosterisessor ophiocephalus* je $Wt = 0,021\ TL^{2.789}$. Veličina kod koje 50% ženki i mužjaka sazrijeva bila je 12,65 cm i 13,91 cm ukupne duljine (*TL*). Dob kod koje 50% ženki i mužjaka sazrijeva je između 2,9 i 3,5 godina starosti.

Ključne riječi: starost, rast, *Zosterisessor ophiocephalus,* Gabes zaljev, Tunis, Sredozemno more