SOMATIC GROWTH, CONDITION AND FORM FACTOR OF *TRACHINUS DRACO* LINNAEUS, 1758 IN THE GULF OF TUNIS

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ملخص

دراسة النمو و الحالة عند سمك البلّم في خليج تونس: يهدف هذا العمل إلى تحليل نسق النمو و دراسة تغيرات عامل الحالة و عامل الشكل عند الأسماك من نوع البلّم. تم جمع العينات بصفة شهرية في الفترة الممتدة بين فيفري 2014 و جانفي 2015. بينت دراسة العلاقة بين الطول و الوزن أن الوزن ينمو أكثر من الطول الكامل لدى البلّم. النمو الأضعف عند الإناث تم تسجيله في أواخر الصيف و خلال الخريف، أما بالنسبة للذكور فقد كان فالشتاء. و قد تبين من خلال دراسة العلاقة بين الطول و الوزن وجود إختلاف في نسق النمو بين الجنسين مع نسق نمو أكبر عند الإناث. يعود الإختلاف على مستوى العلاقة بين الطول و الوزن من منطقة إلى أخرى على الأرجح إلى إختلاف الظروف المناخية.

التغيرات الموسمية في عامل الحالة و عامل الشكل مرتبطة على الأرجح بالدورة الجنسية لهذا النوع من الأسماك. عامل الحالة المتوسط شهد زيادة طفيفة من المحيط الأطلسي إلى البحر الأبيض المتوسط و البحر الأسود، و نفس التدرج شهده عامل الشكل أيضا. إذا، هذان العاملان يمكن إستخدامهما كمؤشرين حساسين لقياس التغيرات البيئية.

الكلمات المفاتيح: البلّم، خليج تونس، النمو، الحالة.

RESUME

Croissance somatique, condition et facteur de forme de *Trachinus draco* Linnaeus, 1758 dans le golfe de Tunis : Cette étude présente des analyses relatives aux relations taille-masse, au facteur de condition ainsi qu'au facteur de forme de la grande vive, *Trachinus draco*, dans le golfe de Tunis. Un échantillonnage mensuel a été effectué au niveau des ports du golfe de Tunis entre février 2014 et janvier 2015. Les relations taille-masse des mâles, des femelles et de tous les individus sexes regroupés de l'échantillon indiquent une croissance allométrique positive. La croissance somatique la plus faible a été observée à la fin de l'été et en automne pour les femelles mais plutôt en hiver pour les mâles. La croissance somatique des femelles ($W = 0.004\ L^{3.136}$) est significativement différente de celle des mâles ($W = 0.005\ L^{3.077}$) avec un meilleur taux de croissance pour les femelles. Les variations biogéographiques des relations taille-masse de *Trachinus draco* sont vraisemblablement dues aux conditions environnementales et aux ressources alimentaires différentes dans chaque zone d'étude.

Les fluctuations saisonnières du facteur de condition des mâles et des femelles suggèrent une relation étroite avec le cycle sexuel de l'espèce. Le facteur de condition moyen (K_{mean}) des populations augmente légèrement en allant de l'Atlantique vers la Méditerranée orientale et la Mer Noire; cette même tendance graduelle a été observée pour la valeur de la médiane du facteur de forme $a_{3.0}$. Ainsi, le facteur de condition et le facteur de forme peuvent être utilisés comme indicateurs sensibles pour mesurer les variations environnementales.

***Mots clés* :** *Trachinus draco*, golfe de Tunis, relation taille-poids, condition, facteur de forme.

ABSTRACT

This study presents analyses about weight-length relationships, condition factor and form factor of *Trachinus draco* in the Gulf of Tunis. The fish samples were collected monthly from commercial landings of the soecues in the Gulf of Tunis between February 2014 to January 2015. The weight-length relationships of males, females and combined sexes exhibited a positive allometric growth. The lowest somatic growth was recorded in late summer and autumn for females but in winter for males. The somatic growth of females ($W = 0.004\ L^{3.136}$) was significantly different from that of males ($W = 0.005\ L^{3.077}$) with a better growth rate for the former. Biogeographical variations of the weight-length relationships of *Trachinus draco* are probably due to the different environmental conditions and food supply of each studied regions.

The seasonal fluctuations of the condition factor of males and females, suggested a close relationship with the sexual cycle of the species. The mean condition factor (K_{mean}) of populations varied slightly higher as going from the Atlantic to the eastern Mediterranean basin and the Black Sea; a same gradual tendency was observed for the calculated median $a_{3.0}$ value of the form factor. Then, condition factor and form factor may be used as sensible indicators for measuring environmental variations.

***Key words*:** *Trachinus draco*, Gulf of Tunis, weight-length relationship, condition, form factor.

INTRODUCTION

Biological informations such as body length and weight constitute necessary data for assessing population structure (Froese, 2006). Weight-length relationships (WLRs) are useful to predict weights from easier measures of lengths (Santos *et al.*, 2002). Moreover, they allow to evaluate weight-at-age (Petrakis and Stergiou, 1995) and fish condition (Stergiou and Moutopoulos, 2001), to realize morphometric comparisons of species from different regions (Stergiou and Moutopoulos, 2001) and to estimate population biomass of a fish stock for the purpose of its sustainable exploitation (Dulčić and Kraljević, 1996). In addition, these body parameters are included in the expression of the "form factor" to compare the body shape of fish of different populations or species (Froese, 2006).

In this study, a first analysis, relative to the weight-length relationships, the form factor and the condition of *Trachinus draco* (Linnaeus 1758), was carried out in the Gulf of Tunis (Central Mediterranean). For that purpose, the guidelines presented on this subject, by Froese (2006) and Froese *et al.* (2011), was taken into account as far as possible. Somatic growth and "well-being" of fishes were studied according to sex, month, season and sexual activity/inactivity period. It should be known that, *T. draco*, commonly called the greater weever, is everywhere used locally for human consumption but is not considered of high commercial interest since it is rather landed as a by-catch of the bottom trawlers in the fisheries (Ak and Genç, 2013). However, in recent years, the decline of fish resources, the high demand of fishery products and the human need of protein of high value increased interest in a greater variety of fish and especially the by-catch ones as the greater weaver (Portillo *et al.*, 2008). Moreover, *T. draco* is widespread at depths of 20 to 130 m on sandy and muddy fine sand bottoms of the entire Tunisian littoral (Azouz, 1971). Its distribution extends on all the coasts of the Mediterranean Sea and on the eastern coasts of the Atlantic Ocean, which had allowed us to compare our present results in the field with those conducted in other areas.

MATERIAL AND METHODS

Fish sampling

The studied samples were collected from the commercial landings of four sampling sites belonging to the Gulf of Tunis: La Goulette, Kalâat El-Andalous, Soliman and Ghar El Melh (Fig. 1).

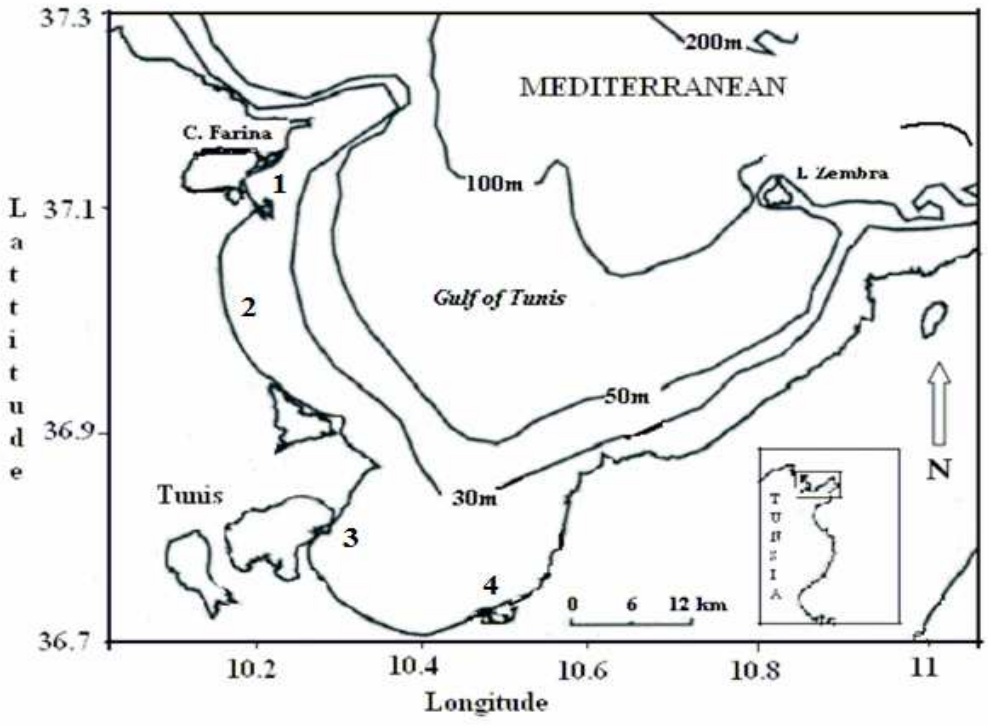

Figure 1: Sampling stations of *Trachinus draco* in the Gulf of Tunis (1: Ghar El Melh, 2: Kalâat El-Andalous, 3: La Goulette, 4: Soliman).

Samples were obtained monthly from February 2014 to January 2015. All the randomly collected individuals were examined in the laboratory for total length (*TL*) to the nearest mm and for total weight (*TW*) and eviscerated weight (*EW*) to the nearest 0.1 g.

Weight-length relationships

Weight-length relationships (*WLRs*) are most commonly expressed by the exponential equation :

$W = a\ TL^b$

Where *W* is weight : total weight (TW) or eviscerated weight (EW) (g), *TL* is total length (cm), *a* is the intercept or initial growth coefficient and *b* is the slope i.e. the growth coefficient (Le Cren, 1951; Ricker, 1975; Froese, 2006).

WLRs were established for males, females, individuals with undetermined sex and for the total sample. The significance of the correlation between the variables *W* and *L* was analysed by the ANOVA test. For each sex, weight-length relationships were analyzed according to month, season and sexual activity/inactivity period. The *b*-value was tested by a t-test to determine whether somatic growth is isometric (b=3) or allometric (hypoallometric: b<3 or hyperallometric: b>3) with a statistical level of significance of 5%. The calculated average lengths and average weights of the sexual categories were tested by the Mann-Whitney U test. When comparing the two WLRs, for males and females, the slopes and intercepts of both of them were compared by the ANCOVA test.

Condition Factor

To evaluate the fluctuations of the "fatness" and "well-being" of the studied species, the following relative condition factor (K_r) of Le Cren (1951) was used :

$K_r = EW / a\ TL^b$

The eviscerated weight was chosen in the condition factor expression to avoid the skew induced by the use of total weight; indeed this latter takes into account the fluctuating weights of gonads and stomachs through the year cycle of the species.

The formula of the condition factor was estimated for each sexual category (males, females and individuals with undetermined sex) and for the total sample, per month, season and sexual activity/inactivity period as we did for the WLRs. After concluding the study of the condition factor local variations, the "mean condition factor" (K_{mean}) of Clark (1928) was used to compare the condition of the Tunisian population of *T. draco* with the others populations from the Atlantic and the Mediterranean Sea.

$K_{mean} = 100\ a\ TL^{b-3}$

Form factor

According to Froese (2006), the slope of *log a* vs *b* can be used to estimate for a given WLR the value that coefficient "*a*" would have if the exponent *b* was 3. This value ($a_{3.0}$) can be interpreted as a form factor of the species or population and is expressed by the following formula:

$a_{3.0} = 10^{log\ a - S(b-3)}$

Where *S* is the slope of the regression of *log a* vs *b*.

Since several WLRs, of *T. draco* from the Gulf of Tunis, are not yet available for the estimation of the regression of *log a* vs *b*, the value of S = -1.358 was used as proxy for estimating the form factor, as recommended by Froese (2006). To compare the body shape of *T. draco*, the existing WLRs were grouped in the following three geographical areas: Atlantic ocean, Oriental and Occidental Mediterranean basins. In the Atlantic ocean, data from the Bay of Biscay (France), from the Gulf of Cadiz (SW Spain), from the Algarve and the central coasts of Portugal were collected. The Oriental Mediterranean basin comprised the Balearic Islands (Spain), the Gulf of Tunis (Tunisia) and the Sicilian coasts (Italy). The Occidental Mediterranean basin is represented by the Aegean Greek coasts, the Mediterranean and Aegean Turkish coasts and the Egyptian coasts (Fig. 2). The established parameters *a* and *b* were used to calculate the form factors ($a_{3.0}$) relative to each geographical area.

RESULTS

Weight-length relationships

A total of 603 individuals were collected during the study period. They were composed of 157 males, 203 females and 243 individuals of undetermined sex. Individuals of undetermined sex were present in a higher proportion in the period of sexual inactivity (November-May) and their number decreased in the period of sexual activity (June-October) until reaching 0% August and September (Fig. 3); this was established knowing that the period of reproduction of *Trachinus draco* in the Gulf of Tunis extends from June to October (Hamed and Chakroun-Marzouk, 2015).

The size range of the studied sample was comprised between 10 and 32 cm. The mean total lengths of males (21.18 cm ± 0.19), females (21.95 cm ± 0.20) and of individuals with undetermined sex (20.28 cm ± 0.19) differed significantly from each other (Mann-Whitney U test, $p<0.05$). The mean total length of the overall sample of *T. draco* from the Gulf of Tunis is 21.08 cm ± 0.12. The mean total weights of males (62.48 g ± 1.85), females (73.07 g ± 2.32) and individuals with undetermined sex (56.78 g ± 1.69) differed significantly (Mann-Whitney U test, $p<0.05$). The mean total weight of *T. draco* from the Gulf of Tunis is 63.75 g ± 1.18 and the minimum and maximum total weights are respectively 8.51g and 236.33 g. The mean eviscerated weights of males (58.51 g ± 1.71), females (66.98 g ± 2.12) and

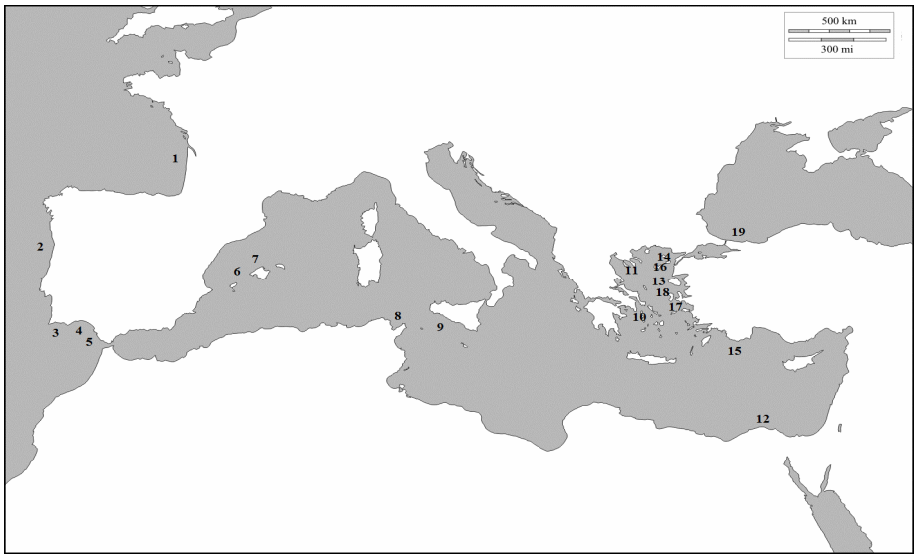

Figure 2: Map showing localities of existing WLRs found in the literature for *Trachinus draco*.

(1) Dorel (1986) ; (2) Mendes et al. (2004) ; (3) Santos et al. (2002) ; (4) Torres et al. (2012) ; (5) Mata et al. (2008) ; (6) Merella et al. (1997) ; (7) Morey et al. (2003) ; (8) Present study ; (9) Giacalone et al. (2010) ; (10) Stergiou and Moutopoulos (2001) ; (11) Karachle and Stergiou (2008) ; (12) Abdallah (2002) ; (13) Karakulak et al. (2006) ; (14) İsmen et al. (2007) ; (15) Sangun et al. (2007) ; (16) Kınacigil et al. (2008) ; (17) Ozaydin et al. (2007) ; (18) Ilkyaz et al. (2008) ; (19) Ak and Genç (2013).

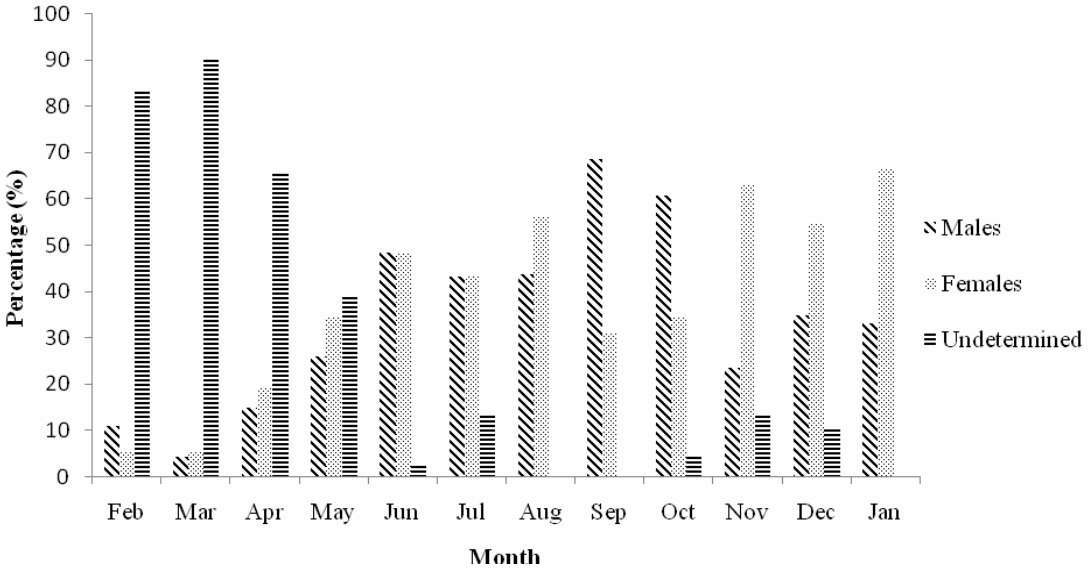

Figure 3: Monthly sex distribution of *Trachinus draco* in the Gulf of Tunis.

individuals with undetermined sex (52.87 g ± 1.56) differed significantly. The mean eviscerated weight of *T. draco* from the Gulf of Tunis is 59.09 g ± 1.07 and the minimum and maximum eviscerated weights are respectively 7.54 and 221.61 g.

The global WLRs using either total or eviscerated weight for males, females and for the overall sample presented a positive allometric growth except for the individuals of undetermined sex which exhibited a negative allometric growth (Table I)

Table I. WLRs parameters per sex of *T. draco* from the Gulf of Tunis. N: sample size, TL min-max: minimum and maximum total length, W min-max: minimum and maximum weight, *a* and *b*: WLR parameters, SE(b): the standard error of the slope, r^2: the coefficient of determination and the growth type, A+: positive allometric growth, A-: negative allometric growth, I: Isometric growth

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			Total weight							**Eviscerated weight**						
	N	**TL min-max (cm)**	**W min-max (g)**	**a**	**b**	**r^2**	**p**	**SE (b)**	**Growth type**	**W min-max (g)**	**a**	**b**	**r^2**	**p**	**SE (b)**	**Growth type**
Males	157	14.2-29.8	16.63-188.22	0.005	3.077	0.92	0.00	0.03	A+	15.23-175.54	0.004	3.097	0.93	0.00	0.03	A+
Females	203	16.2-32	26.86-236.33	0.004	3.136	0.97	0.00	0.02	A+	25.57-221.61	0.004	3.101	0.98	0.00	0.01	A+
Undetermined	243	10-29.8	8.51-179.8	0.008	2.940	0.98	0.00	0.01	A-	7.54-156.32	0.006	2.940	0.98	0.00	0.01	A-
Total	603	10-32	8.51-236.33	0.006	3.040	0.97	0.00	0.01	A+	7.54-221.61	0.006	3.021	0.97	0.00	0.01	A+

Comparing the WLRs between sexes (Fig. 4), females somatic growth was significantly different from that of males (ANCOVA, $p<0.05$). When analyzing WLRs results per month, season and period of sexual activity/inactivity, males and females didn't show the same temporal variations of somatic growth. Indeed, males present the lowest *b*-values in the beginning of winter (December, *b*=2.865; January, *b*=2.180) and also in the late spring (May, *b*=2.741) whereas their *b*-values were highest from August (*b*=3.298) to November (*b*=3.311); their somatic growth is then better in late summer (*b*=3.111) and autumn (*b*=3.072). In contrast, females displayed the lowest somatic growth in autumn (*b*=2.805) then during the spawning and post-spawning period of the studied species, and were in better somatic growth in winter (*b*=3.121) and spring (*b*=3.144). On other side, the *b*-values of the WLRs for males and females vary significantly between the periods of sexual activity and sexual inactivity but they did not vary for the total sample.

Condition factor fluctuations

The mean monthly variations of the relative condition factor (K_r) manifested a significant peak in March (1.08 ± 0.02) for males and in April for females (1.10 ± 0.02) and for the total sample (1.13 ± 0.14). The mean monthly K_r for both sexes and for the total sample decreased between May and September (Fig. 5). The fluctuations of K_r among seasons showed a significant peak in spring for males (1.04 ± 0.01), females (1.09 ± 0.01), individuals with undetermined sex (1.07± 0.02) and for the total sample (1.08 ± 0.01). The K_r variations per period of sexual activity/inactivity show that relative condition was significantly the highest in the sexual inactivity period for males (1.06 ± 0.01), females (1.08 ± 0.01) and individuals with undetermined sex (1.07 ± 0.01) but was the same between the two periods for the total sample (1.07 ± 0.01).

The condition factor (K_{mean}) represents the mean condition factor for a given length; the lowest values are recorded in the eastern side of the Atlantic and in the western Mediterranean basin, they improve in the central Mediterranean Sea and become slightly higher in the eastern Mediterranean basin and also in the Black Sea (Fig. 6).

Form factor evaluation

The calculated median value of the form factor of the *T. draco* population of the Gulf of Tunis was $6.43\ 10^{-3}$. In the present work, the form factor was used to determine whether the body shape of a population of a given sector is different from the other ones. The calculated median $a_{3.0}$ value was $6.17\ 10^{-3}$ in the Atlantic Ocean, a little higher in the Western Mediterranean basin ($6.24\ 10^{-3}$) and highest in the Eastern Mediterranean basin ($6.88\ 10^{-3}$) (Fig. 7).

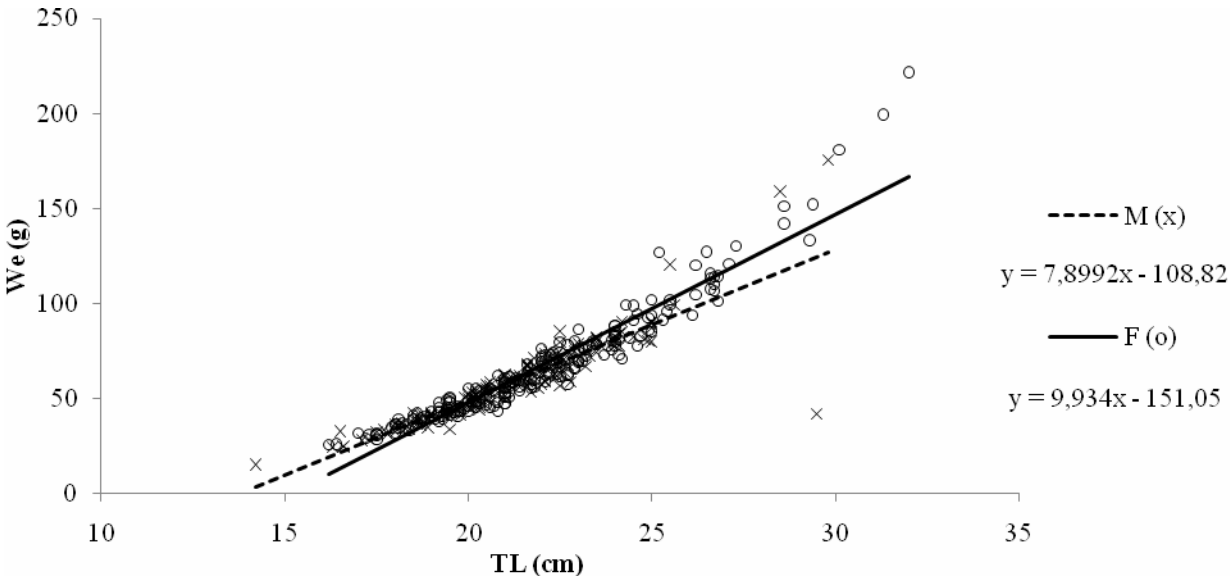

Figure 4: Comparison of the weight-length relationships between males (M) and females (F) in the Gulf of Tunis.

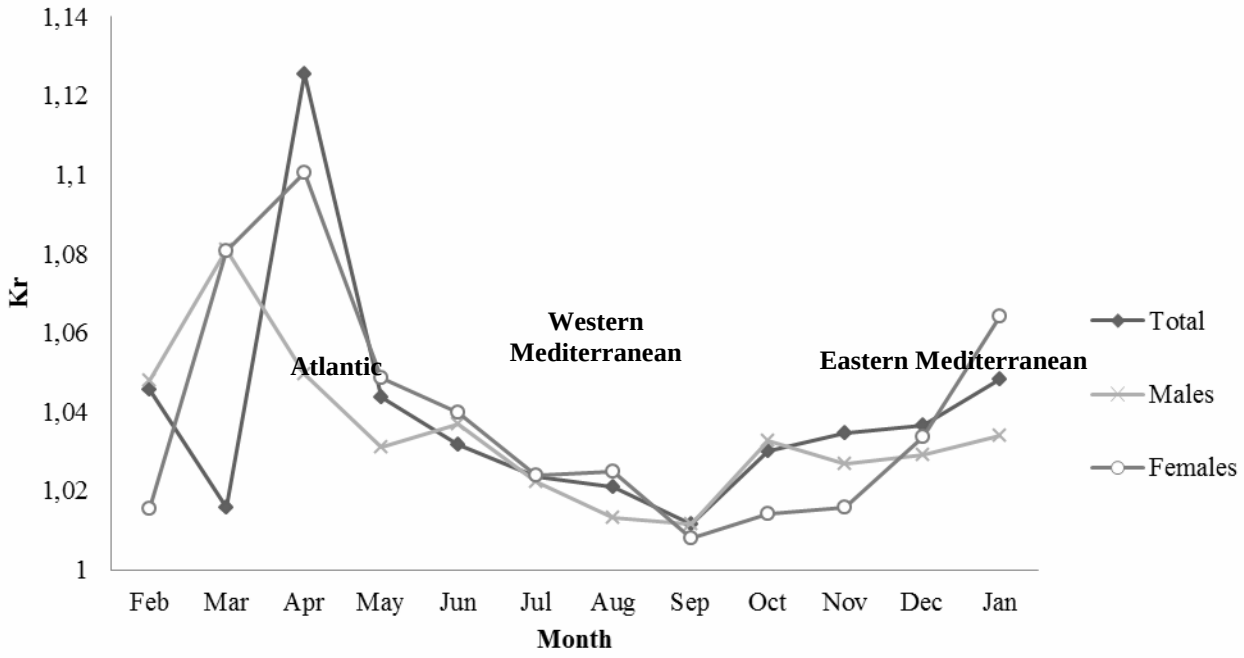

Figure 5: Monthly variations of the relative condition factor (K_r) of *T. draco* in the Gulf of Tunis.

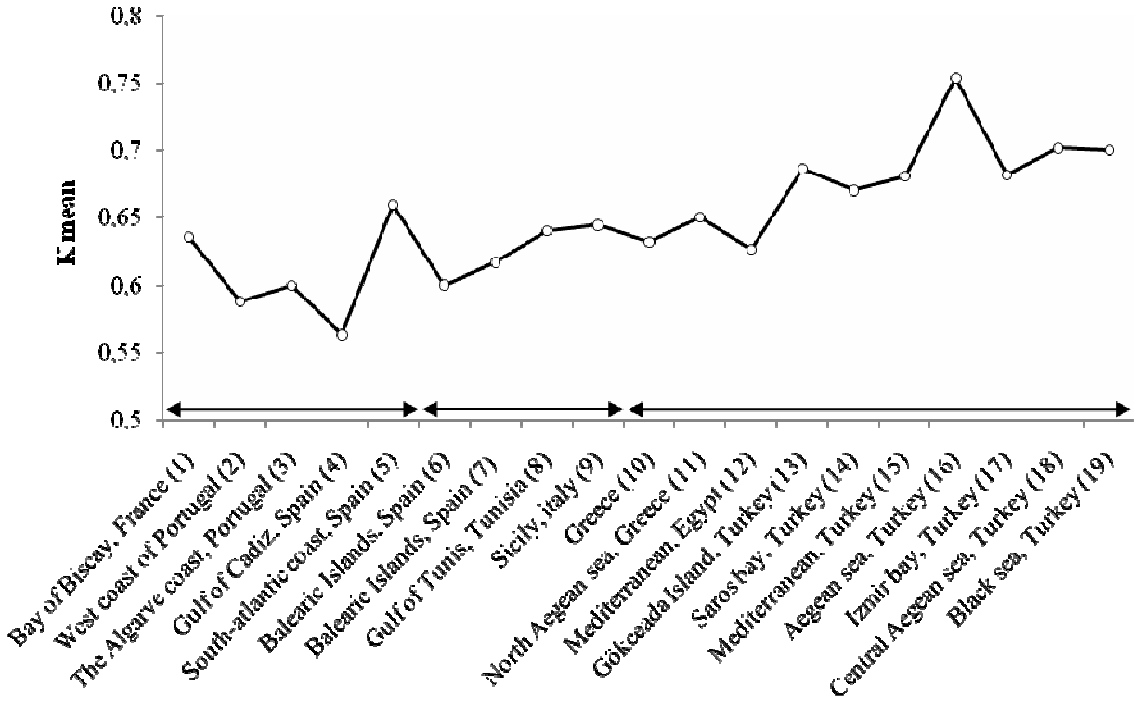

Figure 6: Variation of the mean condition factor (Kmean) of *T. draco* between regions.
(1) Dorel (1986) ; (2) Mendes et al. (2004) ; (3) Santos et al. (2002) ; (4) Torres et al. (2012) ; (5) Mata et al. (2008) ; (6) Merella et al. (1997) ; (7) Morey et al. (2003) ; (8) Present study ; (9) Giacalone et al. (2010) ; (10) Stergiou and Moutopoulos (2001) ; (11) Karachle and Stergiou (2008) ; (12) Abdallah (2002) ; (13) Karakulak et al. (2006) ; (14) İsmen et al. (2007) ; (15) Sangun et al. (2007) ; (16) Kınacigil et al. (2008) ; (17) Ozaydin et al. (2007) ; (18) Ilkyaz et al. (2008) ; (19) Ak and Genç (2013).

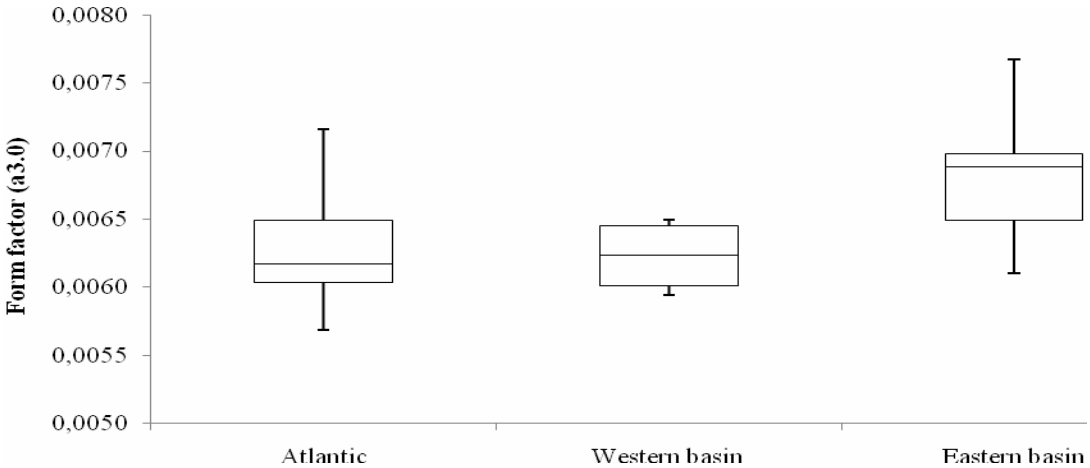

Figure 7: Distribution of the form factor between the Atlantic and the Western and Eastern Mediterranean basins.

DISCUSSION

One of the essential biological parameters for a fish species is its maximum size (TLmax); indeed, size is a very good indicator of the place of a given species in the ecosystem and in the food web. For example, on a local state, it was observed that overfishing changes the length frequency of populations causing a decrease of the maximum size of fish in the catches, especially the larger ones (Froese, 2004). Then, data on maximum lengths are important since their following, on time series, can provide additional information in support of the estimated level of exploitation of a population.

For *T. draco,* the maximum total length recorded in the Gulf of Tunis was 32 cm and is relative to the biggest female; it is close to that reported in Greece waters (Stergiou and Moutopoulos, 2001). However, higher TLmax were recorded in the Bay of Biscay (TL = 38 cm, Dorel, 1986), on the Portuguese coasts (TL = 34 cm, Gonçalves *et al.*, 1997; TL = 36.8 cm, Mendes *et al.*, 2004) and on the Turkish coasts (TL = 35.2 cm, Karakulak *et al.*, 2006; TL = 37 cm, İsmen *et al.*, 2007 ; TL = 36.6 cm, Kınacigil *et al.*, 2008). Lower maximum sizes were observed in the East coasts of the Adriatic Sea (TL = 26.8 cm, Dulčić and Kraljević, 1996), in the Balearic Isles (TL = 24.2 cm, Merella *et al.*, 1997), in the Egyptian coasts (TL = 23 cm, Abdallah, 2002), in the Mediterranean Turkish coasts (TL = 20 cm, Sangun *et al.*, 2007) and in the Black Sea coasts (TL = 25.8 cm, Ak and Genç, 2003). The comparison of the WLRs of *T. draco* from the Gulf of Tunis, with those established in other geographical areas (Table II), showed that the somatic growth of the population of the Tunisian coasts present a great similarity with the one obtained in the north-eastern Mediterranean Sea of Turkey (Sangun *et al.*, 2007) and in the eastern coast of Black Sea (Ak and Genç, 2013). Nevertheless, in the Bay of Biscay (Dorel, 1986), in the eastern Adriatic (Dulčić and Kraljević, 1996), the Balearic Islands (Merella *et al.*, 1997), the south-west coast of Portugal (Gonçalves *et al.*, 1997), the Egyptian (Abdallah, 2002) and Turkish coasts (Karakulak *et al.*, 2006), the somatic growth of *T. draco* is lower than that of the Gulf of Tunis. On the other hand, in Greek coasts (Stergiou and Moutopoulos, 2001), Portuguese coasts (Mendes *et al.*, 2004), the Bay of Saros (İsmen *et al.*, 2007) and the Aegean Sea (Kınacigil *et al.*, 2008), the somatic growth of *T. draco* is higher than the Gulf of Tunis one. Likely, these spatial variations of the WLRs are imputable to the influence of different environmental conditions and food availability on fish growth (Barlow, 1961; Teletchea, 2009). However, these variations may be also the result of factors related to sampling since the sample structure as its size range, sex composition, preservation method, temporal resolution and maturity stage of individuals, vary among localities.

In the Gulf of Tunis, somatic growth was positive allometric type for the whole population; fish growing faster in weight than in length. During the period of sexual activity, the value of the *b* coefficient, of *T. draco* females, is significantly lower than the theoretical value of 3; the species become thinner when growing. This trend is observed in females fishes because the energy used for somatic growth, during the sexual inactivity period, is rather involved for the needs of the vitellogenesis during the period of sexual activity.

The somatic growth of the two sexes was significantly different (ANCOVA, $p<0.05$), with a

Table II. Comparison of weight-length relationships of *T. draco* in different maritime localities. N: sample size, TL min-max: minimum and maximum total-length, a: intercept of the WLRs, b: slope of the WLRs.

	Geographical area	a	b	N	TL min-max	Author
Atlantic	Bay of Biscay, France	0.009	2.874	181	7.5 -38.5	Dorel (1986)
	South coast of Portugal	0.016	2.930	14	9.6 - 24.2	Gonçalves et al. (1997)
	South-Atlantic coast, Spain	0.007	2.980	231	12.5 - 29.5	Mata et al. (2008)
	Gulf of Cadiz, Spain	0.005	3.075	141	11.2 - 28.8	Torres et al. (2012)
	The Algarve coast, Portugal	0.004	3.119	2767	11.8 - 39.6	Santos et al. (2002)
	West coast of Portugal	0.004	3.173	34	21.5 - 39	Mendes et al. (2004)
Eastern Mediterranean	Gökceada Island, Turkey	0.024	2.578	32	4.4 - 35.2	Karakulak et al. (2006)
	Mediterranean, Egypt	0.011	2.800	170	10 - 23	Abdallah (2002)
	Eastern Adriatic, Croatia	0.021	2.934	22	9.2 - 26.8	Dulčić and Kraljević (1996)
	North Aegean sea, Greece	0.005	3.062	25	15 - 30.5	Karachle and Stergiou (2008)
	Mediterranean, Turkey	0.005	3.090	54	9 - 20	Sangun et al. (2007)
	Central Aegeansea, Turkey	0.005	3.100	95	15.3 - 36.6	Ilkyazet al. (2008)
	Mediterranean, Greece	0.004	3.120	85	14.5 - 32	Stergiou and Moutopoulos (2001)
	Aegean sea, Turkey	0.005	3.137	-	-	Kınacigil et al. (2008)
	Izmir bay, Turkey	0.004	3.178	45	17.2 - 34	Ozaydin et al. (2007)
	Saros bay, Turkey	0.004	3.202	1025	15 - 37	İsmen et al. (2007)
Western Mediterranean	Balearic Islands, Spain	0.010	2.835	27	6.2 - 26.5	Morey et al. (2003)
	Balearic Islands, Spain	0.007	2.93	497	14 - 34	Merella et al. (1997)
	Gulf of Tunis, Tunisia	0.006	3.040	603	10 - 32	Present study
	Sicily, italy	0.005	3.059	21	16 - 29.5	Giacalone et al. (2010)
Black Sea	Eastern coast, Turkey	0.007	3.005	636	5 - 25.8	Ak and Genç (2013)
	Eastern coast, Turkey	0.004	3.433	338	5 - 35	Ak et al. (2009)

igher growth rate for the females. This result corroborates the only other one recorded along the eastern coast of the Black Sea by Ak and Genç (2013).

As there is a gap in knowledge regarding the fitness and health of fishes, the morphometric condition index may be used in studies on fish metabolism and activity, life-history traits, measures of environmental and anthropogenic factors and in stock management (Loret *et al.*, 2014). The best condition of *T. draco* was registered in spring (April, May and June) and is probably related to the increase of temperature and to the better availability of food in the Gulf of Tunis; in fact, individuals start, at this time, to reload their lipid reserves preparing themselves for the reproduction activity (Hamed and Chakroun-Marzouk, 2015). From July to October, the well-being of the greater weaver, specially the females, is substantially affected as it coincides with the release of gametes. In the Kattegat (Bagge, 2004) and in the Black Sea (Ak and Genç, 2013), the condition factor of females reaches its highest values, just before spawning in June and in May, while in the Gulf of Tunis the highest values were in March and April. The lowest values were observed in July and August in the Kattegat (Bagge, 2004) and in the Black Sea (Ak and Genç, 2013), respectively during and after spawning, and in August and September in the Gulf of Tunis. Then the seasonal cycle of the condition of *T. draco* is in close relationship with gonadal development.

The mean condition factor of the populations of *T. draco* increases slightly from the eastern Atlantic coasts to the eastern Mediterranean basin and Black Sea, this is probably in relation with the different somatic growths of each population. Moreover, the obtained value of the form factor for *T. draco* in the Gulf of Tunis, indicated that the species belongs anyway to the ″elongated body shape″ pointed out by Kulbicki *et al.* (2005). No reference dealing with the form factor is till now available in the literature for *T. draco* and then the present result provided an important basis for future comparisons. However, slight variations of the form factor were sensible between the different studied geographical areas; these are in relation with the fact that morphological appearances are affected by environmental factors and developmental stages (Barlow, 1961; Teletchea, 2009).

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