

# New data on puffer fish species (Osteichthyes: Tetraodontidae) occurring in Tunisian waters (central Mediterranean Sea)

Nouvelles données sur les poissons ballons  
(Ostéichtyens, Tetraodontidae) des eaux tunisiennes  
(Méditerranée centrale)

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## Résumé

Enajjar S., N. Ben Hadj Hamida, A. Saadaoui,  
M.N. Bradai – [Nouvelles données sur les poissons ballons  
(Ostéichtyens, Tetraodontidae) des eaux tunisiennes  
(Méditerranée centrale)]. *Mar. Life*, 18: 33-41.

Quatre tetraodontidae ont été recensés dans les eaux tunisiennes : *Lagocephalus lagocephalus*, *Spherooides pachygaster*, *Lagocephalus sceleratus* et *Ephippion guttiferum*.

Le compère tête de lièvre, *Lagocephalus lagocephalus*, est une espèce Atlanto-méditerranéenne à affinité chaude. Il a été signalé pour la première fois dans le golfe de Gabès en 1966. La taille des spécimens pris dans les eaux tunisiennes est comprise entre 43 et 76,5 cm avec un mode de 50 cm LT. Ces tailles sont plus importantes que celles signalées dans d'autres régions de la Méditerranée.

Le tétrodon à tête carrée, *Spherooides pachygaster*, est considéré comme typique de la faune ichtyologique de l'Atlantique oriental tropical et subtropical. Il a été signalé pour la première fois dans le golfe de Gabès (sud de la Tunisie) en 1992. Les longueurs totales moyennes sont 33,74 et 39,74 cm respectivement pour les mâles et les femelles.

La taille des individus pêchés dans cette zone est plus importante que celle rapportée pour le détroit de Sicile.

Le poisson ballon à bande argentée, *Lagocephalus sceleratus*, est un immigrant Indopacifique. Trois observations confirmées ont été signalées dans le golfe de Gabès. La première prise a été faite par un chalutier de fond le 8 décembre 2010, la seconde au filet maillant le 5 juin 2014 et la troisième par un chalutier le 12 mars 2015.

### MOTS CLÉS :

Nouvelles données, poissons ballons, Tetraodontidae, eaux tunisiennes, Méditerranée centrale.

## Abstract

Enajjar S., N. Ben Hadj Hamida, A. Saadaoui,  
M.N. Bradai – New data on puffer fish species (Osteichthyes:  
Tetraodontidae) occurring in Tunisian waters (central  
Mediterranean Sea). *Mar. Life*, 18 : 33-41.

Four Tetraodontidae species have been recorded in Tunisian coastal waters: *Lagocephalus lagocephalus*, *Spherooides pachygaster*, *Lagocephalus sceleratus* and *Ephippion guttiferum*.

The puffer fish, *Lagocephalus lagocephalus*, is an Atlanto-Mediterranean species with warm water affinity. It was recorded for the first time in the Gulf of Gabès in 1966. Sizes of specimens fished from the Tunisian coast ranged between 43 to 76.5 cm TL. These dimensions are greater than those recorded in other Mediterranean areas.

The blunthead puffer, *Spherooides pachygaster*, is considered as a typical species of the tropical and subtropical fauna of the Eastern Atlantic. It was recorded for the first time in the Gulf of Gabès (southern Tunisia) in 1992. The mean total length of specimens landed in the area was 33.74 and 39.74 cm TL respectively for males and females. The dimensions recorded from this area are greater than those reported from the strait of Sicily.

The silverstripe blaasop, *Lagocephalus sceleratus*, is an Indo-Pacific migrant. Three confirmed sightings have been recorded in the Gulf of Gabès. The first was caught by a bottom trawler on 8 December 2010, the second was caught by gillnet on 5 June 2014 and the most recent by a bottom trawler in 12 March 2015.

### KEY-WORDS:

New data, puffer fish, Tetraodontidae, Tunisian waters, central Mediterranean Sea.

## Introduction

The family of Tetradontidae includes many species which are variously called puffer fish or balloon fish. Puffer fish are generally believed to be the second most poisonous vertebrates in the world. Certain internal organs contain a venom, “tetrodotoxin”, that is highly toxic to most animals. They are distributed in tropical and subtropical areas of the Atlantic, Indian and Pacific Oceans.

Following climate changes and other factors, the introduction of warm and tropical alien species has been exacerbated by the observed warming in the Mediterranean Sea. Certain exogenous species originating from the Indo-Pacific area and the Atlantic, such as Tetraodontidae species, inhabit new territories from eastern to western Mediterranean. They have become abundant and are competing with endemic species of the area.

This work provides data on the Tetraodontidae (species, capture, size and biological data) in Tunisian coastal waters as a transitional zone between the western and eastern areas of the Mediterranean Sea.

## Material and methods

The study was based on data we collected along the Tunisian coast from 1996 to 2014 and on published data.

The total length (TL) was measured to the nearest millimeter. The total weight (TW) of each specimen was weighed to the nearest 0.1 g. The TL and TW relation was calculated separately for each sex. The parameters “a” and “b” of the length-weight relation were estimated by the least square Regression method.

Individual total lengths were pooled in classes of 5 cm for length frequency distributions using a histogram to determine the distribution pattern. Length-frequency distributions of females and males were compared using Anova.

Sex ratio was expressed as the percentage of females to males (F/M). A Chi-square test ( $\chi^2$ ) was used to examine the homogeneity of the sex ratio.

When possible, stomachs were examined. Vacuity index (VI) was calculated as weight of each prey item, divided by the total weight of the stomach content, multiplied by 100. Ingested prey were identified to the lowest possible taxonomic level.

Gonads were weighed and the stage of maturity was noted.

Fishermen were approached for information on capture date, location, depth and the fishing gear used.



**Photo 1**

Tetraodontidae species observed in Tunisian coastal waters. a: *Lagocephalus lagocephalus*, b: *Lagocephalus scleratus*, c: *Sphoeroides pachygaster*.  
*Les tertaodontidae des eaux tunisiennes*. a : *Lagocephalus lagocephalus*, b : *Lagocephalus scleratus*, c : *Sphoeroides pachygaster*.

## Results

In this study we focus on the three first species (**Photo 1**), *Ehippion guttiferum* was recorded only once and *Lagocephalus spadiceus* was a misidentification.

Four Tetraodontidae species have been recorded in Tunisian coastal waters: *Lagocephalus lagocephalus* (Chakroun, 1966; Bradai *et al.*, 2004; Hattour *et al.*, 2004), *Sphoeroides pachygaster* (Bradai *et al.*, 1993), *Lagocephalus scleratus*, an Indo-Pacific migrant (Jribi, Bradai, 2012) and *Ehippion guttiferum* (Hachaichi, 1981). Charfi-Cheikhrouha (2004) reported the capture of *Lagocephalus spadiceus* on the north coast of Tunisia (Rafraf - Bizerte), but this identification is doubtful; the fin ray formula is for example better suited to *L. lagocephalus* than to *L. spadiceus*.

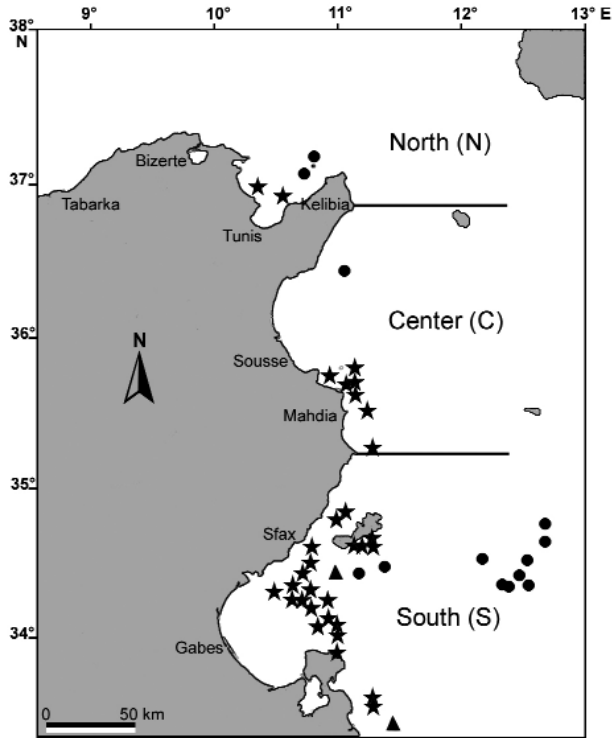
### *Lagocephalus lagocephalus*

Several fishermen have confirmed that these fish are increasingly being caught. Our own observations total 64 specimens fished along Tunisian coasts (**Table I, Figure 1**), most of them (84.4%) caught with gill-nets mainly in the Gulf of Gabès (southern Tunisia). Bottom trawls, purse seine nets and the traditional “Charfia” fixed fishery, used in Kerkennah Island, have also caught this Puffer fish.

**Table I**

Data collected on  
*Lagocephalus lagocephalus*  
 from Tunisia. N: north,  
 C: centre, S: south.  
*Lagocephalus lagocephalus*  
 collectés dans les eaux  
 tunisiennes. N : nord,  
 C : centre, S : sud.

Month	Date	Fishing zone	Gear	Total length (cm)	Total weight (g)	Sex	References	
January	02/01/2004	C	Gill net	73.5	3200	-	Hattour <i>et al.</i> , 2004	
	20/01/2004	N	Gill net	65	2700	-	Hattour <i>et al.</i> , 2004	
February	15/02/2014	C	-	40	1000	-	Present work	
March	17/03/2004	S	Gill net	51.8	1524	F	Present work	
	10/03/2004	C	Gill net	50.2	1174	M	Present work	
	17/03/2004	C	Gill net	45.6	1065	M	Present work	
	22/03/2004	S	Gill net	45.5	936	F	Present work	
	30/03/2004	S	Charfia	50.4	1235.02	F	Present work	
	01/03/2004	C	Gill net	50.2	1174	M	Present work	
	01/03/2014	N	Trawl	43	681.23	F	Present work	
April	01/04/1999	S	-	50	-	-	Present work	
	22/04/2000	S	-	76.5	3783	F	Present work	
	06/04/2004	S	Charfia	43.1	715.82	F	Present work	
	30/04/2004	S	Gill net	52.6	1359.37	M	Present work	
	30/04/2004	S	Gill net	48.2	1408.18	F	Present work	
	01/04/2012	S	-	50.8	1083	F	Present work	
	01/04/2012	S	-	50	1015	F	Present work	
	03/04/2012	S	Gill net	54	1594.23	F	Present work	
	05/04/2008	S	Gill net	56	1715	M	Present work	
	10/04/2014	S	Gill net	54.5	1594.45	F	Present work	
	05/04/2009	S	Gill net	56	1715	M	Present work	
	12/04/2014	S	Charfia	54.5	1594.45	F	Present work	
	05/04/2004	C	Gill net	63	2650	-	Hattour <i>et al.</i> , 2004	
	02/04/2004	C	Gill net	45	1120	-	Hattour <i>et al.</i> , 2004	
	May	30/05/2003	S	Gill net	60.5	2513.57	F	Present work
		07/05/2004	S	Gill net	48.8	1231	M	Present work
13/05/2004		S	Gill net	53.3	1639	F	Present work	
13/05/2004		S	Gill net	45.1	951.52	M	Present work	
14/05/2004		S	Gill net	52.8	1863.4	F	Present work	
16/05/2004		S	Gill net	57	1619.15	F	Present work	
18/05/2004		S	Gill net	53.9	1213.6	F	Present work	
20/05/2004		S	Charfia	51.5	1486.5	F	Present work	
22/05/2004		S	Gill net	46.1	1001.69	M	Present work	
26/05/2004		S	Gill net	56.7	2268.65	F	Present work	
29/05/2004		S	Beach seine	42.4	692.44	M	Present work	
29/05/2004		S	Beach seine	48.1	1061.23	M	Present work	
23/05/2006		S	-	50	1270	-	Present work	
27/05/2008		S	-	-	-	-	Present work	
26/05/2009		S	Gill net	55	1935	F	Present work	
12/05/2014		S	Gill net	57	2284	F	Present work	
05/05/2014		S	Beach seine	43.3	684	-	Present work	
21/05/2014	S	stranded	58	2249	-	Present work		
June	04/06/1996	S	Purse seine	53	1951	F	Present work	
	23/06/2004	S	Gill net	62.2	2908.52	F	Present work	
	27/06/2007	S	Gill net	62	2770	F	Present work	
	27/06/2007	S	Gill net	64	2230	F	Present work	
	27/06/2007	S	Gill net	56	1345	M	Present work	
	27/06/2007	S	Gill net	68	2420	M	Present work	
	27/06/2007	S	Gill net	57	1915	F	Present work	
August	11/08/2006	S	-	53.5	1850	M	Present work	
September	06/09/2005	S	-	64	2662	F	Present work	
December	12/12/2003	C	Gill net	60	2065	F	Present work	
	01/12/2003	C	Gill net	60	2065	F	Present work	
Unknown	2012	S	Gill net	66.7	2157	F	Present work	
	-	C	-	-	-	-	Present work	
	2012	S	-	55	1042	F	Present work	
	2012	S	-	54	1176.5	M	Present work	
	2012	S	-	51.5	1043.3	F	Present work	
	2012	S	-	56	558.53	-	Present work	
	2012	S	-	54	1911.51	F	Present work	
	2012	S	-	54	1367.8	F	Present work	
	2012	S	-	49	1223.7	F	Present work	
	2012	S	-	42	708.7	M	Present work	
2012	S	-	48	677.1	-	Present work		



**Figure 1**  
Map showing the capture points of the three Tetraodontidae species sampled from Tunisian coasts. Star: *Lagocephalus lagocephalus*; Circle: *Sphoeroides pachygaster*; Triangle: *Lagocephalus scleratus*. Répartition des captures des Tetraodontidae des côtes tunisiennes. Etoile : *Lagocephalus lagocephalus*; Cercle : *Sphoeroides pachygaster*; Triangle : *Lagocephalus scleratus*.

Recorded captures were made between 1996 and 2014. Observations took place mainly in spring and the beginning of summer (**Figure 2**).

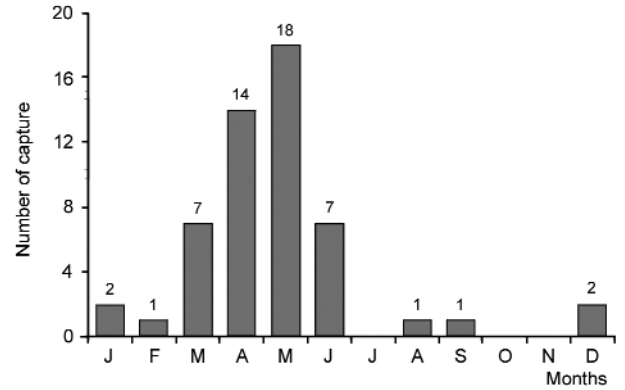
Females ranged from 43 to 76.5 cm Total Length (TL) and males from 42 to 68 cm TL (**Figure 3**). The most common size is around 55 cm for the total sample. Mean total length was greater for females (55.21 cm) than for males (50.47 cm). Differences were statistically significant (Anova,  $p < 0.05$ ).

Females outnumbered males by F/M 2.06: 1, which was a significant departure from the hypothetical 1:1 and the rate of femininity is 67.31%.

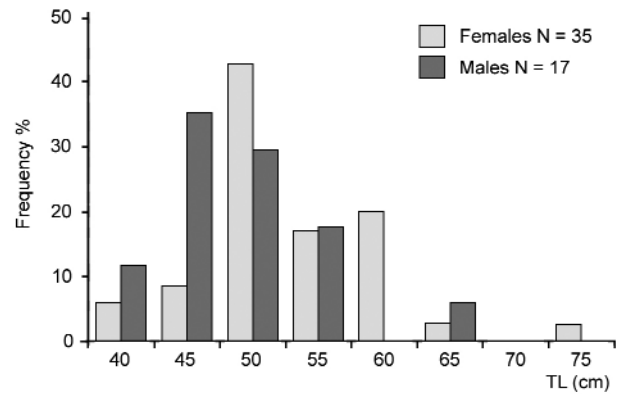
Length-weight relationships females and males was not significantly different, test  $t = 0.903$  (**Figure 4**).

Among 47 stomachs examined, 35 were empty. The vacuity index (VI) was 74.47%. *Lagocephalus lagocephalus*, consumed essentially mollusks (*Sepia officinalis*), fish (*Sardinella aurita*, *Sardinella pilchardus*) and crustaceans (crabs and shrimps). Many leaves of *Posidonia oceanica* and *Cymodocea* were also observed.

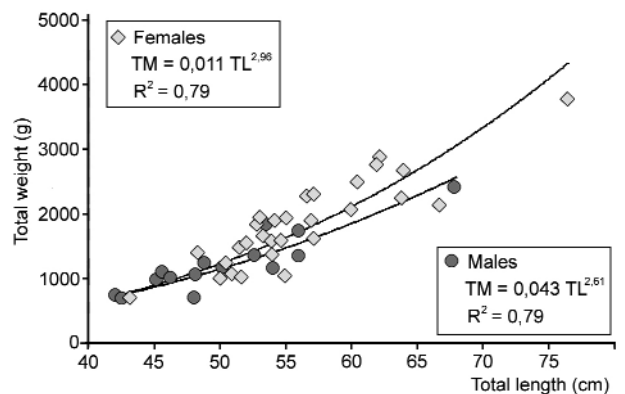
Mature females were observed between April and June, except one in September.



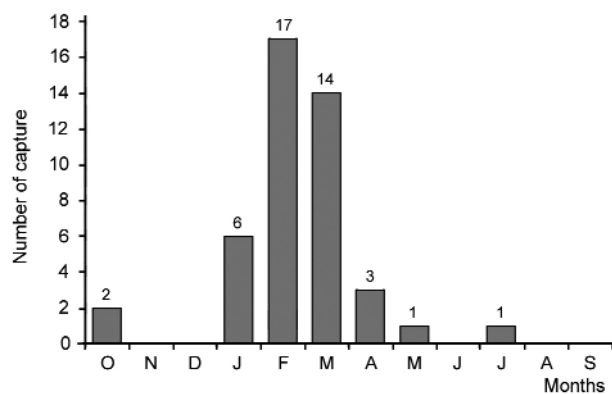
**Figure 2**  
Distribution of *Lagocephalus lagocephalus* catches by month on Tunisian coasts. Distribution mensuelle des *Lagocephalus lagocephalus* capturés dans les eaux tunisiennes.



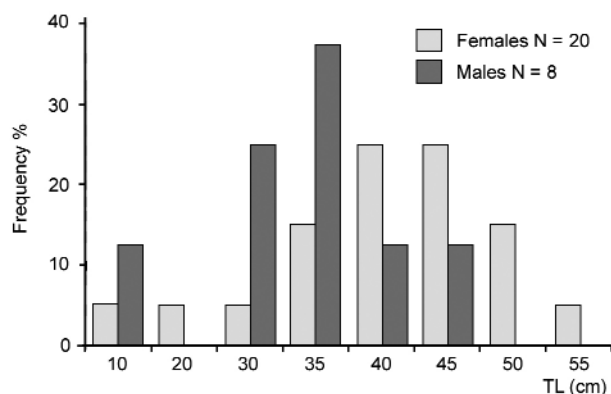
**Figure 3**  
Total length frequency of *Lagocephalus lagocephalus* sampled on Tunisian coasts. Fréquence des tailles des *Lagocephalus lagocephalus* dans les eaux tunisiennes.



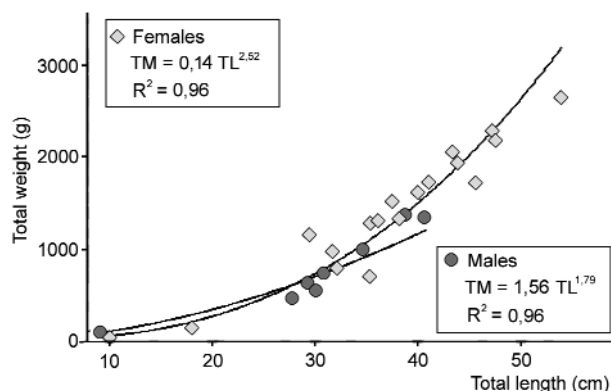
**Figure 4**  
Length-weight relationships of *Lagocephalus lagocephalus* from Tunisian coasts. Relation taille poids des *Lagocephalus lagocephalus* dans les eaux tunisiennes.



**Figure 5**  
 Distribution of *Sphoeroides pachygaster* catches by month on Tunisian coasts.  
 Distribution mensuelle des *Sphoeroides pachygaster* capturés dans les eaux tunisiennes.



**Figure 6**  
 Total length frequency of *Sphoeroides pachygaster* sampled from Tunisian coasts.  
 Fréquence des tailles des *Sphoeroides pachygaster* dans les eaux tunisiennes.



**Figure 7**  
 Length-weight relationships of *Sphoeroides pachygaster* from Tunisian coasts.  
 Relation taille poids de *Sphoeroides pachygaster* dans les eaux tunisiennes.

### *Sphoeroides pachygaster*

45 specimens of the blunthead puffer, *Sphoeroides pachygaster*, were examined between 1992 and 2014 (Table I), the majority of them caught with bottom trawls at depths of less than 100 m.

Around 94% of catches were in the Gulf of Gabès (Table II, Figure 1). The peak of capture was from February to March (Figure 5).

The smallest specimen observed was a juvenile of 9 cm TL, caught in the Gulf of Hammamet in October 2009 by a bottom trawl at a depth of 50 m (Chérif *et al.*, 2010). Females ranged from 10 to 54 cm total length (TL) and males from 9 to 40.8 cm TL (Figure 6). Mean total length for females as 37.17 cm while it was 30.22 cm for males. Differences were statistically significant (Anova,  $p < 0.05$ ). Females outnumbered males by 2.5:1, which was a significant departure from the hypothetical 1:1 and the rate of femininity is 72%.

Length-weight relationships females and males was not significantly different (test  $t = 0.675$ ) (Figure 7).

Of 25 stomachs examined, 8 were empty. The blunthead puffer consumes a wide range of fish: *Mullus barbatus*, *Mullus surmuletus*, *Trachurus trachurus*, *Conger conger*, *Engraulis encrasicolus*, *Boops boops*. They feed also on crustaceans (crabs) and mollusks (*Loligo vulgaris*, *Eledone moschata*, *Sepia officinalis*, and gastropod). Mature females were observed from January to April.

### *Lagocephalus scleratus*

Three confirmed sightings of the silverstripe blaasop, *Lagocephalus scleratus*, were observed in Tunisia. The first was caught by a bottom trawler on 8 December 2010, at the southern end of the Gulf of Gabès (Jribi, Bradai, 2012), the second observed specimen was captured by gillnet in the north of the Gulf of Gabès on 5 June 2014 and the last was landed by a bottom trawler on 12 March 2015 in the same area (present work) (Table III, Figure 1).

### Discussion and conclusion

Sizes of *Lagocephalus lagocephalus* recorded from Tunisian coastal waters ranged between 43 and 76.5 cm total length, with a mode of 50 cm TL, whereas, the Indo-Pacific, Atlantic and Mediterranean specimens do not exceed a maximum of 60 cm total length. The most common sizes ranged from 40 to 45 cm (Tortonese, 1986; Whitehead *et al.*, 1986; Nakabo, 2002; Shipp, 2002). Mature males and females (Photo 2) were observed in the Gulf of Gabès, suggesting that the puffer fish is

Month	Date	Fishing zone	Gear	Total length (cm)	Total weight (g)	Sex	References
January	26/01/2007	N	bottom trawl	47.5	2205	F	Present work
	30/01/2007	S	bottom trawl	38.1	1335	F	Present work
	30/01/2007	S	bottom trawl	36.2	1315	F	Present work
	30/01/2007	S	bottom trawl	32.1	790	F	Present work
	30/01/2007	S	bottom trawl	31.8	995	F	Present work
30/01/2007	S	bottom trawl	32.3	815	F	Present work	
February	12/02/2008	S	-	45.6	1735	F	Present work
	06/02/2009	S	bottom trawl	28	465.7	M	Present work
	24/02/2009	S	-	44	1600	-	Present work
	24/02/2009	S	-	49	1760	-	Present work
	24/02/2009	S	-	43	1660	-	Present work
	18/02/2014	S	bottom trawl	54	2640.4	F	Present work
	18/02/2014	S	bottom trawl	-	-	-	Present work
	18/02/2014	S	bottom trawl	-	-	-	Present work
	18/02/2014	S	bottom trawl	-	-	-	Present work
	12/02/2008	-	-	45.6	1735	-	Present work
	25/02/2014	S	bottom trawl	35.3	697.5	F	Present work
	25/02/2014	S	bottom trawl	40.8	1339.9	M	Present work
	25/02/2014	S	bottom trawl	-	-	-	Present work
	25/02/2014	S	bottom trawl	-	-	-	Present work
	25/02/2014	S	bottom trawl	-	-	-	Present work
	25/02/2014	S	bottom trawl	-	-	-	Present work
	March	25/03/1992	S	-	28.4	-	-
25/03/1992		S	-	-	-	-	Bradai <i>et al.</i> , 1993
25/03/1992		S	-	-	-	-	Bradai <i>et al.</i> , 1993
27/03/1996		-	-	-	-	-	Present work
24/03/2004		S	-	40.1	1623.78	F	Present work
24/03/2004		S	Gill net	37.6	1523.27	F	Present work
24/03/2004		S	Gill net	34.7	996.9	M	Present work
05/03/2005		S	Gill net	29.4	1537	F	Present work
06/03/2007		S	bottom trawl	35.6	1290	F	Present work
06/03/2007		S	bottom trawl	29.5	615	M	Present work
06/03/2007		S	bottom trawl	30	580	M	Present work
06/03/2007		S	bottom trawl	31	760	M	Present work
06/03/2007		S	bottom trawl	43.5	2055	F	Present work
06/03/2007	S	bottom trawl	38.8	1380	M	Present work	
April	05/04/2005	S	Gill net	47.3	2276	F	Present work
	11/04/2008	S	-	44	1950	F	Present work
	11/04/2008	-	-	44	1950	F	Present work
May	13/05/2014	N	bottom trawl	18	146.28	-	Present work
July	03/07/1992	S	bottom trawl	41	1725	F	Bradai <i>et al.</i> , 1993
October	3/10/2009	C	bottom trawl	9	41.86	M	Cherif <i>et al.</i> , 2010
	3/10/2009	C	bottom trawl	10.1	47.91	F	Cherif <i>et al.</i> , 2010
Unknown	-	S	Gill net	22.5	59.6	-	Present work

**Table II**

Data collected on *Sphoeroides pachygaster* from Tunisia; N: north, C: centre, S: south.  
*Sphoeroides pachygaster* collectés dans les eaux tunisiennes. N : nord, C: centre, S : sud.

Month	Date	Fishing zone	Gear	Total length (cm)	Total weight (g)	Sex	References
December	08/12/2010	S	bottom trawl	60	2687	-	Jribi, Bradai, 2012
June	05/06/2014	S	Gill net	55.5	2061.3	-	Present work
March	12/03/2015	S	bottom trawl	63.2	2996	-	Present work

**Table III**

Data collected on *Lagocephalus sceleratus* examined in Tunisia, S: south.  
*Lagocephalus sceleratus* collectés dans les eaux tunisiennes. S : sud

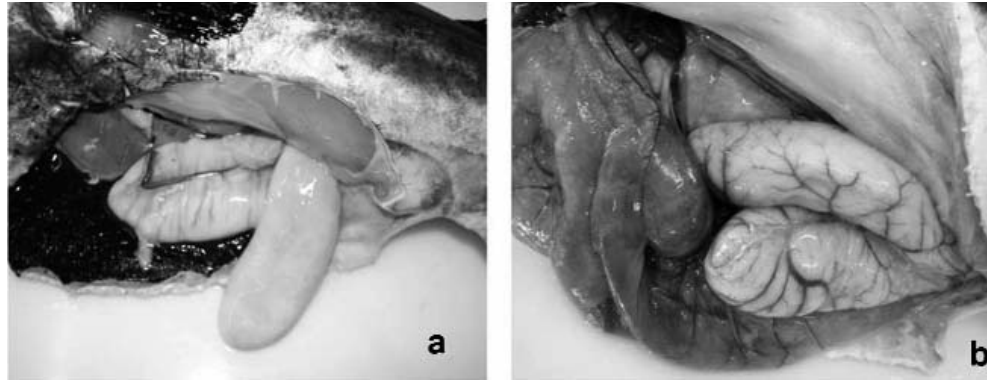
acclimated to Tunisian water conditions. The absence of juveniles suggests that the species do not reproduce in Tunisia or that breeding areas are not frequented by fishermen. A preliminary toxicity study of *Lagocephalus lagocephalus* in Tunisia, using the standard bioassay method of Kawabata (1978), shows that the flesh and the liver of this puffer fish is contaminated with toxic compounds able to induce gastrointestinal disorders and oxidative stress (Saoudi *et al.*, 2008).

In the Mediterranean Sea, the blunthead puffer, *Sphoeroides pachygaster*, was reported for the first time in 1979 from the Balearic Islands, in the western Mediterranean Sea (Oliver, 1981), and since then several records of this species have been reported in the western and central Mediterranean Sea (Psomadakis *et al.*, 2006). Recently, this species was reported from the Tyrrhenian Sea (Ligas *et al.*, 2006) and the Adriatic Sea (Ligas *et al.*, 2007). It has also been mentioned in the eastern

**Photo 2**

Mature testis (a) and ovaries (b) of *Lagocephalus lagocephalus* from Tunisian coasts.

*Testicule mature et ovaire de Lagocephalus lagocephalus des côtes tunisiennes.*



Mediterranean Sea: Levantine basin (Golani, 1996), Turkey (Eryilmaz *et al.*, 2003; Bilecenoglu, 2010) and Greece (Peristeraki *et al.*, 2006). The species is now considered as established in the Mediterranean Sea (Schiberras, Schembri, 2006; Zenetos *et al.*, 2008), it has shown a significant increase in abundance over time and there is now a steady population with the presence of spawning females (Maiorano *et al.*, 2010). In Tunisia coastal waters, the species was recorded for the first time in the Gulf of Gabès in 1992 (Bradai *et al.*, 1993). Sizes recorded from this area are greater than those reported in the strait of Sicily where the mean total length did not exceed 17.64 cm for males and 22.61 cm for females, the total length structure showed a main peak at 15-16 cm, and the smallest specimens reached 9.5 cm (Ragonese *et al.*, 1997). The mean total length in southern Tunisia is 33.74 and 39.74 cm respectively for males and females. The peak of capture is 35 cm for males and 45 cm for females. The smallest fish measured 22.5 cm. Although mature males and females were common, some juveniles and maturing specimens were reported in the north and the north-east of Tunisia. The situation in the two areas (Gulf of Gabès and Sicily) should be studied further in order to understand the distribution pattern of juveniles and adults and to delineate the breeding areas.

The silverstripe blaasop, *Lagocephalus sceleratus*, is an Indo-Pacific migrant ranked among the 100 “worst” Invasive Alien Species (IAS) in the Mediterranean Sea, with a profound social and ecological impact (Streftaris, Zenetos, 2006). It was first recorded in the Mediterranean Sea in 2003 in Gokova Bay (Turkey). Since then, it has been recorded in the Aegean Sea (Akyol *et al.*, 2005; Bilecenoglu *et al.*, 2006), in the Cretan Sea (Kasapidis *et al.*, 2007) and in the Levantine coasts (Nader *et al.*, 2012). The propagation of this species to the central and western part of the Mediterranean Sea has intensified in recent years. It was recorded at Ain Al-Ghazala and Bombah Bay (Libya) (Milazzo *et al.*, 2012), in the Gulf of Gabès in 2010 (Jribi, Bradai, 2012), and on the Algerian coast towards the

Tunisian border (port of El-Kala and Annaba) in 2013 (Kara *et al.*, 2015). In October 2013, *Lagocapthalus sceleratus* was caught at Lampedusa Island (Italy) (Azzurro *et al.*, 2014) at a depth of 20 m. The silverstripe blaasop is being caught as by-catch in relatively significant numbers in the eastern Mediterranean fisheries, has no current economic value and is therefore immediately discarded at sea (EastMed, 2010). *Lagocephalus sceleratus* is considered as one of the most toxic representatives among the puffer-fishes, since it contains tetrodotoxin, which may cause poisoning and even death (Chua, Chew, 2009; Katikou *et al.*, 2009).

A campaign to increase awareness regarding this highly toxic fish was undertaken in Tunisia targeting both fishermen and consumers. Local authorities were informed of the presence of this species and of the necessity of avoiding its consumption. A brochure illustrated with photographs was produced and information concerning the fish was broadcast in the local media.

The Mediterranean Sea is known as a hotspot for the introduction of warm and tropical exotic species. This phenomenon is the result of climate change (increases in salinity and seawater temperatures, etc.), the opening of the Suez Canal and other factors. The puffer fish, like many other warm water affinity species, is considered as an established species; it has colonized new territories from the eastern to western Mediterranean.

These species compete with native species. Several studies around the Mediterranean Sea have focused on this group, given its negative impact on the fisheries sector of the area. A study carried out in Cyprus from 2009 to 2010 showed that *Lagocephalus sceleratus* has become more abundant in landings of artisanal fisheries. This toxic species represents more than 4% of the weight of total catches from the area (Nader *et al.*, 2012).

Identification and monitoring of invasive species at an early stage will better prepare fisheries managers to come up with preventive/adaptive measures and possible economic uses for the new migrants

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## Bibliography

- Akyol O., V. Ünal, T. Ceyhan, M. Bilecenoglu**, 2005 - First confirmed record of *Lagocephalus sceleratus* (Gmelin, 1789) in the Mediterranean Sea. *J. Fish Biol.*, **66** (4) : 1183-1186.
- Azzurro E., L. Castriota, M. Falautano, F. Giardina, F. Andaloro**, 2014 - The silver-cheeked toadfish *Lagocephalus sceleratus* (Gmelin, 1789) reaches Italian waters. *J. Appl. Ichthyol.*, **30** : 1050-1052.
- Bilecenoglu M.**, 2010 - Alien marine fishes of Turkey – an updated review. In: *Fish invasions in the Mediterranean Sea: change and renewal*. D. Golani, B. Appelbaum-Golani (eds), Pensoft Publ., Sofia-Moscow, pp : 189-217.
- Bilecenoglu M., M. Kaya, S. Akalin**, 2006 - Range expansion of silverstripe blaasop, *Lagocephalus sceleratus* (Gmelin, 1789), to the northern Aegean Sea. *Aqua. Invasions*, **1** (4) : 289-291.
- Bradai MN, M. Ghorbel, A. Bouain**, 1993 - Premières observations dans le golfe de Gabès (Tunisie) de *Sphoeroides cutaneus* (Tetraodontidae). *Cybium*, **17** (1) : 86.
- Bradai M.N., J.P. Quignard, A. Bouain, O. Jarbouï, A. Ouannes-Ghorbel, L. Ben Abdallah, J. Zaouali, S. Ben Salem**, 2004 - Ichtyofaune autochtone et exotique des côtes tunisiennes : recensement et biogéographie. *Cybium*, **28** : 315-328.
- Chakroun F.**, 1966 - Capture d' animaux rares en Tunisie. *Bull. Inst. natl sci. tech. Océanogr. Pêche, Salammbô*, **1** (2) : 75-79.
- Charfi-Cheikhrouha F.**, 2004 - Premières observations de quatre espèces de poissons allochtones a Rafrat (nord-est de la tunisie). *Bull. Inst. natl sci. tech. Océanogr. Pêche, Salammbô*, **31** : 115-117.
- Chérif M., M.M. Ben Amor, M. Bdioui, S. Ben Salem, H. Missaoui, C. Capapé**, 2010 -Additional records of the blunthead puffer, *Sphoeroides pachygaster* (Osteichthyes: Tetraodontidae) off the Tunisian coast (Central Mediterranean). *Ann. Ser. Hist. Nat.*, **20** (1) : 33-36.
- Chua H.H., L.P. Chew**, 2009 - Puffer Fish Poisoning: A Family Affair. *Med. J. Malaysia*, **64** (2) : 181-182.
- EastMed**, 2010 - Report of the Sub-Regional Technical meeting on the Lessepsian migration and its impact on Eastern Mediterranean fishery. GCP/INT/041/EC - GRE - ITA/TD-04, 133 pp.
- Eryilmaz L., M. Özulu , N. Meriç**, 2003 - The Smooth Pufferfish, *Sphoeroides pachygaster* (Müller & Troschel, 1848) (Teleostei: Tetraodontidae), new to the Northern Aegean Sea. *Zool. Middle East*, **28** : 125-126.
- Golani D.**, 1996 - The marine ichthyofauna of the eastern Levant - history, inventory and characterization. *Israel. J. Zool.*, **42** (1) : 15-55.
- Hachaichi M.**, 1981- Première capture d'*Ehippion guttiferum* (Bennett, 1831) (Pisces, Tetraodontidae) dans les eaux tunisiennes. *Bull. Inst. natl sci. tech. Océanogr. Pêche, Salammbô*, **8** : 115-117.
- Hattour A., Nakamura I., A. Nguira**, 2004 - A large oceanic puffer fish rare in Tunisian waters. *Bull. Inst. natl sci. tech. Océanogr. Pêche, Salammbô*, **31** : 123-125.
- Jribi I., M.N. Bradai**, 2012 - First record of the Lessepsian migrant species *Lagocephalus sceleratus* (Gmelin, 1789) (Actinopterygii: Tetraodontidae) in the Central Mediterranean. *Bioinvasions Rec.*, **1** (1) : 49-52.
- Kara H., E. Ben Lamine, P. Francour**, 2015 - Range expansion of an invasive pufferfish, *Lagocephalus sceleratus* (Actinopterygii: Tetraodontiformes: Tetraodontidae), to the south-western Mediterranean. *Acta ichtyol. pisca.*, **45** (1) : 103-108.
- Kawabata T.**, 1978 - Puffer toxin. In: *The manual for the methods of food sanitation tests II*, Jpn Food Hyg. Assoc., Tokyo, pp: 232-240.
- Kasapidis P., P. Peristeraki, G. Tserpes, A. Magoulas**, 2007 - First record of the Lessepsian migrant *Lagocephalus sceleratus* (Gmelin 1789) (Osteichthyes: Tetraodontidae) in the Cretan Sea (Aegean, Greece). *Aquat. Invasions*, **2** (1) : 71-73.
- Katikou P., D. Georgantelis, N. Sinouris, A. Petsi, T. Fotaras**, 2009 - First report on toxicity assessment of the Lessepsian migrant pufferfish *Lagocephalus sceleratus* (Gmelin, 1789) from European waters (Aegean Sea, Greece). *Toxicon*, **54** (1) : 50-55.
- Ligas A., R. Sirna, P. Sartor**, 2006 - Nuova segnalazione di *Sphoeroides pachygaster* (Müller & Troschel, 1848) (Pisces, Tetraodontidae) nel Mar Tirreno Settentrionale. *Biol. mar. Mediterr.*, **13** (2) : 274-275.



**Ligas, A., P. Sartor, M. Sbrana, R. Sirna, S. De Ranieri,** 2007 - New findings of *Fistularia commersonii* Rüppell, 1835 and *Sphoeroides pachygaster* (Müller & Troschel, 1848) in the northern Tyrrhenian Sea. *Atti Soc. tosc. Sci. nat. Mem., Ser. B*, **114**: 131-133.

**Maiorano P., L. Sion, R. Carlucci, F. Capezzuto, A. Giove, G. Costantino, M. Panza, G. D'Onghia, A. Tursi,** 2010 - The demersal faunal assemblage of the north-western Ionian Sea (central Mediterranean): current knowledge and perspectives. *Chem. Ecol.*, **26** (Suppl. 1): 219-240.

**Milazzo M., E. Azzurro, F. Badalamenti,** 2012 - On the occurrence of the silverstripe blaasop *Lagocephalus sceleratus* (Gmelin, 1789) along the Libyan coast. *BiolInvasions Rec.*, **1** (2): 125-127.

**Nader M., S. Indary, L. Boustany,** 2012 - FAO EastMed The Puffer Fish *Lagocephalus sceleratus* (Gmelin, 1789) in the Eastern Mediterranean. GCP/INT/041/EC - GRE - ITA/TD-10, 34 pp.

**Nakabo T.** (ed.), 2002 - *Fishes of Japan with pictorial keys to the species, English edition II*. Tokai University Press, Tokyo, 1749 pp.

**Oliver P.**, 1981 - Sobre la aparición de algunos peces raros en las islas Baleares. *Bol. Inst. esp. Oceanogr.*, **6** (304): 59-64.

**Peristeraki P., G. Lazarakis, C. Skarvelis, M. Georgiadis, G. Tserpes,** 2006 - Additional records on the occurrence of alien fish species in the eastern Mediterranean Sea. *Medit. mar. Sci.*, **7** (2): 61-66.

**Psomadakis P.N., P. Ceddia, M. Vacchi,** 2006 - Additional record of *Sphoeroides pachygaster* (Pisces: Tetraodontidae) in the Tyrrhenian Sea and notes on the distribution of the species in the Mediterranean. *Mar. Biodiv. Rec.*, **1** (e18), doi: 10.1017/S 1755267206001862.

**Ragonese S., P. Jereb, U. Morara,** 1997 - Morphometric relationships of *Sphoeroides pachygaster* (Pisces - Tetraodontidae) of the Strait of Sicily (Mediterranean Sea). *Cah. Biol. mar.*, **38**: 283-289.

**Saoudi M., A. Abdelmouleh, W. Kammoun, F. Ellouze, K. Jamoussi, A. El Feki,** 2008 - Toxicity assessment of the puffer fish *Lagocephalus lagocephalus* from the Tunisian coast. *C. r. Biol.*, **331** (8): 611-616.

**Sciberras A., P.J. Schembri,** 2006 - Geographic distribution: *Rana bedriagae*. *Herpetol. Rev.*, **37** (1): 102.

**Shipp R.L.**, 2002 - Tetraodontidae. In: *The living marine resources of the Western Central Atlantic. Volume 3: Bony fishes part 2 (Opistognathidae to Molidae), sea turtles and marine mammals*. K.E. Carpenter (ed.), FAO Publ., Rome, pp: 1988-2013.

**Streftaris N., A. Zenetos,** 2006 - Alien Marine Species in the Mediterranean - the 100 'Worst Invasives' and their Impact. *Medit. mar. Sci.*, **7** (1): 87-118.

**Tortonese E.**, 1986 - Balistidae, Monacanthidae, Ostraciantidae, Tetraodontidae, Diodontidae, Molidae. In: *Fishes of the North-eastern Atlantic and the Mediterranean. Vol. III*. P.J.P. Whitehead, M.L. Bauchot, J.C. Hureau, J. Nielsen, E. Tortonese (eds), UNESCO Publ., Paris, pp: 1335-1350.

**Whitehead P.J.P., M.L. Bauchot, J.C. Hureau, J. Nielsen, E. Tortonese** (eds), 1986 - *Fishes of the North-eastern Atlantic and the Mediterranean. Vol. III*. UNESCO Publ., Paris, pp: 1015-1473.

**Zenetos A., V. Vassilopoulou, M. Salomidi, D. Poursanidis,** 2008 - Additions to the marine alien fauna of Greek waters (2007 update). *Mar. Biodiv. Rec.*, **1** (e91), doi: 10.1017/S 1755267207009281.

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