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RANGE EXPANSION OF AN INVASIVE PUFFERFISH, *LAGOCEPHALUS SCELERATUS* (ACTINOPTERYGII: TETRAODONTIFORMES: TETRAODONTIDAE), TO THE SOUTH-WESTERN MEDITERRANEAN

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Abstract. Three specimens of silver-cheeked toadfish, *Lagocephalus sceleratus* (Gmelin, 1789), were caught on eastern coasts of Algeria during the winter of 2013–2014. This is the first record of this invasive species from Algeria, providing further evidence of its occurrence along north-African coasts and confirming its entry into the Western basin of the Mediterranean. The human-health implications of this toxic fish in this region are discussed.

Keywords: fish, Lessepsian migrant, silver-cheeked toadfish, giant toadfish, silverside blaasop, spotted rough-backed blowfish, alien, non-indigenous species, Algeria

Representatives of the family Tetraodontidae are marine and estuarine fishes distributed in tropical and sub-tropical areas of the Atlantic-, Indian-, and Pacific Oceans. This family comprises 26 genera and 189 species (Froese and Pauly 2014), among which nine can be found in the Mediterranean (Akyol et al. 2005, Corsini et al. 2005, Golani et al. 2006), of which seven are non-indigenous (Golani et al. 2002).

The genus *Lagocephalus* is distinguished from other genera of Tetraodontidae by two separate lateral lines, the lower usually on a fold of skin, a caudal peduncle rather narrow, a lunate caudal fin, two nostrils on each side of the snout with more or less developed papilla, and no bony plates on the back. This genus includes four species inhabiting the Mediterranean. Only *Lagocephalus lagocephalus* (Linnaeus, 1758) is of Atlanto-Mediterranean origin, while the remaining three species: *Lagocephalus spadiceus* (Richardson, 1845); *Lagocephalus suezensis* Clark et Gohar, 1953; and *Lagocephalus sceleratus* (Gmelin, 1789) are Lessepsian migrants, which have penetrated to the Levantine basin by way of the Suez Canal. *Lagocephalus sceleratus* can be distinguished from all its Mediterranean congeners by the following characters: the regular distribution of spots of equal size along the dorsal area, the absence of spiny rays in the dorsal and anal fins, and the presence of small spinules on the belly and on the dorsal surface extending to the origin of the dorsal fin.

The silver-cheeked toadfish, *Lagocephalus sceleratus* (known also as giant toadfish, silverside blaasop, or spotted rough-backed blowfish), is a reef-associated species, widely distributed in the tropical Indo–West Pacific Ocean (Smith and Heemstra 1986) as well as the Red Sea, and more recently in the eastern basin of the Mediterranean Sea. Its first record was published by Filiz and Er (2004) and it documented a finding from Gökova Bay (southern Aegean Sea, Turkey). The chronologically first observed specimen, however, was captured in 2003, but reported later by Akyol et al. (2005). The previous 1977 record by Mouneimne (1977) was a misidentification of the similar puffer fish *Lagocephalus suezensis* (see Golani 1996). Soon after its first detection, the species underwent a population explosion in many localities of the Levant Basin such as Israel (Golani and Levy 2005), Turkey (Bilecenoglu et al. 2006), Crete (Kasapidis et al. 2007), and Cyprus (Katsanevakis et al. 2009). In 2011, Halim and Rizkalla (2011) provided concrete evidence of the occurrence of *L. sceleratus* along the Mediterranean coast of Egypt and considered that this species was first caught in 2008 off Alexandria, becoming abundant soon afterwards, especially along the coasts of the Sinai and off the Nile

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Delta. It has since then showed a rapid expansion throughout the eastern Mediterranean Sea reaching its northernmost parts: Ionian Sea (Kapiris et al. 2014) and mid-eastern Adriatic (Dulčić et al. 2014), Libya (Milazzo et al. 2012), as well as south-western- (Jribi and Bradai 2012) and northern Tunisia (Ben Souissi et al. 2014). Table 1 summarizes the chronology of documented records (location of capture, date, number and length of the specimens, depth) of this species in the Mediterranean.

The silver-cheeked toadfish, *Lagocephalus sceleratus*, is one of the largest members of its family, reaching 110 cm of total length and 7 kg of weight (Nader et al. 2012). Generally, it inhabits sandy or muddy substrate areas near shallow coral reefs at depths between 18 and 100 m (Smith and Heemstra 1986, Froese and Pauly 2014). In eastern Mediterranean (Rhodes), according to Kalogirou (2013), this species was found to feed on invertebrates and fish. During the early life stages, it feeds on various invertebrates. The predominant mollusc species found in the diet of the larger (> 20 cm) *L. sceleratus* individuals were the economically important *Sepia officinalis* and *Octopus vulgaris*. The size at which 50% of individuals are mature was estimated at 36 cm (Kalogirou 2013).

In this paper, we present the first record of the silver-cheeked toadfish, *Lagocephalus sceleratus*, in Algerian waters, confirming the spreading of this invasive species in the western Mediterranean, and discussing the risks it poses to the health of consumers who are in general unaware of its toxicity.

During the winter of 2013–2014, three specimens of *Lagocephalus sceleratus* were caught on the eastern coast of Algeria (Fig. 1) using bottom trawl and gillnet to a depth of 50 to 60 m. Field constraints did not allow preservation of these individuals which were identified on

Table 1

Chronology of documented records of *Lagocephalus sceleratus* in the Mediterranean

No.	Location	Date	*N*	Total length [cm]	Depth [m]	Reference
1	Akyaka (Gökova Bay), Turkey	08.2003	1	—	—	Filiz and Er 2004
2	Kemer (Antalya Bay), Turkey	18.09.2004	1	38.9	30	Bilecenoglu et al. 2006
3	Jaffa coast, Israel	08.11.2004	1	10.1	—	Golani and Levy 2005
4	Cyprus	2004	several	—	—	Katsavenakis et al. 2009
5	Haifa Bay, Israel	24.02.2005	1	61.8	30	Golani and Levy 2005
6	Bodrum (Gokova Bay), Turkey	10.03.2005	2	—	—	Bilecenoglu et al. 2006
7	Adrasan coast (Antalya Bay), Turkey	14.03.2005	2	—	3	Bilecenoglu et al. 2006
8	Crete (Heraklion Bay), Greece	20.07.2005	1	34.8	9	Kasapidis et al., 2007
9	Rhodes coast (Ladiko), Greece	21.09.2005	1	37.6	15–20	Corsini et al. 2006
10	Kas (Antalya Bay), Turkey	03.10.2005	1	—	—	Bilecenoglu et al. 2006
11	Chania (Georgioupolis Bay), Greece	20.12.2005	1	—	30	Kasapidis et al. 2007
12	Hekim island (Izmir Bay), Turkey	21.04.2006	1	49.8	10–12	Bilecenoglu et al. 2006
13	Behramkale (Edremit Bay), Turkey	07.2008	1	—	60	Türker-Çakır et al. 2009
14	Alexandria, Egypt	2008	several	—	80	Halim and Rizkalla 2011
15	Rhodes island, Greece	2008/2009	290	5.3–63.1	5–35	Kalogirou 2013
16	Iskenderun Bay, Turkey	02.2009	4	38.8–61.1	40	Torcu Koç et al. 2011
17	Antalya Bay, Turkey	2008/2010	656	12.5–65	—	Aydın 2011
18	Ain Al Ghazala lagoon, Libya	09.2010	5	27.8	15–25	Milazzo et al. 2012
19	Mersin Bay, Turkey	10.11.2010	2	8.4, 7.5	72	Yaglioglu et al. 2011
20	Iskenderun Bay, Turkey	29.11.2010	2	7.5, 6.5	53	Yaglioglu et al. 2011
21	Gulf of Gabes, Tunisia	08.12.2010	1	60	—	Jribi and Bradai 2012
22	Tunisian coasts	12.2010–07.2013	12	52–64	—	Ben Souissi et al. 2014
23	Iskenderun Bay, Turkey	2011/2012	77	8.9–78.4	8–50	Başusta et al. 2013
24	Jakljan island (mid-E Adriatic), Croatia	17.10.2012	1	66.3	—	Sulić Šprem et al. 2014
25	Trebinje (Middle eastern Adriatic), Croatia	17.03.2013	1	49.2	—	Dulčić et al. 2014
26	Lampedusa Island, Italy	07.10.2013	1	41	20	Azzurro et al. 2014
27	Avola (South eastern Ionian Sea), Italy	16.01.2014	1	65	15–20	Kapiris et al. 2014
28	El Kala, Algeria	14.12.2013	1	—	—	This study
29	Annaba, Algeria	11.01.2014	2	32–48	50–60	This study

N = number of specimens studied.

the basis of photographs and according to the observations made on the site of capture. These photographs allowed clear recognition of important taxonomic characters which are in agreement with the descriptions of Smith and Heemstra (1986) and Turan (2007).

Data on the three catches are given in Table 2. The body of the captured specimens was elongated and cylindrical, slightly compressed laterally and ventrally (Fig. 2). Back and upper flanks silvery to grey covered with black dots. The belly was white and rough. The dorsal and anal fins were short-based and posterior in position. These specimens are also characterized by: the absence of body scales, two quite distinct lateral lines, gill opening of a single slit in front of the pectoral fins, pectoral fins with a wide base and a round posterior edge, top of the pectoral fin base below the lower margin of the eye, a distinct wide silver band on the lower part of the flanks and a silver blotch in front of the eyes, dark pectoral fin base and white belly, grey-brownish dorsal area with black, regularly distributed spots of equal size.

Lagocephalus sceleratus was thought to be absent from the entire African Mediterranean coast (Shakman and Kinzelbach 2007), although its presence was suspected by Golani (2010). Our observations provided additional evidence—after Jribi and Bradai (2012), Milazzo et al. (2012), and Ben Souissi et al. (2014)—of the occurrence of *L. sceleratus* along the North African coast and its spread in the Western Mediterranean. The relatively large size of individuals captured and their presence in the Far East of Algerian coast suggests their arrival from their last place of record on the north-western coast of Tunisia, near Tabarka (Ben Souissi et al. 2014). Among specimens collected in Tunisia, some females were mature with ripe gonads (gonad weight up to 245 g), suggesting that a breeding population may be established.

Lagocephalus sceleratus is the sixth non indigenous teleost fish species recorded in Algeria, after the Senegalese sole, *Solea senegalensis* Kaup, 1858 (see Chaoui and Kara 2004); the Bermuda sea chub, *Kyphosus sectator* (Linnaeus, 1758) (see Hemida et al. 2004); the blue-spotted cornetfish, *Fistularia commersonii* Rüppell, 1838 (see Kara and Oudjane 2009); the spotted halfbeak, *Hemiramphus far* (Forsskål, 1775) (see Kara et al. 2012); and the blackmouth splitfin, *Synagrops japonicus* (Döderlein, 1883) (see Hannachi et al. in press*). It is the second representative of Tetraodontidae found after the

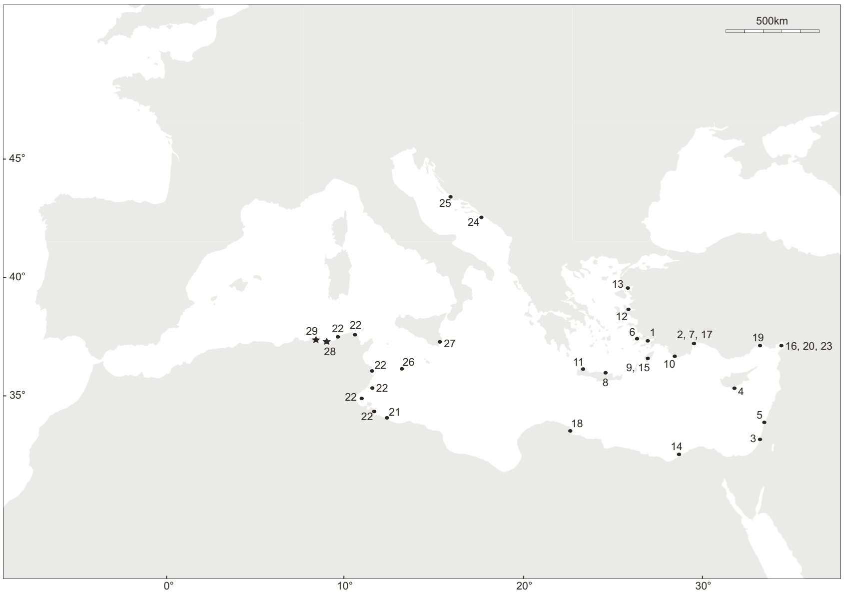

Fig. 1. Map pointing out the capture area of *Lagocephalus sceleratus* on Algerian coasts (stars) and chronology of the first records in the Mediterranean; Record numbers explained in Table 1

Table 2

Characteristics of catches of *Lagocephalus sceleratus* carried out on the Eastern coast of Algeria

No.	Locality	Geographic coordinates	Date	Depth [m]	TL [cm]	W_t [g]	Fishing gear
1	El Kala	36°56′16″N, 8°27′21″E	14/12/2013	—	—	—	Gillnet
2	Annaba	36°54′22″N, 7°54′38″E	11/01/2014	60	48	1400	Trawl
3	Annaba	36°54′30″N, 7°48′12″E	11/01/2014	50	32	788	Trawl

TL = total length, W_t = total weight.

* Hannachi M.S., Boubekeur M.S., Derbal F., Kara M.H. 2015(?) Unusual presence of juveniles of the Indo-Pacific blackmouth splitfin *Synagrops japonicus* in the south-west Mediterranean coast. Acta Adriatica, in press.

Fig. 2. Specimen of *Lagocephalus sceleratus* (No. 02 from Table 2; 48 cm TL) captured in Annaba on 11 January 2014

blunthead puffer, *Sphoeroides pachygaster* (Müller et Troschel, 1848) (see Hemida et al. 2009). The observed increase of the mean annual temperature observed within the last several years in the Mediterranean waters (Béthoux et al. 1990, Francour et al. 1994, Vargas-Yáñez et al. 2005) could possibly explain the recent spreading of Lessepsian migrants from the eastern to the western Mediterranean basin, and their progressive geographical dispersal (Koukouras et al. 2010). In addition to the presently observed warming of the western basin, the changes in the main current circulation in the Mediterranean during the last few decades may also explain the recent spread of Red Sea species towards the western basin (see Francour et al. 2010, Otero et al. 2013). To reach the Algerian coast, *L. sceleratus* moved from East to West against the general current circulation along the North African coast. However, its spreading to the north-western basin, especially along the Italian and French coasts will be favoured by the Ligurian Current and we can then predict its subsequent spreading northward.

Lagocephalus sceleratus has already established a population, which is colonizing new territories of the eastern Mediterranean at a relatively rapid rate. Today, it is regarded to be among the most successful invasive species in the Mediterranean Sea with a significant impact on the surrounding ecosystem and on the fisheries sector (Zenetos et al. 2005, Peristeraki et al. 2006, Streftaris and Zenetos 2006). Kalogirou (2013) classified this species as a pest for fisheries and a potential threat for biodiversity, and *L. sceleratus* has been included in the black list of the 18 worst fish species by the IUCN (Otero et al. 2013). More importantly, *L. sceleratus* is considered to be a serious hazard to consumers since it contains a strong marine toxin called tetrodotoxin (TTX), which can be lethal to humans (Kasapidis et al. 2007, Bentur et al. 2008, Eisenman et al. 2008, Katikou et al. 2009). TXT is a non-protein organic compound (aminoperhydroquinazoline) and one of the strongest marine paralytic toxins known today (El-Ganainy et al. 2006). Up to now, three cases of poisoning of persons who had consumed this fish were reported from Israel, Lebanon (Golani et al. 2006), and Tunisia (Ben Souissi et al. 2014). In Egypt, although landing of these fishes is forbidden as a commercial species, they are illegally landed and consumed as food in the Red Sea and Gulf of Suez areas. It is considered delicious seafood in Suez City, Egypt, where it is illegally sold, decapitated and eviscerated (Halim and Rizkalla 2011) in spite of several fatal poisonings being reported there (Zaki 2004). Thus, the dramatic spread of the species along the Mediterranean coast reinforces the need for a public information campaign, especially in North African countries, to raise awareness of the dangers to human health (Azzurro 2010). To implement such an information campaign, a previous clear information workflow from scientists to public authorities and policy makers should be established.

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