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Rapid Communication

New records of the silver-cheeked toadfish *Lagocephalus sceleratus* (Gmelin, 1789) in the Tyrrhenian and Ionian Seas: early detection and participatory monitoring in practice

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Abstract

The silver-cheeked toadfish *Lagocephalus sceleratus* (Gmelin, 1789)—an invasive toxic species well established in the eastern Mediterranean—is rapidly expanding through the western Basin and a public campaign was set to inform Italian citizens on the risks associated with its consumption. Both news media and local communities responded rapidly to the initiative generating an increasing flow of information. On 15 April 2016, a new capture of this species (off Briatico, Calabria, Italy at 25 m of depth), was promptly reported to the authors, representing the first documented record of *L. sceleratus* from the Tyrrhenian Sea. On 7 June 2016, a second specimen was captured at Montebello Ionico in Calabria. This case of early detection is here presented as a successful example of interplay among citizens, researchers, and policy makers: a powerful approach for monitoring the spread of invasive species and reducing their potential impacts through increasing awareness.

Key words: pufferfish, biological invasions, Mediterranean

Introduction

Early detection and rapid response (EDRR) is recognized as a key aspect for invasive species management (Genovesi and Shine 2004) and acknowledged by the European Commission (COM 2008). These principles, today included in the new European regulation (EU) No 1143/2014 on the prevention and management of the introduction and spread of invasive alien species, are deemed to be crucial for tackling unwanted invasions. Promoting public awareness and disseminating information to the local communities, even through specific alerts, is a key driver to promptly detect unwanted invasive species and in the last few years several theoretical frameworks have been developed through formalised early warning systems (Genovesi et al. 2010). Besides these theoretical efforts, mostly elaborated at the policy level, members of the public are increasingly participating in scientific research (Shirk et al. 2012) opening new potential for tracking biodiversity changes in both terrestrial and marine environments (Simpson et al. 2009; see Azzurro et al. 2013 for exotic fish species in the Mediterranean Sea). These "contributory projects" (*sensu* Shirk et al. 2012),

which are generally designed by scientists and for which members of the public primarily contribute data, have great potential for tackling the issue of invasive species. They may provide early detection, generate large data sets, and ultimately contribute to management actions.

The silver-cheeked toadfish *Lagocephalus sceleratus* (Gmelin, 1789) (Tetraodontidae), one of the "worst" invaders of the Mediterranean Sea (Streftaris and Zenetos 2006), is expanding rapidly through the western Mediterranean Sea. Due to its toxicity, many Mediterranean countries have promptly responded by informing the general public about the risks associated to the consumption of this species. These awareness initiatives, necessary to limit the impacts of this invasion (Nader et al. 2012), have been carried out in countries such as Egypt, Turkey, Lebanon, Cyprus, Greece and Tunisia (see Ben Souissi et al. 2014 and references therein). Today, the consumption of the silver-cheeked toadfish is illegal in many nations, including Japan and Malaysia where other pufferfish are traditionally (and legally) consumed. At the European level, European Regulations Directive 91/493/CEE, 853/2004/EC and 854/2004/EC have issued a ban on the fishery, marketing, and consumption of *L. sceleratus* and Italy bans the commercialization of all Tetraodontidae (Art. 5 DL n. 531/1992).

Due to the rapid expansion of the silver-cheeked toadfish through the Strait of Sicily (Jribi and Bradai 2012), Italian researcher, at the Institute for Environmental Protection and Research (ISPRA) initiated information gathering activities among southern Sicilian fisheries but no further observations of this species were recorded until 2013. The first documented record of *L. sceleratus* from Italian waters is dated 7 October 2013 from Lampedusa Island (Azzurro et al. 2014) and prompted a series of initiatives at both the national and local scale. Other observations indicating rapid expansions of this species' distribution were documented in Algeria (Kara et al. 2015), Malta (Deidun et al. 2015), Spain (Katsanevakis et al. 2014), and in the Eastern Adriatic Sea (Šprem et al. 2014).

Material and methods

On 22 December 2015, a national awareness campaign was launched by ISPRA in collaboration with the Ministry for Agricultural and Forestry Policies, the Italian Harbour-master's Office, and the web platform http://www.seawatchers.org hosted by the Institute of Marine Sciences—Consejo Superior de Investigaciones Científicas ICM-CSIC of Barcelona (Spain). This campaign reinforced those initiatives undertaken soon after the first record of *L. sceleratus* in Italian waters (Andaloro et al. 2016). The communication with the public (ongoing) is mostly set through the dissemination of a fact sheet (Figure 1), written in Italian, which warns of the risks associated with the consumption of this species. The first section of the factsheet contains a description of *L. sceleratus,* an update on its geographical spread in the Mediterranean Sea, and warnings about its toxicity—specifying that tetrodotoxin is resistant to cooking. The second section of the factsheet explains how to recognize *L. sceleratus* from other co-occurring pufferfish [i.e., *L. lagocephalus* (Linnaeus, 1758) and *Sphoeroides pachigaster* (Müller and Troschel, 1848)]. In case of capture/observation of the silver-cheeked toadfish, fishermen were invited to immediately contact ISPRA. A dedicated email "pescepalla@isprambiente.it" plus three telephone numbers were made public to receive such information. The campaign was advertised by different media sources ranging from popular TV programmes to online articles and local newspapers. Here we present two new Mediterranean records of *L. sceleratus*. In both cases, researcher made direct contacts with the fisherman to verify the observation and acquire specific details.

Results and discussion

On 15 April 2016, an adult specimen of *L. sceleratus* (Figure 2) was captured by purse seine targeting the European pilchard (*Sardina pilchardus*), 1.85 km off the Briatico coasts (Calabria, Italy) (Lat 38.742; Long 16.033), at 25 m of depth. This unusual capture, which represents the first documented occurrence of silver-cheeked toadfish in the Tyrrhenian Sea, was documented through a video recording by a local newspaper and communicated to ISPRA researchers the same day as the capture. Then, researchers validated the record and immediately alerted the local harbour officer who traced the fisherman. The specimen, kept frozen by the same fishermen and then shipped to the ISPRA laboratories, weighed 2.463 kg and was 58 cm total length (TL). At the same time, ISPRA launched a press release and published a short video (http://www.youtube.com/watch?v=c2fjI7pYGIg) to promote the alert. On 7 June 2016, a second specimen was recorded from Montebello Ionico, Calabria at "Saline Ioniche" (Lat 37.925; Long 15.754) and promptly posted to seawatchers.org (http://www.observadoresdelmar.es/observacio-detall.php?projecte_id=9&id=5549). The specimen, of an estimated weight of 4 Kg, was captured by surfcasting at a depth of 4 meters on a sandy bottom and then released alive. This latter stands for the second record of *L. sceleratus* in the Ionian Sea, the

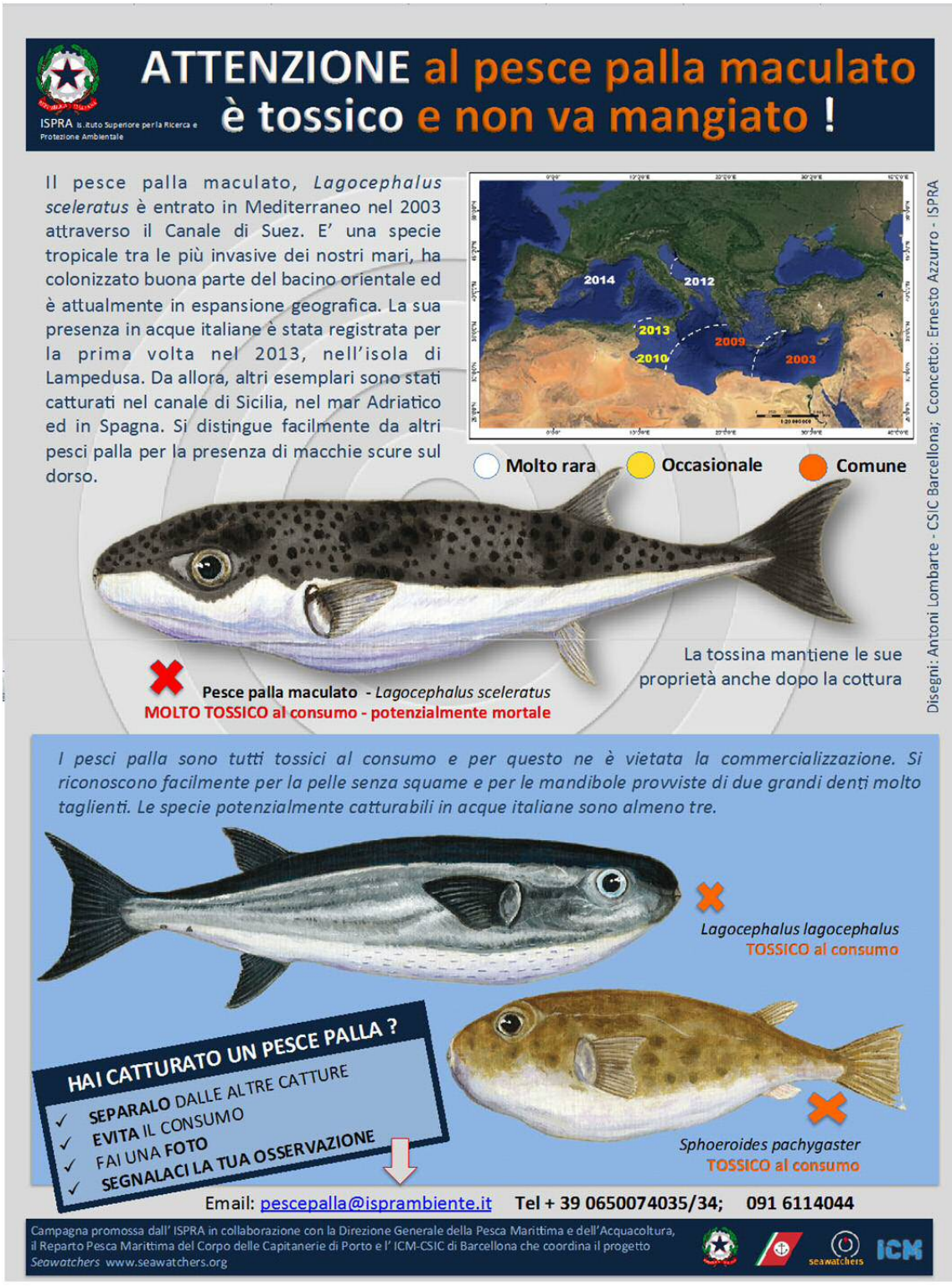

Figure 1. Poster advertising the toxicity of the *Lagocephalus sceleratus*, as part of the information campaign carried out in Italy, with information on other pufferfish occurring in the area. Drawings of A. Lombarte. The high resolution version of the poster can be downloaded at http://www.isprambiente.gov.it/files/comunicati-stampa/2015/Locandina_pesce_palla.pdf .

Figure 2. On the left, the silver-cheeked toadfish captured off Briatico, Italy, Southern Tyrrhenian Sea (Photo credits: Lieutenant O Iemma); on the right the specimen captured at Saline Ioniche (Ionian Sea). Photo credits: P Romeo.

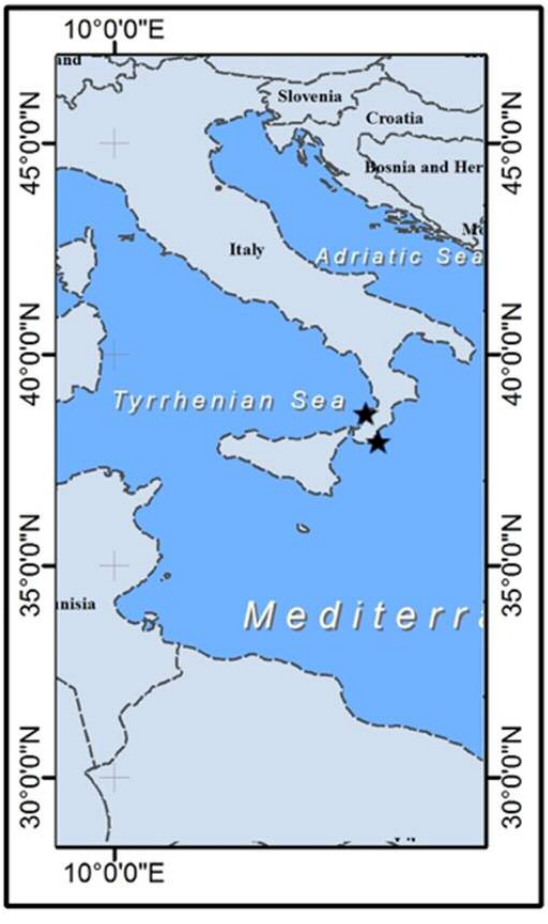

Figure 3. Two new occurrences of *Lagocephalus sceleratus* in the Tyrrhenian and Ionian Seas according to the present study.

first capture being reported in January 2014 near Syracuse (south-east Ionian Sea) by Kapiris et al. (2014). Similarly to the case reported by Azzurro et al. (2014) and dealing with the first Italian record of *L. sceleratus,* this new capture generated a great deal of interest among the media and social networks. The number of Italian articles and web pages providing information on "*Lagocephalus sceleratus*" and published online, jumped from 39 (in 2015) to 215 (in May 2016) (Source: "Google news" retrieval engine). As often happens for toxic or venomous species (e.g., Hayes and Mackessy 2010), it must be noted that the alert campaign also stimulated a series of sensationalistic reports in the lay press, some of them providing incorrect identifications. This is for example the case of the oceanic puffer *Lagocephalus lagocephalus* (Il Tirreno 2016) and the brown trout *Salmo trutta* (Leccesette 2015), misidentified with the highly venomous silver-cheeked toadfish. Notwithstanding these inaccurate new reports, it must be admitted that the clamour raised about a toxic invasive species probably triggered intense interest in local communities and encouraged a spontaneous exchange of information based on mutual benefit and interest. Outcomes of this entire process are not limited to the (early) detection of invasive species in new locations but must be also related to social aspects, such as an increased awareness on this issue of public concern. These activities are also expected to ameliorate the willing of local communities to be engaged in participatory monitoring and improve the relationships between local communities and public research and management, which are very desirable aspects of every social-ecological system.

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References

Andaloro F, Castriota L, Falautano M, Azzurro E, Deidun A, Fenech-Farrugia A (2016) Public feedback on early warning initiatives undertaken for hazardous non-indigenous species: the case of *Lagocephalus sceleratus* from Italian and Maltese waters. *Management of Biological Invasions* 7: 313–319, http://dx.doi.org/10.3391/mbi.2016.7.4.01

Azzurro E, Broglio E, Maynou F, Bariche M (2013) Citizen science detects the undetected: the case of *Abudefduf saxatilis* from the Mediterranean Sea. *Management of Biological Invasions* 4: 167–170, http://dx.doi.org/10.3391/mbi.2013.4.2.10

Azzurro E, Castriota L, Falautano M, Giardina F, Andaloro F (2014) The silver-cheeked toadfish *Lagocephalus sceleratus* (Gmelin, 1789) reaches Italian waters. *Journal of Applied Ichthyology* 30: 1050–1052, http://dx.doi.org/10.1111/jai.12471

Ben Souissi J, Rifi M, Ghanem R, Ghozzi L, Boughedir W, Azzurro E (2014) *Lagocephalus sceleratus* (Gmelin, 1789) expands through the African coasts towards the Western Mediterranean Sea: A call for awareness. *Management of Biological Invasions* 5: 357–362, http://dx.doi.org/10.3391/mbi.2014.5.4.06

COM (Commission of the European Communities) (2008) Towards an EU strategy on invasive species. COM (2008) 789 final. SEC (2008) 2887 et SEC (2008) 2886

Deidun A, Fenech-Farrugia A, Castriota L, Falautano M, Azzurro E, Andaloro F (2015) First record of the silver-cheeked toadfish *Lagocephalus sceleratus* (Gmelin, 1789) from Malta. *BioInvasions Records* 4: 139–142, http://dx.doi.org/10.3391/bir.2015.4.2.11

Genovesi P, Shine C (2004) European strategy on invasive alien species: Convention on the Conservation of European Wildlife and Habitats (Bern Convention) (No. 18–137). Council of Europe, 67 pp

Genovesi P, Scalera R, Brunel S, Roy D, Solarz W (2010) Towards an early warning and information system for invasive alien species (IAS) threatening biodiversity in Europe. European Environment Agency (EEA). EEA Technical report No 5/2010, 47 pp

Hayes WK, Mackessy SP (2010) Sensationalistic journalism and tales of snakebite: are rattlesnakes rapidly evolving more toxic venom? *Wilderness & Environmental Medicine* 21: 35–45, http://dx.doi.org/10.1016/j.wem.2010.01.006

Il Tirreno (2016) Pesce palla trovato spiaggiato: Guai a mangiarli. Online article published at: http://iltirreno.gelocal.it/cecina/cronaca/2016/05/11/news/pericoloso-pesce-palla-trovato-spiaggiato-1.13453871?ref=search (accessed on 3 October 2016)

Jribi I, Bradai MN (2012) First record of the Lessepsian migrant species *Lagocephalus sceleratus* (Gmelin, 1789) (Actinopterygii: Tetraodontidae) in the Central Mediterranean. *BioInvasions Records* 1: 49–52, http://dx.doi.org/10.3391/bir.2012.1.1.11

Kapiris K, Apostolidis C, Baldacconi R, Başusta N, Bilecenoglu M, Bitar G, Bobori DC, Boyaci YÖ, Dimitriadis C, Djurović M, Dulčić J, Durucan F, Gerovasileiou V, Gökoglu M, Koutsoubas D, Lefkaditou E, Lipej L, Marković O, Mavrić B, Özvarol Y, Pesic V, Petriki O, Siapatis A, Sini M, Tibullo D, Tiralongo F (2014) New Mediterranean marine biodiversity records (April, 2014). *Mediterranean Marine Science* 15(1): 198–212

Kara MH, Lamine EB, Francour P (2015) Range expansion of an invasive pufferfish, *Lagocephalus sceleratus* (Actinopterygii: Tetraodontiformes: Tetraodontidae), to the south-western Mediterranean. *Acta Ichthyologica et Piscatoria* 45: 103, http://dx.doi.org/10.3750/aip2015.45.1.13

Katsanevakis S, Acar Ü, Ammar I, Balci BA, Bekas P, Belmonte M, Chintiroglou CC, Consoli P, Dimiza M, Fryganiotis K, Gerovasileiou V, Gnisci V, Gülşahin N, Hoffman R, Issaris Y, Izquierdo-gomez D, Izquierdo-Munoz A, Kavadas S. Koehler L, Konstantinidis E, Mazza G, Nowell G, Önal U, Özen MR, Pafilis P, Pastore M, Perdikaris C, Poursanidis D, Prato E, Russo F, Sicuro B, Tarkan AN, Thessalou-Legaki M, Tiralongo F, Triantaphyllou M, Tsiamis K, Tunçer S, Turan C, Türker A, Vapici S (2014) New Mediterranean Biodiversity Records (October, 2014). *Mediterranean Marine Science* 15(3): 675–695, http://dx.doi.org/10.12681/mms.1123

Leccesette (2015) E' allarme per il pesce palla maculato avvistato anche in Puglia: è tossico anche cotto. Online article published at: http://www.leccesette.it/dettaglio.asp?id_dett=32248&id_rub=216 (accessed on 3 October 2016)

Nader MR, Indary S, Boustany L (2012) The puffer fish *Lagocephalus scleratus* (Gmelin, 1789) in the Eastern Mediterranean. EastMed Technical Documents (FAO), 34 pp

Shirk JL, Ballard HL, Wilderman CC, Phillips T, Wiggins A, Jordan R, McCallie E, Minarchek M, Lewenstein BV, Krasny ME, Bonney R (2012) Public participation in scientific research: a framework for deliberate design. *Ecology and Society* 17: 29, http://dx.doi.org/10.5751/es-04705-170229

Simpson A, Jarnevich C, Madsen J, Westbrooks R, Fournier C, Mehrhoff L, Browne M, Graham J, Sellers E (2009) Invasive species information networks: collaboration at multiple scales for prevention, early detection, and rapid response to invasive alien species. *Biodiversity* 10: 5–13, http://dx.doi.org/10.1080/14888386.2009.9712839

Šprem JD, Dobroslavić T, Kožul V, Kuzman A, Dulčić J (2014) First record of *Lagocephalus sceleratus* in the Adriatic Sea (Croatian coast), a Lessepsian migrant. *Cybium* 38: 147–148

Streftaris N, Zenetos A (2006) Alien Marine Species in the Mediterranean – the 100 "Worst Invasives" and their impact. *Mediterranean Marine Science* 7: 87–118, http://dx.doi.org/10.12681/mms.180