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FIRST RECORD OF THE LONG-JAWED SQUIRRELFISH *HOLOCENTRUS ADSCENSIONIS* (OSBECK, 1765) IN THE ADRIATIC SEA

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ABSTRACT

A specimen of Holocentrus adscensionis (Osbeck, 1765) was observed, photographed and filmed for several days in August 2022 in the shallow rocky zone of the WWF Miramare marine protected area near Trieste (Gulf of Trieste, northern Adriatic). This is the first record of this species in the Gulf of Trieste and in the Adriatic Sea, and the second in the Mediterranean Sea.

Key words: *Holocentrus adscensionis*, Holocentridae, Atlantic influx, Gulf of Trieste, Mediterranean Sea

PRIMA SEGNALAZIONE DEL PESCE SCOIATTOLO *HOLOCENTRUS ADSCENSIONIS* NEL MARE ADRIATICO

SINTESI

Un esemplare di Holocentrus adscensionis (Osbeck, 1765) è stato osservato, fotografato e filmato per diversi giorni nell'agosto del 2022 nella zona rocciosa poco profonda dell'area marina protetta WWF Miramare, vicino a Trieste (Golfo di Trieste, Adriatico settentrionale). Si tratta del primo avvistamento di questa specie nel Golfo di Trieste e nell'Adriatico, e del secondo nel Mediterraneo.

Parole chiave: *Holocentrus adscensionis*, Holocentridae, afflusso atlantico, Golfo di Trieste, Mediterraneo

INTRODUCTION

The ongoing process of biotic globalisation evidenced by the arrival of new species to the Mediterranean Sea is affecting its marine biodiversity at an alarmingly high rate. The number of alien fish species in the Mediterranean has substantially increased after year 2000 with approximately 40% of the total number of fish species arrivals reported after the beginning of the 21st century (Zenetos *et al.*, 2017). Many fish species came to the Mediterranean Sea through the Suez Canal, some through the Strait of Gibraltar, some unaided by human activities (Zenetos *et al.*, 2012), others by following towed oil platforms (Dragičević *et al.*, 2012; Paiuelo *et al.*, 2016). The northernmost portion of the Adriatic Sea is also affected by the invasion of alien fish species from the Red Sea, known as Lessepsian migration (Lipej & Dulčić, 2004).

This paper presents the first record of *Holocentrus adscensionis* (Osbeck, 1765) in Italian and Adriatic waters and proffers a possible explanation for it.

MATERIAL AND METHODS

The shoreline of the Miramare Marine Protected Area (MPA) near Trieste is mainly characterised by structured rocky limestone bottom with many different habitat types, and sediment-bottom areas. On August 14, during a night dive, one of the divers visiting the Miramare MPA (Gulf of Trieste, northern Adriatic Sea), spotted a fish with a distinctive red livery. Alerted at the end of the dive, MPA researchers began an immediate search for the individual, and after two days and more than 300 minutes of diving, on August 16, the team located the specimen hiding among the rocks below the south wall of Miramare Castle at a depth of about 3.5 m (Fig. 1).

The sighting area appears to be a rocky landslide composed of medium-sized limestone boulders covered by turf and colonised mainly by organ pipe sponges (*Aplysina aerophoba*) and black sponges of the genus *Sarcotragus*. The area is characterised by a high density of fish fauna. During the first day of sighting, the researchers focused on taking photographs and video material suitable for identifica-

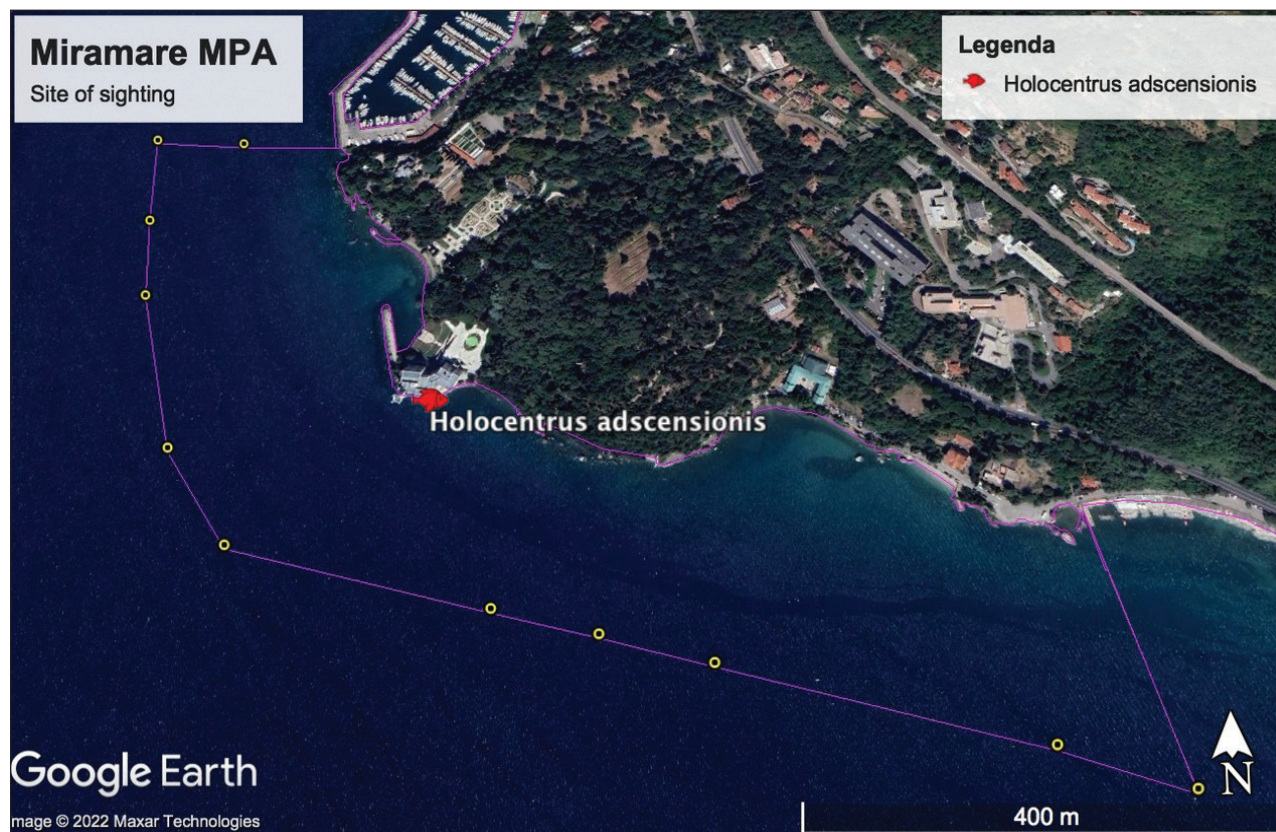


Fig. 1: Map of the study area indicating the locality where the specimen of *Holocentrus adscensionis* was photographed and filmed.

Sl. 1: Zemljevid obravnavanega območja z lokaliteto, kjer je bil fotografiran in posnet primerek vrste *Holocentrus adscensionis*.



Fig. 2: A specimen of long-jawed squirrelfish *Holocentrus adscensionis*, photographed in the marine protected area of WWF Miramare near Trieste on August 16, 2022. **Sl. 2:** Primerek vrste veveričjaka *Holocentrus adscensionis*, fotografiran 16. avgusta 2022 v zavarovanem območju WWF Miramare.

tion. On the following day, they tried to capture the specimen with a hand net. Unfortunately, the specimen eluded capture and the next day, despite intense effort, the researchers were no longer able to spot it.

RESULTS AND DISCUSSION

Based on direct observations, digital photographs and videos, the specimen was identified as a *Holocentrus adscensionis* (Osbeck, 1765) (Fig. 2). The main distinguishing features were the two rather long spines on the head, with the preopercular spine distinctly larger than the opercular one (Fig. 3) (Fischer *et al.*, 1981). In addition, the posterior margin of upper jaw reached the posterior margin of pupil (Uyeno *et al.*, 1983). The anterior part of the dorsal fin with 11 spines was, as usual in this species, yellowish. The anterior part of the soft dorsal fin rays and the upper caudal lobe were distinctly elongate. The dorsal fin was without the evident white spots behind the tip of each spine (Greenfield, 2003) that are typical of a related species, *H. rufus*. The specimen was characterised by a long and oblong

body with slender caudal peduncle. The body had a faint pattern of alternating red and white transverse stripes. The breast and belly were white. The front part of the head was dark red with the white streak on the cheek clearly visible.

The specimen was hiding in a small cavity, making rare excursions out of its shelter. During the few exits outside its shelter in the rock crevices it was immediately attacked by different seabream species (genus *Diplodus*).

The long-jawed squirrelfish inhabits the waters of the western Atlantic coast from North Carolina (USA) to Brazil, including the Gulf of Mexico and the Caribbean (Woods & Greenfield, 1978), and of the eastern Atlantic coast from Gabon to Ascension Island (Ben-Tuvia, 1990). The long-jawed squirrelfish feeds on meroplankton, including crab and shrimp larvae, as well as juvenile fish, and mainly during the night (Beets, 1997). During the day it generally hides in the crevices within coral colonies (Greenfield, 1981). The long-jawed squirrelfish prefers structurally more complex habitats, as they offer more shelter place (Ferreira *et al.*, 2004). This was also the case in the Miramare MPA. Since *H.*

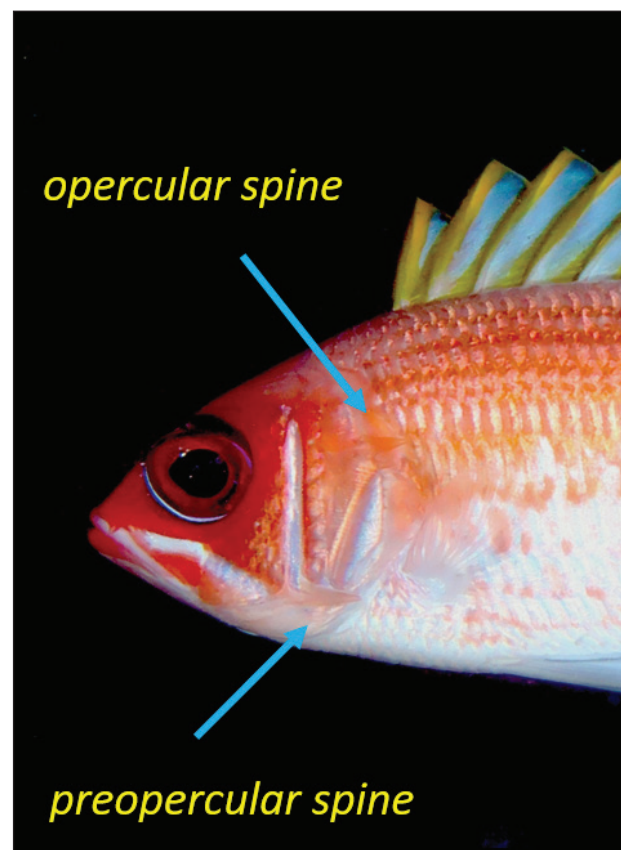


Fig. 3: Head detail of the specimen of *Holocentrus adscensionis* showing opercular and preopercular spines. **Sl. 3:** Detajl glave primerka vrste *Holocentrus adscensionis*, na katerem sta vidna operkularni in preoperkularni trn.

Tab. 1: Non-native fish species recorded in the Gulf of Trieste. Legend: AT – species arrived through the Gibraltar Strait (Atlantic influx), AQ – released aquarium fish, LM – Lessepsian migration, M – month, n - number of specimens, I – introduction, Y – year, IT – Italy, and SI – Slovenia.

Tab. 1: Tujerodne in druge vrste, opažene v Tržaškem zalivu. Legenda: AT – vrste, ki so prišle skozi gibraltarsko ožino (atlantski vtok), AQ – ribe, izpuščene iz akvarija, LM – lesepska selitev, M – mesec, n – število primerkov, I – vnos ali prihod, Y – leto, IT – Italija, in SI – Slovenija.

species	locus	Y	M	n	I	source
<i>Plectorhinchus mediterraneus</i>	Miramare (IT)	1993	Aug	1	AT	Lipej <i>et al.</i> , 1996
<i>Plectorhinchus mediterraneus</i>	Piran (SI)	1993	Dec	1	AT	Lipej <i>et al.</i> , 1996
<i>Epinephelus coioides</i>	Gulf of Trieste (IT)	1998	May	1	LM	Parenti & Bressi, 1998
<i>Terapon theraps</i>	Gulf of Piran (SI)	2007	Aug	1	LM	Lipej <i>et al.</i> , 2007
<i>Siganus luridus</i>	Miramare (IT)	2010	Aug	1	LM	Poloniato <i>et al.</i> , 2010
<i>Stephanolepis diaspros</i>	Gulf of Piran (SI)	2013	Sep	1	LM	Lipej <i>et al.</i> , 2014a
<i>Chrysiptera cyanea</i>	Portorož (SI)	2014	Aug	3	AR	Lipej <i>et al.</i> , 2014b
<i>Oplegnathus fasciatus</i>	Trieste (IT)	2015	Sep	1	AT	Ciriaco & Lipej, 2015
<i>Abudefduf saxatilis</i>	Muggia (SI)	2021	Aug	1	AT	Lipej <i>et al.</i> , 2021
<i>Holocentrus adscensionis</i>	Miramare (IT)	2022	Aug	1	AT	This work

adscensionis is a nocturnal species, it may have been previously overlooked in Mediterranean waters, as already pointed by Vella *et al.* (2016).

According to Kovačić *et al.* (2020), 444 fish species were confirmed in the Adriatic Sea through an evidence based approach. Their checklist did not include the squirrelfish, so the finding of *H. adscensionis* in the Gulf of Trieste represents an additional species to be added to the Adriatic checklist and the first record in Italian seas. It also represents the second record of this squirrelfish species in the Mediterranean after it was recorded by Vella *et al.* (2016) in Maltese waters. The family Holocentridae comprises about 83 species, which are mostly found in waters below 100 m of depth (Nelson *et al.*, 2016). Some of them are important in commercial and recreational fisheries.

Until recently, the redcoat squirrelfish, *Sargocentron rubrum* (Forsskal, 1775) was the only squirrelfish species reported in the Mediterranean basin. It was recorded as early as 1947 by Haas & Steinitz (1947) in Israeli waters and later on the north African coast in Libya (Štirn, 1970). Nowadays, this species is reported to be established (Golani & Ben Tuvia, 1985) and relatively common along the Mediterranean coast of Egypt (*sensu* Farrag *et al.*, 2018). The second reported species, as previously mentioned, was the *H. adscensionis* recorded

in the Maltese waters of the Mediterranean Sea by Vella *et al.* (2016). Over the past two years another three squirrelfish species have been discovered in Mediterranean for the very first time. In 2021, *Sargocentron spinosissimum* (Temminck & Schlegel, 1843) and *Sargocentron tiereoides* (Bleeker, 1853) were found in the Mediterranean waters of Egypt (Deef, 2021), while in 2022 the first Mediterranean record of silverspot squirrelfish *Sargocentron caudimaculatum* (Rüppell, 1838) was reported from Tunisian waters (Ghanem *et al.*, 2022).

Despite their northernmost position, the Gulf of Trieste and the adjacent northern Adriatic Sea have witnessed many alien fish species. Their introductions are well documented, but their number is much lower compared to other Mediterranean areas. The very first alien species documented in the northern Adriatic was the silver pomfret *Pampus argenteus*, which was caught in the waters off Rijeka (Fiume) in 1896 (Dulčić *et al.*, 2004). Further new arrivals to the study area (Gulf of Trieste) were not reported until 1993, when a specimen of rubberlip grunt *Plectorhinchus mediterraneus* (Guichenot, 1850) was caught in the waters off Miramare and another in the Bay of Piran (Lipej *et al.*, 1996), and in 1998, when an orange-spotted grouper (*Epinephelus coioides*) was captured alive and kept in the Trieste aquarium (Parenti & Bressi, 1998).

Later other alien fish species were reported as well, such as the large-scaled terapon *Terapon theraps* Cuvier, 1829 in the waters off Piran in 2007 (Slovenia) (Lipej *et al.*, 2008), *Siganus luridus* (Rüppell, 1829) at Miramare (Trieste) (Poloniato *et al.*, 2010), the reticulated leatherjacket *Stephanolepis diaspros* (Fraser-Brunner, 1940) in the Bay of Piran (Lipej *et al.*, 2014a), the barred knifejaw *Oplegnathus fasciatus* (Temminck & Schlegel, 1843) in the waters off Muggia (Ciriaco & Lipej, 2015), and the sergeant major *Abudefduf saxatilis* (Linaneus, 1758) at Punta Sottile, Muggia (Lipej *et al.*, 2020). There was also a case of an intentional release of three specimens of blue devil *Chrysiptera cyanea* (Quoy & Gaimard, 1825) from aquaria in the waters off Piran (Lipej *et al.*, 2014b). One of these, which was collected by divers, was kept in the aquarium tank of the Marine Biology Station Piran for many months until it died. Since the majority of alien species were sighted or caught only as single specimens, it is rather difficult to speculate about the means of their arrival to the Gulf of Trieste.

After the first record of *S. luridus* in the Adriatic Sea, obtained through observations, photographs, and videos of a single specimen at Bagno Ducale (Miramare MPA, Trieste) (Poloniato *et al.*, 2010), the species was subsequently also recorded in other parts of the Adriatic Sea (Dulčić *et al.*, 2011). The same occurred with some other mentioned aliens: *T. theraps* was later confirmed in Greek waters, *O. fasciatus* was captured some months after the first record in the waters off Rijeka (Dulčić *et al.*, 2016), and *A. cf. saxatilis/vai-giensis/troschellii* was confirmed in the Adriatic, also by Dragičević *et al.* (2021).

Although a captured specimen that was properly prepared, and stored in a registered museum collection, thus enabling the acquisition of basic biometric and mer-

istic data as well as material for genetic research, would be more appreciated by ichthyologists, high-quality evidence testifying to the occurrence of the species, such as photographs and film recordings, is sufficient to confirm the presence of a species in a certain environment (*sensu* Kovačić *et al.*, 2020). This is especially true with regard to tropical species, which often stand out for their colourful patterns. The photographed records of rare or endangered species are very important and may even constitute the only evidence of the presence of certain species (Lipej *et al.*, 2005). Regular monitoring of alien fish species in the Gulf of Trieste and elsewhere in the Adriatic Sea and in the Mediterranean is an important prerequisite for understanding the impact of newcomers on the native biota. This is also important in the case of squirrelfish species, since some of them (such as *S. rubrum*) have already established viable populations in the eastern Mediterranean Sea. According to some authors, *H. adscensionis*, the long-jawed squirrelfish, is a potentially successful invader since it demonstrates great resilience, being able to survive for many days inside traps and in polluted areas (Wyatt, 1983).

This record of the long-jawed squirrelfish is further evidence of how effective a tool citizen science can be in the monitoring of alien species in the Mediterranean Sea (Crocetta *et al.*, 2017; Tiralongo *et al.*, 2019).

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PRVI ZAPIS O POJAVLJANJU VRSTE VEVERIČJAKA *HOLOCENTRUS ADSCENSIONIS*
(OSBECK, 1765) V JADRANSKEM MORJU

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POVZETEK

Na plitvi skalnati brežini znotraj zavarovanega območja WWF Miramare pri Trstu (Tržaški zaliv, severni jadrán) so v več avgustovskih dneh opazovali, fotografirali in posneli primerek vrste *Holocentrus adscensionis* (Osbeck, 1765). Gre za prvi primer opazovanja te vrste v Tržaškem zalivu in Jadranskem morju ter drugi v Sredozemskem morju.

Ključne besede: *Holocentrus adscensionis*, Holocentridae, atlantski vtok, Tržaški zaliv, Sredozemsko morje

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