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Chlorurus rhakoura Randall & Anderson, 1997 (Perciformes, Scaridae), an Indo-Pacific fish new to the Mediterranean Sea

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Abstract

The scarid fish *Chlorurus rhakoura* Randall & Anderson, 1997, of eastern Indo-Pacific origin, is recorded for the first time from the Mediterranean Sea. A small school of six individuals of this species were caught off Portopalo, Sicily, Italy in February 2017. Morphometric measurements and meristic traits are provided based on four specimens, and the possible vector of introduction of the species into the Mediterranean is briefly discussed.

Keywords: *Chlorurus rhakoura,* first record, Indo-Pacific Ocean, Mediterranean Sea, non-native species.

Introduction

The raggedfin parrotfish, *Chlorurus rhakoura* Randall & Anderson, 1997, is a rare species in its native range, present in Sri Lanka and in the Dampier Archipelago, Northwest Australia, (Hutchins, 2004). It was recorded for the first time at Ujung Pulau Cut, West Sumatra and at Simeulue, Indonesia in 2007 (Herdiana *et al.,* 2008). A single individual of *C. rhakoura* was recently (7th September, 2016) found at the Pamban Landing Centre, Gulf of Mannar and was collected and preserved at the museum of the Mandapam Regional Centre, India (Saravanan *et al*., 2016).

C. rhakoura is an inshore reef parrotfish. In the Dampier Archipelago, it occurs in areas of high coral cover. This species is found either solitary or in small schools (Choat *et al*., 2012a).

This note describes a new case of an Indo-Pacific fish introduced into the Mediterranean Sea and documents the presence of a second alien species of Scaridae in the basin, the first being *Scarus ghobban*, Forsskål, 1775 (Goren & Aronov, 2002).

Materials and Methods

On 18th February 2017 a small school consisting of six individuals of an unknown parrotfish were caught by a local professional fisherman using a trawl net. The capture occurred 5 miles SE of Portopalo, province of Syracuse, Sicily, Italy at approximate coordinates 36° 36.561'N - 15° 8.456'E (Fig. 1), on a sandy-rocky bottom at about 40-50 m depth. Four specimens were delivered to the Museo Civico di Storia Naturale di Comiso (province of Ragusa), while two others were unfortunately sold immediately on the fish market (Fig. 2).

The four specimens delivered to the museum, one adult and three subadult females, were identified according to Smith & Heemstra (1986), Randall & Anderson (1997), Bellwood (2001), Choat *et al*. (2012b) and Rajasuriya (2013). Bauchot (1987) and Golani et al. (2006) were also consulted. Morphometric and meristic data are presented in Table 1.

The specimens were preserved in alcohol, in the fish collection of the Museo Civico di Storia Naturale di Comiso with the following catalogue numbers: MSNC 4547; MSNC 4548-1; MSNC 4548-2; MSNC 4548-3.

Results

According to Randal & Anderson (1997), *Chlorurus rhakoura* is one of a complex of three allopatric species of the Indo-Pacific region. The other two species are *Chlorurus oedema* (Snyder, 1909) and *Chlorurus cyanescens* (Valenciennes in Cuvier & Valenciennes, 1840). These three parrotfishes all have a bulbous protuberance of the same shape on the forehead as adults, 3 median predorsal scales, 2 rows of scales on the cheek, and 15 pectoral rays.

C. rhakoura differs from both *C. cyanescens* and *C. oedema* in having a caudal fin with strongly exserted rays, in contrast to a fin with a smooth margin. In *C. Rhakoura*, the caudal fin is longer as a result of the posterior extension of the caudal rays. In addition, the penultimate anal ray of *C. rhakoura* is very long.

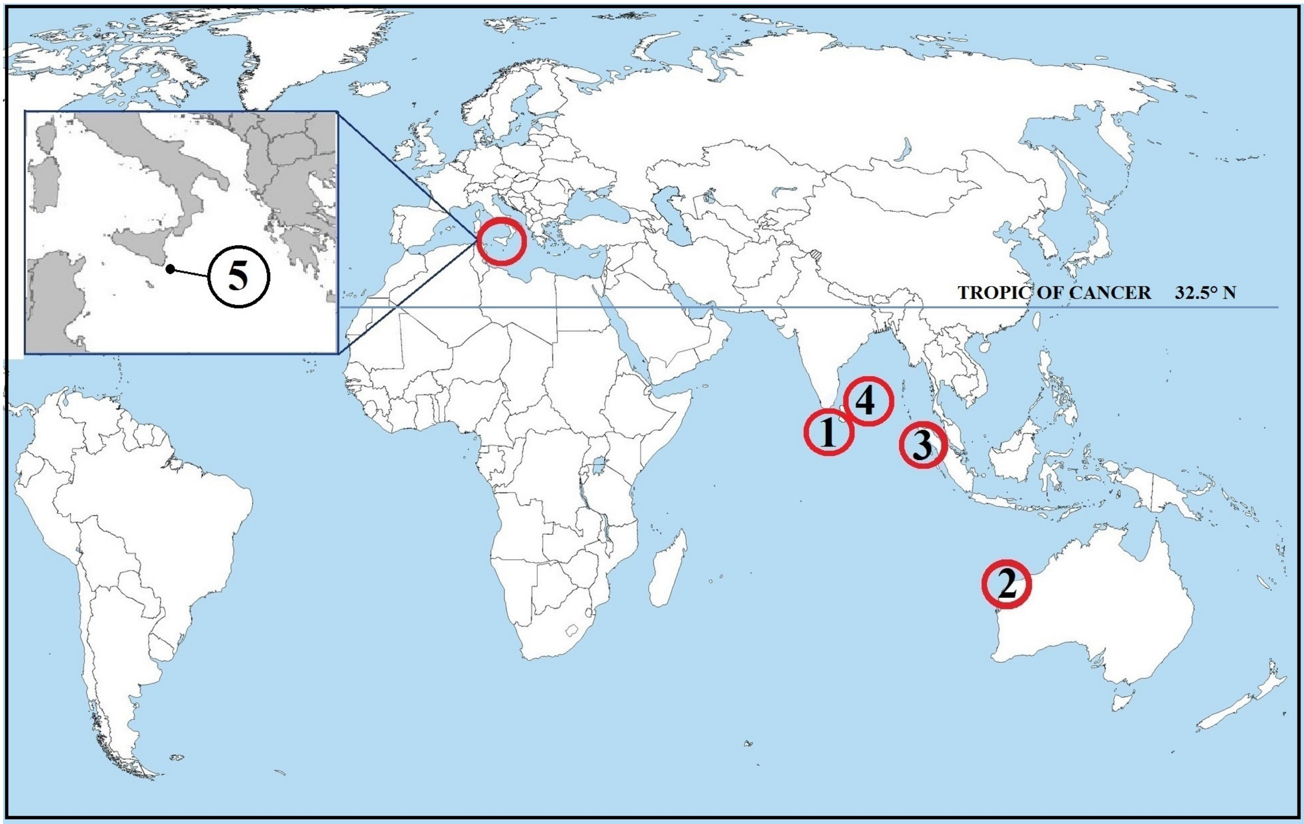

Fig. 1: Record points of *Chlorurus rhakoura* Randal & Anderson, 1997 in the Indo-Pacific Ocean and in the Mediterranean Sea.
1 - Sri Lanka (Randall & Anderson, 1997);
2 - North West Australia, Dampier Archipelago (Hutchins, 2004);
3 - Ujung Pulau Cut, West Sumatra and at Simeulue, Indonesia (Herdiana *et al.,* 2008);
4 - Pamban Landing Centre, Gulf of Mannar, India (Saravanan *et al*., 2016);
5 - Portopalo, Syracuse, Italy (Present work).

Fig. 2: The six freshly caught specimens of *Chlorurus rhakoura* photographed in the fish market of Portopalo (Photo: F. Santocono).

Table 1. Morphometric measurements (mm), meristic counts and weight (g) of four specimens of *Chlorurus rhakoura* caught off Portopalo, Syracuse, Italy, Mediterranean Sea.

Chlorurus rhakoura	MSNC 4547	MSNC 4548-1	MSNC 4548-2	MSNC 4548-3
Sex	F	F	F	F
Total length (mm)	352	275	283	289
Standard length	338	272	278	282
Body depth	117	83	96	98
Body width	49	41	45	46
Head length	92	72	73	75
Snout length	34	26	26	26
Orbit diameter	12	11	11	11
Interorbital width	35	29	31	32
Caudal-peduncle depth	47	33	36	36
Caudal-peduncle length	23	18	16	16
Predorsal length	82	68	70	72
Preanal length	188	151	157	163
Prepelvic length	81	69	69	70
Dorsal-fin base	170	131	139	142
First dorsal spine	30	23	23	24
Ninth dorsal spine	35	25	25	28
Longest dorsal ray	38	28	29	29
Anal-fin base	69	54	58	64
Third anal spine	31	19	20	20
Longest anal ray	45	28	29	28
Caudal fin length	37	19	18	23
Pectoral-fin length	73	49	59	57
Pelvic-spine length	53	34	36	37
Pelvic-fin length	67	42	44	47
Dorsal rays	IX, 10	IX, 10	IX, 10	IX, 10
Anal rays	III, 9	III, 9	III, 9	III, 9
Pectoral rays	15	14	14	14
Weight	1013	451	549	565

One of our specimens, the largest, has 15 pectoral rays; the others have 14 pectoral rays like one of Randal & Anderson's paratypes; all our specimens have 3 median predorsal scales; 2 scale rows on the cheek with the upper row having 7 and the lower row having 5 scales. Our only adult specimen, MSNC 4547, presents the following characteristics: a prominent fleshy protuberance on the forehead (Fig. 3); a premaxillary dental plate with 2 short, laterally projecting teeth; mouth slightly inferior, the gape angling upward about 12° to the horizontal axis of the body; dental plates with a median suture, the upper plate overlapping the lower; surface of dental plates smooth except near margin where slightly nodular, the margin crenulate; lips covering only about one-fourth of dental plates (Fig. 3a); a caudal fin with strongly exserted rays (Fig. 3b), giving the posterior margin a ragged appearance; the penultimate soft rays of the dorsal and anal fins prolonged; the posterior margin of the pectoral fins scalloped. The fresh specimens had the following coloration: dark gray-brown background colour with the body scales having a dull blue-green cast and very dark purplish or deep blue edges; margins of dorsal and anal fins bright blue (Figs 2, 3, 4).

Discussion

Aquatic ecosystems have been subject to some quite spectacular invasions. Compared to terrestrial systems, inland, marine and transitional waters are highly vulnerable to either the accidental or deliberate introduction of species and to their subsequent spread. According to Spanier & Galil (1991), marine taxa could be introduced in new marine ecosystems in several ways, such as movements through corridors, transfer on drifting logs, and by anthro-

Fig. 3: The adult female of *Chlorurus rhakoura* (MSNC 4547) caught off Portopalo, Syracuse, Italy. Detail: premaxillary dental plate with 2 short, laterally-projecting teeth (a), exserted rays of caudal fin (b) (Photos: G. Insacco).

pogenic activities. Today, great attention is paid to unintentional pathways of aquatic alien species introductions through ballast-water (Carlton and Geller, 1993; Ruiz *et al.*, 1995), transport via trailer boats (Leung *et al.*, 2006; Rothlisberger *et al.*, 2010), bait-bucket releases by anglers (Litvak and Mandrak, 1993; Di Stefano *et al.*, 2009), and escapes associated with aquaculture (Naylor *et al.*, 2001; De Silva *et al.*, 2009) or aquarium trade (Katsanevakis et al., 2013). Moreover, intentional release in the wild of marine species kept in aquaria is also acquiring importance as a pathway of introduction (Zenetos *et al.,* 2016).

In the case of our *Chlorurus rhakoura*, an introduction of aquarium specimens is absolutely unlikely since the species does not appear among those regularly captured and sold for aquaria. The species is not of particular interest for amateur breeders, considering its nondescript coloration. Besides, 6 specimens were found, not only one; the fact that, for non-expert eyes, juvenile specimens of *C. rhakoura* could be misidentified with the native *Sparisoma cretense* (Linnaeus, 1758) should not be undervalued; the introduction of the species into the basin via the Suez Canal, through the so-called Lessepsian migration process, appears improbable at the moment, mostly because the species is not reported from the Red Sea (Golani & Bogorodsky, 2010). According to a survey carried out by the Smithsonian Environmental Research Center on

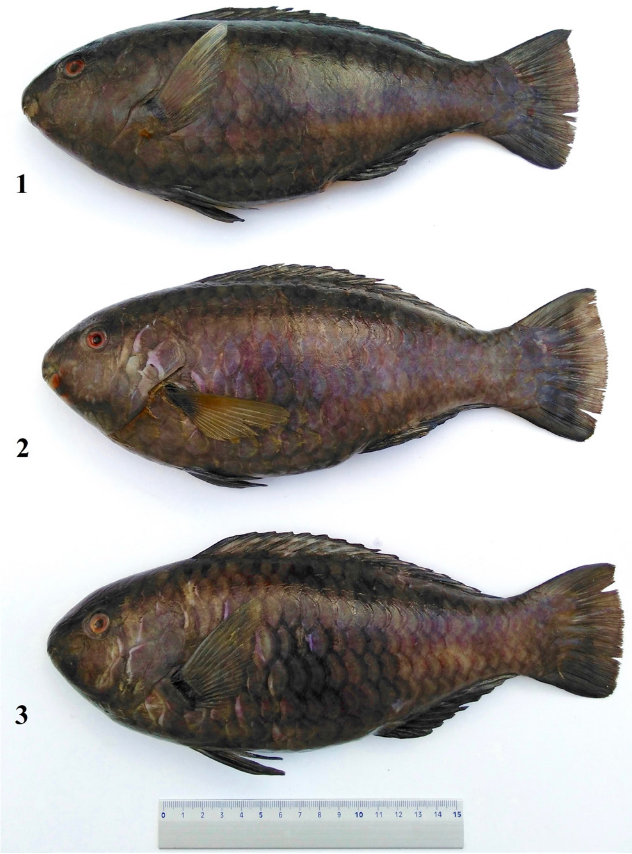

Fig. 4: Subadult females of *Chlorurus rhakoura* (MSNC 4548-1; MSNC 4548-2; MSNC 4548-3) caught off Portopalo, Syracuse, Italy (Photo: G. Insacco).

70 vessels arriving at Chesapeake Bay harbours, 90% of these live organisms are transported in ballast water, including clams and mussels, copepods, barnacles, diatoms, and juvenile fish (Chesapeake Bay Commission, 1995; Darby, 1997). According to Deidun *et al.* (2016), shipping is the leading vector for trade in the world and alone is currently responsible for transporting over 80% of world commodities (UNCTAD/RMT, 2014). Concurrently, the global shipping sector transports approximately three to five billion tons of ballast water internationally every year (GLOBALLAST, 2015). Although ballast water is essential for the safe and efficient cargo operations of all types of vessel, such a process also constitutes a serious threat to ecological, economic and human health systems due to the inadvertent introduction of invasive aquatic species in new marine regions. It is expected that increases in transoceanic vessel traffic (using current ballast practices) will multiply the risk, since introductions are likened to “ecological roulette,” that is, the greater the number of releases with potential invasive species, the more likely it is for an invading species to successfully colonize and grow in numbers (Carlton, 2001a, b; Kolar & Lodge, 2001; Tzankova, 2001). It is thought that the origin of transoceanic vessel traffic from known high-risk donor port regions, such as Southeast Asia, Asia and the Mediterranean (also heavily invaded) is also likely to increase the risk (Williams *et al*., 1988). In the Mediterranean Sea, these dynamics and concerns are even more pronounced due to its status as a biodiversity hotspot and its simultaneous importance as a shipping transit route, linked to the recent expansion of the Suez Canal, completed on the 6th August 2015, which should double maritime traffic through the Canal, with the current average of 49 transits per day expected to increase to 97 passages per day (SCA, 2015; Deidun *et al*., 2016). A vessel from the Eastern Mediterranean arriving in Baltimore harbour in April 1995 was found to contain over 50 actively swimming individuals of a fish (*Liza sp.*) ranging from 30 to 36 cm in length in a ballasted cargo hold (Ruiz and Carlton, 1995). The grates or screens over the ballast sea chest may have fallen off allowing the intake of unusually large species. An interview with the staff of an Italian drilling platform (Scarabeo 9, Saipem) from Soyo, Angola showed that a Bluespotted Seabream or *Cephalopholis taeniops* (Valenciennes, 1828) individual, weighing about 4 kilograms, was found in the sea chest inspection well after a trip from Angola to Las Palmas harbour, Gran Canaria, Canary Islands. This species is known for the Canary Islands as recently introduced (Brito *et al*., 2011). We assume that the scarid *C. rhakoura* had been introduced into the Mediterranean through shipping. According to Schembri & Tonna (2011), transport by shipping is a realistic possibility. The same authors rule out transport in ballast water. However, transport in a sea chest or similar water-filled space of a large vessel, such as postulated in the case of *Oplegnathus fasciatus* Temminck & Schlegel, 1844 (Schembri *et al*. 2010), is a possibility. It is also possible that the fish travelled in association with the fouling on the hull of a vessel, although in this regard, a slow moving barge or drilling platform is a more probable vector than a ship (see discussion in Galil, 2008). In addition, the Maltese Islands and the Sicilian oriental coast are important staging points for drilling platforms, and these occasionally remain moored in coastal waters for weeks, giving ample opportunity for the transport of biota associated with the platform to inshore waters.

As a matter of fact, the intense maritime traffic in the area under study could suggest shipping as the main vector of introduction of the species (larval forms and juveniles) up to the southern Sicilian waters. The harbours of Augusta, Syracuse and Gela, important centres of hydrocarbon loading and unloading operations, as well as the commercial harbour of Catania and Pozzallo are all located near the capture area (Deidun *et al*., 2016; Insacco *et al*., 2017). A check of the naval traffic register of the Capitaneria di Porto, Guardia Costiera of Augusta (Syracuse) has shown that over the last three years at least a dozen ships from the Indian Ocean have crossed the waters under study. According to Darby (1997), the maximum size range of organisms that can be taken into a ship depends on the method of ballasting and the size of the intake screens. Pumped water transfers organisms through pump impellers, which may kill some organisms. If gravity-loading is used, organisms are not transported through an operating pump, thus eluding possible mechanical destruction, although there are still external and internal screens through which larger organisms generally cannot pass. However, exceptions may occur in poorly maintained vessels, allowing these larger organisms to be transported. The findings of *Chlorurus rhakoura* from off the south-eastern coasts of Sicily, presented here, document the first record of the species in the Mediterranean basin. Moreover, the present record is consistent with the role played by the Strait of Sicily as an ecological corridor for the dispersion of species from east to west and from west to east of the basin, as indicated by the recent records of the alien taxa of Atlantic origin *Pisodonophis semicinctus* (Richardson, 1848) (Insacco & Zava, 1999), *Penaeus aztecus* Ives, 1891 (Scannella *et al*., 2017), *Callinectes sapidus* Rathbun, 1896 (Insacco & Zava, 2017) and of the Lessepsian species *Siganus rivulatus* Forsskål and Niebuhr, 1775 (Insacco & Zava, 2016), *Trachysalambria palaestinensis* (Steinitz, 1932) (Insacco *et al*., 2017) and, *Pterois miles* (Bennet, 1828) (Azzurro *et al*., 2017).

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