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New records and underwater observation of the rare fish *Scorpaenodes arenai* (Osteichthyes: Scorpaenidae) from the central and western Mediterranean Sea

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Abstract

New records of the rare Messina rockfish *Scorpaenodes arenai* (Osteichthyes: Scorpaenidae) stranded on the Sicilian coast of the Strait of Messina (central Mediterranean Sea) are reported. Morphometric and meristic characters are given together with information on age data. The first underwater observations by remotely operated vehicle (ROV) in different Mediterranean areas contribute to improve current knowledge on distribution, behavior and habitat preference of this species.

Keywords: *Scorpaenidae*, *Scorpaenodes arenai*, stranding, ROV, Mediterranean Sea

Introduction

The Mediterranean Sea is a region of high biodiversity, with about 17,000 species censused (Coll et al. 2010). However, being a semi-closed basin, the Mediterranean ecosystem has a complex equilibrium, with several environmental and human factors that interact and influence its biodiversity. In particular, the pressure of climate change and anthropic activities (e.g., fishing, maritime traffic, industrial activities, etc.) determined strong impacts on marine species and habitats.

The monitoring of the status and possible changes of Mediterranean biodiversity is, therefore, an important issue to be implemented. The discovery of new species and the finding of non-indigenous species or new records of rare species are important sources of information. In the Mediterranean, Sicilian and Tunisian waters are known as high-diversity hot spots for ray-finned fish (Coll et al. 2010). In particular, the Strait of Messina has long been considered an important area hosting rare and deep-sea species whose stranding makes them available for taxonomic studies (Genovese et al. 1971; Berdar et al. 1977, 1983; Spalletta et al. 1995).

In this paper, the worthy finding of four stranded specimens of the Messina rockfish *Scorpaenodes arenai* Torchio, 1962 (Fam.: Scorpaenidae) is reported, along with underwater observation of this species in different areas of the central Mediterranean Sea. This rare, poorly known species (Spalletta et al. 1995) is the only member of genus *Scorpaenodes* in the Mediterranean Sea. The new records and underwater observations contribute to improve current knowledge on *S. arenai*, particularly on geographical distribution and habitat preference.

Materials and methods

A specimen of 108.9 mm total length (TL) was found stranded on the shore of the Strait of Messina on 13 April 2012. Additional individuals of 70.6, 102.1 and 56.5 mm TL were collected on 12 November 2012, 18 March 2013 and 27 March 2013, stranded in the same area (Table I). Other specimens were observed by means of *Pollux 3*, a remotely operated vehicle (ROV) equipped with a Nikon D80 camera, in four sites of the Central Mediterranean Sea (Table I). Rockfish were

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Table I. Date, location and geographical coordinates of *Scorpaenodes arenai* stranded on the shore of the Strait of Messina, and individuals observed by means of remotely operated vehicle (ROV, *Pollux 3*) in the Mediterranean Sea (*Favazzina is located on the boundaries between the Strait of Messina and the Tyrrhenian Sea on the Calabrian coast).

	Area	Location	Date	Depth	Geographical coordinates	
					Latitude	Longitude
Stranded fish	Strait of Messina	Cape Peloro	13 April 2012	–	38°15'37.95" N	15°37'49.66" E
	Strait of Messina	Cape Peloro	12 November 2012	–	38°15'35.79" N	15°37'35.00" E
	Strait of Messina	Cape Peloro	18 March 2013	–	38°15'34.74" N	15°37'36.50" E
	Strait of Messina	Cape Peloro	27 March 2013	–	38°15'55.76" N	15°38'56.19" E
Fish observed by ROV	Tyrrhenian Sea	Gulf of Naples	23 June 2012	–97.6	40°47'20.10" N	14°15'55.61" E
	Tyrrhenian Sea	Gulf of Naples	23 June 2012	–100.7	40°47'20.34" N	14°15'56.27" E
	Tyrrhenian Sea	Gulf of Naples	24 June 2012	–71.9	40°34'40.83" N	14°25'10.01" E
	Tyrrhenian Sea	Gulf of Naples	24 June 2012	–110.3	40°34'33.96" N	14°25'02.58" E
	Tyrrhenian Sea	Cape of Milazzo	6 August 2014	–135.0	38°14'59.28" N	15°15'35.46" E
	Tyrrhenian Sea	Cape of Milazzo	8 August 2014	–130.0	38°16'27.00" N	15°13'20.46" E
	Strait of Messina*	Favazzina	27 July 2012	–125.7	38°16'02.58" N	15°44'45.25" E
	Strait of Messina*	Favazzina	26 June 2013	–115.0	38°16'12.95" N	15°45'08.47" E
	Strait of Sicily	Graham Bank	15 July 2012	–70.9	37°10'32.91" N	12°42'55.26" E
	Strait of Sicily	Graham Bank	20 June 2014	–102.0	37°09'26.57" N	12°42'09.37" E
	Strait of Sicily	Graham Bank	20 June 2014	–117.0	37°09'28.08" N	12°42'09.09" E
	Strait of Sicily	Graham Bank	20 June 2014	–76.0	37°08'55.48" N	12°42'46.64" E
	Strait of Sicily	Graham Bank	21 June 2014	–103.0	37°10'52.93" N	12°42'44.87" E

photographed and filmed during daytime hours (from 11:26 to 17:15) to acquire diagnostic characters for species identification.

All specimens were identified as *S. arenai* according to Torchio (1962), Eschmeyer (1969), Hureau and Litvinenko (1986) and Bauchot (1987). Images of stranded specimens were taken by digital camera (Figure 1); morphometric measurements were made to the nearest 0.1 mm by a caliper, and mass to the nearest 0.01 g; and meristic data were recorded. Sex was determined by macroscopic observation of gonads, and a maturity stage of development was assigned according to a five-point maturity scale (Holden & Raitt 1974). All stomachs were empty. Sagittal otoliths were removed, cleaned and stored dry. Both left and right otoliths were measured to the nearest 0.01 mm with a Zeiss Discovery V8 stereomicroscope coupled with AxioVision digital image processing software, and age readings were carried out on left sagittae after immersion in a mixture of alcohol and glycerin for about 20 hours.

Stranded specimens were preserved in alcohol 80° and are deposited within the ISPRA (Institute for Environmental Protection and Research) ichthyologic collection held in the Laboratory of Milazzo (fish codes: ISPRA-SCO-ARE-01, ISPRA-SCO-ARE-02, ISPRA-SCO-ARE-03 and ISPRA-SCO-ARE-04).

Results

Morphometric measurements and proportions of *S. arenai* are reported in Table II, whereas meristic and biological data are summarized in Table III.

The stranded specimens had a slightly compressed short body, with a prominent snout and large mouth, lacking palatine teeth. Head spines were well developed, including five suborbital spines on each side and two interorbital spines. Coronal spines were absent. Dorsal fins were made up of 13 hard rays and 10 soft rays. The caudal fin had rounded margins. The first hard ray of the ventral fin was very short, whereas the second one was longer and thicker than the others.

The color was generally reddish-orange with a pale abdomen. The body was crossed by about six vertical reddish-brown bars, and fins were pale with vertical rows or concentric rings of red spots. The mouth showed a whitish color inside. The eye had a dark iris, with brownish radial bands. A black blotch was located between the eighth and eleventh rays of the dorsal fin in three specimens (it is lacking in ISPRA-SCO-ARE-03). Based on the annulation pattern in sagittal otoliths, age estimates ranged between 2 and 5 years.

Analysis of ROV images

The identification of *S. arenai* by ROV underwater observations was carried out using images and video analysis. In some images, it was possible to observe a dorsal fin with 13 spines, different from *Scorpaena* spp. that have 12 spines. Moreover, supraopercular tentacles on the head of *S. arenai* were very small and not evident, differently from other Mediterranean scorpaenids fishes. Large flaps and body skin

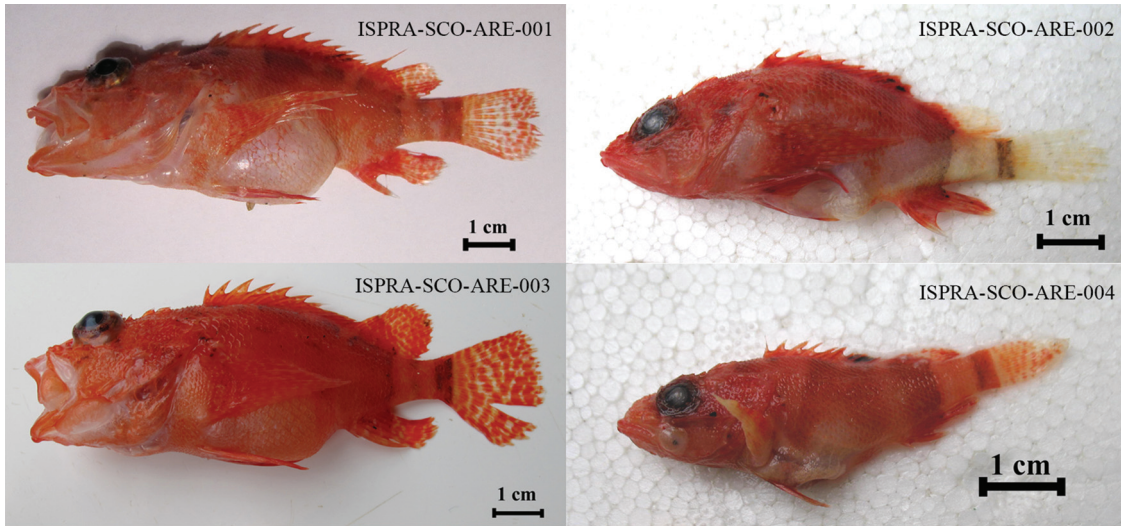


Figure 1. The specimens of *Scorpaenodes arenai* stranded on the shore of the Strait of Messina.

Table II. Measurements and proportions of the specimens of *Scorpaenodes arenai* stranded on the shore of the Strait of Messina.

Code number	ISPRA-SCO-ARE-01	ISPRA-SCO-ARE-02	ISPRA-SCO-ARE-03	ISPRA-SCO-ARE-04
<i>Measurements and Proportions</i>	<i>mm</i>	<i>mm</i>	<i>mm</i>	<i>mm</i>
Total length (TL)	108.9	70.6	102.1	56.5
Standard length	92.0 (84.5% TL)	55.4 (78.5% TL)	83.7 (82.0% TL)	46.4 (82.1% TL)
Caudal length	16.9 (15.5% TL)	15.2 (21.5% TL)	18.4 (18.0% TL)	10.1 (17.9% TL)
Head length (HL)	38.0 (34.9% TL)	23.8 (33.7% TL)	38.0 (37.2% TL)	19.3 (34.1% TL)
Interorbital length	5.2 (13.7% HL)	2.9 (12.2% HL)	5.0 (13.2% HL)	2.7 (14.0% HL)
Preorbital length	14.0 (36.8% HL)	5.7 (23.9% HL)	12.6 (33.2% HL)	5.7 (29.5% HL)
Eye–operculum distance	15.7 (41.3% HL)	11.0 (46.2% HL)	15.4 (40.5% HL)	8.8 (45.6% HL)
Horizontal eye diameter	9.3 (24.5% HL)	7.4 (31.1% HL)	9.0 (23.7% HL)	6.0 (31.1% HL)
Vertical eye diameter	8.6 (22.6% HL)	6.9 (29.0% HL)	8.0 (21.0% HL)	4.9 (25.4% HL)
Operculum–tail distance	51.5 (47.3% TL)	31.6 (44.7% TL)	65.3 (64.0% TL)	36.3 (64.2% TL)
Predorsal length	38.5 (35.3% TL)	22.2 (31.4% TL)	34.9 (34.2% TL)	18.3 (32.4% TL)
Prepectoral length	40.3 (37.0% TL)	24.0 (34.0% TL)	37.8 (37.0% TL)	20.0 (35.4% TL)
Preanal length	69.6 (63.9% TL)	38.1 (53.9% TL)	58.4 (57.2% TL)	34.0 (60.2% TL)
Preventral length	38.2 (35.1% TL)	20.6 (29.1% TL)	36.2 (35.4% TL)	17.1 (30.3% TL)
Pectoral fin length	27.1 (24.9% TL)	21.0 (29.7% TL)	26.8 (26.2% TL)	13.0 (23.0% TL)
Pelvic fin length	20.4 (18.7% TL)	14.6 (20.7% TL)	20.2 (19.8% TL)	11.9 (21.1% TL)
Base dorsal fin	46.5 (42.7% TL)	30.5 (43.2% TL)	41.5 (40.6% TL)	23.1 (40.9% TL)
Base anal fin	10.5 (9.6% TL)	7.7 (10.9% TL)	10.3 (10.1% TL)	6.0 (10.6% TL)
Upper jaw length	17.1 (15.7% TL)	12.1 (17.1% TL)	15.8 (15.5% TL)	9.4 (16.6% TL)
Lower jaw length	17.8 (16.3% TL)	12.6 (17.8% TL)	16.0 (15.7% TL)	10.0 (17.7% TL)
Maximum trunk height after the operculum	29.4 (27.0% TL)	19.3 (27.3% TL)	27.7 (27.1% TL)	13.1 (23.2% TL)
Minimum trunk height at caudal peduncle	8.5 (7.8% TL)	5.5 (7.8% TL)	8.4 (8.2% TL)	4.7 (8.3% TL)
Maximum height at anus	21.9 (20.1% TL)	15.3 (21.6% TL)	23 (22.5% TL)	11.0 (19.5% TL)

appendages easily observable in *Scorpaena elongata*, *S. scrofa* and *S. porcus* were absent in *S. arenai*. The color of *S. arenai* was also peculiar, being characterized by vertical bars as described for the stranded specimens. Furthermore, the vertical bars on the caudal fin of *Scorpaena porcus* and *S. maderensis* were absent in *S. arenai*.

The occurrence of *S. arenai* in the Gulf of Naples and Cape of Milazzo (Tyrrhenian Sea) and in the Graham Bank (Strait of Sicily) was recorded for the first time by underwater observation. All individuals observed by ROV showed a particular behavior, consisting in lying upside-down, belly up at the entrance of small crevices looking for potential prey

Table III. Meristic and biological data of the individuals of *Scorpaenodes arenai* stranded in the Strait of Messina.

Code number	ISPRA-SCO-ARE-01	ISPRA-SCO-ARE-02	ISPRA-SCO-ARE-03	ISPRA-SCO-ARE-04
Meristic data				
Dorsal fin rays	XIII+10	XIII+10	XIII+10	XIII+10
Anal fin rays	III+5	III+5	III+5	III+5
Pectoral fin rays	17	17	17	17
Pelvic fin rays	I + 5	I + 5	I + 5	I + 5
Caudal fin rays	I + 16	I + 16	I + 16	I + 16
N. suborbital spines	5 (1 row) on each side	5 (1 row) on each side	5 (1 row) on each side	5 (1 row) on each side
N. interorbital spines	2	2	2	2
N. suppl. preopercular spines	1 on each side	1 on each side	1 on each side	1 on each side
Coronal spines	absent	absent	absent	absent
Palatine teeth	absent	absent	absent	absent
Biological data				
Mass (g)	14.43	5.38	18.88	2.85
Sex	M	M	F	F
Maturity stage	II	II	II	II
Left otolith length (mm)	6.06	4.69	6.17	3.49
Right otolith length (mm)	6.03	4.68	6.18	3.47
Growth increments	5	3	4	2

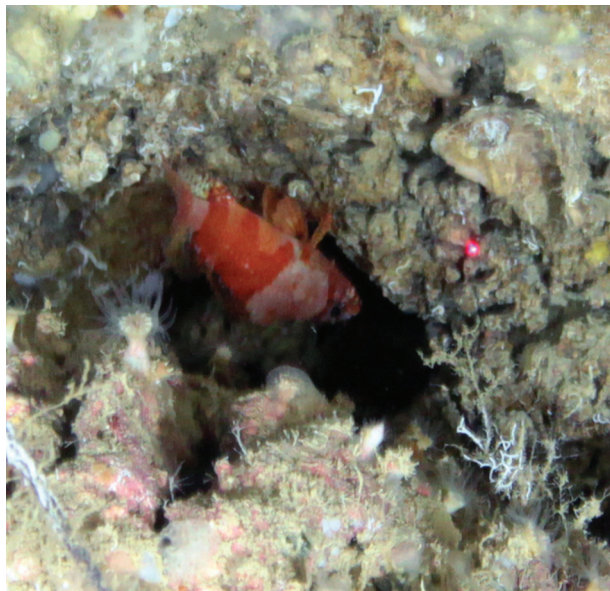


Figure 2. The particular behavior of *Scorpaenodes arenai*, consisting in lying upside-down, belly up at the entrance of small crevices looking for potential prey.

(Figure 2). Moreover, the fish showed an elusive behavior when the ROV tried to approach them to within to 3–4 m, swimming fast into the crevices. Underwater images revealed for the first time the habitat preference of this species, characterized by deep rocky banks (depth range: 70–135 m), in areas poorly or not colonized by arborescent cnidarians (e.g., sea fans, black corals), commonly present in this habitat.

Discussion

So far, all Mediterranean specimens of *S. arenai* (overall 13 individuals, as reported by Spalletta et al. 1995) were collected exclusively stranded on the shore of the Sicilian coast of the Strait of Messina (Torchio 1962; Berdar et al. 1977; Berdar & Cavaliere 1980; Li Greci et al. 1981; Costa et al. 1993; Spalletta et al. 1995). This species had been considered endemic to this area until 1995, when six individuals were collected in the Azores waters (Atlantic Ocean), at 15–31 m depth (Azevedo & Heemstra 1995). The ROV underwater observations of *S. arenai* carried out in the Gulf of Naples (Tyrrhenian Sea) and the Strait of Sicily extend the Mediterranean range distribution of this species, whereas the other location of Favazzina (Calabrian coast) close to the Strait of Messina confirmed the most important site of occurrence. The collection of stranded specimens allowed us to record the largest size (108.9 mm TL) of *S. arenai* ever observed; indeed, until now, the maximum size known for the species was 106 mm.

In agreement with a previous study (Li Greci et al. 1981), the maximum age estimated was 5 years in specimens between 56.5 and 108.9 mm TL. The deposition pattern of annuli in this species is similar to that observed in other Mediterranean Scorpaeniformes, such as *Helicolenus dactylopterus* (Consoli et al. 2010), *S. maderensis* (La Mesa et al. 2005) and *S. notata* (Scarcella et al. 2011).

We think that stranded individuals in the Strait of Messina come from deep waters, as they are transported to the shore by local upwelling and strong

tidal currents with other specimens of mesopelagic and deep fauna; moreover, when stranded *S. arenai* were found on the shore, they showed bulging eyes and an inflated swimbladder, signs of barotrauma likely due to a fast vertical emersion from deep waters. The elusive behavior observed in *S. arenai* was not recorded for other Mediterranean scorpaenids, frequently observed during ROV explorations, which were easily approached at less than 1 m without any reaction.

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