

The importance of underwater photography in detecting cryptobenthic species: new *in situ* records of some gobies (Teleostei: Gobiidae) from Italian Seas with ecological notes

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Although recent scuba-diving techniques improved biological research and exploration in shallow waters, distribution and ecology of cryptobenthic gobies (Teleostei: Gobiidae) are still widely unknown. In this work new records of 5 species, including some ecological information collected by scuba divers and underwater photographers, are presented for Italy (Mediterranean Sea).

Key words: gobies, Gobiidae, distribution, ecology, photography, Italy

INTRODUCTION

Even if the Mediterranean Sea is a well investigated basin from an ichthyological point of view, many cryptic species show huge gaps in the knowledge of their distribution and ecology. In particular, some gobies (Teleostei: Gobiidae) lead a lifestyle that may prevent their detection with standard collecting methods, even in well-known areas. Moreover, the description of several species in the last decades (MILLER, 1992; AHNELT & PATZNER, 1995; KOVAČIĆ & MILLER, 2000) based on single or very few specimens, suggests that many new distribution records have to come. Recently, however, an increasing interest in this fish group (also attested by the birth of a dedicated website in 2009; PATZNER, 2009) and the improvement of scuba-diving techniques permitted a wider exploration of shallow waters and caves, enhancing possibilities of finding rare or at least cryptobenthic species also by underwater photographers (AHNELT *et al.*, 1994; HERLER & PATZNER, 2002). The most striking case of this situation is represented by

Didogobius schlieveni Miller, 1992, originally described from a single specimen collected in Croatia (MILLER, 1992) and only known by few other specimens photographed in France (BALLESTA *et al.*, 1998; FRANCOUR, 2008), Tuscany (PATZNER, 2007) and Croatia (KOVAČIĆ, 2005). Recent works (e.g. KOVAČIĆ *et al.*, 2012) demonstrated that species richness in certain areas can be strongly affected by research defect. In this paper, we present some new *in situ* records of 5 gobiid species from Italy, collected by scuba-divers during the last years in four regions (Tuscany, Sardinia and Sicily) and verified on the basis of photographs taken.

MATERIAL AND METHODS

Gobiids were looked for while scuba-diving or snorkeling, inside and outside underwater caves, sometimes turning stones and pebbles, during day and night time; all records are from 1998 to 2012. Depths were recorded using instruments commonly used among scuba-divers (i.e. dive computers) or estimated in case of very

shallow waters. A mute map of study area was downloaded from www.d-maps.com website, and modified with Adobe Photoshop 7.0 in order to locate presented and bibliographic records. Photographs of live specimens were taken by Marco Colombo (first author) but also given by two other underwater photographers, i.e. Stefano Guerrieri and Alessandro Pagano; shots were examined in order to have correct identifications, and species that cannot be identified by macroscopic characters weren't included in this work, even though we are aware of the difficulties in identification of some species without examining lateral line at microscope, as already stated in some works (e.g. KOVAČIĆ, 2008); only photographed specimens (apart from one case in which the species is highly recognizable and misidentification unlikely) were considered for this study, but only one photography for each species is presented in this work; the other ones will be easily obtainable by contacting authors for further analysis by other researchers. None of the specimens were collected.



Fig. 1. Geographical map of *Chromogobius quadrivittatus* new (black squares) and bibliographic records (white squares) from Italy. NOTE: some bibliographic sources quote this species from all Italian zoogeographic regions but without indicating detailed records (original map source: http://d-maps.com/pays.php?num_pay=200&lang=it)

RESULTS AND DISCUSSION

During this work, 16 photographs from various authors have been analyzed, leading to new records of 5 cryptobenthic gobiid species from three Italian regions (Mediterranean Sea). Geographical distribution of the records is given in maps (Fig. 1- Fig. 5); photographs of the specimens are given in Fig. 6; localities and available ecological information of the sightings are given in Table 1.

In the following paragraphs, distribution and ecology of considered species are discussed.

Chromogobius quadrivittatus (Steindachner, 1873)

This species has been previously recorded from Spain (Catalonia: AHNELT, 1990), southern continental France (AHNELT, 1990), Corse



Fig.2. Geographical map of *Chromogobius zebratus* bibliographic records (white squares) from Italy. NOTE: some bibliographic sources quote this species from all Tyrrhenian, Ionian and possibly Adriatic regions but without indicating detailed records; Apulia record is considered dubious (original map source: http://dmaps.com/pays.php?num_pay=200&lang=it)

Table 1. New records and new ecological data for 5 cryptobenthic gobiid species from Italy

Species	Date	Locality	Depth	Environment	Notes	Observer
<i>Chromogobius quadrivittatus</i> (Steindachner, 1873)	24.VIII.2011	Porto Conte (Sassari), Sardinia	0.3 m	Rocky bottom with pebbles, wide growth of photophilous algae	Specimen under a 40 cm-wide stone; NEW RECORD	M. Colombo
	25.VIII.2011	Meloria shoals (Livorno), Tuscany	3 m	Pebbles	NEW RECORD	S. Guerrieri
<i>Chromogobius zebratus</i> (Kolombatovic, 1891)	18.IX.2004	Calafuria (Livorno), Tuscany	13 m	Sandy bottom with few sparse boulders		S. Guerrieri
	29.II.2008	Calafuria (Livorno), Tuscany	15 m	Sandy bottom with few sparse boulders		S. Guerrieri
	summer 1998	Terrauzza cave (Siracusa), Sicily	23 m	Cave with muddy bottom		A. Pagano
<i>Didogobius splechnai</i> (Ahnelt & Patzner, 1995)	1.VIII.2010	Pozzo cave – Punta Giglio (Sassari), Sardinia	10 m	Vertically- developed cave, with fine sediment on the horizontal planes of the sides	Specimen near a crack of the rock wall, escaped inside the shelter before it was possible taking photographs; NEW RECORD	M. Colombo
	27.VIII.2012	Capo Galera (Sassari), Sardinia	3 m	Little cave with rock walls and pebbles on the bottom, subjected to strong waves in case of rough sea	Specimen near a crack of the wall; NEW RECORD	M. Colombo
	summer 1998	Terrauzza cave (Siracusa), Sicily	23 m	Cave with muddy bottom		A. Pagano
	16.V.2008	Calafuria (Livorno), Tuscany	12 m	Rocky bottom		S. Guerrieri
<i>Gammogobius steinitzi</i> Baht, 1971	26.VII.2008	Sassoscritto cliff (Livorno), Tuscany	25 m	Ceiling under a boulder		S. Guerrieri
	29.X.2010	Calafuria (Livorno), Tuscany	13 m	Rocky bottom		S. Guerrieri
	20.VIII.2011	Castel Sonnino (Livorno), Tuscany	6 m	Ceiling of a little cave		S. Guerrieri
<i>Thorogobius macrolepis</i> (Kolombatovic, 1891)	11.V.2012	Sassoscritto cliff (Livorno), Tuscany	40 m	Area between coralligenous shoal and sandy bottom	Specimen at night outside its shelter; NEW RECORD	S. Guerrieri

(AHNELT, 1990) and northern Adriatic Sea (AHNELT, 1990; KOVAČIĆ, 2005), and eastward as far as Lebanon (AHNELT, 1990) and Black Sea (AHNELT, 1990).

In Italy, its distribution is generically indicated for all biogeographic areas (RELINI & LANTERI, 2010), and, in particular, for north-eastern Sardinia (AHNELT, 1991). In this work we present



Fig.3. Geographical map of *Didogobius splechnai* new (black squares) and bibliographic records (white squares) from Italy. NOTE: the two new records from north-western Sardinia are grouped in the map due to their geographical vicinity (original map source: http://d-maps.com/pays.php?num_pay=200&lang=it)



Fig.4. Geographical map of *Gammogobius steinitzi* bibliographic records (white squares) from Italy. NOTE: different localities from Livorno are grouped in the map due to geographical vicinity (original map source: http://d-maps.com/pays.php?num_pay=200&lang=it)

two additional new records of this uncommon goby, one from north-western Sardinia (Porto Conte, Sassari, 2011; Fig. 6A) and one from Tuscany (Meloria shoals, Livorno, 2011). A comprehensive map of new and bibliographic known records is given in Fig. 1.

As far as ecology is concerned, the species seems to colonize rocky tide pools in shallow water (also brackish water in Black Sea; AHNELT, 1990), and this is confirmed by our data: the Sardinian specimen has been found at a depth of about 0.3 m in some pools among rocks, under a medium-sized stone (40 cm diameter; M. Colombo, pers.obs.), while the Tuscan specimen has been photographed at a depth of 3 m among pebbles (S. Guerrieri, pers.comm.). Therefore, it seems the species has mostly been observed on shallow hard bottoms with a good availability of incoherent material, probably used as shelter, even though some records are known from deeper water (10 m; PATZNER, 1999)



Fig. 5. Geographical map of *Thorogobius macrolepis* bibliographic records (white squares) from Italy. NOTES: a new record presented in this work from Livorno area is grouped here with bibliographic records from other nearby spots; some sources indicate this species for southern Tyrrhenian Sea without specifying exact localities (original map source: http://d-maps.com/pays.php?num_pay=200&lang=it)



Fig. 6. Cryptobenthic gobies from Italy: A) *Chromogobius quadrivittatus*, specimen from Porto Conte, Sardinia (photo by M.Colombo); B) *Chromogobius zebratus*, specimen from Calafuria, Tuscany (photo by S.Guerrieri); C) *Didogobius splechnai*, specimen from Capo Galera, Sardinia (photo by M.Colombo); D) *Gammogobius steinitzi*, specimen from Sassoscritto, Tuscany (photo by S.Guerrieri); E) *Thorogobius macrolepis*, specimen from Sassoscritto, Tuscany (photo by S.Guerrieri)

Chromogobius zebratus
(Kolombatovic, 1891)

This species, usually considered less common than *C.quadrivittatus*, is recorded from Spain (Atlantic: ALBERTO & NIETO, 1993; Catalonia: MERCADER, 1994; Balears: AHNELT & PATZNER, 1996), Corse (BOUCHEROT & TOMASINI, 1989), Croatia (AHNELT, 1990), Greece (Crete:

KOVAČIĆ *et al.*, 2011) and Turkey (ENGIN & DALGIÇ, 2008).

In Italy the distribution of the species seems to cover all Tyrrhenian and Ionian biogeographic regions (except for Messina's strait) and possibly Adriatic (RELINI & LANTERI, 2010), although for most of the Italian coasts there are no documented records; single records are reported from north-western Sardinia (AHNELT, 1990),

north-eastern Sardinia (AHNELT, 1990; AHNELT, 1991), Tuscany (PIAZZI *et al.*, 2009), southern Tyrrhenian Sea (PATZNER, 2009) and Sicily (COSTA, 1991; PATZNER, 2009), while an uncertain record from the Ionian Sea with a brief description and a drawing but without any photography of the sampled specimens is reported by PARENZAN (1984). A comprehensive map of bibliographic records is given in Fig. 2.

As far ecology is concerned, previous data suggest that the species lives in shallow water (0.5-2 m in Sardinia and Turkey: AHNELT, 1990; ENGIN & DALGIÇ, 2008; 4 m in Catalonia: MERCADER, 1994; 5-12 m in the Balears: AHNELT & PATZNER, 1996; PATZNER, 1999) in tide pools, on open sandy bottoms near boulders, but also in little caves (AHNELT, 1990; AHNELT & PATZNER, 1996; PATZNER, 1999; ENGIN & DALGIÇ, 2008). In this work we report two previously known records from Calafuria, Tuscany (PIAZZI *et al.*, 2009; Fig. 6B) but specifying ecological data, not reported in the mentioned paper; our data (S. Guerrieri, pers.com.) suggest that in Tuscany this species seems to prefer sandy habitats with sparse boulders as already observed in Turkey (ENGIN & DALGIÇ, 2008), but in deeper water (13-15 m).

***Didogobius splechnai*
Ahnel & Patzner, 1995**

This species is recorded from Spain (Balears; AHNELT & DORDA, 2004; CARDONA & ELICES, 2000; HERLER *et al.*, 1999; SCSEPKA *et al.*, 1999), southern continental France (FRANCOUR, 2008), Croatia (HERLER & PATZNER, 2002; KOVAČIĆ, 2005) and Turkey (FRANCOUR *et al.*, 2007).

In Italy, this species is recorded from north-eastern Sardinia (HERLER & PATZNER, 2002), Tuscany (Elba island; HERLER & PATZNER, 2002) and Sicily (Lampedusa island; STEFANNI, 1999). In this work, we report ecological information of a previously-known record from Sicily (cave Terrauzza, Siracusa, 1998: A. Pagano, pers.com.; RELINI & LANTERI, 2010) and two different new records from north-western Sardinia (cave Pozzo- Punta Giglio, Sassari, 2010; Capo

Galera, Sassari, 2012: M. Colombo, pers.obs.). Even though in the first one photographic material is missing, we considered it was due to highly recognizable colour pattern of this species. A comprehensive map of new and bibliographic records is given in Fig. 3.

Ecological demands of this goby seem to be connected to caves 11-16 m deep (HERLER & PATZNER, 2002), even though some authors report it from 40 m (PATZNER, 1999) and 55-56 m (AHNELT & DORDA, 2004). Previous observations seem to indicate a preference for sandy bottoms inside caves, where these gobies wait near a hole or a crack (PATZNER, 1999; FRANCOUR, 2008), however our data suggest that some specimens can also be found on the walls, on little shelves (Fig. 6C; M. Colombo, pers.obs.). HERLER & PATZNER (2002) state that the finding of this species in a 4 m deep cave among *Posidonia* rhizomes is unusual, however this species can also be found in shallow water if suitable caves are available (M. Colombo, pers.obs.; PATZNER, 1999).

***Gammogobius steinitzi* Bath, 1971**

This species is recorded from Spain (Balears: AHNELT & PATZNER, 1996; SCSEPKA *et al.*, 1999; KOVTUN, 2012), southern France (BATH, 1971), Croatia (KOVAČIĆ, 1999; KOVAČIĆ, 2005), Greece (Crete: KOVAČIĆ *et al.*, 2011) and Crimea (KOVTUN, 2012).

In Italy this goby is recorded from Sardinia (PAIS *et al.*, 1999) and Tuscany (Giglio island: AHNELT *et al.*, 1998; Calafuria: PIAZZI *et al.*, 2009); in this work we present ecological information of a previously-known record from Sicily (cave Terrauzza, Siracusa, 1998: A. Pagano, pers.com.; RELINI & LANTERI, 2010) and integrate ecological informations of known findings in Calafuria and surroundings (PIAZZI *et al.*, 2009; Fig. 6D). A comprehensive map of bibliographic records is given in Fig. 4.

Our ecological data confirm that this goby, as the previous ones, seems to live inside caves with a preference for walls and ceilings at 3-43 m of depth (KOVAČIĆ, 1999; KOVTUN, 2012; PATZNER, 1999; SCSEPKA *et al.*, 1999), although a

juvenile has been found inside a hole made by *Lithophaga lithophaga* (PATZNER, 1999) and S. Guerrieri (pers.com.) reports some specimens on rocky bottoms not strictly connected to caves.

***Thorogobius macrolepis*
(Kolombatovic, 1891)**

This bigger species is known from Spain (Balears: AHNELT & PATZNER, 1996), Croatia (AHNELT & KOVAČIĆ, 1997), Turkey (FRANCOUR *et al.*, 2007) and Cyprus (KOVAČIĆ & GOLANI, 2007).

In Italy, this species is recorded from Tuscany (PIAZZI *et al.*, 2009), southern Tyrrhenian Sea (RELINI & LANTERI, 2010), Ionian Sea (GUIDETTI *et al.*, 2006; RELINI & LANTERI, 2010) and Tremiti Islands (GUIDETTI *et al.*, 2006). Hereby, we add a new record (Sassoscritto, Livorno, 2012: S. Guerrieri, pers.com.; Fig. 6E) with ecological data nearby the previously recorded locality of Calafuria, Tuscany (PIAZZI *et al.*, 2009).

A comprehensive map of new and bibliographic records is given in Fig. 5.

According to the observer, this species is not uncommon during the night at the border between coralligenous shoals and sandy bottoms, at a depth of about 40 m (quite deeper with respect to the other considered species), and this seems in accordance with previous records (PATZNER, 1999; FRANCOUR *et al.*, 2007).

Most of the cryptobenthic gobies considered show speleophilic habits which tend to make them go unnoticed with standard research meth-

ods (HERLER & PATZNER, 2002). The known distribution of many cryptobenthic species seems to reflect the distribution of appreciated diving spots, more than the actual distribution of the species, and it is very likely that these gobies are also present in areas that are less attractive for scuba-divers. However, it is possible that distribution of these fish is connected to patches of suitable habitats and not continuous as usually indicated. In conclusion, as already stated in BALLESTA *et al.* (1998), this work shows that rocky bottoms down to 20 m depth have not been well investigated, but underwater photography lead by recreational divers can be a useful tool for qualitative census (i.e. clues of presence) of at least easily recognizable species.

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Važnost podvodne fotografije u određivanju kriptobentičkih vrsta: novi *in situ* zapisi nekih glavoča (Teleostei: Gobiidae) iz talijanskih voda, s ekološkim bilješkama

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SAŽETAK

Iako su nedavno tehnike ronjenja poboljšale biološka istraživanja u plitkim vodama, distribucija i ekologija kriptobentičkih glavoča (Teleostei: Gobiidae) je i dalje potpuna nepoznanica. U ovom istraživanju imamo nove zapise 5 vrsta, uključujući neke ekološke informacije koje su sakupili ronionci i podvodni fotografi, za područje Italije (Sredozemno more).

Ključne riječi: glavoči, Gobiidae, distribucija, ekologija, fotografiranje, Italija