



Short communication

Occurrence of the Atlantic species, *Pisodonophis semicinctus* (Osteichthyes: Ophichthidae), along the Mediterranean coast

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Introduction

Eight species of the snake eel family (Ophichthidae) can be found in the Mediterranean Sea (Bauchot, 1986). One of these species, *Pisodonophis semicinctus* (Richardson, 1848), is common in the eastern Atlantic Ocean, from Morocco to Angola (Froese and Pauly, 2012). It usually burrows on sandy and muddy bottoms in coastal waters at depths from 10 to 30 m (Bauchot, 1986) where it is often caught by beach fishing nets (Séret and Opic, 1990). *P. semicinctus* can grow up to 800 mm in total length (Séret and Opic, 1990). The species is rare outside the inter-tropical zone (Blache and Saldanha, 1972). Only two observations were recorded in the northern part of the Atlantic Ocean at the end of the 20th century: one individual was trawled in the Arcachon Basin (Quéro, 1998), and another in 2001 along the south Galician coast near A Guarda harbour (Banon et al., 2002). *P. semicinctus* remained unknown among the Mediterranean fauna until a 1957 discovery in Algeria (Dieuziede and Roland, 1958). Since then, only nine other observations have been reported in the Mediterranean.

The aim of this study was (i) to synthesize all records of *Pisodonophis semicinctus* in the Mediterranean Sea, including a previously unpublished record; and (ii) to discuss several hypotheses regarding the spread of *P. semicinctus*.

Materials and methods

Data concerning records of *Pisodonophis semicinctus* in the Mediterranean Sea were compiled from published scientific literature. The unpublished record corresponds to a new record made by one of the contributing authors (R. M.).

Results

The first identified *Pisodonophis semicinctus* in the Mediterranean Sea was caught in 1957 by hook-and-line fishing in a shallow, sandy-rocky bottom along the Algerian coast (Dieuziede and Roland, 1958) (Fig. 1; Table 1). In 1991, a specimen was captured during a night commercial bottom trawl near Cap Bon (north of Tunisia) in the ‘Kelibia’ fishing grounds by fishermen from Mazara (Ragonese and Giusto, 2000). Another individual was trawled in 1997 on the southeastern tip of Sicily; this specimen was preserved in formalin and included in the collections of the Museo Civico di Storia Naturale, Comiso, Ragusa, Italy (Insacco and Zava, 1999). Two other individuals were later captured along the

coast of Tunisia: one in the Gulf of Gabès in June 1998 and another one in the canal of La Goulette (Gulf of Tunis) in October 2000 (Bradai et al., 2004). The species was concurrently reported in 1998 in the Tyrrhenian Sea, south of Livorno (Italy), where a specimen was trawled on a sandy bottom (Serena, 2001). The next record was during a 2000–2001 survey of the invertebrate fauna of the Cyclops Islands in the Marine Protected Area (Acitrezza, Eastern Sicily) (Cantone et al., 2003). The most recent observation was reported in 2009 from the south coast of Turkey (Ekincik Bay, Mugla) where a specimen was captured by longline fishing (Bilecenoglu et al., 2009), which constitutes the most distant observation of this species in the Mediterranean Sea and the only one from the eastern part.

In France, the presence of *Pisodonophis semicinctus* was first reported in 1980 when a specimen was captured by trammel net near Cassis (Bouches-du-Rhône, France). This was only the second observation of this species in the Mediterranean Sea following the initial report in 1957. This individual was kept alive in an aquarium for more than 6 months (Escoubet et al., 1981).

A previous and unpublished record was of a specimen caught in Corsica by a leisure fisherman in the waters of Corsica (northwestern Mediterranean Sea) in May 2008, almost three decades after the first French record. The catch was in the northeastern part of Maccinaggio in a rocky area off Maremortu (north of Corsica, 42°59'97" N; 9°28'30" E) at a depth of 25 m. The specimen was 430 mm total length and the ninth chronological record of this species in the Mediterranean Sea (Table 1). Unfortunately, the specimen was not preserved.

Discussion

Little information is available concerning the biology of *P. semicinctus*. However, similar to other species of the genus Ophichthidae, the reproduction of *P. semicinctus* could occur during the warm hydrological season where it produces pelagic larvae (Bauchot, 1986). The origin of the specimens observed in the Mediterranean Sea could then be explained by an input of larvae following the circulation of Atlantic water that enters the Mediterranean Sea through the Straits of Gibraltar (Millot, 1987), as in the case of other Atlantic species found in the Mediterranean Sea (e.g. Psomadakis et al., 2006).

Before 2008, most observations of *P. semicinctus* in the Mediterranean were recorded from around the Siculo-Tunisian Strait, which is a meeting point for exotic species coming



Fig. 1. Localisation and date of the different observations of *Pisodonophis semicinctus*, within the Mediterranean Sea and the contiguous Atlantic (● = former findings; ★ = new finding).

Table 1
Observations of *Pisodonophis semicinctus* inside the Mediterranean basin

Year of observation	Location	Total length (mm)	Depth (m)	Bottom	Reference
1957	Cherchell (Algeria)	812	17	Sand-rock	Dieuziede and Roland, 1958
1980	Cassis (France)	ca. 1 m	20–30	Seagrass bed	Escoubet et al., 1981
1991	Cap Bon (Tunisia)	800	30	nd	Ragonese and Giusto, 2000
1997	Southern coast of Sicily (Italy)	705	30	Seagrass bed	Insacco and Zava, 1999
1998	Gulf of Gabès (Tunisia)	786	15	nd	Bradai et al., 2004
1998	South of Livorno (Tyrrhenian Sea, Italy)	940	15	Sand	Serena, 2001
2000	Gulf of Tunis (Tunisia)	550	nd	nd	Bradai et al., 2004
2000–2001	Cyclops Islands (Italy)	nd	nd	Hard bottom	Cantone et al., 2003
2008	North of Corsica (France)	430	25	Rocky	Present study
2009	Ekincik Bay (South, Turkey)	860	18	nd	Bilecenoglu et al., 2009

nd, no data.

from the Suez Canal and the Straits of Gibraltar (Ben Rais Lasram et al., 2009). The previously unpublished 2008 record from Corsica as described in the present paper confirms the presence of this species in the northwestern Mediterranean Sea. Meanwhile, the specimen caught in 2009 could support the hypothesis of its progressive diffusion toward the eastern part of the Mediterranean, as suggested by Ragonese and Giusto (2000). Various observations of some Atlantic species that have thrived in the Mediterranean, such as *Sphoeroides pachygaster* (Psomadakis et al., 2006) and *Parablennius pilicornis* (Pastor and Francour, 2010), have shown their spread to follow a clear pathway along the coasts, from Gibraltar toward the eastern Mediterranean (see Pastor and Francour, 2010).

Six of the ten records of *P. semicinctus* in the Mediterranean Sea have been observed since 1997. The increasing trend in the number of observations is similar to that of other Atlantic species over the past 10 years. For instance, about 80% of the *Kyphosus sectator* records from the Mediterranean Sea (the oldest dating from 1847) were made after 1996 (Francour and Mouine, 2008), a proportion that further increased during the summer of 2009 when several individuals were captured along the French Mediterranean coast (*P. Francour*, unpubl. data). Also, more than 70% of *Lampris guttatus* specimens reported by Francour et al. (2010) within the western Mediterranean (the oldest record before 1807) have been observed since 1997. The increase in records of species coming from the Atlantic could be attributed to: (i) a recent increase in water flux from the Atlantic to the Mediterranean through the Straits of Gibraltar; and (ii) changes in hydroclimatic conditions, such as the warming of the Mediterranean Sea, which would favour

the spreading of species with subtropical and tropical affinities (e.g. Francour et al., 1994; Quignard and Tomasini, 2000). These explanations are concordant with Ben Rais Lasram and Mouillot (2009), who hypothesized that among other reasons, the currently warmer Mediterranean Sea acts increasingly as a catchment basin for southern species invading from the Atlantic.

At present, more than 100 exotic fish species have been observed in the Mediterranean (Ben Rais Lasram et al., 2008a,b; Ben Rais Lasram and Mouillot, 2009). This number has increased since the 1950s (Galil, 2008). More than half of these species come from the Red Sea through the Straits of Suez (Galil, 2008; Bariche, 2010a,b, 2011) while the remainder come via the Atlantic Ocean through the Straits of Gibraltar (Ben Rais Lasram, 2009; Pastor and Francour, 2010); many of these species have thrived (e.g. Psomadakis et al., 2006; Pastor and Francour, 2010). The development of a volunteer network in the Mediterranean, as is already being experienced with coral reefs, and an improved cooperation with the professional fishermen will help facilitate the reporting of previously unrecorded species and the monitoring of changes in the fauna and flora of the Mediterranean Sea.

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References

- Banon, R.; Del Rio, J. L.; Pineiro, C.; Casas, M., 2002: Occurrence of tropical affinity fish in Galician waters, north-west Spain. *J. Mar. Biol. Ass. U.K.* **82**, 877–880.
- Bariche, M., 2010a: *Champsodon vorax* (Teleostei: Champsodontidae), a new alien fish in the Mediterranean. *Aqua Internat. J. Ichthyol.* **16**, 187–200.
- Bariche, M., 2010b: First record of the angelfish *Pomacanthus maculosus* (Teleostei: Pomacanthidae) in the Mediterranean. *Aqua Internat. J. Ichthyol.* **16**, 31–33.
- Bariche, M., 2011: First record of the cube boxfish *Ostracion cubicus* (Ostraciidae) and additional records of *Champsodon vorax* (Champsodontidae) from the Mediterranean. *Aqua Internat. J. Ichthyol.* **17**, 181–184.
- Bauchot, M. L., 1986: Ophichthidae. In: *Fishes of the North-Eastern Atlantic and the Mediterranean*. P. J. P. Whitehead, M. L. Bauchot, J. C. Hureau, J. Nielson, E. Tortonese (Eds), UNESCO, Paris, pp. 577–585.
- Ben Rais Lasram, F., 2009: Diversité ichthyologique en Méditerranée: patrons, modélisation et projections dans un contexte de réchauffement global. PhD thesis, University of Montpellier, France.
- Ben Rais Lasram, F.; Mouillot, D., 2009: Increasing southern invasion enhances congruence between endemic and exotic Mediterranean fish fauna. *Biol. Invasions* **11**, 697–711.
- Ben Rais Lasram, F.; Tomasini, J. A.; Romdhane, M. S.; Chi, T. D.; Mouillot, D., 2008a: Historical colonization of the Mediterranean Sea by Atlantic fishes: do biological traits matter? *Hydrobiologia* **607**, 51–62.
- Ben Rais Lasram, F.; Tomasini, J. A.; Romdhane, M. S.; Chi, T. D.; Mouillot, D., 2008b: Ecological correlates of dispersal success of Lessepsian fishes. *Mar. Ecol. Prog. Ser.* **363**, 273–286.
- Ben Rais Lasram, F.; Guilhaumon, F.; Mouillot, D., 2009: Fish diversity patterns in the Mediterranean Sea: deviations from a mid-domain model. *Mar. Ecol. Prog. Ser.* **376**, 253–267.
- Bilecenoglu, M.; Kaya, M.; Eryigit, A., 2009: New data on the occurrence of two alien fishes, *Pisodonophis semicinctus* and *Pomadasys stridens*, from the Eastern Mediterranean Sea. *Medit. Mar. Sci.* **10**, 151–155.
- Blache, J.; Saldanha, L., 1972: Contributions à la connaissance des Poissons Anguilliformes de la côte occidentale d'Afrique. *Bulletin de l'Institut Fondamental de l'Afrique Noire* **34**, Sér. A, **1**, 127–159.
- Bradai, M. N.; Quignard, J. P.; Bouain, A.; Jarboui, O.; Ouannes-Ghorbel, A.; Ben Abdallah, L.; Zaoui, J.; Ben Salem, S., 2004: Ichtyofaune autochtone et exotique des côtes tunisiennes: recensement et biogéographie. *Cybiu* **28**, 315–324.
- Cantone, G.; Catalone, D.; Di Pietro, N.; Fassari, G.; Mollica, E.; Scuderi, D., 2003: L'area marina protetta "Isole Ciclopì": un forziere di biodiversità? *Biol. Mar. Mediterr.* **10**, 25–33.
- Dieuziede, R.; Roland, J., 1958: Deuxième complément au catalogue des poissons des côtes algériennes. *Bull. travaux publiés par la station d'aquaculture et de pêche de Castiglione* **9**, 103–132.
- Escoubet, P.; Muriga, P.; Pras, A., 1981: Note sur la présence de *Pisodonophis semicinctus* (Richardson, 1848) sur les côtes françaises (Anguilliformes, Ophichthidae). *Cybiu* **5**, 101–102.
- Francour, P.; Mouine, N., 2008: First record of *Kyphosus sectator* (Linnaeus, 1758) (Kyphosidae) along the French Mediterranean coast. *Cybiu* **32**, 275–276.
- Francour, P.; Boudouresque, C. F.; Harmelin, J. G.; Harmelin-Vivien, M.; Quignard, J. P., 1994: Are the Mediterranean waters becoming warmer? Information from biological indicators. *Mar. Poll. Bull.* **28**, 523–526.
- Francour, P.; Cottalorda, J. M.; Aubert, M.; Bava, S.; Colombey, M.; Gilles, P.; Kara, H.; Lelong, P.; Mangialajo, L.; Miniconi, R.; Quignard, J. P., 2010: Recent occurrences of Opah *Lampris guttatus* (Actinopterygii: Lampriformes: Lampridae) in the western Mediterranean Sea. *Acta Ichthyol. Pisc.* **40**, 91–98.
- Froese, R.; Pauly, D., 2012: FishBase. Available at: <http://www.fishbase.org>, Version (accessed 01/2012).
- Galil, B. S., 2008: Alien species in the Mediterranean Sea - which, when, where, why? *Hydrobiologia* **606**, 105–116.
- Insacco, G.; Zava, B., 1999: First record of the saddled snake eel *Pisodonophis semicinctus* (Richardson, 1848) in Italian waters (Osteichthyes, Ophichthidae). *Atti della Società Italiana di Scienze naturali e del Museo Civico di Storia Naturale in Milano* **140**, 283–286.
- Millot, C., 1987: Circulation of the Western Mediterranean Sea. *Oceanol. Acta* **10**, 143–149.
- Pastor, J.; Francour, P., 2010: Occurrence and distribution range of *Parablennius pilicornis* (Actinopterygii: Perciformes: Blenniidae) along the French Mediterranean coast. *Acta Ichthyol. Pisc.* **40**, 179–185.
- Psomadakis, P. N.; Ceddia, P.; Vacchi, M., 2006: Additional record of *Sphaeroides pachygaster* (Pisces: Tetraodontidae) in the Tyrrhenian Sea and notes on the distribution of the species in the Mediterranean. *JMBA2 - Biodiversity Records* 5186. Published online.
- Quéro, J. C., 1998: Changes in the Euro-Atlantic fish species composition resulting from fishing and ocean warming. *Ital. J. Zool.* **65**(Suppl.), 493–499.
- Quignard, J. P.; Tomasini, J. A., 2000: Mediterranean fish biodiversity. *Biol. Mar. Mediterr.* **7**, 1–66.
- Ragonese, S.; Giusto, G. B., 2000: On a saddled snake eel *Pisodonophis semicinctus* (Osteichthyes: Ophichthidae) trawled in the Strait of Sicily (Mediterranean Sea). *J. Mar. Biol. Ass. U.K.* **80**, 951–952.
- Serena, F., 2001: Ritrovamento di *Pisodonophis semicinctus* (Anguilliformes, Ophichthidae) al largo della Toscana. *Biol. Mar. Med.* **8**, 783–785.
- Séret, B.; Opic, P., 1990: Poissons de mer de l'Ouest Africain tropical. ORSTOM Ed., Paris, p. 445.

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