

**A NEW RECORD AND BIOLOGICAL EVIDENCE SUPPORTING THE ESTABLISHMENT
OF *BERYX SPLENDENS* (ACTINOPTERYGII: BERYCIFORMES: BERYCIDAE)
IN THE WESTERN MEDITERRANEAN BASIN**

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Di Blasi D., Carligh E., Ferrando S., Ghigliotti L., Psomadakis P.N., Vacchi M. 2018. A new record and biological evidence supporting the establishment of *Beryx splendens* (Actinopterygii: Beryciformes: Berycidae) in the western Mediterranean basin. *Acta Ichthyol. Piscat.* 48 (2): 183–188.

Abstract. A new specimen of splendid alfoncino, *Beryx splendens* Lowe, 1834, was caught by trawling in July 2016 in the Ligurian Sea at the depth of 350 m, in the proximity of a submarine canyon. It represents the 10th documented record of *B. splendens* in the Mediterranean. Because of the rarity of the records in the basin, there could be doubts whether to consider or not such species as established in the area. However, some findings may support the hypothesis of the possible establishment of the species in the Mediterranean Sea. For example, the stomach of the specimen was nearly full, with rests of one crustacean decapod, one fish, and some cephalopods, which are commonly reported prey items for the species. Macroscopic observation and histological analysis of the gonads revealed that the specimen was a male in an advanced stage of gonadal development. Finally, the coherence of habitat type and prey items with that of extra-Mediterranean populations coupled with gonadal maturation consistent with the observations on other specimens caught in the Mediterranean.

Keywords: splendid alfoncino, *Beryx splendens*, exotic species, Mediterranean Sea, Ligurian Sea, new record, stomach contents, gonad analysis

INTRODUCTION

The genus *Beryx* is composed of three species. Two of them, the splendid alfoncino, *Beryx splendens* Lowe, 1834, and alfoncino, *Beryx decadactylus* Cuvier, 1829, are worldwide distributed in the oceans, where they live in the proximity of the rocky bottom of continental slopes and seamounts, down to the depth of 1300 meters, preferably in warm and temperate waters (Busakhin 1982, Orsi Relini et al. 1995). The third, more recently described species, *Beryx mollis* Abe 1959, seems to be confined to the China Sea and western Indian Ocean (Akimoto et al. 2006).

In the Mediterranean Sea, only the two former species have been sporadically reported. Four *Beryx decadactylus* specimens were recorded between the late 19th and early 20th centuries off Nice in 1885 (Bellotti 1891, Orsi Relini et al. 1995), off Camogli (Genoa) in 1899 (Ariola 1904, Orsi Relini et al. 1995), off Vada (Livorno) in 1907, and off Catania in 1908 (Orsi Relini et al. 1995). The first occurrence of *Beryx splendens* in the Mediterranean waters was reported by Gavagnin et al. (1992) through the analysis of a good

quality photo taken on a specimen caught by bottom drop lines off Nice. A second specimen was subsequently trawled off Genoa in 1993 (Orsi Relini et al. 1995). The third catch of *B. splendens* in Mediterranean Sea (the first from outside the Ligurian Sea) was carried out in 2001 by a trawler targeting deep-water shrimps off the coast of Anzio (central Tyrrhenian Sea) (Psomadakis et al. 2006). Subsequent specimens were all captured in the Tyrrhenian Sea: by bottom drop-lines in 2007 off the Cilento coast (Psomadakis et al. 2012b), by bottom trawls in 2009 off the Monte Argentario Promontory (Ligas et al. 2010), and off Cape Carbonara (Follesa et al. 2011), and again off the Cilento coast in 2010 by bottom trawl (Psomadakis et al. 2012b). In addition, two unpublished records were reported by Orsi Relini (2010); these latter specimens were caught off Portofino (Ligurian Sea) and off the Calabrian coast (southern Tyrrhenian Sea). In all cases, the fish were caught by deep-sea fishing gears (longlines and trawl nets) at depths between ca. 100 and 1000 m.

Given the absence of *Beryx splendens* in the Red Sea and its presence in the Atlantic waters, ingression of

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pelagic larvae (Lehodey et al. 1997) or adults from the Strait of Gibraltar is supposed to be the way of entrance of *B. splendens* into the Mediterranean Sea (Orsi Relini et al. 1995, Follesa et al. 2011).

The rarity and the scattered distribution of the Mediterranean records resulted in the inclusion of *Beryx splendens* in the CIESM Atlas of exotic species in the Mediterranean Sea, with the status of alien species of Atlantic origin (Golani et al. 2002, 2013, Psomadakis et al. 2012a). Alternatively, some authors consider *B. splendens* a species of Atlantic origin recorded in the Mediterranean as a consequence of a natural range expansion and not as “aliens”, because their migrations were not human mediated (Zenetos et al. 2012, Iglésias and Frotté 2015).

In this paper, we report a new record of *Beryx splendens*, and discuss the possible establishment of the species in the western Mediterranean Sea.

MATERIALS AND METHODS

The specimen of *Beryx splendens* (Fig. 1) was caught by the commercial fishing trawler *D’Ercole Padre* in the early July 2016 in the Gulf of Genoa (44.31033°N, 008.76917°E; Ligurian Sea, north-western Mediterranean Sea) at about 350 m depth, near the edge of the slope, in the vicinity of a submarine canyon. Upon collection, the fish was frozen and stored at -20°C for further analysis.

In the laboratory, morphometric and meristic data were acquired to assure a correct identification of the species, based on the features described by Maul (1986), Yoshino et al. (1999), Yoshino and Kotlyar (2001), Moore (2002), and Kotlár (unpublished*) (Table 1). Measurements were made with an accuracy of 0.1 cm using a measuring board with a sliding cursor. Measurements and counts were

taken following Holden and Raitt (1974). The degree of stomach fullness was assessed following Lebedev (1946). Stomach contents were identified and the digestion degree of the contents was determined following Magnuson (1969). Sex and maturity stage was determined according to Holden and Raitt (1974). A little portion of gonad was taken and fixed in a 4% paraformaldehyde solution, embedded in paraffin wax, and 5 µm sections were stained with haematoxylin-eosin for subsequent histological analysis based on the maturity scale proposed by Lehodey et al. (1997).

After analysis, the specimen was preserved frozen and deposited in the collection of the National History Museum of Genoa with the voucher number MSNG 60133.

RESULTS

The specimen (Fig.1) measured 35.2 cm in standard length (SL), and 37.4 cm in fork length (FL). Total weight of the whole and the gutted specimen was 1078.7 g and 997.4 g, respectively. The stomach was nearly full corresponding to stage IV of the Lebedev’s scale (Lebedev 1946). The high state of digestion of the content, stage IV according to Magnuson (1969) prevented us from identifying prey items to lower taxonomic levels. However, we could recognize the remains of one decapod crustacean, one fish, and some cephalopods. Stomach contents were kept and preserved in 70% ethanol. According to macroscopic observations of the gonads, the specimen was a male at the stage of maturation IV (near spawning) (Holden and Raitt 1974). Histological observations revealed a slightly earlier stage of maturation, with the presence of spermatocytes I and II, spermatids, and spermatozoa (Fig. 2), corresponding to stage 4–5 of the maturity scale described by Lehodey et al. (1997).



Fig. 1. *Beryx splendens* (352 mm SL) caught in the Gulf of Genoa, Italy, in July 2016 at a depth of about 350 m and deposited in the collection of the National History Museum of Genoa: voucher number MSNG 60133

* Kotlár A.N. 1996. Beriksoobraznye ryby mirovogo okeana. [Beryciform fishes of the world ocean.] Doctoral thesis, VNIRO, Moscow, Russia. [In Russian.]

Table 1
Morphometric and meristic data of the newly recorded specimen of *Beryx splendens* from the Gulf of Genoa (MSNG 60133), Italy compared with data reported for the three known *Beryx* species

Character	MSNG 60133		<i>Beryx splendens</i>		<i>Beryx decadactylus</i>		<i>Beryx mollis</i>	
	Absolute value/comment	%SL	Absolute value/comment	Ref.	Absolute value/comment	Ref.	Absolute value/comment	Ref.
Standard length (SL)	352 mm							
Fork length	374 mm	106.3						
Pre-anal length	218 mm	61.9						
Pre-dorsal length	151 mm	42.9						
Pre-pectoral length	118 mm	33.5						
Pre-ventral length	130 mm	36.9						
Head length	120 mm	34.1	34.0–36.0	A	33.0–37.0	A	31.3–39.3	B, C
Eye diameter	42 mm	11.9	10.6–14.1	B			12.6–17.3	B, C
Dorsal fin length	71 mm	20.2						
Anal fin length	116 mm	32.9						
Body depth at opercular margin	121 mm	34.4						
Body depth at dorsal fin	128 mm	36.4	33.0–40.0	A	44.0–50.0	A	34.6–39.0	B, C
Dorsal fin rays	IV, 12		III–IV, 13–14	B, C	III–IV, 16–21	A, D	IV, 12–13	B, C
Pectoral fin rays	17		17–20	B	14–18	D	15–18	B, C
Pelvic fin rays	I, 11		I, 10–12	B	I, 9–10	D	I, 9–11	B, C
Anal fin rays	III, 28		IV, 25–30	B	III–IV, 25–30	D	IV–V, 24–32	B, C
Lateral line scales	72				59–73		60–79	B, C
Scales above lateral line	11							
Scales below lateral line	19							
Gill rakers on first gill arch	26		25–27	A	20–26	A	20–27	B, C
Pyloric caeca	24		27–36	A, C	61–100	A, D	15–20	B, C
Origin of the anal fin	Behind posterior end of dorsal fin		Behind posterior end of dorsal fin	C	Below the middle of dorsal fin	C	Behind posterior end of dorsal fin	B, C
Spines on the snout	One pair		One pair	C	Four pairs	C	One pair	B
Shape of posterior nostril	Slit-like		Slit-like	B, C	Oval	D	Oval	B, C

%SL = value expressed as a percentage of standard length; A = Maul 1986, B = Yoshino and Kotlyar 2001, D = Moore 2002; due to dehydration and damage of the caudal fin, total length of our specimen was not measurable.

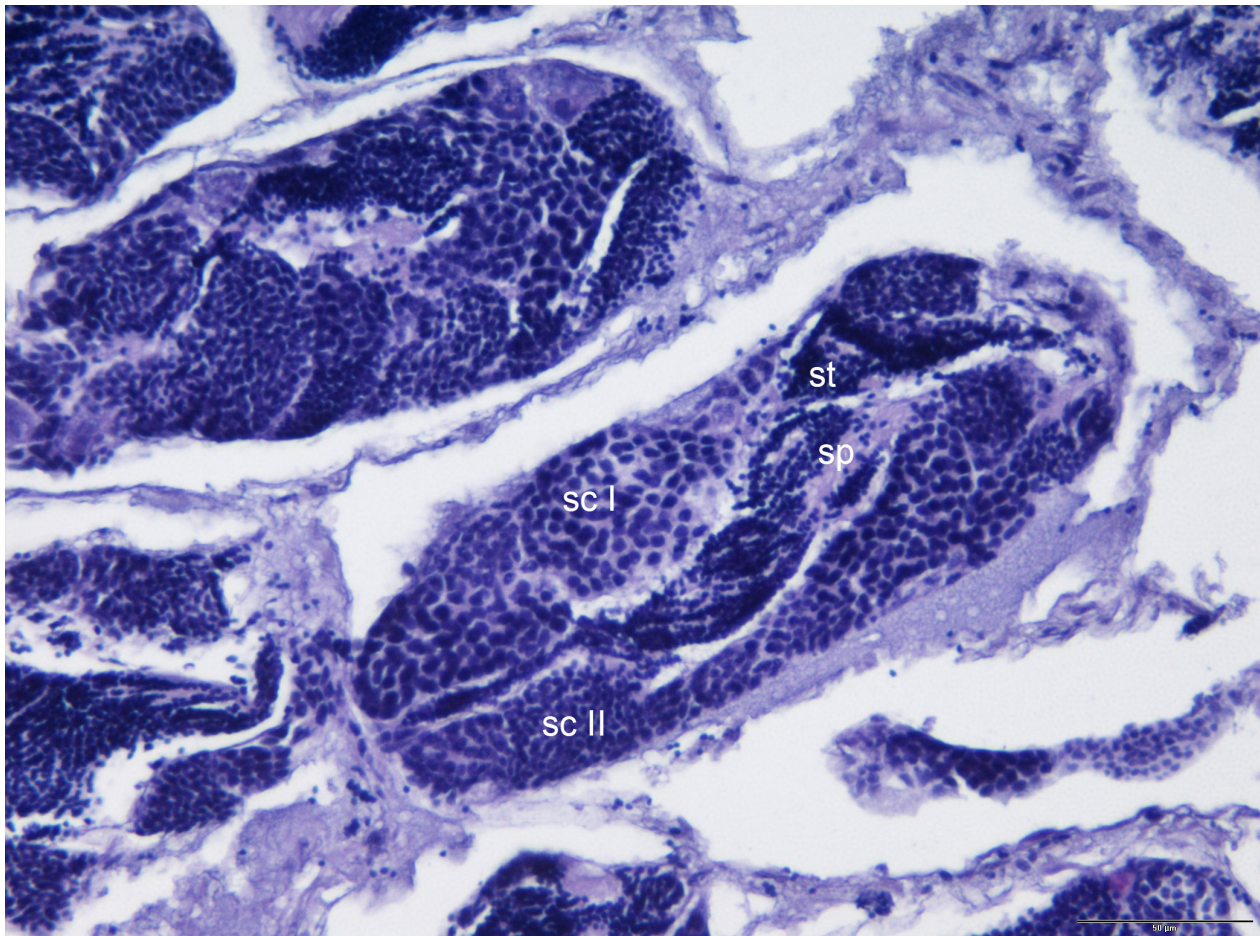


Fig. 2. Histological section of the male gonad of *Beryx splendens* from the Gulf of Genoa, Italy: haematoxylin-eosin; sc I = spermatocytes I, sc II = spermatocytes II, st = spermatids, sp = spermatozoa; scale bar = 50 μm

DISCUSSION

The habitat and the depth at which the new specimen was caught were typical for this species. As suggested by Ligas et al. (2010) and Psomadakis et al. (2012b), the paucity of records in the Mediterranean waters could be due not only to the rarity of the species but also to the sampling difficulties in such areas. Hard submarine structures are difficult to access for sampling activities (Danovaro et al. 2010) and deep long-lines and bottom drop-lines, the main gears used for fishing this species (Horn and Massey 1989, Rico et al. 2001), are less common in the Mediterranean than in the Atlantic (Rico et al. 2001). As a consequence, the areas in which *Beryx splendens* could potentially reside remain poorly explored.

The occurrence of one crustacean, one fish, and some cephalopods in the stomach is consistent with the preferential diet of the species as reported for populations occurring in the Atlantic Ocean (Dürr and Gonzáles 2002). Prey items similar to those eaten by the fish in the Atlantic Ocean, are available in the deep habitats of the Mediterranean Sea. These might, therefore, represent suitable habitats for the establishment of the species.

Additionally, the observed advanced stage of gonadal maturation (close to spawning), was consistent with the observations on other specimens caught in the Mediterranean (Ligas et al. 2010, Follesa et al. 2011, Psomadakis et al.

2012b). According to González et al. (2003), the spawning period of this species varies among different zones in the eastern Atlantic Ocean and normally extends for some months. In the light of observations made on individuals captured in the western Mediterranean Sea, the spawning season in this area is likely to start in mid-Summer.

In conclusion, the new record reported herein represents the 10th finding of the species in the Mediterranean basin (most of them occurred starting from 2001). According to the “CIESM Atlas of exotic species in the Mediterranean” criteria (that consider “established” those species that have self-maintaining populations as evidenced by a minimum of three published records from either different localities or in different periods) (Golani et al. 2013), we can consider the splendid alfonsino as “established” in the western Mediterranean.

ACKNOWLEDGEMENTS

The authors thank Corrado D’Ercole for the precious gift of the specimen and for the information given, which were necessary to contextualize the catch. Such collaborative relationship highlights the importance of the fisheries for the development of marine biological knowledge.

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Received: 8 November 2017

Accepted: 19 February 2018

Published electronically: 30 June 2018