Cephalopod biology and fisheries in European waters: species accounts

Sepia orbignyana

Pink cuttlefish

8 *Sepia orbignyana* Férussac *in* d'Orbigny, 1826

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Common names

Seiche rosée (France), Κοκκινοσουπιά [kokkinosoupia] (Greece), seppia pizzuta (Italy), choco-de-cauda (Portugal), choquito picudo (Spain), pink cuttlefish (UK) (Figure 8.1).

Synonyms

Acanthosepion orbignyanum Rochebrune, 1884, *Sepia rubens* Philippi, 1844, *Acanthosepion enoplon* Rochebrune, 1884.

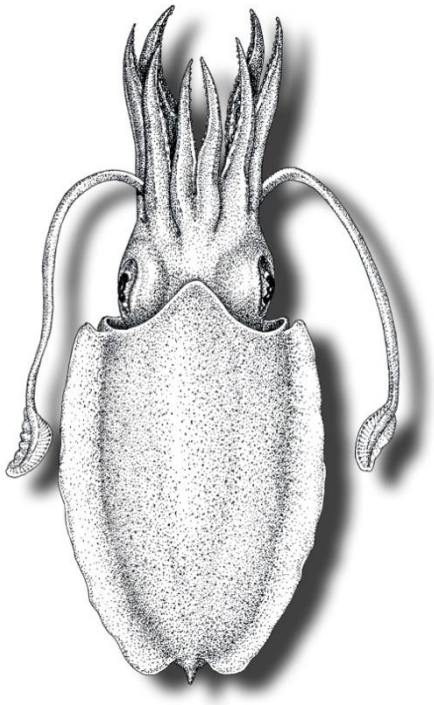

Figure 8.1. *Sepia orbignyana*. Dorsal view. From Guerra (1992).

8.1 Geographic distribution

The pink cuttlefish, *Sepia orbignyana* Férussac in d'Orbigny, 1826, is found in the Northeast Atlantic and throughout the Mediterranean (Nesis, 1982/1987; Roper *et al.*, 1984; Guerra, 1992; Reid and Jereb, 2005) (Figure 8.2), although the northern limits of its distribution are unclear. It is reported in the Irish Sea and the English Channel (Nesis, 1982/87, Reid and Jereb, 2005), but it is not included among the species listed by Massy (1928) for the Irish coast. In addition, although Adam (1952) indicates that its distribution extends to the Arcachon Basin (western France), there is no mention of its presence along the east coast of England in old records (e.g. Grimpe, 1925), and the reference to the English Channel by Norman (1890, p. 484 in Stephen, 1944) apparently is a misquotation. Strandings of cuttlebones of this species are, however, known from North Sea coasts (e.g. the Netherlands; Cadee, 2002). The species can be found south along the French and Spanish coasts (Morales, 1958; Adam and Rees, 1966), in the Bay of Biscay, south to ca. 17°S (southern Angola; Adam, 1962). *Sepia orbignyana* is widely distributed throughout the Mediterranean Sea (Mangold and Boletzky, 1987; Bello, 2004; Salman, 2009) including western and central Mediterranean parts (Mangold-Wirz, 1963a**;** Sánchez, 1986a, Belcari and Sartor, 1993; Jereb and Ragonese, 1994; Giordano and Carbonara, 1999**;** Relini *et al.*, 2002; Cuccu *et al.*, 2003a), the Adriatic Sea, although it is only rarely caught in the northern part (Casali *et al.*, 1998; Krstulović Šifner *et al.*, 2005; Piccinetti *et al.*, 2012)**,** the Ionian Sea (Tursi and D'Onghia 1992; Lefkaditou *et al.*, 2003a; Krstulović Šifner *et al.*, 2005), the Aegean Sea, and the Levant Basin (D'Onghia *et al.*, 1992; Salman *et al.*, 1997; 1998; Lefkaditou *et al.*, 2003b). The species has been recorded also in the Sea of Marmara (Katağan *et al.*, 1993; Ünsal *et al.*, 1999).

Figure. 8.2. ***Sepia orbignyana.*** **Geographic distribution in the Northeast Atlantic and Mediterranean Sea.**

8.2 Taxonomy

8.2.1 Systematics

Coleoidea – Decapodiformes – Sepiida – Sepiidae – *Sepia.*

8.2.2 Type locality

La Rochelle, France.

8.2.3 Type repository

Muséum National d'Histoire Naturelle, Laboratoire Biologie Invertebres Marins et Malacologie, 55, rue de Buffon, 75005 Paris 05, France**.** [fide Lu *et al.* (1995: 322)].

8.3 Diagnosis

8.3.1 Paralarvae

This species does not have paralarvae *sensu* Young and Harman (1988). Animals newly hatched in the laboratory measure ca. 6 mm ML (Boletzky, 1988).

8.3.2 Juveniles and adults

Sepia orbignyana is a small species, with adult males up to 96 mm and females up to 120 mm ML (Mangold-Wirz, 1963a). The mantle is oval, with the dorsal anterior margin projecting strongly (Figure 8.3). Male and female arms are subequal in length and rather short. Arm suckers are tetraserial. Medial suckers on the non-hectocotylized arms of males are wider than marginal suckers. The left ventral arm is hectocotylized in males: 1–2 rows of normal size suckers are present proximally, followed by greatly reduced suckers medially, then normal size suckers at the distal end to the arm tip.

Suckers of the hectocotylus are arranged in two dorsal and two ventral series displaced laterally. Clubs are short, oval, and bear 5–6 suckers in transverse rows; suckers vary markedly in size. Three large suckers are present medially with one slightly smaller sucker on each side of them. The cuttlebone is oblong, acute anteriorly, bluntly rounded posteriorly, and strongly recurved ventrally; its dorsal surface is rose-coloured or orange. Shell width is ca. 33% and 33–35% of shell length in males and females, respectively. The spine is long, pointed, and straight, directed slightly upwards, with a ventral keel. The anterior striae are shallow, M-shaped, or wavy. The animal's colour is reddish brown. (Adam and Rees, 1966; Nesis, 1982/1987; Neige and Boletzky, 1997; Reid *et al.*, 2005).

Figure 8.3. *Sepia orbignyana*. Dorsal view. Photo: IAMC-CNR (Mazara del Vallo, Sicily, Mediterranean Sea) research team.

8.4 Remarks

Floating cuttlebones may enter the southeastern North Sea and be found stranded on the Belgian coast (Eneman and Kerckhof, 1983; Nesis, 1982/1987). However, although Muus (1963) mentioned the presence of the species in the southern North Sea, no other records of live *S. orbignyana* from these waters exist (e.g. Adam, 1933; Adam and Rees, 1966; Nesis, 1982/1987), as confirmed also by very recent studies (J. Goud, pers. comm.).

On the basis of the animal's morphology (Khromov, 1987a; Khromov *et al.*, 1998), and, subsequently, results on genetic divergence (Pérez-Losada *et al.*, 1996; Sanjuan *et al.*, 1996), it has been suggested that *S. orbignyana* and *S. elegans* belong to the subgenus *Rhombosepion* within the genus *Sepia*.

Morphometric analysis of cuttlebone and statolith shape based on landmarks may prove a useful taxonomic tool to distinguish *S. orbignyana* from closely related species (Neige and Boletzky, 1997; Lombarte *et al.*, 2006).

8.5 Life history

Lifespan is 12–18 months. Spawning shows a clear summer peak in the Atlantic, but is year-round in the Mediterranean. As with other members of the genus, the hatchlings immediately adopt a benthic life style.

8.5.1 Egg and juvenile development

Eggs are laid in batches of 30–40 and are individually introduced into the tissues of sponges, usually Demospongiae, on muddy bottoms (Boletzky, 1998). The sponge provides protection for the eggs. The eggs are whitish-grey in colour, and their gelatinous envelop is less thick than that of other studied species (features which probably represent an adaptation to the "host organism" used to protect the eggs), although the chorion is very hard (Mangold-Wirz, 1963a). Egg diameter increases with the size of the females; maximum reported egg size is 9 mm (Mangold-Wirz, 1963a).

Information on *S. orbignyana* juveniles comes from rearing experiments (Boletzky, 1988). Newly hatched animals measure ca. 6 mm ML. They immediately settle on the substratum and move only over short distances by active swimming as well as by slowly "walking" along the bottom on their ventral arms. They have not been seen to bury themselves in soft substratum, as typical for *S. officinalis*, but they vigorously raise their dorsal arms and quickly wave them laterally when disturbed. They are able to adhere very efficiently to hard substrata by the ventral skin.

8.5.2 Growth and lifespan

In the Catalan Sea, growth rates of females have been reported to be slightly faster than those of males (Mangold-Wirz, 1963a). Studies of populations in the Sicilian Channel (central Mediterranean) by Ragonese and Jereb (1991) confirmed this finding and reported growth rates of 2.9 mm month^{-1} in males and 3 mm in females. Additional support for these results has subsequently come from studies in the Adriatic Sea (Bello, 1988, 2001), Aegean Sea (Lefkaditou *et al.*, 2007), and Portuguese waters. Bello (2001) used the number of chambers in the cuttlebone as an index of relative age. Females also attain significantly larger size than males and are notably heavier (Bello, 1988; Ragonese and Jereb, 1991). Length–weight relationships are summarized in Table 8.1. All studies reported "b" exponent values <3 in both sexes, showing that animals become more slender as size increases.

Table 8.1. *Sepia orbignyana*. Length–weight relationships in different geographic areas for females (F) and males (M). Original equations converted to $W = aML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	*a*	*b*	Sex	Reference
Portuguese waters	0.337	2.486	F	A. Moreno, pers. comm.
	0.284	2.340	M	
Catalan Sea	0.6567	2.15	F	Sánchez (1986)
	0.4052	2.35	M	
Sicilian Channel	0.266	2.58	F	Ragonese and Jereb (1991)
	0.272	2.480	M	
Adriatic Sea	0.224	2.560	F	Bello (1988)
	0.208	2.558	M	
Aegean Sea	0.343	2.305	F	Lefkaditou *et al.* (2007)
	0.525	2.441	M	

Female tentacular clubs are significantly longer than male ones (Bello, 1991a). Subsequently, Bello and Piscitelli (2000) showed that *S. orbignyana* females ingest more food at any given size and suggested a cause–effect relationship between sex-related club size and growth rate. Additional observations on *S. orbignyana* and *S. elegans* demonstrated the existence of a positive correlation between body condition and tentacle club

length in males and females of both species (Bello, 2006) and strongly corroborated the hypothesis that there is indeed a cause–effect relationship.

Lifespan is estimated to be 12–18 months (Mangold-Wirz, 1963a), although preliminary estimates from analysis of length-frequency distributions suggested a longer life, i.e. ca. 3 years (Ragonese and Jereb, 1991). As in many cephalopods, length-frequency distributions generally are polymodal, although it is difficult to identify microcohorts, and growth estimation by means of length-frequency methods is generally unreliable for cephalopods (e.g. Caddy, 1991).

8.5.3 Maturation and reproduction

A predominance of females in June–July is reported for the species in Portuguese waters (A. Moreno, pers. comm.).

In the Mediterranean, the smallest recorded mature male measured 35 mm ML (Belcari and Sartor, 1993), and the smallest mature female, a recent record from the Adriatic Sea, measured 40 mm ML (Ciavaglia and Manfredi, 2009). In Portuguese waters, slightly smaller sizes at first maturity have been observed, i.e. 29 mm ML for males and 32 mm ML for females (A. Moreno, pers. comm.). In the Catalan Sea, ca. 60% of males and females are mature at 50 mm and 80 mm ML, respectively (Mangold-Wirz, 1963a). Equivalent figures for Portuguese waters are 47 mm ML for males and 65 mm ML for females (A. Moreno, pers. comm.).

In Mediterranean waters, spawning is probably year-round (Mangold-Wirz, 1963a; Jereb and Ragonese, 1991a; Belcari and Sartor, 1993; Ciavaglia and Manfredi, 2009), with peaks of activity from spring to autumn. Recruitment also appears to be continuous throughout the year, with peaks in spring and autumn (Jereb and Ragonese, 1991a; Würtz *et al.*, 1991).

Spermatophore length ranges between 5 and 11 mm, and mature males can carry up to 100–150 spermatophores. Mature, smooth, eggs measure 7–9 mm, depending on female size, and mature females may carry up to 400 eggs (>1 mm) in their ovaries; however, as is usually the case for "large" eggs in cephalopods, probably only a fraction reaches maturity (Mangold-Wirz,1963a). It is possible that mature females have already spawned a proportion of their smooth eggs when examined, so the number of smooth eggs in the ovary is not representative of the total number of smooth eggs produced by the female. The maximum number of smooth eggs recorded in a mature female of 91 mm ML was 113 (Mangold-Wirz, 1963a).

8.6 Biological distribution

8.6.1 Habitat

The depth range reported for *S. orbignyana* extends from very shallow (15–20 m; Belcari and Sartor, 1993; Bello *et al.*, 1994; Casali *et al.*, 1998; Ciavaglia and Manfredi, 2009; I. Sobrino, pers. comm.) down to maximum recorded depths of 565 m in the Mediterranean Sea (Cuccu *et al.*, 2003a) and 580 m in the eastern Atlantic (Gulf of Cádiz, I. Sobrino, pers. comm.). However, the species is most abundant between 50 and 250 m throughout the Mediterranean Sea, as confirmed by numerous studies (Mangold-Wirz, 1963a; Adam, 1952; Lumare, 1970; Restuccia and Ragonese, 1986; Sánchez, 1986a; Auteri *et al.*, 1988; Mannini and Volpi; 1989; Soro and Piccinetti-Manfrin, 1989; Katağan and Kocatas, 1990; Repetto *et al.*, 1990; Jereb and Ragonese, 1991a; Würtz *et al.*, 1991; D'Onghia *et al.*, 1992; Belcari and Sartor, 1993; Katağan *et al.*, 1993; Salman *et al.*, 1997; Quetglas *et al.*, 2000; González and Sánchez, 2002; Ciavaglia and Manfredi, 2009). There

is also a major concentration of the species between 340 and 360 m in the Gulf of Cádiz (eastern Atlantic, I. Sobrino, pers. comm.). As in *S. elegans*, it is the peculiar structure of the cuttlebone, which is small, narrow, and with closely packed septa and modified sutures (Ward, 1991), that allows this species to reach these remarkable depths and to be among the deepest living *Sepia* species known. Records from below 450 m are scarce (e.g. Lefkaditou *et al.*, 2003a), and captures below 550 m extremely so, because that is the depth below which the shell starts to implode (Ward and Boletzky, 1984).

The pink cuttlefish is a demersal species that lives mainly on sandy and sandy-muddy bottoms. It is frequently sympatric (and confused) with *S. elegans (*e.g. Jereb and Ragonese, 1991a), and has been found associated with the horned octopus (*Eledone cirrhosa)* in some areas (Lumare, 1970). In the Sea of Marmara, the species can live in brackish waters (Ünsal *et al.*, 1999), and in Portuguese waters, it prefers water temperatures >12°C (A. Moreno, pers. comm.).

Studies on the demersal assemblages in the Moroccan southern Atlantic zone (Serghini *et al.*, 2008) indicate that the distribution of *S. orbignyana* is characterized by marked spatial and temporal variability.

8.6.2 Migrations

In the Mediterranean, males and females are usually found together throughout the year, and no onshore spawning migrations have been reported (Mangold-Wirz, 1963a; Jereb and Ragonese, 1991a; D'Onghia *et al.*, 1992; Ciavaglia and Manfredi, 2009).

8.7 Trophic ecology

8.7.1 Prey

Sepia orbignyana feeds mainly on crustaceans, but small fish, cephalopods, and other invertebrates can also form part of the diet (Table 8.2). In captivity, it will feed on small prawns and mysids (Boletzky, 1988).

Table 8.2. Prey composition of *Sepia orbignyana*, as known from studies in the eastern Atlantic and the Mediterranean Sea (compiled from Allué *et al.* 1977[1]; Auteri *et al.*, 1988[2]; Vafidis *et al.*, 2009[3]).

Taxon	Order / Species
Osteichthyes	indet.[1,2,3]
Crustacea	Decapoda-Natantia indet.[3], Decapoda-Brachyura indet.[3], Mysida indet.[3], Amphipoda indet.[3], Tanaidacea indet.[3], indet.[1,2]
Mollusca	Cephalopoda indet.[1,2,3], indet.[1]
Polychaeta	indet.[3]
Echinodermata	
Crinoidea	*Leptometra phalangium*[2]
Ophiuroidea	*Ophiothrix quinquemaculata*[2]

8.7.2 Predators

Very little information is available as to which species prey on *S. orbignyana*, but it has been found in the stomachs of at least three fish species (Table 8.3). In some cases, however, its presence in the stomach contents of scavenger species, such as the lesser spotted dogfish (*Scyliorhinus canicula*) (Olaso *et al.*, 2002) or seabirds, such as Audouin's gull (*Larus audouinii*) (Oro *et al.*, 2008), is most probably attributable to its being discarded by fisheries. Scars found on cuttlebones have been interpreted as toothmarks (Bello and Paparella, 2003).

Table 8.3. Known predators of *Sepia orbignyana* in the Mediterranean Sea and Northeast Atlantic.

Taxon	Species	References
Chondrichthyes	Lesser spotted dogfish (*Scyliorhinus canicula*)	I. Sobrino, pers. comm.
	Thornback ray (*Raja clavata*)	Kabasakal (2002)
Osteichthyes	Black-bellied anglerfish (*Lophius budegassa)*	I. Sobrino, pers. comm.
Aves	Audouin's gull (*Larus audouinii*)	Oro *et al.* (2008)

8.8 Other ecological aspects

8.8.1 Contaminants

High levels of cadmium have been reported in the pink cuttlefish (Bustamante *et al.*, 2002b), indicating that it has efficient detoxification mechanisms. The high bioavailability of cadmium in the digestive gland cells also indicates a high potential for the trophic transfer of this metal to its predators.

8.8.2 Biochemistry

Studies on the biochemical composition of tissues indicate a lower lipid content and higher protein content in the gonad than in other cephalopod species with a benthic lifestyle (Rosa *et al.*, 2005a).

8.9 Fisheries

Sepia orbignyana is one of the most abundant cephalopod species in some areas of the Mediterranean, i.e. Catalan Sea, Tyrrhenian Sea, Sicilian Channel, southern Adriatic Sea, and Aegean Sea (Mangold-Wirz, 1963a; Lumare, 1970; Mandić and Stjepcević, 1983; Sánchez, 1986a; Jereb and Ragonese, 1991a; Würtz *et al.*, 1991; D'Onghia *et al.*, 1992, 1996; Belcari and Sartor, 1993). It is taken mainly as bycatch, both in the Mediterranean and in West African otter-trawl fisheries. Separate landing statistics are not reported, but *S. orbignyana* represents a significant percentage of the catches in some areas. In the Mediterranean Sea, it is marketed fresh and frozen, along with *S. elegans* and small *S. officinalis*, and constitutes a valuable resource locally.

In the Sicilian Channel, research studies have shown an exploitation rate of 0.60 for this species, which suggests intense fishing pressure (Ragonese and Jereb, 1991). More recent studies on the selectivity of diamond, hexagonal, and square-mesh codends (Tosunoğlu *et al.*, 2009) confirmed that the current legal minimum mesh size and codend configurations for demersal trawling are not suitable for regulating fishing on this species, or indeed on other cephalopod species.

8.10 Future research, needs, and outlook

Sepia is the most speciose genus of the Sepiidae, but many species are poorly known, and the systematics of the genus are not clearly resolved (see Khromov *et al.*, 1998, and Reid *et al.*, 2005, for recent reviews). Khromov *et al.* (1998) proposed subdivision of the genus into six "species complexes", but genetic data are still required to test this idea. Further research is needed to clarify the systematics of the group and the position of this species within the group.

Considering the relative importance of the resource in many areas of its distributional range and the intense fishing pressure detected in some of these areas, detailed studies on ecological aspects would be welcome to avoid potential overexploitation. It is essential that separate statistics are collected for landings of individual *Sepia* species.