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Research Article

First record of invasive caprellid *Caprella scaura* Templeton, 1836 sensu lato (Crustacea: Amphipoda: Caprellidae) from the Iberian Peninsula

Julián Martínez* and Idoia Adarraga

Sociedad Cultural INSUB. Museo Okendo. Apdo. 3223, 20080 Donostia-San Sebastián, Spain

**Corresponding author*
E-mail: julido@euskalnet.net

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Abstract

The invasive Indian caprellid crustacean *Caprella scaura* sensu lato has been recorded for the first time in the Iberian Peninsula in July 2005 in the brackish waters of the Roses Bay (Girona, Spain). Its most probable introduction vector was shipping. Some ecological and distributional features are succinctly included.

Key words: *Caprella scaura*, invasive species, first record, Iberian Peninsula

Introduction

Caprella scaura Templeton, 1836 is an euryhaline species native to the western Indian Ocean, where it usually inhabits rocky substrates from the intertidal region down to about ten metres depth. *C. scaura* can be immediately distinguished from other European *Caprella* genus species by the well-developed occipital spine on the head in both sexes (Figure 1, c, d). It was first recorded in Rivière Noire (Mauritius) and later reported in various "forms" from numerous areas all over the world. In the last few decades, *Caprella scaura* sensu lato has extended its geographic distribution, and has successively established populations in the Indian Ocean: Arimoto (1976), Ren and Zhang (1996), Laubitz (1995) and Guerra-García (2004); Pacific Ocean: Mayer (1890), Dougherty and Steinberg (1953), Guerra-García (2003a), Guerra-García and Takeuchi (2003, 2004), Guerra-García and Thiel (2001), Thiel et al. (2003) and Laubitz (1991); Atlantic Ocean: Stimpson (1857), Mayer (1890), McCain (1968) and Serejo (1998); Mediterranean Sea: Mizzan (1999), Danesi et al. (1999), Occhipinti-Ambrogi (2000) and Krapp et al. (2006).

This filter feeder caprellid was reported in various habitats associated with brown algae (Lim and Alexander 1986; Takeuchi and Hino 1997; Assis 2004), *Polysiphonia* and *Gracilaria* red algae (Guerra-García and Thiel 2001), *Halodule univervis* (Forsskayl) Ascherson, 1882 and *Halophila ovalis* (R. Brown) Hooker, 1858 seagrasses (Lim and Alexander 1986), *Zostera marina* Linnaeus, 1753 and *Zostera caulescens* Miki, 1932 seagrasses (Takeuchi and Hino 1997), *Dysidea fragilis* (Montagu, 1818) sponge (Serejo 1998) or *Bugula neritina* (Linnaeus, 1758) and *Scrupocellaria* spp. bryozoans (Lim and Alexander 1986, Guerra-García and Thiel 2001).

The specimens were collected in Roses Bay, most of which were found among *Bugula neritina* (Bryozoa), *Mytilus galloprovincialis* (Lamarck, 1819) (Bivalvia), and *Ficopomatus enigmaticus* (Fauvel, 1923) (Polychaeta) from the local fouling communities, in shallow water areas with fluctuating salinity conditions. This record from the Catalan coast reveals that the species has expanded westwards in the Mediterranean Sea.

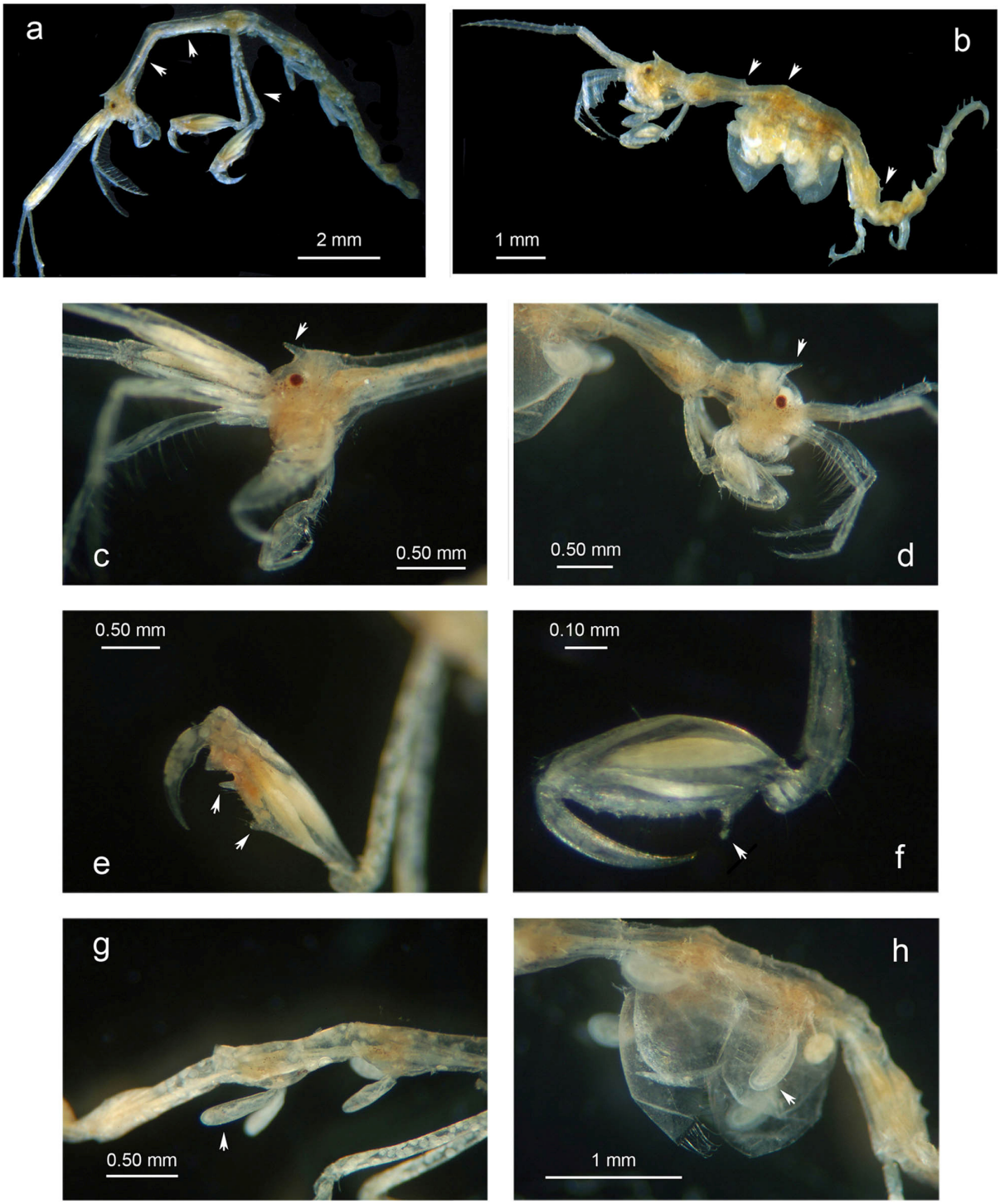

Figure 1. *Caprella scaura* (from Roses Bay, Spain) (a) adult male, entire animal; (b) adult female, entire animal; (c) head of adult male; (d) head of adult female; (e) gnathopod 2 of adult male; (f) gnathopod 2 of adult female; (g) gills of adult male; (h) oostegites and gills of adult female. Arrows indicate most prominent characters that can be used to distinguish this species. (Photo by Julián Martínez).

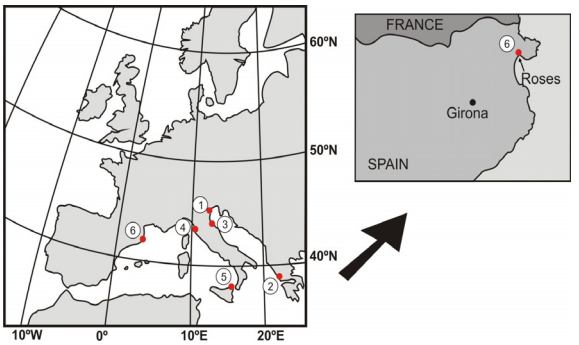

Figure 2. Occurrence of *Caprella scaura* in European coasts and map of the study area (see Annex 1 for details).

Material and methods

Samples were taken the 17th of July 2005 at different sites in Roses Bay (42º16'00" N – 3º10'59" E, Figure 2) from artificial hard substrates at 0.2 m depth. Sampling was collected scraping with a manual scraper a surface of 400 cm^2. Immediately after the collection samples were fixed in a 5 % formalin solution, preserved in 70 % ethanol, and subsequently processed in the laboratory, including determination of the species composition. Previously, the collected material was washed through a 0.25 mm mesh sieve. All organisms were identified to species or genus, except for Nematoda, Nemertea and Platyhelminthes, which were identified to phylum.

In addition, water temperature and salinity were measured in the water column with a HANNA portable multiparameter.

Observations and measurements were made using a microscope with interfererence contrast optics (Nomarsky) and an Olympus stereomicroscope. Adults, juvenil stages and different appendages were photographed on another Olympus stereomicroscope with a Nikon D50 digital camera.

The identification and description of the *C. scaura* specimens was based on the morphological descriptions provided by Templeton (1836), McCain (1968), Guerra-García (2003b) and Krapp et al. (2006).

Results

During a survey at Roses Bay (Girona, Spain) the presence of a dense population of *C. scaura* has been confirmed for one of sampling stations, which is the first record of this species in the Iberian Peninsula (Figure 1). Specimens of *C. scaura* were obtained from a sample of the *Bugula neritina* community, from a unique station (42º15'59.98"N – 3º09'20.03"E), in a semi-enclosed area connected to the sea by a narrow channel. More than 2600 organisms were identified from in this sample, belonging to 43 species or higher taxa (Annex 2). The water temperature at that time was 24.5 ºC, and salinity 29.8 PSU.

Caprella scaura Templeton, 1836

Type locality: Rivière Noire, Mauritius.
Material examined: 517 specimens, including males, females, ovigerous females, in several growth stages.

Locality: Girona, Roses Bay (Figure 2); depth 0.2 m, July 2005, captured in a *Bugula neritina* community. The specimens have been deposited in the Collection of Sociedad Cultural de Investigación Submarina INSUB (Donostia-San Sebastián, Spain) (cod. CRU672).

Diagnosis: Cephalon of both sexes with anteriorly directed spine. In males, pereonites 1 and 2, as well as basis of gnathopod 2 elongated (Figure 1, a).

Male description: Body with anteriorly cephalic spine. Length of largest specimen 18,5 mm. Antenna 1 approximately longer than one-half of the body length; antenna 1 peduncle article 1 subequal to article 3; second article of peduncle the longest; flagellum with up to 9 fused articles. Length of antenna 2 is similar to pereonites 1+2. Antena 1 = 2 x antenna 2. Head convex, lacking rostrum. Occipital spine, acute, well visible (Figure 1, c). Not swollen at back end. Mouthparts typical of the genus. Pereonites 1-5 dorsally smooth, without ventral spine. Gnathopod 2 basis long and subequal to pereon segment 2; propodus of gnathopod 2 elongated, palm with 2 strong teeth (Figure 1, e). Propodus of gnathopod 1 with 2 proximal spines; margin of dactylus and propodus serrate. Propodus of peropods 5-7 proximally slightly wider than distally, with 2 proximal grasping spines, and some pairs of setae. Gills elongate, elliptical, approximately 2/3 longer as segments (Figure 1, g).

Female description: Body with anteriorly cephalic spine, with variously developed knobs on some pereonites (Figure 1, b). Length of largest specimen 13,1 mm, smallest ovigerous female 6,2 mm. Antenna 1 slightly smaller than

one-half body length. Flagellum with up to 4 fused articles. Length of antenna 2 variable, similar pereonites 1+2. As the male, head convex, lacking rostrum. Occipital spine acute, very well-developed (Figure 1, d). Not swollen at back end. Mouthparts typical of the genus. In adult specimens dorsal processes in pereonites, without ventral spine. Gnathopods 2 basis much shorter than pereon segment 2; propodus of gnathopod 2 not elongated, palm with proximal spine, and small distal tooth (Figure 1, f). Propodus of gnathopod 1 very similar to the males one. Pereopods similar to the males. Gills elliptical, but less elongated than in male and shorter, about half as long as segment 4 or 5 (Figure 1, h).

The collected smaller specimens (< 2.5 mm) differ from adults in some features. Thus, the antena 1 and 2 are of similar length; the cephalosoma is roundish and occipital spine absent; gnathopods 1 of the same length as gnathopods 2; pereon segments roundish and the same length; gills smaller than in adults, and rounded.

Discussion

C. scaura is a caprellid of complicated taxonomy which shows a wide morphological variety. After Templeton´s original description, Mayer (1890, 1903 in McCain 1968) described six varieties of *C. scaura*: *C. scaura typica* Mayer, 1890 (type locality: Rio de Janeiro, Brazil), *C. scaura diceros* Mayer, 1890 (type locality: Kobe, Japan), *C. scaura cornuta* Mayer, 1890 (type locality: Rio de Janeiro, Brazil), *C. scaura spinirostris* Mayer, 1903 and *C. scaura scauroides* Mayer, 1903 (type locality for both: North Pacific Ocean) and *C. scaura californica* Mayer, 1903 (type locality: California, USA).

Later, a seventh subspecies was described by Utinomi (1947) from Japan and designated as *C. scaura* f. *hamata.*

Some years later, Dougherty and Steinberg (1953) examining samples taken from California, revived Stimpson´s (1857) *Caprella californica* as a valid species. However, Laubitz (1970) synonymized the two forms with ventral spines: *C. scaura spinirostris* and *C. scaura scauroides* with *C. californica* Stimpson, 1857.

According to current rules, the specimens collected by Templeton in 1836 from Mauritius are to be named as *Caprella scaura scaura* (in Krapp et al. 2006).

At the moment, among the *Caprella* species group with a spine on their head, there are two valid species recognized: *Caprella scaura* (without ventral spine at inter gnathopods 2) and *Caprella californica* (with ventral spine). From *C. scaura* there are five subsepecies known: *C. scaura scaura* Templeton, 1836; *C. scaura typica* Mayer, 1890; *Caprella scaura cornuta* Mayer, 1890; *Caprella scaura diceros* Mayer, 1890; and *Caprella scaura hamata* Utinomi, 1947 (Table 1).

The specimens collected in Roses Bay are lacking ventral spines, and the morphology agrees with that of *Caprella scaura scaura*, described by Templeton (1836) from Mauritius, later by McCain (1968) from the northern Atlantic, and more recently by Guerra-García (2003a) from Australia or Krapp et al. (2006) from the Mediterranean.

The presence of this species in European ecosystems is quite new (Annex 1). *C. scaura* was recorded for the first time in 1994 in the Lagoon of Venice (Mizzan 1999), and was recently reported as very abundant also in the harbour of Ravenna (Sconfietti et al. 2005), and Livorno (Occhipinti-Ambrogi, in Galil et al. 2008). *C. scaura* is an active filter feeder, which especially benefits from high concentrations of plankton and organic matter in the water column. The specimens from Roses Bay were collected in a semi-enclosed area connected to the sea by a narrow channel. The biotope where the sample was collected belongs to the *Bugula neritina* community, which agrees with the observations from other authors in other geographical regions (Lin and Alexander 1986, Guerra-García and Thiel 2001). Thirty-eight ovigerous females were identified in the sample, indicating that *C. scaura* might be established in the area, with a reproducing population.

In the last few decades, *Caprella scaura sensu lato* has widely extended its geographic distribution. The introduction of the species in Mediterranean waters seems to be due to the continuous circulation of yachts; although aquaculture (movement of fish cages) in certain specific zones represent another possible introduction vector (Krapp et al. 2006). Transportation via shipping and aquaculture are the major vectors of global dispersion of alien species (Streftaris et al. 2005). In our case, its presence inside the yachting harbour, suggests that its expansion is at least facilitated by shipping activity.

Table 1. The main differentiating characters of *Caprella scaura* subspecies.

Taxon	Dorsal processes Pereon 1-3 (males)	Dorsal processes Pereon 4 (males)	Dorsal processes Pereon 5 (males)	Spine of Head (males)	Body (females)
C. s. cornuta	-	-	-	Short, blunt	Without protuberances
C. s. diceros	-	+	+	Short, acute	Very spinous
C. s. hamata	+	+	-	Short, acute	Moderately spinous
C. s. scaura	-	-	-	Long, acute	With protuberances
C. s. typica	-	-	+	Short, acute	Extremely spinous

Colonized areas are usually characterized by high population densities (Sconfietti et al. 2005, Costa in Krapp et al. 2006, and Occhipinti-Ambrogi, in Galil et al. 2008). According to these surveys, *C. scaura* appears to be a strong invader, able to colonise a wide geographical range. Its presence in large numbers in the Roses Bay (max. 12925 ind./m^2) suggests a probable future invasion along the Iberian Mediterranean coasts and adjacent areas.

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Annex 1

Records of *Caprella scaura* in Europe

Map ref.	Location	Record coordinates		Date	Reference
		Latitude, N	Longitude, E		
1	Venice Lagoon, Italy	45º26'	12º15'	1994	Mizzan 1999
	Venice Lagoon, Italy	45º27'	12º19'	2004	Krapp et al. 2006
2	Amvrakikos Gulf, Greece	38º44'	20º55'	2002	Krapp et al. 2006
3	Ravenna Harbour, Italy	44º29'	12º17'	2004	Sconfietti et al. 2005
4	Livorno, Italy	43º33'	10º18'	2004	Galil et al. 2008
5	Messina, Sicily	38º11'	15º33'	2004	Krapp et al. 2006
6	Roses Bay, Spain	42º15'	03º09'	2005	Present study

Annex 2. Species composition and abundance of biota found in the *Bugula neritina* community sampled in Roses Bay.

Higher taxon	Species	Nº	Range of density (ind./m^2)
Chlorophyta	*Ulva compressa* Linnaeus 1753 (*)	+	+
	Chaetomorpha linum (Müller) Kützing 1845 (*)	++	++
Rhodophyta	*Ceramium tenerrimum* (G. Martens) Okamura 1933 (*)	+	+
	Polysiphonia sp. (*)	+	+
Nemertea	Nemertea indeter.	5	125
Nematoda	Nematoda indeter.	35	875
Platyhelminthes	Platyhelminthes indeter.	14	350
Polychaeta	*Salvatoria clavata* (Claparède, 1863)	80	2000
	Exogone naidina Örsted, 1845	13	325
	Ambliosyllis madeirensis Langerhans, 1879	1	25
	Ophryotrocha labronica (La Greca and Bacci, 1962)	88	2200
	Boccardia semibranchiata Guerin, 1990	186	4650
	Cirratulus sp.	2	50
	Ctenodrilus serratus (Schmidt, 1857)	195	4875
	Terebella lapidaria Linnaeus, 1767	14	350
	Thelepus setosus (Quatrefages, 1865)	13	325
	Ficopomatus enigmaticus (Fauvel, 1923)	201	5025
	Spirorbis sp.	84	2100
Oligochaeta	Enchytraeidae	9	225
Crustacea	Copepoda harpacticoida	38	950
	Paramysis helleri (GO Sars, 1877)	2	50
	Balanus amphitrite (Darwin, 1854)	4	100
	Semibalanus balanoides (Linnaeus, 1767)	1	25
	Munna sp.	3	75
	Dynamene bidentata (Adams, 1800)	1	25
	Lekanesphaera rugicauda (Leach, 1814)	5	125
	Anthura gracilis (Montagu, 1808)	9	225
	Tanais dulongii (Audouin, 1826)	529	13225
	Hyale perieri (Lucas, 1849)	23	575
	Corophium acherisicum A. Costa, 1851	47	1175
	Corophium insidiosum Crawford, 1937	343	8575
	Melita palmata (Montagu, 1804)	106	2650
	Caprella scaura Templeton, 1836	517	12925
	Carcinus maenas (Linnaeus, 1758)	1	25
Bivalvia	*Mytilus galloprovincialis* (Lamarck, 1819)	29	725
Entoprocta	*Barentsia benedeni* (Foettinger, 1887) (*)	+	+
Bryozoa	*Bugula fulva (*Ryland 1960) (*)	+	+
	Bugula neritina (Linnaeus, 1758) (*)	+++	+++
	Bugula stolonifera Ryland, 1960 (*)	++	++
	Bowerbakia imbricata (Adams, 1798) (*)	++	++
	Zoobothryon verticillatum (Delle Chiaje, 1828) (*)	++	++
Tunicata	*Phallusia mamillata* (Cuvier, 1815)	1	25
	Eudistoma sp. (*)	++	++

(*) In algae and colonial organisms, the symbol (+) indicate presence: + scarce, ++ abundant, and +++ very abundant.