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Occurrence of *Phoronopsis californica* and *Phoronis australis* at Granada Coast (Spain, Western Mediterranean).

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Abstract: *Phoronopsis californica* was collected at the beach of Calabajío (Almuñécar, Granada) at 9 m depth in a *Cymodocea nodosa* meadow with a muddy sand sediment; this represents the first record of this species for the Mediterranean Sea. At others localities of the same Granada province, but at a greater depth, around 15 m, *Phoronis australis* has been found, into a tube-wall of *Cerianthus membranaceus* which is typical for this phoronid species. The new record from Granada coast, enlarges the distribution area of Phoronida in the Mediterranean Sea, particularly that of the genus *Phoronopsis*.

Résumé : *Phoronopsis californica* a été récoltée, pour la première fois en Mer Méditerranée, près de la plage de Calabajío (Almuñécar, Province de Grenade) à une profondeur de 9 m dans un sable fin, légèrement vaseux d'une prairie à *Cymodocea nodosa*. Dans une autre localité de la même province, à une profondeur de 15 m, *Phoronis australis* a été rencontrée, dans la paroi de tubes de *Cerianthus membranaceus*, une situation caractéristique de cette espèce de phoronidien. Ces nouvelles signalisations des environs de Grenade élargissent la distribution géographique des phoronidiens, en particulier celle du genre *Phoronopsis*.

Keywords : Phoronida, Biogeography, Mediterranean Sea.

Introduction

Phoronids constitute a taxonomic class of the phylum Lophophorata, that consists currently of ten valid species (Emig, 1971; 1977a; 1982; 1997), five of wich have been previously cited in the Mediterranean Sea: *Phoronis ovalis* Wright, 1856, *Phoronis psammophila* Cori, 1889, *Phoronis hippocrepia* Wright, 1856, *Phoronis muelleri* Selys-Longchamps, 1903, and *Phoronis australis* Haswell, 1883.

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The first Mediterranean occurrences of *Phoronopsis albomaculata* Gilchrist, 1907, and *Phoronopsis harmeri* Pixell, 1912, in the Chafarinas islands (off the coast of Morocco) has been recently pointed out (Emig *et al.*, in press).

During the benthic survey along the coast of Granada (S of Spain) (Ocaña *et al.*, in press) several specimens of *Phoronis australis*, till now only known from Greece (Stanjek & Wägele, 1981) and Spain (Emig *et al.*, in press), were observed as well as two individuals of *Phoronopsis californica* Hilton, 1930, recorded for the first time in the Mediterranean. These two species were collected for

subsequent anatomical studies. There are few data on *Phoronopsis californica* concerning its anatomy, biology and geographical distribution (Emig & Plante, 1969; Emig, 1971 and Thomassin & Emig, 1983). The distribution of *Phoronopsis californica*, currently known is: Pacific Ocean (California), Indian Ocean (Nosy-Bé; Bank of Zélée) and Atlantic Ocean (Senegal) (Emig, personal communication).

On the contrary, *Phoronis australis* is a better known species, with a mainly tropical world-wide distribution: India, Madagascar, Mozambique, China, Japan, Australia, Senegal, East coast of the USA and Mediterranean Sea (see Emig & Roldán, 1992).

Material and methods.

The specimens of *Phoronopsis californica* were collected by scuba diving on a qualitative sampling, on August 1995 and July 1997, at 9 m depth, off the beach of Calabajío, (Almuñécar, Granada province), whilst the specimens of *Phoronis australis* were observed during simple diving, at 15 m depth, at Punta de la Mona and Cerro Gordo (Granada province; Fig. 1). The observed densities of the phoronids have been calculated through photographic or direct visual recounts. The specimens collected were fixed in 10% formaldehyde-seawater solution. For accurate identification histological sections from the trunk were coloured, with Azan stain, using Heidenhain's method.

Results and discussion.

The two collected specimens of *Phoronopsis californica* present a patent epidermal collar-fold at the base of the lophophore, very characteristic of the genus. The species is the greatest within phoronids, with a length in extension from 220 to 450 mm by a diameter of 2.5 to 4 mm (Emig & Plante, 1969; Emig, 1971; 1979). The total contracted length of our specimens was 30 and 40 mm, which was due to the very strong and rapid retraction down into the tube. As a consequence of this contraction, the observed length became about 1/5 of the natural length of the animal (Emig, 1974).

The body color on living specimens is light orange, with the anterior body part and lophophore transparent. The lophophore arrangement is very characteristic of the species: it is helicoidally-shaped with 4-8 coils on each side; the length of the lophophore is from 5 to 7 mm while that of each tentacle is approximately 2 mm (Fig. 2). On transverse sections a giant nerve fibre is observed on the left side of the trunk and a very thin fibre on the right side, present only down the nephridial level. The longitudinal muscle formula is

$$\begin{array}{c|c} 64 & 65\text{-}66 \\ \hline 40 & 34 \end{array} = 204;$$

It agrees with the general formula and with the mean formula of this species, respectively given below (Emig, personal communication):

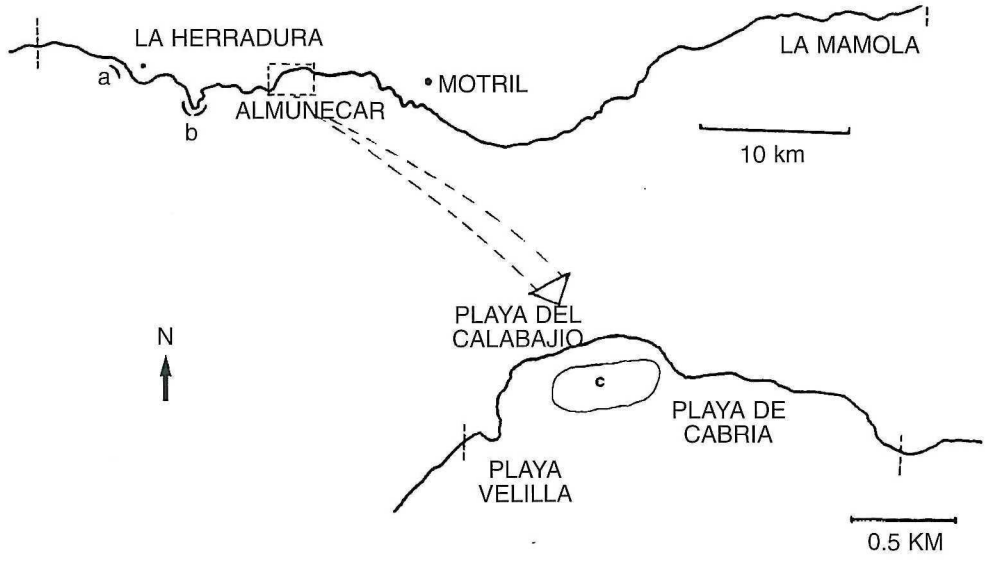

Figure 1. Localities in which *Phoronis australis* (a. Cerro Gordo; b. Punta de la Mona) and *Phoronopsis californica* (c. *Cymodocea nodosa* meadow, beach of Calabajío, Almuñécar) have been recorded at Granada coast.

Figure 1. Localisation des stations de récolte de *Phoronis australis* (a. Cerro Gordo ; b. Punta de la Mona) et *Phoronopsis californica* (c. prairie à *Cymodocea nodosa*, plage de Calabajío, Almuñécar) (Grenade).

Figure 2. Photography of the lophophore of *Phoronopsis californica X 5.*
Figure 2. Photographie du lophophore de *Phoronopsis californica X 5.*

51-81	52-79	[171-243]	65 | 65	=207
35-54	29-40		43 | 35	

The two specimens have been collected at 9 m depth in a *Cymodocea nodosa* (Ucria) meadow in a muddy sand. This does not seem to be the most characteristic habitat of the species, which has previously been cited from mud to coarse sands, in organogenous gravels, in zones under the influence of bottom currents, sometimes stabilized by the rhizomes of a *Thalassodendron ciliatum* meadow (Thomassin & Emig, 1983). Given the rather long time elapsed between the two samples, it can be considered that the population is permanently established. By visual evaluation, this population appears very scattered, with a density of 2 to 3 individuals. m^{-2}. The associated fauna comprised the Sponges, *Ircinia variabilis* (Schmidt, 1866) and *Cliona celata* (Grant, 1826); the Cnidarians *Cerianthus membranaceus* (Spallanzani, 1784), *Adamsia carciniopados* (Otto, 1823) and *Bunodeopsis strumosa* Andres, 1881; the Molluscs *Astraea rugosa* (Linnaeus, 1758), *Turritella communis* Risso, 1826, *Cymatium corrugatum* (Lamarck, 1816), *Coralliophila lamellosa* (Cristofori y Jan, 1832), *Facelina coronata* (Forbes & Goodsir, 1839), *Dendrodoris limbata* (Cuvier, 1804), *Pleurobanchea meckeli* (Blainville, 1825), *Pecten maximus* (Linnaeus, 1758), *Callista chione* (Linnaeus, 1758), *Acanthocardia aculeata* (Linnaeus, 1758), *Panopea glycimeris* (Born, 1778), *Chamelea gallina* (Linnaeus, 1758), *Laevicardium oblongum* (Gmelin, 1791) and *Chlamys flexuosa* (Poli, 1795); the Polychaetes *Diopatra neapolitana* Delle Chiaje, 1841, *Serpula vermicularis* Linnaeus, 1767 and *Sabella spallanzani* (Viviani, 1805); the Crustaceans *Dardanus arrosor* (Herbst, 1796), *Dardanus calidus* (Risso, 1827) and *Pagurus prideauxi* Leach, 1815; the Echinoderms *Holothuria polii* Delle chiaje, 1823, *Antedon mediterranea* (Lamarck, 1816), *Echinocardium sp., Marthasterias glacialis* (Linnaeus, 1758), *Astropecten aranciacus* (Linnaeus, 1758), *Luidia ciliaris* (Philippi, 1837), *Ophiura ophiura* Lamarck, 1816 and *Ophiopsila aranea* Forbes, 1843 and the Urochordate *Phallusia mammillata* (Cuvier, 1804).

The present record from the beach of Calabajío (Almuñécar) significantly extends the distributional range of *Phoronopsis californica* which is recorded for the first time from the Mediterranean Sea. This species may be considered as a cosmopolitan species owing to the world wide distribution of the records. Anyway, there are few records due to the fact that phoronids have been overlooked in benthos studies. Furthermore, *Phoronopsis californica* is

particularly difficult to obtain by dredging because the alarm reaction of the animal is a very rapid retraction down the tube, which can measure at least 45 cm long and is located vertically into the sediment.

At others localities of the same Granada province, but in a deeper site (15 m), a population of *Phoronis australis* has been found, whose tubes are located into the tube-wall of a *Cerianthus membranaceus*, a characteristic feature of the species. So the Mediterranean distribution range of *P. australis* in Spain is extended westerly. The previous records are from El Palmer (Emig, 1977b; Viéitez *et al.*, 1987) and from Cape of Gata (García Raso *et al.*, 1992), province of Almería, from between La Azohía and Cape Tiñoso (province of Murcia) (Calvín & Ros, 1984), and from Port de la Selva (province of Gerona) (G. San Martín, personal communication) which is the northern limit of the species distribution.

At Granada coast, the present population is well established; densities of about 20 individuals by tube of *Cerianthus*, a typical habitat for *Phoronis australis*, have been recorded.

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