

NOTE

Occurrence of the phylum Cycliophora in the Mediterranean

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ABSTRACT: *Symbion pandora* is the single described species of the animal phylum Cycliophora, and was discovered in 1995 on the coast of northern Europe. Specimens have recently been found in the Adriatic Sea, at the Istria Peninsula on the Croatian coast, on the mouthparts of lobster *Homarus gammarus*.

KEY WORDS: *Symbion pandora* · Lobster · *Homarus* · Croatia · Adriatic Sea

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Cycliophorans are microscopic (the single described species was 0.35 mm in length; Funch & Kristensen 1995) marine animals (Metazoa). Their life cycle is very complex. The body of the dominant feeding stage resembles either an entoproct or a sessile rotifer, consisting of a buccal funnel, an ovoid trunk, and a stalk with an adhesive disc which attaches the animal to the host. However, in contrast to rotifers, cycliophorans possess a cellularized epidermis, a true cuticle and lack a mastax. The phylogenetic position of the phylum has attracted a lot of attention. The original suggestion of a link to entoprocts (Funch & Kristensen 1995, Zrzavý et al. 1998), was revised after subsequent molecular and combined data analysis showed a possible relationship to Syndermata (Rotifera and Acanthocephala), within the taxon Gnathifera (Winnepeninckx et al. 1998, Giribet et al. 2000, Zrzavý et al. 2001, Zrzavý 2003). The most recent phylogenetic analysis (Giribet et al. 2004) would apply to both hypotheses (i.e. relationship to either Ectoprocta or Gnathifera).

A new animal species, *Symbion pandora* Funch & Kristensen 1995 (phylum Cycliophora—only contains this species), was discovered and described just 9 yr ago (Funch & Kristensen 1995). These animals had already been observed in the 1960s on lobsters collected in Kattegat, Denmark, and later near Naples, Italy, but the importance of the finding was not recognised at that point. Since then, cycliophorans have

been observed by Funch & Kristensen (1997) in Denmark, Norway, Sweden, the Faroe Islands, and North America. *Symbion* spp. have been collected from the Mediterranean area before, but so far only on *Nephrops norvegicus* (P. Funch pers. comm.). The species and phylum have been included in a web checklist of animals of the Iberian Peninsula and Balearic Islands but there are no accompanying location details or descriptions of the species (see: www.fauna-iberica.mncn.csic.es/htmlfauna/faunibe/zoolist/cycliophora.html).

It has also been listed as present in Brazilian fauna (de Almeida Rodrigues & d'Hondt 1999), although Migotto & Marques (2003) later reported it as absent.

The type species lives mainly on the setae of the mouthparts of the Norway lobster *Nephrops norvegicus* (Linné, 1758). Similar individuals were found on the European lobster *Homarus gammarus* (Linné, 1758) (Funch & Kristensen 1997), and an undescribed species (Obst, Funch & Kristensen unpubl. data) was found on American lobster *H. americanus* Milne Edwards, 1837, from Maine and Nova Scotia.

Recently we have found cycliophorans resembling the shape and size of the type species *Symbion pandora* on the mouthparts of the European lobster *Homarus gammarus* collected in the Adriatic Sea, on the Croatian coast near the Istria Peninsula, from around the small island of Veruda (Fig. 1; depth = 40 m), on August 31, 2003. The host crustacean was an adult male, about 25 cm long (from rostrum to telson).

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Fig. 1. Collection site of the host *Homarus gammarus* with *Symbion pandora* in the Adriatic Sea, at the island of Veruda, Istria Peninsula, Croatian coast

Approximately 200 cyclophorans were found on the setae of distal parts of the endopodites of both pairs of maxillae and all 3 pairs of maxillipeds (Fig. 2). No individuals were observed on the exopodites. The hairy front margins of mandibular palps (exopodites) were extremely heavily infested with another 400 individuals (200 individuals on each of the mandibular palps), exceeding the mass (volume) of the lobster's hairs by several times. Several feeding-stage individuals had

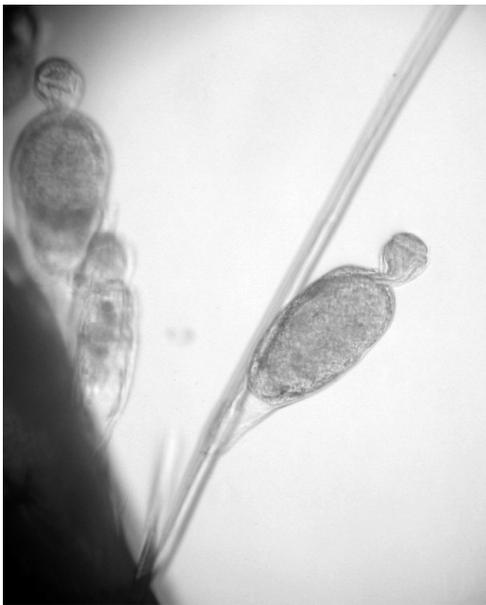


Fig. 2. Adult individuals of cyclophorans *Symbion pandora* (feeding-stage) living on the setae of endopodites of the second maxilla of *Homarus gammarus* from the Adriatic Sea. (See gallery of images at <http://zoo.bf.jcu.cz/kz/kzcz/cyclophoracz.htm>)

an attached male *Prometheus* larva (formerly referred to as 'males' by Funch & Kristensen 1995, and later recognised as larvae containing males by Obst & Funch 2003). The precise count of individuals on the left mandibular palp was as follows: 21 juveniles (small immature feeding stage individuals, without a feeding funnel), 161 'adult' individuals of the feeding stage, plus another 7 individuals with attached *Prometheus* larvae.

Individuals of an unrecognized sessile 'protozoan', (phylum Ciliophora), similar to freshwater *Vorticella* spp., were attached to the basal sections of longer setae. We also inspected the mouthparts of 3 lobsters (2 males and 1 female) *Homarus gammarus* collected at the same location as the recent one, but in 2000. All 3 possessed visually identical cyclophorans in slightly lower quantities at the same places on their mouthparts. We also observed that several other crustacean species collected during diving displayed no traces of epifauna (*Dromia personata*—1 male + 4 females, *Eriphia verrucosa*—3 males + 1 female, *Eupagurus prideauxi*—2 individuals [sex unknown], *Galathea strigosa*—1 male + 3 females, *Nephrops norvegicus*—5 individuals [2 males + 1 female + 2 unknown, interestingly, no *Symbion* sp. individuals were found on these lobsters], *Palinurus* sp.—7 females, *Scyllarus* sp.—2 females), or with the vorticellid ciliates only (2 of 12 [9 males + 3 females] observed *Maja crispata*).

Although Funch & Kristensen (1997) found that a feeding cyclophoran individual will close its ciliated mouth ring due to cessation of water flow or increase in temperature, many of the observed cyclophorans in this study still filtered food particles (beating the mouth ring cilia) several hours after being dislodged from the host (cutting the setae) onto a Petri dish and after placement under microscopic glass. When irritated, or periodically spontaneously, they closed the buccal funnels.

We consider that cyclophorans are widely distributed, living in all suitable waters, although restricted to several host species, namely the large lobsters. de Meeûs & Renaud (2002) suggested that on the basis of host specificity, Cyclophora may contain as many species as available host species. However, it seems that our specimens belong to the described species *Symbion pandora* despite being found on a different host. The fact that cyclophorans were present only on 1 of the 9 investigated decapod species suggests that they are highly host specific, and further research might be restricted only to *Homarus* spp. (3 species) and *Nephrops norvegicus* (a single species) which are very closely related genera within the family Nephropidae (see <http://crayfish.byu.edu/astacidea/nephropidae>). None of the other species of crustaceans observed in this study were closely related to the family Nephropi-

dae, which are related to marine Thaumastocheilidae (pincer lobsters) and freshwater crayfishes (Astacoidea, Parastacoidea). The 2 host genera differ slightly in their preferred depth—*N. norvegicus* can be found in waters as deep as 200 m, often out of scuba divers' reach, while *Homarus* spp. are found at more moderate depths (30 to 50 m). They also slightly differ in their distribution—*N. norvegicus* are more northern, *Homarus* spp. more southern—but they overlap considerably around Europe and North Africa. The European lobster *Homarus gammarus* is found in the eastern Atlantic from northwestern Norway (Lofoten Islands) to the Azores and Morocco. It is also present in the northwestern regions of the Black Sea and in parts of the Mediterranean (Holthuis 1991). *N. norvegicus* is also present around Iceland and Faroe Islands, but absent in the Black Sea (see Fisheries Global Information System [FIGIS] at www.fao.org).

Searching for occurrences of cycliophorans on these 2 genera of host lobsters in seas and countries other than those previously mentioned should be relatively simple, as the hosts are commercially important species which can be bought in many fish markets all over the world. Discoveries of new species are expected.

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