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First Record of *Sylon hippolytes* M. SARS (Crustacea: Cirripedia: Rhizocephala) Parasitic on the Pink Shrimp, *Pandalus borealis* KRÖYER, from Japanese Waters

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Abstract The akentrogonid rhizocephalan *Sylon hippolytes* M. SARS was obtained from the pink shrimp *Pandalus borealis* KRÖYER from the Sea of Japan. This is the first record of *S. hippolytes* from seas of the Far East. The rhizocephalan found was the largest specimen of the species ever recorded, and through serial sections of its externa 935,200 embryos were estimated to occur in the mantle cavity.

The akentrogonid rhizocephalan *Sylon hippolytes* M. SARS is a fairly large and conspicuous parasite which lives attached under the abdomen of several species of shrimps (LÜTZEN, 1981; HØEG & LÜTZEN, 1985). It is locally frequent in many North Atlantic and Northeast Pacific shrimp populations, but until now has never been recorded from the western part of the Pacific Ocean. However, three specimens of the pink shrimp *Pandalus borealis* KRÖYER from the Sea of Japan were infected each with a single parasite of that species.

The material is deposited in the National Science Museum, Tokyo, Japan (NSMT-Cr 1555) and in the Zoological Museum, Copenhagen, Denmark (one sectioned specimen).

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Sylon hippolytes M. SARS, 1870

(Fig. 1)

Material examined. Two specimens, Yamato-tai Bank (39°19.8′–39°26.6′N, 135°03.5′–135°10.9′E), Sea of Japan, 307–388 m in depth, 24–25 September 1988, coll. Kazuya NASHIDA.

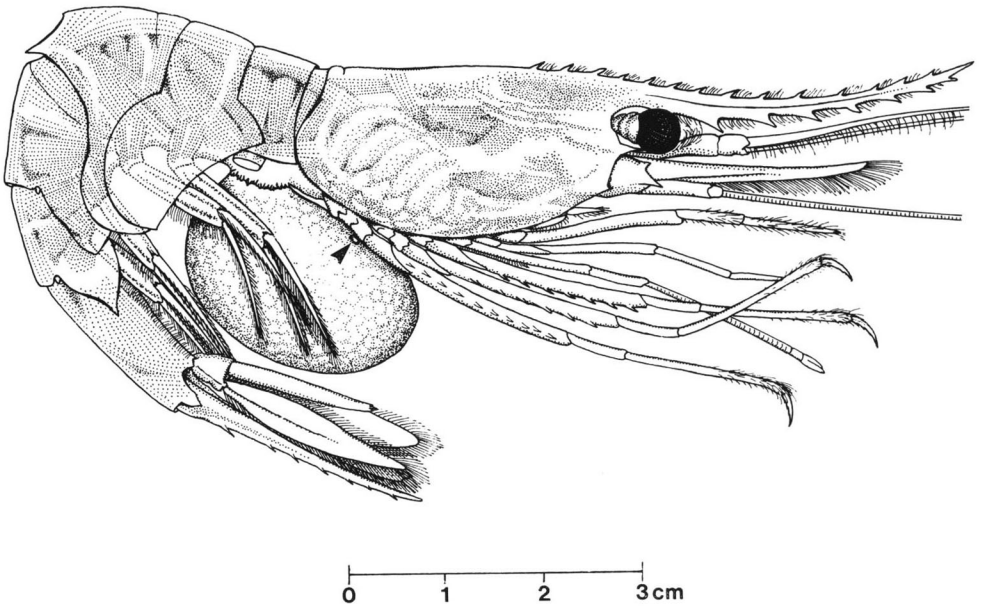

Fig. 1. *Sylon hippolytes* M. SARS on the pink shrimp *Pandalus borealis* KRÖYER. Rostrum and some of the appendages reconstructed; pleura of 1st and 2nd abdominal somites partially removed to display attachment of parasite; arrowhead marks one of the two mantle pores. Yamato-tai Bank, Sea of Japan, 24–25 September 1988.

Description. The larger one of the two specimens (Fig. 1) is egg-shaped, ovigerous, 24 mm long, 14.5 mm broad and 14 mm high and thus the largest specimen of *S. hippolytes* ever reported; the two small, circular mantle pores have been formed. The other specimen is also egg-shaped, but shorter (15.5 mm), non-ovigerous and the mantle pores are still plugged. Both specimens are attached to the vetral side of the first abdominal somite. The border zone between the externa and host skin is distinguished by its blackish-brown colour. Immediately exterior to this zone occurs one annulus in the smaller and two annuli in the larger specimen. The annuli are very delicate circular thickenings of the parasite's cuticle which arise in connection with molting. Whereas the smaller specimen has a completely smooth surface, that of the larger one is finely wrinkled and the system of narrow, branched hemocoelic channels within the mantle is visible.

The larger specimen was embedded in paraffine and cut into a complete section series (10 μm, stained with hematoxylin and eosin). The mantle cavity was filled with a total of 935,200 embryos (calculated from the sections). The shrivelled visceral mass contained a partially degenerate collecteric gland and the completely spent ovary. No sperm nests could be found anywhere within the visceral mass.

Distribution and hosts. The present material was collected at the Yamato-tai

Bank in the central Sea of Japan on 24–25 September 1988, by trawl. Both infected shrimps are females and equally large, measuring 32 mm from the lateral posterior protrusion of carapace to the eye socket (rostrum broken, whence length of cephalothorax immeasurable). A third pink shrimp infected with *S. hippolytes* was taken from the Sea of Japan (42°14′N, 139°38′–139°42′E) at a depth of 740 m off the west coast of Hokkaido on 6 September 1986, but it was unfortunately lost.

The species is hitherto known from both sides of the North Atlantic reaching into the Polar regions, and from the Northeast Pacific (Puget Sound, Washington, and coastal regions of British Columbia, Canada) (HØEG & LÜTZEN, 1985). The following 11 shrimp species of three families are known as hosts from the Pacific Ocean (BUTLER, 1980; BOWER & BOUTILLIER, 1990): Crangonidae-*Metacrangon munita* (DANA); Pandalidae-*Pandalus danae* STIMPSON, *P. borealis*, *P. jordani* RATHBUN, *P. tridens* RATHBUN, *P. goniurus* STIMPSON, and *P. platyceros* BRANDT; Hippolytidae-*Spirontocaris holmesi* HOLTHUIS, *Eualus macrophthalmus* (RATHBUN), *E. fabricii* (KRÖYER), and *Heptacarpus brevirostris* (DANA). It is particularly abundant in some British Columbia populations of *P. platyceros*, in which one of every four, or even three, shrimps is usually infected (BOWER & BOUTILLIER, 1990).

Single infections, as in the Japanese specimens, are most common, but 2, 3, or even 4 parasites per host specimen occasionally turn up (LÜTZEN, 1981). The *sylonized* shrimps are as a rule sterilized, but in exceptional cases females may be berried.

Remarks. The life history of *S. hippolytes* is better known than in most other akentrogonids from the studies by LÜTZEN (1981) and BOWER & BOUTILLIER (1990): the male and female cyprids are morphologically indistinguishable and of the same size; dorsally in the body occurs a large number of rounded, undifferentiated and darkly-staining cells. The site of infection is unknown, but it is assumed that the female cyprid injects these cells through the host's skin, using one of its antennules as has been described in *Clistosaccus* (HØEG, 1990). Within the host the cells collectively or singly give rise to a very much branched internal root system, the youngest stage of which occurs around the hepatopancreas or gonad, but later on spreads backwards along the intestine and nerve cord into the pleon. Between the intestine and the ventral skin, usually within the 1st or 2nd pleomere, the interna thickens to form a tumor containing the lens-shaped nucleus: the primordium of the externa. When ca. 3 mm in diameter the externa breaks through the skin of the host as an ecdysis, at which the shrimp, if female, changes to the breeding dress.

The externa grows to a whitish sphere, 4–6 mm in diameter (size dependent on host species). At this stage LÜTZEN (1981) surmised, and BOWER & BOUTILLER (1990) later observed, that the male cyprids become attrated to the surface of the parasite and inject the undifferentiated cells into its mantle using an antennule. Arrived there the injected cells are probably transported within the numerous hemopcopelic channels to finally turn up as spermatogonia within the hemocoelic lacunae of the single ovary. Incorporated within the ovary the spermatogonia multiply and undergo spermatogenesis, often at the expense of some of the ova, and finally become

concentrated in small "sperm nests". The mature ova are fertilized within the ovary after which they are released through the single colleteric gland into the mantle cavity. There is only one oviposition during the life of the parasite, at which 19,000 to almost one million eggs are laid. During their development two mantle pores appear in the mantle wall, through which the progeny are emitted as cyprid larvae. Following their emission the spent externa elongates, shrivels, and assumes a grayish colour. It is finally sloughed off the shrimp leaving a black scar.

It is not correct, as suggested by BOWER & BOUTILLIER (1990), that a rounded body interpreted by BOSCHMA (1928) and LÜTZEN (1881) as the ganglion, has any connexion with the introduced spermatogonia. Although there is some resemblance between the spermatogonia and the ganglion cells, the body can be traced back to early internal nucleus stages and is thus present long before male cyprid inoculation. A similar ganglion occurs at a morphologically corresponding place in the related *Clistosaccus*.

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