

Bivalve molluscs, *Mytilus trossulus* and *Hiatella arctica*, as facultative epibionts of the crab, *Hemigrapsus sanguineus*, infested by the rhizocephalan, *Sacculina polygenea*

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At the period of sexual reproduction of the rhizocephalan parasite, *Sacculina polygenea*, the sacculinized crab, *Hemigrapsus sanguineus*, can serve as a temporary carrier for juvenile bivalve molluscs, *Mytilus trossulus* and *Hiatella arctica* as facultative epibionts. Such epizoans are never found on the crabs without the rhizocephalan externae or scars produced by the externae. The correlation between sacculinization and the bivalve epibionts is presumably due to maternal 'brooding care' with altering grooming behaviour of the crabs infested by *S. polygenea*.

Lützen & Takahashi (1997) described a new species of rhizocephalan crustacean, *Sacculina polygenea*, a parasite of the crab *Hemigrapsus sanguineus* (de Haan, 1835). At different sites along the coast of Japan the proportion of sacculinized crabs varied from 1.1 to 79.6% (Takahashi & Lützen, 1998). Infestation of crabs by *S. polygenea* leads to host behavioural changes, that is, to 'brooding care' of sacculinean offspring, and to morphological feminization of male crab (Takahashi et al., 1997).

Hemigrapsus sanguineus were collected in July and August 1998–1999 in the vicinity of the Marine Biological Station 'Vostok' of the Institute of Marine Biology at Vostok Bay, Sea of Japan. Forty-seven out of 78 specimens carried externae of *S. polygenea*, and 16 crabs without externae had scars produced by externae and well-developed *S. polygenea* interna. Thus, in this sample of the coastal zone of 'Vostok' Station sacculinized crabs exceeded 80%. Among the sacculinized crabs six specimens were found with small bivalve molluscs attached to the ventral side of the thorax or abdomen, (from one to four on each crab: 4,2,1,1,1,1). Out of ten attached molluscs, nine were identified as *Mytilus trossulus* Gould (Mytilidae), and one as *Hiatella arctica* (Linnaeus) (Hiatellidae). Such epizoans were never found attached to unsacculinized crabs (besides the mentioned, dissected specimens we have externally observed ~120 crabs). Five of the six crabs carried 1–3 externae of *S. polygenea*; in one case a scar produced by a *S. polygenea* externa was clearly seen, and internally the crab carried a well-developed sacculinean interna. A feminized male crab with three externae and *Mytilus trossulus* (shell length 0.8 cm) is shown in Figure 1. The mollusc was located on the thorax–abdomen border and altered the normal abdomen position. In other cases it was necessary to bend off the abdomen to observe the rhizocephalan externae and the molluscs. The most remarkable female crab carried two externae of *S. polygenea* and four molluscs attached to the ventral surface of the thorax; three of them were *M. trossulus* (shell length 0.5–0.8 cm), and one was *H. arctica* (0.6 cm) (Figure 2). Shell length of other mussels attached to sacculinized crabs varied from 0.2 to 1.2 cm. All mussels were juveniles less than three months old.

In Vostok Bay the larvae of *M. trossulus* are found in plankton from June to mid-September (Kasyanov et al., 1998). Larvae of

M. trossulus settle readily on many substrata in the sea, being a very common fouling species (Scarlato, 1981). Considering that the larvae of *Hiatella arctica* are present in Vostok Bay plankton only in September (Kasyanov et al., 1998), the age of the only specimen of *H. arctica* found can be estimated at ~10–11 months. Like *M. trossulus*, *H. arctica* is an eurybiotic fouling species with larvae settling in small rocky crevices (Scarlato, 1981).

During the period of *S. polygenea* reproduction host grooming behaviour is essentially altered (Takahashi et al., 1997). Probably as a consequence of the 'brooding care' the crabs do not discard attached bivalve larvae, which settle at the time and place that externae of *S. polygenea* develop. The attached molluscs are inevitably discarded during crab moulting. It is known that sacculinized crabs can moult (Takahashi & Matsuura, 1994; Lützen & Takahashi, 1997). According to our data, crab moulting in Vostok Bay occurs during July and August. Thus, the lifespan of the attached molluscs does not exceed 11 months, as in the case of *H. arctica*.

Data on the attachment of bivalve molluscs to crabs are sporadic. Franc (1960) noted that *Cardium edule* and some mussels were found attached to the abdomen of *Carcinus maenas*. Lützen (1981) mentioned two *C. maenas* crabs which had *Sacculina carcini* externa concealed among small attached

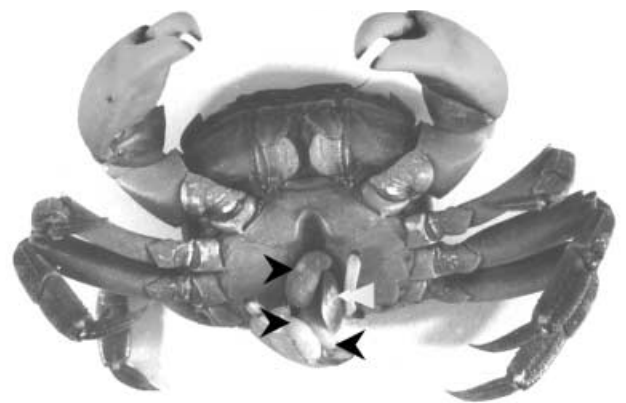


Figure 1. Feminized male of *Hemigrapsus sanguineus* with three externae of *Sacculina polygenea* (black arrowheads) and attached *Mytilus trossulus* (light arrow).



Figure 2. Female of *Hemigrapsus sanguineus* with two externae of *Sacculina polygenea* (black arrowheads), three attached *Mytilus trossulus* (light arrows) and one *Hiatella arctica* (bent arrow).

mussels. However the data were not been discussed by the authors, and any correlation between crab sacculinization and molluscan attachment was not established before this time.

During this study a total of 382 crabs without externae or scars were examined: in no case was there a mollusc attached to the surface of an unsacculinized crab (A.V. Trofimova, personal communication). Two additional cases of small mussels attached to sacculinized crabs were also found.

A correlation between crab infestation by *S. polygenea* and the presence of attached bivalve juveniles on the crab body surface may be considered as being established. It is thought that the modification of the normal cleaning reaction in sacculinized crabs allows for the settlement of bivalve larvae and attachment of postmetamorphic juveniles on the host crab. As a result, during the period of sexual reproduction of *S. polygenea*, sacculinized *Hemigrapsus sanguineus* can serve as temporary carriers for the facultative epibionts, juvenile bivalve molluscs.

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