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# ***Loxothylacus spinulosus* (Crustacea: Cirripedia: Rhizocephala) parasitising *Pilumnopus serratifrons* (Decapoda: Pilumnidae) in Moreton Bay, Queensland, Australia**

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## **ABSTRACT**

Seventy-eight individuals of the cryptic pilumnid crab *Pilumnopus serratifrons* inhabiting galleries in clumps of mussels (*Trichomya hirsutus*) (Mytilidae) were collected from intertidal sea grass beds seaward of Myora Springs, Moreton Bay, North Stradbroke Island, Queensland, Australia. Of the 78 crab individuals, five of the 45 males (11.1%) and 14 of the 33 females (42.4%) were parasitised by the rhizocephalan *Loxothylacus spinulosus*. No gravid females were parasitised, but the parasite appeared to restrict the size range of such females to carapace widths of between 7.5–10.0 mm. No gravid female > 10.0 mm carapace width was identified, all such individuals presumably being castrated by *L. spinulosus*. One male and four females had two parasite externas. □ *Pilumnopus serratifrons*, parasitised, rhizocephalan, *Loxothylacus spinulosus*, Moreton Bay, Australia.

The biology of rhizocephalan barnacles has been reviewed by Høeg & Lützen (1995). Parasitic rhizocephalans have a planktonic larval phase that normally involves several naupliar stages and a cyprid settling stage. Adults are internal parasites of mainly marine shrimps and crabs. The rhizocephalan life cycle is hence both complex and specialised such that the ecologies of host and parasite are highly correlated. Rhizocephalan larvae are dioecious, males being often smaller than females. The life cycle begins with the female cyprid invading a crustacean host and developing into a parasite with an internal root system (interna) that grows inside it and absorbs nutrients. Once the interna matures, it will develop a reproductive body (externa) outside the crab through the region of the abdomen. Male cyprids will then

enter the young (virgin) externa that gives rise to a fertilised externa with the eggs brooded inside it. Larvae will eventually be released *via* the externa.

There are few records of species of rhizocephalans parasitising decapod crustaceans in Australian waters. In Moreton Bay, however, the commercial sand crab *Portunus pelagicus* (Linnaeus, 1758) is parasitised by *Sacculina granifera* Boschma, 1973, and has thus received particular attention (Phillips & Cannon 1978; Bishop & Cannon 1979; Weng 1987; Shields 1992; Shields & Wood 1993; Sumpton *et al.* 1994; Gaddes & Sumpton, 2004). Phillips (1978), however, described three new species of rhizocephalan from Moreton Bay. These were *Heterosaccus lunatus*, *H. multilacinensis* and *Sacculina amplituba* parasitising the portunid crabs *Charybdis callianassa*

(Herbst, 1801), *Charybdis truncata* (Fabricius, 1798) and *Matuta granulosa* Miers, 1877, respectively. Knuckey *et al.* (1995) recorded *Loxothylacus ihlei* (Boschma, 1949) infecting the commercial portunid mud crab *Scylla serrata* (Forskål, 1775) in northern Australia, but while the host is common in Moreton Bay, the parasite appears to be restricted to tropical waters. The present study concerns *Loxothylacus spinulosus* Boschma, 1928, parasitising the pilumnid crab *Pilumnopus serratifrons* (Kinahan, 1856).

## MATERIAL AND METHODS

From 7–25 February 2005, visits were made during low tide periods to the sea grass (*Zostera capricorni*, *Halodule uninervis* and *Halophila ovalis*) beds down-shore from the mangrove-fringe at Myora Springs on the sheltered northwest coast of North Stradbroke Island. The principle research aim was to study a sympatric pair of galeommatid bivalves (*Varotoga* spp.) living commensally within the galleries made by the crab *Pilumnopus serratifrons* in clumps of the mussel *Trichomya hirsutus* (Lamarck, 1819), that here dot the central regions of the muddy, sea grass dominated, intertidal. This research has been separately reported upon by Morton (2008). *Pilumnopus serratifrons* was, however, noticeably parasitised by a rhizocephalan cirripede herein identified as *Loxothylacus spinulosus*. The sex of each crab was recorded and carapace widths measured to the nearest 0.5 mm using vernier calipers. The presence of either a crab egg mass or the externa of *L. spinulosus* was also noted.

The identification of rhizocephalan species is difficult and often relies upon identification of the host, as many are considered to be host-specific, as well as upon microscopic investigation of histological sections through the externa. Accordingly, two externae were removed from their hosts, sectioned longitudinally at 8  $\mu$ m, and stained with Ehrlich's haematoxylin and eosin.

## RESULTS

### TAXONOMIC REMARKS

*Loxothylacus* is characterised by having the stalk and mesentery inserted at different places on the mantle (Boschma 1933: fig. 9), and the

curved male receptacles have their terminal spermatogenic components included within the ovary. Also, as may often occur in kentrogonid rhizocephalans, only one of the receptacles was producing semen.

The external mantle cuticles of the present specimens were scattered with spiny excrescences (5–6 mm), as described for *Loxothylacus spinulosus* by Boschma (1933: fig. 10). The presence of such relatively short excrescences is characteristic of *L. spinulosus* (and *L. omissus* Boschma, 1957). Most other species of the genus have longer structures often arranged in bundles, although three species, *L. scaber* (Boschma, 1931), *L. bicorniger* Boschma, 1959, and *L. engeli* Boschma, 1968, all have a smooth (or nearly so) external cuticle (Boschma 1968). Both sectioned rhizocephalans correspond in all essential characters to the two specimens of *L. spinulosus* described by Boschma (1928, 1957).

*Loxothylacus spinulosus* is known only from eastern Australian waters. The only two earlier records are also from *Pilumnopus serratifrons*: one from Mosman, Sydney, New South Wales, the other from an unknown locality (Boschma 1957). Two specimens originally identified as *L. spinulosus* were described from Hong Kong as infecting *Glabropilumnus seminudus* (Miers, 1884) (Boschma 1955), but subsequently described as a separate species, *L. omissus* Boschma, 1957.

### BIOLOGY

A total of 78 individuals of *Pilumnopus serratifrons* was collected. Of these, five of the 45 males (11.1%) and 14 of the 33 females (42.4%) were parasitised by *Loxothylacus spinulosus*. None of the nine gravid females (27.3%) was parasitised. The mean carapace widths of parasitised male and female individuals of *P. serratifrons* were 10.0 mm and 10.3 mm respectively, as opposed to the mean widths of uninfected conspecifics that were 5.6 mm and 8.3 mm respectively. Of the five parasitised males, four had one parasite and one had two. Of the 14 parasitised females, 10 had one parasite and four had two (Table 1). Gravid females were, however, restricted to a carapace width size range of between 7.5–10.0 mm, all individuals of greater widths being parasitised and reproductively sterile, presumably as a consequence of the rhizocephalan infection.

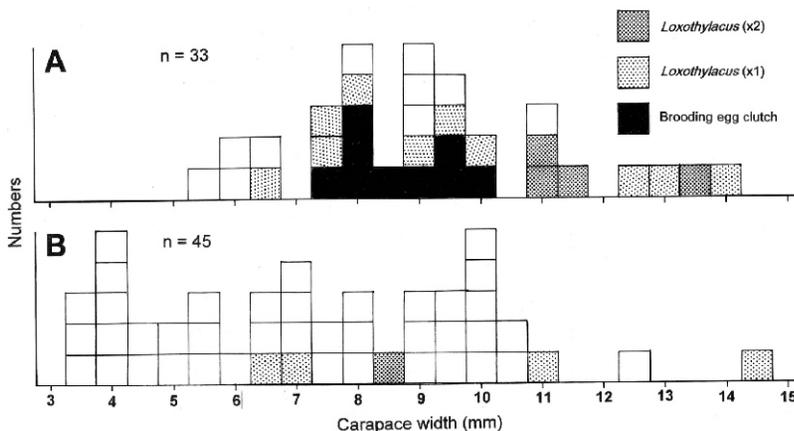
**Table 1.** The numbers of individuals of each sex of *Pilumnopus serratifrons* from the shore at Myora Springs, Moreton Bay, North Stradbroke Island, Queensland, infected with *Loxothylacus spinulosus*.

	Number	Mean carapace width (mm)	Range in carapace width (mm)	Mean width of unparasitised individuals (mm)	Mean width of parasitised individuals (mm)	Numbers of <i>Loxothylacus</i> (with 1 or 2) + %
Males	45	7.3	3.5–14.5	5.6	10.0	5 (4 or 1) + 8.9
Females	33	9.2	5.5–14.0	8.3	10.3	14 (10 or 4) + 42.4
Gravid females	9	8.7	7.5–10.0	–	–	–

## DISCUSSION

*Sacculina carcini* Thompson, 1836, prefers to attack the host crab, *Carcinus maenas* (Linnaeus 1758) at the intermoult rather than the recently moulted stage (Glenner & Werner 1998). Many species of *Sacculina* are host specific, as with those described from Moreton Bay by Phillips (1978), while others are not. Thus, Liu & Lutzen (2000) have shown that in Taiwan, *Sacculina plana* Boschma, 1933, parasitises six species of grapsid crabs including the rocky shore species *Grapsus albolineatus* Lamarck, 1818, *G.* [= *Cyclograpsus*] *intermedius* De Man, 1888, and *G. longitarsis* Dana, 1851. Prevalence ranged from 13.4–71.7% in *G. albolineatus*, with males and females being generally equally infected. Thresher *et al.* (2000) showed that *Sacculina carcini* was unable to attack native crabs in its introduced

range of Australia. In contrast, Goddard *et al.* (2005) showed that *S. carcini* introduced to North America, infected native hosts, at rates ranging from 35–52%, but that the crabs arrested the infection early by melanising the rootlets of the parasite and all such infected native crabs died without producing an externa. Interestingly, in European waters where *S. carcini* is indigeneous, it may infect up to 11 crab species belonging to five genera (Høeg & Lützen 1985). Sumpton *et al.* (1994) have shown that in Moreton Bay females of *Portunus pelagicus* are more liable to infection (12.3%) by *S. granifera* than males (7.0%), although Weng (1987) obtained contrasting results for the same species. In the present study, female *Pilumnopus serratifrons* were over-ridingly selected by *Loxothylacus spinulosus* although, as for *S. granifera* parasitising *P.*



**FIG. 1:** Histograms showing the population structure (in terms of carapace widths) of **A)** female, and **B)** male *Pilumnopus serratifrons* individuals in the mussel (*Trichomya hirsutus*) clusters on the shore at Myora Springs, Moreton Bay, North Stradbroke Island, Queensland. Also identified are gravid (egg bearing) females and individuals parasitised by either one or two *Loxothylacus spinulosus* individuals.

pelagicus (Sumpton *et al.* (1994), the size distributions of infected and uninfected individuals were the same.

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