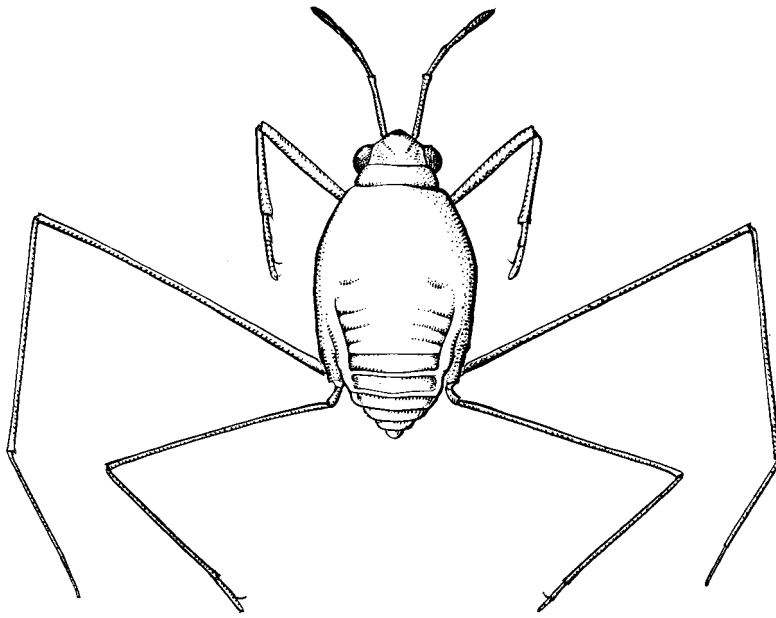


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The water-strider
Halobates hayanus, from
the Low Isles. [Drawing
by S. R. Curtis.]

AUSTRALIAN MARINE INSECTS

By ELIZABETH N. MARKS

Senior Research Officer, National Mosquito Control Committee, Brisbane

THE saltwater coastal environment grades from estuaries and salt marshes through mangrove swamps and sandy beaches, rocky shores and coral reefs, to the open sea. We might class as marine insects those that spend all or most of their life-cycle in the intertidal zone or beyond it. However, when considering marine insects in relation to seas around Australia, one's mind turns to the rocky shores and coral reefs, pounded by violent waves, or to wide expanses rich in animal and plant life exposed at the lowest tides, and it is mainly with the insects of these habitats that I will deal.

On Australia's rocky shores insects of the orders Hemiptera, Coleoptera, Diptera, and Trichoptera occur, as well as the primitive hexapods Collembola (springtails), mites, and a spider; all but Trichoptera are recorded also from coral reefs.

I should like to trace with you my own introduction to marine insects, because this is how any observant naturalist might

encounter them if he or she sets out deliberately to look for them.

In August 1954 Dr M. J. Mackerras and I were members of a scientific party organized by the Great Barrier Reef Committee, which spent 2 weeks on Low Isles, 9 miles northeast of Port Douglas. These are two small sandy islands near either end of a horseshoe-shaped reef opening to the northwest, where, in 1928, a scientific expedition led by Dr C. M. Yonge spent a year in intensive study of corals and the ecology of the reef. They recorded a marine spider, *Desis crosslandi*, but no marine insects. Marine biologists do not look for insects in marine habitats, and entomologists rarely seek them there.

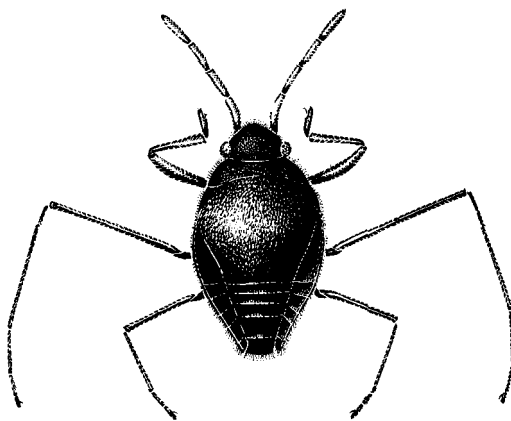
We went to Low Isles armed with some literature, so that we knew a little of the types of insects we should look for and were usually able to identify them to family and sometimes to genus. We later identified the Diptera ourselves and obtained expert

identification for most others. We had waternets, glass vials and alcohol, and a x20 hand lens. We also had a low-power microscope which helped with the very small specimens. Whenever tide and weather allowed we spent most of our time searching for marine insects and observing their habits, and altogether collected five species of bugs, two beetles, and three flies, as well as one collembolan, two mites, and the spider previously recorded.

Full moon was on the 14th, and new moon on the 28th of August. Collection dates are given because the tide or phase of the moon may be significant, particularly in relation to marine midges.

On our first day, the 13th, with a 6-inch tide soon after mid-day, we collected three species of water-striders (Gerroid bugs) skimming over pools on the inner and outer reef, including two long-legged species, one with the underside of the abdomen partly or wholly white (*Halobates hayanus*), and one we called "short-tail" with abdomen scarcely visible (*Hermatobates* species); the third was a smaller, shorter-legged species (*Halovelina* species). These three bugs were frequently encountered thereafter. Under one lump of coral near the outer edge of the reef was a spider (*Desis crosslandi*) and under another a small beetle (*Polypaea coralli*) which we did not find again. A large plum-coloured collembolan was common on and under lumps of hard coral, and 2 days later we found it on soft coral at the reef edge only a foot above the lowest tide level. It appeared to carry an air bubble between the bases of its legs.

On the 15th we saw a few tiny, delicate, pale animals darting about on the surface of some coral pools. In the laboratory these were identified as males of the fly *Pontomyia*. We knew *Pontomyia* had been found in association with the marine plant *Halophila*, and collected a bundle of it. When, next day, this was washed out with sea-water, numerous dead *Pontomyia* males and male and female pupal skins were obtained. On the 16th and 17th we made many more observations of *Pontomyia*, especially over the *Halophila* area and over some large colonies of the coral *Porites*, and found females, mating pairs, and larvae, but after that we saw them no more.



A species of *Halovelina*, from Heron Island.
[Drawing by S. R. Curtis.]

On the 19th, minute bugs (*Corallocoris marksae*), a small beetle (*Dicranolaius alleni*), and two species of mites (one was *Bdellodes pacifica*) were found emerging from crevices in beach rock as the tide receded. On the 21st (after a strong southeaster had been blowing), and later, another long-legged water-strider with underside of the abdomen uniformly black or dark reddish (*Halobates sericeus*) was collected, mainly near the outer edge of the reef.

On the 24th we saw great numbers of small black flies, the size of biting midges, flying low against the wind across the reef towards the cay; they were particularly easy to see over the yellow soft corals when the tide was right out. We found these were males of two species of *Chunio*, easily distinguished from one another on the relative lengths of the antennal segments. Next day mating pairs and the probable larvae were collected over *Porites* colonies. *Chunio* males and the water-striders became entangled in the frothy scum edging in over the reef after the tide turned, and many specimens were collected by gathering this scum and later extracting them from it.

Let us see now what is known about these Low Isles species and other insects of the seas around Australia.

Hemiptera

The genus *Halobates* (Gerridae) is circum-tropical in distribution and includes the only truly oceanic insects. Several species

spend their whole lives on the open sea and are apparently taken in shore collections only after storms or gales. The early naturalists who voyaged on sailing ships were keenly interested in these bugs, and their mapped distribution bears some relation to the routes of certain ships, as well as to prevailing winds and currents.

The genus and three species (including one, *H. sericeus*, that we took at Low Isles) were described in 1822 by the Esthonian naturalist Eschscholz, who collected them on the round-the-world voyage of the *Rurik*, 1815–18. Murray, on the voyage of the *Challenger*, observed that some of them fed on dead *Porpita*, *Physalia*, and other animals floating on the sea. *Halobates* eggs have been found attached to many kinds of floating material, such as seaweed, cuttlefish shells, and wood, and even on the tail feathers of a living noddy tern.

There are two ecologically distinct groups of *Halobates*—the open-ocean group of widely distributed species, and the coastal

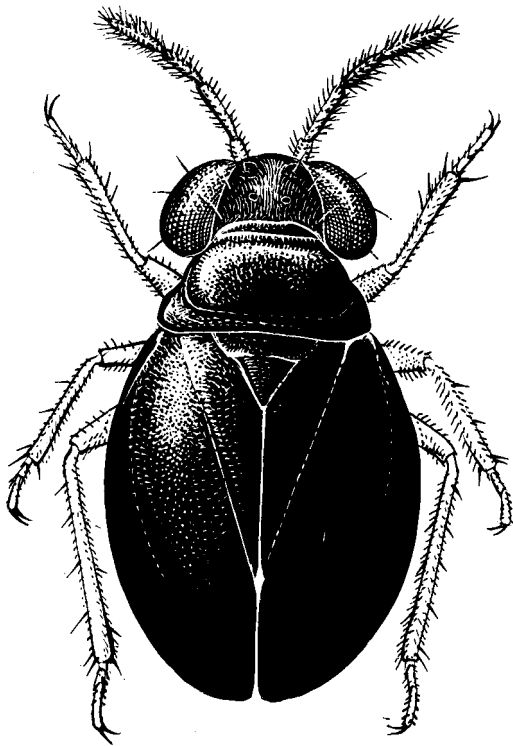
group, some of which apparently have a very restricted distribution; some of these latter lay their eggs in intertidal rock crevices.

Nine species are recorded from Australian seas and shores. The adults are about 4·5 millimetres long. Of the open-ocean species, *H. micans*, which is circumtropical, has been recorded near Sydney; *H. sericeus*, a common species of the north and south Pacific, has been recorded from the east coast between Low Isles and Sydney; and *H. germanus*, a species of the Indian Ocean and southwest Pacific, from our northern coasts. A coastal species with a wide distribution is *H. hayanus*, which occurs round Malaysia and New Guinea, as well as Torres Strait and Low Isles. *H. mjobergi* is recorded from Broome and Monte Bello Island, *H. darwini* only from Darwin, *H. regalis* from Monte Bello Island to Torres Strait, *H. zephyrus* from the vicinity of Moreton Bay, and *H. whiteleggei* from Moreton Bay to Port Hacking; some of these are associated with mangrove areas.

Whereas *Halobates* are clothed with a pile of velvety hairs that make them practically unwettable, and apparently live entirely on the water surface, *Hermatobates* and *Halovelina* retreat into crevices in the coral as the tide floods in. *Hermatobates* (doubtfully placed in Gerridae) can climb and walk rapidly on dry coral. Three species are recorded from northern Australia—*H. weddi* from Monte Bello and Heron Islands, *H. walkeri* from Guichen Reef in the Arafura Sea, and *H. haddoni* from Monte Bello Island, Guichen Reef, and Torres Strait, as well as from New Caledonia, Marquesas, Ryukyu Islands, and Philippine Islands.

Halovelina (Veliidae) includes nine species, of which two are recorded from northwestern Australia—*H. hilli* from Monte Bello Island and *H. maritima* from Cartier and Pelsart Islands. Two other species have been taken in New Guinea. *H. hilli* feeds on *Clunio*, and possibly also on Collembola.

The intertidal dwarf-bug *Corallocoris marksae* is known from Heron Island (the type locality) and Low Isles, and also from New Caledonia, Samoa, and Singapore. These bugs are black, about 1·5 millimetres long, flightless, but strong jumpers. The forewings are convex and toughened, and cover the abdomen, giving the insect a



A minute bug, *Corallocoris marksae*, from Heron Island. [Drawing by S. R. Curtis.]

beetle-like appearance; probably air bubbles are held beneath them. As the tide recedes, the bugs, which are carnivorous, emerge from tiny crevices to forage under the rocks. They have been found in volcanic rock and in granite, as well as coralline beach rock. The eggs are relatively large and are glued to the substrate deep within the crevices. *C. marksae* has been reared in captivity, and its biology is much better known than is that of the other bugs listed. Two other species of *Coralloporis* are recorded, one from Nauru Island and one from Japan.

Coleoptera

Polypaea coralli (Staphylinidae), found at Low Isles, was described in 1878 from Aru Island. Another staphylinid (genus near *Quedius*) is recorded from upturned coral on the outer reef at Heron Island.

Dicranolaius alleni (Melyridae) occurs in beach-rock crevices at Low and Heron Islands. The larva is bright pink with a black head, and G. B. Monteith has observed it at Heron Island preying on an even smaller beetle (Limnichidae) about 1 millimetre long, which also inhabits crevices. These little animals and *Coralloporis* can be collected by taking pieces of rock that have been submerged by the tide, breaking them open, and washing out the cavities.

Diptera

There are marine species of *Idioglochina* (Tipulidae) in the Pacific Islands, and it is likely that two species of this genus known from northern Australia breed in the intertidal zone.

Pontomyia and *Clunio* (Chironomidae) are marine midges which pass their whole adult life in the couple of hours between outgoing and incoming tides. Both have typical Chironomid larvae, cylindrical, segmented, with a distinct head and a small prothoracic proleg. The larvae dwell in tubes which they build by binding algal debris and sand particles with sticky saliva, but tubes of Australian species have not yet been seen. The pupae, which lack respiratory horns, remain in the larval tubes until ready to emerge. Both genera have wingless grub-like females; female *Pontomyia* have only vestiges of mid and hind legs, but female *Clunio* have six short

functional legs and are able to crawl about. In both genera females emerge full of developed eggs and, after mating and fertilization, lay them almost immediately in the algal mat.

Males and mating habits of these genera are very different. *Clunio* males are stoutly built, not unlike a biting midge, but are characterized by relatively enormous claspers representing about half the length of the abdomen. Detailed accounts are available of Japanese and European species. The pupae are non-motile. When ready to emerge, at an ebb tide, gas is formed in the body and they rise to the surface. Males emerge at once and take to flight; within a couple of minutes their terminalia have rotated 180° and they are ready to mate. Females cannot emerge independently, and the female pupa floats at the surface until a *skimming male touches it with fore and mid legs*, stimulating splitting of the skin. He then mounts it, pulls the pupal skin back with his claspers from the female abdomen, and mates. The female is dragged about for a while, trailing behind (such pairs are collected for definite association of the sexes of one species). Then she separates, deposits her egg-mass among the algae, and dies.

The species from Low Isles were close to *C. setoensis* and *C. tsushimensis* var. *minor* from Japan; the second of them has been collected south to Moreton Bay and *C. pacificus* has been reported from New South Wales. The genus is large, with a world-wide distribution.

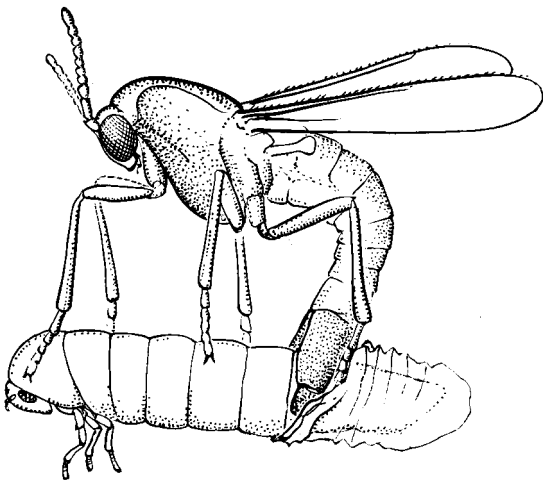
Pontomyia males are delicate pale insects with peculiarly modified wings, narrow and with the apical third bent at an angle. The pupae swim actively to the surface and the female emerges unaided to float passively until clasped by a questing male, which then drags her about in end-to-end position. (We watched mating at Low Isles.)

Buxton, who collected the first known *Pontomyia*, *P. natans*, with a tow-net over *Halophila* in Samoa during nocturnal low tide, was convinced that the males use the wings to swim under water. Wassell collected *P. natans*? in a plankton haul in Princess Charlotte Bay, where they came to a strong light, and he, too, thought they swam beneath the surface. Tokunaga studied a Japanese species, *P. pacifica*, and

Trichoptera

One marine caddis fly, *Philanisus plebeius* (Philanisidae), occurs on rocky headlands and open coasts of southern Australia and New Zealand. It breeds in rock pools close to low tide mark. The larvae make a slightly curved tubular case, which may be covered with fragments of coralline algae. The adults, which have a wing-span of about 1.7 centimetres, generally remain in the shelter of projecting rocks close to water-level. The long ovipositor of the female is probably used to insert the eggs into crevices.

Enough has been said to indicate that the recorded distribution of the insects of the seas around Australia is very much the distribution of a few collectors. A great deal is yet to be discovered about these insects' biology, and they present a challenging and fruitful field of endeavour for naturalists.



A *Clunio* species, near *setoensis*. The male is removing the female pupal skin prior to mating. [Drawing, in part after Hashimoto, by S. R. Curtis.]

concluded that the wings were used in a fluttering motion like oars to propel the insect skimming over the surface, the legs merely acting as supports. Later, he found *P. natans* in Japanese waters and was satisfied it moved in the same way. He suggested Buxton's specimens had been tumbled about in the net while being collected.

The Low Isles species, *P. pacifica*?, appeared to behave as described by Tokunaga; it has been taken also at Sherrard and Green Islands. A larger and distinctive species has been collected in a night plankton haul at Heron Island, but nothing is known of its habits. *P. cottoni*, described from the coast of Reevesby Island in Spencer Gulf, South Australia, is likewise known only from males; it has been taken also at Gunamatta Bay, New South Wales, and (probably this species) at Alexandra Headland, Queensland.

Pontomyia and *Clunio* adults seem to appear in cycles related to moon phases or associated tides, but careful regular observations at one locality are needed to clarify this. Daytime collections of *P. pacifica*? at Green Island and Low Isles appeared related to full moon, and at Sherrard Island to new moon; no observations were made at nocturnal low tides.