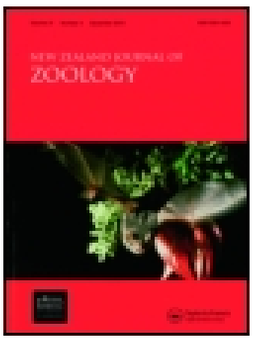

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Introduced Mirinae of New Zealand (Hemiptera: Miridae)

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Abstract Six species of introduced Mirinae, *Closterotomus norvegicus* (Gmelin), *Stenotus binotatus* (F.), *Sidnia kinbergi* (Stål), *Megaloceroea recticornis* (Geoffroy), *Trigonotylus tenuis* (Reuter), and the recently discovered *Taylorilygus apicalis* (Fieber) are now known to be present in New Zealand. Descriptions, diagnoses and figures, including male and female genitalia are provided. Biology, host plants, and economic importance are reviewed, and the list of host plants updated. *Sidnia kinbergi* has been found breeding in high numbers in carrot seed crops.

Keywords Hemiptera; Miridae; Mirinae; Mirini; *Closterotomus*; *Stenotus*; *Sidnia*; *Taylorilygus*; Stenodemini; *Megaloceroea*; *Trigonotylus*; economic importance

INTRODUCTION

Three introduced species of Mirinae, *Closterotomus norvegicus* (Gmelin, 1790), *Stenotus binotatus* (Fabricius, 1794), and *Sidnia kinbergi* (Stål, 1859) have been known in New Zealand for many years. More recently Eyles (1975) recorded two additional introduced species, *Megaloceroea recticornis* (Geoffroy, 1785), and *Trigonotylus tenuis* (Reuter, 1893). *Sidnia kinbergi* is from Australia; the other species are cosmopolitan. All five appear in the checklist by Wise (1977). Larivière (1997) has updated the Heteroptera list, with name changes and the reasons for them. Eyles (1999) records a sixth very recent arrival, *Taylorilygus apicalis* (Fieber, 1861), also cosmopolitan.

Three of the six introduced species of Mirinae are pests of economically significant crops in New Zealand, and the impact of a further two species should be checked. Many Miridae feed on buds, flowers, developing fruits and seeds, and young shoots, causing major malformation at an early stage of growth of plants. This method of attack makes them more serious pests than aphids and psyllids, because even at low population levels mirids can cause large losses in production (Southwood 1996). Progress on integrated chemical and biological control systems, and the need for careful timing of spray applications to avoid killing pollinators, is enabling some reduction in the use of insecticides. Pearson (1991) reports an example in New Zealand where reduction of clover case bearers, *Coleophora alcyonipenella* Kollar, 1832 and *C. mayrella* (Hübner, [1813]), by biological control removed the necessity to spray for these pests, which led to an increase in mirid damage in white clover seed crops.

A key to the genera of the subfamily Mirinae in New Zealand, including these introduced Mirinae together with further new genera, is in preparation.

This paper reviews and diagnoses the six introduced species. *Taylorilygus apicalis* has been fully described and figured as part of the *Lygus*-complex in New Zealand by Eyles (1999). The five earlier recorded introduced species in this subfamily are also described and figured (including male and female genitalia), with notes on their biology and economic importance. Information from labels of specimens accumulating in collections over the years confirms what has been known about host plants, but for some species also increases the range of plants on which they have been found. Some may be chance associations, but some are new host records. In particular, *Sidnia kinbergi* has been found breeding in high numbers on carrot seed crops.

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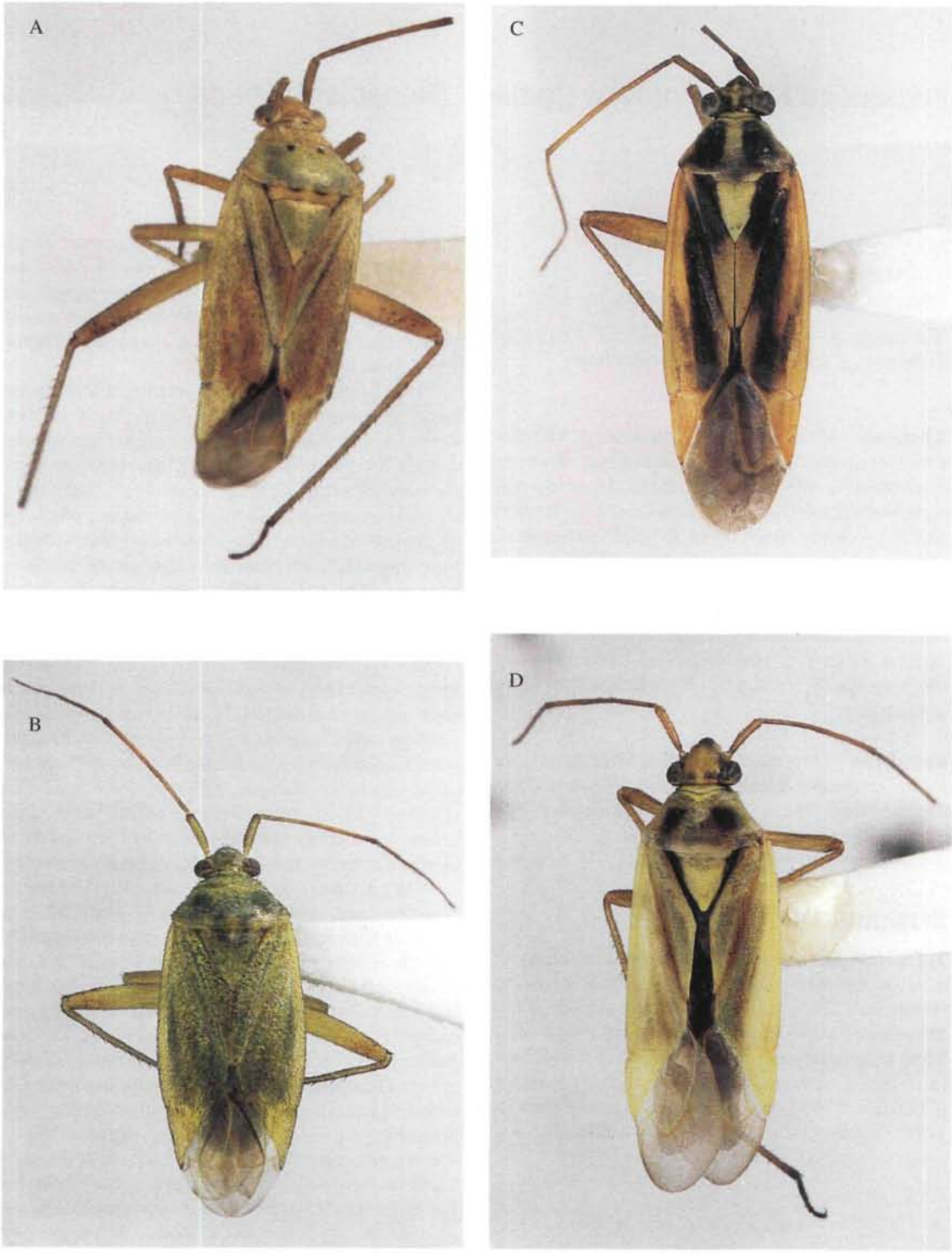
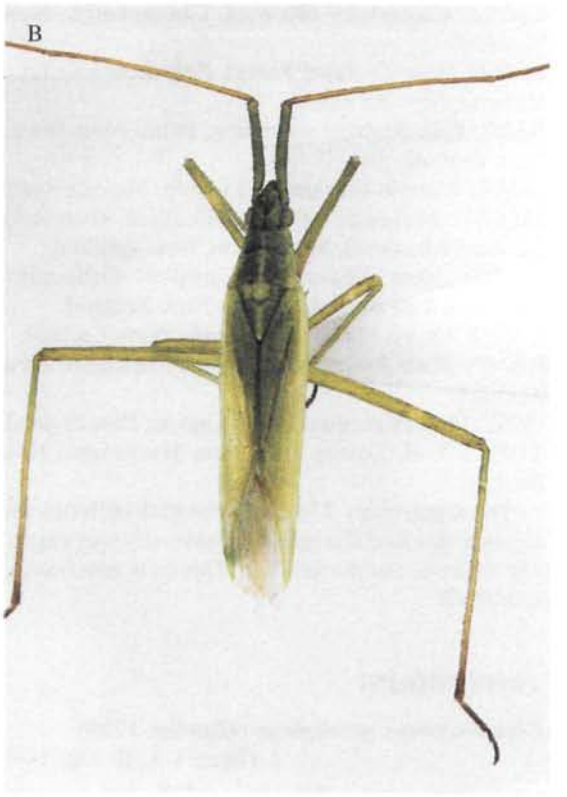


Plate 1 **A**, *Closterotomus norvegicus* ♂ (NZ); **B**, *C. norvegicus* ♀ (Onga Onga); **C**, *Stenotus binotatus* ♂ (Onga Onga); **D**, *S. binotatus* ♀ (Franz Josef).



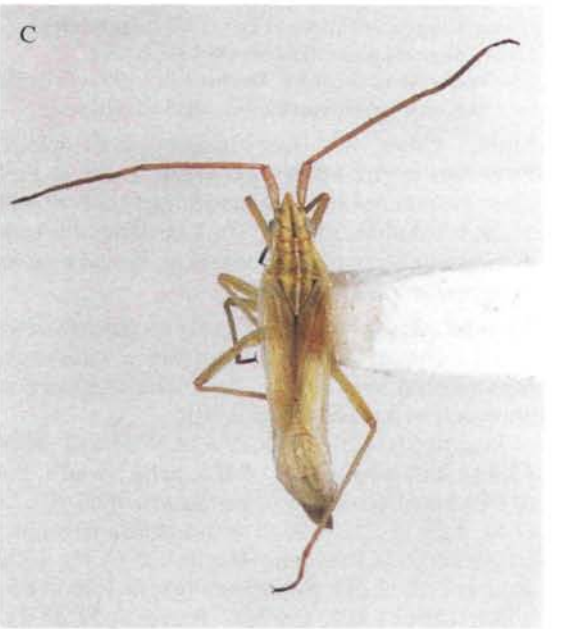


Plate 2 **A**, *Sidnia kinbergi* ♀ (Takapau); **B**, *Megaloceroea recticornis* ♂ (Onga Onga); **C**, *Trigonotylus tenuis* ♂ (Napier).

In the descriptions, measurements given are means of five males and five females (those of females in parentheses). All measurements are in millimetres. Some of the structural terms used in the descriptions are illustrated in Eyles & Carvalho (1991), and some, particularly those referring to the orientation of parts of the female genitalia, in Eyles (1999). The new perspective of the sigmoid process and inter-ramal sclerites figured by Eyles (1999) is also presented here in figures of the female genitalia of the introduced species reviewed.

Botanical names and authorities, and family names of plants mentioned in the text are given in Appendix 1. Works consulted include Allan (1961), Connor & Edgar (1987), Johnson & Brooke (1989), Lambrechtsen (1975), Usher (1974), and Webb et al. (1988).

Abbreviations for repositories

AMNZ: Auckland Museum, Auckland, New Zealand.
CGNZ: Chris Green collection, Henderson, Auckland, New Zealand.

CMNZ: Canterbury Museum, Christchurch, New Zealand.
FRNZ: New Zealand Forest Research Institute, Rotorua, New Zealand.
IGAC: I. G. Andrew collection, Palmerston North, New Zealand.
LUNZ: Lincoln University, Lincoln, New Zealand.
MONZ: Museum of New Zealand (formerly National Museum), Wellington, New Zealand.
NZAC: New Zealand Arthropod Collection, Landcare Research, Auckland, New Zealand.
OMNZ: Otago Museum, Dunedin, New Zealand.
PANZ: Plant Protection Centre, Auckland, New Zealand.
PLNZ: Plant Protection Centre, Lincoln, New Zealand.
THDC: T. H. Davies collection, Haumoana, New Zealand.

The Canterbury Museum material includes the recently donated Canterbury University specimens. The collection of the late T. H. Davies is now housed at MONZ.

TRIBE MIRINI

Closterotomus norvegicus (Gmelin, 1790)

(Plate 1 A, B; Fig. 1–9)

Cimex bipunctatus Fabricius, 1779: 346 (original decription; name preoccupied).
Cimex norvegicus Gmelin, 1790: 2176 (new name).
Calocoris norvegicus: Reuter, 1888 15(1): 232.
Closterotomus norvegicus: Rosenzweig, 1997: 149–150 (n. comb.; *Closterotomus* Fieber, 1858 revalidated).

Male. Green, with varying amounts of orange. Pronotum with 2 black spots (Plate 1, A). In both sexes pronotum, scutellum and wings covered with black, bristle-like, setae. Pygophore with prominent horn-like projection on left side (Fig. 3), and an acute right projection half as long.

Female. Without orange. Freshly caught specimens may be completely green, sometimes without the pronotal black spots (Plate 1, B). Collection specimens often fade to a straw yellow colour.

Length 6.0 (6.5); width 2.54 (2.65). Head: width 1.23 (1.23); length 1.14 (1.12); vertex width 0.50 (0.54). Antennae: length of segments 0.90 (0.90): 2.6 (2.5): 1.23 (1.25): 0.96 (1.00). Labium (rostrum): length 2.6 (2.7). Pronotum: length 1.35 (1.35); width at base 2.18 (2.22). Scutellum: length 1.06 (1.06); width 1.09 (1.10). Corium: length 3.37 (3.49). Cuneus: length 1.34 (1.36); width 0.58 (0.60).

MALE GENITALIA: Vesica (Fig. 1, not inflated) complex, with about 5 substantial membranous lobes or sublobes. Central spiculum-like structure with small process basally. 3 membranous lobes (one may be a sublobe) heavily sclerotised on each side in apical half, and spined on one side only. Sclerotised lobe on left side of figure with large spines pointing basally, and with 2 rows of smaller spines each side of those. Narrow membranous lobe at back and a shorter one in front, with lightly sclerotised spines.

Left paramere (Fig. 2) with very small basal lobe, then gradually curved, rounded apically, with a narrow pointed apical process. Before apex with a concave hollow (dotted line) underneath, and a narrow plate-like lip above (to the front in this view). Right paramere long and slender (Fig. 4) with curved apical process. Turned slightly to the right, (Fig. 5) jutting out square under apical process.

FEMALE GENITALIA: Seminal depository of distinctive shape (Fig. 9), with ventral bulge. Ring sclerites (Fig. 6) large, appearing oval because of concavity, but really hemispherical; inner edge wider than outer edge. Posterior to ring sclerites with a tough membranous bulged area of transverse colourless sclerotised bars (Fig. 6) or tough membranous folds (probably giving flexibility for bending). Ventral edge of this area ends on the membrane linking to top of wings of sigmoid process.

Inter-ramal sclerites (Fig. 7, 8) with bent forward flaps square and hooked apically on inner edge. Sigmoid process (Fig. 7) apparently limited to a triangular body, from which arises a large second set of "wings" extending to level of inner edge of flaps. Wing extends laterally as a tapering sclerotised "support". Membrane or backward extension of flaps curving up to this support. Second set of wings directly above flaps. Not visible in Fig. 7, a concave (convex from posterior) sclerotised supporting extension of the flap curves down and across (Fig. 8). It joins to bottom of sigmoid process wing, or to membrane just beneath the wing. Including its wings, sigmoid process large. Neck and head seem to have disappeared, but may have become flattened and part of the wings. In lateral view wing and body are shaped like the number 2.

MATERIAL EXAMINED: 830 specimens (AMNZ, CGNZ, CMNZ, LUNZ, MONZ, NZAC, OMNZ, PANZ, PLNZ, THDC).

DIAGNOSIS: *C. norvegicus* is distinguished by the horn-like projection on the left side of the genital capsule in males, in combination with the conspicuous black setae and general colour. Females are distinguished by the setae character, together with green or straw colour, and the body form, which

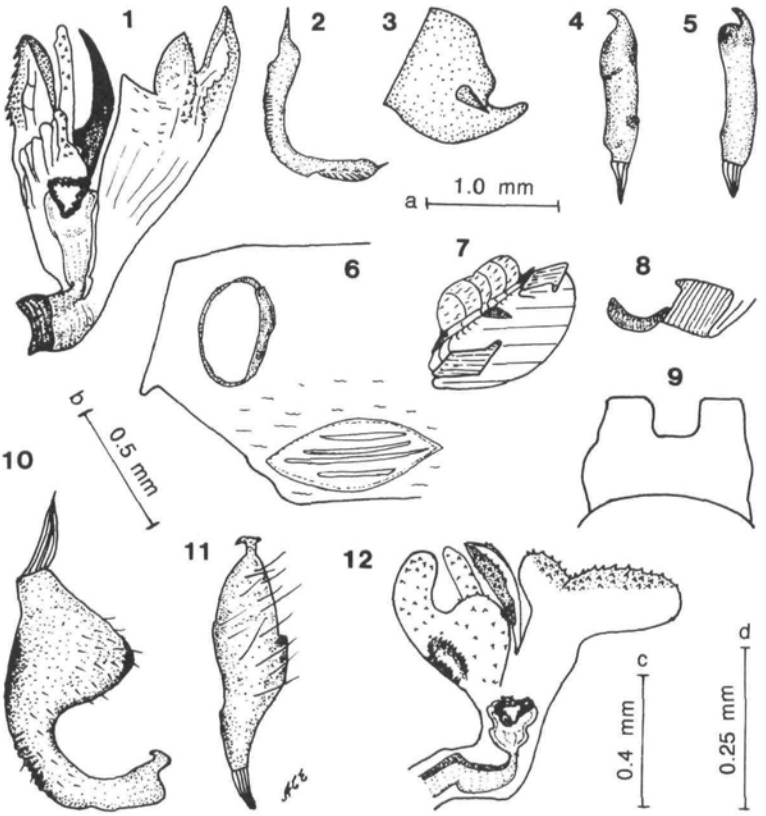


Fig. 1–12 Genitalia. **1–9** *Closterotomus norvegicus*. 1–5 ♂: 1, vesica; 2, left paramere; 3, pygophore, lateral view; 4, 5, right paramere; 6–9 ♀: 6, ring sclerite and area with transverse bars; 7, sigmoid process and inter-ramal sclerites (lateral, slightly anterior view); 8, flap and extension (postero-lateral view); 9, seminal depository. **10–12** *Stenotus binotatus* ♂: 10, left paramere; 11, right paramere; 12, vesica. Fig. 3 to scale a; Fig. 1, 2, 6–8 to scale b; Fig. 4, 5, 12 to scale c; Fig. 10, 11 to scale d; Fig. 9 not to scale.

is broader and larger than all other species of Mirinae in New Zealand.

DISTRIBUTION: This cosmopolitan species occurs throughout New Zealand and on the Chatham Islands. The only areas from which I have not seen specimens are Wairarapa, Kaikoura and Stewart Island.

BIOLOGY: In New Zealand *C. norvegicus* breeds on lucerne, *Lotus pedunculatus*, *Malva sylvestris*, *Cirsium arvense*, and potato (Macfarlane et al. 1981). White clover can be added to this list (Schroeder & Chapman 1995; Schroeder et al. 1998). During the present survey I found large numbers of nymphs living on flowering *Sonchus asper* on the Tukituki Riverbed, Hawke's Bay. Cumber (1959, 1962) recorded it in roadside sweeps, and in separate crops of wheat, barley, and oats.

Host information from specimen labels in collections is as follows. Taken in large numbers on mixed grasses and weeds, e.g., from roadsides, riverbeds, and vacant lots (weeds, especially Umbelliferae = Apiaceae, *Senecio*, daisies and grasses), on flowering lucerne, *Lotus*, white clover (including seed crop), asparagus, strawberries (with nymphs), potato, flowering *Daucus carota* (cultivated and wild), wild parsnip flowers, and ragwort.

It also occurs on *Lotus* or clover and grass mixes, in a mix of *Agrotis capillaris* and *Alopecurus pratensis*, and in pasture with buttercup, *Juncus* with grass, *Chionochloa and* grasses, grass and *Hieracium*, and other mixes (e.g., including *Lotus* and *Juncus*, with either *Myosotis* or *Galium*).

Other specimens have been collected from native and introduced herbs at edge of forest, on *Melicytus ramiflorus*, under wild creeping thyme, on linen flax crop, red clover, wheat, barley, oats, ryegrass, marram grass, sugar beet, beans, broad beans (with nymphs), weeds in blueberries (with many nymphs), nashi fruit, on clover and weeds (with nymphs) in kiwifruit orchard, on hemlock, roses, buddleia flowers, calla lilies, under apricots, on *Solanum aviculare*, *Urtica*, pennyroyal, *Nothofagus*, *Dacrydium cupressinum* (at night), on thistle, nodding thistle, garden flowers, inkweed, *Hebe*, *Dolichoglottis scorzoneroides*, *tussock* and *Bulbinella*, sweeping coastal sedges, in Travis Marsh, Rock and Pillar

Range by sweeping sedges and rushes, on rushes, wild hedge mustard and grass, *Coprosma*, *Cassinia* and *Olearia*, grass and sedge and Ericaceae, Iceland poppy, *Ranunculus lyallii*, introduced broom, and on flowering manuka.

On the Chatham Islands it has been collected on *Cotula coronopifolia*, *Juncus maritimus*?, and *Pimelia arenaria*.

The life cycle in New Zealand has been outlined by Chapman (1984).

ECONOMIC IMPORTANCE: *Calocoris norvegicus*, if uncontrolled, is a major pest of lucerne and lotus seed crops in the South Island (Macfarlane & Pottinger 1976; Macfarlane et al. 1981), and of white clover seed crops in Canterbury (Schroeder & Chapman 1995; Schroeder et al. 1998). An insect management programme is documented by Wightman et al. (1982). Findlay (1975), and Dale et al. (1976) record a new host, autumn-harvested *Asparagus officinalis* at Dannevirke in November 1973, on which these bugs caused "withering and bursting of spears". Watson & Townsend (1981) record *C. norvegicus* on spring-harvested asparagus, adding that it "resulted in rejection by the importing country". McPherson (1957) noted in cocksfoot grown for seed in Canterbury, Otago and Southland, "when cocksfoot is flowering a green plant bug about one-quarter inch long sucks the sap from the seed heads". Although he did not name it there can be no doubt that this was *C. norvegicus*. Ferro (1976, p. 136) lists it as a pest of hops, and Chapman (1976) states that vegetable hosts include potatoes, beans, peas, turnips, lettuce, silver beet, rhubarb, and asparagus. As this species has been collected from such a wide variety of plants, its effects are wide-spread and may normally be diluted. However, as in the case of lucerne and lotus, it may take advantage of a particular crop species if the conditions are right. Those responsible for risk management programmes should keep a wary eye on this species. Its significance in grass seed production should be monitored.

REMARKS: Known as the potato mirid. Cumber (1959) thought it a fairly recent arrival, but Myers knew this species decades ago, and with China published the first record of it from New Zealand (Myers & China 1928). Known under the name *Calocoris norvegicus* (or *norwegicus*) for many years, this species has very recently been transferred to the genus *Closterotomus* in a revision by Rosenzweig (1997). References to the earlier name changes listed above under the species heading may be found in Carvalho (1959) and Schuh (1995).

***Stenotus binotatus* (Fabricius, 1794)**

(Plate 1 C, D; Fig. 10–12, 13–15)

Narrower, but of similar length to *C. norvegicus*. Males often with bright orange markings, restricted to outer half of wing. With 2 longitudinal black stripes, right down the wings and often right down the pronotum in males (Plate 1, C). Clypeus (at front of head) shiny black. Pygophore without projections.

Females paler than males. Some (Plate 1, D) very much paler, but still with 2 black rectangles on pronotum, at least a faint black longitudinal line on wing (more distinct in some females), and still with shiny black clypeus.

Length 5.4 (5.7); width 1.94 (2.20). Head: width 1.02 (1.08); length 0.83 (0.87); vertex width 0.40 (0.51). Antennae: length of segments 0.75 (0.82): 2.19 (2.31): 1.32 (1.44): 0.76 (0.74). Labium: length 2.47 (2.93). Pronotum: length 0.94 (1.06); width at base 1.61 (1.80). Scutellum: length 0.82 (0.88); width 0.78 (0.86). Corium: length 3.0 (3.2). Cuneus: length 1.05 (1.13); width 0.48 (0.50).

MALE GENITALIA: Ductus seminis basally flattened and tape-like (Fig. 12); bulbous before secondary gonopore. Vesica of aedeagus (Fig. 12) with 4 main membranous lobes, two bilobed and bulbous. One with prominent brown sclerotised spined area on top; on reverse side in "stem" of basal half (out of view) with another sclerotised spined area. The other bilobed lobe (left side of figure) with some smaller spines, and towards base a spined, sclerotised arch-like structure. Centrally with a 3rd membranous lobe also spined, and a 4th membranous lobe with a broad spined sclerotised structure.

Left paramere (Fig. 10) with very prominent basal lobe; shaft curving more tightly than in *C. norvegicus*, flattened towards apex (from top to bottom of figure), but concave underneath; apical process broad, flattened, hooked to the left. Right paramere (Fig. 11) of distinctive shape, with main part tapering towards apex; apical process T-shaped (one side longer and hooked).

FEMALE GENITALIA: Seminal depository with 2 big "rings" near base. Ring sclerites (Fig. 13) oval. Sigmoid process and inter-ramal sclerites (Fig. 14) much flattened or compressed from top to bottom compared with other genera, and limited to the floor or lower part of posterior wall. Bent forward flaps markedly diagonally oriented, reaching only half way (or a little more) into centre, and longer towards centre. Sigmoid process limited to a body from which arises a 2nd pair of "wings" (above and behind flaps) which curve well posteriorly, and extend

laterally to level of middle of flaps. Backward extension of flap laterally joins to tip of 2nd set of wings; extension more centrally curves up to 2nd set of wings.

Roof of genital chamber has at posterior a crescentic, colourless, sclerotised structure (Fig.15), with, on membrane of posterior wall, a pair of flexible coil-like "legs" (also colourless, but sclerotised) ending on membrane just before sigmoid process and 2nd set of "wings". Ovipositor bulb with bilobed plate-like anterior extension.

MATERIAL EXAMINED: 882 specimens (AMNZ, CGNZ, CMNZ, FRNZ, IGAC, LUNZ, MONZ, NZAC, OMNZ, PANZ, PLNZ, THDC).

DIAGNOSIS: *S. binotatus* is easily distinguished from other mirids in New Zealand by the 2 longitudinal black stripes, and the shiny black clypeus.

DISTRIBUTION: *S. binotatus*, another cosmopolitan species, lives throughout New Zealand and on Cuvier Island, Kapiti Island and the Chatham Islands. The only areas from which I have not seen specimens are Fiordland and Stewart Island.

BIOLOGY: *Stenotus binotatus* breeds on grasses, the eggs deposited in timothy flowers, young nymphs feeding on cocksfoot flower heads, older nymphs and adults feeding on flowering timothy, meadow foxtail and some Asteraceae (Southwood & Leston 1959).

In New Zealand this species has been taken in numbers from brown top, Yorkshire fog, cocksfoot, "grasses", grass and red clover, *Lotus*/grass mix, legumes and grasses, *Chionochloa* and grasses, sedges and *Paspalum*, clover/ryegrass pasture, grasses and weeds near bush edge, grasses in orchard, and by sweeping a mix of grasses, weeds, *Juncus*, and Cyperaceae in red beech forest, and a mix of weeds, grasses, clover and Apiaceae.

It has been taken on wheat, barley, maize, rushes, grasses/*Cassinia*, bracken/manuka, and buttercup/clover, and in a field of white flowered Apiaceae. It has been collected from a mix of grasses, weeds, *Senecio* and bracken, and from a mix of grass, clover, *Juncus*, and *Hieracium* in a clearing in a totara forest. It has been taken from weeds in blueberries, and from clover and weeds in a kiwifruit orchard.

It has also been collected on coastal shrubs, roadside herbs, *Hypericum*, flowering manuka, by sweeping foliage in bush, by sweeping *Metrosideros* sp. (rata) and surrounding vegetation, and on *Nothofagus*, *Coriaria* and *Olearia*, *Muehlenbeckia*, *Carmichaelia*, *Larix decidua*, *Eucalyptus* (at night), *Melicytus ramiflorus*, *Coprosma robusta*, pohutukawa flowers, hemlock, and *Urtica*.

I have also collected it from grass and weeds at the edge of a flowering, seeding carrot seed crop.

Cumber (1953) showed that this species is on the wing in December and January.

ECONOMIC IMPORTANCE: As this species feeds on the flowering parts, it is not likely to be a problem where grass is regularly grazed. Its effect may be evident where the grass can flower, e.g., on roadsides, along river banks, in forest clearings, or where paddocks are left for silage, hay or grass seed production. In New Zealand *Stenotus binotatus* has not been regarded as a pest in these situations, but it would be worth studying its effects in the last three mentioned, especially in the light of the following. McPherson (1957) noted that in our main cocksfoot seed growing areas (Canterbury, Otago and Southland) a plant bug "of darker colour" [than the green one during flowering] "is numerous on the ripening heads". There is no doubt that this was *Stenotus binotatus*.

REMARKS: I have added to Kelton's (1959) description of the male genitalia, particularly re the lobes and sclerotised areas of the vesica. The two coils on the posterior wall of the female genital chamber are flexible (can be expanded and recompressed with a pin) and give flexibility for bending. The ring sclerites and sigmoid process with a second set of wings are as figured by Slater (1950). The lateral view of the inter-ramal sclerites is a new perspective, and the description and figure of the flexible coils on posterior wall is new.

Sidnia kinbergi (Stål, 1859)

(Plate 2, A; Fig. 16–21)

Colour variable, often with some spotting or mottling with darker brown (Plate 2, A). Field specimens partly green. Some specimens uniformly reddish-brown, some much paler (uniformly stramineous). Some with dark markings on head, others with ornate markings on pronotum.

Length 3.2 (3.8); width 1.67 (2.07). Head: width 0.90 (0.98); length of face 0.77 (0.83); vertex width 0.39 (0.43). Antennae: length of segments 0.48 (0.53): 1.78 (1.80): 0.64 (0.72): 0.55 (0.58). Labium: length 1.50 (1.75). Pronotum: length 0.90 (1. 03); width at base 1.50 (1.69). Scutellum: length 0.70 (0.80); width 0.72 (0.84). Corium: length 1.80 (2.15). Cuneus: length 0.73 (0.82); width 0.44 (0.52).

MALE GENITALIA: Phallotheca as in Fig. 17. Vesica of aedeagus distinctive, with narrow, tubular lobes

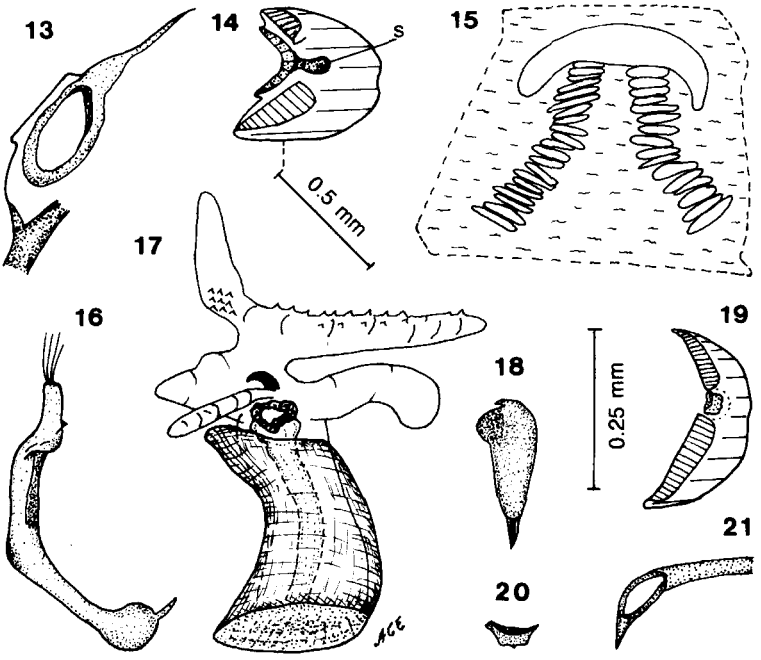


Fig. 13–21 Genitalia. 13–15 *Stenotus binotatus* ♀: 13, ring sclerite; 14, sigmoid process s, and inter-ramal sclerites; 15, "coil" structure on posterior wall (posterior view). **16–21** *Sidnia kinbergi*. 16–18 ♂: 16, left paramere; 17, aedeagus; 18, right paramere; 19–21 ♀: 19, sigmoid process and inter-ramal sclerites (anterior of bug to the right); 20, sigmoid process (dorso-anterior view); 21, ring sclerite.

(Fig. 17). Top lobe (on right) with small spines along top and on back; top lobe on left with a group of spines at base, and diagonal rows of spines on reverse side. Lower lobe on right curves back behind diagonally for a short distance. Near secondary gonopore with a small, very narrow lobe on left; near its base with a horn-shaped sclerotised structure.

Left paramere (Fig. 16) with very small basal lobe; shaft straight then very gradually curved, rounded apically, with a very narrow apical process. Right paramere (Fig. 18) small, bulging before apex, with small, tightly hooked apical process.

FEMALE GENITALIA: Ring sclerites hemispherical with wide edges; connected by a broad brown sclerotised band (Fig. 21). Ventral labiate plate juts out anteriorly only below ring sclerites, between them ending about level of rami.

Sigmoid process very compressed (Fig. 20), with a flat body and a small bent forward "fishtail" (= head and neck in other genera). In lateral view (Fig. 19) C shaped with a long flat base (the body) like a walking stick. Inter-ramal sclerites (Fig. 19) curving well to posterior; with short bent forward flaps linked to body of sigmoid process. Flaps apparently without backward extension.

MATERIAL EXAMINED: 963 specimens (AMNZ, CGNZ, CMNZ, FRNZ, IGAC, LUNZ, MONZ, NZAC, OMNZ, PANZ, PLNZ, THDC).

DIAGNOSIS: *Sidnia kinbergi*, which is broader than the grass mirids (see below), is distinguished from *Closterotomus norvegicus* and *Stenotus binotatus* by the much shorter body, and from them and other New Zealand Mirinae by the strongly declivous cuneus, membrane and pronotum, and short stout first, and reddish-brown third, antennal segments.

DISTRIBUTION: Described from Australia, this species also lives in Tasmania and on Lord Howe Island (Cassis & Gross 1995), and throughout New Zealand, including the Three Kings Islands. The only areas from which I have not seen specimens are the Mackenzie Country, Dunedin, Otago Lakes, Fiordland, Stewart Island and the Chatham Islands. It is also well distributed on offshore islands as follows: Cavalli Is, Mokohinau Is, Little Barrier I, Great Barrier I, Noises Is, Aldermen Is, Mana I, and Motunau I.

BIOLOGY: This species breeds on the passionfruit vine (Myers 1926; Baker 1978). It also breeds on chou moellier as large numbers with nymphs were taken on it, and also adults from turnips in seven localities by Eyles (1960). I also recorded it from other fodder crops.

Macfarlane et al. (1981) show that *Sidnia kinbergi* breeds on lucerne, lotus, white sweet clover, sainfoin, and clovers. They record three alternative hosts: *Chenopodium album*, *Polygonum aviculare*,

and *Cirsium*. Subsequent work confirms that it breeds on white clover (Pearson 1991), and red clover (Schroeder 1998). I have collected it from seeding fat hen in Blenheim in orchards and on roadsides.

A new host record is carrot. I discovered this when searching for *Lygus buchanani* Poppius, 1914 which has been transferred to *Orthops* Fieber, 1858 by Schwartz & Eyles (1999). As some *Orthops* overseas are pests on carrots, I located and sampled on two occasions in January 1997, two carrot seed crops in Hawke's Bay. I did not find *L. buchanani*, but found many adults and nymphs of *Sidnia kinbergi* breeding on the flowering, seeding carrot crops. Carrots are mentioned on labels from two further localities, Lincoln, and another not specified but probably in the North Island. Also 34 males and 24 females were taken from wild carrot flowers in Wainui Inlet, Nelson. At Lincoln a specimen was taken on wild parsnip flowers in an apple orchard.

Another new host record is *Solanum aviculare* from which 35 adults with nymphs were taken by N. Martin at Pukekohe.

As it has been taken on *Muehlenbeckia sp.* or *M. axillaris* in five locations in numbers of 3, 5, and 7 adults, and on *M. australis* in low numbers, this is probably another host, as may be *Atriplex hastatum* = *A. novae-zelandiae* (5 adults).

From the above, it is not surprising that some specimen labels have the following information: legumes and grasses, vacant lot (including *Lotus*, *Juncus* and *Galium*), roadside grass, legumes and ferns, sweeping a mix of *Scirpus**, grass and weeds, sweeping mixed introduced grasses and weeds, sweeping a mix of *Senecio*, grasses and weeds, sweeping a mix of *Sarcocornia*, weeds and grasses (at night), at forest edge on native and introduced herbs, sweeping docks and long grass, sweeping in marsh, in orchard grass, in kanuka bush and scrub, from clover and weeds in kiwifruit orchard, under apricots, and sweeping sedge and *Paspalum*. Single plant species it has been collected from include lucerne, clover, white clover seed crop, red clover, ryegrass, barley, *Paspalum*, buffalo grass, wild turnip, cultivated turnip, mangolds, chou moellier, and asparagus.

The following are plants from which specimens in collections have been taken. Some of these plants could be hosts. *Ipomoea batatas* (14 adults), *Lupinus arboreus*, *Coprosma*, *Haloragis*, *Hebe stricta*, *Hebe parviflora* var. *arborea*, *Juncus acutus*, rushes, sedges, *Asplenium*, *Clianthus puniceus*, *Carmichaelia*, beach plants, tide water monocots, *Hymenanthera* (= *Melicytus*), fleabane, broom, lemon, black currant, vegetables, beans, sweetcorn, pumpkin, *Racosperma*, *Dracophyllum*, *Olearia*, *Cassinia* and *Olearia*, *Salicornia* (see *Sarcocornia*), *Eupatorium*, *Pseudopanax arboreus* with black fruits, *Urtica ferox*, tussock, reeds, *Pittosporum tenuifolium*, chrysanthemum, *Gypsophila*, paeonies, calla lilies, roses, grapes, and apples.

It seems that this species has several hosts or is able to survive for at least short periods on a variety of plants, taking advantage of whatever is flowering and fruiting at various times in its vicinity.

The life cycle in New Zealand has been outlined by Chapman (1984).

ECONOMIC IMPORTANCE: Known as the Australian crop mirid, *Sidnia kinbergi*, if uncontrolled, is a major pest of lucerne and lotus seed crops in the South Island (Macfarlane & Pottinger 1976; Macfarlane et al. 1981; Schroeder 1998), of white clover seed crops in Canterbury (Pearson 1991), and of red clover seed crops in Canterbury (Schroeder 1998). Pearson showed that one bug per plant caused a 50 % reduction in the number of flower heads produced by white clover. In white clover, if the primary apical meristem is damaged, there is no branching and increase in flower heads as reported in the more vigorously growing lotus by Clifford et al. (1983), and which are subject to later bug damage. Baker (1978) records serious damage to strawberry (damaged flowers not fruiting, and damaged fruit becoming distorted). *Sidnia kinbergi* can be controlled with an insect management programme which is carefully balanced so that the timing and type of sprays used do not kill pollinators or predators (Wightman et al. 1982). A similar programme may need to be worked out for carrot seed crops. Because it has such a wide variety of hosts, the risk of damage to other crops, including flowers, should be monitored.

REMARKS: Cumber (1959) and Eyles (1960) referred to this species as *Eurystylus australis* Poppius, 1911 which is now a synonym of *Sidnia kinbergi* (see Schuh 1995).

However, *Eurystylus* Stål, 1871 is a separate valid genus, and there is a separate valid species

*All but two of the species in New Zealand formerly in *Scirpus* have been transferred among three other genera. This species, sampled in Northland, cannot belong in *Scirpus*, but could belong to any of the other three genera (see Johnson & Brooke 1989).

Eurystylus austrinus Kirkaldy, 1908 (which is much larger than *Sidnia kinbergi*).

Taylorilygus apicalis (Fieber, 1861)

This cosmopolitan species has now found its way to New Zealand and appears to be established here. It is recorded, described, figured and diagnosed as part of the *Lygus*-complex in New Zealand by Eyles (1999).

DIAGNOSIS: *Taylorilygus apicalis* is distinguished by the combination of a very slender pronotal collar, together with an elaborately spined extra projection basal to basal lobe of left paramere (Eyles 1999).

TRIBE STENODEMINI

The Stenodemini, known as the grass mirids, are long and slender in form, rather like many grass seeds. At first glance they appear like some Nabidae, which have similar colour and form, e.g., *Nabis capsiformis* Germar, 1837. However, in lateral view, the difference is obvious, as the predacious nabids have a curved, raptorial labium (Fig. 22), while these sap- and seed-feeding mirids have a straight labium (Fig. 23).

Megaloceroea recticornis (Geoffroy, 1785)

(Plate 2, B; Fig. 23–28)

Freshly collected specimens green, over time fading to straw-coloured. 1st antennal segment green; 2nd segment yellow in basal half, orange-brown apically; 3rd segment uniform orange-brown; 4th segment brown. Head porrect (Fig. 23); sides of frons arching anteriorly, upturned at apex. 1st antennal segment very long, subequal to combined lengths of head and pronotum (Plate 2, B). 1st and 2nd antennal segments with black bristle-like setae over total length. Labium reaching hind coxae. Pygophore with prominent horn-like projection on left side, and a small acute right projection.

Length 7.6 (8.5); width 1.66 (2.06). Head: width 0.92 (1.00); length 1.07 (1.20); vertex width 0.53 (0.58). Antennae: length of segments 1.73 (1.80): 3.73 (3.74): 3.55 (3.60): 1.12 (1.14). Labium: length 3.33 (3.50). Pronotum: length 1.18 (1.23); length in middle 0.97 (1. 08); width at base 1.32 (1.52). Scutellum: length 0.80 (0.83); width 0.65 (0.70). Corium: length 4.18 (4.43). Cuneus: length 1.43 (1.50); width 0.39 (0.47).

MALE GENITALIA: Vesica of aedeagus (Fig. 24) with 2 curved spiculi, and spines on membranous lobes. Left paramere (Fig. 26) hooked at apex. Right paramere (Fig. 25) long and slender.

FEMALE GENITALIA: Ring sclerites oval (Fig. 27) oriented transversely, with raised wavy edges. Between and behind them a paired brown sclerotised area. Inter-ramal sclerites laterally turn posteriorly; with sock-shaped flaps (Fig. 28) bending forward a long way to level of curving rami. Flaps with small spines on dorsal and ventral surfaces, all along outer edge, and apically on inner edge. Flaps not compressed as in *Trigonotylus*, but elevated at a slight angle. Flaps link via membrane to a sigmoid process more substantial (Fig. 28) than in *Trigonotylus*.

MATERIAL EXAMINED: 79 specimens (AMNZ, CMNZ, LUNZ, NZAC, THDC).

DIAGNOSIS: *M. recticornis* is distinguished from our endemic grass mirids, *Chaetedus* Eyles, 1975, by the much longer 1st antennal segment, and by the black bristle-like setae over total length of 2nd segment.

DISTRIBUTION: First recorded in New Zealand by Eyles (1975) from Nelson district and the Ruahine Ranges, this almost cosmopolitan species is now known from the Tongariro, Hawke's Bay and Ruahine areas in the North Island, and the Nelson, Marlborough Sounds, Kaikoura and North and South Canterbury areas of the South Island. It is probably more widely distributed.

BIOLOGY: In Britain it overwinters as an egg, and may be found along margins of woods, and in fields where the grass is long and uncut (Southwood & Leston 1959). In the USA I have taken it in long flowering grass. In New Zealand I have collected *M. recticornis* by sweeping grass and weeds (with nymphs), roadside vegetation, and flowering grasses in the headland around a carrot seed crop. It has also been taken from grass and clover, *Lotus*/grass, *Hebe*, *Muehlenbeckia*, *Nothofagus*, on Mt Robert sweeping grass and herbs, on Mt Arthur sweeping *Chionochloa* and grasses, and sweeping tussock, and on Banks Peninsula sweeping shrubs in forest, and tussock near beach. Macfarlane et al. (1998) collected it on Yorkshire fog and soft rush in Travis Marsh. In New Zealand adults have been taken in December and January.

ECONOMIC IMPORTANCE: To date there appears to have been no particular study on the significance of this species on pasture production or grass seed production. Outside of New Zealand it is not regarded as a pest. It must have some effect, and this gap in knowledge should be investigated.

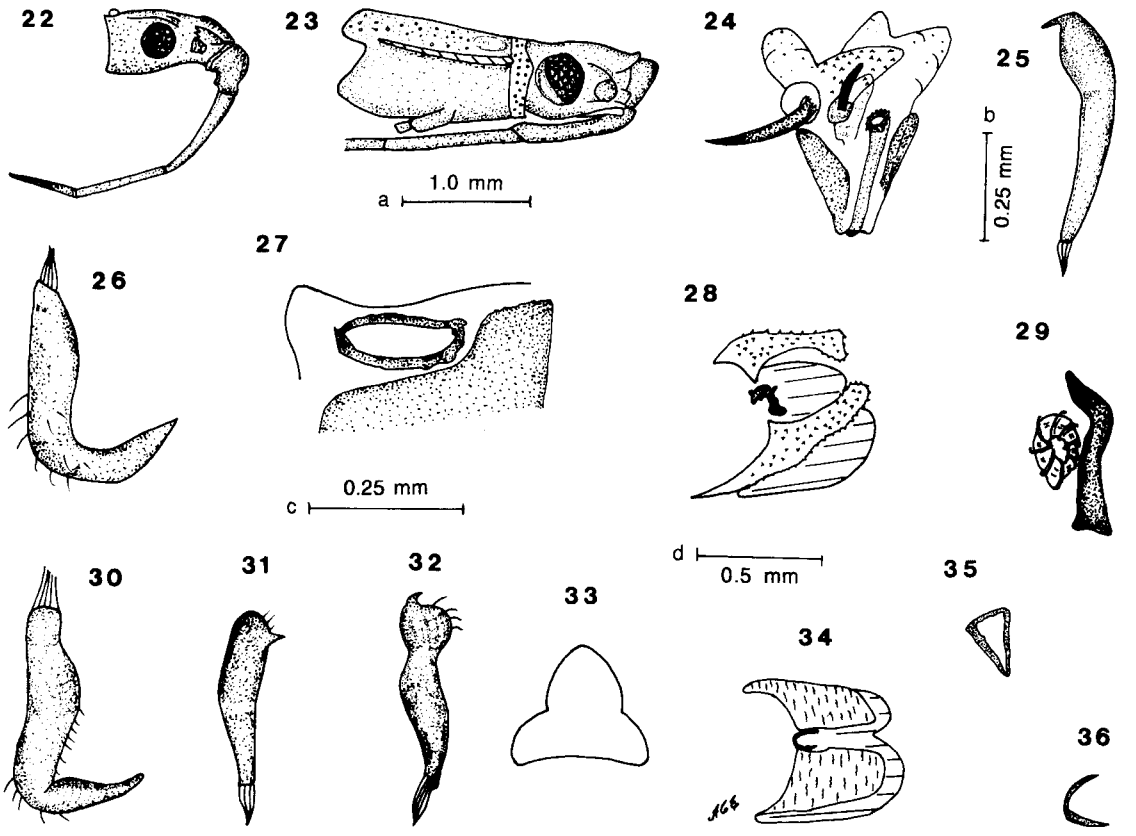


Fig. 22–36 Head, or head/prothorax (lateral view), and genitalia. **22**, *Nabis capsiformis* head. **23–28** *Megaloceroea recticornis*. 23–26 ♂: 23, head (labium in part) and prothorax; 24, vesica; 25, right paramere; 26, left paramere; 27–28 ♀: 27, ring sclerite; 28, sigmoid process and inter-ramal sclerites (anterior of bug to the right). **29–36** *Trigonotylus tenuis*. 29–32 ♂: 29, spiculum and secondary gonopore of vesica; 30, left paramere; 31, 32, right paramere, two views; 33–36 ♀: 33, seminal depository; 34, inter-ramal sclerites; 35, ring sclerite; 36, sigmoid process. Fig. 22, 23 to scale a; Fig. 24–26 to scale b; Fig. 27, 29–32, 34–36 to scale c; Fig. 28 to scale d; Fig. 33 not to scale.

REMARKS: Earliest collection date on New Zealand specimens: January 1942. The genus is keyed in Eyles & Carvalho (1975).

Trigonotylus tenuis (Reuter, 1893)

(Plate 2, C; Fig. 29–36)

Small insects. Pale straw yellow; antennae with pink tinge. Head porrect; clypeus sharply pointed in front between 1st antennal segments (Plate 2, C). Eyes relatively large. 1st antennal segment shorter than head; 2nd segment without dark bristle-like setae. Labium reaching mid coxae.

Length 4.2 (4.3); width 1.0 (1.2). Head: width 0.60 (0.63); length 0.65 (0.64); vertex width 0.30 (0.35). Antennae: length of segments 0.55 (0.56): 1.70 (1.67): 1.45 (1.20): 0.50 (0.50). Labium: length 1.28 (1.36). Pronotum: length 0.56 (0.60); length in middle 0.47 (0.50); width at base 0.88 (0.92). Scutellum: length 0.40 (0.45); width 0.38 (0.45). Corium: length 2.2 (2.5). Cuneus: length 0.88 (1.00); width 0.29 (0.36).

MALE GENITALIA: Spiculum (Fig. 29) of aedeagus of distinctive shape. Left paramere as in Fig. 30. Right paramere (Fig. 31, 32) with distinctive shape and characteristic hook.

FEMALE GENITALIA: Seminal depository as in Fig. 33. Ring sclerite (Fig. 35) triangular (may have been oval and become distorted). Sigmoid process (Fig. 36) greatly reduced to a horseshoe-shaped flange or foot below middle of inter-ramal sclerites. Inter-ramal sclerites (Fig. 34) laterally curve sharply to posterior (on left of figure); flaps (wings) tightly bent

forward a long way, almost to where rami curve to posterior. Flaps rather compressed (flattened dorsoventrally), covered with fine transverse wrinkles, curled up at ends, and linked to sigmoid process.

MATERIAL EXAMINED: 30 specimens (NZAC).

DIAGNOSIS: *Trigonotylus tenuis* is easily distinguished by the slender body, small size, very short 1st antennal segment, and pointed clypeus. It is further distinguished from *Chaetedus* by the larger eye (in side view occupying almost full depth of head), and the complete absence of dark bristle-like setae on the 2nd antennal segment (present only basally in *Chaetedus).*

DISTRIBUTION: First recorded in New Zealand by Eyles (1975) from Waitangi and Nelson, this cosmopolitan species is now also recorded from Napier.

BIOLOGY: Outside of New Zealand this species has been recorded on three species of Poaceae, *Chloris inflata*, *Cynodon dactylon*, and *Eleusine indica* by four authors as catalogued by Schuh (1995). I have previously recorded this species from *Paspalum* and *Alyssum* on Norfolk Island, grass on Raoul Island, and in New Zealand grasses near shore of Waitangi Estate, and sweeping inter tidal zone at Rabbit Island, Nelson (Eyles 1975). New material seen was taken at Napier estuary, sweeping grasses. Common to all three New Zealand localities are the close proximity to the shore, and the fact that all are ports. The late T. H. Davies (pers. comm.) believed that some introduced insects came in through Port Napier.

ECONOMIC IMPORTANCE: As with *M. recticornis*, the significance of this species should be investigated.

REMARKS: Earliest collection date on New Zealand specimens: February 1951. The genus is keyed in Eyles & Carvalho (1975). Ring sclerite shape may have become distorted, but this comment applies to this species only. Eyles (1975) recorded this species as *T. doddi* (Distant), transferring it from *Megaloceroea* Fieber (and also synonymised *T. dohertyi* Distant with *doddi).* That contribution enabled Golub (1989) to sink *doddi* as a synonym of *tenuis.*

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Appendix 1 Host plants of the mirid species named and/or plants on which specimens have been taken.

Plant family	Plant genus or species and authority	Plant common name	Mirid species
Actinidiaceae	*Actinidia deliciosa* (A. Chev.) Liang et A. R. Ferg.	kiwifruit	*C. norvegicus* [7] *S. binotatus* [7] *S. kingbergi* [7]
Apiaceae	*Conium maculatum* L.	hemlock	*C. norvegicus* [3] *S. binotatus* [3]
	Daucus carota L.	carrot & wild carrot	*C. norvegicus* [1, 3] *S. binotatus* [7] *S. kinbergi* [1, 2]
	Pastinaca sativa L.	wild parsnip	*C. norvegicus* [3] *S. kinbergi* [3]
Araceae	*Zantedeschia aethiopica* (L.) Sprengel	calla lily	*C. norvegicus* [3] *S. kinbergi* [1]
Araliaceae	*Pseudopanax arboreus* (Murr.) Philipson	five-finger	*S. kinbergi* [3]
Aspleniaceae	*Asplenium* L.	spleenwort	*S. kinbergi* [3]
Asteraceae	*Bellis perennis* L.	daisy	*C. norvegicus* [6]
	Carduus nutans L.	nodding thistle	*C. norvegicus* [3]
	Cassinia R. Br.	cotton wood	*C. norvegicus* [4] *S. binotatus* [4] *S. kinbergi* [4]
	Cirsium Miller	thistle	*C. norvegicus* [3] *S. kinbergi* [1, 2]
	Cirsium arvense (L.) Scop.	Californian thistle	*C. norvegicus* [1, 2] *S. kinbergi* [3]
	Chrysanthemum L.		
	Cotula coronopifolia L.	bachelor's button	*C. norvegicus* [3]
	Dahlia Cav.	dahlia	*C. norvegicus* [3]
	Dolichoglottis scorzoneroides (Hook. f.) B. Nordenstam	snow marguerite	*C. norvegicus* [3]
	Erigeron L.	fleabane	*S. kinbergi* [3]
	Eupatorium L.		*S. kinbergi* [3]
	Hieracium L.	hawkweed	*C. norvegicus* [4] *S. binotatus* [6]
	Lactuca sativa L.	lettuce	*C. norvegicus* [3]

Plant family	Plant genus or species and authority	Plant common name	Mirid species
	Olearia Moench		*C. norvegicus* [4]
			S. binotatus [4]
			S. kinbergi [3, 4]
	Senecio L.		*C. norvegicus* [6]
			S. binotatus [6]
			S. kinbergi [5]
	Senecio jacobaea L.	ragwort	*C. norvegicus* [3]
	Sonchus asper (L.) Hill	puha	*C. norvegicus* [1, 2]
Boraginaceae	*Myosotis* L.	forget-me-not	*C. norvegicus* [5]
Brassicaceae	*Alyssum* L.		*T. tenuis* [4]
	Brassica rapa L.	turnip	*C. norvegicus* [3]
			S. kinbergi [1, 2]
	Brassica rapa subsp. *sylvestris* (L.) Janchen	wild turnip	*S. kinbergi* [3]
	Brassica oleracea L.	chou moellier	*C. norvegicus* [3]
			S. kinbergi [1, 2]
	Matthiola incana (L.) R. Br.	stock	*C. norvegicus* [3]
	Sysimbrium officinale (L.) Scop.	hedge mustard	*C. norvegicus* [3]
Buddlejaceae	*Buddleja davidii* Franchet	buddleia	*C. norvegicus* [3]
Cannabaceae	*Humulus lupulus* L.	hop	*C. norvegicus* [1]
Carryophillaceae	*Gypsophila* L.		*S. kinbergi* [3]
Chenopodiaceae	*Atriplex novae-zelandiae* Aellen		*S. kinbergi* [1]
	Beta vulgaris L.	mangold, silver- & sugar beet	*C. norvegicus* [3]
			S. kinbergi [3]
	Chenopodium L.	fat hen	*S. kinbergi* [1, 2]
	Chenopodium album L.	fat hen	*S. kinbergi* [1, 2]
	Sarcocornia A. J. Scott		*S. kinbergi* [3, 5]
Clusiaceae	*Hypericum* L.		*S. binotatus* [3]
Convolvulaceae	*Ipomoea batatas* Poir.	kumara	*S. kinbergi* [1, 2]
Coriariaceae	*Coriaria* L.	tutu?	*S. binotatus* [3]
Cucurbitaceae	*Cucurbita maxima* Duchesne	pumpkin	*S. kinbergi* [3]
Cyperaceae	–	sedges	*C. norvegicus* [3, 4, 5]
			S. binotatus [4]
			S. kinbergi [3]
	Scirpus L.		*S. kinbergi* [5]
Dennstaedtiaceae	*Pteridium esculentum* (Forst. f.) Ckn.	bracken	*C. norvegicus* [4]
			S. binotatus [4, 6]
Epacridaceae	*Dracophyllum* Labill.	grass tree	*S. kinbergi* [3]
Ericaceae	*Vaccinium corymbosum* L.	blueberry	*C. norvegicus* [7]
			S. binotatus [7]
Fabaceae	*Carmichaelia* R. Br.	native broom	*S. binotatus* [3]
			S. kinbergi [3]
	Clianthus puniceus (G. Don) Sol. ex Lindl.	kaka beak	*S. kinbergi* [3]
	Cytisus scoparius (L.) Link.	broom	*C. norvegicus* [3]
			S. kinbergi [3]
	Lupinus arboreus Sims	tree lupin	*S. kinbergi* [3]
	Lotus pedunculatus Cav.	lotus	*C. norvegicus* [1, 2, 4, 5]
			S. binotatus [4]
			S. kinbergi [1, 2, 5]
			M. recticornis [4]
	Medicago sativa L.	lucerne	*C. norvegicus* [1, 2]
			S. kinbergi [1, 2]
	Melilotus albus Medikus	white sweet clover	*S. kinbergi* [1, 2]
	Onobrychus viciifolia Scop.	sanfoin	*S. kinbergi* [1, 2]
	Phaseolus L.	bean	*C. norvegicus* [1]

Continued overleaf

Appendix 1 (*continued*)

Plant family	Plant genus or species and authority	Plant common name	Mirid species
			S. kinbergi [3]
	Pisum sativum L.	garden pea	*C. norvegicus* [1]
	Racosperma C. Martius	wattle/acacia	*S. kinbergi* [3]
	Trifolium L.	clover	*C. norvegicus* [1, 4]
			S. binotatus [4, 6]
			S. kinbergi [1, 2, 4]
			M. recticornis [4]
	Trifolium pratense L.	red clover	*C. norvegicus* [3]
			S. binotatus [4]
			S. kinbergi [1, 2]
	Trifolium repens L.	white clover	*C. norvegicus* [1, 2]
			S. kinbergi [1, 2]
	Vicia faba L.	broad bean	*C. norvegicus* [1, 2]
Fagaceae	*Nothofagus* Blume	beech	*C. norvegicus* [3]
			S. binotatus [3]
			M. recticornis [3]
Grossulariaceae	*Ribes nigrum* L.	black currant	*S. kinbergi* [3]
Halorigaceae	*Haloragis erecta* (Murray) Oken		*S. kinbergi* [3]
Juncaceae	*Juncus* L.	rush	*C. norvegicus* [3, 4, 5]
			S. binotatus [4, 6]
			S. kinbergi [3, 5]
	Juncus acutus L.	sharp rush	*S. kinbergi* [3]
	Juncus effusus L.	soft rush	*M. recticornis* [3]
	Juncus maritimus Lam.	sea rush	*C. norvegicus* [3]
Lamiaceae	*Mentha pulegium* L.	pennyroyal	*C. norvegicus* [3]
	Thymus pulegioides L.	wild creeping thyme	*C. norvegicus* [3]
Liliaceae	*Asparagus officinalis* L.	asparagus	*C. norvegicus* [1, 2]
			S. kinbergi [3]
	Bulbinella Kunth	Maori onion	*C. norvegicus* [4]
Linaceae	*Linum monogynum* Forst. f.	linen flax	*C. norvegicus* [3]
Malvaceae	*Malva sylvestris* L.	large flowered mallow	*C. norvegicus* [1, 2]
Myrtaceae	*Eucalyptus* L'Her.	gum tree	*S. binotatus* [3]
	Kunzea ericoides (A. Rich.) J. Thompson	kanuka	*S. kinbergi* [4]
	Leptospermum scoparium J. R. et G. Forst.	manuka	*C. norvegicus* [3]
			S. binotatus [3, 4]
	Metrosideros Banks et Gaertn.	rata	*S. binotatus* [4]
	Metrosideros excelsa Sol. ex Gaertn.	pohutukawa	*S. binotatus* [3]
Paeoniaceae	*Paeonia* L.	paeony	*S. kinbergi* [3]
Papaveraceae	*Papaver nudicaule* L.	Iceland poppy	*C. norvegicus* [3]
Passifloraceae	*Passiflora edulis* Sims	black passionfruit	*S. kinbergi* [1, 2]
Phytolaccaceae	*Phytolacca octandra* L.	inkweed	*C. norvegicus* [3]
Pinaceae	*Larix decidua* Miller	Japanese larch	*S. binotatus* [3]
Pittosporaceae	*Pittosporum tenuifolium* Sol. ex Gaertn.	kohuhu	*S. kinbergi* [3]
Poaceae	*Agrotis capillaris* L.	brown top	*C. norvegicus* [4]
			S. binotatus [1]
	Alopecurus pratensis L.	meadow foxtail	*C. norvegicus* [4]
			S. binotatus [1, 2]
	Ammophila arenaria (L.) Link.	marram grass	*C. norvegicus* [3]
	Avena sativa L.	oats	*C. norvegicus* [3]
	Chionochloa Zotov	snow grass/ snow tussock	*C. norvegicus* [4]
			S. binotatus [4]
			M. recticornis [1, 4]
	Chloris inflata		*T. tenuis* [1]

Plant family	Plant genus or species and authority	Plant common name	Mirid species
	Cynodon dactylon (L.) Pers.	Indian doab	*T. tenuis* [1]
	Dactylis glomerata L.	cocksfoot	*C. norvegicus* [1]
			S. binotatus [1, 2]
	Eleusine indica Gaertn.	goose grass	*T. tenuis* [1]
	Holcus lanatus L.	Yorkshire fog	*S. binotatus* [1]
			M. recticornis [3]
	Hordeum L.	barley	*C. norvegicus* [3]
			S. binotatus [3]
			S. kinbergi [3]
	Lolium L.	ryegrass	*S. binotatus* [4]
			S. kinbergi [3]
	Paspalum L.		*T. tenuis* [4]
	Paspalum dilatatum (Poir.)	paspalum	*S. binotatus* [4]
			S. kinbergi [3, 4]
	Phleum pratense L.	timothy	*S. binotatus* [1, 2]
	Stenotaphrum secundatum (Walt.) Kuntze	buffalo grass	*S. kinbergi* [3]
	Triticum L.	wheat	*C. norvegicus* [1]
			S. binotatus [3]
	Zea mays L.	maize/sweetcorn	*S. binotatus* [3]
			S. kinbergi [3]
	–	grass(es)	*C. norvegicus* [4, 5]
			S. binotatus [1, 2, 4]
			S. kinbergi [1, 4, 5]
			M. recticornis [1, 2, 4]
			T. tenuis [1]
	–	tussock	*S. kinbergi* [3]
			M. recticornis [3]
Podocarpaceae	*Dacrydium cupressinum* Lamb.	rimu	*C. norvegicus* [3]
Polygonaceae	*Muehlenbeckia* Meissn.		*S. binotatus* [3]
			S. kinbergi [1]
			M. recticornis [3]
	Muehlenbeckia australis (Forst. f.) Meissn.	pohuehue	*S. kinbergi* [3]
	Muehlenbeckia axillaris (Hook. f.) Walp.	creeping pohuehue	*S. kinbergi* [1]
	Polygonum aviculare L.	wireweed	*S. kinbergi* [1, 2]
	Rheum rhabarbarum L.	rhubarb	*C. norvegicus* [3]
	Rumex L. probably *obtusifolius* L.	dock	*S. kinbergi* [4]
Ranunculaceae	*Ranunculus* L.	buttercup	*C. norvegicus* [4]
			S. binotatus [4]
	Ranunculus lyallii Hook. f.	giant b'cup/Mt Cook lily	*C. norvegicus* [3]
Rosaceae	*Frageria* x *ananassa* Duchesne	garden strawberry	*C. norvegicus* [1, 2]
			S. kinbergi [1, 2]
	Malus x *domestica* Bookh.	apple	*S. kinbergi* [3]
	Prunus armeniaca L.	apricot	*C. norvegicus* [7]
			S. kinbergi [7]
	Pyrus pyrifolia (Burm. f.) Naki	nashi	*C. norvegicus* [3]
	Rosa L.	rose	*C. norvegicus* [3]
			S. kinbergi [3]
Rubiaceae	*Coprosma* J. R. et G. Forst.		*C. norvegicus* [3]
			S. kinbergi [3]
	Coprosma robusta Raoul	karamu	*S. binotatus* [3]
	Galium L.	bedstraw	*C. norvegicus* [5]
			S. kinbergi [5]
Rutaceae	*Citrus limon* (L.) Burman f.	lemon	*S. kinbergi* [3]

Continued overleaf

Appendix 1 (*continued*)

Plant family	Plant genus or species and authority	Plant common name	Mirid species
Scrophulariaceae	*Hebe* Comm. ex Juss.	hebe	*C. norvegicus* [3]
			M. recticornis [3]
	Hebe parviflora var. *arborea* (Buchan.) L. B. Moore	koromiko-taranga	*S. kinbergi* [3]
	Hebe stricta (Benth.) L. B. Moore		*S. kinbergi* [3]
Solanaceae	*Solanum aviculare* Forst. f.	poroporo	*C. norvegicus* [3]
			S. kinbergi [1, 2]
	Solanum tuberosum L.	potato	*C. norvegicus* [1, 2]
Thymelaeaceae	*Pimelia arenaria* Cunn.		*C. norvegicus* [3]
Urticaceae	*Urtica* L.	nettle	*C. norvegicus* [3]
			S. binotatus [3]
	Urtica ferox Forst. f.	tree nettle	*S. kinbergi* [3]
Violaceae	*Melicytus* J. R. et G. Forst.		*S. kinbergi* [3]
	Melicytus ramiflorus J. R. et G. Forst.	mahoe	*C. norvegicus* [3]
			S. binotatus [3]
Vitaceae	*Vitus* L.	grape	*S. kinbergi* [3]

[1] taken on plant in high numbers;
[2] breeds on plant;
[3] taken on plant in low numbers (1–2 specimens);
[4] taken either on this or another plant genus or species swept or beaten together (details under insect species);
[5] taken by sweeping or beating a mix of three different species of plants including this plant (details under insect species);
[6] taken by sweeping or beating a mix of four different species of plants including this plant (details under insect species);
[7] not taken on this plant, but on other plants or weeds in this crop (details under insect species).