New Zealand Journal of Zoology, 1987, Vol. 14: 587–592
0301–4223/87/1404–0587$2.50/0

A new indigenous aphid from New Zealand (Homoptera: Aphididae)

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Abstract *Paradoxaphis aristoteliae* n. gen. and sp. was described and figured from specimens collected on *Aristotelia serrata* (Elaeocarpaceae) in Southland and Nelson, New Zealand.

Keywords Homoptera; Aphididae; *Paradoxaphis aristoteliae*; new genus; new species; *Aristotelia serrata*

INTRODUCTION

Of the 89 aphids in the Superfamily Aphidoidea recorded by Wise (1977), only 6 are recognised as indigenous to New Zealand. This paper describes a new indigenous species from the native shrub *Aristotelia serrata* (J. R. and G. Forst) W. R. B. Oliver (Elaeocarpaceae). A new genus is erected and Eastop's (1979) key for the identification of genera in the subtribe Aphidina is amended to accommodate it.

SYSTEMATICS

Paradoxaphis n. gen.

Description. Medium sized aphids, body with pointed hairs. Head with moderately developed antennal tubercles. Compound eyes with well developed triommatidia. Antennae six segmented, as long as or longer than body, primary sensoria with small cilia, apterae and alatae without secondary sensoria, processus terminalis 2.2–2.7× as long as base of sixth antennal segment. Rostrum extending to hind coxae, ultimate rostral segment 1½–1¾× as long as basal width. First tarsal chaetotaxy 3 : 3 : 2. Spiracles on abdominal segments I and II widely separated. Lateral abdominal tubercles present or absent on abdominal segment I; if present, then placed posteroventrally to the spiracle on that segment. Lateral abdominal tubercles absent from abdominal segment VII. Siphunculi strongly developed, tapering, 1/6–1/4 of body length. Cauda pointed and finger-shaped. Media of forewing once or twice branched.
Type of species: *Paradoxaphis aristoteliae* sp. n.

Paradoxaphis aristoteliae sp. n.

Apterous viviparous female (Fig. 1)

Colour in life not noted.
Description. MOUNTED SPECIMENS. Oval body, 1.5–2.0 mm long (mean 1.77). Without abdominal pigmentation, some specimens with pale pleural sclerotisation. Abdominal segments I and VII with 1 marginal hair on each side, segments II–VI with 1 or 2 marginal hairs, marginal hairs 15–18 μm long. Dorsal hairs 15–20 μm long (0.5–0.7× basal diameter of antennal segment III); 5–6 hairs on abdominal segment I, 6–8 on segment II, 4–7 on segment III, 3–4 on segment IV, 2–3 on segment V and 2 each on segments VI–VIII. Head (Fig. 1a) usually with 2 pairs of hairs on frons (one specimen has an additional hair); a single hair present on each antennal tubercle; 2 hairs midway between the antennal tubercles and the row of 4 hairs between the eyes. Prothorax with 2 hairs behind each eye and 2–3 hairs placed in the centre of the segment; mesothorax with one row of 8–10 hairs and metathorax with one row of 10–12 hairs. Marginal tubercles on prothorax and abdominal segment VII absent. Fifteen aphid specimens were examined; of these, 7 had marginal tubercles on each side of abdominal segment I, 2 had a marginal tubercle on one side of the abdomen only, and in the other 6 specimens the abdominal marginal tubercles are absent.

Head smooth, with moderately developed diverging antennal tubercles and prominent convex frons when viewed from above. Compound eyes with prominent triommatidia. Antennae six

Received 28 July 1986; accepted 17 March 1987

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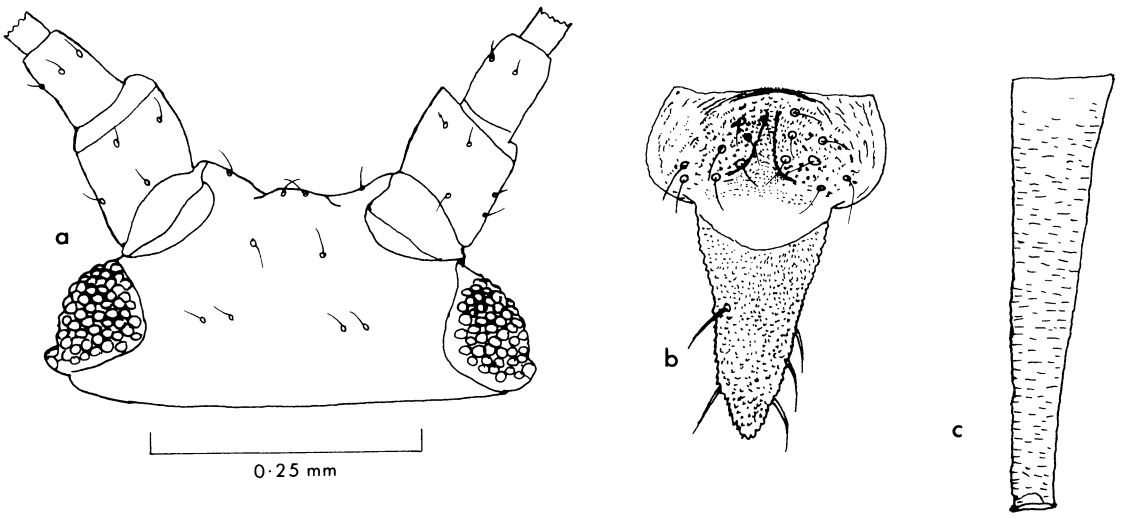

Fig. 1 *Paradoxaphis aristoteliae.* Apterous viviparous female: (a) head; (b) anal plate and cauda; (c) siphunculus.

segmented, flagellum 1.61–2.10 mm long (mean 1.89). Secondary sensoria absent; primary sensoria ciliated; segments I and II rough, segment I with 5–7 hairs; segments III–VI imbricated; antennal hairs fine pointed; longest hair on antennal segment III 0.4–0.6× as long as basal diameter of the segment. Flagellum of antennae 1.0–1.2× length of body. Lengths of antennal segments: I, 0.08–0.10 mm; II, 0.07–0.09 mm; III, 0.33–0.43 mm (mean 0.39); IV, 0.30–0.43 mm (mean 0.38); V, 0.35–0.44 mm (mean 0.40); VI base, 0.18–0.23 mm (mean 0.21); VI processus terminalis, 0.45–0.58 mm (mean 0.52). Processus terminalis 2.2–2.7× as long as base of antennal segment VI. Antennal segment I, brown; segment II, pale brown; segment III, almost colourless; segment IV, same as III but darker at apices; segment V, pale brown basal half, darker brown apical portion; segment VI, brown, except for a lighter area at base.

Rostrum just reaching hind coxae; ultimate rostral segment 85–95 μm long, 1.50–1.75× as long as basal width, 0.70–0.85× as long as hind tarsus II and with 2 secondary hairs. Mid-thoracic furca sessile. Spiracles reniform; those on abdominal segments I and II distant from one another. Siphunculi, (Fig. 1c) dark brown, imbricated; well developed, tapering strongly from base (basal diameter 2–3× sub-apical diameter); weakly flanged; length of siphunculi, 0.34–0.47 mm (mean 0.40), 1.60–2.00× as long as cauda and 0.20–0.27 of body length. Cauda, (Fig. 1b) pointed and finger shaped; 0.19–0.25 mm long (mean 0.23); 0.10–0.13 mm wide at base; 1/8–1/7 as long as body; spinosely imbricated and bearing 5–8 hairs which are 45–55 μm long. Genital plate with 2–4 hairs on anterior portion and 4–7 hairs, 15–22 μm long, on hind margin. Anal plate (Fig. 1b) slightly divided, with 8–9 hairs, 35–60 μm long, on each half.

Fore and mid femora brown on distal fifth, pale proximally; hind femora with darkened distal area occupying about half of the segment; tibiae pale; except for distal fifth which is brown; tarsi brown. Length of hind tibiae, 0.90–1.15 mm (mean 1.05). Hind tarsal segment II, 0.11–0.13 mm long, 1.2–1.4× as long as ultimate rostral segment; empodial hairs fine, ⅔ the length of claws. First tarsal chaeotaxy 3 : 3 : 2. Longest hairs on femora and tibiae 25–30 μm equal to, or a little less than, basal diameter of antennal segment III.

Material examined. Fifteen specimens collected from leaves of *Aristotelia serrata* (Elaeocarpaceae), Dolamore Park, Gore, Southland on 26 February 1982 and 12 January 1983 and at Lake Rotoroa, Nelson on 29 December 1983.

Type data. Holotype and 8 **paratypes** in the New Zealand Arthropod Collection, Entomology Division, DSIR, Auckland, New Zealand; 2 **paratypes** at the British Museum (Natural History), London (Deposition No. BM.1986-445); 4 **paratypes** in the collection of the Plant Protection Centre, MAF, Auckland, New Zealand.

Alate viviparous female (Fig. 2)

Colour in life not noted.

Description. MOUNTED SPECIMENS. Body oval 1.78–2.00 mm long (mean 1.90). Abdominal pigmentation absent. Abdominal segments I, V, VI,

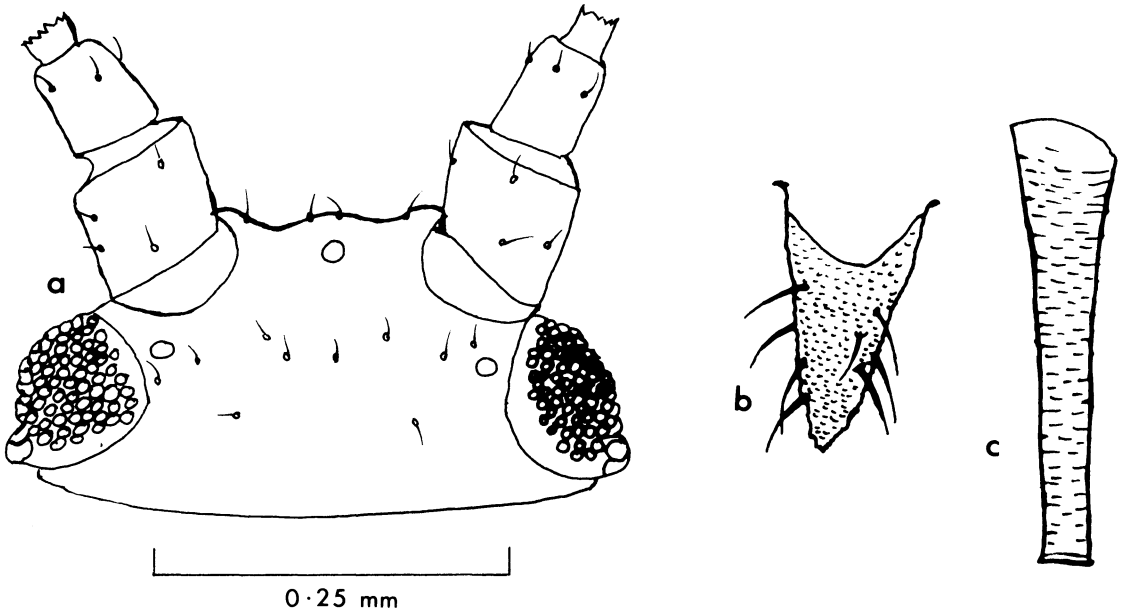

Fig. 2 *Paradoxaphis aristoteliae.* Alate viviparous female: (a) head; (b) cauda; (c) siphunculus.

and VII with 1 marginal hair on each side; segments II, III, and IV with 1 or 2 marginal hairs on each side; marginal hairs 13–20 μm long. Dorsal abdominal hairs 18–30 μm long; 4–6 hairs on abdominal segments I–IV; 2–4 hairs on abdominal segment V; 2–3 hairs on abdominal segments VI and VII. Head (Fig. 2a) with 2 pairs of hairs 12–15 μm long on frons (an occasional specimen with an extra hair); a single hair 12–15 μm long, on each antennal tubercle; a row of 4 hairs, 15–18 μm long, between the eyes; 2 hairs, 15 μm long, between the ocelli. Marginal tubercles absent on prothorax and abdominal segment VII; tubercle usually present on abdominal segment I.

Head smooth with moderately developed diverging antennal tubercles. Compound eyes with prominent triommatidia. Antennae six segmented, flagellum 1.64–2.10 mm long (mean 1.95), 1.00–1.12× length of body; secondary sensoria absent, primary sensoria ciliated. Lengths of antennal segments: I, 0.10 mm; II, 0.08 mm; III, 0.34–0.44 mm (mean 0.41); IV, 0.28–0.42 mm (mean 0.39); V, 0.38–0.45 mm (mean 0.41); VI base, 0.18–0.23 mm (mean 0.22); VI processus terminalis, 0.47–0.56 mm (mean 0.53). Processus terminalis 2.3–2.6× as long as base of antennal segment VI. Antennal segment I with 5–8 hairs; segments I and II rough, segments III–VI imbricated. Antennal hairs fine pointed; those on antennal segment III 0.016–0.02 mm long, the longest hair on antennal segment III about 4/5 of the basal diameter of the segment. Antennal segment I dark brown; segment II light brown; segment III almost colourless at base, darker at apex; segment IV pale brown; lighter at base; segment V pale brown; base of segment VI pale brown; processus terminalis of segment VI light brown, paler at apex.

Rostrum extending to mid-coxae; ultimate rostral segment 90 μm long, 0.75–0.80× as long as hind tarsus II and usually with 2, sometimes 3, secondary hairs. Mid-thoracic furca with well developed peduncle. Spiracles reniform; those on abdominal segments I and II relatively distant from one another. A lateral abdominal tubercle is sometimes present on abdominal segment I; when present, it is placed posteroventrally to the spiracle. Siphunculi (Fig. 2c) well developed, dark brown, imbricated, tapering strongly from base (basal diameter 2–3× that of sub-apical diameter), weakly flanged; 0.30–0.34 mm long (mean 0.32), 1.3–1.8× length of cauda and 0.15–0.19× body length. Cauda (Fig. 2b) pointed, finger-shaped 0.18–0.25 mm long (mean 0.20), 1/7–1/10 the length of body; strongly imbricated and bearing 6–10 hairs which are 50–70 μm long. Genital plate with 2–3 hairs on anterior portion and 4–8 hairs, 25–30 μm long, on hind margin. Anal plate divided with 6–9 hairs, 50–60 μm long, on each half.

Fore femora pale on proximal half, darker on distal half, mid femora pale on proximal quarter, light brown on distal three quarters; hind femora pale on proximal fifth, dark brown on distal four

fifths. Tibiae pale except for distal quarter which is light brown; tarsi light brown. Length of hind tibiae, 0.92–1.19 mm (mean 1.09). Hind tarsal segment II, 0.11–0.12 mm, 1.20–1.33× as long as ultimate rostral segment; empodial hairs fine pointed, ⅔ length of claws. First tarsal chaetotaxy 3 : 3 : 2. Longest hairs on femora and tibiae 25–30 μm long, about equal to, or a little less than, basal diameter of antennal segment III. Forewing with pale stigma, median vein usually once branched. The single alate specimen seen from Southland had the media once branched on one forewing and twice branched on the other. Hind wings with media and cubitus present.

Material examined. Eight specimens collected from leaves of *Aristotelia serrata* (Elaeocarpaceae), Dolamore Park, Gore, Southland on 12 January 1983 and Lake Rotoroa, Nelson on 29 December 1983.

Type data. **Holotype** and 2 **paratypes** in the New Zealand Arthropod Collection, Entomology Division, DSIR, Auckland, New Zealand; 2 **paratypes** at the British Museum (Natural History), London (Deposition No. BM 1986–445); 3 **paratypes** in the collection of the Plant Protection Centre, MAF, Auckland, New Zealand.

Remarks. The genus *Aristotelia* which comprises about 10 species of trees and shrubs, is found in Australia, Vanuatu, South America, and New Zealand. One of two New Zealand species, *A. serrata*, commonly known as Wineberry, is found throughout both main islands (Poole & Adams 1964). *A. serrata* shrubs growing in the Waitakere Ranges, 25 km west of Auckland, and in Christchurch, were examined on several occasions but no specimens of *P. aristoteliae* were found. The only locations where the aphid has been collected are in the South Island — at extreme opposites of the island.

There were some slight differences in size of specimens between the two populations. Only one alate viviparous specimen was collected in Southland but this, unfortunately, arrived at the laboratory in poor condition. Consequently, it was not possible to make a good slide mount and to compare the alate morphs of the two populations. However, sufficient numbers of apterous viviparous forms were available to make comparisons and conclude that the Southland aphids were somewhat smaller than the Nelson ones. The body length of the Southland aphids ranged from 1.50–1.95 mm (mean 1.69) compared to 1.82–2.00 mm (mean 1.86) for the Nelson specimens. Hind tibiae and flagella of the Nelson aphids were appreciably longer than those of the Southland aphids but other appendages, such as siphunculi, caudae, and ultimate rostral segment, were very similar in appearance and size. The size variation in the two populations could be because of nutritional, seasonal, climatic, or possibly other factors.

As a general rule, alate viviparous morphs of aphids are endowed with secondary sensoria on the third antennal segment. It is notable, therefore, that of the six alate viviparous females of native New Zealand aphids so far described, three of the species lack such sensoria.

DISCUSSION

Classification of insects belonging to the Superfamily Aphidoidea is being constantly revised. Eastop (1966) recognised four families in this Superfamily and said, (p. 400), "Börner & Heinze (1957) provide a classification recognising eight families." Later (Eastop & van Emden 1972), Eastop used only three family names. Stroyan (1977) provided a key naming nine families not including the Adelgidae and Phylloxeridae, two of the four families listed by Eastop (1966). Heie (1980) proposed a classification recognising eight families.

Although there are differences of opinion as to how many families should be recognised in the Aphidoidea, the consensus is that the Aphididae is the major family in the group with the Aphidinae as the major subfamily. There is also general agreement as to the criteria for the subdivision of this subfamily into the tribes Macrosiphini and Aphidini and the further subdivision of the tribe Aphidini into the subtribes Rhopalosiphina and Aphidina (Börner 1952; Eastop 1966; Shaposhnikov 1964).

There is some uncertainty as to the taxonomic position of *Paradoxaphis aristoteliae*, hence the generic name given it. Although there is no doubt as to its placement in the subfamily Aphidinae, further classification is difficult as the aphid possesses elements of both tribes in the subfamily. Two slide mounted specimens were sent to Dr Eastop at the British Museum (Natural History). Dr Eastop (pers. comm.) replied: "I am not sure what group it belongs to. It has many Aphis-like characters, viz, chaetotaxy of antennal I, ultimate rostral segment, 1st and 2nd tarsal segments and 8th abdominal tergite. The antennal and body hairs are pointed, as in most Aphidina, and the spiracles of abdominal segments I and II are widely spaced as in that group. However there are no lateral tubercles on the 7th abdominal segment, and one of your specimens has a pair of tubercles on the first segment while the other doesn't. The macrosiphine characters include moderately well developed antennal tubercles; antennae much longer than body and a long base to antennal VI".

Of the various features of aphid morphology which must be taken into consideration when classifying a specimen into either of the tribes of the Aphidinae, the most consistent and stable are the relative distances separating the spiracles on abdominal segments I, II, and III. In the tribe Aphidini, Eastop (1966) states: "Spiracles of abdominal segments I and II placed far apart". Shaposhnikov (1964) states: "Distance between centre of spiracles of abdominal segments II and III not more than twice the distance between spiracles of segments I and II". The spiracles on abdominal segments I and II of *P. aristoteliae* are widely separated — the distance separating II and III ranging from 1.5–2.0× (mean 1.75) the distance between I and II, placing *P. aristoleliae* in the Aphidini, according to Eastop's and Shaposhnikov's criteria.

Also referring to the Aphidini, Eastop (1966) states: "Lateral abdominal tubercles present on segments I and VII" but Shaposhnikov (1964) allows for their possible absence. In a more recent work, Eastop (1979) modified his opinion and now allows for the absence of lateral abdominal tubercles. *P. aristoteliae* is remarkably inconsistent in regard to tubercles on abdominal segment I. Of the 15 apterous specimens examined, 7 had marginal tubercles on each side of abdominal segment I, 2 had a tubercle on one margin only, and the other 6 specimens were without tubercles on this segment. Similarly, of the eight alate specimens examined, four had marginal tubercles on each side of abdominal segment I, one had a tubercle on one margin only, and three were without tubercles on this segment. None of the specimens had tubercles on abdominal segment VII. Notwithstanding its possession of some Macrosiphine characters, I believe that *P. aristoteliae* is correctly placed in the tribe Aphidini. When present, the tubercle on abdominal segment I is placed slightly posteroventrally to the spiracle on that segment, thereby making the aphid a member of the subtribe Aphidina.

Eastop's 1979 paper provides a key for the identification of the 24 genera of the subtribe Aphidina and for a few similar genera of uncertain taxonomic position. In applying *Paradoxaphis* to this key, one comes to an impasse at either couplet No. 5 or No. 8, depending on whether the specimen under examination has lateral abdominal tubercles or not.

The first half of couplet No. 5 applies to specimens without lateral tubercles on abdominal segments I and VII. But according to the key, as these tubercle-less aphids have either 3 : 3 : 3 or 2 : 2 :2 first tarsal chaetotaxy, one cannot progress from this section of the couplet as *Paradoxaphis* has 3 : 3 : 2 first tarsal chaetotaxy. The second half of couplet No. 5 applies to specimens with lateral abdominal tubercles on the first and usually the seventh segments and the first tarsal chaetotaxy is commonly 3 : 3 : 2. From this point in the key, the progression is to couplet No. 8.

The first half of couplet No. 8 refers to aphids with lateral tubercles on the first abdominal segment only and with 2 : 2 : 2 first tarsal chaetotaxy. This cannot apply to *Paradoxaphis* as all specimens have 3 : 3 : 2 first tarsal chaetotaxy. One can go no further with the key as the second half of the couplet applies to aphids with lateral tubercles on both first and seventh abdominal segments. It is therefore concluded that *Paradoxaphis* is a hitherto undescribed genus of the subtribe Aphidina.

Eastop's key can be made to accommodate *Paradoxaphis* by the following amendments and additions.

5. Lateral tubercles absent from both first and seventh and usually also the other abdominal segments. First tarsal chaetotaxy 3 : 3 : 3, 3 : 3 : 2, or 2 : 2 : 2. Processus terminalis 1.7–5.5× as long as the base of sixth antennal segment 6
Lateral tubercles present on the first and usually also on the seventh abdominal segments. First tarsal chaetotaxy commonly 3 : 3 : 2 8

5. All first tarsal segments bearing 3 hairs. Triommatidion inconspicuous. Processus terminalis 1.7–1.9× as long as the base of antennal VI. Siphunculi wider than and about 2½× as long as the cauda which bears only 4–6 hairs (Fig. 29). On *Rhododendron* (Ericaceae), India ..... *Indiaphis.*
First tarsal chaetotaxy 3 : 3 : 2 or 2 : 2 : 2. Triommatidion evident at hind margin of eye. Processus terminalis 2.2–5.5× as long as the base of antennal VI ..... 6(a)

6(a) First tarsal chaetotaxy 3 : 3 : 2. Processus terminalis 2.2–2.7× as long as the base of antennal VI. On *Aristotelia* (Elaeocarpaceae), New Zealand ..... *Paradoxaphis* partim
First tarsal chaetotaxy 2 : 2 : 2. Processus terminalis 3.0–5.5× as long as the base of antennal VI 7

7. (As original).

8. Lateral tubercles present only on first abdominal segment. First tarsal chaetotaxy 3 : 3 : 2 or 2 : 2 : 2 ..... 8(a)
Lateral tubercles present on both the first and seventh abdominal segments. First tarsal chaetotaxy 3–4 : 3–4 : 2–3 9

8(a) First tarsal chaetotaxy 3 : 3 : 2. Siphunculi 1.3–2.0× as long as cauda which bears 5–10 hairs. Processus terminalis 2.2–2.7× as long as base of antennal VI. Ultimate rostral segment with primary hairs in normal position. On *Aristotelia* (Elaeocarpaceae), New Zealand ..... *Paradoxaphis*

First tarsal chaetotaxy 2 : 2 : 2. Siphunculi 0.5–0.7 of the length of the cauda which bears 4–6 hairs (Fig. 31). Processus terminalis 3.3–3.7× as long as the base of antennal VI. Ultimate rostral segment with one of the pairs of primary hairs displaced so far forwards (Fig. 30) that it seems to bear 4 accessory hairs. On *Epilobium* (Onagraceae), India and Australia ..... *Casimira*

ACKNOWLEDGMENTS

I thank Ms C. Butcher, Entomology Division, DSIR, Auckland, for providing the initial specimens and Mrs J. Butel, Ministry of Agriculture and Fisheries, Gore, for collecting additional specimens; Mrs O. R. Green, Plant Protection Centre, Ministry of Agriculture and Fisheries, Auckland, for making some of the slide mounts in my absence; Dr V. F. Eastop, British Museum (Natural History), London, for collecting the Lake Rotoroa specimens and for his learned comments on the aphid and on the initial draft of this paper. Mr M. O'Donnell, Plant Protection Centre, Ministry of Agriculture and Fisheries, Lincoln, checked *A. serrata* shrubs in the Christchurch area. Thanks also to Dr W. Kuschel, formerly of Entomology Division, DSIR, Auckland, for his scholarly advice on naming the aphid.

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DATE OF PUBLICATION

(I.C.Z.N.; Rec. 2lb, 2ld)

The nominal year of publication (as noted on the journal cover, title page, and on the heading of this paper) is 1987, the actual year of publication is 1988. See Volume 15, number 1, for exact date of publication.