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Two new and rare psyllids (Hemiptera, Psylloidea) from French Polynesia

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Abstract

Two new psyllid species, *Ctenarytaina elinae* **sp. nov.** and *Anomocephala rosiegeorgeorum* **sp. nov.**, are described from French Polynesia. Both are single island endemics known only from a small number of specimens. *Ctenarytaina elinae* **sp. nov.** is in the primarily Austro-Pacific genus *Ctenarytaina* Ferris & Klyver (Aphalaridae), and with the addition of *C. elinae* there are now three *Ctenarytaina* species in French Polynesia. *Ctenarytaina elinae* **sp. nov.** is endemic to Tahiti in the Society Islands, and although the host is unrecorded there is some evidence to suggest it may be *Metrosideros* (Myrtaceae). Previously monotypic, *Anomocephala* Tuthill (Triozidae), with the addition of *A. rosiegeorgeorum* **sp. nov.**, now includes two species, and both of these are endemic to Rapa island in the southern Austral archipelago. Both the genus, *Anomocephala*, and the type species, *Anomocephala unica* Tuthill, 1942, are redescribed. The host plant of *Anomocephala rosiegeorgeorum* **sp. nov.** is likely *Metrosideros collina*. The new species names recognize entomologists working in the Pacific, and this contribution to this special issue honours one of the most prolific psyllid researchers and taxonomists, Daniel Burckhardt.

Key words: insect conservation, endemism, *Metrosideros*, Myrtaceae, Pacific islands, taxonomy

Introduction

Rare, single island endemics are, by definition, of conservation concern. Here, I describe two rare psyllid species (Hemiptera, Psylloidea) known from just a few specimens on single islands in French Polynesia. This geologically complex Pacific region is composed of three major archipelagoes as well as smaller island systems distributed over an area greater than 4000 km^2. Despite the remoteness of many of the islands, psyllids have colonized all three major French Polynesian archipelagoes (Austral, Society, and Marquesas). The number of species is not large, around 20 species are known (with several still undescribed) from four psyllid families (Aphalaridae, Carsidaridae, Liviidae, Triozidae) (Klyver 1932; Tuhill 1942, 1956; Claridge *et al*. 2014; Ouvrard 2022). Many of the records represent just a handful of individuals with little or no host or biological information, and there is no doubt that more intensive study in this part of the Pacific would increase our understanding of both described species, including the new species described here, and as yet undescribed taxa.

The genus *Anomocephala* Tuthill, 1942 was described from a single male, and only the head and forewing were illustrated by Tuthill (1942). Only one additional male is recorded here, and based on this specimen and Tuthill's original description, I redescribe the genus and the type species, *Anomocephala unica* Tuthill, 1942.

Methods

Specimens were collected in the field into 90–95% ethanol and subsequently stored at -20 °C. Ethanol-preserved material, including DNA vouchers from non-destructive DNA extractions, was macerated and cleared in 10% potassium hydroxide and clove oil, and then slide mounted in Canada balsam as described in Hodkinson & White (1979). Morphological terminology follows Burckhardt *et al*. (2020), Hodkinson & White (1979), Hollis (1984), and Percy (2003). Single whole specimens preserved in ethanol were used for DNA extraction and sequencing

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of regions cytochrome oxidase one (COI) and cytochrome b (cytB) follow protocols in Percy (2017) and Percy *et al*. (2018); sequences are deposited in Genbank database. Genetic distances reported here were obtained using neighbour-joining analyses with uncorrected (p) distances in PAUP* (Swofford 2003). The species described here were also included in the mitogenome analysis of Percy *et al*. (2018). Specimens were imaged using a Zeiss Axio Scope A1 microscope with imaging software ZEN v2.6; HeliconFocus v8.2.2 and Inkscape v1.2 were used to prepare images for publication; measurements were made with ImageJ (Rasband 1997–2018). Type material is deposited in the Natural History Museum, London, UK (NHMUK), with additional material in my personal collection at the Biodiversity Research Centre, University of British Columbia (DMPC).

Abbreviations used in the descriptions are as follows (all measurements are recorded in mm). Adults: WL, forewing length; WW, forewing width; HW, head width; AL, antennal length; PB, distal proboscis segment length; WL:WW, ratio forewing length:width; WL:RsL: ratio forewing length:vein Rs length; CUR, ratio forewing cell cu$_1$ width:height; MR, ratio forewing cell m$_1$ width:height; HM:HCU, ratio height forewing cells m$_1$:cu$_1$; HW:VW, ratio head width:vertex width; VL:VW, ratio vertex length:width; VL:GC, ratio vertex length:genae length; WL:HW, ratio forewing length:head width; AL:HW ratio antennal length:head width; HW:HT ratio head width:hind tibia length; HT:HF, ratio hind tibia length:femur length. Adult male terminalia: MP, proctiger length; PL, paramere length; AEL, distal aedeagus segment length; PL:HW, ratio paramere length:head width; MP:PL, ratio proctiger length:paramere length; PL:AEL, ratio paramere length:distal aedeagus segment length; AEL:AELH, ratio distal aedeagus segment length:aedeagus apical head length; PL:SH, ratio paramere length:subgenital plate height. Adult female terminalia: FP, proctiger length; FSP, subgenital plate length; RL, anal ring length; OVH, ovipositor valvulae dorsalis height; EL, egg length; EW, egg width; FP:RL, ratio female proctiger:anal ring length; FP:HW, ratio female proctiger:head width; FP:SP: ratio female proctiger:subgenital plate length; EL:EW, ratio egg length:egg width.

Taxonomic treatment

Family APHALARIDAE Löw, 1879

Ctenarytaina Ferris & Klyver, 1932

Type species: *Ctenarytaina fuchsiae* (Maskell)

Key to adults of *Ctenarytaina* in French Polynesia

1 Head with genae conical, diverging, with more acute apices; forewing broad (ratio WL:WW < 2.4) and remaining broad in apical half with broadly rounded apex, cell cu$_1$ higher and narrower (ratio CUR < 2.5) with arching vein Cu$_{1a}$ . . . . *C. remota* Tuthill, 1956 (on Hivaoa, Marquesas Islands)

\- Head with genae broad, converging and mostly contiguous with bluntly rounded apices; forewing narrower (ratio WL:WW > 2.4) and increasingly narrow in apical half to narrowly rounded apex, cell cu$_1$ lower and wider (ratio CUR > 2.5) with more or less straight vein Cu$_{1a}$ 2

2 Smaller species, length including wings < 2 mm; head with vertex longer and narrower (ratio VL:VW > 0.5) and notably narrowed anteriorly, genae very short (see Fig. 1c in Tuthill 1942) (ratio VL:GC > 0.3) . . . . *C. lulla* (Tuthill, 1942) (on Huahine, Society Islands)

\- Larger species, length including wings > 2 mm (Fig. 1N); head with vertex shorter and wider (ratio VL:VW < 0.5), not notably narrowed anteriorly (Fig. 1G, 1H), genae longer (ratio VL:GC < 0.3) . . . . *C. elinae* **sp. nov.** (on Tahiti, Society Islands)

Ctenarytaina elinae sp. nov.

(Figs 1, 2)

Adult colour and structure. General colour dark brown-black with dark red markings on head and thorax; forewing membrane ochreous with veins brown. Head wider than thorax, deflexed downwards approximately 50–60° from longitudinal axis of body (Figs 1I, 1N), vertex with distinct preocular tubercule (Fig. 1G), genal processes well developed, moderately long (length approximately 0.5 times vertex length), broad and bluntly rounded (Figs 1G, 1H). Distal proboscis segment short (Fig. 1F). Antenna 10-segmented, shorter than head width (length 0.8–0.9 times head width), segment 3 longest, and segments 4, 6, and 8 subequal in length, a single subapical rhinarium on each of segments 4, 6, 8, and 9, terminal seta longer than either segment 9 or 10 (Figs 1H, 1O). Thorax well arched (Fig. 1N). Mesotibia with a subapical comb of bristles (as typical for the genus). Hind leg coxae with small, globular meracanthus (Fig. 1J); metatibia length 0.5-0.6 times head width, longer than metafemur (Fig. 1J); metatibia without basal genual spine but with a stout basal seta (Fig. 1L), with 6 more or less grouped apical spurs; metatarsi subequal in length; proximal metatarsus with two lateral spurs (Fig. 1K). Forewing length 2.1–2.4 times head width, widest basally, narrowing in apical half to a narrowly rounded apex (Figs 1A, 1B); costal break and pterostigma developed; veins thicker basally than apically (Figs 1A, 1B) and incomplete vein development introducing a break at the junctures of veins M and Cu_{1a} with vein Cu_1 (Fig. 1D); vein Rs length approximately 0.8 times wing length, almost straight, medially weakly curved towards fore margin, vein M much longer than its branches, cell cu_1 long and low, vein Cu_{1a} almost straight to slightly sinuous, medially weakly curved towards hind margin, vein apex reaching the margin distal to bifurcation of vein M (Figs 1A, 1B); membrane with surface spinules (forming linear patterns more basally or cellular patterns more apically) present in all cells. Hindwing broad, length 0.8–0.9 times forewing length, costal margin sinuate, venation prominent, apex more broadly rounded than forewing apex (Fig. 1C). Abdomen with pore fields present on intersegmental membrane (Figs 2M, 2N). Male terminalia (aedeagus missing) as in Figs 2A, 2B; proctiger two-segmented, length approximately 0.6 times head width, with basal segment of proctiger in lateral view more or less parallel sided, weakly produced posteriorly, apical segment short, tubular, length approximately 0.2 times length of basal segment; subgenital plate, in lateral view with dorsal margin concave (Fig. 2B); paramere, in lateral view, digitiform, more or less parallel sided, weakly curving anteriorly, exterior surface with short simple setae, interior surface with stout simple and peg setae (Figs 2C, 2D). Aedeagus missing (lost during slide mounting) but noted as similar to that illustrated for *C. longicauda* Taylor, 1987 (Fig. 2E) with distal portion short and apex bulbous. Female terminalia elongate, massive with respect to body length, extending beyond wing apex (Figs 1N, 2I), with 3 discrete areas of dense sclerosis (Fig. 2O); proctiger length more than 1.2 times head width and more than 3 times anal ring length (Figs 2I, 2K); proctiger in lateral view, with apical portion post anal ring convex with shallow subapical depression (Fig. 2I); proctiger in dorsal view, with basal portion more or less parallel sided, gradually narrowing to acute apex, with 5–9 (at broadest section) longitudinal rows of stout peg setae near ventral margin (Fig. 2K); anal ring narrowly elongate oval and composed of a double row of cells (Fig. 2J); subgenital plate length approximately 0.8 times proctiger length, basal portion in ventral view more or less parallel sided, apical portion gradually narrowing to acute apex (Fig. 2L). Ovipositor with dorsal valvulae small (length less than half anal ring length), low and curved (Fig. 2P).

Adult measurements (mm) and ratios. (1 male, 3 females). WL: 1.62–2.31; WW: 0.67–0.93; HW: 0.76–0.93; AL: 0.68–0.84; PB: 0.08–0.09; WL:WW: 2.42–2.59; WL:RsL: 1.26–1.29; CUR: 2.63–3.35; MR: 0.33–0.4; HM:HCU: 2.07–2.41; HW:VW: 1.58–1.70; VL:VW: 0.43–0.48; VL:GC: 1.92–2.30; WL:HW: 2.13–2.37; AL:HW: 0.84–0.89; HW:HT: 1.80–1.86; HT:HF: 1.22–1.34. Male terminalia: MP: 0.45; PL: 0.26; AEL: missing; PL:HW: 0.34; MP:PL: 1.73; PL:SH: 1.30. Female terminalia: FP: 1.11–1.19; FSP: 0.90–1.00; RL: 0.31–0.38; OVH: 0.02–0.03; EL: 0.24; EW: 0.09; FP:RL: 3.13–3.58; FP:HW: 1.23–1.25; FP:SP: 1.19–1.23; EL:EW: 2.67.

Immature. Unknown.

Egg. Broadly ovoid, apparently smooth, without surface sculpturing or patterning, with a short basal pedicel and a very short tail (Fig. 2Q).

Host plant and biology. The host plant is unrecorded, it may be *Metrosideros* (Myrtaceae) (see Discussion). No biological information is available, but the immatures are likely to be free-living as is typical for the genus (Burckhardt *et al*. 2020).

Note. The aedeagus of the single male specimen and holotype was lost during slide mounting, but the structure of the aedeagus and shape of the distal segment apex had already been noted as similar to that of *C. longicauda* (illustrated in Fig. 2E). *Ctenarytaina lulla* (Tuthill, 1942) is the only other *Ctenarytaina* known from the Society Islands, and the original description of *C. lulla* by Tuthill (1942), which I use for my comparison with *C. elinae*, was based on just two females (material not examined) and no further records are known. Moreover, when Tuthill (1952) transferred the species to *Ctenarytaina* (from *Papiana* Tuthill, 1942) he provided no further description.

Comments and Systematics. Burckhardt *et al*. (2020) noted that extra pore fields on the abdominal intersegmental membrane are present in females only in some species (e.g., *Ctenarytaina insularis* Martoni & Armstrong, 2019); in *C. elinae* these pores are found in both male and female (Figs 2M, 2N). Martoni & Armstrong (2019) clearly considered the Pacific taxa, *C. distincta* (Tuthill, 1943), *C. lulla* and *C. remota* Tuthill, 1956 to be related to the

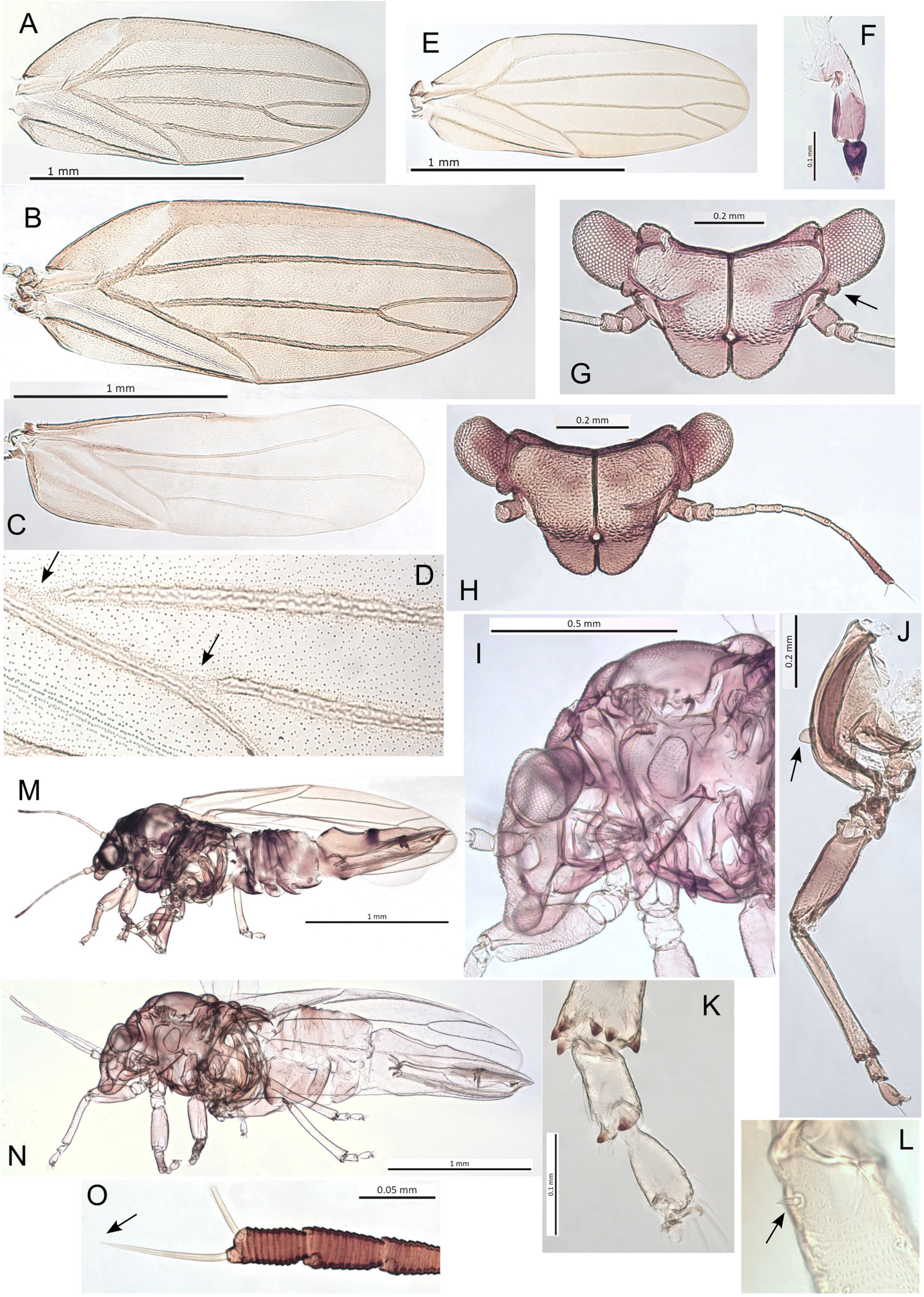

FIGURE 1. A–D, F–L, N *Ctenarytaina elinae* **sp. nov.**, E, M *Ctenarytaina longicauda.* A, forewing (male); B, forewing (female); C, hindwing (female); D, forewing detail, arrows indicating incomplete vein joints; E, forewing (male); F, proboscis; G, head (female, with preocular tubercules indicated); H, head and antennae (male); I, head and thorax (lateral view); J, hind leg, arrow indicating small, globular meracanthus; K, apical metatibial spurs and metatarsi; L, detail of base of metatibia with stout seta indicated by arrow; M female (lateral view); N, female (lateral view); O, antenna, detail of apical segments, arrow indicating long apical seta.

native Australian taxon, *C. insularis*. Burckhardt *et al*. (2020) additionally included *C. longicauda* and three other taxa (*C. baliola* Burckhardt, 2020, *C. bipartita* Burckhardt, Farnier, Queiroz, Taylor & Steinbauer, 2013, *C. cubicella* (Kandasamy, 1986)) together in a larger related group primarily based on the structure of the female terminalia that is somewhat inflated basally and strongly narrowed medially to a narrow apical process. However, this description does not fit the structure of *C. longicauda* or *C. elinae*, and therefore I consider these two latter species to represent a separate species group. I also interpret the presence of two species groups as evidence for at least two separate colonizations across the Pacific and specifically to French Polynesia. There is, nevertheless, evidence that these two species groups are related within *Ctenarytaina*. *Ctenarytaina elinae* **sp. nov.** was included in the mitogenome analysis of Percy *et al*. (2018) (as "DP1.idba.269_Aphalaridae_Ctenarytaina_sp"), where it groups with strong support (100% bootstrap) with an undescribed species (as "DP1.ctg022_circ_Aphalaridae_Ctenarytaina_sp") from New Caledonia close to *C. insularis*, albeit with reasonably deep divergence between them (Percy *et al*. 2018), and based on the COI fragment the divergence is 16.5%. Only four *Ctenarytaina* species were included in Percy *et al*. (2018), but the results suggest that although the *Ctenarytaina* diversity in French Polynesia likely derived from at least two separate colonizations from Australasian origins, the two different species groups (*C. elinae* versus *C. lulla* and *C. remota*) are likely related groups within the genus. The closest relative to *Ctenarytaina elinae* **sp. nov.** (based on morphology, and combined COI and cytB data) appears to be *C. longicauda* which is native to Australia (but introduced in several regions; Burckhardt *et al*. 2020). The relationship between these species is suggested by the extremely elongate and massive female terminalia (Figs 1M, 1N and Figs 2H, 2I), which also readily differentiates *C. elinae* from other known Pacific *Ctenarytaina* taxa. *Ctenarytaina elinae* is a larger species than *C. longicauda* (Figs 1M, 1N), the forewing of *C. longicauda*, although similar in shape to *C. elinae*, is less broad basally (Fig. 1E), the veins do not become thickened in the basal portion of the forewing, cell cu_1 is wider (CUR > 3.5) and cell m_1 is lower (MR > 0.4); the male terminalia structure is also similar between the two species, with similar structure of proctiger, subgenital plate and aedeagus (see note above) (Fig. 2E), but the paramere is more slender in *C. longicauda* (Figs 2F, 2G). The similarities in the general structure of the female terminalia also include the presence of three discrete areas of dense sclerosis (two in the proctiger, one in the subgenital plate, Fig. 2O), and these were illustrated for *C. longicauda* by Taylor (1987); the area of sclerosis post anal ring on the proctiger is more prominent in *C. longicauda* and is sometimes marked in this taxon by darker pigmentation (Fig. 2H). The function of these sclerotized areas is not clear, but they may provide structural reinforcement supporting the relatively massive terminalia. Similarly, the distinctive depression on the dorsal surface of the proctiger towards the apex is more pronounced in *C. longicauda* (Figs 2H, 2I). Despite these shared morphological characters, DNA barcodes indicate that *C. elinae* and *C. longicauda* species are considerably genetically divergent (17.8% COI divergence). No DNA data is available for the other Pacific *Ctenarytaina*.

Genetic resources. Genbank: MG988720 (COI), MG989020 (cytB).

Distribution. Only recorded from a single locality at high elevation on the island of Tahiti, Society Islands, French Polynesia.

Type material. Holotype male (slide mounted), Orohena trail to summit of Pito Hiti, Tahiti Nui, Society Islands, French Polynesia, 2000–2110 m, 1st–2nd June 2006, coll. EC8906, E. Claridge leg. (NHMUK). Paratypes 3 females (slide mounted), as for holotype (NHMUK and DMPC).

Etymology. Named for the entomologist, Elin Claridge, who collected the only known specimens.

Ctenarytaina longicauda Taylor, 1987

(Figs 1E, 1M, 2E–2H)

Ctenarytaina longicauda Taylor, 1987: 231

Note. Specimens were used for molecular analysis and slide mounted to investigate the relationship of this taxon with *C. elinae* **sp. nov.**

Material examined. 1 male, Palikea, southern Waianae Mtns., Oahu, Hawaiian Islands, 21.410712 N, -158.098336 W, 822 m, 08 April 2010, coll. PKSP12326, P. Krusheinycky leg. (DMPC). 3 males, 3 females, Palikea, southern Waianae Mtns., Oahu, Hawaiian Islands, 21.403474 N, -158.097985 W, ex *Lophostemon confertus*, 23 Sept. 2021, coll. 2021-200, J. Matsunaga & K. Magnacca leg. (DMPC).

Genetic resources. Genbank: PP218312, PP218313 (COI), PP235413, PP235414 (cytB).

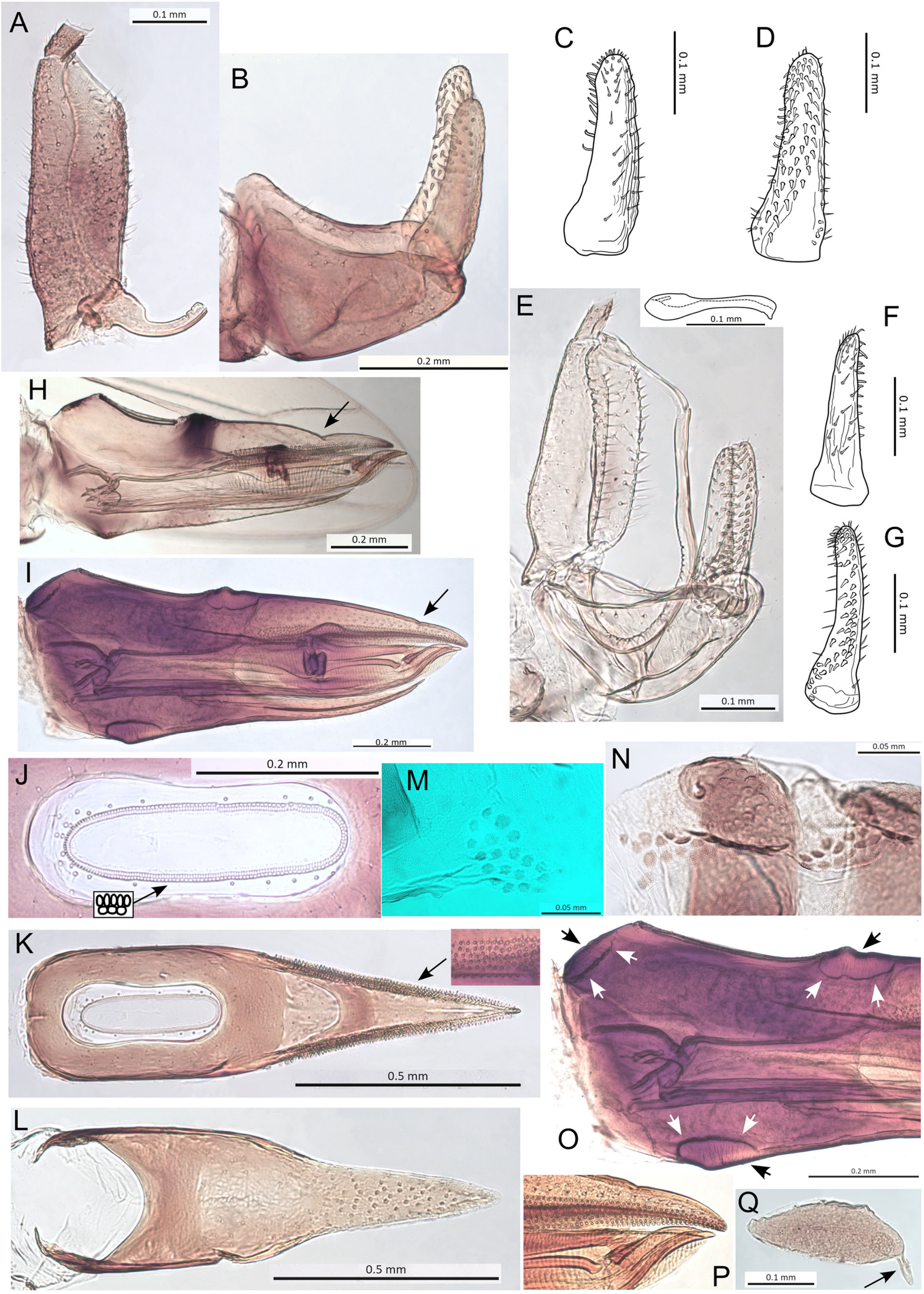

FIGURE 2. A–D, I–P *Ctenarytaina elinae* **sp. nov.**, E–H *Ctenarytaina longicauda.* A, male proctiger; B, male subgenital plate and parameres; C, paramere (exterior view); D, paramere (interior view); E, male terminalia with inset distal aedeagus segment; F, paramere (exterior view); G, paramere (interior view); H, female terminalia (lateral view), arrow indicating subapical depression; I, female terminalia (lateral view), arrow indicating subapical depression; J, anal ring with inset detail of pores; K, female proctiger (dorsal view, inset ventral margin peg setae); L, female subgenital plate (ventral view); M, extra pore fields on abdominal intersegmental membrane (female); N, extra pore fields on abdominal intersegmental membrane (male); O, detail of basal portion of female terminalia with arrows indicating extent of 3 discrete areas of dense sclerosis; P, ovipositor detail; Q, egg with arrow indicating pedicel.

Family TRIOZIDAE Löw, 1879

Genus *Anomocephala* Tuthill, 1942

Type species: *Anomocephala unica* Tuthill, 1942, by original designation and monotypy.

Adult colour and structure. General body colour appears brown or reddish (in ethanol material, no fresh material examined). Forewing clear or with an irregular band of brown pigmentation (sometimes only faint) in the hind margin half of the wing (pigmented band apparently only present in females, but females of only one species known) (Fig. 3C), veins pale or light brown. Head moderately deflexed downwards (20–30° from longitudinal axis of body) (Figs 3Q, 3R); vertex almost rectangular and hardly narrowing anteriorly, medial epicranial suture distinct (Fig. 3G); genal processes long and slender, as long or longer than vertex length, contiguous for almost entire length (Figs 3G, 3I, 3K). Clypeus rounded ventrally, distinctly visible in lateral view (Fig. 3J), distal proboscis segment short (Fig. 3H), distinctly exceeding procoxae (Fig. 3Q). Antenna 10-segmented, longer than head width, segment 3 longest, a single subapical rhinarium on each of segments 4, 6, 8, and 9, terminal segment with two, unequal length setae (Fig. 3F). Thorax moderately arched (Figs 3Q, 3R), width subequal to head width (Fig. 3I). Legs moderately long (Figs 3L, 3O); metacoxa with moderate to large, straight, thorn-shaped meracanthus; length of metafemur shorter than metatibia; base of metatibia with distinct genual spine or cluster of spines, apex more or less expanded, bearing 3 (1+2) sclerotized apical spurs (single spur more or less stalked, pair of spurs basally conjoined or not) and a row of unsclerotized bristles; basal metatarsus without apical spurs, longer than apical metatarsus (Figs 3L, 3M, 3N, 3O, 3P). Forewing widest in the middle third, with typical triozid trifurcation of veins R, M and Cu_1, vein R shorter than vein Cu_1, vein Rs moderately long, reaching forewing margin distal to M fork, membrane with surface spinules dense or sparse, distributed in all cells but few in cell c+sc, a single cluster of marginal radular spines present in cells cu_1, m_2, and m_1, centrally positioned in cu_1 and m_2 and offset towards apex in m_1; apex acute to bluntly acute (Figs 3A, 3C, 3D). Hindwing moderately long, length more than half forewing length (Figs 3B, 3E). Male terminalia with subgenital plate well rounded or more angled; proctiger short, length shorter than paramere, with or without pronounced posterior lobes basally (Figs 4A, 4D); paramere shape variable, simple, digitate, either long and slender or shorter and broad, simple setae on exterior and interior surfaces; distal aedeagus segment apex with a moderate to large bulbous apical head. Female terminalia (only known for *A. rosiegeorgeorum*) short; proctiger length less than head width (Figs 3R, 4G, 4I); proctiger in dorsal view with bluntly rounded apex (Fig. 4G); anal ring relatively large, more than 0.3 times length of proctiger, broader proximally than distally, and composed of a double row of cells (Fig. 4H); subgenital plate shorter than proctiger with a blunt apex; ovipositor with dorsal valvulae high and short, ventral valvulaewith several serrations towards the apex (Fig. 4J).

Immature. Unknown.

Host plant and biology. Unconfirmed without immatures, but most adults were collected from *Metrosideros collina* (J.R.Forst. & G.Forst.) A.Gray. No biological information is available, and it is not known whether the species are free-living or gall forming.

Note. Both genus and type species descriptions were based on a single male specimen, and only the head and forewing were illustrated (Tuthill 1942).

Systematics. The genus was placed within Triozidae Group D in Percy *et al.* (2018) which includes several Pacific island and Australasian genera, including genera on Casuarinaceae hosts, *Aacanthocnema* Tuthill & Taylor, 1955, *Casuarinicola* Taylor, 2010, and also includes genera such as *Cerotrioza* Crawford, 1918 and *Heterotrioza* Dobreanu & Manolache, 1960, but no close relationships to other genera in Group D were strongly supported.

Distribution. Only known from the southern Austral island of Rapa (also known as Rapa Iti).

Key to adults of *Anomocephala* [for *A. unica*, based on a single male specimen and original description]

1 Smaller species, less than 4 mm (WL < 3 mm); forewing apex bluntly acute (Figs 3A, 3C); forewing membrane surface spinules densely distributed; hindwing longer than 0.7 times length of forewing (Figs 3A, 3B); genae longer than vertex (ratio VL:GC < 1 [0.7–0.9]); proctiger shorter than subgenital plate height, with extended posterior lobes basally (Fig. 4A); paramere long and slender (ratio MP:PL < 0.75) (Figs 4A, 4B); distal aedeagus segment shorter (ratio PL:AEL > 1.3), with apical head smaller (Fig. 4C) . . . . *A. rosiegeorgeorum* **sp. nov.**

- Larger species, more than 4 mm (WL > 3 mm); forewing apex acute (Fig. 3D); forewing membrane surface spinules sparsely distributed; hindwing shorter than 0.7 times length of forewing (Figs 3D, 3E); genae subequal to vertex length (ratio VL:GC ~1.00); proctiger longer than subgenital plate height, without extended posterior lobes basally (Fig. 4D); paramere shorter and broader (ratio MP:PL > 0.75) (Figs 4D, 4E); distal aedeagus segment longer (ratio PL:AEL < 1.3), with apical head larger (Fig. 4F) . . . . *A. unica* Tuthill, 1942

Note on species descriptions. The species descriptions below provide details of species specific characteristics not supplied in the generic description above.

Anomocephala rosiegeorgeorum sp. nov.

(Figs 3A–3C, 3F–3N, 3Q–3R, 4A–4C, 4G–4M)

Adult colour and structure. General colour probably dark brown or dark red, apical metatarsus dark brown to black; forewing membrane clear in males, females with an irregular band of brown pigmentation (sometimes only faint, especially in teneral females) in the hind margin half of the wing (Figs 3A, 3C). Genal processes long and slender, longer than vertex length (ratio VL:GC 0.70–0.87), contiguous for almost entire length (Figs 3G, 3I, 3K). Antenna approximately 1.5 times longer than head width (ratio AL:HW: 1.47–1.62), segment 3 long, approximately 1/3 antennal length and subequal or longer than segments 6–8 combined, subapical seta longer than either segment 9 or 10 (Fig. 3F). Metacoxa with moderate sized meracanthus, base of metatibia with distinct genual spine or small cluster of ~2 spines, apex slightly expanded, bearing 3 (1+2) sclerotized apical spurs with single spur slightly stalked, and the pair of spurs hardly conjoined (Figs 3L, 3M, 3N). Forewing membrane surface spinules dense, forewing apex bluntly acute (Figs 3A, 3C). Hindwing more than 0.7 times forewing length, apex broadly rounded (Fig. 3B). Male terminalia with subgenital plate well rounded; proctiger short with pronounced posterior lobes basally (Fig. 4A); paramere long and slender, curving slightly towards posterior and apices turned inwards, with simple setae shorter on exterior and longer on interior surfaces (Figs 4A, 4B); distal aedeagus segment apex with moderate sized bulbous head. Female terminalia as given in generic description, in lateral view proctiger dorsal surface more or less straight or somewhat undulating with longer simple setae in apical portion (Figs 4G, 4H, 4I, 4J).

Adult measurements (mm) and ratios. (4 males, 7 females). WL: 2.39–2.92; WW: 0.81–1.09; HW: 0.61–0.69; AL: 0.87–1.12; PB: 0.09–0.10; WL:WW: 2.68–2.95; WL:RsL: 1.83–2.11; CUR: 1.04–1.37; MR: 0.53–0.62; HM:HCU: 1.36–1.88; HW:VW: 1.68–1.85; VL:VW: 0.54–0.74; VL:GC: 0.70–0.87; WL:HW: 3.85–4.36; AL:HW: 1.47–1.62; HW:HT: 0.91–1.23; HT:HF: 1.17–1.34. Male terminalia: MP: 0.22–0.23; PL: 0.35–0.36; AEL: 0.23–0.25; PL:HW: 0.56–0.59; MP:PL: 0.63–0.64; PL:AEL: 1.44–1.52; AEL:AELH: 2.30–2.78; PL:SH: 1.30–1.44. Female terminalia: FP: 0.42–0.52; FSP: 0.32–0.41; RL: 0.15–0.22; OVH: 0.09–0.10; EL: 0.27–0.32; EW: 0.09–0.11; FP:RL: 2.36–2.80; FP:HW: 0.68–0.76; FP:SP: 1.27–1.50; EL:EW: 2.90–3.10.

Immature. Unknown.

Egg. Oblong-ovoid, approximately 3 times longer than wide, with a short, laterally positioned pedicel sub-basally on ventral side (Figs 4K, 4L); dorsal and lateral surface with distinctly hexagonal, honeycomb-like, sculpturing (Figs 4K, 4M); dorsum keeled with a longitudinal medial ridge (Fig. 4K), ventral side concave (Fig. 4L), tail apparently lacking.

Host plant. Unconfirmed without immatures, but most adults were collected from *Metrosideros collina* (Myrtaceae).

Comment. The most obvious characters that differentiate *A. rosiegeorgeorum* from *A. unica* are used in the species key above, additional differences include smaller meracanthus, metatibia shorter (ratio HT:HF < 1.35), base of metatibia with only a single or small cluster of ~2 genual spines, apex of metatibia less expanded, with spurs less stalked or conjoined (Figs 3L, 3M, 3N, 3O, 3P), forewing relatively shorter (ratio WL:HW < 4.5) with cell r_1 not narrowing as much towards cell apex, cell cu_1 higher (ratios CUR < 1.5 and HM:HCU < 2) (Fig. 3A, 3D), hindwing relatively longer (more than 0.7 times forewing length) with a more broadly rounded apex (Figs 3B, 3E), paramere longer and proctiger shorter (ratio MP:PL < 0.6) (Figs 4A, 4D).

Systematics. This species was included in the mitogenome analysis of Percy *et al*. (2018) (as "DP2.idba.210_circ_Triozidae_Anomocephala_sp"). The two *Anomocephala* species on Rapa are strongly supported as sister taxa (100% bootstrap) and are moderately divergent (9.7% COI divergence). See systematics section under *Anomocephala* and Discussion.

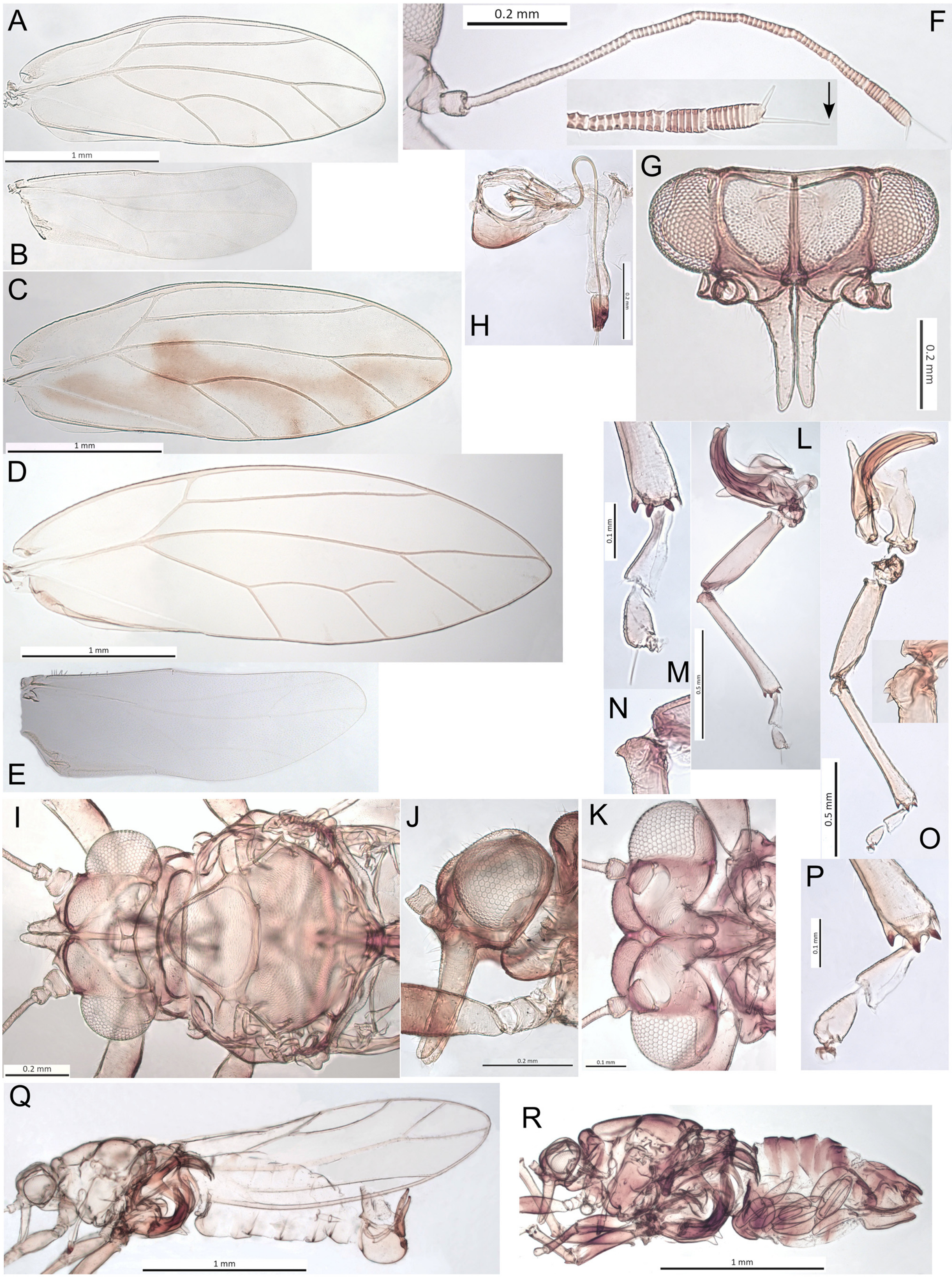

FIGURE 3. A–C, F–N, Q–R *Anomocephala rosiegeorgeorum* **sp. nov.**, D–E, O–P *Anomocephala unica.* A, forewing (male); B, hindwing (male); C, forewing (female); D, forewing (male, with aberrant partial vein off cell cu_1); E, hindwing (male); F, antenna, inset detail of apical segments, arrow indicating long terminal seta; G, head; H, proboscis; I, head and thorax (dorsal view); J, head (lateral view); K, head (ventral view); L, hind leg; M apical metatibial spurs and metatarsi; N, genual spine at base of metatibia; O, hind leg with inset detail of genual spine at base of metatibia; P apical metatibial spurs and metatarsi; Q male (lateral view); R female (lateral view).

Genetic resources. Genbank: MG988637 (COI), MG988913 (cytB).

Distribution. Only known from Mt. Perahu on Rapa island, Austral Islands, French Polynesia.

Type material. Holotype male (slide mounted), Mt. Perahu ridge, 590 m, ex *Metrosideros*, 12 Oct. 2002, coll. "vial 3" AnomoRG, R. Gillespie leg. (NHMUK). Paratypes 2 males, 4 females (slide mounted), as for holotype (NHMUK and DMPC).

Other material examined. 2 males, 6 females (slide mounted) Mt. Perahu, 650 m, ex *Metrosideros*, 9th-11th Dec. 2002, coll. "vials 5, 9, 15" RG-Anomo-02, R. Gillespie leg. (DMPC).

Etymology. The species name honours two Pacific island biologists, professional and familial partners Rosie Gillespie and George Roderick. Although the only specimens of *A. rosiegeorgeorum* were collected by Rosie Gillespie, those who have worked with Rosie and George know that all endeavours are joint and that they operate as a symbiotic unit.

Anomocephala unica Tuthill, 1942

(Figs 3D–3E, 3O–3P, 4D–4F)

Anomocephala unica Tuthill, 1942: 75

Adult colour and structure. General colour dark brown, head and thorax darker, somewhat paler abdomen, apical metatarsus dark brown; forewing clear in males (unknown in females) (Fig. 3D). Genal processes long and slender, approximately same length as vertex length (ratio VL:GC 1.00), initially contiguous basally, becoming slightly divergent towards apices. Antenna incomplete in specimen at hand (segment 3 length: 0.47). Metacoxa with large sized meracanthus, base of metatibia with cluster of genual spines, apex expanded, bearing 3 (1+2) sclerotized apical spurs with single spur stalked, and the pair of spurs distinctly conjoined (Figs 3O, 3P). Forewing long (ratio WL:HW > 4.5) membrane surface spinules sparsely distributed, forewing apex acute (Fig. 3D). Hindwing relatively short, less than 0.7 times forewing length, apex narrowly rounded (Fig. 3E). Male terminalia with subgenital plate angled posteriorly (Fig. 4D); proctiger short, slightly expanded medially towards posterior, without posterior lobes basally (Fig. 4D); paramere moderately long and broad, curving slightly towards posterior, with posterior margin narrowed and bearing several long stout setae, apex bluntly rounded, with simple setae shorter on exterior and longer on interior surfaces (Figs 4A, 4B); distal aedeagus segment relatively long (ratio PL:AEL < 1.3) apex with large bulbous head. Female unknown.

Adult measurements (mm) and ratios. (1 male), [1 male illustrated by Tuthill, 1942]. WL: 3.52; WW: 1.14; HW: 0.74; AL: missing; PB: 0.09; WL:WW: 3.09[–3.13]; WL:RsL: [1.97–]2.15; CUR: 1.67[–1.69]; MR: 0.56; HM:HCU: 2.21[–2.42]; HW:VW: 1.85; VL:VW: 0.58; VL:GC: 1.00; WL:HW: 4.76; HW:HT: 0.97; HT:HF: 1.36. Male terminalia: MP: 0.27; PL: 0.31; AEL: 0.27; PL:HW: 0.42; MP:PL: 0.87; PL:AEL: 1.15; AEL:AELH: 2.45; PL:SH: 1.24.

Immature. Unknown.

Egg. Unknown.

Host plant. Probably *Metrosideros collina*. No immatures were collected, but one of the two known specimens, as well as the majority of adult specimens of the sister species, *A. rosiegeorgeorum* **sp. nov.**, were collected from this plant.

Note. Antenna incomplete in specimen at hand, but Tuthill (1942) describes antenna as long, and almost 3 times head width, which would make the antenna considerably longer than in *A. rosiegeorgeorum*, which is only ~1.5 times head width. However, the relative length of antennal segment 3 (which is present) suggests that the difference in antennal length is likely not that great between the two species. The male forewing in Fig. 3D has an aberrant vein off cell cu_1 which has partly distorted the shape of cell cu_1, and possibly ratios CUR and HM:HCU reported here. Mainly for this reason, ratios were also derived from the forewing illustration in Tuthill (1942).

Comment. This species is known from only two male specimens, one collected in 1934 (Tuthill 1942) and the other in 2004 (reported here); the female and immatures remain unrecorded.

Systematics. This species was included in the mitogenome analysis of Percy *et al*. (2018) (as "DP1.idba.219_circ_Triozidae_Anomocephala_unica"). See systematics section under *Anomocephala*, *A. rosiegeorgeorum* and Discussion.

Genetic resources. Genbank: KY293698 (COI), KY294177 (cytB).

Distribution. Only known from Mt. Perahu on Rapa island, Austral Islands, French Polynesia.

Material examined. 1 male (slide mounted), Mt. Perahu, north ridge, 600 m, ex *Metrosideros*, 17 Dec. 2004, "ECAunica", E. Claridge leg. (DMPC).

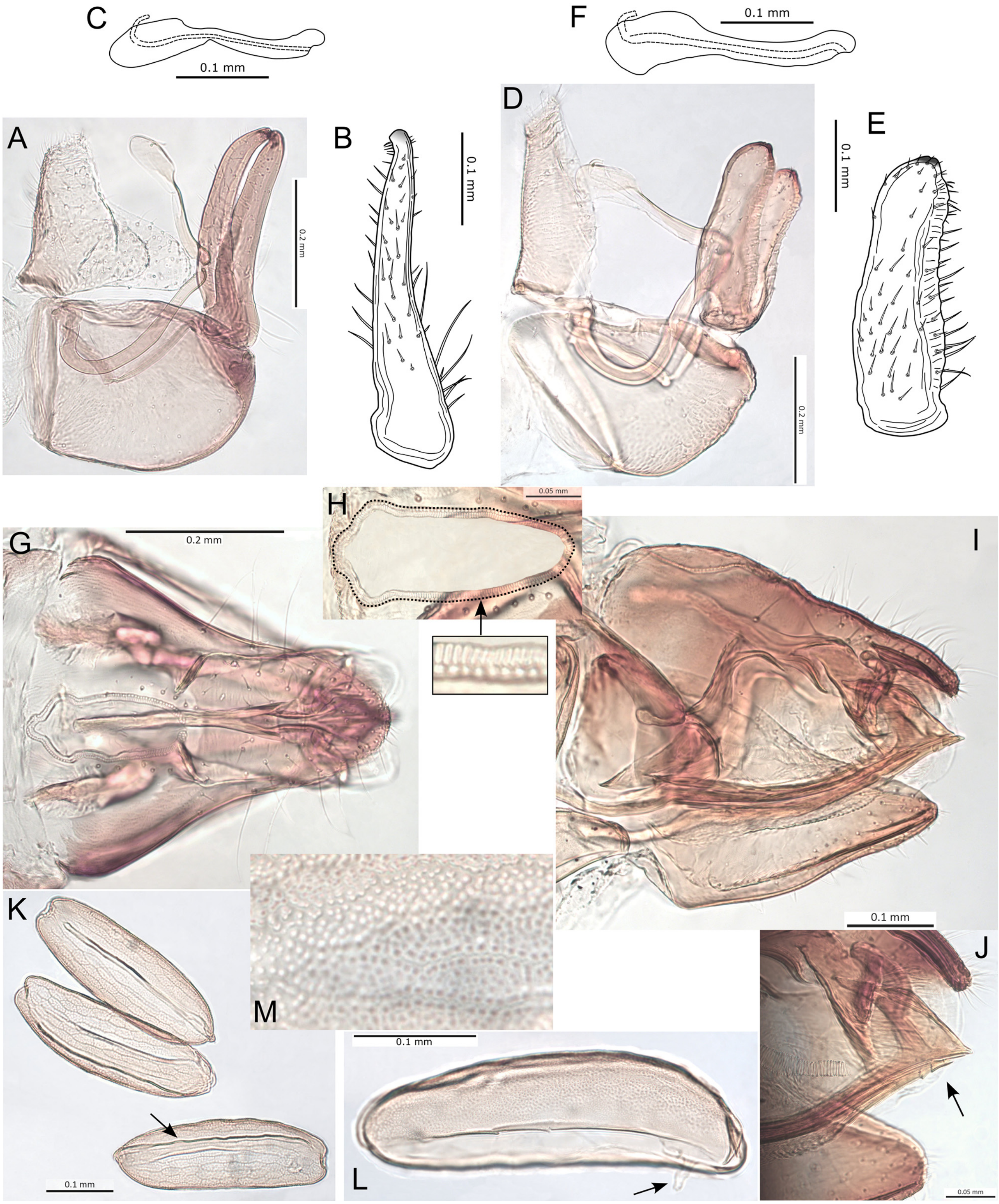

FIGURE 4. A–C, G–M *Anomocephala rosiegeorgeorum* **sp. nov.**, D–F *Anomocephala unica.* A, male terminalia; B, paramere (exterior view); C, distal aedeagus segment; D, male terminalia; E, paramere (exterior view); F, distal aedeagus segment; G, female terminalia (dorsal view); H, anal ring (outlined) with detail of pores (dorsal view); I, female terminalia (lateral view); J, ovipositor, arrow indicating serrations; K, eggs, arrow indicating raised ridge on dorsal surface; L, egg, arrow indicating short pedicel; M, detail of egg surface sculpturing.

Discussion

All three species described here are single island endemics and considered rare and potentially endangered. Conservation of the native habitats on these islands is therefore clearly paramount to the persistence of rare and little studied insect faunas. All French Polynesian *Ctenarytaina* are known from only one or two collection records, with a total of four specimens or less per species (Tuthill 1942, 1956). These have all been found at higher elevation sites, above 1000 m on Tahiti and Hivaoa, and above 500 m on Huahine (Tuthill 1942, 1956). In contrast, *C. distincta* from Mango Island in the Tongan island group, was collected at lower elevation (< 100 m) (Tuthill 1943). Species at higher elevations may be better protected both from human mediated habitat loss and from the impact of natural disasters characteristic of oceanic islands: Mango Island was badly damaged by a tsunami from the 2022 Hunga Tonga-Hunga Haapai eruption, all homes on the island were destroyed and the entire island evacuated. Such catastrophic natural events may impact and even extirpate native fauna such as psyllids, especially if available host plants are adversely impacted and if the insects are already rare with only small population sizes.

Although no immatures have been collected for any of these Polynesian *Ctenarytaina* species to enable confirmation of host plants (Burckhardt *et al*. 2014), the closest relatives occur on hosts in the family Myrtaceae, and in fact the majority of *Ctenarytaina* hosts are from this plant family (Burckhardt *et al*. 2020). The most commonly found member of Myrtaceae in French Polynesia is *Metrosideros collina*, which is a dominant part of the native vegetation. *Metrosideros* also hosts a number of different psyllid groups in other regions of the Pacific (Percy 2017). Three of the four adult specimens of *C. remota* on Hivaoa were collected from *Metrosideros collina* (Tuthill 1956), suggesting that for *C. remota* at least, and potentially also the related *C. lulla*, the host may be *M. collina*. No host data was recorded for *C. elinae*, but the host of the related *C. longicauda* is *Lophostemon* (Myrtaceae) (Burckhardt *et al*. 2020), and therefore it is highly probable that the host of *C. elinae* is also in Myrtaceae, and possibly *Metrosideros*.

The centre of diversity for *Ctenarytaina* is Asia and Australasia (Burckhardt *et al*. 2020) and the closest relative of the Pacific island group that includes *C. distincta*, *C. lulla* and *C. remota*, is a native Australian species, *C. insularis* (Martoni & Armstrong 2019). The closest relative of *C. elinae* is *C. longicauda*, also native to Australia. Therefore, it is reasonable to assume the distribution of *Ctenarytaina* followed a similar west to east distribution route as has been shown for *Metrosideros* in the Pacific (Wright *et al*. 2001; Percy *et al*. 2008). Evidence also points to *Metrosideros* as the host of *Anomocephala*, but again only from adult collections. However, if both *Anomocephala* and the French Polynesian *Ctenarytaina* feed on *Metrosideros*, that would make three genera (*Anomocephala*, *Ctenarytaina*, *Trioza*) in two families (Aphalaridae, Triozidae) using this plant as a host in French Polynesia.

The majority of both plant and animal genera in the Society Islands were found to be polyphyletic suggesting multiple colonizations (Hembry & Balukjian 2016). The pattern of two species groups proposed here for *Ctenarytaina* would fit with this theme. *Anomocephala*, in contrast, does not seem to have any close relatives in French Polynesia or elsewhere in the Pacific. It is not close to other triozid species feeding on *Metrosideros collina* in French Polynesia, e.g., *Trioza zimmermani* Tuthill, 1942 also from the Austral islands (Percy 2017, Percy *et al*. 2018). Rapa island (also known as Rapa Iti to distinguish it from Rapa Nui or Easter Island) is one of the most remote islands in the southern Austral archipelago of French Polynesia, which adds to the mystery surrounding the origins of *Anomocephala.* Although clearly placed within Group D in the mitogenome analysis of Percy *et al*. (2018), *Anomocephala* is not strongly supported grouping with any of the other genera sampled in this group. The two *Anomocephala* species are strongly supported as sister taxa (Percy *et al*. 2018), implying divergence in situ on Rapa, and there may have been sympatric speciation on the same host plant driven by similar processes driving divergence in Hawaiian *Pariaconus* (Percy 2017). *Anomocephala rosiegeorgeorum* and *A. unica* have a moderate degree of genetic divergence (9.7% COI divergence), which, if we apply a mitochondrial divergence rate of 2.5–3% per million years (Papadopoulou *et al*. 2010; Percy 2017) suggests divergence on Rapa within the last 4 million years. This age range fits within the geological age of Rapa (~ 5 million years), and Rapa in particular, is an island that supports unusual diversification processes that are evident in several groups (Gillespie *et al*. 2008).

This special journal issue honours the impressive and invaluable contribution by Daniel Burckhardt to the taxonomy of psyllids and psyllid research more broadly. The new species names proposed here recognize those entomologists working in the Pacific that collected this material.

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