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A new species of large *Hemiandrus* ground wētā (Orthoptera: Anostostomatidae) from North Island, New Zealand

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Abstract

A new species of *Hemiandrus* ground wētā is described from North Island, New Zealand. *Hemiandrus jacinda* **sp. nov.** is larger and more brightly coloured than other species in the region, but appears to be scarce and restricted to remnant native forest habitat.

Key words: Anostostomatidae, *Hemiandrus*, ground wētā, new species, North Island, New Zealand, Jacinda Ardern

Introduction

Despite being New Zealand's most recognised endemic insects, the taxonomy of the flightless orthopteroids known as wētā is far from complete. The family Anostostomatidae Saussure, 1859 (Johns 1997) comprises in New Zealand the tree wētā (*Hemideina*), giant wētā (*Deinacrida*), tusked wētā (*Anisoura*, *Motuweta*) and the ground wētā *Hemiandrus* Ander 1938. *Hemiandrus* is the most speciose of the four groups (Trewick *et al.* 2016) with seventeen valid named species: *Hemiandrus bilobatus* Ander 1938; *H. brucei* Taylor-Smith, Trewick & Morgan-Richards 2016; *H. celaeno* Trewick, Taylor-Smith & Morgan-Richards 2020; *H. electra* Taylor-Smith, Morgan-Richards & Trewick 2013; *H. fiordensis* (Salmon, 1950); *H. focalis* (Hutton, 1896); *H. luna* Taylor-Smith, Trewick & Morgan-Richards 2016; *H. maculifrons* (Walker, 1869) (see Taylor-Smith *et al.* 2013); *H. maia* Taylor-Smith, Morgan-Richards & Trewick 2013; *H. merope* Trewick, Taylor-Smith & Morgan-Richards 2020; *H. nitaweta* Jewell 2007; *H. nox* Taylor-Smith, Trewick & Morgan-Richards 2016; *H. pallitarsis* (Walker, 1871) (See Trewick *et al.* 2020); *H. sterope* Trewick, Taylor-Smith & Morgan-Richards 2020; *H. subantarcticus* (Salmon, 1950); *H. superba* Jewell 2007; *H. taygete* Trewick, Taylor-Smith & Morgan-Richards 2020. *Hemiandrus anomalus* Salmon, 1950 is junior synonym of *H. bilobatus* judging by characters of the male holotype, the female type is a juvenile and not diagnosable. *H. lanceolatus* (Walker, 1869) is represented by a juvenile specimen (Johns 2001) and is best considered nomen nudum. *H. similis* Ander, 1938 is a synonym of *H. pallitarsis* (Trewick *et al.* 2020).

Unlike other New Zealand Anostostomatidae, *Hemiandrus* inhabit capped soil burrows during the day (Johns 2001; Trewick & Morgan-Richards 2019). Some species are known to use abdominal drumming communication (Chappell *et al*. 2012) but their lack of tibial tympana (ears) compared to most other anostostomatids (Field 1993) correlates with a lack of audible stridulation, further adding to their crypsis. Several taxa have yet to be formally recognised and this hampers the study of their natural history and vulnerability. In most instances these are wētā inhabiting more remote habitats, but one of the most striking species in this genus that has so far eluded description (Figure 1) lives in the upper North Island of New Zealand where opportunities for it to have been encountered are relatively high. This wētā was for some time known only from Mount Moehau on the Coromandel Peninsula and was informally referred to as the Moehau wētā (Johns 2001). Recent contributions to the citizen science portal iNaturalist.nz have made it clear that the range of these animals is wider than previously recognised.

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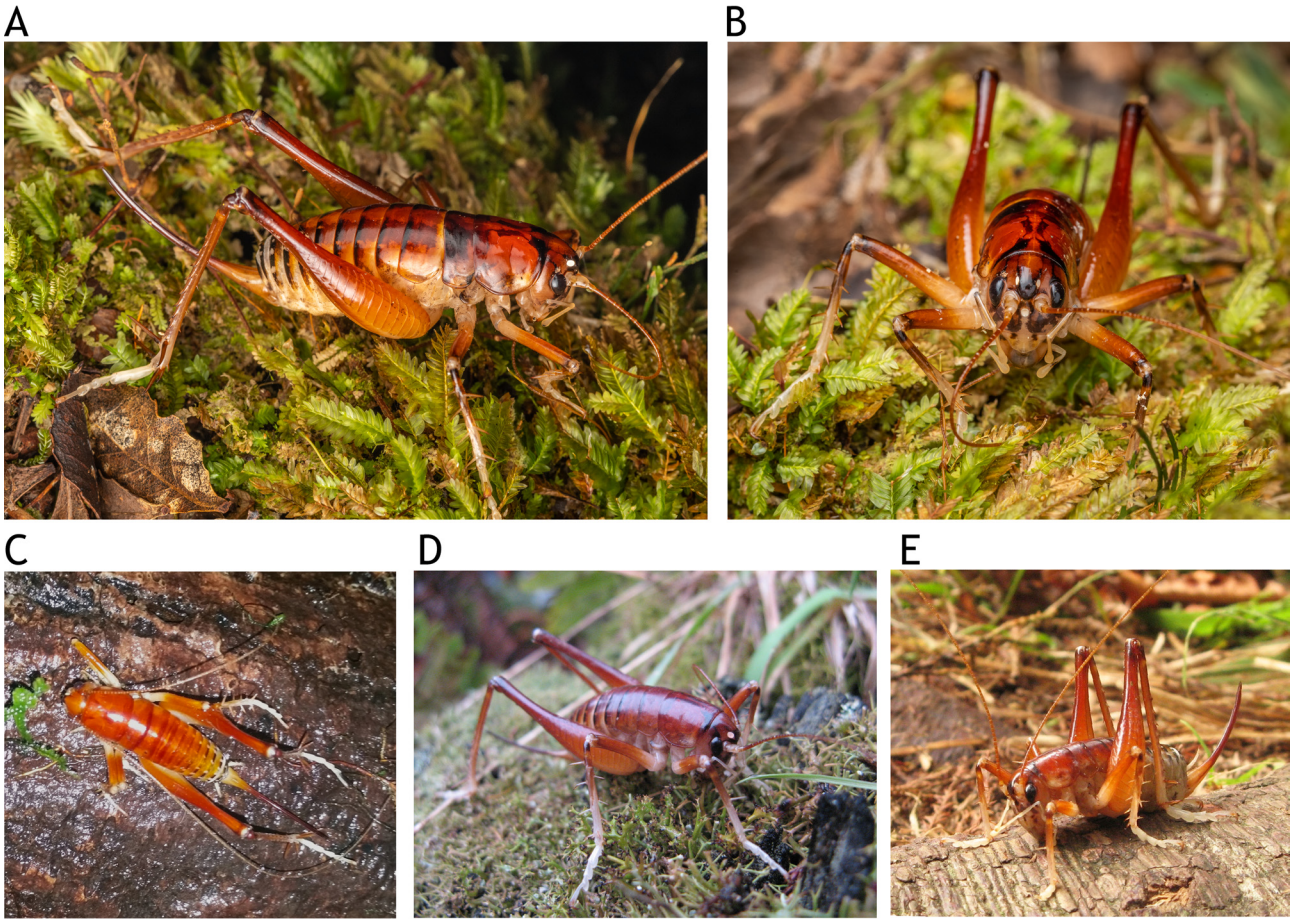

FIGURE 1. Living *Hemiandrus jacinda* **sp. nov.** photographed in North Island, New Zealand. A & B) Adult female (Holotype NMNZ AI.049808) near Crosbies Hut, Coromandel Range, 2020 (© Danilo Hegg). C) Female (iNaturalist 8131115) from Whareorino Range 2017 (© Tim Quinnell). D) Female (iNaturalist 7771459) near Wairere Falls, Kaimai Range 2006. E) Female (iNaturalist7771552) near Ngamarama/Te Tuhi track, Kaimai Range 2009 (© Peter Sweetapple).

Methods

Material was collected by hand and preserved in 75–95% ethanol in the Phoenix insect collection at Massey University, Palmerston North (MPN). Specimens were examined and anatomical features photographed and measured using an Olympus SZX7 Zoom Stereomicroscope with an attached SC100 digital camera and Cellsens software. Additional measurements were obtained using digital callipers accurate to 0.01mm. Anatomical features were examined as previously described (Taylor *et al*. 2013). Mitochondrial DNA cytochrome oxidase subunit I sequences were generated using standard methods (Trewick & Morgan-Richards 2005) with PCR primers C1-J–2195 (Simon *et al.* 1994) and mtd12_wetaR (Bulgarella *et al*. 2014). DNA was extracted from muscle tissue taken from hind femura. Previously published sequences (Pratt *et al*. 2008; Chappell *et al*. 2012) were obtained from Genbank for comparison. DNA sequence checks, data alignment and analysis used Geneious v10.2 (Kearse *et al*. 2012). Phylogenetic analysis was implemented in Geneious v10.2 using, Bayesian inference with chain length of 5 million and burnin of 100,000 generations and GTR +I+G model of DNA evolution. Type material is in the Museum of New Zealand Te Papa Tongarewa (NMNZ).

New species

Class: Insecta:

Order: Orthoptera:

Suborder: Ensifera:

Superfamily: Stenopelmatoidea Burmeister, 1838

Family: Anostostomatidae Saussure, 1859

Genus: *Hemiandrus* Ander, 1938.

***Hemiandrus jacinda* sp. nov.**

Diagnosis. A comparatively large, long-limbed, glossy and predominantly orange-red *Hemiandrus*. The maxillary palp with 3rd segment naked and 4th segment pilose on distal section. Body with posterior edges of segments darker than anterior, and with longitudinal bands. Fore tibiae with single articulated superior prolateral linear spine. Mid tibiae 1½ times length of pronotum. Hind femura with one prolateral apical spine and one retrolateral alpical spine. Adult female with weakly curved ovipositor ¾ body length and a pair of slerotised cusps on the posterior margin of sternite S6. Male with protruding section of the subgenital plate forming two fingers.

Etymology. This long-limbed, red species is named for New Zealand Prime Minister (2017–) Jacinda Kate Laurell Ardern.

Description. *Dimensions*. Adult female (NMNZ AI049808, formerly GW1328) total length (from anterior of head to posterior tip of ovipositor) about 50mm; antennna ~75mm; pBL (anterior of head to posterior of abdomen) 28.9mm; pronotum length 7.7mm; ovipositor 21.51; fore femur length 8.87mm; mid femur length 12.49mm; hind femur length 25.3mm and depth 6.43mm; fore tibia length 10.29mm; mid tibia length 11.58mm; hind tibia length 24mm; hind tarsus 11.45mm. Adult male (NMNZ AI049810, formerly GW208) pBL 24.3mm; PL 6.11mm; fore femur length 8.2mm; mid femur length 9.3mm; hind femur length 22mm and depth 5.26mm; hind tibia length 20.24; hind tarsus length 9.84mm.

Head. Glabrous and glossy, prominent fastigium black with large white lateral ocelli; frons pale with dark patches and large white median ocellus; vertex and occiput with black to orange-brown pattern; gena cream with few dark patches; clypeus cream; labrum mostly cream to pale orange at the periphery which bears stout setae; mandibles cream to pale orange with dark proximal patch and darkening to near black sclerotised tips and ventral surfaces cream; palps cream. Antennae at least twice as long as body, pale orange-brown with pale scape and pedestal which along with first third is glabrous, distal 60% pilose. Eyes black. 5th segment of maxillary palp pilose, 4th segment 55% pilose, remainder of 4th segment and segments 1–3 with sparse pale setae (Figure 2).

Thorax. Pronotum glabrous and microsculptured, broader than long at the posterior margin, predominantly orange-scarlet in colour with near black pigmentation on anterior margins and orange-brown band along posterior margin, a small cream patch on either side at the anterior-ventral corner, a pair of red-brown markings positioned either side of the midline in the centre of the pronotum align with similar pigmentation on meso- and metanotum and tergites to form two longitudinal stripes. Meso- and metanotum similar in colouring to abdominal tergites. Sternum cream-white with dark tips to four sternal spines.

Legs. Coxae and trochanters white-cream. Femorae yellow-cream at base grading to orange-red and darkest at distal margins, glossy, glabrous but with sparse short setae. Fore and mid femora lack spines. Hind femora without spines except at distal apex where there is a dark, stout, sharp, spine on both sides. The prolateral spine is on the inferior surface of the joint while the retrolateral one is on the distal margin (Figure 3). All tibiae orange-red to rusty brown on proximal half, shading to cream on distal portion, except hind tibiae that are pigmented except for distal 15–20% (Figure 4). Tarsi cream or orange tinted, glabrous with sparse orange setae most dense at apex of segment 1 near brown claw.

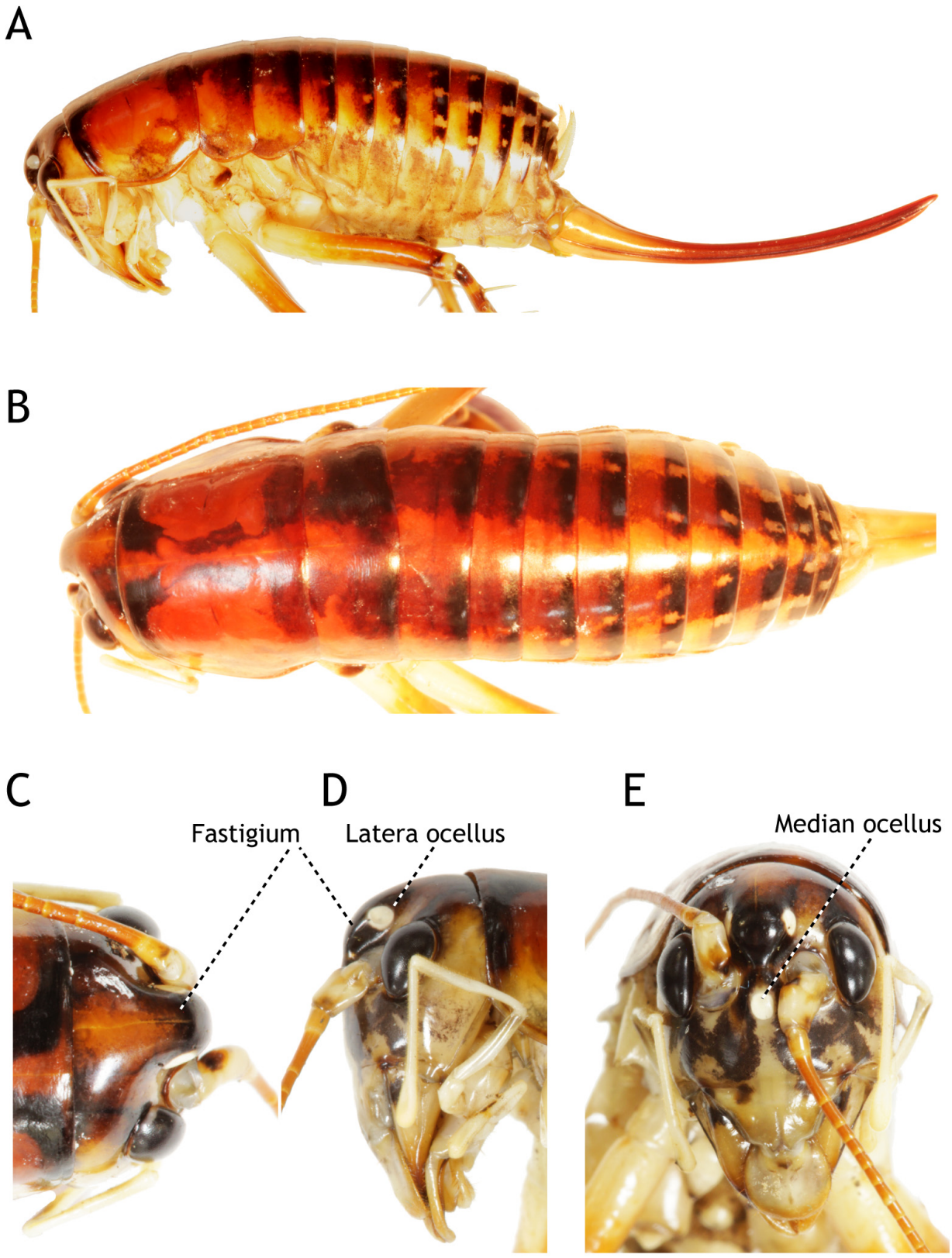

FIGURE 2. *Hemiandrus jacinda* **sp. nov.**, (Holotype NMNZ AI.049808). A) Lateral and B) dorsal view of body. C) Dorsal, D) lateral and E) anterior views of head.

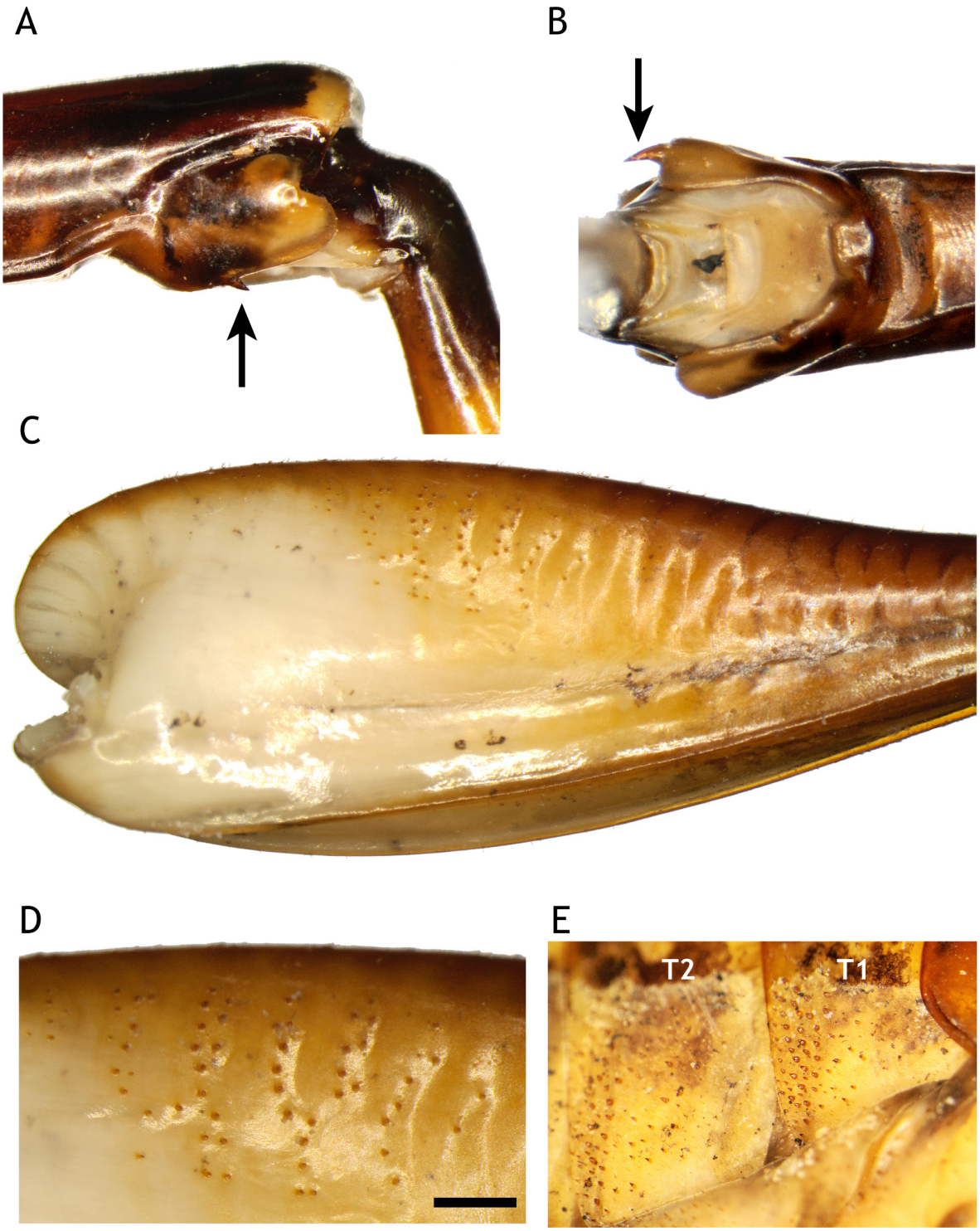

FIGURE 3. *Hemiandrus jacinda* **sp. nov.**, hind femur (Holotype NMNZ AI.049808). A) Lateral view of prolataeral apical spine. B) Ventral view of retrolateral apical spine. C) Retrolateral surface of anterior section of femur showing stridulatory pegs. D) Arrangement of stridulatory pegs on retrolateral surface of femur and, E) corresponding section of abdomen showing pegs on tergites one and two.

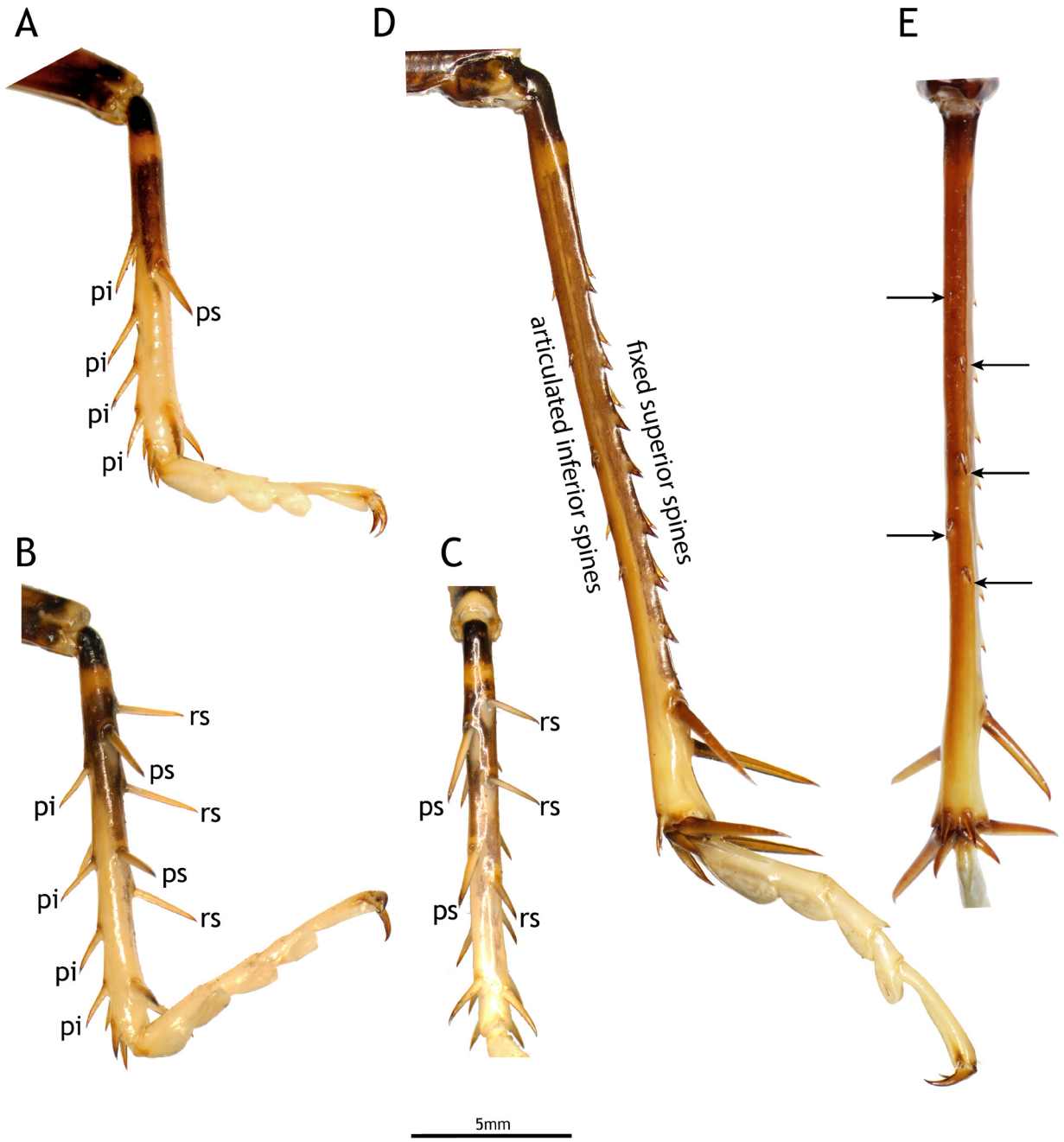

FIGURE 4. *Hemiandrus jacinda* **sp. nov.**, tibiae and tarsi (Holotype NMNZ AI.049808). A) Fore tibia and tarsus. B) Mid tibia and tarsus. C) Mid tibia superior spines. D) Hind tibia and tarsus. E) Hind tibia inferior spines (arrows). Fore and mid tibial linear spines: prolateral inferior (pi), prolateral superior (ps), retrolateral superior (rs). Arrows indicate articulated linear spines on inferior surface of hind tibia.

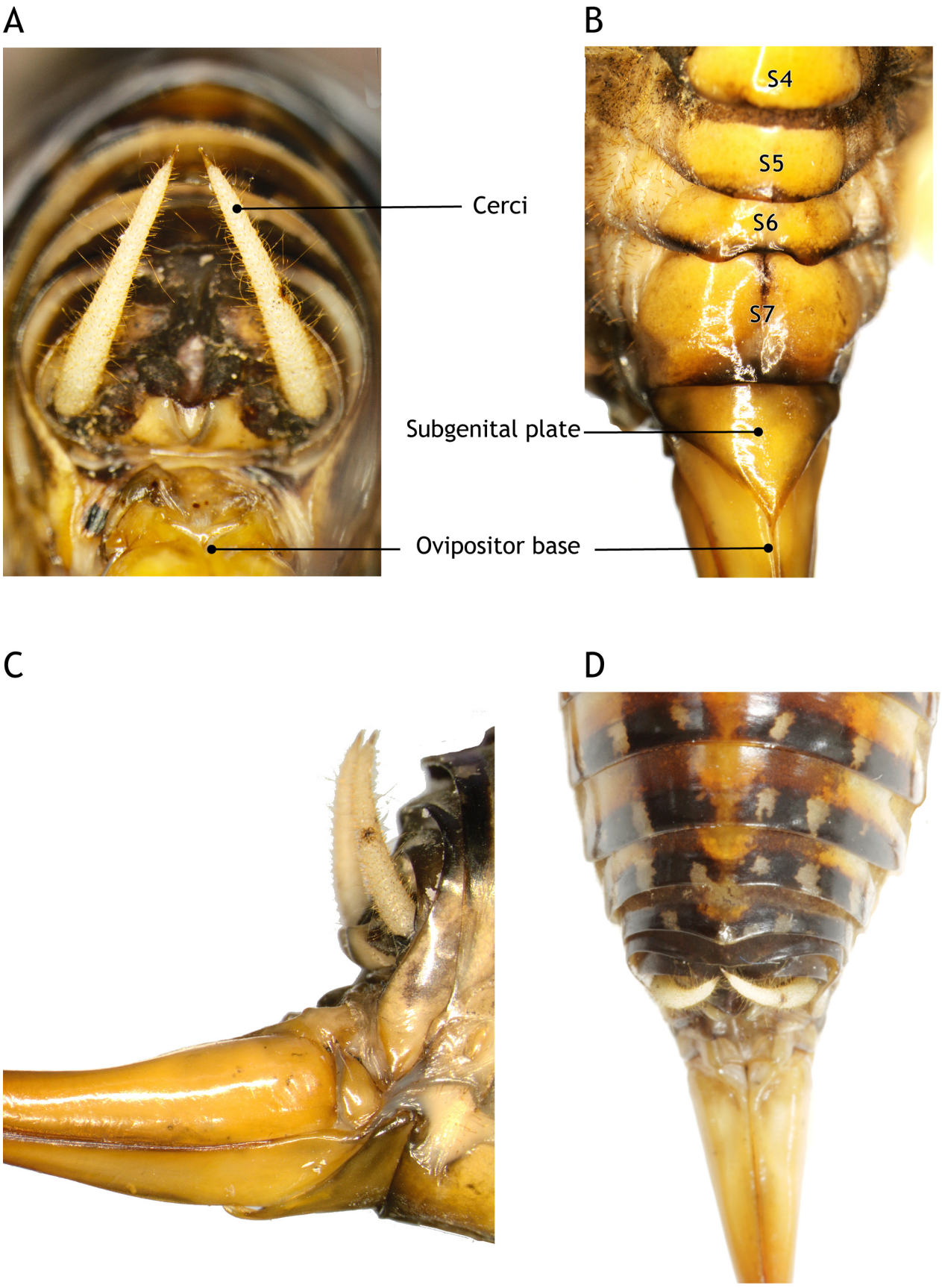

FIGURE 5. *Hemiandrus jacinda* **sp. nov.**, female terminalia (Holotype NMNZ AI.049808). A) posterior, B) ventral, C) lateral and D) dorsal views of terminalia.

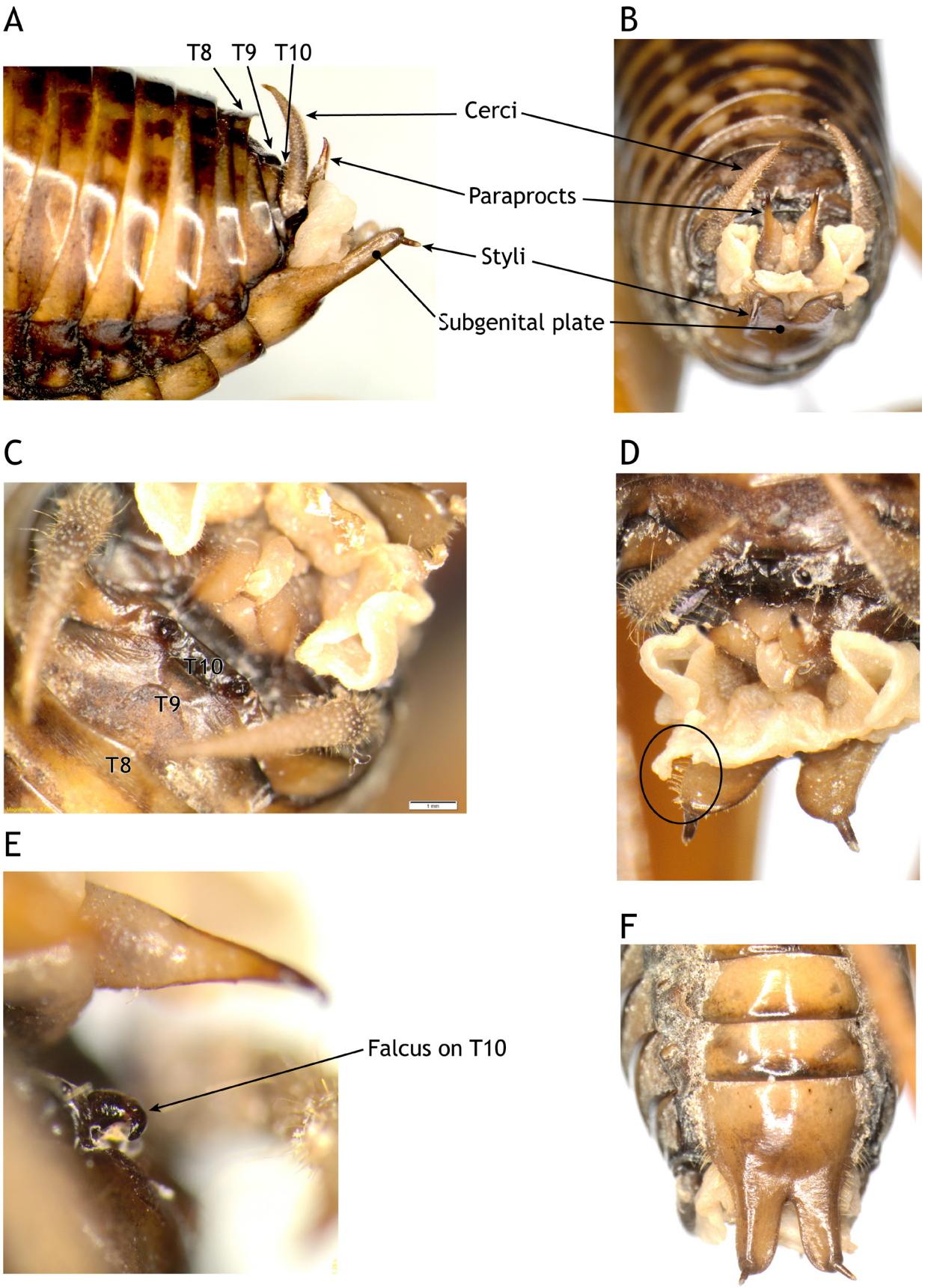

FIGURE 6. *Hemiandrus jacinda* **sp. nov.**, male terminalia (Paratype NMNZ AI.049810). A) Lateral and B) Posterior views. C) Dorsal view of tergites T8–T10. D) Oblique dorsal view of subgenital plate with margin of hairs. E) Falcus on T10. F) Ventral view of glossy sternites and subgenital plate. Not to scale.

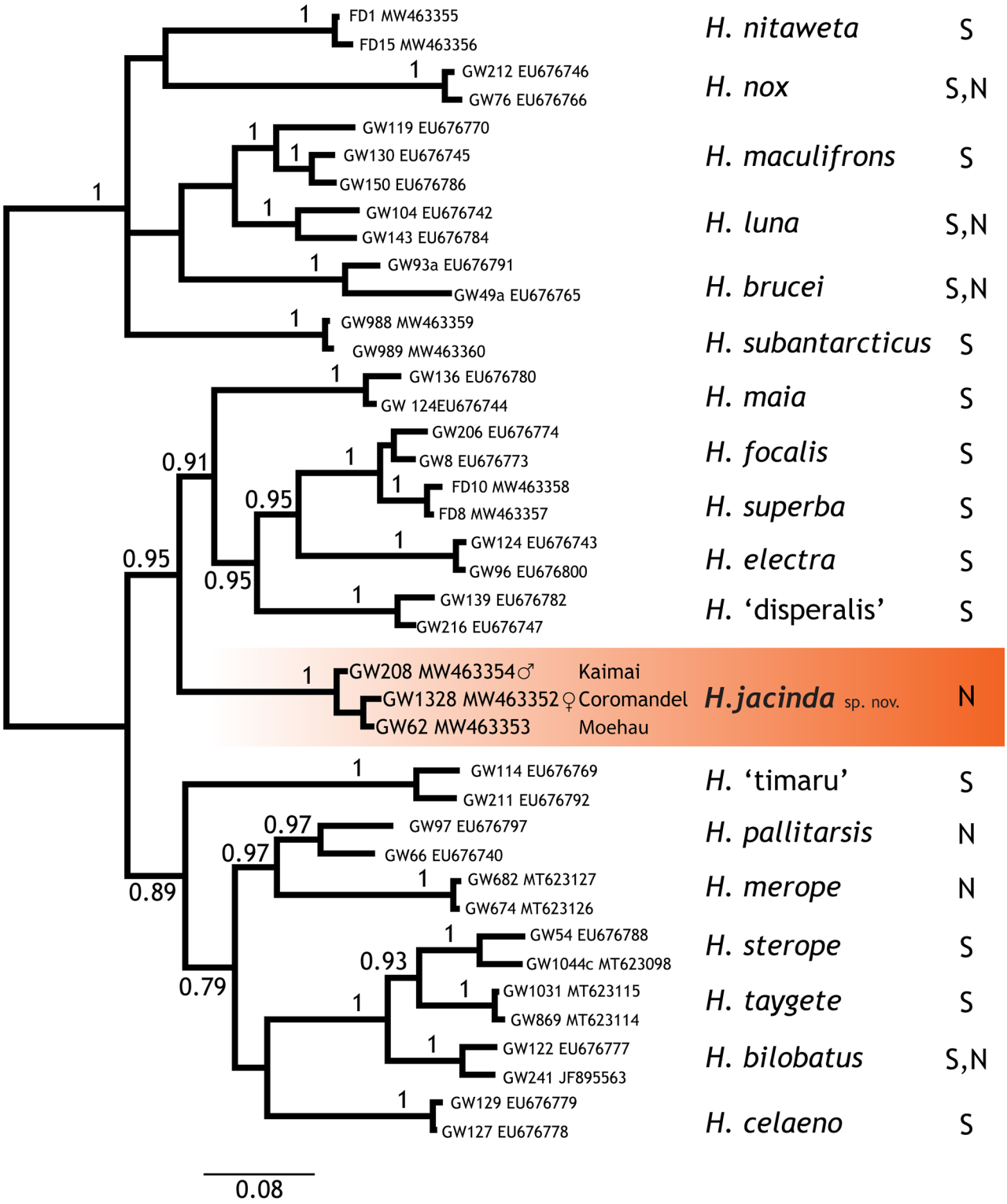

FIGURE 7. Phylogenetic relationships among New Zealand *Hemiandrus* taxa using alignment of 797bp DNA sequences from the mitochondrial gene cytochrome oxidase subunit I (COI). Bayesian analysis used a GTR invariant/gamma model with four rate categories and chain length of five million generations. Numbers at nodes indicate Bayesian support criteria. Geographic ranges of each taxon are indicated as north of Cook Strait (N), south of Cook Strait (S), or both. Note that Genbank accession EU676743 and EU676747 are incorrectly recorded as *Hemiandrus* 'disperalis' (Pratt *et al*. 2008), whereas these sequences came from specimens identified as *H. electra* (Taylor-Smith *et al*. 2013).

Fore tibiae lack tympana (Figure 4). Fore and mid tibiae armed with long, erect, pigmented articulated spines arranged unevenly. Fore tibiae: a single prolateral linear spine on the superior surface plus a pair of apical spines; four prolateral and four retrolateral linear spines on the inferior surface plus an apical pair. Mid tibiae: two prolateral and three retrolateral linear spines on the superior surface plus a pair of apical spines that are set back from the apex (the combination might be interpreted as three prolateral and four retrolateral articulated spines without apicals); inferior surface has four prolateral and four retrolateral spines plus a pair of apicals. Hind tibiae: five or six unpaired small articulated linear spines along the inferior surface; seven or eight small fixed spines on prolateral and retrolateral angles of the superior surface; a pair of long, sturdy, dark-tipped, articulated apical spines displaced a little from the distal end of the superior surface with the retrolateral spine being more distal than the prolateral one; a pair of small subapical spines at the base of the inferior surface; a pair of larger inferior apical spines; a pair of long, stout superior apical spines. Tarsi: cream, four-segmented and with few setae.

Abdomen. Glabrous and microsculptured above. Tergites predominantly orange to scarlet in colour with dark and pale markings; dark brown to black on posterior margins and bearing a number of non-melanised spots. Anterior portion of tergites non-melanised, pale orange but with darker red-brown patch on either side of midline. Lateral surfaces of tergites 1–3 bear patches of posterior-pointing tubercles that probably engage with similar pegs on the retrolateral surface of hind femur as in stridulation (Figure 3). Cerci cream. Sternites cream to yellow.

Female. Ovipositor long (about 2/3rds length of the body) and gently curved, yellow at base, becoming deep rusty-brown, (Figure 5). Cerci elongate, cylindrical, bearing dense short hairs and sparse very long hairs, except for tip which is naked with one or two hairs at the tip. Posterior margins of tergites 1–10 simple; posterior margins of sternites 1–5 and 7 simple; sternite S6 with broad weak medial depression and pair of sclerotised cusps; subgenital plate triangular and tapering to a sharp point.

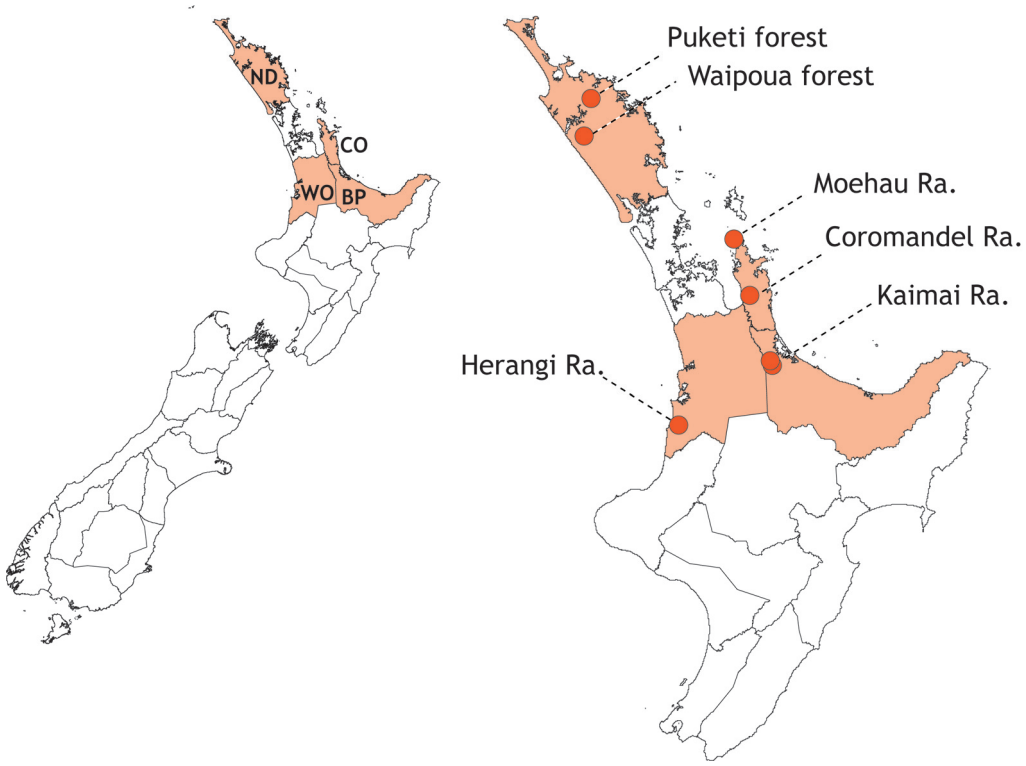

FIGURE 8. Known distribution of *Hemiandrus jacinda* **sp. nov.** in North Island, New Zealand. Orange spots indicate sampled localities with relevant entomological regions shaded (Crosby *et al.* 1976).

Male. Terminalia comprise a pair of upright dark-tipped paraprocts, a pair of long tapering cerci clothed in short and long hairs and subgenital plate that is deeply incised forming two fingers with short, cylindrical, naked styli. The subgenital plate has longish golden hairs on the dorso-lateral margin but is glabrous beneath. Sternites glossy. Posterior margins of tergites 1–8 simple; the 9th tergite (T9) forms a pair of blunt lobes on posterior margin; T10 has a pair of short, dark anterior-facing hooked falci aligned with T9 lobes (Figure 6).

Type data. HOLOTYPE: adult female, near Crosbies Hut, Te Puru stream headwaters, Thames, CL, October 2020, Danilo Hegg (NMNZ AI.049808, previously MPN GW1328) inaturalist.nz/observations/63866403.

PARATYPE: adult male, near Pomarangai track, Maugamangero, Herangi Ranges, WO, March 2005, Peter Lei (NMNZ AI.049810, previously MPN GW208).

Material examined. Near Crosbies Hut, Te Puru stream headwaters, Thames, CL, 30/x/2020, GW1328 ♀, inaturalist.nz/observations/63866403. Mangahorehore ridge, Puketi Forest, 26/xi/1992, ND, GW903♂. Near Pomarangai track, Maugamangero, Herangi Ranges, WO, 1/iii/2005, GW208 ♂.

Other records. Near Te Tuhi track, Waiteariki stream headwaters, Kaimai Range, BP, 14/ii/2009, ♀, inaturalist.nz/observations/7771552. Near North-South track, Wairere stream headwaters, Kaimai Range, BP, 17/vi/2006, ♀, inaturalist.nz/observations/7771459. Near Mount Whareorina, Herangi Ranges, WO, 25/ix/2017, ♀, inaturalist.nz/observations/8131115. Waipoua Forest, Wairau Summit (probably Parataiko Range), ND, 7–14/xii/1995, ♂, det. B.L.Taylor-Smith, AMNZ5182. Kinleith Forest, Cochrane Road, BP, 10/v/2007, ♀, det. B.L.Taylor-Smith, AMN5222. Waipoua Forest, Yakas Track, ND, 2–16/ix/1998, ♂, NZAC03015722.

Phylogenetic relationship. Analysis of an alignment of 40 mtDNA COI sequences representing 16 described and 2 putative New Zealand *Hemiandrus* taxa. The phylogenetic tree resolved *H. jacinda* **sp. nov.** as a genetically distinct cluster of haplotypes representing three individuals from Moehau, Coromandel and Kaimai ranges (Figure 7). They form a novel lineage that is the only North Island representative of this *Hemiandrus* clade. Analysis of genetic distances using the Kimura 2 parameter model of DNA evolution, estimated using the Species Delimination plugin of Geneious v10.2 revealed an average of 2.3% K2P among *H. jacinda* **sp. nov.** sequences, and a mean divergence of 14.0% from the closest relative in the analysis (*Hemindrus focalis*).

Distribution. Sparse records from native wet forests in Northland, Bay of Plenty, Waikato and Coromandel in the upper North Island, New Zealand (Figure 8).

Comments. *Hemiandrus jacinda* **sp. nov.** is the largest species of this genus in North Island, New Zealand. It is sympatric with *H. pallitarsis* (Trewick *et al*. 2020) and *H. nox* (Taylor-Smith *et al*. 2016). *Hemiandrus brucei* and *H. luna* may also exist in the same range. *Hemiandrus pallitarsis* is a member of the short-ovipositor clade of small to medium sized (partial body length 8–12mm) ground wētā (Chappell *et al*. 2012; Trewick *et al*. 2020). *Hemiandrus nox*, *H. brucei* and *H. luna* are small (partial body length < 10mm), dark, long-ovipositor species belonging to the *H. maculifrons* complex (Taylor-Smith *et al*. 2016). In addition to size and colour adult *Hemiandrus jacinda* **sp. nov.** are readily distinguished from other co-occurring ground wētā by quantitative traits including: more articulated spines on inferior surface of hind tibiae; two apical spines on hind femura. Females have prominent sclerotized cusps on posterior margin of sternite S6. Males have a distinctive, deeply cleft subgenital plate (Figure 9); T9 has two blunt lobes c.f. a single medial lobe in *H. pallitarsis* and a pair of pointed lobes in *H. nox*; T10 falci aligned with T9 lobes c.f. T10 falci close together in *H. pallitarsis* and hidden beneath T9 in *H. nox*.

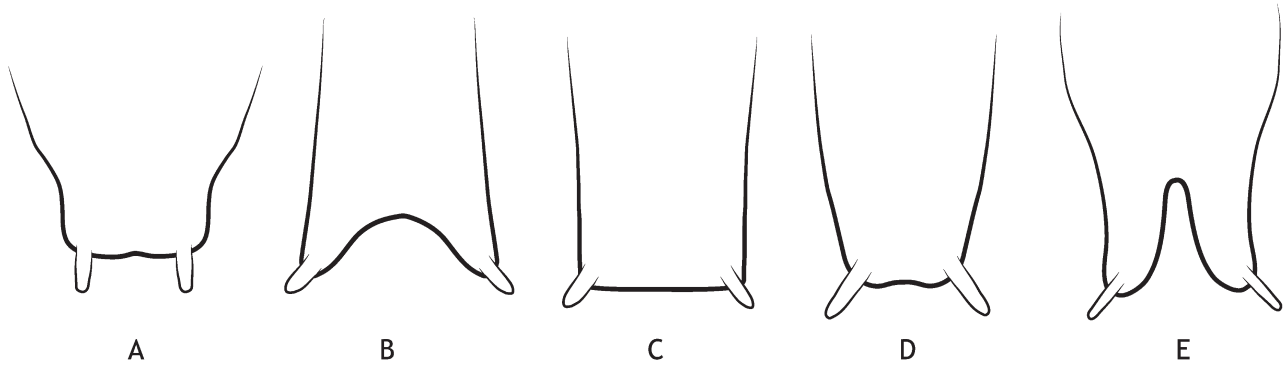

FIGURE 9. *Hemiandrus* male subgenital plates. Ventral subgenital plate outlines of ground wētā species that occur in upper North Island, New Zealand. A) *H. pallitarsis*. B) *H. brucei*. C) *H. luna*. D) *H. nox*. E) *H. jacinda* **sp. nov.** Not to scale.

Available photographs suggest that the degree of melanisation varies in *H. jacinda* **sp. nov.** (Figure 1). This could be ontogenetic in which case juveniles may by paler in colour and dominated by orange/red (see Figure 1E).

Hemiandrus jacinda **sp. nov.** probably represents the same entity previously referred to by the tag-name *H.* 'elegans' (Johns 2001; Trewick *et al*. 2016) and referred to as *Hemiandrus* 'Moehau' (Sherley 1998; Trewick *et al*. 2012). The Department of Conservation status report (Trewick *et al*. 2016) records this taxon as at risk, naturally uncommon and sparse. The scarcity of *H. jacinda* **sp. nov.** despite a relatively wide geographic range and close proximity to region of highest human population which can influence biological discovery (Taylor-Smith *et al*. 2019), is a cause for concern. That such a large and striking animal can elude observation suggests that either its behaviour is highly effective at minimising detection or it now exists at low density.

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