



Redescription of *Notholimmophila* Alexander and *Acantholimmophila* Alexander, poorly known New Zealand endemics (Diptera: Tipulomorpha: Limoniidae)

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Abstract

Notholimmophila exclusiva (Alexander, 1922) remains the only known species of the genus *Notholimmophila* Alexander, 1924. *Acantholimmophila* Alexander, 1924 includes two species, *A. maorica* (Alexander, 1922) and *A. bispina* (Alexander, 1922). These taxa, known exclusively from New Zealand, cannot be properly identified on the basis of available taxonomic information, and this situation prevents the advancement of any further studies. In this paper, *Notholimmophila* and *Acantholimmophila* are revised and the included species are redescribed and illustrated in detail.

Key words: *Acantholimmophila*, Limoniidae, morphology, New Zealand, *Notholimmophila*, taxonomy

Introduction

Alexander (1922a, 1922b) described three New Zealand taxa under the genus *Limnophila*: *L. exclusiva*, *L. maorica* and *L. maorica bispina*. Alexander (1924) then erected the monotypic genus *Notholimmophila* for *L. exclusiva*, and for the two other taxa he erected the genus *Acantholimmophila*. The justification for this seems to rest in Alexander's (1924) recognition of *Limnophila* as a non-natural assemblage of taxa:

“The genus Limnophila s.l. includes a considerable number of species found in all regions of the world. The structure of the adult flies seems to afford relatively few characters upon which to subdivide this heterogeneous aggregation. The genotype, L. pictipennis (Meigen), was designated by Westwood in 1840 and so restricts the name to the small Palaearctic group that was formerly called Poecilostola, Schiner, and strictly congeneric groups. Following this strict usage of the name, it seems probable that few, or possibly none, of the New Zealand species so far described as species of Limnophila really belong here.” (Alexander, 1924: 366)

The paraphyly of the genus *Limnophila* was demonstrated in the study of Ribeiro (2008). Both *Acantholimmophila* and *Notholimmophila* were included in the analysis. *Notholimmophila* was placed, at least tentatively, in a clade together with other genera with restricted distributions in southern temperate areas of the globe, such as *Bergrothomyia* (Australia, Tasmania), *Mesolimmophila* and *Chilelimnophila* (Southern South America). *Acantholimmophila* was placed as the sister group of the widely distributed genus *Epiphragma*, a relationship suggested by Alexander (1924). As far as known, *Notholimmophila* and *Acantholimmophila* occur exclusively in New Zealand, in both North and South islands. Their very small diversity, restricted distributions, and putative phylogenetic positions as related to more diverse groups suggest they may constitute relicts of ancient, previously more diverse clades.

No morphological characters of either *Notholimmophila* or *Acantholimmophila* were ever illustrated until the depiction of their male genitalia by Ribeiro (2008: figs. 85, 159; 96–97, 170–171). However, without a firsthand comparison with the types or other properly identified specimens, which are few, the identification of these taxa solely on the basis of available taxonomic information would be very difficult. The redescriptions made here are aimed to provide better grounds for the recognition of both *Notholimmophila* and *Acantholimmophila*, as well as useful information for future comparative studies. So far, the immature stages of these genera are unknown, as well as any aspect of the biology of the included species.

Material and methods

The studied specimens belong to the Alexander Collection of Crane Flies housed at National Museum of Natural History, Smithsonian Institution, Washington DC, U.S.A. (USNM). Descriptive terminology follows McAlpine (1981) for most characters and Ribeiro (2006) for the structures of the male gonostylus. The adopted terminology for the wing veins is shown in Figures 12 and 22. Photographs were taken with a Nikon DS-Ri1 digital camera attached to Nikon SMZ1000 (stereoscopic) and 80i (compound) microscopes. Deep focus images were stacked with Combine ZP software. Measures were taken with Carl Zeiss AxioVision (Release 4.8) software, calibrated for both types of microscopes. Dissections of the male terminalia were cleared in warmed KOH and mounted for study in a non-permanent slide with glycerol. After study and illustration the dissected structures were transferred to a microvial with glycerol and pinned with its corresponding specimen. Illustrations were made with a drawing tube attached to the microscopes. Abbreviations used in the figures are as follows:

aed, aedeagus; *aed apod*, aedeagus apodeme; *anepst cleft*, anepisternal cleft; *aprn*, antepronotum; *cerc*, cercus; *cerv scl*, cervical sclerite; *cgonst*, clasper of gonostylus; *comp eye*, compound eye; *cx*, coxa; *epm*, episternum; *goncx*, gonocoxite; *hyp vlv*, hypogynial valve; *interb*, interbase; *lbl*, labella; *lgonst*, lobe of gonostylus; *ltg*, laterotergite; *mtepm*, metaepimeron; *mtepst*, metaepisternum; *mtg*, mediotergite; *ped*, pedicel; *plp*, palpus; *pltr2*, mesothoracic pleurotrochantin; *pltr3*, metathoracic pleurotrochantin; *pm*, paramere; *pprn*, postpronotum; *s8*, sternite 8; *s9*, sternite 9; *scp*, scape; *sct*, scutum; *sctl*, scutellum; *t8*, tergite 8; *t9*, tergite 9.

Details on the examined specimens are as provided under the description of each taxon, where label information is in italics, information of different labels is separated by a vertical line, and locality coordinates and other added information is within square brackets.

Genus *Notholimnophila* Alexander, 1924

Notholimnophila Alexander, 1924: 369. Type species: *Limnophila exclusa* Alexander, 1922a.

Diagnosis. According to the analysis of Ribeiro (2008), the genus *Notholimnophila* can be recognized by the following combination of autapomorphic features: anterodorsal region of the head slightly protuberant; apex of vein Sc situated just before the level of first bifurcation of Rs; vein Rs originating between the levels of the tips of A₁ and A₂; petiole of cell R₂ between ca. half and the total length of R₃; vein M₁₊₂ non-bifurcated (cell m1 absent); posterior margin of ninth tergite forming extensions longer than wide.

Notholimnophila exclusa (Alexander, 1922)

(Figures 1–16)

Notholimnophila exclusa (Alexander, 1922). Type species: *Limnophila exclusa* Alexander, 1922a: 517–518 (original description); Alexander, 1924: 369 (taxonomy); Ribeiro, 2008: figs. 85, 159 (illustrations of male genitalia); Oosterbroek, 2011 (catalogue citation).

Redescription. Coloration (male and female): Head and appendages brownish grey, little darker than thorax. Thorax brownish, darker dorsally, gradually turning to pale brown-yellowish toward coxae. Scutum with distinct dark brown markings: an anteromedial band plus two posterolateral strips. Wings with a brownish tinge, darker along cell c. Darker brown areas at base of Rs, along the cord, pterostigma and distal parts of wing. Male abdomen including genitalia brownish. Female abdomen brownish. Ovipositor yellowish. Legs pale brown-yellowish, with darker areas at tips of femora and tibiae. Tarsi dark brown.

Dimensions. Head length, ca. 1.0 mm; Head width, ca. 1.0 mm; thorax length, 2.8–2.9 mm; thorax height ca. 2.5 mm; wing length, 10.0–11.3 mm; wing width, 2.2–2.3 mm; gonocoxite length, ca. 0.63 mm; gonocoxite width ca. 0.32 mm.

Morphology. Head (Figs 2, 3). Flagellum 14-segmented; first 3–4 flagellomeres sub globular, conspicuously stouter than remaining, bearing stout dorsal verticils; remaining flagellomeres more ovoid, bearing longer verticils; Scape ca. 1.86x longer than wide and ca. 2.7x longer than pedicel; palpus 4-segmented, all segments tubular in



FIGURES 1–3. *Notholimnophila excluda* (Alexander). Male holotype. 1: habitus. 2: head, lateral view. 3: head, dorsal view.

shape, subequal in length; eyes separated dorsally by a distance virtually equal to the length of scape, and ventrally by a much narrower space. Wing (Figs 5, 12). Vein h situated at the level of midlength between origin and bifurcation of M+Cu; tip of Sc at the level of first bifurcation of M; Sc-r oblique, little longer than tip of Sc; R_1 somewhat sinuous between r-r and sc-r, straight and pointed upwards after contact with r-r; Rs with or without spur at its base, mostly straight; r-r situated at level of bifurcation of R_{2+3} ; R_2 parallel with longitudinal axis of wing; R_3 more oblique in position, pointed downwards; cell r2 about as long as its petiole; r-m subequal in length or little longer than basal section of M_{1+2+3} ; only three branches of M reaching wing margin; discal cell large, almost as long as cell r2; m-cu situated at midpoint of discal cell; tip of vein A_1 at the level of vein Sc; tip of vein A_2 at the level of origin of Rs; Thorax (Figs 4, 13). Thoracic sclerites as in Figure 13; tibial spurs present and distinct; tibial spur formula 1:2:2; Tarsal claws simple and smooth. Male genitalia (Figs 6–9, 14–16). Posterior margin of tergite 9 forming extensions longer than wide. Gonocoxite cone-shaped, ca. 2.5x longer than wide; gonostylus terminal; lobe of gonostylus ca. 3.4x longer than wide, gradually narrowed toward tip; clasper of gonostylus ca. 3.3x longer than wide, glabrous, simple, strongly serrated; aedeagus relatively short, reaching the level the tips of the interbasis; aedeagal sheath lacking processes or extensions; interbase blade-like, little serrated at apex, fused medially but with no conspicuous lateral extensions articulating with paramere. Female terminalia (Figures 10, 11): tergite 10 ovoid, ca. 2x longer than wide; hypogynial valve well sclerotized; apex of hypogynial valve reaching midlength of cercus.



FIGURES 4–5. *Notholimmophila exclusa* (Alexander). Female. 4: head and thorax, lateral view. 5: wing.

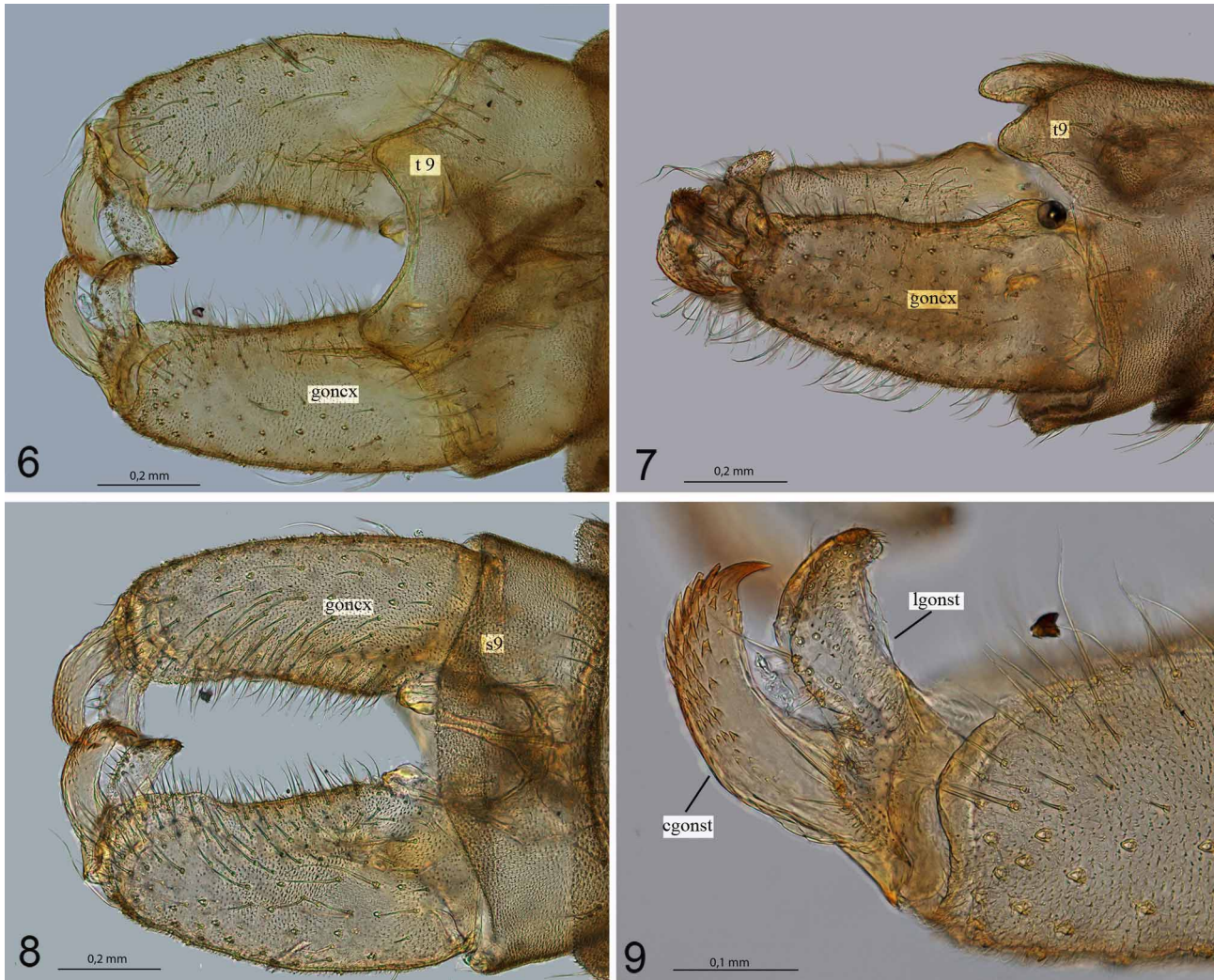
Material examined. Holotype. Male. *Charteris Bay, Canterbury, N.Z.* [ca. 43°38'S 172°42' E], alt. 200–300 ft. [70–92m], Nov. 12, 1921, J.W.Campbell.

Preservation. The male holotype is pinned and in virtual perfect condition, with only the left flagellum missing. The specimen was not dissected.

Paratype. Female. *Ohakune, N.Z.* [ca. 39°25'S 175°23' E], Alt. 2060 ft. [628m], Nov. 12, 1921, T.R.Harris. | Allotype.

1 male and 1 female. *Ohakune, N.Z.* [ca. 39°25'S 175°23' E], alt. 2060 ft. [628m], Dec. 10, 1922, T.R.Harris / *Limnophila exclusa* Al., Det. C.P.Alexander, 1923.

1 male. *New Zealand: S. Is., Kumara* [42°37'S 171°11'E], 23 february 1929, J.W.Campbell | *Notholimmophila exclusa* Alexander. Det. G.C.Ribeiro, 2011.



FIGURES 6–9. *Notholimnophila excluda* (Alexander). Male terminalia. 6: dorsal view. 7: lateral view. 8: ventral view. 9: Detail of gonostylus, dorsal view.

Remarks. The two specimens mentioned in the original description – one male and one female – were designated as holotype and allotype, respectively. The study of Ribeiro (2008) indicated *Bergrothomyia*, a genus including three species in Australia (Victoria, New South Wales) and Tasmania, as the closest relative of *Notholimnophila*. *Bergrothomyia* differs from *Notholimnophila* mostly by having a rostrum as long as the head and the vein M bifurcated into M_1 and M_2 .

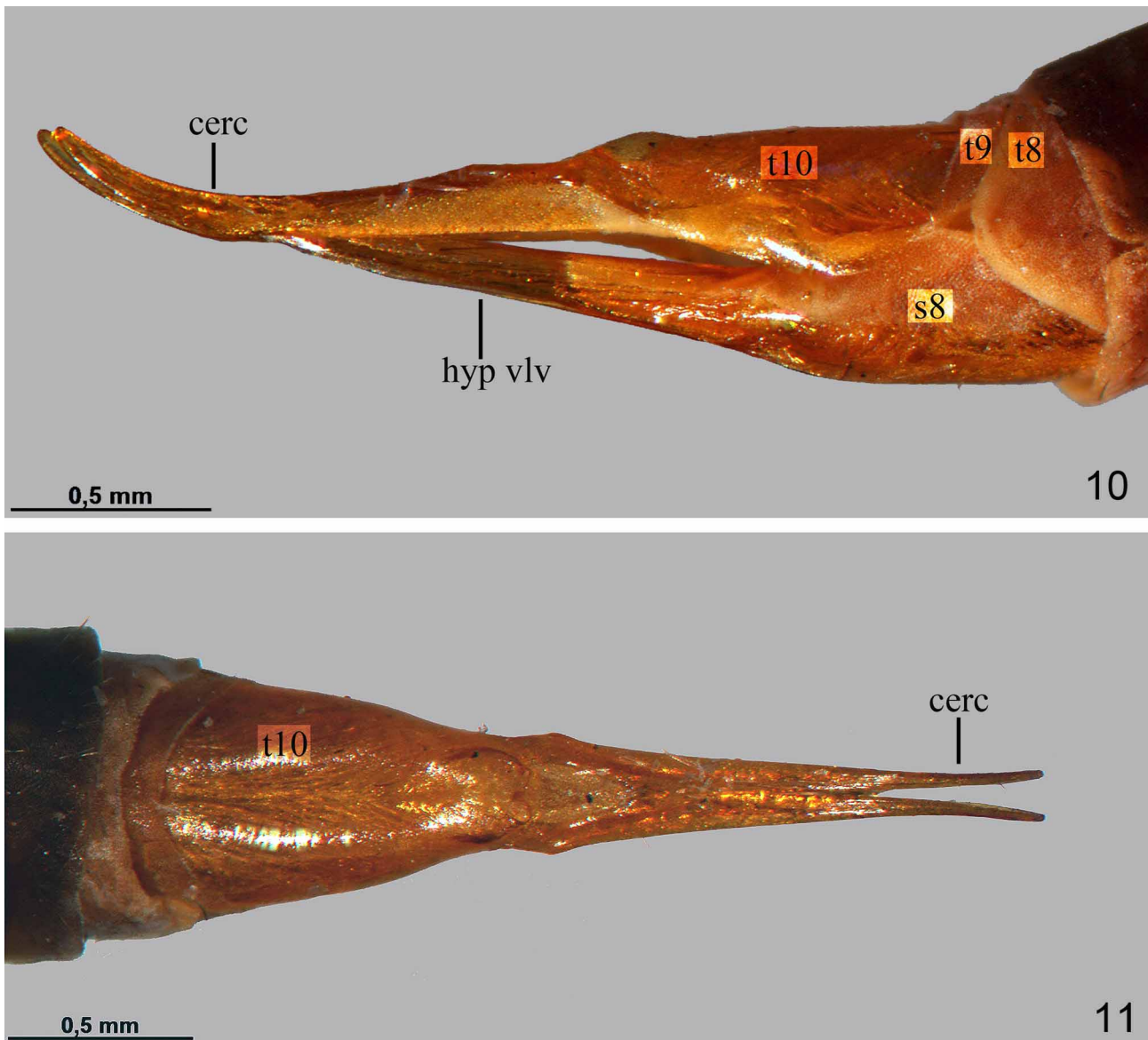
Genus *Acantholimnophila* Alexander, 1924

Acantholimnophila Alexander, 1924: 368. Type species: *Limnophila maorica* Alexander, 1922b.

Diagnosis. According to the analysis of Ribeiro (2008), the genus *Acantholimnophila* can be recognized by the following combination of autapomorphic features: length of scape up to 1.5x the length of the pedicel; flagellomeres tubular in shape; veins R_2 and R_3 reaching the wing margin almost parallel to each other; gonostylus subterminal in position.

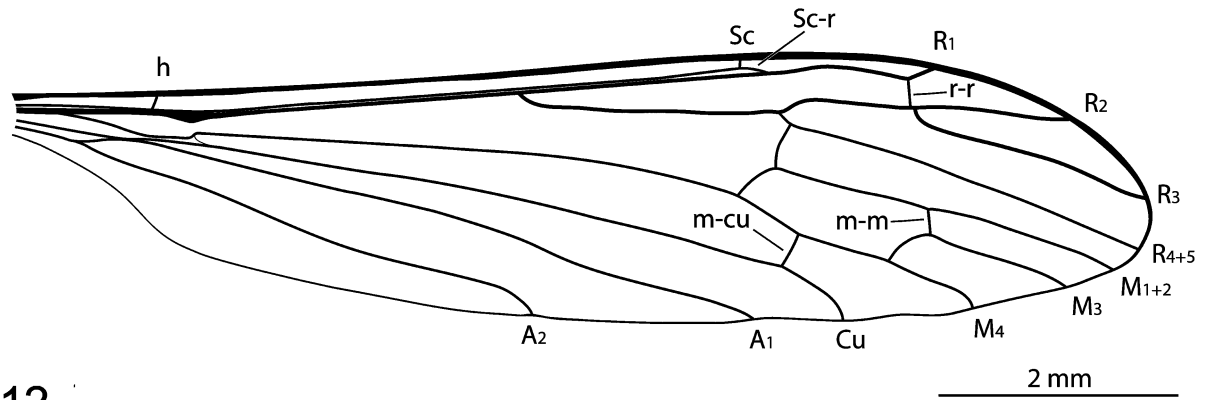
Redescription. Coloration (male and female). General coloration pale brown.

Morphology. Head (Figs 19–20). Antenna as long as body; Flagellum 14-segmented, tubular in shape, decreasing in length toward tip of antenna, bearing short verticils; scape slightly longer than pedicel and ca. 1.25x longer than wide; palpus 4-segmented, all segments tubular in shape; eyes separated dorsally by a wide area. Wing

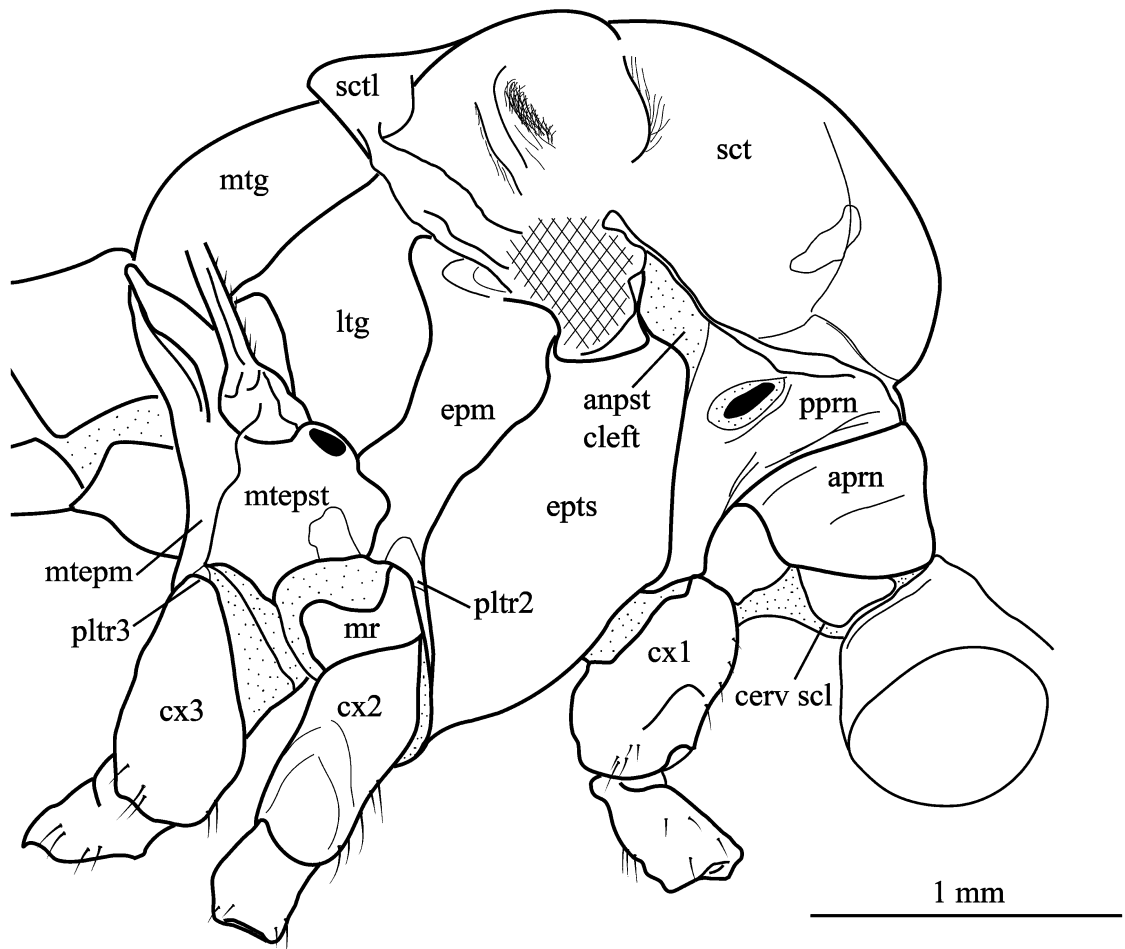


FIGURES 10–11. *Notholimmiphila excluda* (Alexander). Female ovipositor. 10: lateral view. 11: dorsal view.

(Figs 21–22, 29). Macrotrichia all along wing veins; Vein h situated near the origin of vein M+Cu; tip of Sc reaching wing margin at the same level as tip of vein A₁; R₁ long, slightly sinuous, reaching C at the level of tip of M₄; r-r very faint or absent; origin of Rs situated near the level of vein A₂; R₂₊₃ very short; veins R₂, R₃ and R₄ running parallel to each other, pointing downwards near tip of wing; r-m little shorter than basal section of M₁₊₂₊₃; four branches of M reaching wing margin; cell M₁ ca. 2x longer than its petiole; discal cell present; position of m-cu variable; A₁ reaching wing margin at the level of vein Sc; A₂ reaching wing margin near the level of origin of Rs. Thorax (Figs 18,23, 28). Thoracic sclerites as in Figure 23; tibial spurs very small, barely distinct. Male genitalia (Figs 24–26, 30–31). Posterior margin of tergite 9 forming extensions longer than wide. Gonocoxite cone-shaped, ca. 2.15– 3.0x longer than wide, with an acute apex; gonostylus subterminal; lobe and clasper of gonostylus subequal in length, ca. 4.5x longer than wide; clasper of gonostylus harry, gradually narrowing and curved toward tip; interbase well developed, long and narrow, at least 5.0x longer than wide, not connected to each other medially; aedeagus relatively short, not extending posteriorly beyond mid length of gonocoxite; area of the aedeagal sheath between parameres and aedeagus very wide. Female terminalia (Figure 27): hypogynial valve greatly developed, in lateral view ca. 2.5x broader than cercus; apex of hypogynial valve reaching about 2/3 of the length of cercus.



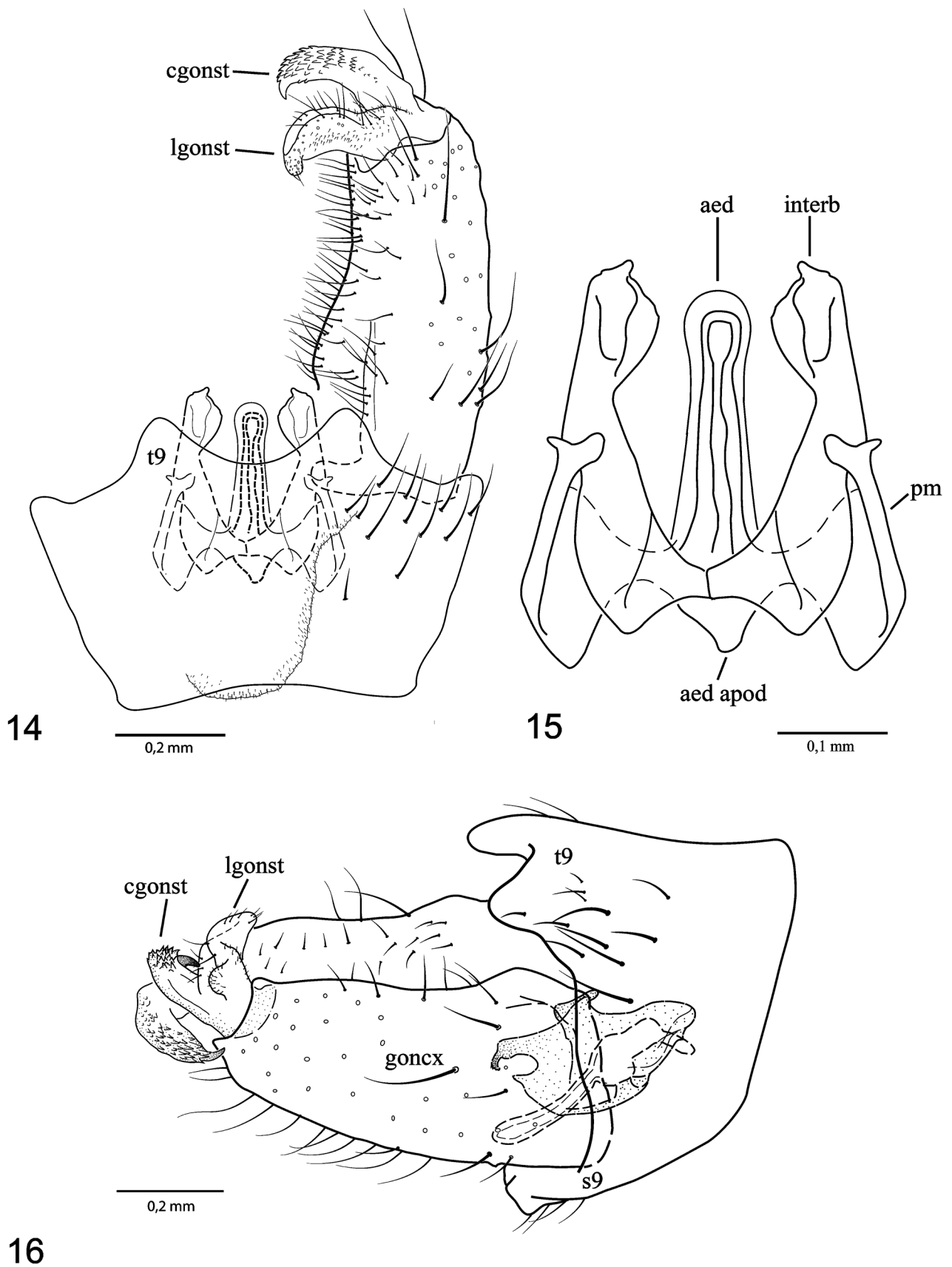
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FIGURES 12–13. *Notholimmnophila excluda* (Alexander). 12: wing venation. 13: thoracic sclerites, lateral view.

Remarks. The study of Ribeiro (2008) indicated a sister-group relationship between *Acantholimmnophila* and the widely distributed genus *Epiphragma*, on the basis of shared apomorphic features such as the expansion of the aedeagal sheath between the medial margin of paramere and lateral margin of aedeagus, and the extended lateral margins of the interbases. In fact, the morphology of the male genitalia looks very similar in both genera. However, *Epiphragma* species are larger flies, with wings strongly patterned with ocelliform markings, one or more additional cross-veins in cell C and first and second flagellomeres fused.



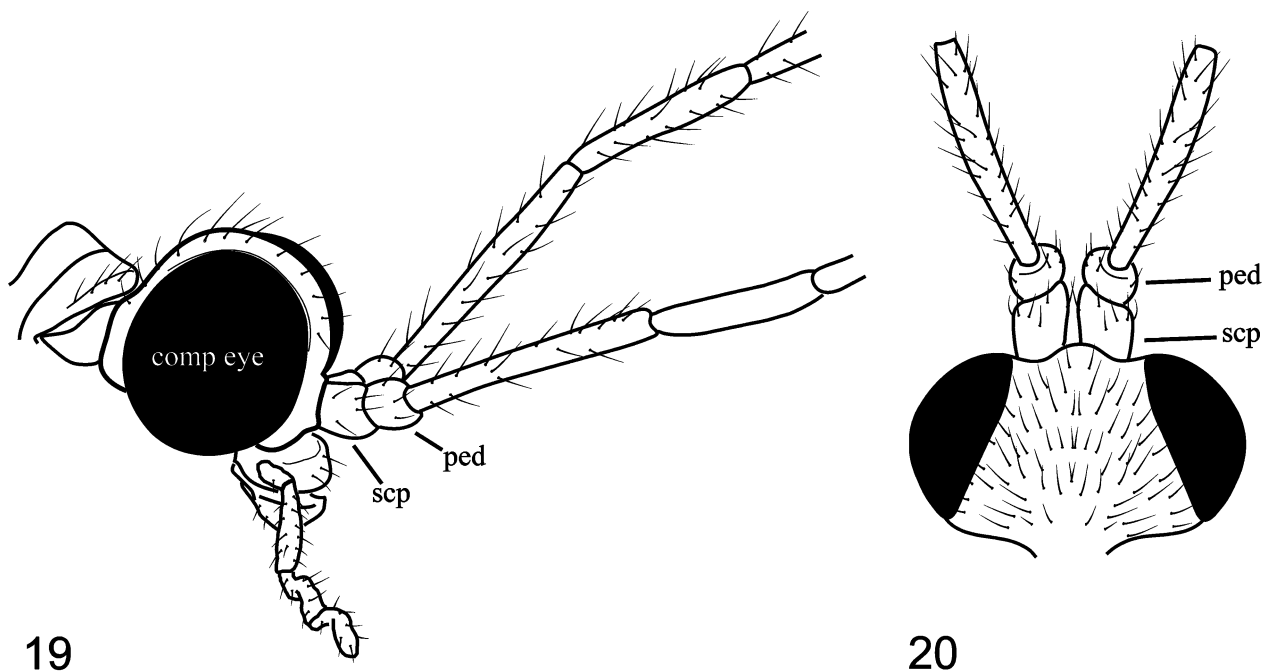
FIGURES 14–16. *Notholimnophila exclusa* (Alexander). 14: male genitalia, dorsal view. 15: aedeagus and associated structures, dorsal view. 16: male terminalia, lateral view.



FIGURE 17. *Acantholimnophila maorica* (Alexander). Male holotype, habitus.



FIGURE 18. *Acantholimnophila maorica* (Alexander). Male holotype, head and thorax, lateral view.



FIGURES 19–20. *Acantholimnophila maorica* (Alexander). Head. 19: lateral view. 20: dorsal view.

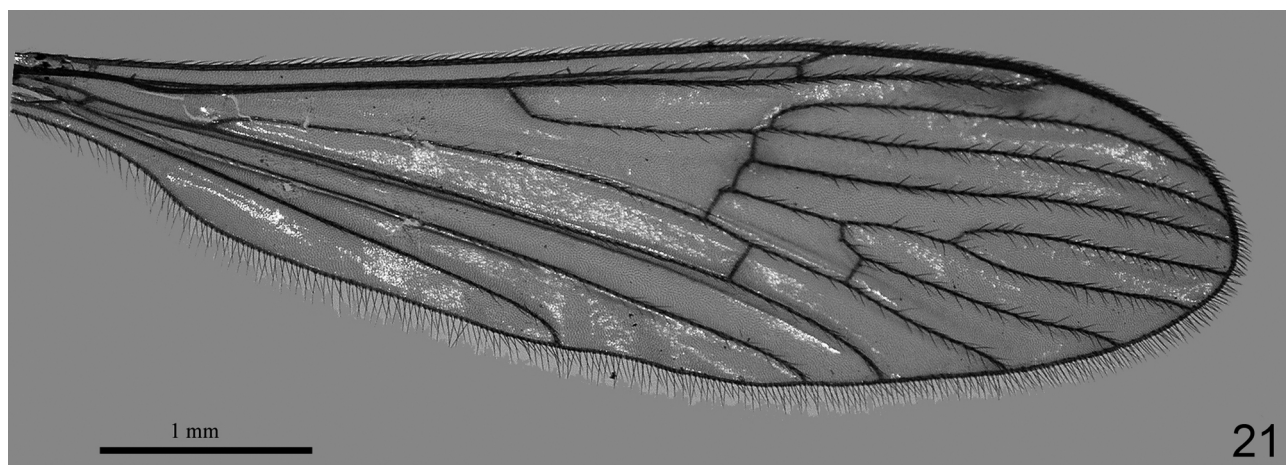


FIGURE 21. *Acantholimnophila maorica* (Alexander). Male holotype, wing.

***Acantholimnophila maorica* (Alexander, 1922)**

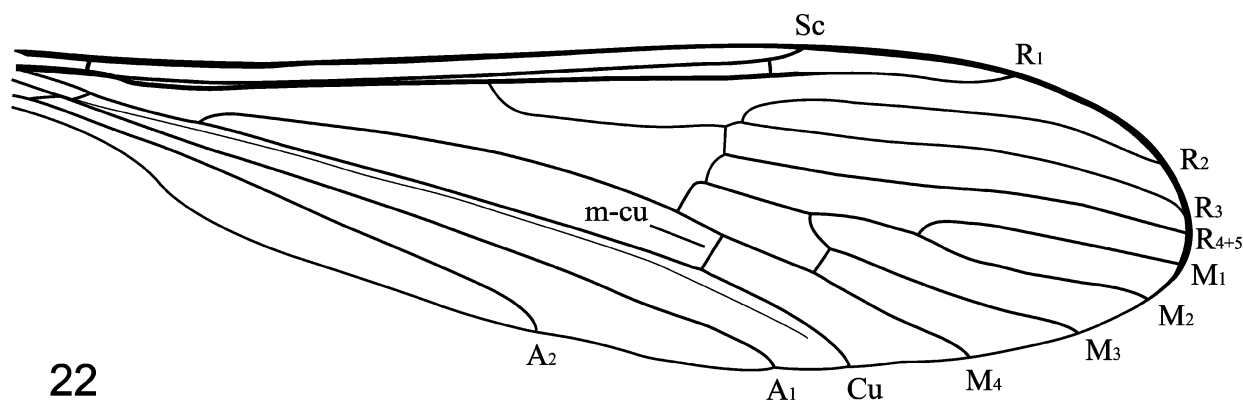
(Figs 17–27)

Acantholimnophila maorica (Alexander, 1922). Type species: *Limnophila maorica* Alexander, 1922b: 309–310 (original description); Alexander, 1924: 368 (taxonomy); Ribeiro, 2008: figs. 97, 171 (illustrations of male genitalia); Oosterbroek, 2011 (catalogue citation).

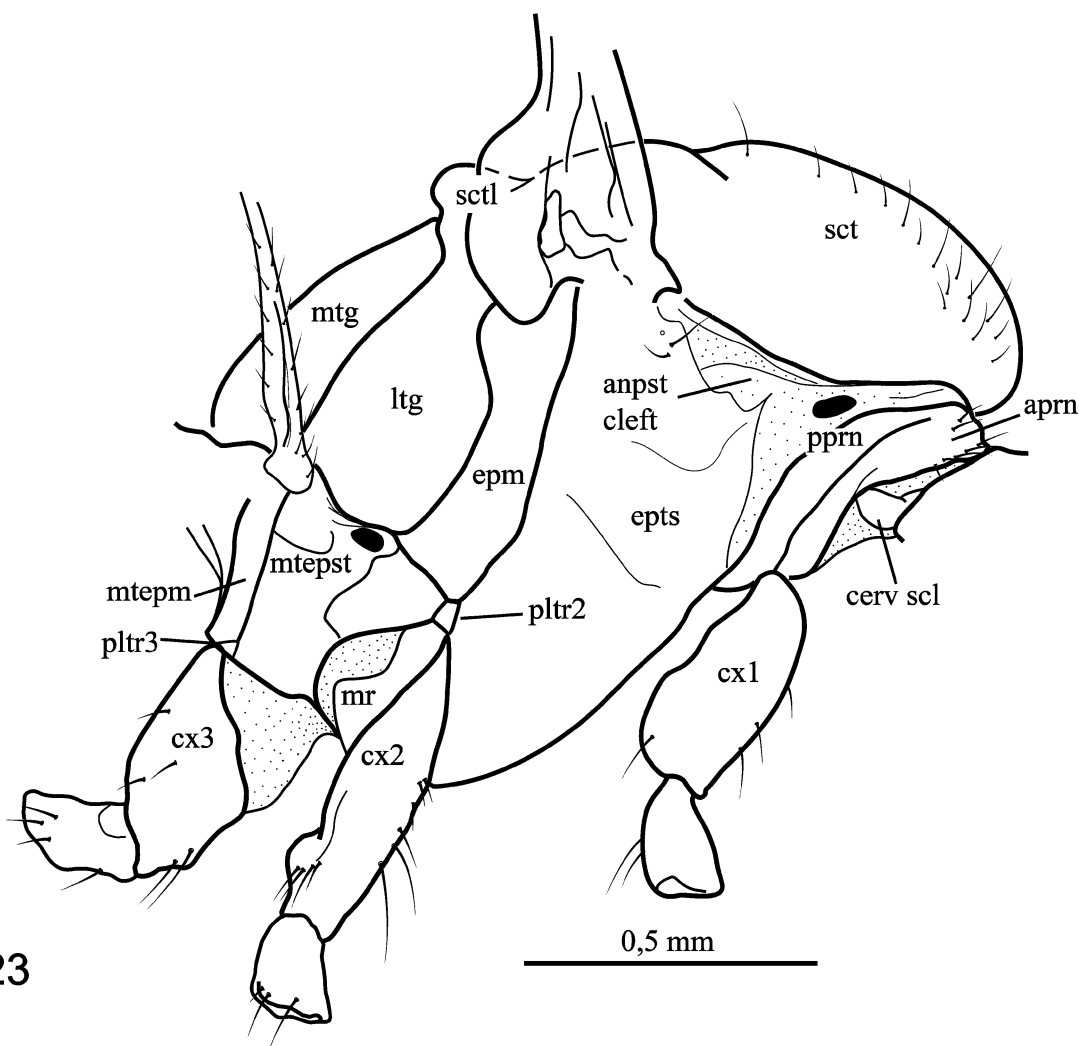
Diagnosis. *Acantholimnophila maorica* distinguishes from *A. bispina* mainly by having the interbase relatively longer, narrower, with a simple, non-bifid tip.

Dimensions. Thorax length, 1.00–1.10 mm; thorax height, 0.8–0.92 mm; wing length, 5.25–7.35 mm; wing width, 1.12–1.68 mm; gonocoxite length, 0.47–0.58 mm; gonocoxite width, 0.21–0.29 mm; clasper of gonostylus length, 0.19–0.22 mm; clasper of gonostylus width, 0.03–0.05 mm; lobe of gonostylus length, 0.18–0.19 mm; lobe of gonostylus width, 0.03–0.05 mm.

Material examined. Holotype. Male. *Ohakune, N.Z* [North Island, 39°25'05"S 175°23'54"E]. *Alt. 2060 ft* [627.8m], *Oct. 1, 1921, T.R. Harris.*



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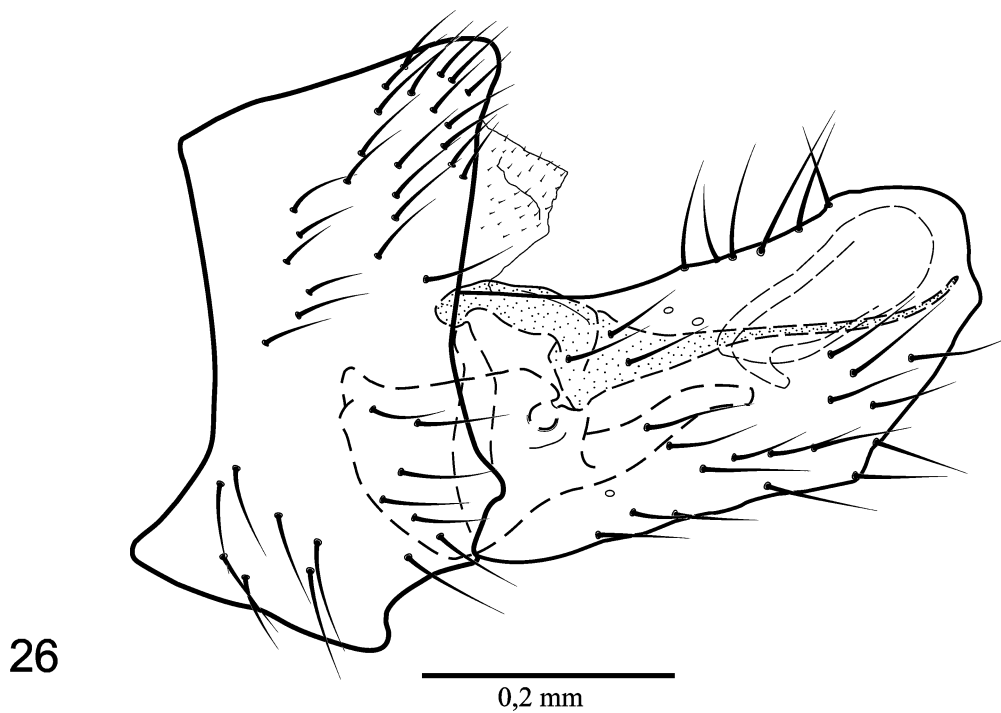
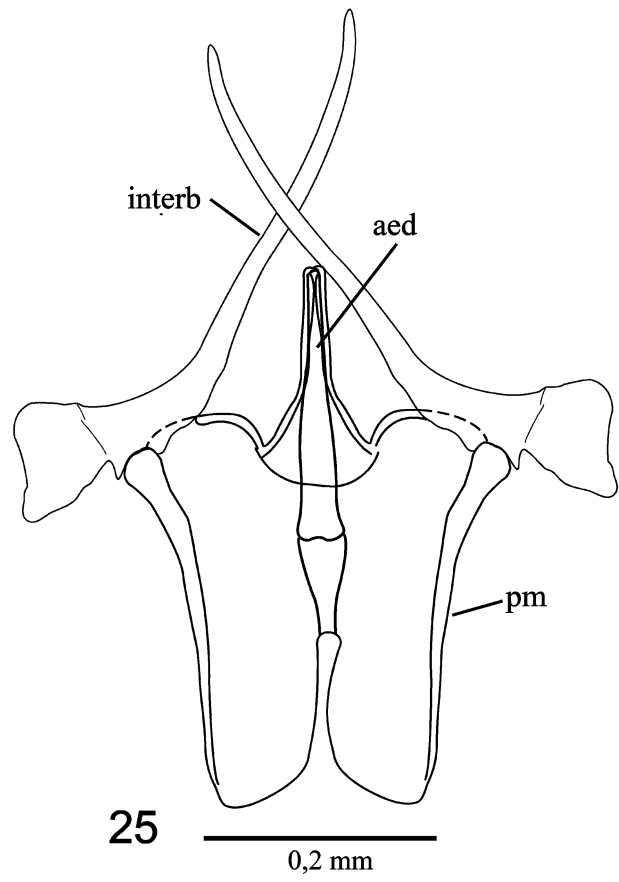
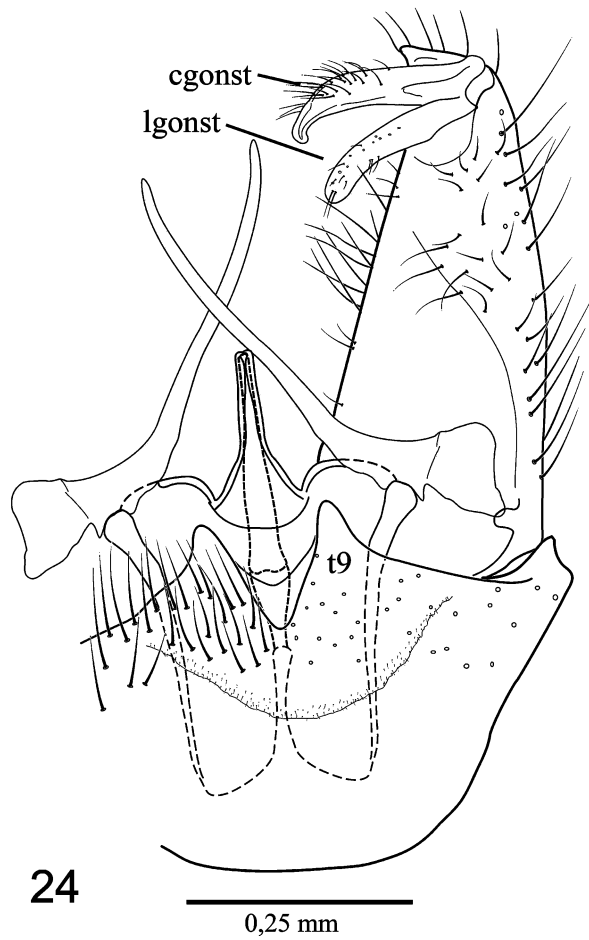


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FIGURES 22–23. *Acantholimmophila maorica* (Alexander). 22: wing venation. 23: thoracic sclerites, lateral view.

Preservation. Specimen not dissected and nearly intact, with one wing and leg fragments glued in a sheet of paper pinned with the specimen.

Paratypes. 1 female. *Graymouth, New Zealand* [South Island, 49°27'S 171°12'E], *Sea-level, sept. 7, 1921, T.R. Harris.* | *Allotype.* 1 male. *Graymouth, New Zealand* [South Island, 49°27'S 171°12'E], *Sea-level, sept. 7, 1921, T.R. Harris.* 1 male. *Ohakune, N.Z* [North Island, 39°25'S 175°23'E]. *Alt. 2060 ft. [627.8m], Oct. 4, 1921, T.R. Harris.* 2 males. *Ohakune, N.Z* [North Island, 39°25'S 175°23'E]. *Alt. 2060 ft. [627.8m], Oct. 10, 1921, T.R. Harris.* 1 male. *Ohakune, N.Z* [North Island, 39°25'S 175°23'E]. *Alt. 2060 ft. [627.8m], Oct. 11, 1921, T.R. Harris.* 1 male. *Ohakune, N.Z* [North Island, 39°25'S 175°23'E]. *Alt. 2060 ft. [627.8m], Sept.21, 1921, T.R. Harris.* 3 males and 1 female. *Dunedin, N.Z., Nov. 26, 1921, Geo. Howes.*



FIGURES 24–26. *Acantholimnophila maorica* (Alexander). 24: Male genitalia, dorsal view. 25: aedeagus and associated structures, dorsal view. 26: male terminalia, lateral view.

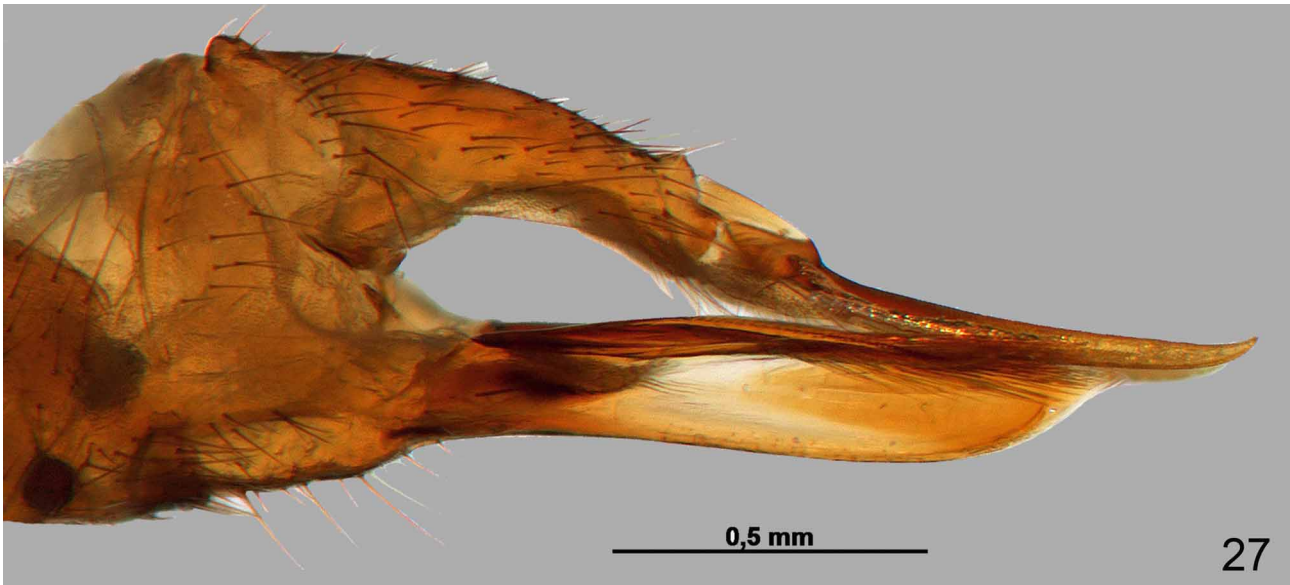


FIGURE 27. *Acantholimnophila* sp. (presumably *maorica*). Female ovipositor, lateral view.

Non-types. 2 males. *Ohakune, N.Z* [North Island, 39°25'S 175°23'E]. *Alt. 2060 ft. [627.8m], Nov. 8, 1922, T.R. Harris* | *Limnophila maorica* Alex. Det. C.P.Alexander, 1922. 1 female. *Ohakune, N.Z* [North Island, 39°25'S 175°23'E]. *Alt. 2060 ft. [627.8m], Nov. 14, 1922, T.R. Harris* | *Limnophila maorica* Alex. Det. C.P.Alexander, 1922. 1 male and 1 female. *Ohakune, N.Z* [North Island, 39°25'S 175°23'E]. *Alt. 2060 ft. [627.8m], Nov. 16, 1922, T.R. Harris* | *Limnophila maorica* Alex. Det. C.P.Alexander, 1922. 2 males. *Ohakune, N.Z* [North Island, 39°25'S 175°23'E]. *Alt. 2060 ft. [627.8m], Nov. 22, 1922, T.R. Harris* | *Limnophila maorica* Alex. Det. C.P.Alexander, 1922. 1 male. *Ohakune, N.Z* [North Island, 39°25'S 175°23'E]. *Alt. 2060 ft. [627.8m], Nov.24, 1922, T.R. Harris* | *Limnophila maorica* Alex. Det. C.P. Alexander, 1922.

***Acantholimnophila bispina* (Alexander, 1922)**

(Figs 28–31)

Acantholimnophila bispina (Alexander, 1922). Type species: *Limnophila bispina* Alexander, 1922b: 310 (original description); Alexander, 1924: 368 (taxonomy); Ribeiro, 2008: figs. 96, 170 (illustrations of male genitalia); Oosterbroek, 2011 (catalogue citation).

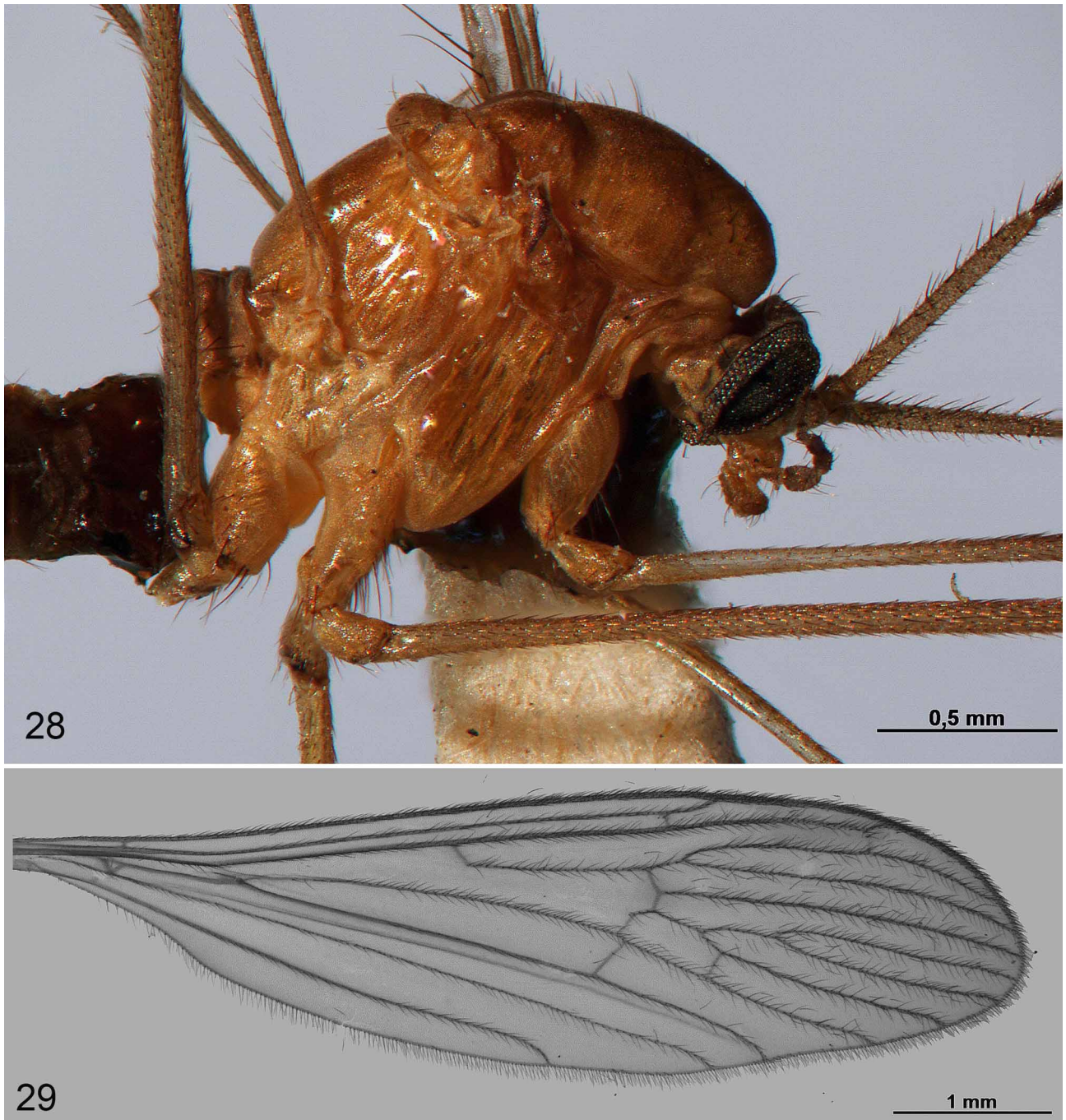
Diagnosis. *Acantholimnophila bispina* distinguishes from *A. maorica* mainly by having the interbase relatively shorter and stouter, terminating in a bifid tip.

Dimensions. Thorax length, 1.00–1.12 mm; thorax height, 0.82–0.87 mm; wing length, 5.95–7.0 mm; wing width, 1.33–1.68 mm; gonocoxite length, 0.40–0.54 mm; gonocoxite width, 0.18–0.21 mm; clasper of gonostylus length, 0.18–0.19 mm; clasper of gonostylus width, 0.03 mm; lobe of gonostylus length, 0.18–0.21 mm; lobe of gonostylus width, 0.03 mm.

Material examined. Holotype. Male. *Graymouth, New Zealand* [South Island, 49°27'S 171°12'E], *Sea-level, sept. 7, 1921, T.R. Harris.*

Preservation. The specimen is nearly intact, with one wing and terminalia mounted in a separate microscope slide.

Non-types. 1 male. *New Zealand, Ross* [South Island, 42°53'170°48'], *Westland, Feb. 21, 1923, T.R. Harris* | *Acantholimnophila bispina* (Alex.), Det. C.P. Alexander, 1923. 1 male. *New Zealand, White Rock, Mt. Thomas, Canterbury,* [South Island, 43°09'S 172°21'E] *Alt. 800 ft [243.8m], xi–26–'22 [November 26, 1922], J.W.Campbell* | *Acantholimnophila bispina* (Alex.). 1 male. *New Zealand, Glentui* [South Island, 43°13'S 172°17'E], *S. Lyndsay* | *Acantholimnophila bispina* (Alex.), Det. C.P. Alexander, 1921.

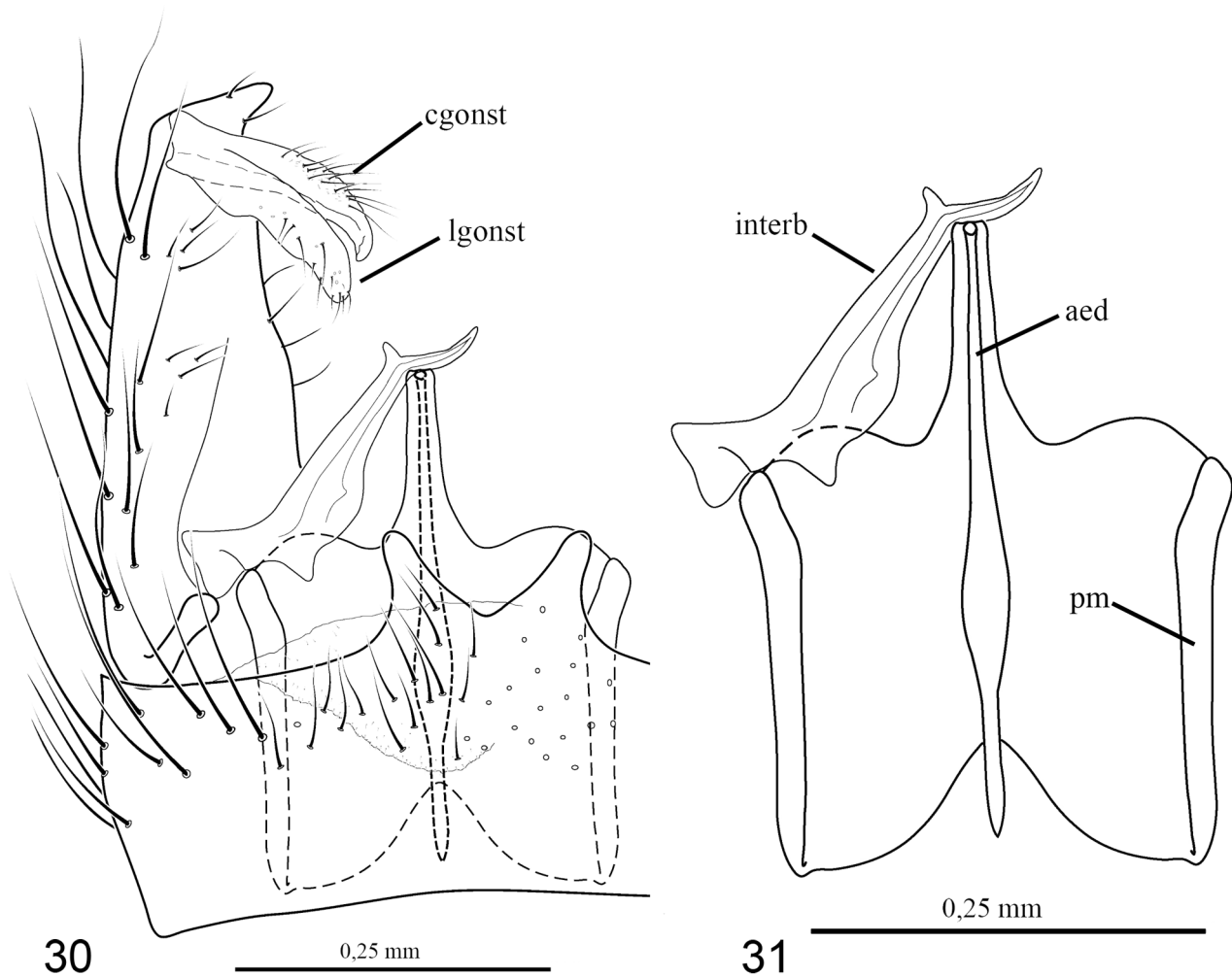


FIGURES 28–29. *Acantholimnophila bispina* (Alexander). Male holotype. 28: head and thorax, lateral view. 29: wing.

Remarks. The diagnostic features of both *Acantholimnophila* species refer to details of the male genitalia. Male-female associations are difficult to be defined objectively, and can only be presumed on the basis of co-occurrence.

Acknowledgements

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FIGURES 30–31. *Acantholimmophila bispina* (Alexander). 30: male genitalia, dorsal view. 31: aedeagus and associated structures, dorsal view.

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