



## Revision of the Australian Andini (Hemiptera: Fulgoromorpha: Cixiidae) with a description of five new species

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### Abstract

Andini, a tribe comprising two genera, *Andes* Stål, 1866 and *Parandes* Muir, 1925, is primarily distributed through the tropical and subtropical regions of South East Asia, Australia and Africa. One species, *Andes migratorius* (Distant, 1907), was previously known from Australia, the following five Australian species are herein described as new: *Andes dossenus* sp. nov., *A. ikelus* sp. nov., *A. lamondensis* sp. nov., *A. moaensis* sp. nov. and *A. turrondi* sp. nov. Lectotypes are designated for *Brixia migratoria* Distant, 1907 and *Leirioessa tortricomorpha* Kirkaldy, 1907. Maps of the known distribution for each species are given and the close links between the Australian and Asian fauna are discussed.

**Key words:** Auchenorrhyncha, Fulgoroidea, planthopper, morphology, distribution, *Andes*, Australia

### Introduction

The planthopper family Cixiidae comprises more than 150 genera and 2000 species worldwide (Holzinger *et al.* 2002). Some cixiids are economically important due to their ability to transmit plant phytoplasma diseases (Alma 2002, Liefing *et al.* 1998, Maixner *et al.* 1995) or plant pathogenic bacteria (Danet *et al.* 2003). The tribe Andini Emeljanov 2002, represented by the genera *Andes* Stål, 1866 and *Parandes* Muir, 1925, is one of the smaller tribes within Cixiidae.

*Parandes* is monotypic with *Parandes simplicus* Muir, 1925 from West Borneo whereas more than 100 species are described within the genus *Andes*. The two genera differ in the shape and size of the front coxae, which are straight in *Andes* and produced and rounded on the outer edge of the apical half in *Parandes*. *Andes* primarily occurs in the tropical and subtropical regions of South East Asia, Australia and Africa. Major contributors to the knowledge of the genus were Distant (1907, 1911), Fennah (1956, 1957, 1978, 1985), Muir (1921, 1922, 1925b, 1926), Synave (1953a, 1953b, 1960, 1967) and Van Stalle (Van Stalle 1982, 1983, 1984a, 1984b, 1985, 1986; Van Stalle & Synave, 1984).

In 1907, two Australian species, *Brixia migratoria* Distant, 1907 and *Leirioessa tortricomorpha* Kirkaldy, 1907, were described from specimens collected in Queensland. Kirkaldy (1907) characterised the genus *Leirioessa* Kirkaldy, 1907 as “Apparently allied to *Brixia*, but the vertex is broader than an eye and well produced anteriorly. Antennae not exerted, second segment globular. Pronotum of very different structure. Tegmina apically rounded, distinctly widening towards the apex. Hind tibiae with three larger and sometimes one or two smaller spines.” *Leirioessa* was made a junior synonym of *Andes* by Muir (1925b) so that *Leirioessa tor-*

*tricomorpha* became *Andes tortricomorphus*. Muir (1925b) also transferred *Brixia migratoria* into *Andes* as *Andes migratorius* (Distant). Jacobi (1928) synonymised the two Australian species, but rejected the placement within *Andes* based on the fact that in Kirkaldy's drawing of the forewing of *Andes tortricomorpha* (Kirkaldy 1907: Plate 27, Figure 21) Subcosta, Radius and Media do not arise separately from the basal cell but form a common stem. He stated that a specimen from Malanda which he had examined had an even longer common stem. Based on this, Jacobi (1928) concluded that the specimen illustrated by Muir (1925b) as *Andes tortricomorpha* was misidentified and *Leirioessa tortricomorpha* = *migratoria* could not be congeneric with *Andes*. Holzinger *et al.* (2002) synonymised *Leirioessa* with *Andes* thereby transferring *L. migratoria* back to *Andes*. We have accepted this synonymy based on reasons given in the discussion section of this paper.

## Materials & Methods

### Preparation of male genitalia

Male specimens were softened and dissected following the protocol described by Löcker *et al.* (2006).

### Measurements

The morphological terms applied here are as used by Löcker *et al.* (2006) and illustrated in Fig. 4A, except for the nomenclature applied in this paper to the venation of the tegmen, which follows Anufriev & Emeljanov (1988), and differs slightly from that applied in Löcker *et al.* (2006).

The following measurements were taken in this study:

- body length: tip of head to tip of forewing
- width of vertex: width level with tip of basal emargination
- length of vertex: subapical transverse carina to tip of basal emargination
- length of frons: apical transverse carina to frontoclypeal suture, in median line
- width of frons: at level of frontoclypeal suture
- width of forewing: at level of apex of clavus
- length of forewing: base to tip of wing

### Abbreviations

AMS	Australian Museum, Sydney
ANIC	Australian National Insect Collection, CSIRO, Canberra
BMNH	Natural History Museum, London
BPBM	Bishop Museum, Honolulu, Hawaii
LBOB	Lois O'Brien private collection, USA
MAGD	Northern Territory Museum, Darwin
NSW	New South Wales
NT	Northern Territory
NTDPI	Northern Territory Department of Primary Industries, Darwin
QDPC	Queensland Department of Primary Industries, Brisbane
Qld	Queensland
UQIC	University of Queensland Insect Collection, Brisbane.

## Genus *Andes* Stål

*Andes* Stål, 1866: 166. Type species *Andes undulata* Stål 1870, subsequent designation by Muir (1925b).  
*Leirioessa* Kirkaldy 1907: 112, synonymised by Muir 1925b: 201. Type species *Leirioessa torricomorpha* Kirkaldy (1907), by original designation.

**Remarks.** The genus *Andes* was described by Stål in 1866, however he did not describe a species within this genus until 1870.

**Colour.** Vertex brown with two longitudinal white stripes; frons brown, lateral carinae paler, sometimes with brown dots; body brown; forewings hyaline, colourless, with two brown transverse bands (tb1, tb2) (Figs 1A, 1F, 2A, 2F, 3A, 3F) and scattered brown marks; median ocellus often reddish.

**Morphology.** Body length: ♂ 3.8–6.6 mm.

**Head:** Vertex with u- or v-shaped basal emargination; lateral carinae strongly elevated; median carina absent; apical transverse carina well developed; subapical transverse carina well or weakly developed. Maximum width of frons more than 2 x apical width, steadily broadening; position of maximum width distinctly dorsad of centre of frontoclypeal suture; lateral carinae strongly elevated; frontoclypeal suture slightly semi-circular bent upwards, median part not reaching lower margin of antennal scape; median ocellus present. Median and lateral carinae of postclypeus well developed; median carina of anteclypeus well developed; lateral carinae absent.

**Thorax:** Pronotum with hind margin rectangular to slightly obtusely angled. Mesonotum with 3 well developed carinae. Forewing in resting position steeply tectiform, apices of wings touching; costal margin slightly outwardly convex basally; tubercles present along veins; Sc+R+M arising separately from a common point on the basal cell or forming a minute common stem (less than 3 x diameter of tubercle); position of r-m at same level as (rarely slightly basad of) fork MA+MP; icu distinctly distad of apex of clavus; RP apically trifid; MA apically trifid; MP apically bifid; fork of CuP+1A central within clavus (rarely basad or distad of centre of clavus); 10 apical cells. Fore leg: coxa with outer margin straight, subparallel with inner margin, not produced. Hind leg: tibia with 6 apical teeth forming uninterrupted row of spines (rarely small gap present, dividing spines in two groups of three teeth); tarsomeres without platellae; 2<sup>nd</sup> tarsomere with 1–4 very fine setae underneath row of apical teeth.

**Remarks.** The following attribute distinguishes the Australian *Andes* from all other Australian cixiid genera, Sc+R+M arising separately from a common point on the basal cell or forming a minute common stem (less than 3 x diameter of a tubercle).

**Distribution.** Palaearctic Region, Afrotropical Region, Oriental Region, Australian Region (New South Wales, Northern Territory, Queensland).

### Key to Australian species of *Andes* Stål

- 1 Lateral carinae of frons pale with large brown dots (Figs 1C, 3C); shape of genital styles as in Figs 4F, 8D .....2
- Lateral carinae of frons pale without dots (Figs 1E, 2C,E, 3E); shape of genital styles not as above.....3
- 2(1) Cucullus of aedeagus (Fig. 4A) in left lateral view with a pointed rim as in Fig. 4A; phallosheca left laterally without ridges (Fig. 4A) ..... *A. dosseus* Löcker, sp. nov.
- Cucullus of aedeagus in left lateral view with a rounded rim as in Fig. 8A; phallosheca left laterally with a long flattened ridge bearing a smaller elliptic ridge as in Fig. 8A ..... *A. moaensis* Löcker, sp. nov.
- 3(1) Forewing with transverse band (tb1) narrow, yellowish to light brown, at least one pterostigma length basad of pterostigma (Fig. 1F); genital styles apically rounded with a tapering process as in Fig. 5F; aedeagus with numerous pointed, flattened processes as in Figs 5A,B ..... *A. ikelus* Löcker, sp. nov.

- Forewing with transverse band (tb1) wide, mid to dark brown, immediately basad of pterostigma (Figs 2A,F, 3F); genital styles rounded without process (Figs 6E, 7G, 9F); aedeagus without pointed flattened processes (Figs 6A, 7A,B, 9A,B) .....4
- 4(3) Rim of cucullus smooth as in Fig. 7A; shape of cucullus narrow as in Fig. 7A.....  
..... *A. migratorius* (Distant, 1907)
- Rim of cucullus distinctly serrated as in Figs 6A, 9A; shape of cucullus moderately wide to very wide as in Figs 6A, 9A .....5
- 5(4) Cucullus very wide, covering all or most of flagellum in lateral view (Fig. 9A); shape of cucullus in lateral view as in Fig. 9A..... *A. turrondi* Löcker, sp. nov.
- Cucullus not as wide, only partly covering flagellum in lateral view (Fig. 6A); shape of cucullus in lateral view as in Fig. 6A .....  
..... *A. lamondensis* Löcker, sp. nov.

***Andes dossenus* Löcker, sp. nov.**

(Figs 1A–C, 4)

**Types.** *Holotype*, ♂, AUSTRALIA, Qld: 3 km ENE Mt Tozer, 12.44S 143.14E, 28.vi.–4.vii.1986 (T. Weir & A. Calder) (ANIC), *Paratypes*, AUSTRALIA, Qld: 3 ♂, 5 ♀, same data as holotype (ANIC), 1 ♂, 2 ♀, 9 km ENE of Mt Tozer, 12.43S 143.17E, Iron Range Nat. Park, malaise trap, 10.vii.1986 (D.C.F. Rentz) (ANIC), 2 ♂, 2 miles NE Mt Lamond, Iron Range, N.Qld, ex malaise trap, 22.xii.1971 (D.K. McAlpine & G.A. Holloway) (AMS), 1 ♂, Middle Claudie River, mv lamp, 29.vi.1982 (M.A. Schneider & G. Daniels) (UQIC), 3 ♂, Middle Claudie River, Iron Range, N.Qld, 22.x.1974 (M.S. Moulds) (AMS), 1 ♂, 1 ♀, Claudie River, 1 mile W. Mt Lamond, 13.xii.1971 (AMS), 1 ♂, Claudie River near Mt Lamond, N.Qld, 3.vi.1966 (D.K. McAlpine) (AMS), 1 ♂, 1 ♀, Gordon Creek, Iron Range, 1.5 km East Cook's Hut, 12.43S 143.19E, N.Qld, swept in rainforest, 8.v.1981 (S.F. McEvey) (ANIC).

**Etymology.** The species name is the Latin word for clown and refers to the spotted colouring on the face.

**Colour.** Vertex mid or dark brown with two longitudinal, white stripes; frons mid or dark brown, lateral carinae paler, with distinct mid to dark brown dots; pronotum light brown; mesonotum light or mid brown; legs light brown; forewing hyaline, colourless, with transverse band (tb1) narrow, weakly developed, brown, basad of pterostigma, covering fork CuA1+CuA2 and terminating at CuP, forewing with transverse band (tb2) narrow, weakly developed, brown, around basal cell reaching into clavus, forewing sometimes with light brown marks scattered across wing, veins concolorous with cells, tubercles mid brown, pterostigma light brown; abdominal sternites light or mid brown.

**Morphology.** Body length: ♂ 3.8–4.7 mm, ♀ 4.8–5.7 mm.

**Head:** Vertex 0.5–0.8 x as long as wide. In lateral view, vertex and frons forming curve, head at junction of vertex and frons no more than slightly produced. Frons 2.6–3.7 x longer than wide; median carina incomplete, covering 1/4 to 1/2 of length of frons; lateral carinae no more than slightly extending laterally, no more than partly concealing base of antennae; median ocellus separated from frontoclypeal suture by no more than its own diameter. Rostrum distinctly surpassing hind coxae.

**Thorax:** Forewing 2.7 x longer than wide; CuA1+CuA2 forking 1/3–1/4 away from apex of clavus; costa with 11–16 tubercles. Hind leg: tibia with 2–4 small to medium sized lateral spines; 1<sup>st</sup> tarsomere with 7–9 apical teeth; 2<sup>nd</sup> tarsomere with 7–8 apical teeth and 2–3 very fine setae underneath row of apical teeth.

**Male genitalia:** Anal tube as in Figs 4D–E; genital styles and ventromedian process as in Figs 4F–G. Aedeagus (Figs 4A–C): phallosome with long, moderately wide cucullus, shaped as in Fig. 4A, lower rim of cucullus slightly serrated, in left lateral view pointed (Fig. 4A); flagellum unarmed; virga elongated, sinuate.

**Remarks.** *Andes dossenus* shares the spotted colouring on the face with *A. moaensis*. It differs from *A. moaensis* in the shape of the cucullus and the absence of ridges on the phallosome.

***Andes ikelus* Löcker, sp. nov.**

(Figs 1D–F, 5)

**Types.** *Holotype*, ♂, **AUSTRALIA, Qld**: “National Bridge” [could be Natural Bridge, 28.13S, 153.14E], 24.i.1961 (J.L. Gressitt) (BPBM 16628), *Paratype*, **AUSTRALIA, Qld**: 1 ♂ or ♀, same data as holotype (BPBM).

**Etymology.** The Greek term “ikelos” means “like”. This species resembles *Andes distinctus* Muir (1925) from Borneo (see Remarks below).

**Colour.** Vertex light brown with two longitudinal white stripes; frons light brown without brown dots; pronotum light brown; mesonotum light to mid brown; legs light brown; forewing hyaline, colourless, with transverse band (tb1) narrow, yellowish to light brown, at least one pterostigma length basad of pterostigma, covering fork CuA1+CuA2 or passing slightly distad and terminating at CuP, forewing with transverse band (tb2) narrow, weakly developed, yellowish to light brown, along CuP, forewing with brown marks near icu and fork MA1+MA3, veins concolorous with wings, tubercles and pterostigma light brown; abdominal sternites light to mid brown.

**Morphology.** Body length: ♂ 5.9 mm.

**Head:** Vertex 0.8 x as long as wide. In lateral view, vertex and frons forming curve, head at junction of vertex and frons not produced. Frons 3.6 x longer than wide; median carina incomplete, covering about 1/4 of length of frons; lateral carinae not extending laterally, not concealing base of antennae; median ocellus separated from frontoclypeal suture by more than its own diameter. Rostrum slightly surpassing hind coxae.

**Thorax:** Forewing 2.6 x longer than wide; CuA1+CuA2 forking 1/3 away from apex of clavus; costa with 20 tubercles. Hind leg: tibia with 6 small to medium sized lateral spines; 1<sup>st</sup> tarsomere with 8 apical teeth; 2<sup>nd</sup> tarsomere with 7 apical teeth.

**Male genitalia:** Anal tube as in Figs 5C–D; genital styles and ventromedian process as in Figs 5E–F. Aedeagus (Figs 5A–B): phallosome without cucullus, with numerous flattened processes as in Figs 5A–B; flagellum unarmed; virga elongated, sinuate.

**Remarks.** This species shares the external appearance, in particular the colouration of the wing and head, the shape of the genital styles and the general structure of the aedeagus, of *Andes distinctus* Muir (1925) from Sandakan, Malaysia (holotype examined). However, *A. distinctus* varies in the shape and presence of certain flattened processes on the aedeagus. The overall shape of the genital styles is further shared with *Andes siberutensis* Muir (1926) from Siberut, Indonesia. The latter has a number of rounded spines on the aedeagus whereas *A. ikelus* and *A. distinctus* are characterised by flattened spines on the aedeagus.

*Andes ikelus* can be distinguished from all other Australian Andini by the presence of numerous flattened processes on the phallosome and the absence of a cucullus.

***Andes lamondensis* Löcker, sp. nov.**

(Figs 2A–C, 6)

**Types.** *Holotype*, ♂, **AUSTRALIA, Qld**: Claudie River near Mt Lamond, ex malaise trap, 15.xii.1971 (D.K. McAlpine, G.A. Holloway, D.P. Sands) (AMS K218693), *Paratypes*, **AUSTRALIA, Qld**: 1 ♀, 3 km ENE Mt Tozer, 12.44S 143.14E, 28.vi.–4.vii.1986 (T. Weir & A. Calder) (ANIC), 1 ♂, same data, ex malaise trap, (J.C. Cardale) (ANIC).

**Etymology.** This species is named after the type locality Claudie River near Mt Lamond in northern Queensland.

**Colour.** Vertex light or mid brown with two longitudinal, white stripes; frons mid or dark brown, lateral carinae paler, without dots; pronotum light brown; mesonotum light to mid brown; legs light brown; forewing

hyaline, colourless, with transverse band (tb1) wide, mid to dark brown, extending to immediately basad of pterostigma, covering fork CuA1+CuA2 and terminating at CuP, forewing with transverse band (tb2) narrow, mid to dark brown, around basal cell reaching into clavus, forewing with mid or dark brown marks scattered across wing, apical half of wing with light brown patches; veins concolorous with cells, tubercles mid brown, pterostigma light brown; abdominal sternites light or mid brown.

**Morphology.** Body length: ♂ 5.6 mm, ♀ 6.1 mm.

**Head:** Vertex 0.8 x as long as wide. In lateral view, vertex and frons forming curve, head at junction of vertex and frons slightly or distinctly produced. Frons 3.0–3.2 x longer than wide; median carina incomplete, covering 1/3 to 1/2 of length of frons; lateral carinae not extending laterally, not concealing base of antennae; median ocellus separated from frontoclypeal suture by less than its own diameter. Rostrum distinctly surpassing hind coxae.

**Thorax:** Forewing 2.3–2.6 x longer than wide; CuA1+CuA2 forking 1/5–1/6 away from apex of clavus; costa with 16–17 tubercles. Hind leg: tibia with 6 small to medium sized lateral spines; 1<sup>st</sup> tarsomere with 8–9 apical teeth; 2<sup>nd</sup> tarsomere with 7–8 apical teeth and 2–3 very fine setae underneath row of apical teeth.

**Male genitalia:** Anal tube as in Figs 6B–C; genital styles and ventromedian process as in Figs 6D–E. Aedeagus (Fig. 6A): phallosome with long, wide cucullus, shaped as in Fig. 6A, lower rim of cucullus conspicuously serrated, in left lateral view straight, oblique (Fig. 6A); flagellum unarmed; virga elongated, sinuate.

**Remarks.** The proportions and shape of the cucullus in combination with the conspicuously serrated rim of the cucullus are diagnostic for this species.

### ***Andes migratorius* (Distant)**

(Figs 2D–F, 7)

*Brixia migratoria* Distant 1907: 279.

*Leirioessa tortricomorpha* Kirkaldy 1907: 112 (Plate 8, Figs 19–21), synonymised by Jacobi 1928: 35.

*Andes tortricomorphus* (Kirkaldy), Muir 1925: 222 (Plate 2, Fig. 28).

*Andes migratorius* (Distant), Muir 1925: 223.

*Leirioessa migratoria* (Distant), Jacobi 1928: 35.

*Andes migratorius* (Distant), Holzinger *et al.* 2002: 124.

**Types.** Lectotype of *Brixia migratoria* here designated, ♂, AUSTRALIA, Qld: F.P. Dodd (BMNH). Lectotype of *Leirioessa tortricomorpha*, here designated, ♂, AUSTRALIA, Qld: Kuranda, viii.1904 (BPBM). Paralectotype: AUSTRALIA, Qld: 1 ♀, Cairns, viii.1904 (BPBM).

**Remarks.** Distant's (1907) original description of *Brixia migratoria* does not specify whether the type series consists of more than one specimen. Only one specimen has been found in the BMNH and it is here designated as lectotype in order to clarify the identity of the species. A lectotype and paralectotype for *Leirioessa tortricomorpha* are here designated to give a diagnostic reference for that name. Holzinger *et al.* (2002: 124) listed *Leirioessa* as a synonym of *Andes* without listing the included species.

**Other material examined.** AUSTRALIA, NSW: 1 ♂, Lorien Refuge, 3km N Lansdowne nr Taree, rain-forest margin, malaise trap, 23–30.iii.1987 (G. Williams) (ASCU), 1 ♀, same data, 9.–15.iii.1987 (ASCU), AUSTRALIA, Qld: 5 ♂, 3 ♀, 1 ♂ or ♀ (abdomen missing), State Forest near Caloundra Turnoff, SE.Qld, 8.iii.1984 (I.D. Galloway) (QDPC), 1 ♂, 1 ♀, Cairns (CAS), 1 ♂, 22 [miles] SW Ingham, 30.v.1961 (R. Straatman) (ANIC), 1 ♂, Camp Mountain, SE.Qld, malaise trap, open sclerophyll gully, 29.xii.1979–7.i.1980 (Marks) (QDPC), 3 ♂, 1 ♀, 11 km W Caloundra, 11.xi.1989 (C.W. & L.B. O'Brien) (LBOB), 1 ♂, 1 ♀, Mt Windsor Tableland Forestry Hut, 16.15.42S 145.02.25E, 1060m, pans, 16.–17.iv.1994 (D. Bickel) (AMS), 1

♂, Upper Cedar Creek, via Samford, 6.xii.1962 (G. Monteith) (UQIC), 1 ♂, Palm Island, N.Qld, 20.xii.1930–6.i.1931 (I.M. Mackerras) (ANIC).

**Colour.** Vertex light or mid brown with two longitudinal, white stripes; frons mid or dark brown, lateral carinae paler, without dots; pronotum light brown; mesonotum light to mid brown; legs light brown; forewing hyaline, colourless, with transverse band (tb1) wide, mid to dark brown, extending to immediately basad of pterostigma, covering fork CuA1+CuA2 and terminating at CuP, forewing with transverse band (tb2) narrow, mid to dark brown, around basal cell reaching into clavus, forewing with mid or dark brown marks scattered across wing, apical half of wing with light brown patches; veins concolorous with cells, tubercles mid brown, pterostigma light brown; abdominal sternites light or mid brown.

**Morphology.** Body length: ♂ 5.6–6.6 mm, ♀ 6.1–7.1 mm.

**Head:** Vertex 0.8–1.0 x as long as wide. Junction of vertex and frons slightly angular and distinctly produced in lateral view. Frons 2.5–3.1 x longer than wide; median carina incomplete, covering 1/3 to 1/2 of length of frons; lateral carinae not extending laterally, not concealing base of antennae; median ocellus separated from frontoclypeal suture by less than its own diameter. Rostrum slightly or distinctly surpassing hind coxae.

**Thorax:** Forewing 2.4–2.7 x longer than wide; CuA1+CuA2 forking 1/5–1/6 away from apex of clavus; costa with 11–16 tubercles. Hind leg: tibia with 2–6 small to medium sized lateral spines; 1<sup>st</sup> tarsomere with 8–9 apical teeth; 2<sup>nd</sup> tarsomere with 7–8 apical teeth and 1–3 very fine setae underneath row of apical teeth.

**Male genitalia:** Anal tube as in Figs 7D–E; genital styles and ventromedian process as in Figs 7F–G. Aedeagus (Figs 7A–C): phallosome with long, very slender cucullus, shaped as in Fig. 7A, rim of cucullus smooth, in left lateral view convex (Fig. 7A); flagellum unarmed; virga elongated, sinuate.

**Remarks.** The structure of the male genitalia, in particular the shape of the cucullus, is shared with *Andes brunneus* Muir (1925) and *A. indistinctus* Muir (1925) from Borneo. In *A. brunneus*, however, the cucullus is smaller, covering only the apical third of the phallosome, whereas in *A. migratorius* half to 3/4 of the phallosome is covered by the cucullus. *Andes indistinctus* differs from *A. migratorius* in the shape of the anal tube, which bears a triangular process with an acute apex on its apical lobes.

*Andes migratorius* can be distinguished from all other Australian Andini by the unique combination of a long, very slender cucullus and an unspotted face.

### *Andes moaensis* Löcker, sp. nov.

(Figs 3A–C, 8)

**Types.** *Holotype*, ♂, AUSTRALIA, Qld: Moa Island, N.Qld, swept rainforest, 1.ii.1980 (S.F. McEvey) (ANIC), *Paratypes*, AUSTRALIA, Qld: 1 ♂, 1 ♀, Batavia Downs, 12.40S 142.40E, at light, 22.vii.1992 (P. Zborowski & E.S. Nielsen) (ANIC).

**Etymology.** This species is named after the type locality Moa Island in northern Queensland.

**Colour.** Vertex mid or dark brown with two longitudinal, white stripes; frons mid brown, lateral carinae paler, with distinct dark brown dots; pronotum and mesonotum light to mid brown; legs light brown; forewing hyaline, colourless, with transverse band (tb1) sometimes weakly developed, brown, extending to basad of pterostigma, covering fork CuA1+CuA2 and terminating at CuP, forewing with transverse band (tb2), sometimes weakly developed, narrow, brown, around basal cell reaching into clavus, forewing sometimes with brown marks scattered across wing, veins concolorous with cells, tubercles mid brown, pterostigma light brown; abdominal sternites mid brown.

**Morphology.** Body length: ♂ 5.4–5.5 mm, ♀ 6.5 mm.

**Head:** Vertex 0.5–0.6 x as long as wide. In lateral view, vertex and frons forming curve, head at junction of vertex and frons not produced. Frons 2.7–2.9 x longer than wide; median carina incomplete, covering 1/3 to

1/2 of length of frons; lateral carinae not extending laterally, not concealing base of antennae; median ocellus separated from frontoclypeal suture by less than its own diameter. Rostrum slightly or distinctly surpassing hind coxae.

**Thorax:** Forewing 2.6–2.7 x longer than wide; CuA1+CuA2 forking 1/3 away from apex of clavus; costa with 14–18 tubercles. Hind leg: tibia with 3 small to medium sized lateral spines; 1<sup>st</sup> tarsomere with 8 apical teeth; 2<sup>nd</sup> tarsomere with 8 apical teeth and 3 very fine setae underneath row of apical teeth.

**Male genitalia:** Anal tube as in Figs 8B–C; genital styles and ventromedian process as in Figs 8D–E. Aedeagus (Fig. 8A): phallosome with long, very slender cucullus, shaped as in Fig. 8A, rim of cucullus smooth; phallosome left lateral with a long, flattened ridge; flagellum unarmed; virga elongated, sinuate.

**Remarks.** *Andes moaensis* can be distinguished from all other Australian Andini by the combination of the frons with distinct dark brown dots and the phallosome with a long flattened ridge.

***Andes turrondi* Löcker, sp. nov.**

(Figs 3D–F, 9)

**Types.** *Holotype*, ♂, AUSTRALIA, NT: 12 km NNW of Mt Cahill, 12.46S 132.39E, 25.x.1972 (Upton & Barrett) (ANIC), *Paratypes*, AUSTRALIA, NT: 7 ♂, 4 ♀, same data as holotype (ANIC), 2 ♂, 8 ♀, Dripstone Park, 12.21S 130.52E, at light, 6.iv.1991 (M.S. Upton) (ANIC), 1 ♂, same data, 12.iv.1991 (ANIC), 2 ♂, 1 ♀, Alawa, at light, 8.ii.2003 (G.R. Brown) (NTDPI), 5 ♂, 9 ♀, Kakadu NP, Nourlangie Camp, mv light, 17.–18.xi.1979 (M.B. Malipatil) (MAGD).

**Etymology.** “Turrondi” means “to saw” in Kurna, a language spoken by Aboriginal people living in the Adelaide Plains (Thieberger & McGregor 1994). This species is named after the serrated rim of the cucullus.

**Colour.** Vertex mid brown with two longitudinal, white stripes; frons mid to dark brown, lateral carinae paler, without dots; pronotum light brown; mesonotum light to mid brown; legs light brown; forewing hyaline, colourless, with transverse band (tb1) wide, mid to dark brown, extending to immediately basad of pterostigma, covering fork CuA1+CuA2 and terminating at CuP, forewing with transverse band (tb2) narrow, mid to dark brown, around basal cell reaching into clavus, forewing with mid or dark brown marks scattered across wing, apical half of wing with light brown patches; veins concolorous with cells, tubercles mid brown, pterostigma light brown; abdominal sternites light or mid brown.

**Morphology.** Body length: ♂ 4.7–5.5 mm, ♀ 5.7–6.7 mm.

**Head:** Vertex 0.5–0.8 x as long as wide. In lateral view, vertex and frons forming curve, head at junction of vertex and frons no more than very slightly produced. Frons 2.5–3.8 x longer than wide; median carina incomplete, covering about 1/2 of length of frons; lateral carinae not extending laterally, not concealing base of antennae; median ocellus separated from frontoclypeal suture by less than its own diameter. Rostrum slightly surpassing hind coxae.

**Thorax:** Forewing 2.4–2.6 x longer than wide; CuA1+CuA2 forking 1/5–1/6 away from apex of clavus; costa with 13–16 tubercles. Hind leg: tibia with 3–5 small to medium sized lateral spines; 1<sup>st</sup> tarsomere with 8 apical teeth; 2<sup>nd</sup> tarsomere with 8 apical teeth and 1–4 very fine setae underneath row of apical teeth.

**Male genitalia:** Anal tube as in Figs 9C–D; genital styles and ventromedian process as in Figs 9E–F. Aedeagus (Figs 9A–B): phallosome with long, very wide cucullus, distinctly curved in left lateral view (Fig. 9A), lower rim of cucullus conspicuously serrated; flagellum unarmed; virga elongated, sinuate.

**Remarks.** The proportions and shape of the cucullus in combination with the conspicuously serrated rim of the cucullus are diagnostic for this species.

## Discussion

Our investigations of the Australian material of *Andini* showed that the Subcosta, Radius and Media veins either form a minute common stem (about the length of less than 3 x the diameter of a tubercle) or they arise separately from a common point on the basal cell and thus do not form a common stalk. In some cases both character states appeared on different wings of the same specimen. The male lectotype of *Andes tortricomorpha* has only one forewing present and, on this, all three veins arise from a common point on the basal cell. It is, however, unclear whether Kirkaldy's illustration was based on this particular specimen (and wing). From Kirkaldy's illustration it is impossible to determine which of the two states is present: arising separately from one point, or a minute stem (in this case about the length of 1 tubercle diameter). Muir's definition of *Andes* includes the state arising from one point but does not mention the occurrence of a minute stem. Nevertheless, due to the variability of this character within each species and even within both wings of the same specimen, the fact that the common stem, if present, is minute and the observation that the types of *Leirioessa migratoria* and *L. tortricomorpha* match the description of *Andes* as recognised here, we confirm *Leirioessa* as a junior synonym of *Andes* as first proposed by Muir (1925b).

Muir (1925b) gives the following character state in his description of *Andes*, "Cu forks about one-third from apex of clavus ...". This state is present in the Australian species of *A. ikelus* and *A. moaensis*. In *A. dos-senus* Cubitus Anterior (CuA) forks about 1/3–1/4 from apex of clavus, whereas in *A. turrondi*, *A. migratorius* and *A. lamondensis* CuA forks about 1/5–1/6 from apex of clavus. Nevertheless, this slight variation is not regarded as sufficient justification to create a separate genus. "Hind tibiae unarmed or with very small spines", is another feature described by Muir (1925b). In the Australian material we observed 2–6 small or medium sized spines. These definitions of size are, however, very subjective and might still fall into Muir's category of "very small spines".

The six species treated in this paper are endemic to Australia. Maps of the known distribution of each species are shown in Fig 10. *Andes turrondi* is the only species occurring in the Northern Territory, where it inhabits the northern, tropical regions. The species with the widest distribution is *A. migratorius*. It is widely distributed in Queensland and two specimens are even recorded from NSW. *Andes ikelus* has been found in only one locality in Queensland. The data label on the specimen says, "Australia: Queensland Prov.: National Bridge". This could be a misspelling of Natural Bridge near Brisbane. The other three species show a fairly restricted distribution in Cape York (North Queensland). *Andes moaensis* has also been recorded on Moa Island, in Torres Strait. Based on the fact that the main distribution of the genus lies in the tropical and subtropical areas it is not surprising that the Australian species exhibit a distribution restricted to areas with an average rainfall of more than 1000 mm per year. The representation of species in Cape York seems to indicate that the genus dispersed into Australia via Cape York from SE Asia through New Guinea. This is supported by morphological evidence which shows close links to the Southeast Asian fauna. The Australian species seem to have originated from two different roots. *Andes ikelus* shares external appearance, in particular the colouration of the wing and head, and the general structure of the male genitalia with *Andes distinctus* from Borneo (Sandakan). Based on the presence and shape of the cucullus, other Australian *Andes* should be related with species such as *A. hemina* Fennah (1978) from Malaysia (Kuala Lumpur, Kedah) and Vietnam (Cuo-phuong province), *A. brunneus* Muir (1925) from Borneo (Sandakan) and *A. indistinctus* Muir (1925) from Borneo (Mowong).

The African fauna, with differently shaped male genitalia, lacking virga and cucullus, seems to be distinctly different and may even need to be transferred to a different genus within *Andini*, which suggests that *Andes* in its current concept represents a paraphyletic taxon. Further taxonomic research, particularly phylogenetic analyses of the world *Andes* fauna, is needed to test our hypotheses of the origins of the Australian *Andes* fauna and the parphyly of the genus.

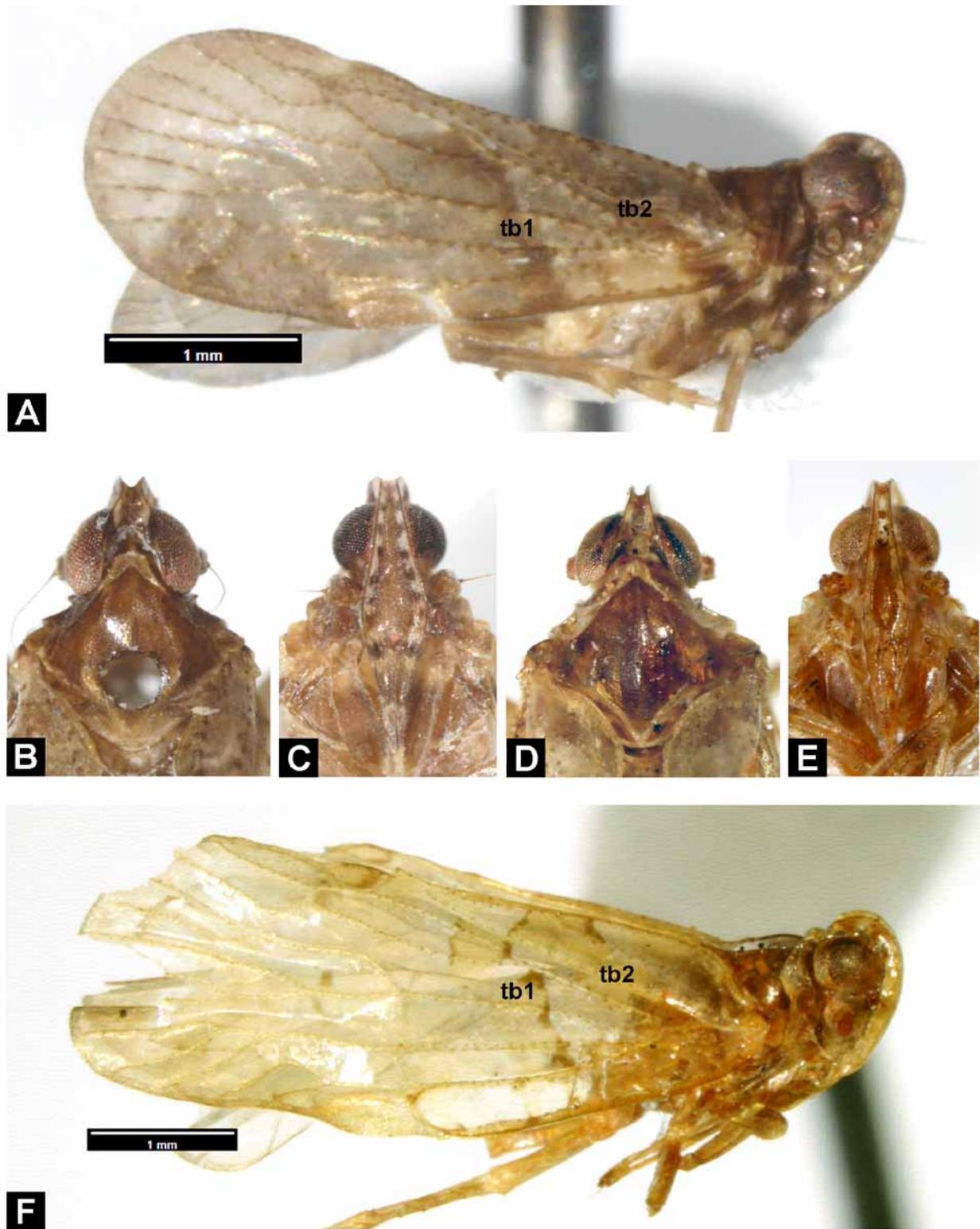
## Acknowledgements

We are grateful to all collectors and curators of insect collections, who have enabled us to use their material for our research, in particular Keith Arakaki (BPBM), Dave Britton (AMS), Lois O'Brien (LBOB) and Tom Weir (ANIC). This work has been undertaken by the first author as part of her PhD project. We acknowledge invaluable input in the developmental stages of this work by Marie-Claude Larivière (NZAC) without whom this project could not have been extended to include the Andini. Our sincere thanks go to Holger Löcker for his generous assistance. Financial support from the Australian Biological Resources Study (ABRS), a division of the Australian Government's Department of the Environment and Heritage (DEH) and The University of Sydney and in-kind support from NSW Department of Primary Industries and Charles Sturt University are gratefully acknowledged.

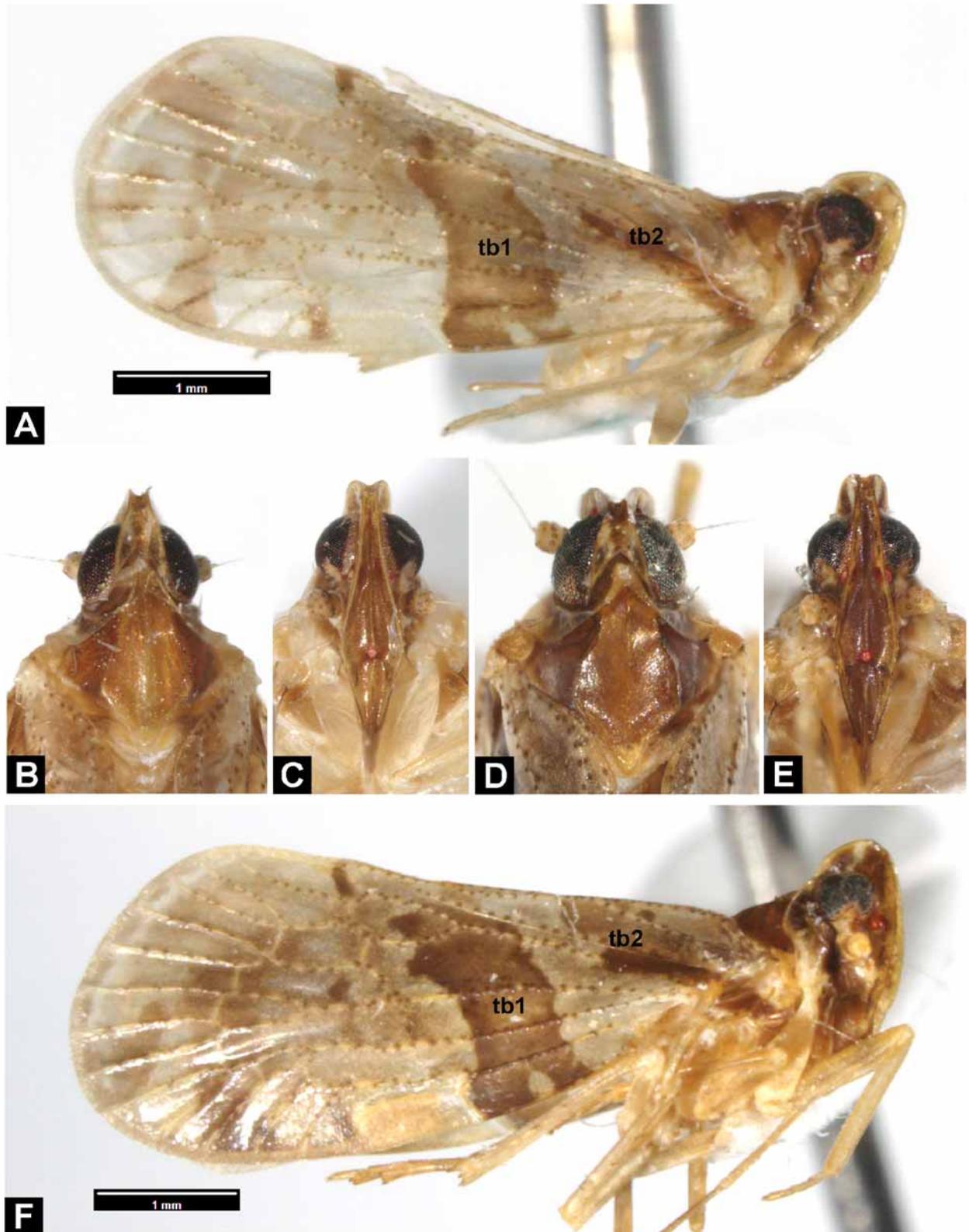
## References

- Alma, A. (2002) Auchenorrhyncha as pests on grapevine. *Denisia*, 4, 531–538.
- Danet, J.L., Foissac, X., Zreik, L., Salar, P., Verdin, E., Nourrisseau, J.G., & Garnier, M. (2003) "*Candidatus* Phlomobacter fragariae" is the prevalent agent of marginal chlorosis of strawberry in French production fields and is transmitted by the planthopper *Cixius wagneri* (China). *Phytopathology*, 93, 644–649.
- Distant, W.L. (1907) Rhynchotal Notes XLI. *Annals and Magazine of Natural History*, (7) 19, 277–295.
- Distant, W.L. (1911) Description of new genera and species of Oriental Homoptera. *Annals and Magazine of Natural History* (8) 8, 735–747.
- Emeljanov, A.F. (2002) Contribution to classification and phylogeny of the family Cixiidae (Hemiptera, Fulgoromorpha). *Denisia*, 4, 103–112.
- Fennah, R.G. (1956) Fulgoroidea from Southern China. *Proceedings of the California Academy of Sciences. Fourth Series*, 28, 441–527.
- Fennah, R.G. (1957) Fulgoroidea from the Belgian Congo (Hemiptera Homoptera). *Annales du Musée Royal du Congo Belge, Sciences Zoologiques*, 59, 1–206.
- Fennah, R.G. (1978) Fulgoroidea (Homoptera) from Vietnam. *Annales Zoologici. (Warsaw)*, 34, 207–280.
- Fennah, R.G. (1985) A new name in *Andes* (Hom., Fulgoroidea: Cixiidae). *Entomologist's Monthly Magazine*, 121 (Jan.–Apr.), 85.
- Holzinger, W.E., Emeljanov, A.F., & Kammerlander, I. (2002) The family Cixiidae Spinola 1839 (Hemiptera: Fulgoromorpha)—a Review. *Denisia*, 4, 113–138.
- Jacobi, A. (1928) Results of Dr E. Mjöberg's Swedish Scientific Expeditions to Australia 1910–1913. Rhynchota, Homoptera. 1. Fulgoridae und Cercopidae. *Arkiv for Zoologi*, 19A, 1–50.
- Kirkaldy, G.W. (1907) Leafhoppers - Supplement (Hemiptera). *Bulletin of the Hawaiian Sugar Planters' Association Division of Entomology*, 3, 1–186.
- Liefting, L.W., Padovan, A.C., Gibb, K.S., Beever, R.E., Andersen, M.T., Newcomb, R.D., Beck, D.L., & Forster, R.L.S. (1998) '*Candidatus* Phytoplasma australiense' is the phytoplasma associated with Australian grapevine yellows, papaya dieback and *Phormium* yellow leaf diseases. *European Journal of Plant Pathology*, 104, 619–623.
- Löcker, B., Fletcher, M.J., Gurr, G.M., Holzinger, W.E., & Löcker, H. (2006) Taxonomic and phylogenetic revision of the Gelastocephalini (Hemiptera: Cixiidae). *Invertebrate Systematics* 20, 59–160.
- Maixner, M., Ahrens, U., & Seemüller, E. (1995) Detection of the German grapevine yellows (Vergilbungskrankheit) MLO in grapevine, alternative hosts and a vector by a specific PCR procedure. *European Journal of Plant Pathology*, 101, 241–250.
- Muir, F. (1921) On Some Samoan Fulgorids (Homoptera). *Proceedings of the Hawaiian Entomological Society*, 4, 564–584.
- Muir, F. (1922) New Indian Homoptera. *Records of the Indian Museum*, 24, 343–355.
- Muir, F. (1925a) *Parandes*, a new Cixiid genus (Homoptera, Fulgoroidea). *The Philippine Journal of Science*, 26, 511–513.
- Muir, F. (1925b) The genus *Andes* Stål (Cixiidae: Homoptera). *Philippine Journal of Science*, 27, 201–226.
- Muir, F. (1926) *Spolia Mentawiensia*: Fulgoroidea, Homoptera. *Malayan Branch Royal Asiatic Society*, 4, 392–412.
- Stål, C. (1866) Hemiptera Homoptera Latreille. *Hemiptera Africana*, 4, 1–276.
- Stål, C. (1870) Hemiptera insularum Philippinarum. Bidrag till Philipppinska öarnes Hemipter-fauna. *Öfversigt af Kongliga Svenska Vetenskaps-Akademiens Förhandlingar*, 27, 607–776.

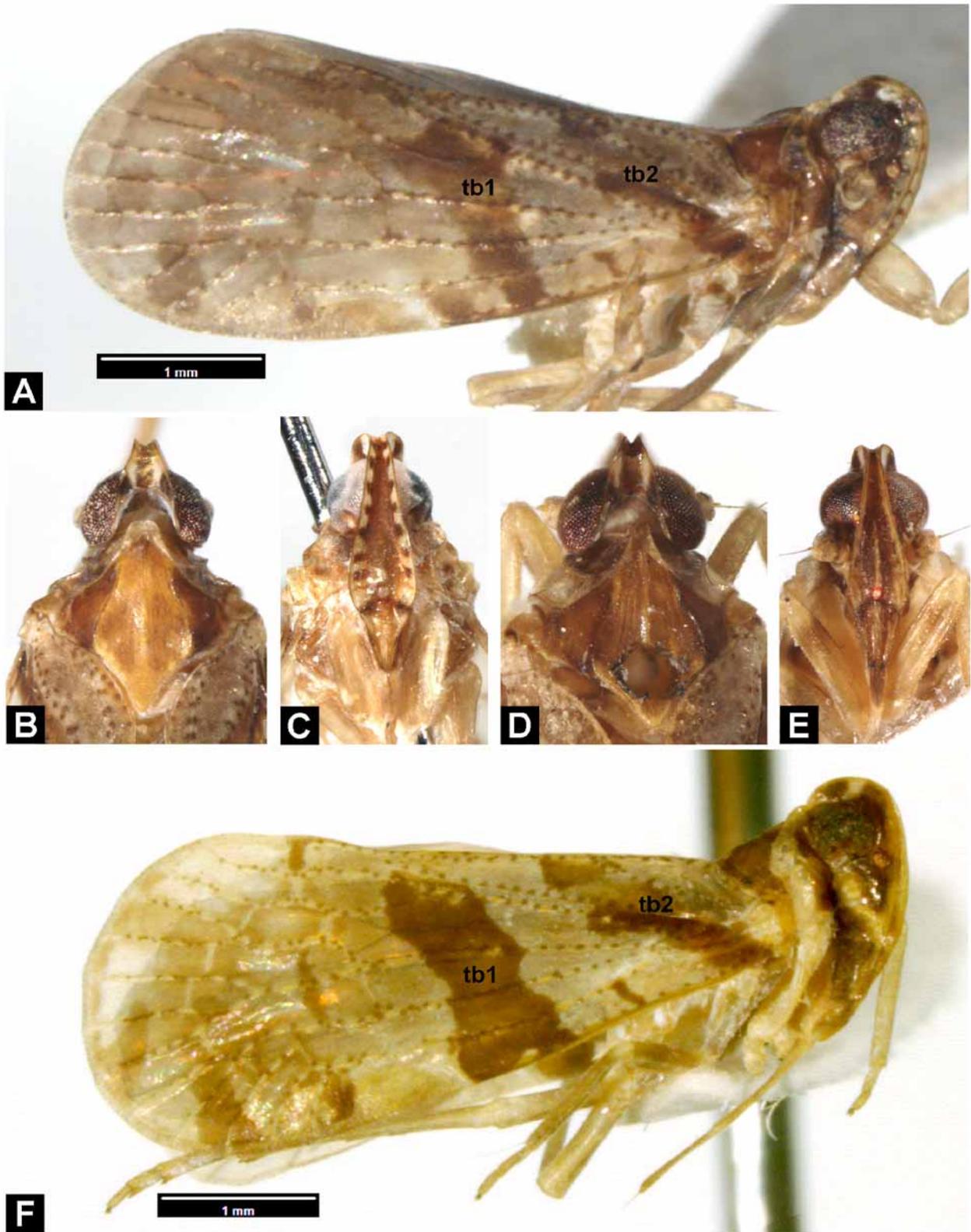
- Synave, H. (1953a) Cixiidae (Hemiptera Homoptera). *Institut des Parcs Nationaux du Congo Belge or Parc National Albert I. Mission G.F. De Witte 1922–1935*, 79, 9–34.
- Synave, H. (1953b) Exploration du Parc National de l'Upemba. *Institut des Parcs Nationaux du Congo Belge*, 23, 1–49.
- Synave, H. (1960) Cixiidae (Homoptera-Fulgoroidea). *Exploration du Parc National de la Garamba, Mission H. de Saeger*, 18 (2), 2–44.
- Synave, H. (1967) Contribution à la faune du Congo (Brazzaville). Mission A. Villiers et A. Descarpentries. XLVII. Homoptères Cercopidae et Fulgoroidea. *Bulletin de l'I.F.A.N.*, 29, sèr. A, 1, 347–369.
- Van Stalle, J. (1982) Scientific results of the Belgian Mount-Cameroon Expedition (February – April 1981) III. Fam. Cixiidae, Derbidae, Meenoplidae, Dictyopharidae, Achilidae, Lophopidae, and Tettigometridae (Homoptera – Fulgoroidea). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Entomologie*, 54 (6), 1–18.
- Van Stalle, J. (1983) Description of new Cixiidae from the genera *Andes* Stål and *Myndus* Stål (Homoptera, Fulgoroidea). *Biologisch Jaarboek*, 51, 67–78.
- Van Stalle, J. (1984a) Les Cixiides de la foret de tai (Côte-d'Ivoire) description de neuf especes nouvelles (Homoptera, Fulgoroidea). *Revue Française d'Entomologie*, 6, 137–146.
- Van Stalle, J. (1984b) New and interesting African Cixiidae (Homoptera, Fulgoroidea), with notes on synonymy. *Annales Zoologici Fennici*, 21, 105–128.
- Van Stalle, J. (1985) Five new Cixiidae (Homoptera, Fulgoroidea) from Papua New Guinea. *Annales de la Société Royale Zoologique de Belgique*, 115 (2), 155–163.
- Van Stalle, J. (1986) New and interesting Cixiidae (Homoptera, Fulgoroidea) from the Cameroon Highlands. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Entomologie*, 56, 25–33.
- Van Stalle, J. & Synave, H. (1984) Description of four new West African Cixiidae (Homoptera, Fulgoroidea). *Proceedings of the Entomological Society of Washington*, 86, 217–222.



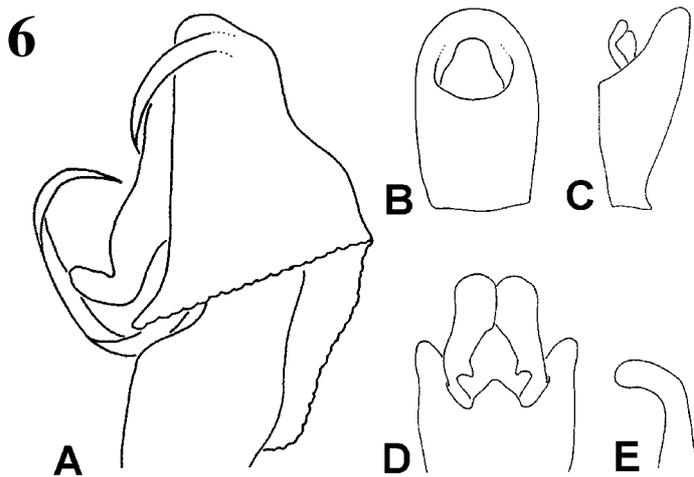
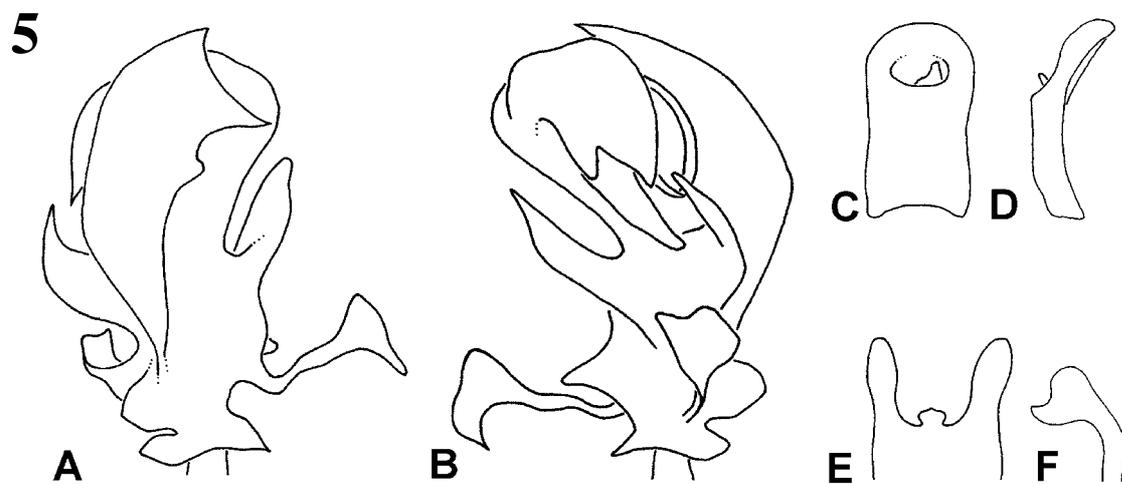
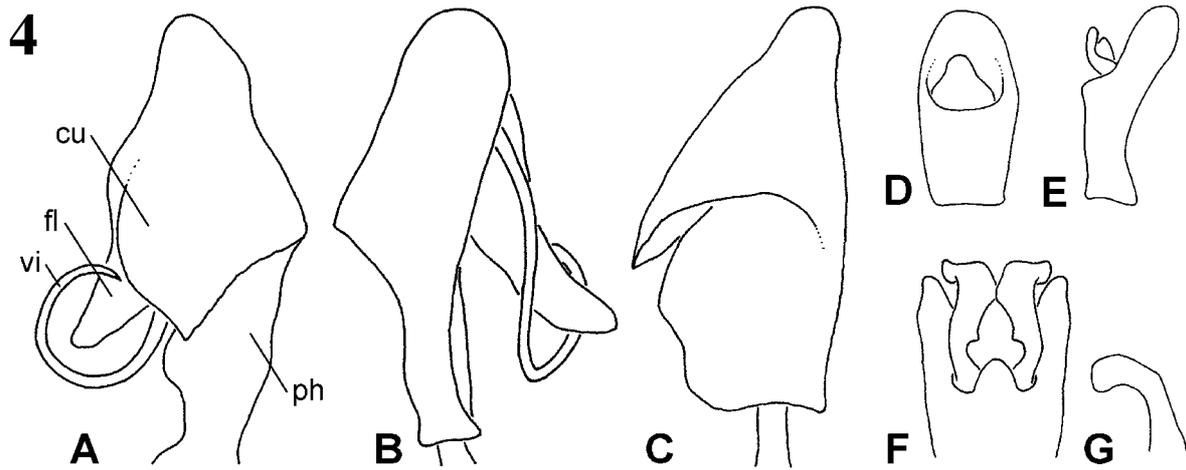
**FIGURE 1.** *Andes dossenus*: A habitus; B, C head. *A. ikeus*: D, E head; F habitus. tb1 = transverse band 1; tb2 = transverse band 2.



**FIGURE 2.** *Andes lamondensis*: A habitus; B, C head. *A. migratorius*: D, E head; F habitus. tb1 = transverse band 1; tb2 = transverse band 2.



**FIGURE 3.** *Andes moaensis*: A habitus; B, C head. *A. turrondi*: D, E head; F habitus. tb1 = transverse band 1; tb2 = transverse band 2.

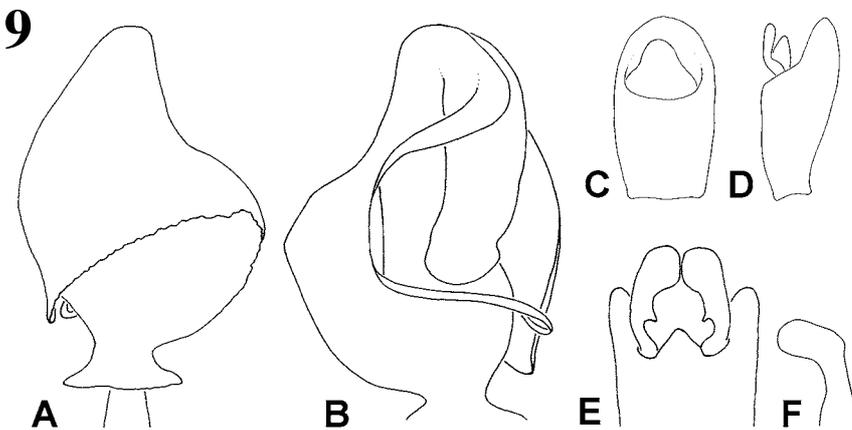
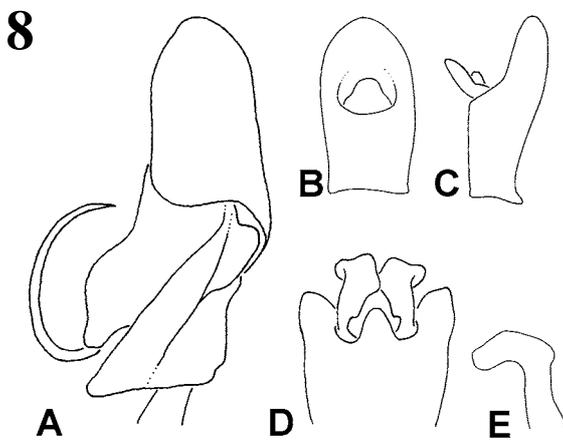
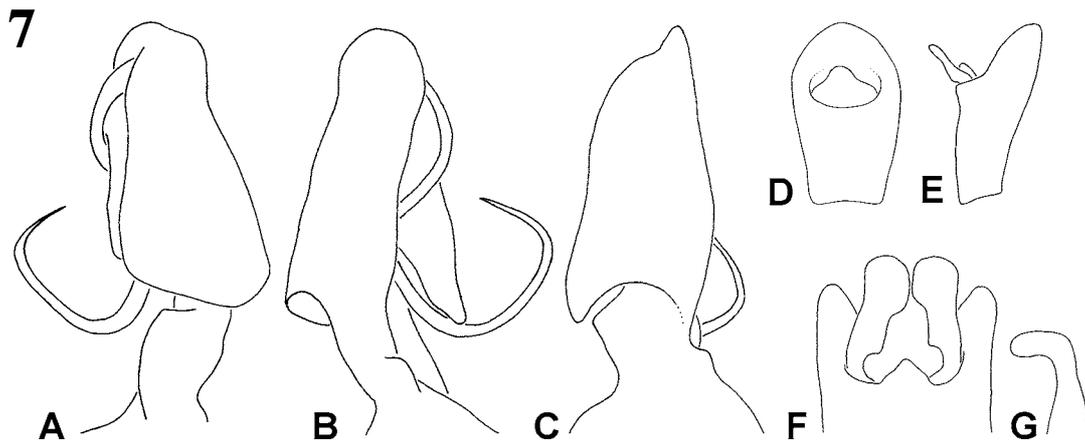


**FIGURE 4.** *Andes dosseus*: A–C aedeagus, (A) left lateral (B) right lateral (C) ventral; D, E anal tube; F, G genital styles.

Abbreviations: cu = cucullus, fl = flagellum, ph = phallosome, vi = virga.

**FIGURE 5.** *A. ikelus*: A, B aedeagus, (A) left lateral (B) right lateral; C, D anal tube (damaged); E pygofer, F genital style.

**FIGURE 6.** *A. lamondensis*: A aedeagus, left lateral; B, C anal tube; D, E genital styles.



**FIGURE 7.** *Andes migratorius*: A–C aedeagus, (A) left lateral (B) right lateral (C) ventral; D, E anal tube; F, G genital styles.

**FIGURE 8.** *A. moaensis*: A aedeagus, left lateral; B, C anal tube; D, E genital styles.

**FIGURE 9.** *A. turrondi*: A, B aedeagus, (A) left lateral (B) dorsal; C, D anal tube; E, F genital styles.



**FIGURE 10.** Known distribution. A *Andes dosseus*; B *A. ikelus*; C *A. lamondensis*; D *A. migratorius*; E *A. moensis*; F *A. turrondi*.

