

***Ehrendorferiana*, a new genus of Neotropical jumping plant lice (Insecta: Hemiptera: Psylloidea) associated with conifers (Cupressaceae)**

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Abstract

Ehrendorferiana, n. gen. and its two included new species, *E. austrocedri* (type species) and *E. fitzroyae* are diagnosed and illustrated. The new genus is a member of the predominantly temperate Neotropical subfamily Aphalaroidinae (Psyllidae). It forms a likely monophyletic group with *Baccharopelma*, *Panisopelma* and *Russelliana*, and probably is the sister taxon of the latter genus. Apart from two species of Triozidae from New Zealand, *Ehrendorferiana* is unique within Psylloidea in its host association with conifers.

Keywords: Hemiptera; Psylloidea; Cupressaceae; Neotropical; Taxonomy; New taxa

Introduction

Jumping plant lice constitute a small group of plant sap-sucking insects. Most of the slightly over 3000 described species are very host-specific, particularly during the larval phase. In general, psylloids are associated with dicotyledonous angiosperms (Hollis 2004; Burckhardt 2005). A few exceptions are known of psylloids developing on monocotyledonous angiosperms: the Holarctic genus *Livia* on *Juncus* and *Carex* (Hodkinson and Bird 2000), five species of the Hawaiian *Megatrioza* on *Pritchardia* (Uchida and Beardsey 1988), at least two Palaearctic *Bactericera* species on *Allium* (Burckhardt and Lauterer 1997), and an undescribed Australian species on *Livistonia* (Hollis 2004). While the adults of many Holarctic species overwinter on conifers, on which they may feed when the temperatures are warm enough, only two species are known so far that develop on conifers, i.e. *Trioza colorata* (Ferris & Klyver, 1932) and *T. dacrydii* Tuthill, 1952, associated with *Dacrydium* species (Podocarpaceae) in New Zealand (Tuthill 1952). Here a new genus of the unrelated Aphalaroidinae (Psyllidae) is described for two new Chilean species associated with the conifer family Cupressaceae.

Material and methods

Material was examined from the Muséum d'histoire naturelle Genève (MHNG) and Naturhistorisches Museum Basel (NHMB); additional paratypes are deposited in The Natural History Museum London (BMHN) and the Museo Nacional de Historia Natural Santiago de Chile (MNSC). Drawings and measurements were made from slide-mounted material. The morphological nomenclature mostly follows Ossiannilsson (1992).

Taxonomy

***Ehrendorferiana*, new genus**

Etymology. The genus is dedicated to Professor Dr. Friedrich Ehrendorfer (University of Vienna), honorary member of the Society for Biological Systematics (GfBS) and eminent botanist in the field of plant evolution and geography.

Type species. *Ehrendorferiana austrocedri*, n. sp., by present designation.

Diagnosis. Adult. Head (Figs. 2, 3) as wide as mesoscutum, with concave hind margin; inclined, in profile, at a 45° angle to longitudinal body axis (Fig. 1). Vertex trapezoidal, with indented foveae, otherwise

relatively flat, smoothly passing into genae anteriorly, lacking large humps on either side of mid-line anteriorly, at most with flat tubercle; lateral ocelli at posterior edge of vertex, not on raised tubercles. Genal processes short or moderately long, conical, subacute, contiguous or well separated medially. Setae on vertex microscopic, on genal processes moderately long. Sculpture on vertex consisting of plate-like structures along the margins, indistinct or completely reduced in the middle; on genal processes consisting of transverse, scale-like structures. Eyes hemispherical or subglobular. Antenna 10-segmented; a single subapical rhinarium on each of segments 4, 6, 8 and 9; rhinarium covered with a few longer spines at base (Figs. 12, 13); segment 10 shorter and more slender than segment 9 (Figs. 12, 13). Thorax, in profile, moderately arched dorsally. Pronotum transversely ribbon-shaped; propleurites narrow, suture oblique with only one dorsal arm developed, proepisternum smaller than proepimerum (Fig. 14). Mesopraescutum lens-shaped; mesoscutum convex; mesoscutellum and metascutellum weakly produced, not horn-shaped. Forewing (Figs. 4, 5) oval, broadly rounded apically; costal break present; pterostigma well-developed, long; vein Rs almost straight; veins M+Cu₁ and Cu₁ subequal in length; vein M weakly curved; cells m₁ and cu₁ subequal; anal break near apex of vein Cu_{1b}; surface spinules densely, irregularly spaced, covering entire surface up to the veins with the exception of a small area at base of cell c+sc. Hindwing slightly shorter than forewing; costal setae grouped; vein Cu₁ indistinct at base, not clearly joining neither R nor M. Metacoxa with large, pointed meracanthus; metatibia with or without genual spine, bearing a posteriorly open crown of 8-10 short, partly densely spaced, sclerotised apical spurs; metabasitarsus lacking lateral sclerotised spurs. Male terminalia (Figs. 6, 10) bearing tubular proctiger and slightly elongate subgenital plate. Paramere (Figs. 8, 9) simple, narrowing to apex which is curved inwards and backwards; outer face with long setae in apical half, inner face covered in long setae except for base and apex. Aedeagus with basal portion narrowly curved proximally, straight distally apart from weakly sinuous apical part; distal segment (Figs. 7, 11) with two short, pointed processes ventrally; sclerotised end tube of ductus ejaculatorius moderately long and weakly sinuous. Female terminalia (Figs. 15, 16) relatively short; proctiger with large circumanal ring; subgenital plate bare basally, covered in setae apically. Dorsal valvula membranous, irregularly rounded apically; inner valvula cuneate; ventral valvula straight, bearing two subapical lateral teeth, pointed apically.

Fifth instar larva (Fig. 19). Body elongate; across wing pads almost as wide as long. Dorsal face with macroscopic simple setae restricted to cephalothoracic

plate and eye; remainder of dorsal surface covered in microscopic simple setae, sclerites bearing microsculpture. Antenna 7-segmented with a single subapical rhinarium each on segments 3 and 5, and two on segment 7. Meso- and metanotal sclerites relatively small. Forewing pad large, lacking humeral lobes and specialised dorsal or lateral setae. Hindwing pad lacking specialised setae. Legs moderately long; claws and arolium developed; petiole about as long as claws (Fig. 18). Caudal plate large, with indistinct blunt angle apically. Circumanal ring (Fig. 20) ventral, relatively small, distance from hind margin to abdominal apex shorter than ring width; outer ring composed of a single row of very elongate, narrow pores.

Comments. The temperate Neotropical *Ehrendorferiana*, n. gen. comprises two species, *E. austrocedri*, n. sp. and *E. fitzroyae*, n. sp., which can be separated by the characters listed in Table 1. The members of both species are associated with Cupressaceae.

Ehrendorferiana austrocedri, new species

Etymology. The species is named after its host plant, *Austrocedrus*, a genus of Cupressaceae restricted to southern Chile and Argentina.

Type material. Holotype ♂. Chile: VIII Región, Prov. Bio Bio, Parque Nacional Laguna del Laja, sector Chacay, 1200 m, 19.i.1996, *Austrocedrus chilensis* (D. Burckhardt) (MHNG, dry-mounted). Paratypes. Chile: 55 ♂, 48 ♀, 7 larvae, same data as holotype (MHNG, NHMB, dry- or slide-mounted, or in 70% alcohol); 24 ♂, 25 ♀, 1 larva, sector Lagunillas, 1100 m, 21.i.1996 (MHNG, BMHN, NHMB, MNSC, dry- or slide-mounted, or in 70% alcohol); 2 ♂, 4 ♀, same as preceding except sectors Saltos Chilcas and Torbellino (MHNG, dry-mounted); 4 ♂, 4 ♀, same data except sector to El Abanico, 900-1100 m, 22.i.1996 (MHNG, dry-mounted, or in 70% alcohol); 3 ♀, IX Región, Prov. Cautín, Parque Nacional Conguillío, south entrance, 800 m, 30.i.1996, *Austrocedrus chilensis* (D. Burckhardt) (MHNG, dry-mounted).

Description. Adult. Coloration. Head yellow or ochreous dorsally, slightly lighter ventrally; ocelli reddish, eyes grey; antenna yellow with brown apices of segments 4-8, segment 9 brown, segment 10 black. Clypeus yellowish. Thorax ochreous, pronotum and thorax laterally slightly lighter. Legs yellow with tarsal apices and claws brown. Forewing semitransparent, ochreous, veins and membrane concolorous. Abdomen including terminalia ochreous, tip of paramere and tip of female proctiger dark brown or black. Younger specimens lighter, yellow rather than ochreous.

Structure. Genal processes short, medially contiguous at base; eyes hemispherical (Fig. 2). One terminal antennal seta longer and one shorter than antennal

Table 1: Characters separating *Ehrendorferiana austrocedri*, n. sp. and *E. fitzroyae*, n. sp.

Characters	<i>E. austrocedri</i>	<i>E. fitzroyae</i>
<u>Adult</u>		
General body coloration	ochreous	reddish brown, with dark brown abdominal sclerites
Genal processes	short, medially contiguous at base (Fig. 2)	moderately long, well separated medially (Fig. 3)
Eyes	hemispherical (Fig. 2)	subglobular (Fig. 3)
Terminal antennal setae	1 shorter, 1 longer than antennal segment 10 (Fig. 12)	both longer than antennal segment 10 (Fig. 13)
Forewing	apex narrowly rounded, vein Cu ₁ shorter than or as long as Cu _{1b} (Fig. 4)	apex widely rounded, vein Cu ₁ longer than Cu _{1b} (Fig. 5)
Genua spine	absent	present
Apical dilatation of distal portion of aedeagus	irregularly angular (Fig. 7)	lens-shaped (Fig. 11)
Dorsal outline, in profile, of female proctiger distal to circumanal ring	evenly curved (Fig. 15)	angular (Fig. 16)
Female subgenital plate	short (Fig. 15)	long (Fig. 16)
<u>Fifth instar larva</u>		
Forewing pad	outer margin almost straight in the middle (Fig. 17)	outer margin evenly curved (Fig. 19)
Host plant	<i>Austrocedrus chilensis</i>	<i>Fitzroya cupressoides</i>

segment 10 (Fig. 12). Forewing with apex narrowly rounded; vein Cu₁ shorter than or as long as Cu_{1b} (Fig. 4). Metatibia without genua spine, bearing a crown of 8-9 apical sclerotised spurs. Apical dilatation of distal portion of aedeagus irregularly angular (Fig. 7). Dorsal outline of female proctiger, in profile, distal to circumanal ring evenly curved; female subgenital plate short (Fig. 15). Measurements and ratios as in Tables 2 and 3.

Fifth instar larva. Coloration. Body dirty yellowish. Antenna yellow basally, brown in apical third. Apices of tarsi brown.

Structure. Outer margin of forewing pad almost straight in the middle (Fig. 17). Measurements and ratios as in Table 4.

Host plant. *Austrocedrus chilensis* (D. Don) Pic. Serm. & Bizzarri (Cupressaceae).

***Ehrendorferiana fitzroyae*, new species**

Etymology. The species is named after its host plant, *Fitzroya*, a genus of Cupressaceae restricted to southern Chile and Argentina.

Type material. Holotype ♂. Chile: X Región, Prov. Valdivia, Monumento Natural Alerce Costero, near El Mirador, ca. 25-30 km W La Unión, 850 m, 29.xii.1990, *Fitzroya cupressoides* (D. Burckhardt & D. Agosti) (MHNG, dry-mounted). Paratypes. Chile: 8 ♂, 10 ♀, 62 larvae, same data as holotype (MHNG, BMNH, MNSC, NHMB, dry- or slide mounted); 18 larvae, X Región, Prov. Chiloé, Parque Nacional Chiloé, Rancho Grande, near Cucao, 300-600 m, 4.i.1991, *Fitzroya cupressoides* in *Fitzroya* forest (D. Burckhardt & D. Agosti) (MHNG, slide-mounted); 1 larva, same data except Rancho Grande, 42°33'S 74°02'W, 250-400 m, 29.xii.1992, *Fitzroya cupressoides* (D. Burckhardt)

(MHNG, dry-mounted); 31 ♂, 30 ♀, 2 larvae, same data except 8.ii.1996 (MHNG, dry- or slide-mounted, or in 70% alcohol).

Description. Adult. Coloration. Head light reddish brown. Antenna with segments 1 and 2 reddish brown or ochreous, segment 3 yellowish, segments 4-8 greyish, segments 9 and 10 almost black; eyes dark greyish. Thorax light reddish brown dorsally, with dark brown sclerites and reddish membrane laterally and ventrally; pronotum and mesopraescutum slightly darker than mesoscutum; mesoscutum sometimes with a hint of longitudinal markings. Forewing semitransparent, with membranes dirty whitish at base and yellowish or ochreous in the middle and apically; veins reddish brown. Hindwing transparent, whitish. Legs dirty greyish-brownish, coxae partially almost black. Abdomen with dark brown sclerites and reddish membranes; male terminalia ochreous with dark tip of paramere, female terminalia dark brown. Younger specimens with less extensive dark colour.

Structure. Genal processes moderately long, well separated medially; eyes subglobular (Fig. 3). Both terminal antennal setae longer than antennal segment 10 (Fig. 13). Forewing with apex widely rounded; vein Cu_1 longer than Cu_{1b} (Fig. 5). Metatibia with genual spine, bearing a crown of 8-10 apical sclerotised spurs. Apical dilatation of distal portion of aedeagus lens-shaped (Fig. 11). Dorsal outline of female proctiger, in profile, distal to circumanal ring angular; female subgenital plate long (Fig. 16). Measurements and ratios as in Tables 2 and 3.

Fifth instar larva. Coloration. Head, wing pads and caudal plate straw-coloured; antenna yellow in basal half, brown in apical half. Dorsal thoracic and abdominal sclerites brown, membranous portions reddish. Legs light reddish brown, tarsi brown. Abdominal sternites light brown, membrane reddish.

Structure. Outer margin of forewing pad evenly curved (Fig. 19). Measurements and ratios as in Table 4.

Host plant. *Fitzroya cupressoides* (Molina) I. M. Johnston (Cupressaceae).

Table 2: Measurements (in mm) of adult *Ehrendorferiana* spp. Number of measured specimens = 3 ♂, 3 ♀. Abbreviations: HW = head width; AL = antenna length; WL = forewing length; MP = male proctiger length; PA = paramere length; AE = length of distal portion of aedeagus; FP = female proctiger length.

Species	HW	AL	WL	MP	PA	AE	FP
<i>E. austrocedri</i>	0.60-0.65	0.50-0.65	1.40-1.70	0.20	0.15	0.15	0.40-0.41
<i>E. fitzroyae</i>	0.62-0.70	0.75-0.85	1.50-2.15	0.20	0.15	0.20	0.45-0.50

Table 3: Ratios of adult *Ehrendorferiana* spp. Number of measured specimens = 3 ♂, 3 ♀. Abbreviations: ALHW = antenna length/head width ratio; WLHW = forewing length/head width ratio; WLB = forewing length/breadth ratio; TLHW = metatibia length/head width ratio; MPHWH = male proctiger length/head width ratio; FPHWH = female proctiger length/head width ratio; FPCR = female proctiger length/circumanal ring length ratio; FPFS = female proctiger length/subgenital plate length ratio.

Species	ALHW	WLHW	WLB	TLHW	MPHW	FPHWH	FPCR	FPFS
<i>E. austrocedri</i>	0.82-1.08	2.33-2.75	2.00-2.43	0.50-0.67	0.33	0.62-0.67	2.00-2.05	2.67-4.00
<i>E. fitzroyae</i>	1.10-1.29	2.41-3.07	2.11-2.36	0.56-0.64	0.32	0.66-0.74	2.25-2.50	2.00-2.50

Table 4: Measurements (in mm) and ratios of fifth instar larval *Ehrendorferiana* spp. Abbreviations: n = number of measured specimens; BL = body length; AL = antenna length; WL = forewing pad length; CPW = caudal plate width; BLW = body length/width ratio; ALWL = antenna length/forewing pad length ratio; CPLW = caudal plate length/width ratio; CPRW = caudal plate width/circumanal ring width ratio.

Species	n	BL	AL	WL	CPW	BLW	ALWL	CPLW	CPRW
<i>E. austrocedri</i>	1	1.50	0.40	0.50	0.60	1.15	0.8	0.67	3.00
		1.05-	0.40-	0.50-	0.55-	1.04-	0.75-	0.54-	3.67-
<i>E. fitzroyae</i>	3	1.20	0.48	0.60	0.70	1.15	0.96	0.64	4.67

Phylogenetic considerations

Ehrendorferiana, n. gen. belongs to the psyllid subfamily Aphalaroidinae which was redefined by Burckhardt (1987) who included eight New World genera, viz. *Aphalaroida*, *Baccharopelma* (as *Neopelma*), *Connectopelma*, *Panisopelma*, *Prosopidopsylla*, *Sphinia*, *Russelliana* and *Zonopelma*. The following four genera also belong to the Aphalaroidinae: the Afrotropical *Pachyparia* (Burckhardt and Mifsud 1998), the New World *Freysuila*, the Old World *Yangus* (D. Hollis, pers. comm.), and the American *Telmapsylla* (NHMB data).

Within the Aphalaroidinae, *Ehrendorferiana* forms a likely monophyletic group together with *Baccharopelma*, *Panisopelma* and *Russelliana* based on the lack of metabasitarsal spurs in the adults. The absence or paucity of long dorsal or marginal setae on the larval forewing pads and the relatively small circumanal ring with narrow, elongate pores suggest a probable sister-taxon relationship of *Ehrendorferiana* with *Russelliana*. Larval *Panisopelma* have wing pads covered in long capitate setae, and those of *Baccharopelma* moderately long simple setae. The larvae of *Ehrendorferiana* differ from those of *Russelliana* in the pedicel length of the tarsal arolium. It is about as long as the claws in the former but distinctly longer in the latter. Adult *Ehrendorferiana* differ from those of *Russelliana* in paramere shape, which is narrow and simple in the former but broad with a tooth or thumb-like anterior process in the latter. The aedeagus in *Ehrendorferiana* is elongate with short median processes, whereas in *Russelliana* it is short, massive bearing an apical beak-like extension, and often large median processes. Adult *Ehrendorferiana* differ from those of *Panisopelma* in the absence of an R-M cross-vein in the forewing, simple parameres, and the distal portion of the aedeagus bearing two median processes; adult *Baccharopelma* differ from *Ehrendorferiana* in the lamellar parameres and the posteriorly truncate female proctiger.

Discussion

Ehrendorferiana is unique among Psylloidea in its host association with the conifer family Cupressaceae. Two trioqid species from New Zealand also develop on conifers but of the family Podocarpaceae. Neither *Ehrendorferiana* nor the two trioquids from New Zealand are primitive psyllids, and thus both associations with conifers represent derived features. According to Burckhardt (2005) the Aphalaroidinae belongs to the probably monophyletic "psyllid assemblage" together with the Psyllinae/Arytaininae, Ciriacecreminae, Acizziinae, and Euphalerinae which primitively probably was associated with Fabaceae. Again within the Aphalaroidinae five genera are exclusively and one partially associated with Fabaceae (Table 5). Among the five former are the two Old World genera which together possibly constitute the sister group of the remainder of the subfamily which is restricted to the New World (Table 5). It is therefore likely that the association with Fabaceae constitutes also the primitive condition within the Aphalaroidinae. The subfamily successfully radiated in the New World probably by repeated shifts to new host taxa including Cupressaceae.

The family Cupressaceae is represented in Chile with three genera, each containing a single species. *Austrocedrus chilensis* and *Fitzroya cupressoides* each host a psyllid species. On the third species, *Pilgerodendron uviferum* (D. Don) Florin, no psyllids could be found, despite intensive searches in southern Chile (X Región) (D. Burckhardt, pers. observation).

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Table 5: Known genera of Aphalaroidinae, with distribution and host associations.

Genus	Biogeographical region	Host taxon
<i>Aphalaroida</i> Crawford	New World	Fabaceae
<i>Baccharopelma</i> Burckhardt, Espírito-Santo, Fernandes & Malenovský	Neotropical	<i>Baccharis</i> (Asteraceae)
<i>Connectopelma</i> Šulc	Neotropical	Rhamnaceae
<i>Ehrendorferiana</i> , n. gen.	Neotropical	Cupressaceae
<i>Freysuila</i> Aleman	New World	Fabaceae
<i>Pachyparia</i> Loginova	Afrotropical	Fabaceae
<i>Panisopelma</i> Enderlein	Neotropical	<i>Larrea</i> (Zygophyllaceae)
<i>Prosopidopsylla</i> Burckhardt	Neotropical	Fabaceae
<i>Russelliana</i> Tuthill	Neotropical	many families of dicotyledonous angiosperms, including Fabaceae
<i>Sphinia</i> Blanchard	Neotropical	<i>Colliguaja</i> (Euphorbiaceae) and <i>Kageneckia</i> (Rosaceae)
<i>Telmapsylla</i> Hoskinson	New World	<i>Avicennia</i> (Verbenaceae)
<i>Yangus</i> Fang	Old World	Fabaceae
<i>Zonopelma</i> Burckhardt	Neotropical	<i>Misodendrum</i> (Misodendraceae)

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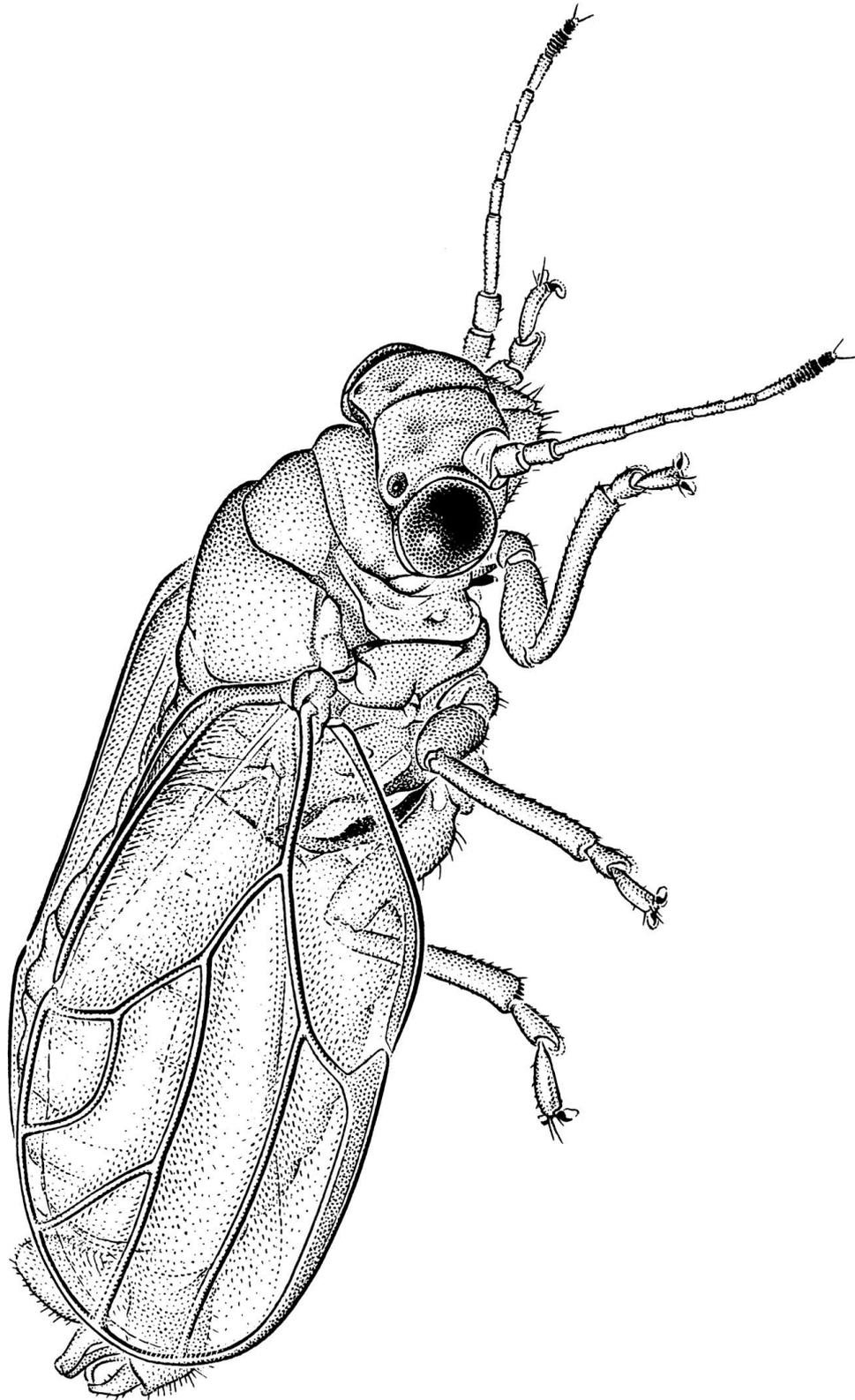
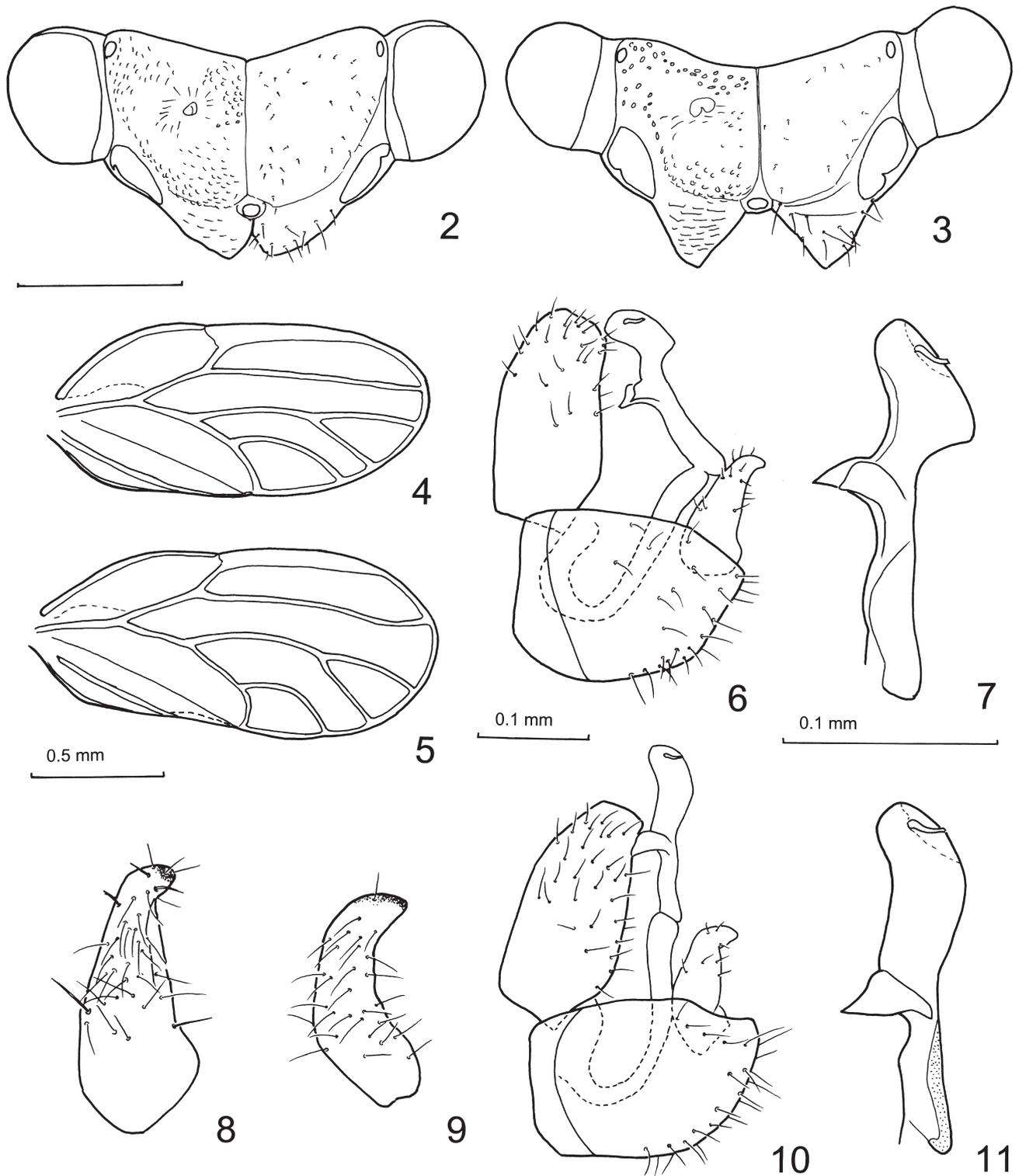
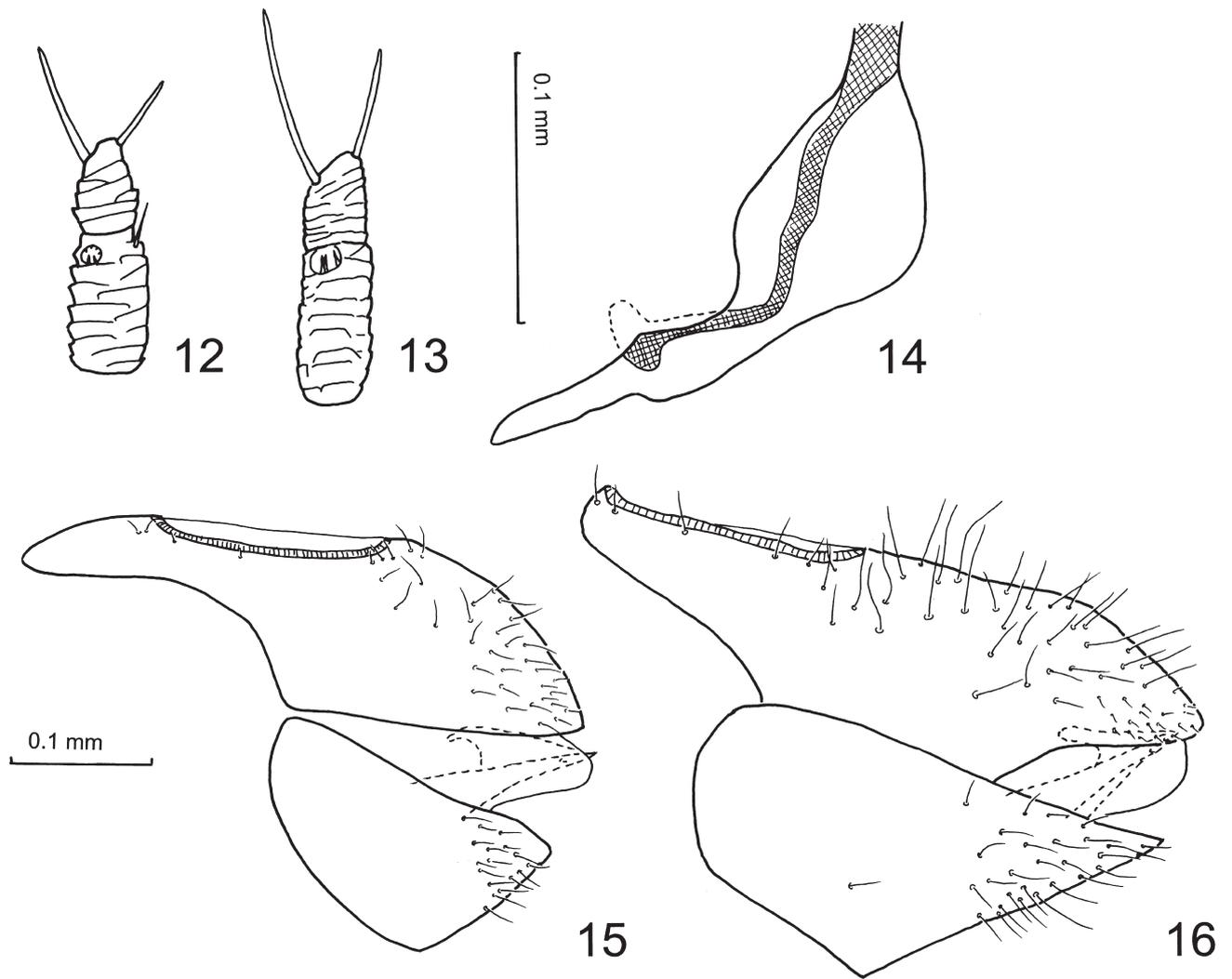


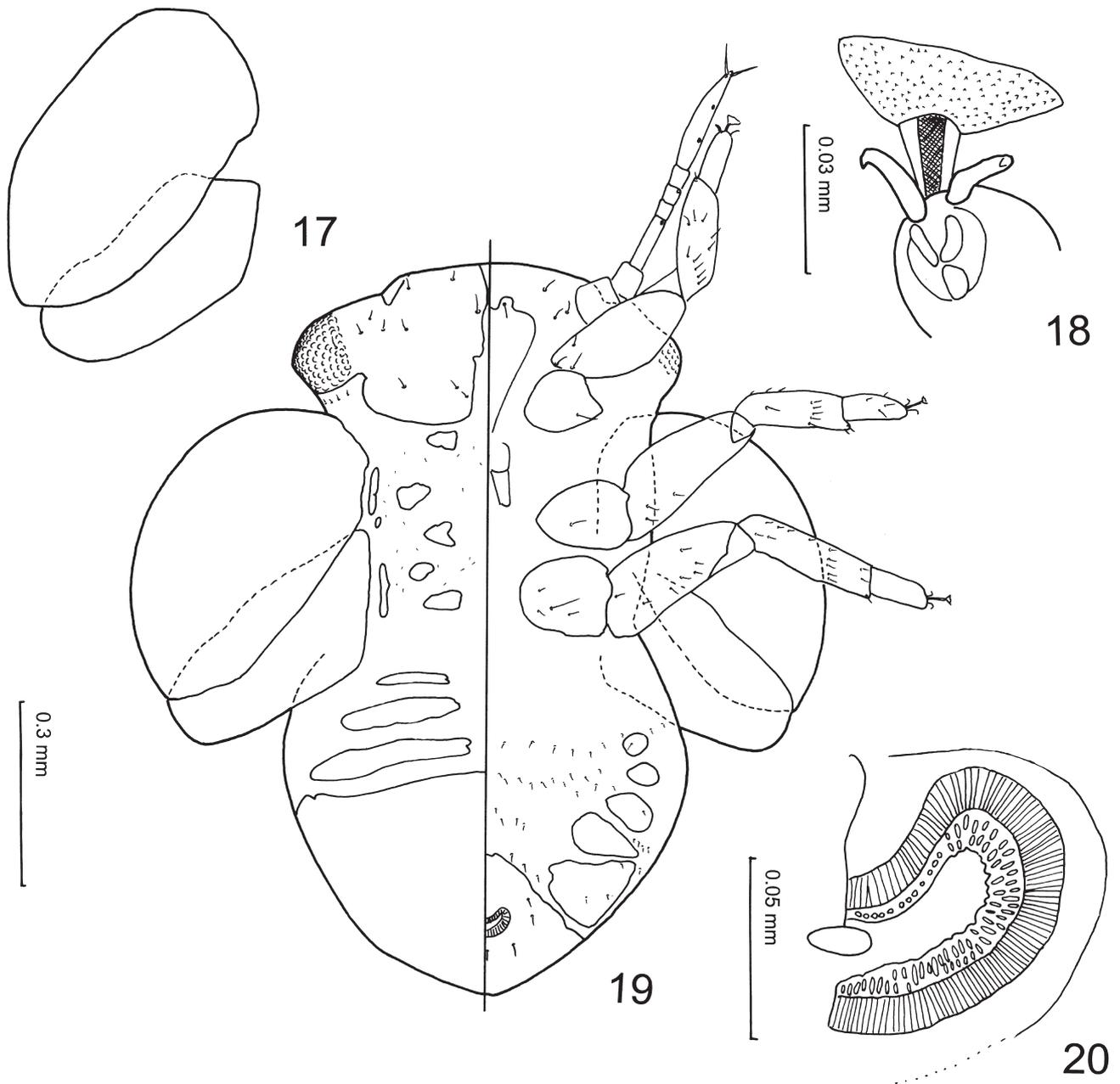
Fig. 1: *Ehrendorferiana austrocedri*, sp. n., habitus of male (drawing A. Coray).



Figs. 2-11: *Ehrendorferiana* spp., adult structures. (2; 3) head, dorsal view; (4; 5) forewing; (6, 10) male terminalia, in profile; (7, 11) distal portion of aedeagus; (8, 9) paramere, inner surface. 2, 4, 6-8 = *E. austrocedri*; 3, 5, 9-11 = *E. fitzroyae*. Scale bars: 2, 3 = 0.2 mm; 4, 5 = 0.5 mm; 6, 10 = 0.1 mm; 7-9, 11 = 0.1 mm.



Figs. 12-16: *Ehrendorferiana* spp., adult structures. (12, 13) antennal segments 9 and 10; (14) propleurite; (15, 16) female terminalia, in profile. 12, 15 = *E. austrocedri*; 13, 14, 16 = *E. fitzroyae*. Scale bars: 12-14 = 0.1 mm; 15, 16 = 0.1 mm.



Figs. 17-20: *Ehrendorferiana* spp., larval structures. (17) left wing pads, dorsal view; (18) tarsal apex with claws and arolium; (19) fifth instar larva, left dorsal face, right ventral face; (20) half of circumanal ring. 17 = *E. austrocedri*; 18-20 = *E. fitzroyae*. Scale bars: 17, 19 = 0.3 mm; 18 = 0.03 mm; 20 = 0.05 mm.