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A new genus and species of Lasiopteridi (Diptera, Cecidomyiidae) on *Haplopappus foliosus* (Asteraceae) from Chile



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ABSTRACT

A new genus and species of gall midge, *Haplopappusmyia gregaria*, is described and illustrated (larva, pupa, male, and female). This species induces apical galls on *Haplopappus foliosus* (Asteraceae), an endemic shrub from central Chile. The specimens were collected at La Ligua Municipality, Petorca Province, Valparaíso region, Chile, during spring of 2011–2014. This area corresponds to one of the fifth Mediterranean Matorral biome, considered among Earth's biodiversity hotspots. The new genus is characterized by presenting lateral margin of antennal scape with a mesal reentrance; four-segmented palpus, one-toothed tarsal claws, R5 straight, reaching C anterior to wing apex; male seventh and eighth tergites lacking sclerotization mesally, beyond proximal margin; presence of trichoid sensilla on the abdominal terga and sterna of both sexes, protrusible ovipositor with elongate fused cerci, and larva with 4 pairs of setose terminal papillae.

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Introduction

The Chilean fauna of Cecidomyiidae is poorly known. It comprises only 29 species according to Gagné and Jaschhof, 2014 and most part were described at the beginning of the 20th century. Recent contributions are very scarce.

In this paper, a new genus of Lasiopteridi is described from galls formed from leaf swelling on the apical tip of *Haplopappus foliosus* DC. (Asteraceae) branches, a plant from central Chile. This host plant is an endemic shrub common to the coastal Mediterranean Matorral's sclerophyllous/xeric plant community. This shrub is present from Coquimbo to Maule regions (Gajardo, 1994). *H. foliosus* has been mainly studied due to its resinous surface chemistry (Urzúa, 2004; Urzúa et al., 2010) with insecticidal and antibacterial properties (Urzúa et al., 2003), whereas most of its ecological interactions remaining unknown.

Material and methods

Studied area

Field works were done by CV at Los Molles, Bioparque Puquén (site 1: 32°10'51.70"S; 71°32'1.64"O and site 2: 32°14'15.36"S;

71°31'16.67"O and at Punta Pullally, Pullally (site 3: 32°24'43.80"S; 71°24'51.59"O), La Ligua Municipality, Petorca Province, Chile, during spring and summer of 2011–2014 (Fig. 1). This area corresponds to one of the fifth Mediterranean biomes and it is considered one of Earth's biodiversity hotspots (Myers et al., 2000). This kind of environment occupy only 5% of Earth terrestrial surface but hosts over 20% of vascular plant species (Cowling et al., 1996; Butchart et al., 2010), and it is currently under risk due to human activities such mining, forestry, agriculture and urbanization (Andrade and Hidalgo, 1996; Smith-Ramírez, 2004; Pauchard et al., 2006). Vegetation in this ecoregion is distributed in coastal terraces and is dominated by endemic species of sclerophyllous trees, shrubs and cacti from the *Lithreo-Lucumetum* association (Parsons and Parsons, 1976; Rundel, 1981). The most representative plant genera are: *Bahia* Lag. (Asteraceae), *Fuchsia* L. (Onagraceae), *Puya* Molina (Bromeliaceae), *Pouteria* Aubl. (Sapotaceae) and *Haplopappus* Cass. (Asteraceae) (Enríquez et al., 2012). Weather it is characterized by a low thermal oscillation, with an annual average temperature of 14°C, average 450 mm in annual precipitation, and 75% average humidity, keeping this level almost the whole year due to oceanic influence (Di Castri and Hajek, 1976).

Despite territorial narrowness, the Chilean Mediterranean region is strongly marked by sharp humidity gradients from east to west; with western coastal terraces enriched by the strong rain-shadow effect of the Coastal Cordillera (Armesto et al., 2007). The interception of this western winds causes a considerable

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Fig. 1. Map of Collection Sites in Petorca Province, Valparaiso Region, Chile. Left panel show three main sites: Bioparque Puquén (site 1: $32^{\circ}10'51.70''\text{S}$; $71^{\circ}32'1.64''\text{O}$ and site 2: $32^{\circ}14'15.36''\text{S}$; $71^{\circ}31'16.67''\text{O}$ and at Punta Pullally (site 3: $32^{\circ}24'43.80''\text{S}$; $71^{\circ}24'51.59''\text{O}$). Right panel show northern half-Chile map highlighting Petorca Province, V Region, Chile.

drop in humidity and precipitation in central depression and eastern montane valleys (Armesto et al., 2007). In this highly-environmentally variable land strip, *Haplopappus* is one of the most diverse and abundant asteraceous genus in Chilean Matorral, ranging from coastal terraces to the Andean belt (Hall, 1928; Klingenberg, 2007).

Insect rearing and collection

Apical galls from *H. foliosus* (Fig. 2) were collected from sites described above and were transported in paper envelopes to laboratory, where part of the sample was dissected under a microscope to obtain larvae and pupae. The remainder was kept at 50% RH, 25°C and 16/8 light/dark conditions in stand-up position with stem trunk side inserted in individual agricultural foam grow substrate (Tray PeatFOAM[®]) material placed in moistened trays. The collected galls were individually kept in transparent mica polypropylene cylinders (3 cm \times 5 cm) covered on top by fine mesh cotton tissue caps (50 threads/cm). Cylinders were periodically checked in order to collect any imago emerged. Additionally, live galls were isolated in the field using 5 cm \times 10 cm mesh cotton tissue bags and checked every field trip for adults. Voucher specimens are deposited at the Entomological Collection of the *Museu Nacional/UFRJ* (MNRJ) and entomological collection of the *Museo Nacional de Historia Natural*, Santiago, Chile (MCCN). We identified the host plant, *H. foliosus*, based on morphological traits described by Klingenberg (2007).

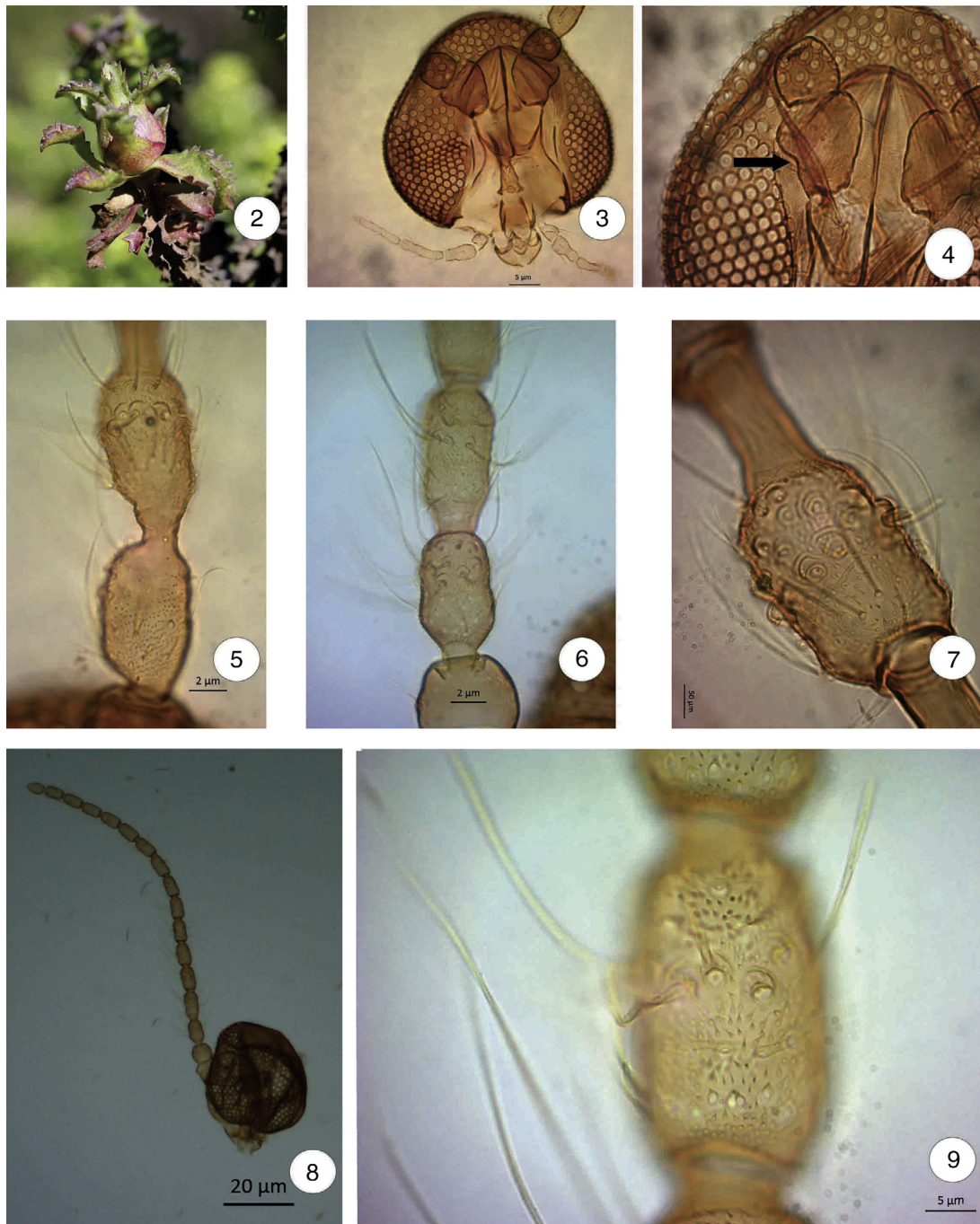
Results

Taxonomy

Haplopappusmyia Maia and Villagra, **gen. nov.** (Figs. 3–36).

Diagnosis: The new genus is unique in having the following set of derived characters: eye facets separated at the vertex and laterally, lateral margin of scape with a mesal reentrance; first and second flagellomeres connected in males and discrete in females; R5 straight, reaching C anterior to wing apex; male seventh and eighth tergites lacking sclerotization mesally, beyond proximal margin and protrusible ovipositor with fused cerci. Non-derived features exhibited by the genus are: four-segmented palpus, toothed tarsal claws, presence of trichoid sensilla on the abdominal terga and sterna, larva with six lateral papillae on each side of the spatula and eight setose terminal papillae.

Adult description. Head (Fig. 3): Eye facets circular, separated at vertex by about four facets long and slightly farther apart near level of antennal bases, contiguous elsewhere. Antennae: scape and pedicel with a few setae and several setiform scales ventrally; lateral margin of scape with a mesal reentrance (Fig. 4); first and second flagellomeres connected in males and discrete in females (Figs. 5 and 6). Male antennae with 5+? flagellomeres; flagellomeres (Fig. 7) with circumfila consisting of a complete subbasal and distal ring connected by two vertical strands; short, straight setae encircling base below proximal circumfilum, many long, basally curved setae from hooded alveoli situated between circumfilum rings, these present chiefly on venter. Female antenna



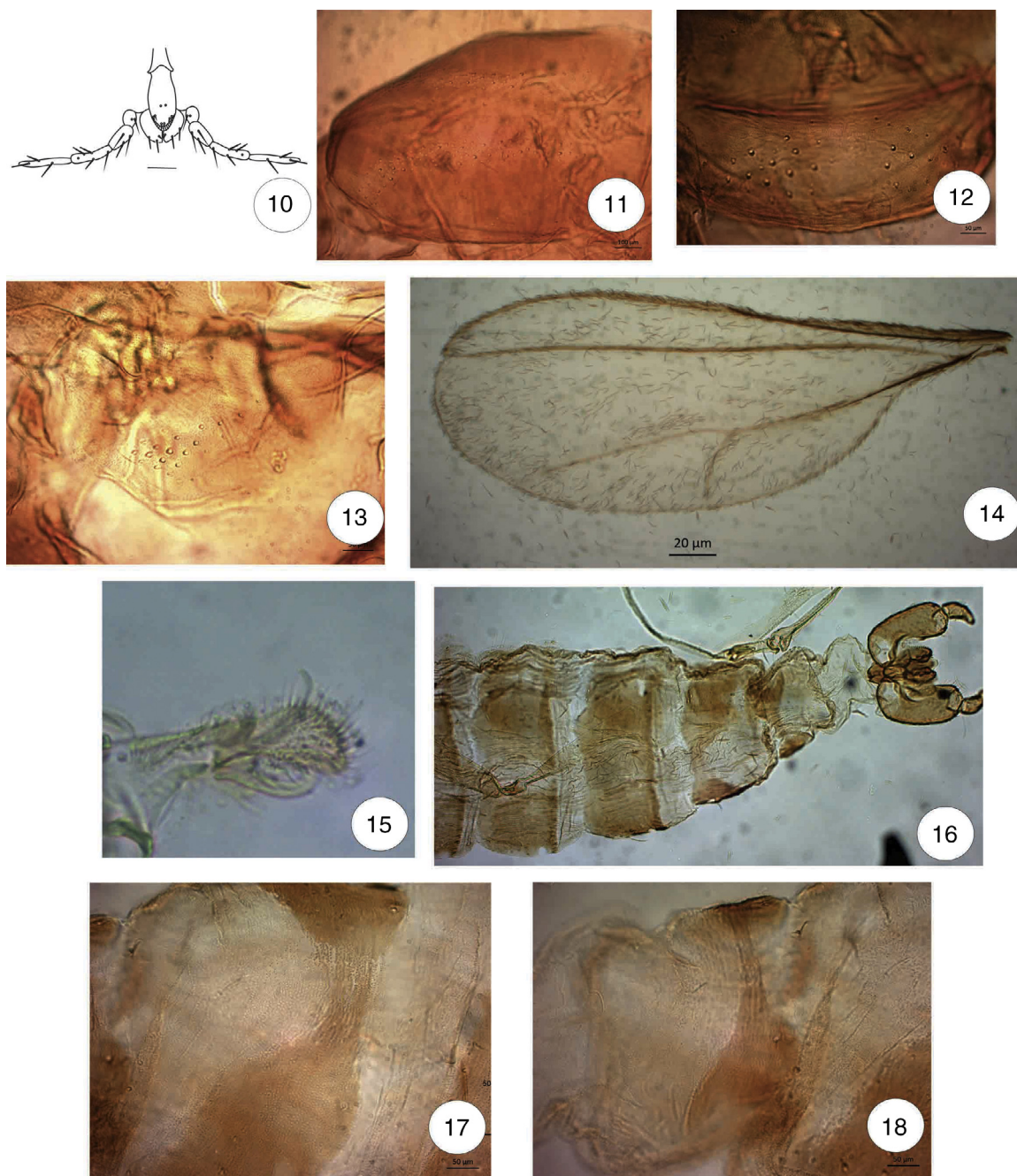
Figs. 2–9. (2) Bud gall on *Haplopappus foliosus* (Asteraceae). Scale bar: 5 mm. (3–9) *Haplopappusmyia gregaria* Maia and Villagra, new genus and species: (3) adult: male head, frontal; (4) male scape and pedicel; (5) male 1st and 2nd flagellomeres; (6) female 1st and 2nd flagellomeres; (7) male 4th flagellomere; (8) female antenna; (9) female 5th flagellomere.

with 15 flagellomeres (Fig. 8), necks short than in males, with two complete circumfilar rings, and with fewer hooded alveoli and their setae (Fig. 9). Frons with many setae and setiform scales (Fig. 3). Labella hemispherical in frontal view, with several, strong setae apically (Fig. 10). Palpus four-segmented, first ovoid, the others cylindrical and crescent in length, all segments variously covered with scales and setae (Fig. 10).

Thorax: Scutum (Fig. 11) with four longitudinal rows of setae with a few scales intermixed, the second dorsocentral rows broadest anteriorly, tapering posteriorly and vanishing before scutellum, the 2 lateral rows broadest mesally, tapering posteriorly and vanishing before scutellum. Scutellum (Fig. 12) with abundant

setae and few scales on anterior half but discontinuous mesally. Anepimeron setose (Fig. 13); other pleura bare. Wing (Fig. 14): C broken beyond junction with R5; R5 straight, reaching C anterior to wing apex; M slightly apparent; CuA forked. Acropods (Fig. 15): tarsal claws strongly curved near midlength, with basal tooth; empodia wide and as long as claws; pulvilli slightly longer than half-length of claws.

Male abdomen: Tergites and sternites with anterior pair of trichoid sensilla. Tergites (Fig. 16): first through sixth rectangular, short and broad, fourth about 2.5 times as wide as long, all with single posterior row of setae and covered elsewhere with scales; sixth about 1.3 times as broad as long, seventh and eighth gradually less

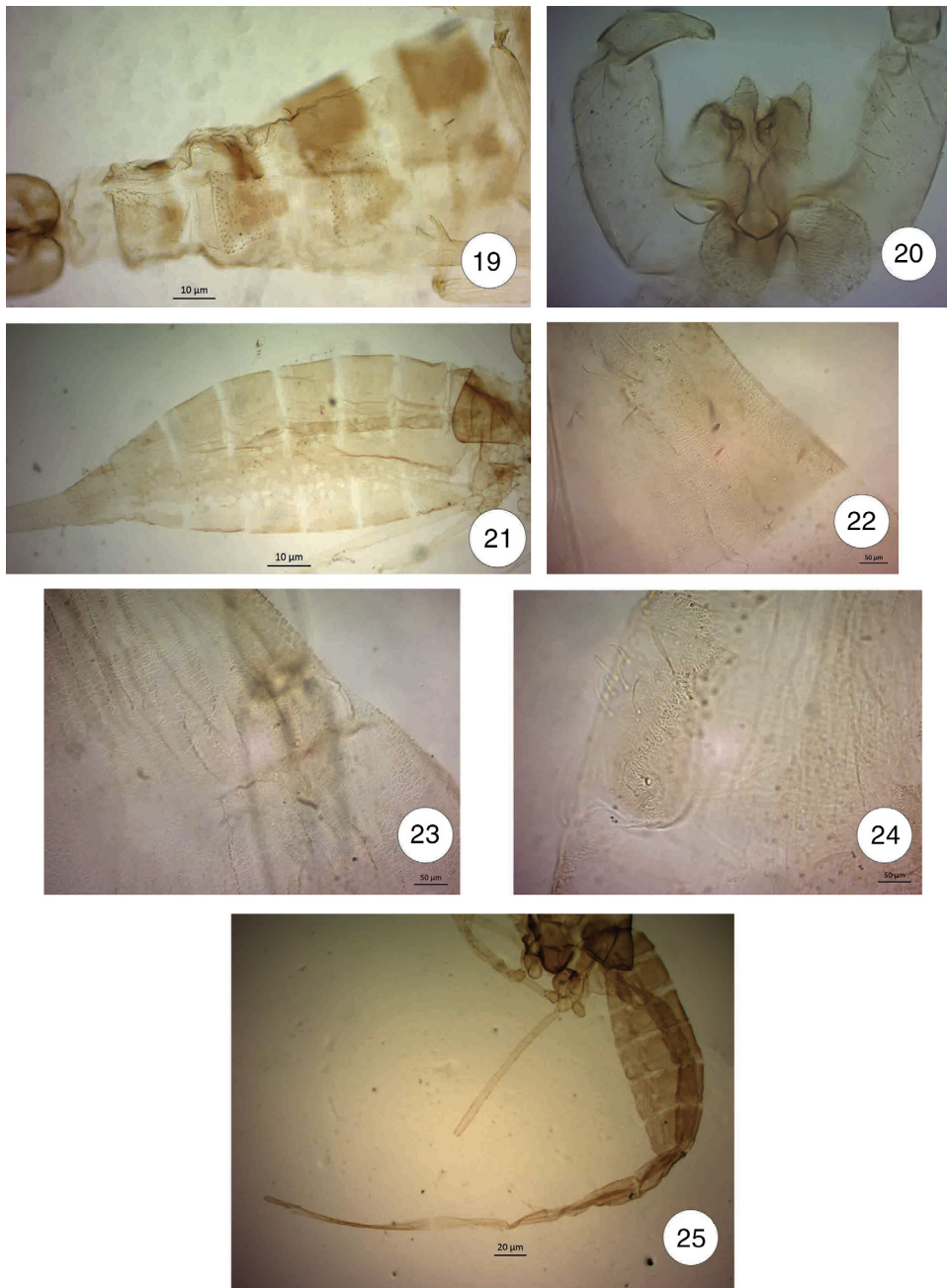


Figs. 10–18. *Haplopappusmyia gregaria* Maia and Villagra, new genus and species: (10) male, mouth parts, frontal, scale bar: 0.05 mm; (11) Thorax: scutum, dorsal; (12) scutellum, dorsal; (13) anepimeron, lateral; (14) Male wing; (15) female hindleg, tarsal claw and empodium, lateral. (16) male abdomen, from 6th tergite to end, dorsal; (17) male 7th tergite, dorsal; (18) male 8th tergite, dorsal.

broad than sixth, seventh similar in length of sixth, eighth slightly shorter than the precedent, seventh and eighth sclerotized, except mesally beyond proximal margin, both without scales or setae, but with anterior pair of trichoid sensilla (Figs. 17 and 18). Pleura with scales. Sternites (Fig. 19): second through sixth rectangular, about 1.8 as broad as long, seventh and eighth squarish, eighth 0.8 time as long as seventh, seventh with closely set rows of large posterior setae, setae and scales elsewhere, eighth with closely set rows of large posterior setae, setae and scales near midlength. Terminalia (Fig. 20): cercus ovoid, with a few setae dorsally and ventrally on apical half; hypoproct deeply notched, longer than aedeagus, with conical lobes, each with a few setae apically; lateral part of gonocoxites cylindrical, mediobasal lobe entire, with medial

reentrance, clasping and nearly as long as aedeagus, with a few short apical setae on raised bases, otherwise covered with long setulae; apodeme entire; gonostylus conical, tapering to apical tooth, mostly glabrous and ridged dorsally, setulose ventrally, setae situated mainly on distal half; aedeagus slightly longer than gonocoxal lobes, convex apically.

Female abdomen (Fig. 21): Tergites and sternites with anterior pair of trichoid sensilla. Tergites: rectangular, first through sixth about three times as wide as long, setation as for male; seventh about twice as wide as long, with mostly double row of posterior setae, scales elsewhere (Fig. 22); eighth not pigmented, with setae posteriorly and no scales (Fig. 23). Pleura with scales. Sternites: second through sixth squarish, about as wide as long; with mostly



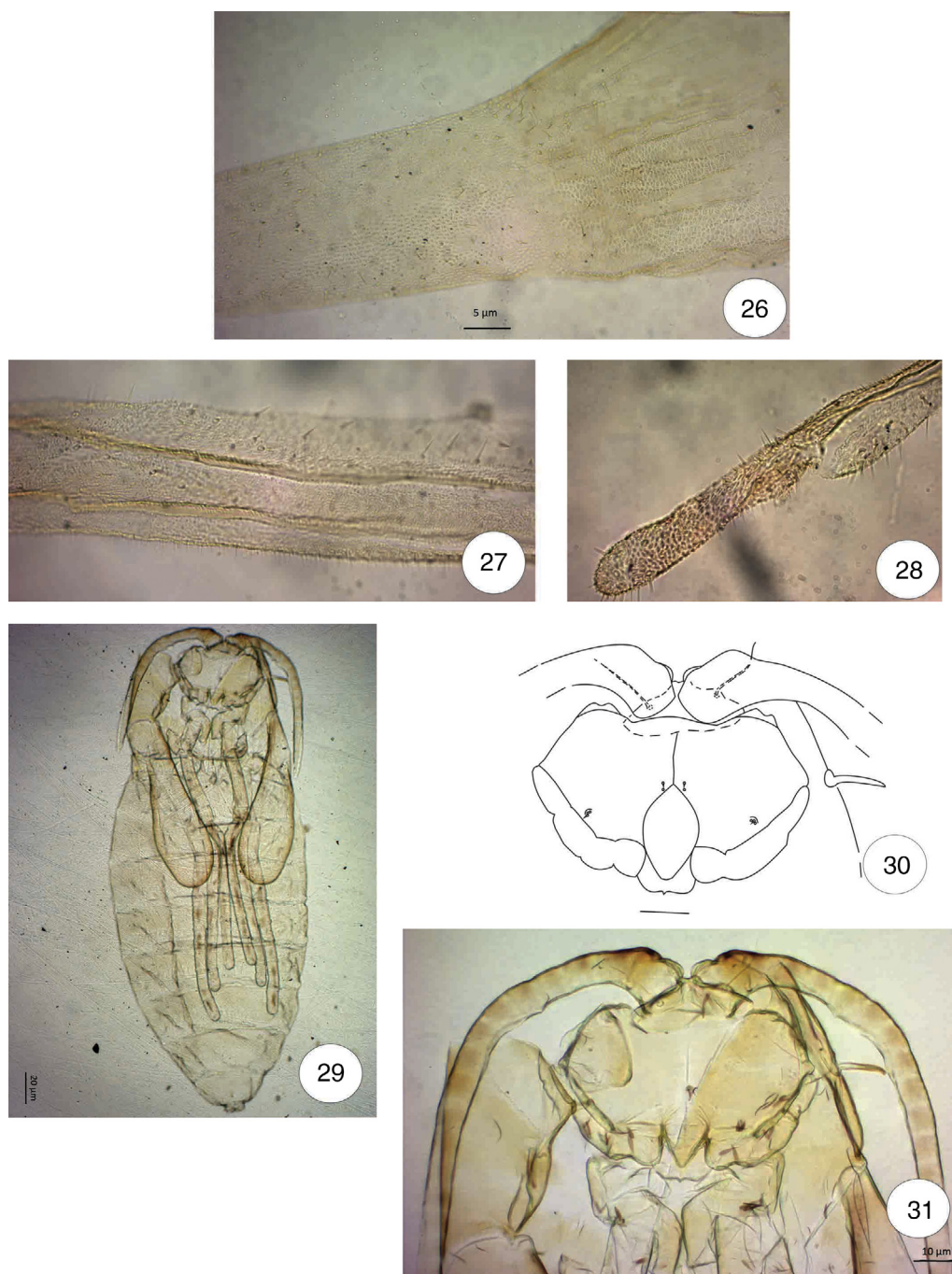
Figs. 19–25. *Haplopappusmyia gregaria* Maia and Villagra, new genus and species: (19) male abdomen, from 6th sternite to end, lateral; (20) male terminalia, dorsal. (21) female abdomen, dorsolateral; (22) female 7th tergite, lateral; (23) female 8th segment, dorsolateral; (24) female 7th sternite, ventral; (25) ovipositor.

double row of posterior setae, scattered scales at midlength and scattered setae and scales on anterior half; seventh rectangular, about 2.5 times as wide as long, with several setae posteriorly, a few setae at midlength and scarce anteriorly, scattered scales elsewhere (Fig. 24). Ovipositor (Fig. 25): very elongate, about 11 times as long as seventh tergite (from anterior margin of ninth segment to cerci), tapered, entirely setulose; eversible part with short scattered setae (Fig. 26); protrusible part with scattered setae (Fig. 27); cerci (Fig. 28) fused, cylindrical elongate, with scattered setae; hypoproct in ventral depression of fused cerci, with a few setae.

Pupa (Fig. 29). Integument mostly hyaline, head, leg bases and wing borders pigmented, apices of antennal bases more intensely pigmented. Vertex on each side with long seta on raised base; face

with full complement of papillae (Fig. 30). Prothoracic moderately long (Fig. 31). Abdominal terga, pleura and sterna evenly spiculose (Figs. 32–33).

Larva (third instar). Cylindrical. Color: orange (Fig. 34). Head capsule hemispherical, apodemes about as wide as head; antennae about twice than wide (Fig. 35). Spatula (Fig. 36) robust, elongate, with two triangular, anterior teeth. Spiracles present on metathorax. Integument (Fig. 34): with pointed verrucae dorsally, laterally and ventrally on all thoracic and abdominal segments. Papillae: one asetose sternal papilla and two groups of three lateral papillae, two setose, on each side of spatula, other papillae not apparent. Terminal segment with four pairs of setose terminal papillae, all subequal in length.



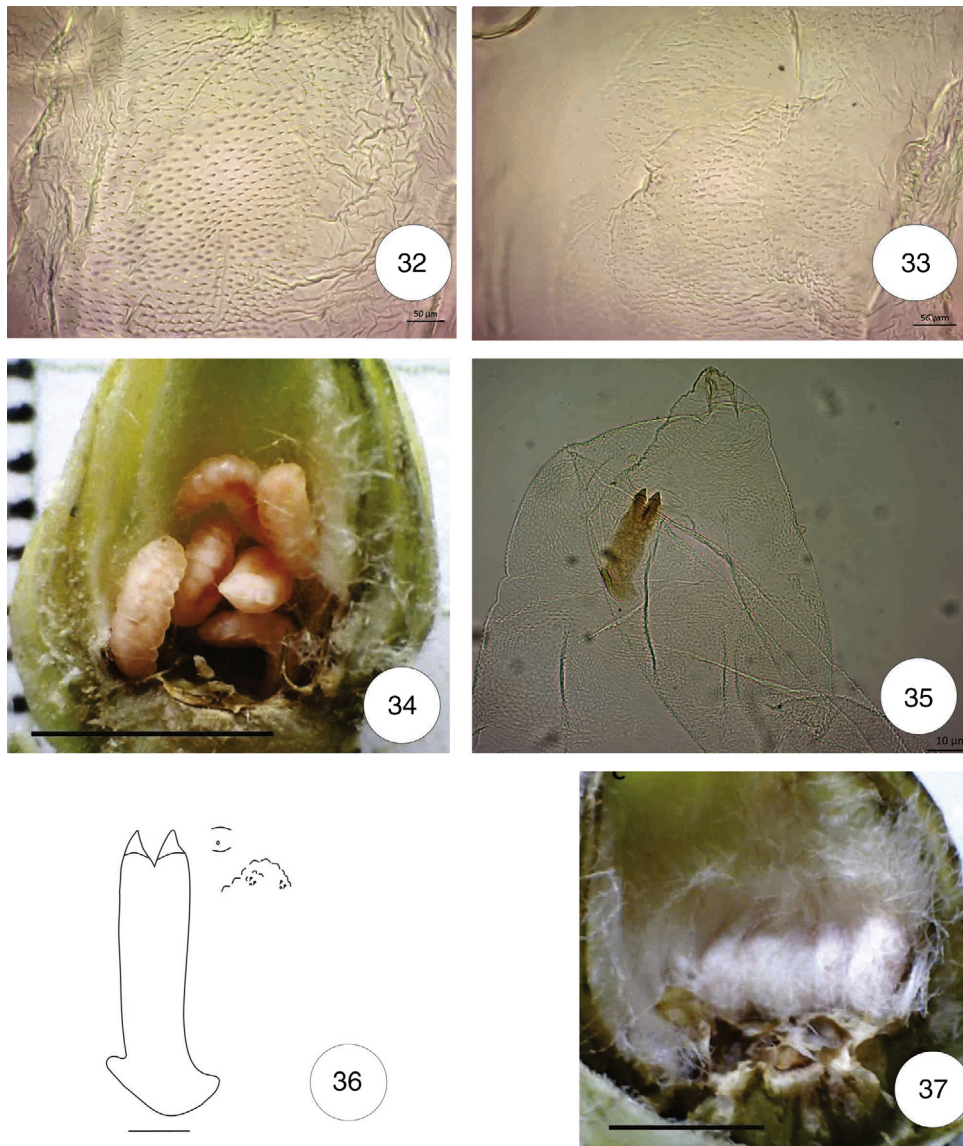
Figs. 26–31. *Haplopappusmyia gregaria* Maia and Villagra, new genus and species: (26) ovipositor (eversible part), lateral; (27) ovipositor (protrusible part), lateral; (28) female cerci, lateral. (29) pupal exuvia, ventral; (30) pupa head, ventral, scale bar: 0.10 mm; (31) pupa, prothoracic spiracle.

Type-species, *Haplopappusmyia gregaria*.

Etymology. *Haplopappusmyia* is composed by *Haplopappus*, the generic name of the host plant and *myia*, a common suffix for Diptera.

Comments. The new genus belongs to the supertribe Lasiopteridi based on the number of antennal flagellomeres (more than 12) and features of the mesobasal lobes of the gonocoxites, which are well developed, mostly setulose, and at least partially sheathing aedeagus (Gagné, 1994). But, it does not fit in any known tribe. Nevertheless, in the Gagné's key to genera of Neotropical Lasiopteridi (Gagné, 1994), *Haplopappusmyia*, n. gen., will key in couplet 27 as *Dasineura* Rondani, 1840. According to Gagné and Jaschhof, 2014, the tribe Dasineurini is characterized

by presenting male flagellomeres with definitive necks, R5 joining C at least slightly before the wing apex, female eighth abdominal tergite as long or longer than seventh and tending to divide longitudinally. The first two conditions are observed in the new genus, but not the other two. In *Haplopappusmyia*, the female eighth abdominal tergite is shorter than seventh and it is rectangular. Besides, according to Gagné, 1994, the genus *Dasineura* is traditionally defined by the following morphological characters: antennae with 15 flagellomeres, palpi with four segments, tarsal claws toothed, R5 shorter than wing apex, gonostylus partially setulose, female eighth tergite longitudinally divided, ovipositor elongate-protrusible, female cerci fused, spatula clove-shaped, larva with six lateral papillae on each side of the spatula and six setose terminal



Figs. 32–37. *Haplopappusmyia gregaria* Maia and Villagra, new genus and species: (32) pupa, abdominal terga, dorsal; (33) pupa, abdominal sterna, ventral. (34) Larva; (35) cephalic capsule; (36) spatula and papillae, ventral. (37) Cut of Gall showing cocoons in a common chamber. Scale bar: 5 mm.

papillae. *Haplopappusmyia* presents all of these features, except the female eighth tergite longitudinally divided. Other differences between both genera are: the separated eyes at the vertex, the scape with a lateral reentrance (differing from the common condition, which does not include this reentrance), the first and second flagellomeres connected in males and discrete in females, and the distinct shape of the male seventh and eighth tergites. In fact, *Dasineura* is a catchall genus (Gagné, 1994) and a detailed morphological and phylogenetic study is necessary to define its limits.

Based on the mentioned differences, a new unplaced Neotropical genus of Lasioteridi is proposed here.

The Neotropical plant-feeding Lasioteridi comprise 52 previously described genera (Gagné and Jaschhof, 2014; Gagné and Etienne, 2015), 12 of them include species which are associated with Asteraceae (Gagné and Jaschhof, 2014): *Alycaulus* Rübsaamen, 1916, *Asteromyia* Felt, 1910, *Baccharomyia* Tavares, 1917, *Dasineura* Rondani, 1840, *Domolasioptera* Möhn, 1975, *Geraldesia* Tavares, 1917, *Isolasioptera* Möhn, 1974, *Meunieriella* Kieffer, 1909, *Neolasioptera* Felt, 1908, *Rhopalomyia* Rübsaamen 1892, *Scheueria* Kieffer & Herbst 1909, and *Trotteria* Kieffer, 1902.

Among them, 11 are included in tribes: *Alycaulus*, *Asteromyia*, *Baccharomyia*, *Geraldesia*, *Meunieriella*, and *Neolasioptera* in Alycaulini, *Dasineura* in Dasineurini, *Domolasioptera* in Camptoneuromyiini, *Isolasioptera* in Lasioterini, *Rhopalomyia* in Rhopalomyiini, and *Trotteria* in Trotterini, excepting *Scheueria*.

Gagné & Etienne, 2015 published a key to adults of all unplaced Neotropical genera of Lasioteridi, excluding only *Angeiomyia* Kieffer & Herbst (1909), known only from the larval stage. *Haplopappusmyia*, n. gen., will key in couplet 9 of this key, as male hypoproct is deeply divided, but the female fused cerci are longer than the predicted. This couplet leads to *Riveraella* Kieffer & Herbst, 1911 and *Xyloperrisia* Kieffer, 1913. Both genera have four-segmented palpus, the last segment somewhat longer than the second; male flagellomeres with at most two transverse, closed appressed circumfila connected by two longitudinal strands; tarsal claws with a basal tooth; Costa broken beyond its juncture with R₅; fused female cerci appreciably longer than wide, and male hypoproct deeply divided, as in the new one. But, in *Riveraella* the vein R₅ is as long as wing, and in *Haplopappusmyia* it is shorter. In *Xyloperrisia* the tarsal claws are little short than the empodia, the male gonostyli are enlarged at midlength and pupa has strongly

developed antennal horns; these features are not presented by the new genus.

Haplopappusmyia gregaria Maia and Villagra, **sp. nov.** (Figs. 4,8,10,13–14 and 29)

Adult description. Wing (Fig. 14) length: male 2.35–2.55 mm ($n=5$); female 2.30–2.50 mm ($n=3$). Antennae; scape (Fig. 4) obconical about as long as wide; pedicel (Fig. 4) spheroid, about 0.05–0.06 mm of diameter; flagellomeres cylindrical, first and second totalizing 0.20 mm long in males with 0.05 mm wide, third to fifth flagellomeres similar, all 0.11–0.10 mm long and 0.04–0.05 mm wide, nodes four times as long as necks, (other flagellomeres missing in male). Female antenna: basal flagellomeres similar in length, 0.07–0.09 mm long, last flagellomeres shorter with 0.05 mm long, nodes six times as long as necks (Fig. 8). Palpus four-segmented (Fig. 10), first not much longer than wide, second about twice as long as wide, third usually about three times as long as wide, and fourth about eight times as long as wide. Thorax; Anepimeron with a group of mesal setae (Fig. 13). Male terminalia; gonocoxites about twice as long as wide, 2.5 times as long as gonostylus. Gonostylus twice as long as wide. Female fused cerci about 4.6 as long as broad.

Pupa. Body length: 3.1 mm ($n=1$), apical setae 0.15 mm ($n=2$), prothoracic spiracule 0.11–0.13 mm ($n=2$), wing sheath reaching $\frac{1}{2}$ of the fourth abdominal segment, fore leg sheath reaching the $\frac{1}{2}$ of the sixth abdominal segment, mid leg sheath reaching the posterior margin of the sixth abdominal segment and hind leg sheath reaching the distal $\frac{1}{3}$ of the seventh abdominal segment (Fig. 28).

Larva (third instar). Body length, 4.40 mm ($n=1$). Spatula length, 0.25 mm ($n=1$). Terminal segment convex with four pairs of terminal papillae, all similar in length.

Type material. Holotype male, reared from bud galls on *Haplopappus foliosus* DC. (Asteraceae). Chile, Petorca Province, La Ligua Municipality, 29/III/2014, C. A. Villagra collector, deposited in the entomological collection of the Museu Nacional, Rio de Janeiro, Brazil (MNRJ).

Paratypes: four males (two in MNRJ and two in the Museu Nacional de Historia Natural, Santiago, Chile – MCCN), four females (two in MNRJ and two in MCCN), one pupal exuvia in MNRJ, seven larvae, four in MNRJ and three in MCCN, same data as holotype.

Etymology. The name “*gregaria*” refers to larval behavior of this gall midge, which lay gregariously in a common chamber inside the gall until pupation.

Life history. The host plant, *Haplopappus foliosus*, blooms from late spring to the end of summer (from November to March). Floral heads grow on the apical tip of each branch (Klingenberg, 2007). However, when parasitized by gall-inducing insects this plant develops spherical swelling of apical leaves in the apical position of branches in early spring (September), earlier than floral bud formation, through the blooming season these spherical swellings grow to attain similar size than floral heads, and dry up later in the season, remaining as lignified tissue at the end of the summer (Leniz & Villagra, personal observation). The galling larvae are gregarious (Fig. 34) and pupate in the gall, in individual cocoons (Fig. 37) from which they emerge as adults.

Conflicts of interest

The authors declare no conflicts of interest.

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