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ARTICLE

A new species of gall midge (Diptera: Cecidomyiidae) associated with *Peumus boldus* (Monimiaceae) in Chile

Lubia María Guedes[1,3]; Valeria Cid Maia[2,4]* & Narciso Aguilera[1,5]

[1] Universidad de Concepción, Facultad de Ciencias Forestales, Departamento de Silvicultura, Laboratorio de Semioquímica Aplicada. Concepción, Chile.
[2] Universidade Federal do Rio de Janeiro, Museu Nacional, Departamento de Entomologia. Rio de Janeiro, RJ, Brasil.
[3] ORCID: 0000-0002-0665-5505. E-mail: lubiamariaguedesg@gmail.com
[4] ORCID: 0000-0001-9396-5618. E-mail: maiavcid@acd.ufrj.br (corresponding author)
[5] ORCID: 0000-0002-8528-1942. E-mail: naraguilera@udec.cl

Abstract. Chile is characterized by high levels of endemism among its flora and fauna, yet its diverse gall-inducing organisms remain poorly studied. We describe *Dasineura peumi* **sp. nov.,** a new gall-inducing midge (Diptera: Cecidomyiidae) associated with *Peumus boldus* Molina (Monimiaceae), an economically significant medicinal plant native to Chile's sclerophyllous forests. This species induces solitary or clustered fusiform galls on the stems, each housing a single larva. Morphological and phenological analyses were conducted on samples collected in the Bíobío Region of Chile in 2021 and 2022. Morphological studies revealed key diagnostic traits: antennae with 18 flagellomeres in both sexes, tarsal claws with a prominent basal tooth, as long as the empodia, and a band-like male tergite 8. The ovipositor measures 1.0-1.10 mm, approximately four times the length of the seventh tergite. Pupae are characterized by long vertical setae, very short antennal horns, a complete arrangement of facial papillae, digitiform prothoracic spiracles, and spines absent from the abdomen. Larvae possess a long spatula with two anterior teeth and an anchor-like base, a complete arrangement of lateral papillae, and eight short, uniform terminal papillae. This species has a multivoltine life cycle, with development independent of the host plant's phenology.

Keywords. Gall-inducing species; Multivoltine; Neotropical; Sclerophyllous forest; Stem galls.

INTRODUCTION

Gall-inducing insects exhibit remarkable diversity within the animal kingdom because of their unique ability to trigger the formation of galls on plants, influencing plant morphology, nutrient cycling, and species interactions (Miller & Raman, 2019). Despite their ecological importance, comprehensive studies on gall-inducing insect fauna in sclerophyllous forests are scarce (Espírito-Santo & Fernandes, 2007; Fagundes *et al.,* 2020). This forest type hosts rich and drought-adapted flora, providing a unique habitat for various gall-inducing species (Price *et al.,* 1987). However, the limited research on these insects in sclerophyllous ecosystems limits our understanding of their biodiversity and the ecological interactions they sustain.

Chile is often described as a continental island due to its geographical isolation (Young, 2021). The Chilean Mediterranean region, located between 30° and 38°S, is characterized by high biodiversity, largely attributed to its unique geographic features (Fuentes-Castillo *et al.,* 2019). This ecosystem supports a wide variety of plant-insect associations (Gonzalez *et al.,* 2020), particularly those involving plant-galling insects (Quintero *et al.,* 2014). Many tree species in the native Chilean sclerophyllous forest host at least one gall morphotype. However, studies of gall inducers in Chilean forests are still rare, with less than 25% of the native woody flora surveyed and herbaceous species largely unexplored, indicating that a substantial portion of gall-inducing diversity remains unknown (Quintero *et al.,* 2014). Among the most common species in these forests is *Peumus boldus* Molina (Monimiaceae) (Vogel *et al.,* 2011).

Peumus boldus is a native and commercially important medicinal tree that is found from the Coquimbo Region to the Los Lagos Region. Galls on *P. boldus* were first recorded in the literature by Kieffer & Herbst (1905) from samples collected in Concepción, Chile. These galls were described as stem swellings that were 10-12 mm long and 3 mm wide, with one internal chamber that was 5-8 mm long and 1 mm wide and was occupied by a single larva. The gall midge was identified at the

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genus level as *Perrisia* Rondani, 1846 (Diptera, Cecidomyiidae Kieffer & Herbst, 1905), a synonym of *Dasineura* Rondani, 1840 (valid name). Gagné (1994) reported two different gall midge larvae from these galls but did not confirm their taxonomic placement. Although the developmental stages and structure of stem galls have been recently described (Guedes *et al.,* 2023a, b), the identity of the gall inducer remains unresolved. Consequently, this study aims to describe the gall midge associated with *P. boldus* stems and to document its life cycle.

MATERIAL AND METHODS

Study area

The study was conducted between 2022 and 2023 in a natural population of *P. boldus* (Fig. 1A) at the Hualpén Terrestrial Biological Station, Biobio, Chile (36.80°S, 73.16°W at 62 m.a.s.l.). This biological station is one of the fragments of the coastal sclerophyllous forest of the Hualpén Peninsula.

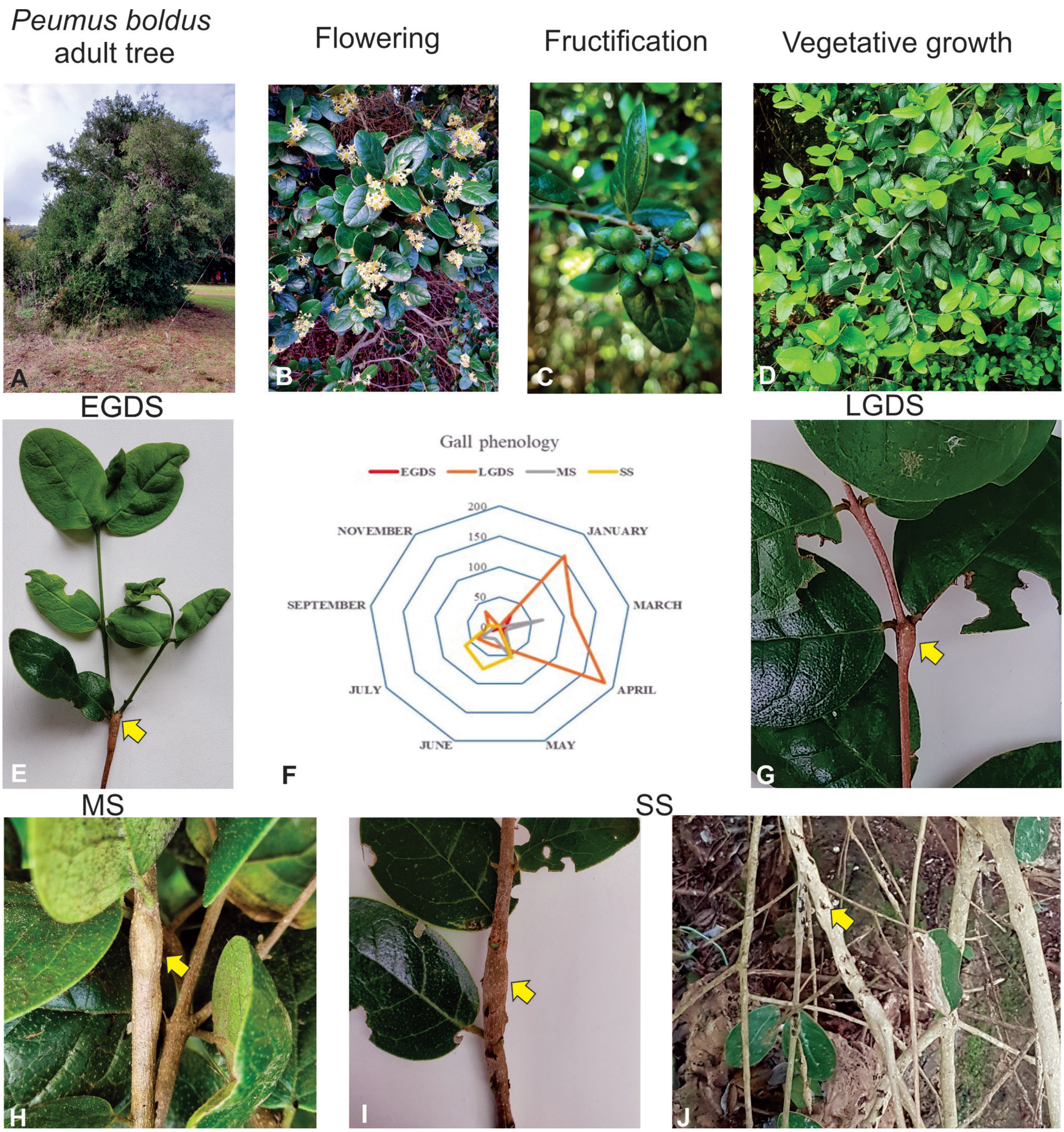

Figure 1. Phenology of *Peumus boldus* (A-D) and the associated gall inducer *Dasineura peumi* **sp. nov.** (E-J). (A) Adult tree in its natural habitat. (B) Flowering branch. (C) Fruiting. (D) Branches in vegetative growth. (E) Gall in early growth and development (EGDS). (F) Spider graph of the developmental cycle of the gall inducer. (G) Gall during later growth and development (LGDS). (H) Mature gall (MS). (I-J) Senescent galls: (I) Gall shortly before the adult emerges. (J) Gall without adults. Yellow arrows indicate the presence of gall(s) on the branch.

Climate data

The climate of Concepción city, Biobío Region, is temperate oceanic. According to the Köppen climate classification, it is a Mediterranean climate with winter rain and coastal influence (Csb (i)). The climate data (Table S1) were sourced from the climate services of the "Dirección General de Aeronáutica Civil, Dirección Meteorológica de Chile", corresponding to the meteorological station 360019 (Carriel del Sur). The data are available at "Servicios Climáticos (https://www.meteochile.gob.cl)".

Plant host phenology

During the study, the flowering (Fig. 1B) of *P. boldus* occurred between June and August, with a peak in July. Fruiting (Fig. 1C) occurred shortly after, between July and January. Vegetative growth (Fig. 1D) occurred between August and November, with a peak in September.

Field and laboratory work

Study of the biological cycle of the gall midge

During the study, four galled branches were collected monthly from each of the five *P. boldus* trees (n = 5). The galls were examined under a magnifying glass, and the number of galls was recorded according to their developmental stages as defined by Guedes *et al.* (2023b): (i) growth and development stage (GDS) (Figs. 1E, G), which includes larvae in the first to third instars. Additionally, two phases were identified: an early phase with first-instar larvae (EGDS) (Fig. 1E) and a late phase with second- and third-instar larvae (LGDS) (Fig. 1G); (ii) a maturation stage (MS) (Fig. 1H), which includes fourth-instar larvae; and (iii) a senescent stage (SS) (Figs. 1I, J), characterized by pupae or an emerged adult.

Morphological identification

Gall samples were dissected to obtain larvae and pupae, whereas other samples were kept in rearing containers in the laboratory at room temperature to obtain adults and pupal exuviae. The samples were preserved in 70% ethanol and later mounted on microscope slides following the methods outlined in Gagné (1994). Morphological studies and drawings were made with the aid of an optical microscope coupled with a photographic camera and a drawing tube. Larvae, pupae, males, and females are described, and the most relevant morphological characteristics are illustrated. All drawings were edited via Corel DRAW® (Corel Corporation, Canada).

Measurements were made via a microscope slide with a scale ranging from 0.01 to 5.0 mm. The length of the wings was measured from the arculus to the apex, the length of the females from the head vertex to the posterior margin of the 8th abdominal segment, and the length of the ovipositor (when completely protracted) from the anterior margin of the 8th tergite to the cercus. We included all measurements after the description of each sex and life stage. Adult morphological terminology follows Gagné (1994).

Permanent slides were deposited in the Entomological Collection of the Museu Nacional/Universidade Federal do Rio de Janeiro (MNRJ). We morphologically compared the new species to other Neotropical species of *Dasineura.*

RESULTS

Dasineura Rondani, 1840, is characterized by an uneven number of antennal flagellomeres within a species, not restricted to 12; male flagellomeres with a single basal node and distinct apical neck; and female flagellomeres almost without necks beyond the node. The costal vein is broken just posteriad to the R5 vein and terminates anterior to the wing apex. The tarsal claws are robust, curved beyond midlength, with a basal tooth; the empodia are approximately as long as the tarsal claws and the pulvilli are approximately ⅓ the length of the claws. The gonocoxite has a mediobasal lobe closely juxtaposed to the side of the aedeagus; the female eighth tergite is longitudinally divided into two sclerites; the ovipositor is elongate-protrusible, and the cerci are fused to form a single lobe; and the larvae have a full basic cecidomyiine complement of papillae and clove-shaped spatula (Gagné *et al.,* 2014).

Dasineura peumi, sp. nov.
(Figs. 2-3)

Diagnosis

Adult: Antenna with 18 flagellomeres of both sexes, antennal nodes and necks subequal in length; ovipositor 1.0-1.10 mm long (including cerci), approximately four times the length of the 7th tergite. **Pupa:** Vertical seta longer than the prothoracic spiracle, two lower facial papillae and three lateral facial papillae on each side; prothoracic spiracle digitiform; abdominal terga without dorsal spines. **Larva:** Spatula with moderately developed stalks and eight short terminal papillae with setae, all similar in length.

Description

Male

Body: 2.45-3.00 mm long (n = 3). **Head:** (Fig. 2A) 0.45-0.50 mm diameter (n = 3); eye facets contiguous, except between the eyes at the vertex and near the level of the antennal bases (Fig. 2A). Antennae: scape and pedicel with setae and scales ventrally; 18 flagellomeres with long, bare necks; nodes and necks subequal in length, 1st and 2nd flagellomeres connate; circumfila consisting of two complete rings – one subbasal and other distal

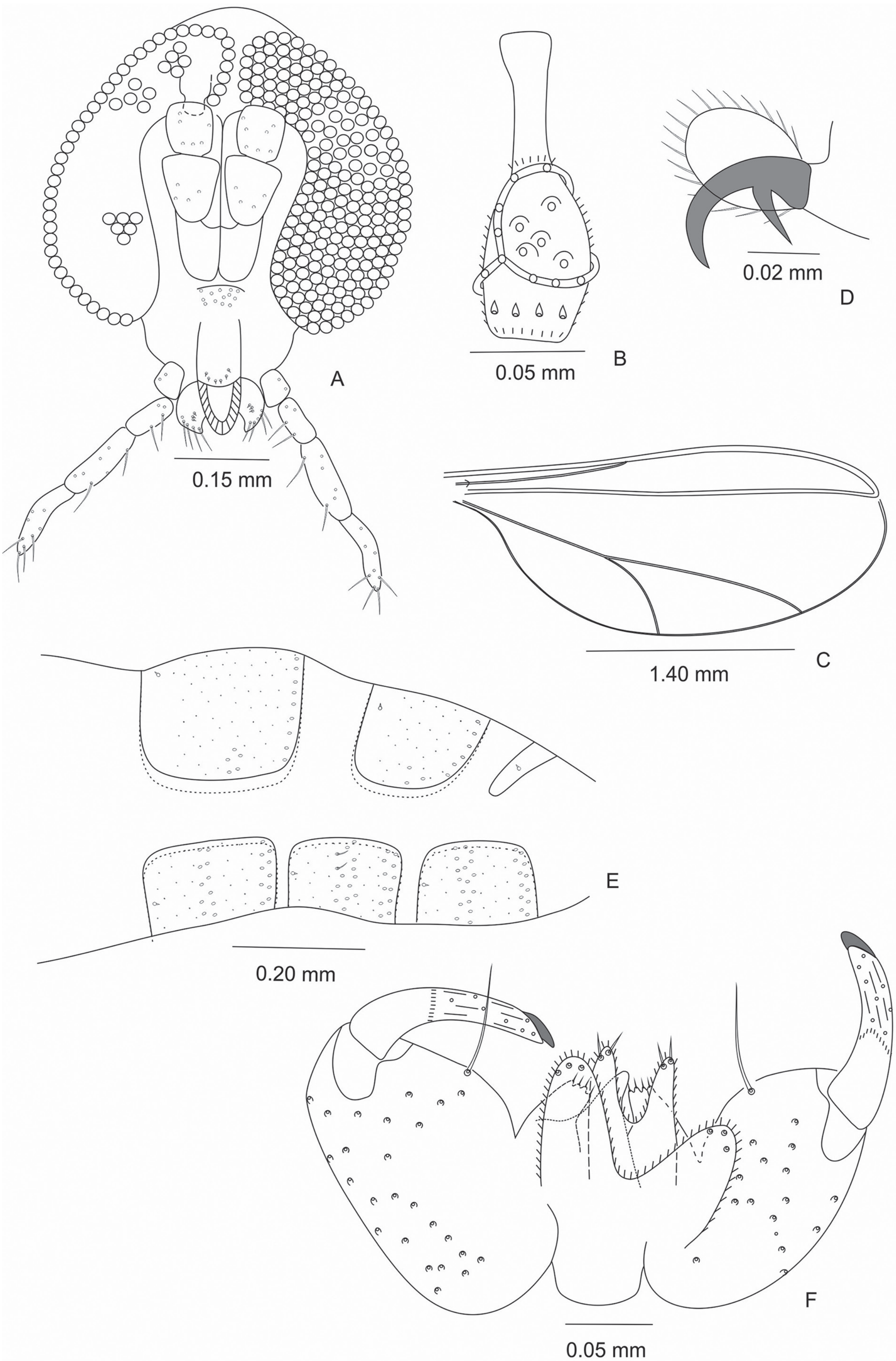

Figure 2. Male of *Dasineura peumi* **sp. nov.** (A) Head, frontal view. (B) 5th flagellomere. (C) Wing. (D) Lateral view of the foreleg, tarsal claw and empodium. (E) Abdomen, three last segments, lateral view. (F) Terminalia, dorsal view.

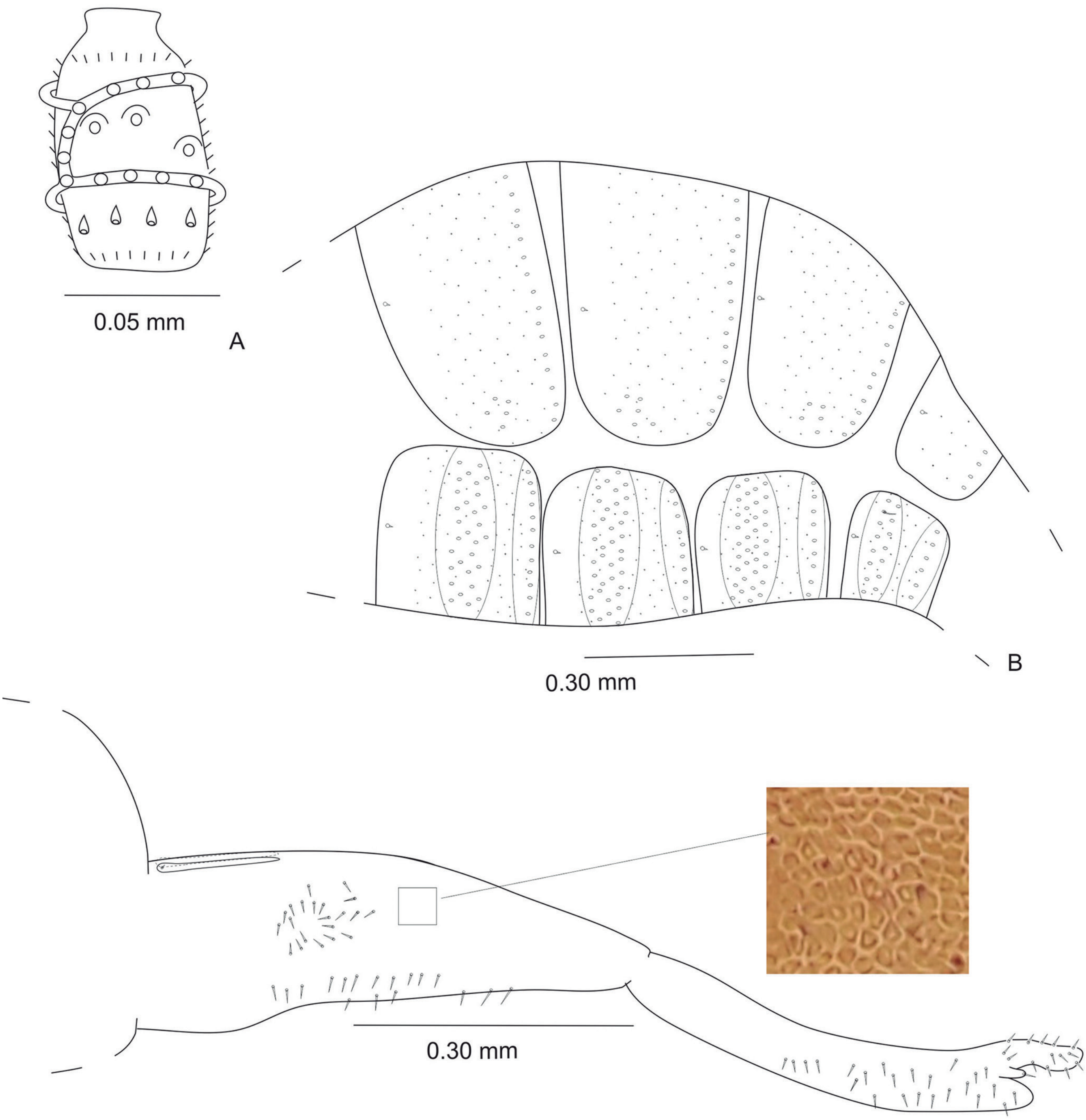

Figure 3. Female of *Dasineura peumi* **sp. nov.** (A) 5th flagellomere. (B) Abdomen, 4th to 7th segments, lateral view. (C) Lateral view of the 8th abdominal segment to the cercus.

– connected by two vertical strands; each flagellomere with short, straight setae encircling the base below the subbasal circumfila, many long, basally curved setae emerging from hooded alveoli between circumfilar rings (Fig. 2B). Frons with numerous setae and setiform scales. Mouthparts (Fig. 2A): labella hemispherical, with several strong apical setae and shorter mesal setae; palpus four-segmented: 1st segment spheroid; 2nd-4th segments cylindrical; all segments with scales and setae. **Thorax:** scutum with four longitudinal rows of setae with few intermixed scales; two dorsocentral rows broadest anteriorly, tapering posteriorly and fading before the scutellum; two lateral rows continuous along the length of the scutum. Scutellum with abundant setae on the anterior half, discontinuous mesally, without setae laterally. Anepisternum with few scales dorsally, anepimeron with setae and scales, other pleura bare. Wing (Fig. 2C): 2.70-2.85 mm long (n = 3); R5 straight, M not apparent, CuA forked. Tarsal claws strongly curved near midlength, with long, prominent basal teeth; empodia approximately as long as the claws; and pulvilli half the length of the claws (Fig. 2D). **Abdomen (Fig. 2E):** tergites and sternites with an anterior pair of trichoid sensilla. Tergites: first through seventh rectangular, each with a single posterior row of setae and few lateral setae, and covered elsewhere with scales; 8th tergite notably shorter than the 7th tergite, with a length ratio of 1:6, band-like, with only an anterior pair of trichoid sensilla as vestiture. Sternites: second through

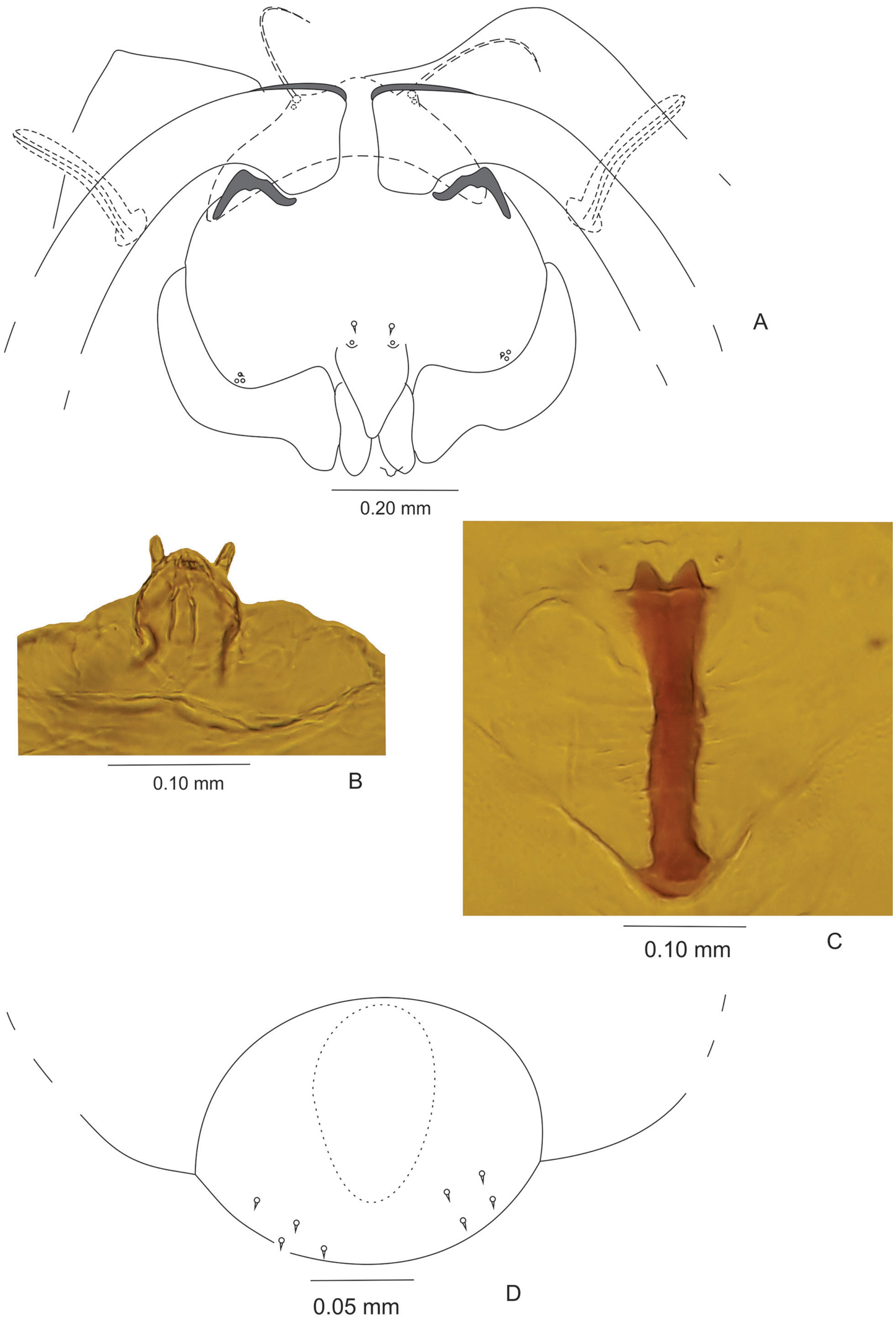

Figure 4. Immature phases of *Dasineura peumi* **sp. nov.** (A) Pupal head, frontal view. (B-D) Larva: (E) Head, ventral view. (F) Prothoracic spatula, ventral view (lateral papillae not visible). (G) Terminal segment, ventral view.

seventh rectangular, each with a posterior row of setae, irregular rows of setae near midlength, few lateral setae, and covered elsewhere with scales. Terminalia (Fig. 2F): cercus ellipsoid with a few setae dorsally and ventrally on the apical third; hypoproct as long as cerci, deeply notched, with conical lobes, noticeably thinner than cercal lobes, each lobe with setae apically and laterally; gonocoxite 1.5 times longer than gonostylus, cylindrical, with several short apical setae on raised bases, otherwise covered with long setulae, apodeme entire; mediobasal lobes entire and nearly as long as aedeagus; gonostylus claviform, widest near the base, tapering to the apex, mostly glabrous with dorsal ridges, setulose ventrally; setae distributed from the base to the apex both dorsally and ventrally; aedeagus conical, slightly longer than the mediobasal lobes, with a convex apex.

Female

Body: 2.30-2.70 mm long (n = 3). **Head:** 0.40-0.50 mm diameter (n = 2). Antennae: 18 flagellomeres with short necks, two complete circumferential rings and fewer hooded alveoli and setae (Fig. 3A). Proportion of flagellomere nodes and necks: 7:1. **Thorax:** wings 2.70-2.85 mm long (n = 4). **Abdomen (Fig. 3B):** tergites and sternites each with an anterior pair of trichoid sensilla; 1st-7th tergite rectangular with a setation pattern similar to that of the male; 7th tergite with mostly a double row of posterior setae, many scales on the posterior third, and an anterior pair of trichoid sensilla (Fig. 3B); 8th tergite divided longitudinally into two narrow sclerites, both wider anteriorly than posteriorly, each one with only anterior trichoid sensilla, no setae or scales (Fig. 3C). Sternites: 2nd through 6th, similar to those in males; 7th sternite with mostly double rows of posterior setae, long and short setae scattered at midlength and shorter setae and scales scattered on the posterior half. The pleura is covered with scales. Ovipositor 1.00-1.10 mm long (including cerci), elongate, tapered, entirely setulose, approximately four times the length of the 7th tergite; eversible part with short ventrolateral setae basally, protrusible part with ventral setae on the distal half and thin lateral sclerites; cerci elongated – ovoid, fused, with long dorsolateral setae as well as short ventrolateral setae; and hypoproct with apical setae (Fig. 3C).

Pupa: Integument almost entirely hyaline, antennal horns and prothoracic spiracles pigmented. Head (Fig. 4A): vertex on each side with a long seta (0.23 mm long, n = 1) and raised base; antennal horns very short; two lower facial papillae on each side, one setose and one bare, seta of lower facial papillae 0.02 mm long; three lateral facial papillae on each side, two setose and one bare, setae of lateral facial papillae less than 0.01 mm long. Prothoracic spiracle digitiform, relatively long, 0.18-0.22 mm long (n = 5). Abdominal terga without spines, terga, pleura and sterna evenly spiculose.

Larva: Body: 2.70-3.90 mm long (n = 10). Yellowish-orange, cylindrical. The head capsule is hemispherical, and the antennae are conical and longer than wide (Fig. 4B). Spatula (Fig. 4C) 0.30-0.33 mm long (n = 8), with two conical anterior teeth, an anchor-like base and a moderately developed stalk; two groups of three lateral papillae, two setose and one bare on each side of the spatula. The integument verrucose dorsally in the prothoracic segment, less extensively in the mesothoracic segment, and dorsolaterally and laterally in the remaining segments, except in the last segment; pointed spicules ventrally on the anterior and posterior thirds of the metathorax and all the abdominal segments. The eight short terminal papillae were all setose and similar in length (Fig. 4D).

Gall morphotype

The galls are fusiform and dark brown, resembling the color of the stems (Figs. 1E, G-J). They are typically solitary but occasionally form clusters, with a single elongated larval chamber that houses one larva.

Biology

The species is multivoltine, meaning that galls are present in all developmental stages throughout the year, except for the senescence stage, which does not occur during the first months of the year (January-April) (Fig. 1F). The peaks of induction and the greatest number of galls in the growth and development stage were recorded between January and May (Fig. 1F). There was an increase in the number of mature and senescent galls between May and July (Fig. 1F).

Materials examined

Holotype ♂: Chile, Biobío Region, Parque Botánico Hualpén, VI.2021, L.M. Guedes leg. (MNRJ-ENT1-71013); paratypes: same data, 2♂ (MNRJ-ENT1-71014, MNRJ-ENT1-71025), 4♀ (MNRJ-ENT1-71018, MNRJ-ENT1-71021, MNRJ-ENT1-71023, MZUC-48246), 3 pupal exuviae (MNRJ-ENT1-71015), and 12 larvae of 3rd instar (7 MNRJ-ENT1-71019, 1 MNRJ-ENT1-71022, 4 MZUC-48248); same locality and collector, VI.2022, 4 pupal exuviae (2 MNRJ-ENT1-71027, 2 MZUC-48247) and 9 larvae of 3rd instar (4 MNRJ-ENT1-71016, 5 MNRJ-ENT1-71017).

Etymology: *"peumi"* refers to the plant genus where the gall midge induces galls.

Remarks

Females of the Neotropical genus *Dasineura* exhibit two distinct conditions of the eighth tergite: either intact or divided longitudinally into two sclerites (*see* Table 1). Females with an entire eighth tergite do not conform to the genus definition proposed by Gagné *et al.* (2014), meaning that they do not belong to *Dasineura.* For this

Table 1. List of Neotropical species of *Dasineura* Rondani, 1840 (Diptera, Cecidomyiidae) with data on host plants, described phases, and shape of the female 8th tergite. An asterisk indicates that the type of material is lost.

Species	Host plant	Described phases	Female 8th tergite
Dasineura braziliensis (Tavares, 1922)	*Protium heptaphyllum* (Aubl.) Marchand (Burseraceae)	♀ and larva*	unknown
Dasineura byrsonimae Maia, 2010 Male,	*Byrsonima sericea* DC. (Malpighiaceae)	♂, ♀, pupa, and larva	Entire
Dasineura chilensis (Kieffer & Herbst, 1909)	*Baccharis rosmarinifolia* (Asteraceae)	♂, ♀, and pupa	unknown
Dasineura copacabanensis Maia, 1993	*Eugenia copacabanensis* Kiaersk. (Myrtaceae)	♂, ♀, and larva	Entire
Dasineura corollae Gagné, 1977	*Eupatorium* sp. and *Chromolaena odorata* (Asteraceae)	♂, ♀, pupa, and larva	longitudinally divided
Dasineura couepiae Maia, 2001	*Couepia ovalifolia* (Schott) Benth. Ex Hook. f. (Chrysobalanaceae)	♂, ♀, pupa, and larva	longitudinally divided
Dasineura eugeniae Felt, 1912	*Eugenia buxifolia* (Myrtaceae).	♂ and ♀	longitudinally divided
Dasineura gardoquiae Kieffer & Herbst, 1905	*Gardoquia gilliesii* (Lamiaceae)	larva*	unknown
Dasineura gigantea Angelo & Maia, 1999	*Psidium cattleyanum* Sabine (Myrtaceae)	♂, ♀, pupa, and larva	longitudinally divided
Dasineura globosa Maia, 1996	*Eugenia astringens* Cambess (Myrtaceae)	♂, ♀, and pupa	Entire
Dasineura gracilicornis (Kieffer & Herbst, 1905)	unspecified shrub	gall*	unknown
Dasineura marginalis Maia, 2005	*Eugenia astringens* Cambess (Myrtaceae)	♂, ♀, and pupa	longitudinally divided
Dasineura myrciariae Maia, 1996	*Myrciaria floribunda* (H. West ex Willd.)	♂, ♀, pupa, and larva	Entire
Dasineura occulta Pereira-Colavite & Urso-Guimarães, 2013	*Hypochaeris chillensis* (Kunth) Britton (Asteraceae)	♂, ♀, pupa, and larva	Entire
Dasineura oportunista Cornejo & Martínez, 2019	*Prosopis caldenia* Buckart (Fabaceae)	♂, ♀, pupa, and larva	longitudinally divided
Dasineura ovalifoliae Fernandes & Maia, 2011	*Erythroxylum ovalifolium* Peyr. (Erythroxylaceae)	♂, ♀, pupa, and larva	Entire
Dasineura subinermis (Kieffer & Herbst, 1911)	*Baccharis rosmarinifolia* (Asteraceae)	adult and pupa*	unknown
Dasineura tavaresi Maia, 1996	*Neomitranthes obscura* (DC.) N. Silveira (Myrtaceae)	♀, pupa, and larva	Entire
Dasineura theobromae Maia, 2006	*Theobroma bicolor* (Sterculiaceae)	♂, ♀, pupa, and larva	Entire

reason, they were not included in our morphological comparisons.

The females of *D. braziliensis* Tavares, 1922, *D. chilensis* Kieffer & Herbst, 1909, and *D. eugeniae* Felt, 1912, are known. However, their 8th tergite was not described. The type of the first two species is lost, so this information cannot be recovered. In contrast, the type of *D. eugeniae* held at the United States National Museum (USNM), Smithsonian Institution, Washington, U.S.A., was examined by Dr. Raymond Gagné (USDA, U.S.A.), who confirmed that the 8th tergite is longitudinally divided.

Females of *D. gardoquiae* Kieffer & Herbst, 1905 and *D. gracilicornis* Kieffer & Herbst, 1905 are unknown. The former species was described on the basis of the larva and gall, whereas the latter was described only from the gall (Kieffer & Herbst, 1905). *Dasineura subinermis* Kieffer & Herbst, 1911 is known from adults and pupae (Kieffer & Herbst, 1911). As the descriptions of these three species are very superficial, they do not allow for morphological comparisons. Furthermore, their types are lost. Therefore, *D. gardoquiae, D. gracilicornis* and *D. subinermis* were not included in our discussion.

We compared the new species with *D. braziliensis, D. chilensis, D. corollae* Gagné, 1977, *D. couepiae* Maia, 2001, *D. eugeniae, D. gigantea* Angelo & Maia, 1999, *D. marginalis* Maia, 2005, and *D. oportunista* Cornejo & Martínez, 2019, on the basis of the literature (Kieffer & Herbst, 1909; Felt, 1912; Tavares, 1922; Gagné, 1977; Angelo & Maia, 1999; Maia, 2001, Maia *et al.,* 2005; Cornejo *et al.,* 2019) as well as on examination of specimens from the MNRJ. As the descriptions are not standardized, the available morphological data are not the same for all species.

Adults: Adults of *D. peumi* **sp. nov.** are large, surpassed in size only by *D. gigantea* Angelo & Maia, 1999. Its antenna has 18 flagellomeres, as in *D. eugeniae,* whereas the others include 12 (*D. chilensis*), 12-13 (*D. corolla*), 13 (*D. oportunista*), 14 (*D. braziliensis*), 14-17 (*D. couepiae*), 22-24 (*D. gigantea*), and 21-22 (*D. marginalis*) flagellomeres. However, in *D. eugeniae,* the pulvilli are as long as the tarsal claws are, whereas in the new species, the pulvilli are shorter. The ovipositor of both species is approximately ⅔ the length of the abdomen; nevertheless, these species differ in the proportion between the length and width of the cercus (three times as long as wide in *D. eugeniae* and four times as long as wide in the new species).

Male flagellomeres have nodes and necks subequal in length in *D. peumi* and *D. corolla,* whereas in *D. couepiae, D. gigantea* and *D. oportunista,* necks are longer than nodes, and in *D. marginalis,* they are shorter. Differences related to the tarsal claws and empodia were also observed. The empodial and tarsal claws are subequal in length in the new species and in *D. marginalis.* In all other species, the former are longer than the latter. With respect to the male terminalia, in the new species, male gonostyli are clearly the narrowest and longest. In addition, its aedeagus is convex apically, as in *D. gigantea* and *D. marginalis,* whereas in the others, it is quadrangular at the apex or has an apical reentrance.

Pupa: Differences were observed in the relative length of the vertical setae, arrangement of the lateral facial papillae, relative length and shape of the prothoracic spiracles and arrangement of the abdominal dorsal spines. The vertical setae and prothoracic spiracles are subequal in length only in *D. peumi,* whereas in *D. chilensis, D. corolla, D. gigantea,* and *D. marginalis,* the former are longer than the latter, whereas in *D. couepiae* and *D. oportunista,* the former are shorter. *Dasineura peumi* has the complete arrangement of lateral facial papillae, as do *D. couepiae* and *D. gigantea,* whereas they are absent in *D. corolla, D. marginalis,* and *D. oportunista*. The prothoracic spiracles are digitiform in *D. peumi* and setiform in all other species. Finally, the abdominal dorsal spines are absent in the new species and in all other species except *D. corollae*.

Larva: The spatula of *D. peumi* has two apical teeth, as in all other species, but its stalk is moderately developed, as in *D. corolla* and *D. oportunista*. In *D. gigantea,* the stalk is shorter, whereas in *D. couepiae,* it is longer. Eight setose lateral papillae are observed in most species, except in *D. couepiae* and *D. gigantea,* whose number is reduced to six.

DISCUSSION

Morphological analyses confirmed that the inducer of *P. boldus* stem galls represents a new species from the genus *Dasineura,* which is currently known only from Chile. Diagnostic characteristics that distinguish this species include the number of antennal flagellomeres, the relative length of the antennal nodes and necks, the relative length of the empodia and pulvilli, and the shape of the gonostyli and aedeagus. Furthermore, the relative length of the vertical setae and prothoracic spiracles, the arrangement of the facial papillae in the pupae, the relative length of the spatula stalk and the number of terminal papillae in the larvae were important in distinguishing *D. peumi* from other related species.

From an ecological and biological perspective, *D. peumi* demonstrates multivoltine behavior, with galls developing throughout the year. This emphasizes its adaptability and interaction with its host plant species, an evergreen species (Guedes *et al.,* 2023a, b). Notably, the peaks of gall induction do not coincide with the vegetative growth stage of *P. boldus*. Typically, gall-inducing insects induce galls in young, relatively reactive, and nutritious tissues (Oliveira *et al.,* 2016). However, *D. peumi* is capable of inducing galls on mature stems (Guedes *et al.,* 2023b). The eggs are likely deposited near leaf traces and access the cambial zone, establishing themselves in the stem during secondary growth. A high number of galls have been observed just below the leaf insertion, but this is not a consistent pattern; galls can also develop in other stem locations, often far from leaf insertions.

Previous studies speculated that larvae might produce lignolytic enzymes that degrade xylem lignin or may associate with lignolytic fungi, a phenomenon observed in other gall-forming cecidomyiids (Guedes *et al.,* 2023b). Notably, gall induction and senescence align with the warmest (February) and coldest (June) months of the year, respectively, suggesting that this pattern may allow the gall inducer to avoid the most extreme climatic periods of the Chilean Mediterranean climate.

In contrast, other gall-inducing species on evergreen plants in Chilean sclerophyllous forests exhibit univoltine life cycles with strategies to navigate critical climate periods. The calophyids (Hemiptera, Calophyidae) that induce galls on the stems and leaves of the evergreen species *Schinus polygama* (Anacardiaceae) undergo diapause during winter, emerging in late summer (January-February) to induce new galls (Guedes *et al.,* 2018a, b). In the same host plant, another gall inducer, *A. parrai,* induces galls in spring and emerges in late summer, although its overwintering location remains unknown (Silva *et al.,* 2018).

CONCLUSION

The present study identified *D. peumi* as a new species of gall-inducing insect associated with *P. boldus* in Chile. Through detailed morphological analysis, we clarified its taxonomic position within the genus *Dasineura*. The unique life cycle of *P. peumi,* characterized by year-round gall induction independent of the phenology of its host plant, provides valuable insight into the biology and ecology of gall-inducing species in Chile's endemic sclerophyllous forests.

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SUPPLEMENTARY MATERIAL

Table S1. Average temperature and precipitation for 2022 and 2023. The data are available at "Servicios Climáticos (https://www.meteochile.gob.cl)" and correspond to the meteorological station 360019 (Carriel del Sur).

Year	Max Temp (°C)	Min Temp (°C)	Coldest Month	Warmest Month	Total Precipitation (mm)	Driest Month	Wettest Month
2022	17.4	9.2	August	February	835.2	February	July
2023	17.8	9.3	July	February	797.7	February	June

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