



## ***Penapis larraini* Packer, a new species of rophitine bee (Hymenoptera: Halictidae) from a fog oasis in Northern Chile**

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### **Abstract**

*Penapis larraini* Packer, **sp. nov.** (Hymenoptera: Halictidae: Rophitinae), is described from Alto Patache, South of Iquique, a fog oasis in the very dry coastal desert region of northern Chile. It is compared to other species of the genus, and its unusual foggy habitat is described.

**Key words:** Bees, Atacama Desert, taxonomy, new species, fog oasis, *lomas* vegetation, paleoenvironments

### **Resumen**

Se describe una nueva especie *Penapis larraini* Packer (Hymenoptera: Halictidae: Rophitinae) del oasis de niebla Alto Patache, al sur de Iquique, en la zona costera del desierto en la provincia de Iquique en Chile. Es comparada con otras especies del género y se describe este inusual hábitat nebuloso.

### **Introduction**

*Penapis penai* Michener was the first species of the bee subfamily Rophitinae described from South America (Michener, 1965; at that time the subfamily was known as the Dufoureae). Since then, an additional two genera have been described: *Ceblurgus* (Urban and Moure, 1993) from Brazil and *Goeletapis* (Rozen, 1997) from Peru, as well as two additional species of *Penapis* (Rozen, 1997). In this paper I describe a fourth species of *Penapis* that is both morphologically and ecologically distinctive.

### **Methods**

Descriptive terminology and format follow Rozen (1997). In addition to standard body size metrics, intertegular width (ITW) was also measured (Cane, 1987) as this is becoming commonly used in trait-based biodiversity assessments (e.g. Williams *et al.* 2010) and has been used for a long time as a comparative statistic to estimate relative egg size (Iwata and Sakagami, 1966). Images were taken with a Visionary Digital BK Plus imaging system using a Canon EOS 40D digital SLR camera and processed with Adobe Photoshop. Institutional acronyms are as follows: PCYU—Packer Collection at York University, Toronto; PUCV—Pontificia Universidad Católica de Valparaíso.

## Taxonomy

### *Penapis larraini* Packer, new species

(Figs. 1, A–J)

**Diagnosis.** The male can be differentiated from other species of the genus by the absence of sublateral processes on S6 and the form of the sublateral processes on S5 (Figs. 1C–F). In side view, the latter have a narrow, digitiform apex, which is dorsoventrally flattened (Fig. 1E). All other species in the genus have rounded (in *P. penai* angulate) sublateral processes on S6 and approximately triangular processes on S5, which are not dorsoventrally flattened, rather they are uniformly obliquely compressed. The female is most easily distinguished by the punctuation of the metasomal terga: T1–T4 have large, shallow punctures on the apical half (excepting the apical impressed areas) and T2–T4 have minute, denser punctures bearing minute setae that are restricted to the anterior half of the tergum (slightly more extensive medially) (Fig. 1J). Other species have the horizontal portion of T1 impunctate, or almost so, and the minute punctures of T2–T4 more extensive, at least on T3 approaching the apical impressed areas medially to a distance much less than the length of the impressed area (Fig. 1K). The male has similar sculpture but is more readily separated by the sternal characters noted above.

**Description. Male:** Head width 1.85–1.90mm, ITW 1.4–1.45mm, wing length 4.8–5.0mm, body length 7.4–7.6mm. Lower part of face moderately projecting (Fig. 1A). Pterostigma with pale disc bordered by brown marginal veins. Midtibial spur gently curved almost to base. S4 with more than 10 outwardly recurved plumose setae on each side; apical comb pale amber, more than 20 straight setae on each side, narrowly interrupted medially (Fig. 1B), comb setae finer and longer than in other species. S5 with median apical process shorter than sublateral process, laterally compressed and somewhat downcurved apically; sublateral process in lateral view with deep basal portion ending in acute angulation ventrobasad of dorsoventrally flattened, narrow apical projection (Figs. 1C–E). S6 lacking sublateral process, surface flat, apical concavity broad, truncate (Fig. 1F). S8 and genital capsule as in figures 1G and 1H.

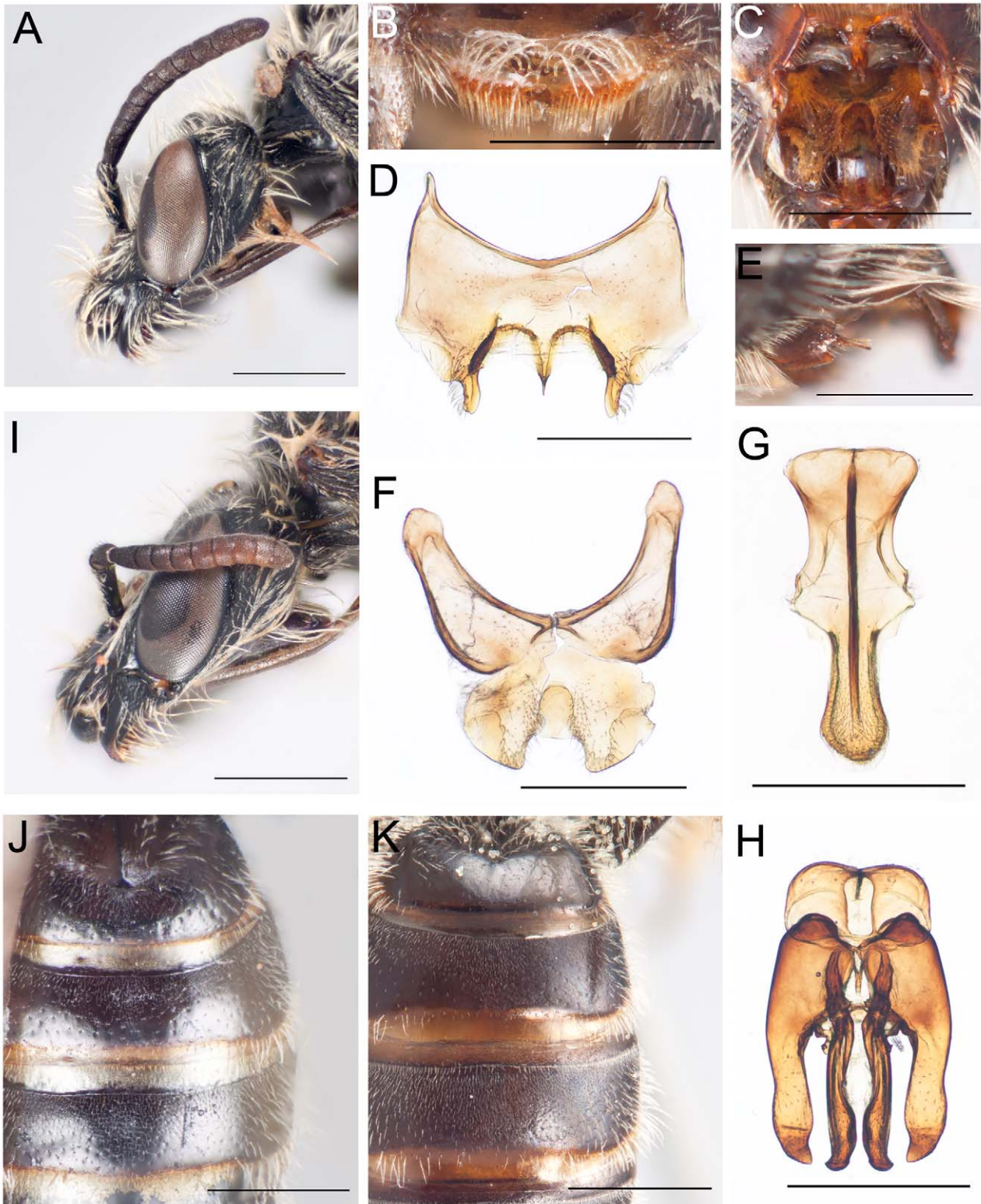
**Female:** Head width 4.8–5.2mm, ITW 1.42–1.52mm, wing length 4.8–5.2mm, body length 7.3–8.4mm. Mid-femur flat over most of anterior surface, somewhat concave towards apex because of apicodorsal swelling. Scopa pale straw. Metasomal terga with sparse, shallow, large punctures on apical half (apical impressed areas excepted); punctures smaller, denser and more distinct on T5 and T6; anterior half of T2–T4 with minute punctures separated by  $\geq$  their diameters; minute punctures extending slightly past midlength of tergum medially, less extensive laterally (Fig. 1J).

**Material studied.** Holotype male: CHILE Region I, Alto Patache, xi.1997, W. Sielfeld. Allotype female, one male paratype and two female paratypes with identical label data, PUCV with one pair of paratypes at PCYU. Three female paratypes (one missing the head) same locality, 820m, one each from 30.xi.1997, 02.xii.1997 and 07.xii.1997, H. Larrain, two at PCYU, one at PUCV. Although not stated on any labels, the locality is at 20°49'S; 70°09'W.

**Etymology.** The species is named after Horacio Larrain, eco-anthropologist and archaeologist of the Universidad Bolivariana in Iquique, northern Chile. The name is appropriate as his wife, Marta, is a sister of the renowned, late Chilean entomologist Luis Peña, after whom the genus and its type species were named. Dr. Larrain collected the first specimens of the species seen by the author and has been involved with numerous research projects on the *locus typicus*.

## Discussion

The climatic conditions at Alto Patache are of sufficient interest to deserve treatment in some detail. The site is approximately 65km south of Iquique and is 3.5km from the ocean at 20°49'S and 70°09'W, occupying areas between 500 and 800masl (Sagredo *et al.*, 2002; Cereceda *et al.*, 2008a). The surrounding area is extremely arid with an average annual rainfall of only 0.8mm over 30 years (Cereceda *et al.*, 2008a). There is evidence that the northern Atacama has been hyperarid, at least in part, for over 22 million years (Latorre *et al.*, 2007). The site is one of a series of isolated fog-dependent vegetation types called “*lomas formations*” that dot the desert near-shore of Peru and northern Chile (Cereceda *et al.*, 2004; Dillon *et al.*, 2009). Fog oases generally share several features:



**FIGURES 1A–K.** A–J. *Penapis larraini* Packer, n. sp. A–H male, I–J female. K. *Penapis toroi* female. A. head lateral view. B. S4 ventral view. C. apex of metasoma ventral view. D. S5 ventral view. E. S5 lateral view. F. S6 ventral view. G. S8 ventral view. H. Genital capsule ventral view. I. Head lateral view. J. T1–T3 dorsal view. K. T1–T3 dorsal view. Note that the individual shown in J has the most sparse but large punctures of all the specimens available. Scale line = 1mm.

being located on headlands with a bay to the south and with a mountain of over 900m to the south of that (Cereceda *et al.*, 2002). These circumstances, combined with the prevailing W or SW winds, cause the humid air masses to cool as they go over the mountain forming huge fog masses that concentrate at higher altitudes in the bay. Over 7 years, the average daily condensation was 7.8 litres per m<sup>2</sup> per day, with a peak averaging almost 14l in winter and a minimum of 2l/m<sup>2</sup>/day in summer (Cereceda *et al.*, 2008a). Peak fog water occurs at altitudes of 750–850masl and amounts are negligible below 550m (Cereceda *et al.*, 2008a). Humidity is high with mean monthly values always above 70%, approaching 90% in September and October (Cereceda *et al.*, 2008b). Conditions are cool at the site, with average mean annual temperatures (measured over two years) of 12.5°C and mean monthly averages ranging from 10°C in June and July to 18°C in February (Cereceda *et al.*, 2008b). Comparable water collection and humidity data from four fog oases in Northern Chile are given in Larrain *et al.* (2002) wherein Alto Patache was shown to be the most promising in terms of water collection after the Cerro Moreno fog oasis in Antofagasta.

Over 40 vascular plant species are known from Alto Patache, and overall, the level of floral endemism in northern Chilean fog oases is 43% (Muñoz-Schick *et al.*, 2001), very similar to that for *lomas* formations throughout Peru and Chile (Dillon *et al.*, 2009). Flowering, and hence bee activity, occurs in the spring (August to early December) but is sparse except in seasons after early spring rainfall, which is a rare occurrence: ENSO phenomena may be accompanied by short local rains, as happened in 1986, 1997 and 2002 (Larrain, personal communication).

Floral hosts of *Penapis* have generally been thought to be *Argylia* spp. (Rozen, 1997). However, *P. toroi* has been collected abundantly by the author at flowers of *Nolana* north and east of Chañaral but not on *Argylia* (Packer, unpublished observations). *Argylia radiata* (L.) D. Don is very rarely found at Alto Patache but there are 4 species of *Nolana* (Muñoz-Schick *et al.*, 2001), three of which, *N. sedifolia* Poepp., *N. intonsa* I.M. Johnst. and *N. jafuelli* I.M. Johnst. are extremely abundant in rainy years, particularly the latter, which forms meadows of thousands of plants along the higher slopes (Cereceda *et al.*, 2004; H. Larrain, pers. communication).

Two other species of *Penapis* are known from inland of the only known locality for *P. larraini*: *P. toroi* and *P. moldenkei* have both been recorded from La Tirana (Rozen, 1997), an area where the water table is high enough to permit persistence of forests primarily of tamarugos – *Prosopis tamarugo* Phil. (Mooney *et al.*, 1980). Alto Patache is approximately 75km SW of La Tirana and separated from it by inhospitable desert. There are over 100 *lomas* formations in Peru and northern Chile (Dillon *et al.*, 2009), and additional collecting in the more floristically diverse ones will undoubtedly reveal additional undescribed bee species. Genetic studies of population isolation would also be of considerable interest as would phylogenetic analyses as have been performed on some of the plant taxa (e.g. Dillon, *et al.*, 2009).

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