



A new *Paracoccus* species from Palaearctic region (Hemiptera, Sternorrhyncha, Coccoidea, Pseudococcidae)

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Abstract

A new mealybug species, *Paracoccus leucadendri* **sp. nov.**, is described from Portugal. This is the first record of a *Paracoccus* species from Europe. It is suggested that its presence in Portugal is the result of a fortuitous introduction with its host plant, *Leucadendron* sp. (Proteaceae). An identification key is presented to distinguish this new *Paracoccus* species from other mealybug species reported on Proteaceae in the world.

Key words: *Paracoccus leucadendri* **sp. nov.**, *P. claudus*, *P. evae*, *P. herreni*, *P. invectus*, *P. orsomi*, Iberian Peninsula

Introduction

Mealybugs (Hemiptera: Pseudococcidae) constitute the second largest family of scale insects (Hemiptera: Coccoidea), with more than 2000 described species and ca. 290 genera (Ben-Dov, 2009a). About 160 species of mealybugs are recognized as pests worldwide (Miller *et al.*, 2002). Pest mealybugs are often invasive species. For example, approximately 70% of the mealybug species that are considered as pests in USA are invasive (Miller *et al.*, 2002).

The mealybug genus *Paracoccus* includes 86 described species, mostly from the Australasian (36 species), Afrotropical (21) and Nearctic (17) regions, plus a few species from the Neotropical (8) and Oriental (10) regions (Ben-Dov, 2004). Only one species, *Paracoccus tuaregensis* (Balachowsky), is known from the Palaearctic region, described off *Ficus* (Moraceae) from Algeria (Balachowsky, 1951; Ben-Dov, 1994). In this paper, a new species of *Paracoccus*, collected off *Leucadendron* (Proteaceae) in Portugal, is described.

Proteaceae have been cultivated for cut flowers along the Southwestern coast of Portugal since the 1990s. Mealybugs are considered major pests of several Proteaceae cultivars in this region (Leandro *et al.*, 2006). Their pest status is due both to cosmetic damage originated by the contamination of flowers with mealybugs, honeydew and/or sooty mold, as well as to the inefficacy of chemical control. In the most susceptible varieties, infestation levels can reach 65% of plant stems in late spring (Leandro *et al.*, 2006). No information was available on the identity of mealybug species associated with Proteaceae in Portugal. The *Paracoccus* species here described is the first mealybug species reported of Proteaceae from mainland Europe. The possible occurrence of other mealybug species is under investigation.

According to Ben-Dov (2009b), 29 species of mealybugs in 15 genera are reported worldwide on Proteaceae, namely *Apodastococcus* (1 species), *Australicoccus* (1 species), *Delottococcus* (3 species), *Dysmicoccus* (1 species), *Eucalyptococcus* (1 species), *Ferrisia* (2 species), *Maconellicoccus* (2 species), *Melanococcus* (1 species), *Misericoccus* (1 species), *Nipaecoccus* (4 species), *Phenacoccus* (2 species),

Planococcus (2 species), *Pseudococcus* (5 species), *Rastrococcus* (2 species), *Ripersiella* (1 species). An identification key is presented to distinguish the new *Paracoccus* species from these other mealybug species.

Materials and methods

The description is based on 10 slide-mounted specimens prepared according to the methods of Williams & Watson (1988). Measurements were made using a compound microscope with an ocular micrometer and are given as minimum and maximum. The illustration of the adult female was prepared based on multiple specimens, with the assistance of LAS (Leica Application Suite; Leica Microsystems Launches Branding Campaign, Wetzlar, Germany). Important details are enlarged as photographs around the central illustration, but the sizes are not proportional to each other. Terminology follows that of Williams (2004).

Abbreviations for depositories are as follows: DISTEF (Dipartimento di Scienze e Tecnologie Fitosanitarie, University of Catania, Italy); DPPF (Departamento de Protecção de Plantas e de Fitoecologia, Instituto Superior de Agronomia, Lisboa, Portugal).

Paracoccus leucadendri Mazzeo & Franco sp. nov. (Fig. 1)

Diagnosis. Specimens preserved in alcohol and acetic acid appeared pink in colour, becoming green in KOH.

Adult female

Mounted material: Body oval, largest specimen 2.48 mm long and 1.68 mm wide. Anal lobes moderately developed, each ventral surface with an apical seta 185–210 µm long; anal lobe bar about 35.5 µm long and bar seta about 38 µm long. Antennae each 350–400 µm long, with 8 segments. Legs well developed; hind trochanter + femur 230–270 µm long, hind tibia + tarsus 250–445 µm long, claw about 25 µm long. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 1.09–1.71. Translucent pores present on hind coxa and tibia.

Labium 130–145 µm long, similar in length to clypeolabral shield. Circulus absent. Ostioles well developed, each lip with 2 or 3 setae and about 11 trilocular pores. Anal ring about 67.5 µm long and 82.5 µm wide, bearing 6 setae, each 125–170 µm long.

Cerarii numbering 17 pairs; each anal lobe cerarius lightly sclerotised, with 2 conical setae, each about 17.5–27.5 µm long and 5 µm wide, plus 2–4 auxiliary setae and 14–21 trilocular pores. Anterior cerarii each with 2 conical setae and 4–8 trilocular pores, sometimes reduced on head to a single conical seta; preocular cerarius sometimes with 3 conical setae.

Dorsal surface with short, stiff setose setae, each mostly 5.0–12.5 µm long. Multilocular disc pores absent. Trilocular pores evenly distributed. Oral rim tubular ducts, each about 10–12.5 µm long, with rim about 7.5–11.25 µm in diameter, present singly near all abdominal cerarii (except anal lobe cerarius) and also near most thoracic cerarii; one duct also present behind each frontal cerarius; a few others distributed singly on medial areas of abdomen from segment VI to II and scattered on thorax.

Ventral surface with normal flagellate setae. Multilocular disc pores, each about 7.5 µm in diameter, present posterior to vulva and in double rows across abdominal segments VII & VI and in single rows on segments V & IV; also with about 4–20 multilocular disc pores scattered on thorax and head.

Oral collar tubular ducts together with multilocular disc pores present in rows on abdominal segments and in a group lateral to each anterior coxa.

Type material. HOLOTYPE: adult female, Portugal, Zambujeira do Mar (Odemira), on *Leucadendron* cv. Rosette (*L. laureolum* × *L. elimense* ssp. *salterii*) (Proteaceae), 15 November 2007, J.C. Franco, slide n. 1296.01 (DISTEF); **PARATYPES:** 9 adult females, Portugal, same data as for holotype, slides n. 1296.02 – 1296.08 (DISTEF) plus slides n. 1296.09 and 1296.10 (DPPF).

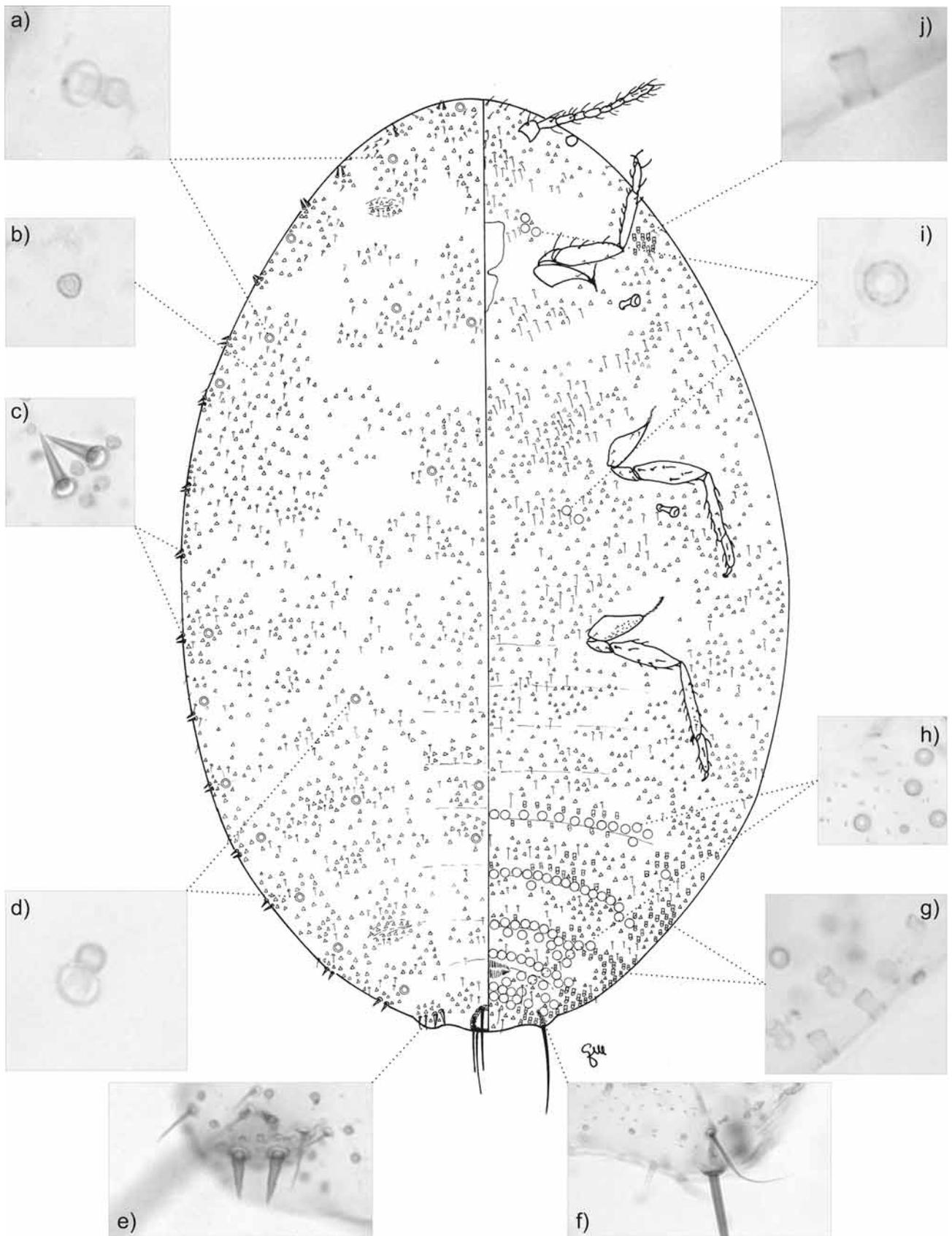


FIGURE 1. *Paracoccus leucadendri* Mazzeo & Franco **sp. nov.** **a, d:** oral rim tubular duct; **b:** trilocular duct; **c:** cerarian setae; **e:** anal lobe cerarius; **f:** anal lobe bar and seta; **g, j:** oral collar ducts; **h, i:** multilocular disc pores.

Etymology. The epithet “leucadendri” is the Latin genitive of the genus name of the plant host, *Leucadendron*.

Comments. *Paracoccus leucadendri* **sp. nov.** lacks a circulus and has, like many other species of *Paracoccus*, a group of oral collar tubular ducts in the lateral area near to each anterior coxa. It is close to the following species of *Paracoccus*: *P. claudus* De Lotto, *P. evae* Williams, *P. herreni* Williams & Granara de Willink, *P. investus* Williams and *P. orsomi* Mamet. It differs from these as follows:

- from *P. claudus* (only known from Namibia, West Africa on *Calicorema* (Amaranthaceae)) in possessing multilocular disc pores on the venter of the thorax and in having oral rim tubular ducts in the median area of dorsum of the thorax (absent in *P. claudus*);

- from *P. evae* (only known from Indonesia off Asteraceae and Poaceae) in the large number and distribution of oral rim tubular ducts (very few on *P. evae*), and in having 8-segmented antennae (*P. evae* has 7-segmented antennae);

- from *P. herreni* (restricted to the Neotropics and only known on Euphorbiaceae and Verbenaceae) in lacking both a circulus and oral rim tubular ducts ventrally (both present in *P. herreni*);

- from *P. investus* (only known from India and Thailand off Orchidaceae) in having 17 pairs of cerarii (*P. investus* has 9–14 cerarii), ostioles with lips well developed (often indistinct in *P. investus*), in the distribution of multilocular disc pores and oral collar tubular ducts and in lacking circulus (present or absent in *P. investus*);

- from *P. orsomi* (only known from Madagascar off an unknown plant) in possessing oral rim tubular ducts on the thorax (absent on *P. orsomi*) and in lacking translucent pores on femur (present on *P. orsomi*).

Possible origin of *P. leucadendri*

We believe that the presence of *P. leucadendri* along the Southwestern coast of Portugal is the result of an accidental introduction from Southern Africa along with its host plant (“cultural immigrants” *sensu* Bodenheimer (1934); “obvious introductions” *sensu* Ben-Dov (1990)). This is because: (i) *Leucadendron* is a recently introduced crop in Portugal which originated from Southern Africa (Liu *et al.*, 2007); (ii) there are no other known species of *Paracoccus* in Europe; and (iii) most *Paracoccus* species are known from only one zoogeographic region (Ben-Dov, 2004), i.e. they have a highly restricted distribution.

According to Ben-Dov *et al.* (2009), 101 mealybug species in 49 genera are known from South Africa. Of these, 11 species have been reported off Proteaceae (Ben-Dov, 2009a): *Delottococcus confusus* (De Lotto), *D. proteae* (Hall), *D. trichiliae* (Brain), *Ferrisia malvastra* (Mc Daniel), *F. virgata* (Cockerell), *Misericoccus inops* De Lotto, *Nipaecoccus viridis* (Newstead), *Phenacoccus stelli* (Brain), *Planococcus citri* (Risso), *Pseudococcus calceolariae* (Maskell) and *P. longispinus* (Targioni Tozzetti). None of the five reported *Paracoccus* species from South Africa, namely *P. burnerae* (Brain), *P. larinus* De Lotto, *P. latebrosus* De Lotto, *P. muraltae* (Brain) and *P. perperus* De Lotto, is known off Proteaceae (Ben-Dov *et al.*, 2009). However, mealybugs were included by Ben-Jaacov & Silber (2007) in the list of severe pest groups of proteaceous species in South Africa, although they did not state which species were involved. On the other hand, four mealybug species were listed as pests of Proteaceae in South Africa by Lubbe (2006), namely, *Delottococcus quaesitus* (Brain), *Phenacoccus stelli*, *Planococcus citri* and *Pseudococcus calceolariae*.

Identification key for mealybug species reported off Proteaceae

1. Anal lobes membranous or sclerotized, each strongly produced, forming a deep notch at apex of abdomen; always with a curved and well-developed anal lobe bar, sometimes represented by the inner part only
..... *Melanococcus albizziae* (Maskell)
Anal lobes, if present, only moderately produced, not forming a deep notch at apex of abdomen 2
2. Cerarian setae truncate, distinctly flat at apices..... 3

	Cerarian setae, if present, pointed at apices, never truncate	4
3.	Quinquelocular pores of two sizes, larger type situated around most of body margin.....	
 <i>Rastrococcus banksiae</i> Williams	
	Quinquelocular pores of one size only	<i>Rastrococcus nivalis</i> (Maskell)
4.	Dorsal tubular ducts large, each with orifice surrounded by a round, flat sclerotised area containing within its borders 1 or more setae, or with setae adjacent to rim	5
	Dorsal tubular ducts, if present, not with this combination of characters	6
5.	Multilocular disc pores present in rows on abdominal segment VI and more posterior segments	
 <i>Ferrisia virgata</i> (Cockerell)	
	Multilocular disc pores absent from abdominal segment VI, few adjacent to vulva only	<i>Ferrisia malvastra</i> (McDaniel)
6.	Denticle present on plantar surface of claw	7
	Denticle absent on plantar surface of claw	9
7.	Antennae 7 segmented.....	<i>Misericoccus inops</i> De Lotto
	Antennae 8 or 9 segmented.....	8
8.	Oral rim tubular ducts present, arranged around margins	<i>Phenacoccus hakeae</i> Williams
	Without oral rim tubular ducts.....	<i>Phenacoccus stelli</i> (Brain)
9.	Oral rim tubular ducts present somewhere on body (sometimes rim obscure but with some indication of sclerotization around orifice or with rim projecting from surface of integument).....	10
	Oral rim tubular ducts usually absent	22
10.	Oral rim tubular ducts on dorsum in marginal groups of 3 or 4 behind each frontal cerarius and next to each cerarius on abdominal segment VII.....	<i>Apodastococcus aldinganus</i> Williams
	Oral rim tubular ducts not with this distribution	11
11.	Anal lobe bar present, sometimes small, but always present from at least bar seta	12
	Anal lobe bar entirely absent	16
12.	Oral rim tubular ducts numerous, tending to form bands across segments	<i>Maconellicoccus hirsutus</i> (Green)
	Oral rim tubular ducts fewer, in single rows across segments.....	13
13.	Translucent pores present on hind coxa, femur and tibia; dorsal body setae short and stiff; oral rim tubular ducts present on dorsum only	<i>Paracoccus leucadendri</i> sp. nov.
	Translucent pores absent from hind coxa and femur, generally present on hind tibia; dorsal body setae short and slender or stout, with a flagellate apex; oral rim tubular ducts present on dorsum and sometimes also on marginal and submarginal areas of venter, although occasionally on venter only	14
14.	Ventral marginal area adjacent to dorsal cerarius XIII (<i>sensu</i> De Lotto, 1977) with a group of oral collar ducts	
 <i>Delottococcus proteae</i> (Hall)	
	Without oral collar ducts on area adjacent to dorsal cerarius XIII (<i>sensu</i> De Lotto, 1977)	15
15.	Margin of body with 18 pairs of cerarii.....	<i>Delottococcus trichiliae</i> (Brain)
	Margin of body with some cerarii missing from cephalothoracic region.....	<i>Delottococcus confusus</i> (De Lotto)
16.	Antennae 9 segmented; rims of oral rim tubular ducts extremely narrow.....	<i>Maconellicoccus ugandae</i> (Laing)
	Antennae with less than 9 segments; rims of oral rim tubular ducts normal and conspicuous	17
17.	Cerarii numbering at most 7 pairs, present on abdomen only; anal lobe cerarii each with 5–7 setae of different sizes, but always with two larger than others	<i>Australicoccus grevilleae</i> (Fuller)
	Cerarii numbering 16 or 17 pairs.....	18
18.	Dorsal oral rim tubular ducts, often each with 1 or 2 discoidal pores and a single short seta adjacent to rim, present behind each frontal cerarii and next to most abdominal cerarii.....	<i>Pseudococcus maritimus</i> (Ehrhorn)
	Dorsal oral rim tubular ducts not as above	19
19.	Eyespots with discoidal pores present in sclerotized rim	<i>Pseudococcus jackbeardsleyi</i> Gimpel & Miller
	Eye without discoidal pores	20
20.	Multilocular disc pores usually surrounding vulva only, except for occasional pores on abdominal segment VI; dorsal oral rim tubular ducts usually in groups of 3 next to most cerarii, each group comprising 1 large and 2 small ducts or rarely with only 1 small duct	<i>Pseudococcus longispinus</i> (Targioni Tozzetti)
	Multilocular disc pores on at least 3 segments anterior to vulva; dorsal oral rim tubular ducts not as above	21
21.	Dorsum with an oral rim tubular duct just behind each frontal cerarius &/or with groups of ventral oral collar ducts present on head and thoracic margins.....	<i>Pseudococcus hypergaeus</i> Williams
	Dorsum without an oral rim tubular duct just behind each frontal cerarius; oral collar tubular ducts few on venter of head and thorax.....	<i>Pseudococcus calceolariae</i> (Maskell)
22.	Minute tubular ducts present on both dorsum and venter, each with orifice narrower than a trilocular pore but with a wide external rim	<i>Ripersiella cobelopus</i> (Williams)
	Minute tubular ducts as above absent.....	23
23.	All or some dorsal setae stiff, these thick or conical, nearly or quite as large as cerarian setae, never all flagellate,	

slender or minute.....	24
All dorsal setae flagellate, slender or minute; if minute they are much shorter than cerarian setae	28
24. Dorsal surface with short, pointed setae of different sizes	<i>Dysmicoccus queenslandianus</i> Williams
Dorsal surface with setae stiff, thick, lanceolate or conical, never slender except for one or two auxiliary setae and some setae on anal lobe segment	25
25. Oral collar tubular ducts numerous on dorsum.....	<i>Nipaeococcus viridis</i> (Newstead)
Oral collar tubular ducts absent on dorsum	26
26. Anal lobe bar absent	<i>Nipaeococcus nipae</i> (Maskell)
Anal lobe bar present	27
27. Cerarii recognizable as 17 distinct pairs; cerarii on abdomen often with more than 2 cerarian setae and those on head with 4 or 5 setae	<i>Nipaeococcus banksiae</i> Williams
Cerarii present as about 12 distinct pairs, becoming unrecognizable on head and thorax; those on abdomen usually with 2 cerarian setae only.....	<i>Nipaeococcus ericicola</i> (Maskell)
28. Cerarii numbering 17 pairs, all on sclerotised areas.....	<i>Eucalyptococcus hakeae</i> Qin
Cerarii numbering 18 pairs, only anal lobe cerarii with some sclerotisation	29
29. Head with 14–35 tubular ducts and/or thorax with 7–30 ducts near eighth pair of cerarii; total number of ducts on head and next to eighth pair of cerarii 19–50; multilocular disc pores on posterior edges of abdominal segments IV–VII usually present in single rows.....	<i>Planococcus citri</i> (Risso)
Head with 0–13 tubular ducts and/or thorax with 0–6 ducts near eighth pair of cerarii; total number of ducts on head and next to eighth pair of cerarii 0–18; multilocular disc pores on posterior edges of abdominal segments IV–VII usually present in double rows.....	<i>Planococcus minor</i> (Maskell)

Acknowledgments

Thanks are due to D.J. Williams (The Natural History Museum, London, UK), Danièle Matile-Ferrero (Muséum National d’Histoire Naturelle, Paris, France), and Jean-François Germain (Laboratoire National de la Protection des Végétaux, Montpellier, France) for reviewing the description and for their comments on the species; to Mário Oliveira (Europrotea) and Ana Passarinho for their help with the collection of the studied specimens; to Elisabete Figueiredo (Instituto Superior de Agronomia, Portugal) and Maria José Leandro (Flora United Farm Lda, Portugal) for their help in obtaining some publications on Proteaceae; and to Chris Hodgson (National Museum of Wales, Cardiff, UK), Sebastiano Barbagallo (Dipartimento di Scienze e Tecnologia Fitosanitarie, Catania, Italy), Rosa Henderson (Landcare Research, Auckland, New Zealand) and an anonymous reviewer for their critical review and suggestions that significantly improved an early version of the manuscript.

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