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# Three new species in the subfamily Eriopeltinae Šulc from Italy (Hemiptera, Coccoidea, Coccidae) with comments on the genus *Lecanopsis*

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## Abstract

Three new coccid species, namely *Hadzibejliaspis ferenci* Pellizzari **n. sp**., *Lecanopsis sicula* Pellizzari **n. sp.** and *L. salvatorei* Pellizzari **n. sp.** are described and illustrated. Identification keys for the genera in the subfamily Eriopeltinae Šulc and to species in the genera *Hadzibejliaspis* Koteja and *Lecanopsis* Targioni Tozzetti are provided.

**Key words**: soft scales, *Hadzibejliaspis, Lecanopsis,* identification keys

## Introduction

The family Coccidae includes about 1140 species and is the third largest family in the Superfamily Coccoidea, although it is likely that there are more than twice as many species as currently recognized. Members of the family are present in all zoogeographical regions, but the richest in terms of number of genera and species are the Palaearctic and the Neotropical Regions (Kozár & Ben-Dov, 1997). Ten subfamilies are recognized in the Coccidae, based on the morphology of the adult female and, when known, that of the adult males (Hodgson, 1997). At present, the subfamily Eriopeltinae (as defined by Hodgson, 1994: 55) contains 13 genera (*Eriopeltis* Signoret, *Exaeretopus* Newstead, *Hadzibejliaspis* Koteja, *Idiosaissetia* Brain, *Lecanopsis* Targioni Tozzetti, *Luzulaspis* Cockerell, *Membranaria* Brain, *Poaspis* Koteja, *Psilococcus* Borchsenius, *Scythia* Kiritshenko, *Symonicoccus* Koteja & Brookes, *Vittacoccus* Borchsenius and *Waricoccus* Brookes & Koteja). Of these, species belonging to *Idiosaissetia* and *Membranaria* are African or Asiatic, the genera *Symonicoccus* and *Waricoccus* are known only in Australia, whereas the other genera have a Palaearctic distribution. *Eriopeltis*, *Scythia*, *Psilococcus* and *Vittacoccus* are clearly recognizable genera, whereas *Exaeretopus*, *Hadzibejliaspis*, *Lecanopsis*, *Luzulaspis* and *Poaspis* share a number of morphological characters that can make it difficult to place a species confidently in some of these genera. With regard to the host plants, *Eriopeltis*, *Scythia*, *Exaeretopus*, *Hadzibejliaspis*, *Lecanopsis* and, *Poaspis* are known mostly off Poaceae whereas *Luzulaspis*, *Psilococcus* and *Vittacoccus* live on Cyperaceae.

A synopsis of the attempts by different authors to form natural groups or tribes among the Eriopeltinae species is reported below.

Šulc (1941) introduced the genus *Mohelnia* (= *Scythia*) and created the Tribe Eriopeltini Šulc to take *Eriopeltis*, *Mohelnia* (= *Scythia*) and *Scythia*. In fact, even though the adult females do have a different morphology, *Eriopeltis* and S*cythia* have similar first-instar nymphs with spines on the margin of the head (Šulc, 1941; Řeháček, 1960). Later, Borchsenius (1957) placed the following genera in the subfamily Filippiinae: *Eriopeltis, Exaeretopus*, *Lecanopsis, Luzulaspis, Psilococcus, Scythia, Vittacoccus* plus *Chlamydolecanium* Goux, *Filippia* Targioni Tozzetti, *Metaceronema* Takahashi, *Parafairmaria* Cockerell and *Stotzia* Marchal. Danzig (1986) accepted this point of view. However, Giliomee (1967)**,** on the basis of male characters, recognized the *Eriopeltis* group, with *Eriopeltis* and *Luzulaspis,* but considered that *Filippia* had no connection with these genera. Koteja (1969, 1970) also compared male morphology and demonstrated an affinity between *Eriopeltis*, *Scythia*, *Luzulaspis*, *Psilococcus* and *Vittacoccus*. The same author (Koteja, 1978) discussed and diagnosed the genera in the tribe Eriopeltini, established the new genera *Hadzibejliaspis* and *Poaspis* and regarded *Eriopeltis, Exaeretopus*,

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*Hadzibejliaspis*, *Lecanopsis*, *Luzulaspis*, *Poaspis*, *Psilococcus*, *Scythia* and *Vittacoccus* as a natural group. Koteja had doubts only about *Lecanopsis*, mainly because of its different biology: *Lecanopsis* species overwinter as third-instar females, whilst the other genera overwinter in the egg stage. Koteja (1978) also provided a key to the above genera in which the ratio of the length-width of the hind tibia proved to be a good character to separate *Lecanopsis* from the other genera. Kosztarab and Kozár (1988) also recognized the same genera as members of the Eriopeltinae.

Tang *et al*. (1990) and Tang (1991) introduced the tribe Lecanopsini for *Lecanopsis* and *Psilococcus*, characterized by the presence of a large peritreme cavity with inner spiracular disc pores. Later, Hodgson (1994), based mainly on female morphology, clustered similar genera in distinct groups in the subfamily Eriopeltinae: the *Exaeretopus*-group with *Exaeretopus, Luzulaspis, Poaspis* and *Vittacoccus*; the *Paralecanopsis* (= *Lecanopsis*)-group, with *Lecanopsis* and *Psilococcus* and the *Scythia* and *Idiosaissetia* group. *Eriopeltis* and *Hadzibejliaspis* were rather distinctive genera and were not placed in any of the above groups.

In spite of these efforts, the relationships of the Eriopeltinae and related genera is still unclear and the morphological differences between some genera (i.e.between *Hadzibejliaspis* and *Lecanopsis*, and between *Exaeretopus*, *Luzulaspis* and *Poaspis*) remain uncertain. The morphology of the first-instar nymphs could help in generic identification but unfortunately they are known only in a few genera.

In this paper three new species are described, one in *Hadzibejliaspis* and two in *Lecanopsis*. With the aim to better understand their possible relationships, species belonging to *Exaeretopus*, *Luzulaspis* and *Poaspis* have been studied also and their morphology compared with *Hadzibejliaspis* and *Lecanopsis* species.

## Materials and methods

Specimens were mounted according to the procedures of Howell & Kosztarab (1972) and Ben-Dov & Hodgson (1997). Measurements and frequencies are given as a mean, followed by the ranges in parentheses. Terminology follows that of Hodgson (1994).

Specimen depository: The Scientific Museums of the University of Padova (Italy), Department of Agronomy, Food, Natural Resources, Animals and Environment - Entomology. Abbreviation of the depository: DAFNAE.

## Genus *HADZIBEJLIASPIS* Koteja

The genus *Hadzibejliaspis* was established by Koteja (1978) to include the species *Exaeretopus stipae* Hadzibejli, 1960. According to Koteja (l.c.), the genus is characterised by the presence of very large tubular ducts, each 40–45 µm long and 9–10 µm wide, with longitudinal ridges on their inner surface. Moreover, there is one pair of pregenital setae present medially on each of the posterior 5 or 6 abdominal sternites plus 0–2 spiracular disc pores near each spiracular opening and 4–8 in each peritreme cavity. According to Koteja (l.c.), the genus *Hadzibejliaspis* shares some morphological characteristics with the genus *Exaeretopus* (body shape, and some characters of legs and antennae), with *Luzulaspis* (presence of long median setae on 6 posterior abdominal sternites) and with *Lecanopsis* (presence of large tubular ducts).

Hodgson (1994) redescribed the genus based on 2 rather poor paratypes, and added some details and remarks, i.e. the peculiar tubular ducts on his specimens were 35–40 µm long, with 2/3 of each duct slightly sclerotised; he was unable to determine the number of pairs of pregenital setae due to the bad condition of the specimens. The same paratypes have been studied in the present work and the data reported by Hodgson are confirmed.

Information on the biology of *H. stipae* is very scarce. According to Hadzibejli (1960, 1973), egg laying occurs in early June among the leaves of *Stipa caucasica,* but the females can drop to the ground easily, as they are not fixed on the host plant; the female secretes a loose ovisac of thick, waxy, brilliant threads that do not entirely cover the body; and each female can lay up to 160 pinky-yellowish eggs. *H. stipae* has been collected so far only in Georgia, near Tbilisi, off *Stipa caucasica* and S. *pulcherrima* (Hadzibejli, 1960, 1973).

*Hadzibejliaspis* was monotypic until now. However, a revision of the material close to *Lecanopsis* present in the DAFNAE collection, highlighted the presence of a new species, whose morphological characters are here ascribed to *Hadzibejliaspis.*

***Hadzibejliaspis ferenci* Pellizzari sp. n.**
(Fig. 1)

**Type material**. **Holotype:** adult female, **Italy**, Abruzzo region, Parco Nazionale, Villetta Barrea, Val Fondillo (AQ), 1100m asl, 7.v.1989, leg. S. Marotta, slide C. **Paratypes:** 5 adult females, same data as holotype, slides n. A,B,D,E,F; 1 adult female, Parco Nazionale, pass between Villetta Barrea and Scanno, 1100m asl, leg. A.Tranfaglia, slide n. 24 (no collecting date); 1 adult female, Parco Nazionale, Passo Godi, 24.v.2000, leg. Fontana & Malagnini, slide n. 984; 1 adult female and 2 first instars, Calabria region, Pollino, Piani di Ruggio, 1550m a.s.l., 26.vi.1998, leg. Fontana, slides n. 855/1–3; 1 adult female and 2 first instars, La Sila, M. Sorbella, 1730m asl, 23.vi.1999, leg. Fontana & Malagnini, slides n. 905/1–3; 5 adult females, Molise region, Valle Fiorita (IS), 23.v.2000, 1400m asl, leg. Fontana & Malagnini, slides 978/1–7.

**Adult female**

**Living specimens**: oval, pink-yellowish, partly enclosed in a white, waxy, sub-spherical egg-sac.

**Mounted specimens**: body oval, 3.3 mm (2.8–4) long, 2.2 mm (1.8–2.8) wide.

**Venter**: derm membranous, dermal spinules present medially on thoracic and abdominal segments. Antennae 8 segmented; in some specimens one antenna 8-segmented, other 7-segmented; length of segments in µm: I 40 (42–40); II 30,5 (32–30); III 46 (50–40); IV 36 (30–42); V 30 (24–36); VI 23 (20–28); VII 22 (20–26) and VIII 32. Scape and segment II each with 2 setae, III and IV without setae, V with 2 or 3 flagellate setae, VI with 1 fleshy seta, VII with 1 fleshy setae + 1 hair-like seta, and VIII with 3 fleshy setae + 5 or 6 hair-like setae. Legs well developed, narrow (Table 1: c). Tibio-tarsal sclerosis present. Measurements of hind leg: coxa 98 (90–100) µm long; trochanter + femur 198 (190–200) µm; tibia 162 (150–170) µm long and 29 µm wide (length to width ratio 5.5:1); tarsus bent, with a clear indentation on its dorsal margin, 99 (90–110) µm long; claw without a denticle; claw digitules longer than claw, slightly broadened apically, tarsal digitules longer than claw, thin and with a small apical swelling. Spiracles with peritreme 38 (34–48) µm wide; peritreme cavity 45 (40–50) µm wide, each cavity with 8-16 multilocular disc pores, each with 7 or 8 loculi (Table 1: a). Spiracular disc pores, each 6 or 7 µm wide with 5–9 loculi (usually 7 or 8), forming a loose group anterolateral to each spiracle, with 20 (10–27) pores near each anterior spiracle and 10 (5–19) pores near each posterior spiracle. Simple pores scattered. Pregenital disc pores mostly with 7 or 8 loculi, each 7.5–8.5 µm wide, numerous around genital opening, becoming progressively less numerous across preceding abdominal segments. Tubular ducts of two sizes: large tubular ducts 32 (24–35) µm long, 8 µm (6–9) wide, with a thin inner ductule 19 µm long and small terminal gland; small ducts 24 µm (16–28) long, 4 µm (3–5) wide, inner ductule not seen; larger tubular ducts more frequent than small ones, numerous on venter and thorax, less frequent on head; many large tubular ducts with characteristic elongate ridges along at least part of their inner surface. Body setae very small, about 7–8 µm long, scattered; with one pair of interantennal setae, 50–60 µm long; with one pair of pregenital setae present medially on last 4 or 5 abdominal sternites, each 50–64 µm long. Other body setae very small, about 8–10 µm long, scattered.

**Dorsum**: derm membranous, with segmentation apparent on thorax and abdomen. Eyespots present near margin, small, 28 µm wide. Preopercular pores without a dark rim, small, mostly 5 (4–6) µm wide, forming a sparse, irregular band 4–5 pores wide (maximum) from anal plates to metathoracic segment. Tubular ducts same shape and size as on venter, larger ducts scarce on head, most numerous on thorax and abdomen; smaller ducts, sparse, most frequent on anal lobes. Body setae short, about 6 µm long, sparse. Marginal setae bent, each about 9 µm long on thorax and abdomen, but those on anal lobes and head apex up to 16–20 µm. Anal ring with 6 setae, each about 100 µm long. Anal plates subtriangular, with three apical or subapical setae.

**First instar (crawler)** (Fig. 2)

**Living specimens:** body yellowish, elongate oval and flattened. Legs and antennae well developed.

**Mounted specimens:** body oval 460 (405–525) µm long and 210 (200–225) µm wide. Eyes situated dorso-marginally.

**Venter**: antennae 6 segmented**,** 96 (93–104) µm long, third segment slightly longer than others. With 1 pair of interantennal setae and 1 trilocular pore near scape of each antenna. Legs subequal, well developed. Tarsal digitules clearly longer than claw digitules. Loop of mouth stylets 225 µm long, reaching abdominal segment IV. Spiracles small, each with two spiracular disc pores in peritreme cavity; spiracular disc pores with 5–9 loculi, forming a group of 5–7 pores between each anterior spiracle and body margin and a group of 3–8 pores between each posterior spiracle and body margin. Minute hair-like setae distributed in a submarginal row around body and in two medial and submedial longitudinal rows on abdomen.

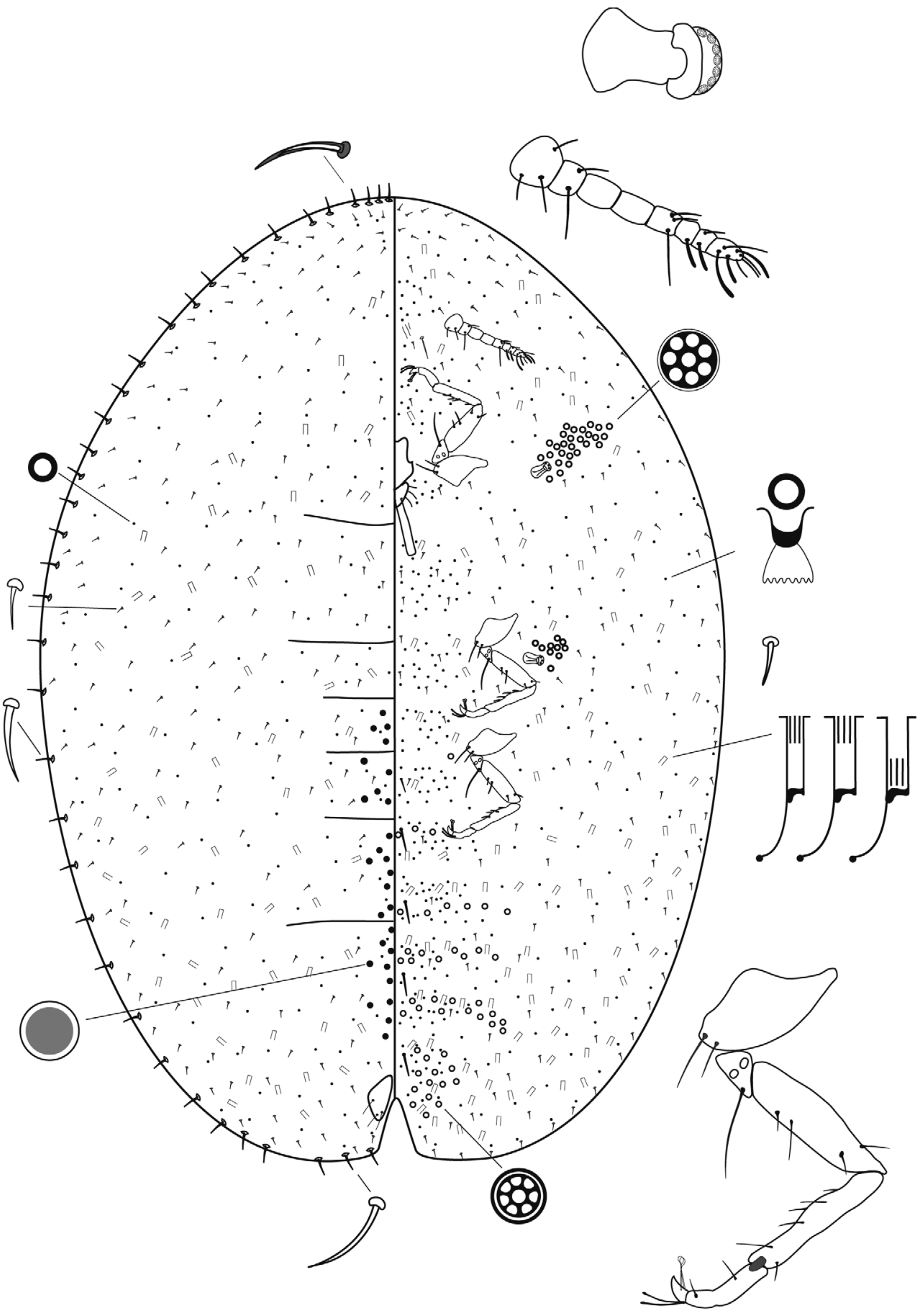

**FIGURE 1.** *Hadzibejliaspis ferenci* **n. sp.**, adult female.

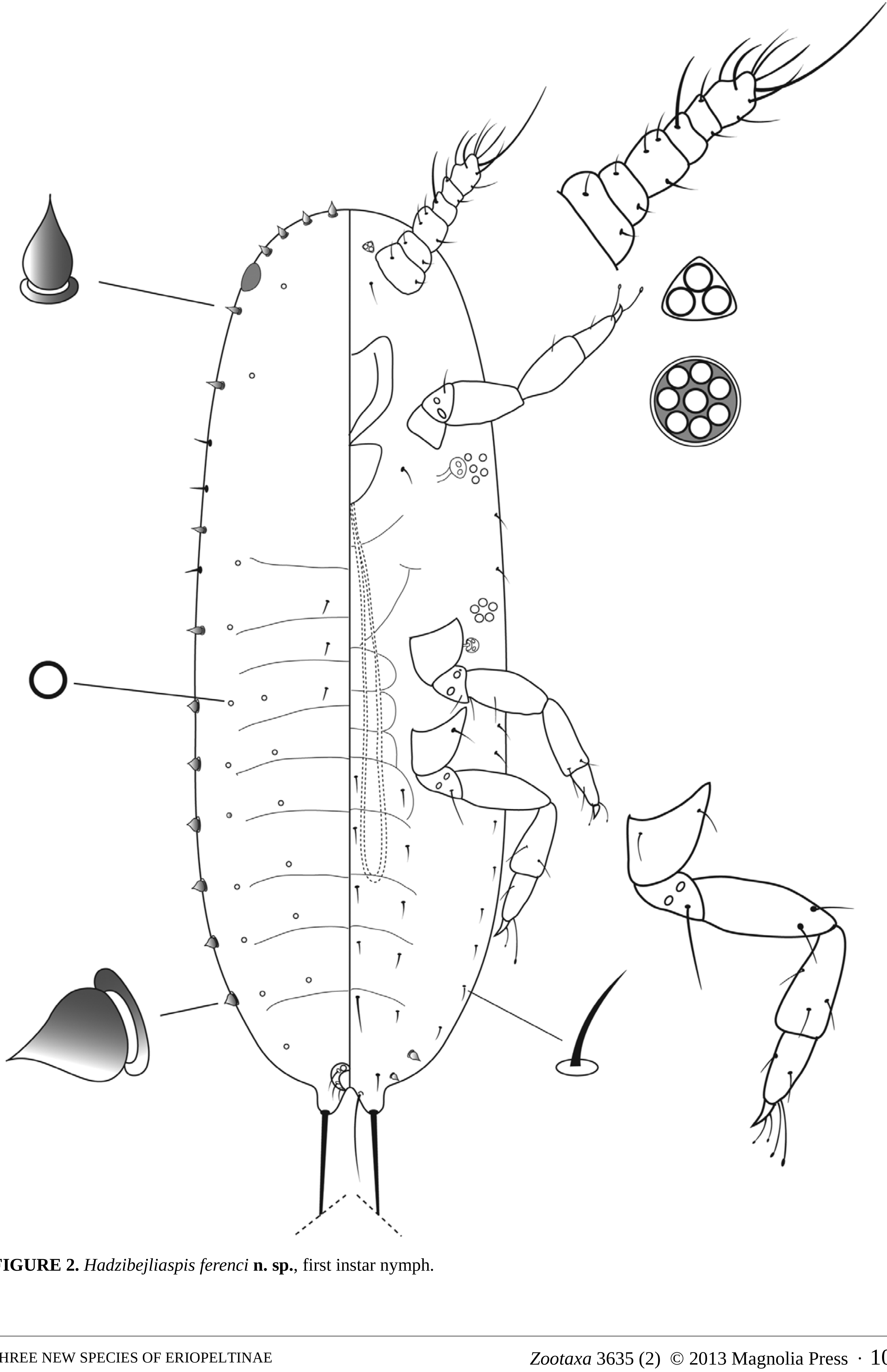

**FIGURE 2.** *Hadzibejliaspis ferenci* **n. sp.**, first instar nymph.

**Margin**: anal lobes well developed, each with an apical seta 200 µm long. Marginal setae minaret-like, with 5 on either margin of head (3 or 4 anterior to each eye-spot and 1 posterior to each eyespot), plus 3 on margin of thorax and 8 or 9 on either margin of abdomen. Minaret-like setae on head and thorax smaller than those on abdomen.

**Dorsum**: with 1 pair of short dorsal setae medially on each thoracic segment. Small simple pores present, forming a submarginal and a submedial longitudinal row on thorax and abdomen and with 1 or 2 pores also on head. Anal ring round, with pores and 6 short setae. Normal anal plates absent.

**Etymology.** The species is named in honour of Dr. Ferenc Kozár (Hungarian Academy of Sciences, Plant Protection Institute, Budapest, Hungary), eminent coccidologist and generous friend.

**Host plant.** Specimens on slides n. 855, 905, 978, 984 collected near roots of unknown plants under stones; slides A-F collected near roots of unknown plants, and slide n. 24 off roots of "Gramineae (= Poaceae) or Fabaceae".

**Distribution.** Italy (Abruzzo, Molise, Calabria regions). All specimens were collected at 1000 to 1500m asl.

**Comments.** The adult females of *H. ferenci* differ from those of *H. stipae* in having (characters of *H. stipae* in brackets): (i) 8–16 spiracular disc pores within each peritreme cavity (3 or 4); (ii) spiracular disc pores also forming a group of about 20 pores near each anterior spiracular opening (1 or 2), and (iii) each tubular duct slightly sclerotised along about 1/3 of length (2/3). The first-instar of *H. ferenci* is of the *Lecanopsis* type, with minaret-like setae on body margin.

*H. ferenci* is assigned to the genus *Hadzibejliaspis* because of the presence of: (i) 5 pairs of pregenital setae, (ii) hind tibia with length/width ratio greater than 5:1, (iii) large tubular ducts, in part with ridges, and (iv) spiracles opening into a small peritreme cavity with few inner disc pores.

## Genus *LECANOPSIS* Targioni Tozzetti

The history and the distinctive morphological characters of the adult female and female nymphs of this genus are given in Fontana & Pellizzari (2001) and Pellizzari & Fontana (2001a; 2002).

## *Lecanopsis sicula* Pellizzari n. sp.

(Fig. 3 )

**Type material. Holotype:** adult female, **Italy,** Sicily, Carlentini (Borgorizzo), 29.v.1998, leg. P. Fontana, slide n. **852**/1. **Paratypes**: 5 adult females, 3 first instars, same data as holotype, slides n. 852/2-17.

**Adult female**

**Living specimens:** oval, slightly convex, pale yellow.

**Mounted specimens**: body oval, 4 (3.6– 4.3) mm long, 2.3 (2–2.5) mm wide.

**Venter**: derm membranous, dermal spinules present medially on thoracic and abdominal segments. Antennae usually 8 segmented (one specimen with 7-segmented antennae, two specimens with one antenna 8 segmented, other 7 segmented); length of segments in µm: I 46 (40–50); II 47 (40–50); III 54 (46–60); IV 40 (28–54); V 28 (26–30); VI 21 (18–24); VII 18 (16–24), and VIII 33 (30–36). Scape and segment II each with 2 setae, III and IV without setae, V with 2 hair-like setae, VI with 1 fleshy seta, VII with 1 fleshy setae + 1 hair-like seta, and VIII with 3 fleshy setae + 4 or 5 hair-like setae. Legs well developed, stout (Table 1: D). Tibio-tarsal sclerosis present. Measurements of hind leg: coxa 138 (120–150) µm long; trochanter + femur 246 (220–270) µm; tibia 200 (190–210) µm long and 40 µm wide ((length to width ratio 5:1); tarsus 102 (90–110) µm, bent, with a clear indentation on its dorsal margin; claw 14–16 µm, without a denticle; claw digitules longer than claw, broad; tarsal digitules longer than claw, thin and with a small apical swelling.

Spiracles with peritreme 51 (48–56) µm wide; peritreme cavity large, round, 70 (66–76) µm wide, each peritreme cavity with 30–60 multilocular disc pores, each with 7 or 8 loculi (Table 1: B). Spiracular disc pores, each 6–8 µm wide with 7 or 8 loculi, with 1–5 near each anterior spiracle, and 0 or 1 near each posterior spiracle. Simple pores numerous, scattered. Pregenital disc pores each 7–9 µm wide with 7–9 loculi, present around genital opening and across abdominal segments, less numerous near submargin and on anterior abdominal segments.

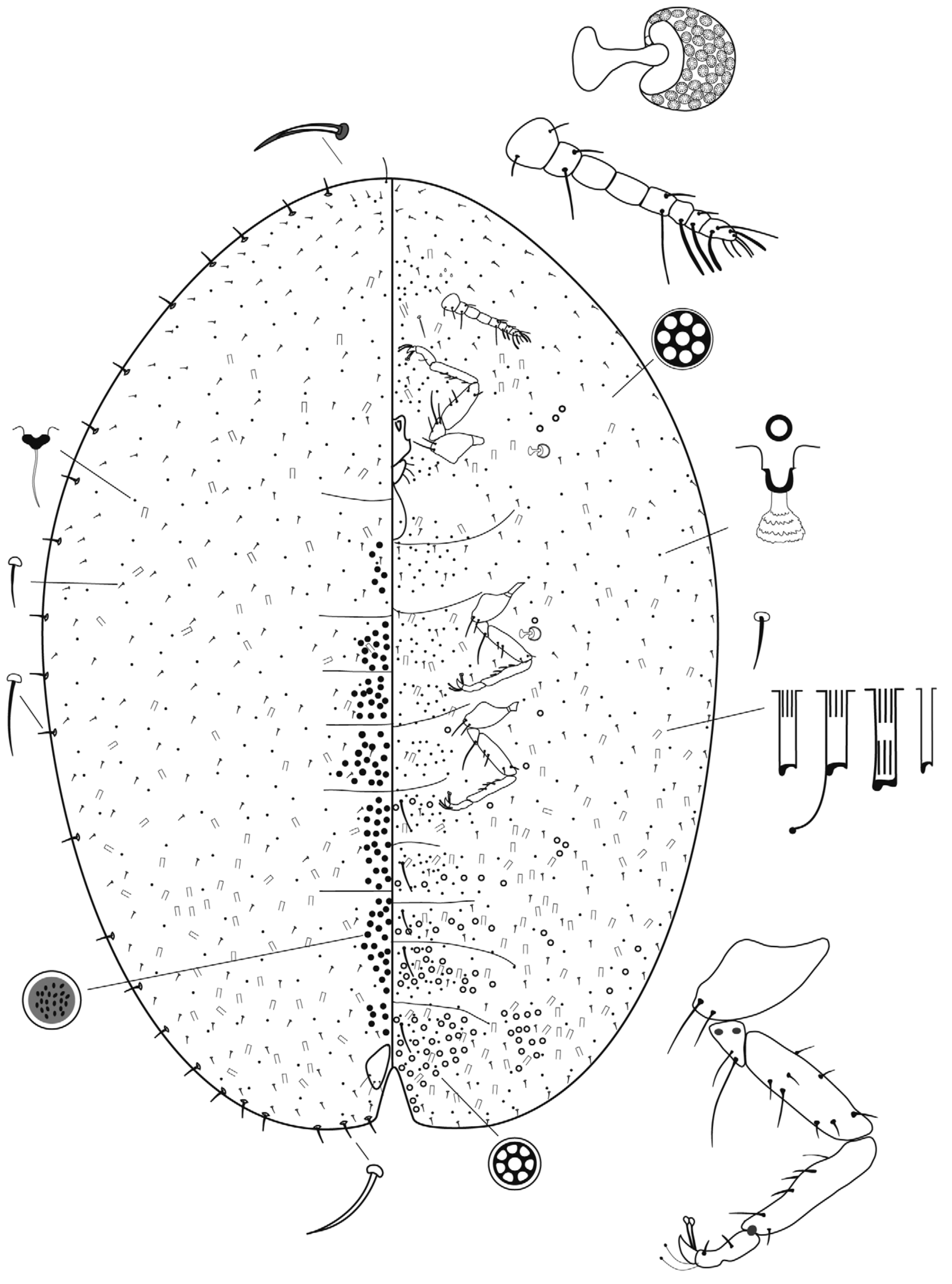

**FIGURE 3.** *Lecanopsis sicula* **n. sp.**, adult female.

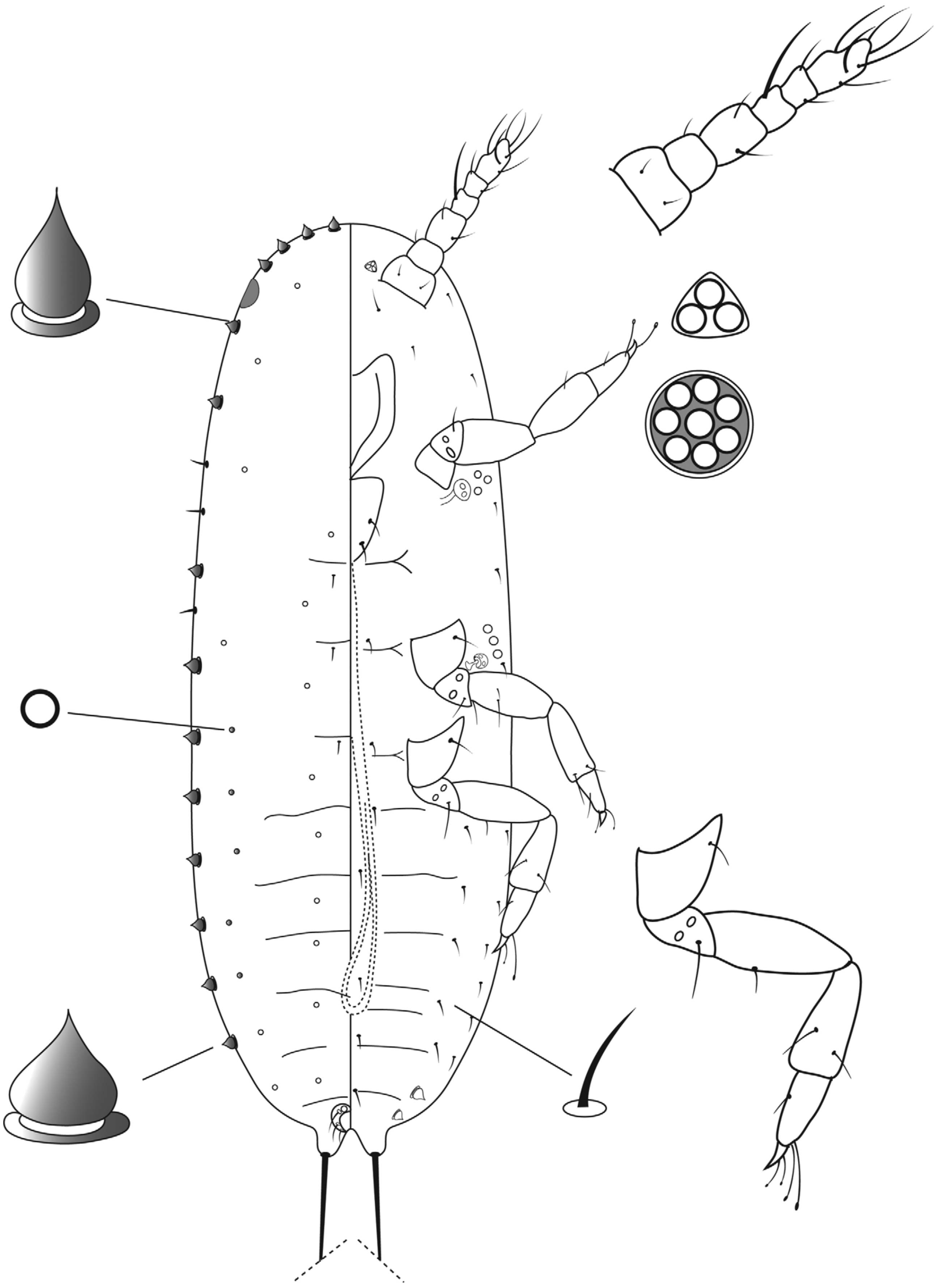

**FIGURE 4.** *Lecanopsis sicula* **n. sp.**, first instar nymph.

Tubular ducts of three sizes, all with elongate ridges along half or 1/3rd of outer and 1/3rd of inner end (Fig. 4): large ducts each 36 (32–40) µm long, 8 (6–9) wide, mostly with a narrow inner ductule; small tubular ducts each 27–32 µm long, about 5 µm wide, inner ductule not seen; large ducts more frequent than small ducts and most numerous on abdomen and thorax, rare on head. Also with a thin type of tubular duct, each 28–30 µm long and 3.2 µm wide, few, present on either side of anal cleft only. Body setae very small, about 6–8 µm long, sparse; with one pair of interantennal setae, 60–70 µm long; and with a pair of pregenital setae medially on posterior 4 or 5 abdominal sternites, most posterior pair of setae each 50–80 µm long, other pairs usually shorter, about 20–30 long.

**Dorsum**: derm membranous, with segmentation apparent on thorax and abdomen. Eyespots present near margin. Preopercular pores 5–8 µm wide, possibly convex, with a dark rim and a granulate surface, forming a sparse longitudinal band 10–12 pores wide from anal plates to prothorax, but wider on metathorax and anterior abdominal segments. Simple dark-rimmed pores numerous, scattered**.** Tubular ducts as on venter, rare on head, numerous on thorax and abdomen, more frequent on anal lobes. Body setae very short, about 6 µm long, sparse. Marginal setae all bent, each about 8–12 µm long on thorax and abdomen but those on head apex 16–30 µm long; anal lobe setae 10–20 µm long. Anal ring with 8 setae, each about 150–160 µm long. Anal plates subtriangular, with three apical or subapical setae.

**First instar (crawler)** (Fig. 4)

**Living specimens:** orange, elongate and flattened. Legs and antennae well developed.

**Mounted specimens:** body elliptic, elongate, 525 (500–560) µm long and 200 (190–215) wide. Eyes situated dorso-marginally.

**Venter**: antennae 6-segmented, 116 (100–125) µm long. With one pair of interantennal setae. With one trilocular pore near each scape. Legs subequal, well developed; measurements of hind leg: coxa 20 µm long; trochanter + femur 60 µm; tibia 40 µm; tarsus 30 µm. Tarsal digitules longer than claw digitules. Stylet loop 300 µm long, reaching abdominal segment VI. Spiracles small, each with 2 disc pores in peritreme cavity. Spiracular disc pores each with 5–9 loculi, forming a group of 2–5 pores between anterior spiracle and body margin, and a group of 2–4 between posterior spiracle and body margin. Minute setae forming a submarginal row around body and present in two medial and submedial longitudinal rows on each side of abdomen, with most posterior pair of medial setae longer than others.

**Margin**: anal lobes well developed, each with an apical seta 150–160 µm long. Marginal setae minaret-like, present on body margin with 16 setae on each side: 5 on head, 3 on thorax and 8 on abdomen; setae on head and thorax smaller than those on abdomen.

**Dorsum**: With a pair of minute setae medially on each thoracic segment. Small simple pores present in a submarginal and a submedial longitudinal row on thorax and abdomen, with 1 or 2 pores also on head. Anal ring with 6 setae. Anal plates absent.

**Etymology.** The feminine Latin adjective *sicula* meaning “pertaining to Sicily” where this new species was collected.

**Host plant.** Collected on the crown of *Lolium* sp. (Poaceae).

**Distribution.** Sicily (Italy)

**Comments.** The adult female of *L. sicula* has: (i) large peritreme cavities with 30+ disc pores in each cavity (as in *Lecanopsis*); (ii) hind tibia up to 5 times longer than wide**;** (iii) large tubular ducts with ridges along their inner surface, and (iv) one pair of pregenital setae medially on each of the last five abdominal segments (as in *Hadzibejliaspis*). In addition, the first-instar nymphs are *Lecanopsis* type, with marginal minaret-like setae. The first-instar nymph of *L. sicula* is morphologically close to that of *L. mirabilis* (Pellizzari and Fontana, 2002) but has fewer (2–4) spiracular disc pores near each spiracular opening (4–8 near each anterior spiracle and 2–8 near each posterior spiracle on *L. mirabilis*).

### *Lecanopsis salvatorei* Pellizzari n. sp.
(Fig. 5)

**Type material**. **Holotype:** adult female, **Italy**, Basilicata region, Laurenzana (Potenza), 1300m asl, 26.x.1993, leg. S. Marotta, slide n. 1700/1. **Paratypes:** 5 adult females, same data as holotype, slides n. 1700/2–7.

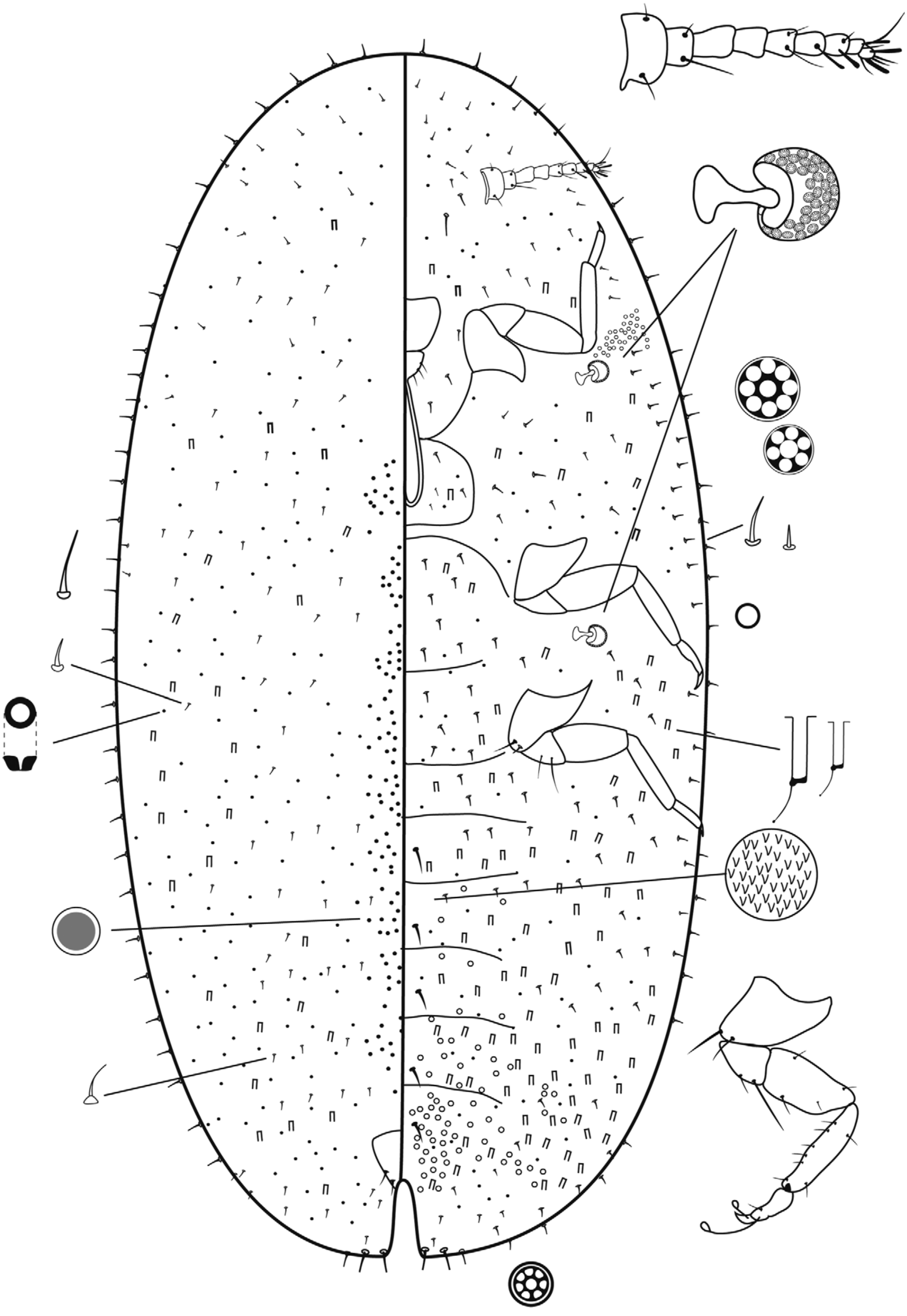

**FIGURE 5.** *Lecanopsis salvatorei* **n. sp.**, adult female.

**Adult female**

**Unmounted female**: not seen.

**Mounted specimens**: elongate oval, 3 mm (2.2–3.6) long, 1.5 mm (1–1.7) wide.

**Venter**: derm membranous, with signs of segmentation on thorax and abdomen; dermal spinules present medially on all thoracic and abdominal segments. Antennae 8 segmented; length of segments in µm: I 50 (44–60); II 30µ (28–34); III 63 (54–70); IV 36 (28–46); V 33 (30–36); VI 27 (26–30); VII 26 (22–30) and VIII 36 (30–40). Scape and segment II each with 2 setae, III without setae, IV without setae or with 1 hair-like seta, V with 2 hair-like setae, VI with 1 fleshy seta, VII with 1 fleshy setae + 1 hair-like seta, and VIII with 3 fleshy setae + 4 or 5 hair-like setae. Legs well developed, stout. Tibio-tarsal sclerosis present. Measurements of hind leg: coxa 116 (100–125) µm long; trochanter + femur 225 (200–250); tibia 198 (175–215) long, 47 wide (length to width ratio 4.2:1); tarsus 89 (80–100) µm; claw digitules broad, longer than claw; tarsal digitules thin, longer than claw, capitate, each about 40 µm long. Spiracles with peritreme 40–42 µm wide; peritreme cavity round, large, 75 (70–80) µm wide, each peritreme cavity with 30–35 spiracular disc pores. Spiracular disc pores, each 5–6 µm wide with 3–8 loculi (mostly 8): with 39 (32–51) pores either forming a loose group or a sparse band reaching body margin near each anterior spiracle; spiracular disc pores usually absent near posterior spiracle (3 specimens each with one pore). Simple pores scattered but absent medially. Pregenital disc pores each 6–8 µm wide with 5–7 loculi (mostly with 7), distributed mostly around genital opening, scarce on posterior IV–VII pregenital segments. Very small simple pores, each 1.6 µm wide, scattered, especially numerous medially and submedially on thoracic segments. Ventral tubular ducts of two sizes: small ducts each 16–20 µm long, 5 µm wide; large ducts each 25 (22–29) long, 8 µm wide, both ducts frequent on abdomen, less frequent on thorax, rare on head. Small simple pores sparse. Body setae very small, spinose, each about 5–8 µm long; with two pairs of interantennal setae, longer pair each 35 (30–40) µm long, shorter pair 12–16 µm long; also with 3 or 4 very small setae, about 6 µm long on frons. With an irregular submarginal row of small bent setae, each 16–20 µm long, distributed around body submargin. With a pair of pregenital setae present medially on posterior 4 or 5 abdominal segments, most posterior setae 54 (48–60) µm long, other pairs clearly smaller, variable in length, each 14–30 µm. Stylet loop reaching mesocoxae.

**Dorsum**: derm membranous. Preopercular pores each 6–10 µm wide, distributed in a longitudinal band, with maximum width 6–8 pores, narrower than space between coxae, extending from anal plates to mesothorax inclusive. Marginal setae of various sizes, bent: setae on head each 33 (30–40) µm long; setae on thorax and abdomen smaller, each 17 (13–20) µm long and those on anal lobes each 24 (20–32) µm long. Dorsal setae sparse, mostly 10–12 µm long but up to 16 µm. Dorsal tubular ducts sparse on abdomen, rare on thorax and head. Dark-rimmed simple pores, each about 5 µm wide, numerous throughout dorsum. Anal ring round, with 8 setae, each 110–130 µm long; anal plates together quadrate, with rounded outer angles, each plate 150 µm long and 75 µm wide.

**Etymology.** This species is dedicated to the memory of the well-known coccidologist Salvatore Marotta, who collected and mounted this new species.

**Host plant.** Off roots of *Festuca* (Poaceae). According to the label data, the adult females of this species were collected in late October at 1300m asl, suggesting that this should be the overwintering stage.

**Distribution.** Southern Italy (Basilicata Region).

**Comments.** Adult female *L. salvatorei* have numerous ventral tubular ducts and large peritreme cavities, each with 30+ disc pores, as in the genus *Lecanopsis*. But, *L. salvatorei* has a pair of pregenital setae medially on the posterior 4 or 5 abdominal segments (as in *Hadzibejliaspis*). No first instar nymphs are available.

## Key to Palaearctic Genera of the Subfamily Eriopeltinae based on adult females

1. With a ventral or dorsal submarginal band of 5-locular pores . . . . . . . . . . 2
- Without a ventral or dorsal submarginal band of 5-locular pores . . . . . . . . . . 3
2. With a dorsal marginal band of 5-locular pores; preopercular pores distributed in a longitudinal band from anal plate to thorax . . . . . . . . . . *Vittacoccus*
- With a ventral marginal band of 5-locular pores; preopercular pores forming a group on posterior abdominal tergites . . . . . . . . . . *Psilococcus*
3. Legs markedly reduced in size or with only 2 or 3 short segments . . . . . . . . . . 4
- Legs normal, stout or slender, with 5 segments . . . . . . . . . . 5

4. Dorsal setae cone-shaped, truncate; antennae 6–8 segmented; legs reduced in size but otherwise normal . . . . . . . . . . *Eriopeltis*
- Without dorsal cone-shaped setae; antennae 1–4 segmented; legs reduced to 1–3 short segments . . . . . . . . . . . . . . . . . . *Scythia*
5. Legs and antennae stout; hind tibia broad, less than 5 times longer than wide; each spiracle opening into a large, round peritreme cavity, each cavity with numerous spiracular disc pores . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *Lecanopsis*
- Legs and antennae slender; hind tibia narrow, more than 5 times longer than wide; each spiracle opening into a small peritreme cavity, each cavity with few spiracular disc pores 6
6. Tubular ducts large (usually 32–40 µm long and 8 µm wide), with elongate inner ridges; stigmatic spines absent . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *Hadzibejliaspis*
- Tubular ducts usually less than 25 µm long and 6 µm wide; stigmatic spines usually present, at least in anterior stigmatic areas . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7
7. Body oval; usually with 2, exceptionally (*E. formiceticola*) 4–8, long interantennal setae (each longer than 50 µm); marginal setae short, sparse; usually with one stigmatic spine in each anterior stigmatic area . . . . . . . . . . . . . . . . . . . . . . . . *Exaeretopus*
- Body elongate oval, or elongate with parallel sides; usually with 10–70 long interantennal setae (each longer than 50 µm); marginal setae forming an irregular double row; stigmatic setae present in both anterior and posterior stigmatic areas . . . . . . 8
8. With 35–70 interantennal setae in total; on Poaceae. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *Poaspis*
- With 10–25 interantennal setae in total; mostly on Cyperaceae and Juncaceae . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *Luzulaspis*

## Key to adult female *Hadzibejliaspis*

1. With 1 or 2 spiracular disc pores near each anterior spiracle; with 3 or 4 spiracular disc pores within each peritreme cavity . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *H. stipae* (Hadzibejli).
- With a group of 18–24 spiracular disc pores near each anterior spiracle; usually with 8–16 spiracular disc pores within each peritreme cavity. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *H. ferenci* **sp. n.**

## Key to adult female *Lecanopsis*

The key omits *L. iridis*, whose adult female is unknown. Descriptions and redescriptions of *L. aphenogastrorum*, *L. shutovae*, *L. taurica* and *L. myrmecophila* are based on the only one or two adult females of the type series, often in bad condition, so that their intraspecific variability is not known. The above reported species have not been recorded since their description (see Pellizzari & Fontana, 2002, for details).

1 Marginal setae long, stout . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .*L. taurica* Borchsenius
- Marginal setae short, thin . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2
2 Groups of multilocular dark-rimmed pores present on dorsum . . . . . . . . . . . . . . . . . . . . . . . . *L. mirabilis* Pellizzari & Fontana
- Groups of multilocular dark-rimmed pores absent on dorsum . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3
3 Preopercular pores distributed in a longitudinal median band, equal to or wider than the space between coxae . . . . . . . . . . . . 4
- Preopercular pores distributed in a longitudinal median band clearly narrower than the space between coxae . . . . . . . . . . . . . 6
4 Antennae 7 or 8 segmented; longitudinal band of preopercular pores as wide as space between coxae; spiracular disc pores absent or rare near anterior spiracles. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .*L. subterranea* (Gomez-Menor Ortega)
- Antennae 6 or 7 segmented; longitudinal band of preopercular pores wider than space between coxae; with numerous spiracular disc pores near anterior spiracles . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5
5 Antennae usually 7 segmented; spiracular disc pores near anterior spiracles much more numerous (20–204, average 86) than near posterior spiracles (0–51, average 11). . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *L. clodiensis* (Pellizzari)
- Antennae 6 segmented; with about 14–30 pores spiracular disc pores near both anterior and posterior spiracles . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .*L. turcica* (Bodenheimer)
6 Preopercular pores present on head . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7
- Preopercular pores absent from head . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 11
7 Preopercular pores sparse, forming a very narrow longitudinal band (maximum width 2–4 pores) extending from head to anal region; pregenital disc pores present only near genital opening and on anal lobes. . . . . . . . . . . . . . . . .*L. myrmecophila* Leonardi
- Preopercular pores usually numerous and forming a longitudinal band greater that 4 pores wide; pregenital disc pores present near genital opening, on anal lobes and across abdominal segments . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 8
8 Spiracular disc pores forming an elongate, irregular band extending from each spiracle to body margin and with a few pores extending along body margin . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *L. shutovae* Borchsenius
- Spiracular disc pores forming a band extending from each spiracle to body margin but without pores along body margin . . . 9
9 Spiracular disc pores usually absent near posterior spiracles (rarely 1–3); antennae usually 8 segmented (rarely 7 segmented) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *L. marottai* Pellizzari & Fontana
- Spiracular disc pores present near posterior spiracles; antennae 6 or 7 segmented . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 10

10 Antennae 6 segmented; preopercular pores large, each about 8.5 µm wide, in a longitudinal band 8–10 pores wide. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *L. aphenogastrorum* Gómez-Menor Ortega

\- Antennae 7 segmented; preopercular pores each about 5–7 µm wide, in a sparse longitudinal band 7–8 pores wide. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *L. pellizzariae* Fontana & Malagnini

11 Spiracular disc pores present near each anterior and posterior spiracle; with a pair of pregenital setae present medially on posterior-most abdominal segment only . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *L. formicarum* Newstead

\- Spiracular disc pores usually absent near posterior spiracle (maximum 1 pore); with a pair of pregenital setae present medially on posterior 4 or 5 abdominal segments . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 12

12 Spiracular disc pores in a band of 15–40 pores associated with each anterior spiracle . . . . . . . . . . . . . . . . . . *L. salvatorei* **sp. n.**

\- Spiracular disc pores few, only 2 or 3 near each anterior spiracle . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *L. sicula* **sp. n.**

## Discussion

The absence of large, round peritreme cavities, each with numerous disc pores, seems a good character to separate *Hadzibejliaspis* (Table 1: A) from *Lecanopsis* (Table 1: B). The ratio of the length/width of the hind tibia, introduced by Koteja (1978) to separate these genera, is also a good character, but the length/width ratio of the hind tibia is here slightly modified: length/width ratio more than 5:1 = *Hadzibejliaspis* (instead of "at least 6" as proposed by Koteja) (Table 1: C); length/width ratio up to 5:1 = *Lecanopsis* (Table 1: D). In addition, *Lecanopsis* usually only has long pregenital setae on the posterior-most pregenital segment, whereas *Hadzibejliaspis* has pairs of almost equally long setae on the posterior-most 4 or 5 abdominal segments. Both *L. sicula* and *L. salvatorei* have pairs of pregenital setae on the posterior-most 4 or 5 abdominal segments (as in *Hadzibejliaspis*) but the most posterior pair of setae is distinctly longer (50–80 µm) than the other pairs (14–30 µm). This characters is shared with *L. mirabilis* and *L. pellizzariae* (Fontana & Malagnini, 2001), which have short pregenital setae apart from the most posterior pair.

In addition, both *L. mirabilis* and *L. pellizzariae* exhibit peculiar morphological and biological characters. The most striking character of *L. mirabilis* adult female is the presence of multilocular dark-rimmed pores, either singly or forming groups of 2–4 pores on the dorsum (Table 1: E). This character is very rare in the Coccidae and absent in the other *Lecanopsis* species known so far.

*L. pellizzariae* is characterised by the third-instar female nymphs having well-developed legs and by the unusual increase in body size of the adult female due to its feeding activity (Fontana & Malagnini, 2001), whereas in the other *Lecanopsis* species, the third-instar female nymphs have reduced legs, the adult females do not feed and the increase in body size occurs in the third instar (Boratynski *et al*., 1982; Pellizzari & Fontana, 2001a).

The presence of large tubular ducts with elongate ridges on their inner surface was considered a diagnostic character of *Hadzibejliaspis* (Koteja, 1978). Nevertheless, some *Lecanopsis* species do have this morphological character. Boratynski *et al*. (1982: 526) clearly illustrated the tubular ducts of adult female *L. formicarum* as ridged. Among the tens of *Lecanopsis* preserved in the DAFNAE collection, several adult female *L. subterranea*, *L. clodiensis* and *L. formicarum* have tubular ducts partially sclerotised and with elongate inner ridges. The recognition of ridges associated with the ducts appears to largely depend on the age of the specimens, on the staining procedure and on the age of the slides. In the same species, the ridges may be clearly visible on some specimens, at least along part of the length of the tubular ducts, whereas in other specimens they are not visible at all. The degree of sclerotisation can also vary, some specimens having completely unsclerotised ducts whilst, in other specimens, the tubular ducts appear more or less fully sclerotised. The tubular ducts of adult female *L. clodiensis* were studied under a SEM microscope and the waxy tube extruded by this duct is clearly ridged (Table 1: F) (Fontana, 1998). Nevertheless, the presence of tubular ducts with inner ridges was mainly overlooked until the present study.

The first-instar nymphs of *Lecanopsis* are characterized by the peculiar minaret-like setae along the body margin (Pellizzari & Fontana, 2001a), so far unknown in other coccid genera. The distribution and number of both these minaret-like setae and the spiracular disc pores can help in identifying *Lecanopsis* species (Pellizzari, 1995; Pellizzari & Fontana, 2002). The first-instar nymphs of *H. ferenci* are of the "*Lecanopsis* type", with minaret-like setae on the body margin, highlighting an unexpected affinity among *Lecanopsis* and *Hadzibejliaspis*. The morphology of second- and third-instar females of *Lecanopsis* species is also peculiar, but unfortunately the same stages are not known in *Hadzibejliaspis*.

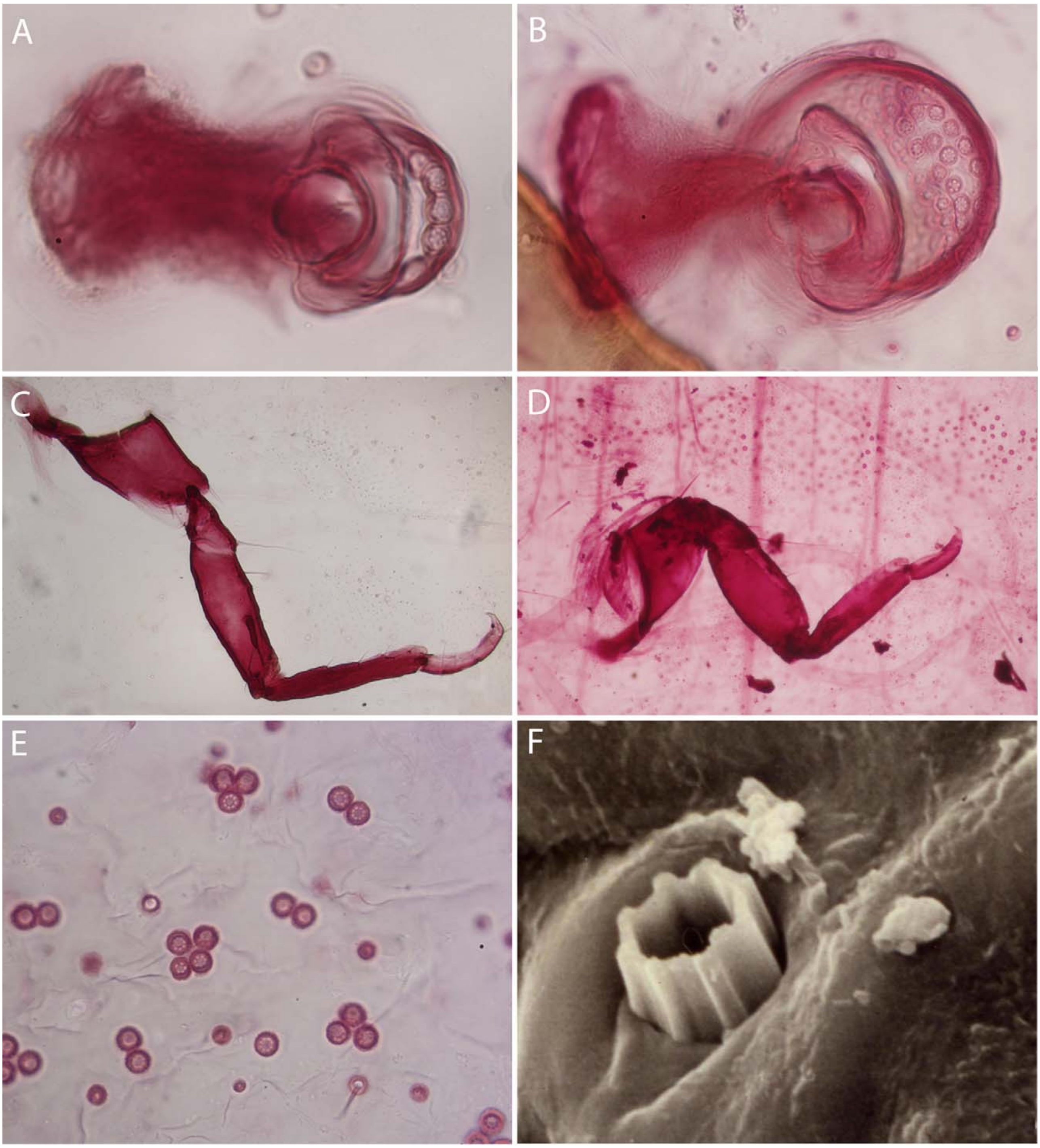


**TABLE 1.** A—Spiracle and peritreme cavity of *Hadzibejliaspis ferenci* **n. sp.**, adult female; B—Spiracle and peritreme cavity of *Lecanopsis sicula* **n. sp.**, adult female; C—Hind leg of *Hadzibejliaspis ferenci* **n. sp.**, adult female; D—Hind leg of *Lecanopsis sicula* **n. sp.**, adult female; E—Dorsal dark-rimmed multilocular disc-pores in *Lecanopsis mirabilis* Pellizzari & Fontana; F—ridged waxy tube extruded by a dorsal tubular duct of *Lecanopsis clodiensis* (Pellizzari).

With regard to their biology, Goux (1943), Koteja (1969, 1978) and Danzig (1986) report that, unlike *Lecanopsis* species, the other Eriopeltinae overwinter in the egg stage. A detailed biology is only known for *L. formicarum*, *L. clodiensis* and *L. pellizzariae* (Boratynski *et al*., 1982; Pellizzari & Fontana, 2001; Fontana & Malagnini, 2001). These species overwinter as third-instar females and second-instar male nymphs, with the adult females usually present from April to late June, depending on meteorological conditions and locations. The collection dates on the labels of other adult female *Lecanopsis* species agree with this conclusion (Pellizzari & Fontana, 2002). On the other hand, *L. salvatorei* perhaps overwinters in the adult stage, as suggested by the collecting date on the slide labels (October 26). With regard to the two *Hadzibejliaspis* species, the few known biological data only indicate that the adult females were collected and laid eggs during May and June, so that it seems unlikely they overwinter in the egg stage. Based on the above reasons, *Lecanopsis* and *Hadzibejliaspis* possibly form a related group: their peculiar first-instar morphology confirms this point of view. *Psilococcus*, a monotypic genus, should belong to the same group because of the presence of spiracles opening into a large peritreme cavity with many inner spiracular disc pores, as highlighted by Tang *et al*. (1990). Incidentally, the adult female *Psilococcus* has a ventral marginal band of 5-locular pores, so resembling the second- and third-instars of several *Lecanopsis* species; unfortunately, the nymphs of *Psilococcus* are unknown and, moreover, it develops on Cyperaceae and overwinters in the egg stage (Koteja, 1969). On the basis of female morphology, it seems likely that *Exaeretopus*, *Luzulaspis* and *Poaspis* are closely related genera but the relationships and affinities among the Eriopeltinae can be clarified only by more intensive collecting and with more biological and molecular data, plus studies of the first instars and adult males.


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