The Western Palaearctic species of *Psilophrys Mayr* (Hymenoptera, Chalcidoidea: Encyrtidae), parasitoids of kermesids (Hemiptera, Coccoidea: Kermesidae) attacking oaks (*Quercus* spp.)

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Abstract
The genus *Psilophrys Mayr* is defined by means of a brief diagnosis, and an identification key to the females of all five known western Palaearctic species is provided. Two species (*P. aristotelei* and *P. bella*) are described as new. The known hosts and distribution of all species are summarized.

Keywords: Encyrtidae, Europe, Kermesidae, natural enemies, oak, parasitoids, western Palaearctic

Introduction
Species of *Kermes* (Hemiptera: Kermesidae) are specialist sap-feeders on oaks and can be economically important where they occur, especially on white oak (*Quercus alba*) and bur oak (*Q. macrocarpa*) in north America (Brant and Mason 2004). The scale insect induces leaf yellowing, leaf distortion, flagging terminals and twig dieback, thus resulting in reduced growth and vigour of the tree (Krischik and Davidson 2004). Amongst the most important natural enemies of *Kermes* are encyrtids of the genus *Psilophrys*. Species of this genus are specialist endoparasitoids of *Kermes* and undoubtedly exert some level of control on populations of these scales.

During a survey of the parasitoids of scale insects conducted in the Caucasus and Turkey between 1984 and 2004, a new species of *Psilophrys* was reared from a *Kermes* in Turkey. This species is here described as a new species together with a second new species reared from *Kermes* in Greece, present in the collections of the Natural History Museum, London. This brings the total number of species of the genus known for the Western Palaearctic, to five and therefore, to facilitate their identification, a key to these five species is presented below together with their diagnostic features.
Descriptions and terminology follow Noyes (2004). The following abbreviations are used in the text: AOD, diameter of anterior ocellus; AOL, distance between posterior and anterior ocelli; EL, maximum eye length; FV, minimum frontovertex width; FVL, maximum frontovertex length; F1, F2, etc., first funicle segment, second funicle segment, etc.; GL, maximum gonostylus (=third valvula) length; HH, height of head; HW, maximum head width; MS, malar space (shortest distance from the eye to mouth margin); MSL, median length of mesoscutum; MSW, maximum width of mesoscutum; MT, mid tibia length; MTS, mid tibial spur length; MW, mouth width; OCL, occipital ocellar line (distance of posterior ocellus from occipital margin); OL, ovipositor length; OOL, ocular–ocellar line (shortest distance between posterior ocellus and adjacent eye margin); OPL, length of outer plate of ovipositor; OPW, maximum width of outer plate of ovipositor; POD, diameter of posterior ocellus; POL, posterior ocellar line (=the shortest distance between the posterior ocelli); SL, scape length; SW, scape width; TA, distance between toruli and anterior ocellus; TE, distance between torulus and eye margin; TM, distance between torulus and mouth margin; TT, distance between toruli.

**Acronyms for depositories**

The following acronyms are used: AFSDU, Agricultural Faculty, Suleyman Demirel University, Isparta, Turkey; BMNH, Natural History Museum, London, UK; DEZP, Department of Entomology and Agricultural Zoology, University of Naples of Frederico II, Naples, Italy; OUM, Oxford University Museum, Oxford, UK; IZGAS, Institute of Zoology, Georgian Academy of Sciences, Tbilisi, Georgia.

**Psilophrys** Mayr

*Psilophrys* Mayr 1876, p 727.
Type species: *Encyrtus longicornis* Walker, by original designation.

**Diagnosis**

Body dark brown with metallic reflections. Head 1.7–2.0 × as wide as frontovertex; ocelli forming obtuse angle; maxillary and labial palpi four- and three-segmented respectively; mandible with one tooth and a truncation; antenna inserted near mouth margin; scape cylindrical; funicle six-segmented, segments gradually increasing in width distally and all segments longer than wide; pedicel at most 1.7 × as long as F1. Fore wing usually infuscate around marginal and stigmal veins, rarely entirely hyaline; postmarginal vein not longer than stigmal vein; marginal vein longer than wide. Ovipositor hardly exserted; third valvula freely articulated with second valvifer.

**Comments**

The genus *Psilophrys* is most similar to *Aphycoïdes*, species of both taxa being of generally similar habitus, having similar venation and the cercal plates situated near the apex of the gaster. It is likely that with further study the two genera will be considered synonymous, but for the present *Psilophrys* can be separated from *Aphycoïdes* by the mandibles having only one tooth and a truncation, and the flagellum generally relatively longer and more slender, with the pedicel at most only 1.7 × as long as F1, and all funicle segments longer than wide. In *Aphycoïdes* the mandible has two teeth and a truncation and the pedicel is at least 2 × as long as F1, and the funicle has at least F6 transverse.
Key to females of western Palaearctic species *Psilophrys*

1. Fore wing apex without marginal fringe (Figure 2) . . . . . . . . . . . . 2
   – Fore wing apex with marginal fringe (Figure 6) . . . . . . . . . . . . 3

2. Antenna with F1 at least 1.4× as long as pedicel . . . . . . . . . . . . tenuicornis
   – Antenna with F1 at most 1.1× as long as pedicel (Figure 1) . . . . aristotelei sp. n.

3. Antenna with pedicel at least 1.45× as long as F1; hind coxa dark brown . parvulus
   – Antenna with pedicel not more than 1.1× as long as F1, hind coxa entirely yellow . 4

4. Antenna with F1 at most 2× as long as wide . . . . . . . . . . . . ghilarovi
   – Antenna with F1 at least 3× as long as wide (Figure 5) . . . . . . bella sp. n.

*Psilophrys parvulus* Guerrieri and Viggiani

*Psilophrys parvulus* Guerrieri and Viggiani 1991, p 139–150. Holotype ♀, Italy, DEZP, not examined.

**Diagnosis**

*Female.* Length 1.0–1.1 mm. Body dark brown, slightly shiny; all legs dark brown. Head about 1.7× as wide as frontovertex; FV at narrowest point more than 2× as wide as long; scape about 1.4× as long as club and about 5× as long as wide; pedicel almost 1.7× as long as F1; OCL>OOL; ocelli forming obtuse angle; fore wing about 2.3× as long as

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Figures 1–3. *Psilophrys aristotelei*, ♀. (1) Antenna. (2) Fore wing. (3) Ovipositor.
wide and with marginal fringe at apex; stigmal vein proximally slightly bent, not straight. Ovipositor slightly exserted, exserted part at most as long as mid tibial spur.

Male. Similar to female except for genitalia, partially two-segmented clava and setae on funicle relatively longer, about as long as diameter of segments.

Material examined
Paratypes: Italy, 3♀, 3♂, Rispescia (GR), ex Kermes bacciformis on Quercus, 12 June 1968 (L. Santini). Material in BMNH.

Psilophrys aristotelei sp. n.
(Figures 1–3)

Diagnosis
Female holotype. Length 1.84 mm. Body generally dark brown with a metallic silver-green reflection. All legs dark brown, only fore tibia dusty yellow. Fore wing virtually hyaline, but with a dark spot beneath marginal vein.
Head about 1.1 × as wide as high and about 1.9 × as wide as FV; FV about 1.9 × as wide as long; OOL equal to OCL and POD; ocelli forming an obtuse angle; antenna with scape...
about 1.50–1.65 × as long as club and 6 × as long as wide, other proportions as in Figure 1. Relative measurements: HW 55, FV 29, FVL 15, SL 24, SW 4.5, AOD 5, POD 4, POL 17, AOL 8.

Thorax about 1.2 × as long as gaster excluding ovipositor; mesoscutum about 1.2 × as wide as long; scutellum about 1.1 × as wide as long; fore wing (Figure 2) about 2.3 × as long as wide; marginal vein subquadrate; hind wing about 3.6 × as long as wide. Relative measurements: MSW 38, MSL 31, SCW 32, SCL 29.

Ovipositor (as in Figure 3) hardly exserted, the exserted part at most one-third as long as mid tibial spur.

Female paratype (slide-mounted). Toruli separated by own lengths and from anterior ocellus by about 2.5 × distance of torulus from eye margin; eye about 1.5 × as long as malar space, the latter rounded in facial view; mouth width subequal to eye length. Sculpture on mesoscutum and scutellum similar, composed of small rounded cells. Syntergum about 3 × as wide as long. Relative measurements: TA 27, TE 12, EL 22, MS 15, MW 21, HW 52, HH 47, OL 67, ML 50, OPL 51, OPW 18, GL 10, MSL 18.

Variation. The length varies from 1.4 to 1.9 mm, otherwise little variation in material examined.

Male. Unknown.

Material examined

Holotype ♀: Greece, Olympia, Ex Kermes sp. on Quercus ilex, 30 April to 7 June 1984 (J. M. Cox). Paratypes: Greece, 22 ♀, same data as holotype. Holotype and paratypes in BMNH, one paratype in IZGAS.

Comments

Psilophrys aristotelei is most similar to tenuicornis and bella, all three species having similar body shape, general colour, and wing venation. They can be separated using the characters given in Table I.

Table I. Characters used to separate Psilophrys aristotelei, P. tenuicornis, and P. bella.

| P. aristotelei sp. n. | P. tenuicornis | P. bella sp. n. |
|----------------------|--------------|----------------|
| Torulus separated from mouth margin by about 2.7 × its own length | Torulus separated from mouth margin by about 7 × its own length | Torulus separated from mouth margin by about 3.8 × its own length |
| Mid tibia about 2.8 × as long as midtibial spur | Mid tibia 2.7–3.0 × as long as midtibial spur | Mid tibia 3.6–3.9 × as long as midtibial spur |
| Mid tarsus first segment almost as long as II–IV together | Mid tarsus first segment almost 1.2 × as long as II–IV together | Mid tarsus first segment almost as long (15) as II–IV together |
| Outer plate of ovipositor about 2.8 × as long as wide | Outer plate of ovipositor about 5.7 × as long as wide | Outer plate of ovipositor about 4.9 × as long as wide |
| Apex of fore wing without marginal fringe | Apex of fore wing without marginal fringe | Apex of fore wing with marginal fringe |
| Legs mostly dark brown with only fore tibia dusky yellow | Legs mostly dark brown with middle and fore tibia dusky yellow | Legs dusky yellow with only hind femora dark brown |
**Psilophrys ghilarovi** Japoshvili

*Psilophrys ghilarovi* Japoshvili 2005, p 524–526. Holotype: ♀, Turkey, IZGAS, examined.

**Diagnosis**

**Female.** Length 1.26–1.68 mm. Head dark brown, almost black; thorax and gaster dark brown; fore and mid coxae dirty yellow, hind coxa yellow, only hind femora and tibia are dark brown, rest of legs are yellow. Head about 1.7 × as wide as frontovertex which is almost 3 × as long as its minimum width; scape about 5.4 × as long as wide and about 1.4 × as long as club; pedicel equal to F1 or very slightly longer; OOL > OCL; ocelli forming an obtuse angle. Fore wing about 2.1 × as long as wide; fore wings with marginal fringe present; base of stigmal vein straight; ovipositor slightly exserted, exserted part two-thirds as long as mid-tibial spur.

**Male.** Similar to female except for genitalia and antenna. F1 about 1.5 × as long as pedicel, setae on funicle about 0.5 × as long as diameter of segments and clava solid.

**Distribution**

Turkey (Japoshvili 2005).

**Host**

*Kermes palestiniensis* (Hemiptera: Kermesidae).

**Material examined**

Holotype ♀: Turkey: Isparta, near lake Egirdir, Ex *Kermes palestiniensis* on *Quercus coccifera*, 3–7 August 2001 (O. Demirozer) (IZGAS). Paratypes: Turkey, 10♀, 3♂, same data as holotype; 8♀, Antalya, Kurshunlu, Ex *K. palestiniensis* on *Q. coccifera*, 24 July 2001 (G. Japoshvili); 2♂, Cire (Jire), Ex. *K. palestiniensis* on *Q. coccifera*, 18–28 June 2002 (G. Japoshvili); 3♂, 4♀, Isparta, Cire (Jire) ex *K. palestiniensis* on *Quercus coccifera*, 18–28 June 2002 (G. Japoshvili); 10♀, Egirdir, ex *K. palestiniensis* on *Q. coccifera*, 3–7 July 2001 (G. Japoshvili). Paratypes in IZGAS and BMNH.

**Psilophrys bella** sp. n.

(Figures 4–6)

**Diagnosis**

**Female holotype.** Length 1.67 mm. Body generally dark brown, with metallic silver reflection; scape yellow, pedicel slightly dusky yellow, flagellum and club brown; legs yellow, only hind femur dark brown; fore wing hyaline.

Head about 1.1 × as wide as high; and about 1.8 × as wide as frontovertex; occipital margin sharp; eye about 1.2 × as long as malar space; scape about 1.7 × as long as club which is longer than F5–F6 combined, and about 3.4 × as long as wide, other proportions of antenna as in Figure 5; palp formula 4-3; mandible with one tooth and a truncation; ocelli forming obtuse angle; OCL about 0.5 × diameter of ocellus; distance between
torulus and anterior ocellus about $3.3 \times$ length of torulus; first segment of maxillary palp as long as first segment of labial palp. Relative measurements: HW 40, FV 21, FVW 13, TT 5, TM 2, POL 11, AOL 6, EL 20, MS 18.

Mesoscutum with well-developed cell structure; sculpture on scutellum with relatively larger mesh than that of mesoscutum; fore wing (Figure 6) about $2 \times$ as long as wide; apex of fore wing with a well-developed marginal fringe; hind wing about $4 \times$ as long as wide; mid basitarsus segment equal to segments II–IV combined together.

Hypopygium well developed, about $2.8 \times$ as wide as long, but not reaching apex of gaster; ovipositor slightly everted, the everted part about $0.1 \times$ as long as gaster.

**Female paratype (slide mounted).** Outer plates of ovipositor (Figure 4) $4.9 \times$ as long as wide; OL about $4.8 \times$ GL; ovipositor 1.68–1.77 $\times$ as long as mid tibia. Relative measurements: OL 79, GL 19, OPL 54, OPW 11, MT 47, MTS 13.

**Variation.** The length varies from 1.5 to 1.8 mm, otherwise little variation in material examined.

**Male.** Length 1.25–1.38 mm. Generally similar in colour to female, but legs dusky yellow with hind femur and tibia dark brown. Antennae with F1 about $2 \times$ as long as pedicel and almost $3 \times$ as long as wide; F4–F6 each about $2 \times$ as long as wide; setae on funicle about half as wide as segments; clava solid.

**Distribution**

Turkey.

**Host**

*Kermes palestiniensis* (Hemiptera: Kermesidae).

**Material examined**

Holotype ♂: Turkey, Isparta, Cire (Jire), Ex *K. palestiniensis* on *Quercus coccifera*, 18–28 June 2002 (G. Japoshvili). Paratypes: 4 ♀, 3 ♀, same data as holotype. Holotype and paratypes in IZGAS.

**Psilophrys tenuicornis** Graham

*Encyrtus longicornis* Walker 1847, p 229. Lectotype ♂ (designated Graham 1969, p 235), England, OUM, examined.

*Psilophrys longicornis* (Walker); Mayr 1876, p 728.

*Psilophrys tenuicornis* Graham 1969, p 235. Replacement name for *Encyrtus longicornis* Walker, 1847, nec Dalman, 1820.

**Diagnosis**

**Female.** Length 1.5–2.5 mm. Body dark brown with golden-green metallic reflection, mesoscutum with a blue sheen and scutellum with violet reflection; only hind tibia and femora entirely dark brown, base of front and middle femora dark brown; head about $1.7 \times$
as long as frontovertex; mandible with one tooth and a truncation. FV about $2 \times$ as wide as long; F1 almost $1.5 \times$ as long as pedicel; scape about $1.9 \times$ as long as club and about $6 \times$ as long as wide; OOL equal to OCL, which is about half longest diameter of posterior ocellus; ocelli forming an obtuse triangle; mandible with one tooth and truncation. Fore wing about $2.3 \times$ as long as wide; apex of fore wing without marginal fringe; base of stigmal vein forming an angle. Ovipositor exserted, exserted part about $0.2 \times$ as long as gaster without exserted part of ovipositor.

**Male.** Length 1.6–2.0 mm. Colour as for female, structurally similar except for antenna and genitalia. Antenna with F1 almost $3 \times$ as long as pedicel and $4 \times$ as long as wide, F5 about $3 \times$ as long as wide, F6 about $2.6 \times$ as long as wide; clava solid.

**Material examined**

Type material: Lectotype ♀: England, “LECTO-TYPE O.U.M.” “51” “Encyrtus longicornis Dal.” “Encyrtus longicornis Walker LECTOTYPE ♀ M. de V. Graham det. 1958” (OUM). Other material: Turkey, 3♀, 1♂, Isparta, Sutcular, Adada, Ex K. palestiniensis on Q. coccifera, 10–11 July 2002 (G. Japoshvili) (IZGAS); 7♀, 1♂, Isparta, Sutcular, Adada, Ex K. palestiniensis on Q. coccifera, 10–11 July 2002 (G. Japoshvili) (IZGAS); Austria, 1♀, Austria, Bisamberg, 6 August 1944 (Novitzky) (BMNH).

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