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CHALCIDOIDEA (HYMENOPTERA) REARED FROM FRUITS OF *JUNIPERUS PHOENICEA*, WITH DESCRIPTIONS OF THREE NEW SPECIES

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Abstract: Fruits of *Juniperus phoenicea*, collected chiefly in north-eastern Spain (provinces of Lleida, Huesca and Zaragoza) but with a small sample from the Canary Islands, were found to be infested by a small community of phytophages supporting a number of parasitoid species, especially Chalcidoidea. Three new species of Chalcidoidea are described.
Key words: Hymenoptera, Chalcidoidea, *Eupelmus*, *Entedon*, *Aprostocetus*, new species, *Juniperus phoenicea*, fruit, Spain.

Chalcidoidea (Hymenoptera) emergidos de frutos de *Juniperus phoenicea*, con descripción de tres nuevas especies
Resumen: Frutos de *Juniperus phoenicea* colectados principalmente en el noreste de España (provincias de Lérida, Huesca y Zaragoza) pero con una pequeña muestra de las islas Canarias contenían una pequeña comunidad de insectos fitófagos, que a su vez soportaban una serie de especies parasitoides, principalmente Chalcidoidea. Se describen tres nuevas especies de Chalcidoidea.
Palabras clave: Hymenoptera, Chalcidoidea, *Eupelmus*, *Entedon*, *Aprostocetus*, nuevas especies, *Juniperus phoenicea*, frutos, España.

Taxonomy/Taxonomía: *Eupelmus acinellus* Askew **sp.n.**, *Entedon juniperi* Askew **sp.n.**, *Aprostocetus galbulus* Ribes **sp.n.**

Introduction

Juniperus phoenicea (Phoenician juniper) (Cupressaceae) is a coniferous evergreen shrub or small tree found throughout the Mediterranean and Macaronesian regions. It is largely monoecious, with the female fruits or cones ('berries', galbules) globose, 6-14 mm in diameter, orange to reddish brown with a pinkish bloom when mature. Each is composed of six to eight scales which fuse together to form a fleshy, berry-like fruit which contains up to nine hard seeds. The fruit is mature about eighteen months after pollination, at the second winter, and undispersed fruits remain on the tree for a longer time staying partly viable. Fruit production is irregular, depending in part on climatic conditions, and tends to be periodical with alternating years of high and low productivity.

Because of the extended maturation time and irregular fruiting cycle, trees usually bear fruits at different stages of maturation, from young green fruits of the current year, reddish brown maturing fruits of the previous year, some reddish black fruits of two years previously, and often also older, greyish, disintegrating fruits. This extended time allows for the development of a complex community of phytophagous insects and parasitoids exploiting each maturation stage.

There have been several studies on the phytophagous communities developing in *Juniperus phoenicea* fruits. The biology of several conifer pests, including those attacking species of *Juniperus*, is summarized by Roques (1983), and the ecological relations of those exploiting conifer seeds is discussed by Turgeon *et al.* (1994) and Roques & El Alaoui El Fels (2005). A comparative specific treatment of Mediterranean *Juniperus* species, dealing with the phenology of fruits and their pests, and infestation rates, is found in Roques *et al.* (1984). Local Spanish studies on insect frugivory in *J. phoenicea* have been conducted in the Canary Islands (Guido & Roques, 1996) and Balearic Islands (Traveset & Sans, 1994). The focus of these investigations has been mainly the impact of phytophagous insects on fruit and seed production, and the consequences for the natural regeneration of *Juniperus* stands. Scant reference has been made to the parasitoids of the phytophages. Insect communities similar to that in *J. phoenicea* fruits develop, with slight variations, in fruits of other *Juniperus* species, and these have been studied mainly on *J. thurifera* and *J. communis* in our area.

Two differing notations of the fruiting cycle of *J. phoenicea* are used. Female cones start to develop in autumn, and they are pollinated and become small green fruit the next spring. These small fruits may be described as being in the second year of cone development, maturing in the third year. More usually, however, they are referred to as being in the first year of fruit development, maturing in the second year, and this latter notation is used in this paper.

Materials and methods

Samples of fruits of *Juniperus phoenicea* L. were collected, mostly in winter, from Lleida (three sites in 2006-2009) and in 2009 from Peñalba (Huesca) and Caspe (Zaragoza) (A. Ribes). J. Blasco-Zumeta kindly provided samples from Los Monegros near Pina de Ebro (Zaragoza) in 1992 and 2007. A small sample was collected on La Gomera, Canary Islands, in March 1999 (R.R. Askew).

A total of about 5000 fruits was collected in north-eastern Spain during the three winter seasons. The fruits were collected at different stages of maturation and these were stored separately in closed containers. Small samples of *J. oxycedrus* and *J. thurifera* fruits, occurring near *J. phoenicea* stands, were also collected for comparison. Samples were inspected periodically for insect emergences,

which mostly occurred between March and June. Type material will be deposited in the Museo Nacional de Ciencias Naturales, Madrid, in the Natural History Museum, London, and in the authors' collections, where non-type material is also deposited.

Some fruits were cut open in winter to obtain larvae of the phytophagous hosts and their parasitoids and these were either reared to adults in individual tubes plugged with cotton, or stored in ethanol for determination and reference. Some single fruit, and some seeds separated from their fruits, were also stored individually so that any host remains of emerging parasitoids could be located. Detailed quantitative data were not collected in the present study and assessments of frequency of fruit pests and their parasitoids are only approximate. Photographs were taken with a digital camera attached to a stereomicroscope or a microscope, and multiple images were combined using CombineZ5 software (Alan Hadley, micropics.org.uk).

Results and discussion

The most frequently reared phytophages were the chalcid *Megastigmus amicorum* Bouček (Hymenoptera, Torymidae) (633 specimens) and the moth *Mesophleps oxycedrella* (Millière) (Lepidoptera, Gelechiidae) (190 specimens). These species overwinter as larvae in the fruits and could easily be found. Larvae of a weevil, probably *Nanodiscus transversus* (Aubé) (Coleoptera, Nanophyidae), were also found. This species either overwinters or emerges in autumn, depending on climatic conditions. Another reported overwintering phytophage, *Pammene oxycedrana* (Millière) (Lepidoptera, Tortricidae), was apparently absent from our samples. One species of Lepidoptera developing in *J. phoenicea* fruits, *Argyresthia chrysidella* (Peyerimhoff) (Yponomeutidae), has a different life cycle, larvae leaving the fruits in autumn to pupate in the soil, and this species was also missing from our samples, as were *Pammene juniperana* (Millière) and *Argyresthia praecocella* (Zeller), which usually feed on juniper species other than *J. phoenicea.* Fruits with enlarged seeds, probably galled by the acarine *Trisetacus quadrisetus* (Thomas) (Eriophyoidea), were found at some locations.

The phytophages were similar to those found in France and Corsica (Roques *et al.,* 1984) and in the Monegros area of Spain (Askew *et al.,* 2001), except for the absence of *P. oxycedrana*. Elsewhere the phytophage fauna displays local variations; in the Canary Islands *N. transversus* was the dominant phytophage, *P. oxycedrana* was relatively common but *M. amicorum* was absent (Guido & Roques, 1996), and in the Cabrera Islands (Balearics) only *M. oxycedrella* was present (Traveset & Sans, 1994).

Some late successional fauna was found developing in third and fourth year fruits. Fruit pulp often becomes infested by fungus and then several acarine species may appear. A species commonly found feeding on these acarines was a neuropteran, probably *Hemisemidalis pallida* (Withycombe) (Coniopterygidae). Occasional larvae and emerging adults of an undetermined species of Dasytidae (Coleoptera), several adult Anobiidae (Coleoptera) and larvae of two Cecidomyiidae (Diptera) species were also found in old fruits. Adult Cecidomyiidae were not obtained but larvae of two species, one yellow and one whitish, were seen (fig. 3h-j).

Seventeen species of parasitic Hymenoptera were obtained from *J. phoenicea* fruits: 8 Chalcidoidea, 5 Ichneumonoidea, 1 Platygastroidea and 3 Ceraphronoidea. In Fig. 1 we present a provisional schema of relationships between phytophages, parasitoids and predators in *J. phoenicea* fruits, based on our own observations and including bibliographic data. A large proportion of relationships still remain uncertain.

Below we give descriptions of three new species of Chalcidoidea, *Eupelmus acinellus* Askew (Eupelmidae), *Entedon juniperi* Askew (Eulophidae, Entedoninae) and *Aprostocetus galbulus* Ribes (Eulophidae, Tetrastichinae), and an account of other species of parasitic Hymenoptera, chiefly Chalcidoidea, found associated with fruits of *J. phoenicea*.

***Eupelmus acinellus* Askew sp. n.**
Fig. 2a-h.

FEMALE. (fig. 2a) Head and thorax green to blue-green, sometimes with blue to violet tints on mesoscutum and scutellum; gaster coppery except first tergite which is blue-green. Antenna with scape and pedicel black with metallic reflections; flagellum dark brown. Legs dark brown or black with weak metallic tints on profemur and protibia; knees of front and middle legs and apical one-sixths of meso- and metatibiae yellowish to pale testaceous, mesotibial spur with black tip; protarsus infuscate, meso- and metatarsi with their basitarsi yellowish but darkening distally thereafter, the mesobasitarsal pegs black. Wings clear (holotype) to slightly infumate. Ovipositor sheath tricoloured, its basal and apical quarters respectively black and brown, the middle section yellowish.

Length 2.2-4.1 mm (holotype 3.9 mm).

Head in dorsal view 1.9x as broad as long, broader than mesoscutum; temples 0.2x length of eye; POL 2.5x OOL, posterior ocellus separated from adjacent eye by about 1.4 times its major diameter. Head in front view 1.2-1.3x as broad as high; eyes separated by 0.43x head breadth; inner orbital crests low; hairs on frons white; mouth 1.2x malar space. Antenna (fig. 2c) with scape about 4.6x as long as broad and 0.9x height of an eye, with a ventral carina; pedicel plus flagellum 1.3 times as long as breadth of head; pedicel in dorsal view about 3.0x as long as broad and 0.7x combined length of the transverse anellus and first funicle segment (F1); proximal half of flagellum narrower than pedicel, the funicle segments shortening and slightly widening distally, F1 about 3.0x as long as broad, F7 only slightly longer than broad and 1.3x as broad as pedicel; clava comprising almost one-quarter of the flagellum length, 2.5x as long as broad, with oblique dividing lines between the segments and micropilosity over most of the outer surface.

Mesosoma in dorsal view about 1.8x as long as broad; prothorax with white admarginal hairs; mesoscutum with reticulate sculpture on depressed area behind raised part of median lobe; scutellum 1.3x as long as broad, the frenal area sharply declived; mesopleuron with exceedingly fine reticulate sculpture medially, coarser basally and distally. Mesotibia (fig. 2g) with an apical row of six black pegs in front of spur; ventral surfaces of mesotarsal segments 1-4 with black pegs, the basitarsus with 30 in four rows, second segment with nine in two rows, third with five and fourth with two; metacoxa with very short dorsal pilosity.

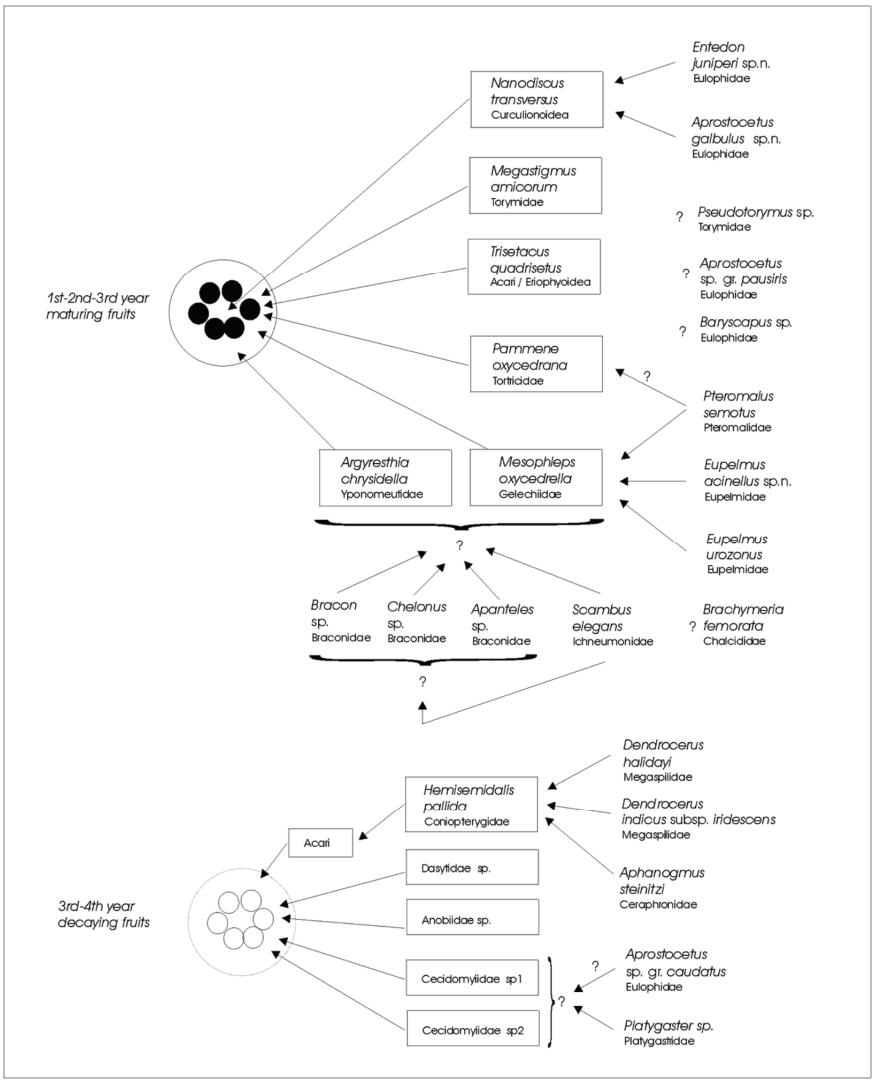

Fig. 1. Provisional food web relationships in *Juniperus phoenicea* fruits. // Red provisional de relaciones alimentarias en los frutos de *Juniperus phoenicea.*

Forewing (fig. 2e) with short pilosity distributed much as in *Eupelmus urozonus* Dalman, linea calva ('speculum') well-developed; lengths of costal cell: marginal vein: stigmal vein: postmarginal vein as 80:68:18:19; stigmal vein slightly curved, the stigma comprising about one-third of the vein and separated from postmarginal vein by slightly more than its depth (including uncus).

Gaster (excluding ovipositor sheath) 1.3x as long as mesosoma, usually laterally compressed in dry material; ovipositor sheath usually about 0.6x length of remainder of gaster and 1.1-1.3 (holotype) x length of metatibia. In one very small specimen (length 2.2 mm) the ovipositor sheath is only 0.47x as long as remainder of gaster and 0.9x as long as the metatibia.

MALE. (fig. 2b) Head and thorax green, the head tending to blue-green; protibia with a pale longitudinal stripe, otherwise legs darker than in female with only the knee and extreme apex of mesotibia and the basitarsi of middle and hind legs pale.

Length 2.2 mm (allotype).

Head in dorsal view 1.9x as broad as long. Antenna (fig. 2d) with scape 2.6-2.7x as long as broad; pedicel plus flagellum 1.3x as long as breadth of head; flagellum of even thickness, stouter than pedicel, all funicle segments subequal about 1.3x as long as broad with a fringe of pilosity (viewed in profile) about one-quarter the depth of the segments; clava about 2.2x as long as broad, as long as F6 plus F7. Gena with one long, curved seta twice the length of adjacent setae.

Forewing (fig. 2f) with marginal vein 3.1x as long as stigmal vein.

TYPE MATERIAL: Holotype ♀: SPAIN, LLEIDA, Juncosa, alt. 790 m, UTM 31T CF17, ex fruit of *Juniperus phoenicea* collected 28.X.2006, emerged 25.iii.2007 (forced) (A. Ribes).

Allotype ♂: same data as holotype.

Paratypes, 10♀♀ 10♂♂: 3♀♀ 2♂♂, same data as holotype except emergence dates 2-25.III.2007 (1♂) and after 25.III.2007 (3♀♀ 1♂); 2♀♀ 5♂♂, same data as holotype except fruits collected 26.XII.2007 and emerged 26.V.2008 (1♂), 2.VI.2008 (1♂) and 19.VI.2008 (2♀♀ 3♂♂); 3♀♀ 2♂♂, same data as holotype except fruits collected 27.I-20.IV.2009 and emerged 29.V-2009 (1♂), 1-VI.2009 (1♀) and 4.V.2009 (2♀♀ 1♂); 2♀♀ 1♂, SPAIN, CANARY ISLANDS, La Gomera, Vallehermosa, La Culato, ex fruits of *J. phoenicea* collected 28.III.1999, emerged on or just before 11.VIII.1999 (R. R. Askew).

The holotype, allotype and some paratypes will be deposited in the Museo Nacional de Ciencias Naturales, Madrid, and the remaining paratypes in the Natural History Museum, London and the authors' collections.

ADDITIONAL MATERIAL, 9♀♀ 7♂♂: 1♀, SPAIN, LLEIDA, Sant Llorenç de Montgai, alt. 260 m, UTM 31T CG23, ex mature red fruit of *J. phoenicea* collected 28.II.2007, emerged 12.XII.2007; 2♀♀ 1♂, LLEIDA, Juncosa, ex fruits of *J. phoenicea* collected 26.XII.2007, emerged VI.2008; 3♀♀ 4♂♂, LLEIDA, Juncosa, ex fruits of *J. phoenicea* collected 27.I-20.II.2009, emerged 25.III-1.VII.2009; 1♀ 1♂, LLEIDA, Juncosa, ex fruits of *J. oxycedrus* collected 26.XII.2007, emerged 23.V.2008 (1♂) and 14.VI.2008 (1♀); 1♀, LLEIDA, Juncosa, 27.VI.2009, sweeping *J. phoenicea* trees; 1♀ 1♂, SPAIN, HUESCA, Peñalba, alt. 280 m., UTM 30T YL49, ex fruits of *J. phoenicea* collected 9.II.2009, emerged 26.V-28.V.2009.

ETYMOLOGY. The name *acinellus* is from the Latin word *acinus*, a berry. Although a cone, the fruit of juniper is commonly referred to as a berry.

BIOLOGY. (larva, fig. 2h) The host of *E. acinellus* in juniper fruit is established as *Mesophleps oxycedrella* (fig. 2i). Three fruits from which *E. acinellus* emerged and which were stored in individual tubes were opened and found to contain the remains and galleries of *Mesophleps* larvae. In fruits opened in winter several live *Eupelmus* larvae were found near the remains of *Mesophleps* larvae. One *Eupelmus* larva developed into an adult *E. urozonus* but the remaining fruit samples yielded only *E. acinellus*. Therefore in Lleida both *Eupelmus* species parasitize *M. oxycedrella*. Interestingly, the small sample from La Gomera also produced three specimens of each of *E. acinellus* and *E. urozonus*, together with two adult *Mesophleps oxycedrella.*

Two other species of *Eupelmus*, *E. juniperinus* Bolivar and *E.pallicornis* Gijswijt, are associated with *Juniperus* in Spain. *E. pallicornis* is a parasitoid of *Etsuhoa thuriferae* (Diptera, Cecidomyiidae) forming galls on *J. thurifera* (Gijswijt 1993) and *E. juniperinus* has been reared from male cones of *J. thurifera* and is also associated with *J. oxycedrus* (Askew & Nieves-Aldrey, 2000). Both these species are in a different group to *E. acinellus,* having pale mesobasitarsal pegs, no linea calva and at least the prepectus and tegula yellow and non-metallic.

COMMENTS. The group of species allied to *E. urozonus* Dalman, to which *E. acinellus* belongs, is characterized by an ovipositor sheath which is shorter than the length of the rest of the gaster and which is black basally, yellowish medially and darkened towards its tip, by the pegs on the mesobasitarsus being black, by the mesoscutum being entirely reticulately sculptured, and by the possession of an oblique bare strip (linea calva, speculum) on the forewing (e.g. Askew & Nieves-Aldrey, 2000). In this group, *E. annulatus* Nees, *E. cerris* Förster and *E. stenozonus* Askew have an ovipositor sheath at least as long as the metatibia. In *E. annulatus* and *E. cerris*, both parasitoids in cynipid oak galls, the ovipositor sheath is only about as long as the metatibia, but in *E. stenozonus*, a species from the Canary Islands with unknown host, it is almost 1.2 times as long as the metatibia and 0.7 times as long as the rest of the gaster. In sheath length *E. acinellus* is not very different from *E. stenozonus*, but females of the two species differ in several other characters. The body colour of *E. acinellus* is green to blue-green (partly coppery in *E. stenozonus* and other allied species), the legs are darker, especially the mesotibia which is pale only on the apex and the spur has a distinct black tip (mesotibia of *E. stenozonus* testaceous with the basal half or less infuscate and the spur without a black tip), the ovipositor sheath has the pale median zone much longer than the basal black zone (at most not quite so long as the basal zone in *E. stenozonus*), the forewing stigma is small, occupying less than half of the stigmal vein (comprising over half the stigmal vein in *E. stenozonus*), the pilosity of basal and costal cells is dark (pale and indistinct in *E.stenozonus*), and the gaster is very distinctly longer than the mesosoma (only as long in *E. stenozonus*).

The antenna of male *E. acinellus* has a slightly narrower scape than that of male *E. stenozonus* (at least 2.6 times compared to scarcely 2.5 times as long as broad), and the funicle segments are relatively longer (F1 of *E. acinellus* at least 1.3 times as long as broad, subquadrate in *E. stenozonus*) and have less outstanding pilosity (viewed in profile, the fringe of pilosity on the funicle segments of *E. stenozonus* is about half the depth of the segments).

***Entedon juniperi* Askew sp. n.**

Fig. 3a-g.

FEMALE. (fig. 3a, c) Head and thorax dark bluish green with most of scutellum and sides of thorax purplish; propodeum greenish blue; gaster with tergites 1 and 6 blue-green, the remainder purplish. Antennal scape and pedicel blue-green; flagellum dark brown with weak metallic reflections. Coxae, femora and tibiae black with blue-green metallic reflections; no pale stripes on front tibia, knees and apices of tibiae pale yellow, the metatibia pale on apical one-fifth or so; mesotarsus with segments 1-3 pale, remainder of tarsi more or less darkened. Wings clear, veins yellowish.

Length 2.3(holotype)-2.4 mm.

Head in dorsal view strongly transverse, 2.5x as broad as long and 1.2x as broad as mesoscutum; ocelli in a triangle of about 120°, POL 4.0x OOL, posterior ocellus separated from occiput by about one-quarter and from adjacent eye by about one major diameter. Head in front view 1.3x as broad as high; gena convex; mouth 1.8x malar space; facial sculpture dense reticulation with maximum areole diameter scarcely more than half that of anterior ocellus; clypeus with anterior margin not produced, straight. Occipital edge of vertex sharp but not carinate, with hardly developed prominence behind outer seta of vertex. Antenna (fig. 3f) with scape not nearly reaching to anterior ocellus, 0.6x as long as height of eye; length of pedicel plus flagellum 0.8x breadth of head; pedicel in profile 2.3x as long as broad; F1 slightly narrower than and 1.2-1.4x as long as pedicel, 2.7-3.0x as long as broad; F2 0.75x as long as F1, 1.8x as long as broad; F3 0.9x as long as F2, 1.6x as long as broad; funicle segments progressively broadening, F3 about 1.4x as broad as F1, and with distinct petioles between the segments and between F3 and the clava; clava 2.8-2.9x as long (including apical spine) as broad, 1.6-1.8x as long as F3, its apical spine stout and half as long as C2.

Mesosoma 1.4x as long as broad; pronotum 0.75x as broad as mesoscutum with collar not horizontal, in same plane as front of mesoscutum, with only a very weak carina anteriorly so that it is scarcely visible in profile; mesoscutum and scutellum with strongly raised reticulate sculpture and rather dull, the anterior areoles of the scutellum only slightly lengthened longitudinally; mesoscutum 1.8x as broad as long; scutellum about 1.1x as long as mesoscutum,

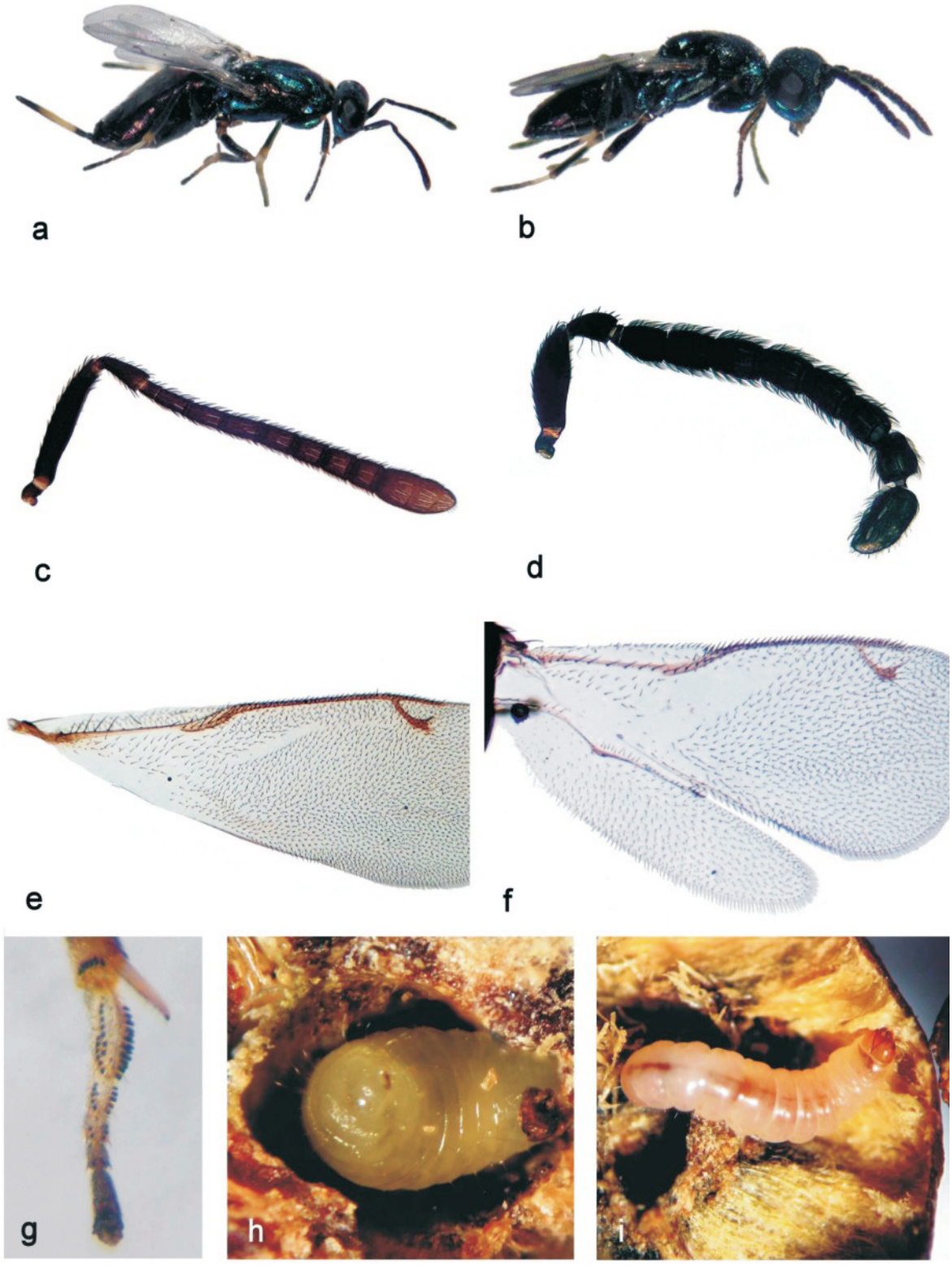

Fig. 2. *Eupelmus acinellus* Askew sp. n. **a)** female lateral view; **b)** male lateral view; **c)** female antenna; **d)** male antenna; **e)** female forewing detail; **f)** male forewing detail; **g)** female mesotarsus and apex of mesotibia; **h)** *Eupelmus acinellus* larva; **i)** *Mesophleps oxycedrella* larva. // *Eupelmus acinellus* Askew sp. n. **a)** hembra en vista lateral; **b)** macho en vista lateral; **c)** antena de la hembra; **d)** antena del macho; **e)** detalle del ala anterior de la hembra; **f)** detalle del ala anterior del macho; **g)** mesotarso y ápice de la mesotibia de la hembra; **h)** *Eupelmus acinellus*, larva; **i)** *Mesophleps oxycedrella*, larva.

almost as long as broad, without a transverse impression, the bases of its setae separated by about 0.65x a setal length. Propodeum 0.3x as long as scutellum; median carina bifurcated close to anterior margin and in a smooth groove; median area smooth and shining; callus pilose with one posterior seta twice as long as the others. Legs not short, metafemur 3.4x as long as broad, metatibia 1.4x as long as metatarsus (excluding pretarsus), metatarsus with fourth segment fully as long as metabasitarsus.

Forewing (fig. 3e) 2.2x as long as marginal vein plus parastigma; marginal vein weakly arched; stigmal vein shorter than postmarginal vein, the stigma almost sessile; speculum large, open below, extending well beyond apex of costal cell.

Gaster ovate, 2.0-2.3x as long as broad, slightly longer than head plus mesosoma; petiole conical, about as long as propodeal nucha; tergite 7 about 1.4x as broad as long.

MALE. (fig. 3b, d) Head and thorax green with only posterior half of scutellum purplish. Legs with apices of tibiae more broadly yellowish than in female, the mesotibia pale over its apical one-quarter; metatarsal segments 2-4 only slightly infuscate. Gaster with a pale spot on tergite 1.

Length 1.9-2.2 (allotype) mm.

In structure, the male differs from the female as follows. Antenna (fig. 3g) with scape almost reaching the lower margin of the anterior ocellus, 3.0x as long as broad; flagellum with four well-separated funicle segments and two discoid anelli; first funicle segment (F1) hardly narrower than but almost 2.0x as long as pedicel, 3.2x as long as broad; F2 the broadest flagellar segment, almost 2.0x as long as its maximum breadth and 0.7-0.8x as long as F1; F3 and F4 slightly shorter than F2, F3 1.7-2.0x as long as broad; petioles between funicle segments longer than broad; flagellum with slightly curved hairs which stand out at about 45°, the hairs somewhat longer than the breadth of their segments; clava (including spine) 2.8-3.0x as long as broad, the apical spine occupying about one-fifth to almost a quarter of the length of the segment and with an apical seta. Gaster with petiole in dorsal view 2.0x as long as broad and 0.2x length of remainder of gaster, its sides gently converging anteriorly, its surface shiny and almost smooth; postpetiolar gaster about 1.5x as long as broad.

TYPE MATERIAL: Holotype ♀: SPAIN, LLEIDA, Juncosa, alt. 790 m, UTM 31T CF17, ex fruit of *Juniperus phoenicea* collected 28.X.2006, emerged 25.III.2007 (forced) (A. Ribes).

Allotype ♂: data as for holotype except emergence date 28.ii.2007.

Paratypes, 22♀ 16♂♂: 6♀♀ 4♂♂, data as holotype except emergence 2.III.2007 (2♂♂), 2-25.III.2007 (3♀♀ 2♂♂) and 7.III.2007 (3♀♀); 13♀♀ 10♂♂, data as holotype except fruits collected 26.XII.2007, emerged 27.IV.2008 (1♀ 6♂♂), 30.IV.2008 (4♀♀ 4♂♂), 4.V.2008 (7♀♀) and 29.V.2008 (1♀ ex fruit containing curculionid larva); 2♀♀, SPAIN, LLEIDA, Mont-rebei, UTM 31T CG06, alt. 560 m., collected 31.I.2008, emerged 30.IV.2008 (A. Ribes); 1♀ 1♂, SPAIN, ZARAGOZA, Pina de Ebro, ex fruits of *J. phoenicea* collected 14.X.1992, emerged 25.V.1993 (J. Blasco-Zumeta); 1♂, PORTUGAL, BAIXO ALENTEJO, Santo André Sines, Monte Velho, ex fruits of *J. phoenicea* (with *Mesophleps oxycedrella*) collected 19.X.1997, emerged 28.V.1998 (M. F. V. Corley).

The holotype, allotype and some paratypes will be deposited in the Museo Nacional de Ciencias Naturales, Madrid, and the remaining paratypes in the Natural History Museum, London and the authors' collections.

ADDITIONAL MATERIAL, 9♀♀ 6♂♂: 1♀ (much damaged) 1♂, data as holotype, emerged III.2007; 4♀♀ 1♂, data as holotype except fruits collected 26.XII.2007, emerged 2008; 3♀♀ 2♂♂, locality as holotype, emerged 7-16.V.2009 from fruits collected 20.II-20.IV.2009; SPAIN, ZARAGOZA, Pina de Ebro, 1♀ 1♂ ex fruits of *J. phoenicea* collected 14.X.1992, emerged 25.V.1993 and 1♂ ex fruit of *J. phoenicea* collected 9.XII.2007, emerged 15.V.2008 (J. Blasco-Zumeta).

BIOLOGY. Most species of *Entedon* are endoparasitoids of larval Coleoptera. *E. juniperi* attacks *Nanodiscus transversus*, a weevil whose larvae are found only in *J. phoenicea* fruits in the western Mediterranean basin. *N. transversus* has been found as a larva in the samples but it was not reared. The adult weevils were collected by sweeping *J. phoenicea* trees in July. From a dissected fruit containing a live *N. transversus* larva, an adult female *E. juniperi* emerged having almost certainly been an endoparasitoid of the weevil larva.

Other species in the *squamosus* complex (which includes *E. juniperi*, see below) whose hosts are known, are koinobiont egg-larval or larval-larval endoparasitoids of xylophagous beetles. *E. ergias* is a well-documented parasitoid of Scolytidae (Beaver, 1966) and *E. armigerae* has been reared from *Magdalis armigera* (Geoffroy) (Curculionidae) and *Scolytus laevis* Chapuis (Scolytidae) infesting *Ulmus* (Graham, 1971), and from *Dasytes aeratus* Stephens (*aerosus* Kiesenwetter) (Melyridae) in twigs of *Prunus padus* (Hansson, 1987).

COMMENTS. *E. juniperi* is referable to the group of species that includes the European *E. ergias* Walker, 1839, *E. squamosus* Thomson, 1878, *E. armigerae* Graham, 1971 and *E. marci* Askew, 1992, a group designated by Gumovsky & Boyadzhiev (2003) as 'species complex *squamosus* of *perturbatus* group' and characterized by the absence of a frontal fork, truncate clypeus, small mouth not more than 2.3 times as broad as malar space, occipital edge not or weakly carinate and sometimes produced behind each outer seta of the vertex as a blunt tooth, forewing speculum open below, propodeum with smooth, convex submedian areas and metacoxa with a dorsal protrusion. The protibia in species of this group is usually without pale longitudinal stripes, although in males and in female *E. ergias* these may be partly formed and in male *E. ergias* they are usually complete. In males (where known) the funicle is 4-segmented and the gaster has a pale subbasal spot.

Key to *Entedon* species in the *squamosus* complex

1. Posterior ocellus equidistant from adjacent eye and edge of occiput ..... *ergias*
− Posterior ocellus closer to edge of occiput than to adjacent eye 2

2. Thoracic dorsum dark blue-green with much of mesonotum in female and posterior half of scutellum in male bluish purple; female gaster 1.7-2.3 times as long as broad, almost as long as or slightly longer than rest of body 3

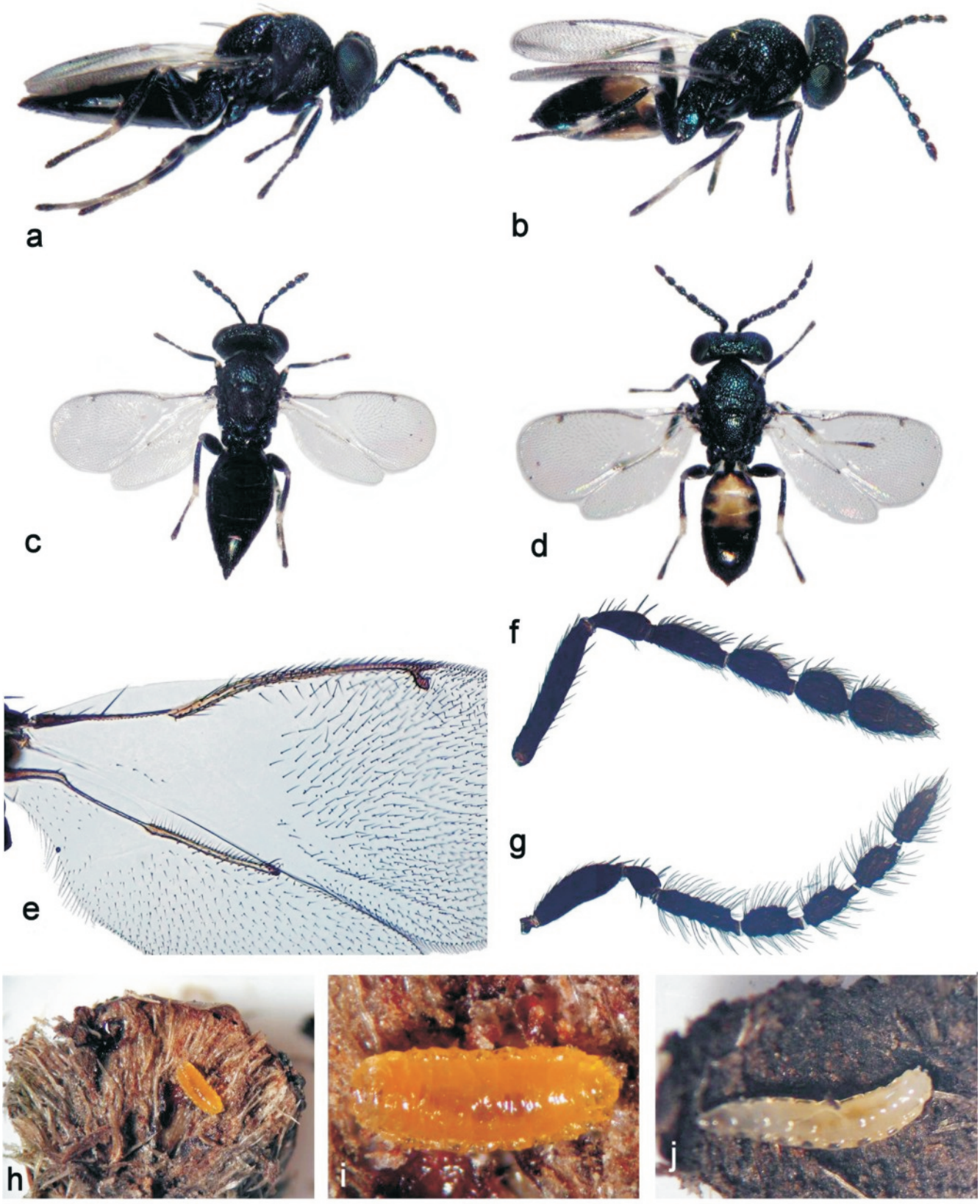

Fig. 3. *Entedon juniperi* Askew sp. n. **a)** female lateral view; **b)** male lateral view; **c)** female dorsal view; **d)** male dorsal view; **e)** female wings; **f)** female antenna; **g)** male antenna; **h-i)** Cecidomyiidae sp. larva; **j)** Cecidomyiidae sp. larva. // *Entedon juniperi* Askew sp.n. **a)** hembra en vista lateral; **b)** macho en vista lateral; **c)** hembra en vista dorsal; **d)** macho en vista dorsal; **e)** alas de la hembra; **f)** antena de la hembra; **g)** antena del macho; **h-i)** Cecidomyiidae sp., larva; **j)** Cecidomyiidae sp., larva.

− Thoracic dorsum green to clearer blue-green, often with bronze tints (scutellum occasionally with a narrow median longitudinal violet stripe); female gaster 1.3-1.8 times as long as broad, at least slightly shorter than rest of body [males unknown] 4

3. Pronotal collar in profile forming an almost continuous curve with mesoscutum; female antenna with first funicle segment 1.2-1.4 times length of pedicel, clava at least 2.5 times as long as broad; mouth about 1.8 times as broad as malar space; male with petiole of gaster 2.0 times as long as broad and prominences of occipital edge absent .....*juniperi* sp. n.
− Pronotal collar in profile short but forming a distinct horizontal shelf; female antenna with first funicle segment about 1.5 times length of pedicel, clava about 1.5 times as long as broad; mouth about 2.3 times as broad as malar space; male with petiole of gaster as long as broad and prominences of occipital edge distinct (incipient also in female)..... *marci*

4. Female: gaster 1.3-1.5 times as long as broad; antenna with scape pale basally, first funicle segment about 1.6 times as long as pedicel and at most 3.0 times as long as broad, pedicel plus flagellum about 0.8 times breadth of head ..... *squamosus*
− Female: gaster 1.5-1.8 times as long as broad; antenna with scape entirely black or with a minute pale spot at base, first funicle segment 1.7-2.2 times as long as pedicel and at least 3.5 times as long as broad, pedicel plus flagellum almost as long as breadth of head..... *armigerae*

Additional characters of *E. juniperi* which distinguish it from *E. marci* are its finer reticulate sculpture on the mesoscutum, making it appear less shiny, the posterior ocellus separated from an eye by about its major diameter (by more than a diameter in *marci*) and bases of scutellar setae separated by about 0.7 times a setal length (by about 0.8 times in *marci*).

Aprostocetus galbulus Ribes sp. n.

Fig. 4a-d.

Female. Body (fig. 4a, b) yellow with more or less extensive black markings which have a weak metallic tinge. Head yellow with ocellar triangle and inner occiput black; antenna with scape and pedicel black, scape yellowish at base and on anterior margin, flagellum blackish brown. Mesosoma yellow with the following areas darkened: pronotum black anteriorly with two small black spots in posterolateral angles; anterior half of mesoscutum with two large, dark testaceous spots; axilla anteriorly dark testaceous; scapula black in anterior third; propodeum black; thorax laterally yellow but mesosternum and anterior part of prosternum dark testaceous. Legs including coxae yellow with only anterior tarsus and last tarsomeres of middle and posterior tarsi darkened. Wings hyaline; tegula yellow; venation light brown. Gaster mainly dark dorsally with transverse yellow bands in anterior halves of tergites, similarly patterned ventrally with dark colouration palest laterally; ovipositor sheath black.

In dark specimens the spots on the mesoscutum and axilla are blackened, not testaceous and the axilla has only a yellow spot posteriorly; scutellum black outside sublateral lines; metanotum black at sides; mesopleuron partly black; mesosternum black; gaster dorsally black centrally with diffuse, transverse yellow bands; antenna with scape black except for a small yellow spot basally. Unusually small specimens may be even darker than described above, but the posterior femora always remain entirely yellow.

Length usually 1.4-2.4 mm, but usually more than 2.0 mm (holotype 2.05 mm).

Head in dorsal view as broad as mesoscutum, 2.2-2.3x as broad as long; POL 1.6-1.8x OOL, OOL 1.7-1.85x OD. Eyes 1.25-1.35x as long as broad, separated by 1.3-1.45x their length. Head in frontal view almost as high as broad; malar space 0.6-0.7x height of eye, malar sulcus slightly curved without a suborbital fovea. Antenna (fig. 4c) with scape 0.8-0.9x height of eye, reaching lower edge of anterior ocellus; pedicel plus flagellum 1.08-1.16x as long as breadth of mesoscutum; pedicel 2.2-2.4x as long as broad, shorter than F1; three funicle segments elongated, F1 slightly longer than the others, F2 0.91x and F3 0.88x as long as F1, becoming progressively slightly broader apically; F1 2.25-2.4x, F2 1.8-2.0x and F3 1.6-1.85x as long as broad. Clava 2.8-3.2x as long as broad with C1 occupying half its length, C1 1.4-1.6x as long as broad, terminal spine short and inconspicuous; flagellum with short, adpressed pilosity and a few slightly outstanding hairs, sensillae moderately numerous, decumbent, in 1-2 irregular rows on each segment.

Mesosoma 1.65-1.70x as long as broad, setae pale; propodeal slope about 50º; pronotum 0.22-0.28x length of mesoscutum with scattered adpressed setae over its surface and a row of long, reclinate setae on posterior margin; midlobe of mesoscutum 1.05x as long as broad, median line distinct, 5(4-6) adnotaular setae in a single row on each side, the posterior ones longer and slightly darkened basally, reticulate sculpture very fine, superficial, slightly shiny, with areoles about twice as long as broad. Scutellum 1.20-1.25x as broad as long, submedian lines slightly nearer to sublateral lines than to each other enclosing a space 2.25-2.75x as long as broad, with a shallow black depression on anterior margin, two pairs of pale setae (often with an additional seta on one side), the anterior pair in the middle, their length 0.85-0.90x distance between submedian lines, posterior pair as long as distance between submedian lines and darkened basally; dorsellum convex, 1.9-2.1x as broad as long, hind edge obtusely angulate. Propodeum shiny with very fine superficial reticulation, medially very slightly emarginate, 1.25-1.40x longer than dorsellum, median carina rather thin, foveate anteriorly, widening posteriorly, spiracle oval, of moderate size with outer rim covered by raised callus, callus with 4 setae, occasionally 3-6. Legs of moderate length and thickness, hind coxa 2.2-2.35x as long as broad, mesotibia with spur 0.9-1.0x as long as basitarsus, fourth tarsomere as long as or slightly longer than basitarsus.

Forewing (fig. 4d) 2.1-2.15x as long as broad; costal cell 0.97-1.08x as long as marginal vein, 8.5-10.0x as long as broad, its lower surface with a complete row of setae in distal two-thirds; submarginal vein with 4(-6) dorsal setae; marginal vein moderately thick, 3.5-3.8x as long as stigmal vein, with 12-14 setae on its front edge; stigmal vein at an angle of 40° to the costal edge with an elongated oval stigma; postmarginal vein a short stub, 0.3-0.45x as long as stigmal vein; speculum of moderate size, extending under

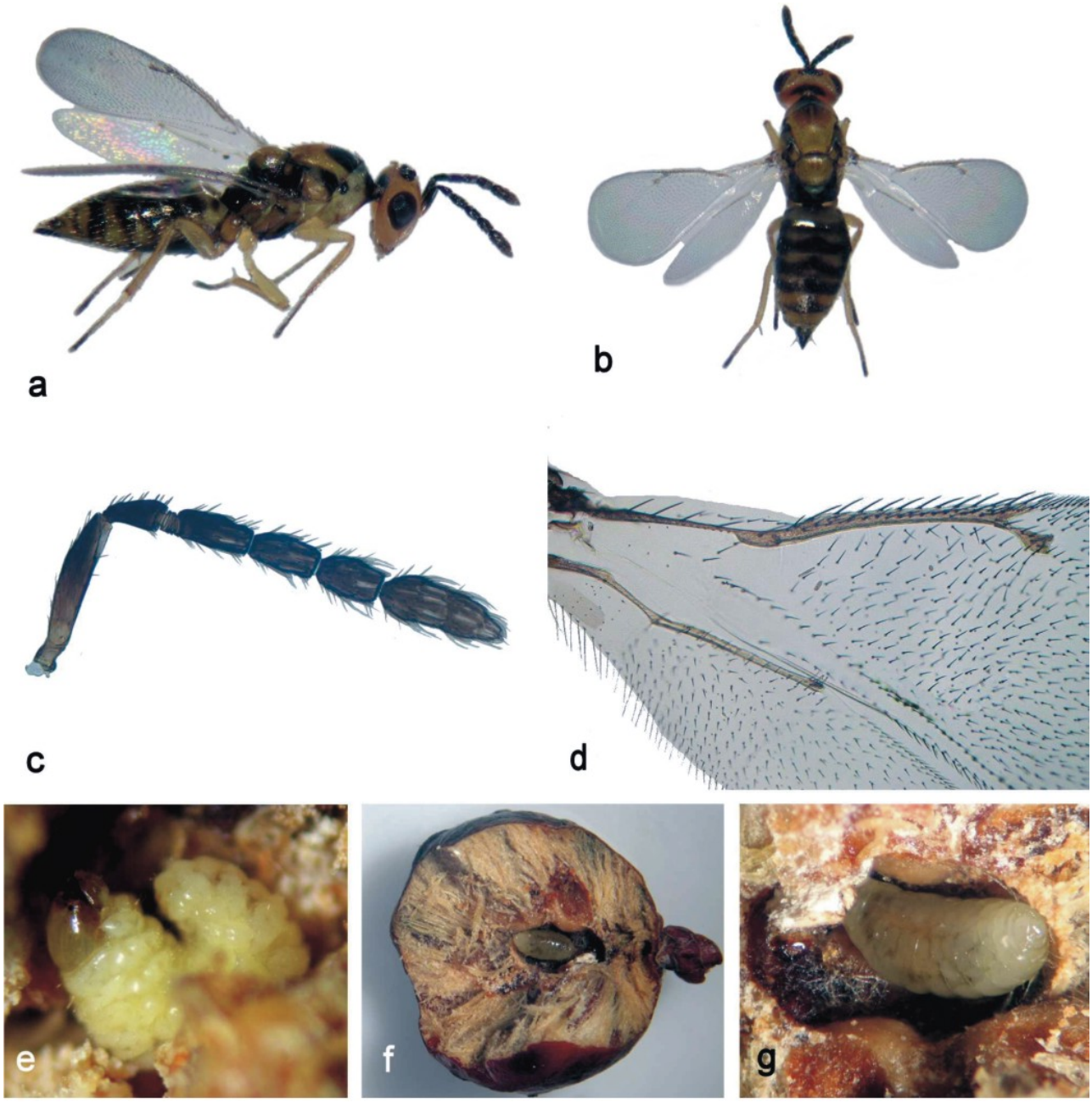

Fig. 4. *Aprostocetus galbulus* Ribes sp. n. **a)** female lateral view; **b)** female dorsal view; **c)** female antenna; **d)** female wings detail; **e)** *Nanodiscus transversus* larva; **f)** *J. phoenicea* fruit, with *N. transversus* cavity, parasitized; **g)** *A. galbulus* larva, with *N. transversus* remains. // *Aprostocetus galbulus* Ribes sp. n. **a)** hembra en vista lateral; **b)** hembra en vista dorsal; **c)** antena de la hembra; **d)** detalle del ala de la hembra; **e)** *Nanodiscus transversus*, larva; **f)** fruto de *J. phoenicea* con cavidad de *N. transversus*, parasitado; **g)** *A. galbulus*, larva, con restos de *N. transversus*.

basal third of marginal vein, closed below except basally; basal cell bare, basal vein pilose and 1 seta on cubital vein; subcubital row of setae reaching distal edge of speculum; wing rather thickly pilose, with a small bare area distad of stigma, marginal cilia of forewing 0.25-0.35x as long as stigmal vein; hindwing subobtuse at apex, marginal cilia 0.20-0.25x as long as width of wing.

Gaster sublanceolate, 1.95-2.2x as long as broad, as long or slightly longer than head plus mesosoma, apex acuminate, last tergite as broad as or slightly broader than long; ovipositor hardly exserted, sheath plus postcercale 0.2x as long as metatibia; cercus with the two longer setae subequal in length, slightly darkened, weakly curved; tip of hypopygium reaching 0.45-0.5x length of gaster.

MALE. Unknown.

TYPE MATERIAL: Holotype ♀: SPAIN, LLEIDA, Juncosa, alt. 790 m, UTM 31T CF17, reared from *Juniperus phoenicea* fruit collected 26.XII.2007, emerged 24.VI.2008 (A. Ribes).

Paratypes, 16♀♀: 4♀♀, data as holotype; 6♀♀ data as holotype except emergence dates 26.V.2008 (1♀), 19.VI.2008 (4♀♀) and 26.VI.2008 (1♀); 5♀♀ from fruits collected 28.X.2006, emerged III-IV.2007; SPAIN, LLEIDA, Sant Llorenç de Montgai, alt. 260 m, UTM 31T CG23, 1♀ reared from *J. phoenicea* fruit collected 28.II.2007, emerged 12.XII.2007 (A. Ribes).

The holotype and some paratypes will be deposited in the Museo Nacional de Ciencias Naturales, Madrid, and the remaining paratypes in the Natural History Museum, London and in the authors' collections.

ADDITIONAL MATERIAL, 5♀♀: 2♀♀ (small and dark), data as holotype except emerged 19.VI.2008; 2♀♀ same data as holotype except emerged IV.2008; 1♀, same locality as holotype, fruit collected 27.I.2009, emerged 1.VI.2009; 1♀, SPAIN, LLEIDA, Juncosa, 27.VI.2009, sweeping *J. phoenicea* trees.

ETYMOLOGY. Named from Latin *galbulus*, cypress cone, a botanical term for the fleshy, berry-like fruit of junipers.

BIOLOGY. Specimens were reared in spring from *Juniperus phoenicea* fruits collected the previous winter, and the host has been identified as the weevil *Nanodiscus transversus* (Aubé) (Coleoptera, Nanophyidae). Some dissected fruits were each found with a eulophid larva and *N. transversus* host remains inside the central cavity (fig. 4e-g). The weevil remains appeared as a dry, whitish compact mass with the brown cephalic sclerites visible, the condition suggesting that the eulophid larva had been an ectoparasitoid. Some of the eulophid larvae were stored individually with the fruit remains, and from these one adult *A. galbulus* emerged. *Entedon juniperi,* the eulophid endoparasitoid of *N. transversus*, was also identified in the samples. It is not clear whether *A. galbulus* is a primary parasitoid, or a secondary parasitoid via *E. juniperi*.

Aprostocetus species in the *pausiris*-group are mostly parasitoids of Cecidomyiidae (Diptera), less often of Tephritidae (Diptera), Apionidae and Curculionidae (Coleoptera), and Eurytomidae (Hymenoptera), and some may behave as secondary parasitoids (Graham 1987). Three additional species of Tetrastichinae, two *Aprostocetus* and one *Baryscapus*, were also found in *J. phoenicea* fruits but they were rare and are discussed in the next section.

COMMENTS. *Aprostocetus galbulus* belongs to the rather heterogeneous *A. pausiris*-group (species with the longest cercal seta usually almost straight and scarcely longer than the next longest, a single row of adnotaular setae, propodeum medially longer than the dorsellum and body frequently with extensive yellow colouration). In Graham's key (1987: 138-142) *A. galbulus* runs to *A. venustus* (Gahan), but some dwarf specimens, which have relatively longer antennae, might run to *A. tompanus* (Erdös). *A. galbulus* differs from both of these species in having yellowish posterior femora which are not black proximally, and yellowish coxae.

A. galbulus differs from *A. tompanus* (couplet 37) in having shorter antennae with pedicel plus flagellum 1.08-1.16x the mesoscutal breadth (1.25-1.35x mesoscutal breadth in *A. tompanus*) and less elongated mesosoma 1.65-1.7x as long as broad (1.7-1.75x as long as broad in *A. tompanus*). *A. galbulus* and *A. tompanus* have similarly shaped funicle segments and clava, but the adnotaular and scutellar setae are pale in *A. galbulus* and dark in *A. tompanus*, *A. galbulus* has relatively broader forewings 2.1-2.15x as long as broad (2.25-2.35x as long as broad in *A. tompanus*), and usually shorter gaster 1.95–2.2x as long as broad (2.1-2.7x as long as broad in *A. tompanus*). *A. tompanus* is recorded by Andriescu (1960) as a parasitoid of *Apion* in clover flowers.

A. galbulus differs from *A. venustus* (couplet 45) in having a more elongated antennal clava 2.8-3.2x as long as broad (1.9-2.4x as long as broad in *A. venustus*), more elongated funicle segments with pedicel plus flagellum slightly but distinctly longer than breadth of mesoscutum (not or barely longer *A. venustus*), POL 1.6-1.8x OOL (1.85-2.1x OOL in *A. venustus*), OOL 1.7-1.85x ocellar diameter (1.2-1.4x OD in *A. venustus*), and mesosoma 1.65-1.70x as long as broad (1.4–1.5x as long as broad in *A. venustus*). *A. galbulus* and *A. venustus* also have very different biologies; *A. venustus* is a parasitoid of *Bruchophagus* (Hymenoptera, Eurytomidae) in seeds of Fabaceae.

Other Chalcidoidea associated with the fruit of *Juniperus phoenicea*

Brachymeria femorata (Panzer, 1801) (Chalcididae)
This is quite common in Los Monegros, where several females have been seen by J. Blasco-Zumeta crawling over fruits of *J. phoenicea* (3 voucher specimens collected 28.VIII.1992) and also overwintering under bark of *J. thurifera*. Eight specimens were collected by sweeping *J. phoenicea* at Fraga, Serreta Negra, Huesca, UTM 31T BF59, alt. 300 m, 26.VI.2009 (A. Ribes). *B. femorata* is known to be a primary pupal parasitoid of a range of macrolepidoptera (Pieridae, Nymphalidae, Arctiidae, Noctuidae) and a hyperparasitoid of *Lasiocampus* (Lasiocampidae). The only microlepidopteran to be listed as a host in Noyes (2007) is *Plutella maculipennis* (Curtis) (Yponomeutidae). *Mesophleps oxycedrella,* which feeds in juniper fruits, is probably too small to be a suitable host (Askew *et al.,* 2001).

Megastigmus amicorum Bouček, 1970 (Torymidae)
A phytophagous chalcid in juniper seeds, *M. amicorum* was described from *Juniperus oxycedrus* in Croatia and Bulgaria (Bouček 1970), and has since been found to be widespread in the Mediterranean region. In Spain many were reared, mostly in July 1992, from fruits of *J. phoenicea* collected in Los Monegros three months previously (Askew *et al.* 2001). More recently, 14♀♀ 10♂♂ emerged 11.V-24.VI.2008 from *J. phoenicea* fruits collected in December 2007, 19♀♀ 13♂♂ emerged 22.V-1.VII.2009 from fruits collected between January and April 2009, and 4♀♀ 4♂♂ emerged 7-18.VII.2009 from fruits collected 27.VI.2009 at Juncosa, Lleida. Additionally, from *J. phoenicea* fruits collected in February 2009, there emerged between 16.V-1.VII.2009 but mostly 22.V-1.VI.2009, 212♀♀ 125♂♂ *M. amicorum* from a sample from Sant Llorenç de Montgai, Lleida, 108♀♀ 121♂♂ from a sample from Peñalba, Huesca and 3♀♀ from a sample from Caspe, Zaragoza, UTM 30T YL48, alt. 325 m. From *J. oxycedrus* only 1♀ emerged, date unknown, from fruits collected 31.I.2008 at Mont-rebei, Lleida.

There is considerable variation in this species, particularly in male colouration. A dark form has the head (except part of the vertex), the lower part of the thorax, the coxae and the gaster partly to entirely blackish, and the stigma is roundish, larger and darker. In contrast, a pale form has the head and thorax wholly yellowish, the gaster yellowish with transverse dark dorsal stripes, the stigma is elongate-oval, slightly smaller, and less darkened. Intermediates occur between these forms. This variation is found in samples from the same location, but pale or dark forms can be predominant at different locations. It has been found that some

specimens appear to differ in their male genitalia. From the dissected specimens, 16 were found having three spines on the digitus (as noted for *M. amicorum*), and 3 were found having four spines (as noted for *M. thuriferana* Roques & El Alaoui). Both pale and dark forms were found with four or three spines. Specimens with four spines occurred at two locations, where *J. thurifera* does not grow, and why this variation in male genitalia occurs remains uncertain. Females of *M. amicorum* from *J. phoenicea* seeds have a relatively short ovipositor, 1.2-1.25x as long as the gaster, more resembling the ovipositor length of *M. thuriferana* than of typical *M. amicorum*, in which it is 1.4x as long as the gaster.

Roques & Skrzypczynska (2003) found morphological variation between populations of *Megastigmus* on *Juniperus* in the western Mediterranean, where *J. phoenicea* also presents considerable intraspecific genetic variation. In a recent molecular analysis (Auger-Rozenberg *et al*., 2006), the populations infesting seeds of *J. thurifera*, previously recorded as *M. amicorum*, were recognized as a new species, *M. thuriferana*, and it is hypothesized that *M. amicorum* may still comprise disparate populations whose status requires further investigation. Pale and dark forms in male phenotype were described for *M. amicorum, M. bipunctatus* (Swederus) and *M. thuriferana.* In our samples 10♀♀ 15♂♂ *M.* cf. *amicorum*, pale form, emerged 20.VI-7.VII.2009, from green fruits of *J. thurifera* collected 9.ii.2009 at Pina de Ebro, Zaragoza. They are similar to *M. amicorum* in ovipositor length, and differ from *M. thuriferana* in the male genitalia having three spines on the digitus. The *Megastigmus* infesting *Juniperus* hosts exhibit a high level of host specificity, even though rare host shifts have been observed to other species or genera of Cupressaceae. *M. amicorum* has shifted rarely on to *Cupressus arizonica* Greene and *C. goveniana* Gord. (Roques & Skrzypczynska, 2003).

Grissell & Prinsloo (2001) also described the existence of pale and dark forms, bridged by intermediate forms, in several species of *Megastigmus* associated with Acanardiaceae seeds, but they found no differentiation within male phenotypes in a DNA analysis.

***Pseudotorymus* sp.** (Torymidae)
An unidentified female *Pseudotorymus* emerged on 20.V.2009 from a *J. phoenicea* fruit collected on 9.II.2009 at Peñalba, Huesca (UTM 30T YL49). Three other female *Pseudotorymus* emerged 7-11.V.2009 from *J. thurifera* fruits collected 9.II.2009 at Pina de Ebro, Zaragoza (UTM 30T YL39) (A. Ribes). In all four insects, the ovipositor sheath is 1.3-1.4 times as long as the metatibia and 0.7-0.8 times as long as the remainder of the gaster. However, the antennae differ remarkably in the females from *J. thurifera,* the two larger specimens having 7 funicle segments with sensillae, but the smaller having only 6. In this latter specimen the second flagellar segment is anelliform and barely half as long as the third, whilst in the larger specimens the second flagellar segment approaches the length of the third. The female from *J. phoenicea* has antennae similar to those of the larger insects from *J. thurifera,* but its body colour is green with bronze tints on the mesopleuron whereas females from *J. thurifera* are blue-green with violet tints mid-dorsally. Another species of *Pseudotorymus* was recorded in *J. thurifera* fruits in Morocco (El Alaoui El Fels *et al*., 1999) as a predator in seeds galled by the acarine *Trisetacus* sp. More material is needed to ascertain the identity of the *Pseudotorymus* in *Juniperus* fruits.

Eupelmus urozonus Dalman, 1820 (Eupelmidae)
Three specimens of *Eupelmus urozonus* emerged with *E. acinellus*, together with the gelechiid moth *Mesophleps oxycedrella*, from *J. phoenicea* fruits collected on La Gomera, Canary Islands, and one female was reared from fruits collected in Los Monegros, Zaragoza (Askew *et al.,* 2001). A fruit of *J. phoenicea*, collected in February 2009 at Sant Llorenç de Montgai, Lleida, was opened on 2.III.2009 and found to contain a live *Eupelmus* larva with the cephalic remains of a *Mesophleps* larva. The *Eupelmus* larva was stored and *E. urozonus* emerged on 21.V.2009, confirming *M. oxycedrella* as a host of *E. urozonus*. The record of *E. urozonus* parasitizing *Megastigmus amicorum* in Monegros (Askew *et al.,* 2001) requires confirmation. Samples from Lleida of *J. phoenicea* seeds with the fruit pulp removed yielded 7♀♀ 14♂♂ *M. amicorum* but no parasitoids.

Pteromalus semotus (Walker, 1834) (Pteromalidae)
We have found several specimens of *P. semotus* associated with *J. phoenicea* fruits. One female emerged by 16.iii.2008 from a fruit collected 9.XII.2007 in Los Monegros, Zaragoza (J. Blasco-Zumeta), 1♀ emerged 22.IV.2008 from a fruit collected 26. XII.2007 in Juncosa, Lleida, and 2♀♀ 3♂♂ emerged 30.III-15.IV.2009 from fruits collected 9.II.2009 in Peñalba, Huesca. In addition, 9♀♀ 12♂♂ emerged 21.III-2.V.2009 from *J. thurifera* fruits collected 9.II.2009 in Pina de Ebro, Zaragoza (A. Ribes). A fruit collected in Peñalba was opened on 18.II.2009, and inside a seed a dead adult female *P. semotus* was found with the remains of a Lepidoptera larva, probably *Mesophleps oxycedrella*. *P. semotus* has also been reared from *J. thurifera* fruits containing *Mesophleps oxycedrella* in Los Monegros (Askew *et al.,* 2001) and the specimens from *J. phoenicea* were probably behaving as primary or secondary parasitoids of this gelechiid moth.

***Aprostocetus* sp. A** (Eulophidae)
A single female *Aprostocetus*, apparently in the *pausiris*-group (Graham, 1987) like *A. galbulus* (above), emerged from a *J. phoenicea* fruit collected near Pina de Ebro (Zaragoza, Spain) on 22.II.1992 (J. Blasco-Zumeta). The antennal flagellar segments are thin and elongated, similar to those of *A. rubicola* Graham, and it probably represents an undescribed species. The same, or a closely related species, emerged from both male and female cones of *J. thurifera* collected in 1992 in Los Monegros (Askew *et al.,* 2001).

***Aprostocetus* sp. B** (Eulophidae)
Another single female *Aprostocetus,* probably in the *caudatus*-group (Graham, 1987), emerged by 20.VI.2009 from a *J. phoenicea* fruit collected at Peñalba, Huesca on 9.II.2009. Species in the *caudatus*-group for which hosts are known are all parasitoids of Cecidomyiidae. In the sample from which the *Aprostocetus* emerged, amongst other phytophages, a cecidomyiid larva was found inside a fruit, and this could be a host. A record of *Aprostocetus* sp. parasitizing *Contarinia* sp. (Cecidomyiidae) in *J. thurifera* fruits is known from Morocco (El Alaoui El Fels *et al*., 1999).

Two females of probably the same species emerged 13.V.2009 from male cones of *J. phoenicea* in which some undescribed species of Cecidomyiidae develops. The cones were collected 4.II.2009 at Sant Llorenç de Montgai, Lleida. Two females of a different but closely related species emerged 7.V.2009 from male cones of *J. thurifera* collected 9.II.2009 at Pina de Ebro, Zaragoza. More material is needed to study the several undescribed species of Tetrastichinae in *Juniperus* fruits.

***Baryscapus* sp.** (Eulophidae)
Two females of a *Baryscapus* species near *nigroviolaceus* (Nees) were reared in April from *J. phoenicea* old fruits collected 20.ii.2009 at Juncosa, Lleida. They run to *B. nigroviolaceus* in Graham's key (1991: 87) but differ from examples of that species reared from *Leucoptera laburnella* (Stainton) (Lepidoptera, Lyonetiidae) in having brown and not black antennae and a rather short gaster which is only twice as long as broad.

Other parasitic Hymenoptera associated with fruit of *Juniperus phoenicea*

Scambus elegans (Woldstedt, 1877) (Ichneumonidae: Pimplinae)
Several specimens were found (*det.* M. Shaw) associated with *J. phoenicea* fruits: 1♂ emerged 20.III.2008, from fruits collected

31.I.2008 in Mont-rebei, Lleida; 2♂♂ emerged 31.III.2008, from fruits collected 26.XII.2007 in Juncosa, Lleida; 1♀ 1♂ emerged 18.II-21.III.2009, from fruits collected 9.II.2009 in Peñalba, Huesca. Two males emerged 21.III-3.IV.2009 from *J. thurifera* fruits collected 9.II.2009 near Pina de Ebro, Zaragoza (A. Ribes). *S. elegans* has a broad host range of weakly to moderately concealed hosts, often associated with evergreen vegetation, including species in the Lepidoptera families Tortricidae, Gracillariidae, Yponomeutidae, etc. It is also a pseudohyperparasitoid in Ichneumonoidea cocoons (Fitton *et al.,* 1988). Known hosts of *S. elegans* include *Pammene juniperana* and *Argyresthia crhysidella* in *Juniperus* in France (Cleu, 1957). The probable host in *J. phoenicea* is *Mesophleps oxycedrella,* this being the only lepidopteran reared (190 specimens) from the *J. phoenicea* samples, but the presence of *Pammene oxycedrana* or *Argyresthia chrysidella* could not be discounted. A female specimen, which emerged 14.III.2009 from *J. thurifera* fruits collected 9.II.2009 near Pina de Ebro, is exceptionally large and may have been associated with *Pammene juniperana* which, together with *M. oxycedrella*, was found plentifully in the sample.

Micromonodon tener (Kriechbaumer, 1893) (Ichneumonidae: Cryptinae)
A female (*det.* K. Horstmann) emerged XII.2007 from *J. oxycedrus* fruits collected 6.VII.2007 at Fulleda, Lleida, UTM 31T CF39, alt. 630 m. (A. Ribes). Not found in *J. phoenicea*, this is the first record of the species and genus in Spain.

***Chelonus* spp.** (Braconidae)
Several specimens were found associated with *J. phoenicea* fruits: 1♀ 3♂♂ emerged 19.VI-26.VI.2008, from fruits collected 26.XII. 2007 in Juncosa, Lleida. 1♀ of another species emerged vi.2009, from fruits collected 4.II.2009 in Sant Llorenç de Montgai, Lleida. 2♀♀ 3♂♂ of a species similar to *Chelonus hiemalis* Gautier & Cleu, emerged 18.IV-1.VI.2009 from *J. thurifera* fruits, collected 9.ii.2009 near Pina de Ebro, Zaragoza (A. Ribes). *C. hiemalis* was described as a parasitoid of *Argyresthia chrysidella* in *J. oxycedrus* fruits in France (Cleu, 1933), emerging at the end of winter. Another species, *Chelonus minutus* Costa, is known as a parasitoid of *A. praecocella* in *Juniperus* sp. (Yu *et al*., 2005). *Argyresthia chrysidella* is a possible host in *J. phoenicea* fruits, as is *Mesophleps oxycedrella*.

***Bracon* sp.** (Braconidae)
One specimen was found associated with *J. phoenicea* fruits, a male emerging 28.II.2007 (forced) from fruits collected 28.X.2006 at Juncosa, Lleida. Also, 1♀ emerged 11.V.2009 from *J. oxycedrus* fruits collected 20.II.2009 at Juncosa, and 1♀ 3♂♂ emerged 7.v-16.V.2009, from *J. thurifera* fruits collected 9.II.2009 near Pina de Ebro, Zaragoza (A. Ribes). *Bracon laetus* (Wesmael) was recorded as a parasitoid of *Argyresthia chrysidella* in *J. oxycedrus* fruits in France (Cleu, 1933), emerging in September. Another species, *Bracon ochraceus* Szépligeti (*det.* J. Papp), was reared from *J. thurifera* fruits from Pina de Ebro, Zaragoza (J. Blasco-Zumeta). (M. Shaw, pers. comm.). There is also a record of a species of *Bracon* parasitizing *Argyresthia reticulata* Staudinger in *J. thurifera* fruits in Morocco (El Alaoui El Fels *et al*., 1999). Possible hosts living in *J. phoenicea* fruits are *Argyresthia chrysidella* and *Mesophleps oxycedrella.*

***Apanteles* sp.** (Braconidae)
A female emerged on 30.IV.2009 from *J. phoenicea* fruits collected 9.II.2009 at Peñalba, Huesca. A record of an *Apanteles* species parasitizing *Pammene oxycedrana* in *J. thurifera* fruits is known from Morocco (El Alaoui El Fels *et al*., 1999).

Aphanogmus steinitzi Priesner, 1936 (Ceraphronidae)
A male and female were reared from *J. phoenicea* fruits, emerging 7-11.V.2009 from fruits collected 20.IV.2009 at Juncosa, Lleida. *A. steinitzi* is known as a parasitoid of Coniopterygidae (Neuroptera), and has been reared from cocoons of *Conwentzia psociformis* (Curtis), *Coniopteryx tineiformis* Curtis and *Semidalis aleyrodiformis* Stephens (Priesner, 1936). In *Juniperus* it is probably a parasitoid of *Hemisemidalis pallida*, common in old fruits. This is possibly the first record of the species in Spain.

Dendrocerus halidayi (Curtis, 1829) (Megaspilidae)
A male and female emerged 15.V-21.V.2009 from *J. phoenicea* fruits collected 20.II.2009 at Juncosa, Lleida, and a female emerged on 20.III.2007 (forced) from fruits collected 2.III.2007 at Pobla de Cérvoles, Lleida, UTM 30T CF28, alt. 670 m. (A. Ribes). *D. halidayi* is known to attack Coniopterygidae: *Semidalis aleyrodiformis* Stephens and *Conwentzia psociformis* (Curtis) are previously reported hosts. In *Juniperus* fruits, *D. halidayi* is a parasitoid of *Hemisemidalis pallida*, an empty silken cocoon of this coniopterygid being found in an old greyish fruit of *J. phoenicea* from which *D. halidayi* had emerged.

Dendrocerus indicus iridescens Dessart, 1994 (Megaspilidae)
Two males emerged in May 2009 from fruits collected in February 2009. One male was reared from a *J. phoenicea* fruit from Juncosa, Lleida, and the other from a *J. thurifera* fruit from Pina de Ebro, Zaragoza; 1♀ 1♂ emerged, 7.VII.2009, from *J. phoenicea* foliage collected 27.VI.2009 at Juncosa, Lleida; 1♀ 1♂ were collected by sweeping *J. phoenicea* at Fraga, Serreta Negra, 26.VI.2009, and another female 27.VI.2009, at Juncosa, Lleida (A. Ribes). *D. indicus* subspecies *iridescens* was described from Spain, collected from *J. thurifera* in Los Monegros (J. Blasco-Zumeta) and Italy (Dessart, 1994). It is associated with *Hemisemidalis pallida* on *J. thurifera* (Dessart, 1997) in galls of *Etsuhoa thuriferae* Skuhravá (Cecidomyiidae), and also with *Semidalis pseudouncinata* Meinander (Coniopterygidae) on *Cupressus* in Italy. In our samples it is a parasitoid of *H. pallida*, one male emerging from an old, greyish fruit containing a silken cocoon of *H. pallida* inside of which was the pupal case of *Dendrocerus*. Also in the fruit were seeds eaten by *Mesophleps* and filled with frass, and the remains of a *Nanodiscus* larva, both eaten by acarines which would have been consumed by *H. pallida*.

***Platygaster* sp.** (Platygastridae)
One female was reared from a *J. phoenicea* fruit on 18.II.2009, the fruit having been collected nine days previously in Peñalba, Huesca. It is almost certainly a parasitoid of larval Cecidomyiidae.

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