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Aylax hypecoi Trotter (Hymenoptera, Cynipidae) in Europe: Redescription, with taxonomic and biological notes

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Abstract

Aylax hypecoi (Trotter) (Hymenoptera, Cynipidae, Aylacini), a poorly known cynipid wasp inducing galls on *Hypocoum* species (Papaveraceae), was described from North Africa and also doubtfully recorded from Greece about a century ago. The species has now been found in Bulgaria and thus its presence in Europe is confirmed for the first time. The species is redescribed and illustrated with SEM pictures of the adult female; galls are also described and illustrated. Data on distribution and biology are given, and its taxonomic and phylogenetic position are discussed. *Aylax spirorhynchusii* Diakontshuk, 1990, another aylacine species, recorded from Transcaucasus and Middle Asia as a gall-inducer on *Spirorhynchus sabulosus* Kar. and Kir. (Brassicaceae) is a synonym of *Aylax hypecoi* and the host plant record stated is a possible misidentification.

Keywords: *Aylacini*, *Aylax*, *Aylax spirorhynchusii*, *Bulgaria*, *Cynipidae*, *galls*, *Hypocoum*

Introduction

Members of the gallwasp tribe Aylacini (Hymenoptera, Cynipoidea, Cynipidae) induce galls on herbaceous plants from different families, mainly Asteraceae, Papaveraceae, Lamiaceae, and Rosaceae. The tribe currently embraces roughly 160 species worldwide (Liljeblad 2002) distributed in the Holarctic Region. The group is more diverse in the Western Palearctic, especially in the Mediterranean region and around the Black Sea, from where the tribe hypothetically originated and diversified (Liljeblad and Ronquist 1998; Nieves-Aldrey 2001; Ronquist and Liljeblad 2001; Liljeblad 2002). Current phylogenetic studies indicate that that tribe is a para- or polyphyletic assemblage, comprising the basal lineages of gall wasps (Liljeblad and Ronquist 1998; Ronquist 1999; Nylander et al. 2004a, 2004b). Western European genera of Aylacini were revised by Nieves-Aldrey (1994) as well as the Iberian Peninsula species (Nieves-Aldrey 2001).

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Recently a large number of species have been described from South-East Europe and Central Asia, mostly by L. Diakontshuk (see Zerova et al. 1988; Liljeblad 2002). However, the taxonomic and/or biological information for many of them is insufficient and sometimes even incorrect and either the specific or generic status of many species must be revised.

Aylax species have a Palearctic distribution. Twenty-two species have been described from the Western Palearctic, reared from galls on plants of several families, mainly Papaveraceae, but also Asteraceae, Fabaceae, Campanulaceae, Brassicaceae, and Scrophulariaceae. Sixteen species are known from Western Europe, but 12 of them have not been found again after the description and have a doubtful status. The only two species recorded from the Iberian Peninsula are associated with species of *Papaver* (Papaveraceae), mainly *P. rhoeas* L., and *P. dubium* L. (Nieves-Aldrey 2001).

Cynipid galls collected by Anelia Stojanova (Plovdiv University) in May 2001 in Bulgaria on *Hypocoum imberbe* Sibth. and Sm. and sent to G.M. for identification, yielded some adult cynipid wasps that after examination appeared to be *Aylax hypecoi* Trotter, a singular species that has been not found since its description in 1913 from Tripoli (North Africa) (Trotter 1913).

The examined material of *Aylax hypecoi* is listed below. We have not been able to locate the type material of *Aylax hypecoi*, so comparisons are based on the original description (Trotter 1913) and one given also in Houard (1913). Specimens were dissected in 70% ethanol, air dried, mounted on stubs and coated with gold, and photographed with a scanning electron microscope FEI QUANTA 200. Forewings were mounted in euparal on slides, later checked under a stereomicroscope. Pictures of forewing and galls were taken with a digital camera attached to a Leica stereomicroscope. Morphological structures and abbreviations follow Ronquist and Nordlander (1989), Ronquist (1995a, 1995b), and Nieves-Aldrey (2001).

***Aylax hypecoi* Trotter, 1913**

(Figures 1, 2)

Aulax Hypecoi Trotter 1913, p 214.

Aylax spirorhynchusii Diakontshuk 1990, p 126. **New synonym.**

Redescription

Female

Body 2.1–2.5 mm ($N=14$), measured from anterior margin of head to posterior margin of metasoma. Body mostly black, pronotum, except dorso-medially, scutellum dorsally and medial strip of mesopleuron reddish; antennal scape, distal half of coxae and other parts of legs predominantly reddish brown; metasoma reddish brown.

Head. Head, in dorsal view 2.3 times as broad as long. POL 1.7 times OOL, posterior ocellus separated from inner orbit of eye by 1.6 times its diameter. The sculpture is delicately coriaceous with some clear piliferous punctures.

In anterior view (Figure 1A) head slightly trapezoid, 1.3 times as broad as high; lower face moderately pubescent, not keeled medially; with facial striae radiating from clypeus, scarcely reaching compound eyes and lower margin of antennal sockets. Upper face and vertex delicately smooth and shining coriaceous sculpture, with only some sparse setae. Ocellar plate raised. Lateral margin of gena almost straight and convergent, not distinctly

Figure 1. *Aylax hypecoi*, female (SEM). (A) Head anterior view; (B) head posterior view; (C) antenna; (D) mesosoma dorsal view; (E) mesosoma lateral view; (F) mesosoma posterodorsal view.

Figure 2. *Aylax hypecoi*, female and galls. (A) Mesosoma, anterodorsal view showing the pronotum; (B) metasoma, lateral view; (C) left forewing; (D) emerged adult female; (E) section of a gall showing an adult female inside; (F) galls in fruits of *Hypecoum*.

bowed, height of malar space 0.5 times the height of compound eye. Clypeus subtrapezoid. Ventral margin of clypeus distinctly projecting. Anterior tentorial pits indicated. Epistomal sulcus and clypeo-pleurostomal lines weakly marked. Antennal sockets situated at mid-height of compound eye; distance between antennal rim and compound eye as long as width of antennal socket including rim; distance between antennal sockets less than 0.5 times the diameter of an antennal socket.

Occiput densely pubescent (Figure 1B). Without occipital carina but some conspicuous transverse rugae present above occipital foramen. Gular sulci free, well separated at hypostomata. Oral foramen about two times as long as occipital foramen; distance between oral and occipital foramina about 0.6 times height of occipital foramen.

Mouthparts: mandibles moderately large, right mandible with three teeth; left with two teeth. Maxillary stipes about three times as long as broad. Maxillary palp five-segmented. Labial palp three-segmented.

Female antenna (Figure 1C) 0.7 times as long as body, with 12 antennomeres. Elongate placodeal sensilla inconspicuous but present from second flagellomere. Scape 1.4 times as long as broad; 1.4 times as long as pedicel. F1 as long as F2. F3–F7 decreasing in length. Ultimate flagellomere 2.6 times as long as penultimate.

Mesosoma. Pronotum medially long (high) (Figure 2A), in anterior view ratio of median distance between anterior and posterior margins to lateral distance between these margins about 0.35. Submedian pronotal depressions oval transverse, deep, open laterally, separated by a distance equal to its breadth. Posterior pronotal plate sparsely pilose. Lateral surface of pronotum without sculpture, densely pubescent.

Mesonotum: dorsal view (Figure 1D) and lateral view (Figure 1E). Scutum shining, minutely coriaceous, with some scattered slight piliferous punctures. Notauli narrow and shallow, clearly visible only in posterior one-third of mesoscutum, faint anteriorly. Median mesoscutal impression absent. Scutellar foveae shallow, smooth and shining, irregularly square-shaped relatively large and separated medially by a septum; their inner posterior margins indistinct. Scutellum relatively large, as long as 0.9 times mesoscutum. Dorsal surface of scutellum medially almost smooth, laterally with concentric strong rugae. Posterodorsal and posterior margins of axillula distinct. Mesopleuron beneath mesopleural triangle longitudinally costulate and shining (Figure 1E). Mesopleural triangle distinctly impressed, ventral margin clearly marked.

Metanotum: metascutellum (Figure 1F) conspicuously constricted medially. Bar ventral to metanotal trough almost smooth. Metanotal trough narrow, pubescent.

Metapectal–propodeal complex: metapleural sulcus meeting anterior margin of metapectal–propodeal complex slightly above mid-height of latter. Lateral propodeal carinae relatively narrow, subparallel. Lateral and median propodeal area smooth and strongly pubescent. Nucha moderately long dorsally, almost smooth.

Legs: claws without a basal lobe or tooth.

Forewing (Figure 2C): slightly longer than body, hyaline and pubescent. Marginal cell open along anterior margin; about 2.5 times as long as broad. R_1 ending slightly before the anterior margin of wing; first abscissa of radius (2r) curved and radius (Rs) ending close to anterior margin of wing. Areolet present, closed by nebulous to tubular veins. Hair fringe along apical present, short to moderately long

Metasoma. Female metasoma (Figure 2B): as long as mesosoma; third abdominal tergum (second gastral) covering about one-third of metasoma; about 1.4 times as long as fourth tergum; a conspicuous hair patch is present antero-medially on the third abdominal tergum. Fourth to seventh terga smooth and bare excepting a pair of long setae medially on the fourth tergum. Ventral spine of hypopygium short, not projecting, united almost to apex with the lateral flaps. A couple of rows of long setae are present on each side, the apical ones surpassing the apex of the ventral spine.

Male

Body length, measured from anterior margin of head to posterior margin of metasoma, 2.0 mm (the only male we have). Head and mesosoma black, antenna black with some darkish brown tones, coxae, trochanter and basal half of femora black, tibiae and tarsi dark brown; metasoma dorsally dark brown to black laterally and ventrally; antenna 14-segmented, F1 very slightly longer than F2 and shorter than scapus; subsequent flagellomeres shorter, ultimate flagellomere 1.6 times as long as penultimate. Otherwise similar to female.

Material studied

Bulgaria, Plovdiv, Dzhenem tepe, 165 m, A. Stojanova leg., five females reared from galls collected on *Hypocoum imberbe* (Papaveraceae), galls collected on 19 May 2001, insects emerged or were dissected from galls in early 2002—in the collection of the Museo Nacional de Ciencias Naturales, Madrid, Spain. “Bulgaria, Plovdiv, Dzhenem tepe, 165 m, A. Stojanova leg., ex galls on *Hypocoum imberbe*”. Galls were collected on 19 May 2001 (28 females emerged in the laboratory), 13 June 2001 (34 females and one male emerged in the laboratory) and 28 March 2002 (three females emerged in the laboratory)—in the collection of the Systematic Parasitoid Laboratory, Kőszeg, Hungary.

Biological data*Life cycle*

A. hypocoi induces galls in the fruits of *Hypocoum* species (Papaveraceae). The life cycle is typically univoltine as in most Aylacini. All reared specimens, except one male, were females. Adults emerge from galls from the end of the winter in North Africa to early spring in Europe, at the time the host plant starts flowering. Galls develop and mature in spring. Insects are overwintering as larvae inside the galls and pupate during the next winter or spring.

Gall

Galls are formed in fruits of *Hypocoum* species. They have been recorded from *H. imberbe*, *H. geslini*, and *H. grandiflorum*. Galls in fruits of *H. imberbe* collected in Bulgaria (Figure 2E, F) form a conspicuous swelling of the fruit. Fruits of *Hypocoum* species are typically nodose, divided by transverse septa, thus galled fruits affect one or more seeded sections which are considerably inflated. The shape is oval or globose, slightly more elongated at the longitudinal axis. Each gall is 0.4–0.5 mm wide and 0.6–0.7 mm long. The sample of fruits examined contained from one to three galls (Figure 2F). Each individual gall has a single larval chamber separated from the outside by a thick wall (Figure 2E).

Distribution

The species was originally described from Tripoli (North Africa) and recorded from Algeria and Greece (Houard 1913; Trotter 1913). After the proposed synonymy of *A. spirorhynchusii* the distribution of *A. hypocoi* extends from Eastern Mediterranean to Transcaucasia (Armenia) and Central Asia (Turkmenistan).

Comments and discussion

Synonymy

Aylax spirorhynchusii Diakontshuk was described from Transcaucasia and Central Asia from material reared from stem galls of *Spirorhynchus sabulosus* Kar. and Kir. (Brassicaceae) (Diakontshuk 1990). The paper represented the first published record of a cynipid gall on Brassicaceae and was subsequently recorded in a recent paper on the evolution of gall wasp host plant association (Ronquist and Liljeblad 2001). We were able to examine a female holotype and female and male paratypes as well as three galls of *A. spirorhynchusii* deposited in the Schmalhausen Institute of Zoology, Kiev, Ukraine. Examined type specimens (females and males) are congeneric with our studied material of *A. hypecoi*, except for the general reddish colour of females, extending to almost the whole body. The examined male paratypes are identical in colour to that of the *A. hypecoi* male. The shape and general structure of three galls of *A. spirorhynchusii* also deposited in the cynipid collection of the Schmalhausen Institute of Zoology, Kiev correspond well with those of *Aylax hypecoi*. Diakontshuk (1990) described the gall as forming on a stem, but the galls deposited in the collection are more like a swelling in a fruit, as in *A. hypecoi*. For this reason we think that the host plant was misidentified and the host plant, in fact, was a *Hypecoum* or a closely related genus. We consider *A. spirorhynchusii* as a synonym of *A. hypecoi* and we question the record of a Brassicaceae from the literature as a valid host plant record for Cynipidae.

Related species

Aylax sensu Nieves-Aldrey (1994) comprises only three species, two associated with plants of the genus *Papaver* (Papaveraceae) and the present one on *Hypecoum* (also Papaveraceae). However, there are other species described within *Aylax*, many of them recorded only once more than one century ago, and estimated as having uncertain status (Dalla Torre and Kieffer 1910; Liljeblad 2002). Diakontshuk (1983) described three species inducing galls on Asteraceae: *Aylax ascanica* on *Serratula*, and *A. phaeopappuci* and *A. ruthenicae* on *Centaurea*. G.M. examined the types of these three species in the collection of the Schmalhausen Institute of Zoology, Kiev, and they appeared to belong to *Isocolus* rather than *Aylax sensu* Nieves-Aldrey (1994). Belizin (1959) described *Aylax taneritis* from Uzbekistan on the basis of one female; males and galls are unknown. In his diagnosis he mentioned that the species closely resembles *Aylax ibericus* Tavares, 1927, a synonym of *Isocolus lichtensteini* (Mayr, 1882) (synonymy in Nieves-Aldrey 2001). The description given by Belizin (1959) is not clear enough to decide whether this species really belongs to *Aylax* or if it is an *Isocolus*. The holotype must be examined in order to decide where this species belongs.

We have already examined the case of *A. spirorhynchusii*. The other species mentioned above must be examined in order to place them within the taxonomic and phylogenetic schemes of the Aylacini and the Cynipidae currently proposed (Nieves-Aldrey 1994; Liljeblad and Ronquist 1998; Nylander et al. 2004a, 2004b).

Aylax hypecoi is a very distinctive species. It differs morphologically from other *Aylax* species associated with Papaveraceae, namely *Aylax papaveris* (Perris) and *Aylax minor* Hartig, in many characters, mainly the general coloration of the body, the shape of the head and clypeus, the number of antennal segments, relative length of the pronotum dorso-medially, the relative length of notauli, the sculpture of the mesoscutum, the form of scutellar foveae, and the form and sculpture of the scutellum.

Aylax hypecoi is also quite similar to *Neaylax versicolor* (Nieves-Aldrey, 1985), a species formerly described within *Aylax* and later transferred to *Neaylax* (Nieves-Aldrey 1994). However, the generic status of the latter has been recently questioned, after its galls were discovered on another host plant, *Fumaria* (Papaveraceae) (Nieves-Aldrey 2003). *Aylax hypecoi* shares with *N. versicolor* a similar coloration, antennae 12-segmented, the pronotum dorso-medially relatively long, with similar submedial pronotal pits, the relative length of notauli, and the sculpture of the mesopleuron and the forewing venation. Furthermore, both species are associated with closely related plants of the family Papaveraceae in the genera *Hypecoum* and *Fumaria*.

Aylax hypecoi can be separated from other *Aylax* species associated with *Papaver* and *Neaylax versicolor* with the following identification key:

1. Body entirely black; female antenna 14-segmented; pronotum medially short, as long as or slightly longer than transverse length of submedial pronotal pit (Figure 3A); mesopleuron without or with indistinct longitudinal striae; Rs of forewing reaching anterior margin of forewing (Figure 3B) *A. papaveris* and *A. minor*
- Body with reddish brown coloration variably extended; female antenna 12-segmented; pronotum medially long, 1.5–2 times as long as transverse diameter of submedial pronotal pit (Figures 2A, 3C); mesopleuron with longitudinal striae, extended on speculum (Figure 1E); Rs of forewing not reaching anterior margin of forewing (Figures 2C, 3F) 2
2. Head rounded in front view; ventral end of clypeus slightly projecting (Figure 3E); coriaceous sculpture on mesoscutum stronger, dull; scutellum strongly irregularly rugose (Figure 3D); galls on *Fumaria* spp. *Neaylax versicolor*
- Head trapezoid in front view; ventral end of clypeus distinctly projecting (Figure 1A); coriaceous sculpture on mesoscutum weaker, shining; scutellum very delicately alutaceous medially, laterally with concentric rugae (Figure 1D); galls on *Hypecoum* spp. *Aylax hypecoi*

Phylogenetic position and generic assignment of *Aylax hypecoi*

As we have emphasized, *Aylax hypecoi* differs clearly from the other species of *Aylax sensu* Nieves-Aldrey (1994) and thus, it should be transferred to another genus. However, the morphological diagnostic characters do not fit with any of the described aylacine genera. Consequently, it seems necessary to erect a new genus for this species. Moreover, the results of a recent phylogenetic analysis using three molecular markers: COI, 28S, and EF1 α , (Nylander et al. 2004a, 2004b) shows *Aylax hypecoi* nested within a monophyletic group of Aylacini including species of *Isocolus*, *Aulacidea*, *Antistrophus*, being its closest relative *Neaylax versicolor* (Nieves-Aldrey, 1985) (Figure 4). *Neaylax versicolor* is an aylacine species inducing galls on *Fumaria* (Papaveraceae, Fumarioideae) while *A. hypecoi* forms galls on *Hypecoum*, a plant also belonging to the Papaveraceae (Papaveraceae, Hypecoae). This group is well separated from a monophyletic clade enclosing the cynipid genera *Aylax*, *Barbotinia*, and *Iraella*, all of them associated with plants of the genus *Papaver* (Papaveraceae, Papaveroideae). In consequence, given the morphological and phylogenetic closeness of *Aylax hypecoi* and *Neaylax versicolor*, a new genus grouping these species will be described elsewhere (J. L. Nieves-Aldrey et al., in preparation).

Figure 3. (A) *Aylax minor*, anterodorsal view of pronotum. (B) *Aylax papaveris*, forewing venation. (C–F) *Neaylax versicolor*: (C) pronotum; (D) mesosoma dorsal view; (E) head anterior view; (F) forewing venation.

Parasitoids

From the collected galls we reared a number of chalcid wasps (Chalcidoidea). The species have been provisionally identified by Richard R. Askew as follows:

Pteromalus bedeguaris, one male (Hymenoptera, Pteromalidae) (doubtful identification).

Eupelmus microzonus (Hymenoptera, Eupelmidae), two males, one female.

Glyphomerus tibialis (Hymenoptera, Torymidae), one male, four females.

Genus indet. near *Exopristus* (Hymenoptera, Torymidae).

Figure 4. The phylogenetic relationships of *Aylax hypaei* after Nylander et al. (2004a, 2004b) (distant clades omitted). Majority-rule consensus tree from analysis of three genes (EF1 α , COI, 28S) combined with morphology.

Note added in proof

Correcting proofs of this article, we noticed the recent publication of a paper (Stojanova 2005) describing a new parasitoid species of the genus *Glyphomerus* (Hym., Torymidae) reared from the galls of *A. hypaei*. This new species, *G. aylax* Stojanova, is likely to be the same identified by us as *G. tibialis*.

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