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Two new species of the genus *Holoparasitus* OUDEMANS from the Mediterranean Basin - Algeria and Sardinia (Acari: Gamasida: Parasitidae)

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ABSTRACT. *Holoparasitus annulus* n. sp. and *Holoparasitus sardensis* n. sp. from Algeria and Sardinia, respectively, are described and a new *Holoparasitus annulus* species-group based on these species is defined.

Key words: acarology, taxonomy, Parasitidae, *Holoparasitus*, new species, biogeography, Algeria, Sardinia.

INTRODUCTION

The genus *Holoparasitus* OUDEMANS includes predatory mites living in upper soil horizons, especially in forests of the Holarctic region. Many descriptions of new species and revisions of type specimens from old collections were made in the last decade (JUVARA-BALS & WITALIŃSKI 2000; WITALIŃSKI & SKORUPSKI 2002, 2003a, b; WITALIŃSKI 2004).

In this paper two closely related mite species are described and a new *annulus* species-group is proposed to accommodate them among the different lineages of the genus *Holoparasitus.*

MATERIAL AND METHODS

Specimens were collected from leaf litter and moss in forest habitats in the Atlas de Blida Mountains, Algeria, and Sardinia, Italy. Morphological terminol-

ogy is based on EVANS & TILL (1979); the system of setal notation for the idiosoma follows LINDQUIST & EVANS (1965) as modified by LINDQUIST (1994). Since some new quantitative characters seem to be important for the differential diagnosis of closely related species (JUVARA-BALS in prep.), the height (h) and basal width (b) of the epigynium (fig. 13), as well as the length of the peritrematal groove were measured.

The types are deposited in the Museum of Natural History – Geneva (MNHG), Switzerland, and in the Zoological Museum of Jagiellonian University (ZMJU), Cracow, Poland.

Holoparasitus annulus species-group

The two new species, *H. annulus* and *H. sardensis,* can be placed in a new species group. Only the specific characters of the new species group are given. For other morphological features of the genus *Holoparasitus* and its different species groups (*caesus, calcaratus, mallorcae, peraltus*) see JUVARA-BALS (1975), HYATT (1987), JUVARA-BALS & WITALIŃSKI (2000), WITALIŃSKI & SKORUPSKI (2002, 2003b).

DIAGNOSIS

Male: Excipulum on sternum absent; central part of hypostom regularly triangular and moderately sclerotised, neither tongue-shaped nor extended anteriorly; gnathotectum trispinate; corniculi with proximal protuberance; setae *v1* on palptrochanter stout; fixed cheliceral digit straight and obliquely truncate, pilus dentilis dislocated towards middle of inner margin; genital lamina with strongly sclerotised, circular central structure (fig. 23: a) flanked by lateral, sclerotised semicircular elements (fig. 23: b); central circular structure continues on posterior side with a sclerotised element attached to the anterior margin of sternal shield, supporting the genital complex; anterior margin of genital lamina with lateral angles rounded and two prongs, medially; tritosternum on a large microsclerite; gland pores *gv2* in unmodified cuticle; coxa II with 6+1 denticles in a fan arrangement; femur II with main spur thumb-like and rounded apically, axillary process straight with apex at the same level as that of main spur.

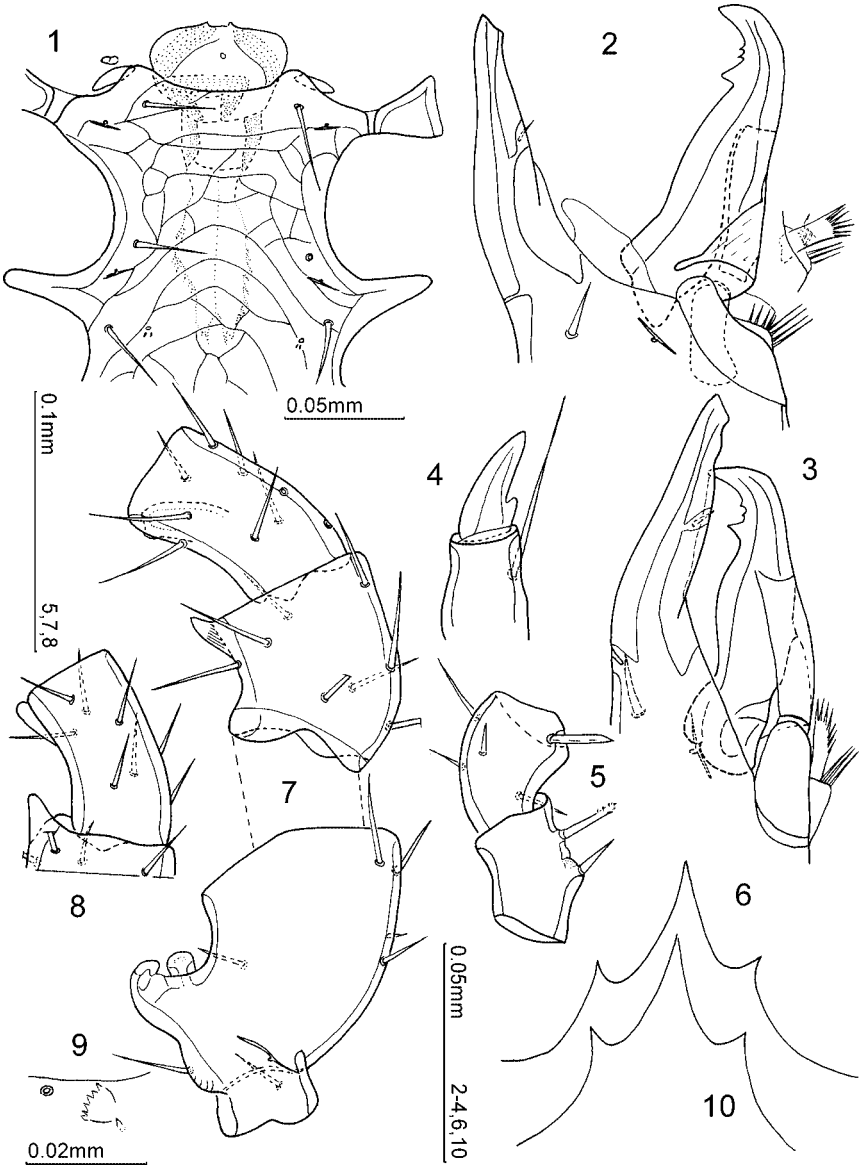
Female: Sternal shield with a prominently sclerotised margin between *st1* setae, overlapping the presternal plate; lateral presternal platelets free; epigynial subapical structure weakly sclerotised forming two hyaline, membranous protrusions extending beyond the epigynial margin; endogynium visible as an arcuate cuticular plate laterally connected to metagynial sclerites, with ventrally visible ring-like opening; gland pores *gv2* in unmodified cuticle.

Holoparasitus annulus n. sp.

(Figs 1-22, 34)

ETYMOLOGY

The name of this species refers to the ring-like opening (Lat. *annulus* = ring) of the female endogynium.



1-10. *Holoparasitus annulus* n. sp. Male: 1 - sternogenital region; 2 - chelicera, antiaxial; 3 - idem, paraxial; 4 - corniculus; 5 - palptrochanter and palpfemur; 6 - gnathotectum; 7 - leg II femur, tibia, genu; 8 - tibia II, different aspect; 9 - group of denticles on coxa II. Female: 10 - gnathotectum

DIAGNOSIS

In both sexes, the gnathotectum is trispinate with central prong larger than lateral ones; gland pores *gv1* present. In males, microsclerite under the genital lamina trapezoidal; the fixed digit of chelicera is straight, toothless, and obliquely cut terminally, movable digit with 2 denticles followed by a tooth; the brush-like process of the arthrodial membrane moderate. In females, the presternal plate bears anteriorly two groups of tiny teeth; sclerotised margin of sternal shield between setae *st1* straight; subapical epigynial structure with a straight sclerotised line crossing under the apex at the level of anterior edges of wing-like, membranous lateral protrusions. Sclerotised annulus in endogynium circular or elliptical.

DESCRIPTION

Male. Idiosoma reddish-brown, 575-630 x 395-400 µm; length of podonotal setae: *j1*=30 µm, *z1*, *s2*, *r3* ca.18 µm, others around 36 µm; opisthonotal setae very short, ca. 12 µm; length of peritrematal groove=195-200 µm.

Idiosoma, ventral side. Genital lamina with two small prongs on anterior margin and with rounded lateral angles; its dorsal side with two lateral and one median heavy sclerotisations. Subgenital microsclerite trapezoidal, with a central, oval orifice. A sclerotised strip on internal margin of sternogenital shield, between protuberances delimiting genital concavity (figs 21, 22). Sternogenital shield reticulated, with arcuate lines running behind *st2* (fig. 1). Gland pore *gv2* simple, with single opening. Length of sternal setae: *st1*=42 µm, *st2*-*st3*=35-40 µm; length of opisthogastric setae 24-36 µm.

Gnathosoma. Gnathotectum trispinate (fig. 6). Corniculi with proximal protuberances (fig. 4). Hypognathal groove with 10 rows of denticles (fig. 34); palpcoxal setae pilose and hypostomatic setae simple. Incisions present in cuticle behind hypostomatic setae. Palptrochanter with *v1* simple, stout, located on a small prominence, whereas *v2* pilose (fig. 5).

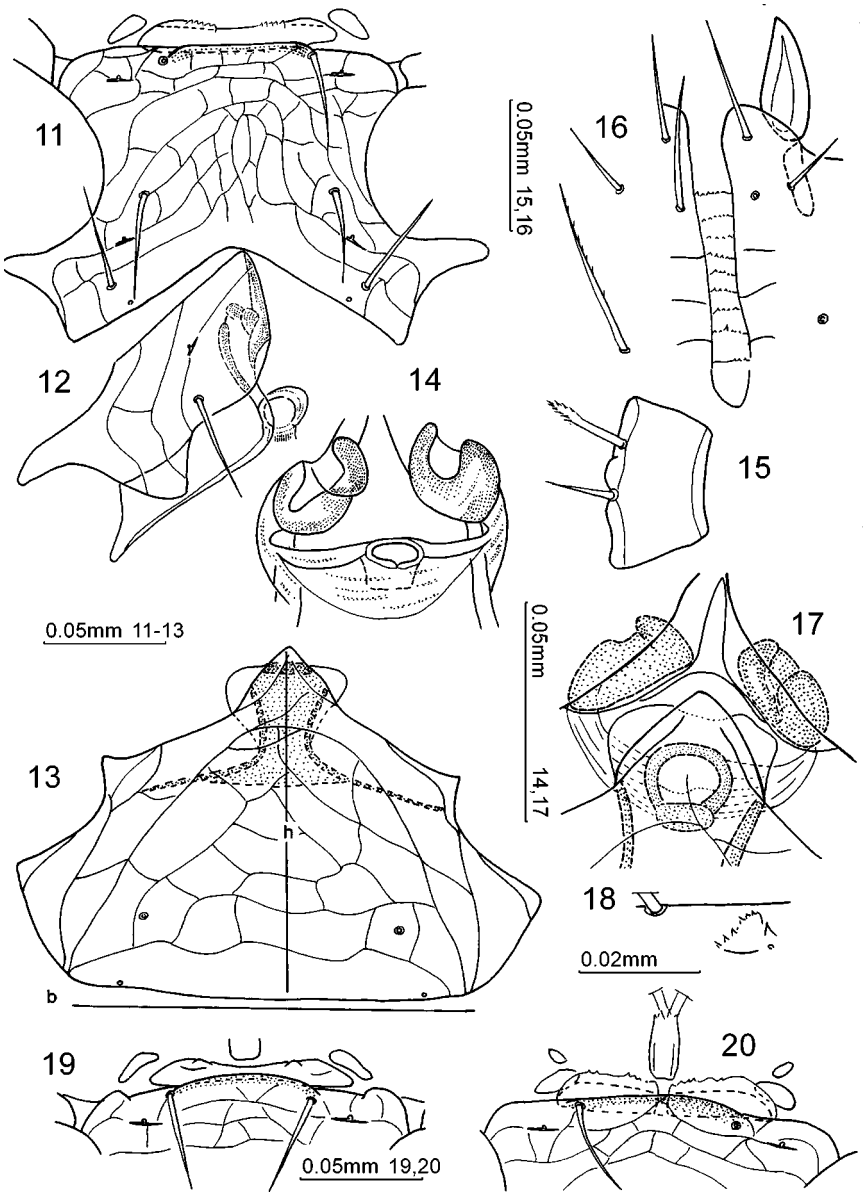
Chelicera (figs 2, 3). Fixed digit straight, toothless, its apex obliquely cut; movable digit with 2 denticles followed by a large tooth on its inner margin; spermatodactyl straight, extending to the middle of digit; brush-like process of arthrodial membrane moderate.

Leg II. Coxa with fan-like group of 6+1 denticles (fig. 9). Armature of leg II (figs 7, 8): femoral spur and axillary process low and apically rounded, their tips reaching approximately the same level; spur on genu situated on distal margin, triangular and elongate, its pointed tip protrudes beyond genu margin; spur on tibia trapezoidal (fig. 7).

Measurements. Tarsus I=155-160 µm, tarsus IV=170-175 µm.

Female. Dimensions of idiosoma 695-720 x 430-455 µm; dimensions of podonotal setae *j1*= 36 µm, others about 40-45 µm; opisthonotal setae short, ca. 12 µm. Length of peritrematal groove 205-210 µm.

Idiosoma, ventral side. Presternal plate with denticles at anterior margin. Sternal shield with sclerotised convexity on its anterior margin between setae *st1*; sternal reticulation weakly pronounced behind pores *iv2* (*pst2* auct.); gland pore



11-20. *Holoparasitus annulus* n. sp. Female: 11 - presternal plate and sternal shield; 12 - paragynium; 13 - epigynium; 14, 17 - endogynium; 15 - palptrochanter; 16 - hypognathal groove and corniculus; 18 - group of denticles on coxa II; 19, 20 - presternal plates, lateral platelets and anterior margin of sternum in two specimens

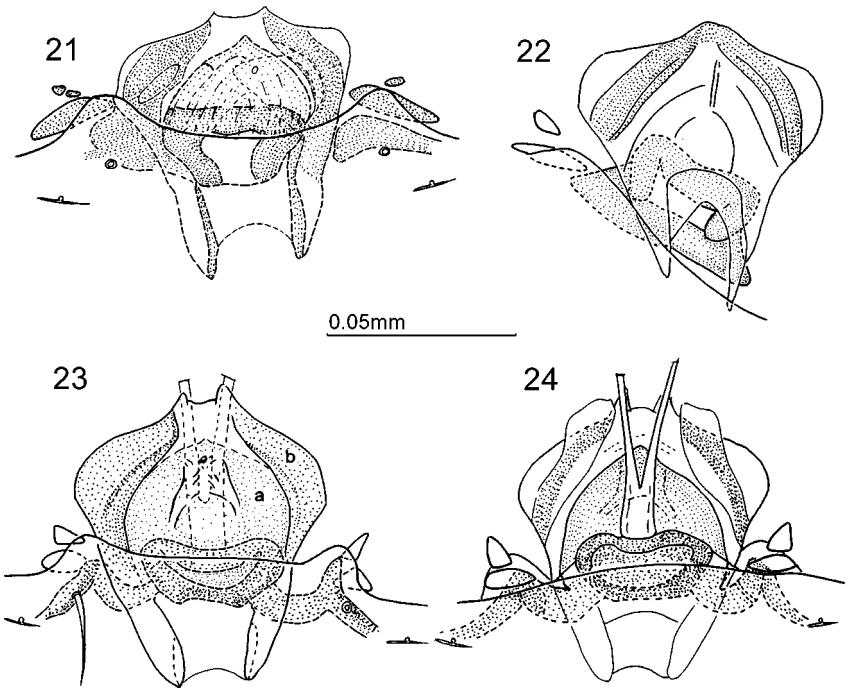
gv1 weakly discernible, located at posterior margin behind setae *st3* (fig. 11). Length of sternal setae: *st1*=54 µm, *st2*=45 µm, *st3*=50 µm.

Genital region. Paragynium with large triangular postero-lateral protrusion 'locking' epigynial shield; metagynial sclerite well sclerotised, with rounded edge (fig. 12). Epigynium with large, triangular apex; its subapical structure with a sclerotised anterior edge visible as a line continuous with membranous wing-like protrusions (fig. 13). Endogynium shows ring-like opening with a sclerotised thickening on its posterior margin (figs 14, 17). Gland pore *gv2* simple, with one opening. Length of ventral setae 38-42 µm.

Gnathosoma. Gnathotectum trispinate, similar to that of male (fig. 10). Hypognathal groove with 9 rows of denticles, posterior 3 with few denticles; palpcoxal setae pilose, hypognathal setae simple (fig. 16). Palptrochanter with seta *v1* simple and *v2* barbed (fig. 15).

Legs. Coxa II with a 6+1 group of denticles (fig. 18).

Measurements. Epigynium: h=155 µm, b=180 µm, h/b=0.86. Tarsus I=156-168 µm, tarsus IV=184-190 µm.



21-24. Male: anterior margin of sternal shield, genital lamina and microsclerite. 21, 22 - *Holoparasitus annulus* n. sp., ventral view; 23 - *Holoparasitus sardensis* n. sp., ventral view; 24 - idem, dorsal view

TYPE MATERIAL

Holotype ♂, paratypes 1♂, 5♀♀, Algeria, Atlas de Blida, Chrea, sifting of leaf litter in a cedar forest mixed with young oak trees, 1400m a.s.l., 3.05.1988, leg. C. BESUCHET and I. LÖBL. Types deposited in MNHG.

***Holoparasitus sardensis* n. sp.**

(Figs 23-33, 35-41)

ETYMOLOGY

The name refers to Sardinia where the species was collected.

DIAGNOSIS

Gnathotectum trispinate, with minute denticles between central and lateral prongs; gland pores *gv1* absent. In males, microsclerite under genital lamina heavily sclerotised, elliptical and laterally continuous with arched thickenings; fixed digit of chelicera straight, toothless, obliquely cut at the end; movable digit with proximal larger tooth followed by two-three small denticles positioned distally. In females, the presternal plate is smooth; sternal shield with arched sclerotised margin between *st1* setae; apex of epigynium triangular, subapical epigynial structure with interrupted subapical line continuous with horn-like membranous projections directed anterolaterally; endogynium typically with mono, bi-, or tripartite annular opening located medially and followed posteriorly by a thickening; ventrolaterally to the opening, a dentate lamella is discernible.

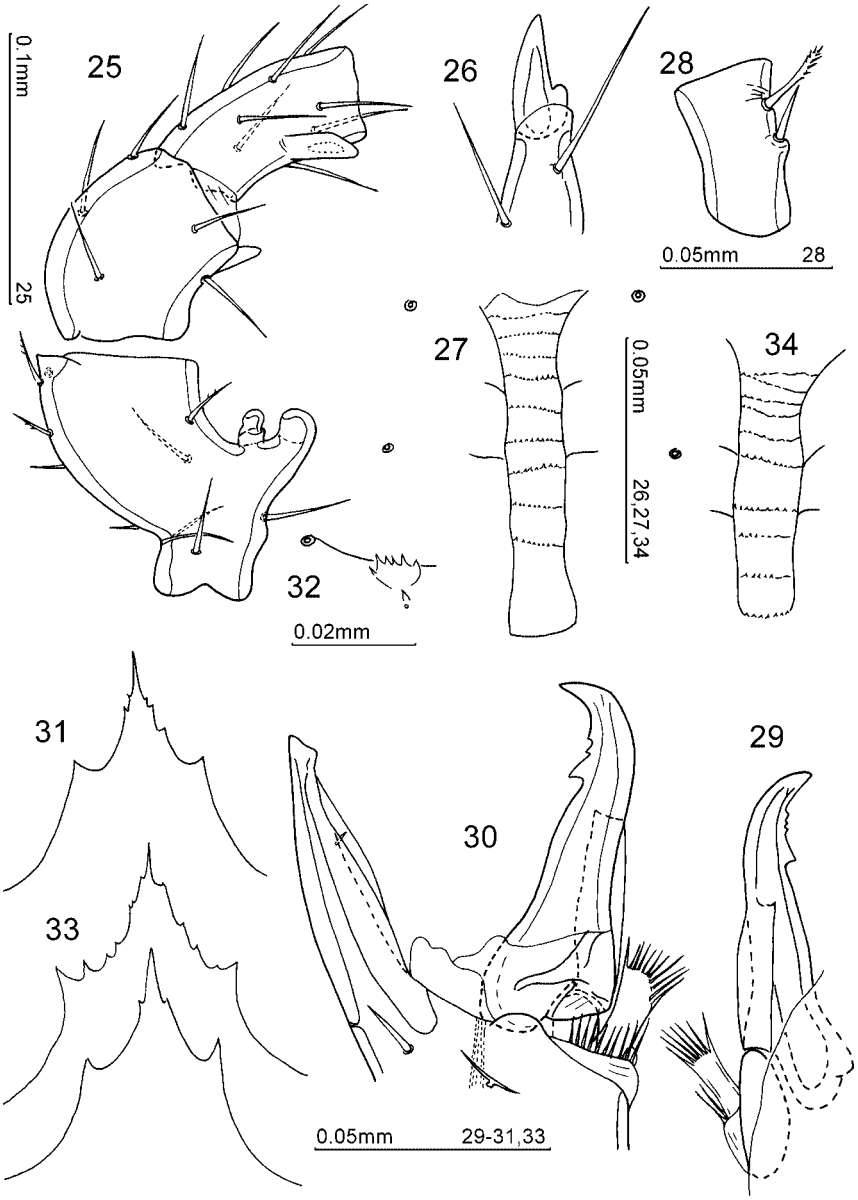
DESCRIPTION

Male. Idiosoma brownish, 570-630 x 375-415 µm (N=6). Length of podonotal setae 14-21 µm, *j1* ca. 33 µm, opisthonotal setae short, 12-17 µm; length of peritrematal groove ca. 192 µm.

Idiosoma, ventral side. Genital opening and genital lamina with strongly sclerotised, circular central structure flanked by lateral elements which are pointed terminally and stretch out basally to form semicircular extensions (figs 23, 24). Sternogenital shield reticulated, gland pores *gv1* absent, gland pores *gv2* simple, with single opening. Length of sternal setae 34-37 µm. Opisthogaster with 8 pairs of ventral setae about 30-43 µm long.

Gnathosoma. Gnathotectum trispinate with minute denticles between central and lateral prongs (fig. 31). Corniculi with proximal protuberances (fig. 26). Hypognathal groove bears 9 rows of denticles (fig. 27). Hypostomatic setae simple, palpcoxal setae barbed.

Chelicera (figs 29, 30). Fixed digit toothless, with obliquely truncate apex and interior margin formed by thin cuticular lamella with a smooth, convex edge; movable digit with normal, curved apex and one prominent tooth followed distally by 2-3 fine denticles; spermatodactyl straight, arthrodial membrane with a well pronounced brush-like process (fig. 29).



25-33. *Holoparasitus sardensis* n. sp. Male: 25 - leg II, femur, genu and tibia; 26 - corniculus; 27 - hypognathal groove; 28 - palptrochanter; 29 - chelicera movable digit, paraxial; 30 - chelicera, antiaxial; 31 - gnathotectum; 32 - group of denticles on coxa II. Female: 33 - gnathotectum. 34. *Holoparasitus annulus* n. sp. male: hypognathal groove

Pedipalps. Trochanter with seta *v1* simple and located on prominence, much thicker and shorter than *v2* which is pilose distally (fig. 28).

Legs. Legs I, III, IV unremarkable. Coxa II with fan-like formation of 6+1 denticles (fig. 32). Leg II spurred as follows (fig. 25): main femoral spur thumb-like and rounded apically, axillary process straight, with apex at same level as main spur. Genu with narrow, conical spur located close to and extending beyond its distal margin. Spur on tibia low and sharpened distally, ending behind tibial margin.

Measurements. Tarsus I=156 µm, tarsus IV=165-170 µm.

Female. Idiosoma brownish, 640-700 x 480-500 µm (N=5). Length of podonotal setae 20-24 µm (but *j1* ca. 40 µm); opisthonotal setae short, 14-17 µm. Length of peritrematal groove 190-195 µm.

Idiosoma, ventral side. Presternal plate ribbon-like and smooth, lateral platelets free. Sternal shield with arcuate sclerotised margin between *st1* setae, partly overlapping presternal plate. Sternal reticulation weakly pronounced posteriorly to pores *iv2* (*pst2* auct.) (fig. 35). Gland pores *gv1* absent. Length of sternal setae 50-58 µm. Paragynia with short, curved metagynial sclerites and with large posterior lobe similar in size and shape to the main part of the paragynium (fig. 37). Apex of epigynium broad and triangular, subapical epigynial structure weakly pronounced and represented by two thickenings, protruding anterolaterally to form horn-shaped membranous extensions (fig. 36). Endogynium relatively small, visible as an arcuate cuticular plate connected laterally to metagynial sclerites. Endogynial opening sometimes elliptical, but usually bipartite or tripartite, located centrally in this plate and followed posteriorly by a thickening of similar size (figs 38-41). A dentate lamellar membranous structure discernible ventrolaterally to the opening. Gland pore *gv2* simple. Opisthogaster with 8 pairs of ventral setae, 33-52 µm long.

Gnathosoma. Gnathotectum as in male, trispinate, usually with minute spines between central and lateral prongs (fig. 33). Corniculi conical. Hypognathal groove with 9 rows of minute denticles; hypostomatic setae simple, palpcoxal ones barbed.

Pedipalps. Trochanter with seta *v1* simple and *v2* pilose distally.

Legs. Leg structure and setation normal. Coxa II with fan-like arrangement of 6+1 denticles, as those in male.

Measurements. Epigynium: h=144-156 µm; b=168-192 µm; h/b=0.83. Tarsus I=150 µm; tarsus IV=177-180 µm.

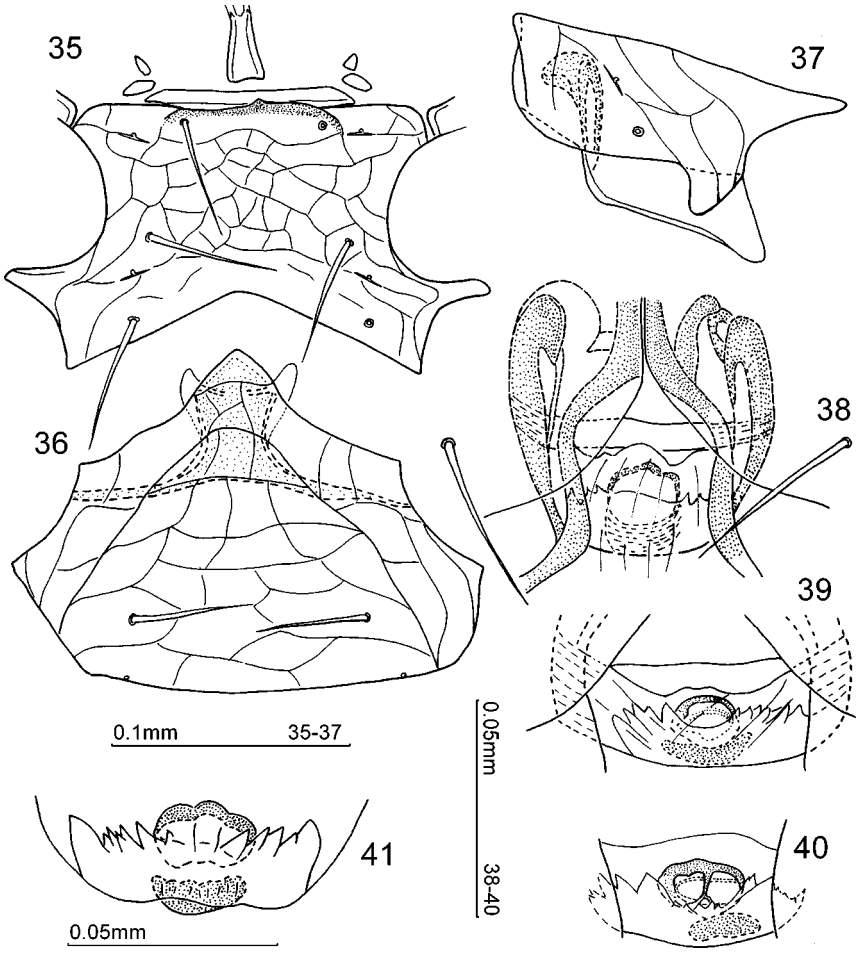
TYPE MATERIAL

Holotype ♂ (slide no. 958 A/1, in ZMJU), paratypes 7♂♂, 11♀♀ (slides no. 958 A/2-A/6, 961-965, in ZMJU), paratypes 6♂♂, 5♀♀ (in MNHG), Italy, Sardinia, Orroli, close to bridge on Mulargia river, moss and lichens under *Cistus* and *Lentiscus,* 2.04.1978; paratype 1♀ (slide no. 954, in ZMJU), Sardinia, near Laconi (Sarcidano), moss, 1.04.1978. All material collected by the staff of the Department of Evolutionary Biology, University of Siena, Italy.

DISCUSSION

H. annulus n. sp. described from the Blida Mountains of Algeria is very similar to *H. sardensis* n. sp. from Sardinia. These two species seem to be elements of a monophyletic *Holoparasitus annulus* species-group based on several shared characters listed in the group diagnosis. The most distinctive and specific characters include the conspicuous thickening of the anterior margin of the female sternum, the shape of the female endogynium and epigynium, and the structure of the genital opening and chelicerae in males.

Females of these two species can be distinguished by characteristics of the presternal plate, partly serrated in *H. annulus* n. sp. and smooth in *H. sardensis* n. sp.



35-41. *Holoparasitus sardensis* n. sp. Female: 35 - presternal plate, lateral platelets and sternal shield; 36 - epigynium; 37 - paragynium; 38 - endogynial region in ventral perspective; 39-41 - endogynium, different specimens

Differences were also observed in the shape of the subapical epigynial structure protrusions, which are triangular (wing-like) in the Algerian species and curved (horn-like) in the Sardinian species. *H. sardensis* n. sp. also possesses a dentate lamellar structure near the endogynial opening, which is absent in *H. annulus* n. sp. Finally, the opening in the endogynial cuticle is regularly circular in *H. annulus* n. sp., whereas in *H. sardensis* n. sp. it is less regular, usually with a bi- to tripartite anterior edge. A differential characteristic between the males of the two species involves the subgenital sclerite, which is trapezoidal in *H. annulus* n. sp. and elliptical in *H. sardensis* n. sp. In both sexes differences were found in details of the gnathotectum (smooth edges of central prong in *H. annulus*, tiny denticles between central and lateral prongs in *H. sardensis*) and in the presence (*H. annulus*) or absence (*H. sardensis*) of the gland pores *gv1*.

As stated above, both new species differ from known species in many respects. For example, contrary to the shape of the endogynium in *H. annulus* and *H. sardensis,* the endogynium in most *Holoparasitus* species is cup-shaped (e.g.: *H. calcaratus* (KOCH, 1839), *H. gibber* JUVARA-BALS et WITALIŃSKI, 2000, *H. globosus* WITALIŃSKI, 1994, *H. peraltus* (BERLESE, 1906)) or bubble-shaped (e.g.: *H. caesus* MICHERDZIŃSKI, 1969, *H. tuberculatus* JUVARA-BALS, 1975). In several species the endogynium has a modified shape (e.g.: cup-shaped with asymmetric prolongation in *H. lawrencei* HYATT, 1987, or semicircular, with a lamellar protrusion split into two parts in *H. excisus* (BERLESE, 1906)). In *H. vasilei* JUVARA-BALS, 1995, the relatively small endogynium is subcircular and possesses two holes; in *H. crassisetosus* JUVARA-BALS et WITALIŃSKI, 2000 and *H. digitiformis* JUVARA-BALS et WITALIŃSKI, 2000 the endogynium is small, cup-shaped, with a circular sclerotised opening continued by a dorsally directed tubular (*H. crassisetosus*) or solid (*H. digitiformis*) appendage.

The presence of the gland pore *gv1* is plesiomorphic in Parasitidae and its lack is an advanced state. This gland disappeared in many species of Parasitinae (ATHIAS-HENRIOT 1980, 1982) and of Pergamasinae (JUVARA-BALS 2002). In *H. sardensis* n. sp. *gv1* is absent. We studied a small sample of *H. annulus* n. sp. in which we found a male specimen with only one gland pore *gv1*, suggesting its variable state.

Another character that deserves some clarification is the presternal plate in females. The smooth plate seems to be a plesiomorphy in *Holoparasitus* and the serrated condition an apomorphic state. A serrated presternal plate is a frequent character in the *Holoparasitus mallorcae* species-group that now includes 6 species (JUVARA-BALS 1975, JUVARA-BALS & WITALIŃSKI 2000), and many undescribed species present in the collection of MNHG (JUVARA-BALS in prep.). A serrated presternal plate is an unstable character; interestingly, in some specimens of *H. annulus* n. sp., we observed a lower number of denticles (figs 19, 20).

We presume that the two species described in this paper evolved independently after separation by a geographical upheaval in the Mediterranean area. In the middle of the Miocene, North Africa was linked to Sardinia and Corsica forming the Tyrrhenian area (POMEROL 1973, DERCOURT et al. 2000). The disjunction occurred probably in the late Miocene. We assume that the ancestors of *H. annulus* n. sp. and *H. sardensis*

n. sp. were distributed over this area and later dramatic geological events caused the isolation of populations and subsequent vicariant speciation.

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