A REDEFINITION OF ARADOPOGAGUS (HYMENOPTERA: SCELIONIDAE), WITH A
KEY TO DESCRIBED SPECIES

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Abstract

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A new, broader concept of the genus Aradophagus Ashmead is presented to include Abuko Masner and Huggert and Ladora Masner and Huggert (new synonyms). The extent of the tribe Aradophagini is discussed and some character states re-evaluated. Ladora maura Masner and Huggert is synonymized under Apegus squamosus Dodd (new synonym). The distribution of some species of Aradophagus is discussed. The first fossil member of the genus is reported from late Tertiary amber of Hispaniola (Dominican Republic). Aradophagus diazi sp.nov. is described from Venezuela as the first member of the genus and the tribe in South America. A key to described world species of Aradophagus is presented.

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INTRODUCTION

The genus Aradophagus was proposed by Ashmead (1893) for A. fasciatus Ashmead described from Florida and presumed to parasitize the eggs of Aradidae (Heteroptera). Ashmead classified the genus in the subfamily Telenominae (actually the tribe Telenomi), a placement followed by most subsequent authors (Kieffer 1926; Muesebeck and Walkley 1951; Masner and Kozlov 1965; Kozlov in Medvedev 1971; Kozlov and Kononova 1983). Kozlov (1970) erected the tribe Aradophagini in the Telenominae to contain the single genus Aradophagus. Masner (1976a) classified Aradophagus and the Aradophagini in the subfamily Scelioninae; this concept was reaffirmed by Masner and Huggert (1979) after dissection of the metasoma of A. fasciatus. The genera Abuko Masner and Huggert (one species), Ladora Masner and Huggert (three species), and two new species of Aradophagus also were described (Masner and Huggert 1979). Galloway and Austin (1984) reported three species of Ladora from Australia, originally described by Dodd (1914, 1915, 1926), the first two of these species in Microteleia Kieffer and the last in Apegus Foerster. Mineo and Caleca (1992) described Aradophagus nicolai from Zimbabwe.

The tribe Aradophagini, as interpreted by Masner and Huggert (1979), contained three genera: Aradophagus, Abuko, and Ladora. The concepts of the three genera were based on
fragmentary knowledge of the world fauna; members of the Aradophagini are very rare in collections. During the past 14 years one of us (L.M.) focussed on accumulating additional material of this tribe. New evidence failed to support the continued existence of Abuko and Ladora as separate genera. Character states believed to be of generic value appeared to be only of specific value (e.g. ocellar configuration, presence or absence of striae on cheek, presence or absence of notaulus, relative length of T2 and T3, etc.). Thirty-four undescribed species of Aradophagus were studied (Canadian National Collection of Insects, CNCI) from Africa and Madagascar (21 spp.), Australia (11 spp.), the Orient (1 sp.), and North America (1 sp.). These species bridge the morphological gaps between all three genera. As a result both Abuko and Ladora are treated here as junior synonyms of Aradophagus. Mineo and Caleca (1992) similarly expressed an opinion that Abuko and Aradophagus could be the same genus.

The revised generic diagnosis (see below) takes into consideration all described (11) as well as undescribed (34) species known to us. The widely separated notauli deserve special attention. When notauli are present in Aradophagus, they are usually abbreviated, parallel, and situated near the posterolateral corners of the mesoscutum. The unusual position of notauli in some Aradophagus is interpreted as a result of flattening of the mesoscutal plate (similar to Platyscelio Kieffer). The parapsidal lines (Menke 1993), located laterad of the notauli, occur in several undescribed species of Aradophagus as mere traces. Parapsidal lines are present in some Scelionidae (e.g. in Leptoteleia Kieffer, Masner 1978), and appear as smooth, glabrous, elevated ridges. The telescoped ovipositor tube and extruded apical tergite of the Aradophagini are homologous with these structures in the tribe Calliscelionini. Aradophagini can be distinguished from Calliscelionini by the unusually high position of the foramen magnum and the consequently long hypostomal bridge, the long bidentate mandibles, the trapezoidal, densely striate T1, and the rather wide laterotergites, which are only loosely attached to the sternum of the metasoma.

**MATERIALS AND METHODS**

This report is based on examination of 474 specimens; 45 species were recognized, of which 11 are keyed. Almost all specimens belong to the Canadian National Collection of Insects (Ottawa, Ontario), but several were borrowed from the Australian National Insect Collection (ANIC, Canberra) and from the Museo del Instituto de Zoologia Agricola (MIZA, Maracay, Venezuela).

The use of a light disperser (drawing film such as Mylar) placed between the light source and specimen proved indispensable, especially in light-coloured members of Aradophagus, for observing microsculpture and micropilosity under high magnification (120x). For morphological terms and abbreviations see Masner (1980).

**ARADOPHAGUS ASHMED**

*Aradophagus* Ashmead, 1893: 138, 166
*Microteleia* sensu Dodd, 1914: 121
*Microteleia* sensu Dodd, 1915: 449
*Apegus* sensu Dodd, 1926: 302
*Abuko* Masner and Huggert, 1979: 1098–1099 (new synonym)
*Ladora* Masner and Huggert, 1979: 1096 (new synonym)

Body of most species elongate, moderately to considerably depressed dorsoventrally, rarely short and squat, moderately to distinctly convex; foramen magnum located near vertex, occiput consequently very narrow and hypostomal bridge very broad; eye glabrous or with short hairs, eyes in some species remarkably small, shorter than temple; ocelli usually arranged in curved line or very low triangle, POL always longer than LOL, OOL at least one ocellar diameter (1d), usually longer; malar sulcus present; cheek striate or not; clypeus
subrectangular, and prominent, with anterolateral corners pointed; mandible long and slender, bidentate, teeth long and sharp; palpi short, papal formula 2-1; oral carina often sharply projecting, near mandibular condyle (Fig. 3, arrow); hypostomal and occipital carinae present, weak, or absent; interantennal keel convex, bulging, sometimes continuing dorsally in weak keel; radicle usually distinctly elongate, up to one-third length A1; antennal formula 12-12, female antenna with 5-segmented slender clava, antenna often with several antennomeres contrasting whitish (e.g. A3–A7, A12), male antenna with A3–A11 short, subquadrate; skaphion absent; notauli, when present, usually abbreviated anteriorly and running parallel, rarely almost percurrent; parapsidal lines indicated in some species as faint ridges; scutellum strongly transverse, usually narrow and strip-like, flattened and level with mesocutum and metanotum, rarely more convex and clearly longer than dorsellum; metastomum unarmed, dorsellum well defined, subrectangular; propodeum usually with median carina and lateral plicae; metanotum present or absent, mesepisternum relatively wide, separated from mesepimemum by deep crenulate groove or line; fore wing usually with 1 or 2 dark transverse bands, marginal vein usually as long as stigmatic vein or longer, postmarginal vein long; hind wing with complete submarginal vein; metastoma moderately to strongly flattened, usually elongate, rarely subcircular, T2 or T3 the longest and widest terga; T1 usually trapezoidal, rarely broadly transverse (but still subtrapezoidal), with dense, strong, percurrent, longitudinal striae, T1 often lighter than rest of metastoma; T7 (abdominal 8 + 9) in female external, sclerotized, with cerci, extruded in eversible tube during oviposition; laterotergites relatively wide, locking loosely on sternal plates, submarginal groove not developed; laterosternites well developed (dissection necessary to observe them); sexes in some species strongly dichromatic, females light-coloured and males dark-coloured.

The above definition applies simultaneously to the tribe Aradophagini. Character states such as short, squat, convex body, and metasoma subcircular with T1 strongly transverse, refer to a group of undescribed species from Australia, Madagascar, South Africa, and the United States (Texas). These forms, which are similar in habitus to species of Gryon Haliday or Trissolcus Ashmead, are considered more primitive than the flattened, elongate forms of the described species of Aradophagus (see key below). The shorter, convex members display sculpture that is generally rougher than in more flattened members. However all intermediate states exist between these two groups. We expect that further exploration of the world Aradophagini will support our new, broader concept of Aradophagus. Presently the following species are transferred to Aradophagus (all new combinations), viz. sarotes Masner and Huggert (from Abuko), brunneus Masner and Huggert and trjapitzini Masner and Huggert (from Abuko), bruneus Masner and Huggert and trjapitzini Masner and Huggert (from Ladora), and pulchricorpus Dodd and pulchripennis Dodd (from Microteleia).

Currently 11 species of Aradophagus have been described worldwide; an additional 34 undescribed species are known to us (CNCI). Information based on all species indicates that members of Aradophagus prefer dry to arid habitats, especially on the African continent, but also in Madagascar, western and southern Australia, and one species (only males known) in desert habitats in Texas. Three species display a wide distribution: A. fasciatus is Holarctic (Masner and Huggert 1979); A. squamosus is known from Australia (Queensland), Africa (South Africa, Zimbabwe), and the United States (Florida; new record); and A. microps Masner and Huggert is known from South India, Italy (Sicily), and Spain. Prior to this study, Aradophagus was not recorded south of the United States and no fossils were known. Aradophagus diazi sp.nov., from Venezuela, is the first extant member known to us to occur in South America. We also examined a female of Aradophagus sp. in a piece of amber from Hispaniola (Dominican Republic) (CNCI) presumed to be from the late Tertiary. This species resembles A. squamosus in having only one dark band in the fore wing.

The host and the habits of Aradophagus are not known. Ashmead’s (1893) original assumption of Aradidae as the host was never confirmed; so far only members of the genera
Telenomus Haliday and Aradocnus Masner (Johnson 1992) were positively reared from eggs of Aradidae. Masner and Kozlov (1965) mentioned dead wood as a possible habitat and Masner (1976b) reported *A. fasciatus* intercepted in large numbers over several years inside a house. Mineo and Gatto (1982) reported *A. microps* in large numbers from yellow pan traps operated in vineyards and citrus orchards. The record (Masner and Huggert 1979) of an armoured scale as host for *A. squamosus* (= *A. maurus*) remains highly doubtful. However, it is plausible to assume that at least the strongly flattened members of *Aradophagus* may attack flattened eggs of a host associated with dead wood. Finding the first positive host record as well as habits for any species of *Aradophagus* remains a challenge.

### KEY TO THE DESCRIBED WORLD SPECIES OF *ARADOPHAGUS*

1. Notauli not developed; OOL slightly to considerably longer than LOL. .......................... 2
   — Notauli developed, sulciform and abbreviated anteriorly; OOL distinctly shorter than LOL. .................................................. 4

2. OOL at least twice as long as LOL; eye remarkably small, in frontal view subequal to temple; temple longer than cheek; marginal vein twice as long as stigmal vein; South India, Italy (Sicily), Spain (Castellón). .......................... *A. microps* Masner and Huggert ♀ ♂
   — OOL only slightly longer than LOL; eye large, in frontal view 2–3 times longer than temple; temple shorter than cheek; marginal vein about as long as stigmal vein. .................................. 3

3. Mesoscutum entirely and evenly coriaceous, with polygonal sculpture clearly elongate; in female A3–A7 and A12 whitish in contrast to dark A2 and A8–A11 male yellow; (intercepted on ship from Mexico). .......................... *A. pulchricornis* Masner and Huggert ♀ ♂
   — Mesoscutum coriaceous only anteriorly and laterally, with large smooth area posteromedially; in female A3–A12 black in contrast to light A2; male dark; Holarctic. .......................... *A. fasciatus* Ashmead ♀ ♂

4. Fore wing with single dark zone .................................................. 5
   — Fore wing with 2 dark zones ................................................. 7

5. Propodeum below spiracle largely smooth; frons almost smooth; Australia, South Africa, Zimbabwe, the United States (Florida). .......................... *A. squamosus* (Dodd) ♀ ♂
   — Propodeum below spiracle largely rugulose; frons finely to clearly coriaceous. ............................................ 6

6. Mesoscutum between notauli coriaceous; frons clearly coriaceous; Morocco, Gambia, Italy (Sicily), Spain (Mallorca). .......................... *A. brunneus* (Masner and Huggert) ♀ ♂
   — Mesoscutum between notauli largely smooth; frons only finely coriaceous; Central Asia, Pakistan (new record). .......................... *A. trijapitzini* (Masner and Huggert) ♀ ♂

7. Body black; mesoscutum between notauli coriaceous; Australia (Queensland). .......................... *A. pulchripennis* (Dodd) ♀ ♂
   — Body lighter, light brown, reddish-yellow, or yellow; mesoscutum between notauli smooth ........................................... 8

8. Fore wing with tuft of black, erect bristles below submarginal vein; Gambia, Zimbabwe .......................... *A. sarotes* (Masner and Huggert) ♀ ♂
   — Fore wing without tuft of bristles ........................................... 9

9. T2 clearly longer than T3; notauli almost percurrent; Zimbabwe. .......................... *A. nicolai* Mineo and Caleca ♀ ♂
   — T2 clearly shorter than T3; notauli at most exceeding basal half of mesoscutum. ..................................... 10

10. Head, mesosoma, and T1 reddish-yellow, rest of metasoma black; female A2 and A3 black; notauli exceeding basal half of mesoscutum; Australia (Queensland) .......................... *A. pulchricorpus* (Dodd) ♀ ♂
    — Entire body yellow but T3 with 2 darker spots posterolaterally; female A2 and A3 yellowish-white; notauli not exceeding basal half of mesoscutum; Venezuela (Lara). .......................... *A. dazi* sp. nov. ♀

*Aradophagus squamosus* (Dodd) comb.nov.

*Apegus squamosus* Dodd, 1926: 302 ♀

*Apegus squamosus*: Galloway, 1976: 85
Ladora squamosus (1): Galloway and Austin, 1984: 63

Ladora maura Masner and Huggert, 1979: 1097 ♀ (new synonym)

We compared three females (ANIC) from Australia (Queensland: Brisbane, March 1930; Queensland, Gogango, Sep. & Dec. 1931, identified by A.P. Dodd [Dodd’s handwriting]), the paratype female of L. maura (CNCI) from South Africa (Humansdorp, Dec. 1960), a female (CNCI) from Zimbabwe (Chishawasha, May 1990, A. Watsham, pan trap), and five females (CNCI) from the United States, Florida (Alachua Co., Gainesville, Feb.–Nov. 1987 & 1988, D.B. Wahl, Malaise trap and interception trap in regrown oak forest). All individuals are identical except that Dodd’s specimens are somewhat faded due to age. The fragmentary distribution pattern spanning localities in three continents indicates the possible cosmopolitan nature of A. squamosus. It is only logical to assume that the host of this parasitoid is a very widespread insect, possibly a tramp, or A. squamosus is polyphagous.

Aradophagus diazi sp.nov.
(Figs. 1, 2, 3)

Diagnosis. FEMALE. Body considerably depressed dorsoventrally, distinctly flattened dorsally (lateral view); head in frontal view subcircular, wider than high, frons and vertex with deep punctures, punctures sparser on frons than on vertex; process on oral carina (near mandibular condyle) prominent (Fig. 3, arrow); cheek not striate, but with rudiments of irregular striation near mandibular condyle; hypostomal carina not developed; OOL distinctly shorter than LOL; notaulus strongly impressed but not exceeding basal half of mesoscutum; parapsidal lines faintly indicated as shallow depressions; fore wing predominantly infuscate with 2 lighter zones; metasoma elongate, strongly depressed dorsoventrally, almost foliaceous; T2 slightly shorter than T3; T3 with 2 dark, circular spots posterolaterally; laterotergites (T3) subequal in width to gap between them.

Description. HOLOTYPE FEMALE. Length 1.04 mm (measured from anterior ocellus to apex of metasoma). Body predominantly pale yellow, T3 with 2 dark circular spots near posterolateral corners; antenna varicoloured, radicle and scape pale yellow as body, A2–A3 dirty yellow, A4–A7 whitish, A8–A12 black; legs completely yellow, slightly more pale than body; fore wing predominantly infuscate, with basal third portion hyaline and with 1 transverse hyaline band near the middle of the wing below marginal vein.

Head in frontal view subcircular, distinctly wider than high (39:28); interorbital space slightly larger than eye height (21:19); eye glabrous, eye height larger than malar space (22:8); inner orbits subparallel; interantennal bulge rather long, moderately convex, not continuing dorsally in keel; frons smooth, highly shining with deep scattered setigerous punctures; head in dorsal view strongly transverse (39:11), slightly wider than mesosoma (39:33); OOL slightly longer than 1d; ocelli in low triangle, OOL:LOL:POL in proportions 2:7:15; vertex and occiput without trace of coriaceous reticulation; head in lateral view strongly depressed, distinctly higher than long (28:11); head from posterior view (Fig. 2) with occipital carina finely crenulate on both sides; hypostomal line developed; hypostomal carina absent; inner tentorial pits connected with foramen magnum by sulci; radicle, as long as one-third length of A1 (8:24); antennomeres in relative proportions (length:width) 24:4; 10:3; 7:4; 5:3; 3:3; 3:4; 3:4; 4.5:4; 5:4; 5:4; 5:4; 6:5:4.

Mesosoma in dorsal view slightly elongate (38:33); mesoscutum transverse (30:17), predominantly smooth and shining, finely coriaceous anteriorly; scutellum broadly transverse (21:5) with several minute foveolae in anterolateral corner, scutellar rim not crenulate but indicated by fine line; dorsellum subrectangular and about half length of scutellum; propodeum laterad of plica finely rugulose; mesosoma in lateral view flattened with mesoscutum only gently convex anteriorly, mesoscutum and scutellum on same level;
Figs. 1–3. *Aradophagus diazi* sp. nov. ♀: 1, body (dorsal view); 2, head (posterior view); 3, body (lateral view).
fore wing reaching almost to tip of metasoma; marginal:stigmal:postmarginal veins in ratios 10:10:12.

T1 trapezoidal, wider than long (17:10), with strong, dense longitudinal striae; T2 trapezoidal and shorter than T3 (14:17), wider than long (31:14) and with delicate longitudinal striae, striae medially reaching three-quarters of tergite; T3 almost rectangular, wider than long (31:17), with faint longitudinal reticulation anteromedially; T4–T7 almost smooth.

MALE. Unknown.

**Type Material.** Holotype ♀ VENEZUELA, Lara, Tarabana, March, 1991, F. Díaz, Malaise trap (MIZA); Paratypes 1 ♀, with same data as holotype, and 6 ♀♂ with same data but caught 1–4 February 1991 (MIZA; Universidad Centro Occidental, Barquisimeto, Venezuela; CNCI; BMNH.)

**Distribution.** Venezuela (Lara).

**Discussion.** Aradophagus diazi combines some character states of the former genera Abuko and Ladora; with the former it shares the absence of striae on cheeks and with the latter the T2–T3 ratio. This new species differs from A. sarotes by the absence of a specialized tuft of black bristles below the submarginal vein, and in the T2–T3 ratio; from A. nicolai it differs principally by sculpture of the head, length ratio of T2–T3, and colour of the metasoma. Aradophagus diazi differs from all species described in Ladora by the colour of the body and absence of striae on the cheek. The main diagnostic characters of A. diazi are the sculpture of the head, the spots on T3, the T2–T3 ratio, and the relatively short notaualus.

**Etymology.** The new species is named in honour of Dr. Francisco Díaz (Universidad Centro Occidental, Venezuela), a good friend, and enthusiastic hymenopterist, who collected this new species.

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