Descriptions of the triungulins of *Synhoria testacea* (Fabricius) and another undetermined African species (Coleoptera: Meloidae), with data on Horiini larvae

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The first instar (triungulin) larva of *Synhoria testacea* (Fabricius), and another unidentified East African species, probably also a *Synhoria*, are described. The descriptions and illustrations clearly demonstrate two pairs of ocelli in both species. Comparative morphological data and information on Horiini triungulins are also included.

Key words: Coleoptera, Meloidae, *Synhoria*, triungulin, morphology, systematics.

INTRODUCTION

The pantropical Horiini (Coleoptera: Meloidae) include species in the genera *Cissites* Latreille (two in Central and South America), *Horia* Fabricius (one in Africa, one occurring throughout Africa to India, three in East Asia, one in New Guinea and one in Queensland, Australia), and *Synhoria* Kolbe (three in Africa, one in Madagascar and the Comores Islands, and one in East Asia) (Betrem 1932; Bologna 1991, unpubl.).

The tribes Horiini, Sitarini and Nemognathini comprise the subfamily Nemognathinae (Bologna 1991). First instar (triungulin) Nemognathinae larvae are parasitoids of Apoidea and are phoretic on bees. The Horiini are usually regarded as the most primitive Nemognathinae because of the plesiomorphic state of certain morphological and eco-ethological adult and larval characters (MacSwain 1956; Selander 1964; Bologna 1991) including: unmodified maxillae of adults, gonostyli not completely fused in *Cissites*, triungulin with one or two pairs of ocelli, eighth abdominal spiracle of triungulin not placed on a protruding evagination, sixth instar larva free outside the exuvia of the fifth instar, larval development of the seventh instar outside of the host cell and construction of a pupal cell in the host gallery. However, this tribe is also characterized by some specializations that we regard as autapomorphies: head and mandibles well developed in the adult male, aphagy in the adult, oviposition directly in the bee's nest and obligate parasitism of the genus *Xylocopa* Latreille (Anthophoridae).

The recent discovery of the triungulin of *Stenodera puncticollis* (Laporte de Castelnau), an Anatolian species currently referable to Nemognathini, but with some primitive characters and intermediate conditions in common with Meloinae, will necessitate a complete revision of Nemognathinae and, more generally, of the tribal systematics of Meloidae (Bologna & Pinto, in prep.)

The triungulins of two *Cissites*, three (?four) *Horia*, and two *Synhoria* have previously been described (Table 2). In the present paper the triungulin of *Synhoria testacea* (Fabricius) (*sensu* Betrem 1932) is described, together with another unidentified African horiine species, probably referable to *Synhoria* or *Horia*, the only two genera known from Africa.

MATERIALS AND METHODS

A single *S. testacea* female was collected in October 1982 in the Cedarberg Mountains, southwestern Cape Province, South Africa. She was ovipositing in her pupal cell at the end of a tunnel excavated by *Xylocopa capitata* Smith. The nest was occupied by a *X. capitata* female that was stocking larval cells (Watmough, *in litt.*). Identification of *S. testacea* material was confirmed by examination of the female and 28 larvae hatched from her eggs. Eight slide-mounted (Canada balsam) triungulins and three metal-coated specimens were examined; other larvae are preserved in 70 % alcohol. We also examined one slide-mounted (Faure liquid) triungulin of an unidentified horiine collected in Uganda in 1975 on an unidentified *Xylocopa* species.

Adults and triungulins are in M.A. Bologna's collection, University of Tuscia, Viterbo.

Morphological analysis and illustrations were

Table 1. Known hosts and vectors of the genus *Synhoria*.

Species	Hosts or vectors	References
S. maxillosa (Fabricius)	*Xylocopa appendiculata* *X. aestuans* *Xylocopa* sp.	Koningsberg 1908; Van Zijp 1921; Cros 1924; Ishida 1982; Taketsuka 1984, 1986 (also under *H. cephalotes, C. sasakii, H. tosana*)
S. testacea (Fabricius)	*X. capitata* *Xylocopa* sp. *X. sicheli*	Watmough 1974, 1983; Gess 1981 (also under *S. hottentota*); This paper
Synhoria sp. ?*Synhoria* sp. *S. ?cephalotes* (Olivier)	*X. flavorufa* *Xylocopa* sp. *Tachytes hamiltoni*	Eardley 1983 This paper Cros 1924 (under *S. fischeri*)

Table 2. List of described triungulins of Horiini, localities and references.

Species	Locality	References
Horia fabriciana Betrem	Egypt	Cros 1929 (under *H. testacea* Fabricius = *H. fabriciana* Aurivillius)
Horia debyi (Fairmaire)	Sri Lanka	Bugnion 1909 (under *Cissites testaceus* Fabricius); Cros 1919 (*idem*), 1924, 1938a,b
Horia insularis Cros	Sumatra	Cros 1929, 1938a,b
Horia sp.	Sumatra	Vitzthum 1930
Horia or *Synhoria* sp.	Zaire	Cros 1938a,b
?*Synhoria* sp.	Uganda	This paper
Synhoria testacea (Fabricius)	South Africa	This paper
Synhoria ?cephalotes (Olivier)	Kenya	Cros 1924 (under *S.?fischeri* Kolbe), 1938b (under Nemognathinae species)
Synhoria maxillosa (Fabricius)	Sumatra	Cros 1924 (under *Cissites*), 1927 (*idem*), 1938a (under *Horia* (*Synhoria*)), 1938b (*idem*)
Cissites auriculata (Champion)	Mexico Mexico Mexico & Honduras	Cros 1927, 1938a,b MacSwain 1956 MacSwain 1961
Cissites maculata (Swederus)	Argentina Argentina, Uruguay, Peru, Brazil, Colombia, Galapagos Is., Panama, Mexico, Haiti, Santo Domingo	Cros 1938a,b MacSwain 1961

carried out using Leitz Ortholux and Zeiss Axioplan microscopes equipped with photocameras. Scanning electron micrographs were taken with a Philips SEM 505.

BIOLOGY OF THE TRIBE HORIINI

During their larval development, Horiini are obligate parasitoids of anthophorid bees of the genus *Xylocopa* (Bologna 1991), but information on hosts and biology of horiines is widely dispersed in the literature. About 30 species of *Xylocopa* are known to be hosts or vectors of *Cissites, Horia* and *Synhoria*, and most of the data were summarized by MacSwain (1961) and Hurd (1978). The life cycle of Horiini, similar in all the genera, was briefly outlined by Guilding (1825), Bugnion (1909), Bianchi (1962), Ishida (1982) and Taketsuka (1984, 1986), and discussed by Bologna (1991). Host records for the genus *Synhoria* are summarized in Table 1.

DESCRIPTIONS OF TRIUNGULINS

Synhoria testacea (Fabricius), Fig. 1

Colour golden-brown; head (particularly around eyes) and coxae slightly darker. Cuticle not reticulate; thoracic sternites barely sclerotized. Line of dehiscence present on head, pro-, meso- and metanotum.

Size. Body length 1.17–1.25 mm; length of longest pair of caudal setae 0.16–0.18 mm; maximum width of head 0.20–0.22 mm; length of antenna without terminal seta 0.07 mm; maximum width of pronotum 0.26–0.29 mm (quantitative data presented below represent the ranges based on eight non-metal-coated individuals).

Head (Figs 1–4) longer than wide, widest at tempora, conically truncate at anterior margin, slightly curved posteriorly around eyes. Epicranial suture Y-shaped, lateral arms weakly divergent at base, subparallel to the level of antennal base, then slightly curved; basal stem of epicranial suture very short. Two ocelli on each side (Figs 1, 3, 4), slightly posterior to middle of head, slightly convex and contiguous, the first dorsally placed, the second laterally, hardly visible in dorsal view and slightly anterior to the first. Epicranial setation as in Fig. 1; all setae very short, except at anterior margin. Labrum transverse, oval, fused with clypeus, not visible dorsally; anterior margin with a dorsal series of very short setae, and a transverse row of sensory pits. Antenna (Figs 2, 3) with length/width ratio of segments I, II and III, 0.75, 1.70, 2.92 respectively; all segments cylindrical, segment I with parallel sides, asymmetrically longer on dorsal side; segment II enlarged medially on ventral side, with a short subterminal seta on the same side; segment III with parallel sides, one seta located medially on ventral side, and one short seta at apex; terminal seta about 10 times longer than segment III, large at base and filiform at apex. Mandible (Fig. 2) with base very broad, tapering towards apex, with six prominent tooth-like transverse ridges; posterior condyle large. Maxillary mala (Fig. 2) unmodified, with four setae apically (an additional seta in one specimen), a very long basal seta, four shorter basal setae and two sensory pits. Maxillary palpi directed laterally, length greater than antennal segments excluding the terminal seta; all segments cylindrical but tapering apically, segment I very short, one third the length of segment II, segments II and III more elongate, segment II slightly enlarged at apex with one apical seta, segment III a little longer than II, asymmetrically enlarged medially on ventral side in basal half, with two median setae, apex with a prominent two-segmented sensory appendix and several microsetae and papillae. Labium transverse, oval; labial palpi cylindrical, segment II about twice as long as segment I, its apex with a prominent two-segmented sensory appendix and several shorter papillae. Gula and postmentum fused and V-shaped.

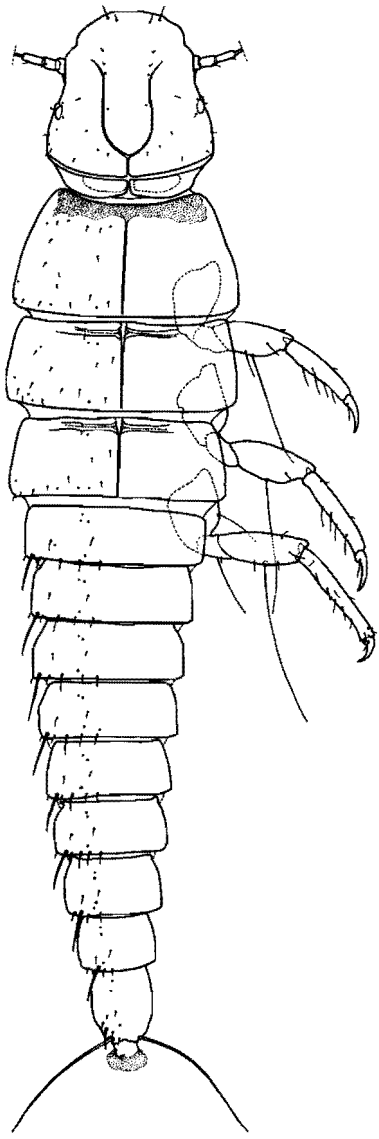


Fig. 1. Triungulin of *Synhoria testacea:* dorsal view.

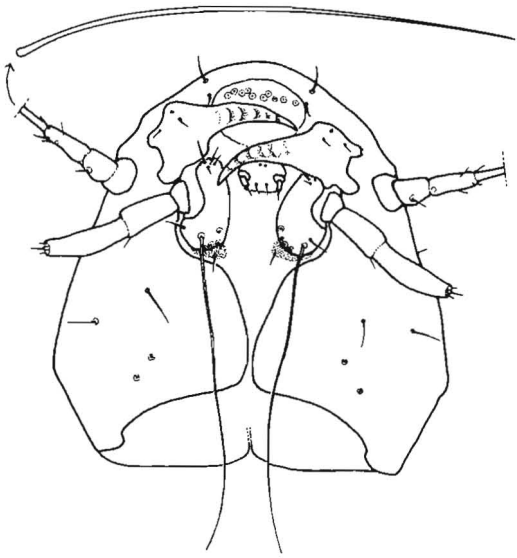
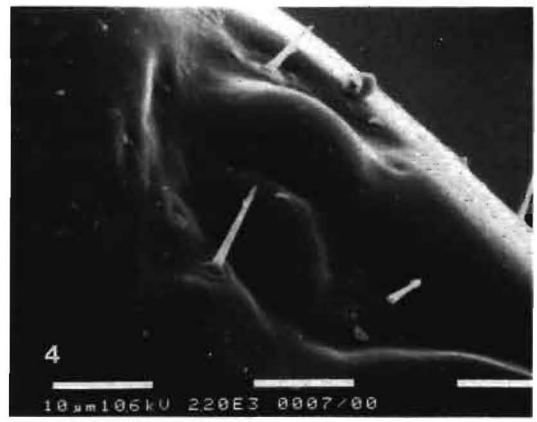


Fig. 2. Triungulin of *Synhoria testacea:* head, ventral view.

Thorax. Thoracic segments (Fig. 1) slightly broader than head, with varying numbers of setae arranged in three irregular zigzag rows. Pronotum about 1.25 times longer than mesonotum, subcampaniform, with lateral margins rounded and narrowed anteriorly, slightly sclerotized apically, with 30 setae and 10 pits. Mesonotum sub-rectangular and transverse, only slightly narrower than pronotum, with an anterior transverse external ridge, with six pits and microsetae in anterior row, and 28 setae and 12 pits at the middle and base. Metanotum slightly narrower than mesonotum, similarly shaped, with anterior, transverse external ridge; setae and pits arranged as in mesonotum, but with two fewer setae at base. Prosternite with four anterior pits, two median setae and with two pairs of setae, the posterior pair longer and asymmetrically positioned; two pits and one seta near base of coxae. Meso- and metasternite with two pairs of setae, basal pair longer.

Legs with femur slightly swollen. Coxa with five basal setae, fourth external seta 1.5 times as long as third, and larger; five additional pits on coxa. Trochanter with a very long ventral seta, that of posterior legs shorter. Femur with a very long ventral seta (Fig. 5), longer than both tibia and claw, slightly vesicular apically, other setae as in Fig. 1. Tibia longer than femur, not swollen, with



Figs 3–5. Triungulin of *Synhoria testacea:* scanning electron micrographs: **3**, head, lateral view; **4**, ocelli, lateral view; **5**, apex of femoral seta.

four pairs of ventral setae on each side (4–5 on metatibiae, that also have some lateral setae). Claw conico-falcate, less than one half as long as tibiae, with one very minute tooth near apex and one basal seta less than one half as long as claw.

Abdomen. Somites transverse (Fig. 1) and progressively narrowed, segment IX longer yet not transverse. Sternites well sclerotized. Spiracles on pleurite I ventrally placed, the others lateral, the last four situated slightly more dorsally. Chaetotaxy as in Fig. 1. Setae of tergites arranged in three parallel rows: anterior row with four pits (six on tergite I) placed in two groups; median row with four setae; basal row with 12 setae (external penultimate seta very large) and two additional pits; tergites VII and VIII with only eight setae in basal row, tergite IX with eight posterior setae, four anterior pits with microsetae, four additional posterior pits, two very long caudal setae and two additional short setae. Sternites with eight setae (four on first sternite) in basal row, the second-most external seta largest, two microsetae anteriorly and two pits; sternite IX with six long setae, two medial setae and two anterior pits. Segment X strongly sclerotized basally, with six basal setae and well-developed pygopod.

?*Synhoria* sp., Fig. 6

The triungulin of this unidentified species is described only with reference to *S. testacea*. In the specimen examined the head is damaged and meso- and metanotum overlap slightly.

Size. Body length 1.14 mm (abdominal segments slightly compressed); longest pair of caudal setae 0.20 mm in length. Maximum width of head 0.24 mm; length of antenna without terminal seta 0.06 mm; maximum width of pronotum 0.30 mm.

Head length and width (Figs 6, 7) subequal (0.24 × 0.23 mm), widest on tempora, anterior part slightly conically produced, rounded at anterior margin; tempora rounded. Second ocellus dorsolaterally placed, clearly visible in dorsal view. Epicranial setation as in Fig. 6. Antenna (Fig. 7) with length/width ratio of segments I, II and III, 0.67, 1.60, 3.38 respectively. Maxillary mala (Fig. 7) with four setae (two long, one longer, and one shorter), one very long basal seta extending beyond posterior margin of head, another more external, and five basal microsetae and pits. Maxillary palpomere III asymmetrically more enlarged medially on ventral side and basally rounded.

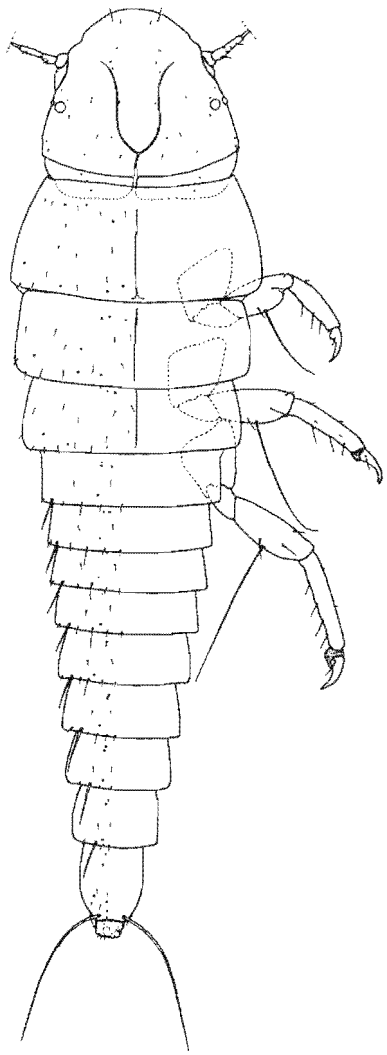


Fig. 6. Triungulin of ?*Synhoria* sp.: dorsal view.

Thorax (Fig. 6). Pronotum with 26 setae and 16 sensory pits; mesonotum with six pits in anterior row, and 22 setae and eight pits in middle and at the base; metanotum with setae and pits arranged as on mesonotum but with four more setae at the base.

Legs (Fig. 6). Coxa with the fourth-most external seta similar in size to third. Tibia with three ventral pairs of setae, four on metatibiae.

Abdomen. Chaetotaxy as in Fig. 6.

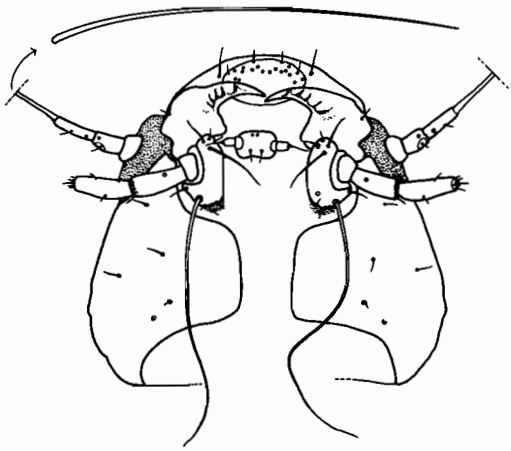


Fig. 7. Triungulin of ?*Synhoria* sp.: head, ventral view.

DISCUSSION

Synhoria testacea (= *S. hottentota* Péringuey) is endemic to southern Africa, being restricted to South Africa, Botswana and Namibia. The horiine triungulin collected in Uganda is presumed to be a species of *Synhoria* owing to the presence of two ocelli. This classification is, however, uncertain because the triungulins of *Synhoria* and *Horia* cannot be distinguished by other diagnostic characters. *Synhoria senegalensis* (Laporte de Castelnau), *S. cephalotes* (Olivier) and *Horia nitida* Gahan are known from Uganda, and *H. fabriciana* Betrem is recorded from Sudan, Somalia and Kenya.

Another horiine triungulin from southern Kenya was described by Cros (1924) and referred to *Synhoria fischeri* Kolbe, a junior synonym of *S. cephalotes*, but later referred to an unidentified genus of Nemognathini (Cros 1938a). The unmodified shape of the eighth abdominal spiracle supports the hypothesis that this larva could be referred to the tribe Horiini.

The triungulin of *S. testacea* differs from the undetermined Ugandan triungulin in the characters indicated in the description.

The systematics of Horiini has not been resolved and the revision by Betrem (1932), based on adult morphology, has not been substantiated by further material or by new microscopical or taxonomic techniques. The genus *Synhoria* is currently considered to be a distinct genus (Bologna 1991) but the taxonomy of the African species, as proposed by Betrem (1932), is unsatisfactory. *Synhoria testacea* could consequently be a synonym of another African species.

The generic and tribal classification of Horiini, based on triungulin morphology, is uncertain because the triungulins of only a few species have been described (Table 2). Several larval descriptions of African and East Asian species of *Horia* and *Synhoria* were provided by Cros (1924, 1927, 1929, 1938b) while both Neotropical species of *Cissites* were revised by MacSwain (1956, 1961).

The unmodified eighth abdominal spiracle in Horiini triungulins, and the other adult and larval morphological and eco-ethological characters summarized above, support MacSwain's (1956) hypothesis that Horiini is a primitive tribe of the Nemognathinae. The presence of only one ocellus in some Horiini was also considered to be a primitive condition (MacSwain 1956), but this character must be re-examined.

The presence of one or two ocelli is one of the most significant characters used to reconstruct phylogenetic relationships among Horiini, because other Nemognathinae triungulins have two ocelli compared with one in the Meloinae. Bugnion (1909) and Cros (1924, 1927, 1938a) described one ocellus in *Horia;* Cros (1927) described two ocelli in *Cissites auriculata* (Champion), but later (Cros, 1938a,b) he recognized only one ocellus in this species and in *C. maculata* (Swederus). MacSwain (1956) correctly identified two ocelli in the genus *Cissites*, but on the basis of Cros' conclusions he recognized only one ocellus in *Horia* (including *Synhoria* as subgenus). We confirmed the presence of two ocelli in the one specimen of *Cissites* in MacSwain's collection (in the California Academy of Sciences, San Francisco) (*Cissites ?maculata* (Swederus) from the Galapagos Islands, on *Xylocopa (Ancylosoma) darwini* Cockerell).

The present study shows that *Synhoria* triungulins have two ocelli (Figs 3, 4). We suspect that all species of this genus have two ocelli, as primarily indicated in *S. maxillosa* (Fabricius) by Cros (1924) and later rejected by the same author (Cros 1938a,b). This character was also described by Cros (1924) in the undetermined triungulin from Kenya, tentatively identified as *S. cephalotes* (see above). The presence of two ocelli in our specimen from Uganda, supports the hypothesis that this species could be a *Synhoria* (*S. senegalensis* or *S. cephalotes*).

The second ocellus, extremely laterally positioned, is not easily visible in dorsal view, but is clearly discernible in SEM examination (Figs 3, 4). This lateral and approximate position of ocelli, and the technical limits of the old microscopes, probably hampered Cros' interpretation of the number of ocelli.

In the triungulin of *Horia* only one ocellus is described, and we confirmed this character on four specimens examined (*Horia* sp., Assam, Doom Dooma, V-11-1943, D.E. Hardy leg., in Prosopidae, Pinto's collection). This supports the hypothesis that a primitive condition exists among the Horiini in *Horia*.

The presence of two ocelli in *Synhoria* invalidates MacSwain's (1956) classification of Horiini genera. No clear diagnostic characters have been found to distinguish *Horia*, *Synhoria* and *Cissites* triungulins, although the presence of one ocellus in *Horia* may separate this genus from the other two. In *Synhoria* and *Horia* the second pair of setae on the posterior margin of sternite VIII are larger and more elongate compared with those of *Cissites*.

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