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NOTES ON THE BIOLOGY OF *EUPHORIASPIS HIRTIPES* (HORN) AND DESCRIPTIONS OF THE LARVA AND PUPA (COLEOPTERA: SCARABAEIDAE)

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ABSTRACT

Euphoriaspis hirtipes (Horn) is a myrmecophilous scarab that occurs only in portions of the prairie region of the central United States. The immature stages are passed within the thatch nests of the genus *Formica*. The eggs remain unknown, but the third instar larva and the pupa are described and illustrated.

INTRODUCTION

Euphoriaspis hirtipes (Horn) (Fig. 1) was originally described in the genus *Euphoria*, but Casey (1915) later established the monotypic genus *Euphoriaspis* for it. Blackwelder (1939) placed *Euphoria aestuosa* Horn in *Euphoriaspis* upon the recommendation of Chapin, but I do not know if this move was justified. *Euphoriaspis*, both morphologically and behaviorally, is a highly derived genus that probably arose from a *Euphoria* or *Euphoria*-like ancestor.

Prior to this study, there were very few specimens of adult *E. hirtipes* in collections with the exception of the University of Nebraska which possessed 125 examples collected in 1905. The immature stages were undescribed and very little was known of the biology of this species other than that adults could be found in some numbers in ant nests (Riley 1882; Schwarz 1889). Examples of adults collected during this study are in a number of institutional and private collections, and examples of the immature stages are in collections of the University of Nebraska, the U.S. National Museum, and the author.

Field-collected 3rd instar larvae were successfully reared in the laboratory. A sandy soil base and an upper layer of ant nest thatch material were placed in plastic shoeboxes at 27°C ± 2°; the thatch provided the organic debris needed for food, and the soil enabled construction of pupal chambers.

Other myrmecophilous Scarabaeidae were also found in the same nests with *E. hirtipes*, including *Euphoria inda* (L.) and several species of *Cremastocheilus*. Great care had to be exercised when dealing with the immature stages because of the considerable similarity in appearance between *Euphoriaspis hirtipes* and *Euphoria inda*. The descriptive treatment of the larvae to follow will differentiate the 2 species.

BIOLOGY

Euphoriaspis hirtipes is a myrmecophilous scarab that occurs only in portions of the prairie region of the central United States. It has adapted

well to an environment of sandy grasslands which are usually hot and dry during the summer and very cold during the winter. Adults are nearly always found within the large thatch nests (Fig. 2) of red ants of the genus *Formica*. The basic form of such a nest is a central, rounded pile of thatch from several centimeters to one meter deep and from several centimeters to 1.5 meters across, depending on the age of the nest. The thatch pile may rise 5-25 cm above the surface of the ground. The thatch consists of seeds, small twigs, bits and pieces of grass stems and other plants, and some soil. The

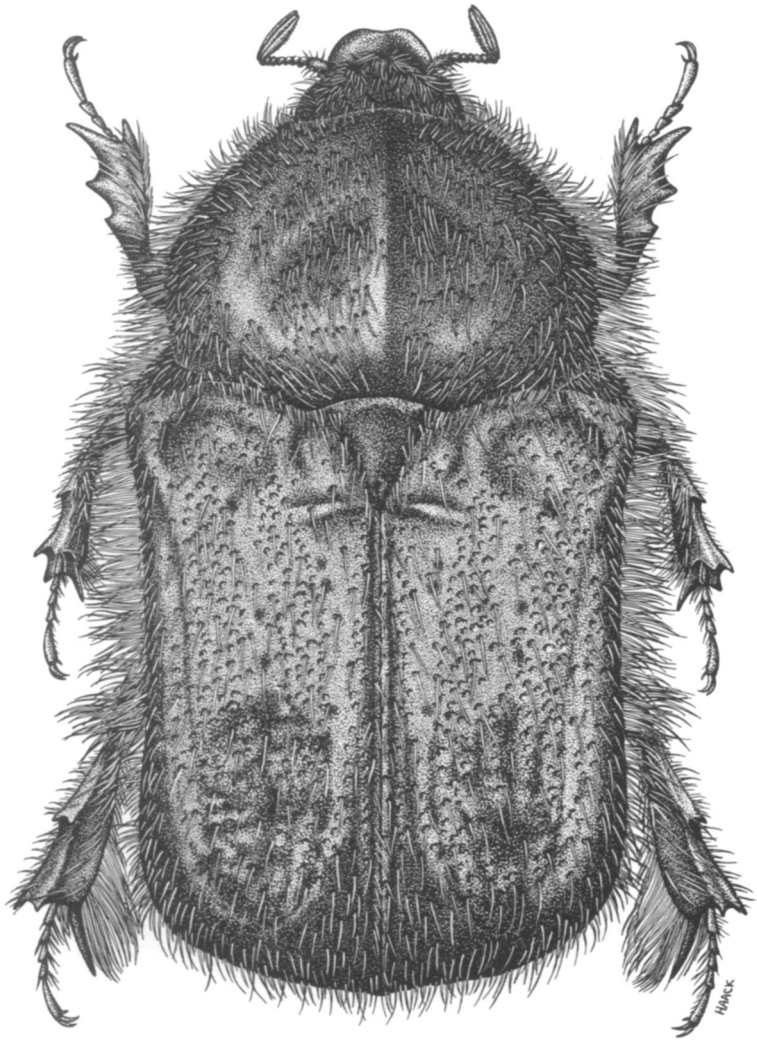

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Fig. 1. Habitus view of adult male *Euphoriaspis hirtipes* (Horn).

ground immediately surrounding the thatch pile is variably honeycombed with ant tunnels, and it is in this region of soil-thatch interface that the larvae and pupae of *E. hirtipes* are most commonly found. Adult beetles are usually scattered randomly throughout the thatch portion of the nest, but most are in the upper 5-25 cm of soil-thatch interface.

Except for one adult taken in flight, all adult beetles were taken in the thatch nests of *Formica* species (*Formica obscuripes* Forel, *F.* near *dakotensis* Emery, and *F.* near *haemorrhoidalis* Emery). I suspect that the beetles can be found with any of the various ant species that construct thatch nests. I have taken as many as 60 larvae and 85 adults from a single nest.

Overwintering adults were found only through early May. Temperatures in the western 2/3 of Nebraska are still cool up until this time, and the adult beetles probably remain clustered within the ant nests to mate and oviposit. The adults seem to leave the nests after the eggs are deposited; I have never found them or their remains in nests during the late spring or summer.

The commensal relationship, if any, between *E. hirtipes* and the ant hosts is uncertain. Clearly, all stages in the life cycle of the beetle are provided some degree of protection, shelter, or food by the ants and their nest, but it remains to be seen what advantage the ants gain from their guests. I *have* seen ants clinging to the humeral region of adult beetles, and this might indicate that the ants are licking some sort of aromatic secretion which is diffused from trichomes on the beetle. Although possible synoecy exists, the beetles are probably treated as symphiles most of the time. Gut analyses by myself and Paul Lago (per. comm.) of adult beetles were negative and so the question remains as to whether adult beetles feed.

Fig. 2. Thatch nest of *Formica* sp.

I have not found the eggs of *E. hirtipes* but believe that they are randomly scattered in the thatch nest material, thus making them extremely difficult to detect. Because larvae have never been seen within a nest during April, I assume the larvae hatch in early May; they then proceed to develop near the periphery of the thatch where they feed on an abundance of decaying organic material. I do not know the exact lengths of each of the 3 instars, but I have taken 2nd and possibly 1st instar larvae from the same nest on May 30. If eggs are deposited from late April until the first 1-2 weeks in May, this would indicate an approximate length of 2-5 weeks for the 1st stage larvae. The 2nd larval stage probably lasts about 3-4 weeks (the month of June), as I have taken well-developed 3rd instar larvae on July 10. Laboratory rearing and field sampling suggest that the 3rd larval stage lasts about 6 weeks (early July to late August).

The larvae are not dependent on their ant hosts for food, *per se*, as an inadvertent experiment demonstrated. At the University of Nebraska's Sandhills Agricultural Laboratory, all the adult *E. hirtipes* were collected from a nest site in early May; the nest was damaged to such an extent that the ants moved and established a new nest 2 meters away. Resampling of the abandoned nest area in mid-July, however, yielded numerous 3rd instar larvae of *E. hirtipes*. Apparently the eggs had been overlooked during the May sampling, and the larvae had hatched and continued to develop and feed on the remaining organic debris in the sandy soil of the abandoned nest; the ants themselves did not actively provide the larvae with food. Had these larvae been left undisturbed they would have probably completed a normal development, the adults then seeking new nests in which to oviposit.

Fig. 3. Pupal cell of *E. hirtipes*.

Laboratory rearing and field sampling indicated that pupation occurs in late August and lasts approximately 10-20 days. An oval, earthen pupal cell (Fig. 3) is formed by the larva prior to pupation, normally 10-25 cm below the surface in the soil adjacent to the central core of thatch material. The winter is then passed by the adult within the ant nest.

Distribution

Euphoriaspis hirtipes is found primarily in the following grassland communities: Nebraska sandhills prairie (*Andropogon-Calamovilfa*); grama-buffalograss (*Bouteloua-Buchloe*); bluestem prairie (*Andropogon-Panicum-Sorghastrum*); wheatgrass-bluestem-needlegrass (*Agropyron-Andropogon-Stipa*); wheatgrass-needlegrass (*Agropyron-Stipa*); and probably bluestem-grama prairie (*Andropogon-Bouteloua*). It is apparently restricted to these prairie areas in Nebraska, eastern Colorado, North Dakota, and possibly a large portion of Kansas and South Dakota. Additional collecting is needed to determine whether the species occurs in Wyoming. Fig. 4 illustrates the collecting records and possible range of *E. hirtipes* based on the ranges of the previously mentioned grassland associations. Searches of the collections at the University of Kansas, the University of Colorado, and the U. S. National Museum did not reveal any additional distributional data, and so the specimens from Nebraska and North Dakota and the larvae from Colorado seem to constitute the only known records. This species is relatively widespread in Nebraska but is most common in the more arid sandhills region in the western part of the state.

Locality Records (Fig. 4).—321 specimens examined (210 adults, 8 pupae, 103 larvae). COLORADO (8): *El Paso:* Colorado Springs. NEBRASKA (313): *Cuming:* West Point; *Custer:* Berwyn; *Dodge* (Horn 1879): Glencoe (10 mi. W. Scribner) (Schwarz 1889); *Garden:* Ash Hollow State Historical Park; *McPherson:* Univ. Nebr. Sandhills Agr. Lab.; *Sheridan:* no data; *Thomas:* Nebraska National Forest. NORTH DAKOTA (Lago, pers. comm.): *Grant; Kidder; Morton; Stutsman.*

Third Stage Larva
(Figs. 5-8)

Maximum width of head capsule (Fig. 5) 3.80 mm; surface of head irregularly reticulate, testaceous. Frons with median, shallow, longitudinal depression; depression forked anteriorly, extending forward from epicranial suture; frons with anterior frontal seta, posterior frontal seta, exterior frontal seta, and anterior angle seta on each side. Dorsoepicranial setae 1-2 large and 5-10 small setae on each side, usually in irregular, oblique line diverging from center-base of head. Labrum trilobed, clithra present. Epipharynx (Fig. 6) without plegmata; haptomeral region with irregular, transverse, curved row of short heli. Left mandible (Fig. 7) with 2 scissorial teeth anterior to scissorial notch and 2 scissorial teeth posterior to same notch. Maxilla (Fig. 8) with galea and lacinia fused, forming mala; mala with 3 unci at apex, unci of lacinia fused at bases. Antennae with 2 dorsal sensory spots on last segment.

Spiracles reniform. Thoracic spiracle with posterior emargination in respiratory plate; each abdominal spiracle with anterior emargination in respiratory plate. Thoracic spiracle 0.35-0.50 mm long and 0.25-0.35 mm wide. Abdominal spiracles about same size as thoracic spiracle.

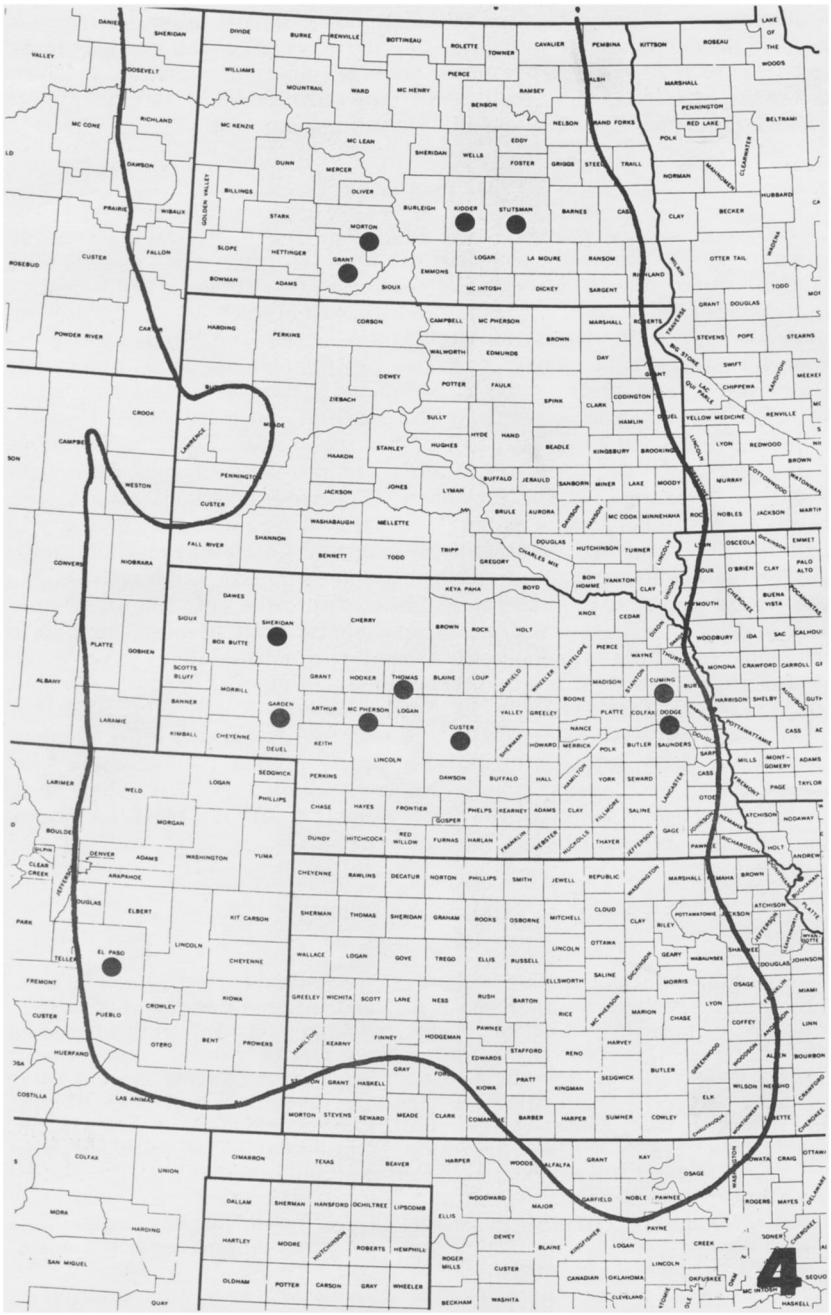
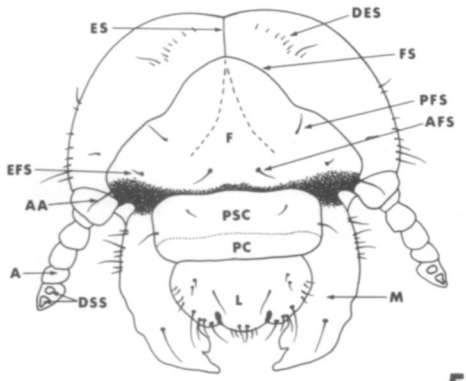


Fig. 4. Distribution of *E. hirtipes*. Dots indicate collecting records, solid line indicates estimated total possible range for the species. See text.

Dorsa of abdominal segments 7 and 8 each with 2 sparse, transverse bands of setae, each band with 2-3 sparse, irregular rows of short, stout setae and a few long setae; each posterior row with several very long setae. Dorsa of abdominal segments 9 and 10 fused. Spiracular areas of abdominal segments 1-8 each with 15-27 setae. Pleural lobes of same segments with several short setae and usually 14-25 long setae. Venter of abdominal segments 1-8 each with long, irregular, transverse row of setae, each row with 23-32 very long setae and some smaller setae. Pedal area of same segments with 5-9 short setae and 3-4 long setae. Raster without pallidia. Teges with numerous posteriorly directed short setae and with several very long setae interspersed laterally. Lower anal lip with numerous short setae as on



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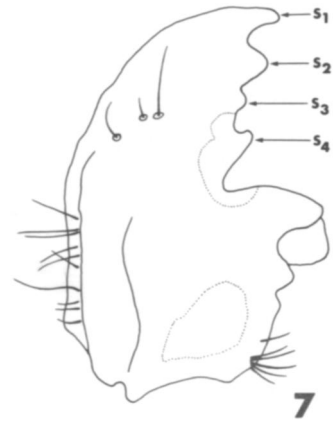

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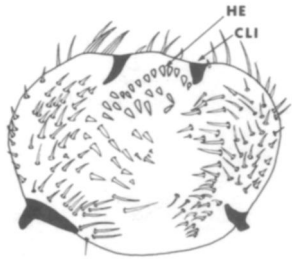

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Fig. 5. Frontal view of head of 3rd stage larva. A, antennae; AA, setae of exterior angle of frons; AFS, anterior frontal setae; DES, dorsoepicranial setae; DSS, dorsal sensory spots; EFS, exterior frontal setae; ES, epicranial suture; F, frons; FS, frontal suture; L, labrum; M, mandible; PC, preclypeus; PFS, posterior frontal setae; PSC, postclypeus.

Fig. 6. Epipharynx of 3rd stage larva. CLI, clithrum; HE, heli.

Fig. 7. Dorsal aspect of left mandible of 3rd stage larva. S_{1-49}, scissorial teeth.

Fig. 8. Ventral aspect of left mala and hypopharynx of 3rd stage larva. GU, unci of galea; LP, labial palp; LU, unci of lacinia; MA, mala; MP, maxillary palp.

teges and with 24-40 long setae; 2-3 very irregular, transverse rows of short setae adjacent to anal slit. Claws on legs cylindrical, each with about 10 setae.

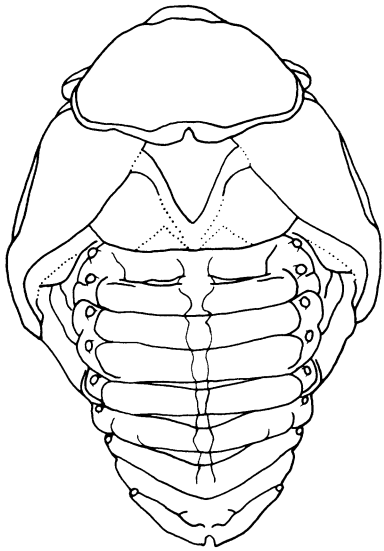
Diagnosis.—*Euphoriaspis hirtipes* may be easily distinguished from the closely related *Euphoria inda* by the following characteristics: Frons in *E. hirtipes* with 8 setae, 4 in *E. inda* (see Ritcher 1945, 1966). Dorsoepicranial setae 6-12 in *E. hirtipes*, 4-6 in *E. inda*. Spiracular area of *E. hirtipes* with 15-27 setae, only 9-13 in *E. inda*. Pleural lobes of *E. hirtipes* with 14-25 long setae, only 12-15 in *E. inda*. Venter of each abdominal segment in *E. hirtipes* with 23-32 long setae, only 14-25 in *E. inda*. Pedal area of *E. hirtipes* with 5-9 short setae and 3-4 long setae, 1-3 short setae and 1-3 long setae in *E. inda*.

PUPA

(Figs. 9-10)

Length 13.8-15.8 mm. Shape elongate, oval, stout, exarate. Color cream white to light yellow-brown; color darkens to dark brown as eclosion approaches. Head ovate, glabrous, bent sharply beneath thorax, mouthparts directed posteriorly. Eyes, antennae, mandibles, and palps clearly discernible. Pronotum orbicular, transverse, widest at base, glabrous. Scutellum of mesothorax large, triangular, partially covering metathorax. Elytra closely appressed and curving ventrally around body, extending posteriorly to 5th abdominal segment.

Fore- and mesofemora extend at approximately 90° from longitudinal axis of body; metafemora sub-perpendicular to longitudinal axis of body.



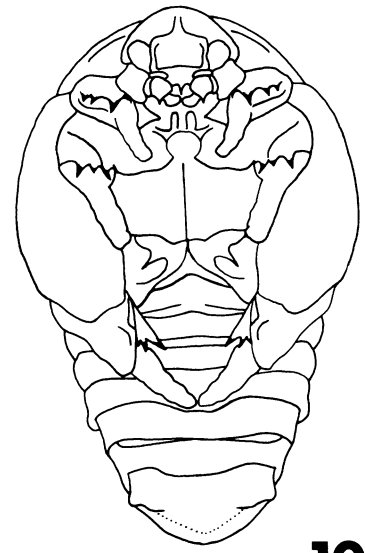


Fig. 9. Dorsal aspect of pupa.

Fig. 10. Ventral aspect of pupa.

Darkly sclerotized apical spines of all tibiae distinct. Legs without setae. Abdomen with 9 movable, glabrous segments, last segments slightly emarginate at apex.

ACKNOWLEDGMENTS

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