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New larval descriptions for two species of *Euphoria* Burmeister (Coleoptera: Scarabaeidae: Cetoniinae: Cetoniini: Euphoriina) with a key to the known larvae and a review of the larval biology for species in the genus.

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New Larval Descriptions for Two Species of *Euphoria* Burmeister (Coleoptera: Scarabaeidae: Cetoniinae: Cetoniini: Euphoriina) with a Key to the Known Larvae and a Review of the Larval Biology

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ABSTRACT The larvae of *Euphoria devulsa* Horn and *Euphoria lurida* (F.) (Coleoptera: Scarabaeidae: Cetoniinae: Cetoniini: Euphoriina) are described for the first time. The larval biology of these species and others in the genus is reviewed. A key to the 7 known species of *Euphoria* larvae is provided.

RESUMEN Se describe por primera vez la larva de *Euphoria devulsa* Horn y de *Euphoria lurida* (F.) (Coleoptera: Scarabaeidae: Cetoniinae: Cetoniini: Euphoriina). Se aportan datos sobre la biología larvaria de dichas especies y de otras especies del género. Se proporciona una clave de identificación para las larvas de especies de *Euphoria* hasta ahora conocidas.

KEY WORDS Scarabaeidae, Cetoniinae, *Euphoria*, larvae, ant associates, packrat middens

THE GENUS *Euphoria* Burmeister (Coleoptera: Scarabaeidae: Cetoniinae: Cetoniini: Euphoriina) contains between 50 and 80 species that occur in the New World from southern Canada to northern Argentina (Blackwelder 1944, Hardy 1988). The highest diversity of *Euphoria* species occurs in México and Central America (Blackwelder 1944, Deloya and Morón 1997). Hardy (1988) estimated that of the 70 names used in the genus *Euphoria*, ≈50 were valid. This total includes *Euphoria hirtipes* Horn, which was previously in the genus *Euphoriaspis* Casey until that genus was synonymized under *Euphoria* by Hardy (1988). Since Hardy's 1988 paper, 2 new species of *Euphoria* have been described. Deloya and Woodruff (1995) described a new species of *Euphoria* from Honduras and stated that there are 65 species in the genus and 35 species in Mexico. Deloya and Nogueira (1996) described a new species from western Mexico and stated that there are 70 species of *Euphoria*, of which 35 species occur in Mexico. Deloya and Morón (1997) declared that 33 species of *Euphoria* occur in Mexico. Krajcík (1998) lists 75 valid species of *Euphoria* and, contrary to Hardy (1988), lists *Euphoriaspis* as a valid genus. With all the imprecise information recently published, it is evident that a revision of the genus *Euphoria* is severely needed.

Although the subfamily Cetoniinae is a diverse group that is found worldwide, there are few explicit descriptions of larval morphology or adult and larval biology. Larvae of *Euphoria* are associated with highly organic matter including compost, dry dung, gopher burrows, packrat middens, debris piles of *Atta* spp. ants, and thatch nests of *Formica* spp. ants. The larvae are generally found 7–14 cm within the soil (Ritcher 1945, 1966; Kohlmann 1979).

Hayes (1925, 1929) was the first to describe the larvae of *Euphoria* [*E. fulgida* (F.), *E. inda* (L.), and *E. sepulcralis* (F.)] and make significant observations on the larval biology. Ritcher (1945, 1966) provided the first refined and detailed descriptions of *Euphoria* larvae when he described *E. fulgida*, *E. herbacea* (Olivier), *E. inda*, and *E. sepulcralis*. Ratcliffe (1976) described the larva and pupa of *E. hirtipes* Horn (as *Euphoriaspis hirtipes*) and discussed the biology of this species. In our current article, we describe *E. devulsa* Horn and *E. lurida* (F.) using the terminology of Ritcher (1966) and Morón (1986), we provide a key to the 7 known larvae in the genus *Euphoria*, and we review the larval biology of *Euphoria* species. In his key to the genera of the subfamily Cetoniinae (based on third-instar larvae), Ritcher (1945, 1966) characterized *Euphoria* larvae as having the following: labrum trilobed; clithra present; claws cylindrical, rounded apically, and bearing 7 or more setae; palidia monostichous if present, parallel or diverging at base. Larval specimens of each species were deposited in the University of Nebraska State Museum. Additional larval specimens are deposited at Oregon State University (*E. devulsa*) and the Entomological Collection of the University of Alicante, Spain (CEUA) (*E. lurida*).

Euphoria devulsa Horn Third-instar larva (Figs. 1–13)

The larval description of *Euphoria devulsa* is based on 5 third-instar larvae collected from packrat (*Neo-*

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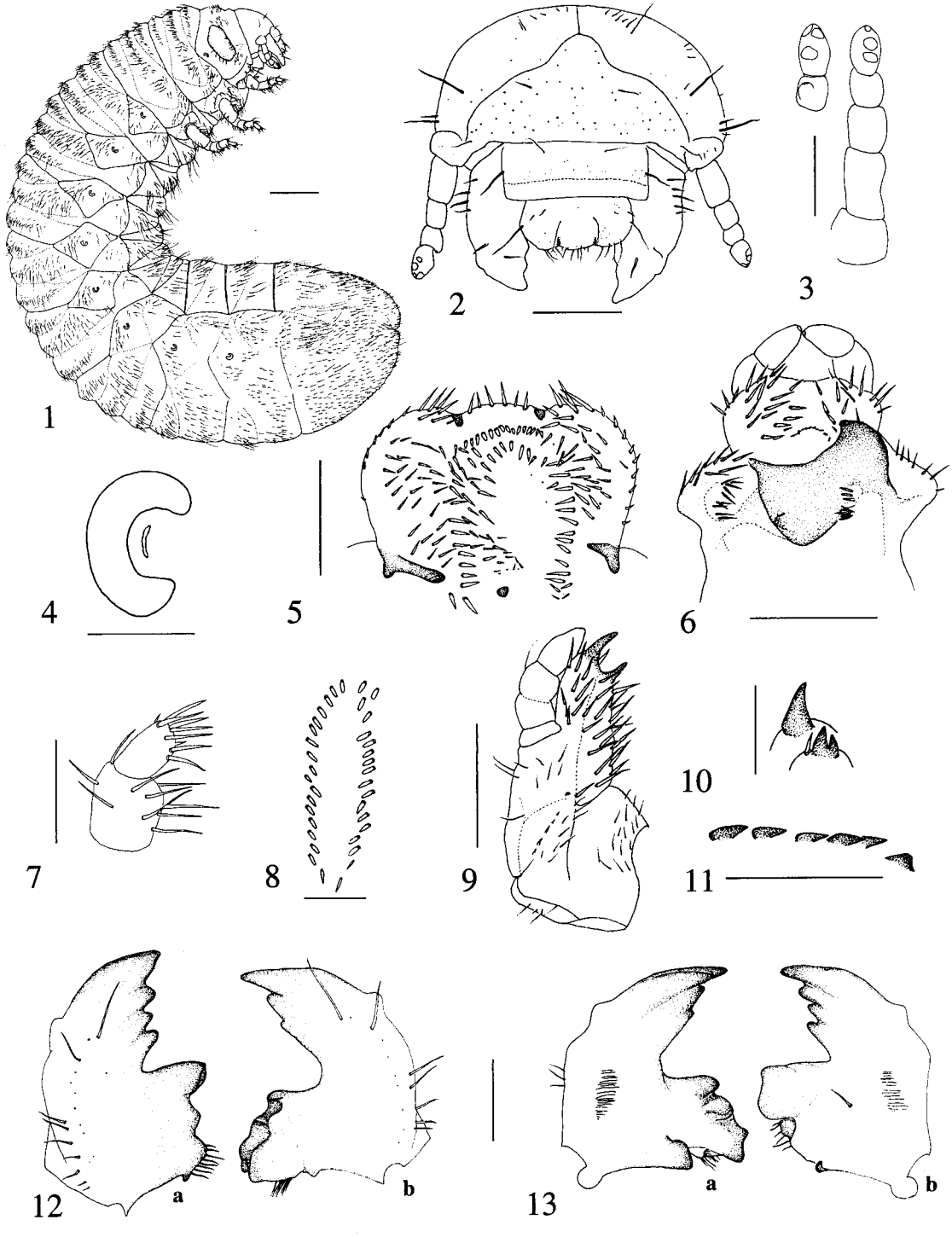


Figs. 1–13. *Euphoria devulsa* third-instar larva. (1) Habitus. (2) Frontal view of head. (3) Dorsal view of antenna and ventral view of apical antennal segment showing sensory spots. (4) Thoracic spiracle. (5) Epipharynx. (6) Dorsal view of hypopharynx. (7) Tarsungulus of anterior leg. (8) Palidia. (9) Dorsal view of maxilla. (10) Apex of right mala showing unci. (11) Stridulatory area of maxilla. (12) Dorsal view of (a) left and (b) right mandibles, respectively. (13) Ventral view of (a) right and (b) left mandibles, respectively. Bar = 0.5 mm, except in Fig. 1 = 2 mm, Fig. 2 = 1 mm, Figs. 7, 10, and 11 = 0.25 mm.

toma micropus Baird) middens with the following collecting data: Laguna Madre, 40 km southeast of Harlingen, TX; 1 May 1945, D. E. Hardy. Six adult specimens that were collected as pupae and reared to adulthood were identified by M. Robinson. Specimens are housed at Oregon State University and the University of Nebraska State Museum.

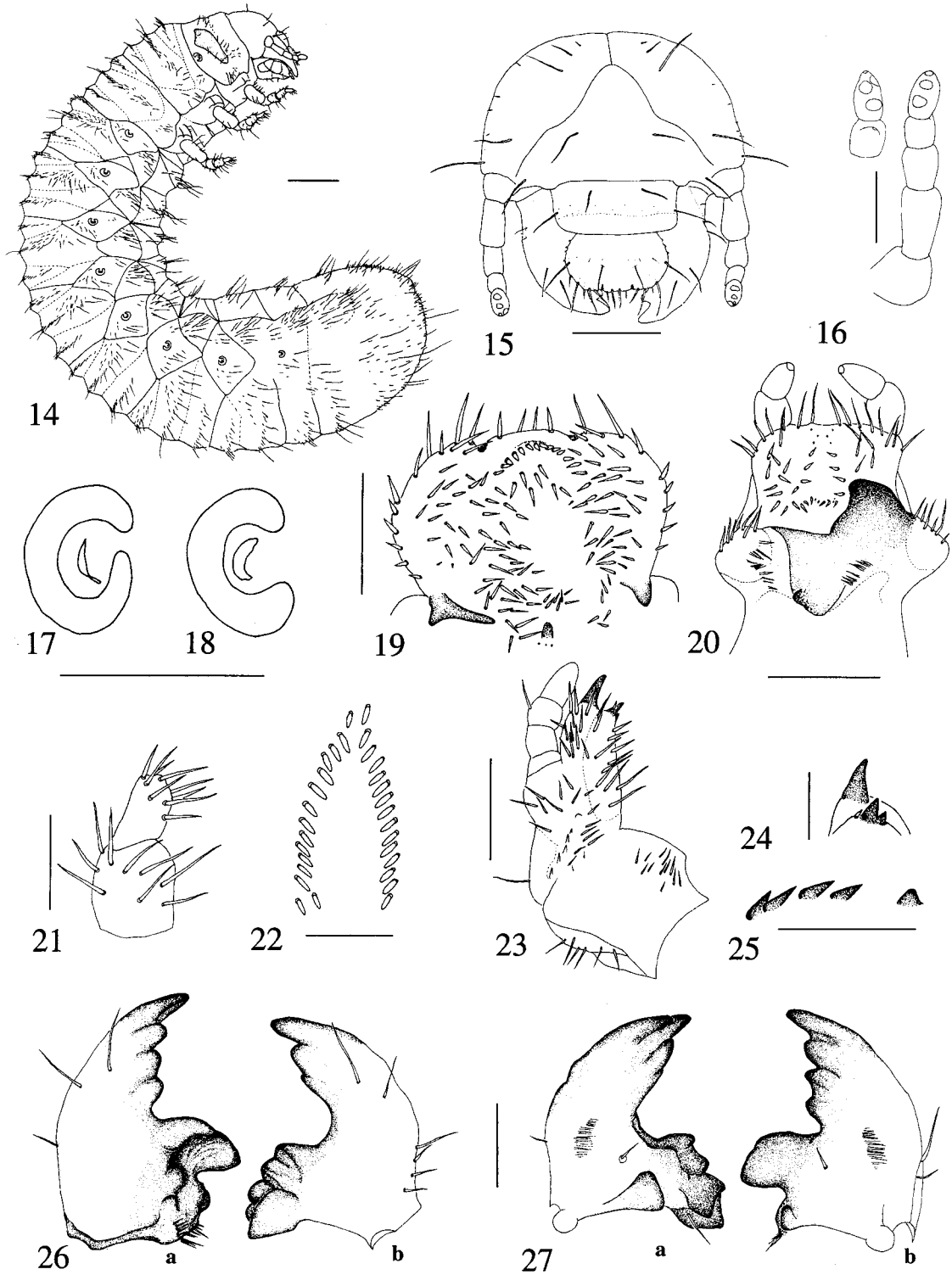
Description. Width of head capsule 3.5 mm. *Cranium* (Fig. 2). Surface light yellowish-brown, finely reticulate. Frons punctate at base, distance between punctures ≈4 times diameter of puncture; frons with single posterior frontal seta and single anterior angle seta on each side. Dorsoepicranium with 2–6 moderately long and 1 long setae on each side. *Clypeus.* Shape rectangular. Postclypeus punctate at base, distance between punctures >4 times diameter of puncture, with anterior clypeal seta and exterior clypeal seta on each side. Preclypeus poorly sclerotized, glabrous. Labrum trilobed, clithra present. *Epipharynx* (Fig. 5). Plegmatia absent. Corypha with 4 long setae. Haptomeral region with slightly curved, transverse row of 13–16 short heli. Acanthoparia with 7–9 short, sickle-shaped setae. Gymnoparia narrowed. Chaetoparia setose, with straight, longitudinal row of 14–16, long, stout setae on each side. Dexiotorma long with pternotorma present. Laeotorma short with pternotorma present, 1/2 length of dexiotorma. Nesia with sensorial cone. *Left Mandible* (Figs. 12a and 13b). Scissorial region with 2 teeth anterior to scissorial notch and 2 teeth posterior to notch; stridulatory area elongate-oval with ≈15 stridulatory ridges. Lateral face with 5 setae. Dorsal surface apical to molar area with 2 setae. Molar area bilobed, with 2 dorsomolar setae; basomedial angle with brustia consisting of 6–9 setae; basolateral angle with preartis. Prominent process at the lateral edge adjacent to scissorial teeth. *Right Mandible* (Figs. 12b and 13a). Scissorial region with 4 teeth; stridulatory area elongate-oval with ≈19 stridulatory ridges. Lateral face with 4–7 setae. Dorsal surface apical to molar area with 2 setae. Molar area trilobed, with 2 dorsomolar setae; basolateral angle with preartis; calx present. Prominent process at lateral edge adjacent to scissorial teeth. *Maxilla* (Fig. 9). Galea and lacinia fused (forming mala). Mala with 4 rows of setae and unci; galea with large uncus at apex, lacinia with 2 unci at apex (terminal unci fused at base) (Fig. 10). Cardo with 4–7 setae; stridulatory area (Fig. 11) consisting of a row of 5–6 curved, acute teeth and small, anterior conical process. *Labium* (Fig. 6). Hypopharyngeal sclerome with well-developed truncate process on right side, 2 groups of ≈10 setae on each side. Lateral lobe with 6–7 setae on each side. Glossa at apex with 4–5 sensillae, disc with 14–16 setae set in 2 or 3 rows on each side, base with transverse row of ≈11 short setae. *Antennae* (Fig. 3). Four-segmented. Apical segment with 2 dorsal and 3 ventral sensory spots. *Spiracles* (Fig. 4). Thoracic and abdominal spiracle size 0.25–0.26 mm high, 0.17–0.19 mm wide; respiratory holes irregularly suboval with ≈14 holes across diameter. *Legs.* Tarsunguli cylindrical (Fig. 7), rounded at apex, bearing 11–12 setae. *Body vestiture* (Fig. 1). Dorsa of abdominal segments I-VII with 2–4 rows of short setae, each posterior row with long to short setae. Abdominal segments IX-X fused, densely setose with short, acute setae and widely separated, long setae. Spiracular area of abdominal segments I-VIII with 12–24 short to long setae. Pleural lobes of abdominal segments I-VIII with 13–25 short to long setae. Raster (Fig. 8) with pair of palidia joined anteriorly and slightly diverging posteriorly; each palidium consisting of 13–17 pali. Septula 2.4 times longer than wide, weakly rounded anteriorly. Tegilla composed of short and long, straight, acute setae, united anterior to palidia. Lower anal lip with ≈60 short, acute setae. Approximate dorsal body length: 41 mm.

Remarks. *Euphoria devulsa* differs from other known *Euphoria* larvae by the following combination of characters: spiracles of the abdominal segments similar in size, raster with palidia, and lower anal lip with ≈60 short setae. Larvae of *E. devulsa* were found in packrat middens. Adults have been found in nests of harvester ants, *Pogonomyrmex* sp. (Hardy 1988), and larvae may also develop here.

Euphoria lurida (F.) Third-instar larva
(Figs. 14–17, 19–27)

The larval description of *E. lurida* is based on 3 third-instar larvae and 9 second-stage larvae reared from 18 second-stage larvae by José R. Verdú from an old dung pat at Horto Florestal, Rio Claro, State of São Paulo, Brazil on 20 September 1996. Six adult specimens collected as second-instar larvae and reared to adulthood were identified by M. Jameson. Specimens are deposited at the University of Alicante Entomology Collection (CEUA) and University of Nebraska State Museum.

Description. Width of head capsule 3.0 mm. *Cranium* (Fig. 15). Surface light yellowish-brown, finely reticulate. Frons with single posterior frontal seta and single anterior angle seta on each side. Dorsoepicranium with 1 long and 1–2 short setae. *Clypeus.* Shape rectangular. Postclypeus with anterior clypeal seta and exterior clypeal seta on each side. Preclypeus poorly sclerotized, glabrous. Labrum trilobed, clithra present. *Epipharynx* (Fig. 19). Plegmatia absent. Corypha with 4 long setae. Haptomeral region with curved, transverse row of 12 short heli. Acanthoparia with 5–6 short, sickle-shaped setae. Gymnoparia narrowed. Chaetoparia densely setose in indistinct rows. Dexiotorma long with pternotorma present. Laeotorma short with pternotorma present, 1/2 length of dexiotorma. Nesia with sensorial cone. Haptolauchus with 3 sensillae basal to sensorial cone. *Left Mandible* (Figs. 26a and 27b). Scissorial region with 2 teeth anterior to scissorial notch and 2 teeth posterior to notch; stridulatory area elongate-oval with ≈24 stridulatory ridges, length >2 times the width. Lateral edge with 3–6 setae. Dorsal surface apical to molar area with 2 setae. Molar area bilobed, with 2 dorsomolar setae; basomedial angle with brustia consisting of 8–10 setae; basolateral angle with preartis. *Right Mandible* (Figs. 26b and 27a). Scissorial region with 4 scissorial teeth; stridulatory area elongate-oval with ≈21 stridulatory



Figs. 14–27. *Euphoria lurida* third-instar larva. (14) Habitus. (15) Frontal view of head. (16) Dorsal view of antenna and ventral view of apical antennal segment showing sensory spots. (17) Thoracic spiracle. (18) Thoracic spiracle of *Euphoria sepulcralis* third-instar larva. (19) Epipharynx. (20) Dorsal view of hypopharynx. (21) Tarsungulus of anterior leg. (22) Palidia. (23) Dorsal view of maxilla. (24) Apex of right mala showing unci. (25) Stridulatory area of maxilla. (26) Dorsal view of (a) left and (b) right mandibles, respectively. (27) Ventral view of (a) right and (b) left mandibles, respectively. Bar = 0.5 mm, except in Fig. 14 = 2 mm, Fig. 15 = 1 mm, Figs. 21, 24, and 25 = 0.25 mm.

ridges. Lateral face with 6–7 setae. Dorsal surface apical to molar area with 2 setae. Molar area trilobed, with 2 dorsomolar setae; basolateral angle with preartis; calx present. *Maxilla* (Fig. 23). Galea and lacinia fused (forming mala). Mala with 4 rows of setae and unci; galea with large uncus at apex, lacinia with 2 unci at apex (terminal unci fused at base) (Fig. 24). Cardo with 3–8 setae; stridulatory area (Fig. 25) consisting of a row of 5–6 curved, acute teeth and small, anterior conical process. *Labium* (Fig. 20). Hypopharyngeal sclerome with well developed truncate process at right side, 2 groups of ≈10 setae on each side. Lateral lobe with 6–7 setae on each side. Glossa at apex with 5–6 sensillae, disc with 2–3 rows of setae on each side and base with transverse row of ≈10 short setae. *Antennae* (Fig. 16). Apical segment with 2 dorsal and 3 ventral sensory spots. *Spiracles.* Thoracic spiracle (Fig. 17) size 0.34–0.38 mm high, 0.24–0.25 mm wide; respiratory holes irregularly suboval with ≈23 holes across the diameter. Spiracles of abdominal segments I-VII similar in size to thoracic spiracles, those of abdominal segment VIII slightly smaller. *Legs.* Tarsunguli cylindrical (Fig. 21), rounded at apex, bearing 9 setae. *Body Vestiture* (Fig. 14). Dorsa of abdominal segments I-VII with 2–4 rows of short setae, each posterior row with long to short setae. Abdominal segments IX-X fused, sparsely setose with short and long setae. Spiracular area of abdominal segments I-VIII each with 7–16 short to long setae. Pleural lobes of abdominal segments I-VIII with 12–15 short to long setae. Raster (Fig. 22) with pair of palidia joined anteriorly and slightly diverging posteriorly; each palidium consisting of 15–19 pali. Septula 2.2 times longer than wide, weakly rounded anteriorly. Tegilla composed of short and long, straight, acute setae, united anterior to the palidia. Lower anal lip with ≈17 short and long setae and a transverse row of 13 cylindrical long setae. Approximate dorsal body length: 41 mm.

Remarks. *Euphoria lurida* differs from other known *Euphoria* larvae by the following combination of characters: spiracles of the abdominal segments I-VII similar in size, those of the abdominal segment VIII slightly smaller, raster with a pair of palidium joined anteriorly and slightly diverging posteriorly, each palidium consisting of 15–19 pali. Larvae of *E. lurida* were found in an old dung pat.

Key to Species of the Known Third-Instar Larvae of the Genus *Euphoria*

1. Spiracles of the abdominal segments similar in size 2
1′. Spiracles of the abdominal segments I-VII similar in size, those of the abdominal segment VIII slightly smaller 5
2. Raster without palidia 3
2′. Raster with palidia 4
3. Cranium with exterior frontal setae and anterior angle setae present . . . *Euphoria hirtipes* Horn
3′. Cranium with exterior frontal setae and anterior angle setae absent . . . . . *Euphoria inda* (L.)
4. Lower anal lip with ≈25 long setae. Thoracic spiracles ≈0.50 mm long and 0.34 mm wide. Respiratory plate with maximum of ≈30 holes along any diameter . . . *Euphoria fulgida* (F.)
4′. Lower anal lip with ≈60 short setae. Thoracic spiracles ≈0.26 mm long and 0.19 mm wide. Respiratory plate with maximum of ≈14 holes along any diameter . . *Euphoria devulsa* Horn
5. Each palidium of raster with >12 pali; palidia joined anteriorly, parallel or slightly diverging posteriorly (Fig. 22). 6
5′. Each palidium of raster with <12 pali; the 2 palidia parallel . . *Euphoria herbacea* (Olivier)
6. Each palidium of raster with 15–19 pali; thoracic spiracles with distance between 2 lobes of respiratory plate much less than diameter of the plate at the middle (Fig. 17) . . . . . *Euphoria lurida* (F.)
6′. Each palidium of raster with 12–16 pali; thoracic spiracles with distance between 2 lobes of respiratory plate wider than diameter of plate at middle (Fig. 18) . . . *Euphoria sepulcralis* (F.)

A Review of the Biology of *Euphoria* Immatures

***Euphoria* Eggs.** Female *Euphoria* spp. generally deposit eggs in moist, organic substrates such as piles of composting vegetative matter, dung, packrat middens, or ant nests (Ritcher 1966, Ratcliffe 1976, Hardy 1988). Hayes (1925) noted that eggs of *E. fulgida* were deposited singly within the substrate rather than in clusters. Ratcliffe (1976), in his study of *E. hirtipes* in black field ant (*Formica* sp.) nests, found high concentrations of all stages of larvae and adults but was unable to find any eggs. He assumed that eggs were scattered throughout the thatch nest and therefore difficult to find (like finding a needle in a haystack!). Hayes (1925) recorded that the egg stage lasted 8–13 d in *E. fulgida* and 9–13 d in *E. sepulcralis.*

***Euphoria* Larvae in Dung and Compost.** Hayes (1925) collected *E. sepulcralis* larvae under dung in different habitats including "high upland prairie pastures" and "low, sandy dune soils" in a river valley near Manhattan, KS. Ritcher (1945, 1966) found *E. sepulcralis* larvae "under a piece of dead bluegrass sod" in Kentucky. *Euphoria sepulcralis* larvae apparently develop in manure, decaying organic matter, or moist organic soil regardless of biotope. The same seems to be true of other species such as *E. herbacea*, *E. fulgida*, and *E. lurida.* Hayes (1925) successfully reared a number of *E. fulgida* larvae on manure and other decaying vegetable matter. Ritcher (1945, 1966) found that *E. herbacea* larvae feed in both wooded and bluegrass pastures in Kentucky and are found at a depth of ≈7–8 cm. José R. Verdú collected the larval specimens of *E. lurida* used in our descriptions from an old dung pat in Horto Florestal, Rio Claro, Brazil. Lugger (1899) noted that the larvae of *E. inda* were abundant under rotting melons, potatoes, and other compost in a poorly drained area. Blatchley (1910) recorded *E. inda* larvae in rotting wood. Ritcher (1945, 1966) observed *E. inda* larvae in organic soil under or near hay and

straw stacks, compost, and manure in Gay Mills, WI. Kohlmann (1979) found the larvae of the same species in similar habitats near Mexico City, Mexico, noting that all stages of larvae were found 4–17 cm deep in the soil. Kohlmann (1979) hypothesized that the depth at which the larvae were found was a function of the depth of the organic soil layer. Generally, *E. inda* larvae can be found anywhere in the rich organic soil found between the surface and the deeper inorganic (mineral) soil. Ritcher (1945, 1966) also had specimens from Springfield, MA, that were associated with the roots of *Akebia quinata* (Houttuyn) Decaisne (an introduced vine native to eastern Asia) (Voss 1985). It is unclear if the larvae were actually feeding on the living root system of the plant or simply feeding on the organic matter in the surrounding soil.

***Euphoria* Larvae in Ant Nests and Refuse Piles.** Ratcliffe (1976) gave a detailed description of the larval biology of *E. hirtipes*, a myrmecophilous species in which all life stages were found in association with the large thatch nests (consisting of seeds, small twigs, bits and pieces of grass stems and other plants, and some soil) of *Formica* species in Nebraska, North Dakota, and Colorado. Windsor (1964) reported *E. hirtipes* (incorrectly identified as *E. inda*) associated with *Formica obscuripes* Forel nests in shortgrass prairie in Colorado. Lago et al. (1979) found *E. hirtipes* in *F. obscuripes* nests in North Dakota. Ratcliffe (1976) described the basic form of the ant nests as a "pile of thatch from several centimeters to one meter deep and from several centimeters to 1.5 m across, depending on the age of the nest." Ratcliffe (1976) observed that the larvae and pupae of *E. hirtipes* were most abundant in the stratum where the thatch pile meets the moist organic soil. Here the larvae feed on the abundance of decaying organic material. Although *E. hirtipes* is always associated with ant nests, the larvae are able to develop normally in the thatch piles even in the absence of ant hosts (Ratcliffe 1976). Ratcliffe (1976) resampled an abandoned nest ≈2.5 mo after the ants had left and found numerous third-instar larvae of *E. hirtipes* that had developed from the egg stage without the company of living ants. The habitat within the thatch nest seems to be similar to the moist, organic compost piles that are optimal for the development of some of the other *Euphoria* species. It is possible that the ancestral *E. hirtipes* were incidental visitors in the thatch nest before they became reliant on this habitat for survival. Other species of *Euphoria* are ant associates. Dugés (1887) collected *Euphoria canescens* (Gory & Percheron) larvae and adults under debris piles of *Atta cephalotes* (L.) ants, probably near Guanajuato, Mexico. Wheeler (1910) noted that *E. inda* larvae develop in nests of *Formica* species. Hinton and Ancona (1935) found larvae and adults of *E. lineoligera* Blanchard, *E. pulchella* (Gory & Percheron), and *E. dimidiata* (Gory & Percheron) under debris piles of *Atta sexdens* (L.) in Tejupilco, state of Mexico. Rojas (1986) collected larvae and adults of *E. dimidiata* and *E. lineoligera* under debris piles of *Atta mexicana* (Smith) ants in Higuerillas, Querétaro, Mexico. Hardy (1988) collected numerous *E. dimidiata* (Gory & Percheron) pupae "in the soil beneath debris piles of *Atta* sp. in Jalisco, Mexico" and also found fragments of *E. lineoligera* adults. Hardy (1988) also reported that *E. canescens* occurs in *Atta* nests. Deloya (1988) listed *E. leucographa* (Gory & Percheron), *E. dimidiata*, and *E. lineoligera* as part of the entomofauna associated with debris piles of *Atta mexicana* in Acahuizotla, Guerrero, Mexico. Deloya and Morón (1994) cited the collection of larvae and adults of *E. dimidiata*, *E. pulchella*, *E. biguttata* (Gory & Percheron), *E. canescens*, *E. subtomentosa* Mannerheim, and *E. lineoligera* under the debris piles of *Atta mexicana* in Acamilpa and Cerro del Higuerón, Morelos, Mexico. One of us (M.A.M.) also collected larvae and adults of nearly all the above cited species in the same habitat but in Ajijic, Jalisco, and near Mezquititlán, Hidalgo, Mexico, during 1976 and 1980. Peter Holm collected larvae and adults of *E. canescens* and *E. lineoligera* from debris piles of *Atta* species at Alamos, Sonora, Mexico in October 1996 (specimens deposited at the University of Nebraska State Museum).

***Euphoria* Larvae in Packrat Middens.** The specimens of *E. devulsa* used in our description were collected by D. E. Hardy in *Neotoma micropus* (packrat) middens from Laguna Madre, TX. A. R. Hardy (1988) noted that *E. devulsa* adults also occur in *Pogonomyrmex* sp. ant nests. According to the label data on adult specimens *E. fulgida limbalis* Fall, *E. sepulcralis nitens* Casey, *E. kerni* Haldeman, and *E. fascifera trapezium* Casey are also associated with packrat nests (Hardy 1988). Packrat middens are well known sources of fossil insects (see Elias 1987, 1992). Elias (1992) reported finding *E. kerni* in late Quaternary packrat middens from the Chihuahuan desert. Careful study of contemporary packrat middens may reveal additional biological habits of some species of *Euphoria.* Henry Dybas reportedly reared many *E. discicollis* (Thomson) adults from larvae collected in soil near the dung chamber of *Geomys* sp. pocket gophers (Hardy 1988). Skelley (1991) reported that larvae of *Stephanucha thoracica* Casey inhabit *Geomys pinetus* Rafinesque mounds in north central Florida. Skelley's (1991) findings about *Stephanucha* species are congruent with the observations of *Euphoria* larval biology, thus establishing a common pattern for the subtribe Euphoriina (sensu Hardy 1988).

***Euphoria* Pupae.** There have been a few observations of the pupal stages of *Euphoria.* The only description of *Euphoria* pupa is by Ratcliffe (1976) for *E. hirtipes.* Kohlmann (1979) observed (near Mexico City) that *E. inda* larvae migrated down to the stratum between the organic and inorganic soil layers to pupate. Ratcliffe (1976) noted a similar behavior in *E. hirtipes.* Kohlmann (1979) also observed that *E. inda* prepupae have black fecal matter (analyzed as plant fibers and small pieces of nondigested plant tissue) accumulate in the terminal segments of the abdomen, which is easily seen through the transparent surface. Hayes (1925) (for *E. fulgida* and *E. sepulcralis*) and Kohlmann (1979) (for *E. inda*) observed that the fecal material is secreted by the larvae to construct an earthen pupal cell. The pupal cell consists of soil ce-

mented together with the fecal matter (Hayes 1925). Kohlmann (1979) also noted that "the cocoon is made of mineral soil, it is oval shaped, is 17-20 mm in length and 13-15 mm width, the wall is 1 mm thick." Ritcher (1945, 1966) observed *E. inda* pupae within oval earthen cells formed by the larvae 5–13 cm under the surface. Ratcliffe (1976) observed the same in *E. hirtipes* at 10–25 cm under the surface.

***Euphoria* Overwintering Strategies.** Two different overwintering strategies have been observed in *Euphoria* species. *Euphoria sepulcralis* (Hayes 1925; Ritcher 1945, 1966), *E. hirtipes* (Ratcliffe 1976), and *E. inda* (Ritcher 1945, 1966; Kohlmann 1979) overwinter (or remain quiescent during the dry season in Mexico) as adults. *Euphoria fulgida* (Hayes 1925) and *E. herbacea* (Ritcher 1945, 1966) overwinter in the soil in the prepupal stage.

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