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THE BLISTER BEETLES OF FLORIDA (Coleoptera: Meloidae)[1]

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The family Meloidae - blister beetles - contains about 2500 species, divided among 80 genera and 3 subfamilies. Florida has 26 species, only a small fraction of the total number in the U.S. but nearly three times that in the West Indies [12]. Adult beetles are phytophagous, feeding especially on plants in the families Amaranthaceae, Compositae, Leguminosae, and Solanaceae. Most adults eat only floral parts, but some, particularly those of **Epicauta** spp., eat leaves as well. A few adults are nocturnal; most are diurnal or show no distinct diel cycle. Since adults are gregarious and often highly colored, they tend to be conspicuous. However, except for first instar larvae (triungulins) frequenting flowers or clinging to adult bees, larval blister beetles are seldom seen. So far as known, all larvae are specialized predators. Larvae of most genera enter the nests of wild bees, where they consume both immature bees and the provisions of one or more cells. Those of some Meloinae, including most **Epicauta** spp., prey on the eggs of acridid grasshoppers. A few larvae evidently prey on the eggs of blister beetles [11]. Of the Florida species, **Nemognatha punctulata** LeC. [misidentified as **Zonitis vittigera** (LeC.)] has been found in a nest of a **Megachile** sp. in Cuba [9] and several members of the genus **Epicauta** have been associated with the eggpods of **Melanoplus** spp.

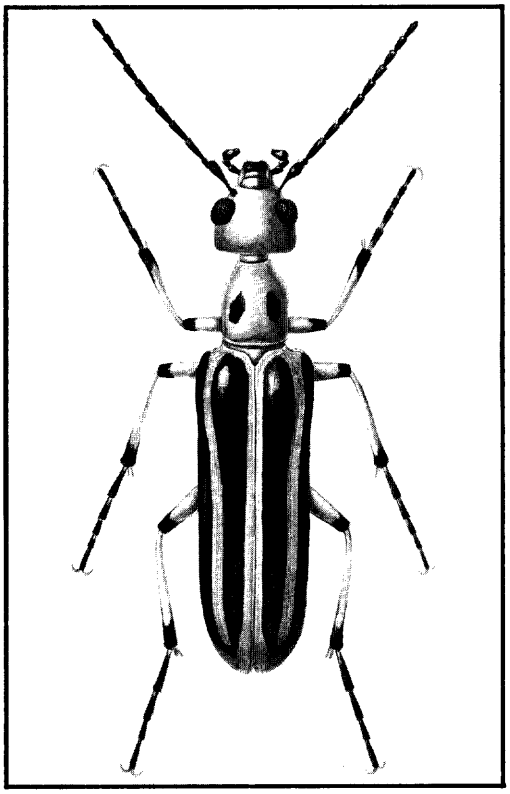

Fig. 1. **Pyrota lineata**, adult.

Identification. Adults (Fig. 1) are rather soft-bodied, long-legged beetles with the head deflexed, fully exposed, and abruptly constricted behind to form an unusually narrow neck, the pronotum much narrower at the anterior end than the posterior and not carinate laterally, the forecoxal cavities open behind, and (in all Florida species) each of the tarsal claws cleft into two blades. Body length generally ranges between 3/4 and 2 cm in the Florida species. Families with which blister beetles are likely to be confused are Oedemeridae (see [3]) and Lagriidae.

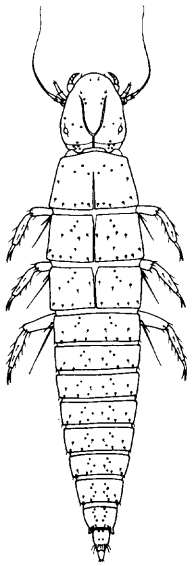

Fig. 2. **Nemognatha piazata**, triungulin.

Triungulin larvae of Nemognathinae (Fig. 2) found in flowers or attached to the hairs of bees are sometimes mistaken for those of Rhipiphoridae. In both groups the body is navicular and heavily sclerotized and there is a definite pattern of setation. Nemognathine larvae are distinctive in having 1-2 (not 4-5) stemmata on each side of the head, an ecdysial line on the thorax, and no pulvilli.

Keys to genera for adult beetles and triungulin larvae are given in references [2] and [7], respectively. Adults of most of the Florida species are described by Enns and Werner [4,13].

Life Cycle. Eggs are laid in masses in the ground or under stones (Meloinae) or on the food plants of adults (Nemognathinae). Larval development is hypermetamorphic, with 4 distinct phases (Fig. 3).

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In the first instar or triungulin (T) phase the larva reaches its feeding site on its own (most Meloinae) or is carried there by an adult bee, to which the larva attaches from a flower [Meloini (not in Florida) and Nemognathinae]. After feeding to repletion, the larva, with ecdysis, becomes scarabaeiform and enters a period of rapid growth (first grub phase, FG) that lasts until the end of instar 5 or 6. In some species that prey on bees the FG larva uses only a single cell; in others it digs into nearby cells and devours their contents. In Meloinae the fully fed FG larva generally excavates a chamber apart from the feeding site. In instar 6 or 7 the larva typically becomes heavily sclerotized and immobile (coarctate phase, C). In this phase the musculature undergoes profound degeneration and respiration is reduced to an extremely low level, permitting survival for more than a year, if necessary. When development resumes the muscles regenerate and, with ecdysis, the larva once again becomes scarabaeiform (second grub phase, SG); at this point it may or may not excavate a pupal chamber. Nemognathinae are unusual in that the SG larva and following pupa and adult are encapsulated by the cast but intact skins of the last instar FG larva and the C larva.

Several alternative developmental pathways have been identified (Fig. 3). In response to high temperature, many **Epicauta** larvae pupate directly from the FG phase or fail to diapause in the C phase; both patterns are conducive to multivoltinism. Rarely, a larva pupates directly from the C phase. Presumably in response to adverse environmental conditions, larvae of several genera of Meloinae can return to the C phase after reaching the SG phase. Most species pass the winter or dry season as coarctate larvae; a few do so as diapausing eggs, triungulin larvae, or adults.

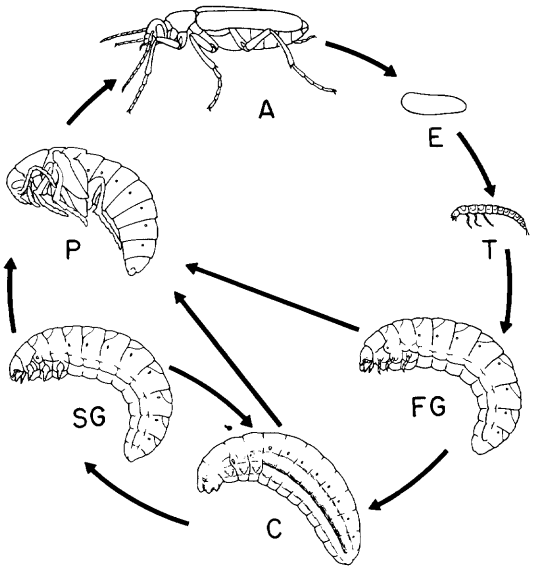

Fig. 3. Life cycle.

Adults commonly live 3 months or more. Females typically mate and oviposit periodically throughout their adult lives.

Cantharidin. Blister beetles receive their common name from the ability of their hemolymph to produce blistering on contact with human skin. Hemolymph is often exuded copiously by reflexive bleeding when an adult beetle is pressed or rubbed. Blisters commonly occur on the neck and arms, as the result of exposure to adult beetles attracted to outdoor lights at night. General handling of adults seldom results in blistering unless the hemolymph contacts the relatively thin skin between the fingers.

The blistering agent is cantharidin, an odorless terpene (exo-1,2-**cis**-dimethyl-3,6-ep-oxyhexahydrophthalic anhydride) occurring elsewhere only in beetles of the family Oedemeridae [3]. Cantharidin or cantharides (dried, pulverized bodies of adult beetles) was once employed extensively in human and veterinary medicine, primarily as a vesicant and irritant and is still used in the U.S. as the active ingredient in a proprietary wart remover. Taken internally or absorbed through the skin, cantharidin is highly toxic to mammals. There is an extensive literature dealing with its reputed aphrodisiacal properties and numerous reports of human poisonings, both accidental and deliberate. Cantharides is sometimes specified as the Eurasian **Lytta vesicatoria** (L.) ("Spanish Fly"); however, other genera, particularly **Mylabris** and **Epicauta**, have been more commonly used, especially for extraction of cantharidin. Recorded cantharidin content of adult beetles (by dry weight) ranges from less than 1% to a high of 5.4%. Biological synthesis and function have been largely neglected. It is widely assumed that cantharidin confers chemical protection from predators, but there is little evidence for this. In at least some species females receive large quantities of cantharidin from males during copulation. In any case, females incorporate the material in a coating applied to the eggs.

Recent cases of fatal poisonings of valuable horses in Florida, Oklahoma, Tennessee, and Texas by ingestion of blister beetles trapped in baled alfalfa hay [6,10] have revived interest in the pathology of cantharidin toxicosis and led to the development of a highly sensitive technique for detection of the compound [8]. Poisonings have been traced to adults of **Epicauta occidentalis** Werner and, possibly, **E. temexa** Adams & Sel. Neither species occurs in Florida, but a close relative [**E. vittata** (Fabr.)] and 3 other species of the genus [**E. fabricii** (LeC.), **E. pennsylvanica** (DeG.), and **E. pestifera** Werner] occur in alfalfa fields here and pose a potential threat if horse owners turn to locally grown alfalfa as a source of hay.

Crop Damage. Several of the Florida blister beetles feed on cultivated plants. Species of **Epicauta**, particularly **E. pestifera** and **E. vittata**, often damage alfalfa, beet, potato, tomato, and other crops by defoliation. Because of the beetles' gregarious behavior, their attacks can be locally catastrophic. Carbaryl, marketed as Sevin, is frequently recommended when control is indicated. In small gardens, it may be sufficient simply to pick the beetles from the plants.

Geographic Distribution. Fourteen of the Florida species are limited largely or entirely to the Atlantic and/or Gulf coasts of the U.S., 10 are more or less widely distributed in the central and/or eastern states, and 2 occur both in the southeastern U.S. and the West Indies. No species is endemic. Both species ranging into the West Indies belong to South and Central American groups and probably reached the continental U.S. from the islands. A third, weaker faunal link with the West Indies is represented by **Pseudozonitis longicornis** (Horn), whose group includes 1 West Indian species and 2 relictual species in east Texas [4,12].

Annotated List of Species

In the following list, geographic distribution outside Florida is not summarized for species that range considerably beyond the Gulf and Atlantic coasts in the U.S. Seasonal distribution is not mentioned for species that are active in the adult stage from spring to late summer or early fall. In general, summaries of food plants do not pertain exclusively to Florida.

Meloinae

Pyrota limbalis LeC. Washington, D.C., S to Highlands Co., Florida. One record at light.

P. lineata (Ol.). Northern Florida, including the panhandle, S to Polk Co. Aug.-Oct. Several Compositae and **Gerardia** (Scrophulariaceae).

P. mutata (Gemm.). Northern Florida, including the panhandle, S to Polk Co. **Cicuta, Daucus, Eryngium**, and several other Umbelliferae.

P. sinuata (Ol.). Coastal Plain from Mississippi to North Carolina; S in Florida to Highlands Co. **Gerardia** (Scrophulariaceae).

Lytta polita Say. Georgia border S to Charlotte and Highlands counties. Dec.-Jun. Has been taken in large numbers at lights.

Epicauta batesi Horn. Coastal Plain from New Jersey to Alabama; S in Florida to Polk Co.

E. excavatifrons Maydell. Coastal Mississippi and Alabama and S in Florida to Marion Co. Sep.-Oct. Recorded twice from grass.

E. fabricii (LeC.). Northern Florida, including the panhandle, S to Highlands Co. Apr.-May. Commonly on Leguminosae, including alfalfa, **Baptisia**, bean, pea, and sweetclover; sometimes attacks potato and glandless cotton. At lights.

E. floridensis Werner. Primarily coastal, from Texas and Oklahoma to New Jersey; probably statewide in Florida. **Ipomoea** (Convolvulaceae), **Schrankia** (Leguminosae), and (in captivity) **Solanum** (Solanaceae).

E. heterodera Horn. Coastal Mississippi to Georgia and S in Florida to Osceola Co. Sep.-Nov. **Helenium** and other Compositae.

E. pennsylvanica (DeG.). Alachua, Leon, and Marion counties. Wide variety of plants, including many Compositae, **Chenopodium** (Chenopodiaceae), and such crops as alfalfa, beet, and potato.

E. pestifera Werner. Northern Florida, including the panhandle, S to Indian River Co. Many Leguminosae and Solanaceae, including alfalfa, beet, egg plant, potato, soybean, and tomato.

E. sanguinicollis Horn. Alachua, Citrus, Sumter, and Brevard counties. Recorded in the literature only from Florida, but I have two specimens labeled "Savannah, Georgia." Jul. and Oct. Compositae, **Schrankia** (Leguminosae), and cotton.

E. strigosa (Gyll.). Coastal Plain from Mississippi to New Jersey; probably statewide in Florida. Principally on Compositae, **Opuntia** (Cactaceae), **Ipomoea** (Convolvulaceae), and **Vigna** (Leguminosae). Common.

E. tenuis (LeC.). Described from an unspecified locality in Georgia and subsequently recorded in Florida from Baker and Volusia counties S to Highlands Co. May-Jun.

E. torsa (LeC.). Oklahoma and east Texas, E on the Coastal Plain to Georgia and N to Massachusetts; probably statewide in Florida. Apr.-Jun. **Ilex** (Aquifoliaceae), **Sapindus** (Sapindaceae), and **Albizzia, Amorpha**, and **Robinia** (Leguminosae).

E. vittata (Fabr.). Represented in Florida, where it occurs commonly throughout the state except for the Keys, by the "lemniscate" or southeastern coastal race [1]. Mar.-May. Wide variety of plants, including **Amaranthus** (Amaranthaceae) and such crops as alfalfa, bean, beet, cotton, potato, and tomato. Attracted to lights.

Nemognathinae

Tetraonyx quadrimaculata (Fabr.). Trinidad, Lesser Antilles, Puerto Rico, Hispañola, and the U.S. Coastal Plain from northern Florida (Alachua and Putnam counties) to Alabama and North Carolina. Convolvulaceae (**Ipomoea**) and Leguminosae (**Bradburya, Coelosia**) in the U.S. and these families and Bignoniaceae, Euphorbiaceae, and Verbenaceae in the West Indies. Reported damaging grapefruit flowers in Puerto Rico.

Nemognatha nemorensis Hentz. N Florida, S to Pinellas and Brevard counties. Several Compositae, including **Bidens, Erigeron, Heterotheca,** and, particularly, **Rudbeckia.**

N. piazata Fabr. Represented in Florida by the nominate race (Mississippi to West Virginia south), which occurs statewide, including the Keys. **Cirsium** and **Tetraognotheca** (Compositae).

N. punctulata LeC. Bahama and Cayman islands, Cuba, Jamaica, and the southeastern U.S. Recorded in Florida only from the Keys and Dade Co. **Bidens** and "thistle" (Compositae). Not common.

Zonitis cribricollis (LeC.). Widely distributed in Florida, S to Dade Co. **Achillea, Coreopsis, Helianthus,** and **Rudbeckia** (Compositae). Rare.

Z. vittigera (LeC.). Represented in Florida, where it occurs S to Highlands Co., by the nominate, eastern race. Numerous Compositae and **Psoralea** (Leguminosae).

Pseudozonitis longicornis (Horn). Kansas and east Texas E along the Coastal Plain to South Carolina; recorded in Florida from Highlands Co. S to the Keys. Mar.-Jul. At lights. Rare.

P. pallida Dillon. Oklahoma and east Texas E to Florida, where it extends S through Dixie and Alachua counties to Hillsborough Co. At lights. Not common.

P. schaefferi (Blatch.). A taxonomically isolated species known only from Florida (Pinellas, St. Johns, and Volusia counties) and Myrtle Beach, South Carolina [5]. Feb.-May.

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