EENY358

UF UNIVERSITY of FLORIDA
IFAS Extension

Bella Moth, Rattlebox Moth, Inornate Moth or Calico Moth, *Utetheisa ornatrix* (Linnaeus) (Insecta: Lepidoptera: Arctiidae: Arctiinae)[1]

Donald W. Hall[2]

Introduction

The bella moth, *Utetheisa ornatrix* (Linnaeus), is one of our most beautiful moths. Unlike most moths, which are nocturnal, the bella moth is diurnal and flies readily when disturbed. Therefore, it is more commonly seen than nocturnal species by the general public.

Synonymy

The adult bella moth is highly variable in coloration which has resulted in confusion regarding its taxonomy and the assignment of many names to the numerous color "forms". Linnaeus originally described two species in the genus *Phalaena* -- *ornatrix* (more whitish or pale specimens) and *bella* (brightly colored specimens), and Hübner later moved them to the genus *Utetheisa*. Forbes lumped both forms under the species *U. ornatrix*. The Entomological Society of America's Common Names of Insects and Related Organisms publication uses the common name "bella moth," but uses the scientific name *Utetheisa bella* (Linnaeus) instead of *U. ornatrix* (Linnaeus).

Distribution

This species is found from Connecticut westward to southeastern Nebraska, and southward to southern New Mexico and Florida. It is more common in southern part of its range.

Description

Eggs: The eggs are white to yellow and spherical.

Larvae: The larvae are orange-brown with broad irregular black bands on each segment. Full-grown larvae are 30-35 mm in length. There are distinct white spots on the anterior and posterior margins of the black bands. Whereas most arctiid larvae have verrucae (elevated wart-like areas on the cuticle) bearing many setae, Utetheisa larvae lack verrucae, and setae occur singly.

1. This document is EENY-358 (IN644), one of a series of Featured Creatures from the Entomology and Nematology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Published: October 2005. This document is also available on Featured Creatures Website at **http://creatures.ifas.ufl.edu**. Please visit the EDIS Website at **http://edis.ifas.ufl.edu**.

2. Donald W. Hall, professor, Department of Entomology and Nematology, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

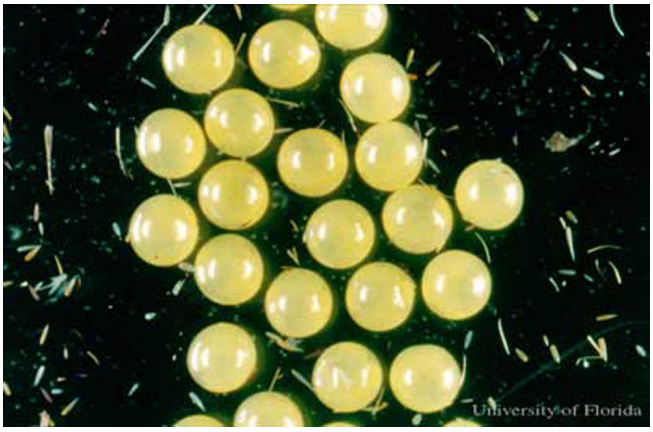

Figure 1. Eggs of the bella moth, *Utetheisa ornatrix* (Linnaeus). Credits: Don Hall, University of Florida

Figure 2. Larva of the bella moth, *Utetheisa ornatrix* (Linnaeus). Credits: Don Hall, University of Florida

Pupae: The pupae are black with irregular orange-brown bands and are covered with a loose layer of silk.

Figure 3. Pupa of the bella moth, *Utetheisa ornatrix* (Linnaeus). Credits: Don Hall, University of Florida

Adults: The adult bella moth is a rather small moth (wingspan 3.0 - 4.5 cm). The more common "bella" form commonly has the front wings yellow with white bands each containing a row of black dots, and the hindwings bright pink with an irregular marginal black band. The paler form originally designated "ornatrix" is restricted to southern Florida and southern Texas.

Figure 4. Adult bella moth, *Utetheisa ornatrix* (Linnaeus), on fruit of lanceleaf rattlebox, *Crotalaria lanceolata* E. Mey. Credits: Don Hall, University of Florida

Figure 5. Adult bella moth, *Utetheisa ornatrix* (Linnaeus). with wings spread. Credits: Don Hall, University of Florida

Life Cycle and Biology

The bella moth has two generations northward but may breed continuously in the southernmost parts of its range. Eggs are laid in clusters on the foliage. Upon hatching, the young larvae feed on the foliage, but later move to the pods which they bore into to feed on the seeds. Upon reaching maturity, larvae

migrate from the host plant to pupate in sheltered situations under loose bark on nearby trees, in thick vegetation, or in debris.

Much of what we know about the biology of the bella moth is due to the fascinating work of Thomas Eisner and his colleagues and graduate students. This work is summarized in his recent book, **For Love of Insects**. The biology of the bella moth is intricately intertwined with its *Crotalaria* host plants. *Crotalaria* (particularly the seeds) are laced with pyrrolizidine alkaloids. Bella moth larvae sequester these chemicals and become poisonous (and usually repellent) to predators. The alkaloids are retained in the pupal and ultimately the adult stages. Thus these stages also are poisonous to predators. The alkaloids appear to have little effect on pathogenic fungi or parasitic Hymenoptera.

Adults are concentrated in patches of *Crotalaria*. Males become active approximately 1-1 1/2 hours after sunset and are attracted to females by a pulsed sex attractant pheromone (primarily Z,Z,Z-3,6,9-heneicosatriene) originating from glands at the tip of the female's abdomen.

Males convert some of their Crotalaria alkaloids to a related compound hydroxydanaidal (HD), and upon approaching a female, expose two eversible brushes (coremata) from the tip of the abdomen that contain HD saturated scales. Fanning the female with the coremata stimulates her to raise her wings exposing her abdomen. The male then lands beside her and copulates. In addition to sperm, males also transfer nutrients and Crotalaria alkaloids to the female during mating via the spermatophore. The concentration of HD in the coremata is correlated with the amount of alkaloid carried by the males, and females appear to measure the HD concentration of males and use that information for selecting males with the potential to donate the most pyrrolizidine alkaloids in the spermatophore.

During oviposition, the female contributes not only her own alkaloids, but also those received from the male to her eggs making the eggs toxic to potential predators. *Crotalaria lanceolata* and *C. pallida* both have extrafloral nectaries that are often visited in the Gainesville, Florida area by aggressive Florida carpenter ants, *Camponotus floridanus* (Buckley), and red imported fire ants, *Solenopsis invicta* Buren. There is experimental evidence that the cavity-nesting ant, *Leptothorax longispinosus* is repelled by eggs containing the *Crotalaria* pyrrolizidine alkaloids. It is not known whether the bella moth eggs are protected from carpenter ants and fire ants by the alkaloids.

Adult bella moths live approximately three weeks and females mate on average four to five times -- each time receiving additional nutrients and alkaloids via the spermatophores. The additional nutrients and alkaloids allow the female to lay a larger number of eggs than would otherwise be possible and also to continue to invest sufficient amounts of alkaloids in the eggs.

Because most of our common Crotalarias are introduced weedy species and toxic to cattle, the bella moth plays a beneficial role by eating their seeds and suppressing their reproduction.

Hosts

Although a variety of plants in the family Fabaceae are listed in the literature as hosts for the bella moth, species in the genus *Crotalaria* are without a doubt the major if not the only true hosts. It is likely that the other host records are due to the habit of full-grown larvae to wander from the host (and frequently onto other species) prior to pupation.

Only four species of *Crotalaria* are native to the southeastern U.S. of which two occur in Florida -- Avon Park rattlebox (*C. avonensis* DeLaney & Wunderlin), which is restricted to Florida, and rabbitbells (*C. rotundifolia* J.F. Gmel.). Many other species of *Crotalaria* were introduced into the southeastern U.S. 55-65 years ago for soil improvement and forage. Unfortunately, species of *Crotalaria* are toxic to livestock due to the presence of pyrrolizidine alkaloids, and can potentially be fatal. Three species have become established and are common in Florida. These are *Crotalaria lanceolata* E. Mey. and *Crotalaria pallida* Aiton var. *obovata* (G. Don) Pohill (formerly *Crotalaria mucronata* Desv.) which are both native to Africa and *Crotalaria spectabilis* Roth which is native to Asia. The name *Crotalaria* originates from the Greek root "crotal" which means "a rattle." It is the same root word as

used in the genus name for rattle snakes, Crotalus. The mature dried fruit of *Crotalaria* rattles like a rattle snake when the pods are shaken or blown by the wind.

Figure 6. Lanceleaf rattlebox, *Crotalaria lanceolata* E. Mey, in fruit. This plant is a host of the bella moth, *Utetheisa ornatrix* (Linnaeus). Credits: Don Hall, University of Florida

Selected References

Common Names of Insects and Related Organisms. (1995-2005). Entomological Society of America. http://www.entsoc.org/Pubs/Books/Common_Names/results.asp (28 September 2005).

Connor WE, Roach B, Benedict E, Meinwald J, Eisner T. 1990. Courtship pheromone production and body size as correlates of larval diets in males of the arctiid moth, *Utetheisa ornatrix*. Journal of Chemical Ecology 16:543:552.

Figure 7. A flower spike of lanceleaf rattlebox, *Crotalaria lanceolata* E. Mey, with carpenter ants feeding at extrafloral nectaries. This plant is a host of the bella moth, *Utetheisa ornatrix* (Linnaeus). Credits: Don Hall, University of Florida

Connor WE, Eisner T, Vander Meer RK, Guerrero A, Meinwald J. 1981. Precopulatory sexual interaction in an arctiid moth (*Utetheisa ornatrix*): role of a pheromone derived from dietary alkaloids. Behavioral Ecology and Sociobiology 9:227-235.

Connor WE, Boada R, Schroeder FC, González A, Meinwald J, Eisner T. 2000. Chemical defence: bestowal of a nuptial alkaloidal garment by a male moth upon its mate. Proceedings of the National Academy of Sciences USA 97:14406-14411.

Connor WE, Eisner T, Vander Meer RK, Guerrero A, Ghiringelli D, Meinwald J. 1980. Sex attractant of an arctiid moth (*Utetheisa ornatrix*): a pulsed chemical signal. Behavioral Ecology and Sociobiology 7:55-63.

Figure 8. Smooth rattlebox, *Crotalaria pallida* Aiton var. *obovata* (G. Don) Pohill (formerly *Crotalaria mucronata* Desv.), with flowers and fruit. This plant is a host of the bella moth, *Utetheisa ornatrix* (Linnaeus). Credits: Don Hall, University of Florida

Figure 9. Showy rattlebox, *Crotalaria spectabilis* Roth., a host of the bella moth, *Utetheisa ornatrix* (Linnaeus). Credits: Don Hall, University of Florida

Covell CV. 1984. A Field Guide to the Moths of Eastern North America. Houghton Mifflin Company. Boston.

Doussard DE, Harvis CA, Meinwald J, Eisner T. 1991. Pheromonal advertisement of a nuptial gift by a male moth *Utetheisa ornatrix*. Proceedings of the National Academy of Sciences USA 88:9224-9227.

Doussard DE, Ubik K, Harvis CA, Resch J, Meinwald J, Eisner T. 1988. Biparental defensive endowment of eggs with acquired plant alkaloid in the moth *Utetheisa ornatrix*. Proceedings of the National Academy of Sciences USA 85:5992-5996.

Eisner T. 2003. For Love of Insects. Harvard University Press. Cambridge, Massachusetts.

Eisner T, Eisner M. 1991. Unpalatability of the pyrrolizidine alkaloid containing moth, *Utetheisa ornatrix*, and its larva, to wolf spiders. Psyche 98:111-118.

El-Sayed AM (2004). Compound - Z3Z6Z9-21Hy. The Pherobase: Database of Insect Pheromones and Semiochemicals. http://www.pherobase.com/database/compounds-detail-Z3Z6Z9-21Hy.html (28 September 2005).

Forbes WTM. 1960. The Lepidoptera of New York and neighboring states. Part IV. Agaristidae through Nymphalidae, including butterflies. Cornell University Agricultural Experiment Station Memoir 329. Ithaca, New York.

González A, Rossini C, Eisner M, Eisner T. 1999. Sexually transmitted chemical defense in a moth (=*Utetheisa ornatrix*). Proceedings of the National Academy of Sciences USA 96:5570-5574.

Heitzman JR, Heitzman JE. 1987. Butterflies and Moths of Missouri. Missouri Department of Conservation. Jefferson, Missouri.

Iyengar VK, Eisner T. 1999. Female choice increases offspring fitness in an arctiid moth (*Utetheisa ornatrix*). Proceedings of the National Academy of Sciences USA 96:15013-15016.

Iyengar VK, Eisner T. 1999.Heritability of body mass, a sexually selected trait in an arctiid moth (*Utetheisa ornatrix*). Proceedings of the National Academy of Sciences USA 96:9169-9171.

Iyengar VK, Rossini C, Eisner T. 2001. Precopulatory assessment of male quality in an arctiid moth (*Utetheisa ornatrix*): hydroxydanaidal is the only criterion of choice. Behavioral Ecology and Sociobiology 49:283-288.

Isley D. 1990.Vascular Flora of the Southeastern United States. Vol. 3, Part 2. Leguminosae (Fabaceae). The University of North Carolina Press. Chapel Hill.

Jain SC, Doussard DE, Conner WE, Eisner T, Guerrero A, Meinwald J. 1983. Polyene pheromone components from an arctiid moth (*Utetheisa ornatrix*): characterization and synthesis. Journal of Organic Chemistry 48:2266-2270.

Kimball CP. 1965. Lepidoptera of Florida. Arthropods of Florida and Neighboring Land Areas. Division of Plant Industry. State of Florida Department of Agriculture. Gainesville, Florida.

LaMunyon CW. 1997. Increased fecundity, as a function of multiple mating, in an arctiid moth, *Utetheisa ornatrix*. Ecological Entomology 22:69-73.

Linnei C. 1758. System Naturae. Regnum Animale. 10th Ed. Lipsiae, sumptibus Guilielmi Engelmann, 1894. (In Latin)

Opler P. (2004). Moths of North America. United States Geological Survey Northern Prairie Wildlife Research Center. http://www.npwrc.usgs.gov/resource/distr/lepid/moths/mothsusa.htm (28 September 2005).

Tietz, HM. 1972. An Index to the Described Life Histories, Early Stages and Hosts of the Macrolepidoptera of the Continental United States and Canada. Vol. 1. The Allyn Museum of Entomology. Sarasota, Florida.

Stehr FW. 1987. Immature Insects. Vol. 1. Kendall/Hunt Publishing Company. Dubuque, Iowa.

United States Department of Agriculture. (2005). Natural Resources Conservation Service Plants Database. http://plants.usda.gov/ (28 September 2005).

Wunderlin RP, Hansen BF. 2003. Guide to the Vascular Plants of Florida. University Press of Florida. Gainesville, Florida. 2nd edition.

Wunderlin RP, Hansen BF. (2005). Atlas of Florida Vascular Plants. [Landry SM, Campbell KN. (application development), Florida Center for Community Design and Research.] Institute for Systematic Botany, University of South Florida, Tampa. http://www.plantatlas.usf.edu/ (28 September 2005).