

- VALLÉE, G. & R. BÉRIQUE. 1979. Dégâts d'une hépiale et susceptibilité des peupliers. *Phytoprotection* 60:23–30.
- WAGNER, D. L. & J. ROSOVSKY. 1991. Mating systems in primitive Lepidoptera, with emphasis on the reproductive behaviour of *Korscheltellus gracilis* (Hepialidae). *Zool. J. Linn. Soc.* 102:277–303.
- WAGNER, D. L., D. R. TOBI, B. L. PARKER, W. E. WALLNER & J. G. LEONARD. 1989. Immature stages and natural enemies of *Korscheltellus gracilis* (Lepidoptera: Hepialidae). *Ann. Entomol. Soc. Am.* 82:717–724.
- WINN, A. F. 1909. The Hepialidae, or Ghost-moths. *Can. Entomol.* 41:189–193.
- WIPKING, W. & C. MENGELKOCH. 1994. Control of alternate-year flight activities in high-alpine Ringlet butterflies (*Erebia*,

Satyridae) and Burnet moths (*Zygaena*, Zygaenidae) from temperate environments. In H.V. Danks (ed.), *Insect life-cycle polymorphism. Theory, evolution and ecological consequences for seasonality and diapause control*. Kluwer Academic Publishers, Dordrecht, Netherlands. 378 pp.

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TWO LARGE TROPICAL MOTHS (*THYSANIA ZENOBIA* (NOCTUIDAE) AND *COCYTIUS ANTAEUS* (SPHINGIDAE)) COLONIZE THE GALAPAGOS ISLANDS

Additional key words: light traps, island colonization.

The arrival and establishment of a species on an isolated oceanic island is a relatively rare event. The likelihood of colonization depends on a variety of features of the species, including dispersal ability, availability of food (hostplants or prey) and ability to reproduce. In this note, I discuss two recent Galapagos records of tropical moths in the context of island colonization.

Thysania zenobia (Cramer) is a tropical migratory species which has been occasionally collected in the Holarctic region (Ferguson et al. 1991). Its life history is unknown, but legumes are considered probable larval foodplants (Covell 1984). Between 20 and 25 April 1996, three fresh males were collected in a Mercury vapor light trap near Asilo de la Paz, Floreana Island, at 338 m elevation. The trap was located at the border of the agricultural zone and native forest. In March 1997, I collected another specimen in a forest of the endemic composite, *Scalesia pedunculata* Hook at Los Gemelos, Santa Cruz island, at 580 m elevation, feeding in a bait trap (mixture of rotting fruit). The fresh condition of these specimens suggested that they were from a population extant on the island, rather than migrant. These Galapagos specimens are identical in wing pattern and size to series from continental United States reported by Covell (1984).

Cocytius antaeus (Drury) is one of the larger hawk-moths of the Neotropical region. Members of the Annonaceae have been reported as hostplants (Kimball 1965). Dyar (1901) and Matteson (1933) described its life cycle. I collected two specimens on Santa Cruz Island. On 26 May 1996, I captured a fresh female in a mercury vapor lamp trap at Media Luna (580 m elevation), the fresh condition again suggesting an existing population. This habitat is a mature forest of the endemic *Miconia robinsoniana* Cong. (Melastomataceae), native ferns and the introduced tree *Cinchona succirubra* Klotzsch (Rubiaceae). One month later, one worn male was collected by Godfrey Merlen at an outdoor fluorescent light at the Charles Darwin Research Station (sea level).

Although I have never collected larvae of this species, farmers in Santa Cruz and San Cristobal Islands have reported the presence of "voracious green hornworms" feeding on leaves and branches of the introduced custard apple (*Annona cherimola* Mill). It is likely that these reports refer to *C. antaeus*, because no other Galapagos sphingids feed on members of the Annonaceae.

The lack of specimens of these two moth species in previous lepidopteran surveys of the islands suggests that these are relatively recent additions to the fauna. Hayes (1975) did not report their presence in the archipelago but his species list was based on specimens collected by early expeditions with less efficient light traps

(kerosene lamps) and collections made by amateur entomologists. Recently (1989 and 1992), Bernard Landry carried out an intensive Lepidoptera survey on the islands but he never collected the species (Landry pers. comm.). However, it is also possible that the absence of these species from earlier collections is due to flight time. I trapped both species late at night (2300 h to 2400 h) and few collections have been made during these hours by earlier collectors.

Several features of the biology of these two species may have contributed to their ability to reach the Galapagos. Both, *C. antaeus* and *T. zenobia* have a history of long dispersal events by active flying to new areas, including oceanic islands (Ferguson et al. 1991, Schreiber 1978). The occurrence of many species of Annonaceae, all of which were introduced by humans in the present century (Lawesson et al. 1987), has probably favored the establishment of *C. antaeus*.

Although the hostplant of *T. zenobia* is unknown legumes are a likely candidate (Covell 1984). There are many species of legumes on the Galapagos islands, including native and endemic species, and one of these could provide a suitable hostplant.

I suggest that many of the macrolepidoptera that have colonized the Galapagos arrived by natural means and not as a direct result of human activity. However, their establishment has been facilitated by the increase in the number of introduced plant species, deforestation and other human-related activities.

Voucher specimens have been deposited in the entomological collection of the Charles Darwin Research Station Museum on Isla Santa Cruz, Galapagos.

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LITERATURE CITED

- COVELL, C. V. 1984. A field guide to moths of Eastern North America. Houghton Mifflin Co., Boston. 496 pp.
- DYAR, H. G. 1901. Life histories of some North American moths. *Proc. U.S. Natl. Mus.* 23:255–284.
- FERGUSON, D. C., D. J. HILBURN & B. WRIGHT. 1991. The Lepidoptera of Bermuda: their food plants, biogeography, and means of dispersal. *Mem. Ent. Soc. Canada* 158. 105 pp.

- HAYES, A. H. 1975. The larger moths of the Galapagos islands (Geometroidea: Sphingoidea & Noctuoidea). Proc. Calif. Acad. Sci., ser. 4, 40:145–208.
- KIMBALL, C. P. 1965. The Lepidoptera of Florida. Arthropods of Florida and neighboring land areas. State of Florida Dept. of Agriculture, Gainesville, Florida. 361 pp.
- LAWESSON, J. E., H. ADSERSEN & P. BENTLEY. 1987. An updated and annotated check list of the vascular plants of the Galapagos islands. Rept. Bot. Inst. Univ. Aarhus. 16:1–74.
- MATTESON, J. II. 1933. America's largest hawkmoth. Lep. News 1 (2):3–5.
- SCHREIBER, H. 1978. Dispersal centres of Sphingidae (Lepidoptera) in the Neotropical region. The Hague, Boston, Biogeographica 10:1–195.
- LÁZARO ROQUE-ALBELO, *Charles Darwin Research Station, Galapagos Islands, P. O. 17-01-3891, Quito-Ecuador.*

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AN ANTI-PREDATOR BEHAVIOR IN LARVAE OF *LIBYTHEANA CARINENTA* (NYMPHALIDAE, LIBYTHEINAE)

Additional key words: ant-predation, *Celtis*, frass chains.

Strategies of avoiding predators are well documented in larvae of Lepidoptera, and include a variety of morphological, chemical and behavioral traits (Malicky 1970, Brower 1984, Heads & Lawton 1985, Stamp & Casey 1993, Freitas & Oliveira 1992, 1996, Loeffler 1996). One rather unusual behavioral defense found in larvae of species of Charaxinae and Limenitidinae is the construction of frass chains (DeVries 1987, Freitas & Oliveira 1996). Frass chains are stick-like structures formed by fecula and silk where the larvae rest when not feeding, and provide an efficient refuge against predation by "walking" arthropod predators by isolating the larvae from the leaf blade when not feeding (Freitas & Oliveira 1996). In this note, a similar behavior is reported in larvae of the Libytheinae *Libytheana carinenta* (Cr.) at two sites in southeastern Brazil.

Field observations were conducted in two fragments of deciduous forests in São Paulo state; the "Fazenda Três Barras", in Castilho, in February 1995 and in the "Reserva da Mata Santa Genebra", Campinas, in March 1997, March–April 1998 and March–April 1999. The larvae were observed feeding on *Celtis iguanae* (Ulmaceae) in Castilho, and on *C. spinosa* in Campinas.

Larvae of *Libytheana carinenta* were observed resting on the midvein of partially eaten leaves of *Celtis* spp. (Fig. 1). This behavior was observed in all instars, being present even in fully grown fifth instar larvae. Most of the observed eggs ($n > 50$) were laid individually on very young leaves (with five observations of eggs on spines on the shoot tips), and larvae start to eat alongside the central vein just after hatching, resulting in the formation of the stick-like structure on the expanding leaf. Larvae rest on the tip of this structure, returning to the leaf blade only for eating. No larvae of *L. carinenta* were observed feeding asymmetrically on the leaf tip, or on only one side of the leaf.

Although *Celtis spinosa* does not bear extrafloral nectaries, ants were frequently seen on branches and leaves of *Celtis* spp. in forest edges. In this habitat ants commonly associate with Homoptera, especially on shoot tips, and were observed preying on small moth caterpillars, suggesting that they could be effective predators of butterfly larvae as well. As also recorded by Freitas and Oliveira (1996) for another ant-butterfly interaction, these and other ants were never observed climbing onto *L. carinenta*'s stick-like



Fig. 1. Third instar larva of *Libytheana carinenta* resting in the remaining central vein of a *Celtis spinosa* leaf.