Journal of the Lepidopterists' Society
49(1), 1995, 43–48

SEED-BORING BY TROPICAL CLEARWING MOTHS (SESIIDAE): ABERRANT BEHAVIOR OR WIDESPREAD HABIT?

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ABSTRACT. The seed-boring behavior of clearwing moths is discussed, in particular that of *Carmenta foraseminis* Eichlin reared from seeds of *Gustavia superba* (Lecythidaceae) in Panama. Larval food plant and distribution data for a complex of similar species are provided.

Additional key words: *Carmenta foraseminis*, *Gustavia superba*, Barro Colorado Island, life history, seed-predation.

It is well known that larvae of the clearwing moth family Sesiidae are borers in tree trunks, branches, and roots (Scoble 1992). They also attack shrubs, vines, and herbaceous plants, and occasionally feed in galls (Scoble 1992). A number of important pest species decrease plant vigor and inflict serious vegetative damage on commercially grown crops (King & Saunders 1984, Holloway, Bradley & Carter 1987, Scoble 1992).

The vast majority of sesiid larval food plants reported in the literature are for temperate species, and Eichlin and Duckworth (1988) present a list of these for North American clearwing borers. Scant information exists concerning the natural history of tropical sesiids; it has been assumed that their habits are similar to those of temperate species. What follows is a discussion of the seed-feeding behavior of a clearwing moth from Panama.

Larvae of a sesiid were found feeding within the fruits and seeds of *Gustavia superba* (H.B.K.) Berg (Lecythidaceae) that were collected on the ground during June and July 1993, on Barro Colorado Island, Panama. Reared adults were sent for identification to Thomas Eichlin, Insect Biosystematics Laboratory, California Department of Food and Agriculture, Sacramento. He determined that the species is new to science. He, therefore, provides the original description of the species (*Carmenta foraseminis* Eichlin) in this issue of the Journal (Eichlin 1995: 39).

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On Barro Colorado Island, the fruits of *G. superba* mature during the wet season, primarily June, July, and August (Croat 1978, S. Joseph Wright unpublished data). Fruits are multi-seeded and are either cauliflorous or ramiflorous. Although they may be intact when they fall, many are damaged by primates while still on the tree (Oppenheimer 1968, Hladik & Hladik 1969). When collected from the ground, many fruits show damage made by terrestrial mammals (Sork 1987). Most fruits on the ground contain at least some seeds that have been damaged by *C. foraseminis* larvae.

On 26 June 1993, the damaged seeds from two *G. superba* fruits were placed in a plastic container; adult sesiids were reared from them. The first moth emerged from one of the seeds on 11 July. The pupal exuviae was left protruding from the larval tunnel.

An intact fruit of *G. superba* was collected from the forest floor and brought back to the laboratory on 15 July. By 20 August, nine adult *C. foraseminis* (Fig. 1) had eclosed from this fruit, all leaving their pupal exuviae projecting from their tunnels (Fig. 2). Five more adults emerged from the same fruit between 21 August and 8 September.

Additionally, 128 seeds (all showing at least minor tunneling damage) were removed from intact fruit and from fruit partially eaten by vertebrate frugivores and seed-predators. All were placed in an arthropod cage. Thirteen adult *C. foraseminis* emerged from these seeds over the course of 20 days.

Carmenta foraseminis larvae can subsist on either isolated seeds or seeds within fruits of *G. superba*. Because nearly all pupal exuviae were found projecting from seeds or fruits, it seems unlikely that the larvae ever pupate elsewhere, in contrast to some members of the family that pupate in the soil (Scoble 1992).

Given that many, perhaps most, fruits and seeds are eaten by ground-foraging mammals (e.g., agoutis, squirrels, and peccaries) soon after falling (Sork 1987), it is curious that adult moths emerged as many as six weeks after falling to the ground. One would expect that individuals remaining in fallen fruit soon would be eaten or buried by mammals. Perhaps the majority of adults emerge before fruit fall; however, if the majority of infested fruits drop before sesiid emergence, seed-eating mammals may have a large impact on the population dynamics of these insects.

In the species description, Eichlin (1995) reports on *C. foraseminis* reared from seeds of *G. angustifolia* Benth., *G. superba*, and a species of *Eschweilera* (Lecythidaceae), all from Panama, as well as from pods of cacao (*Theobroma cacao* L., Sterculiaceae), from Colombia and Venezuela. He also states that he has seen four females of an unidentified species, reared from seeds of *G. angusta* L. in Bahia, Brazil. These

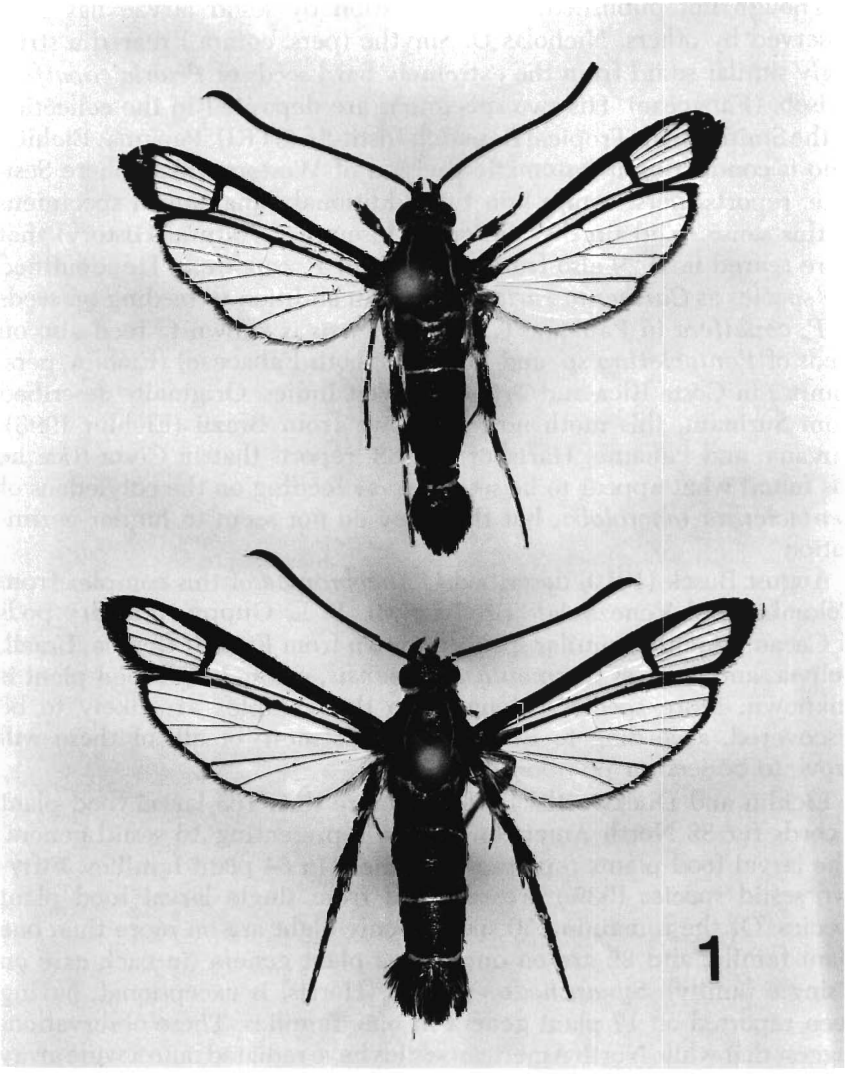

FIG. 1. *Carmenta foraseminis* adults. Male paratype (top), emerged mid July 1993; female allotype (bottom), emerged 8 August 1993.

could be either *C. foraseminis* or *C. guyanensis* (Le Cerf), but males are necessary for positive identification.

According to Eichlin (1995), *C. foraseminis* belongs to a complex of similar appearing species (including *C. guyanensis*, *C. surinamensis* (Möschler), and *C. theobromae* (Busck)), differentiated mostly on the basis of male genitalic structures.

Though not published, seed-infestation by sesiid larvae has been observed by others. Nicholas D. Smythe (pers. comm.) reared a strikingly similar sesiid from the extremely hard seeds of *Prioria copaifera* Griseb. (Fabaceae). His two specimens are deposited in the collection of the Smithsonian Tropical Research Institute (STRI), Panama. Eichlin, who is conducting a systematic revision of Western Hemisphere Sesiidae, reports (pers. comm.) on two additional Panamanian specimens of this same sesiid (in the National Museum of Natural History) that were reared in 1929 also from the seeds of *P. copaifera*. He identified the species as *Carmenta surinamensis*. In addition to feeding on seeds of *P. copaifera* in Panama, *C. surinamensis* is known to feed also on seeds of *Pentaclethra* sp. and *Mora* sp. (both Fabaceae) (Eichlin, pers. comm.) in Costa Rica and Trinidad, West Indies. Originally described from Surinam, this moth now is known from Brazil (Eichlin 1995), Guyana, and Panama. Hartshorn (1983) reports that in Costa Rica he has found what appear to be sesiid larvae feeding on the cotyledons of *Pentaclethra macroloba*, but that they do not seem to hinder germination.

August Busck (1910) described *C. theobromae* of this complex from Colombia and Venezuela: "Bred by Mr. P. L. Guppy from dry pods of Cacao." Another similar species, known from French Guiana, Brazil, Bolivia, and Peru, is *Carmenta guyanensis*, whose larval food plant is unknown. More species belonging to this complex are likely to be discovered, according to Eichlin. Perhaps most, or all, of these will prove to be seed or pod-boring as well.

Eichlin and Duckworth (1988) list more than 165 larval food plant records for 82 North American sesiids, representing 16 sesiid genera. The larval food plants represent 82 genera in 34 plant families. Fifty-two sesiid species (63%) are reported from single larval food plant species. Of the remaining 30 species, only eight are on more than one plant family, and 22 are on one to five plant genera (in each case on a single family). *Synanthedon scitula* (Harris) is exceptional, having been reported on 17 plant genera in nine families. These observations suggest that while North American sesiids have radiated onto a wide array of larval food plants, most species are not particularly polyphagous.

Although records for the few sesiids reared so far from tropical fruits involve only eight plant species in three families, *C. foraseminis* has been reared from fruits of two of those plant families. These limited data raise several questions. Is fruit and seed feeding a widespread habit among tropical sesiids or is it limited to a few species or genera? Do tropical sesiids feed on plant groups different from those of their temperate relatives? Are they more generalized in their choices of larval food plant species than are temperate species? To put it another way,

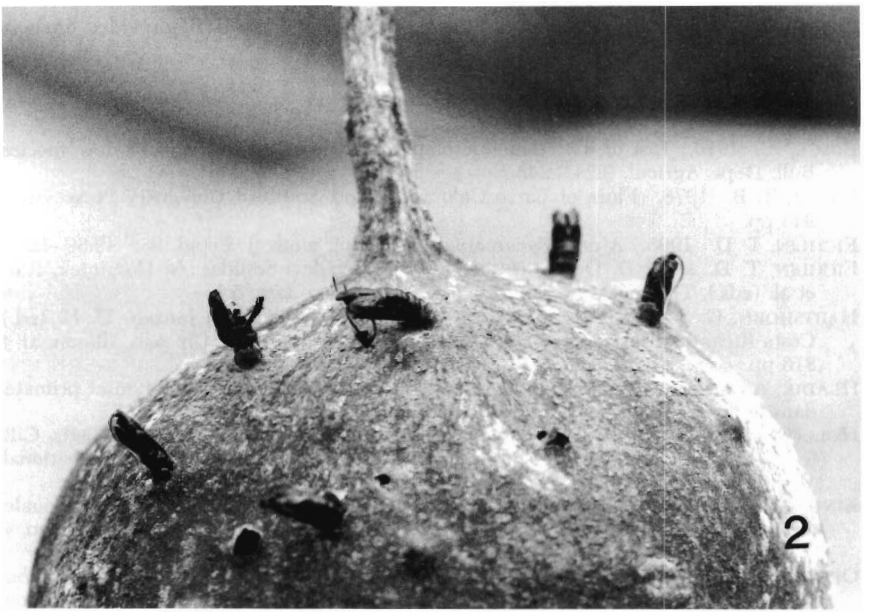

FIG. 2. *Gustavia superba* fruit from which *Carmenta foraseminis* have emerged, leaving their pupal exuviae projecting from their tunnels. The bent over individual just below the pedicel is in the process of eclosion.

is our knowledge of tropical sesiids meager because we've been looking in the wrong places, or is it for lack of trying? We urge others to join the search for answers to these questions. Those wishing to augment our knowledge of tropical sesiid life histories would do well to rear insects from a wide variety of fruits, particularly large ones. Tropical leguminous plants, with their great proliferation and diversity of species, might be a productive group on which to search for seed-boring sesiids. Perhaps plant species related to those utilized by temperate region sesiids should be targeted also.

A total of 10 reared *C. foraseminis* adults have been distributed among the collections of STRI, the Museo de Invertebrados 'G.B. Fairchild' of the University of Panama (MIUP), the NMNH, and Thomas D. Eichlin (CDFA).

ACKNOWLEDGMENTS

We thank Thomas D. Eichlin for identifying the moths and for his helpful advice, Nigel Asquith and James Dalling for supplementing our supply of *G. superba* fruits, and Catherine Craig for the use of her arthropod cages. We are grateful to Thomas D. Eichlin, Nicholas D. Smythe, W. Donald Duckworth, and Daniel H. Janzen for contributing additional natural history information on tropical sesiids. David L. Wagner and John B. Heppner made helpful suggestions on the manuscript. Sigma Xi, the Department of

Ecology and Evolutionary Biology at Princeton University, and STRI provided financial and logistical support to K.E.H.

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Received for publication 15 May 1994; revised and accepted 22 July 1994.