Host Plant Associations among Species in Two Macrolepidopteran Assemblages[1]

Pedro Barbosa,[2] Astrid Caldas and Gaden Robinson[3]

Department of Entomology, Plant Sciences Building, University of Maryland, College Park, MD 20742 USA

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Abstract Host plant associations of macrolepidopteran species in assemblages on box elder, *Acer negundo* L., and black willow, *Salix nigra* (Marsh), were characterized. Almost 90% of the macrolepidoptera collected on these two riparian tree species of the mid-Atlantic area of the United States were new host records. Larvae of 87 species (and another nine specimens identified to genus) were collected on box elder and black willow. About one-fifth of the species were found exclusively on box elder, one-third exclusively on black willow, and about one-half of the macrolepidopteran species were found on both tree species. Although many macrolepidoptera were found on both tree species, they were not equally abundant on both trees, suggesting a predominantly favored tree species. However, there was no statistically significant asymmetry in host tree species use.

Key Words *Acer negundo, Salix nigra,* box elder, black willow, maple, willow, Lepidoptera, larvae, caterpillars, larval abundance

Although most published research on insect herbivores has focused on so-called outbreak species, most insects occur at relatively low abundance. Currently, research in our laboratory focuses on the ecology of scarce species in macrolepidopteran assemblages (i.e., multispecies collections of herbivores usually associated with some food resource) in the form of a plant species, a group of plant species, or even a plant structure (Claridge 1987). The specific assemblages studied occur on two riparian tree species, box elder, *Acer negundo* L., and black willow, *Salix nigra* (Marsh) (Barbosa et al. 2000, 2001). Objectives of our research were to describe the macrolepidopteran assemblages of these two tree species in order to gain a broader understanding of the structure of assemblages of scarce species. Specifically, we aim to determine how components of assemblage structure (i.e., species abundance distribution, diversity, richness, etc.) affect herbivore-plant interactions (i.e., patterns of host-plant use) and patterns of parasitism and predation of the species in these assemblages.

In this paper we report the species of macrolepidoptera that have been found in the assemblages on box elder and black willow and assess the differential use of each tree species by these macrolepidoptera. Further, we note host plant associations which have not been previously reported.

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[2]To whom offprint requests are addressed (email: pb5@umail.umd.edu).

[3]Department of Entomology, The Natural History Museum, Cromwell Road, London, SW7 5BD, UK.

Material and Methods

Collections of Lepidoptera. Macrolepidopteran larvae were collected from four (1991, 1992, 1994-1997) or six (1993) sites in central Maryland, U.S.A. The sites used were Colmar Manor Park of the Dueling Creek Nature Area, Calvert Community Park, Patuxent Wildlife Refuge Research Center, Fort Meade, Paint Branch, and Rock Creek Regional Park, Needham Lake, Montgomery Co. At each site, 20 trees of either black willow or box elder were sampled. Each week only 10 of the 20 trees of each species were searched, with one person visually searching each tree for 10 min. The alternate set of 10 trees was sampled the following week. Black willow trees were 3 to 4 m tall and box elders were 4 to 6 m tall. Absolute sampling by fogging of the two tree species (in which all larvae were sampled) indicated that lower canopy visual sampling, a relative measure of abundance, provided an accurate assessment of all macrolepidopteran species (unpubl. data). The length of the sampling period differed each year (11 June to 22 Aug 1991; 22 June to 16 Sept 1992; 24 May to 20 Aug 1993; 31 May to 25 Aug 1994; 22 May to 6 Oct 1995; 22 Apr to 7 Oct 1996; and 21 April to 15 Sept 1997).

Larvae were reared individually in plastic (15 cm diam) Petri dishes containing damp pieces of filter paper and were provided with leaves that were disinfected in a 0.25% solution of sodium hypochlorite for 15 min and rinsed thoroughly. When larvae pupated, adults were allowed to emerge. Adult insects were pinned, labeled, and identified by comparing specimens with a reference collection or by sending them to the U.S. National Museum for identification.

Differential host plant use. Although some species were found on both tree species, the number of larvae collected on each of the two tree species was usually different. The presence of a greater number of larvae on one of the two tree species might reflect differential oviposition preference by female adults or differential suitability of foliage for larvae. To determine if discrepancies in host tree species use as measured by the number of larvae found on each tree species was significant, we used general linear models (GENMOD) (SAS 1998). That is, the response variable was a distribution created by using a ratio of the number of larvae collected on the preferred tree species (i.e., the one of two tree species on which most larvae were found) to the total number collected on both trees, for each lepidopteran species. The advantage of this analysis is that sample size information is not lost, e.g., a ratio of 2:3 is different from one of 20:30. Because this analysis treats one binary distribution as an independent observation, we used a binary distribution with logit as the appropriate link (SAS 1998).

Host plant associations. Whether or not the collections made over the 7-yr period of this study represented new host plant records was determined using the Natural History Museum's HOSTS database (Robinson 1999, Robinson et al. 2001, 2002). This database is a compilation of about 175,000 host plant records of the world's Lepidoptera drawn from more than 1600 printed, manuscript and electronic sources. The list of Lepidoptera (Table 1) was run against the database, and details of host range reviewed to determine new host plant records. The database contains information on about 19% of the world's described species of Lepidoptera. Although perhaps not comprehensive, the database gives broad, plausible, and credible coverage not available elsewhere.

Table 1. New records of the association of macrolepidoptera and *Acer negundo* and *Salix nigra*

FAMILY	Identified to	New for *A. negundo* only (no. and species)	New for *S. nigra* only (no. and species)	New for both species (no. and species)	Total/ family	Percent new host records (new/total)
Apatelodidae	Genus					
	Species	1 (*Apatelodes torrefacta*)				100% (1/1)
	Family Total	1			1	100% (1/1)
Arctiidae	Genus					
	Species	1 (*Pyrrharctia isabella*)	5 (*Halysidota tessellaris, Hyphantria cunea, Hypoprepia fucosa, Spilosoma congrua, Spilosoma virginica*)	1 (*Halysidota harrisii*)		100% (7/7)
	Family Total	1	5	1	7	100% (7/7)
Geometridae	Genus		1 (*Phigalia* sp.)	1 (*Euchlaena* sp.)		66.7% (2/3)
	Species	5 (*Cepphis decoloraria, Euchlaena pectinaria, Selenia kentaria, Synchlora aerata, Tetracis crocallata*)	11 (*Alsophila pometaria, Anavitrinella pampinaria, Biston betularia, Calothysanis amaturaria, Ectropis crepuscularia, Hypagyrtis unipunctata, Iridopsis larvaria, Melanolophia canadaria, Nemoria lixaria, Phigalia titea, Semiothisa gnophosaria*)	10 (*Anacamptodes defectaria, Euchlaena amoenaria, Euchlaena obtusaria, Eupithecia miserulata, Eutrapela clemataria, Glena cribrataria, Nematocampa resistaria, Prochoerodes transversata, Protoboarmia porcelaria, Xanthotype urticaria*)		96.3% (26/27)
	Family Total	5	12	11	30	93.3% (28/30)
Hesperidae	Genus					
	Species	1 (*Epargyreus clarus*)				100% (1/1)
	Family Total	1			1	100% (1/1)

Table 1. Continued.

FAMILY	Identified to	New for *A. negundo* only (no. and species)	New for *S. nigra* only (no. and species)	New for both species (no. and species)	Total/ family	Percent new host records (new/total)
Limacodidae	Genus	2 (*Apoda* sp., *Packardia* sp.)				100% (2/2)
	Species		3 (*Adoneta spinuloides, Parasa chloris, Parasa indetermina*)	4 (*Acharia stimulea, Euclea delphinii, Isa textula, Prolimacodes badia*)		100% (7/7)
	Family Total	2	3	4	9	100% (9/9)
Lymantriidae	Genus			1 (*Dasychira* sp.)		100% (1/1)
	Species		2 (*Lymantria dispar, Orgyia leucostigma*)	1 (*Orgyia definita*)		100% (3/3)
	Family Total		2	2	4	100% (4/4)
Noctuiidae	Genus	1 (*Zanclognatha* sp.)	1 (*Elaphria* sp.)			66.7 (2/3)
	Species	(*Acronicta retardata, Orthosia rubescens*)	12 (*Acronicta americana, Acronicta connecta, Amphipyra pyramidoides, Catocala amatrix,* Plathypena *scabra, Lithophane antennata, Melipotis jucunda, Nycteola frigidana, Orthosia hibisci, Palthis angulalis, Scoliopteryx libatrix, Zale lunata*)	7 (*Achatia distincta, Acronicta funeralis, Acronicta impleta, Acronicta oblinita, Eupsilia morrisoni, Himella intractata, Morrisonia confusa*)		91.3% (21/23)
	Family Total	3	13	7	26	88.5% (23/26)

Table 1. Continued.

FAMILY	Identified to	New for *A. negundo* only (no. and species)	New for *S. nigra* only (no. and species)	New for both species (no. and species)	Total/ family	Percent new host records (new/total)
Notodontidae	Genus					
	Species	1 (*Heterocampa biundata*)	6 (*Cerura scitiscripta, Clostera inclusa, Furcula cinerea, Schizura concinna, Schizura ipomoeae, Schizura unicornis*)	2 (*Heterocampa guttivitta, Oligocentria semirufescens*)		100% (9/9)
	Family Total	1	6	2	9	100% (9/9)
Nymphalidae	Genus					
	Species		1 (*Basilarchia arthemis*)			33.3% (1/3)
	Family Total		1		3	33.3% (1/3)
Saturniidae	Genus					
	Species					
	Family Total				3	0% (0/3)
Sphingidae	Genus					
	Species	1 (*Ceratomia catalpae*)	1 (*Smerinthus jamaicensis*)			100% (2/2)
	Family Total				2	100% (2/2)
All Families					96	88.5% (85/96)

Results and Discussion

A total of 87 macrolepidopterans identified to species were collected on box elder and black willow over the 7-yr experimental period (96, if one includes macrolepidoptera that could only be identified only to genus). These species represented 11 families. If one considers all 96 macrolepidoptera, 20.8% (20 species) were collected on box elder only, 30.2% (29 species) were collected on black willow only, and 49.0% (47 species) were collected on both tree species. If one considers only specimens identified to species, 18.4% (16 species) were collected on box elder only, 32.2% (28 species) were collected on black willow only, and 49.4% (43 species) were collected on both tree species.

The pattern of host species utilization was far from uniform because although macrolepidopteran species were found on both tree species, for many macrolepidoptera more larvae were found on one tree species compared to the other (i.e., more abundant on black willow than on box elder, or visa versa). For example, although collected on both trees, all of the species in the Arctiidae, Limacodidae, and Saturnidae, 43.7% of the Geometridae, and 62.5% of the Noctuidae were predominantly collected on black willow. In contrast, all species in the Notodontidae, 37.5% of the Noctuidae, 56.3% of the Geometridae, and 75.0% of the Lymantriidae were predominantly collected on box elder. However, the GENMOD analysis showed that there was no statistically significant asymmetry in host tree species use. That is, for those macrolepidopteran species found in greatest abundance on black willow, the magnitude of the difference in abundance of larvae on box elder vs black willow was not significantly greater than the magnitude of the difference in abundance on the two trees for those species that were most abundant on box elder ($\chi^2 = 1.60$; $P = 0.2053$).

The host plant species association of 88.5% of all macrolepidoptera (identified to genus) represent new host tree species records. For 87.6% of the macrolepidoptera identified to species, the tree species upon which they were collected represented a new host record. Of all the macrolepidoptera collected, 14.6%, 43.8%, and 28.1% have never been reported from box elder, black willow, or both tree species, respectively. For the most diverse families, the Geometridae and Noctuidae, new host species records were found for 93.3% and 84.6%, respectively, of the macrolepidoptera collected. However, even in less diverse families, a high percentage of species on box elder, black willow, or both species represented new host records (Table 1). Box elder is widespread in riparian and palustrine communities throughout the contiguous United States and in Canada. Some varieties are also found in mountainous area of Mexico and Guatemala. Similarly, black willow is found throughout the USA and Canada. Therefore, the utilization of both native species, box elder and black willow, is a logical and reasonable pattern for macrolepidoptera existing in riparian habitats such as those surveyed in this study.

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