

Insect Diversity on Mount Mansfield

J. R. Grehan and B. L. Parker

Entomology Research Laboratory
University of Vermont
P. O. Box 53400
Burlington, Vermont 05403

Abstract

Insects were collected from the three permanent survey plots at three different elevations on Mount Mansfield. Complete seasonal surveys were continued for selected groups of Lepidoptera, Coleoptera, Hymenoptera and Diptera. The 1993 collection of 391 species of Lepidoptera are listed. Lepidoptera diversity is compared between survey sites. Most species and individuals are represented by the families Noctuidae, Geometridae, Tortricidae, Pyralidae and Notodontidae. Seasonal patterns are illustrated for selected species.

Introduction

The 1993 season represents the third consecutive year of the insect biodiversity program on Mount Mansfield. The surveys are designed to record the taxonomic composition and abundance of selected insect groups, and monitor seasonal and annual changes taking place.

The major taxa being surveyed comprise the ground dwelling Carabidae (Coleoptera) from pitfall traps, the nocturnal Lepidoptera (moths) from light traps, and the macro-Hymenoptera (wasps, bees), and Diptera (flies) from canopy malaise traps. Preliminary species lists for these groups were presented in the 1991, and 1992 VMC Annual reports.

Methods

Sampling was continued at the established survey sites in a sugar maple forest at 400 m elevation (Proctor Maple Research Center; PMRC), a mixed hardwood forest at 600 m (Underhill State Park; USP), and a sub-alpine balsam fir forest at 1160 m near the southern summit of Mount Mansfield (MMS).

Five permanent 20 m diameter plots were established at each site with a malaise trap installed in the canopy of one dominant sugar maple or fir tree (sub-alpine site) in each of the four outlying plots. Six pitfall traps were installed around each plot at 60° intervals and a single light trap was located in the center plot. The 1993 survey covered the period from 6 May to 5 October. A detailed account of field and laboratory methods is outlined

in the 1991 VMC Annual Report.

The 1991 and 1992 Lepidoptera surveys were concentrated on the larger bodied "macro-Lepidoptera". These moths are mostly larger-bodied species and are generally more accessible to precise identification. Many of the "micro-Lepidoptera", in contrast, are poorly known or require considerable specialist expertise for accurate identification. In 1993 the Lepidoptera survey was extended to include all species as a preliminary attempt to characterize overall diversity for Lepidoptera at the survey sites. The terms "micro-Lepidoptera" and "macro-Lepidoptera" do not comprise natural phylogenetic groups, and are used here for descriptive convenience only.

Lepidoptera were collected from a single light traps operated for only one night per week at each site. The objective of surveying all Lepidoptera species was to characterize species diversity for the larger taxa (families). Individual species identification was a secondary consideration. Most species listed in this report are, however, identified with reasonable confidence. Some micro-Lepidoptera, in particular, will require further evaluation to confirm identifications. Because of the difficulty of distinguishing very small species from external features the number of species listed underestimates the total number of species collected at the traps.

Results

The Carabidae, Hymenoptera, and Diptera are sorted, identified, and entered into a computer database by J. Boone. The data for these groups will

be statistically analyzed to evaluate differences in site diversity.

Lepidoptera diversity

A total of 391 species were identified (Table 1). The pattern of taxonomic representation at the family level was similar at each of the sites, the principal contrast being in the total numbers of individuals (Figs. 1-3). Family diversity for species and individuals was dominated by (in descending order) the Noctuidae, Geometridae, Tortricidae, Pyralidae. Most of the remaining families were represented by very small numbers of species and individuals. Of the dominant families, the Tortricidae and Pyralidae represent micro-lepidopteran groups. The total number of families was similar in the lower sites with five more families being present in PMRC. The greatest contrast involves MMS with only 10 families and just over 200 species for any one family.

Seasonal patterns

It is not practical to present seasonal patterns for all species documented in this report. The following examples illustrate some of the periodicities observed. The patterns do not distinguish between emergence and persistence of adults, except for groups such as the Saturniidae where adults are non-feeding and do not survive the period between light trap sampling.

The flight periods of the forest tent caterpillar (*Malacosoma disstria*) (Fig. 4) and eastern tent caterpillar (*M. americana*) (Fig. 5) represent an activity period of about five weeks, but with most moths appearing within a single week, possibly suggesting a high level of synchrony in emergence. Both

species were most abundant at PMRC.

A number of Lepidoptera at Mount Mansfield exhibited distinct bivoltine generations. The geometrid *Campaea perlata* feeds on many different trees and shrubs including birches, maples, poplars and firs, and is present at both lower elevation sites. It was common over a six week period during mid-summer, and again in the early fall (Fig. 6).

In contrast, the three species of *Plagodis* are usually present in low numbers, and with limited flight periods (Fig. 7). The seasonality of *P. fervidaria* comprised early spring and mid-summer generations separated by an interval of eight weeks. The adult emerge of the other *Plagodis* species occurs within this interval, suggesting that their larval development in the second generation is completed within three or four weeks. All three species are known to feed on a range of hardwood trees.

Two species that are distributed over all sites, but more abundant at higher elevations, are the geometrids *Dysstroma citrata* (Fig. 8), and *D. truncata* (Fig. 9). The infrequent records of *D. citrata* are late summer and early fall, while *D. truncata* is abundant over the latter two months of summer, particularly at site 2. Both species may feed on herbs or tree species.

Two species of saturniid moths are present at the lower elevation sites, but only in low numbers (Fig. 10). They are of potential interest for long-term surveys because they represent of a group of moths that have in the past

demonstrated apparent sensitivity to chemical pesticides. Some species have become locally extinct or greatly reduced in numbers due to pesticides or other environmental impacts. The adults are non-feeding (atrophied mouthparts) and because the light trap specimens are always in perfect condition, the seasonal records can be directly related to weather conditions at the time of collection. The larvae of both species are recorded feeding on a wide range of host trees.

In contrast to the saturniid moths, the fall hemlock looper *Lambdina fiscellaria* has a very broad flight period, and is present in considerable numbers. Although a pest species in some areas of the northeastern United States and Canada, there is no indication at present that the numbers recorded on Mount Mansfield are responsible for specific levels of damage to trees. It is probable, although not confirmed, that the moth feeds on a range of hardwood species on Mount Mansfield.

Discussion

The Lepidoptera diversity patterns are only preliminary, particularly with respect to the micro-Lepidoptera which may be less effectively caught by the light traps. Even if they are attracted to the light, the plexiglass vanes may not be effective in disrupting the flight of these small moths. Long-term documentation will be necessary to confirm the current results, and other collections techniques may be desirable to survey those species not attracted to the lights. Some species of Noctuidae and various other families overwinter as

adults, and are actively feeding in the spring and fall. Some species are rarely, if ever, attracted to lights, and best collected using bait (fermenting alcohol/sugar/fruit).

Long-term comparisons of light trap data may be most informative on species diversity and abundance for the macro-Lepidopteran groups Noctuidae, Geometridae, Notodontidae, Arctiidae, Saturniidae, Sphingidae, Lymantriidae, Lasiocampidae, Drepanidae, and Limacodidae. These are now well documented for Mount Mansfield, and can be identified accurately by visual examination for most species. There are a few exceptions which require closer morphological examination, and the genus *Eupithecia*, in particular, will require further genitalic examination for a comprehensive listing of species.

Micro-Lepidoptera are unlikely to be intensively surveyed on a regular basis because they require greater resources than are available for this study. However, if it were practical, regular surveys of the Tortricidae would be desirable because this is one of the most diverse families of micro-Lepidoptera collected from the Mount Mansfield light traps, and it includes species that are known to feed on tree and shrub foliage, including some with pest status.

The seasonal patterns of Lepidoptera may be strongly influenced by weather patterns, particularly if the weather influences the number of moths attracted to the light traps. Casual observations suggest that cool and/or very wet (heavy rains) weather can reduce the number of moths. The limited sampling of one light trap per

site and for only for one night per week may result in misleading patterns if the trap night coincides with poor weather. Replication and/or multiple sampling nights is desirable, but not feasible at present. In the future the seasonal periodicities of moths could be compared with both weather and tree phenology to develop a predictive model of insect activity and feeding.

Future Plans

The survey program in 1994 will continue for Lepidoptera and carabid beetles, while the canopy Hymenoptera and Diptera survey will be limited to May and June (period of early host-plant foliation). Long-term diversity and abundance trends will be examined by comparing the results of collections from 1991 to 1994.

The ecological and management significance of the Lepidoptera diversity requires information on host-plant associations. This information is currently being compiled from the literature and unpublished sources in cooperation with Dr D. F. Schweitzer of the Nature Conservancy. Documentation of host-plant associations will allow a more precise relationship to be identified for the prevalence of particular species, as well as estimating the significance of lepidopteran diversity in relation to vegetation structure and host-plant composition.

Acknowledgements

We are grateful for the continued support of Ross Bell (University of Vermont) and Bob Davidson (Carnegie Museum of Natural History) with identification of Carabidae and other

Coleoptera. The identification of microlepidoptera was assisted by Mike Sabourin (South Burlington), with specialist confirmations contributed by a number of systematists at regional institutions. Data collection was assisted by Carlos Saltero (University of Vermont Research Program). Data processing and database entry was facilitated by David Barnes, Pete Pfenning and Dave Marcaux (St Albans).

Figure 1. Comparison of species numbers and individuals for families of Lepidoptera collected at Proctor Maple Research Center (400 m) in 1993.

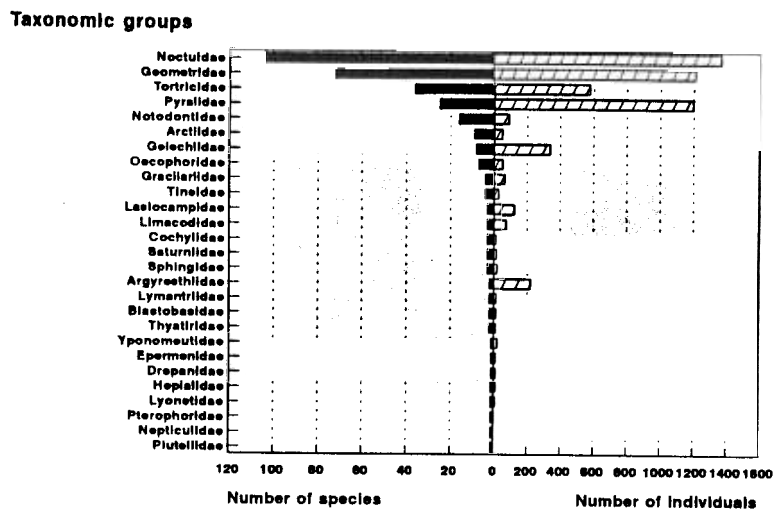


Figure 2. Comparison of species numbers and individuals for families of Lepidoptera collected at Underhill State Park (600 m) in 1993.

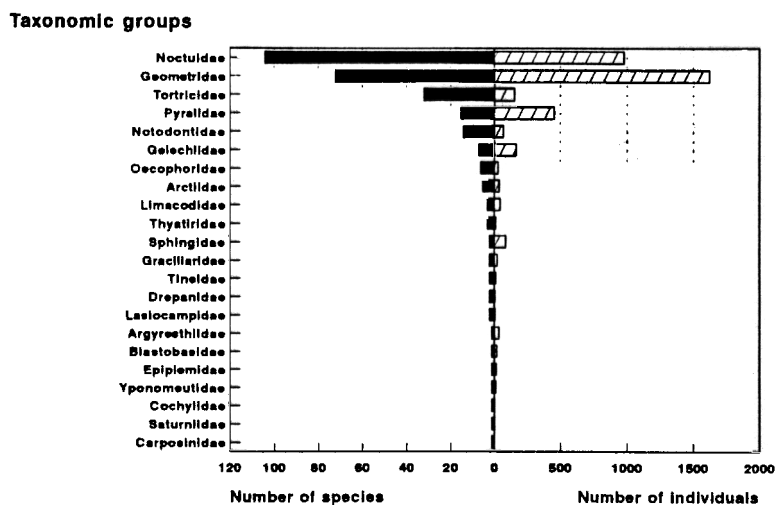


Figure 3. Comparison of species numbers and individuals for families of Lepidoptera collected at Mount Mansfield summit (1160 m) in 1993.

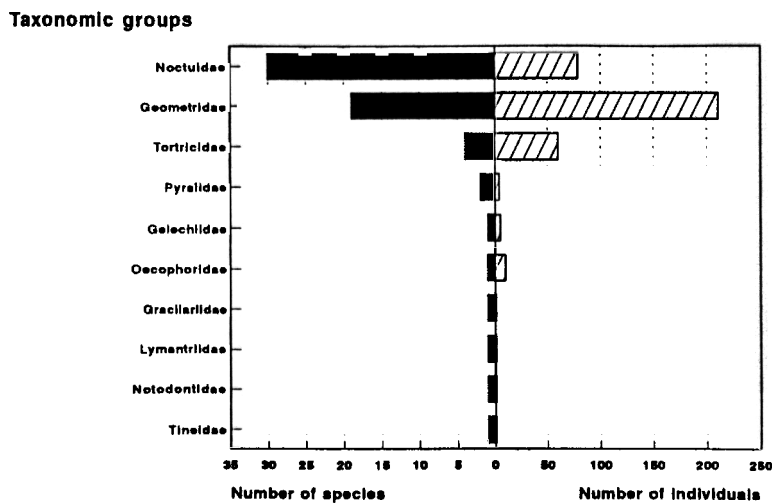


Figure 4. Seasonal collection (one trap night/week) of forest tent caterpillar (*Malacosoma disstria*) at Mount Mansfield sites 2 (Underhill State Park) and 3 (Proctor Maple Research Center).

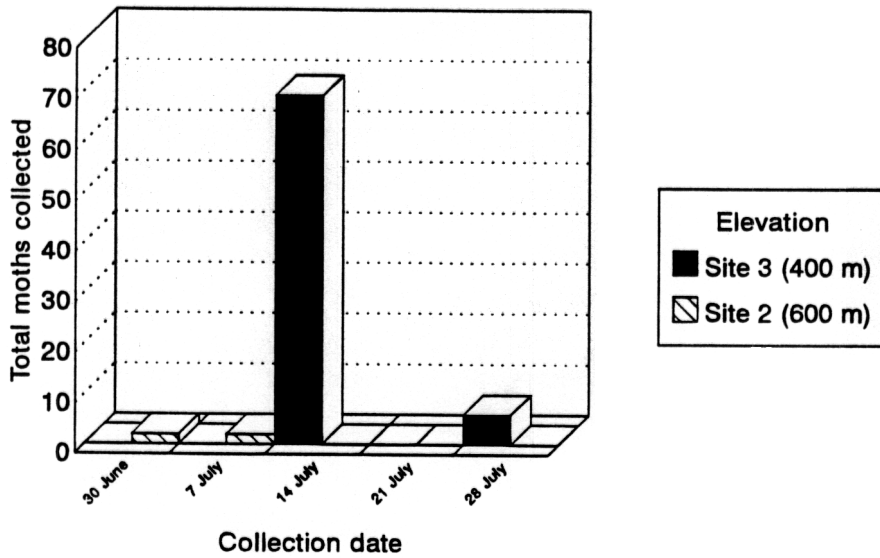


Figure 5. Seasonal collection (one trap night/week) of eastern tent caterpillar (*Malacosoma americanum*) at Mount Mansfield sites 2 (Underhill State Park) and 3 (Proctor Maple Research Center).

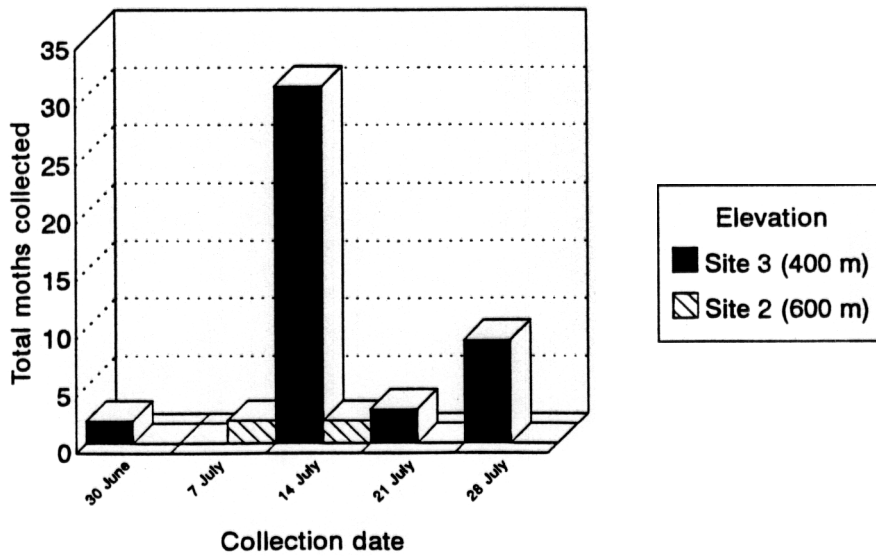


Figure 6. Seasonal collection (one trap night/week) of *Campaea perlata* (Geometridae) at Mount Mansfield sites 2 (Underhill State Park) and 3 (Proctor Maple Research Center).

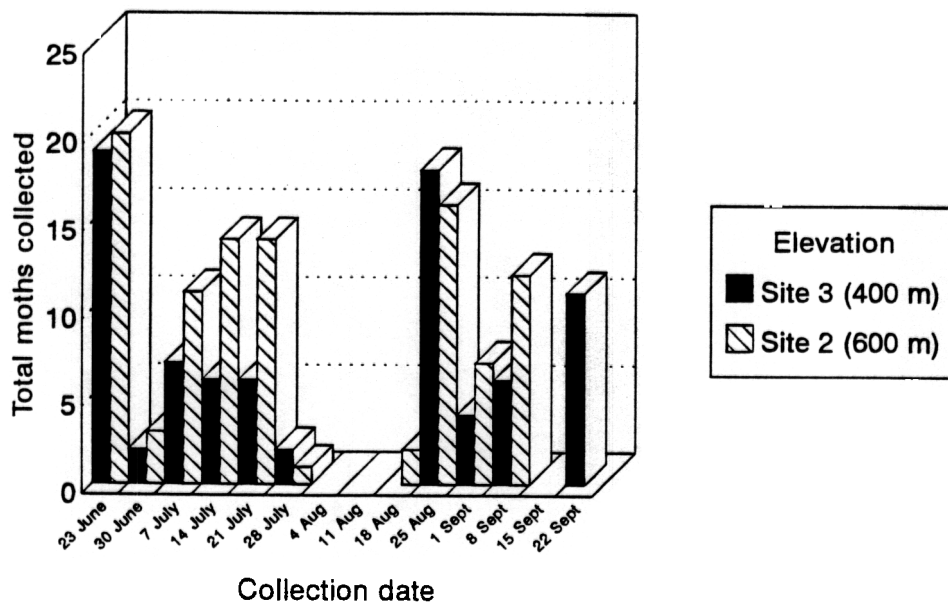


Figure 7. Seasonal collection (one trap night/week) of three *Plagodis* species (Geometridae) at Mount Mansfield. Records are combined for Underhill State Park and Proctor Maple Research Center.

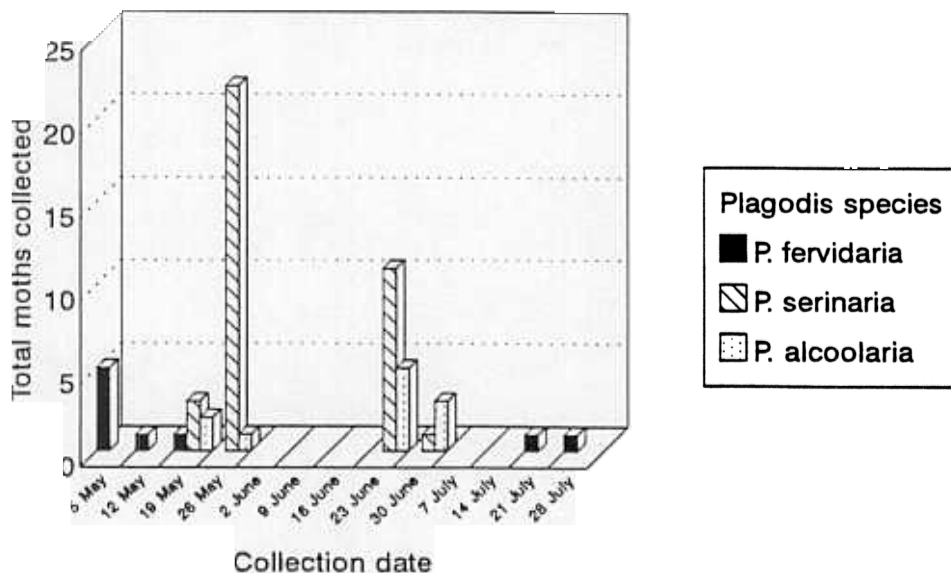


Figure 8. Seasonal collection (one trap night/week) of *Dysstroma citrata* (Geometridae) at Mount Mansfield sites 1 (sub-alpine fir forest), 2 (Underhill State Park) and 3 (Proctor Maple Research Center).

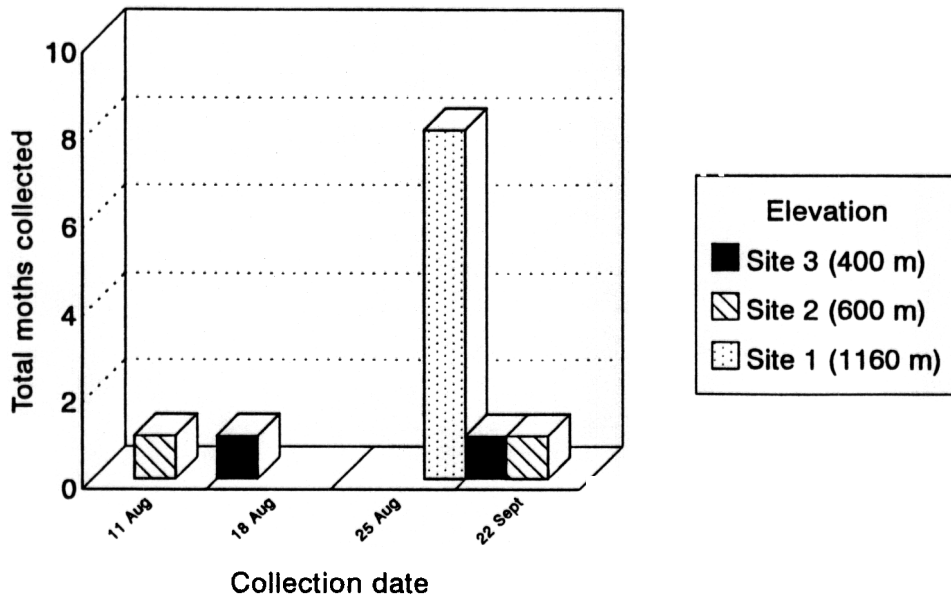


Figure 9. Seasonal collection (one trap night/week) of three *Dysstroma truncata* species (Geometridae) at Mount Mansfield sites 1 (sub-alpine fir forest), 2 (Underhill State Park) and 3 (Proctor Maple Research Center).

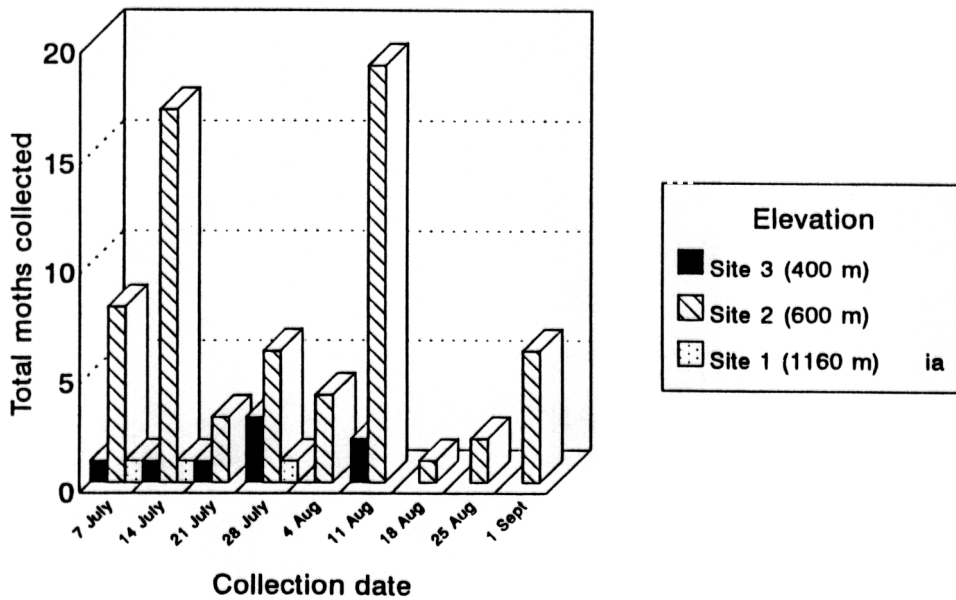


Figure 10. Seasonal collection (one trap night/week) of *Antheraea polyphemus* and *Actias luna* (Saturniidae) combined for site 2 (Underhill State Park) and 3 (Proctor Maple Research Center).

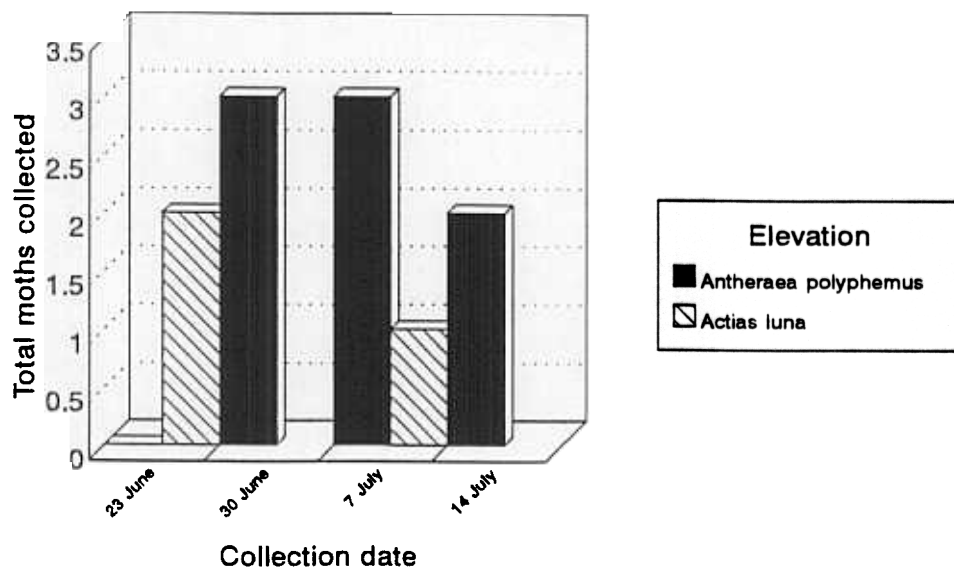


Figure 11. Seasonal collection (one trap night/week) of the fall hemlock looper *Lambdina fiscellaria* (Geometridae) at Mount Mansfield sites 2 (Underhill State Park) and 3 (Proctor Maple Research Center).

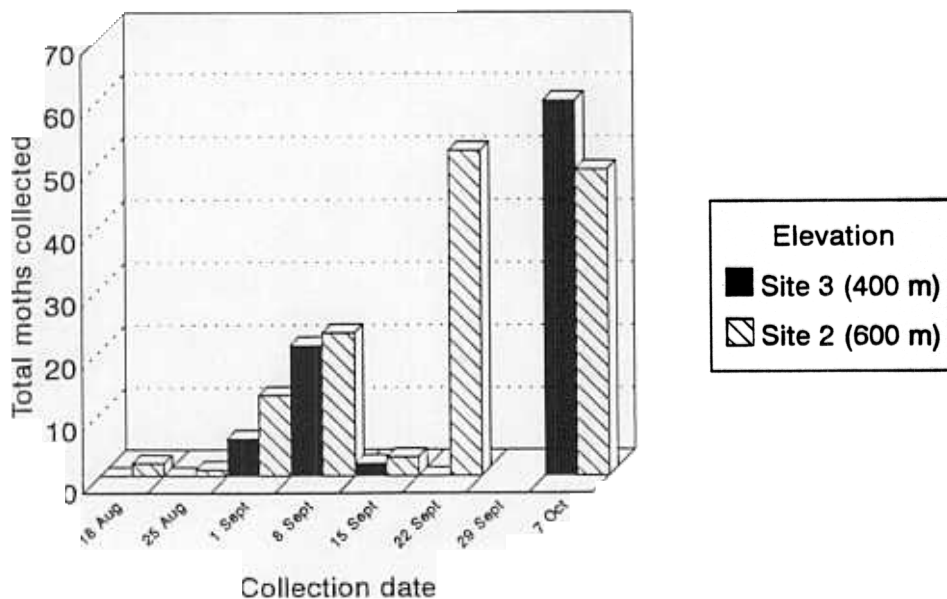


Table 1. Lepidoptera collected from light traps on Mount Mansfield summit (site 1 1160m), Underhill State Park (site 2 600m), and Proctor Maple Research Center (site 3 600m)

	Site		
	1	2	3
Arctiidae: Arctiinae			
<i>Haploa lecontei</i> (Guér-Meneville, 1832)		+	
<i>Lophocampa maculata</i> Harr., 1841		+	+
<i>Phragmatobia assimilans</i> Wlk., 1855		+	+
<i>Phragmatobia fuliginosa</i> (L., 1758)		+	
<i>Spilosoma congrua</i> Wlk., 1855		+	
<i>Spilosoma virginica</i> (F., 1798)		+	
Arctiidae: Ctenuchinae			
<i>Ctenucha virginica</i> (Esp., 1794)		+	
Arctiidae: Lithosiinae			
<i>Clemensia albata</i> Pack., 1864		+	+
<i>Hypoprepia fucosa</i> Hbn., 1827-1831			+
Argyresthiidae			
<i>Argyresthia goedartella</i> (L., 1758)			+
<i>Argyresthia oreasella</i> (Clem., 1860).		+	+
Blastobasidae			
<i>Asaphocrita</i> n.sp.		+	+
<i>Hypatopa</i> sp			+
Carposinidae			
<i>Bondia cresentella</i> (Wlsm., 1882)		+	+
Cochylidae			
<i>Aethes atomosana</i> Bsk., 1907			+
<i>Cochylis dubitana</i> (Hbn., 1799)		+	
<i>Hysterosia hospes</i> Wlsm., 1884			+
<i>Thyraylia bunteana</i> (Rob., 1869)	+		
Drepanidae			
<i>Drepana arcuata</i> Wlk., 1855.		+	+
<i>Drepana bilineata</i> (Pack., 1864)			+
Epermeniidae: Epermeniinae			
<i>Epermenia ?albapunctella</i> Bsk., 1908.			+

Table 1 continued

	Site		
	1	2	3
Epiplemlidae			
<i>Callizzia amorata</i> Pack., 1856.	+		
Gelechiidae: Dichomeridinae			
<i>Dichomeris punctipennella</i> Clem., 1860		+	+
<i>Dichomeris stependiaris</i> (Braun, 1925)		+	
<i>Trichotaphe bilobella</i> (Zell., 1873)			
Gelechiidae: Gelechiinae			
<i>Chionodes continuella</i> (Zell., 1839)		+	+
<i>Chionodes mediofuscella</i> (Clem., 1863)	+	+	
<i>Chionodes obscurusella</i> (Cham., 1872)	+	+	+
<i>Coleotechnites quercivorella</i> (Cham., 1872)		+	+
<i>Filatima</i> sp.1	+	+	
<i>Pseudochelaria pennsylvanica</i> Dietz, 1900		+	
<i>Pseudotelphusa belangerella</i> (Cham., 1875)		+	
Geometridae: Ennominae			
<i>Anacamptodes ephyraria</i> (Wlk., 1860)			+
<i>Anagoga occiduaria</i> (Wlk., 1861)	+	+	
<i>Aethalura intertexta</i> (Wlk., 1860)	+	+	
<i>Besma endropiaria</i> (G. & R., 1867)		+	+
<i>Biston betularia</i> (L., 1758)	+	+	
<i>Cabera erythemaria</i> Gn., 1857	+	+	
<i>Campaea perlata</i> (Gn., 1857)		+	+
<i>Caripeta angustiorata</i> (Wlk., 1863)	+		
<i>Caripeta divisata</i> Wlk., 1863	+	+	+
<i>Ectropis crepuscularia</i> (D. & S., 1775).	+	+	
<i>Ennomos magnaria</i> Gn., 1857			+
<i>Euchlaena serrata</i> (Drury, 1770)		+	+
<i>Euchlaena irraria</i> (B & McD., 1917)			+
<i>Euchlaena tigrinaria</i> (Gn., 1857)	+	+	
<i>Eugonobapta nivosaria</i> (Gn., 1857)		+	+
<i>Eupithecia columbiata</i> (Dyar, 1904)	+	+	+
<i>Eutrapela clemataria</i> (J.E., Smith. 1917)	+	+	
<i>Homochlodes disconventa</i> (Wlk., 1860)	+	+	
<i>Homochlodes lactispargaria</i> (Wlk., 1861).		+	+
<i>Hypagyrtis piniata</i> (Pack., 1870).	+	+	
<i>Hypagyrtis unipunctata</i> (Haw., 1809)		+	+
<i>Iridopsis larvaria</i> (Gn., 1857)		+	+
<i>Itame anataria</i> (Swett. 1913)		+	
<i>Itame pustularia</i> (Gn., 1857)		+	+
<i>Lambdina fiscellaria</i> (Gn., 1857)	+	+	

Table 1 continued

	Site		
	1	2	3
<i>Lomographa glomeraria</i> (Grt., 1881)		+	+
<i>Lomographa vestaliata</i> (Gn., 1857)			+
<i>Lytrosis unitaria</i> (H.-S., 1854)			+
<i>Melanolophia canadaria</i> (Gn., 1857)			+
<i>Melanolophia signataria</i> (Wlk., 1860).		+	+
<i>Metanema inatomaria</i> Gn., 1857	+	+	
<i>Metarranthis angularia</i> B. & McD., 1917		+	
<i>Metarranthis hypocharia</i> H.-S., 1854		+	
<i>Nematocampa resistaria</i> (H.-S., 1855)	+	+	
<i>Nepytia canosaria</i> (Wlk., 1863)		+	
<i>Orthofidonia tinctaria</i> (Wlk., 1860)		+	
<i>Pero hubneraria</i> (Gn., 1857)	+	+	+
<i>Plagodis alcoolaria</i> (Gn., 1857)	+	+	
<i>Plagodis fervidaria</i> H.-S., 1854.	+	+	
<i>Plagodis serinaria</i> H.-S., 1855	+	+	
<i>Probole alienaria</i> H.-S., 1855.		+	+
<i>Probole amicaria</i> (H.-S., 1855)	+		
<i>Protoarmia porcelaria</i> (Gn., 1857)		+	+
<i>Selenia kentaria</i> (G. & R., 1867)	+	+	
<i>Semiothisa aemulataria</i> (Wlk., 1861)		+	+
<i>Semiothisa bisignata</i> (Wlk., 1866)	+	+	+
<i>Semiothisa pinistrobata</i> Fgn., 1972	+	+	+
<i>Semiothisa ulserata</i> (Pears., 1913)	+	+	
<i>Sicya macularia</i> (Harr., 1850)	+	+	+
<i>Tetracis cachexiata</i> Gn., 1857	+	+	
<i>Xanthotype urticaria</i> Swett, 1918	+	+	
Geometridae: Geometrinae			
<i>Nemoria mimosaria</i> (Gn., 1857)	+		
Geometridae: Larentiinae			
<i>Acasis viridata</i> (Pack., 1873)		+	
<i>Anticlea vasiliata</i> Gn., 1857.		+	+
<i>Cladara atroliturata</i> (Wlk., 1863)	+	+	
<i>Cladara limitaria</i> (Wlk., 1860).	+		
<i>Dysstroma citrata</i> (L., 1761)	+	+	+
<i>Dysstroma hersiliata</i> (Gn., 1857)	+	+	
<i>Dystroma truncata</i> (Hufn., 1767).	+	+	+
<i>Ecliptopera silaceata</i> (D. & S., 1875)		+	+
<i>Epirrhoe alternata</i> (Müller, 1764)	+	+	
<i>Epirrita autumnata</i> (Bkh., 1794)	+		+
<i>Eulithis destinata</i> (Mösch., 1860)	+		
<i>Eulithis flavibrunneata</i> (McD., 1943)	+		

Table 1 continued

	Site		
	1	2	3
<i>Eulithis propulsata</i> (Wlk., 1862)	+	+	
<i>Euphyia unangulata intermediata</i> (Gn., 1857)		+	+
<i>Eupithecia absinthiata</i> (Clerck, 1759)		+	
<i>Heterophleps refusaria</i> (Wlk., 1861)		+	+
<i>Horisma intestinata</i> (Gn., 1857)		+	+
<i>Hydrelia inornata</i> (Hulst, 1896)	+	+	
<i>Hydria prunivorata</i> (Fgn., 1955)	+	+	
<i>Mesoleuca ruficillata</i> (Gn., 1857)	+	+	
<i>Orthonama obstipata</i> (F., 1794)	+	+	
<i>Orthonama centrostrigaria</i> (Woll., 1858)		+	
<i>Perizoma basaliata</i> (Wlk., 1862)	+	+	+
<i>Spargania magnoliata</i> Gn., 1857			+
<i>Stamnodes gibbicostata</i> (Wlk., 1862)		+	+
<i>Trichodezia albovittata</i> (Gn., 1857)		+	
<i>Venusia cambrica</i> Curt., 1839	+	+	+
<i>Venusia comptaria</i> (Wlk., 1860)	+	+	
<i>Xanthorhoe abrassaria</i> (H.-S., 1856)	+		
<i>Xanthorhoe ferrugata</i> (Cl., 1759)		+	
<i>Xanthorhoe iduata</i> (Gn., 1857)	+	+	
<i>Xanthorhoe labradorensis</i> (Pack., 1867)	+	+	
Geometridae: Sterrhinae			
<i>Cyclophora pendulinaria</i> (Gn., 1857).		+	+
<i>Pleuroprucha insulsaria</i> (Gn., 1857)			+
<i>Scopula limboundata</i> (Haw., 1809)		+	+
Gracillariidae: Gracillariinae			
<i>Caloptilia burgessiella</i> (Zell., 1873)		+	+
<i>Caloptilia coroniella</i> (Clem., 1864)		+	+
<i>Caloptilia serotinella</i> (Ely, 1910)	+		+
<i>Parornix geminatella</i> (Pack., 1869)			+
Hepialidae			
<i>Korscheltellus gracilis</i> (Grt., 1864)		+	
Incurvariidae: Icurvariinae			
<i>Paraclemensia acerifoliella</i> (Fitch, 1854)			
Lasiocampidae			
<i>Malacosoma americanum</i> (F., 1793).		+	+
<i>Malacosoma disstria</i> Hbn., 1820	+	+	

Table 1 continued	Site		
	1	2	3
Lasiocampidae: Macromphaliinae			
<i>Tolype vellea</i> Stoll., 1791			+
Limacodidae			
<i>Packardia geminata</i> (Pack., 1864)	+	+	
<i>Tortricida pallida</i> (H.S., 1854)		+	+
<i>Tortricidia testacea</i> (Pack., 1864)	+	+	
Lymantriidae: Orgyiinae			
<i>Dasychira plagiata</i> (Wlk., 1885)		+	
<i>Orgyia definita</i> Pack., 1864	+		+
Lyonetiidae			
<i>Bucculatrix ainsliella</i> Murt., 1905		+	
Nepticulidae: Nepticulinae			
<i>Obrussa ochrefasciella</i> Cham., 1873.	+	+	
Noctuidae: Acontiinae			
<i>Leuconycta diptheroides</i> (Gn., 1852)		+	
<i>Lithacodia albidula</i> (Gn., 1852)	+		
<i>Lithacodia concinnimacula</i> (Gn., 1852)	+	+	
<i>Lithacodia muscosula</i> (Gn., 1852)	+	+	
<i>Maliattha synochitis</i> (G. & R., 1868)		+	+
<i>Pseudeustrotia carneola</i> (Gn., 1852)		+	+
Noctuidae: Acronictinae			
<i>Acronicta americana</i> (Harr., 1841)		+	+
<i>Acronicta fragilis</i> (Gn., 1852)		+	+
<i>Acronicta hasta</i> Gn., 1852		+	
<i>Acronicta impressa</i> Wlk., 1856.		+	+
<i>Acronicta innotata</i> Gn., 1852		+	+
<i>Acronicta retardata</i> (Wlk. 1867)		+	
<i>Acronicta tristis</i> Sm., 1911		+	+
Noctuidae: Amphipyrinae			
<i>Achatodes zeae</i> (Harr., 1841)			+
<i>Amphipoea americana</i> (Speyer, 1875)	+		+
<i>Amphipoea velata</i> (Wlk., 1865)	+		
<i>Amphipyra pyramidoides</i> Gn., 1852	+	+	+
<i>Amphipyra tragopoginis</i> (Cl., 1759)			
<i>Apamea dubitans</i> (Wlk., 1856)	+		

Table 1 continued

	Site		
	1	2	3
<i>Apamea amputatrix</i> (Fitch, 1857)	+	+	
<i>Apamea sordens</i> (Hufn., 1766)		+	
<i>Apamea vultuosa</i> (Grt., 1875)		+	
<i>Callopietria mollissima</i> (Gn., 1852)		+	+
<i>Chytonix palliatricula</i> Gn., 1852	+	+	
<i>Elaphria versicolor</i> (Grt., 1875)	+	+	
<i>Enargia decolor</i> (Wlk., 1858)			
<i>Euplexia benesimilis</i> McD., 1922	+		
<i>Hyppa xylinoides</i> (Gn., 1852)			+
<i>Ipimorpha pleonectusa</i> Grt., 1873	+		
<i>Magusa orbifera</i> (Wlk., 1857)			+
<i>Nedra ramosula</i> (Gn., 1852)			+
<i>Oligia crytora</i> (Franc., 1950)		+	+
<i>Oligia exhausta</i> (Sm., 1903).		+	+
<i>Oligia illocata</i> (Wlk., 1857)	+	+	+
<i>Oligia mactata</i> (Gn., 1852)	+	+	+
<i>Papaipema nepheleptema</i> (Dyar, 1908)		+	
<i>Papaipema</i> sp.	+		
<i>Papaipema animoda</i> (Sm., 1894)	+	+	
<i>Phlogophora iris</i> Gn., 1852	+	+	
<i>Phlogophora periculosa</i> Gn., 1852	+	+	+
<i>Psaphida rolandi</i> Grt., 1874		+	
<i>Spodoptera frugiperda</i> (J. E. Smith)		+	
Noctuidae: Catocalinae			
<i>Catocala blandula</i> Hulst, 1884		+	+
<i>Catocola cerograma</i> Gn., 1852		+	
<i>Catocala sordida</i> Grt., 1877			+
<i>Catocala ultronia</i> (Hbn., 1823)		+	
<i>Catocala unijugata</i> Wlk., 1858		+	
<i>Ceratomia undulosa</i> (Wlk., 1856).			+
<i>Parallelia bistriaris</i> Hbn., 1818		+	+
<i>Zale galbanata</i> (Morr., 1876).			+
<i>Zale lunifera</i> (Hbn., 1818)			
<i>Zale minerea</i> (Gn., 1852)	+		
Noctuidae: Cuculliinae			
<i>Anathix ralla</i> (G. & R., 1868)		+	+
<i>Eupsilia morrisoni</i> (Grt., 1874)	+		
<i>Feralia comstocki</i> (Grt., 1874)	+		
<i>Lithophane baileyi</i> Grt., 1877)		+	+
<i>Lithophane fagina</i> Morr., 1874		+	
<i>Lithophane patefacta</i> (Wlk., 1858)	+	+	

Table 1 continued

	Site		
	1	2	3
<i>Metalepsis salicarum</i> (Wlk., 1857)	+		
<i>Pachypolia atricornis</i> Grt., 1874.		+	+
<i>Platypolia anceps</i> (Steph., 1850)	+		
<i>Sunira bicolorago</i> (Gn., 1852)	+	+	+
Noctuidae: Hadeninae			
<i>Achatia distincta</i> Hbn., 1813			
<i>Homorthodes furfurata</i> (Grt., 1875).		+	+
<i>Lacinipolia lorea</i> (Gn., 1852)		+	+
<i>Lacinipolia olivacea</i> (Morr., 1874)	+	+	
<i>Leucania insueta</i> Gn., 1852			+
<i>Melanchra adjuncta</i> (Gn., 1852)	+		
<i>Melanchra assimilans</i> (Morr., 1874)		+	
<i>Morrisonia confusa</i> (Hbn., 1827-1831)	+	+	
<i>Morrisonia evicta</i> (Grt., 1873).	+		
<i>Nephelodes minians</i> Gn., 1852	+	+	+
<i>Orthodes crenulata</i> (Butler, 1890)	+		+
<i>Orthodes cynica</i> Gn., 1852	+	+	
<i>Orthodes detracta</i> (Wlk., 1857)	+	+	
<i>Orthodes goodelli</i> (Grt., 1875)			+
<i>Orthosia revicta</i> (Morr., 1876).	+		
<i>Orthosia rubescens</i> (Wlk., 1865).	+	+	
<i>Polia imbrifera</i> (Gn., 1852)	+	+	
<i>Polia nimbosa</i> Gn., 1852	+	+	+
<i>Protorthodes oviduca</i> (Gn., 1852)	+	+	
<i>Pseudaletia unipuncta</i> Haw., 1809	+		
<i>Pseudothodes vecors</i> (Gn., 1852).	+	+	
<i>Spirameter lutra</i> (Gn., 1852)			+
<i>Tricholita signata</i> (Wlk., 1860)		+	
<i>Trichordestra lilacina</i> (Harv., 1874)		+	
Noctuidae: Herminiinae			
<i>Idia aemula</i> (Hbn., 1813)	+	+	
<i>Idia americalis</i> (Gn., 1854)	+	+	
<i>Idia</i> sp. (<i>coneisa</i> of Forbes)		+	+
<i>Idia lubricalis</i> (Gey., 1832).			+
<i>Idia rotundalis</i> (Wlk., 1866)	+	+	+
<i>Macrochilo absorptalis</i> Wlk., 1859			+
<i>Palthis angulalis</i> (Hbn., 1796)		+	+
<i>Phalaenophana pyramusalis</i> (Wlk., 1859).		+	+
<i>Phalaenostola eumelusalis</i> (Wlk., 1859)	+	+	
<i>Renia flavipunctalis</i> (Gey., 1832)			+
<i>Renia sobrialis</i> (Wlk., 1859)		+	+

Table 1 continued

	Site		
	1	2	3
<i>Zanclognatha cruralis</i> (Gn., 1854)	+	+	
<i>Zanclognatha laevigata</i> (Grt., 1872)		+	+
<i>Zanclognatha ochreipennis</i> (Grt., 1872)	+	+	
<i>Zanclognatha pedipilias</i> (Gn., 1854)		+	+
<i>Zanclognatha protumnusalis</i> (Wlk., 1859)		+	+
Noctuidae: Hypeninae			
<i>Bomolocha edictalis</i> (Wlk., 1859)	+	+	
<i>Bomolocha palparia</i> (Wlk., 1861)	+	+	
<i>Hypena humuli</i> Harr. 1841		+	
<i>Plathypena scabra</i> (F., 1758)	+	+	+
<i>Spargaloma sexpunctata</i> Grt., 1873			+
Noctuidae: Hypenodinae			
<i>Dyspyralis illocata</i> Warren, 1891		+	+
<i>Hypenodes palustris</i> Fgn., 1954)	+	+	+
Noctuidae: Noctuinae			
<i>Abagrotis alternata</i> (Grt., 1864)		+	
<i>Anaplectoides prasina</i> (D & S., 1775)	+	+	+
<i>Anaplectoides pressus</i> (Grt., 1874)		+	
<i>Agrotis ipsilon</i> (Hufn., 1766)			+
<i>Agrotis venerabilis</i> Wlk., 1857	+		
<i>Aplectoides condita</i> (Gn., 1852)		+	
<i>Cerastis tenebrifera</i> (Wlk., 1865)	+	+	
<i>Cryptocala acadensis</i> (Bethune, 1870)	+	+	
<i>Diarsia jucunda</i> (Wlk., 1857)		+	+
<i>Eueretagrotis perattenta</i> (Grt., 1876)		+	+
<i>Eueretagrotis attenta</i> (Grt., 1874)		+	+
<i>Eueretagrotis sigmoides</i> (Gn., 1852)		+	+
<i>Eurois astricta</i> Morr., 1874.	+	+	+
<i>Eurois occulta</i> (L. 1758)	+		
<i>Graphiphora auger haruspica</i> (Grt., 1875)		+	+
<i>Ochropleura plecta</i> (L., 1761)		+	+
<i>Polia purpurissata</i> (Grt., 1864)			+
<i>Spaelotis cldestina</i> (Harr., 1862)	+		
<i>Xestia bicarnea</i> (Gn., 1852)		+	+
<i>Xestia c-nigrum adela</i> (Franc., 1980)		+	+
<i>Xestia dolosa</i> Franc., 1980	+	+	+
<i>Xestia fabulosa</i> Fgn., 1965	+		
<i>Xestia mixta</i> (Wlk., 1856).	+		
<i>Xestia normaniana</i> (Grt., 1874)	+	+	
<i>Xestia smithii</i> (Snell., 1896)	+	+	

Table 1 continued	Site		
	1	2	3
Noctuidae: Nolinae			
<i>Nola triquetrana</i> (Fitch, 1856)		+	
Noctuidae: Pantheinae			
<i>Colocasia flavicornis</i> (Sm., 1884).	+	+	
<i>Colocasia propinguilinea</i> (Grt., 1873)		+	+
<i>Raphia frater</i> Grt., 1864	+		
Noctuidae: Plusiinae			
<i>Anagrapha falcifera</i> (Kby., 1873)	+		
<i>Autographa ampla</i> (Wlk., 1858)		+	
<i>Diachrysis aeroiodes</i> (Grt., 1864)	+	+	
Noctuidae: Rivulinae			
<i>Rivula propinqualis</i> Gn. 1854.		+	+
Noctuidae: Sarrothripinae			
<i>Baileya ophthalmica</i> Gn., 1852			+
Notodontidae			
<i>Clostera albosigma</i> Fitch, 1856		+	
<i>Dasylophia anguina</i> (J. E. Smith, 1797)	+	+	
<i>Dasylophia thyatiroides</i> (Wlk., 1862)			+
<i>Ellida caniplaga</i> (Wlk., 1856)			+
<i>Gluphisia lintneri</i> (Grt., 1877)			+
<i>Heterocampa biundata</i> Wlk., 1855	+	+	
<i>Heterocampa guttivitta</i> (Wlk., 1855).	+	+	
<i>Hyperaeschra georgica</i> (H.-S., 1855)			+
<i>Macrurocampa marthesia</i> (Cram., 1780)			
<i>Nadata gibbosa</i> (J.E. Smith, 1797)	+		
<i>Oligocentria semirufescens</i> (Wlk., 1865)	+		
<i>Peridea angulosa</i> (J.E. Smith, 1797)			+
<i>Peridea basitriens</i> (Wlk., 1855)	+	+	
<i>Peridea ferruginea</i> (Pack., 1864)	+	+	+
<i>Schizura ipomoeae</i> Doubleday, 1841		+	+
<i>Schizura leptinodes</i> (Grt., 1864)	+		
<i>Schizura unicornis</i> (J.E. Smith, 1797)		+	+
<i>Symmerista canicosta</i> Franc., 1946		+	+
<i>Symmerista leucitys</i> Franc., 1946		+	+
Oecophoridae: Ethmiinae			
<i>Machimia tentoriferella</i> (Clem., 1860)	+	+	+

Table 1 continued

	Site		
	1	2	3
Oecophoridae: Depressariinae			
<i>Agonopterix walsinghamella</i> (Bsk., 1902)			+
<i>Bibarrambla allenella</i> (Wlsm., 1882).		+	+
<i>Nites maculatella</i> (Bsk., 1908)	+	+	
<i>Psilocorsis ?reflexella</i> Clem., 1860		+	+
<i>Semioscopis inornata</i> Wlsm., 1882.	+		
<i>Semioscopis packardella</i> (Clem., 1863)	+	+	
Oecophoridae: Oecophorinae			
<i>Callima argenticinctella</i> Clem., 1860.			+
Plutellidae: Plutellinae			
<i>Plutella xylostella</i> (L., 1758).			+
Pterophoridae: Pterophorinae			
<i>Oidaematophorus lacteodactylus</i> (Cham., 1873) gp.			+
Pyralidae: Chrysauginae			
<i>Condylolomia participalis</i> Grt., 1873.		+	+
Pyralidae: Crambinae			
<i>Catoptria latiradiella</i> (Wlk., 1863)			+
<i>Chrysoteuchia topiaria</i> (Zell., 1866)			+
<i>Crambus agitatellus</i> Clem., 1860	+	+	
<i>Crambus albellus</i> Clem., 1860	+	+	
<i>Crambus girardellus</i> Clem., 1860	+	+	
<i>Crambus unistriatellus</i> Pack., 1867		+	+
Pyralidae: Epipaschiinae			
<i>Pococera asperatella</i> Clem., 1860		+	
Pyralidae: Galleriinae			
<i>Aphomia terrenella</i> Zell., 1848			+
<i>Galleria mellonella</i> L., (1758)			+
Pyralidae: Phycitinae			
<i>Acrobasis indigenella</i> (Zell., 1848)			+
<i>Eulogia ochrifrontella</i> (Zell., 1876).		+	+
<i>Oreana unicolorella</i> (Hulst., 1887)			+
<i>Ortholepis pasadamia</i> (Dyar, 1917)			+

Table 1 continued

	Site		
	1	2	3
Pyralidae: Pyralinae			
<i>Herculia olinalis</i> (Gn., 1854)		+	
<i>Hypsopygia costalis</i> (F., 1775)			
<i>Pyralis costiferalis</i> Linnaeus, 1758		+	+
<i>Pyralis disciferalis</i> Dyar, 1908		+	+
Pyralidae: Pyraustinae			
<i>Anageshna primordialis</i> (Dyar, 1907)			+
<i>Herpetogramma abdominalis</i> (Zell., 1872)		+	+
<i>Nascia acutella</i> (Wlk., 1886)		+	+
<i>Nomophila nearctica</i> Mun., 1973		+	
<i>Phlyctaenia coronata tertialis</i> (Gn., 1854)		+	+
Pyralidae: Scopariinae			
<i>Scoparia basalis</i> Wlk., 1866.		+	+
<i>Scoparia biplagiata</i> Wlk., 1866	+	+	+
Saturniidae: Citheroniinae			
<i>Dyrocampa rubicunda</i> (F., 1793)		+	
Saturniidae: Saturniinae			
<i>Agriphila vulgivaigella</i> (Clem., 1860)	+	+	+
<i>Antheraea polyphemus</i> (Cram., 1776)	+	+	
<i>Actias luna</i> (L., 1758)		+	+
Sesiidae: Sesiinae			
<i>Synanthedon acerni</i> (Clem., 1860)	+		
Sphingidae: Sphinginae			
<i>Lapara bombycoides</i> Wlk., 1856	+		
<i>Pachysphinx modesta</i> (Harr., 1839)			+
<i>Paonias excaecatus</i> (J. E. Smith, 1797)	+	+	
<i>Paonias myops</i> (J. E. Smith, 1797)			+
Thyatriridae: Thyatriinae			
<i>Euthyatira pudens</i> (Gn.)	+		
<i>Habrosyne scripta</i> (Gosse, 1840)	+	+	
<i>Pseudothyatira cymatophoroides</i> (Gn., 1852)		+	+
Tineidae			
<i>Acrolophus morus</i> (Grt., 1881)	+	+	+
<i>Amydria effrentella</i> Clem., 1859		+	
<i>Monopis dorsistrigella</i> (Clem., 1859)			+

Table 1 continued

	Site		
	1	2	3
<i>Monopis spilotella</i> Tengstrom, 1848.		+	
<i>Niditinea fuscella</i> (L., 1758)			+
Tortricidae: Olethreutinae			
<i>Ancylis apicana</i> (Wlk., 1866)			+
<i>Ancylis comptana</i> (Frölich, 1828)	+	+	
<i>Ancylis fuscociliana</i> (Clem., 1864)			+
<i>Ancylis metamelana</i> (Wlk., 1863)		+	
<i>Catastega aceriella</i> (Clem., 1861)		+	
<i>Endopiza viteana</i> Clam., 1860.	+		
<i>Epinotia lindana</i> (Fern., 1892)	+		
<i>Epinotia rectiplicana</i> (Wlsm., 1879)			+
<i>Epinotia solandriana</i> (L., 1758).		+	
<i>Epinotia transmissana</i> (Wlk., 1863)		+	
<i>Epinotia trigonella</i> (F., 1758)		+	+
<i>Eucosma derelecta</i> Heinr., 1929		+	+
<i>Eucosma similana</i> (Clem., 1860)	+		
<i>Gretchena delicatana</i> Heinr., 1923		+	+
<i>Hulda impudens</i> (Wlsm., 1884)	+		
<i>Olethreutes appendicea</i> (Zell., 1875)			+
<i>Olethreutes astrologana</i> (Zell., 1875)		+	
<i>Olethreutes glaciana</i> (Mösch., 1860)		+	+
<i>Olethreutes nigrana</i> (Heinr., 1923)			+
<i>Olethreutes permundana</i> (Clem., 1860)	+	+	
<i>Olethreutes quadrifidus</i> (Zell., 1875)		+	+
<i>Olethreutes trinitana</i> (McD., 1931)		+	+
<i>Phaneta parmatana</i> (Clem., 1860)	+		
<i>Proteoteras aesculana</i> Riley, 1881		+	
<i>Proteoteras moffatiana</i> Fern., 1905			+
<i>Tanviva albolineana</i> Kft., 1907	+	+	
Tortricidae: Tortricinae			
<i>Acleris celiana</i> (Rob., 1869)			+
<i>Acleris chalybeana</i> (Fern., 1882)		+	
<i>Acleris logiana</i> (Cl., 1759).	+		
<i>Acleris maccana</i> (Tr., 1835)			+
<i>Acleris semiannula</i> (Rob., 1869)	+		
<i>Acleris subnivana</i> (Wlk., 1863)	+		
<i>Acleris variana</i> Fern., 1886	+		+
<i>Anopina ednana</i> (Kft., 1907)		+	
<i>Archips dissitana</i> Grt., 1879		+	
<i>Archips purpurana</i> (Clem., 1865)	+	+	
<i>Argyrotaenia mariana</i> (Fern., 1882)		+	

Table 1 continued

	Site		
	1	2	3
<i>Argyrotaenia velutinana</i> (Wlk., 1863)		+	
<i>Choristoneura conflictana</i> Wlk., 1863			+
<i>Choristoneura pinus</i> Free., 1953			
<i>Choristoneura rosaceana</i> (Harr., 1841)		+	
<i>Clepsis melaleucana</i> (Wlk., 1863)	+	+	
<i>Clepsis persicana</i> (Fitch, 1856)	+	+	+
<i>Eulia ministrana</i> (L., 1758)		+	+
<i>Pandemis lamprosana</i> (Rob., 1869)			+
<i>Platynota idaeusalis</i> (Wlk., 1859).	+	+	
<i>Ptycholoma virescana</i> (Clem., 1865)		+	+
<i>Sparagonothis pettitana</i> (Rob., 1869)		+	+
<i>Sparganothis reticulatana</i> (Clem., 1860).	+	+	
<i>Syndemis afflictana</i> (Wlk., 1863)		+	
Yponomeutidae			
<i>Swammerdamia caesiella</i> (Hbn., 1796)		+	+