

**Light Trap Survey of Moth Biodiversity
of Mount Mansfield for 2000**



by
M. Scott Griggs
&
John R. Grehan

for the
Vermont Monitoring Cooperative
111 West Street
Essex Junction, Vermont 05452
2001

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M. Scott Griggs

49 Lover's Lane, Grand Isle, VT 05458

&

John R. Grehan

Department of Entomology, 501 ASI Building, Pennsylvania State University
University Park, PA 16802

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Abstract

A light trapping survey of macrolepidoptera and three microlepidoptera families was carried out on Mount Mansfield from June through October 2000 for three permanent Vermont Monitoring Cooperative (VMC) survey plots corresponding to sites used in Lepidoptera surveys from 1991 to 1995. A new sampling site was also established at 950 m on the eastern slope of Mount Mansfield in the Stowe Mountain Resort. A total of 320 species was recorded representing 13 families. The majority (86%) of species were in the families Noctuidae, Geometridae, and Notodontidae. These results are similar to earlier surveys in species richness and evenness, suggesting no significant changes to the Lepidoptera biodiversity have occurred over the last 10 years as detected by black-light trapping.

In 1991 a survey program for insect diversity was initiated to collect insects from malaise traps, pitfall traps, waterpan traps, and light traps. The primary focus was on selected groups of larger sized insects that were practical to document and identify, including various families of Hymenoptera and Diptera, the macrolepidoptera, as well as the Carabidae. These surveys were carried out annually until the close of the 1995 season (Boone, 2000).

The Mount Mansfield Lepidoptera surveys provided the first comprehensive documentation of taxonomic and ecological diversity for Lepidoptera for a Vermont ecosystem. Moths collected from black-light traps indicate the species richness of the fauna is dominated by a small number of families. The addition of new records over succeeding years suggest collecting efficiency for the sampling sites was close to saturation (i.e. relatively few additional species were collected). The macrolepidoptera survey provided representation of most major moth groups, particularly many species with the potential to cause extensive defoliation of host trees. The macrolepidoptera comprise an amalgam of moth families that are not necessarily closely related, but the grouping provides a generally convenient label to refer to the larger-sized species. Efforts were

Introduction

To develop an ecosystem management approach for multiple use forests, the Vermont Monitoring Cooperative established a long-term program for documenting and monitoring the animal and plant biodiversity of Mount Mansfield, Vermont. A component of this inventory program included a survey of the insect fauna at a series of permanent sampling sites at different elevations and habitats.

made to identify as many moth species as possible, but many microlepidoptera could not be determined within the available time because of the need for either specialist assistance or specialized dissection and analysis. The 1991-1995 surveys also included a numerical count of the individuals for each species of the macrolepidoptera collected.

Continuous or repeated long-term surveys of invertebrates are difficult to maintain because of the facilities and specialist knowledge required to collect, store, and identify the numerous species involved. This problem is particularly acute in Vermont where there is a lack of specialist expertise to address the invertebrate biodiversity question on a large scale. Further sampling of the macrolepidoptera was considered feasible by the authors for documenting the number of species present.

A survey restricted to the macrolepidoptera was proposed to address the following questions:

- (1) Are the 1991-1995 surveys representative of Lepidoptera biodiversity for the permanent sampling sites?**
- (2) Is the taxonomic composition of species diversity stable over extended time scales?**
- (3) Do Lepidoptera surveys provide a practical approach to a regular monitoring program?**
- (4) How representative might the three sites be for Mount Mansfield in general?**

To address these questions a black-light sampling program was established at the permanent sample sites on Mount Mansfield with an additional sample being made from a site in the Stowe Mountain Resort.

Methods

The survey was carried out at the Vermont Monitoring permanent sampling sites at elevations

of 400 m at Proctor Maple Research Center (PMRC), 600 m at Underhill State Park (USP), and 1160 m near the Mount Mansfield summit (MMS). A fourth site was selected at an elevation of 950 m on a ski trail in the Stowe Mountain Resort (SMRST) to provide an indication of variability in species composition and evenness on the Mountain. The PMRC site is located at 400 m in a mature sugar maple forest. The USP site comprises a mixed hardwood forest at 600 m, and the MMS site is located near the summit in a sub-alpine balsam fir forest at 1160 m.

Each light trap comprised a vertical 15-watt fluorescent black-light with rain cover and four plexiglass vanes. The light, powered by a 12-volt car battery, was positioned over a collecting bucket containing a killing agent. Light traps were operated for one night at two-week intervals from June until the middle of October. Moths were collected the following morning, sorted, and a minimum of two specimens of each species were pinned, labeled, and stored for identification.

A numerical count of individuals was not included because the amount of time and costs required exceeded available resources, and without the necessary replication such population counts would have limited analytical value. The survey included several families traditionally grouped under 'microlepidoptera' that comprise relatively large moths that can be accurately identified with available resources. These families are the Sesiidae, Limacodidae, and Hepialidae.

Identifications are based on taxonomic or regional publications (Covell 1984, Ferguson 1974, Forbes 1948, 1954, Grehan et al. 1995, Hodges 1983, Holland 1968, Lafontaine 1998, and Rockburne and Lafontaine 1976) and comparisons with specimens in the Scott Griggs Collection and the University of Vermont Entomology Research Laboratory Collection. Uncertain specimens were identified with the assistance of Dr. Dale Schweitzer of The Nature Conservancy.

Results

A total of 320 species representing 13 families were identified (Appendix 1). Site #1 (PMRC) provided 210 species with 87 from this site only. Site #2 (USP) provided 175 species with 63 from this site only. Site #3 (MMS) provided 39 species with 3 species being from this site only, and site #4 (SMRST) provided 50 species with 16 species from this site only. The distribution of species richness among Moth families on Mount Mansfield is dominated by the families Noctuidae, Geometridae, and Notodontidae which account for 86 percent of species recorded in the 2000 survey (Fig. 1).

Discussion

(1) Are the 1991-1995 surveys representative of Lepidoptera biodiversity for the permanent sampling sites?

The most recent survey provided a species record very close to the average of 317 for the previous five years collecting with 244, 266, 284, 399, and 392 species between 1991 and 1995. The higher numbers in 1995 may be due in part to the addition of a fourth sampling site at 715 m.

New records for the 2000 survey total 19 species in the family Noctuidae (Table 1). Almost half are from the new SMRST site, which represents a combination of forest and open herb and shrubland and those species from this site with known host records feed on herbaceous host plants typical of the open ski-trail habitat. The record of *Oligia bridgehami* is of general interest as it has only been sporadically collected in Vermont. Whether this represents sampling error (e.g. failure to be attracted to light) or actual localization or low population density is unknown. The host plants are unknown although it may be a grass or sedge feeder, like other *Oligia* species (D. Schweitzer, personal communication).

(2) Is the taxonomic composition of species diversity stable over extended time scales?

The current and former surveys lack the statistical replication necessary to quantify and compare differences between sites and over time. Descriptive comparisons (Figs 1-5), however, show that three families consistently dominate the species recorded at the light traps (Noctuidae, Geometridae, Notodontidae) over the 10 year period. There were no large fluctuations in total species for the other families.

(3) Do Lepidoptera surveys provide a practical approach to a regular monitoring program?

All invertebrate surveys require considerable taxonomic expertise to deal with the high number of species involved. Sorting light trap material is time-consuming and further time is required for the identification of damaged specimens or identifying those species requiring dissection of microscopic features. The present studies were possible because of the authors' familiarity with the Vermont fauna. While this expertise remains available, Lepidoptera surveys do provide a practical approach for regular monitoring of species diversity to provide a descriptive analysis of biodiversity.

(4) How representative might the three sites be for Mount Mansfield in general?

The abundance of new records at the SMRST site suggest the moth fauna of Mount Mansfield is heterogeneous with respect to major habitat or vegetation differences. The amount of variability in moth diversity may be assessed by further sampling different habitats and localities on the Mountain. The record of *Syngrapha alias* was initially thought to be a new record as it was absent from the VMC database. However, specimens collected from Proctor Maple Research Center and Underhill State Park were found to be present in the University of Vermont Research Laboratory Collection. It is possible that this species was not identified at the time the VMC species list was first compiled. The species is known to feed on black and white spruce (Rockburne and Lafontaine) and since neither host is present on Mount Mansfield

it is possible that *S. alias* is feeding on red spruce. A 1999 light trap survey at the nearby Ethan Allen Firing Range with two traps resulted in a much larger total of 434 species of Lepidoptera in 13 families (Griggs and Grehan, 2000). The area sampled is heavily disturbed and represents a much larger diversity of landform and vegetation types compared with the Mansfield sampling sites and perhaps also the high elevation SMRST site. This diversity of habitat and host-plants may account for the higher species richness.

Conclusions

This survey confirms the efficacy of using macrolepidoptera in a regular monitoring program. With sufficient reference collection material and taxonomic expertise most species can be determined with a high degree of accuracy, ensuring a reliable source of long-term biodiversity information for a major invertebrate component of the Mount Mansfield ecosystem. Further surveys should be conducted at regular intervals, perhaps every five years. A similar sampling program for at least some of the microlepidoptera is also desirable and this should be conducted as a distinct survey program given the complexity of collecting and identifying many microlepidoptera. Surveys of additional habitats are also recommended, particularly for the eastern slopes of the mountain where little collecting has been carried out to date and where further habitat diversity may result in further species records.

Acknowledgements

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References

Boone, J.H., J.R. Grehan, B.L. Parker (2000). A

Checklist of Diptera, Hymenoptera and Coleoptera from Mount Mansfield, Vermont. Agricultural Experiment Station, University of Vermont Miscellaneous Publication No. 118.

Covell, C.V., Jr. (1984). Moths of Eastern North America. A Roger Tory Peterson Field Guide. Easton Press, Norwalk, CT. 406 pages, 74 text figures, 64 plates.

Ferguson, D.C. (1974). Moths of the *Semiothisa signaria* complex (Lepidoptera: Geometridae). The Canadian Entomologist 106, 569-621.

Forbes, W.T.M. (1948). Lepidoptera of New York and Neighboring States. Part II (Geometridae, Lymantriidae, Notodontidae, Sphingidae). Cornell University Agricultural Experiment Station Memoir 274. Ithaca, NY. 263 pages, 255 text figures, keys, food index. June 1948.

Forbes, W.T.M. (1954). Lepidoptera of New York and Neighboring States. Part III (Noctuidae). Cornell University Agricultural Experiment Station Memoir 329. Ithaca, NY. 433 pages, 290 text figures, keys, food index. July 1954.

Grehan, J.R., B.L. Parker, G.R. Nielson, D.H. Miller, J.D. Hedbor, M. Sabourin, M.S. Griggs (1995). Moths and Butterflies of Vermont (Lepidoptera) a Faunal Checklist. Agricultural Experiment Station, University of Vermont, Department of Forest, Parks and Recreation, State of Vermont. Miscellaneous Publication No. 116. Vermont Monitoring Cooperative Bulletin No. 1.

Griggs, M.S., J.R. Grehan (2000). Biodiversity of the Moth Fauna from a Light Trap Survey at Ethan Allen Firing Range. For the Vermont Army National Guard.

Hodges, R.W. *et al.* (1983). Check List of the Lepidoptera of America North of Mexico. E.W. Classey Limited and the Wedge Entomological Research Foundation, London. 284 pages.

Holland W.J. (1968). The Moth Book. Dover

Publications, Inc. NY., NY. 479 pages, 263 figures, 48 color plates. Publication 1593, 164 pages, 613 figures.

Figure Captions

Lafontaine, J.D., in Dominick, R.B., *et al.*, (1998) The Moths of America North of Mexico, Fasc. 27.3, Noctuidae, Noctuidae (Part). The Wedge Entomological Research Foundation, Washington, DC.

Fig. 1. Species richness by family for 2000 survey.

Fig. 2-5. Species richness by family for 1991-1995 surveys.

Rockburne, E.W. and J.D. Lafontaine. (1976). The Cutworm Moths of Ontario and Quebec. Canada Department of Agriculture, Research Branch

Table 1

Mount Mansfield Survey New Species Records			
Family: Noctuidae	Date:	Site:	Host:
<i>Abagrotis brunneipennis</i>	8/19/00	SMRST	Blueberry
<i>Agrotis gladiaria</i>	9/02/00	SMRST	Beans, berries, corn
<i>Apamea sordens</i>	7/1/00	USP	Wheat, corn, timothy
<i>Autographa bimaculata</i>	8/19/00	SMRST	Dandelion
<i>Bomolocha madefactalis</i>	7/15/00	PMRC	Walnut ?
<i>Euxoa detersa</i>	9/2/00	SMRST	Corn, oats, wheat, rye
<i>Feltia tricoso</i>	8/19/00	SMRST	Unrecorded
<i>Galgula partita</i>	10/14/00	PMRC	Wood sorrel
<i>Idia scobialis</i>	8/12/00	PMRC	Unrecorded
<i>Olgia bridghami</i>	9/2/00	SMRST	Unrecorded
<i>Panopoda rufimargo</i>	7/15/00	PMRC	Oak, beech
<i>Papaipema cataphracta</i>	10/14/00	PMRC	Burdocks, thistles
<i>Proxenus miranda</i>	9/2/00	SMRST	Dandelion
<i>Rhynchagrotis anchocelioides</i>	8/26/00	PMRC	Unrecorded
<i>Schinia florida</i>	8/12/00	USP	Evening Primrose
<i>Spartiniphaga includens</i>	9/2/00	SMRST	Tussock sedge
<i>Syngrapha alias</i>	8/19/00	SMRST	White & Black Spruce
<i>Syngrapha octoscripta</i>	8/19/00	MMS	Blueberry
<i>Tarachidia erastrioides</i>	7/15/00	PMRC	Ragweed

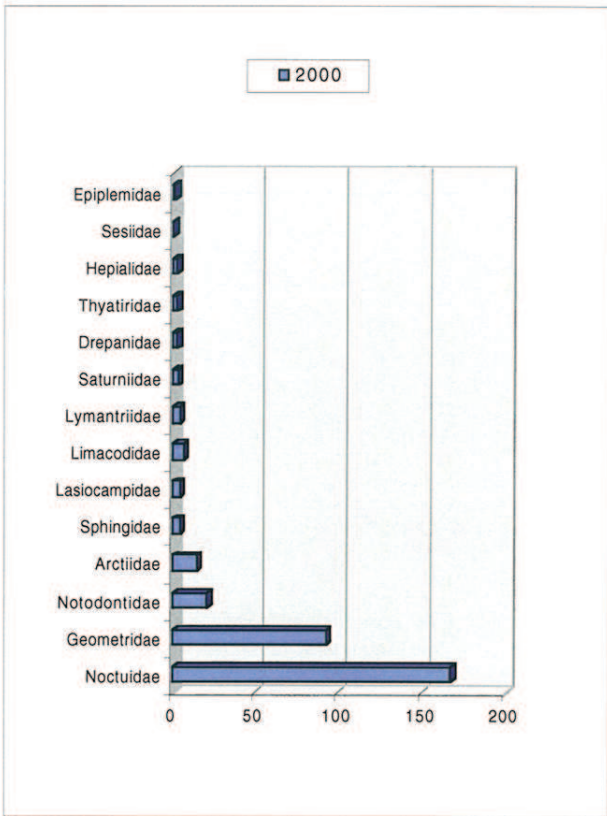


Fig. 1

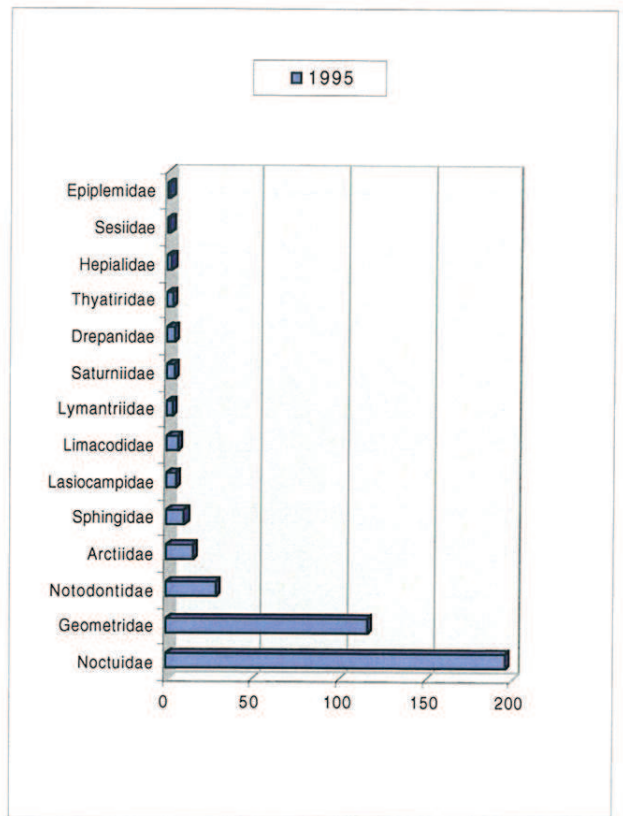


Fig. 2

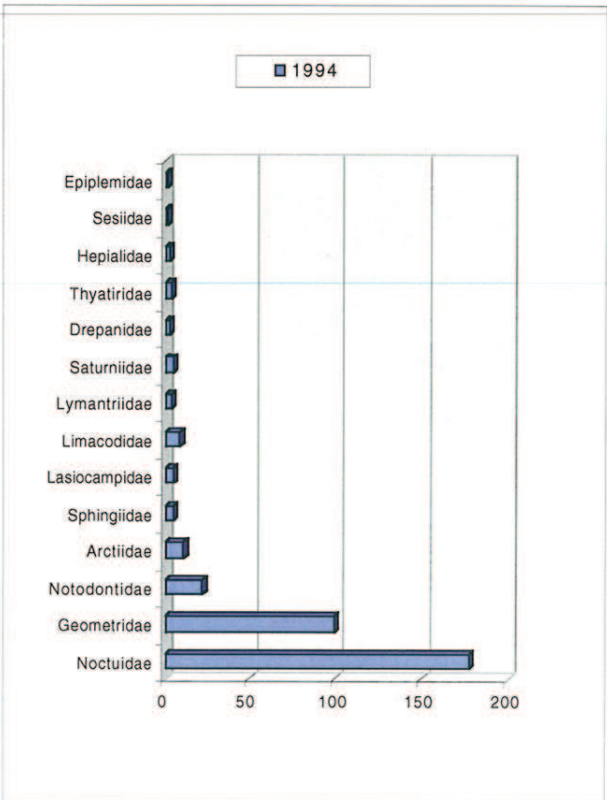


Fig. 3

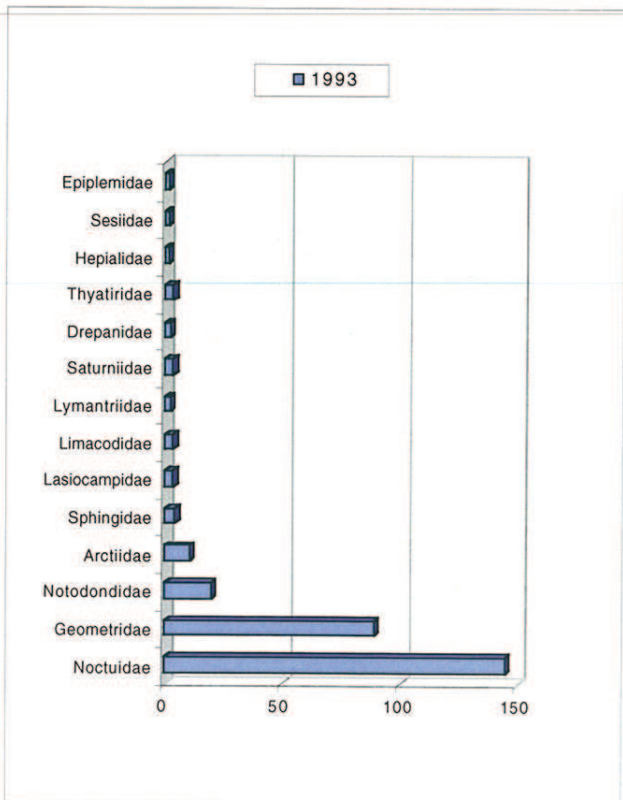


Fig. 4

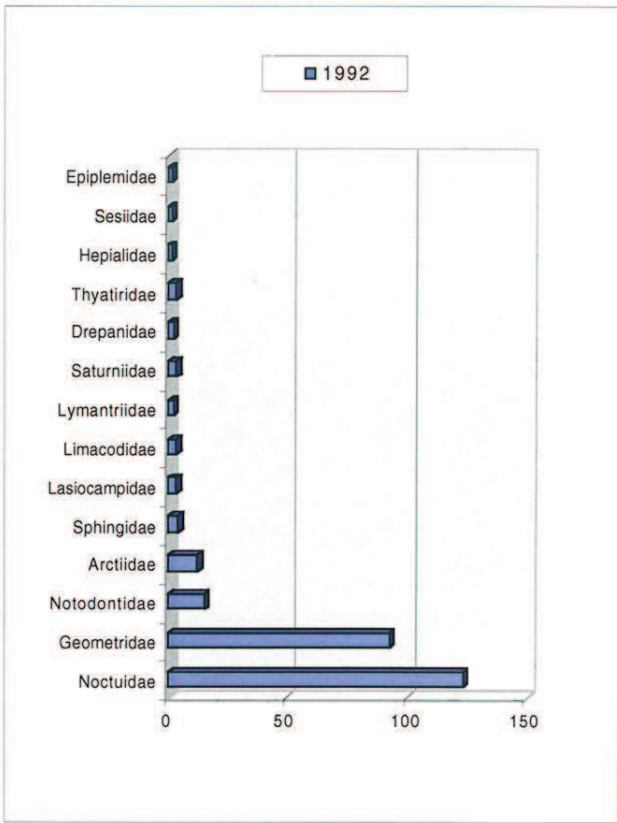


Fig. 4

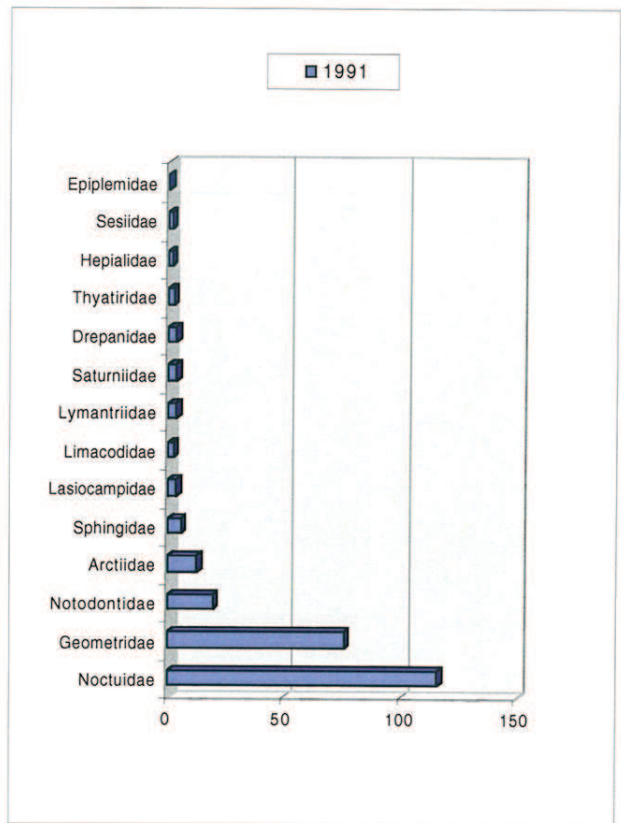


Fig. 5

FAMILY	SPECIES NAME	SITE#1	DATE	SITE#2	DATE	SITE#3	DATE	SITE#4	DATE	RANK	HODGES#
Arctiidae	<i>Cisseps fulvicollis</i>					X	9/9/00			S5	8267
Arctiidae	<i>Clemensia albata</i>			X	7/15/00	X	7/15/00			S5	8098
Arctiidae	<i>Halysidota tessellaris</i>					X	7/15/00			S5	8203
Arctiidae	<i>Haploa lecontei</i>			X	7/15/00	X	7/15/00			S5	8111
Arctiidae	<i>Holmelina laeta</i>					X	7/15/00			S5	8114
Arctiidae	<i>Hyphantria cunea</i>					X	7/15/00			S5	8140
Arctiidae	<i>Hypoprepia fucosa</i>			X	7/29/00	X	7/29/00			S5	8090
Arctiidae	<i>Lophocampa caryae</i>			X	7/1/00	X	7/1/00			S5	8211
Arctiidae	<i>Lophocampa maculata</i>	X	7/22/00	X	7/1/00					S5	8214
Arctiidae	<i>Phragmatobia assimilians</i>			X	6/3/00	X	6/17/00			S5	8158
Arctiidae	<i>Platartia parthenos</i>	X	8/5/00	X	7/15/00	X	7/15/00			S5	8162
Arctiidae	<i>Pyrrharctia isabella</i>					X	7/15/00			S5	8129
Arctiidae	<i>Spilosoma congrua</i>					X	6/17/00			S5	8134
Arctiidae	<i>Spilosoma virginica</i>					X	6/17/00	X	9/2/00	S5	8137
Drepanidae	<i>Drepana arcuata</i>			X	6/3/00	X	6/17/00			S5	6251
Drepanidae	<i>Drepana bilineata</i>					X	6/17/00			S5	6252
Epiplemlidae	<i>Callizzia amorata</i>						7/15/00			S5	7650
Geometridae	<i>Acasis viridata</i>			X	6/3/00					S5	7635
Geometridae	<i>Aethalura intertexta</i>			X	6/3/00					S5	6570
Geometridae	<i>Anacamptodes ephyrraria</i>			X	8/12/00			X	9/2/00	S5	6583
Geometridae	<i>Anagoga occiduaria</i>			X	6/3/00					S5	6836
Geometridae	<i>Besma endropiaria</i>			X	6/3/00	X	6/17/00			S5	6884
Geometridae	<i>Biston betularia</i>			X	6/17/00	X	7/1/00			S5	6640
Geometridae	<i>Cabera erythemaria</i>					X	7/1/00			S5	6677
Geometridae	<i>Campaea perlata</i>					X	6/17/00			S5	6796
Geometridae	<i>Caripeta angustiorata</i>					X	7/29/00			S5	6867
Geometridae	<i>Caripeta divisata</i>	X	7/22/00	X	7/1/00	X	7/15/00			S5	6863
Geometridae	<i>Caripeta piniata</i>									S5	6864
Geometridae	<i>Cepphis armataria</i>			X	7/1/00					S5	6835
Geometridae	<i>Cladara atroliturata</i>			X	6/3/00					S5	7639
Geometridae	<i>Cladara limitaria</i>	X	6/10/00	X	6/3/00					S5	7637
Geometridae	<i>Cyclophora pendulinaria</i>			X	6/3/00					S5	7139
Geometridae	<i>Dysstroma citrata</i>	X	8/19/00	X	7/29/00			X	8/19/00	S5	7182
Geometridae	<i>Dysstroma truncata</i>			X	7/15/00					S5	7187
Geometridae	<i>Dysstroma walkerata</i>			X	7/1/00	X	7/1/00			S5	7188
Geometridae	<i>Ecliptopera silaceata</i>					X	6/17/00			S5	7213
Geometridae	<i>Ectropis crepuscularia</i>			X	6/3/00					S5	6597
Geometridae	<i>Ennomos magnaria</i>			X	9/9/00					S5	6797

FAMILY	SPECIES NAME	SITE#1	DATE	SITE#2	DATE	SITE#3	DATE	SITE#4	DATE	RANK	HODGES#
Geometridae	<i>Epirrhoe alternata</i>			X	6/17/00	X	6/17/00			S5	7394
Geometridae	<i>Epirrita autumnata</i>			X	10/7/00	X	10/7/00	X	9/16/00	S5	7433
Geometridea	<i>Euchlaena irrorata</i>					X	7/1/00			S5	6739
Geometridae	<i>Euchlaena muzaria</i>					X	7/1/00			S5	6725
Geometridae	<i>Euchlaena tigrinaria</i>					X	7/1/00			S5	6737
Geometridae	<i>Eufidonia discospilata</i>			X	6/3/00		6/17/00			S4	6639
Geometridae	<i>Eugonobapta nivosaria</i>					X	7/29/00			S5	6965
Geometridae	<i>Eulithis destinata</i>	X	9/2/00					X	8/19/00	S5	7204
Geometridae	<i>Eulithis flavibrunneata</i>	X	8/19/00					X	8/19/00	S3	7205
Geometridae	<i>Eulithis propulsata</i>							X	8/19/00	S3	7199
Geometridae	<i>Euphyia unangulata</i>			X	7/1/00	X	6/17/00			S5	7399a
Geometridae	<i>Eupithecia absinthiata</i>			X	7/1/00	X	6/17/00			S5	7529
Geometridae	<i>Eupithecia cretaceata</i>			X	6/3/00					S3	7533
Geometridae	<i>Eutrapela clemataria</i>			X	6/3/00	X	6/17/00			S5	6966
Geometridae	<i>Heterophleps triguttaria</i>					X	7/29/00			S5	7647
Geometridae	<i>Heithemia pistasciaria</i>			X	6/3/00	X	6/17/00			S5	7084
Geometridae	<i>Homochlodes disconventa</i>			X	6/17/00	X	7/1/00			S5	6813
Geometridae	<i>Horisma infestinata</i>			X	7/29/00	X	8/26/00			S5	7445
Geometridae	<i>Hydrelia condensata</i>					X	7/1/00			S5	7420
Geometridae	<i>Hydrelia inornata</i>					X	6/17/00			S5	7422
Geometridae	<i>Hydria prunivorata</i>			X	7/1/00	X	7/1/00			S5	7292
Geometridae	<i>Hydriomena perfracta</i>			X	6/3/00					S5	7229
Geometridae	<i>Hypagyrtis unipunctata</i>									S5	6654
Geometridae	<i>Iridopsis lanvaria</i>					X	7/1/00			S5	6588
Geometridae	<i>Itame exauspicata</i>					X	6/17/00			S5	6588
Geometridae	<i>Itame anataria</i>					X	7/29/00			S5	6292
Geometridae	<i>Itame pustularia</i>					X	7/15/00			S5	6287
Geometridae	<i>Itame subcessaria</i>					X	7/15/00			S5	6273
Geometridae	<i>Lambdina fiscellaris</i>					X	7/29/00			S5	6303
Geometridae	<i>Lambdina fiscellaris</i>	X	9/2/00					X	9/2/00	S5	6888
Geometridae	<i>Lambdina athasaria</i>			X	6/3/00	X	6/17/00			S5	6894a
Geometridae	<i>Lomographa glomeraria</i>			X	6/3/00					S5	6668
Geometridae	<i>Lomographa semiclarata</i>			X	6/3/00	X	6/17/00			S5	6666
Geometridae	<i>Lomographa vestaliata</i>			X	6/3/00	X	6/17/00			S5	6667
Geometridae	<i>Melanolophia canadaria</i>			X	6/3/00					S5	6620
Geometridae	<i>Melanolophia signataria</i>			X	6/3/00					S5	6621
Geometridae	<i>Mesoleuca ruficollata</i>			X	6/3/00					S5	7307
Geometridae	<i>Melanema inatomania</i>					X	7/1/00			S5	6819
Geometridae	<i>Metarranthis duaria</i>			X	6/3/00					S5	6822
Geometridae	<i>Nacophora quernaria</i>			X	7/1/00	X	6/17/00			S5	6763

FAMILY	SPECIES NAME	SITE#1	DATE	SITE#2	DATE	SITE#3	DATE	SITE#4	DATE	RANK	HODGES#
Geometridae	<i>Nematocampa resistaria</i>			X	7/29/00	X	7/29/00			S3	7009
Geometridae	<i>Nemoria mimosaria</i>			X	6/3/00	X	6/17/00			S5	7048
Geometridae	<i>Orthofidonia tinctaria</i>			X	6/3/00					S5	6428
Geometridae	<i>Perizoma basifata</i>	X	8/5/00	X	7/29/00	X	7/15/00			S5	7316
Geometridae	<i>Pero hubneraria</i>			X	6/3/00	X	6/17/00			S5	6754
Geometridae	<i>Plagodis alcoalaria</i>			X	6/3/00	X	6/17/00			S5	6844
Geometridae	<i>Plagodis fervidaria</i>			X	6/3/00					S5	6843
Geometridae	<i>Plagodis kuetzingi</i>					X	6/17/00			S5	6841
Geometridae	<i>Plagodis phlogosaria</i>			X	8/26/00	X	7/29/00			S5	6842
Geometridae	<i>Plagodis serinaria</i>			X	6/3/00	X	6/17/00			S5	6840
Geometridae	<i>Probole alienaria</i>			X	6/3/00	X	7/1/00			S5	6837
Geometridae	<i>Protoarmia porcelaria</i>					X	7/15/00			S5	6598
Geometridae	<i>Rheumaptera hastata</i>			X	6/17/00					S5	7293
Geometridae	<i>Scopula limboundata</i>					X	7/15/00			S5	7159
Geometridae	<i>Selenia kentaria</i>			X	6/3/00					S5	6818
Geometridae	<i>Semiothisa aemulataria</i>			X	6/17/00					S5	6326
Geometridae	<i>Semiothisa fissinotata</i>					X	7/15/00			S5	6348
Geometridae	<i>Semiothisa minorata</i>			X	8/12/00	X	6/17/00			S5	6340
Geometridae	<i>Semiothisa pinistrobata</i>									S5	6347
Geometridae	<i>Semiothisa signaria</i>	X	7/22/00	X	6/3/00					S5	6344a
Geometridae	<i>Semiothisa ulserata</i>	X	7/22/00	X	6/3/00	X	6/17/00			S5	6330
Geometridae	<i>Sicya macularia</i>	X	9/2/00	X	8/12/00	X	7/15/00	X	9/2/00	S5	6912
Geometridae	<i>Spargania magnoliata</i>					X	7/1/00	X	9/2/00	S5	7312
Geometridae	<i>Stamnodes gibbicostata</i>			X	9/9/00	X	8/26/00			S5	7333
Geometridae	<i>Tetracis cachexiata</i>			X	6/17/00	X	6/17/00			S5	6964
Geometridae	<i>Trichodezia albivittata</i>					X	7/29/00			S5	7430
Geometridae	<i>Venusia cambrica</i>	X	7/22/00	X	6/17/00	X	7/1/00			S5	7425
Geometridae	<i>Xanthorhoe ferrugata</i>			X	7/1/00	X	6/17/00			S5	7388
Geometridae	<i>Xanthorhoe iduata</i>			X	7/1/00	X	7/1/00			S5	7371
Geometridae	<i>Xanthorhoe labradorensis</i>			X	6/3/00	X	8/26/00			S5	7368
Geometridae	<i>Xanthotype sospeta</i>			X	7/15/00					S5	6743
Geometridae	<i>Xanthotype urticaria</i>			X	7/1/00					S5	6740
Hepialidae	<i>Korscheltellus gracilis</i>			X	7/15/00	X	7/15/00			S5	31
Hepialidae	<i>Sthenopsis auratus</i>			X	7/29/00					S5	22
Lasiocampidae	<i>Malacosoma americanum</i>			X	7/29/00	X	7/15/00			S5	7701
Lasiocampidae	<i>Malacosoma dissirra</i>			X	7/29/00	X	7/29/00			S5	7698
Lasiocampidae	<i>Phyllodesma americana</i>			X	6/17/00	X	6/17/00			S5	7687
Lasiocampidae	<i>Tolyte laricis</i>			X	9/9/00	X	9/9/00	X	9/2/00	S5	7673
Limacodidae	<i>Euclea delphinii</i>			X	7/15/00	X	7/15/00			S5	4697

FAMILY	SPECIES NAME	SITE#1	DATE	SITE#2	DATE	SITE#3	DATE	SITE#4	DATE	RANK	HODGES#
Limacodidae	<i>Lithacodes fasciola</i>					X	7/15/00			S5	4665
Limacodidae	<i>Packardia elegans</i>					X	7/1/00			S5	4661
Limacodidae	<i>Packardia geminata</i>					X	7/15/00			S5	4659
Limacodidae	<i>Tortricida flexuosa</i>					X	7/15/00			S5	4654
Limacodidae	<i>Tortricida testacea</i>			X	6/17/00	X	6/17/00			S5	4652
Lymantriidae	<i>Dasychira dorsipennata</i>			X	7/29/00					S5	8293
Lymantriidae	<i>Lymantria dispar</i>			X	9/9/00	X	8/26/00			S5	8318
Lymantriidae	<i>Orgyia definita</i>			X	10/14/00	X	10/14/00			S5	8314
Lymantriidae	<i>Orgyia leucostigma intermedia</i>			X	9/9/00	X	9/9/00			S5	8316a
Noctuidae	<i>Abagrotis alternata</i>					X	8/26/00			S5	11029
Noctuidae	<i>Abagrotis brunneipennis</i>							X	8/19/00	S4	11044
Noctuidae	<i>Achatia distincta</i>			X	6/3/00					S5	10518
Noctuidae	<i>Achatodes zeae</i>			X	8/26/00	X	7/29/00	X	9/2/00	S5	9520
Noctuidae	<i>Acronicta americana</i>			X	7/1/00					S5	9200
Noctuidae	<i>Acronicta fragilis</i>			X	6/17/00					S5	9241
Noctuidae	<i>Acronicta hasta</i>			X	7/1/00	X	7/1/00			S5	9229
Noctuidae	<i>Acronicta impleta</i>			X	6/17/00	X	6/17/00			S5	9257
Noctuidae	<i>Acronicta increta</i>			X	6/17/00	X	7/1/00			S5	9249
Noctuidae	<i>Acronicta innotata</i>			X	6/17/00	X	7/1/00			S5	9207
Noctuidae	<i>Acronicta laetifica</i>					X	7/15/00			S5	9227
Noctuidae	<i>Acronicta retardata</i>			X	6/17/00	X	6/17/00			S5	9251
Noctuidae	<i>Acronicta superans</i>			X	7/1/00					S5	9226
Noctuidae	<i>Agrotis gladiatoria</i>							X	9/2/00	S5	10648
Noctuidae	<i>Agrotis ipsilon</i>			X	7/22/00	X	6/3/00			S5	10663
Noctuidae	<i>Agrotis venerabilis</i>					X	9/9/00			S5	10651
Noctuidae	<i>Amphipoea americana</i>							X	9/2/00	S5	9457
Noctuidae	<i>Amphipoea velata</i>									S5	9454
Noctuidae	<i>Amphipyra pyramoides</i>			X	7/15/00					S5	9638
Noctuidae	<i>Amphipyra trapogoginis</i>			X	8/26/00	X	8/26/00	X	9/2/00	S5	9639
Noctuidae	<i>Anagrapha falcifera</i>			X	6/3/00	X	6/17/00			S5	8924
Noctuidae	<i>Anaplectoides prasina</i>			X	7/1/00	X	7/29/00			S5	11000
Noctuidae	<i>Anaplectoides pressus</i>			X	7/29/00					S5	11001
Noctuidae	<i>Aplectoides condita</i>			X	6/17/00					S5	10999
Noctuidae	<i>Anathix ralla</i>			X	8/26/00	X	8/26/00			S5	9961
Noctuidae	<i>Apamea amputatrix</i>			X	7/22/00					S5	9348
Noctuidae	<i>Apamea devastator</i>			X	8/5/00	X	8/12/00			S5	9382
Noctuidae	<i>Apamea dubitans</i>			X	8/12/00			X	8/19/00	S5	9367
Noctuidae	<i>Apamea sordens</i>			X	7/1/00					S5	9364
Noctuidae	<i>Apamea verbascoides</i>			X	7/22/00	X	7/15/00			S5	9326

FAMILY	SPECIES NAME	SITE#1	DATE	SITE#2	DATE	SITE#3	DATE	SITE#4	DATE	RANK	HODGES#
Noctuidae	<i>Autographa bimaculata</i>							X	8/19/00	S5	8911
Noctuidae	<i>Autographa mappa</i>			X	7/29/00					S5	8912
Noctuidae	<i>Autographa precatonis</i>	X	6/10/00	X	6/3/00	X	7/29/00			S5	8908
Noctuidae	<i>Baileya ophthalmica</i>			X	6/3/00	X	6/17/00			S5	8970
Noctuidae	<i>Balsa tristrigella</i>					X	6/17/00			S5	9663
Noctuidae	<i>Balsa labecula</i>			X	6/3/00	X	7/15/00			S5	9664
Noctuidae	<i>Bomolocha baltimoralis</i>			X	6/3/00	X	6/17/00			S5	8442
Noctuidae	<i>Bomolocha edictalis</i>			X	7/29/00	X	7/15/00			S5	8452
Noctuidae	<i>Bomolocha madefactalis</i>					X	7/15/00			S5	8447
Noctuidae	<i>Bomolocha palparia</i>					X	7/15/00			S5	8444
Noctuidae	<i>Calaena reniformis</i>							X	9/2/00	S5	9453
Noctuidae	<i>Callopietria cordata</i>					X	7/15/00			S5	9633
Noctuidae	<i>Callopietria mollissima</i>					X	7/1/00			S5	9631
Noctuidae	<i>Catocala blandula</i>			X	7/29/00			X	9/2/00	S5	8867
Noctuidae	<i>Catocala relictata</i>							X	9/2/00	S5	8803
Noctuidae	<i>Catocala ultronia</i>			X	8/12/00	X	8/26/00	X	9/2/00	S5	8857
Noctuidae	<i>Catocala unijuga</i>							X	9/2/00	S5	8805
Noctuidae	<i>Catocola cerograma</i>			X	7/1/00	X	9/9/00			S5	8802
Noctuidae	<i>Cerma cerintha</i>			X	7/1/00	X	6/17/00			S5	9062
Noctuidae	<i>Charadra deridens</i>					X	7/1/00			S5	9189
Noctuidae	<i>Chytonix palliatricula</i>			X	7/1/00	X	7/1/00			S5	9556
Noctuidae	<i>Crocigraphia normanii</i>			X	6/3/00					S5	10501
Noctuidae	<i>Colocasia flavicornis</i>			X	6/3/00	X	6/17/00			S5	9184
Noctuidae	<i>Colocasia propinguilinea</i>			X	6/3/00	X	6/17/00			S5	9185
Noctuidae	<i>Conservula anodonta</i>					X	7/29/00			S3	9548
Noctuidae	<i>Cryptocala acadensis</i>					X	7/29/00			S5	11012
Noctuidae	<i>Diachrysis aeroides</i>					X	7/29/00			S5	8896
Noctuidae	<i>Diarsia jucunda</i>	X	7/22/00	X	7/15/00	X	7/15/00			S5	10919
Noctuidae	<i>Diarsia rubifera</i>			X	9/29/00			X	8/19/00	S5	10917
Noctuidae	<i>Elaphria festivoidea</i>			X	7/1/00	X	6/17/00			S5	9681
Noctuidae	<i>Elaphria versicolor</i>			X	6/17/00	X	6/17/00			S5	9678
Noctuidae	<i>Eosphoropteryx thyatyroides</i>			X	8/26/00					S5	8905
Noctuidae	<i>Eueretagrotis attentata</i>					X	7/29/00			S5	11009
Noctuidae	<i>Eueretagrotis perattenta</i>			X	7/15/00					S5	11008
Noctuidae	<i>Eueretagrotis sigmoides</i>			X	7/29/00	X	7/29/00			S5	11007
Noctuidae	<i>Euplexia benesimilis</i>	X	7/22/00	X	6/3/00	X	7/1/00			S5	9545
Noctuidae	<i>Eurois stricta</i>	X	8/19/00					X	8/19/00	S5	10930
Noctuidae	<i>Euxoa detersa</i>							X	9/2/00	S3	10838
Noctuidae	<i>Feltia herilis</i>					X	9/9/00			S5	10676

Appendix 1

FAMILY	SPECIES NAME	SITE#1	DATE	SITE#2	DATE	SITE#3	DATE	SITE#4	DATE	RANK	HODGES#
Noctuidae	<i>Feltia tricosia</i>							X	8/19/00	S5	10675
Noctuidae	<i>Ferailia comstocki</i>			X	6/3/00					S5	10008
Noctuidae	<i>Galgula partita</i>					X	10/14/00			S5	9688
Noctuidae	<i>Graphiphora auger haruspica</i>			X	7/29/00	X	7/29/00			S5	10928
Noctuidae	<i>Homorhodes fufurata</i>			X	7/15/00	X	7/15/00			S5	10532
Noctuidae	<i>Hypena humuli</i>			X	7/29/00					S5	8461
Noctuidae	<i>Hyperstrotia pervertens</i>					X	7/15/00			S5	9037
Noctuidae	<i>Hyppa xylinoides</i>			X	6/3/00			X	8/19/00	S5	9578
Noctuidae	<i>Idia aemula</i>					X	7/29/00			S5	8323
Noctuidae	<i>Idia americalis</i>					X	7/1/00			S5	8322
Noctuidae	<i>Idia lubricalis</i>					X	7/29/00			S5	8334
Noctuidae	<i>Idia rotundalis</i>					X	7/29/00			S5	8326
Noctuidae	<i>Idia scobialis</i>					X	8/12/00			S5	8330
Noctuidae	<i>Lacinipolia olivacea</i>	X	9/2/00					X	8/19/00	S5	10406
Noctuidae	<i>Lacinipolia renigera</i>					X	7/29/00	X	9/2/00	S5	10397
Noctuidae	<i>Lacinipolia lorea</i>					X	7/1/00			S5	10405
Noctuidae	<i>Leucania pseudargyria</i>			X	7/15/00					S5	10462
Noctuidae	<i>Leuconycta diptheroides</i>					X	7/1/00			S5	9065
Noctuidae	<i>Leuconycta lepidula</i>					X	7/15/00			S5	9066
Noctuidae	<i>Lithacodia muscosula</i>			X	7/1/00	X	7/1/00			S5	9047
Noctuidae	<i>Lithophane baileyi</i>			X	7/1/00	X	10/14/00			S5	9902
Noctuidae	<i>Lithophane hemina</i>			X	10/7/00	X	10/20/00			S5	9893
Noctuidae	<i>Lithophane innominata</i>			X	10/7/00	X	10/20/00			S5	9888
Noctuidae	<i>Lithophane petulca</i>			X	6/3/00	X	9/13/00			S5	9889
Noctuidae	<i>Lithophane petulca</i>	X	9/16/00					X	9/16/00	S5	9889
Noctuidae	<i>Maliattha concinnimacula</i>			X	6/17/00	X	6/17/00			S5	9050
Noctuidae	<i>Maliattha synochitis</i>			X	7/1/00	X	7/1/00			S5	9055.1
Noctuidae	<i>Melanchra adjuncta</i>			X	7/1/00					S5	10292
Noctuidae	<i>Melanchra assimilis</i>					X	7/1/00			S5	10295
Noctuidae	<i>Metalectra quadrisignata</i>			X	7/29/00						8500
Noctuidae	<i>Morrisonia confusa</i>			X	6/3/00					S5	10521
Noctuidae	<i>Morrisonia evicta</i>			X	6/3/00					S5	10520
Noctuidae	<i>Morrisonia latex</i>			X	6/3/00	X	6/17/00			S5	10521.1
Noctuidae	<i>Nedra ramosula</i>							X	9/2/00	S5	9582
Noctuidae	<i>Nephelodes minians</i>			X	9/9/00	X	9/9/00	X	9/2/00	S5	10524
Noctuidae	<i>Noctua pronuba</i>	X	7/22/00	X	7/1/00	X	7/1/00			S5	11012.1
Noctuidae	<i>Ochropleura plecta</i>			X	7/1/00	X	6/17/00			S5	10891
Noctuidae	<i>Oligia bridghami</i>							X	9/2/00	S3	9415
Noctuidae	<i>Oligia crytora</i>			X	7/15/00	X	7/15/00			S5	9410
Noctuidae	<i>Oligia exhausta</i>					X	7/29/00			S5	9408

Appendix 1

FAMILY	SPECIES NAME	SITE#1	DATE	SITE#2	DATE	SITE#3	DATE	SITE#4	DATE	RANK	HODGES#
Noctuidae	<i>Oligia illocata</i>			X	9/9/00	X	9/9/00			S5	9420
Noctuidae	<i>Oligia mactata</i>	X	9/2/00	X	9/9/00	X	9/9/00	X	9/2/00	S5	9419
Noctuidae	<i>Oligia modica</i>			X	8/26/00	X	7/29/00			S5	9404
Noctuidae	<i>Orthodes crenulata</i>					X	7/29/00			S5	10585
Noctuidae	<i>Orthodes cynica</i>					X	6/17/00			S5	10587
Noctuidae	<i>Orthodes detracta</i>					X	7/1/00			S5	10589.1
Noctuidae	<i>Orthosia revicta</i>			X	6/3/00					S5	10490
Noctuidae	<i>Orthosia rubescens</i>			X	6/3/00					S5	10487
Noctuidae	<i>Palthis angularis</i>					X	8/26/00	X	9/2/00	S5	8397
Noctuidae	<i>Panopoda rufimargo</i>					X	7/15/00			S5	8587
Noctuidae	<i>Papaipema cataphracta</i>					X	10/14/00			S5	9466
Noctuidae	<i>Papaipema inquaesita</i>			X	10/14/00	X	9/9/00			S5	9483
Noctuidae	<i>Papaipema unimoda</i>			X	10/14/00					S5	9509
Noctuidae	<i>Parallela bistrifaria</i>			X	6/3/00	X	7/1/00			S5	8727
Noctuidae	<i>Peridroma saucia</i>	X	9/16/00					X	9/16/00	S5	10915
Noctuidae	<i>Phalaenostola larentioides</i>							X	9/2/00	S5	8364
Noctuidae	<i>Phlogophora iris</i>			X	6/17/00	X	6/17/00			S5	9546
Noctuidae	<i>Phlogophora periculosa</i>			X	7/29/00			X	8/19/00	S5	9547
Noctuidae	<i>Platypena scabra</i>	X	8/19/00	X	8/26/00	X	8/26/00			S5	8465
Noctuidae	<i>Platypollia anceps</i>			X	9/9/00			X	9/2/00	S3	9976
Noctuidae	<i>Plusia putnami</i>					X	9/9/00			S5	8950
Noctuidae	<i>Polia imbrifera</i>			X	7/15/00					S5	10276
Noctuidae	<i>Polia nimbose</i>	X	7/22/00	X	7/29/00	X	7/15/00			S5	10275
Noctuidae	<i>Proforhodes oviduca</i>			X	6/3/00					S5	10563
Noctuidae	<i>Proxenus miranda</i>							X	9/2/00	S5	9647
Noctuidae	<i>Pseudaletia unipuncta</i>	X	8/5/00	X	6/3/00			X	8/19/00	S5	10438
Noctuidae	<i>Pseudeustrotia carneola</i>			X	7/1/00	X	7/1/00			S5	9053
Noctuidae	<i>Pseudorthodes vecors</i>			X	7/15/00	X	7/15/00			S5	10578
Noctuidae	<i>Raphia frater</i>					X	6/17/00			S5	9193
Noctuidae	<i>Renia flavipunctalis</i>					X	7/29/00			S5	8384.1
Noctuidae	<i>Rhynchagrotis anchocelioides</i>					X	8/26/00			S5	11045
Noctuidae	<i>Rivula propinquialis</i>					X	8/26/00			S5	8404
Noctuidae	<i>Schinia florida</i>			X	8/12/00					S5	11164
Noctuidae	<i>Spaelotis claudina</i>			X	7/1/00					S5	10926
Noctuidae	<i>Spartinophaga includens</i>							X	9/2/00		9434
Noctuidae	<i>Spirameter lutra</i>			X	7/1/00	X	7/1/00			S5	10301
Noctuidae	<i>Sunira bicolorago</i>			X	10/7/00	X	10/7/00	X	9/16/00	S5	9957
Noctuidae	<i>Syngrapha alias</i>							X	8/19/00	S5	8939
Noctuidae	<i>Syngrapha octoscripta</i>	X	8/19/00							S5	8926

Appendix 1

FAMILY	SPECIES NAME	SITE#1	DATE	SITE#2	DATE	SITE#3	DATE	SITE#4	DATE	RANK	HODGES#
Noctuidae	<i>Syngrapha rectangula</i>			X	7/15/00	X	8/12/00	X	8/19/00	S5	8942
Noctuidae	<i>Tarachidia erastroides</i>					X	7/15/00			S5	9095
Noctuidae	<i>Tricholita signata</i>					X	8/12/00			S5	10627
Noctuidae	<i>Trichordestra legitima</i>					X	7/15/00			S5	10304
Noctuidae	<i>Xestia badicollis</i>					X	8/26/00	X	9/2/00	S5	10968
Noctuidae	<i>Xestia bicarnea</i>			X	7/29/00					S5	10950
Noctuidae	<i>Xestia c-nigrum-adela</i>	X	7/22/00			X	7/1/00			S5	10942a
Noctuidae	<i>Xestia dolosa</i>	X	7/22/00	X	7/1/00	X	7/1/00			S5	10942.1
Noctuidae	<i>Xestia mixta</i>	X	8/5/00					X	8/19/00	S5	10959b
Noctuidae	<i>Xestia normaniana</i>			X	8/12/00	X	7/29/00			S5	10943
Noctuidae	<i>Xestia prequitata</i>	X	8/5/00							S3	10962
Noctuidae	<i>Xestia smithii</i>			X	8/26/00	X	8/26/00	X	8/19/00	S5	10944
Noctuidae	<i>Zale lunata</i>			X	6/17/00	X	6/17/00			S5	8689
Noctuidae	<i>Zale lunifera</i>			X	6/3/00					S5	8713
Noctuidae	<i>Zale minerea</i>			X	6/3/00					S5	8697
Noctuidae	<i>Zanclognatha cruralis</i>			X	7/15/00	X	7/1/00			S5	8351
Noctuidae	<i>Zanclognatha laevigata</i>			X	7/15/00	X	7/15/00			S5	8345
Noctuidae	<i>Zanclognatha ochreipennis</i>									S5	8353
Noctuidae	<i>Zanclognatha profumnusalis</i>	X	7/29/00			X	8/26/00	X	9/2/00	S5	8349
Notodontidae	<i>Clostera albosigma</i>					X	6/17/00			S5	7895
Notodontidae	<i>Dasylophia thyatiroides</i>			X	7/1/00	X	6/17/00			S5	7958
Notodontidae	<i>Elida caniplaga</i>	X		X	6/3/00					S5	7930
Notodontidae	<i>Gluphisia septentrionis</i>	X		X	6/3/00					S5	7931
Notodontidae	<i>Heterocampa biundata</i>	X		X	7/1/00	X	7/1/00			S5	7995
Notodontidae	<i>Heterocampa guttivitta</i>	X		X	6/3/00	X	7/1/00			S5	7994
Notodontidae	<i>Hyperaeschra georgica</i>					X	7/1/00			S5	7917
Notodontidae	<i>Lochmaeus manteo</i>			X	8/26/00	X	7/29/00			S5	7998
Notodontidae	<i>Macrurocampa marthesia</i>			X	7/29/00	X	7/29/00			S5	7975
Notodontidae	<i>Nadata gibbosa</i>			X	7/15/00	X	7/1/00			S5	7915
Notodontidae	<i>Nerice bidentata</i>					X	7/15/00			S5	7929
Notodontidae	<i>Oligocentria semirufescens</i>			X	7/15/00	X	7/15/00			S5	8012
Notodontidae	<i>Peridea basifriens</i>					X	7/1/00			S5	7919
Notodontidae	<i>Peridea ferruginea</i>			X	7/1/00					S5	7921
Notodontidae	<i>Schizura ipomoeae</i>			X	7/15/00					S5	8005
Notodontidae	<i>Schizura leptinodes</i>					X	7/29/00			S5	8011
Notodontidae	<i>Schizura unicomis</i>			X	7/1/00					S5	8007
Notodontidae	<i>Symmerista albifrons</i>					X	7/1/00			S5	7951
Notodontidae	<i>Symmerista canicosta</i>					X	7/1/00			S5	7952
Notodontidae	<i>Symmerista leucitys</i>			X	7/1/00	X	6/17/00			S5	7953

Appendix 1

FAMILY	SPECIES NAME	SITE#1	DATE	SITE#2	DATE	SITE#3	DATE	SITE#4	DATE	RANK	HODGES#
Saturniidae	<i>Actias luna</i>			X	6/17/00	X	6/17/00			S5	7758
Saturniidae	<i>Antheraea polyphemus</i>			X	6/17/00	X	6/17/00			S5	7757
Saturniidae	<i>Dyrocampa rubicunda</i>			X	6/17/00	X	6/17/00			S5	7715
Sphingidae	<i>Ceratonia undulosa</i>			X	7/1/00	X	7/1/00			S5	7787
Sphingidae	<i>Laothoe juglandis</i>			X	7/15/00	X	6/17/00			S5	7827
Sphingidae	<i>Paonias excaecatus</i>	X	8/5/00	X	6/17/00	X	6/17/00			S5	7824
Sphingidae	<i>Paonias myops</i>			X	7/29/00	X	7/15/00			S5	7825
Thyatiridae	<i>Habrosyne scripta</i>			X	6/17/00					S5	6235
Thyatiridae	<i>Pseudothyatira cymatophoroides</i>			X	7/1/00	X	7/15/00			S5	6237