Chapter 11

Monitoring Selected Arthropods

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Abstract

Arthropod populations were sampled in four study areas in southern Ohio in 1995 to document patterns of arthropod diversity and establish a baseline dataset for long-term monitoring in mixed-oak forests. Pitfall, Malaise, and blacklight traps were operated in 12 treatment units from May through September. Several insect groups were selected for detailed study due to their abundance and potential to reflect community dynamics. These taxa include ground beetles (Family: Carabidae), scarab beetles (Family: Scarabaeidae), long-horned beetles (Family: Cerambycidae), carrion beetles (Family: Silphidae), syrphid flies (Family: Syrphidae), ants (Family: Formicidae), vespid wasps (Family: Vespidae), and nocturnal moths (Order: Lepidoptera). From these 8 groups, a total of 706 species were identified, but only 15 species were relatively abundant and evenly distributed across all treatment units. In addition to these common species, several rare species were collected. This work has added to a growing database documenting forest arthropod diversity in southern Ohio.

Introduction

Few studies have attempted to document arthropod diversity across several taxonomic groups within a single ecosystem (Dunwiddie 1991; Parsons et al. 1991; Lattin 1993). Although an all-taxa biodiversity inventory was recently initiated in the Great Smoky Mountains National Park, such studies are rare due to the immense diversity of arthropods. With limited resources, it is nearly impossible to adequately sample all arthropods in a community considering the time, labor, funding, and taxonomic expertise necessary to accomplish such a task. To further complicate matters, arthropod samples often contain many scarce species whose presence provides little information about community dynamics.

Our research efforts concentrated on a limited number of taxa based on their potential to provide information on the long-term dynamics of arthropod communities. These selected groups are common, easily collected, and readily identified insect taxa whose biology is relatively well known. Each of these groups also is associated with the forest floor, and thus are more likely to be affected by surface fires than canopy-dwelling arthropods. Prescribed fire might affect microclimatic conditions on the forest floor by increasing soil temperature and/or decreasing soil moisture.

Among surface-inhabiting arthropods, ground beetles (Coleoptera: Carabidae) are commonly monitored to study the dynamics of community change. Ground beetles are important predators of phytophagous and fungivorous insects and populations are sensitive to changes in soil surface conditions. In past studies, these beetles have served as indicators of environmental disturbance (Basedow 1990; Mossakowski et al. 1990), historical land use (Pizzolotto and Brandmayr 1990), and ecological habitat type (Eyre and Luff 1990; Maelfait and Desender 1990). Sampling these beetles via pitfall traps provides reliable estimates of populations based on their activity on the forest floor (den Boer 1985). Fluctuations in abundance and the absence or presence of certain species can provide information on environmental trends (Thiele 1977).

The scarab beetle subfamilies Scarabaeinae and Geotrupinae (Coleoptera: Scarabaeidae) also are closely associated with the soil surface and are common in southern Ohio. Most Scarabaeinae and Geotrupinae adults are dung feeders, though some species prefer fungus and carrion (Howden 1955). Wind, temperature, and humidity on the forest floor strongly affect the microhabitat of dung (biologically and physically) which in turn can affect the fecundity of these beetles (Helgesen 1967).

Another large beetle family commonly found in Ohio's deciduous forests is the long-horned beetles (Coleoptera: Cerambycidae). Most larvae in this family bore through wood and many are destructive to trees and freshly cut logs (Borrer et al. 1989). Increases in long-horned beetle populations can be indicative of increased environmental stress on nearby trees and/or an increase in the amount of dead timber.

Carrion beetles (Coleoptera: Silphidae) are not a major component of the forest floor community but are important as scavengers and are readily sampled by pitfall trapping. We paid special attention to this family in an attempt to document remaining populations of the federally endangered American burying beetle (*Nicrophorus americanus*), last reported from Ohio in a neighboring county in 1974.

In addition to beetles, several insect families also are common and readily sampled in southern Ohio forests. Ants (Hymenoptera: Formicidae) are typically the most numerous arthropods in most terrestrial ecosystems and are closely associated with soil and/or standing and downed timber. Many flies and wasps are easily collected by Malaise trapping and can be useful measures of forest floor conditions. Examples include syrphid flies (Diptera: Syrphidae) and vespid wasps (Hymenoptera: Vespidae). Some syrphids depend on nectar sources and soil surface moisture and, therefore, could be useful in assessing surface conditions. Vespid species that nest in decaying wood may also reflect surface conditions.

Due to the high diversity of moths and butterflies (Lepidoptera), there have been few studies that have comprehensively sample the lepidopteran fauna of deciduous forests (e.g. Butler et al. 1995; Teraguchi and Lublin 1999). However, many lepidopteran species could be important in assessing community changes. Larvae that feed in leaf litter or on low-growing lichens and shrubs are more likely to be affected by environmental changes to the forest floor than species whose larvae feed in tree canopies. Most nocturnal lepidopterans (primarily moths) are easily sampled with blacklight traps; however, species with a relatively short flight range are better indicators of local environmental conditions (Opler and Buckett 1970).

Our research is a component of a large-scale ecosystem management study of prescribed fire in mixed-oak forest ecosystems. Our objective was to document patterns of arthropod abundance and diversity in selected taxonomic groups to establish an adequate baseline for evaluating the effects of prescribed fire.

Methods

Study Areas and Experimental Design

The study areas and experimental design are described in detail in Chapter 1. Here a brief overview is provided. The four 75-90 ha study areas are located in Vinton County (Arch Rock and Watch Rock) and Lawrence County (Young's Branch and Bluegrass Ridge). The study areas are within in the Southern Unglaciated Allegheny Plateau, which is characterized by high hills, sharp ridges, and narrow valleys. Sandstones and shales are principle bedrocks. Forests are oak-dominated and the current overstory originated in the late-1800s, after the cessation of clearcutting for the charcoal iron industry. In each study area, three prescribed fire treatments were established, a control unit (CONT), an infrequent burn unit (INFR), and a frequent burn unit (FREQ).

Field Methods

In 1995, arthropod traps were deployed near the center of each treatment unit in each of the four study areas. Traps were located at or near ridgetops near the center of the treatment units to reduce edge effects.

Pitfall trapping

In each treatment unit we installed a linear transect of twelve plastic pitfall traps (11-cm diam.) positioned approximately 10 m apart. Each trap was buried with the lip flush with the soil surface and contained 150 ml of ethylene glycol as a killing agent and preservative. A rain cover and mammal-resistant screen were installed over each trap. Traps were in place from May 10 to September 28 (Vinton County) and May 11 to October 10 (Lawrence County). Samples were retrieved and ethylene glycol replaced at weekly intervals until September, thereafter biweekly. All ground beetles (Carabidae), scarab beetles (Scarabaeidae), carrion beetles (Silphidae), and ants (Formicidae) were separated and preserved in 70 percent ethanol for identification to species. Remaining arthropods were preserved in ethanol for future identification.

Malaise trapping

One standard Townes-type Malaise trap (Townes 1962) fitted with custom wet collecting heads was installed in each treatment unit between May 10 and June 1. The collecting head concentrated specimens into an ethanol-filled jar, which was changed weekly. Traps were in place until September 28 at the Vinton County areas and October 10 at the Lawrence County areas. Contents of collecting jars were sorted and the following insect families were identified to species: long-horned beetles

Table 1.—Number of species in selected insect families trapped at study areas in 1995 (numbers in parentheses are number of species unique to the study area).

Family	Study Area[a] AR	BR	WR	YB
Coleoptera:				
Carabidae[b,c]	72(10)	50(2)	64(5)	73(7)
Scarabaeidae[b]	18(0)	15(1)	18(0)	15(0)
Cerambycidae[c,d]	33(5)	29(2)	45(9)	29(5)
Silphidae[c]	6(0)	6(0)	8(0)	6(0)
Diptera:				
Syrphidae[d]	25(4)	15(1)	23(3)	20(3)
Lepidoptera:				
Arctiidae[d]	23(0)	26(2)	24(1)	25(3)
Noctuidae[c]	159(6)	156(19)	184(21)	162(20)
Notodontidae[c]	21(1)	25(3)	31(4)	25(1)
Saturniidae[c]	7(0)	8(2)	9(0)	10(0)
Sphingidae[c]	10(1)	8(2)	9(0)	10(0)

[a] - AR = Arch Rock, Vinton Furnace Experimental Forest, Vinton Township, Vinton County, Ohio. BR = Bluegrass Ridge, Wayne National Forest, Aid Township, Lawrence County, Ohio. WR = Watch Rock, Vinton Furnace Experimental Forest, Vinton Township, Vinton County, Ohio. YB = Young's Branch, Wayne National Forest, Decatur Township, Lawrence County, Ohio.
[b] – species collected by pitfall traps
[c] – species collected by light traps
[d] – species collected by Malaise traps

(Cerambycidae), syrphid flies (Syrphidae), ichneumon wasps (Ichneumonidae), social wasps (Vespidae), and selected Lepidoptera. Horse flies and deer flies (Tabanidae) and tachina flies (Tachinidae) also were separated but not identified to species. The remaining arthropods were preserved in ethanol for future study.

Light-trap sampling

In each treatment unit, a BioQuip bucket-type light trap with an 8-watt fluorescent ultraviolet lamp and 12-volt timer was operated from 9 p.m. until 5 a.m. one night per week from May to September; there were 13 trap-nights at AR and WR and 10 trap-nights at BR and YB. A 2.5-liter bucket hung beneath each light containing ethyl acetate vapor and dichlorvos-impregnated strips as killing agents. Bucket contents were removed the following day, placed in plastic bags, and then stored in a freezer for later identification.

Results

Arthropod taxa collected by the three trapping techniques included spiders (Araneae), harvestmen (Opiliones), mites and ticks (Acari), pillbugs (Isopoda), millipedes (Diplopoda), centipedes (Chilopoda), and insects (Insecta). Of these arthropods, only selected insect families in the orders Coleoptera (beetles), Diptera (true flies), Hymenoptera (ants, bees, and wasps), and Lepidoptera (butterflies and moths) were identified to species (Appendices 1 and 2).

Beetles (Coleoptera)

Ninety-eight species of ground beetles (Carabidae) were collected (Appendix 1). Carabid richness per study area ranged from 50 at BR to 73 at YB (Table 1). Pitfall sampling collected more than 5,100 carabids representing 45 species. However, only 7 species were captured in all 12 treatment units. Fifty-nine carabid species were collected from the light-trap samples, with 13 occurring in all four study areas. Only 7 species were collected by both trapping methods, indicating that the two techniques sample different members of this important family. Of all species, only *Galerita bicolor, Pterostichus tristis*, and *Synuchus impunctatus* were common and evenly distributed across all treatment units (Table 2). Pitfall and blacklight traps also captured *Carabus sylvosus, Piesmus submarginatus*, and *Cyclotrachelus incisus*, all previously unrecorded in Ohio (Purrington and Stanton 1996). *Carabus sylvosus* was fairly common in the Vinton County pitfall traps.

Twenty-one species of scarab beetles (Scarabaeidae) were identified from pitfall and light traps combined (Appendix 1). Although more than 40 percent of these species were observed at all four study areas, only *Ateuchus histeroides*, *Geotrupes splendidus*, and *Onthophagus striatulus* occurred abundantly and evenly in all study areas (Table 2). *Ateuchus histeroides* was the most abundant scarab species in all the pitfall samples and its abundance was significantly greater at the Vinton County sites than the Lawrence County sites. Among the Geotrupinae, the most abundant species was *Geotrupes splendidus*.

Sixty-two species of long-horned beetles (Cerambycidae) were collected by all three trap types combined (Appendix 1). Cerambycidae richness was greater at WR (45 species) than the other study areas (29-33 species; Table 1). Twelve species were collected at all four study areas but no single species was found in comparable numbers across all treatment units.

Table 2.—Mean abundance ± s.e. of 15 common insect species across study sites, 1995; means followed by the same letter are not significantly different at p=0.05 (one-way ANOVA); where no letters are shown, means are not significantly different.

	Study Area			
Insect Species	AR	BR	WR	YB
Coleoptera: Carabidae[a]				
Galerita bicolor	181±67.3	66±30	50±17	60.7±5.3
Pterostichus tristis	39.3±18.9	19±8.9	27±3	39.3±25.2
Synuchus impunctatus	256±155.3	27±9.5	215.7±47.1	75±9.7
Coleoptera: Scarabaeidae[a]				
Ateuchus histeroides	342±111.7[a]	73.7±39.6[b]	281±24.6[a]	37±20.2[b]
Geotrupes splendidus	34.3±2.3	13.7±4.1	50.7±18.7	17.3±4.3
Onthophagus striatulus	73±23.3	22.3±9.7	54.7±21.4	46±8.6
Coleoptera: Silphidae[a]				
Nicrophorus orbicollis	240.3±25.7	97.3±54.6	220±29.5	153.7±50.6
Diptera: Syrphidae[b]				
Volucella vesicularia	32±11.8	21.3±5.9	39.7±13.6	26.7±4.4
Hymenoptera: Formicidae[a]				
Aphaenogaster rudis rudis	366.3±95.5	451±136.2	357.3±26.9	305±52.9
Camponotus spp.	314.3±96.4	377±232.2	807.7±260	485.7±85.1
Lepidoptera: Saturniidae[c]				
Actias luna	24.7±6.6	11.3±1.3	23.7±3.3	18±4.5
Automeris io	40±7.5[a]	18±1.2[b]	24.7±5.2[ab]	38.7±2.7[a]
Dryocampa rubicunda	81±21	31.7±9.5	70±12.1	106±21.8
Lepidoptera: Satyridae[b]				
Cyllopsis gemma	71.7±32.7	31±5.9	72.3±44.1	20±7
Lepidoptera: Zygaenidae[b]				
Pyromorpha dimidiata	60.7±25.7	24.7±15.6	38.7±21.2	57.7±10.1

[a] specimens collected by pitfall traps
[b] specimens collected by Malaise traps
[c] specimens collected by blacklight trap

Eight species of carrion beetles (Silphidae) were identified, of which the burying beetle *Nicrophorus orbicollis* was most abundant, accounting for 92 percent of all Silphidae collected (Appendix 1). This species was common on all study sites and analysis of variance (ANOVA) revealed no statistically significant differences in numbers within or between areas (Table 2). No *Nicrophorus americanus* were recovered.

Incidental observations during this study included several rare beetles. Two specimens of *Megalopinus caelatus* (Staphylinidae) were collected at BR; no previous records are known from Ohio. *Anelaphus pumilum* (Cerambycidae), collected at WR, may be the first collection in Ohio (T. K. Philips, Western Kentucky University, pers. commun.). The first record of *Pemelus costatus* (Hydrophilidae) in Ohio was collected in pitfall traps near WR and BR (M. Archangelsky, CRILAR, Argentina, pers. commun.). *Onthophilus pleurocostatus*, a hister beetle collected in a baited pitfall trap, was new record for Ohio (P. Kovarik, Ohio State University, pers. commun.). *Platydema erythrocerum* (Tenebrionidae), collected in a blacklight trap at WR, was also previously unrecorded in Ohio (C.A. Triplehorn, pers.commun.).

Table 3.—Mean abundance ± s.e. of common insect families captured by Malaise traps 1 June - 22 Sept. 1995. Means followed by the same letter are not significantly different at p=0.05 (one-way ANOVA); where no letters are shown, means are not significantly different.

	Study Area			
Insect family	AR	BR	WR	YB
Diptera:				
Syrphidae	31±11.5	21.3±6	39.7±17	26.7±4.4
Tabanidae	547.7±316.6[a]	205.3±58.3[b]	250.3±92.8[b]	564.7±81.3[a]
Tachinidae	71.7±1	50.3±4.4	77.7±22.9	42.3±5.5
Hymenoptera:				
Ichneumonidae	767.3±134.3[a]	293.3±48.7[b]	353.7±100[b]	362.7±32.9[b]

True Flies (Diptera)

Thirty-seven species of syrphid flies (Syrphidae) were identified from Malaise trap samples (Appendix 1). Nine species were collected at all study areas, but only *Volucella vesicularia* was common and evenly distributed (Table 2). Syrphid flies were not as abundant as horseflies and deer flies (Tabanidae) or tachina flies (Tachinidae). There were significant differences in the abundance of tabanids (Tabanidae) among study areas with significantly higher numbers at AR and YB than BR and WR. The abundance of tachinids was evenly distributed across study areas (Table 3).

Ants and Wasps (Hymenoptera)

Eight species of ants (Formicidae) were recorded from all four study areas (Appendix 1). The most abundant species (Table 2) were in the genera *Aphaenogaster* and *Camponotus* (carpenter ants). Six species of social wasps (Vespidae) were identified but were neither abundant nor evenly distributed (Appendix 1). As a family, the ichneumon wasps (Ichneumonidae) were abundant at all four areas, with significantly greater numbers at AR than the other three study areas (Table 3).

Butterflies and Moths (Lepidoptera)

A total of 464 species in 26 families of macrolepidoptera were identified (Appendix 2). Fifty-three percent of these species were found at all four study areas. The most diverse family was the Noctuidae, of which WR had the highest richness, at 184 species (Table 1). Despite this diversity, only four moth species [*Actias luna* (Saturniidae), *Automeris io* (Saturniidae), *Dryocampa rubicunda* (Saturniidae), and *Pyromorpha dimidiata* (Zygaenidae)] and one butterfly [*Cyllopsis gemma* (Satyridae)] were abundant and evenly distributed across study areas (Table 2). Of these five species, only *Automeris io* showed any significant differences among study areas (Table 2).

Two clearwing moths (Sessiidae) collected by light trap were new records for Ohio (Purrington and Horn 1996). *Synanthedon acerni* was collected at all four study areas. *Synanthedon scitula* was collected only at AR.

Discussion

Overall carabid abundance collected via pitfall trapping was greater than that found in similar studies (Liebherr and Mahar 1979; Lenski 1982; MacLean and Usis 1992). However, the other studies contained fewer study sites and used periodic, rather than continuous, sampling. Likewise, carabid richness collected in these Ohio oak forests was greater than in other studies of similar habitat (Liebherr and Mahar 1979; Lenski 1982). Despite this diversity, many species only occurred in one study area. Only three species were abundant across all treatment units; these species should be important in the future as indicators of environmental change.

Unlike the carabids, species of scarab and silphid beetles were usually found in more than one study area. Species of long-horned beetles were often found in only one study area, though it is possible that more species were present in several study areas but not collected because Malaise and light trapping are not the standard method for collecting these beetles. Of these three families, only four species fit our criteria as potential indicators of environmental change.

The families Syrphidae, Tabanidae, and Tachinidae were abundant at all study areas, but the syrphid flies hold the most promise in assessing population shifts following prescribed fire due to their dependence on nectar sources and soil surface moisture. Within this family, only one species (*Volucella visicularia*) was abundant and evenly-distributed.

Of the hymenoptera, the carpenter ants (*Camponotus*) could be the most useful measure of forest floor surface conditions because they nest in decaying wood. However, their abundance in pitfall traps was determined primarily by the proximity of nests, and thus was highly variable. Therefore *Camponotus* may not be a reliable measure for comparing units or areas.

Many lepidopteran species were found at all study areas. However, many species in the diverse family Noctuidae were collected in only one study area . Of the many species collected, only five were sufficiently abundant and widely distributed to be considered potential indicators.

From these initial patterns of selected insect diversity, it is possible to identify abundant and evenly distributed species to assess the impact of altered microhabitat conditions following prescribed fire. For detecting changes in individual species, fifteen species hold the most promise as environmental indicators following prescribed fire. To detect changes in overall community composition, multivariate analyses (e.g., detrended correspondence analysis) can be used. Also, the species richness values reported here will be important for detecting changes in insect diversity following prescribed fires.

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Appendix 1-- Insect species in selected families recovered from study sites during 1995. p = pitfall trap; m = Malaise trap; l = light trap; o = observed on site; species newly recorded for Ohio are marked with *.**

Species	Study Area AR	BR	WR	YB
ORDER COLEOPTERA				
Carabidae[a]				
Agonum aeruginosum	1		1	
Agonum fidele			1	
Agonum harrisii	1			
Agonum placidum				p
Agonum punctiforme			1	p
Amphasia sericea			1	1
Anatrichis minuta				1
Anisodactylus carbonarius				1
Apenes lucidulus	p	p	1p	1p
Apenes sinuatus	1			1
Badister maculatus			1	1
Badister ocularis				1
Bembidion affine	1		1	1
Bembidion rapidum	1		1	1
Brachinus americanus			p	
Bradycellus tantillus	1			
Calathus gregarius	p			
Calathus opaculus	p		p	1
Calleida viridipennis	1	1	1	1
Calosoma wilcoxi	1			
Carabus goryi	p	p	p	p
*Carabus sylvosus****		p		p
Chlaenius emarginatus	1p	p	1p	p
Chlaenius tricolor	1		1	1
Cicindela sexguttata	mo	o	o	o
Cicindela unipunctata	p			
Clivina americana	1			1
Clivina bipustulata	1	1	1	1
Clivina dentipes	1			1
Clivina impressefrons				1
Coptodera aerata		1	1	1
Cyclotrachelus convivus	p	p	p	p
Cyclotrachelus freitagi			p	
*Cyclotrachelus incisus****	p		p	
Cymindis americanus	p	p	p	p
Cymindis limbatus	1p	1	1	1p
Cymindis neglectus	p		p	
Cymindis platicollis		1	1p	1
Dicaelus ambiguus	p		p	p
Dicaelus dilatatus		p		p
Dicaelus elongatus	p		p	p
Dicaelus furvus		p		
Dicaelus politus	p	p	p	p
Dicaelus purpuratus	p	p	p	p
Dicaelus teter	p	p	p	p

Species	Study Area AR	BR	WR	YB
Dromius piceus	1	1	1	1
Elaphropus sp	1			1
Galerita bicolor	1p	p	p	p
Galerita janus	p	p	p	
Harpalus compar		1	1	1
Harpalus erythropus	1		1	1
Harpalus pensylvanicus				1
Lebia analis				1
Lebia atriventris	1			1
Lebia fuscata	1		1	1
Lebia grandis		1	1	1
Lebia ornata				
Lebia pulchella	1			
Lebia solea	1	1		1
Lebia tricolor	1	1	1	1
Lebia viridipennis	1	1		1
Lebia viridis	1	1	1	1
Loxandrus velocipes		1	1	1
Loxandrus vitiosus	1		1	1
Myas coracinus	p	p	p	p
Notiobia terminata	1	1	1	1
Notiophilus aeneus	p	p	p	p
Oodes amaroides	1		1	1
Pasimachus punctulatus	p		p	p
Patrobus longicornis			1	
Pentagonica picticornis		1		1
*Piesmus submarginatus****	p			p
Platynus cincticollis	1			1
Platynus tenuicollis	1	1	1	1
Plochionus timidus	1	1	1	1
Poecilus chalcites			1	
Pterostichus adoxus	p	p	p	p
Pterostichus atratus	p	p		p
Pterostichus lachrymosus	p			
Pterostichus moestus	p			
Pterostichus permundus			p	
Pterostichus relictus	p		p	p
Pterostichus sayanus	p	p		
Pterostichus stygicus	p	p		
Pterostichus tristis	p	p	p	p
Rhadine caudata	p	p	p	p
Scaphinotus andrewsii mutabilis	p	p		p
Scaphinotus unicolor heros	p			
Selenophorus hylacis	1		1	1
Selenophorus opalinus	1	1	1	1
Sphaeroderus stenostomus lecontei	p	p	p	p
Stenolophus comma		1	1	

Appendix 1 cont.

Species	Study Area AR	BR	WR	YB
Stenolophus lecontei	1	1	1	1
Stenolophus ochropezus	1	1	1	1
Synuchus impunctatus	p	p	p	p
Trichotichus autumnalis		p	p	p
Trichotichnus dichrous	1	1	1	1
Trichotichnus vulpeculus	1	1	1	1
Zuphium americanum	1			
Scarabaeidae[c]				
Ateuchus histeroides	1p	1p	1p	1p
Canthon chalcites	p		p	p
Canthon viridis	p		p	p
Cloeotus globosus	1	1		
Copris fricator	p		p	p
Copris minutus		1p	1p	1p
Dichelonyx elongata	1	1	1	1
Dichotomius carolinus	1		1	
Dynastes tityus		1		
Eucanthus lazarus	1p	1p	1p	1
Geotrupes balyi	p		p	
Geotrupes hornii	1p	p	p	
Geotrupes semiopacus		p	p	
Geotrupes splendidus	p	p	p	p
Onthophagus orpheus canadensis	p		p	
Onthophagus hecate	p	p	p	p
Onthophagus s. striatulus	1p	p	1p	p
Pelidnota punctata	1	1	1	1
Phileurus valgus	1	1	1	1
Popillia japonica	o	o	o	o
Valgus canaliculatus		1	1	1
Xyloryctes jamaicensis	1p			p
Cerambycidae[b]				
Aegoschema modesta			m	1
Amniscus macula	1m	m	m	
Anelaphus pumilus				1
Analeptura lineola	m	m	m	
Aneflomorpha subpubescens	m	m	m	m
Astyleiopus variegatus		m		
Bellamira scalaris	m	m		
Brachyleptura rubrica				m
Clytus ruricola		m		m
Cyrtophorus verrucosus	m			
Distenia undata	m	m		
Eburia quadrigeminata			m	m
Ecyrus dasycerus	1m		1m	

Species	Study Area AR	BR	WR	YB
Elaphidion mucronatum		m	m	m
Elaphidionoides asperses	m	m	m	m
Elaphidionoides parallelus			1	
Elaphidionoides villosus	1m	1m	1m	1m
Enaphalodes rufulus	1		1	1
Euderces picepes			m	m
Gaurotes cyanipennis	m	m	m	m
Goes debilis			m	m
Goes pulcher			1	
Goes pulverulentus			1m	1m
Goes tesselatus	m	1	1	
Goes tigrinus	1		1	1
Graphisurus fasciatus		m	1m	
Hesperophanes pubescens			1	
Heterachthes quadrimaculatus	1		m	
Hetoemis cinerea			1m	
Hyperplatys aspersa				m
Knulliana cincta	1		1	
Lepturges angulatus	m			
Lepturges confluens			1	
Mecas pergrata		m		
Metacmaeops vittata	m	m	m	m
Monochamus titillator			1	
Necydalis mellita	m			
Neoclytus acuminatus	m	m	m	m
Neoclytus mucronatus	m	m	m	
Oberea bimaculata			m	
Oberea ruficollis	m		m	m
Oberea tripunctata	m			m
Orthosoma brunneum	1m	1m	1	1m
Physocnemum violaceipenne			m	
Prionus laticollis	p			
Psyrassa unicolor			m	
Rhopalophora longipes				m
Saperda candida			1	
Saperda discoidea		1m	1m	
Saperda lateralis	m	m		m
Sarosesthes fulminans		m	m	
Smodicum cucujiforme	1			
Stenocorus cinnamopterus		1	1	
Strangalepta abbreviata	m		m	
Strangalia bicolor	m	m	m	m
Strangalia luteicornis	m	m	m	m
Strophiona nitens	m	m	m	m
Tylonotus bimaculatus				1
Typocerus lugubris	m	m	m	m

Appendix 1 cont.

Species	Study Area AR	BR	WR	YB
Typocerus velutinus	m	m	m	
Urgleptes querci		m	m	
Xylotrechus colonus	m	m	m	m
Silphidae[d]				
Necrodes surinamensis			1	1
Necrophila americana	1p	p	p	p
Nicrophorus orbicollis	1p	1p	1p	1p
Nicrophorus pustulatus	1	1	1p	1
Nicrophorus sayi	1p	1p	1p	1p
Nicrophorus tomentosus	p	p	p	p
Oiceoptoma inaequale			p	p
Oiceoptoma noveboracense	p		p	
ORDER DIPTERA				
Syrphidae[e]				
Ceriana abbreviata	m		m	
Chilosia pallipes				m
Chilosia dives	m	m	m	m
Chrysotoxum perplexum	m	m	m	m
Dasysyrphus amolopsus	m			
Didea fuscipes	m		m	
Epistrophe sp.	m	m		
Eristalis arbustorum		m		
Eristalis bastardi	m			
Eristalis flavipes	m		m	m
Eristalis obscurus	m	m	m	m
Ferdinandea dives	m	m	m	
Melanostoma obscurum			m	m
Merodon equestris				m
Mesogramma geminata	m		m	
Mesogramma marginata	m	m	m	m
Metasyrphus emarginatus	m			m
Milesia virginiensis	m	m	m	m
Myiolepta nigra		m		m
Myiolepta varipes			m	
Platycheirus peltitoides	m			
Rhingia nasica				m
Somula decora	m			m
Sphaerophoria scripta			m	
Sphecomyia vittata			m	
Sphegina sp.	m			
Spilomyia hamifera			m	m
Spilomyia longicornis	m		m	
Syrphus sp.	m	m	m	m
Temnostoma balyras	m		m	
Temnostoma trifa		m	m	
Toxomerus geminatus	m	m	m	m
Volucella vesicularia	m	m	m	m
Xanthogramma flavipes	m	m	m	m
Xylota chalybea		m		m
Xylota flavitibia	m		m	
Xylota pigra	m			m
ORDER HYMENOPTERA				
Formicidae[f]				
Aphaenogaster rudis rudis	p	p	p	p
Camponotus americanus	p	p	p	p
Camponotus ferrugineus	p	p	p	p
Camponotus pennsylvanicus	p	p	p	p
Camponotus subbarbatus	p	p	p	p
Crematogaster lineolata	p	p	p	p
Formica subsericea	p	p	p	p
Prenolepis imparis imparis	p	p	p	p
Vespidae[g]				
Dolichovespula maculata	m	m	m	m
Polistes metricus	m		m	
Vespa crabro			m	
Vespula germanica	m		m	m
Vespula maculifrons	m	m	m	m
Vespula squamosa	m	m	m	m

[a] Specific determinations by F. F. Purrington.
[b] Specific determinations by T. K. Philips, D. J. Horn, D. M. Osborne and P. Blades.
[c] Specific determinations by T. K. Philips, F. F. Purrington and A. E. Smith.
[d] Specific determinations by D. J. Horn, G. D. Keeney and F. F. Purrington.
[e] Tentative determinations by E. Johnson and D. J. Horn.
[f] Specific determinations by G. Coovert, W. D. Raby and C. Ranger.
[g] Specific determinations by D. J. Horn.

Appendix 2—Lepidopteran species recovered from study sites during 1995; m = Malaise trap; l = light trap; o = observed on site; species newly recorded for Ohio are marked with *.**

Species[a]	Study area AR	BR	WR	YB
Oecophoridae				
Antaeotrichia schlaegeri	l	l	l	l
Sesiidae				
*Synanthedon scitula****		1		
*Synanthedon acerni****	l	l	l	l
Cossidae				
Prionoxystus robiniae		l	l	l
Tortricidae				
Argyrotaenia alisellana		l		l
Hesperiidae				
Epargyreus clarus	o		o	
Thorybes pylades	m			
Erynnis brizo	m	m	m	m
Erynnis juvenalis	m	m	m	m
Erynnis horatius	m	m	m	m
Pholisora catullus	m			
Ancyloxipha numitor		m		
Thymelicus lineola			m	
Polites peckius	m	m	m	m
Poanes hobomok			m	
Papilionidae				
Papilio polyxenes	o		o	
Papilio glaucus	o	o	o	o
Papilio troilus	mo	m	mo	m
Eurytides marcellus		o	o	
Pieridae				
Pieris rapae	o	m	o	o
Anthocharis midea	o		o	
Colias philodice			o	
Lycaenidae				
Feniseca tarquinius	m		m	m
Satyrium calanus		m		
Calycopis cecrops	m	m	m	m
Incisalia henrici		o	o	
Glaucopsyche lygdamus		m		
Everes comyntas	m	m	m	m
Celastrina ladon	mo	mo	mo	mo
Nymphalidae				
Polygonia interrogationis	o		o	o

Species	Study Area AR	BR	WR	YB
Polygonia comma			o	
Nymphalis antiopa	o		o	
Vanessa atalanta	o	o	o	o
Speyeria cybele	mo	m	o	
Chlosyne nycteis			o	
Phyciodes tharos	o	m	mo	m
Limenitis astyanax	mo	m	mo	
Satyridae				
Enodia portlandia	m		l	
Cyllopsis gemma	m	m	m	m
Hermeuptychia sosybius		m		
Megisto cymela	mo	m	m	m
Cercyonis pegala	m	m	lm	
Zygaenidae				
Pyromorpha dimidiata	m	lm	m	m
Megalopygidae				
Lagoa crispata	l	l	l	l
Norape ovina		l	l	l
Limacodidae				
Apoda yinversum	l	l	l	l
Apoda biguttata	l	l	l	l
Prolimacodes badia	l	l	l	l
Natada nasoni			l	
Euclea delphinii	l	l	l	l
Parasa chloris	l	l	l	l
Pyralidae				
Ostrinia nubilalis	l	l	l	l
Desmia funeralis	l	l	l	l
Palipita magniferalis	l	l	l	l
Pantographa limata	l	l	l	l
Euzophera ostricolorata		l		
Thyatiridae				
Habrosyne scripta	l			
Pseudothyatira cymatophoroides	l	l	l	l
Drepanidae				
Drepana arcuata	l		l	l
Oreta rosea	l	l	l	l

Appendix 2 cont.

Species[a]	Study area AR	BR	WR	YB
Geometridae				
Itame pustularia	l	l	l	l
Semiothisa promiscuata	l	l	l	l
Semiothisa granitata	l	l	l	l
Semiothisa quadrinotaria	l	l	l	l
Glena cribrataria		l	l	l
Iridopsis larvaria	l	l	l	l
Anavitrinella pampinaria	l	l	l	l
Epemecis hortaria	l	l	l	l
Melanolophia canadaria		l		l
Melanolopohia signataria	l	l	l	l
Biston betularia	l	l	l	l
Hypagirtis unipuncta	l	l	l	l
Lomographa vestaliata	l		l	
Lytrosis unitaria	l	l	l	l
Euchlaena amoenaria	l		l	l
Euchlaena tigrinaria	l	l	l	l
Euchlaena irraria	l	l	l	l
Nacophora quernaria	l	l	l	l
Campaea perlata	l	l	l	l
Metarranthis hypochraria				l
Probole nyssaria			l	l
Probole amicaria	l	l	l	l
Plagodis serinaria	l		l	l
Plagodis kuetzingi	l	l	l	l
Plagodis phlogosaria	l	l	l	l
Plagodis alcoolaria	l	l	l	l
Plagodis fervidaria	l	l	l	l
Besma endopriaria	l		l	
Besma quercivoraria	l	l	l	l
Tetracis crocallata	l	l	l	l
Tetracis cachexiata	l	l	l	l
Prochoerodes transversata			l	l
Nematocampa limbata	l		l	l
Nemoria bistriaria	l	l	l	l
Nemoria mimosaria	l	l	l	l
Dichorda iridaria	l	l	l	l
Cyclophora packardi	l		l	l
Scopula limboundata	l	l	l	l
Eulithis diversilineata	l	l	l	l
Ecliptopera atricolorata	l		l	l
Hydriomena transfigurata	l	l	l	l
Hydria prunivorata	l	l	l	l
Orthonama obstipata	l	l	l	l
Orthonama centrostrigaria	l	l	l	l
Eubaphe mendica	l	l	l	l
Eupithecia miserulata	l	l	l	l
Dyspteris abortivaria	l	l	l	l

Species	Study Area AR	BR	WR	YB
Mimallonidae				
Lacosoma chiridota		l		l
Cicinnus melsheimeri	l	l	l	l
Apatelodidae				
Apatelodes torrefacta	l	l	l	l
Olceclostera angelica	l	l	l	l
Lasiocampidae				
Malacosoma disstria	l	l	l	l
Malacosoma americanum	l	l	l	l
Saturniidae				
Eacles imperialis	l	l	l	l
Citheronia regalis	l	l	l	l
Citheronia sepulcralis		l		
Sphingicampa bisecta			l	l
Dryocampa rubicunda	l	l	l	l
Anisota stigma	l	l	l	l
Anisota virginiensis		l	l	
Automeris io	l	l	l	l
Antheraea polmphemus	l	l	l	l
Actias luna	l	l	l	l
Callosamia promethea		l		l
Callosamia angulifera	l	l	l	l
Sphingidae				
Manduca jasminearum		l		
Dolba hyloeus		l		
Ceratomia undulosa	l	l	l	l
Lapara coniferarum		l	l	
Smerinthus jamaicensis			l	
Paonias excaecatus	l	l	l	l
Paonias myops		l	l	l
Laothoe juglandis	lm	m	lm	m
Amphion floridana		m		
Pachysphinx modesta	l		l	
Sphecodina abbottii		l		l
Deidamia inscripta	l	l	l	l
Darapsa myron		l	l	l
Darapsa pholus	l	l	l	
Notodontidae				
Clostera albosigma			l	l
Clostera inclusa	l	l	l	l
Datana ministra		l		l
Datana angusii	l	l	l	l
Datana drexelii	l	l	l	l
Datana major		l		l

Appendix 2 cont.

Species[a]	Study area AR	BR	WR	YB
Datana contracta	1	1	1	1
Datana integerrima		1	1	
Nadata gibbosa	1	1	1	1
Hyperaeschra georgica	1	1	1	1
Peridea basitriens	1	1	1	1
Peridea angulosa	1	1	1	1
Pheosia rimosa	1		1	
Odontosia elegans	1		1	
Nerice bidentata		1		1
Ellida caniplaga	1	1	1	1
Gluphisia septentrionis			1	1
Furcula borealis				1
Furcula cinerea			1	
Symmerista albifrons	1	1	1	1
Dasylophia anguina	1	1	1	1
Dasylophia thyatiroides	1		1	1
Misogada unicolor		1		
Marcrurocampa marthesia	1	1	1	1
Heterocampa obliqua	1	1	1	1
Heterocampa subrotata	1			
Heterocampa umbrata	1	1	1	1
Heterocampa guttivitta	1	1	1	1
Heterocampa biundata		1	1	1
Lochmaeus manteo		1	1	1
Lochmaeus bilineata	1	1	1	1
Schizura ipomoeae	1	1	1	1
Schizura unicornis			1	
Schizura concinna			1	
Schizura leptinoides		1	1	1
Oligocentria semirufescens		1	1	
Oligocentria lignicolor	1	1	1	1
Hyparpax aurora				1
Arctiidae				
Crambidia pallida	1	1		1
Crambidia uniformis	1	1	1	1
Crambidia cephalica		1		1
Cisthene plumbea	1	1	1	1
Cisthene packardii		1	1	
Lycomorpha pholus	1		1	1
Hypoprepia miniata		1		
Hypoprepia fucosa	1	1	1	1
Clemensia albata	1	1	1	1
Pagara simplex				1
Haploa clymene	1	1	1	1
Haploa contigua	1	1	1	1
Haploa lecontei	1	1	1	1
Holomelina opella	1	1	1	1
Pyrrharctia isabella	1		1	1

Species	Study Area AR	BR	WR	YB
Estigmene acrea		1		
Spilosoma latipennis		1		1
Spilosoma congrua	1	1	1	1
Spilosoma virginica	1	1	1	
Hyphantria cunea	1	1	1	1
Ecpantheria scribonia	1	1	1	1
Apantesis phalerata			1	
Apantesis carlota				1
Grammia anna	1	1	1	1
Grammia figurata	1	1	1	1
Grammia parthenice	1	1	1	1
Grammia virgo				1
Halysidota tessellaris	1	1	1	1
Lophocampa caryae	1	1	1	1
Cycnia tenera	1	1	1	1
Euchaetis egle	1	1	1	1
Cisseps fulvicollis	1	1	1	1
Lymantriidae				
Dasychira tephra	1	1	1	1
Dasychira basiflava	1	1	1	1
Dasychira obliquata	1	1	1	1
Orgyia definita			1	1
Orgyia leucostigma	1	1	1	1
Noctuidae				
Idia americalis	1	1	1	1
Idia aemula	1	1	1	1
Idia majoralis				1
Idia rotundalis	1	1	1	1
Idia forbesi	1	1	1	1
Idia julia	1	1	1	
Idia diminuendis	1	1	1	1
Idia scobialis	1		1	1
Idia denticulalis		1		1
Idia lubricalis			1	1
Zanclognatha laevigata	1			
Zanclognatha obscuripennis		1		1
Zanclognatha pedipilalis			1	
Zanclognatha martha				1
Zanclognatha cruralis	1	1	1	1
Zanclognatha jacchusalis	1		1	
Zanclognatha ochreipennis		1	1	1
Chytolita morbidalis		1	1	
Macrochilo absorptalis			1	
Phalaenostola larentioides			1	
Tetanolita floridana				1
Bleptina caradrinalis	1	1	1	1
Renia salusalis		1	1	

Appendix 2 cont.

Species[a]	Study area AR	BR	WR	YB
Renia factioralis				1
Renia nemoralis				1
Renia discoloralis	1	1	1	1
Renia sobrialis		1	1	
Renia adspergillus		1		
Palthis angulalis	1	1	1	1
Palthis asopialis	1	1	1	1
Redectis vitrea		1		
Oxycilla malaca				1
Hypenodes fractilinea			1	
Dyspyralis puncticosta				1
Nigetia formosalis		1	1	
Bomolocha manalis	1	1	1	1
Bomolocha baltimoralis	1	1	1	1
Bomolocha bijugalis	1	1	1	1
Bomolocha palparia	1	1	1	1
Bomolocha abalienalis				1
Bomolocha deceptalis				1
Bomolocha madefactalis	1	1	1	1
Bomolocha sordidula				1
Plathmpena scabra	1	1	1	1
Spargaloma sexpunctata		1		
Pangrapta decoralis	1	1	1	1
Metalectra discalis		1	1	
Metalectra quadrisignata				1
Metalectra richardsi		1		
Arugisa latiorella		1		1
Scolecocampa liburna	1	1	1	1
Physopropus callitrichoides	1	1	1	1
Hypsoropha monilis		1		
Hypsoropha hormos	1	1	1	1
Scoliopteryx libatix				1
Calyptra canadensis	1	1	1	1
Panopoda rufimargo	1	1	1	1
Panopoda carneicosta	1	1	1	1
Cissusa spadix	1		1	
Lesmone detrahens		1		
Zale lunata	1	1	1	1
Zale galbanata	1		1	
Zale aeruginosa		1		
Zale undularis			1	
Zale minerea	1	1	1	1
Zale lunifera	1	1	1	1
Zale unilineata	1		1	
Zale horrida	1		1	1
Euparthenos nubilis	1	1	1	1
Allotria elonympha	1	1	1	1
Parallelia bistriaris	1	1	1	1
Euclidia cuspidea	1	1	1	

Species	Study Area AR	BR	WR	YB
Caenurgina erechtea	1	1	1	1
Mocis texana	1		1	1
Celipetra frustulum	1	1	1	1
Argyrostrotis anilis	1			1
Catocala piatrix	1			
Catocala habilis	1		1	1
Catocala robinsoni	1		1	
Catocala flebilis	1		1	1
Catocala angusi			1	1
Catocala obscura	1	1	1	1
Catocala retecta	1	1	1	1
Catocala residua	1	1	1	1
Catocala insolabilis	1			
Catocala vidua	1	1	1	1
Catocala paleogama	1	1	1	1
Catocala subnata	1		1	1
Catocala neogama	1	1	1	1
Catocala ilia	1	1	1	1
Catocala sordida		1		
Catocala andromedae	1	1	1	1
Catocala coccinata			1	1
Catocala miranda				1
Catocala ultronia	1	1	1	1
Catocala grynea		1		
Catocala dulciola		1		
Catocala clintoni			1	
Catocala similis	1	1		1
Catocala micronympha	1	1	1	1
Catocala amica	1	1	1	1
Catocala lineella	1		1	
Pseudoplusia includens	1	1	1	1
Allagrapha aerea		1	1	
Polychrisia morigera		1		
Chrysanympha formosa	1	1	1	1
Eosphoroptermx thyatiroides	1			1
Autographa precationis	1	1	1	
Anagrapha falcifera	1	1	1	1
Marathyssa inficita			1	
Paectes oculatrix	1	1	1	1
Paectes abrostollela	1	1	1	
Paectes abrostoliodes		1		
Eutelia pygmaea		1		
Eutelia pulcherrima	1			
Baileya ophthalmica	1	1	1	1
Baileya dormitans	1	1	1	1
Baileya levitans	1	1	1	
Baileya australis		1		
Characoma nilotica		1		
Meganola phylla	1	1	1	1

Appendix 2 cont.

Species[a]	Study area			
	AR	BR	WR	YB
Meganola spodia	1	1	1	1
Tripudia quadrifera			1	
Oruza albocostaliata	1	1	1	1
Hyperstrotia pervertens	1		1	1
Hyperstrotia villificans	1	1	1	1
Hyperstrotia secta	1	1	1	1
Thioptera nigrofimbria	1	1	1	1
Lithacodia muscosula	1	1	1	1
Lithacodia musta	1		1	1
Lithacodia carneola	1	1	1	1
Cerma cerintha	1	1	1	1
Leuconycta diphteroides	1	1	1	1
Leuconycta lepidula			1	
Tarachidia erastrioides			1	1
Panthea furcilla	1		1	
Colocasia flavicornis	1	1	1	1
Colocasia propinquilinea	1	1	1	1
Charadra deridens	1	1	1	1
Raphia frater	1	1	1	1
Acronicta americana	1	1	1	1
Acronicta dactylina	1		1	
Acronicta lepusculina				1
Acronicta betulae			1	
Acronicta radcliffei	1		1	
Acronicta funeralis	1	1	1	1
Acronicta vinnula	1	1	1	1
Acronicta superans				1
Acronicta laetifica		1	1	
Acronicta hasta	1	1	1	1
Acronicta spinigera	1	1	1	1
Acronicta morula	1	1	1	1
Acronicta interrupta		1	1	
Acronicta lobeliae	1	1	1	1
Acronicta heitzmani			1	1
Acronicta exilis			1	
Acronicta ovata	1	1	1	1
Acronicta modica	1	1	1	1
Acronicta haesitata	1	1	1	1
Acronicta tristis	1		1	
Acronicta hamamelis	1			
Acronicta increta	1	1	1	1
Acronicta inclara		1		
Acronicta retardata	1	1	1	1
Acronicta afflicta	1	1	1	1
Acronicta impleta	1	1	1	1
Acronicta lithospila	1	1	1	1
Acronicta oblinita		1		
Agriopodes fallax	1	1	1	1
Agriopodes teratophora		1	1	1

Species	Study Area			
	AR	BR	WR	YB
Polygrammate hebraeicum	1	1	1	1
Eudryas unio		1		1
Eudryas grata	1	1	1	1
Apamea cristata				1
Apamea vulgaris			1	
Apamea sordens				1
Agroperina helva			1	
Crymodes devastator				1
Oligia modica				1
Oligia fractilina	1			1
Oligia crytora	1			
Oligia semicana			1	
Oligia obtusa		1		
Archanara oblonga				1
Amphipoea velata				1
Bellura obliqua				1
Euplexia benesimilis	1	1	1	1
Phlogophora periculosa	1	1	1	1
Chytonix palliatricula	1	1	1	1
Dypterygia rozmani	1		1	
Phosphila turbulenta	1	1	1	1
Phosphila miselioides	1	1	1	1
Callopistria mollissima	1	1	1	1
Amphipyra pyramidoides	1	1	1	1
Anorthodes tarda	1	1	1	1
Balsa malana	1		1	
Balsa tristrigella	1	1	1	1
Balsa labecula	1	1	1	1
Elaphria versicolor	1	1	1	1
Elaphria festivoides	1	1	1	1
Elaphria grata		1		1
Galgula partita	1	1	1	1
Perigea xanthioides		1	1	
Platysenta videns	1	1	1	1
Ogdoconta cinereola			1	
Stiroides obtusa				1
Plagiomimicus pityochromus			1	
Basilodes pepita	1		1	1
Cosmia calami	1	1	1	1
Amolita fessa		1		
Lithophane petulca	1		1	
Lithophane hemina	1		1	
Lithophane antennata	1		1	
Pyreferra hesperidago			1	
Sideridis congermana			1	
Polia detracta	1	1	1	
Polia goodelli	1			1
Polia latex	1	1	1	1
Melanchra adjuncta	1	1	1	1

Appendix 2 cont.

Species[a]	Study area			
	AR	BR	WR	YB
Hadena ectypa			1	
Lacinipolia renigera	1	1	1	1
Lacinipolia lorea		1	1	1
Lacinipolia implicata	1	1	1	1
Pseudaletia unipuncta	1	1	1	
Leucania linda	1	1	1	1
Leucania ursula	1	1	1	1
Leucania pseudargyria	1	1	1	1
Orthosia rubescens	1			1
Crocigrapha normani	1		1	1
Egira alternans				1
Achatia distincta	1		1	1
Morrisonia confusa	1		1	
Nephelodes minians	1		1	1
Homorthodes furfurata	1	1	1	1
Ulolonche culea	1	1	1	1
Pseudorthodes vecors	1		1	
Orthodes crenulata	1	1	1	
Orthodes cynica	1	1	1	1
Tricholita signata			1	
Agrotis ipsilon	1	1	1	1
Feltia jaculifera	1	1	1	
Ochropleura plecta	1	1	1	1
Trichosilia geniculata		1		
Euagrotis illapsa	1			
Peridroma saucia	1	1	1	
Xestia adela	1		1	
Xestia dolosa	1	1	1	1
Xestia normaniana			1	
Xestia smithii	1		1	1
Xestia *bicarnea*	1		1	
Protolampra brunneicollis		1	1	
Abagrotis alternata		1	1	
Helicoverpa zea	1	1		1
Schinia arcigera	1		1	1

[a] - Specific determinations by E. H. Metzler, M. Gilligan, T. Gilligan, D. J. Horn, J. W. Peacock, R. D. Watkins and R. Zebold

Species sequence is standard from Hodges et al. (1983)