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THE SPECIES RICHNESS OF LEPIDOPTERA IN A FRAGMENTED LANDSCAPE: A SUPPLEMENT TO THE CHECKLIST OF MOTHS OF BUTLER COUNTY, OHIO

Keith S. Summerville[1] and Thomas O. Crist[1]

ABSTRACT

Land conversion for agriculture or urban expansion has fragmented the midwestern landscape and isolated native biotas in remnant habitat patches. Identification of priority remnants to be targeted for conservation, however, requires an understanding of the species diversity and distributions in such fragmented landscapes. During a 3–year inventory, we estimated the species richness of Lepidoptera in forests and old fields within an agricultural region of southwest Ohio, Butler County. A combination of casual collecting (butterflies) and a systematic field study (moths) were used to sample lepidopteran species at several sites from 1998–2000. Our inventory added 207 new species to the checklist of the Lepidoptera of Butler County, bringing the total described species richness of the region to 599 species (including Peoria tetradella (Pyralidae), a state record). The species accumulation curve produced from our 1999 moth inventory did not reach saturation, suggesting that additional species remain to be recorded. These results indicate that even highly modified landscapes can support a substantial species diversity of Lepidoptera if there are sufficient areas of native habitat. Since short-term insect inventories tend to be biased toward common, well-known species, rapid diversity assessments may miss important elements of conservation interest. Checklists should remain an important data source for species occurrences and biogeography. Without a well-established knowledge of species geography, critical areas of conservation interest may be overlooked or left unprotected.

Over the past century, the North American landscape has become increasingly dominated by anthropogenic land uses (Noss and Cooperrider 1994, Simpson et al. 1994, Daily 1997). Human-dominated systems are inhospitable to many plants and animals, however, and these species are often forced to occupy isolated patches of remnant habitat (Saunders et al. 1991, Panzer et al. 1995, Ehrlich 1996, Samways 1996). Demand for broad-scale conservation initiatives to protect and manage for remnant-dependent species has flourished in recent years, especially for plant and vertebrate species (Thomas 1994). Interest in vertebrate conservation not only stems from a focus on charismatic "megafauna" but also is derived from to our sound knowledge of their regional biogeography (Keast 1990, Andren 1994, Thomas 1994, Forman and Collinge 1996). Except for butterflies (and, in some regions, the Odonata) the regional biogeography of North American in-

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sects is less well known (Kerr et al. 1998, Lattin 1993, Opler 1994, Samways 1994, Robbins and Opler 1997, Hammond and Miller 1998).

Faunal checklists are necessary for analyses of species distributions, relationships between local and regional diversity, and patterns of endemism, concepts which bridge community ecology and conservation biology (Patterson 1987, Doak and Mills 1994, Haila and Margules 1996, Greenberg and Droege 1999, Wright et al. 1998, Covell 1999, Abbitt et al. 2000, Summerville et al. 2001, Summerville and Crist *in press*). Furthermore, species lists serve as data sources for testing the ecological theory commonly applied to conservation practice across broad scales (e.g., species-area relationships, Connor and McCoy 1979; nested-subsets, Patterson 1987, Wright et al. 1998). Unfortunately, publication and analyses of species lists has fallen out of favor among ecologists, and species lists maintained by "amateur" naturalists are frequently overlooked by conservation biologists (Droege et al. 1998, Wright et al. 1998). Rapid identification of diversity hot-spots, vulnerable habitats, and priority sites for conservation, however, are predicated on the availability and accessibility of species occurrence data (Scott and Csuti 1997, Roy and Tumar 2000). When these data are lacking, critical areas of conservation interest may be overlooked or left unprotected (Wilcox 1984, Abbitt et al. 2000).

In this paper, we present a supplement to the checklist of the moths of Butler County, Ohio published by Summerville et al. (1999). Butler County occurs in the North-Central Tillplain, a region that is dominated by agriculture, suburban, and urban land uses. Second-growth forests are restricted to small or moderate-sized woodlots (Simpson et al. 1994, Medley et al. 1995). Given these intensive land uses, it may be tempting to dismiss the region as bereft of appreciable species diversity. To the contrary, we provide evidence that even fragmented landscapes may support considerable lepidopteran species richness provided there are areas of suitable natural habitat present. Furthermore, our supplement provides numerous range extensions for moth species and new species occurrence data for all Lepidoptera that can be used for future regional conservation planning in Ohio and its neighboring states. Finally, we demonstrate that additional diversity remains undetected, even after three years of inventory with periods of intensive sampling at the same sites.

MATERIALS AND METHODS

Lepidopteran diversity was investigated from 1998–2000 in a variety of habitats in northwestern Butler County, Ohio (Fig. 1). We sampled butterflies in 1999–2000 at the Ecology Research Center (ERC) which is maintained by Miami University, Oxford, Ohio (39°N 31.8′; 84°W 43.3′). Detailed descriptions of the old-field habitats at the ERC are provided by Golden and Crist (1999) and Summerville and Crist (2001). A more general description of the other habitats at the ERC was given in Summerville et al. (1999). Moths were sampled from four forest stands in northwestern Butler County: Bachelor Reserve (268 ha; 39°N 30.8′; 84°W 42.6′), Kramer Woods (5.2 ha, 39°N 31.9′; 84°W 42.8′), Ecology Research Center Woodlot (4.6 ha, 39°N 31.8′; 84°W 43.3′), and Jericho Preserve (8.4 ha, 39°N 32.3′; 84°W 42.5′). Three of these woodlots are part of Miami University's Natural Areas (Bachelor, Kramer, and ERC), and Jericho is a privately owned nature preserve (Fig. 1). Kramer, Jericho, and ERC woodlots are relatively similar in composition, with the canopy dominated by a mixture of sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*), and oaks (*Quercus rubra*, *Quercus alba*),

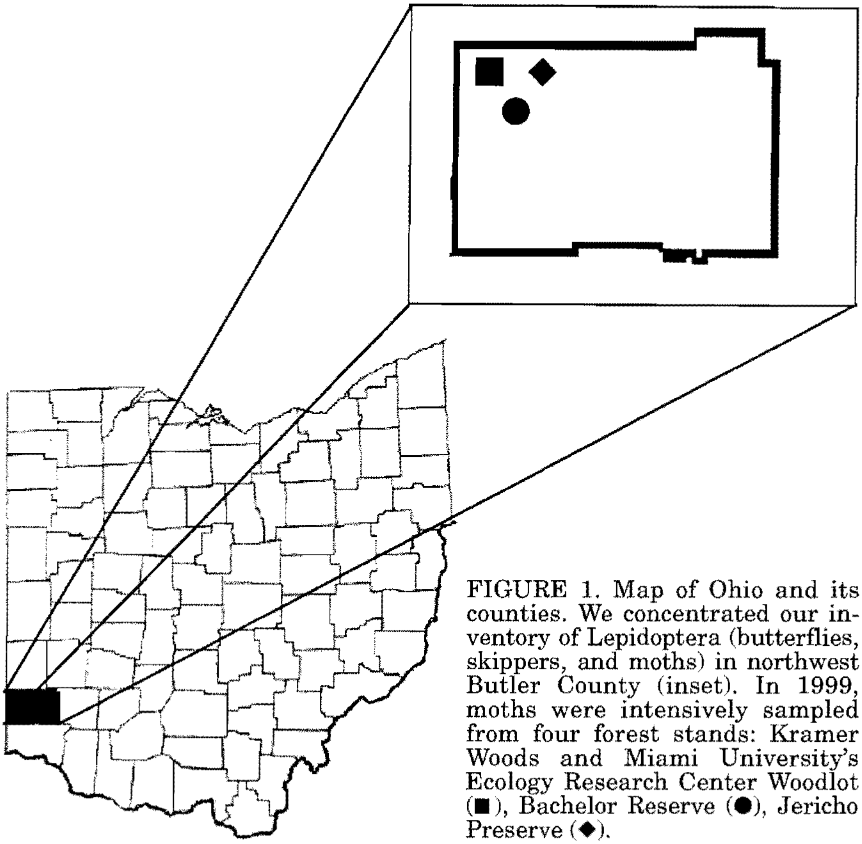

FIGURE 1. Map of Ohio and its counties. We concentrated our inventory of Lepidoptera (butterflies, skippers, and moths) in northwest Butler County (inset). In 1999, moths were intensively sampled from four forest stands: Kramer Woods and Miami University's Ecology Research Center Woodlot (■), Bachelor Reserve (●), Jericho Preserve (◆).

and both Kramer and Jericho support large populations of American beech (*Fagus grandifolia*). All three woodlots contain significant populations of amur honeysuckle (*Lonicera maackii*) and garlic mustard (*Alliaria officinalis*) as well as native populations of spicebush (*Lindera benzoin*) and many woodland herbs. In contrast, Bachelor Reserve is much larger and contains a heterogeneous mixture of early and mid-successional forest stands with both xeric and mesic aspects. A more detailed habitat description for Bachelor Reserve is provided in Summerville et al. (1999).

Universal blacklight traps (12–watt, Bioquip Products; powered with 12–V, 26 Amp-hr batteries) were operated in all four woodlots ca. once a week in June and August 1999 and May to August in Bachelor 1998–9. Within each site, nine trap stations were arranged in a 100–m^2 grid, with each trap station separated by 50 m. Each sampling night, a single trap was placed within each row and column of the grid (a Latin square approach). Traps were positioned on platforms 2 m above the ground to allow optimal broadcast of the light, and operated from 2000 to 600 EDT. Since weather and moon intensity affect capture rates of blacklight traps, we trapped only on nights that had a minimum temperature of 16°C, no precipitation, and low levels of moon illumination (see Yela and Holyoak 1997). Moths were dispatched inside the traps with ethyl acetate and dichlorvos killing agents. Collected specimens were frozen in the lab until they could be properly spread, dissected if required, and identified. Specimens requiring particular expertise for identification were forwarded to appropriate taxonomic authorities. Vouchers for all species collected during the course of this study have been deposited in the Miami University insect collection and the personal collections of the authors.

With the data obtained in 1999 from the four woodlots described above, we used the program PC-ORD (version 4, MJM Software Design 1999) to generate a species accumulation curve for our inventory of the moths of Butler County. This program generates an average species accumulation curve by taking the mean of 500 species accumulation curves produced from randomly reordering the samples. In addition to generating mean species accumulation curves for a given data set, PC-ORD also generates the standard deviation for each point on a curve. We used these values to calculate 95% confidence bands for the number of species collected per sampling effort. Trap-nights were used as the index of sampling effort, where a trap night is equivalent to a single sample obtained from one blacklight trap (n = 72 total trap nights). Overall species richness estimates for Butler County were determined using the first-order jackknife procedure (Heltsche and Forrester 1983). Palmer (1990, 1991) considered the first-order jackknife estimator the most precise and least biased statistic for estimating species richness, although it tends to slightly underestimate the true value of species richness.

Blacklight traps are considered to be a standard technique for sampling nocturnal Lepidoptera, but the technique is biased toward phototactic species (Southwood 1978). Some species of moths are predominantly diurnal (e.g., some Noctuidae: *Schinia* spp.; some Arctiidae: *Alypia* spp.), while others seldom come to light (e.g., most Sessiidae, many Noctuidae: *Lithophane* spp., some Gelechiidae: *Chionodes* spp.). Therefore, we supplemented blacklight sampling with bait lines (a mixture of molasses, rotten fruit, and sugar fermented for 10 d prior to use) in Kramer woods to sample species attracted to fermenting fruit. Additionally, in the summer 2000, we hung general pheromone lures (Clearwing Borer Complex Lure, Great Lakes IPM) in Kramer and Bachelor Woods to sample Sessiidae.

A checklist of all inventoried species except those included in Summerville et al. (1999) was prepared by indexing species according to their family and Hodges checklist number (Hodges et al. 1983). Our checklist supplement, however, includes some modifications to the higher taxonomy of the Lepidoptera. For example, the higher classification of the Papilionoidea reflects the changes of Harvey (1991). Further, we follow Solis (1997) in treating the Pyralidae and Crambidae as distinct families. Finally, the taxonomy of the Tortricidae has been revised from Hodges et al. (1983) so that the Olethreutidae and Cochylidae are considered a subfamily and tribe of tortricids, respectively (reviewed in Heppner 1998). To preserve the integrity of the Hodge's numbering system, however, some of the recent taxonomic revisions within other microlepidopteran families reported in Scoble (1995) and Heppner (1998) have not been directly incorporated into our checklist. Therefore, we caution against using species placements in the checklist as evidence of phylogenetic affiliation.

RESULTS

Over the three-year period of our inventory, we collected ca. 20,000 lepidopteran individuals, adding 207 new species to the checklist of Lepidoptera of Butler County, Ohio (Appendix I). Of these additions, 51 species are butterflies (Papilionoidea) or skippers (Hesperioidea), and the remaining 156 species are moths. Together with the 392 species reported in Summerville et al. (1999), the total richness of Lepidoptera described from Butler County increased to 599 species. A comparison with the statewide list maintained by the Ohio Lepidopterists revealed that virtually all (152 of 156) of the moth species we collected were county records. In contrast, none of the Papilionoidea or Hesperoidea in this checklist were new to our region (Appendix I). Therefore, our inventory expanded the known Ohio ranges for most moths but not for butterflies or skippers.

One species was a state record: *Peoria tetradella* Zeller (Pyralidae). Our collection consisted of two individuals sampled singly on 8 July and 12 July 1998, and both individuals were collected from a single site, Bachelor Reserve. Little is known regarding the biology or natural history of this species (Forbes 1923). The regional distribution of *P. tetradella* is equally enigmatic. In the Midwest, the species is known from isolated records in Indiana, Illinois, and Kentucky, with most occurrence data based on singly collected individuals (Shaffer 1968, Covell 1999).

New family records also accompanied the significant increase in the species richness from Butler County. We inventoried species in five families not included in Summerville et al. (1999): Elachistidae, Coleophoridae, Lyonetiidae, Plutellidae, and Pterophoridae (Table 1). Furthermore, species did not accumulate equitably among the families included in the preliminary inventory of Summerville et al. The species added here disproportionately fall

Table 1. The number of new species collected (for selected speciose families) by our inventory of Lepidoptera of Butler County, and the proportion of the total species richness described for the county in our checklist supplement. In contrast to Summerville et al. (1999), most of the species accumulated in our inventory were microlepidoptera (below, Elachistidae – Pyralidae).

Family	Number of Species in Checklist Supplement[1]	Proportion of the Total Species Richness in Butler County[2]
Elachistidae*	1	1.0
Lyonetiidae*	1	1.0
Coleophoridae*	4	1.0
Plutellidae*	1	1.0
Pterophoridae*	3	1.0
Gelechiidae	9	0.82
Cosmopterigidae	4	0.80
Tortricidae	36	0.64
Oecophoridae	8	0.62
Pyralidae	26	0.42
Geometridae	17	0.25
Noctuidae	38	0.19
Notodontidae	1	0.05
Arctiidae	1	0.04
Saturniidae	0	0.00
Sphingidae	0	0.00

[1]See Appendix I.
[2]Total county richness determined using the data of Summerville et al. (1999) and Appendix I.
*Indicates that the family was not included in Summerville et al. (1999).

within the microlepidoptera (*sensu* McDunnough 1939). For example, between 40–85% of the total species richness of many microlepidopteran families described from Butler County were added near the completion of our 3–year inventory (Table 1). In contrast, ca. 80% of the species reported in the preliminary checklist were large-bodied moths (e.g., Geometroidea, Noctuoidea, Bombycoidea, Sphingoidea, see Table 1).

A total of 569 morphospecies of moths were observed in our 1999 inventory of the four Oxford woodlots, and roughly 1/6 (ca. 90) of these remain unidentified (e.g., Tineioidea, Gelechoidea). In contrast, another 1/5 (ca. 110) of the species inventoried in 1999 were new additions to the checklist. Despite a marked improvement in our estimation of regional species richness through intensive sampling within the four forest stands, the species accumulation curve for the Butler County woodlots still did not saturate (Figure 2). Thus, the number of samples taken in June and August were inadequate to catalog all of the species present in each woodlot during those two months. The first-order jackknife estimate of the total species richness for the woodlots in June and August 1999 was 701, or 132 species higher than observed from the 72 blacklight samples collected in the 1999 inventory (Figure 2). Since the total richness of moths reported in Butler County checklists was 548 of the total 599 lepidopteran species, there may be 150 additional moth species to be described from this area alone, which represents a fraction of the county. The determinations of the 90 unidentified morphospecies from 1999, however, will even be insufficient to match this estimate.

DISCUSSION

The Lepidoptera of Butler County, Ohio comprise a diverse fauna within a highly fragmented landscape. Five years ago, less than 175 species of moths were known from this region (Ohio Lepidopterists, unpubl. data). Remarkably, our inventory has roughly tripled the described richness of moths from Butler County despite the emphasis on the Oxford vicinity. Even more impressive (and potentially alarming) is that this substantial diversity occurs within one of the fastest growing metropolitan sectors of the state. Inventories for Lepidoptera in similarly fragmented regions provide similar results (e.g., Fulton County, Ohio, see Rings et al. 1991) and suggest an important conclusion: lepidopteran species richness may be quite high in remnant habitat patches within fragmented landscapes (Zuidema et al. 1996).

Araujo and Williams (2000) have cautioned that the potential for long-term persistence of species should not be directly inferred from the mere presence of species in an inventory. Thus, sites described in an inventory as being rich in species should not be assumed to possess stable populations and communities (Pressey et al. 1993, Brown 2001). Indeed, several habitat remnants might be required for population viability (Samways 1994). Nonetheless, highly fragmented regions should not be discarded from conservation planning based upon the *a priori* assumption that degraded landscapes lack unique and diverse communities. Within a region, forest remnants similar in size and plant species composition have been shown to support significantly different moth species assemblages (Summerville et al. 2001). Thus, once diverse communities are identified, more specific research should be tailored to assess the structure of the community and its potential for long-term persistence.

Inventories will seldom accumulate species as a random draw from the available species pool. Rather, common species are described first, and rare

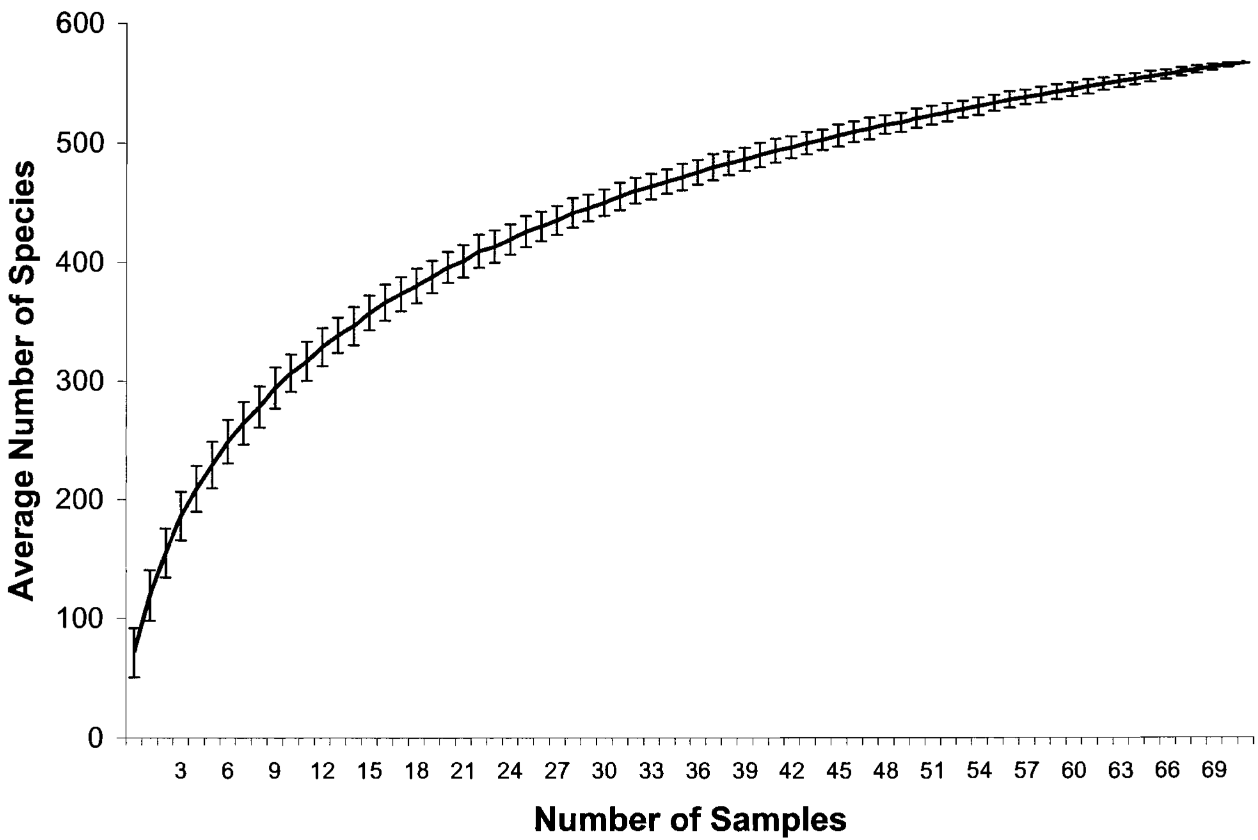

Figure 2. Species accumulation curve for moths sampled from four woodlots in northwest Butler County in 1999. A total of 72 samples were collected in June and August, however, the species accumulation curve never reached a point of saturation. The error bars are 95% confidence intervals.

species are added with increased sampling effort (Gaston et al. 1995). Since moth diversity tends to best be described by the log-normal distribution (with most species represented by few individuals at a site; see Magguran 1985), a substantial investment of effort will be required to: 1) document the occurrence of rare species of conservation interest, and 2) accumulate most or all of the species within an area (Gaston et al. 1995, Longino and Colwell 1997, McKinney 1999). Thus, it would not be surprising if the species accumulation curve for northwest Butler County did not saturate after a modest inventory effort (ca. 50 samples). However, even after 72 trap nights (ca. 19,000 individuals) we were unable to catalog the majority of the moth biodiversity of four woodlots in the area. When considering global lepidopteran diversity, one often conjures images of tropical communities (and rightfully so, see Robinson and Tuck 1993, Solis and Pogue 1999), but our local fauna is also considerably diverse and should command our increased attention.

The sampling bias associated with the inventory of common and rare species can be applied in an analogous manner to macro- and microlepidopteran groups: macrolepidoptera are typically recorded in inventories before microlepidoptera. The bias toward macrolepidopteran families is likely attributable to their species' size, coloration, and relative taxonomic resolution (Gaston et al. 1995, Summerville et al. 1999, Brown 2001). Collectors may first examine species that have a low curatorial investment relative to their aesthetic value. That is, the bigger, brighter, and most easily identified species are studied before the smaller, more drab species that require careful dissection (McKinney 1999). This practice has contributed to a more thorough understanding of the biogeographic distributions of macrolepidoptera compared to the microlepidoptera, which remain poorly known. The disparity between the resolved biogeographic distributions of butterflies and moths is an even larger manifestation of this problem (Robbins and Opler 1997, Abbitt et al. 2000).

The taxonomic impediments that prevent our understanding of patterns in microlepidopteran richness and biogeography are serious problems (Heppner 1999). Recent advances in parataxonomy and taxonomic surrogacy, however, hold promise that patterns can be investigated in the absence of trained systematists (Oliver and Beattie 1993, Longino and Colwell 1997). For example, Robinson and Tuck (1993) used morphospecies as their working taxonomic units while studying community turnover among tropical microlepidoptera. Since extinction threat in fragmented landscapes may be higher for insect groups compared to most other taxa, it seems unwise to retain a sampling bias against microlepidoptera for North American inventories (see McKinney 1999).

Checklists are an important, if underused, tool for the monitoring and conservation of species diversity (Haila and Margules 1996, Droege et al. 1998, Summerville et al. 1999). Many community or ecosystem ecologists accumulate impressive species lists during the course of their research, but checklists are frequently considered as low priority publications among the ecological community (Droege et al. 1998). Broad-scale interpolating of species diversity patterns across geopolitical boundaries (e.g. kriging, comparative floristics; reviewed in Palmer 1995) would be better served if species occurrence data were more readily available and accessible. The process of conservation planning at the scale of ecoregions or landscapes will only be successful if uncertainty in how species richness varies within and among regions is minimized (New 1999). Inventories and species checklists will continue to reduce our uncertainty since both provide fundamental data on the species we stand to lose.

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Appendix I. Additions to the checklist of the Lepidoptera of Butler Co., Ohio.

Hodge Number	Family	Species Name	Butler County Record	Ohio State Record
394	**Tineidae**	*Tinea carniella* Clem. 1859	x	
416		*Monopis dorsistrigella* Clem. 1859	x	
417		*Monopis marginistrigella* Cham. 1873	x	
559	**Lyonetiidae**	*Bucculatrix coronatella* Clem. 1860	x	
620	**Gracillariidae**	*Caloptilia packardella* Cham. 1872	x	
859	**Oecophoridae**	*Agonopteryx curvilineella* Beutenmuller 1889	x	
862		*Agonopteryx clemensella* Cham. 1876	x	
874.1		*Agonopteryx alstroemeriana* Cl. 1759	x	
882		*Agonopteryx robiniella* Pack. 1869	x	
951		*Machimia tentoriferella* Clem. 1860	x	
955		*Psilocorsis quercicella* Clem. 1860	x	
1014		*Antaeotricha leucillana* Zell. 1854	x	
1065		*Martyringa latipennis* Wlsm. 1882	x	
1129	**Elachistidae**	*Cosmiotes illectella* Clem. 1860	x	
1254	**Coleophoridae**	*Coleophora malivorella* Riley 1878	x	
1361		*Coleophora borea* Braun 1921	x	
1389		*Coleophora apicialbella* Braun 1920	x	
1420		*Duospina trichella* Bsk. 1908	x	
1490	**Cosmopterigidae**	*Cosmopteryx gemmiferella* Clem. 1860	x	
1508		*Stagmatophora sexnotella* Cham. 1878	x	
1515		*Limnaecia phragmitella* Staint. 1851	x	
1615		*Walshia miscecolorella* Cham. 1875	x	
1685	**Gelechiidae**	*Metzneria lappella* L. 1758	x	
1864		*Pseudochelaria walsinghami* Dietz 1900	x	
1985		*Gnorimoschema gallaeasterella* Kellicott 1878	x	
2093		*Chionodes mediofuscella* Clem. 1863	x	
2233		*Anacampsis conclusella* Wlk. 1864	x	
2277		*Dichomeris georgiella* Walk. 1866	x	
2295		*Dichomeris flavocostella* Clem. 1860	x	

2298		*Dichomeris juncidella* Clem. 1860	x
2306		*Dichomeris washingtoniella* Bsk. 1906	x
2366	**Plutellidae**	*Plutella xylostella* L. 1758	x
2707	**Tortricidae**	*Bactra verutana* Zell. 1875	x
2749		*Eumarozia malachitana* Zell. 1875	x
2791		*Olethreutes exoletus* Zell. 1875	x
2794		*Olethreutes quadrifidus* Zell. 1875	x
2800		*Olethreutes nigrana* Heinr. 1923	x
2806		*Olethreutes ochrosuffusana* Heinr. 1923	x
2838		*Olethreutes coruscana* Clem. 1860	x
2861		*Hedya ochroleucana* Frolich 1828	x
2863		*Hedya chionosema* Zell. 1875	x
2927		*Phaneta ochrocephala* Wlsm. 1895	x
2936		*Phaneta tomonana* Kft. 1907	x
3051		*Eucosma glomerana* Wlsm. 1879	x
3110		*Eucosma gomonana* Kft. 1907	x
3120		*Eucosma derelecta* Heinr. 1929	x
3122		*Eucosma wandana* Kft. 1907	x
3127		*Eucosma sombreana* Kft. 1905	x
3169		*Pelochrista womonana* Kft. 1907	x
3172		*Epiblema strenuana* Wlk. 1863	x
3186		*Epiblema scudderiana* Clem. 1860	x
3233		*Proteoteras crescentana* Kft. 1907	x
3264		*Gretchena amatana* Heinr. 1923	x
3359		*Ancylis metamelana* Wlk. 1863	x
3375		*Ancylis divisana* Wlk. 1863	x
3404		*Dichrorampha simulana* Clem. 1860	x
3417		*Talponia plummeriana* Bsk. 1906	x
3425		*Sereda tautana* Clem. 1865	x
3439		*Grapholita interstinctana* Clem. 1860	x
3494		*Cydia latiferreanus* Wlsm. 1879	x
3503		*Croesia semipurpurana* Kft. 1905	x

(Continued)

Appendix I. (Continued)

Hodge Number	Family	Species Name	Butler County Record	Ohio State Record
3517		*Acleris subnivana* Wlk. 1863	x	
3622		*Argyrotaenia juglandana* Fern. 1879	x	
3648		*Archips argyrospila* Wlk. 1863	x	
3688		*Ptycholoma peritana* Clem. 1860	x	
3809		*Aethes argentilimitana* Rob. 1869	x	
3810		*Aethes atomosana* Bsk. 1907	x	
3870	**Hesperiidae**	*Epargyreus clarus* Cram. 1775		
3910		*Thorybes pylades* Scudder 1870		
3932		*Staphylus hayhurstii* Edw. 1870		
3945		*Erynnis icelus* S. & -B. 1870		
3947		*Erynnis juvenalis* F. 1793		
3977		*Pholisora catullus* F. 1793		
3993		*Nastra lherminier* Latr. 1824		
4004		*Ancyloxypha numitor* F. 1793		
4012		*Thymelicus lineola* Ochs. 1808		
4013		*Hylephila phyleus* Drury 1773		
4036		*Polites coras* Cram. 1775		
4041		*Polites themistocles* Latr. 1824		
4047		*Wallengrenia egeremet* Scudder 1864		
4048		*Pompeius verna* Edw. 1870		
4051		*Atrytone delaware* Edw. 1863		
4059		*Poanes hobomok* Harr. 1862		
4060		*Poanes zabulon* B. & -L. 1834		
4157	**Papilionidae**	*Battus philenor* L. 1771		
4159a		*Papilio polyxenes asterius* Stoll 1782		
4170		*Papilio cresphontes* Cram. 1777		
4176		*Papilio glaucus* L. 1758		
4181		*Papilio troilus* L. 1758		
4197	**Pieridae**	*Pieris rapae* L. 1758		

4209		*Colias philodice* Godt. 1819	
4210		*Colias eurytheme* Bdv. 1852	
4251a	**Lycaenidae**	*Lycaena phlaeas americana* Harr. 1862	
4282a		*Satyrium calanus falacer* Godt. 1824	
4336a		*Strymon melinus humuli* Harr. 1841	
4361		*Everes comyntas* Godt. 1824	
4363a		*Celastrina ladon ladon* Cram. 1780	
4410	**Libytheidae**	*Libytheana bachmanii bachmanii* Kirtland 1851	
4420	**Nymphalidae**	*Polygonia interrogationis* F. 1798	
4421		*Polygonia comma* Harr. 1824	
4432		*Nymphalis antiopa* L. 1758	
4434		*Vanessa virginiensis* Drury 1773	
4435		*Vanessa cardui* L. 1758	
4437a		*Vanessa atalanta rubria* Fruhstorfer 1909	
4440		*Junonia coenia* Hubner 1822	
4447		*Euptoieta claudia* Cram. 1775	
4450		*Speyeria cybele* F. 1775	
4451		*Speyeria aphrodite* F. 1787	
4522b		*Limenitis arthemis astyanax* F. 1775	
4465		*Boloria bellona* F. 1775	
4481		*Phyciodes tharos* Drury 1773	
4523		*Limenitis archippus* Cram. 1776	
4557		*Asterocampa celtis* B. & -L. 1835	
4562.1		*Asterocampa clyton* B. & -L. 1835	
4568.1		*Enodia anthedon* A. H. Clark 1936	
4578		*Megisto cymela* Cram. 1777	
4587b		*Cercyonis pegala alope* F. 1793	
4614		*Danaus plexippus* L. 1758	
4639	**Zygaenidae**	*Pyromorpha dimidiata* H.-S. 1854	x
4661	**Limacodidae**	*Packardia elegans* Pack. 1864	x
4716	**Crambidae**	*Scoparia biplagialis* Wlk. 1966	x

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Appendix I. (Continued)

Hodge Number	Family	Species Name	Butler County Record	Ohio State Record
4755		*Synclita obliteralis* Wlk. 1859	x	
4895		*Chalcoela inphitalis* Wlk. 1859	x	
4945		*Crocidophora tuberculalis* Led. 1863	x	
4962		*Hahncappsia marculenta* G. & R. 1867	x	
4975		*Achyra rantalis* Gn. 1854	x	
5018		*Pyrausta demantrialis* Druce 1895	x	
5142		*Diacme elealis* Wlk. 1859	x	
5176		*Anageshna primordialis* Dyar 1907	x	
5182		*Blepharomastix ranalis* Gn. 1854	x	
5435		*Fissicrambus mutabilis* Clem. 1860	x	
5464		*Urola nivalis* Drury 1773	x	
5500		*Xubida panalope* Dyar 1917	x	
5552	**Pyralidae**	*Galasa nigrinodis* Zell. 1873	x	
5579		*Epipaschia zelleri* Grt. 1876	x	
5659		*Acrobasis palliolella* Rag. 1887	x	
5661		*Acrobasis juglandis* LeBaron 1872	x	
5669		*Acrobasis stigmella* Dyar 1908	x	
5745		*Glyptocera consobrinella* Zell. 1872	x	
5803		*Nephopterix celtidella* Hulst. 1890	x	
5926		*Canarsia ulmiarrosorella* Clem. 1860	x	
5944		*Homoeosoma deceptorium* Heinr. 1956	x	
5997		*Euzophera ostricolorella* Hulst. 1890	x	
5999		*Eulogia ochrifrontella* Zell. 1876	x	
6007		*Vitula edmandsii* Pack. 1864	x	
6044		*Peoria tetradella* Zell. 1872	x	x
6092	**Pterophoridae**	*Genia tenuidactyla* Fitch 1854	x	
6186		*Hellinsia inquinatus* Zell. 1873	x	
6214		*Hellinsia glenni* Cashatt 1972	x	
6326	**Geometridae**	*Semiothisa aemulataria* Wlk. 1861	x	

6342		*Semiothisa bisignata* Wlk. 1866	x
6353		*Semiothisa multilineata* Pack. 1873	x
6360		*Semiothisa quadrinotaria* H.-S. 1855	x
6362		*Semiothisa continuata* Wlk. 1862	x
6584		*Anacamptodes humaria* Gn. 1857	x
6662		*Paleacrita vernata* Peck. 1795	x
6737		*Euchlaena trigrinaria* Gn. 1857	x
6763		*Nacophora quernaria* J. E. Smith 1797	x
6892		*Lambdina pellucidaria* G. & R. 1867	x
6894		*Lambdina fervidaria* Hbn. 1827	x
7046		*Nemoria bistriaria* Hbn. 1818	x
7114		*Idaea demissaria* Hbn. 1831	x
7132		*Pleuroprucha insulsaria* Gn. 1857	x
7197		*Eulithis gracilineata* Gn. 1857	x
7399		*Euphyia unangulata* Haw. 1809	x
7416		*Orthonama centrostrigaria* Woll. 1858	x
7698	**Lasiocampidae**	*Malacosoma disstria* Hbn.1820	
7701		*Malacosoma americanum* F. 1793	
7903	**Nodontidae**	*Datana angusii* G. & R. 1866	
8072	**Arctiidae**	*Cisthene packardii* Grt. 1863	x
8123		*Holomelina ferruginosa* Wlk. 1854	x
8133		*Spilosoma latipennis* Stretch 1872	
8118		*Holomelina opella* Grt. 1863	x
8314	**Lymantriidae**	*Orgyia definita* Pack. 1864	x
8340	**Noctuidae**	*Zanclognatha lituralis* Hbn. 1818	x
8345		*Zanclognatha laevigata* Grt. 1872	x
8353		*Zanglognatha ochreipennis* Grt. 1872	x
8355		*Chytolita morbidalis* Gn. 1854	x
8357		*Hormisa absorptalis* Wlk. 1859	x
8362		*Phalaenostola metonalis* Wlk. 1859	x
8384.1		*Renia flavipunctalis* Gey. 1832	x

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Appendix I. (Continued)

Hodge Number	Family	Species Name	Butler County Record	Ohio State Record
8393		*Lascoria ambigualis* Wlk. 1866	x	
8401		*Redectis vitrea* Grt. 1878	x	
8404		*Rivula propinqualis* Gn. 1854	x	
8421		*Hypenodes fractilinea* Sm. 1908	x	
8500		*Metalectra quadrisignata* Wlk. 1858	x	
8509		*Arugisa latiorella* Wlk. 1863	x	
8881		*Abrostola urentis* Gn. 1852	x	
8962		*Paectes abrostoloides* Gn. 1852	x	
9003		*Tripudia quadrifera* Zell. 1874	x	
9037		*Hyperstrotia pervertens* B. & McD. 1918	x	
9066		*Leuconycta lepidula* Grt. 1874	x	
9184		*Colocasia flavicornis* Sm. 1884	x	
9245		*Acronicta haesitata* Grt. 1882	x	
9249		*Acronicta increta* Morr. 1974	x	
9251		*Acronicta retardata* Wlk. 1861	x	
9257		*Acronicta impleta* Wlk. 1856	x	
9507		*Papaipema limpida* Gn. 1852	x	
9626		*Trachea delicata* Grt. 1874	x	
9647		*Athetis miranda* Grt. 1873	x	
9650		*Anorthodes tarda* Gn. 1852	x	
9915		*Lithophane grotei* Riley 1882	x	
9916		*Lithophane unimoda* Lint. 1878	x	
9933		*Eupsilia vinulenta* Grt. 1864	x	
9950		*Chaetaglaea sericea* Morr. 1874	x	
10405		*Lancinipolia lorea* Gn. 1852	x	
10445		*Leucania linda* Franc. 1952	x	
10585		*Orthodes crenulata* Butler 1890	x	
10651		*Agrotis venerabilis* Wlk. 1857	x	
10674		*Feltia subgothica* Haw. 1809	x	
10675		*Feltia tricosa* Lint. 1874	x	
10915		*Peridroma saucia* Hbn. 1808	x	