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Inventory of the Nolidae, Erebidae, and Noctuidae (Insecta: Lepidoptera) of Plummers Island, Maryland

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Abstract.—From 1902–2005 six species of Nolidae, 88 species of Erebidae, and 118 species of Noctuidae have been recorded from Plummers Island, Montgomery County, Maryland. Extensive collecting conducted from 1998–2005 resulted in five species of Nolidae, 70 species of Erebidae, and 88 species of Noctuidae. Only the Nolidae had sufficient specimens collected from 1902–1930 to compare with collections taken from 1998–2005. Five species were present from 1902–1930, and five from 1998–2005 with no change in species richness. A 20% species turnover was noted, with one extinction and one colonization. Owing to probable under-sampling from 1902–1930, the Erebidae and Noctuidae show a 37% and a 32% increase, respectively. This is contrary to other studies at Plummers Island, which showed a decrease in species richness. Species accumulation curves were based only on material collected from 1998–2005. Both abundance and incidence-based estimators were used to predict six species of Nolidae, 79–102 species of Erebidae, and 101–135 species of Noctuidae. Of the total of 212 species for all three families, 75.9% of the species were represented by 10 or fewer specimens. A checklist of the Nolidae, Erebidae, and Noctuidae, and their monthly abundances from 1902–2005 is provided.

Key words.—Species richness, Potomac River, historical records, Washington Biologists' Field Club, Chesapeake and Ohio Canal National Historical Park.

Faunal inventories are necessary to establish baseline data to evaluate change in ecosystems, species abundance and richness, and invasion and extinction rates. After a baseline inventory has been completed, a monitoring protocol should be established to evaluate faunal changes.

Plummers Island is within the Chesapeake and Ohio (C&O) Canal National Historical Park and has been an area of extensive collecting by members of the Washington Biologists' Field Club since its establishment in 1901. Historical data from the site has shown conspicuous declines in species richness for two groups of insects, ground beetles (Coleoptera: Carabidae; Erwin 1981) and leafroller moths (Lepidoptera: Tortricidae; Brown 2001). The Nolidae, Erebidae, and Noctuidae were first collected from Plummers Island in 1902. The Nolidae had sufficient historic material to make valid comparisons with recent collections. The Erebidae and Noctuidae were not sufficiently collected during the historical period (1902–1930) to make valid comparisons with recent

collections. Therefore, the results of this paper establish the baseline data for the Erebidae and Noctuidae of Plummers Island.

The higher classification of the Noctuidae recently was revised. Early classifications placed the Nolidae, Erebidae, and Noctuidae within the Noctuidae (Franclemont & Todd 1983, Kitching 1984). The Nolidae were recognized as a separate family and characterized by the elongate, bar-shaped, retinaculum in the male, which is similar to that of Arctiidae (Kitching & Rawlins 1999). The Erebidae were recently reestablished (Fibiger & Lafontaine 2005) to include the quadrid subfamilies in which species with hindwing vein M3 is attached to vein Cu1, resulting in that vein appearing 4-branched. The Noctuidae include the trifid subfamilies in which species have vein M3 in the hindwing either absent or reduced and not attached to vein Cu1, resulting in that vein appearing 3-branched. The checklist of species uses this new classification and provides the monthly abundance for all samples from 1902–2005.

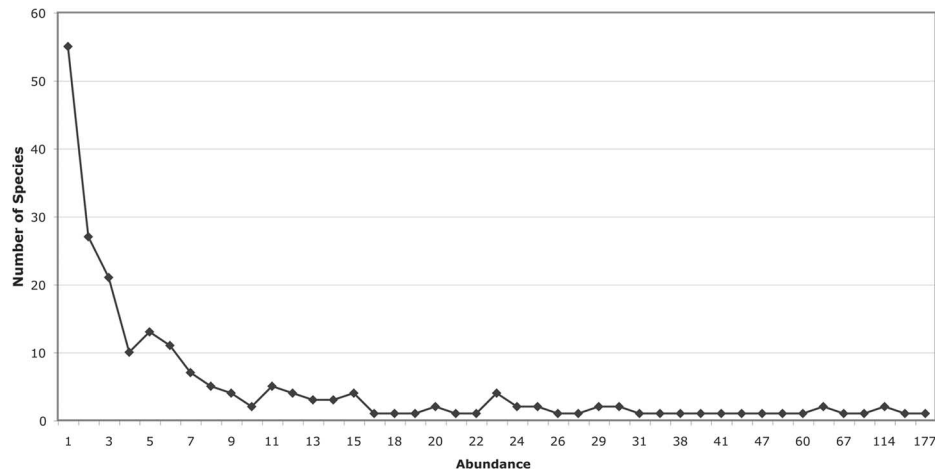


Fig. 1. Rarity. Combined incidence of species rarity for the Nolidae, Erebididae, and Noctuidae, showing number of species (Y-axis) that are represented by number of specimens, or abundance (X-axis).

Materials and Methods

Study site.—Plummers Island is located on the northern shore of the Potomac River in Montgomery County, Maryland, east of Highway I-495 (Capitol Beltway), 14.5 km northwest of The Mall, Washington, D.C. The study area includes the 3.60 hectares of the Island itself and 15.58 hectares of the adjacent Maryland shore (Erwin 1981). Several collecting sites were located on both Plummers Island and the adjacent Maryland shore. The recorded coordinates are 38°58.0'N, 077°10.0'W for Plummers Island and 38°59.4'N, 077°10.3'W for the adjacent Maryland shore.

Collecting methods.—Ultraviolet light traps and UV lights with a sheet were used to collect the recent material. The traps employed a collecting chamber with vanes set into a funnel which housed either an 8- or 15-watt UV light. A white sheet was suspended between two trees and a 15-watt UV light was hung in front of the sheet, and specimens were hand picked from the sheet.

Collections.—Two collections were used in this study, the historical collection (1902–1930) and the recent collection (1998–2005) (see Appendix). Both collections are housed in the National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C.

Data.—All specimens from Plummers Island were given a unique number in the form of a bar-code label (USNM ENT 00000000). All data associated with these collections are in a database in FileMaker® format.

The EstimateS program (Colwell 2005) uses a sample by species abundance matrix. The sample was defined as each unique collecting date from 1998 to 2005, with the number of specimens collected on that date, or sample, for each species. There were 27 samples used to compute the species richness estimators

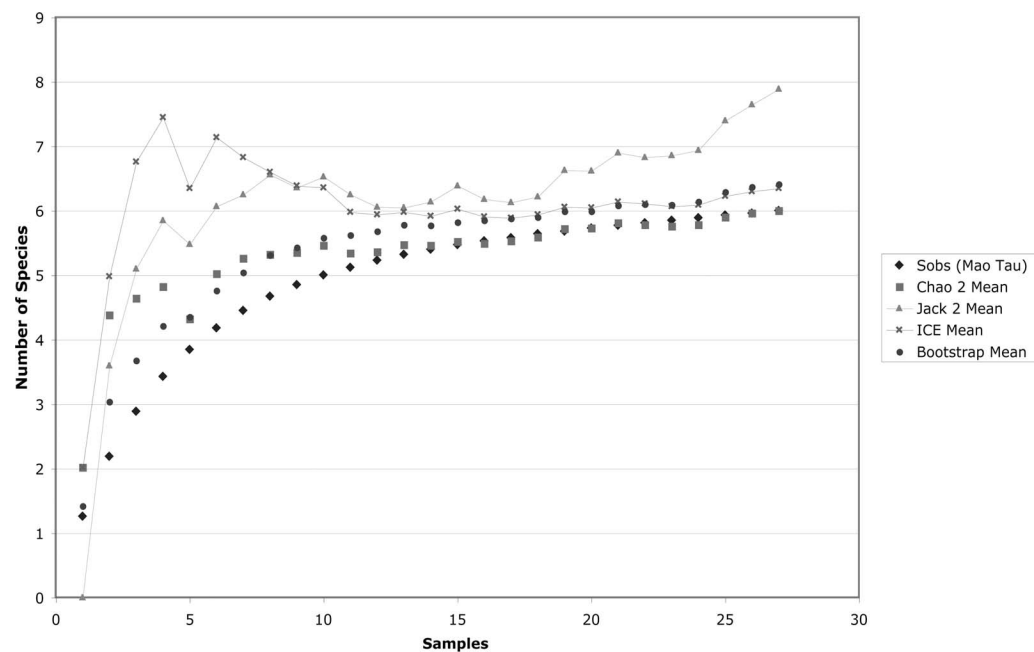
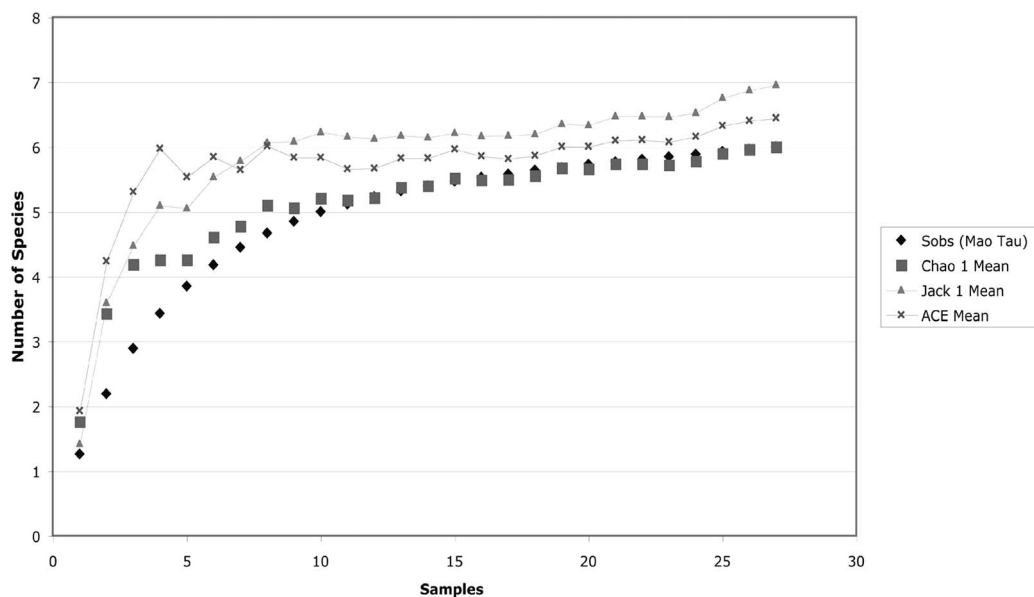
in the Nolidae, 79 for the Erebididae, and 81 for the Noctuidae.

Data analysis.—Species richness estimators were divided into two groups, those that use abundance data, or counts of individuals for each species in each sample; and incidence data, or the occurrence (presence/absence) of each species in each sample. Abundance based species richness estimators used were Chao 1, Jackknife 1, and ACE. Incidence based estimators used were Chao 2, Jackknife 2, ICE, and Bootstrap. All estimators were produced using EstimateS (Colwell 2005). For computing Chao 2 in both the Erebididae and Noctuidae the classic equation was used instead of the bias-corrected equation because Chao's estimated CV for incidence distribution was greater than 0.5. Explanations and equations that produced these species richness estimators are found in Appendix B of the EstimateS Users Guide (Colwell 2005).

Brown (2001) compared the historical and recent Tortricidae fauna of Plummers Island and showed that the species richness had decreased over time. In this study, only the Nolidae had a large enough historical sample to do a similar comparison. The percent change in species richness (R) was calculated by $R = (b - d)/b$, where “b” is the number of species from the historical period and “d” is the number of species from the recent collecting (Brown 2001). Species turnover (T) was calculated by $T = (e + c)/(b + d)$, where “e” is the number of apparent extinctions, “c” is the number of apparent colonizations, “b” is the number of species present during the historical period, and “d” is the number of species present during the recent collecting.

Results

Species rarity.—All families are combined in Fig. 1 to illustrate the rarity of species in a sample, where



Figs. 2, 3. Estimators for Nolidae. 2, Abundance-based species richness estimators; 3, Incidence-based species richness estimators.

the number of species represented by a few individuals predominates in the study area. The combined number of species of Nolidae (6), Erebidae (88), and Noctuidae (118) is 212. Of these 212 species, 161 or 75.9% are represented by 10 or fewer specimens.

Species richness.—Six species of Nolidae have been recorded from Plummers Island. Both the abun-

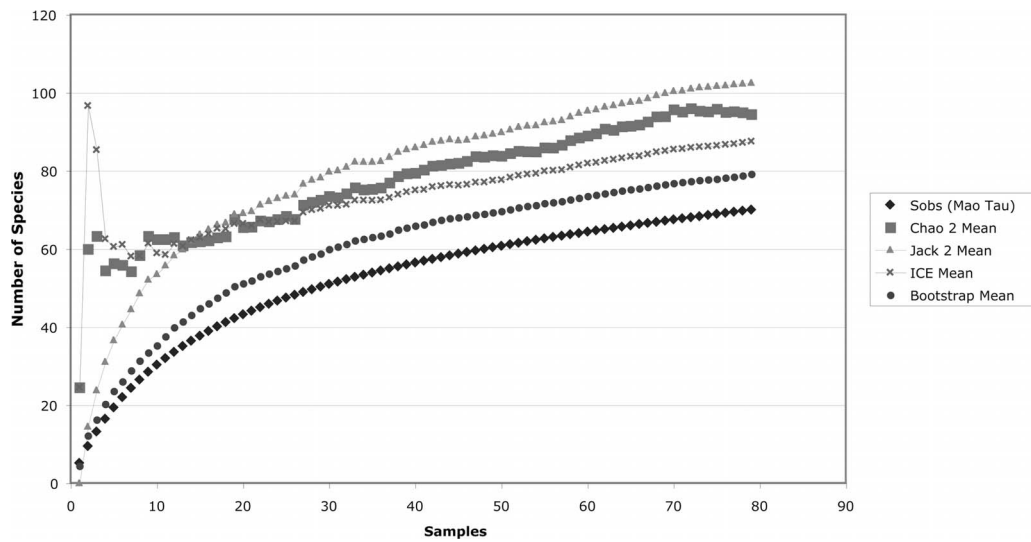
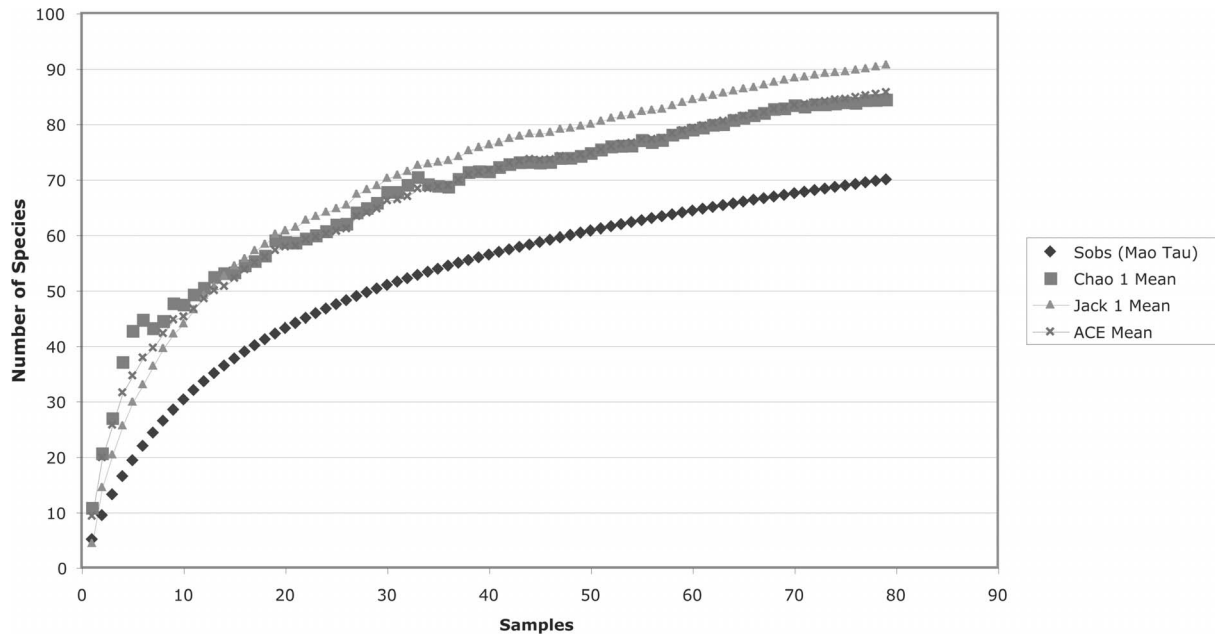
dance-based (Fig. 2, Table 1) and incidence-based (Fig. 3, Table 2) estimators predict a species richness of six. The species accumulation curves (Figs. 2, 3) reach an asymptote. Chao 1 and Chao 2 accurately predicted the number of observed species, and the other estimators predict from 76.0% to 94.5% of the observed number of species.

Table 1.—Abundance based species richness estimators and percent of observed species (S_{obs}) in the Nolidae.

	S_{obs}	Chao 1	Jackknife 1	ACE
S_{obs}	6	6	6.96	6.45
% of S_{obs}	100	100	86.2	93.0

Table 2.—Incidence based species richness estimators and percent of observed species (S_{obs}) in the Nolidae.

	S_{obs}	Chao 2	Jackknife 2	ICE	Bootstrap
S_{obs}	6	6	7.89	6.35	6.41
% of S_{obs}	100	100	76.0	94.5	93.6



Figs. 4, 5. Estimators for Erebidæ. 4, Abundance-based species richness estimators for the Erebidæ; 5, Incidence-based species richness estimators for the Erebidæ.

Overall, 88 species of Erebidæ have been collected on Plummers Island, with 70 species now present. The species accumulation curves for the present fauna (Figs. 4, 5) show the estimated species (Tables 3, 4) for Plummers Island. The abundance-based estimators predict an extant fauna of between 77–82 species (Fig. 4, Table 3). The incidence-based estimators predict an extant fauna of between 79–102 species

(Fig. 5, Table 4). None of the accumulation curves reached an asymptote (Figs. 4, 5).

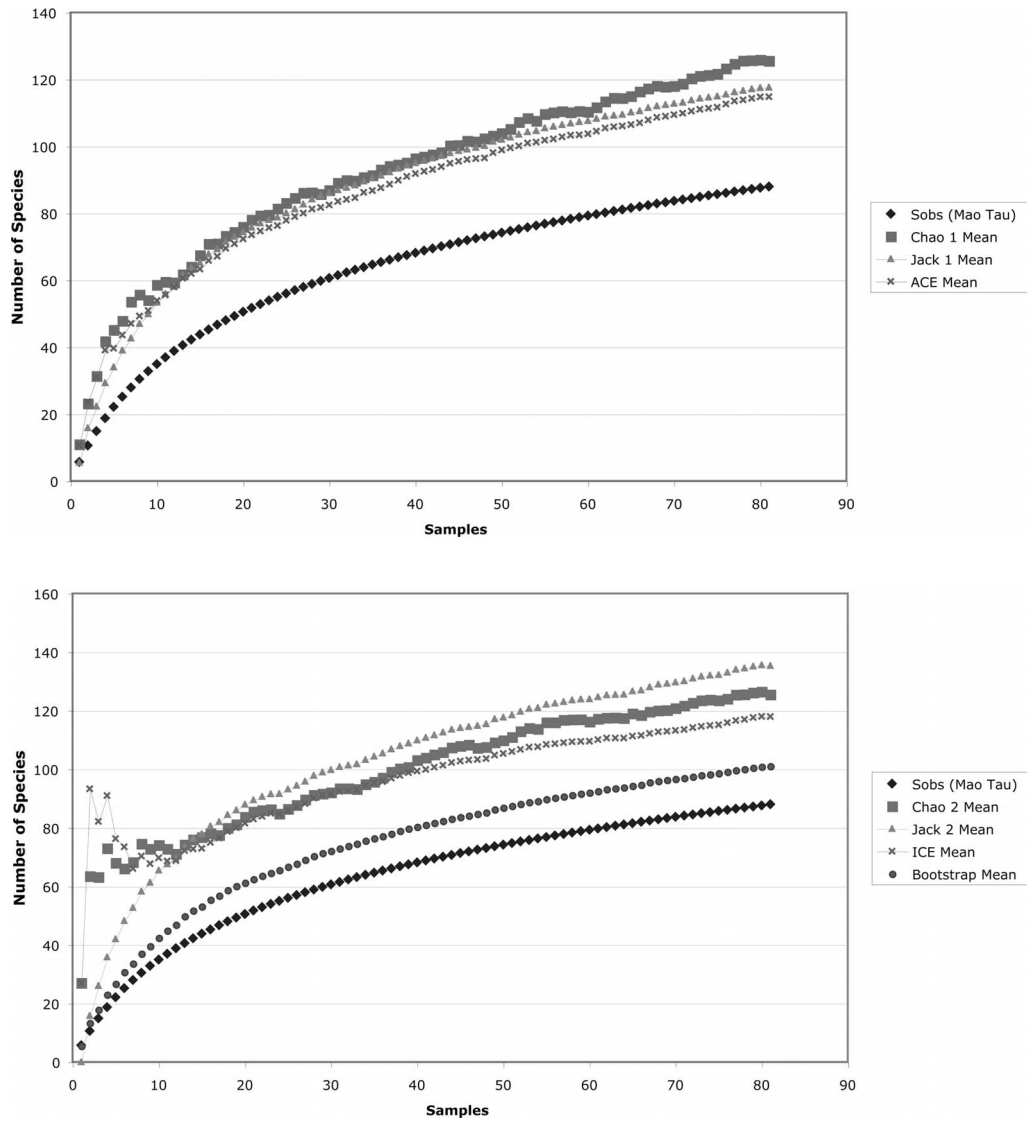
Overall, 118 species of Noctuidæ have been collected on Plummers Island, with 88 species now present. The species accumulation curves for the present fauna (Figs. 6, 7) show the estimated species (Tables 5, 6) for Plummers Island. The abundance-based estimators predict an extant fauna of between 114–125

Table 3.—Abundance based species richness estimators and percent of observed species (S_{obs}) in the Erebidæ.

	S_{obs}	Chao 1	Jackknife 1	ACE
S_{obs}	70	84.45	90.73	85.75
% of S_{obs}	100	82.9	77.2	81.6

Table 4.—Incidence based species richness estimators and percent of observed species (S_{obs}) in the Erebidæ.

	S_{obs}	Chao 2	Jackknife 2	ICE	Bootstrap
S_{obs}	70	94.5	102.54	87.58	79.2
% of S_{obs}	100	74.1	68.3	79.9	88.4



Figs. 6, 7. Estimators for Noctuidae. 6, Abundance-based species richness estimators for the Noctuidae; 7, Incidence-based species richness estimators for the Noctuidae.

species (Fig. 6, Table 5). The incidence-based estimators predict an extant fauna of between 101–135 species (Fig. 7, Table 6). None of the accumulation curves reached an asymptote (Figs. 6, 7).

Collecting effort.—The Nolidae is the only family in which there was sufficient collecting during the historical period (1902–1930) to be able to make a faunal comparison with the recent collecting (1998–2005). During the historical period, 37 specimens and 5 species were collected; recent collecting produced 19 specimens and 5 species (Table 7).

Table 5.—Abundance based species richness estimators and percent of observed species (S_{obs}) in the Noctuidae.

	S_{obs}	Chao 1	Jackknife 1	ACE
S_{obs}	88	125.56	117.63	114.81
% of S_{obs}	100	70.1	74.8	76.6

The Erebidae and Noctuidae were not collected adequately during the historical period (1902–1930) to make faunal comparisons with the recent collecting. A total of 146 specimens and 48 species of Erebidae were collected during the historical period, and a total of 821 specimens and 70 species were recently collected (Table 8). In the Noctuidae, 165 specimens and 57 species were collected during the historical period, and a total of 1140 specimens and 84 species were collected recently (Table 9).

Species change and turnover.—In the Nolidae on

Table 6.—Incidence based species richness estimators and percent of observed species (S_{obs}) in the Noctuidae.

	S_{obs}	Chao 2	Jackknife 2	ICE	Bootstrap
S_{obs}	88	125.5	135.33	117.98	101.07
% of S_{obs}	100	70.1	65.0	74.6	87.1

Table 7.—Comparison of number of specimens and species collected during the historical periods (1902–1930 and 1960–1980) and recent collecting (1998–2005) in the Nolidae.

	1902–1930	1960–1980	1998–2005
Specimens	37	6	19
Species	5	1	5

Plummers Island, there was no change in species richness and a 20% species turnover. There was one extinction [*Roeselia minuscula* (Zeller)] and one colonization [*Baileya levitans* (Smith)], with five species present in both the historical period and during recent collecting.

Probably owing to the lack of comprehensive collecting of Erebididae and Noctuididae during the historical period, both of these families showed an increase in species richness. Erebididae had a 37% increase and Noctuididae a 32% increase.

Phenology.—All five species of Nolidae occur at Plummers Island in May (Fig. 8). The Erebididae peaked in July with 53 species (Fig. 9) and the Noctuididae peaked in August with 54 species (Fig. 10).

Discussion

The number of species represented by 10 or fewer specimens at Plummers Island was 75.9%. In similar, but more intensive studies at Great Smoky Mountains National Park (Tennessee and North Carolina) and in George Washington and Monongahela National Forests (West Virginia) (Butler et al. 2001), this number was 53.3% and 39.9%, respectively. The number of specimens collected measured collecting effort. The more specimens that were collected results in a perception of declining rarity. The total number of specimens collected at Plummers Island was 2489, at Great Smoky Mountains National Park it was 8930, and in the National Forests of West Virginia it was 65,115.

Species richness estimators are used to estimate the fauna of an area at the time of collecting and do not include historical data. The species accumulation curve for the Nolidae reached an asymptote with a total of six species (Figs. 2, 3). The Noctuididae and Erebididae have not reached an asymptote (Figs. 4–7). This indicates that collecting needs to continue at Plummers Island. As more collecting is conducted at Plummers Island, the species richness should reach an asymptote for the Erebididae and Noctuididae. By employing different methods of collecting, such as Malaise traps and baiting, species that are not readily attracted to blacklight may be collected. Each collecting method should reach species richness asymptotes independently. By combining all methods, a higher total number of species would be expected than by any single method.

Table 8.—Comparison of number of specimens and species collected during the historical period (1902–1930 and 1960–1980) and recent collecting (1998–2005) in the Erebididae.

	1902–1930	1960–1980	1998–2005
Specimens	146	66	821
Species	44	23	70

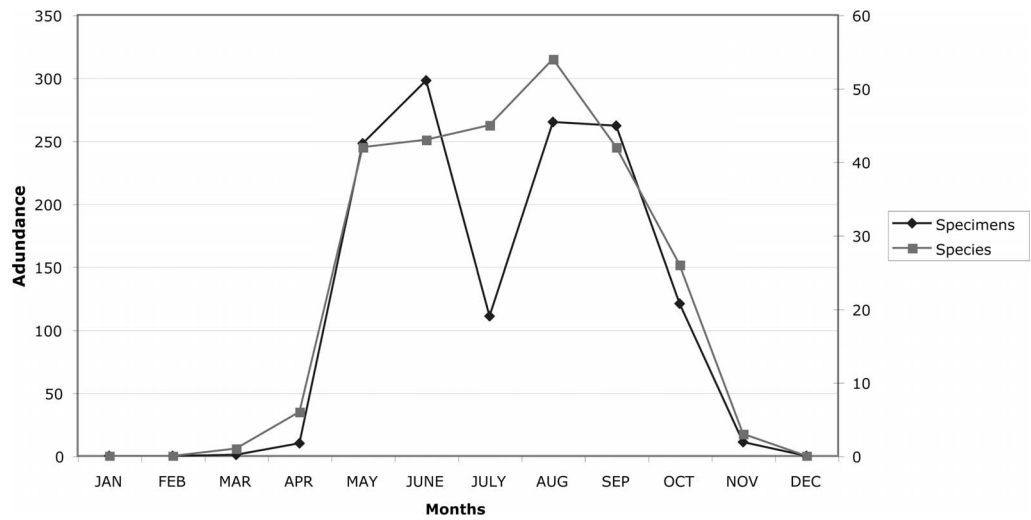
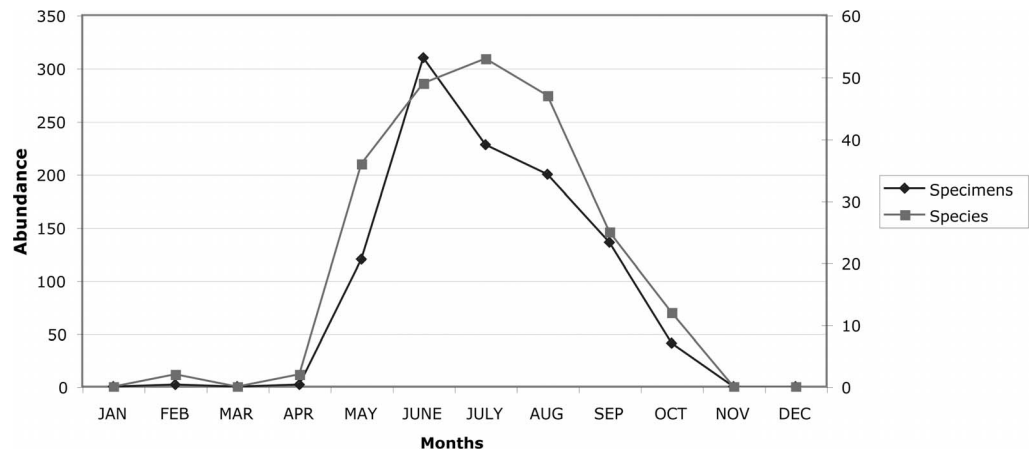
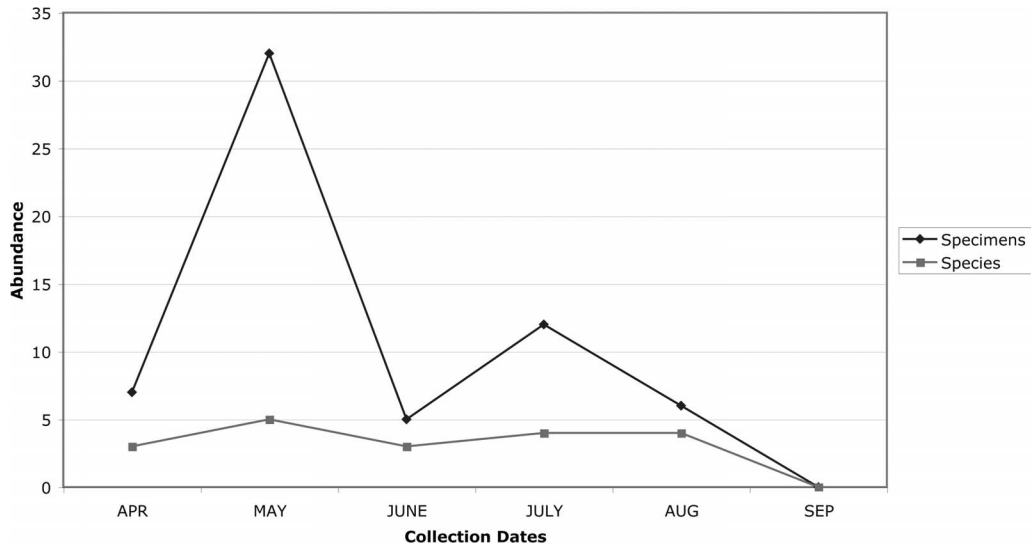
The total number of species recorded from Plummers Island is 88 Erebididae and 118 Noctuididae. The recent fauna consists of 70 species of Erebididae and 88 Noctuididae. I have not found any studies that have used historical data in estimating species richness from a site. It was difficult to compare samples of historic data with data recently collected. Samples were considered “collecting dates,” and with the historical specimens many dates were either missing or only the month and/or year were available. Because of the paucity of specimens compared with recent collections, and lack of collecting dates of some historic data, this study will establish the inventory baseline for Plummers Island Nolidae, Erebididae, and Noctuididae. Therefore, the species richness estimators were used to predict the present fauna on Plummers Island. These data can be used in the future to assess possible faunal and ecological changes on Plummers Island.

Which estimator does the best job of predicting the total fauna of an area? This question cannot be answered because it can vary from group to group and sample to sample. By using the overall species richness as a possible maximum number of species on Plummers Island, the Erebididae have 88 species. In the abundance-based estimators the Chao 1 and ACE predictions are low, and Jackknife 1 predicts 90 species, which is very close to the overall number (Table 3). However, in the Noctuididae there are 118 species, and the Jackknife 1 and ACE predictions are low, and Chao 1 predicts 125 species which is also quite close to the overall number (Table 4). As more samples are added, the number of singletons and doubletons can vary, thus changing the species richness predictions and which estimator will be the most accurate. It is necessary to utilize a variety of estimators to obtain an accurate prediction. As the accumulation curve begins to flatten or reach an asymptote, species richness estimates will become increasingly accurate.

What pattern do the incidence-based estimators show? In the Erebididae only the Bootstrap estimator

Table 9.—Comparison of number of specimens and species collected during the historical period (1902–1930 and 1960–1980) and recent collecting (1998–2005) in the Noctuididae.

	1902–1930	1960–1980	1998–2005
Specimens	165	59	1140
Species	57	27	88



Figs. 8–10. Accumulated monthly abundance from 1902–2005. 8, Nolidae; 9, Erebidae; 10, Noctuidae.

predicts a low number of species. The closest estimator is ICE, which predicts 87 species, and the high is Jackknife 2 with 102. In the Noctuidae the Bootstrap and ICE estimators are low, Chao 2 is closest

with 125, and Jackknife 2 is high with 135 (Table 6). Again, neither family has a “best” estimator.

In order to make valid comparisons between the historical collections and the recent ones, there has

to be a similar collecting effort, or, as defined here, the total number of specimens collected. Only the small family Nolidae had sufficient specimens to make a valid comparison. There was no change in species richness of the Nolidae on Plummers Island with five species occurring during both periods. There was one extinction and one colonization, resulting in a 20% species turnover. In the Tortricidae (Brown 2001) there was a 17% reduction in species richness and a 54% species turnover. One of the possible reasons for this reduction in species richness and high turnover was the natural succession from an open juniper grassland with approximately 3 hectares of the adjacent north shore cleared for agriculture or timber. After the Washington Biologists' Field Club obtained Plummers Island in 1901, it was left to proceed in a natural state after about 1907. Currently, Plummers Island is homogeneous sub mature hickory-maple-oak woodland, with scattered tulip trees (*Liriodendron tulipifera* L., Magnoliaceae) and a scarce understory (Brown 2001). If sufficient collecting of the Erebidae and Noctuidae had been done during the historical period, it is likely that these families would have shown a decrease in species richness instead of increasing by 37% and 32%, respectively. The increase is due to increased collecting effort and not to ecological or environmental change.

In Erebidae species richness reaches its peak in July, even though abundance peaks in June (Fig. 9). This pattern also is true for Noctuidae with peak abundance in June and peak species richness in August (Fig. 10). These peaks could be the result of 1) collecting effort, or 2) the most common species in either family peaking in June. The numbers of sample dates were the same for May and June in the Erebidae, but June had 310 specimens and May only 120. Of the five most abundant species, the third and fifth most abundant had their peaks in June. Collecting effort could have affected the peak abundance in June for Erebidae. The numbers of sample dates were only one greater for May than June in the Noctuidae, with June having 298 specimens and May with only slightly fewer with 254. However, of the five most abundant species, the first and third most abundant had their peaks in June. The abundance of the most common species could account for the peak abundance in June for the Noctuidae.

There have been several state and local inventories of Noctuidae sensu lato, which can be compared with that of Plummers Island. In the following discussion Nolidae, Erebidae, and Noctuidae are all included in the Noctuidae sensu stricto.

Lists of the Lepidoptera have been compiled for several eastern states. For example, the number of Noctuidae species is 709 from Florida (Kimball 1965), 708 from Ohio (Rings et al. 1992), 682 from

Maryland (unpublished list), and 616 from Kentucky (Covell 1999).

Since the first collection of Noctuidae in 1902 from Plummers Island, there has been a total of 212 species recorded. Of these 212 species, 176 were collected from 1998–2005. Compared with other sites in the eastern United States, Plummers Island exhibits an average fauna. Several sites in Ohio have been surveyed, including Cedar Bog with 177 species (Metzler 1989), The Wilderness Center, Stark Co., with 242 species (Rings et al. 1987), Atwood Lake Park, Carroll and Tuscarawas Cos., with 213 species (Rings & Metzler 1988), Mohican State Forest and Mohican State Park, Ashland Co., with 221 species (Rings & Metzler 1989), Fowler Woods State Nature Preserve, Richland Co., with 223 species (Rings & Metzler 1990), Goll Woods State Nature Reserve, Fulton Co., with 209 species (Rings et al. 1991), and Beaver Creek State Park, Columbiana Co., with 298 species (Rings & Metzler 1992). Other studies include the George Washington National Forest, Virginia, and Monongahela National Forest, West Virginia, with a total of 222 species (Butler et al. 2001), and 243 species from Hutcheson Memorial Forest, Somerset Co., New Jersey (Moulding & Madenjian 1979). The most species rich site so far studied in the eastern United States is Great Smoky Mountains National Park (Tennessee and North Carolina) with 491 species of Noctuidae sensu lato (Pogue 2005). Several factors that influence species richness at various sites include collection effort, size of site, diversity of elevation, and species richness of flora.

Plummers Island is only a small portion of the C&O Canal National Historical Park that extends from Washington, D.C., to Cumberland, Maryland for a total of 184.5 miles along the Potomac River. Additional collecting along the entire length of the Canal could show how the Noctuidae fauna along a transect changes from the Coastal Plain, through the Piedmont, to the low mountains of western Maryland.

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Appendix

Checklist of the Nolidae, Erebidae, and Noctuidae of Plummers Island with abundances by month from 1902–2005. Species with an * denote monthly data not available.

	F	M	A	M	J	J	A	S	O	N	Total
Nolidae											
Nolinae											
<i>Meganola minuscula</i> (Zeller)			3	3			1				7
<i>Nola cereela</i> Bosc				1			4				5
<i>Nola triquetra</i> (Fitch)			3	6			1	1			11
Risobinae											
<i>Baileya australis</i> (Grote)			1	14	2	4	1				22
<i>Baileya levitans</i> (Smith)					1						1
<i>Baileya ophthalmica</i> (Guenée)				8	2	3	3				16
Erebidae											
Boletobiinae											
<i>Dyspyralis nigellus</i> (Strecker)						2					2
Calpinae											
Calpini											
<i>Calyptra canadensis</i> (Bethune)					3	1	2				6
<i>Hypsoropha hormos</i> Hübner				1		1					2
<i>Phyprosopus callitrichoides</i> Grote					1						1
<i>Plusiodonta compressipalpus</i> Guenée						3	1	2			6
Scoliopterygini											
<i>Scoliopteryx libatrix</i> (Linnaeus)				1	16	11					28
Catocalinae											
Catocalini											
<i>Catocala amatrix</i> (Hübner)							1		2		3
<i>Catocala cara</i> Guenée								1	1		2
<i>Catocala ilia</i> (Cramer)						1					1
<i>Catocala innubens</i> Guenée						2	1				3
<i>Catocala neogama</i> (J. E. Smith)							1				1
<i>Catocala palaeogama</i> Guenée								1			1
<i>Catocala piatrix</i> Grote						1	2	3			6
<i>Catocala ultronia</i> (Hübner)					3	2					5
<i>Catocala vidua</i> (J. E. Smith)								2			2
Euclidiini											
<i>Caenurgina crassicuscula</i> (Haworth)					6		1	4			11
<i>Caenurgina erechtea</i> (Cramer)						1					1
<i>Celiptera frustulum</i> Guenée	1			2	3		7	2			15
<i>Mocis latipes</i> (Guenée)					2						2
Melipotini											
<i>Melipotis jucunda</i> (Hübner)				1							1
<i>Phoberia atomaris</i> Hübner			1								1
Ophiusini											
<i>Allotria elonympha</i> (Hübner)					1						1
<i>Euparthenos nubilis</i> (Hübner)				1							1
<i>Parallelia bistriaris</i> Hübner				2	8	3	1		1		15
<i>Zale galbanata</i> (Morrison)	1			13	15	21	16				66
<i>Zale horrida</i> Hübner			1			1					2
<i>Zale lunata</i> (Drury)							1		1		2
<i>Zale unilineata</i> (Grote)				1							1
Panopodini											
<i>Panopoda carneicosta</i> Guenée					2	1	1				4
<i>Panopoda rufimargo</i> (Hübner)					3						3
Eubleminae											
Eublemini											
<i>Metalectra discalis</i> (Grote)				1	2						3
<i>Metalectra quadrisignata</i> (Walker)						2					2
<i>Ledaea perditalis</i> (Walker)				1	2	2		1			6
Pangraptini											
<i>Pangrapta decoralis</i> Hübner				1							1
Euteliinae											
<i>Eutelia pulcherrimus</i> (Grote)				1							1

Appendix Continued.

	F	M	A	M	J	J	A	S	O	N	Total
<i>Marathyssa inflicta</i> Walker						2					2
<i>Paectes occulatrix</i> (Guenée)				3	1	2	1				7
Herminiinae											
<i>Bleptina caradrinalis</i> Guenée				1			2	1			4
<i>Chytolita morbidalis</i> (Guenée)				4	17						21
<i>Chytolita petrealis</i> Grote				11	27	4	4	1			47
<i>Idia aemula</i> Hübner				7	4	6	44	9	8		38
<i>Idia americalis</i> (Guenée)				5	16	17	27	23	9		97
<i>Idia forbesi</i> (French)					20		3				23
<i>Idia julia</i> (Barnes & McDunnough)				3	21		5		4		33
<i>Idia lubricalis</i> (Geyer)					2	16	4	1			23
<i>Idia majoralis</i> (Smith)						2					2
<i>Idia n. sp.</i>				3	1						4
<i>Idia rotundalis</i> (Walker)					2		3				5
<i>Idia scobialis</i> (Grote)					2						2
<i>Lascoria ambiguus</i> Walker				8		7	5				20
<i>Macrochilo hypocritalis</i> Ferguson							1				1
<i>Macrochilo orciferalis</i> (Walker)				1			2				3
<i>Palthis asopialis</i> (Guenée)				1	22	45	27	36	10		141
<i>Phalaenophana pyramusalis</i> (Walker)				4	3	6	2				15
<i>Phalaenostola eumelusalis</i> (Walker)					5	3	7				15
<i>Phalaenostola larentioides</i> Grote				1	1	1	3		1		7
<i>Redectis vitrea</i> (Grote)				1	3	1	1	1			7
<i>Renia adspersigillus</i> (Bosc)				4	9	1	7	3	1		25
<i>Renia discoloralis</i> Guenée					1	5	4				10
<i>Renia factiosalis</i> (Walker)					1	10					11
<i>Renia flavipunctalis</i> (Geyer)						1					1
<i>Renia salusalis</i> (Walker)					2						2
<i>Renia sobrialis</i> (Walker)				1		1					2
<i>Tetanolita floridana</i> Smith				5	1	2	12	3			23
<i>Tetanolita mynesalis</i> (Walker)						3	3	4			10
<i>Zanclognatha cruralis</i> (Guenée)				8	53	5	1				67
<i>Zanclognatha jacchusalis</i> (Walker)						1					1
<i>Zanclognatha laevegata</i> (Grote)						1					1
<i>Zanclognatha lituralis</i> (Hübner)				7		4	3				14
<i>Zanclognatha obscuripennis</i> (Grote)				3	5	1	8	7	2		26
<i>Zanclognatha ochreipennis</i> (Grote)				1	2	2					5
<i>Zanclognatha pedipilalis</i> (Guenée)				1	3	1	3				8
<i>Zanclognatha protumnusalis</i> (Walker)								1			1
Hypeninae											
<i>Hypena abalienalis</i> (Walker)				1	1	1	1				4
<i>Hypena baltimoralis</i> (Guenée)				5	3	5	5	1			19
<i>Hypena deceptalis</i> (Walker)							1				1
<i>Hypena humuli</i> Harris					2	1					3
<i>Hypena madefactalis</i> (Guenée)				4	3	3	1				11
<i>Hypena manalis</i> (Walker)					3	2	3	3			11
<i>Hypena palparia</i> (Walker)						1	1				2
<i>Hypena scabra</i> (Fabricius)				2	3	2	2	21	1		31
Hypenodinae											
<i>Schrankia macula</i> (Druce)						1	2				3
Phytometrinae											
<i>Spargaloma sexpunctata</i> Grote					1	1	2	1			5
Rivulinae											
<i>Rivula propinquialis</i> Guenée					1	1	3	2			7
Scoleocampinae											
<i>Isogona tenuis</i> (Grote)					1	4	2				7
<i>Nigetia formosalis</i> Walker					1						1
<i>Scoleocampa liburna</i> (Geyer)					15	12					27
Noctuidae											
Acontiinae											
Acontini											
<i>Spragueia apicalis</i> (Herrich-Schaffer)						1					1

Appendix Continued.

	F	M	A	M	J	J	A	S	O	N	Total
<i>Spragueia leo</i> (Guenée)				1			1				2
<i>Tarachidia candefacta</i> (Hübner)				2							2
<i>Tarachidia erastroioides</i> (Guenée)					3	7	1				11
Acronictinae											
<i>Acronicta betulae</i> Riley							1				1
<i>Acronicta exilis</i> Grote				1		1					2
<i>Acronicta haesitata</i> (Grote)				1	6	2	2				11
<i>Acronicta hamamelis</i> Guenée							1				1
<i>Acronicta hasta</i> Guenée				1							1
<i>Acronicta interrupta</i> Guenée				1							1
<i>Acronicta laetifica</i> Smith				2		1					3
<i>Acronicta lithospila</i> Grote							1				1
<i>Acronicta modica</i> Walker				1							1
<i>Acronicta morula</i> Grote & Robinson				1				1			2
<i>Acronicta oblongata</i> J. E. Smith							1				1
<i>Acronicta ovata</i> Grote*											1
<i>Acronicta radcliffei</i> (Harvey)					1						1
<i>Acronicta retardata</i> (Walker)				1		1					2
<i>Acronicta rubricoma</i> Guenée						1	1				2
<i>Acronicta tristis</i> Smith*											1
<i>Acronicta vinnula</i> (Grote)			2			2					4
<i>Polygrammate hebraicum</i> Hübner							8				8
Agaristinae											
<i>Eudryas grata</i> (Fabricius)					4	4					8
<i>Eudryas unio</i> (Hübner)					1						1
Amphipyriinae											
<i>Amphipyra pyramidoides</i> Guenée						1	1	13	24	6	45
Condicinae											
Condicini											
<i>Condica vecors</i> (Guenée)				1	1	1		1			4
<i>Ogdoconta cinereola</i> (Guenée)								1			1
Leuconyctini											
<i>Leuconycta dipteroides</i> (Guenée)				2	2	1					5
Cuculliinae											
Cuculliini											
<i>Cucullia convexipennis</i> Grote & Robinson						1	2				3
Eustrotiinae											
<i>Hyperstrotia pervertens</i> (Barnes & McDunnough)				2	6		4				12
<i>Hyperstrotia villificans</i> (Barnes & McDunnough)					2	1	1				4
<i>Lithacodia muscosula</i> (Guenée)				8	22	8	27				65
<i>Lithacodia musta</i> (Grote & Robinson)				1	1	3	2	2			9
<i>Maliatthia synochitis</i> (Grote & Robinson)						1		1			2
<i>Ozarba aerea</i> Grote					1	8	5	4			18
<i>Pseudeustrotia carneola</i> (Guenée)				1	3	1		2			7
<i>Thioptera nigrofimbria</i> (Guenée)				1		1	3	1			6
Hadeninae											
Eriopygini											
<i>Homorthodes lindseyi</i> (Benjamin)					2		2				4
<i>Lacinipolia implicate</i> McDunnough							1	7			8
<i>Lacinipolia meditate</i> (Grote)								1			1
<i>Lacinipolia renigera</i> (Stephens)				10	11	1		8			30
<i>Orthodes crenulata</i> (Butler)				2	2		2				6
<i>Orthodes cynica</i> Guenée				77	99		1				177
<i>Orthodes goodelli</i> (Grote)				1	1						2
<i>Pseudorthodes vecors</i> (Guenée)				11	10	4	15				40
<i>Tricholita signata</i> (Walker)							2	1			3
Hadenini											
<i>Melanchra adjuncta</i> (Guenée)				1			1				2
<i>Polia detracta</i> (Walker)				3	2						5
<i>Spiramater grandis</i> (Guenée)					1						1

Appendix Continued.

	F	M	A	M	J	J	A	S	O	N	Total
Leucaniini											
<i>Leucania pseudargyria</i> Guenée					1						1
<i>Leucania ursula</i> (Forbes)				2				1			3
<i>Mythimna unipuncta</i> (Haworth)					5	2	2	3	1		13
Orthosiini											
<i>Morrisonia confuse</i> (Hübner)				1							1
<i>Orthosia garmani</i> (Grote)			3								3
<i>Orthosia rubescens</i> (Walker)				2							2
Tholerini											
<i>Nephalodes minians</i> Guenée								29			29
Heliothinae											
<i>Helicoverpa zea</i> (Boddie)								1	1		2
Noctuinae											
Agrotini											
<i>Agrotis gladiaria</i> Morrison									1		1
<i>Agrotis ipsilon</i> (Hugnagel)					2	4	13	5	2	2	28
<i>Euagrotis iliapsa</i> (Walker)								1			1
<i>Feltia herilis</i> (Grote)							2	51	3		56
<i>Feltia jaculifera</i> (Guenée)							1				1
<i>Feltia subgothica</i> (Haworth)							1	1			2
<i>Feltia tricola</i> (Lintner)							5	4			9
<i>Peridroma saucia</i> (Hübner)					2	2	1				5
Noctuini											
<i>Abagrotis alternate</i> (Grote)					15	6	8	7	6		42
<i>Agnorisma badinodis</i> (Grote)									29		29
<i>Cerastis tenebrifera</i> (Walker)		1	2	1							4
<i>Ochropleura implecta</i> Lafontaine				2		5	1	1			9
<i>Protolampra brunneicollis</i> (Grote)								1			1
<i>Pseudohermonassa bicarnea</i> (Guenée)								5			5
<i>Xestia c-nigrum</i> (Linnaeus)					1	1	10	2			14
<i>Xestia dolosa</i> Franclemont				24	46	3	24	16	1		114
<i>Xestia normanianus</i> (Grote)								7	2		9
<i>Xestia smithii</i> (Snellen)							1	25	4		30
Plusiinae											
Abrostolini											
<i>Abrostola urentis</i> Guenée					6	8	5	3			25
Argyrogrammatini											
<i>Argyrogramma verruca</i> (Fabricius)								1			1
<i>Pseudoplusia includens</i> (Walker)									2		2
Plusiini											
<i>Allagrapha aerea</i> (Hübner)					1	1		2			4
<i>Anagrapha falcifera</i> (Kirby)				1			1	1			3
<i>Autographa precationis</i> (Guenée)				1	3	2	2	1			9
<i>Megalographa biloba</i> (Stephens)		2									2
Psaphidinae											
Phosphilini											
<i>Phosphila miselioides</i> (Guenée)					1		1				2
<i>Phosphila turbulenta</i> Hübner				2	5		3		1	1	12
Stirinae											
Azenini											
<i>Azenia obtuse</i> (Herrich-Schäffer)					2	6	12				20
Stiriini											
<i>Basilodes pepita</i> Guenée						1	9	5			15
<i>Cirrhophanus triangulifer</i> Grote								3			3
Xyleninae											
Actinotiini											
<i>Nedra ramosula</i> (Guenée)				1				2			3
Apameini											
<i>Amphipoea velata</i> (Walker)				2	11						13
<i>Apamea cariosa</i> (Guenée)				1	1	3					5
<i>Apamea vulgaris</i> (Grote & Robinson)				2		1					3

Appendix Continued.

	F	M	A	M	J	J	A	S	O	N	Total
<i>Oligia exhausta</i> Smith					1						1
<i>Oligia modica</i> (Guenée)						1	1				2
<i>Papaipema arctivorens</i> Hampson							38	21	1		60
<i>Papaipema cataphracta</i> (Grote)									9		9
<i>Papaipema cerussata</i> (Grote)									1		1
<i>Papaipema furcata</i> (Smith)							1	15	9		25
<i>Papaipema inquaesita</i> (Grote & Robinson)									1		1
<i>Papaipema lysimachiae</i> Bird								1			1
<i>Papaipema polymniae</i> Bird						1					1
Balsini											
<i>Balsa tristrigella</i> (Walker)							1				1
Caradrinini											
<i>Anorthodes tarda</i> (Guenée)			1	70	5		36	2			114
Cosmiini											
<i>Ipimorpha pleonectusa</i> Grote						1					1
Elaphriini											
<i>Elaphria cornutinus</i> Saluke & Pogue						1					1
<i>Elaphria grata</i> Hübner				1		1	3	7	1		13
<i>Elaphria versicolor</i> (Grote)				2	2	2	1				7
<i>Galgula partita</i> Guenée					4	4	4	8	2		22
Phlogophorini											
<i>Chytonix palliatricula</i> (Guenée)				1	2	2	1				6
<i>Euplexia benesimilis</i> McDunnough				1		4	1				6
Prodeniini											
<i>Spodoptera frugiperda</i> (J. E. Smith)							1	5			6
<i>Spodoptera ornithogalli</i> (Guenée)						2	2	1	1		6
Xylenini											
<i>Agrochola bicolorago</i> (Guenée)									11	2	13
<i>Chaetagnela tremula</i> (Harvey)									3		3
<i>Eucirroedia pampina</i> (Guenée)								3	1		4
<i>Eupsilia morrisoni</i> (Grote)				1					2		3
<i>Lithophane bethunei</i> (Grote & Robinson)			1								1
<i>Metaxaglaea inulta</i> (Grote)									3		3