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An Overview of the Lepidoptera (Insecta) of Plummers Island, Maryland

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Abstract.—Based on the examination of approximately 8100 specimens of Lepidoptera in the collection of the National Museum of Natural History and a review of relevant literature, we document 836 species in 488 genera and 48 families from Plummers Island, Maryland. Although the Lepidoptera are probably the best studied insect order on Plummers Island, data from the Washington, D.C. area indicate that there likely are many more microlepidoptera and butterflies on the site that are yet to be documented. Most families that were sampled adequately both historically (1901–1920) and in recent years (1998–2005) show a reduction in species richness and considerable species turnover. However, interpretation of these data is difficult owing to differences in sampling techniques and sampling frequency over the last 100 years.

Key words.—Inventory, historical records, Chesapeake and Ohio Canal National Historical Park, Potomac River, Washington Biologist' Field Club, butterflies, moths.

Lepidoptera (butterflies and moths), which include about 13% (ca. 12,000 species) of the named insect species in North America (Nomina Insecta Nearctica 2005), are among the four largest orders of holometabolous insects, along with Coleoptera, Hymenoptera, and Diptera. Most lepidopterans are phytophagous or plant feeding in the larval stage, but a few specialize on fungus and/or detritus, and fewer still are predaceous (e.g., Powell 1980, Powell et al. 1998). Owing to their plant-feeding habits, many species are considered pests of crops, ornamental plants, and forest trees. Species such as the gypsy moth (*Lymantria dispar* Linnaeus), spruce budworm [*Choristoneura fumiferana* (Clemens)], and codling moth [*Cydia pomonella* (Linnaeus)] frequently elicit chemical and/or biological control measures that may have negative and long-term effects on many other biotic elements.

Complete inventories of the Lepidoptera of any state, county, or locality in North America are few,

although there are many in various stages of completion (Powell 1995). Published inventories of states or provinces include those for Florida (Kimball 1965), Kentucky (Covell 1999), Maine (Brower 1974, 1983, 1984), New Jersey (Smith 1910, Muller 1965–1976), New York (Forbes 1923–1960), and Ontario (Riotte 1992), although the last is incomplete for microlepidoptera. Ongoing efforts in California (Kelly Richers, pers. comm.) and Ohio (Eric Metzler, pers. comm.) also represent relatively thorough lists of Lepidoptera. At the local level, fairly complete inventories include Jones & Kimball's (1943) survey of Martha's Vineyard and Nantucket, Massachusetts; Proctor's (1946) list for Mount Desert Island, Maine; Powell's multi-year surveys of Big Creek in Monterey County, California (Powell 1995), and the California Channel Islands (e.g., Powell 1985, 1994; Powell & Wagner 1993); and Brown & Bash's (2000) inventory of Marine Corps Air Station Miramar, San Diego, California. While the inventory of the Lepi-

Table 1.—Number of species (and specimens) of each family of Lepidoptera collected on Plummers Island during the three periods of greatest activity from 1901–2005.

Family	Cumulative # spp.	# spp. 1901–1930	# spp. 1960–1980	# spp. 1990–2005
Acrolophidae	12 (331)	11 (108)	9 (29)	10 (194)
Amphisbatidae	4 (140)	3 (19)	4 (42)	4 (79)
Arctiidae	21 (252)	11 (30)	6 (14)	16 (208)
Autostichidae	2 (17)	1 (9)	1 (1)	1 (7)
Bombycidae	1 (5)	1 (1)	1 (2)	1 (2)
Choreutidae	1 (2)	1 (2)	0 (0)	0 (0)
Coleophoridae	23 (127)	15 (87)	2 (9)	8 (31)
Cosmopterigidae	17 (46)	11 (43)	0 (0)	2 (3)
Cossidae	1 (1)	1 (1)	0 (0)	0 (0)
Crambidae	73 (738)	54 (225)	20 (53)	43 (460)
Drepanidae	2 (6)	2 (6)	0 (0)	0 (0)
Elachistidae	17 (404)	14 (100)	4 (24)	13 (280)
Epiplemidae	1 (7)	1 (4)	0 (0)	1 (3)
Erebidae	70 (967)	45 (305)	5 (12)	68 (650)
Eriocraniidae	1 (4)	0 (0)	1 (4)	0 (0)
Gelechiidae	33 (401)	12 (106)	18 (45)	24 (250)
Geometridae	87 (715)	60 (219)	29 (113)	54 (383)
Glyphidoceridae	5 (64)	4 (39)	0 (0)	3 (25)
Glyphipterigidae	1 (1)	0 (0)	0 (0)	1 (1)
Gracillariidae	15 (35)	11 (34)	0 (0)	1 (1)
Hesperiidae	10 (33)	1 (1)	0 (0)	10 (32)
Lasiocampidae	3 (41)	0 (0)	0 (0)	3 (41)
Limacodidae	15 (228)	13 (70)	12 (50)	14 (108)
Lycaenidae	5 (15)	1 (3)	1 (1)	4 (11)
Lymantriidae	5 (59)	2 (9)	0 (0)	3 (50)
Megalopygidae	2 (37)	2 (36)	0 (0)	1 (1)
Nepticulidae	2 (3)	0 (0)	2 (3)	0 (0)
Noctuidae	118 (1205)	62 (325)	10 (105)	83 (775)
Nolidae	5 (56)	3 (12)	0 (0)	5 (44)
Notodontidae	12 (58)	6 (27)	0 (0)	7 (31)
Nymphalidae	11 (18)	1 (1)	0 (0)	10 (17)
Oecophoridae	8 (112)	6 (44)	2 (6)	3 (62)
Opostegidae	1 (2)	1 (2)	0 (0)	0 (0)
Papilionidae	5 (11)	0 (0)	1 (1)	4 (10)
Pieridae	2 (11)	0 (0)	0 (0)	2 (11)
Plutellidae	1 (5)	1 (1)	0 (0)	1 (4)
Psychidae	2 (13)	2 (5)	0 (0)	1 (8)
Pterophoridae	8 (24)	6 (10)	0 (0)	3 (14)
Pyalidae	48 (297)	48 (100)	5 (5)	19 (192)
Saturniidae	9 (21)	5 (7)	0 (0)	8 (14)
Sesiidae	7 (13)	4 (6)	0 (0)	3 (7)
Sphingidae	11 (57)	7 (10)	3 (6)	7 (41)
Thyrididae	2 (8)	2 (8)	0 (0)	0 (0)
Tineidae	23 (103)	15 (51)	5 (25)	4 (27)
Tischeriidae	1 (5)	1 (5)	0 (0)	0 (0)
Tortricidae	127 (1362)	71 (435)	25 (101)	59 (826)
Yponomeutidae	3 (67)	2 (7)	1 (4)	2 (56)
Zygaenidae	3 (13)	1 (3)	2 (4)	1 (6)
TOTALS	836 (8140)	521 (2516)	169 (659)	507 (4965)

doptera of Plummers Island is neither as thorough nor complete as those, fairly comprehensive surveys of several families (e.g., Limacodidae, Gelechiidae, Tortricidae, Noctuidae, Arctiidae) have accumulated over the last 100 years based on historical records and recent collecting efforts. However, because these data are a combination of historical and recently collected specimens, the cumulative lists present a somewhat biased view of the fauna, requiring some interpretation of the collecting data.

Lepidoptera are perhaps the best known insect order on Plummers Island, with 836 species and 488 genera and 48 families represented by either historical or contemporary records (Table 1). The earliest records are from 1901 and the most recent from 2005; however, over this 105-year period, sampling has been sporadic (Fig. 1).

Considerable moth collecting was conducted from about 1901 to about 1925. Some of the labels on these early specimens are difficult to interpret, espe-

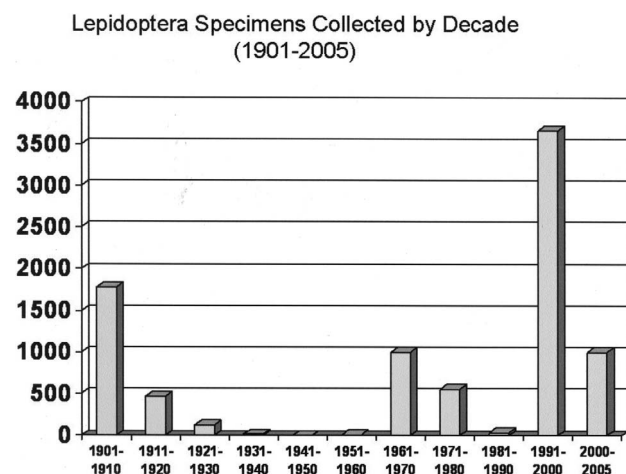


Fig. 1. Histogram of number of specimens collected by decade.

cially the year, and some of our knowledge is based on the type of label, collector, and other sources of information. Several early (1900–1925) members of the Washington Biologists' Field Club were entomologists and avid field collectors (e.g., Raymond Shannon, Herbert Barber, Eugene Schwarz, Waldo McAtee, and others). August Busck, employed as a lepidopterist by the U.S. Department of Agriculture at the National Museum of Natural History, was a frequent visitor to the Island and accumulated hundreds of specimens of Lepidoptera from about 1901–1925. Busck likely was the only early collector who was primarily a lepidopterist, although he collected other insects including mosquitoes. Because his specialty was microlepidoptera, his collecting biases may have been consistent with other collectors later in the century (e.g., Jack F. Gates Clarke, Ronald W. Hodges, Donald R. Davis).

Sampling waned by about 1925, with few or no records from the 1930s, 1940s, and 1950s. In 1962 Ronald W. Hodges collected a large number of microlepidoptera as did Donald R. Davis in 1971–1972. There are only a few records from the mid-1970s until the current inventory began. From 1998 to 2005, the Lepidoptera fauna was sampled on more than 50 occasions, using blacklights (UV) either with a sheet or a trap. Diurnal collecting with a net was infrequent; however, efforts in 2005 and 2006 (ca. 25 days) remedied many of the shortcomings in our knowledge of diurnal Lepidoptera. Two malaise traps deployed in 2005 captured several species of butterflies and sphinx moths unrecorded during the nocturnal work. Recent field work (1998–2005) conducted by John W. Brown and Michael G. Pogue, along with numerous volunteers, students, and interns, funded in part by small grants from the Washington Biologists' Field Club, resulted in about 4700 specimens compared with about 2300 from 1901–1925 (Fig. 1). A 10-week project conducted during

summer 2006 by Kimberly Vann included transect survey work for butterflies.

In addition to the approximately 8100 specimens of Lepidoptera deposited in the USNM collection (Table 1), records of numerous species from Plummers Island are scattered throughout the taxonomic literature (e.g., Busck 1906a, b, 1907a, b, 1908, 1909; Heinrich 1923, 1926; Clarke 1941, Hodges 1962a, b, 1964, 1969; Adamski & Hodges 1986). Many species were described from series of specimens collected either entirely or in part on the Island (see Appendix). Tortricidae is the only family for which an inventory of the site had been published (Brown 2001). However, contributions to this volume include surveys of Limacodidae (Lill 2008), Pyralidae, Crambidae (Solis 2008), Nolidae, Erebididae, Noctuididae (Pogue 2008), and the butterflies (Vann 2008).

The purposes of this contribution are to provide brief summaries of the species richness of Lepidoptera families documented from Plummers Island; compare and contrast the number of species known historically (i.e., 1901–1930) with those currently known to be present (i.e., 1998–2005) for families that appear to be adequately sampled; and provide hypotheses regarding the role of plant community succession in putative changes in the Lepidoptera fauna. The values calculated for percent change in species richness and species turnover are not intended to be precise measures of changes in the fauna, owing to a wide disparity in sampling frequency and methodology over the last century; however, it is likely that they reflect general trends within specific families. Taxonomy follows Hodges (1983), with a few deviations as proposed by Hodges (1998) and Davis & Robinson (1998). The Appendix to this volume includes a complete list of the species, along with the source of the record for Plummers Island (e.g., USNM collection, literature, etc.). For descriptions of site characteristics and historic land-use, see the introductory chapter to this volume (Brown 2008).

Contributions of the authors.—John W. Brown was responsible for compiling data for most families and for preparing the final version of the manuscript; Marc E. Epstein provided the data on Limacodidae and reviewed the text; Kimberly Vann updated the database for several families based on the USNM collection, conducted butterfly surveys, and deployed pheromone traps for gypsy moth (*Lymantria dispar*) and clear-wing moths (Sesiidae); Reed A. Watkins reviewed and commented on the text treating Pterophoridae; Stephen M. Bahr, II, compiled the data on families of Gelechioidea; and Stephen M. Bahr, II, and Erin Kolski were responsible for data capture, data review, data analyses, and various other chores.

Family Accounts

Acrolophidae. In North America, Acrolophidae are represented by two genera formerly assigned to

Tineidae (Davis 1983, Davis & Robinson 1998). It is one of several families that has been sampled adequately both historically (ca. 100 specimens) and recently (ca. 200 specimens) on Plummers Island. We document 12 species: eight species of *Acrolophus* and four species of *Amydria*. Eleven species (87 specimens) (i.e., all but *Acrolophus panamae* Busck) are recorded from 1901–1921, nine (31 specimens) from 1968–1981, and nine (180 specimens) from 1998–2005. Although the last period clearly is the best sampled, we have no recent records of two of the four species of *Amydria*. In the USNM collection there are no U.S. records of *Acrolophus panamae* before the 1960s, except for two specimens from New Jersey (1931, 1932). Among the four *Amydria* is an undescribed species that is recorded only from Maryland (Donald Davis, pers. comm.).

Amphisbatidae. Members of Amphisbatidae formerly were treated as the tribe Amphisbatini of Oecophoridae (Hodges 1983, 1998). This family is represented on Plummers Island by four species. The data for this group are relatively consistent throughout the last century: three species (19 specimens) from 1902–1905; four species (42 specimens) from 1971–1972; and four species (79 specimens) from 1998–2005.

Arctiidae. Twenty-one species of tiger moths are recorded from Plummers Island. The increase in species richness from 12 (1901–1921) to 16 (1998–2005) is not particularly surprising because many more specimens were collected in 1998–2005 (187 specimens) compared with 1901–1921 (30 specimens). Of the 12 species recorded from 1900–1925, five are not among the 16 species recorded during recent efforts (i.e., 1998–2005), strongly suggesting some turnover in the fauna. All 5 are Lithosiinae [i.e., 2 species of *Cisthene*, 2 species of *Crambidia*, and *Lycomorpha pholus* (Drury)] which use lichens as larval host plants (Wagner 2005). According to Lawrey & Hale (1979, 1981), automobile exhaust has adversely affected lichens on Plummers Island and in the region in general. Hence, it is possible that diminished food plant quality has led to the reduction or loss of these lithosiines on the Island. In conflict with this hypothesis, however, is the fact that two other lithosiines (i.e., *Crambidia pallida* Packard and *Hypoprepia fucosa* Hübner) that also feed on lichens are both represented by several specimens from recent survey work. Among the arctiids documented from Plummers Island is an undescribed species of *Crambidia* that occurs from at least Maryland to Georgia (USNM); there are no records of this species from the Island since about 1905.

Autostichidae. This family is represented by two species: *Gerdana caritella* Busck, collected throughout the last century, and six specimens of a single

undetermined species collected by Busck in 1903–1905.

Bombycidae. Five specimens of the widespread eastern U.S. species *Apatelodes torrefacta* (Smith) were examined from Plummers Island: one from 1911, two from 1968, and two from 2005. Although not recorded from Plummers Island, *Olceclostera angelica* (Grote) was collected recently (2006) on the Virginia side of the Potomac at Turkey Run and Great Falls, both within a few miles of the Island; hence, it is a potential resident. *Apatelodes* and its relatives were placed in Apatelodidae by Franclemont (1983), but they now are considered a subfamily of Bombycidae.

Choreutidae. There are two old specimens (ca. 1902) of the widespread eastern species *Brenthia pavonacella* Clemens in the USNM collection. There also is an old pair from Cabin John, less than 5 km from Plummers Island.

Coleophoridae. Coleophoridae include taxa previously treated as Blastobasidae, Momphidae, and Pterolonchidae (Hodges 1998). This is one of few families with more specimens from earlier sampling efforts (84 specimens from 1901–1921) than from recent work (i.e., 36 specimens from 1998–2005). We recorded a total of 23 species of this family, with 15 from 1900–1925 and eight from 1998–2005. With only three species in common to these two periods, there appears to be considerable turnover in the fauna; however, this may be the result of collecting bias or an artifact of sampling technique.

Cosmopterigidae. We found records of 15 species of this family, with 11 species from 1900–1925 and only two from recent collecting (1998–2005). Literature records of this family (Hodges 1964, 1969) corroborate this unusual disparity in the number of records between historical and recent efforts. This putative decline in species richness may represent a real trend rather than sampling error because at least three curators at USNM (A. Busck, J. Clarke, and Ron Hodges) with interest in this group were frequent visitors to the Island over the last century.

Cossidae. The widespread, wood-boring species, *Prionoxystus robiniae* (Peck), is the only cossid recorded from the site, represented by one old record (date on label ambiguous—probably 1905).

Crambidae. The 73 species of this family are treated in this volume by Solis (2008), who presents illustrations of adults along with notes on their U.S. distributions and recorded host plants. *Petrophila bifascialis* (Robinson), whose larva are almost certainly aquatic, is the most abundant moth in blacklight traps from about May–September, frequently with over 100 individuals per trap per night.

Drepanidae. Two common species of drepanids are recorded from the site. We have historical records of both and recent records of neither.

Elachistidae. Seventeen species of Elachistidae are recorded, with nearly the same number of historical (i.e., 14 species from 1900–1925) and recent records (13 species from 1998–2005). Species turnover between these two periods is 26%, one of the smaller changes in the fauna of any lepidopteran family we examined. At least one of the colonists, *Agonopterix alstroemeriana* (Clerck), is a well-known invader from the Palearctic that is relatively new to North America (Berenbaum & Passoa 1983, Powell & Passoa 1991). The life history of one other species, *Ethmia maceliosiella* Busck, was discovered and described from material collected on Plummers Island (Busck & Heinrich 1922). Although the latter was reported as abundant on the Island in 1919, no subsequent records were known until focused survey work yielded two specimens in 1999.

Epiplemididae. One species of epiplemid, *Calledapteryx dryopterata* Grote, is recorded from 1902, 1922, and 1998–2005.

Erebidae. The Erebididae were only recently recognized as a family distinct from Noctuididae. The 70 species documented from Plummers Island are discussed in detail by Pogue (2008) in this volume.

Eriocraniidae. Four specimens of a single species, *Dyseriocrania griseocapitella* (Walsingham), of this primitive microlepidoptera family were recorded from the site by Ronald W. Hodges in 1962.

Gelechiidae. Thirty-three species of gelechiids are recorded from the site. The number of species recorded increased from 12 in 1900–1925 to 18 in 1951–1977, and to 24 in 1998–2005—an increase of 100% in species richness from the turn of the last century. Of the 12 species recorded from the turn of the last century, eight are still present. With four putative species' extinctions and 16 putative species' colonizations, species turnover in this family is 56%. The data from this family are relatively convincing because of the interest in the group by both historic and recent USNM curators and WBFC members.

Geometridae. We captured data for 77 species of geometrids, with about 220 early records and nearly 400 recent records. The number of documented species of geometrids decreased from 60 in 1900–1921 to 54 in 1998–2005, a reduction of 10% in species richness. Of the 60 species recorded from the turn of the last century, only 25 are still present. With 35 putative species' extinctions and 19 putative species' colonizations, species turnover in this family is 47%.

Glyphidoceridae. We recorded five species from the site: three from 1901–1903 and four from 1998–2005, with all three of the historically recorded species (1901–1903) represented by recent records.

Glyphipterigidae. One common species, *Diploschizia impigritella* (Chambers), was documented from the Island during recent survey work (2005); there are no previous records from Plummers Island.

Gracillariidae. We recorded 14 species of gracillariids from the site, with 12 from 1900–1925 and only two from recent collecting. The difference in species richness is almost certainly the result of sampling error. Gracillariids are relatively small moths that are difficult to process. In addition, they are sampled more efficiently by gathering their occupied larval mines, a technique not used during recent collecting activities.

Hesperiidae. This family is treated in detail by Vann (2008), who lists 10 species of skippers from the site.

Lasiocampidae. Three common species of the tent caterpillar family were recorded from 1998–2005, with no historical records. *Tolyte vellea* (Stoll) is represented by a single specimen taken in October; this species flies only late in the year, outside the “normal” collecting period for most field workers. The other two, both species of *Malacosoma*, were taken in moderately large numbers indicating resident populations. Although there are no older records, it is likely that they were present much earlier than collection records indicate.

Limacodidae. The data suggest that Limacodidae are among the more thoroughly inventoried groups of Lepidoptera on Plummers Island; i.e., most of the species known from the Washington, D.C. region were collected on the site. We recorded a total of 15 species. With 13 species documented from 1900–1921 and 14 from 1998–2005, species richness has remained nearly constant. However, one species [*Adoneta spinuolodes* (Herrich-Schäffer)] recorded in the 1900s was not found during recent collecting activities. Two species [*Isa textula* (Herrich-Schaeffer) and *Prolimacodes badia* Hübner] found during recent activities were not recorded by early workers, resulting in a species turnover of 11%. Because the larvae of limacodids feed primarily on tree species, it is highly likely that plant community succession on the site had little influence on species composition, diversity, and abundance.

The only literature reference to Limacodidae from Plummers Island is Dyar (1905), in which he referred to adults of *Adoneta bicaudata* Dyar that were collected by Busck, Barber, and Schwarz on Plummers Island during the summer of 1904 and again by Barber in late July or early August 1905. A male from the latter date was mated in a cage with a female that was reared from a larva collected by Dyar at Tyron, North Carolina in 1904. It appears that Dyar's (1905) larval description of *A. bicaudata* is based on the offspring of adults from these two localities. Lill (2008) presents additional data on this family from Plummers Island.

Lycaenidae. Vann (2008) lists five species of this diurnal butterfly family—one species represented

only by historical records and four species collected in 2005–2006.

Lymantriidae. Five moderately common and widespread species are recorded from Plummers Island: an abundant, fall-flying species [*Orgyia leucostigma* (Smith)] from 1910–2005; and four summer-flying species, one from an older record and the remaining three only from recent collections (1998–2005). Pheromone trapping and diurnal observations revealed that gypsy moth, *Lymantria dispar* (Linnaeus), a notorious pest of forest trees, was abundant on the site from late June through the end of July 2006. Although never abundant in wing traps baited with pheromone, this species was the dominant Lepidoptera in Malaise traps, averaging over 30 individuals per week in July.

Megalopygidae. Two species of Megalopygidae, *Lagoa crispata* (Packard) and *Norape ovina* (Seep), were documented from 1902–1923 by six and 30 specimens, respectively. One specimen of *N. ovina* collected in 2005 is the only recent record for this family on the Island. Megalopygids are medium-sized moths that would have been kept and incorporated into the USNM collection if they had been taken during recent efforts. Hence, *L. crispata* and *N. ovina* may be locally extinct or present only in extremely low densities.

Nepticulidae. Two species of nepticulids were recorded from the site, undoubtedly reflecting a collecting bias—numerous species are present in the region. These are tiny moths that few collectors notice and/or take the time to collect and prepare.

Noctuidae. Consistent with other sites in the temperate regions of the world, the family Noctuidae is one of the most species-rich groups of Lepidoptera on Plummers Island with 88 species documented. The family is discussed in detail in Pogue's (2008) contribution to this volume.

Nolidae. This small group is considered a subfamily within Noctuidae by some and as a distinct family by others. The five species documented from Plummers Island are discussed in detail by Pogue (2008) in this volume.

Notodontidae. Ten species of notodontids are recorded from the site—six from 1900–1925 and seven from 1998–2005, with three species in common between the two periods. Although we have no explanation other than sampling error, this group is poorly represented in samples, with most species represented by only one or two individuals. Hence, the data are not reliable for assessing changes in the fauna.

Nymphalidae. Although we found only one historical record of this family in the USNM collection, we collected or observed 11 common species diurnally and/or in Malaise trap samples in 2005–2006. This number probably represents about 50% of the resident fauna, based on Clark's (1932) list of about

20 species of nymphalids considered as abundant, common, or frequent in the District of Columbia and vicinity. Vann (2008) treats this family in detail.

Oecophoridae. We found records of eight species of oecophorids. Of the six species collected historically (1902–1916), four apparently are no longer present.

Opostegidae. Two specimens of *Pseudopostega albogaleriella* (Clemens) were collected on Plummers Island in 1906; there are no subsequent records.

Papilionidae. The swallowtails are large and conspicuous butterflies, most of which are easily identified by sight (i.e., collections may not be necessary for most species). We collected four species on the Island in 2005–2006—the eastern tiger swallowtail (*Papilio glaucus* Linnaeus), the spicebush swallowtail (*Papilio troilus* Linnaeus), the black swallowtail (*Papilio polyxenes asterius* Stoll), and the zebra swallowtail [*Eurytides marcellus* (Cramer)]. We also discovered a specimen of the giant swallowtail (*Papilio cresphontes* Cramer) in the USNM from the Island that was originally cited by Clark (1932). Vann (2008) provides details on the swallowtails of the Island.

Pieridae. Two common pierid butterflies, *Pieris rapae* (Linnaeus), the European cabbage butterfly, and *Colias eurytheme* (Boisduval), the alfalfa butterfly, were recorded from the Island in 2005–2006. Vann (2008) presents details on this family.

Plutellidae. This small family is represented on the site by a single nearly cosmopolitan pest of mustards (Brassicaceae)—*Plutella xylostella* (Linnaeus). There is an older record (1905) and several recent ones.

Psychidae. The bagworm family is represented in our data by two species. Both were collected in 1900–1920, but only *Kearfottia albifasciella* Fernald has been documented recently.

Pterophoridae. Eight species of plume moths are documented from the site—six from 1900–1920 and three from 1998–2005, with only one species in common between the two sampling periods, suggesting that the two species represented only by recent records may be recent arrivals. Five of the six species collected at the turn of the last century but not recovered during recent field work, feed primarily on weedy composites (Asteraceae) (Matthews & Lott 2005) typical of open situations. Hence, these species may have disappeared as the vegetation of the area reverted from a heterogeneous patchwork of habitats to a somewhat homogeneous secondary woodland.

Pyralidae. A total of 48 species of pyralids is documented from Plummers Island, and these are treated by Solis (2008), who provides illustrations of adults along with notes on their U.S. distributions and recorded host plants.

Saturniidae. Nine species of saturniids are docu-

mented from the site, six based on historical USNM specimens, one from recent rearings by Lill (2008) [i.e., *Antheraea polyphemus* (Cramer)], and three from recent blacklight trapping (2000–2006) [i.e., *Automeris io* (Fabricius), *Callosamia angulifera* (Walker), and *Dryocampa rubicunda* (Fabricius)]. Because species of this family are large and well known, they were neglected, for the most part, during inventory work. Based on the species recorded from surrounding areas (i.e., Maryland), it is possible that the site supports as many as 18 species of this family.

Sesiidae. These day-flying moths with wood-boring larvae are collected infrequently. Seven species of sesiids are recorded from the site—five from 1900–1925 and two from 1998–2005, with no overlap in species. We deployed standard wing traps for 10 weeks in 2006 (June–August) baited with three different sesiid pheromones, and collected examples of three species. Because collections of this family are strongly biased by sampling methodology, which has been inconsistent over the last century, these data are of limited value in assessing changes in species richness and/or turnover. However, it is remarkable that there is no overlap in species composition between early collecting and recent survey efforts.

Sphingidae. The 11 species of hawk moths recorded from the site are all common, widespread species. Because the family includes large, well-known species, there has been a distinct collecting bias away from them, both historically and in present times. The majority of recent records are from Malaise traps deployed on the Island in 2005–2006. Six species are represented by older material (i.e., 1910–1913), two of which [i.e., *Manduca jasminearum* (Guérin) and *Hemaris thysbe* (Fabricius)] were not collected during recent survey efforts, although an individual of the latter (or a congener) was observed. The species recorded in this study represent less than half of the Sphingidae recorded from the Maryland–Washington, D.C. area.

Thyrididae. Two species of thyridids were collected from 1900–1925 and none since. According to Metzler (pers. comm.), *Thyris sepulchralis* Guérin is not attracted to light, and *Dysodia oculatana*, another common eastern thyridid, is rarely taken in blacklight traps.

Tineidae. Twenty-one species of tineid moths are recorded from the site; 15 from 1900–1925 and only four from 1998–2005. Although the group was of special interest to several early collectors, these are small moths that probably frequently were overlooked by recent workers.

Tischeriidae. Five specimens of *Tischeria astericola* Braun were collected by Busck in 1906; there are no subsequent records of this family from the site.

Tortricidae. The leafrollers or tortricids are among the more thoroughly studied groups of insects

on the Island. Brown (2001) reported a total of 119 species from the site, and 6 additional species are recorded in this study. The number of documented species declined from 71 in the decade of 1901–1910 to 59 in the decade 1991–2000, a reduction of 17% in species richness. Of the 71 species recorded from the turn of the last century, only 30 are still present. With 41 putative species' extinctions and 29 putative species' colonizations, species turnover in this family is 54%. Because all local tortricids are phytophagous and many are relatively host specific, changes in the tortricid fauna likely parallel changes in the vegetation composition and/or plant architecture over the last 100 years. Brown (2001) concluded that many of the species that disappeared from the site are those that specialize on herbaceous plants typical of open situations (e.g., Cochylini on Asteraceae), and those that persisted are either highly polyphagous or specialize on tree species.

Yponomeutidae. Two common species were recorded during recent inventory efforts (1998–2005) and a third [*Zelleria celastrusella* (Kearfott)] is represented only by older records (1901–1908). *Atteva punctella* is one of the most frequently collected and abundant moths on the Island ($n > 60$ specimens), with records extending from 1905 to 2005. The absence of older material of *Yponomeuta multipunctella* Clemens suggests that it was not present in the early part of the last century because it fits the “profile” of species that would have been collected by early microlepidopterists. The absence of recent specimens of *Z. celastrusella* suggests that it is no longer present.

Zygaenidae. Three common eastern U.S. species of Zygaenidae are documented from Plummers Island. Only one, *Pyromorpha dimidiata* Herrich-Schüffer, is represented by both historical and recent records.

Discussion

In order to conduct a thorough survey of the Lepidoptera of any site, a wide range of techniques must be employed: blacklights (sheet and/or trap samples); Malaise traps; diurnal collecting (using a net); rearing larvae from host plants; and utilizing pheromones, either synthetic sources, such as have been developed for Sesiidae, or by using “calling” females, such as with Saturniidae (e.g., Brown & Bash 2000). Only blacklight collecting has been utilized to any extent during recent efforts on Plummers Island. Although diurnal surveys focused specifically on butterflies, Sesiidae, and gypsy moth were conducted in 2006. It is likely that as much as 20% of the fauna is under-sampled: butterflies (7–8%), moths not attracted to light or that requiring rearing (10–15%), and species that are collected nearly exclusively with pheromones

(2%). Adults of many microlepidopteran families such as Gracillariidae, Heliozelidae, and Nepticulidae are tiny and difficult to collect and/or process. Hence, these families are discovered, recognized, and sampled less frequently by the generalist and/or student. At the other extreme are the large sphinx or hawk moths (Sphingidae), wild silk moths (Saturniidae), and butterflies, which likewise have been neglected because these families include mostly well-known species. Through efforts in 2006, including diurnal walking transects for butterflies and the deployment of pheromone traps for sesiids and gypsy moth, we attempted to remedy partially the shortcomings in our sampling of diurnal species; and Malaise trapping added significantly to our inventory of hawk moths.

Because the list of species from the Island is cumulative, representing over 100 years of collecting, it is likely that many of the species represented by historical records are no longer present (e.g., Brown 2001), and some records represent strays or vagrants. Although 835 species have been recorded from Plummers Island, the most thoroughly sampled periods fall well short of that total, i.e., 521 species from 1901–1930 and 507 species from 1990–2006. Hence, it seems likely that the Lepidoptera fauna rarely exceeds 500 species at any given time; there is little doubt that faunal composition changes over time. Shetler et al. (2006) documented 885 species of vascular plants from Plummers Island, but they estimate the current flora probably totals about 350 species. The Lepidoptera fauna of Plummers Island undoubtedly “tracks” the flora to some degree because the larvae of most Lepidoptera are phytophagous; hence, one would expect similar patterns in species richness.

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Appendix

Lepidoptera Described from Plummerville Island

TINEOIDEA

- Amydria brevipennella* Dietz, 1905 (unchanged)
Leucomela miriamella Dietz, 1905 (unchanged)
Tinea multistriatella Dietz, 1905 (= *Nemapogon multistriatella*)
Tryptodema sepulchrella Dietz, 1905 (unchanged)

GELECHIOIDEA

- Agonopterix costimacula* Clarke, 1941 (unchanged)
Agonopterix plummerella Busck, 1908 (unchanged)
Agonopterix thelmae Clarke, 1941 (unchanged)
Blastobasis plummerella Dietz, 1910 (= *Asaphocrita plummerella*)
Blastobasis plummerella fuscopurplella Dietz, 1910 (= *Asaphocrita fuscopurplella*)
Gelechia fondella Busck, 1906 (unchanged)
Gerdana caritella Busck, 1908 (unchanged)
Glyphidocera aberratella Busck, 1907 [= *Sceptea aequipulvella* (Chambers)]
Glyphiocera dimorphella Busck, 1907 (unchanged)
Glyphidocera meyrickella Busck, 1907 (unchanged)
Holococera busckiella Dietz, 1910 (= *Asaphocrita busckiella*)
Holococera dives Dietz, 1910 [= *Asaphocrita aphidiella* (Walshingham)]
Holococera elyella Dietz, 1910 (= *Calosima elyella*)
Holococera funebra Dietz, 1910 (= *Hypatopa funebra*)
Holococera ochrocephala Dietz, 1910 (= *Holococera chalcifrontella* Clemens)
Holococera tartarella Dietz, 1910 [= *Hypatopa punctiferella* (Clemens)]
Holococera vestaliella Dietz, 1910 (= *Hypatopa vestaliella*)
Perimede particornella Busck, 1909 (= *Walshia particornella*)

TORTRICOIDEA

- Ancyliis diminuatana* Kearfott, 1905 [= *Ancyliis diminutana* (Haworth)]

Epinotia sotipena Brown, 1986 (unchanged)
Eucosma mandana Kearfott, 1907 (= *Eucosma comatulana*)
Hemimene plummeriana Busck, 1906 (= *Talponia plummeriana*)
Olethreutes islandana Kearfott, 1907 [= *Ecdytopha mana* (Kearfott)]
Phalonia foxcana Kearfott, 1907 (= *Saphenista foxcana*)
Phalonia gunniana Busck, 1907 (= *Thyralia gunniana*)
Phalonia plummeriana Busck, 1907 (= *Phalonidia lepidana*)
Phalonia schwarziana Busck, 1907 (= *Phalonidia lepidana*)

Proteoteras crescentana Kearfott, 1907 (unchanged)
Sparganothis tristriata Kearfott, 1907 (unchanged)
Thiodia alterana Heinrich, 1923 (= *Phaneta parmatana*)
Thiodia ochroterminana Kearfott, 1907 (= *Phaneta ochroterminana*)

GEOMETROIDEA

Xanthotype sospeta var. *marylandensis* Swett [= *Xanthotype sospeta* (Drury)]

ARCTIIDAE

Cisthene plumbea Stretch (unchanged)