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# Inventory of the Butterflies (Insecta: Lepidoptera: Papilionidae, Pieridae, Lycaenidae, Nymphalidae, Hesperiiidae) of Plummers Island, Maryland

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*Abstract.*—A total of 36 species of butterflies was documented from Plummers Island, Maryland, based on four sources: transect survey (2006), diurnal collecting (2005), Malaise trap sampling (2005–2006), and historical records (1904–1997). Each of the four sources contributed species not recorded in the other three, demonstrating the importance of combining methods when compiling inventories. Twenty-five species (69% of the total) were observed during a 10-week transect survey in 2006, with six species not recorded in other sources. Nineteen species (53%) were captured during diurnal collecting in 2005, with five species not recorded in other sources. Eight species (22%) were collected in Malaise traps, with one species not recorded in other sources. Ten species (28%) were represented by historical records in the collection of the National Museum of Natural History, Washington, D.C., with four species not recorded from other sources. The number of species (i.e., 36) is less than what would be expected based on previous inventories of the butterflies of the Washington, D.C. area, and this is most likely the result of the under-sampling.

*Key words.*—Butterflies, insects, inventory, Potomac River, Chesapeake and Ohio Canal National Historical Park.

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Plummers Island, Maryland, a small part of the Chesapeake and Ohio Canal National Historical Park, has been a focal point of biological investigations for over a century (e.g., Erwin 1981, Shetler et al. 2006). Its location and accessibility together with its history of private ownership (1901–1959) by the Washington Biologists' Field Club, have combined to attract biologists from throughout the region. The large number of historical specimens of many disparate groups from the Island residing in the collection of the National Museum of Natural History (USNM), Smithsonian Institution provides a unique opportunity to supplement current biological investigations with historical records (e.g., Erwin 1981, Brown 2001, Staines 2004).

Lepidoptera are an important component of the insect fauna: as nectar feeders they perform an essential role in pollination; the larvae are significant herbivores of vascular plants; and they are an important source of food for birds, small mammals, and other invertebrates. The Lepidoptera fauna of Plummers Island has been sampled both recently and historically (e.g., Brown 2001), particularly the microlepidoptera. Because nearly all recent sampling was conducted using black light traps at night, a small but important diurnal component of the order, the butterflies, is

poorly represented in the samples. In order to begin to remedy this shortcoming, I gathered information on the butterflies of Plummers Island from various sources, including 10 weeks of field surveys in 2006.

## Materials and Methods

### Study Site

Plummers Island is located along the north shore of the Potomac River in Montgomery County, Maryland. For purposes of this study “Plummers Island” refers to the Island proper and the adjacent mainland property, the former ownership of the Washington Biologists' Field Club. For details of site conditions and ownership, see Shetler et al. (2006) and Brown (2008). For a comprehensive review of the flora and history of floristic study see Shetler et al. (2006).

### Data Sources

Data on the butterfly fauna were derived from four sources: 1) a 10-week transect survey conducted in 2006; 2) limited diurnal collecting in 2005; 3) Malaise trap samples from 2005–2006; and 4) historical records (1904–1997) from the USNM collection. The data from these sources present a picture of the fauna that is less than comprehensive because of their nar-

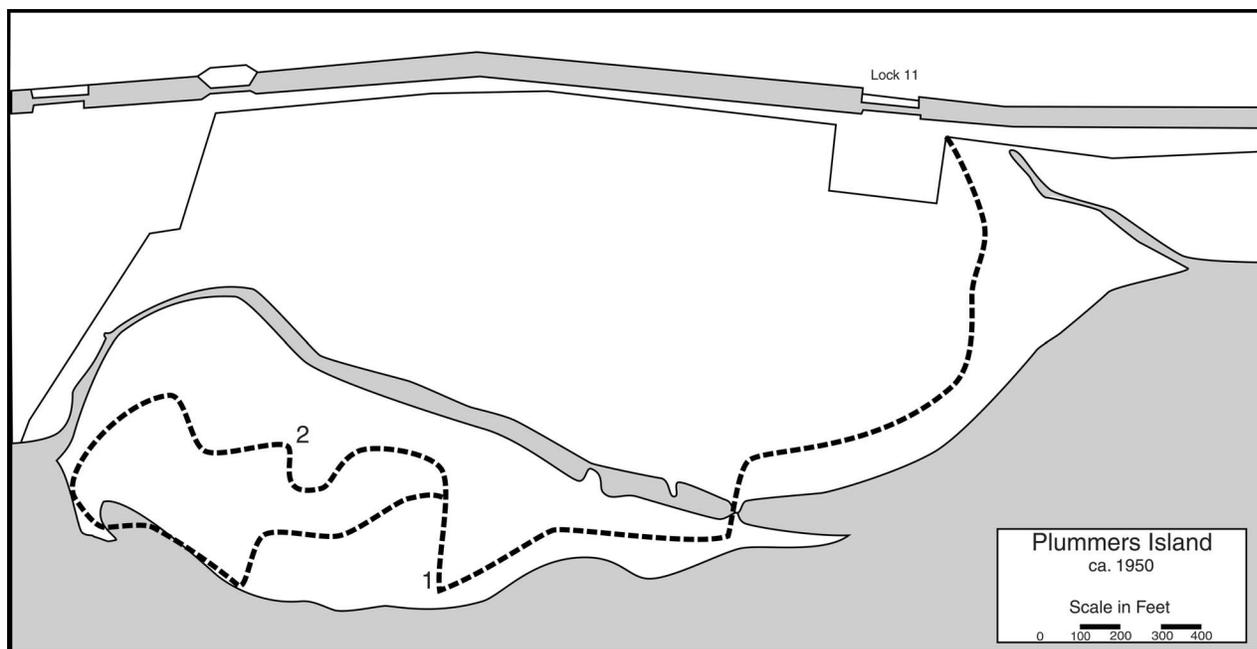


Fig. 1. Plummers Island showing transect (dashed line) and locations of Malaise traps (numbers).

row seasonal and/or temporal coverage. Nonetheless, they provide insight into the relative abundance and diversity of the butterflies of the site. During recent survey work (2005–2006), a minimum of one voucher for each species was deposited in the USNM. Clark (1932), Opler & Krizek (1984), and Opler (1986) were used for general information about local butterfly species.

*Transect survey (2006).*—A meandering transect (i.e., path) approximately 1700 m (1 mile) in length was established during the first visit to the site on 31 May 2006 (Fig. 1). The course of the path was selected to maximize coverage of the site and was adjusted slightly throughout the 10-week period to include sunny open areas, moist sand, hilltops, nectar sources, and butterfly larval host plants as they were discovered. For example, when *Cephalanthus occidentalis* L. (Rubiaceae) was in bloom, additional time was spent observing butterflies at this nectar source. Likewise, in July *Juniperus virginiana* L. (Cupressaceae) was investigated for the presence of *Callophrys gryneus* (Hübner) (Lycaenidae). The transect was walked for approximately 90 minutes twice a week from 31 May to 2 August 2006, usually by two observers. The schedule of daily visits (Table 2) was determined primarily by weather, focused on clear, sunny days. However, surveys were interrupted for two weeks (25 June–7 July) owing to high water which made the Island inaccessible by foot. During each transect survey, every butterfly observed was identified and tallied.

Although most species were identified with little difficulty, there was some ambiguity among a few similar-looking species. Two categories were created

for uncertain visual identifications: 1) “black swallowtail,” which could have been *Papilio polyxenes* (Fabricius), female *P. glaucus* Linnaeus, or *P. troilus* Linnaeus (Papilionidae); and 2) “anglewing,” which could have been either *Polygonia interrogationis* (Fabricius) or *P. comma* (Harris) (Nymphalidae). Data for these two “species” were not used in the daily species totals but were included in the number of individuals observed.

*Diurnal collecting (2005).*—In August and September 2005 John Brown made three trips to Plummers Island (27 August, 5 September, and 12 September) for the purpose of collecting butterflies from late blooming nectar sources, primarily *Eupatorium* sp. (Asteraceae). These efforts focused on the east of the Island.

*Malaise trap sampling (2005–2006).*—Malaise traps were deployed on Plummers Island by David Smith and John Brown from the end of April to the end of September in 2005 and 2006 (Fig. 1). The traps collected insects in 75% ethyl alcohol, and the samples were retrieved every two weeks, with adjustments to the schedule when the traps were inaccessible owing to high water. Butterflies were retrieved from the alcohol samples by Brown.

*Historical records (1904–1997).* The butterfly collection of the USNM was examined for specimens from Plummers Island. The search focused on species either collected recently or listed by Clark (1932) as present in the Washington, D.C. area. The “Washington, D.C. area” refers to Washington, D.C. proper plus adjacent northern Virginia and southern Maryland.

Table 1.—Butterfly species and number of individuals from each source.

	Transect Survey 2006	Diurnal Collecting 2005	Malaise Sampling 2005–2006	Historical Records 1904–1997
Family Papilionidae				
<i>Eurytides marcellus</i> (Cramer)	15	1	4	1
<i>Papilio polyxenes</i> Fabricius	2	0	0	0
<i>Papilio cresphontes</i> Cramer	0	0	0	1
<i>Papilio glaucus</i> Linnaeus	111	0	3	0
<i>Papilio troilus</i> Linnaeus	11	0	1	0
Family Pieridae				
<i>Pieris rapae</i> Linnaeus	166	3	6	1
<i>Colias eurytheme</i> Boisduval	2	0	0	0
Family Lycaenidae				
<i>Callophrys gryneus</i> (Hübner)	0	0	0	3
<i>Parrhasius m-album</i> (Boisduval & LeConte)	1	0	0	0
<i>Strymon melinus</i> (Hübner)	2	2	0	0
<i>Everes comyntas</i> (Godart)	0	2	0	0
<i>Celastrina neglecta</i> (W.H. Edwards)	4	6	0	0
<i>Celastrina ladon</i> Cramer	0	0	0	1
Family Nymphalidae				
<i>Libytheana carinenta</i> (Cramer)	2	0	0	0
<i>Speyeria cybele</i> (Fabricius)	0	0	0	1
<i>Phyciodes tharos</i> (Drury)	7	1	0	0
<i>Polygonia interrogationis</i> (Fabricius)	3	0	0	0
<i>Polygonia comma</i> (Harris)	7	2	0	0
<i>Nymphalis antiopa</i> (Linnaeus)	4	0	0	0
<i>Vanessa atalanta</i> (Linnaeus)	1	1	0	0
<i>Limnitis arthemis</i> (Drury)	1	1	0	0
<i>Asterocampa celtis</i> (Boisduval)	7	0	2	1
<i>Enodia anthedon</i> (A.H. Clark)	10	0	3	1
<i>Megisto cymela</i> (Cramer)	4	0	3	0
<i>Danaus plexippus</i> (Linnaeus)	1	1	0	0
Family Hesperidae				
<i>Epargyreus clarus</i> (Cramer)	17	2	0	0
<i>Erynnis horatius</i> (Scudder)	0	1	0	0

Table 1.—Continued.

	Transect Survey 2006	Diurnal Collecting 2005	Malaise Sampling 2005–2006	Historical Records 1904–1997
<i>Ancyloxypha numitor</i> (Fabricius)				
	0	1	0	2
<i>Hylephila phyleus</i> (Drury)				
	0	1	0	0
<i>Polites peckius</i> (W.F. Kirby)				
	0	1	0	0
<i>Pompeius verna</i> (W.H. Edwards)				
	8	1	0	0
<i>Atalopedes campestris</i> (Boisduval)				
	3	12	0	0
<i>Poanes zabulon</i> (Boisduval)				
	8	2	0	2
<i>Amblyscirtes hegon</i> (Scudder)				
	0	0	1	0
<i>Panoquina ocola</i> (W.H. Edwards)				
	0	2	0	0
Individuals (number of species)	397 (25)	43 (19)	23 (8)	14 (10)

### Nomenclature

Scientific nomenclature and the sequence of families and species follow the North American Butterfly Association List (NABA 2006). Authors of species follow Hodges et al. (1983). Nomenclature for plant species follows Shetler et al. (2006).

### Results

Based on all data sources, 36 species of butterflies were documented from Plummers Island (Table 1). A total of 25 species was contributed by the transect survey (2006), 19 by diurnal collecting (2005), 8 by Malaise trap sampling (2005–2006), and 10 by historical records (1904–1997).

With 25 species, transect surveys (2006) yielded the highest number (69%) of the total species documented. The transect data included six species not found in other sources: *Papilio polyxenes*, *Colias eurytheme* Boisduval (Pieridae), *Parrhasius m-album* (Boisduval & LeConte) (Lycaenidae), *Libytheana carinenta* (Cramer), *Polygonia interrogationis*, and *Nymphalis antiopa* (Linnaeus) (Nymphalidae).

With 19 species, diurnal collecting (2005) yielded the second highest number (53%) of the total species documented. The diurnal collecting contributed five species not found in other sources: *Everes comyntas* (Godart) (Lycaenidae), *Erynnis horatius* (Scudder), *Hylephila phyleus* (Drury), *Polites peckius* (W. F. Kirby), and *Panoquina ocola* (W. H. Edwards) (Hesperiidae).

Malaise trap sampling (2005–2006) yielded eight species, the fourth highest number (22%) of the total species documented. Malaise trap samples included one species not present in other sources, *Amblyscirtes hegon* (Scudder) (Hesperiidae).

Table 2.—Species and individuals observed per transect in 2006.

	5/31	6/4	6/7	6/10	6/14	6/17	6/21	6/24	6/24	7/8	7/11	7/16	7/19	7/22	7/26	7/29	8/2	Total	
Family Papilionidae																			
<i>Eurytides marcellus</i> (Cramer)		7	2				2	1	1	2									15
<i>Papilio polyxenes</i> Fabricius								1		1									2
<i>Papilio glaucus</i> Linnaeus		5	2	3	2		4	3	9	9	5	12	10	10	10	9	13	5	111
<i>Papilio troilus</i> Linnaeus		1	1	4	1	1	1	1	1										11
Family Pieridae																			
<i>Pieris rapae</i> Linnaeus		35	36	18	17	4	20	6	1	12	1	10	2		1		3		166
<i>Colias eurytheme</i> Boisduval		1										1							2
Family Lycaenidae																			
<i>Parrhasius m-album</i> (Boisduval & LeConte)												1							1
<i>Strymon melinus</i> (Hübner)													1					1	2
<i>Celastrina neglecta</i> (W.H. Edwards)		1	1	1						1									4
Family Nymphalidae																			
<i>Libytheana carinenta</i> (Cramer)												2							2
<i>Phyciodes tharos</i> (Drury)							2	1	1	1	1								7
<i>Polygonia interrogationis</i> (Fabricius)		1											2						3
<i>Polygonia comma</i> (Harris)		2	2			1	1					1							7
<i>Nymphalis antiopa</i> (Linnaeus)			3	1															4
<i>Vanessa atalanta</i> (Linnaeus)																		1	1
<i>Limenitis arthemis</i> (Drury)																			1
<i>Asterocampa celtis</i> (Boisduval)				2		1	1	1							1	1			7
<i>Enodia anthedon</i> (A.H. Clark)			1	1										1	3	4			10
<i>Megisto cymela</i> (Cramer)		1	2	1															4
<i>Danaus plexippus</i> (Linnaeus)																	1		1
Family Hesperiidae																			
<i>Epargyreus clarus</i> (Cramer)			3				1	2	2	2	4	1					1	1	17
<i>Pompeius verna</i> (W.H. Edwards)							3	4	1										8
<i>Atalopedes campestris</i> (Boisduval)											1	2							3
<i>Poanes zabulon</i> (Boisduval)			3		1					1							1	2 <sup>1</sup>	8
<i>Erynnis</i> sp.										1									1
Anglewing		3	3	1	1		1	2						1					13
Black Swallowtail			2	2	1								1						7
Total Individuals		57	61	34	23	5	30	22	20	30	10	32	20	10	13	14	25	12	418
Total Species		9	11	8	4	2	6	10	8	9	5	8	7	1	3	4	8	5	

<sup>1</sup> Uncertain identification of one individual.

Historical records (1904–1997) yielded ten species, the third highest number (28%) of the total species documented, with five specimens from 1900–1920, seven from 1969–1982, and one from 1997. Historical records contributed four species not found in other sources: *Papilio cresphontes* Cramer (Papilionidae), *Callophrys gryneus*, *Celastrina neglecta* (W. H. Edwards) (Lycaenidae), and *Speyeria cybele* (Fabricius) (Nymphalidae).

Based on the transect survey data (Table 2), the most frequently observed species were *Pieris rapae* Linnaeus (Pieridae) ( $n = 166$  individuals), *Papilio glaucus* ( $n = 112$ ), *Epargyreus clarus* (Cramer) (Hesperiidae) ( $n = 17$ ), *Eurytides marcellus* (Cramer) (Papilionidae) ( $n = 15$ ), and *Papilio troilus* ( $n = 11$ ). No more than ten individuals of any other species were observed. Five species were represented by observations of a single individual during the 10-week period: *Parhassius m-album*, *Vanessa atalanta* (Linnaeus), *Limenitis arthemis* (Drury), *Danaus plexip-*

*pus* (Linnaeus) (Nymphalidae), and *Erynnis* sp. (Hesperiidae).

The maximum number of individuals and species observed on one transect day (4 June) was 61 specimens representing 11 species. The minimum number of species was one (19 July) and the minimum number of individuals was five (14 June).

#### Species Accounts

The presence of an individual species in a particular place is a balance of many different factors. The herbivorous nature of the larvae combined with the fact that most adults feed on nectar often make vegetation the defining characteristic of distribution, but this is not always true. Other factors such as preferred habitat, flight periods, and broods all combine to the probability of individuals being observed, trapped, or collected. Following is an annotated list of species documented from Plummers Island.

## Family Papilionidae

*Eurytides marcellus*.—According to Clark (1932), this species is found infrequently in the Washington, D.C. area. On Plummerville Island, I observed it often: 15 individuals on six dates between 31 May and 24 June. In addition to the transect data, I discovered one historical record, one specimen collected in 2005, and four specimens collected in Malaise traps. The larvae of this species feed on *Asimina triloba* Dunal (Annonaceae) (Clark 1932, Opler & Krizek 1984), which is common on the site (Shetler et al. 2006).

*Papilio polyxenes*.—Although listed as abundant in the Washington, D.C. area by Clark (1932), I observed this species only twice—21 June and 24 June. I found no historical records.

*Papilio cresphontes*.—This species was not observed on transect surveys, but one historical record (from 1913) was found. Although Clark (1932) reports that *P. cresphontes* does not occur in the D.C. area, Plummerville Island is within its range as portrayed by Opler & Krizek (1984).

*Papilio glaucus*.—This was the second most frequently observed species on the transect: 111 individuals over the 10-week period; it was absent only on one overcast day (14 June). Three specimens were collected in Malaise traps in April 2006 and July of 2005, and there were no historical records. Individuals were observed most often nectaring on *Cephalanthus occidentalis*, from as early as ca. 0630 hrs in the morning to as late as ca. 2030 hrs in the evening (mid-June).

*Papilio troilus*.—This species was observed from the end of May to mid-June, with a specimen collected in a Malaise trap in May 2005. The USNM collection included no historical specimens.

## Family Pieridae

*Pieris rapae*.—This species was the most frequently observed butterfly on Plummerville Island with 166 individuals noted during the 10-week survey period. Observations were most numerous on the first two dates—31 May and 4 June—with more than 35 individuals recorded each day. Records of *P. rapae* were present in every source: one historical specimen, three individuals from 2005, and six specimens in Malaise trap samples.

*Colias eurytheme*.—This species was observed only twice (31 May and 11 July), even though reported as common and widespread (Clark 1932, Opler & Krizek 1984) in the area. No records were found from other sources.

## Family Lycaenidae

*Callophrys gryneus*.—Three historical records of this species were found: two from 1908 and one from

an unknown year; no data were found from the other three sources. *C. gryneus* is always associated with *Juniperus virginiana*, a successional pioneer of old fields that was a predominant tree on the higher parts of Plummerville Island around the turn of the century (Shetler et al. 2006). Over the last hundred years, Plummerville Island has reverted to a mixed forest characterized by a relatively dense tree canopy, with *J. virginiana* being replaced by various deciduous tree species (Shetler et al. 2006). However, scattered individuals of this tree are still present on the Island. The absence of *C. gryneus* from the transect survey can be explained by the fact that its flight period is primarily in the spring before the 10-week survey work commenced.

*Parrhasius m-album*.—Only one individual of this species was observed on the transect survey—11 July. This species is rarely seen in the Washington, D.C. area (R. Robbins, pers. comm.) and was rarely observed historically (Clark 1932). In contrast, the distribution map presented by Opler & Krizek (1984) shows it to be a widespread species. According to Robbins (pers. comm.), *P. m-album* exhibits periodic upsurges in numbers during which sightings may be more frequent.

*Strymon melinus*.—This species was observed during the transect survey twice: 16 July and 29 July, and two individuals were collected in 2005. Although Opler & Krizek (1984) report *S. melinus* to be the most abundant and widespread hairstreak in eastern North America, only four individuals were recorded from Plummerville Island.

*Everes comyntas*.—Clark (1932) characterizes this species as abundant in the Washington, D.C. area, although no individuals were observed on the transect. Two specimens were collected in 2005. The small numbers of individuals of this species and *Strymon melinus* may be due to the paucity of their larval hosts, clover (Fabaceae) and lespedeza (Fabaceae) (R. Robbins, pers. comm.), on the Island.

*Celastrina neglecta*.—This species was observed during the transect surveys ( $n = 4$ ) and collected in 2005 ( $n = 6$ ). One individual was observed on each transect survey from 31 May to 7 June and on 24 June. This species resembles the closely related *Celastrina ladon* Cramer, but the two have different flight periods. Because *C. ladon* flies only in early spring (R. Robbins, pers. comm.), all of the individuals observed on the transect and collected in 2005 are assumed to be *C. neglecta*.

*Celastrina ladon*.—One specimen was present in the USNM collection from 19 April 1969. The identification is based on the spring capture date.

## Family Nymphalidae

*Libytheana carinenta*.—According to Clark (1932) this species is sporadic in distribution in the Wash-

ington, D.C. area. Two individuals were observed during the transect surveys, both on 11 July. No additional data were obtained from other sources.

*Speyeria cybele*.—Although common and widespread throughout much of eastern North America (Opler & Krizek 1984), including the Washington, D.C. area (Clark 1932), only one record was found from Plummers Island—a specimen from 1919 collected by A. Busck. Owing to its large size, the species is unlikely to have been overlooked during the transect surveys. The absence of this species from Plummers Island may be due to the scarcity of its larval hosts, violet species (Violaceae) (R. Robbins, pers. comm.), on the Island.

*Phyciodes tharos* (Drury).—Seven individuals of this species were observed during the transect surveys, most often nectaring on *Justicia americana* (L.) Vahl (Acanthaceae), on six transects between 21 June and 11 July, and on 2 August. Clark (1932) reported it to be the most common butterfly in the D.C. region. The small number of observations of this common butterfly may be attributed to the paucity of aster species (Asteraceae), the larval host of this butterfly (R. Robbins, pers. comm.), on the Island. However, the seasonal timing of the surveys probably also contributed to the limited numbers of observations.

*Polygonia interrogationis*.—Three individuals of this species were observed on the transect: one on 31 May and two on 16 July. The other sources provided no additional data on this species.

*Polygonia comma*.—This species was found twice during diurnal collecting in 2005, and seven individuals were observed during transect surveys on five days: 31 May, 4 June, 17 June, 21 June and 16 July. Both species of *Polygonia* were reported as common along the C&O Canal by Clark (1932).

*Nymphalis antiopa*.—This species was observed on two dates during transect surveys: three individuals on 4 June and one individual on 7 June. Clark (1932) lists this species as frequent but not common in the Washington, D.C. area. He also states that *N. antiopa* is “plentiful” between Cabin John and Great Falls, which includes Plummers Island.

*Vanessa atalanta*.—This species was found during diurnal collecting in 2005, and one individual was observed on the transect survey (2 August). Opler & Krizek (1984) describe the range of this species as widespread from Canada to Mexico and Central America.

*Limenitis arthemis*.—One specimen was collected in 2005, and one individual was observed on the transect on 26 July.

*Asterocampa celtis* (Boisduval).—Seven individuals were observed during six transect surveys from 7 June to 24 June and 26 July to 29 July. One individual was collected by Jack F. G. Clarke in 1982, and two were collected by Malaise trap sampling (2005–

2006). In addition, Clark (1932) reported finding *A. celtis* specifically on Plummers Island. Individuals of this species were most often observed perched on rock outcrops on and adjacent to Plummers Island.

*Enodia anhedon* (A. H. Clark).—Ten individuals of this species were observed on the transect survey on five days. One specimen was discovered in the USNM collection from 1982, and three individuals were collected during Malaise trap sampling.

*Megisto cymela* (Cramer).—Five individuals of this species were observed on the transect, all within the first three dates (31 May, 4 June and 7 June). This species may have been overlooked because the coloring of the wings camouflages it in wooded areas. On the transect it was observed most often in wooded areas, although it is known to spend the day in constant flight (R. Robbins, pers. comm.). Three specimens of *M. cymela* were collected in Malaise traps.

*Danaus plexippus*.—This is a large, well-known species that is common throughout North America (Opler & Krizek 1984). One specimen of *D. plexippus* was collected in 2005, and one was observed on 29 July on the transect survey.

#### Family HesperIIDae

*Epargyreus clarus*.—This species was considered by Clark (1932) to be abundant in the Washington, D.C. area. It was the third most frequently observed species on the transect surveys—53% of the survey dates, with 17 individuals observed. It often was found nectaring on *Cephalanthus occidentalis*. This species was observed during six consecutive transects surveys—from 21 June to 16 July—corresponding to the time *Cephalanthus occidentalis* was in bloom. Three individuals also were observed on 4 June and one individual each on 29 July and 2 August. Two specimens were taken during diurnal collecting in 2005.

*Erynnis horatius*.—One specimen was collected in August 2005, and no other sources yielded data. It is possible that the specimen (*Erynnis* sp.) observed on 8 July was this species, but an accurate identification could not be made based solely on visual observation.

*Ancyloxypha numitor* (Fabricius).—This species was collected once in 2005, and two historical records (both from 1982) were discovered; it was not observed on the transect survey. Opler & Krizek (1984) indicate this species is extremely abundant, especially in early summer.

*Hylephila phyleus*.—This is another common, widespread species (Opler & Krizek 1984) documented by only one specimen taken during diurnal collecting in 2005. It is more common later in the year, beyond the end of the 10-week survey.

*Polites peckius*.—Due to its small size, it is possible that *P. peckius* and other small hesperiids were overlooked during field work in 2006. This species was documented only once, during diurnal collecting in 2005.

*Pompeius verna* (W. H. Edwards).—Eight individuals were observed on the transect survey, and one specimen was collected in 2005. All individuals observed were nectaring on *Cephalanthus occidentalis*.

*Atalopedes campestris* (Boisduval).—Three individuals were observed on the transect survey—all nectaring on *Cephalanthus occidentalis*—on 11 July and 16 July. Twelve specimens were collected in 2005. This species becomes more common in the area later in the year.

*Poanes zabulon* (Boisduval).—Records of this species came from each source, except the Malaise trap. Eight individuals were observed during transect survey, two historical records were discovered, and two specimens were collected in 2005.

*Amblyscirtes hegon*.—This species was collected only in a Malaise trap, the single individual captured between 22 April and 6 May 2006. Plummers Island is at the eastern edge of this species' range, but it may be a recent immigrant to the D.C. area (R. Robbins and R. Smith, pers. comm.).

*Panoquina ocola*.—Two specimens of this species were collected in 2005 and no other sources provided data. According to Opler & Krizek (1984), *P. ocola* probably is resident only in the Deep South, although it may wander irregularly as far north as New Jersey.

### Discussion

While the combination of the four data sources helped to maximize the number of documented species, it is likely that additional species are present on Plummers Island, either as residents or occasional visitors. There is little doubt that increased temporal sampling, both seasonal and multi-year, would contribute significantly to the inventory. For example, Opler (1986) documented 79 species during a 5-year survey of nearby Upper Dogue Creek Drainage, Fairfax County, Virginia. However, Opler's survey included a much larger area with considerably greater habitat heterogeneity.

*Transect survey (2006)*.—The transect survey provided the most data because the goal of this method was to actively search for butterflies. This source resulted in the observation of 418 individuals, representing 69% of the total species. The transect surveys would have been more complete if they had included spring and late summer.

In addition to a mere list of documented species, the transect surveys provide ecological observations, including nectar sources and behavior. For example, once *Cephalanthus occidentalis* bloomed (ca. 21

June), the largest concentration of individuals was observed on this plant species, including *Eurytides marcellus*, *Papilio polyxenes*, *Papilio glaucus*, *Papilio troilus*, *Epargyreus clarus*, *Pompeius verna*, *Atalopedes campestris*, *Poanes zabulon*, and *Erynnis* sp. *Papilio glaucus* was the most frequently observed butterfly on this nectar source.

Another nectar source which attracted considerably fewer butterflies than *Cephalanthus* was *Justicia americana*. Species attracted to this source include *Phyciodes tharos*, *Pieris rapae*, *Eurytides marcellus*, and *Papilio glaucus*.

*Diurnal collecting (2005)*.—Owing to abundant nectar sources (i.e., *Eupatorium* sp.) in late summer 2005 and the relative ease of capturing individuals, Brown visited Plummers Island three times. Based on these three visits, 53% of the total species were collected. Comparing time invested to total species documented, the diurnal collecting in 2005 provided a much more efficient method; 19 species were found during approximately 4 hours compared to 25 species found during approximately 26 hours in transect surveys. This is due to the concentration of individuals on nectar sources and the ability to adjust the focus of fieldwork to different nectar sources as they bloomed. The shortcomings of the diurnal collecting in 2005 were the limited seasonal sampling and narrow habitat coverage. That is, collecting was limited to three days in late August and September focused on only one area at the east end of the Island where *Eupatorium* species were in bloom.

*Malaise trap sampling (2005–2006)*.—Malaise traps are seldom used for butterfly sampling, and it yielded comparatively few individuals. However, this source resulted in eight species (22% of the total fauna), including one species not documented from other sources. With 6 months of sampling each year, this source had the greatest seasonal coverage. Placement of the traps in the woods likely biased the species collected because the majority of butterflies were encountered more commonly in open or sunny places.

*Historical Records (1904–1997)*.—This source provided few data because butterflies apparently were not actively sampled on Plummers Island historically. The records are from 1900–1920, 1969–1982, and 1997. Although historical records contributed the smallest number of individuals ( $n = 14$ ), four of the species were not represented in other sources. The small number of specimens, the limited diversity of species, and the narrow range of collecting dates all highlight the shortcomings of this source. Historical records did provide records of specimens collected in April and early May ( $n = 4$ ), a season not covered by other sources, leading to the addition of *Celastrina ladon* and *Callophrys gryneus* to the species list (R. Robbins, pers. comm.).

The 36 species recorded from Plummers Island

certainly under-represent the actual fauna. Clark (1932) documented 93 butterfly species in the Washington, D.C. area, and Opler (1986) recorded 79 from Upper Dogue Creek Drainage, Fairfax County, Virginia. However, habitat destruction and fragmentation and diminished environmental quality from automobile pollution and other sources undoubtedly have reduced the number of butterfly species in the Washington, D.C. area. For example, a butterfly survey of Rock Creek Park, Washington, D.C., in 1977–1980 recorded about 50 species, but a comparable survey of the same park in 2002–2003 recorded only 24 (R. Smith, pers. comm.).

Several common and widespread species, such as *Vanessa cardui* (Linnaeus), *Junonia coenia* (Hübner), and *Euptoieta claudia* (Claudia) are undocumented from Plummerville Island, but this may reflect the lack of large, open, weedy areas. Species that fly in the spring also are poorly represented or undocumented, including *Anthocharis midea* (Hübner), *Celastrina ladon*, *Erynnis juvenalis* (Fabricius), and *Callophrys niphon* (Hübner) (R. Smith, pers. comm.). In contrast, several species considered uncommon in the area, including *Parrhasius m-album*, *Amblyscirtes hegon*, and *Panoquina ocola*, were discovered, as were a few more southern species, such as *Hylephila phyleus*, *Atalopedes campestris*, and *Panoquina ocola*, that frequently move into the area late in the season (R. Smith, pers. comm.).

The differential investment of time between diurnal collecting (2005) and transect surveys (2006) was large (4 hr. vs. 25 hr.), but the number of species recorded by each source was not (19 vs. 25). The documentation of one species only from Malaise trap sampling was somewhat surprising because this technique is rarely used for inventoring Lepidoptera. While far from comprehensive, the species list compiled during this study helps fill in the gap in our knowledge of the diurnal Lepidoptera of Plummerville Island.

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