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The Invertebrate Fauna of Plummers Island, Maryland: Introduction and Background

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Abstract.—The biota of Plummers Island, Maryland, the research home of the Washington Biologists' Field Club, has been the subject of countless biological investigations over the last 100 years. While the flora and vertebrate fauna are fairly well known, the invertebrate fauna remains poorly documented with the exception of several families of insects. This paper presents a brief description of the site, notes on land-use over the last 100 years, and comments on collecting and research activities focused on invertebrates. It also serves as an introduction for the contributions that constitute this volume—a collection of papers on various aspects of the invertebrate fauna.

Key words.—Inventory, biodiversity, Washington Biologists' Field Club, Chesapeake and Ohio Canal National Historical Park.

In the face of diminishing global biodiversity and a growing emphasis on discovery and documentation of the biota of the species-rich tropical regions of the planet, the biota of our own backyards frequently goes unnoticed and unstudied, especially the invertebrates. And while there is much clamor over the concept of an "All Taxa Biological Inventory" [ATBI] (e.g., Janzen & Hallwachs 1994, Kaiser 1997, Miller 2005), there are still precious few applications of such inventories in progress (e.g., Great Smoky Mountains National Park) (Pickering 1997). With a strong interest in the local biota of the Washington, D.C. area and the Potomac Basin, the Washington Biologists' Field Club for over 100 years has encouraged the investigation of Plummers Island, its former "research station." A sign on the Island boasts "The most thoroughly studied island in North America . . ." As would be expected given 100 years of survey and study, a tremendous amount of natural history information has accumulated on the biota of the site. Although an inventory of the invertebrate fauna is far from complete in its taxonomic coverage, a solid foundation of knowledge has accumulated on this heterogeneous assemblage of mostly small and frequently overlooked animals.

Plummers Island is a small land feature situated along the northern edge of the Potomac River immediately east of where the National Capitol Beltway crosses the Potomac in the state of Maryland. It represents a small piece of an extensive linear parkway that parallels the Potomac River and the historic Chesapeake and Ohio (C&O) Canal. The Island and

adjacent property were leased and subsequently owned by the Washington Biologists' Field Club from 1901 to 1958 when ownership was transferred to the U.S. National Park Service. During this time the site was the subject of countless biological investigations. Even though the site is no longer owned by the Club, studies on its biota continue today through an agreement with the National Park Service. Popular accounts on the natural history of the Island include those by Long (1957, 1966), Kalmbach (1968), and Brown (2005), and details about the Club, its goals, and its history can be found in Perry (2007), from which much of the following text and facts are derived. Historical data on the Island also can be found in McAtee's (1918) "A Sketch of the Natural History of the District of Columbia."

According to Perry (2007), one of the original objectives of the Club was the compilation of a thorough biological inventory of the Island and adjacent mainland property. The first "Committee on Fauna and Flora" of the Club was appointed in 1902, and collecting and study was conducted primarily by committee members in the early years. More recently, individual Club members, guests, and grantees of research awards from the Club have conducted field work on the site. Owing to its long-term use as a "research station," Plummers Island has become one of the world's most famous collecting spots and the type locality of numerous species of invertebrates (Perry 2007), e.g., at least 100 species of insects. Most of the considerable natural history collections made on the site are deposited in the National Mu-

Table 1.—Contributions entitled “Natural History of Plummers Island, Maryland.”

Number	Author/Date	Subject
I.	W. R. Maxon, 1935	introduction
II.	E. P. Killip & S. F. Blake, 1935	flowering plants and ferns
III.	E. C. Leonard, 1935	mosses
IV.	A. K. Fisher, 1935	birds
V.	J. A. Stevenson & E. M. Ermold, 1936	fungi
VI.	M. K. Brady, 1937	reptiles and amphibians
VII.	E. C. Leonard & M. E. Pierce, 1939	liverworts
VIII.	E. C. Leonard & E. P. Killip, 1939	lichens
IX.	E. A. Goldman & H. H. T. Jackson, 1939	mammals
X.	E. P. Killip & S. F. Blake, 1953	flowering plants and ferns
XI.	F. Drouet, 1954	blue-green algae
XII.	K. V. Krombein, 1959	biological note on a wasp
XIII.	K. V. Krombein, 1962	descriptions of new wasps
XIV.	P. J. Spangler, 1962	biological notes on a beetle
XV.	E. W. Baker, 1962	description of a mite
XVI.	K. V. Krombein, 1962	biology of parasitic mite
XVII.	K. V. Krombein, 1963	annotated list of the wasps
XVIII.	K. V. Krombein, 1964	the hibiscus wasp
XIX.	M. D. Leonard, 1966	annotated list of aphids
XX.	R. H. Manville, 1968	annotated list of vertebrates
XXI.	M. E. Hale, 1972	infestation of a lichen
XXII.	W. W. Wirth, N. C. Ratanaworabhan & D. H. Messersmith, 1977	biting midges (1)
XXIII.	J. D. Lawrey & M. E. Hale, 1977	lichen growth rate
XXIV.	W. W. Wirth & W. L. Grogan, 1979	biting midges (2)
XXV.	W. W. Wirth & W. L. Grogan, 1981	biting midges (3)
XXVI.	T. L. Erwin, 1981	ground beetles
XXVII.	D. W. Johnston & D. L. Winings, 1987	birds
XXVIII.	W. C. Starnes, 2002	fishes
XXIX.	S. G. Shetler et al., 2006	vascular plants

seum of Natural History (USNM), Smithsonian Institution. Lists of the flora and fauna as well as contributions to the knowledge of the life history, behavior, and ecology of specific groups of plants and animals have been chronicled in a series of papers titled “The Natural History of Plummers Island” published primarily in the Proceedings of the Biological Society of Washington (see Table 1 and literature cited). Although comprehensive lists of the vascular plants (e.g., Killip 1931, Killip & Blake 1935, 1953; Shetler et al. 2006), lichens (Leonard & Killip 1939, Hale 1970, 1972; Lawrey & Hale 1977), mosses (Leonard 1935), fungi (Stevenson & Ermold

1936), liverworts (Leonard & Pierce 1939), and most vertebrate groups (e.g., McAtee & Weed 1915, Cooke 1929, Fisher 1935, Brady 1937, Goldman & Jackson 1939, Gardner 1950a, b; Stewart & Robbins 1958, Manville 1968, Starnes 2002) have been compiled, our knowledge of the invertebrate fauna is far from complete, with relatively few taxa treated in published accounts. McAtee (1918) presented numbers of species of arthropods documented from the Island (e.g., 450 bugs, 500 flies, and 1500 beetles), but the source of these numbers is not clear.

Stimulated by the 100th anniversary of the Club in 2001, it was determined that all previously published and unpublished information on the biota of the Island should be compiled, summarized, and made available through publication of a book-length treatment. After much discussion it was decided that the biota was best treated in three distinct parts: 1) the flora, 2) the vertebrate fauna, and 3) the invertebrate fauna. The flora recently was reviewed by Shetler et al. (2006), and a summary of the vertebrate fauna is in progress. The purpose of this volume is to provide an overview of our knowledge of the invertebrate fauna of Plummers Island and the adjacent mainland property. The overall goal is to provide new findings and summaries of previously published studies in the context of a collection of contributed papers. The contributions to this volume deal with seven different phyla as defined by Brusca & Brusca (2003): Cnidaria, Platyhelminthes, Nematoda, Annelida, Arthropoda, Bryozoa, and Mollusca, with the greatest number of contributions on Arthropoda. The volume also includes an appendix that lists over 3100 invertebrates documented from the site, along with the source of the documentation (e.g., literature citation, collection, etc.). Owing to the immensity of the invertebrate fauna, the inventory is far from complete. Actually, for many large groups it barely scratches the surface, and for some phyla there are no data at all. The Club hopes that conspicuous shortcomings and gaps in the knowledge of the invertebrate fauna will stimulate others to explore and document the diversity of various poorly studied groups on the Island.

The study methods used in each of the contributions to this volume are discussed in the individual papers. However, many of the inventories and/or annotated lists of species are based on an examination of specimens deposited in the collections of the USNM. The rich historical collections of insects in that institution from Plummers Island have been augmented in recent years by blacklight trapping (1998–2006), Malaise trapping (2005–2006), and limited diurnal collecting (2005–2006), primarily by entomologists associated with the USNM. However, considerable field work over the last decade also has focused on land snails, nematodes, copepods, crayfish,

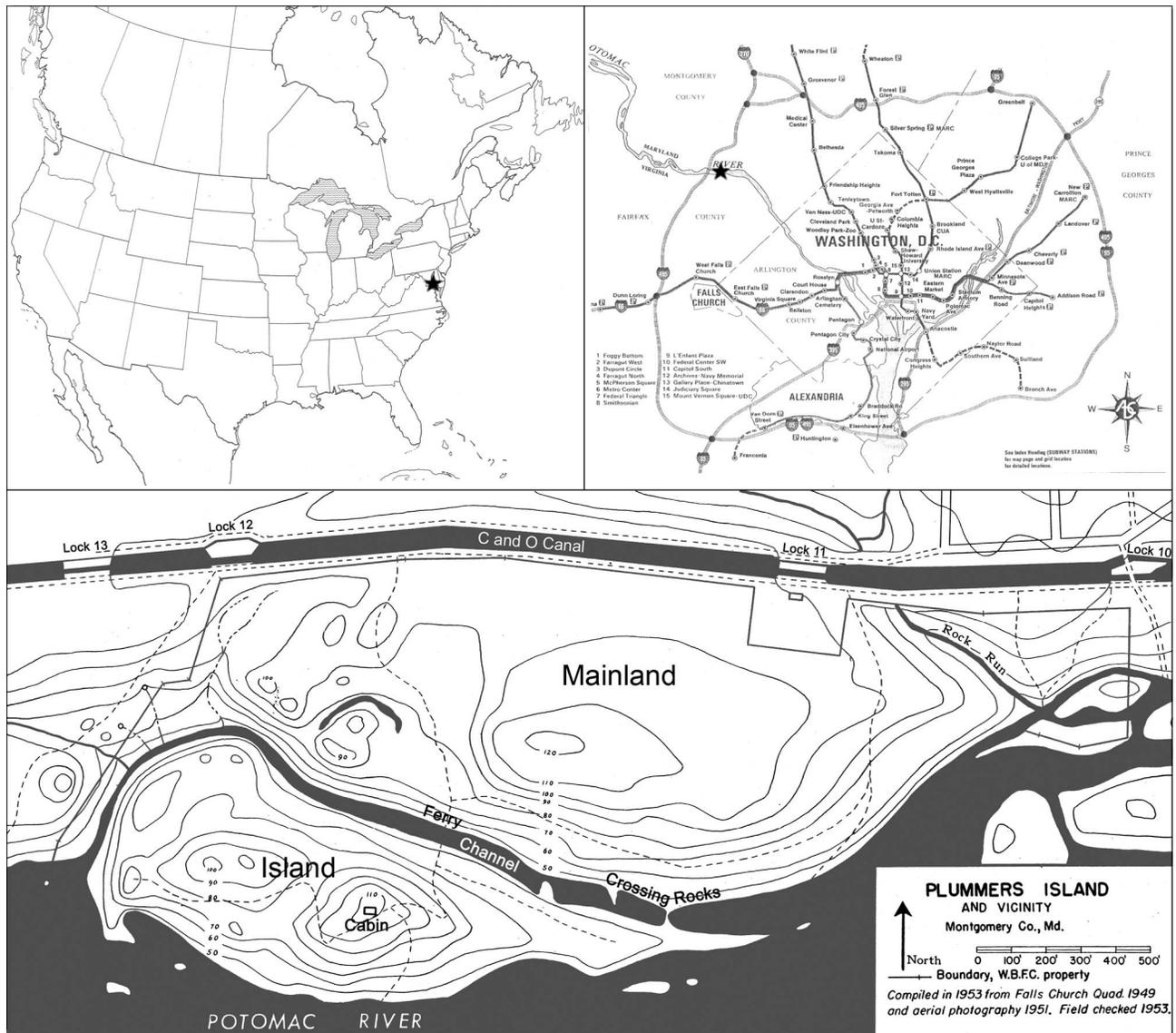


Fig. 1. Location and map of Plummers Island, Montgomery County, Maryland.

terrestrial isopods, and several other groups. The purpose of the section below is to provide general background on site characteristics, sources of invertebrate data, and a brief review of the history of entomological collecting and research on the invertebrate fauna.

Background

Study site.—Plummers Island (Fig. 1) is a 4.8-hectare land feature located along the northern bank of the Potomac River in Montgomery County, Maryland, approximately 14.5 km northwest of The Mall, Washington, D.C., at 39.969°N, 77.177°W. The base of the Island lies at approximately 239 m above mean sea level (amsl); the highest point is 262 m amsl. The Island is delineated from the mainland by a narrow channel (50–100 feet wide) of the Potomac River, with places that can be crossed by foot during low water (usually May through September). The adja-

cent mainland property (14.2 hectares) features a small creek that flows through a fairly deep ravine and three interconnected vernal ponds.

The Island historically was referred to as “win-nemana,” an Indian name meaning “beautiful island.” This name was used as the specific or subspecific epithet for several taxa described from the Island.

Shetler et al. (2006) identify and describe the three main plant communities: riparian, terrace, and upland forest. That treatment provides ample details on the vegetation, flora, and history of botanical investigations on the site.

At the beginning of the 20th century there was a small swamp near Rock Run and approximately 3.2 hectares of cultivated fields, both on the mainland, but these have undergone succession to the subclimax woods present today. Likewise, the Island itself

once supported an open field and a small swamp near the Ferry Towpath, both of which have reverted to subclimax woods. See Erwin (1981) and Maxon (1935) for further historical descriptions of the study area. For purposes of the papers included in this volume, the term Plummers Island generally refers to both the Island proper and the adjacent mainland property south of the C&O Canal (19 hectares).

Historical use.—The Washington Biologists' Field Club, established in 1901 with the goal of encouraging the study of natural history in the Washington, D.C. area, originally leased (in 1901) and eventually purchased (in 1907) Plummers Island and the adjacent mainland parcel. For several years after taking possession of the property, the Club leased a 3.2-hectare open field area to local residents and Club members who used it for gardening. Around 1907, the Club decided to prohibit all human modifications, and the field was abandoned. The field rapidly was invaded by pines (Maxon 1935) and subsequently reverted to the complex of oak, hickory, and maple present today. Cleared areas on the Island presumably were abandoned before purchase by the Club, as described by Erwin (1981). Early photographs show scattered *Juniperus virginiana*, a common inhabitant of abandoned open areas, and the descriptions of several insect species from the Island with the specific epithet "juniperana" or similar names indicate this plant species probably was common on the site. A little gardening was attempted by Club members during World War I. As part of a proposed project to establish an "Arboretum Columbianum" on the mainland property a number of shrubs, trees, and vines of the region were transplanted there, but these activities were curtailed (Perry 2007). Only a very few of the rarest local plants, such as hemlock, white and table mountain pines, and rhododendron, were planted on the Island itself, where the Club intended nature to take its course (Perry 2007).

Members and collectors.—The Club boasts a rich heritage of noted entomologists. Among the early members (ca. 1901–1930) was August Busck, a lepidopterist employed by the U.S. Department of Agriculture at the USNM. Although Busck published no "inventory" of any lepidopteran group on the Island, his systematic treatments, along with those of his co-worker, Carl Heinrich, frequently included descriptions of new species taken on Plummers Island (e.g., Busck 1906a, b, 1907a, b, 1908, 1909; Heinrich 1923, 1926). Later Club members, including J. F. G. (Jack) Clarke (active in the 1950s–1980s) (USDA and then Department of Entomology, USNM), Donald Davis (active in the 1960s–2000s) (Department of Entomology, USNM), and Ronald Hodges (active in the 1960s–1990s) (Systematic Entomology Laboratory, USDA, USNM) continued the accumulation of Lepidoptera specimens from the Island. Systematic

treatments by these lepidopterists, likewise, frequently included descriptions of new species or records from Plummers Island (e.g., Clarke 1941, Hodges 1962a, b, 1964, 1969). Most recently, the lepidopteran fauna has been sampled and/or studied by John Brown, Michael Pogue, and Alma Solis (1998–2005) (all Systematic Entomology Laboratory, USDA, USNM). To date, the only family of Lepidoptera thoroughly inventoried from the Island is Tortricidae (Brown 2001). Most recent field work has been supported by grants from the Club, which include small honoraria for students and interns, who have assisted in collecting, sorting, curating, and databasing.

Among the most active early dipterists were Raymond Shannon, John Malloch, and Fred Knab, but specimens of Diptera also were collected by many early generalist collectors including Herbert Barber, Albert Fisher, Waldo McAtee, William Palmer, and several others. As with most insect groups, collecting waned by the late 1920s. Following nearly 25 years of limited or no field work on the Island's Diptera, several insect collectors, some of which were not dipterists, were active in the last half of the century: Curtis Sabrosky (in 1949), Karl Krombein (in 1960–1971), George Steyskal (in 1963), Paul Spangler (in 1968), Paul Hurd (in 1971–1972), and F. Christian Thompson (in 1971). Exceedingly few specimens were collected from 1973–2005. Early dipterists spear-headed a series of publications on the flies of the Washington, D.C. area in which species collected on Plummers Island were specifically noted, e.g., Knab & Shannon (1916), Banks et al. (1916), McAtee & Walton (1918), McAtee & Banks (1920), Malloch & McAtee (1924), Cole et al. (1924), and Malloch et al. (1931). Later papers that mention specimens from Plummers Island include those by Steyskal (1963), Robinson (1967), a three-part study on the family Ceratopogonidae (Wirth et al. 1977; Wirth & Grogan 1979, 1981), and several others.

Hymenoptera of the Island were sampled from about 1902 to 1919 by James Crawford, a specialist on bees, chalcids, and thrips, who succeeded William Ashmead as assistant curator and later associate curator at USNM. Henry Viereck, also a noted hymenopterist, collected on the Island from about 1910 to about 1923. The bee and wasp fauna was sampled more sparingly by several early generalist collectors such as W. L. McAtee, L. O. Jackson, A. H. Pottinger, R. A. Cushman, and others. Through the 1930s, 1940s, and 1950s little or no collections of Hymenoptera were made on the site. However, the 1960s and 1970s saw a renewed enthusiasm for the Island's bees and wasps, with large numbers of specimens collected by Karl Krombein (in the 1960s–1970s) and Paul Hurd (in 1971). Krombein was the most prolific publisher on the entomofauna of Plummers Island, in particular the wasps, contributing numerous

biological studies (Krombein 1959, 1962b, 1963b, d, 1964a, b, 1967), descriptions of new species (Krombein 1962a, 1963a), and an annotated list of the wasps (Krombein 1963c). In the 1980s Ronald McGinley, former curator of Entomology at USNM, focused his collecting activities on the bees of the Island; additional collecting was done for McGinley by Beth Norden (in 1986) with funding from the Club. In addition to the published work by Krombein, systematic and/or biological studies citing specimens from Plummerville Island include those by Crawford (1909), Viereck (1912), Barber (1951), Baker (1962), Fischer (1967), McComb (1967), Muesebeck (1963), Ribble (1968), and Smith (1969) among others.

Coleoptera were sampled in the early years by two local beetle enthusiasts, Herbert Barber and Eugene Schwarz. Beetles also were collected by several other entomologists and/or naturalists with a greater interest in other groups, e.g., Albert Fisher, Fred Knab, Waldo McAtee, William Palmer, and Raymond Shannon. As with most insect groups, collecting waned from about 1930 to about 1960. In the 1960s Paul Spangler, Curator of Entomology at USNM, was active on the Island; he published a paper on the life history of a predaceous diving beetle (Spangler 1962). The 1970s saw a resurgence of collecting on the site spear-headed by Terry Erwin and colleagues (e.g., Gary Hevel, D. E. Thompson, and Donald Whitehead). Much of this labor supported a paper on the Carabidae by Erwin (1981), which is a model treatment of a local fauna. Erwin (1981) chronicled the change in the carabid beetle fauna from 1900 to 1980, identifying morphological and ecological characteristics of particular species that either succumbed to, or were unaffected by local habitat changes. Erwin's (1981) study was augmented by additional records of carabid beetles by Stork (1984). Most recently Charles Staines (Staines 2004, Staines & Staines 1998) has inventoried the leaf-beetles (Chrysomelidae) of the Island. Material from Plummerville Island has been used in numerous revisions and other published treatments on Coleoptera, both historical and contemporary, including Jeannel (1963), Karren (1966), Butte (1968a, b, c), Peck (1982), Staines & Staines (1999), Steiner (2000), Hoffman et al. (2002), and others.

Heteroptera were collected by the same cast of characters that collected other orders in the early days, e.g., Barber, McAtee, Schwarz, Shannon, and others, with few samples gathered after about the 1920s. Other smaller insect groups that received attention include Dermaptera (earwigs) (McAtee & Caudell 1917), Orthopteroidea (grasshoppers, crickets, and relatives) (McAtee & Caudell 1917 and numerous references included therein), Thysanoptera (thrips) (Hood 1917), Membracidae (tree-hoppers)

(McAtee 1921), Cercopidae (spittle-bugs) (McAtee 1920), Cicadidae (cicadas) (McAtee 1927), Diaspididae (scale insects) (McComb 1963), Aphididae (aphids) (Leonard 1966, 1968), and Siphonaptera (fleas) (Fox 1940). Odonata (dragonflies and damselflies) are among the better studied insect groups on the Island. They were treated initially by Donnelly (1961) in his survey of the Odonata of the Washington, D.C. area and subsequently were the subject of focused survey work by Orr (1994, 1995).

Non-insect invertebrates of Plummerville Island are mentioned in a few published and unpublished accounts, e.g., copepods (Reid 1997), freshwater mollusks (Fuller 1978), nematodes (Cobb 1920), crayfish (Hart 1964), terrestrial isopods (Lohmander 1927), and tetranychoid mites (McComb & Bram 1963).

The vast majority of the insect specimens collected on Plummerville Island, both historically and recently, are deposited in the collection of the USNM. Under contract to National Park Service, the Department of Entomology engaged in "data-mining" activities in 2003–2004 to discover and database target groups of insects (i.e., Coleoptera, Diptera, Lepidoptera, Hemiptera, and Hymenoptera) from Plummerville Island deposited in the collection. The results of these efforts are summarized in an unpublished report submitted to the National Park Service (NPS) (Brown & Bahr 2005). A similar contract to the USNM Department of Invertebrate Zoology, administered by Cheryl Bright, the collections manager for the department, yielded 18 records of miscellaneous invertebrates from Plummerville Island.

Appendix.—The appendix to this volume is a list of species recorded from Plummerville Island based on the data-mining and literature-review activities funded by NPS and the species treated in the contributions to this volume. Classes and orders are listed in a somewhat phylogenetic sequence following that presented by Brusca & Brusca (2003). Families within each order are listed alphabetically for ease of retrieval by the non-specialist. Likewise, species are listed alphabetically within each family. The general arrangement of taxa (e.g., assignment of species to genera, assignment of genera to families, recognized synonymies, etc.) is based primarily on standard catalogs for the North American fauna, most of which are mentioned in specific contributions. For example, the Lepidoptera (butterflies and moths) follow Hodges (1983), with a few deviations as proposed by Hodges (1998). For each species, the source of the record for Plummerville Island is indicated (e.g., USNM collection, literature, etc.), and the references are included in the "Literature Cited" section of the appendix. Species described from Plummerville Island are noted by an asterisk (*) in the appendix.

The appendix represents only a portion of the actual invertebrate fauna of Plummerville Island. Many

groups have not yet been sampled on the Island, and other groups are well sampled but museum records have not been captured. Many groups apparently were well sampled around the turn of the century, but there are exceedingly few recently collected specimens. Hence, for many groups we have considerable knowledge of the historical fauna, but we know very little about the current fauna.

Discussion

Although the results of “long-term” biological inventories abound in the literature (e.g., Powell 1995), few of these include data that span greater than 50 years, and most focus on a specific order or family. Notable examples of long-term invertebrate studies in North America include Jones & Kimball’s (1943) survey of the Lepidoptera of Martha’s Vineyard and Nantucket, Massachusetts; Proctor’s (1946) inventory of the insects of Mount Desert Island, Maine; and Brower’s (1974, 1983, 1984) list of the Lepidoptera of Maine based on data gathered over “52 years of dedicated work in Maine” (Brower 1983). In this context, the invertebrate data compiled from Plummers Island since 1901 are not as thorough as those inventories because of the uneven taxonomic coverage and sporadic sampling efforts. Nonetheless, these data represent a unique opportunity to examine changes in the fauna over an entire century.

Since 1900, the biota of Plummers Island has changed dramatically in response to both natural and anthropogenic forces. Protection of the site in the form of prohibiting activities that degrade habitat (i.e., man-made disturbance) has led to a gradual natural succession in the vegetation from a heterogeneous patchwork of disturbed and native habitats to a somewhat homogeneous, subclimax, oak-hickory-maple woodland. Occasional seasonal flooding scours the shoreline, maintaining some successional habitats along the Island’s edges. In general, natural processes have been allowed to progress with little or no interference.

The few contemporary inventories of insects on Plummers Island (e.g., Erwin 1981, Brown 2001, Staines 2004) strongly implicate plant community succession as the causal factor for declines in species richness over the last 100 years. The hypothesis that changes in the fauna are the result of changes in plant species composition, plant architecture, and plant community succession is consistent with the proposal that “habitat maturation” is the mechanism behind declines of several bird species (e.g., Karr 1968, Morgan & Freedman 1987, Hunt 1998), bird faunas (e.g., Willis 1974, Karr 1982, Johnston & Winings 1987, Robinson 1999), and mammal species (e.g., Litvaitis 1993) that require early successional habitat in the northeastern United States. The importance of

habitat heterogeneity for the conservation of insect species richness was discussed by Morris & Web (1987). Hence, the natural process of habitat maturation or succession may be responsible, in part, for declines in species richness of some invertebrate taxa. Natural events such as flooding, likewise, diminish the species richness of aquatic invertebrates, but these changes typically are more short-term.

Anthropogenic influences on the Island are primarily indirect and include the widespread development and associated habitat fragmentation of the region in general over the last 100 years. While the effects of urbanization are considerable, they have been mitigated, at least in part, by the presence of a broad corridor of native vegetation that remains along both sides of the Potomac River. A more significant impact at the local level was the construction of the American Legion bridge (completed between 1963–1965) which spans the Potomac River immediately west of the Island. Traffic on the bridge almost certainly is responsible for some habitat degradation via air pollution (e.g., Lawrey & Hale 1979, 1981; Lawrey 1993), noise pollution, and light pollution (Frank 1988), but the effect of these perturbations on the invertebrate fauna is difficult or impossible to quantify. Lawrey & Hale (1979) and Lawrey (1993) demonstrated that emissions from automobile traffic had a significant detrimental effect on the growth of lichens on the Island and in the region, and for phytophagous or plant-feeding insects, air pollution likely has had a similar effect on their food plants, reducing population density of some species and perhaps eliminating a few highly sensitive or vulnerable species. For example, Lithosiinae (Lepidoptera: Arctiidae) feed almost exclusively on lichens and therefore, likely have been affected adversely.

The impact of invasive, non-native, or pest invertebrates on the Island appears to be minimal. Lepidopteran species such as army worms (*Spodoptera* spp.) and budworms (*Choristoneura fumiferana* and relatives) that are important pests in the region generally are rare on the Island, but gypsy moth (*Lymantria dispar*) was abundant in 2006 based on visual observations and pheromone trapping. Two recent invaders from the Palaearctic recently documented from the Island, the large yellow underwing moth (*Noctua pronuba*; Lepidoptera: Noctuidae) (Neil 1981, Passoa & Hollingsworth 1996) and *Agonopterix alstroemeriana* (Lepidoptera: Elachistidae) (Berenbaum & Passoa 1983, Powell & Passoa 1991), appear to have had no effect on the local fauna. In contrast, it is possible that *Compsilura concinnata* (Diptera: Tachinidae), a parasitoid fly introduced into North America for control of gypsy moth, has taken its toll on the large moth fauna (e.g., Saturniidae, Sphingidae, Lymantriidae) as it has elsewhere

in the northeastern U.S.A. (e.g., Boettner et al. 2000), but this is not quantified on the Island. The papers in this volume document many other invasive species in various phyla, and some include comments on the potential impact of those animals.

Management is a critical component for the maintenance of species richness in native landscapes in fragmented or urbanized areas. However, before meaningful management strategies can be developed and implemented, it is imperative to know and understand the biotic elements to be conserved. Biotic inventories represent an important and critical first step in this process. The historical collections of biological specimens from Plummers Island provide a unique opportunity to evaluate changes in the biota over the past 100 years in the context of human activity on the Island. These data shed light on the consequences of passive management and hence, may be useful in developing management strategies for the long-term conservation of the local biota of this and similar sites. Inventories must be a continuous process, for just as the historical data provide clues to the past, data gathered today will serve as a baseline critical for assessing changes in the future.

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Literature Cited

- Baker, E. W. 1962. Natural History of Plummers Island, Maryland, XV. Descriptions of the stages of *Chaetodactylus krombeini*, new species, a mite associated with the bee, *Osmia lignaria* Say (Acarina: Chaetodactylidae).—Proceedings of the Biological Society of Washington 75:227–236.
- Banks, N., C. T. Greene, W. L. McAtee, & R. C. Shannon. 1916. District of Columbia Diptera: Syrphidae.—Proceedings of the Biological Society of Washington 29:173–204.
- Barber, H. S. 1951. North American fireflies of the genus *Photuris*.—Smithsonian Miscellaneous Collections 117, vi + 58 pp.
- Berenbaum, M., & S. Passoa. 1983. Notes on the biology of *Agonopterix alstroemeriana* (Clerck) with descriptions of the immature stages (Oecophoridae).—Journal of the Lepidopterists' Society 37:38–45.
- Boettner, G. H., J. S. Elkinton, & C. J. Boettner. 2000. Effects of a biological control introduction on three nontarget native species of saturniid moths.—Conservation Biology 14: 1798–1806.
- Brady, M. K. 1937. Natural History of Plummers Island, Maryland, VI. Reptiles and amphibians.—Proceedings of the Biological Society of Washington 50:137–139.
- Brower, A. E. 1974. A list of the Lepidoptera of Maine—Part 1 The Macrolepidoptera.—Maine Agricultural Experiment Station, Technical Bulletin 66, 136 pp.
- . 1983. A list of the Lepidoptera of Maine—Part 2 The Microlepidoptera Section 1 Limacodidae through Cossidae.—Maine Agricultural Experiment Station, Technical Bulletin 109, 60 pp.
- . 1984. A list of the Lepidoptera of Maine—Part 2 The Microlepidoptera Section 2 Cosmopterigidae through Hespialidae.—Maine Agricultural Experiment Station, Technical Bulletin 114, 70 pp.
- Brown, J. W. 2001. Species turnover in the leafrollers (Lepidoptera: Tortricidae) of Plummers Island, Maryland: Assessing a century of inventory data.—Proceedings of the Entomological Society of Washington 103:673–685.
- . 2005. Long-term data show declines in insect composition on Plummers Island, Chesapeake and Ohio Canal National Historic Park.—Natural Resource Year In Review-2004:69.
- , & S. Bahr, II. 2005. Compiling and analyzing historical insect data for Plummers Island, Maryland. Unpublished report submitted to the United States National Park Service, Washington, D.C., 15 June 2005, 135 pp.
- Brusca, R. C., & G. J. Brusca. 2003. Invertebrates, second edition. Sinauer Associates, Inc., Sunderland, Massachusetts, 936 pp.
- Busck, A. 1906a. Notes on some tortricid genera with descriptions of new American species.—Proceedings of the Biological Society of Washington 19:173–182.
- . 1906b. New American Tineina.—Canadian Entomologist 38:121–125.
- . 1907a. A review of the tortricid subfamily Phaloniinae with descriptions of new American species.—Journal of the New York Entomological Society 15:19–36.
- . 1907b. New genera and species of American Microlepidoptera.—Journal of the New York Entomological Society 15:134–140.
- . 1908. A generic revision of American moths of the family Oecophoridae with descriptions of new species.—Proceedings of the United States National Museum 35(1644):187–207.
- . 1909. Notes on Microlepidoptera, with descriptions of new North American species.—Proceedings of the Entomological Society of Washington 11:87–103.
- Butte, J. G. 1968a. Revision of the tribe Chalepini of America north of Mexico (Coleoptera: Chrysomelidae). I. Genus *Xenochalepus* Weise.—Coleopterists Bulletin 22:45–62.
- . 1968b. Revision of the tribe Chalepini of America north of Mexico (Coleoptera: Chrysomelidae). II. Genus *Chale-*

- pus* Thunberg.—Journal of the New York Entomological Society 76:117–133.
- . 1968c. Revision of the tribe Chalepini of America north of Mexico (Coleoptera: Chrysomelidae). III. Genus *Odon-tota* Chevrolat.—Coleopterists Bulletin 22:101–124.
- Clarke, J. F. G. 1941. Revision of the North American moths of the family Oecophoridae, with descriptions of new genera and species.—Proceedings of the United States National Museum 90:33–286.
- Cobb, N. A. 1920. One hundred new names.—Contributions to the Science of Nematology 9:215–243.
- Cole, F. R., J. R. Malloch, & W. L. McAtee. 1924. District of Columbia Diptera: Tromoptera (Cyrtidae, Bombyliidae, Therevidae, Scenopidae).—Proceedings of the Entomological Society of Washington 26:181–195.
- Cooke, M. T. 1929. Birds of the Washington, D.C., region.—Proceedings of the Biological Society of Washington 42:1–80.
- Crawford, J. C. 1909. A new family of parasitic Hymenoptera.—Proceedings of the Entomological Society of Washington 11:63–64.
- Donnelly, T. W. 1961. The Odonata of Washington, D.C., and vicinity.—Proceedings of the Entomological Society of Washington 63:1–13.
- Drouet, F. 1954. Natural History of Plummers Island, Maryland, XI. Blue-green algae (Myxophyceae).—Proceedings of the Biological Society of Washington 67:239–241.
- Erwin, T. L. 1981. Natural History of Plummers Island, Maryland, XXVI. The ground beetles of a temperate forest site (Coleoptera: Carabidae): An analysis of fauna in relation to size, habitat selection, vagility, seasonality, and extinction.—Bulletin of the Biological Society of Washington 5: 104–224.
- Fischer, M. 1967. Die nearktischen Arten der Gattung *Synaldis* (Hymenoptera, Braconidae, Alysiinae).—Polskie Pismo Entomologiczne 37:431–478.
- Fisher, A. K. 1935. Natural History of Plummers Island, Maryland, IV. Birds.—Proceedings of the Biological Society of Washington 48:159–167.
- Fox, I. 1940. Fleas of eastern United States. Iowa State College Press, Ames, 191 pp.
- Frank, K. D. 1988. Impact of outdoor lighting on moths: an assessment.—Journal of the Lepidopterists' Society 42:63–93.
- Fuller, S. L. H. 1978. Changes in the molluscan community of the Middle Potomac River during the past two decades. Pp. 124–131 in K. C. Flynn & W. T. Mason, eds., Biological resources of the Potomac Basin streams. Interstate Commission on the Potomac River Basin, Rockville, Maryland, 194 pp.
- Gardner, M. C. 1950a. A list of Maryland mammals. Part 1, marsupials and insectivores.—Proceedings of the Biological Society of Washington 63:65–68.
- . 1950b. A list of Maryland mammals. Part II, bats.—Proceedings of the Biological Society of Washington 63:111–114.
- Goldman, E. A., & H. H. T. Jackson. 1939. Natural History of Plummers Island, Maryland, IX. Mammals.—Proceedings of the Biological Society of Washington 52:131–134.
- Hale, M. E. 1970. Single-lobe growth-patterns in the lichen *Parmelia caperata*.—The Bryologist 73:72–81.
- . 1972. Natural History of Plummers Island, Maryland, XXI. Infestation of the lichen *Parmelia baltimorensis* Gyl. & For. by *Hypogastrura packardi* Folsom (Collembola).—Proceedings of the Biological Society of Washington 85: 287–296.
- Hart, C. W. 1964. Two new entocytherid ostracods from the vicinity of Washington, D.C.—Proceedings of the Biological Society of Washington 77:243–246.
- Heinrich, C. 1923. Revision of the North American moths of the subfamily Eucosminae of the family Olethreutidae.—United States National Museum Bulletin 123, 298 pp.
- . 1926. Revision of the North American moths of the sub-families Laspeyresiinae and Olethreutinae.—United States National Museum Bulletin 132, 216 pp.
- Hodges, R. W. 1962a. The genus *Perimede* Chambers in North America.—Proceedings of the Entomological Society of Washington 64:145–154.
- . 1962b. A review of the genus *Periploca* with descriptions of nine new species.—Pan-Pacific Entomologist 38:83–97.
- . 1964. A review of the North American moths of the family Walshiiidae.—Proceedings of the United States National Museum 115:289–330.
- . 1969. Nearctic Walshiiidae—notes and new taxa (Lepidoptera: Gelechioidea).—Smithsonian Contributions in Zoology 18, 30 pp.
- . (ed.). 1983. Check list of the Lepidoptera of America north of Mexico. E. W. Classey Limited and The Wedge Entomological Research Foundation, 284 pp.
- . 1998. Gelechioidea. Pp. 131–158 in N. P. Kistensen, ed., Handbook of Zoology, Volume IV Arthropoda: Insecta Part 35. Lepidoptera, Moths and Butterflies. Volume 1: Evolution, systematics, and biogeography. Walter de Gruyter, Berlin, New York, 487 pp.
- Hoffman, R. L., S. M. Roble, & W. E. Steiner, Jr. 2002. Thirteen additions to the known beetle fauna of Virginia (Coleoptera: Scirtidae, Bothrideridae, Cleridae, Tenebrionidae, Melyridae, Callirhipidae, Cerambycidae, Chrysomelidae).—Banisteria 20:53–61.
- Hood, J. D. 1917. An annotated list of the Thysanoptera of Plummer's [sic] Island, Maryland.—Insector Inscitiae Menstruus 5:53–65.
- Hunt, P. D. 1998. Evidence from a landscape population model of the importance of early succession habitat to the American redstart.—Conservation Biology 12:1377–1388.
- Janzen, D., & W. Hallwachs. 1994. All taxa biodiversity inventory (ATBI) of terrestrial systems. A generic protocol for preparing wildland biodiversity for non-damaging use. Website: www.all-species.org/content/reference/ATBI/Fin.Rep.8feb94.pdf. Accessed 15 March 2006.
- Jeannel, R. 1963. Supplément a la monographie des Anillini (1). Sur quelques espèces nouvelles de l'Amérique du Nord.—Revue Française d'entomologie 30:145–152.
- Johnston, D., & D. Winings. 1987. Natural History of Plummers Island. XXVII. The decline of forest breeding birds on Plummers Island, Maryland, and vicinity.—Proceedings of the Biological Society of Washington 100:62–768.
- Jones, F. M., & C. P. Kimball. 1943. The Lepidoptera of Nantucket and Martha's Vineyard.—Publication of the Nantucket Maria Mitchell Association 4, 217 pp.
- Kaiser, J. 1997. Unique, all-taxa survey in Costa Rica “self-destructs.”—Science 276:893.
- Kalmbach, E. R. 1968. An ornithological treasure awaits resurrection.—Auk 85:703–706.
- Karr, J. R. 1968. Habitat and avian diversity on strip-mined lands in east-central Illinois.—Condor 70:348–357.
- . 1982. Population variability and extinction in the avifauna of a tropical land bridge island.—Ecology 63:1975–1978.
- Karren, J. 1966. A revision of the genus *Exema* of America north of Mexico (Chrysomelidae, Coleoptera).—University of Kansas Science Bulletin 46:647–695.
- Killip, E. P. 1931. Plants recently discovered on Plummers Island as a result of low-water conditions.—Proceedings of the Biological Society of Washington 44:111–115.
- , & S. F. Blake. 1935. Natural History of Plummers Island, Maryland, II. Flowering plants and ferns.—Proceedings of the Biological Society of Washington 48:118–134.
- , & ———. 1953. Natural History of Plummers Island,

- Maryland, X. Flowering plants and ferns. Supplement 1.—Proceedings of the Biological Society of Washington 66: 31–38.
- Knab, F., & R. C. Shannon. 1916. Tanypezidae in the United States.—Insector Inscitiae Menstruus 4:33–36.
- Krombein, K. V. 1959. Natural History of Plummers Island, Maryland, XII. A biological note on *Trypoxylon richardsi* Sandhouse.—Proceedings of the Biological Society of Washington 72:101–102.
- . 1962a. Natural History of Plummers Island, Maryland, XIII. Descriptions of new wasps from Plummers Island (Hymenoptera: Aculeata).—Proceedings of the Biological Society of Washington 75:1–18.
- . 1962b. Natural History of Plummers Island, Maryland, XVI. Biological notes on *Chaetodactylus krombeini* Baker, a parasitic mite of the megachilid bee, *Osmaria (Osmia) lignaria* Say (Acarina: Chaetodactylidae).—Proceedings of the Biological Society of Washington 75:237–250.
- . 1963a. A new *Chrysura* from Plummers Island, Maryland (Hymenoptera, Chrysididae).—Entomological News 74: 149–152.
- . 1963b. Notes on the *Entomognathus* of eastern United States.—Proceedings of the Biological Society of Washington 76:247–254.
- . 1963c. Natural History of Plummers Island, Maryland, XVII. Annotated list of the wasps (Hymenoptera: Bethyloidea, Scolioidea, Vespoidea, Pompiloidea, Sphecoidea).—Proceedings of the Biological Society of Washington 76: 255–280.
- . 1963d. The host-parasite relationship of *Xylocelia virginiana* Rohwer and *Omalus intermedius* (Aaron).—Proceedings of the Entomological Society of Washington 65:264.
- . 1964a. Natural History of Plummers Island, Maryland, XVIII. The hibiscus wasp, an abundant rarity, and its associates (Hymenoptera: Sphecidae).—Proceedings of the Biological Society of Washington 77:73–112.
- . 1964b. Miscellaneous prey records of solitary wasps, V. (Hymenoptera: Aculeata).—Bulletin of the Brooklyn Entomological Society 58:118–120.
- . 1967. Trap-nesting wasps and bees: life histories, nests, and associates. Publication 4670, Smithsonian Press, vi + 570 pp.
- Lawrey, J. D. 1993. Lichens as monitors of pollutant elements at permanent sites in Maryland and Virginia.—Bryologist 96: 339–341.
- , & M. E. Hale. 1977. Natural History of Plummers Island, Maryland, XXIII. Studies on lichen growth rate at Plummers Island, Maryland.—Proceedings of the Biological Society of Washington 90:698–725.
- , & ———. 1979. Lichen growth responses to stress induced by automobile exhaust pollution.—Science 204:423–424.
- , & ———. 1981. Retrospective study of lichen lead accumulation in the northeastern United States.—Bryologist 84:449–456.
- Leonard, E. C. 1935. Natural History of Plummers Island, Maryland, III. Mosses.—Proceedings of the Biological Society of Washington 48:135–137.
- , & E. P. Killip. 1939. Natural History of Plummers Island, Maryland, VIII. Lichens.—Proceedings of the Biological Society of Washington 52:23–26.
- , & M. E. Pierce. 1939. Natural History of Plummers Island, Maryland, VII. Hepaticae.—Proceedings of the Biological Society of Washington 52:21–22.
- Leonard, M. D. 1966. Natural History of Plummers Island, Maryland, XIX. Annotated list of the aphids (Homoptera: Aphididae).—Proceedings of the Biological Society of Washington 79:117–126.
- . 1968. Further records of aphids from Plummers Island, Md. (Homoptera: Aphididae).—Proceedings of the Entomological Society of Washington 70:84.
- Litvaitis, J. A. 1993. Response of early succession vertebrates to historic changes in land use.—Conservation Biology 7:866–873.
- Lohmander, H. 1927. On some terrestrial isopods in the United States National Museum.—Proceedings U. S. National Museum 72 (2713), 18 pp.
- Long, E. J. 1957. A haven for the biologist is Plummers Island.—Nature Magazine 50:465–468.
- . 1966. The island.—American Forests 72:22–24, 59–61.
- Malloch, J. R., & W. L. McAtee. 1924. Flies of the family Drosophilidae of the District of Columbia region.—Proceedings of the Biological Society of Washington 37:25–42.
- , C. T. Greene, & W. L. McAtee. 1931. District of Columbia Diptera: Rhagionidae.—Proceedings of the Entomological Society of Washington 33:213–220.
- Manville, R. H. 1968. Natural History of Plummers Island, Maryland, XX. Annotated list of the vertebrates. Special Publication, Washington Biologists' Field Club, 44 pp.
- Maxon, W. R. 1935. Natural history of Plummers Island, Maryland, I. Introduction.—Proceedings of the Biological Society of Washington 48:115–138.
- McAtee, W. L. 1918. A sketch of the natural history of the District of Columbia.—Bulletin of the Biological Society of Washington 1, 109 pp.
- . 1920. Cercopidae of the vicinity of Washington, D.C., with the descriptions of new varieties of *Clastoptera* (Homoptera).—Proceedings of the Biological Society of Washington 33:171–176.
- . 1921. Membracidae of the vicinity of Washington, D.C.—Proceedings of the Biological Society of Washington 34: 123–134.
- . 1927. Cicadidae of the vicinity of Washington, D.C.—Proceedings of the Entomological Society of Washington 29:70–72.
- , & N. Banks. 1920. District of Columbia Diptera: Asilidae.—Proceedings of the Entomological Society of Washington 22:13–33.
- , & A. N. Caudell. 1917. First list of the Dermaptera and Orthoptera of Plummer's [sic] Island, Maryland, and vicinity.—Proceedings of the Entomological Society of Washington 19:100–122.
- , & A. C. Weed. 1915. First list of the fishes of the vicinity of Plummers Island, Maryland.—Proceedings of the Biological Society of Washington 28:1–14.
- , & W. R. Walton. 1918. District of Columbia Diptera: Tabanidae.—Proceedings of the Entomological Society of Washington 20:188–206.
- McComb, C. W. 1963. A checklist and host index of the Diaspididae of Maryland and the District of Columbia.—University of Maryland, Entomology Leaflet 50, 38 pp. mimeograph.
- . 1967. A revision of the *Chelonus* subgenus *Microchelonus* in North America north of Mexico (Hymenoptera: Braconidae).—University of Maryland Agricultural Experiment Station, Bulletin A149, 148 pp.
- , & R. A. Bram. 1963. A checklist and host index of the tetranychoid mites of Maryland and nearby areas.—University of Maryland, Entomology Leaflet 49, 20 pp. mimeograph.
- Miller, G. 2005. Taxonomy: Linnaeus's legacy carries on.—Science 307:1038–1039.
- Morgan, K., & B. Freedman. 1987. Breeding bird communities in a hardwood forest succession in Nova Scotia.—Canadian Field Naturalist 100:506–519.
- Morris, M. G., & N. R. Web. 1987. The importance of field mar-

- gins for the conservation of insects. In M. Way & P. W. Grieg-Smith, eds., *Field Margins*. BCPC Monograph No. 35. BCBP Publications, Thornton Heath.
- Muesebeck, C. F. W. 1963. A platygasterid parasite of certain wasp larvae.—*Beiträge zur Entomologie* 13:391–394.
- Neil, K. 1981. The occurrence of *Noctua pronuba* (L.) in Nova Scotia: a new North American record.—*Journal of the Lepidopterists' Society* 35:248.
- Orr, R. L. 1994. Baseline survey of Odonata (dragonflies and damselflies) of the C&O Canal National Historical Park (Potomac River Corridor). Unpublished report to C&O National Historical Park, 16 October 1994.
- . 1995. Odonata of Plummers Island.—*Argia* 7:6–8.
- Perry, M. C. (ed.). 2007. *The Washington Biologists' Field Club: Its Members and Its History (1900–2006)*. Washington Biologists' Field Club, Washington, D.C., x + 342 pp.
- Passoa, S., & C. S. Hollingsworth. 1996. Distribution, identification and rate of spread of *Noctua pronuba* (Lepidoptera: Noctuidae) in the northeastern United States.—*Entomological News* 107:151–160.
- Peck, S. B. 1982. A review of the ectoparasitic beetles of North America (Coleoptera: Leptinidae).—*Canadian Journal of Zoology* 60:1517–1527.
- Pickering, J. 1997. *Sciencescope—Smoky Mountains all taxa survey proposed*.—*Science* 278:1871.
- Powell, J. A. 1995. Lepidoptera inventories in the continental United States. Pp. 168–170 in E. LaRoe, G. Farris, C. Puckett, D. Doran, & M. Mac, eds., *Our living resources*. U.S. Department of Interior, Washington, D.C.
- , & S. Passoa. 1991. Rapid colonization of the western United States by the Palearctic moth, *Agonopterix alstroemeriana* (Oecophoridae).—*Journal of the Lepidopterists' Society* 45:234–236.
- Proctor, W. 1946. Biological survey of Mount Desert region. Part VII. The insect fauna. *Wistar Institute of Anatomy and Biology*, Philadelphia, 566 pp.
- Reid, J. W. 1997. Bio-Blitz 97: Copepod Crustaceans. Unpublished report to Superintendent, Chesapeake and Ohio Canal National Historical Park, June 1997.
- Ribble, D. W. 1968. Revision of two subgenera of *Andrena*: *Micrandrena* Ashmead and *Derandrena*, new subgenus (Hymenoptera: Apoidea).—*Bulletin of the Nebraska State Museum* 8:237–394.
- Robinson, D. 1999. Long-term changes in the avifauna of Barro Colorado Island, Panama, a tropical forest isolate.—*Conservation Biology* 13:85–97.
- Robinson, H. 1967. New species of Dolichopodidae from the United States and Mexico (Diptera).—*Proceedings of the Entomological Society of Washington* 69:114–127.
- Shetler, S. G., S. S. Orli, E. F. Wells, & M. Beyersdorfer. 2006. Checklist of the vascular plants of Plummers Island, Maryland. Contribution XXVIII to the Natural History of Plummers Island, Maryland.—*Bulletin of the Biological Society of Washington* 14, 58 pp.
- Smith, D. R. 1969. Nearctic sawflies I. Blennocampinae: Adults and larvae (Hymenoptera: Tenthredinidae).—*United States Department of Agriculture Technical Bulletin No. 1397*, 179 pp. + 19 pls.
- Spangler, P. J. 1962. Biological notes and description of the larva and pupa of *Copelatus glyphicus* (Say) (Coleoptera: Dytiscidae). *Natural History of Plummers Island, Maryland, XIV.—Proceedings of the Biological Society of Washington* 75:19–24.
- Staines, C. L. 2004. Changes in the chrysomelid (Coleoptera) community over a 95-year period on a Maryland river island (USA). Pp. 613–622 in P. Jolivet, J. A. Santiago-Blay, & M. Schmitt, eds., *New developments in the biology of Chrysomelidae*. Academic Publishing, The Hague.
- , & S. L. Staines. 1998. The leaf beetles (Insecta: Coleoptera: Chrysomelidae): potential indicator species assemblages for natural area monitoring. Pp. 233–244 in G. D. Therres, ed., *Conservation of biological diversity: A key to the restoration of the Chesapeake Bay Ecosystem and beyond*. Maryland Department of Natural Resources, Annapolis, Maryland.
- , & ———. 1999. Observations on *Euphoria inda* (L.) (Insecta: Coleoptera: Scarabaeidae).—*Maryland Naturalist* 43: 31–33.
- Starnes, W. 2002. Current diversity, historical analysis, and biotic integrity of fishes in the lower Potomac basin in the vicinity of Plummers Island, Maryland—Contribution to the natural history of Plummers Island, Maryland XXVII.—*Proceedings of the Biological Society of Washington* 115:273–320.
- Steiner, W. E., Jr. 2000. Records and habitat of the “rare click beetle,” *Cerophytum pulsator* (Haldeman), in Virginia and Maryland (Coleoptera: Cerophytidae).—*Banisteria* 15:43–45.
- Stevenson, J. A., & E. M. Ermold. 1936. *Natural History of Plummers Island, Maryland, V. Fungi*.—*Proceedings of the Biological Society of Washington* 49:123–131.
- Stewart, R. E., & C. S. Robbins. 1958. *Birds of Maryland and the District of Columbia*. United States Department of Interior, North American Fauna 62, 401 pp.
- Steyskal, G. C. 1963. A second North American species of *Traginops* Coquillett.—*Proceedings of the Entomological Society of Washington* 49:51–54.
- Stork, N. E. 1984. Additions to the list of Carabidae (Coleoptera) in the fauna of Plummers Island, Maryland.—*Coleopterists Bulletin* 28:137–141.
- Viereck, H. L. 1912. Descriptions of one new family, eight new genera, and thirty-three new species of ichneumon-flies.—*Proceedings of the United States National Museum* 43:575–593.
- Willis, E. O. 1974. Populations and local extinctions of birds on Barro Colorado Island, Panama.—*Ecological Monographs* 44:153–169.
- Wirth, W. W., & W. L. Grogan. 1979. *Natural History of Plummers Island, Maryland, XXIV. Biting midges (Diptera: Ceratopogonidae)*. 2. The species of the tribes Heteromyiini and Sphaerominini.—*Proceedings of the Biological Society of Washington* 91:847–903.
- , & W. L. Grogan. 1981. *Natural History of Plummers Island, Maryland, XXV. Biting midges (Diptera: Ceratopogonidae)*. 3. The species of the tribe Stilobezziini.—*Bulletin of the Biological Society of Washington* 5, 102 pp.
- , N. C. Ratanaworabhan, & D. H. Messersmith. 1977. *Natural History of Plummers Island, Maryland, XXII. Biting midges (Diptera: Ceratopogonidae)*. 1. Introduction and key to genera.—*Proceedings of the Biological Society of Washington* 90:615–647.