

# Sawflies (Hymenoptera, Symphyta) of three Mid-Atlantic Parks in the George Washington Memorial Parkway, U.S.A.

Edward M. Barrows<sup>1</sup>, David R. Smith<sup>2</sup>

<sup>1</sup> *Department of Biology and the Center for the Environment, Georgetown University, Box 571229, Washington, D.C.; Research Associate, Department of Entomology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20013-7012* <sup>2</sup> *Research Associate, Department of Entomology, National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, MRC 168, Washington, D.C. 20013-7012*

Corresponding author: *Edward M. Barrows* ([barrowse@georgetown.edu](mailto:barrowse@georgetown.edu))

---

Academic editor: *Stefan Schmidt* | Received 15 May 2014 | Accepted 4 August 2014 | Published 26 September 2014

---

<http://zoobank.org/DCD45D1E-5D5A-4996-BC05-90E186726A45>

---

**Citation:** Barrows EM, Smith DR (2014) Sawflies (Hymenoptera, Symphyta) of three Mid-Atlantic Parks in the George Washington Memorial Parkway, U.S.A. *Journal of Hymenoptera Research* 39: 17–31. doi: 10.3897/JHR.39.7907

---

## Abstract

A diverse sawfly fauna of 176 species in 66 genera in 10 families occurred in three parks in the George Washington Memorial Parkway – Dyke Marsh Wildlife Preserve (DMWP), Great Falls Park (GFP), and Turkey Run Park (TRP). Adult sawflies flew from early March through mid-November. They included the rarely-collected *Kerita fidala* Ross, a leafminer of *Mertensia virginica* (L.) Pers. ex Link (Boraginaceae) and an unidentified *Caliroa* sp. which consumes *Staphylea trifolia* L. (Staphyleaceae). Nine of the collected species are alien ones in North America. Based on coefficients of community, DMWP was more similar to TRP than GFP, and GFP and TRP were more similar to one another than to DMWP. In DMWP, most species were uncommon in samples. Ninety-five percent of the reported host genera of the collected sawfly species occurred in all three of the parks.

## Keywords

Survey, species list, flight periods, abundance

## Introduction

Symphyla (sawflies) is a hymenopteran suborder of about 9,000 species in about 1,000 genera in 14 families (Taeger et al. 2010), which occurs in many terrestrial habitats worldwide. Sawfly larvae consume foliage, stems, and wood, and adults consume leaf pubescence, nectar, other insects, water, or a combination of these things, depending on the species (Smith 1979, 1993). Larvae are external leaf feeders, gall-formers, leaf-miners, and stem- and wood-borers of a diverse flora of mosses, ferns, conifers, and herbaceous and woody flowering plants. Most sawfly species are larval specialist feeders of one or a few plant genera, except larval Orussidae which parasitize wood-boring beetles. Some sawfly species can cause significant economic damage to agricultural crops, forests, and ornamental plants. Larvae of these species, either as defoliators, stem borers, or wood borers, can reduce growth of plants, even killing them. In the U.S. mid-Atlantic area, adults fly from March through October, with most species flying in spring and early summer.

Our goal is to ascertain sawfly species identities, flight times, and abundances in three parks within the George Washington Memorial Parkway (GWMP). Our samples are from Townes-style Malaise traps (Townes 1972) and hand-collecting in a rare, tidal, freshwater marsh; a floodplain forest; a swamp; and an upland forest in the Piedmont and Coastal Plain geological provinces – Dyke Marsh Wildlife Preserve (DMWP), Great Falls Park (GFP), and Turkey Run Park (TRP), in Fairfax County, Virginia. Our research questions include (1) which species are present in each park, (2) how similar are the species compositions among parks, (3) what are the species flight periods, and (4) more specifically, what are the species and their abundances in three habitats of DMWP? To our knowledge, this is the second-most comprehensive study of sawflies of a U.S. park administered by the National Park Service. Further, this is the first study of a park that occurs in two geological provinces or has a rare, freshwater, tidal marsh.

## Methods

The GWMP comprises 2,984 ha of roads and roadsides, land, and water in the Potomac River Valley on the western side of the river from the Great Falls area south to Mt. Vernon, Virginia and on the eastern side of the river from Glen Echo, MD through Georgetown in Washington, D.C. (Fig. 1). Great Falls Park (323 ha) and TRP (312 ha) are in the northern part of GWMP in the Piedmont Province, and DMWP (154 ha) is in the southern part of GWMP in the Coastal Plain Province. Johnston (2000) described DMWP, and Steury et al. (2008) described the flora of GFP in detail. The GWMP contains many habitats including upland forest; flood-plain forest; swamp forest; freshwater, tidal marsh; mowed areas along its heavily-traveled parkway; and open park areas. This park has a rich biota of perhaps at least 20,000 species of ar-



**Figure 1.** Locations of sawfly sampling sites. Dyke Marsh Wildlife Preserve, Great Falls Park, and Turkey Run Park within the George Washington Memorial Parkway (GWMP) in Virginia.

chaeans, bacteria, and eukaryans, including over 1,300 vascular-plant species. (Johnston 2000, Steury 2011, Barrows and Kjar 2014, pers. obs.). Further, the GWMP has several undescribed insect species and at least 58 rare, threatened or endangered animals and plants.

We sampled DMWP from April 1998 through December 1999 with six Townes-style Malaise traps (Townes 1972), two in each of three habitats (open marsh, flood-plain forest, and ecotone) as described by Barrows et al. (2005). We sampled GFP and TRP in 2006 through 2009 from mid-March through mid-November with Townes-style Malaise traps, supplemented by hand-collecting. In GFP, we ran one trap in each of three habitats – quarry site, Great Falls Swamp, and in the upland

forest by Mine Run. In TRP, we ran one trap in an upland forest and two traps in the floodplain forest near and just upstream from the mouth of Turkey Run. We ran traps long enough each year to obtain entire sawfly seasonal records. In DMWP, we ran traps in the same places in 1998 and 1999. In GFP and TRP, we moved traps within their habitats from year to year to increase the sawfly diversity in our samples and obtained about 72 samples per year for both parks combined. Although Malaise traps obtain biased samples, they are the single best method for collecting and surveying for sawflies. In the mid-Atlantic area, visual searches for sawflies in nature usually do not discover many species.

For DMWP, we extracted all sawflies from samples for quantitative analysis of numbers of adults of each species and their abundances and flight times in the three study habitats. For GFP and TRP, we extracted all sawflies from samples to determine the number of species and their flight times in both of these parks. Over 10,000 specimens were collected during this study. To calculate coefficients of community, we used the formula  $CC = 2c/(a + b)$ , where  $c$  = the number of species that pairs of parks have in common,  $a$  = the species richness of park-1, and  $b$  = the species richness of park-2 of the comparison.

Voucher specimens are deposited in the GWMP Arthropod Collection at TRP and duplicate material is held in the Georgetown University Arthropod Collection and the National Museum of Natural History, Smithsonian Institution, pending cataloging in the NPS ReDiscovery database and processing of loan agreements.

## Results

### Species richness

We found a diverse sawfly fauna of 176 species in 66 genera in 10 families in GWMP which consume at least 57 genera of angiosperms, ferns, gymnosperms, and horse-tails (Table 1). These sawflies include a rarely-collected species (*Kerita fidala* Ross) recorded as a leafminer of *Mertensia virginica* (L.) Pers. ex Link (Boraginaceae) and an unidentified *Caliroa* sp. which consumes *Staphylea trifolia* L (Staphyleaceae) and is still known only from larvae. Both sawfly species were collected in the floodplain near Turkey Run. The record of *K. fidala* is the first for Virginia (Smith 2009). Nine of the collected species are alien in North America. Ninety-five percent of the reported plant host genera of the sawfly species that we caught occurred in all three of the parks.

We found 69 species in DMWP, 134 in GFP, and 115 in TRP. Twelve species were unique to DMWP, 43 to GFP, and 22 to TRP. Forty species were found in all three parks. Coefficients of Community (CCs) for GWMP ranged from 0.49 through 0.68 (Table 2). Dyke Marsh Wildlife Preserve was more similar to TRP than GFP, and GFP and TRP were more similar to one another than to DMWP.

**Table 1.** An annotated list of sawfly taxa of GWMP with flight periods based on our samples, parks in which species occurred, known species host plants, and other notes<sup>†</sup>.

Xyelidae. Larvae of <i>Xyela</i> feed in staminate cones of <i>Pinus</i> species (pines). <i>Xyela</i> are the first sawflies to fly in a given year in the mid-Atlantic Region, as early as late February, but most fly in March and April, and are found wherever pines occur.
<i>Xyela middleauffi</i> Burdick. TRP. May. Host: <i>Pinus</i> .
<i>Xyela bakeri</i> Konow. GFP. March–April. Host: <i>Pinus</i> .
<i>Xyela minor</i> Norton. GFP, TRP. March–April. Host: <i>Pinus</i> .
<i>Xyela pini</i> Rohwer. DMWP (E, 1), GFP, TRP. March–April. Host: <i>Pinus</i> .
Pamphilidae. Larvae of <i>Neurotoma</i> are gregarious and live in webs which they make on their hosts. Larvae of <i>Onycholyda</i> and <i>Pamphilus</i> are solitary and live and feed in rolled leaf margins.
<i>Neurotoma edwardsi</i> Liston. GFP. May–June. Host: <i>Prunus</i> .
<i>Onycholyda amplecta</i> (Fabricius). GFP. June. Host: <i>Rubus</i> .
<i>Onycholyda excavata</i> (Norton). GFP. May. Host: <i>Cornus</i> .
<i>Onycholyda luteicornis</i> (Norton). GFP. April–May. Host: <i>Rubus</i> .
<i>Onycholyda quebecensis</i> (Provancher). GFP, TRP. May–June.
<i>Onycholyda rufofasciata</i> (Norton). GFP, TRP. May–June.
<i>Pamphilus middlekauffi</i> Shinohara & Smith. TRP. May. Hosts: <i>Corylus</i> , possibly <i>Cornus</i> .
<i>Pamphilus ochreipes</i> (Cresson). DMWP (E, M, 3), GFP, TRP. April–May. Host: <i>Viburnum</i> .
<i>Pamphilus pullatus</i> (Cresson). GFP, TRP. April–May. Host: <i>Viburnum</i> .
Diprionidae. Larvae of all species feed externally on needles of conifers. Species are usually present where conifers grow, but rarely occur in Malaise traps
<i>Monoctenus melliceps</i> (Cresson). GFP (quarry only), a site of many <i>J. virginiana</i> trees. March–April. Host: <i>Juniperus</i> , including <i>J. virginiana</i> L.
<i>Neodiprion</i> sp. TRP. One male netted near the Potomac Heritage Trail along the Potomac River. Males cannot be identified. Host: <i>Pinus</i> .
Cimbicidae. Larvae are external feeders.
<i>Abia lonicerae</i> (Linnaeus) <sup>‡</sup> . DMWP (E, 1), GFP, TRP. March–May (most in April). Host: <i>Lonicera</i> . This introduced sawfly is now widespread in eastern U.S.
Argidae. Larvae of all species are external leaf feeders, except <i>Schizocerella pilicornis</i> which is a leafminer.
<i>Arge humeralis</i> (Beauvois), poison-ivy sawfly. DMWP (E, 1), GFP, TRP. June–August. Host: <i>Toxicodendron radicans</i> (L.).
<i>Arge macleayi</i> (Leach). GFP. May. Host: <i>Prunus</i> .
<i>Arge scapularis</i> (Klug). TRP (upland forest). June. Host: <i>Ulmus</i> .
<i>Arge smithi</i> Blank, Liston, & Taeger. GFP (quarry only). April–May.
<i>Arge willi</i> Smith. GFP. May. Host: <i>Corylus</i> .
<i>Atomacera debilis</i> Say. DMWP (E, M, 2). May. Host: <i>Desmodium</i> .
<i>Atomacera decepta</i> Rohwer. DMWP (E, M, 58). TRP. May–September. Host: <i>Hibiscus</i> . This sawfly is common on some <i>Hibiscus</i> cultivars and species known as rose-mallows.
<i>Schizocerella lineata</i> (Rohwer). DMWP (E, M, 9). September. Host: <i>Portulaca</i> . Larvae are external feeders.
<i>Schizocerella pilicornis</i> (Holmgren). DMWP (E, M, 3), TRP. September. Host: <i>Portulaca</i> . Larvae are leafminers.
<i>Sphacophilus cellularis</i> (Say). GFP, TRP. June–July. Hosts: <i>Convolvulus</i> , <i>Ipomoea</i> .
<i>Sterictiphona sericea</i> (Norton). GFP (quarry only). April–May.
<i>Sterictiphona serotina</i> Smith. DMWP (F, 2). April–June. Host: <i>Prunus</i> .
<i>Sterictiphona transversa</i> Smith. GFP (quarry only). April.
Pergidae. The larvae feed gregariously as external leaf feeders on leaf underside.
<i>Acordulecera dorsalis</i> Say. DMWP (E, 1), GFP, TRP. April–June. Hosts: <i>Carya</i> , <i>Castanea</i> , <i>Juglans</i> , <i>Quercus</i> .
<i>Acordulecera mellina</i> MacGillivray. GFP, TRP. May–September. <i>Acordulecera mellina</i> and

---

*Acordulecera pellucida* (Konow). GFP, TRP. May–September. Probably several generations a year (Smith and Barrows 1987).

---

Family Tenthredinidae. This is the largest and most diverse sawfly family in numbers of species, host plants, and habits. Larvae of most species are external leaf feeders, and a few are leafminers and gall formers, as noted below. All six tenthredinid subfamilies occurred in GWMP.

---

Selandriinae. Genera of this subfamily, except *Dolerus*, consume ferns. *Dolerus* larvae feed on *Carex*, *Equisetum*, and grasses.

---

*Aneugmenus flavipes* (Norton). GFP, TRP. May–July. Host: *Pteridium*, probably other ferns.

---

*Dolerus apricus* (Norton). GFP, TRP. April–June. Host: *Equisetum*.

---

*Dolerus hebes* Goulet. DMWP (M, 1), GFP. April–May. Hosts: probably grasses.

---

*Dolerus neoagcistus* MacGillivray. GFP, TRP. March–April.

---

*Dolerus nitens* Zaddach<sup>‡</sup>. GFP, TRP. March–April. Hosts: grasses. This introduced species is now widespread in North America and can be very common in late winter (early March) and early spring.

---

*Dolerus tibialis* Cresson. TRP. May. Host: *Equisetum*.

---

*Dolerus unicolor* (Beauvois). GFP, TRP. March–April. Hosts: grasses.

---

*Dolerus versus* Norton. GFP. April–May.

---

*Heptamelus dahlboomi* (Thomson)<sup>‡</sup>. GFP, TRP. May, July. Hosts: unknown ferns, possibly *Athyrium* as recorded in Europe. Larvae bore downward in stems.

---

*Strongylogaster impressata* Provancher. GFP, TRP. April–May. Hosts: ferns.

---

*Strongylogaster remota* Rohwer. GFP (swamp only). April–May.

---

*Thrinax albidopicta* (Norton). DMWP (F, M, 2), GFP, TRP. April–September. Hosts: ferns.

---

*Thrinax dubitata* (Norton). DMWP (F, 3), GFP, TRP. May–September. Host: *Onoclea sensibilis*.

---

Nematinae. A large and diverse subfamily, dominant in arctic and subarctic regions of the world. Nematines are external gall formers, leaf feeders, leafminers, leaf rollers, and petiole miners.

---

*Amaronematus orbitalis* Marlatt. DMWP (E, M, 2), GFP. March–April.

---

*Caulocampus acericaulis* (MacGillivray). TRP. April. Host: *Acer*. Larvae are petiole miners and can cause premature leaf dropping.

---

*Caulocampus matthewsi* Smith. TRP. April–May.

---

*Cladius difformis* (Panzer), bristly rose slug. DMWP (E, 8), GFP, TRP. March–October. Host: *Rosa*. This sawfly is common on both wild and cultivated roses and has multiple generations throughout the warm season.

---

*Craterocercus fraternalis* (Norton). GFP, TRP. March–April. Host: *Quercus*.

---

*Craterocercus obtusus* (Klug). GFP. March–April. Host: *Quercus*.

---

*Hemichroa militaris* (Cresson). TRP. April. Host: *Amelanchier*.

---

*Hoplocampa marlatti* Rohwer. GFP. April–May. Host: *Prunus*. Larvae of *Hoplocampa* spp. feed in the developing fruits of their hosts.

---

*Kerita fidala* Ross. TRP. March–April, when its host plant *Mertensia virginica* is flowering along the Potomac River. A leafminer.

---

*Nematus abbotii* (Kirby). DMWP (E, M, 8), GFP, TRP. April–June. Host: *Robinia pseudoacacia* L. Larvae occurred on this host at the GFP quarry in April. *Nematus abbotii*, has only one generation and occurs only in spring and has black larvae. Adults of *Nematus tibialis* occur throughout most of the warm season, and this species has entirely green larvae which feed on *R. pseudoacacia*.

---

*Nematus attus* Smith. GFP. April.

---

*Nematus carpini* (Dyar). GFP, TRP. June–September. Host: *Carpinus*.

---

*Nematus corylus* Cresson. GFP, TRP. June–September. Host: *Corylus*.

---

*Nematus erythrogaster* Norton. DMWP (E, M, 7), TRP. April–June. Host: *Alnus*.

---

*Nematus laticulus* Norton. TRP. April. Host: *Betula*.

---

*Nematus lipovskyi* Smith. GFP. April–May. Host: *Rhododendron*.

---

*Nematus oligospilus* (Foerster). DMWP (E, M, 11), TRP. April–June. Host: *Salix*.

---

*Nematus ostryae* (Marlatt). GFP, June. Host: *Ostrya*.

---

*Nematus tibialis* Newman. DMWP (E, F, M, 4), GFP, TRP. April–October. Host: *Robinia pseudoacacia*. See notes under *N. abbotii*.

*Neopareophora litura* (Klug). DMWP (F, 1), GFP, TRP. March–April. Host: *Vaccinium*.

*Pachynematus corniger* (Norton). DMWP (E, M, 5), GFP, and TRP. April–September. Host: grasses. A common sp. with continuous generations during the warm season.

*Pontania populi* Marlatt. DMWP (M, 1). April. Host: *Populus*. Larvae live and feed in rolled leaf margins.

*Priophorus compressicornis* (Fabricius). GFP. May–June. Host: *Prunus*.

*Pristiphora abbreviata* (Hartig). DMWP (E, M, 2), GFP. April. Host: *Malva*.

*Pristiphora acidovalva* Wong. TRP. March–April.

*Pristiphora appendiculata* (Hartig). GFP. June. Host: *Ribes*.

*Pristiphora banksi* Marlatt. DMWP (E, 1), GFP, TRP. May–August. Host: *Vaccinium*.

*Pristiphora chlorea* (Norton). DMWP (E, 1), GFP, TRP. March–April. Host: *Quercus*.

*Pristiphora cincta* Newman. GFP. April.

*Pristiphora micronematica* Malaise. DMWP (E, 1). May.

*Pristiphora siskiyouensis* Marlatt. TRP. June.

*Pristiphora sycophanta* Walsh. DMWP (E, F, 5). April–June. Host: *Salix*.

*Pristiphora zella* Rohwer. DMWP (E, 1), GFP, TRP. May–June.

*Pseudodineura parva* (Norton). GFP, TRP. April–May. A leafminer. Host: *Anemone* (formerly *Hepatica*).

Heterarthrinae, Sluglike larvae of *Caliroa* and *Endelomyia* feed on the undersides of their host leaves. Larvae of other genera are leaf miners.

*Caliroa fasciata* (Norton). GFP. July–August. Host: *Quercus*.

*Caliroa lobata* MacGillivray. GFP, TRP. June–August. Host: *Quercus*.

*Caliroa lunata* MacGillivray. TRP. May–September.

*Caliroa obsoleta* (Norton). GFP, TRP. May–September. Host: *Quercus*.

*Caliroa quercuscoccineae* (Dyar). GFP. September. Host: *Quercus*.

*Caliroa* sp. TRP, larvae only. July. Host: *Staphylea trifolia* L.

*Endelomyia aethiops* (Fabricius), rose slug. GFP, TRP. April–May. Host: *Rosa*. Common on wild and cultivated roses.

*Fenusia pumila* Leach, birch leafminer. TRP. April–May. Host: *Betula*.

*Metallus ochreus* Smith. DMWP (E, M, 2), GFP (swamp only). September–October.

*Metallus rohweri* MacGillivray. A leafminer. A leafminer. DMWP (E, 1), GFP, TRP. August–September. Host: *Rubus*.

*Nefusa ambigua* (Norton). A leafminer. TRP. May. Host: *Viola*

*Profenusia canadensis* (Marlatt). GFP. A leafminer. April–May. Host: *Crataegus*.

Blennocampinae. Larvae of all species are external leaf feeders.

*Eupareophora parca* (Cresson). DMWP (E, M, 5), GFP, TRP. April–May. Host: *Fraxinus*.

*Eutomostethus ephippium* (Panzer)<sup>‡</sup>. GFP, TRP. April–May. Hosts: grasses.

*Eutomostethus luteiventris* (Klug)<sup>‡</sup>. DMWP (E, M, 2), GFP. April–May. Host: *Carex*.

*Halidamia affinis* (Fallén)<sup>‡</sup>. DMWP (E, F, M, 6), GFP, TRP. April–May. Host: *Galium*.

*Monophadnoides conspicuatus* MacGillivray. GFP, TRP. March–April.

*Monophadnoides pauper* (Provancher). GFP. March–April.

*Monophadnoides rubi* (Harris), raspberry sawfly. DMWP (E, 2), GFP, TRP. April–May. Host: *Rubus*.

*Monophadnus pallescens* (Gmelin)<sup>‡</sup>. TRP. April–May. Host: *Ranunculus*.

*Panacharactus niger* (Harrington). GFP. April–May.

*Panacharactus rudis* (Norton). GFP, TRP. April–May. Host: grasses.

*Periclista absens* Smith. DMWP (E, 1). May. Host: *Quercus*.

*Periclista albicollis* (Norton). GFP, TRP. March–May. Host: *Quercus*.

*Periclista bipartita* (Cresson). GFP. April–May. Host: *Quercus*.

---

*Periclista diluta* (Cresson). GFP. April–May. Host: *Quercus*.

*Periclista inaequidens* (Norton). GFP. March–April. Host: *Quercus*.

*Periclista marginicollis* (Norton). GFP, TRP. April–May. Host: *Carya*.

*Periclista subtruncata* Dyar. GFP. March–April. Host: *Quercus*.

*Phymatocera fumipennis* (Norton). GFP, TRP. May–July. Host: *Maianthemum racemosum* (L.) Link.

*Phymatocera racemosae* Smith. GFP, TRP. May–July. Host: *Maianthemum racemosum*.

Allantinae. Larvae are external leaf feeders.

*Allantus nigritibialis* Rohwer. GFP, TRP. March–September. Host: *Rosa*. This species and *Allantus viennensis* can be common on cultivated roses, and they each have spring and fall generations (Smith and Barrows 1987).

*Allantus viennensis* (Schrank)<sup>‡</sup>. DMWP (E, 1), GFP. May. Host: *Rosa*.

*Ametastegia aperta* (Norton). GFP, TRP. April–September. Host: *Rumex*. *Ametastegia aperta* and *A. articulata* have continuous generations throughout the warm season.

*Ametastegia articulata* (Klug). DMWP (E, M, 11), GFP, TRP. April–September. Host: *Rumex*.

*Ametastegia equiseti* (Fallén)<sup>‡</sup>. GRP, TRP. April–September. Host: *Rumex*. *Ametastegia equiseti*, *A. glabrata*, *A. pulchella*, and *A. pallipes* have continuous generations throughout the warm season.

*Ametastegia glabrata* (Fallén), dock sawfly<sup>‡</sup>. DMWP (M, 1), May. Host: *Rumex*.

*Ametastegia pallipes* (Spinola), violet sawfly<sup>‡</sup>. DMWP (E, 1), GFP, TRP. April–September. Host: *Viola*.

*Ametastegia pulchella* (Rohwer). GFP, TRP. April–September. Host: *Polygonum*.

*Dimorphopteryx virginica* Rohwer. TRP. May–June. Host: *Castanea*. We also found one larva, perhaps of this or another *Dimorphopteryx* sp. in the GFP swamp.

*Empria maculata* (Norton). DMWP (M, E, F, 20), GFP, TRP. April–May. Hosts: *Fragaria*, *Rubus*, *Potentilla*.

*Empria multicolor* (Norton). DMWP (F, 1), GFP, TRP. April–May. Host: *Alnus*.

*Macremphytus tarsatus* (Say). DMWP (F, 2), August. Host: *Cornus*.

*Macremphytus testaceus* (Norton). DMWP (M, E, F, 84), GFP, TRP. April–September. Host: *Cornus*.

*Monostegia abdominalis* (F.). DMWP (M, 1), May. Host: *Lysimachia*.

*Monsoma inferentium* (Norton). GFP. April. Host: *Alnus*.

*Phrontosoma belfragei* (Cresson). DMWP (E, 4), April. Host: possibly *Cornus*.

*Pseudosiobla excavata* (Norton). DMWP (M, E, 23), TRP. April–June. Host: *Cephalanthus occidentalis* L.

*Taxonus epicera* (Say). DMWP (M, 2), GFP, TRP. March–September.

*Taxonus pallidicornis* (Norton). DMWP (E, F, 2), GFP, TRP. March, May, September. Host: *Rubus*. This sp. has a large spring generation and a small, late-summer generation.

*Taxonus pallipes* (Say). GFP, TRP. April–September. Host: *Fragaria*. This sp. has continuous generations throughout the warm season.

*Taxonus rufocinctus* (Norton). GFP, TRP. May–June. Host: *Rubus*. This species has a large spring generation and a small late summer generation.

*Taxonus terminalis* (Say). DMWP (M, 2), GFP, TRP. May–June. Host: *Rubus*.

Tenthredininae. Larvae of all species are external leaf feeders.

*Aglaostigma semiluteum* (Norton). DMWP (E, F, M, 3), GFP, TRP. May–June. Host: *Impatiens*

*Lagium atroviolaceum* (Norton). DMWP (E, F, M, 7). GFP. May–July. Host: *Sambucus*.

*Leucopelmonus annulicornis* (Harrington). GFP, TRP. April–May.

*Macrophya alba* MacGillivray. GFP. May–June.

*Macrophya albomaculata* (Norton). DMWP (F, 1), GFP. June–July. Host: *Sambucus canadensis* L.

*Macrophya bifasciata* (Say). GFP. May

*Macrophya cassandra* Kirby. DMWP (M, 3), TRP. April–May.

*Macrophya epinota* (Say). GFP. April–May.

*Macrophya flavicoxae* (Norton). GFP, TRP. May–June.

*Macrophya flavolineata* (Norton). DMWP (M, 6), GFP, TRP. April–June.

*Macrophya ficta* MacGillivray. DMWP (F, M, 9), GFP, TRP. April–June.

---

---

*Macrophya formosa* (Klug). DMWP (F, 7), GFP, TRP. May–July.

*Macrophya goniphora* (Say). DMWP (F, 1), GFP, TRP. May–July.

*Macrophya lineatana* Rohwer. TRP. June.

*Macrophya macgillivrayi* Gibson. DMWP (M, 1), GFP, TRP. April–July.

*Macrophya masneri* Gibson. GFP. April–May.

*Macrophya mensa* Gibson. DMWP (E, F, M, 8), GFP, TRP. April–July.

*Macrophya pannosa* (Say). DMWP (E, F, M, 8), GFP, TRP. April–May. Host: *Sambucus*.

*Macrophya phylacida* Gibson. GFP, TRP. May–June.

*Macrophya pulchella* (Klug). GFP, TRP. April–June.

*Macrophya senacca* Gibson. DMWP (M, 1). April–May.

*Macrophya simillima* Rohwer. GFP, TRP. April–June.

*Macrophya succincta* Cresson. GFP. April–May.

*Macrophya trisyllaba* (Norton). DMWP (F, 29), GFP, TRP. May–July. Host: *Sambucus canadensis* L.

*Macrophya varia* (Norton). DMWP (F, 251), GFP. June–July.

*Macrophya zoe* Kirby. GFP, TRP. April–June.

*Tenthredo carolina* (Rohwer). TRP. June.

*Tenthredo fernowi* Goulet & Smith. GFP, TRP. May–June.

*Tenthredo fisheri* (Rohwer). TRP. May–June.

*Tenthredo maculosa* (Smulyan). TRP. May–June.

*Tenthredo mellicoxa* Provancher. GFP, TRP. April–June.

*Tenthredo nimbipennis* Cresson. GFP. May–June.

*Tenthredo rufopectus* (Norton). DMWP (F, 14), GFP, TRP. May–July.

*Tenthredo verticalis* Say. GFP, TRP. May–June.

*Tenthredo yuasi* MacGillivray. TRP. April–May.

Orussidae. This is the only parasitic symphytan family, and its larvae apparently parasitize wood-boring beetles.

Most specimens are from in the GFP swamp where there were many fallen branches and trees probably harboring orussid hosts.

*Orussus minutus* Middlekauff. GFP. April–June.

*Orussus terminalis* Newman. GFP. June.

Xiphydriidae. Larvae are wood borers in small, weakened branches.

*Xiphydria maculata* Say. GFP, TRP. May–June. Host: *Acer*.

*Xiphydria polia* Smith. GFP. September

*Xiphydria tibialis* Say. DMWP (F, 2), GFP, TRP. May–August. Host: *Prunus*.

Siricidae. Larvae are wood borers.

*Tremex columba* (Linnaeus), pigeon tremex. DMWP (E, F, M, 5), GFP, TRP. August–September Hosts: *Fagus* and some other angiospermous-tree species.

Cephalidae. Larvae are stem borers.

*Hartigia trimaculata* (Say). DMWP (E, M, 3), GFP, TRP. May–June. Hosts: *Rosa*, *Rubus*.

*Janus bimaculatus* (Norton). DMWP (F, 5), GFP, TRP. May–June. Host: *Viburnum*.

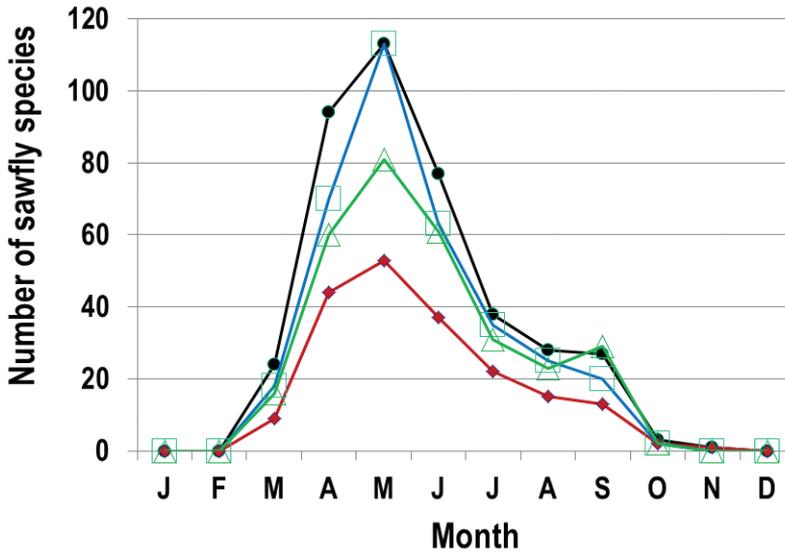
*Janus integer* (Norton), currant stem girdler. DMWP (F, 2), GFP, TRP. May–June. Host: *Ribes*.

<sup>†</sup>Taxon arrangement and nomenclature follows Smith (1979) and Taeger et al. (2010). Collection site abbreviations are: DMWP = Dyke Marsh Wildlife Preserve (E = ecotone; F = lowland forest; M = marsh); GFP = Great Falls Park; TRP = Turkey Run Park; and GWMP = George Washington Memorial Parkway which contains DMWP, GFP, and TRP. Dates of collections of adults are given by month for all three parks combined. Numbers listed for DMWP indicate the number of individuals of a taxon for 1998 and 1999 combined. Recorded host(s), if known, are mostly from Smith (1979), and for most sawfly species only host plant genera are cited.

<sup>‡</sup>An alien species in North America.

**Table 2.** Coefficients of community (CC) of sawflies between pairs of three parks of George Washington Memorial Parkway. DMWP = Dyke Marsh Wildlife Preserve; GFP = Great Falls Park; TRP = Turkey Run Park. Sawfly species numbers for each park are within parentheses.

Park and its number of species	TRP (115)	GFP (134)
DMWP (69)	0.53	0.49
TRP (115)		0.68

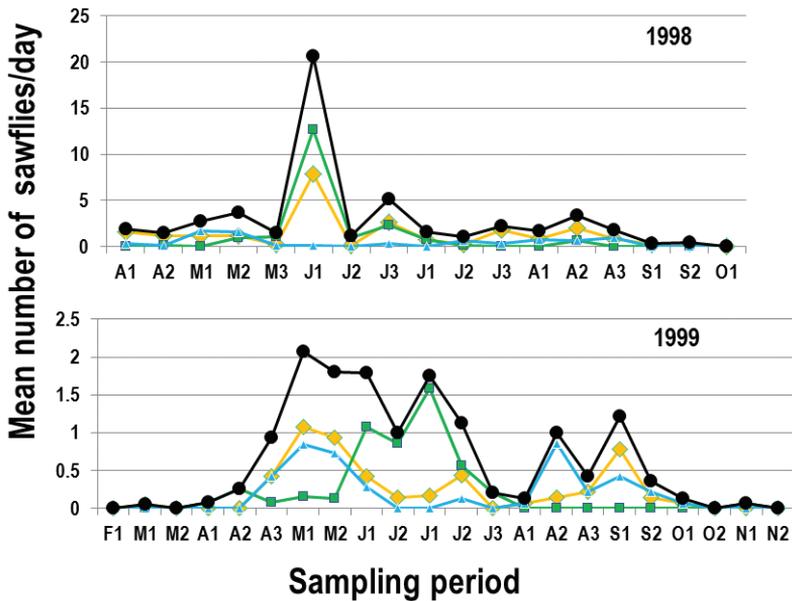


**Figure 2.** Number of sawfly species versus month in the GWMP, Virginia. Diamonds represent sawfly numbers in DMWP; squares, GFP; triangles, TRP; and circles, all three parks combined.

**Flight periods**

As a group, GWMP sawflies flew from early March through mid-November. With regard to species richness and month, more species occurred in April through June than in other months, with species numbers peaking in May in each of the three parks and for all parks combined (Fig. 2). In DMWP, the number of individuals peaked in early June 1998 and early May 1999.

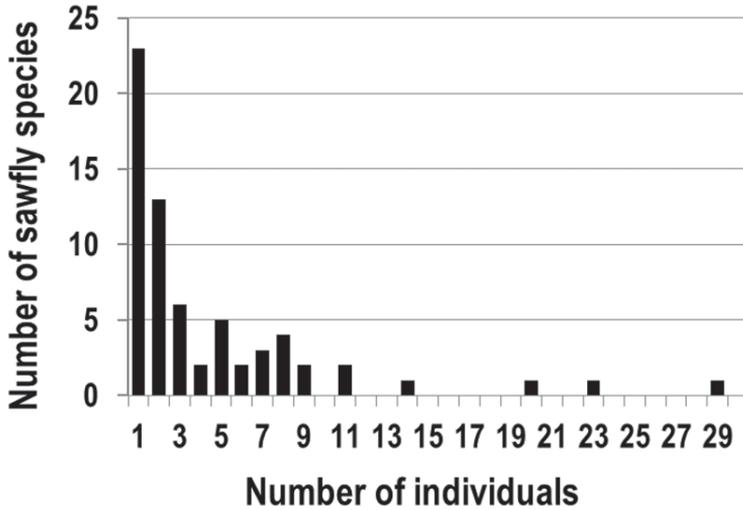
Of the 176 species collected, 138 have a single emergence period in the spring, March through June, indicating a single generation a year. Another 12 species apparently with only a single generation fly only from mid-summer through October, with only 3, both species of *Metallus* and *Tremex*, occurring as late as September and October. The remaining 26 species occur through much of March or April through September and are probably multivoltine. Species of two genera, *Allantus* and *Taxonus* are apparently bivoltine, with a large emergence in the spring and a small emergence in late summer or early autumn.



**Figure 3.** Sawfly abundances (mean per day per sampling period) varied over their flight periods in 1998 and 1999 in Dyke Marsh Wildlife Preserve, Virginia. Diamonds represent sawfly numbers in the ecotone; squares, forest; triangles, marsh; and circles, all three habitats combined. In 1998, sampling interval A1 was from 12–19 April; A2, 19–28 April; M1, 28 April – 10 May; M2, 10–17 May; M3, 17–28 May; J1, 28 May – 6 June; J1, 6–14 June; J3, 14–24 June; J1, 24 June – 7 July; J2, 7–19 July; 1J3, 19–30 July; A1, 30 July – 9 August; A2, 9–12 August; A3, 12–28 August; S1, 28 August – 11 September; S2, 11–26 September; O1, and 26 September – 11 October. No sawflies were in the samples from 11–26 October and 26 October – 6 November; 6–22 November, 22 November – 6 December, and 6–20 December, which are not shown on this graph. In 1999, sampling interval F1 was from 24 January – 15 February; M1; 15 February – 6 March; M2, 6–20 March; A1, 20 March – 3 April; A2, 3–11 April; A3, 11–25 April; M1, 25 April – 8 May; M2, 8–23 May; J1, 23 May – 6 June; J2, 6–20 June; J1, 20 June – 2 July; J2, 2–18 July; J3, 18–23 July; A1, 23 July – 8 August; A2, 8–15 August; A3, 15–29 August; S1, 29 August – 12 September; S2, 12–26 September; O1, 26 September – 11 October; O2, 11–24 October; 16, N1, 24 October – 8 November; and N2, 8–21 November. There were no sawflies in samples J1, 20 December – 3 January; J2; 3–24 January; D1, 21 November – 5 December; and D2, 5–19 December which are not shown on this graph.

### Sawfly abundance and distribution in DMWP

Of the 695 sawfly specimens trapped in DMWP 73% were from 1998, and 27% were from 1999. In both years combined, 42% were in the ecotone; 39%, forest; and 19%, marsh (Fig. 3). A plot of frequency of specimens versus species (Fig. 4) indicates that only a few species were present in large numbers; 71% of the 69 species had 9 or fewer individuals in our sample.



**Figure 4.** Number of species versus number of individuals captured in the DMWP sample. In addition, one species had 58, one had 84, and one had 251 individuals which are not shown on this graph to conserve space.

## Discussion

Our GWMP sawfly survey is the second largest survey of a U.S. park administered by the U.S. National Park Service. Smith (2008) reported on the largest such survey in the Great Smoky Mountains National Park.

## Species richness

We found 176 sawfly species in the GWMP; however, this biotically-rich location might harbor over 200 species. A similar study of species abundance and diversity in two oak-pine forests in Virginia and West Virginia using Malaise traps estimated that 81% of the actual species present were captured over a five-year period (Braud et al. 2003, Strazanac et al. 2003). We expected to find more diprionid species and species of conifer-feeding siricids. We found three *Acordulecera* species, but more are expected once taxonomic problems are resolved. There are several reasons why we did not find more species in our survey. Malaise traps are biased toward strong flying species such as *Taxonus* and *Macrophya*; species that are weak flyers or stay close to their host plant are not often collected in traps. Some mid-Atlantic species are rare or not expected in GWMP. Immature stages of many species are very difficult to find in nature. Adults of some species tend to be in places such as near their hosts or in treetops where we did not site our traps. More intense sampling in already-sampled habitats and sampling of additional unsampled GWMP habitats could obtain more species. Unsampled GWMP sites include areas in Montgomery Co., Maryland, and the District of Colum-

bia, as well as sites with *Pinus* and *Salix*, the floodplain forest of Theodore Roosevelt Island, the Clara Barton Parkway in Maryland, and the George Washington Memorial Parkway in Virginia, where these roads border and run through the GWMP.

The GWMP sawfly fauna is 50% of the 351 sawfly species recorded for the entire state of Virginia (Smith 2006, 2013). In comparison, Smith and Barrows (1987) found 85 species in samples from less natural Maryland habitats using two sets of Malaise traps 0.8 and 1.5 km from TRP. Seventy percent of these species are also in our samples from the three GWMP parks. There are 91 recorded species for Plummers Island, Maryland, located across the Potomac River from TRP (Smith 2008). In another Virginia Coastal Plain site, D. R. Smith (unpublished) found 175 species in Essex Co. based on 10 years of sampling. In other Virginia Piedmont sites, he found about 200 species in the University of Virginia Blandly Experimental Farm and State Arboretum of Virginia, Clarke Co., based on 6 years of sampling; 175 species in Bull Run Mountains Conservancy, Prince William Co., in 3 years; and 125 species in a his suburban yard in Fairfax Co. in 33 years.

### **Abundance, distribution, and flight periods**

Flight times and numbers of adult sawflies can vary from year to year as occurred in the DMWP samples. Factors including distribution of host plants, adult foods, and mates; drying winds; natural enemies; soil moisture and temperature; and weather affect adult abundances, distributions, and flight periods (Wallace and McNeal 1966), subjects not yet studied in DMWP.

### **Sawfly abundance and distribution in DMWP**

The causes of the sawfly abundance and distribution in DMWP are not yet studied. Our plot of frequency of specimens versus species (Fig. 4) shows that the majority of species were not common in our samples. Smith and Barrows (1987) found a similar relationship in their sample from a less natural area and a yard in the Washington, D.C., area. Low numbers of specimens of many species may have occurred in our sample because of factors such as a species' being rare, rare individual's of more common species straying into our study site from elsewhere, and a species' flight habit precluding our trapping the species. In DMWP, adult sawflies were more common in 1998 than in 1999 based on trap samples, as also occurred in other DMWP insects such as fireflies (Barrows et al. 2008) and mecopterans (Barrows and Flint 2009). In contrast, DMWP rhopalosomatids (Barrows 2013) and sialids (Barrows et al. 2005) were more frequently captured in 1999 than in 1998.

In summary, we found a rich fauna of 176 sawfly species which feed on many plant genera in the GWMP, and as a group, the sawflies flew from early March through November. Sawfly species in DMWP were most common in its ecotone, followed by its

forest and marsh, and these species greatly varied in abundance. In this time of worrisome, rapid global change, threats to the GWMP include air, soil, and water pollution; many alien, invasive species; flooding; and erosion (Litwin et al. 2013, pers. obs.). In fact, DMWP is losing about 0.6–0.8 hectare per year due to erosion. The National Park Service may restore the marsh to some extent in this decade. Increased marshland from restoration could change the mean population sizes of some the DMWP sawfly species. Since Symphyta is a species-rich, GWMP taxon, it is an appropriate one for monitoring GWMP's health in forthcoming years. This large, wasp suborder is an understudied animal taxon, and myriad aspects of the biologies of GWMP and other species are ripe for investigation.

## Acknowledgments

We thank O. S. Flint, Jr.; T. J. Henry; W. N. Mathis; and R. O'Hanlon for help with setting up and maintaining traps. Many Georgetown University students, including K. Church, K. Differding, and S.-M. K. Wise helped to process DMWP samples. Friends of Dyke Marsh, Georgetown University, the National Park Service (grant GWMP-00052), and the Washington Biologist's Field Club provided financial support for this study. Brent W. Steury critiqued a preliminary draft of this paper, and K. Barnes helped to produce Fig. 1.

## References

- Barrows EM, Flint OS Jr (2009) Mecopteran (Mecoptera: Bittacidae, Meropeidae, Panorpidae) flight periods, sex ratios, and habitat frequencies in an United States mid-Atlantic freshwater tidal marsh, low forest, and their ecotone. *Journal of the Kansas Entomological Society* 82: 223–230. doi: 10.2317/JKES0807.15.1
- Barrows EM, Kjar DS (2014) Arthropods of Dyke Marsh Wildlife Preserve, Virginia: A Searchable Online Database (ADMWPD). <http://data.georgetown.edu/departments/biology/nps/dmwp>
- Barrows EM, Arsenault SB, Grenier NP (2008) Firefly (Coleoptera: Lampyridae) flight periods, sex ratios, and habitat frequencies in a United States mid-Atlantic freshwater tidal marsh, low forest, and their ecotone. *Banisteria* 31: 47–52.
- Barrows EM, McIntyre AM, Flint OS Jr (2005) Alderfly (Neuroptera: Sialidae) flight periods, sex ratios, and habitat use in a Virginia freshwater tidal marsh, low forest, and their ecotones. *Proceedings of the Washington Entomological Society* 107: 693–699.
- Braud R, Smith DR, Strazanac JS, Butler L (2003) Diversity, abundance, and seasonality of adult and larval Symphyta (Hymenoptera) in the George Washington National Forest, Virginia, and the Monongahela National Forest, West Virginia. *Proceedings of the Washington Entomological Society* 105: 756–768.
- Johnston DW (2000) The Dyke Marsh Preserve Ecosystem. *Virginia Journal of Science* 51: 223–272.

- Litwin RJ, Smoot JP, Pavich MJ, Oberg E, Steury B, Helwig B, Markewich HW, Santucci VL, Sanders G (2013) Rates and probable causes of freshwater tidal marsh failure, Potomac River estuary, northern Virginia, USA. *Wetlands* 33: 1037–1061. doi: 10.1007/s13157-013-0461-6
- Smith DR (1979) Symphyta. In: Krombein KV, Hurd PD Jr, Smith DR, Burks BD (Eds) *Catalog of Hymenoptera in America North of Mexico. Volume 1, Symphyta and Apocrita (Parasitica)*. Smithsonian Institution Press, Washington, D.C., 3–137.
- Smith DR (1993) Chapter 1. Systematics, life history, and distribution of sawflies. In: Wagner MR, Raffra KK (Eds) *Sawfly Life History Adaptations to Woody Plants*. Academic Press, Inc., 3–32.
- Smith DR (2006) List of the sawflies (Hymenoptera: Symphyta) of Virginia. *Banisteria* 28: 1–23.
- Smith DR (2008) Hymenoptera (Insecta) of Plummers Island, Maryland: Symphyta and selected families of Apocrita. *Bulletin of the Biological Society of Washington* 15: 160–167. doi: 10.2988/0097-0298(2008)15[160:HIOPIIM]2.0.CO;2
- Smith DR (2009) An obscure sawfly, *Kerita fidala* Ross (Hymenoptera: Tenthredinidae), new to Virginia, a leafminer of Virginia bluebell, *Mertensia virginica* (L.) Pers. ex Link (Boraginaceae). *Banisteria* 33: 53.
- Smith DR (2013) The columbine sawfly, *Pristiphora rufipes* Serville, new to Virginia, and other additions to the list of Virginia sawflies (Hymenoptera: Tenthredinidae). *Banisteria* 41: 98–99.
- Smith DR, Barrows EM (1987) Sawflies (Hymenoptera: Symphyta) in urban environments in the Washington, D.C. Area. *Proceedings of the Entomological Society of Washington* 89: 147–156.
- Steury BW (2011) Additions to the vascular flora of the George Washington Memorial Parkway, Virginia, Maryland, and the District of Columbia. *Banisteria* 37: 35–52.
- Steury BW, Fleming GP, Strong MT (2008) An emendation of the vascular flora of Great Falls Park, Fairfax County, Virginia. *Castanea* 73: 123–149. doi: 10.2179/0008-7475(2008)73[123:AE-OTVF]2.0.CO;2
- Strazanac JS, Smith DR, Braud RA, Fritzler CJ, Butler L (2003) Symphyta (Hymenoptera) species richness in mixed oak-pine forests in the central Appalachians. *Proceedings of the Washington Entomological Society* 105: 131–137.
- Taeger A, Blank SM, Liston A (2010) World catalog of Symphyta (Hymenoptera). *Zootaxa* 2580: 1–1064.
- Townes HK (1972) A light-weight Malaise trap. *Entomological News* 89: 239–247.
- Wallace LE, McNeal FH (1966) Stem sawflies of economic importance in grain crops in the United States Department of Agriculture. *Technical Bulletin* 1350: 1–50.