

A Floral Survey of Cliff Habitats along Bull Run at Manassas National Battlefield Park, Virginia, 2014

Data Series 940

U.S. Department of the Interior
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Cover. Vegetation grows on an east-facing cliff along Bull Run near Sudley Springs in Manassas National Battlefield Park, Virginia. The cliffs are islands of specialized habitat; they support plant species found nowhere else in the park, including locally uncommon or rare species. Photograph by Matthew Struckhoff, August 2014.

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By Esther D. Stroh, Matthew A. Struckhoff, and Keith W. Grabner

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Conversion Factors

Inch/Pound to International System of Units

Multiply	By	To obtain
	Length	
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
meter (m)	1.094	yard (yd)
centimeter (cm)	2.54	inches (in)

Datum

Horizontal coordinate information is referenced to the World Geodetic System 1984 (WGS84).

Acknowledgments

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Abstract

Isolated patches of native vegetation in human-modified landscapes are important reservoirs of biological diversity because they may be the only places in which rare or native species can persist. Manassas National Battlefield Park, Virginia, is an island embedded in a matrix of intensively modified lands; it is becoming increasingly isolated due to growth of the greater Washington, D.C. area. A series of cliffs along Bull Run support an eastern white pine community disjunct from its more typical range in the Appalachian Mountains. Cliffs frequently support vegetation communities that differ from surrounding habitat. In this ecological context, the cliffs along Bull Run are islands of specialized habitat within an island of natural and semi-natural communities (the park), surrounded by a human-dominated landscape. A floral survey of these cliffs was a top priority identified by the National Park Service National Capital Region via the National Resource Preservation Program; in 2014, we completed a floral survey of 11 cliffs in the park. We recorded 282 species in 194 genera and 83 families, including 23 newly documented species for the park.

Introduction

Geographically isolated patches of native vegetation in human-modified landscapes are important reservoirs of biological diversity because such patches may represent the only habitats in which rare species persist (Bennett and Arcese, 2003). Many eastern national parks, including Manassas National Battlefield Park in Virginia, exist as small islands embedded in a matrix of developed or intensively modified lands. These national parks sometimes serve as refugia for populations of native species that are generally absent in the surrounding area; in the context of projected climate change, this role will become more important in fragmented and human-dominated landscapes (Baron and others, 2008).

Manassas National Battlefield Park contains some of the highest quality natural communities in the region and supports at least 706 plant species in 10 broad habitat types (Fleming, 1993; Belden and Fleming, 2001). The park is becoming

increasingly isolated due to the growth of the city of Manassas and has become a natural oasis as the surrounding landscape is developed due to growth of the greater Washington, D.C., area (Belden and others, 1998; Fleming and Belden, 2004).

At local scales, variations in soil, topography, and exposure can create microclimates that support a suite of species that is atypical of the surrounding landscape. In particular, cliffs (also called bluffs) support vegetation communities that differ from surrounding habitat (Davis, 1951; Camp and Knight, 1997; Cooper, 1997); this was determined to be the case at Manassas National Battlefield Park when a 1998 natural heritage inventory noted a series of bluffs (the Bull Run Bluffs) supporting an eastern white pine community disjunct from its more typical range in the Appalachian Mountains (Belden and others, 1998). Overall, about 13 percent of the park supports an upland dry-mesic oak-hickory forest; however, a small, east-facing part of bluffs with this forest type also contains more mesophytic species such as *Carya cordiformis* (bitternut hickory), *Quercus muehlenbergii* (chinkapin oak), *Fraxinus americana* (white ash), *Asimina triloba* (pawpaw), and *Staphylea trifolia* (American bladdernut; Fleming and Belden, 2004). In this ecological context, the bluffs along Bull Run are islands of specialized habitat within an island of natural communities (the park) surrounded by a human-dominated landscape.

The atypical (locally uncommon or rare) species and communities associated with bluffs in Manassas National Battlefield Park add to the biodiversity of the park and increase its biological value in the human-dominated landscape that surrounds it (fig. 1). A 1993 survey for threatened and endangered plants and animals in Manassas National Battlefield Park did not include the bluffs along Bull Run; however, the survey recommended that the bluffs be thoroughly surveyed, due to the occurrence of locally rare species such as *Tsuga canadensis* (eastern hemlock), *Pinus strobus* (white pine), and *Taxus canadensis* (Canada yew; Fleming and Belden, 2004). Additionally, because of their steepness, bluffs and associated slopes may provide refugia from intensive deer browsing that has been documented in the park (Gorsira and others, 2006). This report provides the recommended survey of bluff vegetation and additional data for the park to assess the effects of deer browsing on park habitats.



Figure 1. A typical east-facing cliff approximately 30 meters downstream from Farm Ford along Bull Run in Manassas National Battlefield Park, Virginia. Localized microclimates provide habitat for atypical or disjunct species; steep topography provides protection from deer browsing. Photograph by U.S. Geological Survey.

Study Area

Manassas National Battlefield Park lies in the Culpeper Basin of the Piedmont physiographic province (not shown). The Culpeper Basin is one of several basins along the boundary between the Blue Ridge and Piedmont Provinces associated with the Appalachian Mountains. The Culpeper Basin trends northeast-southwest and is about 120 kilometers long and 30 kilometers wide (National Park Service Geologic Resources Division, 2008). Specific bluffs of interest identified by park resource management staff include outcrops of Balls Bluff siltstone on the eastern border of the park, along the edge of Bull Run, from about 630 meters (m) to 1,000 m northwest of U.S. Route 29 (fig. 2). This area was referred to as “Bull Run Bluffs” in a Natural Heritage inventory of the park and a subsequent publication (Belden and others, 1998; Fleming and Belden, 2004).

Methods

For the purposes of this survey, bluffs were broadly defined to include exposed rock faces from 2 m to 10 m tall, steep slopes above these faces beginning at obvious inflection points in the slope, talus slopes at the foot of rock faces, and slopes with abundant rock outcrops and a pitch exceeding approximately 45 degrees adjacent to such rock faces. These areas were perceived to be too steep or treacherous for deer access and likely to provide refuge from browsing. Steep slopes with minimal or no rock outcrops and silty toe-slopes associated with fluvial activity at the base of cliff faces were excluded from sampling, because they were not steep enough or rocky enough to fit our definition of “bluff.”

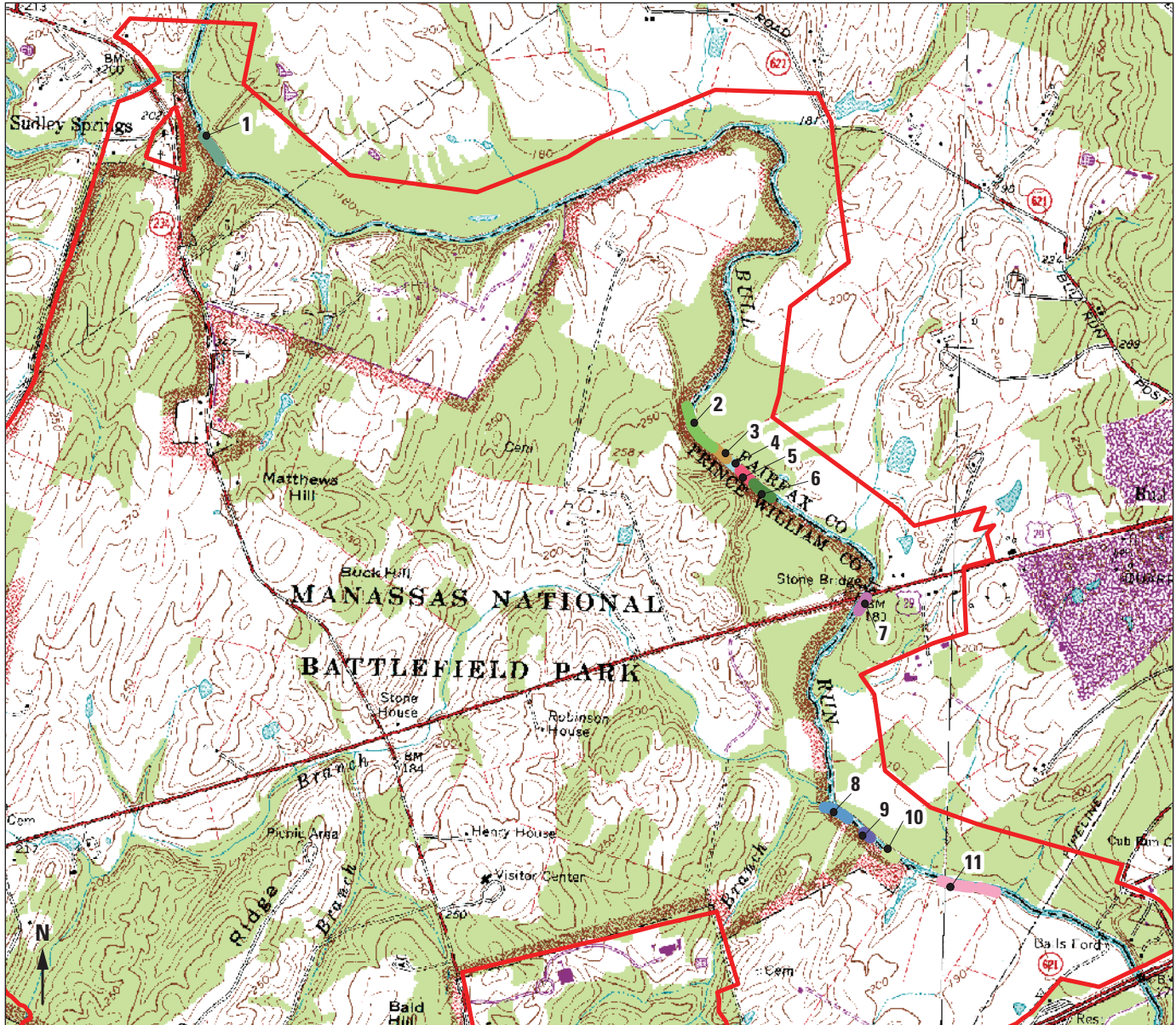
Reconnaissance in January 2014 identified 11 bluffs for sampling, including five within the Bull Run Bluffs area described by Belden and others (1998), one additional bluff upstream and five additional bluffs downstream along Bull Run (fig. 2). The bluff names used in this document are unique to the study, but often reference features identified on topographic maps or in literature for the park. The most upstream bluff, Sudley Springs (site 1), is located approximately 270 m downstream from the confluence of Catharpin Creek and Bull Run. Next, the Bull Run Bluffs (Belden and others, 1998) are divided into five distinct units; from upstream to downstream these are as follows: (2) Mind the Gap, (3) Nose to Nose, (4) Farm Ford-upstream, (5) Farm Ford-downstream, and (6) Let the Madness Begin. A bluff extending approximately 64 m downstream from the utility right-of-way adjacent to the Highway 29 bridge across Bull Run is called (7) Stone Bridge. Four bluffs starting at and extending downstream from the mouth of Holkums Branch are called (8) Holkums Branch, (9) Revolution No. 9, (10) Lewis Ford, and (11) Chevy Ford (the last bluff beginning at a former dump site with numerous abandoned vehicles).

Each bluff was subdivided into sections of varying length to create sampling blocks with fairly homogeneous aspect and substrate (for example, cliff faces and the slopes above them or steep slopes with abundant rock outcrops). Obvious topographic features such as large fissures in the rock face or drains from the uplands were also used to subdivide bluffs into sampling blocks. For each block, we recorded coordinates of the endpoints using a handheld global positioning system (GPS) and the following environmental data: mean slope (degrees) measured with a clinometer; mean aspect (degrees) measured with a sighting compass; visual estimates of the percent cover of rock, bare soil, moss and lichen, leaf litter, down dead wood, and root and bole of live woody stems; and presence of any seeps, and whether or not the base of the block directly touched the waters of Bull Run. The horizontal length of each block was estimated in a global information system using endpoint GPS coordinates. Maximum vertical height of each block was measured with a distance tape from the top to the bottom of the sampling block at its highest point. Photographs were taken at various points and these photographs accompany the database provided with this report with brief descriptions of the subject and block location (Stroh and others, 2015). Bluffs and their sampling blocks are listed in table 1.

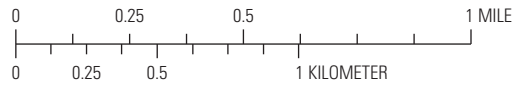
Vegetation sampling involved systematically and repeatedly traversing the block until the entire area was surveyed. Where needed for safety or to avoid excessive damage to the flora, climbing ropes and harnesses were used to either rappel down a bluff face or to prevent falls while traversing a slope horizontally. Ground flora and shrubs were identified to species; percent foliar cover of each species was estimated and assigned a cover class (0–1, 1–5, 5–15, 15–25, 25–35, 35–45, 45–55, 55–65, 65–75, 75–85, 85–95, 95–100) within the sampling block. Trees with a diameter at breast height (dbh) greater than or equal to 10 centimeters (cm) rooted inside or overhanging the block were identified to species and dbh was measured with a diameter tape to the nearest centimeter. All blocks were sampled once in the middle of May 2014 to detect spring ephemeral species and early-season flowering species; all were surveyed again in late August 2014 to confirm identification of late flowering species and detect late-emerging species.

If a plant could not be identified in the field, a specimen was collected for later identification by closer inspection, dissection, and consultation of keys; all specimens were destroyed after identification. The primary references for identification of species were the “Flora of Virginia” (Weakley and others, 2012) and “Herbaceous Plants of Maryland” (Brown and Brown, 1984). Additional information, such as growth habit or morphological descriptions not included in the other references, was gleaned from the 3-volume “Steyermark’s Flora of Missouri” (Yatskievych, 1999, 2006, 2012). Scientific nomenclature follows the Integrated Taxonomic Information System (ITIS; <http://www.itis.gov>); common names and status as non-native are from the PLANTS database (U.S. Department of Agriculture, Natural Resource Conservation Service, 2014).

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Base imagery from U.S. Geological Survey
 1:24,000 topographic maps: Manassas and
 Gainesville, Virginia quadrangles



EXPLANATION

- National park boundary (National Park Service, 2012)
- ⁹ Cliff vegetation survey site and number (table 1)

Figure 2. Cliff vegetation survey sites at Manassas National Battlefield Park, Virginia.

Table 1. Eleven cliff vegetation survey sites at Manassas National Battlefield Park, Virginia.

[Coordinates are Universal Transverse Mercator, Zone 18N. Datum is World Geodetic Survey 1984 (WGS 84). Site names are unique to this study, but many are based on features identified on the park visitor map.]

Site number	Site name	Sampling block	Description	Approximate Northing of upstream terminus	Approximate Easting of upstream terminus	Approximate length (meters)	Approximate maximum height (meters) including slope above
1	Sudley Springs	1	Short cliff and slope above	4,302,051	279,919	29	3
		2	Cliff and slope above	4,302,078	279,900	33	14
		3	Cliff and slope above	4,302,125	279,861	61	18
2	Mind the Gap	1	Cliff	4,300,856	281,947	34	16
		2	Cliff and slope	4,301,006	281,865	155	24
3	Nose to Nose	1	Slope with rock outcrops	4,300,808	282,013	29	14
		2	Cliff and slope above	4,300,835	281,982	41	22
4	Farm Ford-upstream	1	Cliff and slope above	4,300,769	282,055	22	11
		2	Cliff to downstream nose slope	4,300,783	282,039	21	15
5	Farm Ford-downstream	1	Cliff to end of lower geologic stratum	4,300,716	282,116	30	9
		2	Cliff to end of upper geologic stratum	4,300,733	282,096	26	8
		3	Small pinnacle	4,300,740	282,089	5	3
6	Let the Madness Begin	1	Cliff to where trail drops to flood plain	4,300,655	282,181	16	3
		2	Cliff to gap in cliff	4,300,669	282,163	29	10
		3	Slope with rock outcrops	4,300,685	282,146	22	5
		4	Cliff below trail	4,300,638	282,206	23	7
7	Stone Bridge	1	Cliff from low flat to downstream end	4,300,202	282,607	50	3
		2	Cliff upstream from low flat	4,300,215	282,616	14	6
8	Holkums Branch	1	Cliff facing Holkums Branch	4,299,342	282,439	24	6
		2	Cliff facing Bull Run across flood plain	4,299,339	282,463	38	9
		3	Cliff over and facing Bull Run	4,299,313	282,513	31	10
9	Revolution No. 9	1	Cliff over water	4,299,236	282,603	35	4
10	Lewis Ford	1	Cliff over water	4,299,151	282,698	39	9
11	Chevy Ford	1	Cliff from dump to large white oak on upper slope	4,299,036	282,926	49	12
		2	Cliff to drain	4,299,020	282,973	55	12
		3	Short cliff downstream from drain	4,299,011	283,027	22	4
		4	Cliff to low flat at downstream end	4,299,007	283,085	67	12

Results

A total of 27 blocks were sampled on the 11 bluffs (table 1). The horizontal lengths of blocks range from approximately 5 to 155 m, and approximately 1,000 linear meters of bluffs and associated slopes were sampled. The vertical height of bluffs and associated slopes range from 3 to 24 m. All bluffs are either east or north facing, except for Stone Bridge, which faces west-northwest.

Identified plants include 282 species in 194 genera and 83 families, including 48 non-native species. The list in the appendix table 1–1 indicates the number and proportion of blocks in which each species was encountered. Three species occurred in every block sampled: *Eurybia divaricata* (white wood aster), *Lonicera japonica* (Japanese honeysuckle; non-native), and *Parthenocissus quinquefolia* (Virginia creeper). Twenty-four species occurred in more than 80 percent of the sampled blocks (table 2).

New Species

This report documents 23 previously unrecorded species for the park (table 3). A few of these (*Carex albursina*, *Osmorhiza claytonii*, and *Woodsia obtusa*, for example) had likely been identified as different species by previous studies in the park. Five of the newly documented species are exotic species that, based on their infrequent occurrence and low abundance, presently do not represent a significant ecological threat on the bluffs: *Bromus inermis* (smooth brome), *Euonymus fortunei* (winter creeper), *Paulownia tomentosa* (princess tree), *Sedum sarmentosum* (stringy stonecrop), and *Ulmus pumila* (Siberian elm).

Problematic Identification of Species Groups

Within the genus *Elymus*, identification as *E. hystrix* (eastern bottlebrush grass) was reserved for instances in which flowering specimens were present to support it; otherwise, non-flowering plants in the genus were assumed to be *E. virginicus* (Virginia wild rye). Although *Leersia oryzoides* (rice cutgrass) has been documented in previous studies in the park (Fleming and Belden, 2004; NPSpecies, 2014), all specimens encountered during this study were small and lacked stoutness sufficient to match descriptions for that species; these species were recorded as *L. virginica* (whitegrass), which has previously been identified in the park (Fleming and Belden, 2004; NPSpecies, 2014). Other genera in the grass family that presented identification difficulties, even when in flower, included *Muhlenbergia*, *Agrostis*, and *Poa*.

A sedge species with broad leaves frequently encountered on mesic slopes was identified as *Carex albursina* (white bear sedge) rather than the similar *C. laxiflora* (broad looseflower sedge), which has previously been recorded for the park

(Fleming and Belden, 2004; NPSpecies, 2014). Identification as *C. albursina* was based primarily on the fact that non-flowering specimen leaf width frequently exceeded that given in descriptions of the latter species (Yatskievych, 1999; Weakley and others, 2012). A commonly occurring narrow-leaved sedge forming tufts on upper slopes was identified as *C. albicans* (whitening sedge). This is probably the same species previously identified as *C. albicans* var. *australis* (stellate sedge) by others (Fleming and Belden, 2004; NPSpecies, 2014) and treated as *C. emmonsii* (*Carex albicans* var. *emmonsii* Dewey ex Torr. Rettig) in “Flora of Virginia” (Weakley and others, 2012), but specimens collected during this study all had culms equaling or longer than the leaves and lacked teeth on the red-tinged perigynia scales. Finally, a fine-leaved sedge frequently encountered growing on bluff faces was identified as *C. appalachica* (Appalachian sedge), rather than the similar *C. radiata* (eastern star sedge; Weakley and others, 2012). The latter species has been recorded in the park (Fleming and Belden, 2004; NPSpecies, 2014), but rarely grows on rock faces (Weakley and others, 2012).

Plants identified as *Woodsia obtusa* (bluntlobe cliff fern) likely represent the species previously identified as *Cystopteris protrusa* (lowland bladderfern; Fleming and Belden, 2004; NPSpecies, 2014). The former species is distinguished from the latter by tan scales along its lower rachis and by its cup-like indusia; however, young specimens of *Woodsia* can lack scales (Weakley and others, 2012). During this study, most specimens that lacked scales were young and co-occurred with plants identified as *Woodsia* based on the presence of abundant and obvious scales, and therefore also were classified as *Woodsia*. *Woodsia* does not appear on other Manassas National Battlefield Park plant lists (Fleming and Belden, 2004; NPSpecies, 2014).

Osmorhiza claytonii (Clayton’s sweetroot) was recorded at two sampling blocks. Previous research in the park (Belden and Fleming, 2001) documented *O. longistylis* (aniseroot), which is distinguished from *O. claytonii* by having a less hairy stem, exerted styles clearly visibly to the naked eye, and foliage with a stronger anise scent (Weakley and others, 2012). Field identification during this study was based on stem hairiness and style length.

Specimens originally identified in May as *Symphytichum cordifolium* (common blue wood aster) were changed in August to *Eurybia divaricata* (white wood aster), a similar appearing species (when young) with which it was always found; no flowering specimens were found during either sampling event that would confirm identification as *S. cordifolium*. Two other common asters, *S. lanceolatum* (white panicle aster) and *S. lateriflorum* (calico aster), are also difficult to distinguish when not in flower, and were frequently recorded together. The former designation was reserved for specimens with hairs occurring in high landscape positions, the latter for mostly glabrous specimens found in lower landscape positions.

Table 2. Plant species recorded at more than 80 percent of 27 sampling blocks at Manassas National Battlefield Park, Virginia.

[Nomenclature follows the Integrated Taxonomic Information System (<http://www.itis.gov>); nativity status is from the PLANTS database (U.S. Department of Agriculture-Natural Resource Conservation Service, 2014).]

Scientific name	Family	Common name	Number of blocks	Proportion of blocks
<i>Asplenium platyneuron</i> (L.) Britton, Sterns & Poggenb.	Aspleniaceae	ebony spleenwort	22	0.81
<i>Carex albicans</i> Willd. ex Spreng.	Cyperaceae	whitetinge sedge	22	0.81
<i>Carpinus caroliniana</i> Walter	Betulaceae	American hornbeam	26	0.96
<i>Carya cordiformis</i> (Wangenh.) K. Koch	Juglandaceae	bitternut hickory	24	0.89
<i>Danthonia spicata</i> (L.) P. Beauv. ex Roem. & Schult.	Poaceae	poverty oatgrass	24	0.89
<i>Dryopteris marginalis</i> (L.) A. Gray	Dryopteridaceae	marginal woodfern	26	0.96
<i>Eurybia divaricata</i> (L.) G.L. Nesom	Asteraceae	white wood aster	27	1.00
<i>Fraxinus americana</i> L.	Oleaceae	white ash	26	0.96
<i>Galium aparine</i> L.	Rubiaceae	stickywilly	24	0.89
<i>Lonicera japonica</i> Thunb.*	Caprifoliaceae	Japanese honeysuckle	27	1.00
<i>Maianthemum racemosum</i> (L.) Link	Asparagaceae	feathery false lily of the valley	22	0.81
<i>Microstegium vimineum</i> (Trin.) A. Camus*	Poaceae	Nepalese browntop	26	0.96
<i>Ostrya virginiana</i> (Mill.) K. Koch	Betulaceae	hophornbeam	26	0.96
<i>Parthenocissus quinquefolia</i> (L.) Planch.	Vitaceae	Virginia creeper	27	1.00
<i>Pilea pumila</i> (L.) A. Gray	Urticaceae	Canadian clearweed	22	0.81
<i>Polypodium virginianum</i> L.	Polypodiaceae	rock polypody	22	0.81
<i>Prunus serotina</i> Ehrh.	Rosaceae	black cherry	25	0.93
<i>Quercus rubra</i> L.	Fagaceae	northern red oak	24	0.89
<i>Micranthes virginiensis</i> (Michx.) Small	Saxifragaceae	early saxifrage	25	0.93
<i>Solidago caesia</i> L.	Asteraceae	wreath goldenrod	25	0.93
<i>Stellaria media</i> (L.) Vill.*	Caryophyllaceae	common chickweed	24	0.89
<i>Stellaria pubera</i> Michx.	Caryophyllaceae	star chickweed	22	0.81
<i>Toxicodendron radicans</i> (L.) Kuntze	Anacardiaceae	eastern poison ivy	26	0.96
<i>Woodsia obtusa</i> (Spreng.) Torr.	Woodsiaceae	bluntlobe cliff fern	25	0.93

*Non-native.

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Table 3. Newly documented plant species for Manassas National Battlefield Park, Virginia.

[Nomenclature follows the Integrated Taxonomic Information System (<http://www.itis.gov>); status as non-native is from the PLANTS database (U.S. Department of Agriculture-Natural Resource Conservation Service, 2014)]

Species name and author	Common name	Comment
<i>Acalypha rhomboidea</i> Raf.	common threeseed mercury	One specimen collected.
<i>Bidens bipinnata</i> L.	Spanish needles	Not collected.
<i>Boechera laevigata</i> (Muhl. ex Willd.) Al-Shehbaz	smooth rockcress	Two specimens collected.
<i>Bromus inermis</i> Leyss.*	smooth brome	One specimen collected.
<i>Cardamine parviflora</i> L.	sand bittercress	Two specimens collected.
<i>Carex albursina</i> E. Sheld.	white bear sedge	The similar and closely related <i>C. laxiflora</i> (broad looseflower sedge) is recorded in the park, but sterile specimens with leaves wider than in <i>C. laxiflora</i> descriptions (Yatskievych, 1999; Weakley and others, 2012) were encountered at numerous sampling blocks. Three specimens were collected.
<i>Carex appalachica</i> J.M. Webber & P.W. Ball	Appalachian sedge	This includes fine-leaved, few-flowered sedges growing on cliffs and rock outcrops. The similar <i>C. radiata</i> (eastern star sedge) was also recorded in the park, but rarely occurs on rock faces (Weakley and others, 2012). One specimen with poorly developed fruits was collected.
<i>Clematis virginiana</i> L.	devil's darning needles	Not collected.
<i>Digitaria filiformis</i> (L.) Koeler	slender crabgrass	Not collected.
<i>Euonymus fortunei</i> (Turcz.) Hand.-Maz.*	winter creeper	Not collected.
<i>Houstonia longifolia</i> Gaertn.	longleaf summer bluet	One specimen collected.
<i>Osmorhiza claytonii</i> (Michx.) C.B. Clarke	Clayton's sweetroot	The similar <i>O. longistylis</i> (aniseroot) is recorded for the park, but is characterized by obvious exerted styles, moderate hairiness on the stem and a strong anise scent to the foliage (Yatskievych, 1999; Weakley and others, 2012). The encountered specimens were densely hairy on the stem and had only moderately exerted styles indicative of <i>O. claytonii</i> . Anise flavor was detected by chewing the developing seeds (leaves were not tested).
<i>Paulownia tomentosa</i> (Thunb.) Steud.*	princess tree	Not collected.
<i>Physalis heterophylla</i> Nees	clammy groundcherry	Not collected.
<i>Phytolacca americana</i> L.	American pokeweed	Not collected.
<i>Rubus pensilvanicus</i> Poir.	Pennsylvania blackberry	One specimen collected.
<i>Sedum sarmentosum</i> Bunge*	stringy stonecrop	One specimen collected.
<i>Silene virginica</i> L.	fire pink	Not collected.
<i>Smilax bona-nox</i> L.	saw greenbrier	Not collected
<i>Solidago altissima</i> L.	Canada goldenrod	One specimen collected.
<i>Tilia americana</i> L.	American basswood	Not collected.
<i>Ulmus pumila</i> L.*	Siberian elm	Not collected.
<i>Woodsia obtusa</i> (Spreng.) Torr.	bluntlobe cliff fern	This species is probably the same plant identified as <i>Cystopteris protrusa</i> (lowland bladderfern) by other authors (Weakley and others, 2012; NPSpecies, 2014). Specimens encountered during this study usually had obvious and persistent brown scales on the stem, suggesting identification as <i>Woodsia</i> ; specimens lacking such scales were usually small and found in close proximity to larger specimens with scales.

*Non-native.

Summary

We conducted a floral survey in 27 sampling blocks on 11 cliffs in Manassas National Battlefield Park, Virginia in 2014. We identified ground flora and shrubs to species and estimated percent foliar cover of each species in each sampling block. Trees were identified to species and their diameters were measured. We recorded 282 species in 194 genera and 83 families, including 23 newly documented species for the park. The three most common species occurred in every sampling block; 24 species occurred in more than 80 percent of the sampling blocks.

Accompanying Database

A database to accompany this report (Stroh and others, 2015) includes species lists, block-level percent cover for individual groundflora and shrub species, and diameters at breast height (dbh) for trees greater than 10 cm dbh. Environmental data for each sampling block includes World Geodetic System 1984 Zone 18N Easting and Northing coordinates of upstream terminus of sampling block; block length (m), maximum height (m), slope (degrees), and primary aspect (degrees); and percent cover of rock, bare soil, moss and lichen, leaf litter, down dead wood, and root and bole of live woody stems. Photographs of sampling blocks can be downloaded with the database and are accessible through hyperlinks within the database. A readme file and a shapefile of bluff locations accompany the database.

Management Uses of the Data

Species lists for individual bluffs or sampling blocks can be generated using the database that accompanies this report (Stroh and others, 2015). In addition to the final identification for each species, this database retains the original field identification and a justification for modifications to the species identification where appropriate, which allows users to identify locations where specimens belonging to problematic species groups were recorded if further field verification is desired. The database also provides the vegetative percent cover of each species in each block in the shrub and groundflora layers, and stem diameter measurements for trees with a dbh exceeding 10 cm; these data can be used to locate large patches of groundflora species, and individual or large specimens of tree species.

The database provided with this report (Stroh and others, 2015) can also be used to locate and monitor the occurrence of individual examples of species that are uncommon for the region, such as *Tsuga canadensis* (eastern hemlock), *Pinus strobus* (white pine), and *Kalmia latifolia* (mountain laurel). These species are disjunct from their more typical ranges and have affinities with more northern or cooler mountain habitats

(Fleming and Belden, 2004). These species also contribute to the biological diversity of the park and increase its value as a natural oasis in a highly fragmented and developed landscape. Additionally, the database can be used to identify locations where actions may be needed to control exotic species, including the frequently encountered *Lonicera japonica* (Japanese honeysuckle), *Microstegium vimineum* (Nepalese browntop), and *Alliaria petiolata* (garlic mustard), and the newly documented *Paulownia tomentosa* (princess tree).

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Appendix

12 **A Floral Survey of Cliff Habitats along Bull Run at Manassas National Battlefield Park, Virginia, 2014**

Table 1–1. List of 282 species (48 non-native) in 83 families recorded in a floral survey of cliffs at Manassas National Battlefield Park, Virginia.

[Nomenclature follows the Integrated Taxonomic Information System (<http://www.itis.gov>); status as non-native (indicated by asterisk) is from the PLANTS database (U.S. Department of Agriculture-Natural Resource Conservation Service, 2014).]

Scientific name and author	Common name	Number of blocks	Proportion of blocks
Family Acanthaceae			
<i>Justicia americana</i> (L.) Vahl	American water-willow	2	0.07
Family Aceraceae			
<i>Acer negundo</i> L.	boxelder	24	0.89
<i>Acer rubrum</i> L.	red maple	22	0.81
Family Anacardiaceae			
<i>Rhus aromatica</i> Aiton	fragrant sumac	13	0.48
<i>Toxicodendron radicans</i> (L.) Kuntze	eastern poison ivy	26	0.96
Family Annonaceae			
<i>Asimina triloba</i> (L.) Dunal	pawpaw	21	0.78
Family Apiaceae			
<i>Chaerophyllum procumbens</i> (L.) Crantz	spreading chervil	3	0.11
<i>Cryptotaenia canadensis</i> (L.) DC.	Canadian honewort	3	0.11
<i>Erigenia bulbosa</i> (Michx.) Nutt.	harbinger of spring	5	0.19
<i>Osmorhiza claytonii</i> (Michx.) C.B. Clarke	Clayton's sweetroot	2	0.07
<i>Sanicula canadensis</i> L.	Canadian blacksnakeroot	5	0.19
Family Araceae			
<i>Arisaema triphyllum</i> (L.) Schott	Jack in the pulpit	4	0.15
Family Aristolochiaceae			
<i>Asarum canadense</i> L.	Canadian wildginger	1	0.04
Family Aspleniaceae			
<i>Asplenium platyneuron</i> (L.) Britton, Sterns & Poggenb.	ebony spleenwort	22	0.81
<i>Asplenium rhizophyllum</i> L.	walking fern	7	0.26
<i>Asplenium trichomanes</i> L.	maidenhair spleenwort	15	0.56
Family Asteraceae			
<i>Achillea millefolium</i> L.*	common yarrow	4	0.15
<i>Ageratina altissima</i> (L.) King & H. Rob.	white snakeroot	12	0.44
<i>Ambrosia artemisiifolia</i> L.	annual ragweed	1	0.04
<i>Antennaria plantaginifolia</i> (L.) Richardson	woman's tobacco	9	0.33
<i>Artemisia annua</i> L.*	sweet sagewort	2	0.07
<i>Artemisia vulgaris</i> L.*	common wormwood	2	0.07
<i>Bidens bipinnata</i> L.	Spanish needles	1	0.04
<i>Bidens frondosa</i> L.	devil's beggartick	1	0.04
<i>Conoclinium coelestinum</i> (L.) DC	blue mistflower	3	0.11
<i>Eclipta prostrata</i> (L.) L.	false daisy	1	0.04
<i>Elephantopus carolinianus</i> Raeusch.	Carolina elephantsfoot	2	0.07
<i>Erechtites hieraciifolius</i> (L.) Raf. ex DC.	American burnweed	13	0.48
<i>Erigeron annuus</i> (L.) Pers.	eastern daisy fleabane	4	0.15
<i>Eupatorium serotinum</i> Michx.	lateflowering thoroughwort	3	0.11
<i>Eurybia divaricata</i> (L.) G.L. Nesom	white wood aster	27	1

Table 1–1. List of 282 species (48 non-native) in 83 families recorded in a floral survey of cliffs at Manassas National Battlefield Park, Virginia.—Continued

Scientific name and author	Common name	Number of blocks	Proportion of blocks
Family Asteraceae—Continued			
<i>Hieracium caespitosum</i> Dumort.*	meadow hawkweed	5	0.19
<i>Hieracium gronovii</i> L.	queendevil	2	0.07
<i>Hieracium scabrum</i> Michx.	rough hawkweed	1	0.04
<i>Hieracium venosum</i> L.	rattlesnakeweed	12	0.44
<i>Lactuca canadensis</i> L.	Canada lettuce	1	0.04
<i>Packera aurea</i> (L.) A. Love & D. Love	golden ragwort	2	0.07
<i>Prenanthes serpentaria</i> Pursh	cankerweed	1	0.04
<i>Solidago altissima</i> L.	Canada goldenrod	4	0.15
<i>Solidago bicolor</i> L.	white goldenrod	14	0.52
<i>Solidago caesia</i> L.	wreath goldenrod	25	0.93
<i>Solidago juncea</i> Aiton	early goldenrod	1	0.04
<i>Solidago nemoralis</i> Aiton	gray goldenrod	2	0.07
<i>Solidago ulmifolia</i> Muhl. ex Willd.	elmleaf goldenrod	2	0.07
<i>Symphyotrichum lanceolatum</i> (Willd.) G.L. Nesom	white panicle aster	12	0.44
<i>Symphyotrichum lateriflorum</i> (L.) A. Love & D. Love	calico aster	11	0.41
<i>Symphyotrichum undulatum</i> (L.) G.L. Nesom	wavyleaf aster	7	0.26
<i>Taraxacum officinale</i> F.H. Wigg.*	common dandelion	8	0.3
<i>Verbesina alternifolia</i> (L.) Britton ex Kearney	wingstem	14	0.52
<i>Xanthium strumarium</i> L.	rough cocklebur	1	0.04
Family Balsaminaceae			
<i>Impatiens capensis</i> Meerb.	jewelweed	9	0.33
Family Berberidaceae			
<i>Berberis thunbergii</i> DC.*	Japanese barberry	3	0.11
Family Betulaceae			
<i>Betula nigra</i> L.	river birch	5	0.19
<i>Carpinus caroliniana</i> Walter	American hornbeam	26	0.96
<i>Ostrya virginiana</i> (Mill.) K. Koch	hophornbeam	26	0.96
Family Boraginaceae			
<i>Mertensia virginica</i> (L.) Pers. ex Link	Virginia bluebells	2	0.07
<i>Myosotis macrosperma</i> Engelm.	largeseed forget-me-not	8	0.3
Family Brassicaceae			
<i>Alliaria petiolata</i> (M. Bieb.) Cavara & Grande*	garlic mustard	20	0.74
<i>Barbarea vulgaris</i> W.T. Aiton*	garden yellowrocket	2	0.07
<i>Boechera laevigata</i> (Muhl. ex Willd.) Al-Shehbaz	smooth rockcress	6	0.22
<i>Cardamine concatenata</i> (Michx.) Sw.	cutleaf toothwort	11	0.41
<i>Cardamine hirsuta</i> L.*	hairy bittercress	1	0.04
<i>Cardamine parviflora</i> L.	sand bittercress	10	0.37
Family Campanulaceae			
<i>Lobelia cardinalis</i> L.	cardinalflower	2	0.07
<i>Lobelia spicata</i> Lam.	palespike lobelia	3	0.11
<i>Triodanis perfoliata</i> (L.) Nieuwl.	clasping Venus' looking-glass	3	0.11

Table 1–1. List of 282 species (48 non-native) in 83 families recorded in a floral survey of cliffs at Manassas National Battlefield Park, Virginia.—Continued

Scientific name and author	Common name	Number of blocks	Proportion of blocks
Family Caprifoliaceae			
<i>Lonicera japonica</i> Thunb.*	Japanese honeysuckle	27	1
<i>Lonicera maackii</i> (Rupr.) Herder*	Amur honeysuckle	17	0.63
<i>Symphoricarpos orbiculatus</i> Moench	coralberry	6	0.22
<i>Viburnum acerifolium</i> L.	mapleleaf viburnum	20	0.74
<i>Viburnum prunifolium</i> L.	blackhaw	12	0.44
Family Caryophyllaceae			
<i>Dianthus armeria</i> L.*	Deptford pink	3	0.11
<i>Paronychia canadensis</i> (L.) Alph. Wood	smooth forked nailwort	10	0.37
<i>Silene caroliniana</i> ssp. <i>pennsylvanica</i> (Michx.) R.T. Clausen	Pennsylvania catchfly	15	0.56
<i>Silene virginica</i> L.	fire pink	1	0.04
<i>Stellaria media</i> (L.) Vill.*	common chickweed	24	0.89
<i>Stellaria pubera</i> Michx.	star chickweed	22	0.81
Family Celastraceae			
<i>Celastrus orbiculatus</i> Thunb.*	oriental bittersweet	9	0.33
<i>Euonymus americanus</i> L.	bursting-heart	5	0.19
<i>Euonymus fortunei</i> (Turcz.) Hand.-Maz.*	winter creeper	1	0.04
Family Clusiaceae			
<i>Hypericum prolificum</i> L.	shrubby St. Johnswort	1	0.04
<i>Hypericum punctatum</i> Lam.	spotted St. Johnswort	8	0.3
Family Commelinaceae			
<i>Commelina communis</i> L.*	Asiatic dayflower	8	0.3
Family Convolvulaceae			
<i>Ipomoea hederacea</i> Jacq.*	ivyleaf morning-glory	1	0.04
Family Cornaceae			
<i>Cornus florida</i> L.	flowering dogwood	4	0.15
<i>Nyssa sylvatica</i> Marshall	blackgum	7	0.26
Family Crassulaceae			
<i>Sedum sarmentosum</i> Bunge*	stringy stonecrop	1	0.04
<i>Sedum ternatum</i> Michx.	woodland stonecrop	20	0.74
Family Cupressaceae			
<i>Juniperus virginiana</i> L.	eastern redcedar	19	0.7
Family Cyperaceae			
<i>Carex albicans</i> Willd. ex Spreng.	whitetinge sedge	22	0.81
<i>Carex albursina</i> E. Sheld.	white bear sedge	18	0.67
<i>Carex amphibola</i> Steud.	eastern narrowleaf sedge	7	0.26
<i>Carex appalachica</i> J.M. Webber & P.W. Ball	Appalachian sedge	13	0.48
<i>Carex blanda</i> Dewey	eastern woodland sedge	21	0.78
<i>Carex cephalophora</i> Muhl. ex Willd.	oval-leaf sedge	9	0.33
<i>Carex communis</i> L.H. Bailey	fibrousroot sedge	1	0.04
<i>Carex glaucoidea</i> Tuck. ex Olney	blue sedge	2	0.07
<i>Carex grayi</i> Carey	Gray's sedge	1	0.04
<i>Carex hirsutella</i> Mack.	fuzzy wuzzy sedge	9	0.33

Table 1–1. List of 282 species (48 non-native) in 83 families recorded in a floral survey of cliffs at Manassas National Battlefield Park, Virginia.—Continued

Scientific name and author	Common name	Number of blocks	Proportion of blocks
Family Cyperaceae—Continued			
<i>Carex jamesii</i> Schwein.	James' sedge	1	0.04
<i>Carex nigromarginata</i> Schwein.	black edge sedge	10	0.37
<i>Carex radiata</i> (Wahlenb.) Small	eastern star sedge	3	0.11
<i>Carex rosea</i> Schkuhr ex Willd.	rosy sedge	2	0.07
<i>Carex stricta</i> Lam.	upright sedge	1	0.04
<i>Carex willdenowii</i> Schkuhr ex Willd.	Willdenow's sedge	6	0.22
Family Dioscoreaceae			
<i>Dioscorea villosa</i> L.	wild yam	14	0.52
Family Dryopteridaceae			
<i>Dryopteris marginalis</i> (L.) A. Gray	marginal woodfern	26	0.96
<i>Onoclea sensibilis</i> L.	sensitive fern	2	0.07
<i>Polystichum acrostichoides</i> (Michx.) Schott	Christmas fern	19	0.7
<i>Woodsia obtusa</i> (Spreng.) Torr.	bluntlobe cliff fern	25	0.93
Family Ebenaceae			
<i>Diospyros virginiana</i> L.	common persimmon	1	0.04
Family Elaeagnaceae			
<i>Elaeagnus umbellata</i> Thunb.*	autumn olive	14	0.52
Family Ericaceae			
<i>Kalmia latifolia</i> L.	mountain laurel	2	0.07
<i>Rhododendron periclymenoides</i> (Michx.) Shinnery	pink azalea	3	0.11
<i>Vaccinium pallidum</i> Aiton	Blue Ridge blueberry	14	0.52
<i>Vaccinium stamineum</i> L.	deerberry	4	0.15
Family Euphorbiaceae			
<i>Acalypha rhomboidea</i> Raf.	common threeseed mercury	7	0.26
<i>Acalypha virginica</i> L.	Virginia threeseed mercury	8	0.3
Family Fabaceae			
<i>Amphicarpaea bracteata</i> (L.) Fernald	American hogpeanut	6	0.22
<i>Baptisia tinctoria</i> (L.) Vent.	horseflyweed	1	0.04
<i>Cercis canadensis</i> L.	eastern redbud	6	0.22
<i>Desmodium nudiflorum</i> (L.) DC.	nakedflower ticktrefoil	3	0.11
<i>Lespedeza cuneata</i> (Dum. Cours.) G. Don*	sericea lespedeza	2	0.07
<i>Lespedeza violacea</i> (L.) Pers.	violet lespedeza	1	0.04
<i>Trifolium campestre</i> Schreb.*	field clover	2	0.07
<i>Trifolium</i> L.	clover	2	0.07
<i>Trifolium pratense</i> L.*	red clover	1	0.04
Family Fagaceae			
<i>Fagus grandifolia</i> Ehrh.	American beech	1	0.04
<i>Quercus alba</i> L.	white oak	12	0.44
<i>Quercus montana</i> Willd.	chestnut oak	14	0.52
<i>Quercus rubra</i> L.	northern red oak	24	0.89
<i>Quercus stellata</i> Wangenh.	post oak	2	0.07
<i>Quercus velutina</i> Lam.	black oak	2	0.07

Table 1–1. List of 282 species (48 non-native) in 83 families recorded in a floral survey of cliffs at Manassas National Battlefield Park, Virginia.—Continued

Scientific name and author	Common name	Number of blocks	Proportion of blocks
Family Fumariaceae			
<i>Corydalis flavula</i> (Raf.) DC.	yellow fumewort	10	0.37
<i>Dicentra cucullaria</i> (L.) Bernh.	Dutchman's breeches	8	0.3
Family Hamamelidaceae			
<i>Hamamelis virginiana</i> L.	American witchhazel	8	0.3
Family Hydrangeaceae			
<i>Hydrangea arborescens</i> L.	wild hydrangea	19	0.7
Family Hydrophyllaceae			
<i>Hydrophyllum virginianum</i> L.	eastern waterleaf	1	0.04
Family Iridaceae			
<i>Sisyrinchium mucronatum</i> Michx.	needle-tip blue-eyed grass	1	0.04
Family Juglandaceae			
<i>Carya cordiformis</i> (Wangenh.) K. Koch	bitternut hickory	24	0.89
<i>Carya glabra</i> (Mill.) Sweet	pignut hickory	8	0.3
<i>Carya tomentosa</i> (Lam. ex Poir.) Nutt.	mockernut hickory	4	0.15
<i>Juglans nigra</i> L.	black walnut	7	0.26
Family Juncaceae			
<i>Juncus dudleyi</i> Wiegand	Dudley's rush	1	0.04
<i>Luzula bulbosa</i> (Alph. Wood) Smyth & L.C.R. Smyth	bulbous woodrush	1	0.04
Family Lamiaceae			
<i>Clinopodium vulgare</i> L.	wild basil	6	0.22
<i>Cunila origanoides</i> (L.) Britton	common dittany	7	0.26
<i>Glechoma hederacea</i> L.*	ground ivy	17	0.63
<i>Lamium purpureum</i> L.*	purple deadnettle	10	0.37
<i>Lycopus americanus</i> Muhl. ex W.P.C. Barton	American water horehound	6	0.22
<i>Perilla frutescens</i> (L.) Britton*	beefsteakplant	15	0.56
<i>Scutellaria lateriflora</i> L.	blue skullcap	1	0.04
<i>Teucrium canadense</i> L.	Canada germander	1	0.04
Family Lauraceae			
<i>Lindera benzoin</i> (L.) Blume	northern spicebush	12	0.44
<i>Sassafras albidum</i> (Nutt.) Nees	sassafras	6	0.22
Family Liliaceae			
<i>Allium canadense</i> L.	meadow garlic	1	0.04
<i>Allium</i> L.	onion	8	0.3
<i>Allium vineale</i> L.*	wild garlic	3	0.11
<i>Erythronium americanum</i> Ker Gawl.	dogtooth violet	3	0.11
<i>Maianthemum racemosum</i> (L.) Link	feathery false lily of the valley	22	0.81
<i>Polygonatum biflorum</i> (Walter) Elliott	smooth Solomon's seal	19	0.7
Family Magnoliaceae			
<i>Liriodendron tulipifera</i> L.	tuliptree	6	0.22
Family Menispermaceae			
<i>Menispermum canadense</i> L.	common moonseed	2	0.07

Table 1–1. List of 282 species (48 non-native) in 83 families recorded in a floral survey of cliffs at Manassas National Battlefield Park, Virginia.—Continued

Scientific name and author	Common name	Number of blocks	Proportion of blocks
Family Monotropaceae			
<i>Monotropa uniflora</i> L.	Indianpipe	1	0.04
Family Moraceae			
<i>Morus rubra</i> L.	red mulberry	5	0.19
Family Oleaceae			
<i>Chionanthus virginicus</i> L.	white fringetree	9	0.33
<i>Fraxinus americana</i> L.	white ash	26	0.96
Family Onagraceae			
<i>Circaea lutetiana</i> L.	broadleaf enchanter's nightshade	11	0.41
Family Ophioglossaceae			
<i>Botrychium virginianum</i> (L.) Sw.	rattlesnake fern	1	0.04
Family Orobanchaceae			
<i>Orobanche uniflora</i> L.	oneflowered broomrape	8	0.3
Family Oxalidaceae			
<i>Oxalis dillenii</i> Jacq.	slender yellow woodsorrel	6	0.22
<i>Oxalis stricta</i> L.	common yellow oxalis	15	0.56
<i>Oxalis violacea</i> L.	violet woodsorrel	2	0.07
Family Papaveraceae			
<i>Sanguinaria canadensis</i> L.	bloodroot	5	0.19
Family Phytolaccaceae			
<i>Phytolacca americana</i> L.	American pokeweed	2	0.07
Family Pinaceae			
<i>Pinus strobus</i> L.	eastern white pine	6	0.22
<i>Pinus virginiana</i> Mill.	Virginia pine	15	0.56
<i>Tsuga canadensis</i> (L.) Carrière	eastern hemlock	10	0.37
Family Plantaginaceae			
<i>Plantago rugelii</i> Decne.	blackseed plantain	6	0.22
Family Platanaceae			
<i>Platanus occidentalis</i> L.	American sycamore	9	0.33
Family Poaceae			
<i>Agrostis hyemalis</i> (Walter) Britton, Sterns & Poggenb.	winter bentgrass	23	0.85
<i>Andropogon virginicus</i> L.	broomsedge bluestem	1	0.04
<i>Anthoxanthum odoratum</i> L.*	sweet vernalgrass	4	0.15
<i>Bromus inermis</i> Leyss.*	smooth brome	10	0.37
<i>Dactylis glomerata</i> L.*	orchardgrass	6	0.22
<i>Danthonia spicata</i> (L.) P. Beauv. ex Roem. & Schult.	poverty oatgrass	24	0.89
<i>Dichanthelium acuminatum</i> var. <i>lindheimeri</i> (Nash) Gould & C.A. Clark	Lindheimer panicgrass	4	0.15
<i>Dichanthelium boscii</i> (Poir.) Gould & C.A. Clark	Bosc's panicgrass	1	0.04
<i>Dichanthelium clandestinum</i> (L.) Gould	deertongue	13	0.48
<i>Dichanthelium linearifolium</i> (Scribn.) Gould	slimleaf panicgrass	3	0.11
<i>Digitaria filiformis</i> (L.) Koeler	slender crabgrass	1	0.04
<i>Elymus hystrix</i> L.	eastern bottlebrush grass	4	0.15

Table 1–1. List of 282 species (48 non-native) in 83 families recorded in a floral survey of cliffs at Manassas National Battlefield Park, Virginia.—Continued

Scientific name and author	Common name	Number of blocks	Proportion of blocks
Family Poaceae—Continued			
<i>Elymus virginicus</i> L.	Virginia wildrye	19	0.7
<i>Festuca subverticillata</i> (Pers.) E.B. Alexeev	nodding fescue	17	0.63
<i>Leersia virginica</i> Willd.	whitegrass	13	0.48
<i>Microstegium vimineum</i> (Trin.) A. Camus*	Nepalese browntop	26	0.96
<i>Muhlenbergia frondosa</i> (Poir.) Fernald	wirestem muhly	1	0.04
<i>Muhlenbergia schreberi</i> J.F. Gmel.	nimblewill	8	0.3
<i>Muhlenbergia sobolifera</i> (Muhl. ex Willd.) Trin.	rock muhly	6	0.22
<i>Poa annua</i> L.*	annual bluegrass	11	0.41
<i>Poa compressa</i> L.*	Canada bluegrass	8	0.3
<i>Poa sylvestris</i> A. Gray	woodland bluegrass	8	0.3
<i>Schedonorus arundinaceus</i> (Schreb.) Dumort.*	tall fescue	4	0.15
<i>Setaria viridis</i> (L.) P. Beauv.*	green bristlegrass	1	0.04
<i>Sphenopholis nitida</i> (Biehler) Scribn.	shiny wedgescale	3	0.11
Family Polygonaceae			
<i>Persicaria hydropiperoides</i> (Michx.) Small	swamp smartweed	18	0.67
<i>Persicaria perfoliata</i> (L.) H. Gross*	Asiatic tearthumb	3	0.11
<i>Persicaria virginiana</i> (L.) Gaertn.	jumpseed	3	0.11
<i>Rumex crispus</i> L.*	curly dock	1	0.04
Family Polypodiaceae			
<i>Polypodium virginianum</i> L.	rock polypody	22	0.81
Family Portulacaceae			
<i>Claytonia virginica</i> L.	Virginia springbeauty	14	0.52
Family Primulaceae			
<i>Lysimachia ciliata</i> L.	fringed loosestrife	1	0.04
Family Pteridaceae			
<i>Adiantum pedatum</i> L.	northern maidenhair	4	0.15
Family Pyrolaceae			
<i>Chimaphila maculata</i> (L.) Pursh	striped prince's pine	3	0.11
Family Ranunculaceae			
<i>Actaea racemosa</i> L.	black baneberry	4	0.15
<i>Anemone americana</i> (DC.) H. Hara	roundlobe hepatica	3	0.11
<i>Anemone virginiana</i> L.	tall thimbleweed	3	0.11
<i>Aquilegia canadensis</i> L.	red columbine	18	0.67
<i>Clematis ochroleuca</i> Aiton	curlyheads	1	0.04
<i>Clematis virginiana</i> L.	devil's darning needles	1	0.04
<i>Ranunculus abortivus</i> L.	littleleaf buttercup	20	0.74
<i>Ranunculus micranthus</i> Nutt.	rock buttercup	18	0.67
<i>Ranunculus recurvatus</i> Poir.	blisterwort	3	0.11
<i>Thalictrum dioicum</i> L.	early meadow-rue	9	0.33
<i>Thalictrum thalictroides</i> (L.) Eames & B. Boivin	rue anemone	1	0.04

Table 1–1. List of 282 species (48 non-native) in 83 families recorded in a floral survey of cliffs at Manassas National Battlefield Park, Virginia.—Continued

Scientific name and author	Common name	Number of blocks	Proportion of blocks
Family Rosaceae			
<i>Agrimonia rostellata</i> Wallr.	beaked agrimony	1	0.04
<i>Amelanchier arborea</i> (F. Michx.) Fernald	common serviceberry	17	0.63
<i>Duchesnea indica</i> (Andrews) Focke*	Indian strawberry	1	0.04
<i>Geum canadense</i> Jacq.	white avens	12	0.44
<i>Physocarpus opulifolius</i> (L.) Maxim.	common ninebark	1	0.04
<i>Potentilla recta</i> L.*	sulphur cinquefoil	1	0.04
<i>Potentilla simplex</i> Michx.	common cinquefoil	7	0.26
<i>Prunus americana</i> Marshall	American plum	3	0.11
<i>Prunus avium</i> (L.) L.*	sweet cherry	9	0.33
<i>Prunus serotina</i> Ehrh.	black cherry	25	0.93
<i>Rosa carolina</i> L.	Carolina rose	7	0.26
<i>Rosa multiflora</i> Thunb.*	multiflora rose	11	0.41
<i>Rubus cuneifolius</i> Pursh	sand blackberry	1	0.04
<i>Rubus occidentalis</i> L.	black raspberry	5	0.19
<i>Rubus pensilvanicus</i> Poir.	Pennsylvania blackberry	11	0.41
Family Rubiaceae			
<i>Galium aparine</i> L.	stickywilly	24	0.89
<i>Galium circaezans</i> Michx.	licorice bedstraw	13	0.48
<i>Galium concinnum</i> Torr. & A. Gray	shining bedstraw	7	0.26
<i>Galium triflorum</i> Michx.	fragrant bedstraw	16	0.59
<i>Houstonia caerulea</i> L.	azure bluet	19	0.7
<i>Houstonia longifolia</i> Gaertn.	longleaf summer bluet	13	0.48
<i>Houstonia purpurea</i> L.	Venus' pride	5	0.19
<i>Mitchella repens</i> L.	partridgeberry	6	0.22
Family Salicaceae			
<i>Salix nigra</i> Marshall	black willow	2	0.07
Family Santalaceae			
<i>Comandra umbellata</i> (L.) Nutt.	bastard toadflax	1	0.04
Family Saururaceae			
<i>Saururus cernuus</i> L.	lizard's tail	4	0.15
Family Saxifragaceae			
<i>Heuchera americana</i> L.	American alumroot	21	0.78
<i>Micranthes virginianensis</i> (Michx.) Small	early saxifrage	25	0.93
Family Scrophulariaceae			
<i>Mimulus alatus</i> Aiton	sharpwing monkeyflower	2	0.07
<i>Paulownia tomentosa</i> (Thunb.) Steud.*	princess tree	2	0.07
<i>Verbascum thapsus</i> L.*	common mullein	6	0.22
<i>Veronica arvensis</i> L.*	corn speedwell	2	0.07
<i>Veronica hederifolia</i> L.*	ivyleaf speedwell	17	0.63
<i>Veronica officinalis</i> L.*	common gypsyweed	2	0.07
<i>Veronica peregrina</i> L.*	neckweed	1	0.04

Table 1–1. List of 282 species (48 non-native) in 83 families recorded in a floral survey of cliffs at Manassas National Battlefield Park, Virginia.—Continued

Scientific name and author	Common name	Number of blocks	Proportion of blocks
Family Simaroubaceae			
<i>Ailanthus altissima</i> (Mill.) Swingle*	tree of heaven	2	0.07
Family Smilacaceae			
<i>Smilax bona-nox</i> L.	saw greenbrier	8	0.3
<i>Smilax tamnoides</i> L.	bristly greenbrier	4	0.15
Family Solanaceae			
<i>Physalis heterophylla</i> Nees	clammy groundcherry	1	0.04
<i>Physalis virginiana</i> Mill.	Virginia groundcherry	1	0.04
<i>Solanum carolinense</i> L.	Carolina horsenettle	2	0.07
Family Staphyleaceae			
<i>Staphylea trifolia</i> L.	American bladdernut	12	0.44
Family Tiliaceae			
<i>Tilia americana</i> L.	American basswood	6	0.22
Family Ulmaceae			
<i>Celtis occidentalis</i> L.	common hackberry	19	0.7
<i>Ulmus americana</i> L.	American elm	8	0.3
<i>Ulmus pumila</i> L.*	Siberian elm	8	0.3
<i>Ulmus rubra</i> Muhl.	slippery elm	17	0.63
Family Urticaceae			
<i>Boehmeria cylindrica</i> (L.) Sw.	smallspike false nettle	12	0.44
<i>Pilea pumila</i> (L.) A. Gray	Canadian clearweed	22	0.81
Family Valerianaceae			
<i>Valerianella radiata</i> (L.) Dufr.	beaked cornsalad	4	0.15
Family Verbenaceae			
<i>Phryma leptostachya</i> L.	American lopseed	1	0.04
<i>Verbena urticifolia</i> L.	white vervain	1	0.04
Family Violaceae			
<i>Viola pubescens</i> Aiton	downy yellow violet	1	0.04
<i>Viola sororia</i> Willd.	common blue violet	13	0.48
<i>Viola striata</i> Aiton	striped cream violet	4	0.15
Family Vitaceae			
<i>Parthenocissus quinquefolia</i> (L.) Planch.	Virginia creeper	27	1
<i>Vitis vulpina</i> L.	frost grape	19	0.7

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