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Source: Natural Areas Journal, 37(1) : 108-117

Published By: Natural Areas Association

URL: <https://doi.org/10.3375/043.037.0113>

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An Invasive Plant Watch List for the National Capital Regional National Parks (USA)

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Natural Areas Journal 37:108–117

ABSTRACT: Early detection and rapid response (EDRR) are critical tools for managing invasive plants. A watch list made up of high-priority early detection species that are not yet known to occur in the target area is an important EDRR tool. To make a watch list I used the EDDMapS database of plant occurrences to identify nonnative plants reported within 150 miles of the District of Columbia. I sorted the list to include only species not reported by park staff to be invasive in park natural areas. The resulting 97 candidate species were prioritized using NatureServe's Invasive Species Assessment Protocol (ISAP) to produce an Invasive Species Impact Rank (I-Rank). The ISAP includes questions in four categories (Ecological Impact, Current Distribution and Abundance, Trend in Distribution and Abundance, and Management Difficulty). Each category contributes to an overall I-Rank. The 20 species with the highest I-Rank became the basis for a priority watch list. The watch list will be used to guide presence/absence data collection and treat all identified populations on park land. Removing these populations will protect natural areas and reduce management costs in future years.

Index terms: biological invasions, risk assessment, watch list

INTRODUCTION

Ecological impacts of invasive plants can include inhibiting native plants (Pratti and Bossdorf 2003; Greer et al. 2014; Brouwer et al. 2015), creating reproductive sinks (Schmidt and Whelan 1999; Borgmann and Rodewald 2004; Keeler and Chew 2008), changing soil conditions (Reinhart and Callaway 2006; Rout et al. 2013), and reducing the pollination of native plants (Brown et al. 2002; Tscheulin and Petanidou 2013; Spellman et al. 2015). Because resources are limited, species targeted for control must be prioritized (Fox and Gordon 2004; Krug et al. 2010). Prioritization schemes can identify species for treatment (e.g., Hiebert and Stubbendieck 1993; Nel et al. 2004; DPI 2008; Ou et al. 2008; Brunel et al. 2010; Essl et al. 2011), sites for protection (e.g., Goodall and Naudé 1998; Dawson et al. 2014), populations for treatment (e.g., Frey et al. 2015), or through a combination of species and site prioritization (Downey et al. 2010; Williams et al. 2014). The work described here involves prioritizing species for treatment. Species prioritization protocols have been developed by government agencies (e.g., Self 1986, cited in Hiebert and Stubbendieck 1993; Heffernan et al. 2001; Gross and Olin 2011; Jordan et al. 2012) and nongovernmental organizations (e.g., Washington Invasive Species Council, n.d.; Fox et al. 2009; Cal-IPC 2012) for at least 30 years.

In the early 2000s, the National Park Service (NPS) collaborated with NatureServe to create the Invasive Species Assessment Protocol (ISAP; Morse et al. 2004; Ran-

dall et al. 2008). NatureServe created the ISAP to build upon the organization's assessments of native species and to assess the impact of nonnative species on native biodiversity (Randall et al. 2008). The ISAP was designed to be used "in a large geographical area such as a nation, state, province, or ecological region" (Morse et al. 2004). The ISAP results in an Invasive Species Impact Rank (I-Rank). NatureServe used the ISAP to rank 538 plant species for the United States (NatureServe 2014). In addition, the ISAP has been used in its published form or in a modified form to rank at least 183 species in New York State (Jordan et al. 2012), 52 species in Nebraska (Williams 2013), and 134 species in Vietnam (Tan et al. 2012). I chose the ISAP as a prioritization tool because it had been used for many species in many areas, included important factors (ecological impact, rate of spread, and similar habitats invaded elsewhere), and included a way to express uncertainty. Ecological impact is an important factor because nonnative species are only a concern when they have ecological impacts (Hulme et al. 2013; Ricciardi et al. 2013; Simberloff et al. 2013) and can spread from where they are introduced. Rate of spread is an important factor because a fast-spreading species has the potential to impact a larger area than a species that spreads slowly. Similar habitats invaded elsewhere is the factor that is most predictive for invasiveness (Mack 1996; Reichard and Hamilton 1997; Kolar and Lodge 2001; Gordon et al. 2008).

Before species can be prioritized one must determine which species are candidates for prioritization. Treating invasive species

when they are rare (early detection and rapid response) is an efficient strategy for managing invasive plants (Cusack et al. 2009). Early detection and rapid response are critical aspects to the management of nonnative invasive species (Mehta et al. 2007; Hauser and McCarthy 2009; Goldberg et al. 2013). Rejmanek and Pitcairn (2002) evaluated noxious plant eradication efforts in California and concluded that efforts on populations larger than 100 ha were often unsuccessful, whereas eradication efforts on populations smaller than 1 ha were much more likely to succeed. Pluess et al. (2012) conducted a worldwide review of eradication efforts for many taxa. For plant eradication efforts they concluded that the likelihood of success was greater if the efforts were initiated within the first four years of the invasion process. I chose candidate species for prioritization that were believed to be absent from, but found near, National Capital Region (NCR) parks.

NPS has spent thousands of person-hours and millions of dollars in the NCR treating invasive species over the last 20 years. Most treatment efforts performed by NPS staff, volunteers, or contractors have focused on species that have had known negative ecological impacts. Target species have either been widespread (e.g., *Pueraria montana* var. *lobata* (Willd.) Maesen & S.M. Almeida ex Sanjappa & Predeep and *Ailanthus altissima* (Mill.) Swingle) or uncommon (e.g., *Buddleja davidii* Franch. and *Oplismenus hirtellus* ssp. *undulatifolius* (Ard.) U. Scholz). This paper covers a third group—watch list species. I define watch list species as those species likely to become early detection targets because they have both a high potential to impact ecosystems and are nearby but not yet documented in the area of interest. Faulkner et al. (2014) outlined a system to build a watch list for South Africa. Their list included nonnative species that were reported as invasive elsewhere, were absent from South Africa, were species for which occurrence data were available, were found in similar climates as the target area, and had the potential to be introduced. The system I describe here shares these characteristics but is on a smaller scale (i.e., the NCR parks are spread across a region of less than 25,000 km² whereas South

Africa covers more than 1 million km²), only considers species nearby, and ranks individual species relative to others on the watch list. My objective was to produce a prioritized regional watch list for national parks in the NCR.

Building a watch list is challenging because of limited time available to conduct assessments, limited data available about assessed species, and lack of knowledge about species that are not yet found in the area of interest. The number of detected invasive species is increasing (Aukema et al. 2010) and NPS resources are shrinking (National Park Foundation 2011), therefore limited person-hours are available to evaluate species. Choosing a protocol that can be conducted in only a few hours rather than a few days (e.g., Koop et al. 2012) increases the number of species that can be evaluated. Creating prioritized lists of invasive plants can be challenging because ecological impact data may not be available or may be hard to access for each evaluated species (McGeoch et al. 2012). Choosing a protocol that can reflect the uncertainty of the data reviewed can mitigate the problem of limited data. Although many prioritization schemes have been used to prioritize species for treatment, most land managers prioritize species for treatment ad hoc. Fox and Gordon (2004) reviewed 113 invasive plant priority lists and found only 10% were the result of a ranking process. Ad hoc prioritization does not make the most efficient use of limited resources. In addition, species that are uncommon or absent are hard for staff and volunteers to learn. If a species is not recognized, it may not get reported or treated. Producing a prioritized list reduces the number of species a manager must learn.

METHODS

I obtained a list of plants reported as invasive in and around NCR parks from EDDMapS (Early Detection and Distribution Mapping System; EDDMapS 2013), an online repository of invasive species occurrence data. EDDMapS staff produced a list of records from within 241 km (150 miles) of Washington, DC, with a two-step process. First, staff queried the database for all records within a square area roughly 241

km (150 miles) on each side that is centered on Washington, DC (between 36°0'0"N and 42°0'0"N and between 74°0'0"W and 80°0'0"W; DMS). Second, EDDMapS staff overlaid the query results in ArcGIS (ESRI 2010) with a map layer of a circle with a 241-km radius around Washington, DC, and trimmed the output to exclude records outside the circle (Figure 1). The radius of 241 km was chosen because it included all NCR parks and at least a few counties beyond each park. Because the query was built on a latitude/longitude search, it did not include records that did not have a latitude and longitude associated with them. Records may never have had latitude and longitude or may have had it withheld when EDDMapS received the data. Many of the records without latitude and longitude were provided to EDDMapS from the USDA Plants Database (USDA NRCS 2015), the Biota of North America Program (Kartesz 2015), the USFS Forest Inventory and Analysis Database (USDA USFS 2015), or herbaria. Excluding these records may have excluded species in our area. However, because of the large number of records, it is likely that the vast majority of taxa are represented in both categories (those with and those without latitude/longitude data).

The EDDMapS records were summarized by taxa and exported to an Excel spreadsheet (Microsoft 2010). Records included record and taxa identification codes used by EDDMapS, latitude and longitude, and the state and county of the record. I removed synonyms based on ITIS (2013), removed names for species native in all three primary jurisdictions (Maryland, District of Columbia, and Virginia), and combined records that had subspecific taxa with those that were recorded to the specific level (hereafter, the *150-mile list*).

To obtain a list of species already known to be invasive in NCR parks I used a list that was assembled by NCR staff in 2012 and 2013 by polling park managers. Taxa were included on the list if the park manager reported the species as invasive in natural areas in NCR parks. I removed synonyms based on ITIS (2013) and consolidated species listed more than once (hereafter, the *park list*).

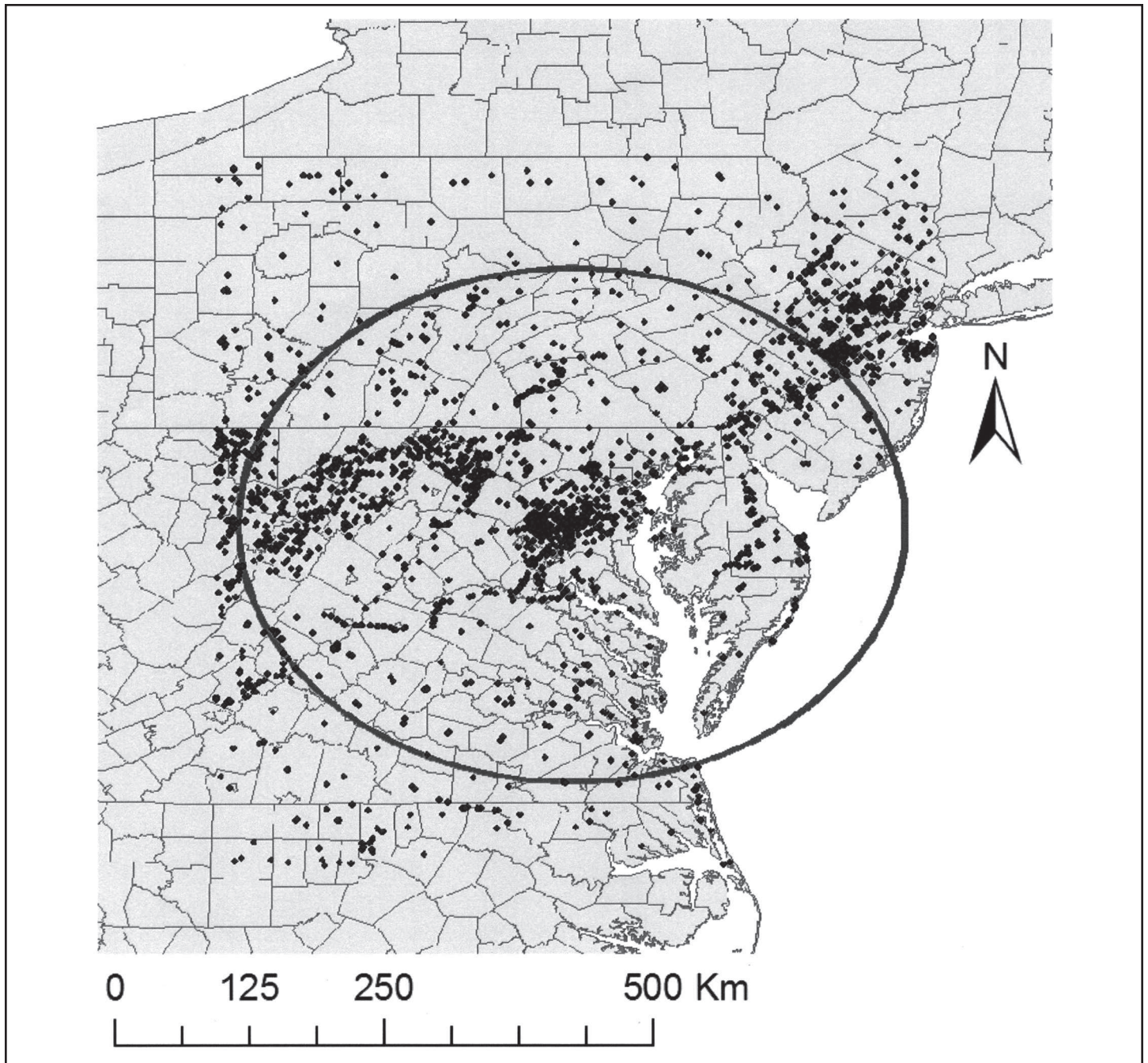


Figure 1. The EDDMapS records used to build the 150-mile list.

To identify invasive species not yet found in NCR parks I removed species on the *park list* from the *150-mile list*, yielding the *candidate list* (Table 1). In addition to species not yet found in NCR parks, the species on the *candidate list* might have belonged to two other categories: (1) species not well known and, therefore, not reported by park staff, or (2) species known but not considered by a park manager to

be invasive in natural areas.

I prioritized species on the *candidate list* using the ISAP and used the highest-priority species to create the *watch list*. Taxa on the *candidate list* were looked up in the NatureServe Explorer (Natureserve 2014). Any taxa with a completed I-Rank had its I-Rank reviewed and, if needed, modified for our region. Modifications

were performed if additional information was available since the ranking had been conducted by NatureServe or if there was evidence that the behavior of the species in the Mid-Atlantic differed from the behavior of the species nationally. Species without an existing I-Rank were put through the NatureServe ISAP (Morse et al. 2004; Randall et al. 2008). Initial assessments were conducted by volunteers and then reviewed

Table 1. Candidate list. The x indicates species on the watch list. Many Candidate species are known to occur in parks. They occur on this list because they are not considered invasive in park natural areas, they are poorly known, or they were not known to occur in park natural areas at the time the Park List was created.

Species	Common name	NatureServe I- Rank	NCR I-Rank
<i>Agrostis gigantea</i> Roth	water bentgrass	Medium/Low	Medium/Low
<i>Alnus glutinosa</i> (L.) Gaertn.	black alder	Medium	Medium
<i>Alopecurus geniculatus</i> L.	water foxtail	NA	Low
<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	alligator weed	Medium	Medium
<i>Ambrosia artemisiifolia</i> L.	common ragweed	NA	Medium/Low
<i>Arctium lappa</i> L.	great burdock	Insignificant	Insignificant
<i>Artemisia annua</i> L.	annual wormwood	Low	Low
<i>Asparagus officinalis</i> L.	asparagus	Medium/Insignificant	Medium/Insignificant
^a <i>Bambusa bambos</i> (L.) Voss	thorny bamboo	NA	Medium/Insignificant
<i>Barbarea vulgaris</i> W.T. Aiton	yellow rocket	Insignificant	Insignificant
<i>Berberis julianae</i> C.K. Schneid.	wintergreen barberry	NA	Medium/Low
<i>Buxus microphylla</i> Siebold & Zucc.	littleleaf boxwood	NA	Insignificant
<i>Buxus sempervirens</i> L.	common boxwood	NA	Insignificant
<i>Callitriche stagnalis</i> Scop.	pondwater starwort	Low	Low
<i>Cardamine impatiens</i> L.	Narrowleaf bittercress	Low	Low
<i>Carduus acanthoides</i> L.	plumeless thistle	Medium	Medium
<i>Carduus crispus</i> L.	curled thistle	Insignificant	Insignificant
x ^b <i>Cenchrus setaceus</i> (Forssk.) Morrone	fountaingrass	High/Medium	High/Medium
<i>Centaurea macrocephala</i> Puschk. ex Willd.	big-headed knapweed	Low	Low
<i>Centaurea nigra</i> L.	black knapweed	Insignificant	Insignificant
<i>Chenopodium album</i> L.	lambsquarters	NA	Low/Insignificant
<i>Chenopodium glaucum</i> L.	oak-leaf goosefoot	NA	Low
<i>Crupina vulgaris</i> Cass.	common crupina	Low	Medium/Low
<i>Dipsacus laciniatus</i> L.	cutleaf teasel	Medium/Low	Medium/Low
<i>Echinochloa crus-galli</i> (L.) P. Beauv.	barnyard grass	Low	Low
x <i>Egeria densa</i> Planch.	brazilian elodea	High/Medium	High/Medium
<i>Eichhornia azurea</i> (Sw.) Kunth	anchored water hyacinth	NA	Medium/Low
x <i>Eichhornia crassipes</i> (Mart.) Solms	common water hyacinth	High	High
<i>Epilobium hirsutum</i> L.	hairy willow herb	Medium/Low	Medium/Low
<i>Eragrostis curvula</i> (Schrud.) Nees	weeping lovegrass	Medium/Low	Medium
<i>Eranthis hyemalis</i> (L.) Salisb.	winter aconite	NA	Insignificant
x <i>Fallopia sachalinensis</i> (F. Schmidt) Ronse Decr.	giant knotweed	High/Medium	High/Medium
<i>Fatoua villosa</i> (Thunb.) Nakai	hairy crabweed	NA	Low
<i>Forsythia viridissima</i> Lindl.	greenstem forsythia	NA	Medium/Insignificant

Continued

Table 1. (Continued)

Species	Common name	NatureServe I- Rank	NCR I-Rank
<i>Galega officinalis</i> L.	goat's rue	Low/Insignificant	Low/Insignificant
x <i>Glossostigma cleistanthum</i> W.R. Barker	mudmats	NA	High/Medium
<i>Hibiscus syriacus</i> L.	rose of Sharon	NA	Low/Insignificant
<i>Holcus lanatus</i> L.	velvetgrass	Medium	Medium
x <i>Hypericum perforatum</i> L.	common St. John's wort	High/Medium	High/Medium
<i>Juncus inflexus</i> L.	European meadow rush	NA	Medium
<i>Koelreuteria paniculata</i> Laxm.	golden rain tree	Insignificant	Insignificant
x <i>Lamium galeobdolon</i> (L.) L.	yellow archangel	NA	High/Low
<i>Landoltia punctata</i> (G. Mey.) Les & D.J. Crawford	dotted duckmeat	NA	Low
<i>Lapsana communis</i> L.	nipplewort	NA	Low
<i>Lonicera fragrantissima</i> Lindl. & Paxton	sweet breath of spring	NA	Low
<i>Lotus corniculatus</i> L.	bird's foot trefoil	Medium/Low	Medium/Low
x <i>Ludwigia grandiflora</i> (Michx.) Greuter & Burdet	large-flower primrose-willow	High	High
<i>Ludwigia peploides</i> (Kunth) P.H. Raven	creeping water primrose	NA	Low
<i>Lycopus europaeus</i> L.	gypsywort	NA	Insignificant
<i>Lysimachia vulgaris</i> L.	garden loosestrife	NA	Medium
<i>Marsilea mutica</i> Mett.	Australian water clover	NA	Medium/Low
<i>Marsilea quadrifolia</i> L.	European water clover	NA	Medium/Low
<i>Mentha aquatica</i> L.	water mint	NA	Low/Insignificant
<i>Mentha spicata</i> L.	bush mint, spearmint	NA	Insignificant
<i>Mentha x gracilis</i> Sole (pro. sp.)	gingermint	NA	Insignificant
<i>Mollugo verticillata</i> L.	carpet-weed	NA	Insignificant
<i>Myosotis scorpioides</i> L.	forget-me-not	NA	Medium/Low
<i>Myosoton aquaticum</i> (L.) Moench	giant chickweed	NA	Low/Insignificant
x <i>Myriophyllum aquaticum</i> (Vell.) Verdc	parrot feather	High/Medium	High/Medium
x <i>Myriophyllum spicatum</i> L.	Eurasian watermilfoil	High	High
x <i>Najas minor</i> All.	brittle waternymph	High/Medium	High/Medium
x <i>Nandina domestica</i> Thunb.	heavenly bamboo	High/Low	High/Medium
<i>Nelumbo nucifera</i> Gaertn.	sacred lotus	NA	Low/Insignificant
x <i>Nymphoides peltata</i> (S.G. Gmel.) Kuntze	yellow floating heart	High/Medium	High/Medium
<i>Oenanthe javanica</i> (Blume) DC.	Java waterdropwort	NA	Low
<i>Persicaria longiseta</i> (Bruijn) Kitag.	Oriental lady's thumb	NA	Medium

Continued

Table 1. (Continued)

Species	Common name	NatureServe I-Rank	NCR I-Rank
x <i>Phellodendron amurense</i> Rupr.	Amur cork tree	NA	High/Low
<i>Phyllostachys aureosulcata</i> McClure	yellow grove bamboo	NA	Medium/Low
<i>Pinus thunbergii</i> Parl.	Japanese black pine	NA	Low
<i>Pistia stratiotes</i> L.	water lettuce	NA	Medium
<i>Poa trivialis</i> L.	rough bluegrass	Medium/Low	Medium/Low
x <i>Poncirus trifoliata</i> (L.) Raf.	hardy orange	NA	High/Low
<i>Populus alba</i> L.	white poplar	High/Low	Medium/Low
<i>Potamogeton crispus</i> L.	curly pondweed	Medium	Medium
<i>Puccinellia distans</i> (Jacq.) Parl.	European alkaligrass	NA	Low/Insignificant
x <i>Rhamnus cathartica</i> L.	common buckthorn	High/Medium	High
x <i>Rhamnus frangula</i> L.	glossy false buckthorn	High/Medium	High/Medium
<i>Rorippa sylvestris</i> (L.) Besser	creeping yellow cress	Medium/Low	Medium/Low
<i>Rosa luciae</i> Franch. & Rochebr. ex	memorial rose	NA	Medium/Low
<i>Rumex obtusifolius</i> L.	bitter dock	NA	Low/Insignificant
<i>Salix alba</i> L.	golden willow	NA	Low
<i>Salix fragilis</i> L.	crack willow	NA	Low
<i>Salix purpurea</i> L.	basket willow	NA	Medium/Low
<i>Setaria faberi</i> R.A.W. Herrm.	Chinese foxtail	NA	Low/Insignificant
<i>Sonchus arvensis</i> L.	creeping sowthistle	Medium/Low	Medium/Low
x <i>Spiraea japonica</i> L. f.	Japanese spiraea	High/Medium	High/Medium
<i>Spiraea thunbergii</i> Siebold ex Blume	Thunberg's meadowsweet	NA	Low/Insignificant
x <i>Tamarix parviflora</i> DC.	tamarisk	NA	High/Low
<i>Taxus baccata</i> L.	English yew	NA	Low/Insignificant
<i>Trapa natans</i> L.	water chestnut	Medium	Medium
<i>Veronica beccabunga</i> L.	European speedwell	NA	Low/Insignificant
<i>Viburnum setigerum</i> Hance	tea viburnum	NA	Low/Insignificant
<i>Viburnum sieboldii</i> Miq.	Siebold's arrowwood	NA	Low/Insignificant
x <i>Vincetoxicum nigrum</i> (L.) Moench	black swallow-wort	High	High
<i>Vincetoxicum hirundinaria</i> Medik.	white swallow-wort	Low	Low
<i>Vitex rotundifolia</i> L. f.	roundleaf chastetree	Medium/Low	Medium/Low
<i>Yucca glauca</i> Nutt.	beargrass	NA	Insignificant

^a *Bambusa bambos* is likely a misidentified *Phyllostachys aureosulcata* McClure or *Pseudosasa japonica* (Siebold & Zucc. ex Steud.) Makino ex Nakai

^b *Cenchrus setaceus* is likely a misidentified *C. compressus* (R. Br.) Morrone

The production of the Watch List encouraged the identification of and reporting of the species on the list. It is now known that these species do occur in NCR parks: *Cenchrus setaceus*, *Cenchrus compressus*, *Hypericum perforatum*, *Lamium galeobdolon*, *Myriophyllum spicatum*, *Najas major*, *Nandina domestica*, *Phellodendron amurense*, *Poncirus trifoliata*, *Rhamnus cathartica*, and *Spiraea japonica*.

by interns to ensure consistent treatment across taxa. I conducted a final review of all assessments for all candidate taxa. The ISAP comprises 20 questions divided into four sections (Figure 2). Answers range from A (High) to D (Insignificant). In cases where the information available is not sufficient to narrow the rank to a specific level (e.g., B; Medium), a range I-Rank (e.g., A/B; High/Medium) is assigned. U (Unknown) is given for a plant that warrants a ranking of AD (High/Insignificant). Uncertainty may be a reflection of conflicting published information or uncertainty about the quality of the published information. Any taxon with a ranking word including “High” (i.e., High, High/Medium, High/

Low) was placed on the *watch list*. These rankings were chosen to capture the species that posed the highest potential threat to ecosystems in the NCR.

RESULTS

EDDMapS provided a list of 12,707 records covering 257 taxa. After being trimmed of synonymous taxa, natives, and species-level duplicates, the *150-mile list* contained 116 species—species that were reported from within 150 miles of Washington, DC. The *park list* included 195 species—species that were reported as invasive in NCR natural areas. Once the

species on the *park list* had been removed from the *150-mile list*, the *candidate list* had 97 species (Table 1)—species that were found in the area but had not been reported as invasive in national park natural areas. Forty-five of the species on the *candidate list* had ranks available on NatureServe; 11 of those were modified (Table 2). In some cases, new information was available since the creation of the I-Rank by NatureServe, and in other cases the behavior of the species in our region differed from the national-level behavior. The remaining 52 taxa were ranked using the ISAP (Table 1). The 20 species ranked as High, High/Medium, or High/Low make up the watch list (Table 2).

<p>QUALIFYING QUESTIONS</p> <ol style="list-style-type: none"> i. Nonnative established outside of cultivation in region of interest? ii. Occurs in conservation areas? <p>I. ECOLOGICAL IMPACT</p> <ol style="list-style-type: none"> 1. Impact on ecosystem processes and system-wide parameters 2. Impact on ecological community structure 3. Impact on ecological community composition 4. Impact on individual native plant or animal species 5. Conservation significance of the communities and native species threatened <p>II. CURRENT DISTRIBUTION AND ABUNDANCE</p> <ol style="list-style-type: none"> 6. Current range size in region 7. Proportion of current range where species is negatively impacting biodiversity 8. Proportion of region's biogeographic units invaded 9. Diversity of habitats or ecological systems invaded in region <p>III. TREND IN DISTRIBUTION AND ABUNDANCE</p> <ol style="list-style-type: none"> 10. Current trend in total range within region 11. Proportion of potential range currently occupied 12. Long-distance dispersal potential within region 13. Local range expansion or change in abundance 14. Inherent ability to invade conservation areas and other native species habitats 15. Similar habitats invaded elsewhere 16. Reproductive characteristics <p>IV. MANAGEMENT DIFFICULTY</p> <ol style="list-style-type: none"> 17. General management difficulty 18. Minimum time commitment 19. Impacts of management on native species 20. Accessibility of invaded areas
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Figure 2. I-Rank questions answered for each evaluated species. Answers range from A (high) to D (insignificant). Answers can have two letters (e.g., AC). U (unknown) is given in place of AD.

Table 2. Summary of I-Ranks performed by NatureServe and by the process outlined in this paper. The first column lists each possible ranking, the second column lists the number of species ranked by NatureServe that were not modified by me, and the third column lists the number of species ranked by NatureServe that were modified by me. The fourth column lists the number of I-Ranks that were conducted for species for which NatureServe had not produced an I-Rank.

	By NatureServe		New
	Not modified	Modified	
High	4	0	0
High/Medium	9	1	1
High/Low	0	2	4
Medium	0	6	4
Medium/Low	8	1	9
Medium/Insignificant	1	0	2
Low	6	1	11
Low/Insignificant	1	0	13
Insignificant	5	0	8
Total	34	11	52

DISCUSSION

The process outlined above took advantage of existing resources to produce a prioritized list of invasive species with a high likelihood of being found within NCR parks in the near future. These are critical species for park managers to learn to identify and to map and treat when they are found.

My approach mitigates the challenge of limited time available for species assessments by using preexisting data sources, volunteer labor to evaluate species, and a protocol that can be conducted in a few hours. Because the ISAP has been conducted for more than 900 species, time can be saved by modifying the existing ISAPs. The ISAP capacity for expressing uncertainty can also speed up the review process. Both the semi-quantitative nature of the ISAP and the ability to express uncertainty in responding to ISAP questions mitigate the consequences of limited published research on the impacts of invasion of individual species. The process has led to a formalized (i.e., not ad hoc) priority list. The production of the *watch list* encouraged NPS staff to look for and report the species on the list; it is now known that nine *watch list* species do occur in NCR parks (*Hypericum perforatum*, *Lamium galeobdolon*, *Myriophyllum spicatum*, *Najas major*, *Nandina domestica*, *Phellodendron amurense*, *Poncirus trifoliata*, *Rhamnus*

cathartica, and *Spiraea japonica*).

The difficulties all rankers faced underscore the importance of sharing data. Without EDDMapS and NatureServe both sharing their data, a project like this would not be possible. However, additional occurrence data is needed to increase the robustness and usefulness of the *watch list* and early detection efforts generally.

The approach described above can be used inside or outside of the United States, at other regional groups of parks, or at larger or finer scales. A candidate list can be built if data are available on which species are found within the area of interest and which species are found in the broader region. Once a candidate list is built and prioritized the highest priority species form the *watch list*.

ACKNOWLEDGMENTS

Thank you to all of the 44 volunteers who invested roughly 175 hours in drafting I-Ranks. Thanks to EDDMapS and NatureServe for making their information public and R. Wallace for extracting the data from EDDMapS. Thank you to J. Swearingen and all of the park managers for contributing to the list of weeds in the natural areas they manage and managing those natural areas. Thank you to K. Heffernan for early brainstorming. Thanks to T. Molyneux, F.

Watson, C. Khoury, and C. Blair for their thorough review of the I-Ranks conducted by volunteers. Thank you to P. Downey, D. Herman, and anonymous reviewers for their review of drafts.

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