Invasive Plant Inventory and Early Detection Prioritization Tool (Version 5.0)

User's Guide

December 2021

ON THE COVER
Purple loosestrife (*Lythrum salicaria*) © 2009 Barry Rice

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Chapter 1: Introduction

1.1. Tool Purpose

The Invasive Plant Inventory[1] and Early Detection[2] Prioritization Tool (short name = Invasive Species Prioritization Tool, hereafter referred to as IPPT or Tool[3]) is an Access database that guides land managers through the process of prioritizing which species and areas to survey and ultimately manage. This document describes the IPPT - why it was developed and how to use it. Following prioritization, surveys are conducted to assess invasive species status, beginning with priority species in priority areas. This information helps a land manager 1) fully understand the situation, 2) clearly describe the desired change in invasive species status over time (objectives), 3) decide how best to achieve objectives over time given available resources, 4) guide on-the-ground management actions, and 5) monitor and evaluate how invasive species status changes in response to management over time.

The IPPT was designed to help land managers make decisions about investments in inventory and early detection surveys – what species and where. Some users have expanded the purpose of this tool to inform decisions about what species to control (suppress, contain, eradicate) and where. Ideally, these decisions are informed by survey data that prove a more accurate picture of how much and where populations occur. This information can then be used to clearly describe the desired outcomes in response to management (objectives), as well as where and how to target prevention and removal actions. Once a clear picture of the problem is attained, additional criteria (beyond what is already in the IPPT) are then considered, such as:

- Size of infestations
- Number of infestations
- Difficulty in accessing infestations for control
- Control costs
- Values of areas where infestations are located (such as ecological, recreational, cultural)
- Species fecundity
- Seed longevity

1.2. Background

Invasive species are considered one of the primary threats to biodiversity (Didham et al. 2005, Williams 2003) and their management often consumes a significant portion of available resources (USFWS 2013). Managing for all non-native species is impractical and unnecessary (Hiebert and Stubbendieck 1993, Randall 2000, Skurka Darin et al. 2011), therefore land managers must decide which species are most harmful ('invasive') and where they should focus available invasive management resources.

In 2010-2013, the U. S. Fish and Wildlife Service (USFWS) partnered with Utah State University to conduct invasive plant prioritization workshops and inventories on selected National Wildlife Refuges across the United States. The purpose of this work was to develop better tools and support for planning and implementing invasive plant inventories or early detection surveys in the National Wildlife Refuge System (NWRS). This work was based on integrated pest management principles that data describing the location and abundance of invasive plants is essential for successful prevention or control of invasive plants (Figure 1). Among the many lessons learned, the workshops highlighted the need for an objective, transparent and documented process for deciding what non-

[1] An inventory is a survey that documents the presence, relative abundance, status, and/or distribution of abioticresources, species, habitats, or ecological communities at a particular time.

[2] Early detection is a type of survey focused on the detection of highly invasive species that are not yet establishedbut have a high likelihood of establishment or occur in small, isolated populations within a defined spatial scope.

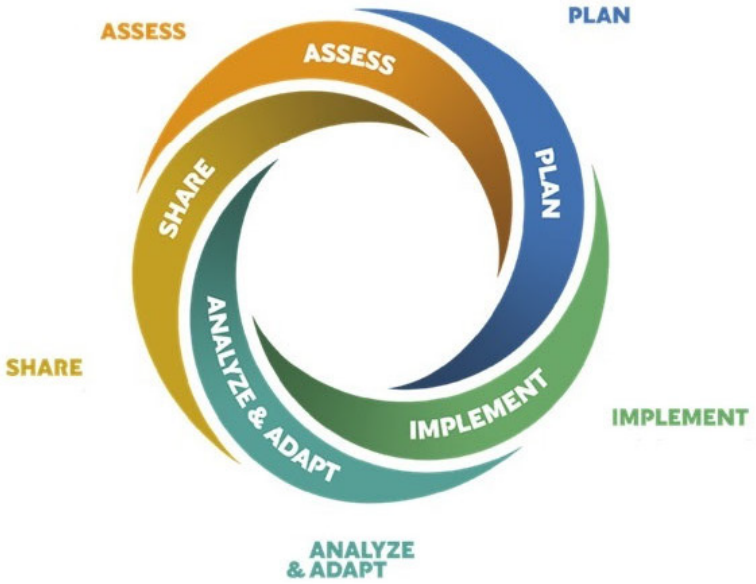
[3] Previous acronyms used include IPIEDPT and IPIP.

native plant species are a priority for inventory or early detection (and ultimately management), and where it is most critical to conduct these surveys because it is often not necessary or feasible to survey all non-native plants species everywhere. To meet this need, the USFWS developed the IPPT.

The IPPT integrates site-specific knowledge and larger landscape invasive species rankings to inform local priorities. The IPPT uses a standard set of criteria (Tables 1-3) to help land managers prioritize species and areas to survey. In general, species believed to be absent (but have the potential to occur) or which have low distribution and abundance, high potential to spread and high potential for ecological harm to natural resources of conservation concern are a high priority. Areas with high conservation value, low perceived levels of infestation and high invasion risk (e.g., high density of terrestrial or aquatic pathways) are a high priority. The tool produces a ranked list of areas and invasive plant species to consider for inventory. Users can also create area-specific ranked species lists or lists that distinguish species occurring within or outside (early detection) the spatial scope of the project.

The first version of the IPPT was developed in 2013 by the USFWS in partnership with Utah State University. Over time the IPPT has been revised to better meet user needs. A major revision of the IPPT occurred in 2021 (version 5.0). Version 5.0 improves upon data workflows, data documentation and the user interface. This user guide reflects those changes. Lastly, the IPPT was initially developed for the NWRS but it can be applied wherever invasive plants pose a threat to natural resources[4]. The Tool can also be used to prioritize taxa other than plants.

[4] Version 5.0 is designed to integrate with USFWS species database (FWSpecies). Earlier versions of the Tool are not dependent on USFWS data systems.



The five iterative phases of strategic and adaptive invasive species management.[1] Start at the appropriate step for your work.

Assess

- Identify project scope, team & conservation priorities
- Prioritize species & areas to assess
- Assess and document the distribution and abundance of invasive species, beginning with priority species in priority areas

Plan

- Develop SMART2 objectives describing desired future status of invasive species
- Identify and prioritize optimal strategies and associated activities to achieve objectives
- Develop Monitoring plan to assess implementation of strategies and evaluate progress towards achieving objectives

Implement

- Develop operational plan to guide implementation of strategies (who, what, where, when, how) and information management
- Implement IPM strategies
- Monitor: ED, efficacy, mgt actions

Analyze and Adapt

- Analyze implementation and efficacy data
- Evaluate results relative to objectives > adapt strategies/resource allocation to maximize results

Share

- Document, share, and foster learning

[1] Figure adapted from the Conservation Measures Partnership, version 4.0 (www.conservationmeasures.org)

[2] SMART = Specific, Measurable, Achievable, Results-Oriented, Time-Bound

Figure 1. The Five iterative phases of strategic and adaptive invasive species management. Source: USFWS, National Wildlife Refuge System

Table 1. Criteria used to rank areas for invasive plant inventory or early detection.

Category	***Area Criteria***
Conservation Value	Ecological integrity Importance to priority natural resources of conservation concern Importance to other priority resources of conservation concern Innate resistance to invasion
Invasion Risk	Terrestrial pathways Aquatic pathways Transport vectors Anthropogenic disturbance
Invasive Plant Status	History of inventory or monitoring Infestation levels (perceived) Number of invasive plant species (perceived)

Table 2. Criteria used to rank non-native plant species for inventory or early detection.

Category	***Species Criteria***
Larger Landscape Invasiveness	Invasiveness ranking
Status and Habitat Suitability	Proximity Current species abundance (perceived) Habitat suitability
Local Species Impacts	Ecological and other impacts (current) Ecological and other impacts (potential)
Larger Landscape Designation	Larger landscape management importance

Table 3. Criteria used to rank non-native plants within specific areas. These criteria build upon species scores generated after priotizing species across the entire project scope (see Table 1).

Category	***Criteria***
Species Presence/Proximity	Presence (perceived) Status and distribution (perceived)
Species Habitat Suitability	Habitat suitability

1.3. Tool ServCat Documentation

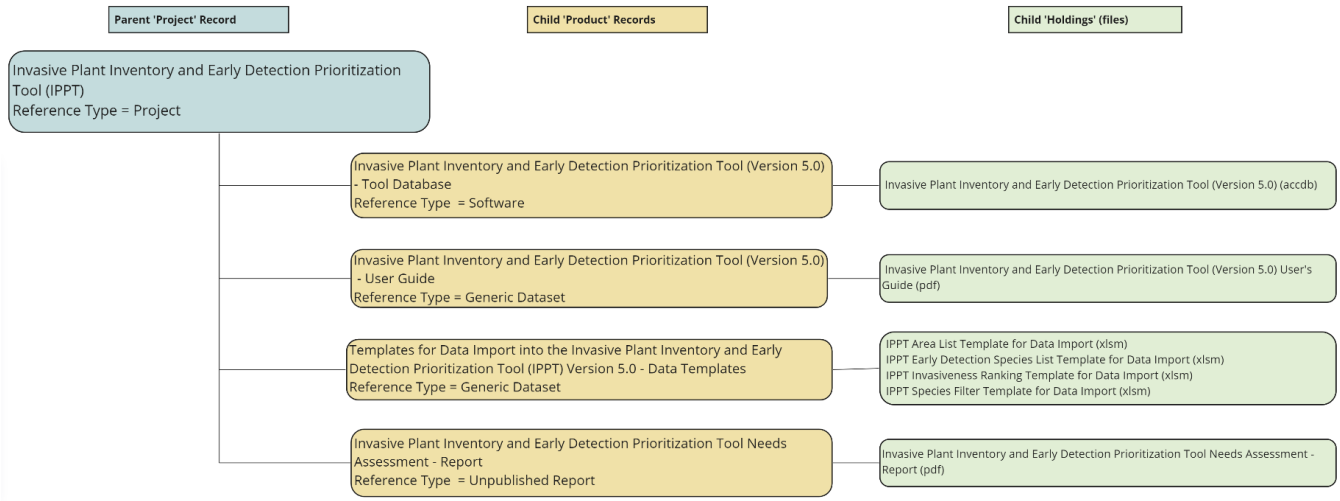


Figure 2 ServCat organization for the Invasive Plant Inventory and Early Detection Prioritization Tool

Table 4 Standard ServCat entries for the Invasive Plant Inventory and Early Detection Prioritization Tool

Holding	***Description***	***File Type***	***File Name***	***Child ServCat Record***
Description of project holdings (files)	A file that describes the content of the ServCat project record.	txt	Readme.txt	Data Documentation
IPPT database	Version 5.0 of the IPPT database.	accdb	IPPT_20220107.accdb	Software
IPPT User Guide	A detailed guide of how to use the IPPT (this document).	pdf	IPPT_User_Guide_20220111.pdf	Software
Areas Template	Area Template for Data Import used to import a list of areas into the IPPT.	xlsm	IPPT_Areas_Template.xlsm	Data Templates
Early Detection Species Template	Early Detection Template for Data Import used to import a list of early detection species into the IPPT.	xlsm	IPPT_EarlyDetection_Template.xlsm	Data Templates
Invasiveness Ranking Filter Template	Invasiveness filter Template for Data Import used to import an invasiveness ranking filter into the IPPT.	xlsm	IPPT_InvasivenessFilter_Template.xlsm	Data Templates
Other Species Filter Template	Other Species Filter Template for Data Import used to import species filters that are not invasiveness rankings.	xlsm	IPPT_SpeciesFilter_Temlate.xlsm	Data Templates
Invasive Plant Inventory and Early Detection Prioritization Tool Needs Assessment	This report summarizes all feedback and suggestions gathered from needs assessment interviews conducted in 2020-2021.	pdf	IPPT_Interviews_Summary_20211227.pdf	Report

1.4. Tool Design and Layout

The IPPT tool contains a series of pages which are grouped and colored coded by general function in the tools' navigation bar (Figure 3). The navigation bar includes the following page groups:

- **Tool background and project information** (light grey). The 'About', 'Getting Started', and 'Project Details' pages. These pages provide basic information about the tool, its intended use, and for describing the project.
- **Data management** (yellow). The 'Manage Area List', 'Manage Species List', 'Manage Species List Filters' pages allow users to import and remove data from the tool. The 'Select Species' page is used to select which species will be prioritized.
- **Prioritization** (green). 'Prioritize Areas' and 'Prioritize Species' pages are used to rank areas and species within a defined spatial scope (the 'project') using a standard set of criteria (Appendix A, B). The Area-Species Link is used to rank species within individual areas.
- **Reports** (purple). Pages used to generate species and area prioritization reports.
- **Export** (light grey). Navigates back to the 'Project Details' page and exports tool data and reports in the format for ServCat documentation.

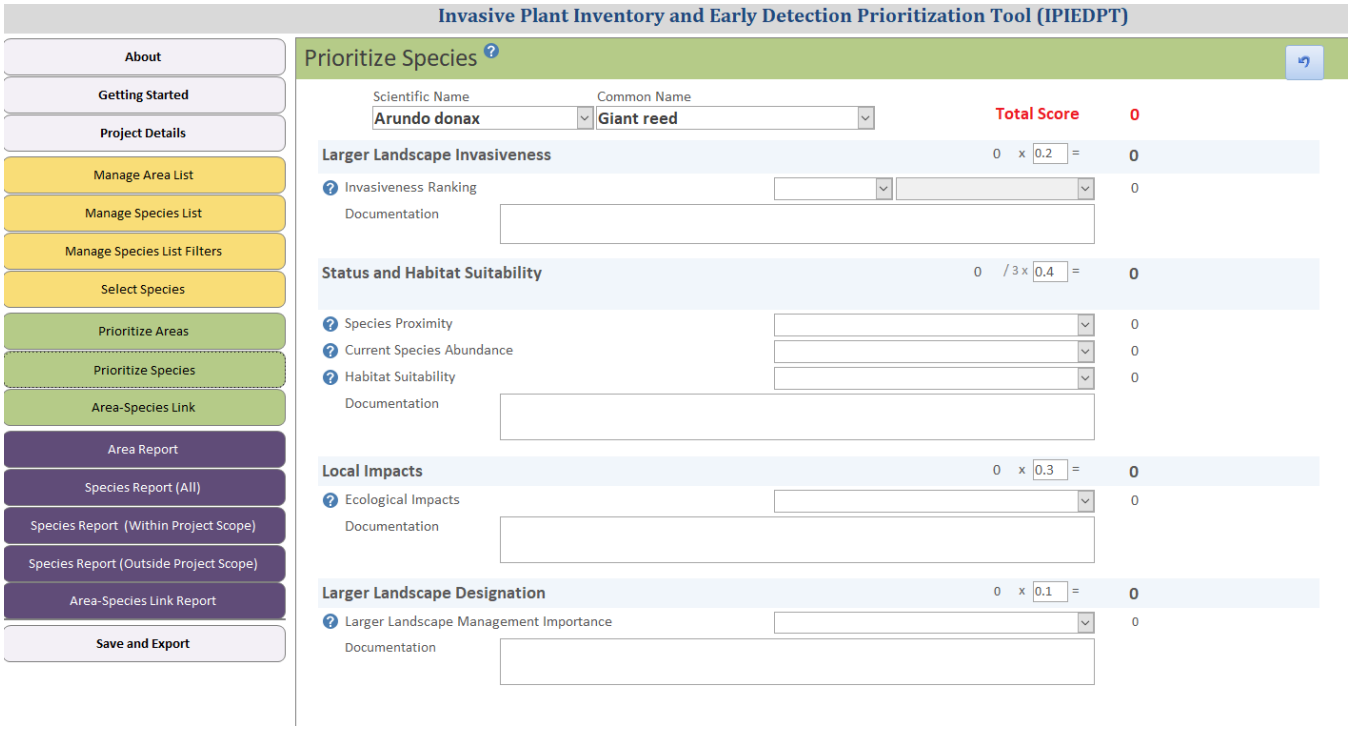


Figure 3. Example of species ranking using the using the invasive plant inventory and early detection prioritization tool. Note: The IPPT is an Access Database file developed at 1680 x 1050 display resolution. This resolution is suggested for best viewing.

1.5. Prioritization Workflow

The prioritization workflow using the IPPT is depicted in Figure 3. The specific steps of the workflow and where the information resides in this guide is presented in Table 4.

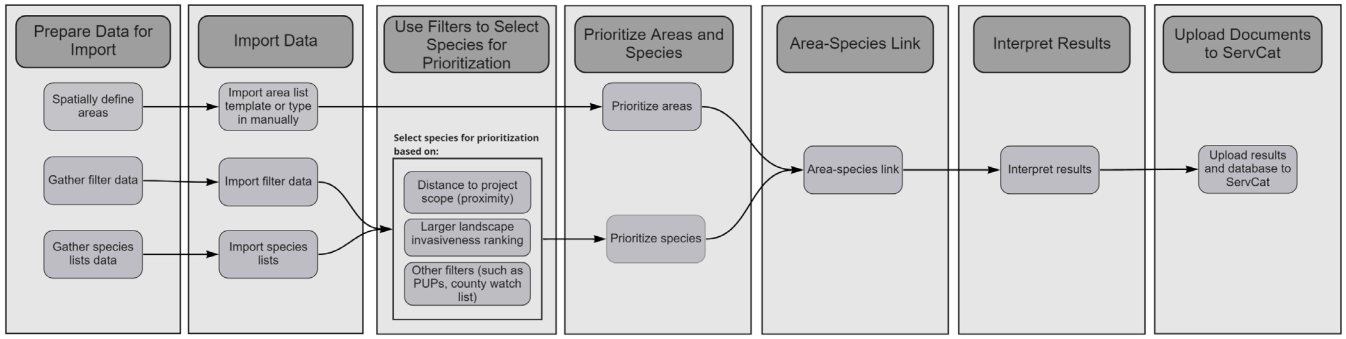


Figure 4. Workflow for prioritizing species and areas using the invasive plant inventory and early detection prioritization tool.

Table 5. Steps for using the Invasive Plant Inventory and Early Detection Prioritization Tool.

Workflow Element (see Figure 3)	***Step***	***Description***	***Guide Location***
Prepare Data Templates	Gather information	Gather information to support the prioritization process, such as spatial attributes of the project site, species lists, species occurrence data, management data, and management plans.	Chapter 2.1
Prepare Data for Import	Prepare Data for Import	Prepare data for import into the tool using data templates.	Chapter 2.2
Import Data	Import Area List	Use the Area Template for Data Import or manually type in areas and their brief descriptions.	Chapter 3.1
Import Data	Import Species List Data	Use the FWSpecies download to import a list of species on refuge to the tool. Use the Early Detection Template for Data Import to import a list of early detection species and their distances from refuge into the tool.	Chapter 3.2
Import Data	Import Species List Filter Data	Use the Invasiveness Ranking Template for Data Import to import invasiveness rankings to the tool. Use the Other Species Filters Template for Data Import to import other non-scoring filters to the tool.	Chapter 3.3
Use Filters to Select Species for Prioritization	Select Species for Prioritization	Use the invasiveness rankings or other species filters to select which species to prioritize.	Chapter 4.1
Prioritize Areas and Species	Prioritize Areas	Review the area prioritization criteria and follow the step-by-step instructions for prioritizing areas.	Chapter 5.1.2
Prioritize Areas and Species	Prioritize Species	Review the species prioritization criteria and follow the step-by-step instructions for prioritizing species.	Chapter 5.2.2
Area-Species Link	Area-Species Link	Review the area-species link criteria and follow the step-by-step instructions for completing the area-species link section of the tool.	Chapter 6.1
Interpret results	Utilizing Prioritization Reports	Review prioritization results and make final decisions regarding inventory or early detection survey priorities.	Chapter 7.2
Upload Documents to ServCat	Data Management	Export and upload the required data to ServCat then consider how to use or the data for next steps.	Chapter 7.3

1.6. Species and Area Scoring Methods

Several criteria are used to score species and areas (Tables 1-2) and each criterion can receive a score from 0 to 10. Criteria are presented as questions the user responds to in a "yes/no/unknown" format or chooses from a list of states or conditions that best describe the situation. Each descriptive response corresponds to a numerical value which is then used to calculate species and area scores and generate ranked lists. Users are encouraged to use the '*Documentation'* boxes included in each section to document sources of information and any other pertinent information used to inform the process.

Criteria are grouped into categories of like information such as criteria relating to vector pathways (Table 1). Where more than one criteria are assessed within a category, an average score is calculated. The 'Total Score' for a given area or species is the sum of category scores. When using the 'Area-Species Link' module of the tool, the 'Prioritize Species' score is modified by adding the scores of 3 additional criteria about species within a particular area.

Each category of criteria is assigned a default weight, which can be changed by the user to meet project-specific needs. For example, some project teams may feel that larger landscape invasiveness rankings are less important than local impacts and therefore weight impacts higher.

Chapter 2. Preparing for Prioritization

The following sections describe how to prepare data used by the IPPT to help teams prioritize species and areas for surveys.

2.1. Gather Background Information

The following project-specific information should be discussed *before* the prioritization process begins:

- **Project scope**. The spatial extent of lands within which species andareas will be prioritized for invasive plant inventory and management.
- **Project team**. Discuss and identify who will (or should) be involved in the prioritization process, reviewing results, or subsequent inventory or early detection efforts. Ideally, the team includes people involved in managing invasive plants within the scope, internal or external invasive species experts, and stakeholders or partners who care about the status of invasive plants within the vicinity of the project scope.

The following project-specific information should be gathered to support the prioritization process:

- **Project-specific species lists**. Gather and update lists of plant species known to occur within the project scope. Review and update species lists in FWSpecies if refuge lands are involved.
- **Invasive plant treatment history**. Gather data relating to invasive plant species treatment – the species, locations, and strategies employed. Refuge data is commonly available in the Pesticide Use Proposal System (PUPS Welcome Page (fws.gov)).
- **Internal spatial data**. Spatially referenced data and maps that visually depict characteristics of the project scope including the following:
    - Boundaries and management units
    - Environmental characteristics such as hydrology, landcover, vegetation, hydrology, topography
    - Human infrastructures such as buildings, roads, trails, public use areas
    - Sensitive species locations
    - Internal invasive plant occurrence or treatment data
- **External spatial data.** Invasive occurrence data that encompasses the project scope and adjacent areas (such as within 50 miles). Sources include (Calflora/CalWeedMapper, Biodiversity Serving Our Nation (BISON) and EDDMapS. This information serves to identify early detection targets.
- **External invasive species lists**. Consult with U. S. Department of Agriculture, local weed management areas, invasive plant early detection networks or other conservation management partnerships or collectives to compile lists of non-native or invasive plant species of management concern. This includes larger landscape ranked invasive species lists (often state or regional), state noxious weed lists, or local early detection or watch species lists.
- **Planning documents**. Gather management plans that describe the conservation purpose, goals, and objectives of the project scope. Include any plans that involve vegetation management, including vegetation management plans, fire management plans, or integrated pest management plans.

2.2. Prepare Data for Import

The following data are compiled and prepared for import to the IPPT to support the prioritization process using Templates for Data Import:

- Area list
- Current species list
- Early detection species list
- Species list filters and Invasiveness Rankings

The following sections describe how to prepare each of these data sources for import to the IPPT using the appropriate Templates for Data Import. Once the area list, species list, and species list filters templates are created following the instructions below, the data will be ready for import to the IPPT (see Chapter 3).

2.2.1 Areas List

Areas are place names that represent geographic extents under consideration for inventory or early detection. Areas are commonly defined by existing management units, plant community boundaries, ecosystem boundaries, or a combination of these features. If management units are used to define area boundaries, consult with the I&M data manager to ensure the boundaries match what is already stored in the FWS AGOL enterprise system. If management units are not going to be used and a map of areas does not already exist, develop a spatial data layer depicting the areas. It is often useful to provide a map of the areas and associated spatial characteristics (see Section 2.1 for data to consider) to support the prioritization process.

The areas list can be imported into the IPPT using the Area List Template for Data Import. The following steps describe how to prepare an areas list using the Area List Template for Data Import:

1. Download the Area List Template for Data Import here (ServCat record 140614).
2. If there is a Feature ID related to a spatial layer, insert it in the 'Feature ID' field.
3. Enter the area name in the 'Area Name' Field and a short description of the area in the 'Area Description' field.

The areas list can also be entered manually in the tool by typing the area names and area descriptions in the associated text boxes in the 'Manage Areas List' page (see Chapter 5.1.2).

2.2.2 Current Species List

The current refuge non-native plant list is obtained from FWSpecies and then directly imported to the IPPT. FWSpecies is used because it is the authoritative data source for refuge species occurrences. If a project encompasses non-refuge lands, the Early Detection template can be used to import the current species list (see Section 2.2.3). A basic overview of video of FWSpecies can be found here: https://web.microsoftstream.com/video/06834b31-7e71-4fec-b7f2-631a54f2cbc4). For more detailed information about FWSpecies, refer to the FWSpecies User Guide (ServCat record 169133).

The following steps describe how to prepare the list of current species (from FWSpecies) for import to the IPPT:

1. Review and update (if needed) the list of current refuge plant species in FWSpecies (https://ecos.fws.gov/FWSpecies/). Instructions on how to add or remove species are found on the '*Adding and Deleting Species in FWSpecies'* training video (https://web.microsoftstream.com/video/57f79c08-641c-4ba4-9654-3649d0f36126) or the *'Quick Help 4: Add a Species to a Refuge'* help document (ServCat record 83277).
2. Review and update FWSpecies plant species 'Origin' and 'Occurrence' fields (referred to as 'tags' in FWSpecies). Only species with 'Origin' = 'Non-Native' will be imported to the IPPT during import (see Chapter 3). The FWSpecies tag 'Occurrence' is by the used by the IPPT to evaluate species proximity to the project scope. Ensure 'Occurrence' = 'Present' for all species known to occur. Instructions on how to edit a species record are found in the FWSpecies '*Quick Help 3: Edit a Species Record*' (ServCat record 83272) and the '*Updating Species Lists in FWSpecies*' training video

(https://web.microsoftstream.com/video/0b84fa68-11a2-46b5-a4b1-401e2cadd733).

3. Download the species tagged as non-native for the refuge(s) of interest. Instructions on how to download a refuge species list are found in the FWSpecies document titled '*Quick Help 2: Species Lists*' (ServCat record 83271). Store the file for future import to the IPPT.

2.2.3 Early Detection Species List

The early detection species list is a list of non-native plant species classified as invasive (non-native and harmful), occur near the project scope such as within 10, 50, or 200 miles (with 200 miles from the refuge or complex as the suggested maximum distance), and which have the potential to spread into the project scope in the future. Sources of early detection species include web-based spatial databases (such as EDDMapS, Biodiversity Serving Our Nation (BISON), CalWeedMapper, and the Alaska Natural Heritage Program) or local weed watch lists.

Early detection species lists are structured for import to the IPPT using a data template called 'Template for Data Import'. The following steps describe how to prepare the early detection species list for import to the IPPT:

1. Download the Early Detection Template for Data Import here (ServCat record 140614) and keep it in your Downloads folder then connect to FWS VPN.
2. Copy and paste the scientific and common names from the early detection data source into the 'Scientific Name Verbatim' and 'Common Name' fields accordingly.
3. The 'Taxon Code' and 'ITIS TSN' columns will auto populate. This can take a minute or more if there are 100 or more species. If the 'Taxon Code' column has "NA" instead of a number, adjustments need to be made to the 'FWSpecies Scientific Name' column. Often, extra spaces or authorship need to be removed to match the exact spelling found in the FWSpecies database. For example*: "Lepidium latifolium L."* will not produce a FWS Taxon Code, but "*Lepidium latifolium"* will. In the case of "*Anthriscus sylvestris (L.) Hoffm"*, authorships need to be removed to leave just "*Anthriscus sylvestris."* If the above examples do not apply, a different scientific name may also be used to represent the same species so additional research may be needed. If this is the case, one option is to search the common name in the FWSpecies advanced search option (https://ecos.fws.gov/FWSpecies/Search/Advanced) and see which scientific names match the common name of the species of interest. Any adjustments to the scientific name made in the 'FWS Scientific Names' column can be noted in the 'Notes' column. The 'Scientific Name Verbatim' column should not be edited.
4. Calculate the minimum distance of each species to the refuge boundary and enter them in the 'Distance from Refuge' field of the data template. This proximity is commonly used to pare down (filter) a species list, if necessary, to focus early detection and rapid response efforts. This information also provides a baseline assessment of the current invasive species situation surrounding the project scope. The minimum distance of novel species occurrences from the project scope boundary (proximity) can be calculated in a geographic information system (such as ArcGIS) using spatially referenced species occurrence data (such as points), combined with distance buffers from the project scope boundary (see Appendix C). Alternatively, proximity may be estimated based on local knowledge or expert opinion. Proximity of novel invasive plant species to project scope is a parameter that is evaluated (scored) during the species prioritization process. Therefore, distances should be as well informed as possible, yet inability to calculate distances to refuge should not be a barrier to tool or template use.

2.2.4 Species List Filters and Larger Landscape Invasiveness Rankings

Species list filters are species lists used in the prioritization process to help a project team select non-native

plants to prioritize. Larger landscape ranked list of invasive species (invasiveness rankings) are used as a species list filter and to help prioritize species. Common sources of species list filters include the following:

- Species previously treated on the refuge as listed on the FWS Pesticide Use Proposal System (PUPS species list)
- U.S. Department of Agriculture state noxious weed lists
- Larger landscape invasive species rankings (i.e., California Invasive Plant Council Inventory or Alaska Center for Conservation Science invasive plant ranking system)
- Local list of invasive plant species of concern, such as a 'watch list' from local weed management areas or other conservation management partnerships/collectives

Selecting species to prioritize (species list filters). At the start of a project, teams compile non-native plants and early detection species to consider for prioritization (Sections 2.2.2, 2.2.3). The compiled list of species is referred to as the Comprehensive Species List'. In some cases, the Comprehensive Species List may be quite large (100+ species). Because it is typically not necessary nor feasible to and manage all non-native plants, project teams can use one or more species list filters to select species that are generally recognized as problematic from the Comprehensive Species List. Species list filters are cross walked to the Comprehensive Species List and help the team quickly view species that are considered important at larger landscape scales or were previously managed (PUPS species lists). Teams can then focus the prioritization effort on the filtered list, and then can manually add or remove species through discussion. As a general guide, it is wise to aim for 30 or fewer species to prioritize.

The following steps describe how to prepare the species filter for import to the IPPT:

1. Download the Species Filter Template for Data Import here (ServCat record 140614) and keep it in your Downloads folder then connect to FWS VPN.
2. Navigate to the 'Species' tab and copy and paste the scientific and common names from the invasiveness ranking data source into the 'Scientific Name Verbatim' and 'Common Name' fields accordingly. The 'Taxon Code' and 'ITIS TSN' columns will auto populate. This can take a minute or more if there are 100 or more species. If the 'Taxon Code' column has "NA" instead of a number, adjustments need to be made to the 'FWSpecies Scientific Name' column. Often, extra spaces or authorship need to be removed to match the exact spelling found in the FWSpecies database. For example*: "Lepidium latifolium L."* will not produce a FWS Taxon Code, but "*Lepidium latifolium"* will. In the case of "*Anthriscus sylvestris (L.) Hoffm"*, authorships need to be removed to leave just "*Anthriscus sylvestris."* If the above examples do not apply, a different scientific name may also be used to represent the same species so additional research may be needed. If this is the case, one option is to search the common name in the FWSpecies advanced search option (https://ecos.fws.gov/FWSpecies/Search/Advanced) and see which scientific names match the common name of the species of interest. Any adjustments to the scientific name made in the 'FWS Scientific Names' column can be noted in the 'Notes' column. The 'Scientific Name Verbatim' column should not be edited.
3. Include source data in the 'Source' tab and save the document.

Larger landscape invasiveness rankings. These are a special category of species list filters that identify the relative harm of invasive plants to wildlands within a specific area, often a state. They serve as a species list filter and they can also be used to prioritize species. Larger landscape invasiveness rankings are often developed by non-profit or academic institutions, such as state invasive plant councils, to conduct a comprehensive evaluation of the scientific literature and consult with experts to determine harm by a non-native plant to wildlands. While they also consider harm to agriculture, the focus of these rankings is harm to wildlands or more natural systems. State noxious weed lists are typically not used as invasiveness rankings but should still be considered as a species list filter.

If you wish to add a larger landscape invasiveness ranking or species list filter, the list needs to be structured for import using the Invasiveness Filter Template for Data Import. Before investing in this, review default lists that are already contained within the IPPT (Appendix B: Invasiveness Ranking). The following steps describe how to prepare the invasiveness ranking filter for import to the IPPT:

1. Download the Invasiveness Filter Template for Data Import here (ServCat 140614) and keep it in your Downloads folder then connect to FWS VPN.
2. Navigate to the 'Assign Scores' tab and assign a numeric value from 0-10 to the ranks provided by the invasiveness ranking system. Invasiveness rankings are used in the Species Prioritization step so need to be normalized by assigning a score value between 0-10.
4. After completing the 'Assign Scores' tab, navigate to the 'Species' tab and copy and paste the scientific and common names from the invasiveness ranking data source into the 'Scientific Name Verbatim' and 'Common Name' fields accordingly. Refer to Step 4 in the Species Filter instructions above for more detail.
5. The 'Taxon Code' and 'ITIS TSN' columns will auto populate.
6. If the 'Assign Scores' tab is completed, copy and paste the invasiveness ranking for the corresponding species into the 'Rank Description' tab and the scores will be auto populated.
7. Include source data in the 'Source' tab and save the document.

Chapter 3. Import Data for Prioritization

The following sections describe how to import area and species lists into the IPPT to help teams prioritize areas and species for surveys. Data must be structured using data templates described in Chapter 2 of this guide with the exception of the area list which may be entered manually in the tool. The data management pages of the IPPT can be accessed from the navigation pane and are color-coded yellow.

3.1. Import Area List

If using the Area List Template for Data Import, follow the instructions below for importing the data into the IPPT.

1. Navigate to the 'Manage Area List' page from the navigation pane in Figure 4.
2. Click the 'Import from file' button on the top right.
3. In the pop-up, click on the Excel icon to browse for and select the Area List Template for Data Import then click 'Ok'.

To manually enter the list of areas and associated descriptions, type area names and area descriptions in their associated text boxes. To delete areas, click the "X" button.

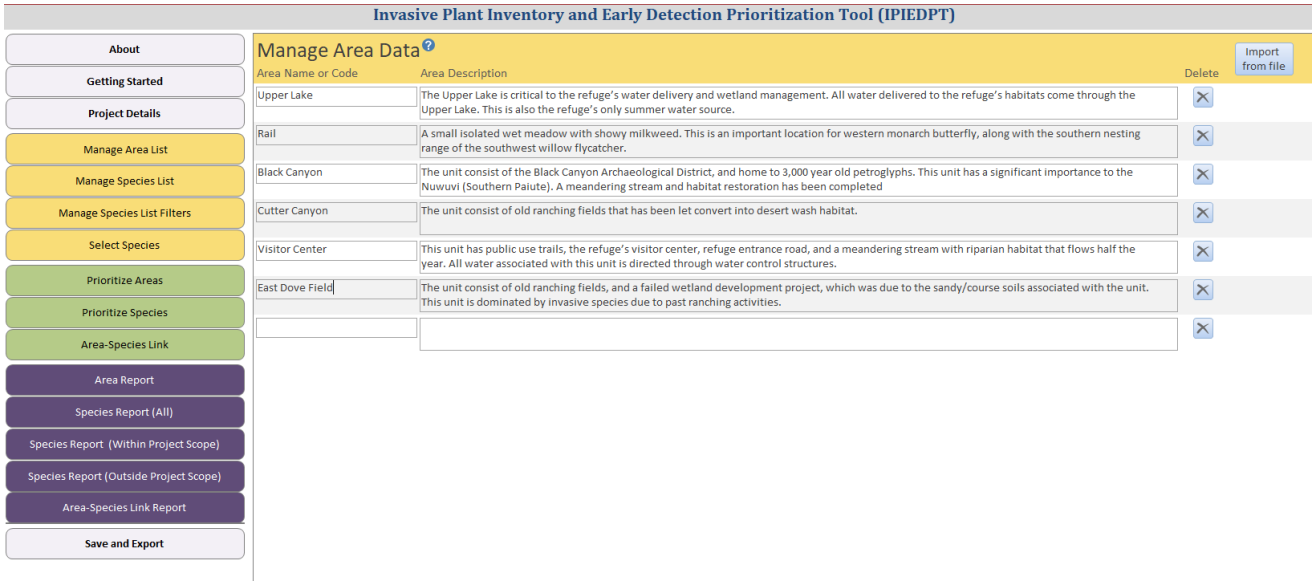


Figure 5 Import or manually enter Area List.

3.2. Import Species Lists

1. Navigate to the 'Manage Species List' page from the navigation pane (Figure 5).
2. Click the 'Import from file' button on the top right.
3. In the pop-up, indicate which type of species list is being imported (either FWSpecies or early detection). Species may also be removed by clicking the "X" button.
4. Repeat if more than one list is imported.
5. Close the pop-up window and the imported species list will be displayed.

Though the species list may be manually entered by typing directly into the species list text boxes, doing so is undesirable as human errors may be made. It is important the FWS Taxon Code act as a unique identifier for each species as only species with unique FWS Taxon Codes will be displayed. Using the Templates for Data Import also standardize the species scientific names which makes comparing tool results from multiple refuges easier, thus templates are recommended to create the species list.

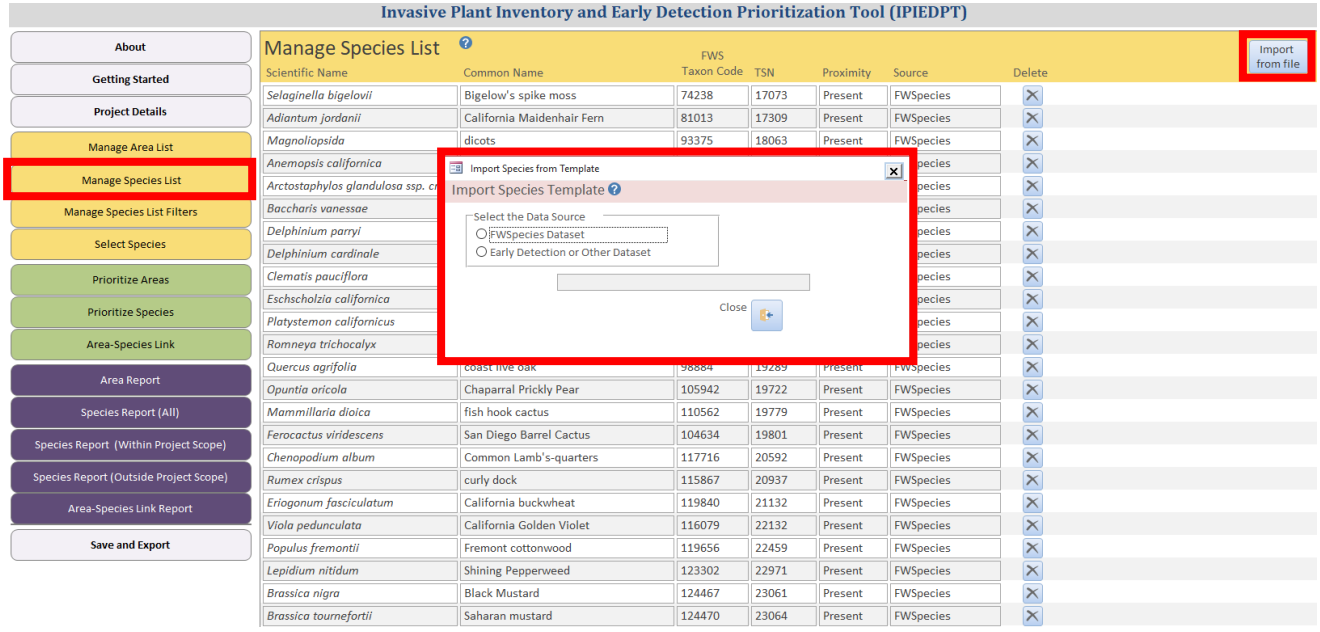


Figure 6. How to import a species list to the Invasive Plant Inventory and Early Detection Prioritization Tool.

3.3. Import Species List Filters

1. Navigate to the 'Manage Species List Filters' page from the navigation pane of the IPPT (Figure 6).
2. Delete species list filters that are not likely to be used to select species for prioritization OR to prioritize species.
3. Click the 'Import from file' button on the top right.
4. In the pop-up, indicate if the filter is an 'Invasiveness Ranking' or 'Other [species] Filter'. If the species list will be used to select species AND to later prioritize species (to assess invasiveness), then choose 'Invasiveness Ranking'. If the list will only be used as a filter, then choose 'Other Filter.'
5. Close the pop-up and the imported filter will display in the list of species filters.

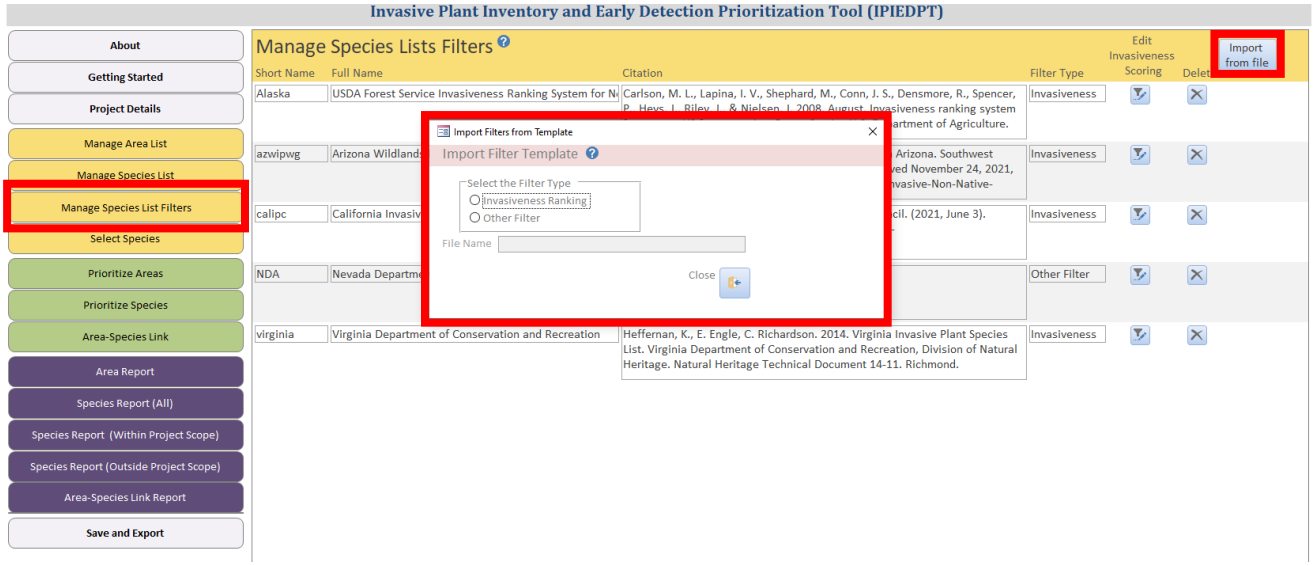


Figure 7. How to import a species list filter to the Invasive Plant Inventory and Early Detection Prioritization Tool.

If an invasiveness ranking was not normalized properly when developing the template, or the user wants to make changes to the scoring, the invasiveness ranking scoring can be defined here on the 'Manage Species Lists Filters' page. The following steps describe how to do this:

1. Click the 'Edit Invasiveness Scoring' button associated with the invasiveness ranking source to be edited.
2. In the pop-up window, edit the value(s) under 'Updated Score'. The Imported Score will be displayed, as well as the Score Definition and Description. The Score Description may be written here if a deeper understanding of the scoring is helpful. The Imported Score and Definition are not editable, but an invasiveness ranking Template for Data Import may be reimported if these adjustments need to be made (Figure 7).
3. Close the pop-up window and the edits will be saved. This pop-up may also be used to view pre-loaded invasiveness ranking system scores to become familiar with them.

An example of when one would make these adjustments is if interpretation of invasiveness ranking had changed or was initially misunderstood. If a rank of 'Limited' and 'Watch list' on Cal-IPC (Cal-IPC 2021) initially received a score of 0, but the user wanted to distinguish the two, the user would change 'Updated Score' where 'Score definition' was "Limited" from 0 to 1. Now, 'Watch list' receives a score of 0 and 'Limited' receives a score of 1 (this is simply an example and the pre-loaded Cal-IPC ranking is 'Watch list' = 0 and 'Limited' = 1).

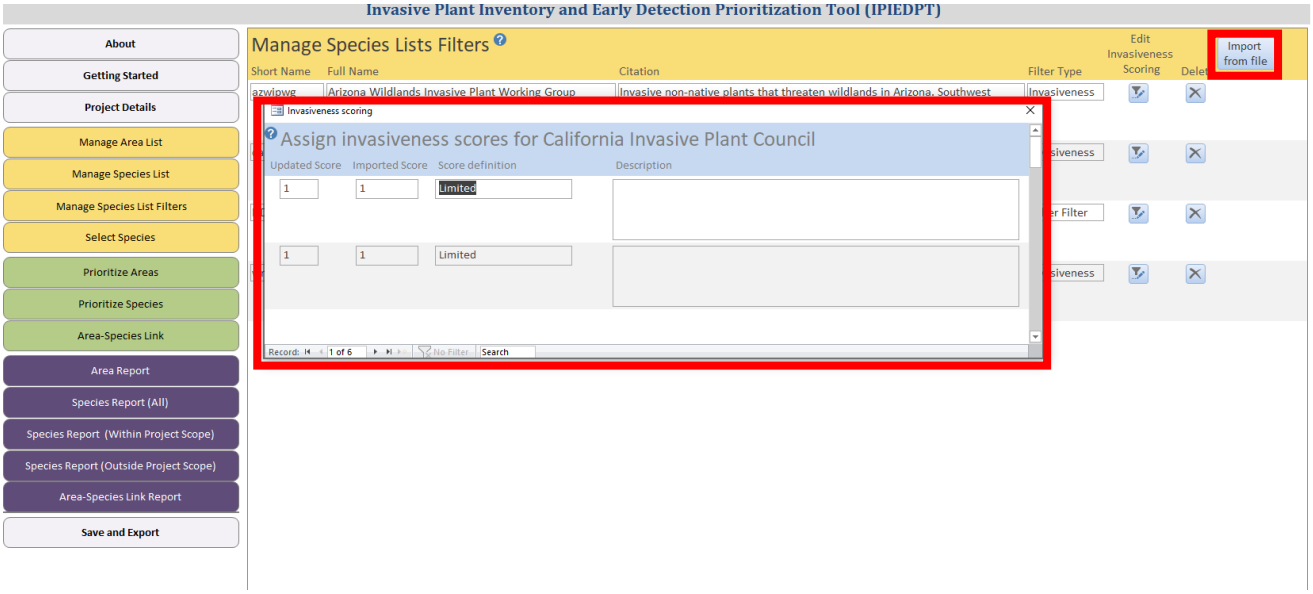


Figure 8. How to assign invasiveness scores to an imported invasiveness ranking. Note: this is only an example, the Cal-IPC ranked species list is a default list in the Invasive Plant Inventory and Early Detection Prioritization Tool.

Chapter 4. Select Species and Areas for Prioritization

The purpose of this step is to reduce the 'Comprehensive Species List' (= count of current species + count of early detection) to a more manageable list of species for prioritization using species list filters (see Chapters 2 and 3 for how to prepare and import species list filters). While there is no limit to the number of species that can be prioritized, it is recommended that no more than 30 species are prioritized to reduce time and effort as well as considering the necessity and reality of surveying and managing all non-native plant species. Ideally, the focus is on species that have potential to cause harm to species of conservation concern or it is highly uncertain.

4.1. Select Species for Prioritization

1. Navigate to the 'Select Species' page in the navigation pane of the IPPT (Figure 7). The Comprehensive Species List' will be displayed.
2. Select species for prioritization using one of the following options:
   a. **Manual** (Figure 7). Manually select individual species using the arrow button next to each species of interest or select all species using the 'Select Displayed' button. The species will be moved over to the 'Selected Species List'. The number of species selected is shown in the upper right corner of the window. The selected species list can then be previewed or exported.
   b. **Apply species list filters** (Figure 8). There are two filter categories, 'Proximity' or 'Other filters'. The values of these filters are auto populated from data previously imported by the user or already contained within the IPPT. The values *within* 'Proximity' or within 'Other Filters' are additive, meaning if a species matches anyone of the values selected it will be selected. However, values selected in the two filter boxes have an inclusive only relationship meaning that only values that are represented by both filter box selections are displayed. The number of species selected is shown in the upper right corner of the window. The selected species list can then be previewed or exported.

      Example (Figure 8): You wish to select species that are on the refuge (Proximity = 0, Present) AND that are ranked 'High' on Cal-IPC. First select 'Present' (the occurrence pulled from (FWSpecies Refuge Species List) and '0' (the miles from refuge pulled from the Early Detection Species List) from the 'Proximity' filter box, then select 'calipc ;– High' from the 'Other filters.' The species that are 'Present' or 0 miles from the refuge AND "calipc – High" will be displayed. Then use the 'Select displayed' button to move the species to the Selected Species List.

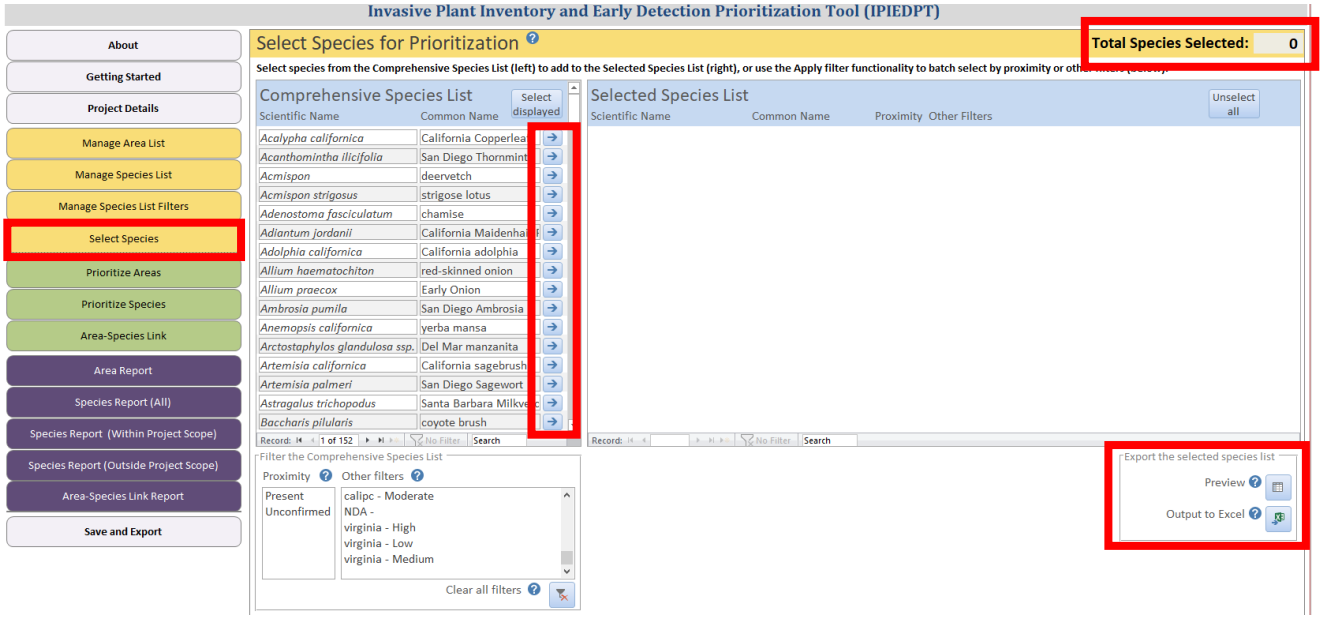


Figure 9. Manually selecting species for prioritization in the Invasive Plant Inventory and Early Detection Prioritization Tool.

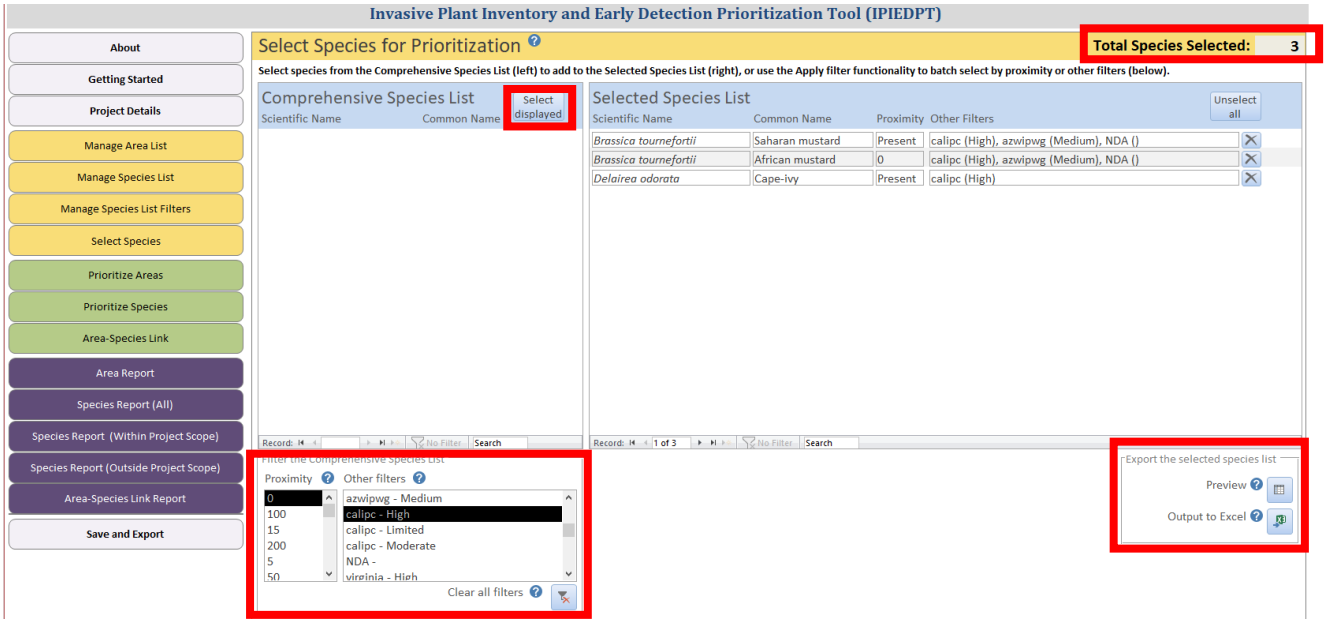


Figure 10. Using species list filters to select species for prioritization in the Invasive Plant Inventory and Early Detection Prioritization Tool.

Chapter 5. Prioritize Species and Areas

This chapter describes how to prioritize areas and species for inventor or early detection using a standard set of criteria. Prioritization occurs once the IPPT is populated with species and area data (described in Chapters 2-4).

5.1. Area Prioritization Criteria

A set of 11 standardized criteria are used to prioritize areas. The criteria address area characteristics including ecological integrity, importance to priority natural resources of conservation concern, invasive plant status (best guess), and risk of invasion (including vector pathways, disturbance and use patterns) (Table 1, Appendix A). All people involved in the prioritization process should have a copy of Appendix A to refer to during the prioritization process. The following is a brief description of the general categories of criteria used to prioritize areas for inventory (see Appendix A. for area criteria details).

- *Area Conservation Values.* This category considers the ecological integrity of a defined area and its importance to listed species and other resources of conservation concern. Areas with high ecological integrity and which are important to resources of conservation concern receive a high score in this category.

- *Invasion Risk.* This category considers invasion risk of areas, including vector pathways (both terrestrial and aquatic), transport vectors, the types and frequencies of anthropogenic disturbance, and innate resistance to invasion. Areas exhibiting a high density of vector pathways, low resistance to invasion, frequent vector transport events, and anthropogenic disturbance are at higher risk of invasion and therefore receive a high score inthis category.

- *Invasive Plant Status.* This category considers the status of invasive plant species within an area and whether any information on those invasive species exists (e.g., time since last inventory, inventory completeness). Areas that have not had comprehensive invasive species inventories within the last 10 years are in greater need of documentation so will score higher than areas with more recent inventories. Areas that are already highly infested will receive a lower score in this category.

Area prioritization can occur as soon as the target areas have been selected. The person(s) involved in area prioritization should ideally be very familiar with the characteristics of the project scope and its associated areas, including its ecological health, importance to resources of conservation concern, vector pathways, disturbances, infestation levels, and history of monitoring. Users should remember that this is a "snapshot" approach; in other words, they should answer the questions to the best of their ability based on status of the area, not future status. Lastly, spatially referenced data and maps should be referred to during the prioritization process, especially with respect to terrestrial and aquatic pathways, past inventory or monitoring data, and sensitive resource occurrences.

5.1.2 Area Prioritization Steps

The following steps describe how to prioritize areas in the IPPT (Figure 9):

1. Select 'Prioritize Areas' from the navigation pane
2. Adjust area category weights as needed. These weights will carry forward for all areas.

3. Select the area to prioritize
4. Answer questions related to each criterion (N=11). For more information about a criterion, click the question mark.

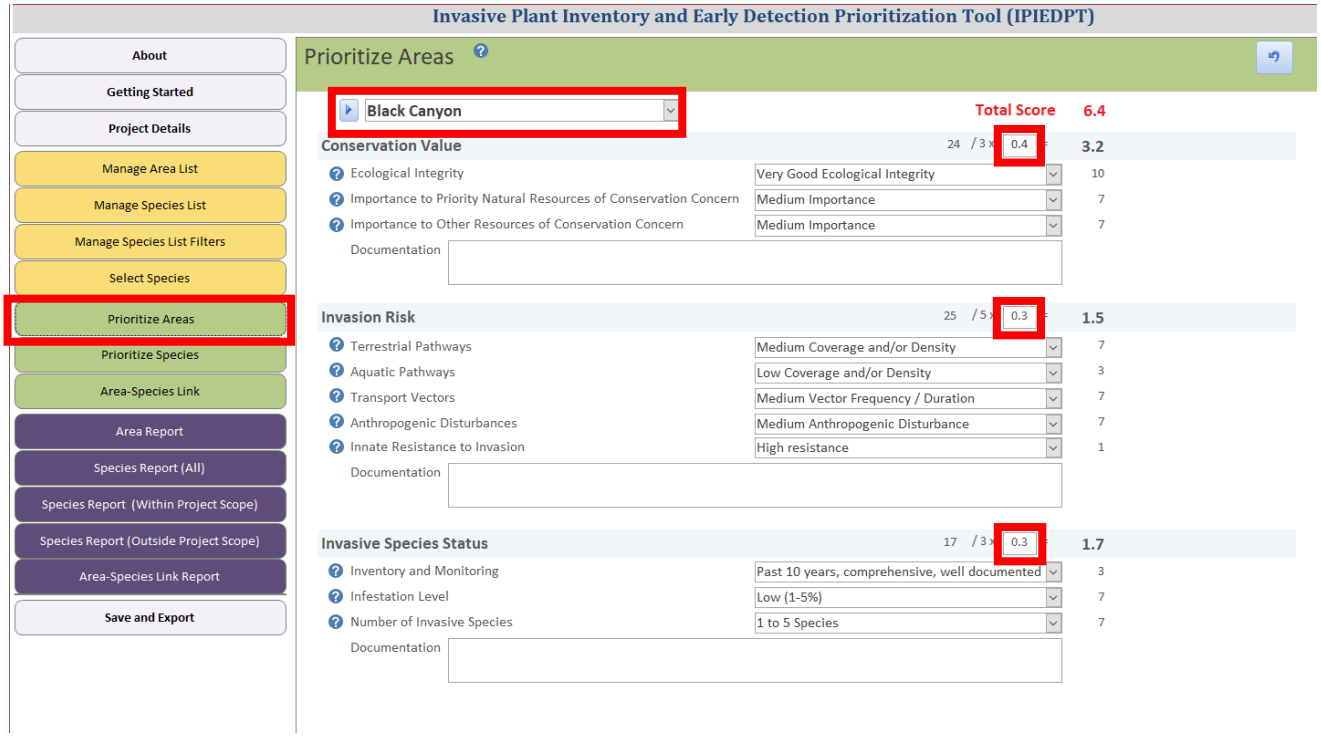


Figure 11. Prioritizing areas using the Invasive Species Inventory and Early Detection Prioritization Tool.

5.2. Species Prioritization Criteria

A set of 6 standardized criteria are used to prioritize each selected species. The criteria address species characteristics including invasiveness to wildlands, impacts to local resources of conservation concern, status, likelihood of further spread, and larger landscape management importance (Table 2, Appendix B). Below is a brief description of the general categories of criteria used to prioritize species and are described in more detail in Appendix B. All people involved in the prioritization process should have a copy of Appendix A to refer to during the prioritization process.

- *Larger Landscape Invasiveness.* Invasiveness of a species to wildlands based on a compilation of scientific evidence and expert opinion. These larger landscape species assessments or 'rankings' are usually conducted at a state or multi-state level of resolution and are focused on impacts to wildlands but also consider impacts to agriculture or rangelands. They are distinguished from Department of Agriculture noxious weed lists that primarily focus on impacts to agriculture and rangelands. Criteria used to characterize invasiveness vary among ranking systems, but common criteria include ecological impacts (e.g., to wildlands or natural abiotic processes); biological characteristics including reproductive capacity and rate of spread; distribution; and difficulty of control. The IPPT is populated with some of these larger landscape invasiveness rankings but the user can import and use new or revised lists that suite their needs (see Chapters 2-4). Select 'Manage Species Filters' from the navigation pane to see the default invasiveness lists in the IPPT.

- *Status and Habitat Suitability.* This category considers the status and potential for spread of invasive species within the project scope. Criteria in this category consider the species proximity to the

project scope, abundance within the project scope, and habitat suitability within the project scope. For species not known to occur within the project scope, the user will select the answer that best approximates the nearest documented infestation of the species (ranging from < 1 mile to > 100 miles from project scope boundary) and assess habitat suitabilitywithin the project scope. Species that are found on the refuge at low infestation levels will score equally to species that are found close to the refuge because of the innate bias of thetool towards early detection and rapid response.

- *Local Species Impacts.* This category consists of a single criterion used to assess the *local* ecological impacts, or potential impacts, of a given species *within* the project scope. The 'invasiveness' criteria consider general impacts to wildlands based on available science/evidence while this criterion relies heavily on local knowledge about species impacts. Among the most useful indicators of whether a species will have ecological impacts in the future (especially among early detection species or species that are not yet widespread) is to consider larger landscape invasiveness rankings. It is also important to examine history of invasiveness in other, similar environments, so it is important to not dismiss species because they are not currently found within the project scope or not currently a problem (Hiebert and Stubbendieck 1993, Skinner et al. 2000, Williams 2003). In addition, a site may have unique environmental characteristics that exacerbate ecological impacts of a particular species.

- *Larger Landscape Designations.* Because noxious weed and invasive plant designations and regulations vary from state to state, users will be asked whether the species of interest is designated as noxious or is a banned invasive plant on county, state, or federal lists, or whether the species is of a local concern by a cooperative weed management area or early detection network. Although listed noxious species may not rank the highest for inventory because of other criteria (i.e., they are widespread throughout the project scope), they may need to be managed to comply with state and/or local regulations. Knowledge and understanding of these lists may also be helpful when prioritizing species since the number of places where that species has been regulated and is already considered problematic is good indicator of the potential for a species to be invasive (Skinner et al. 2000).

5.2.2 Species Prioritization Steps

The following steps describe how to prioritize species in the IPPT (Figure 10):

1. Select 'Prioritize Species' from the navigation pane.
2. Adjust species category weights as needed. These weights will carry forward for all species.
3. Select the species to prioritize.
4. Answer questions related to each criterion (N=6). For more information about a criterion, click the question mark.

**Note for 'Larger Landscape Invasiveness': if an invasiveness ranking exists for a selected species (either preloaded in the tool or imported by the user), the invasiveness ranking system options will appear in the drop-down menu). If more than one ranking system ranked the species, the user can choose the system that best suits their needs. The user also has the option of selecting Custom from the drop-down menu and provide best-guess of the larger landscape invasiveness ranking (Figure 11). If a custom ranking is selected, the rationale for the score should be documented in the 'Documentation' box.

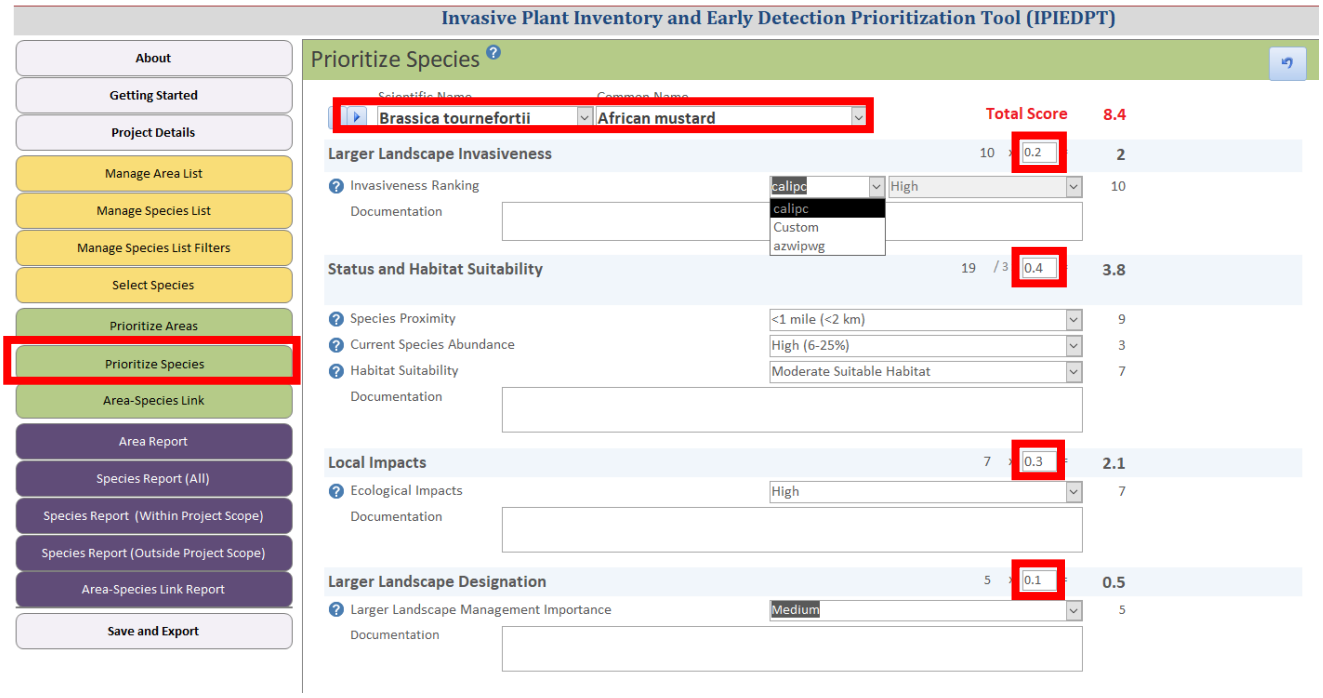


Figure 12. Prioritizing species using the invasive plant inventory and early detection prioritization tool.

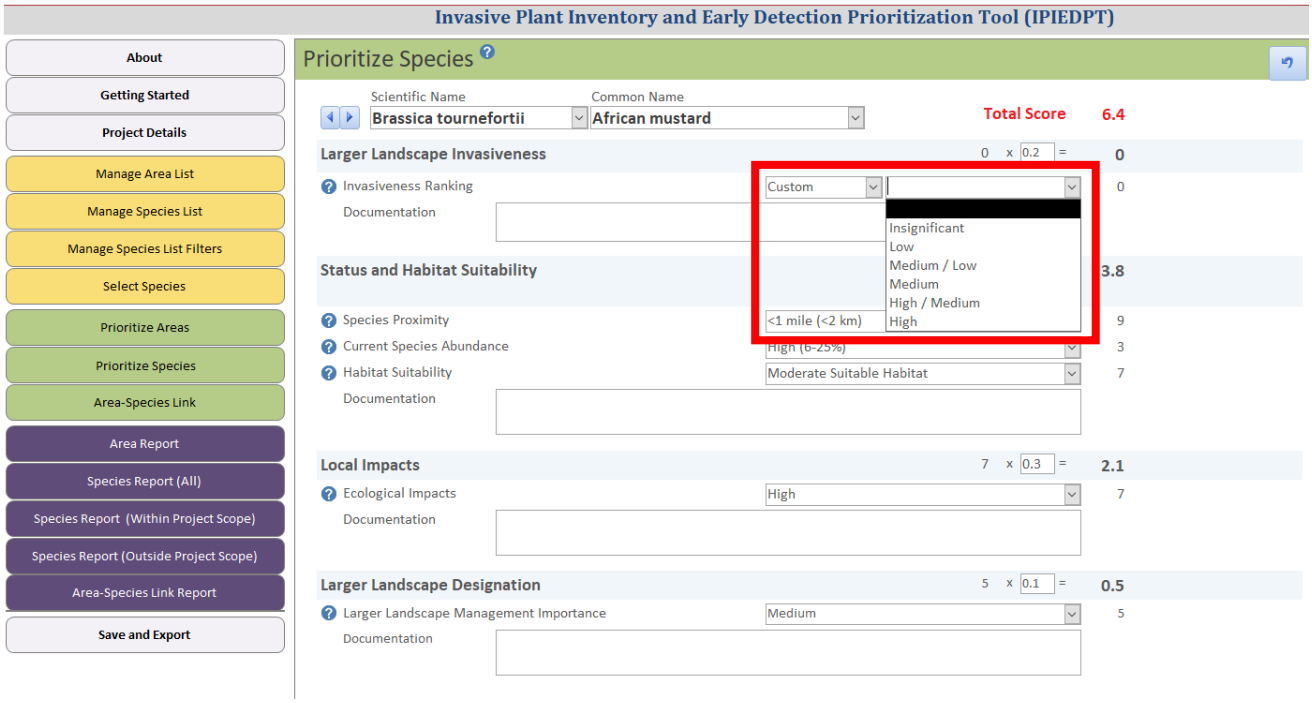


Figure 13. Using a custom invasiveness ranking when a species is not addressed by invasiveness rankings used by the Invasive Species inventory and Early Detection Prioritization Tool.

Chapter 6. Area-Species Link

Up to this point, the prioritization of species (Section 5.2) applies to the entire project scope. In some cases, teams may wish to take the prioritization a step further and prioritize species within areas for to focus surveys, referred to here as the 'Area-Species Link'. The ranking of species for specific areas builds upon information captured during project-wide species prioritization. Prioritization within individual areas considers area-specific species presence, status, and habitat suitability. This step may be particularly useful when areas are dissimilar in the habitat provided for invasive species or the status of invasive species and therefore species priorities may vary among areas.

6.1. Area-Species Link Steps

The following steps describe how to prioritize species for areas using the 'Area-Species Link' page of the IPPT (Figure 12):

1. Select 'Area-Species Link' from the navigation pane.
2. Select target area
3. Answer species-specific questions. For more information about a criteria, click the question mark.

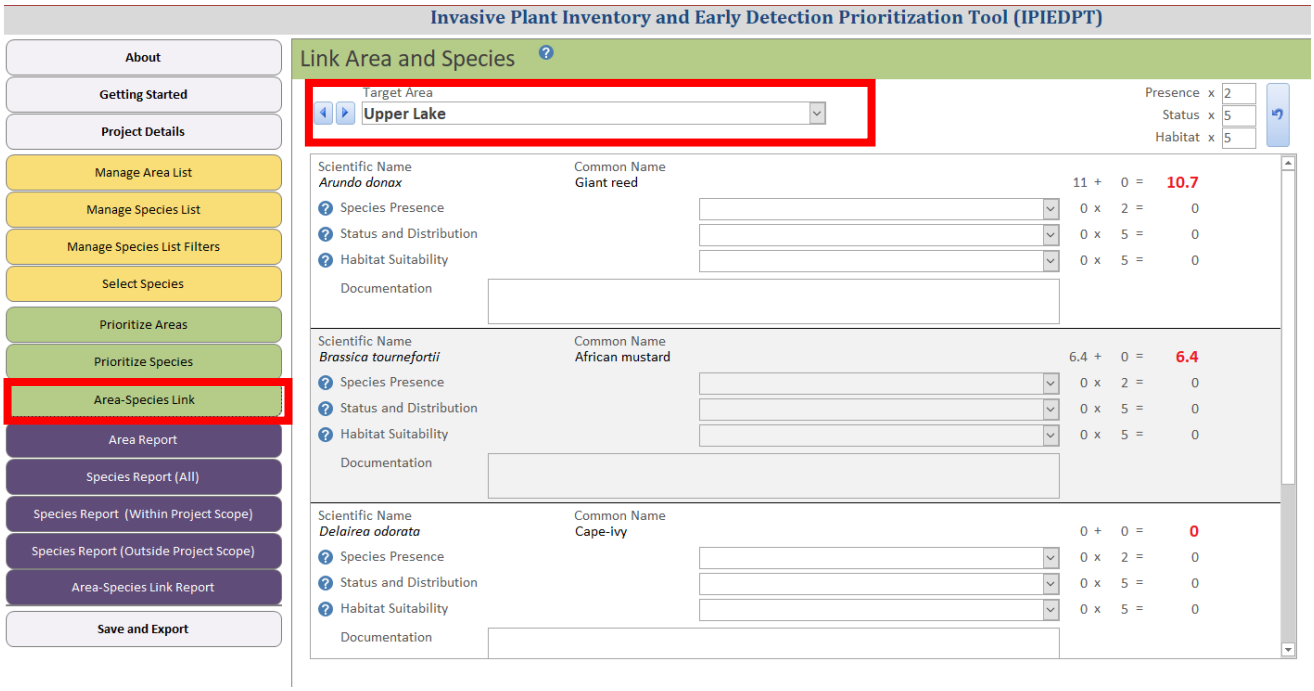


Figure 14. Prioritizing species within areas, the 'Area-Species Link'.

Chapter 7. Data Reporting, Management, and Utility

7.1. Prioritization Reports

The IPPT uses the results of prioritization to generate the following standardized reports (Figure 13):

- Area Report. A prioritized list of areas
- Species Report (All). A prioritized list of non-native plant species. Includes species that already occur within the project scope and species that have the potential to invasive the scope in the future (early detection species).
- Species Report (Within Project Scope). A prioritized list of non-native plant species. Only includes species that already occur within the project scope.
- Species Report (Outside Project Scope). A prioritized list of non-native plant species. Only includes species that have the potential to invasive the scope in the future (early detection species).

Reports can be exported (as a PDF) or printed for viewing purposes.

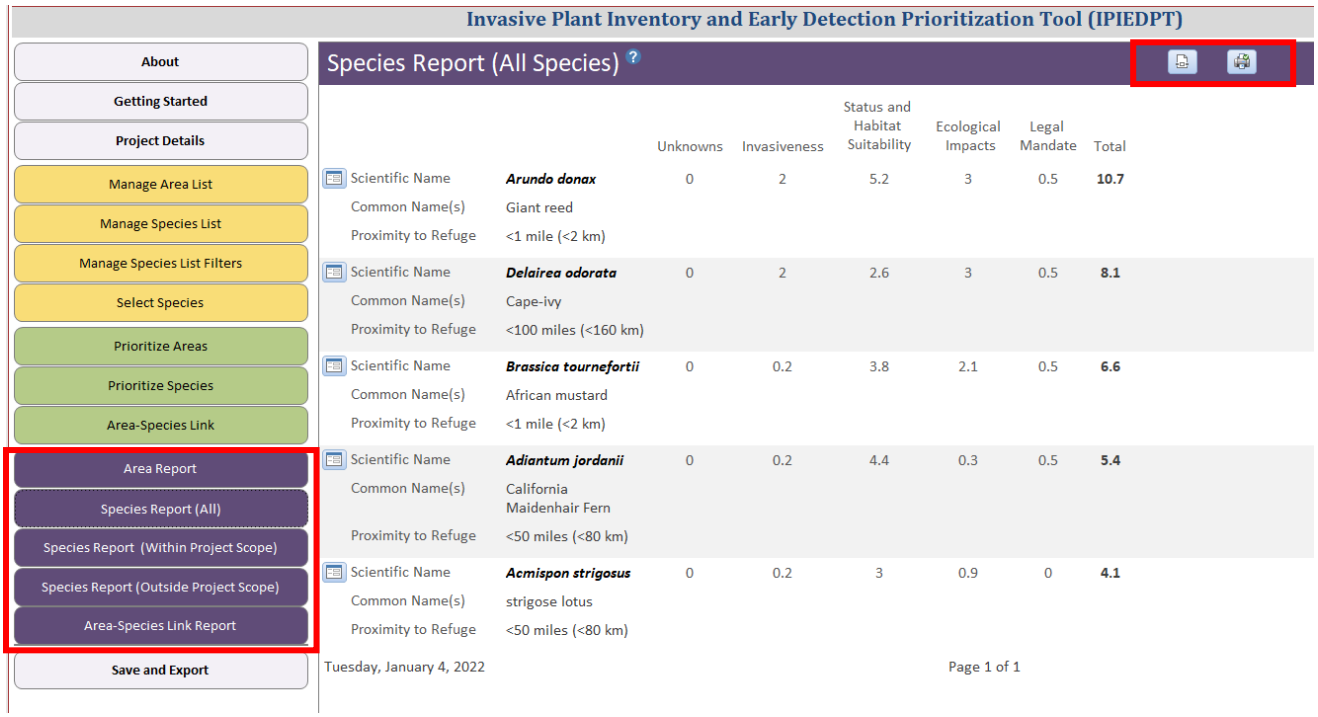


Figure 15. Creating prioritization reports in the Invasive Plant Inventory and Early Detection Prioritization Tool

The collection of 4 reports can also be exported as an excel file by navigating to the Save and Export page. This feature supports ServCat documentation of the prioritization process (see Section 7.3 below for more information). Clicking on the Save and Export page will bring the user back to the Project Details page and export the data documents required for ServCat. If the Project Name or Refuge LIT code are not entered, a message will display to enter them as they are both required for the file naming conventions.

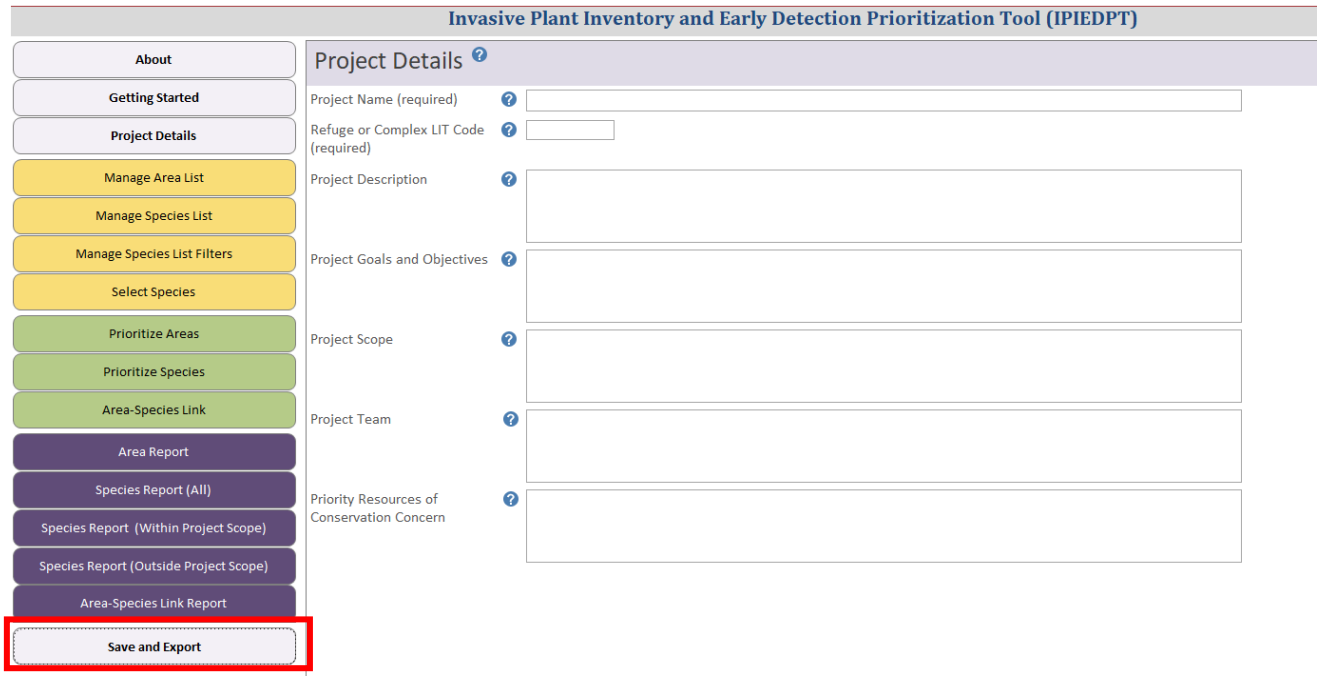


Figure 16 Creating prioritization reports in the Invasive Plant Inventory and Early Detection Prioritization Tool

7.2. Utilizing Prioritization Results

The IPPT was designed to help land managers make decisions about investments in inventory and early detection surveys. Once results are generated, the team evaluates the prioritization results and adjusts as needed. The products are then archived in ServCat and survey planning begins.

The following elements should be considered when planning an inventory or early detection survey:

- Survey objectives
- Survey utility
- Survey measures
- Survey design
- Survey methods
- Data analysis
- Data management
- Funding and technical expertise needed
- Survey timing (plant phenology and detectability)
- Protocol documentation

The following are some resources to help plan and implement inventory or early detection surveys, as well as manage and utilize the data:

- Existing protocols, guides, and survey reports: ServCat (https://ecos.fws.gov/ServCat/), USGS ScienceBase (https://www.sciencebase.gov/catalog/), National Park Service Data Store (https://irma.nps.gov/DataStore/)
- Summary of survey protocols and procedures for assessing the status and trends of invasive plants (ServCat record 128344)
- *Invasive Plant Inventory and Early Detection Guide* (USFWS 2018) (ServCat record 114935)
- Consult with invasive species experts or I&M program staff

7.3. Data Management

A critical element of a strategic and adaptive approach to invasive plant management is to *share learning*. Products from the prioritization process should be archived in ServCat so that current and future staff can easily discover and use the information. In addition, prioritization results should be reviewed and updated over time as conditions change. To export files for ServCat documentation from the tool in proper format, refer to Section 7.1, Figure 15. The figure below depicts a general guide for archiving information generated from the prioritization process using ServCat (see ServCat Record 142296). For more detailed information on storing prioritization products in ServCat, consult with your regional invasive species coordinator or data manager.

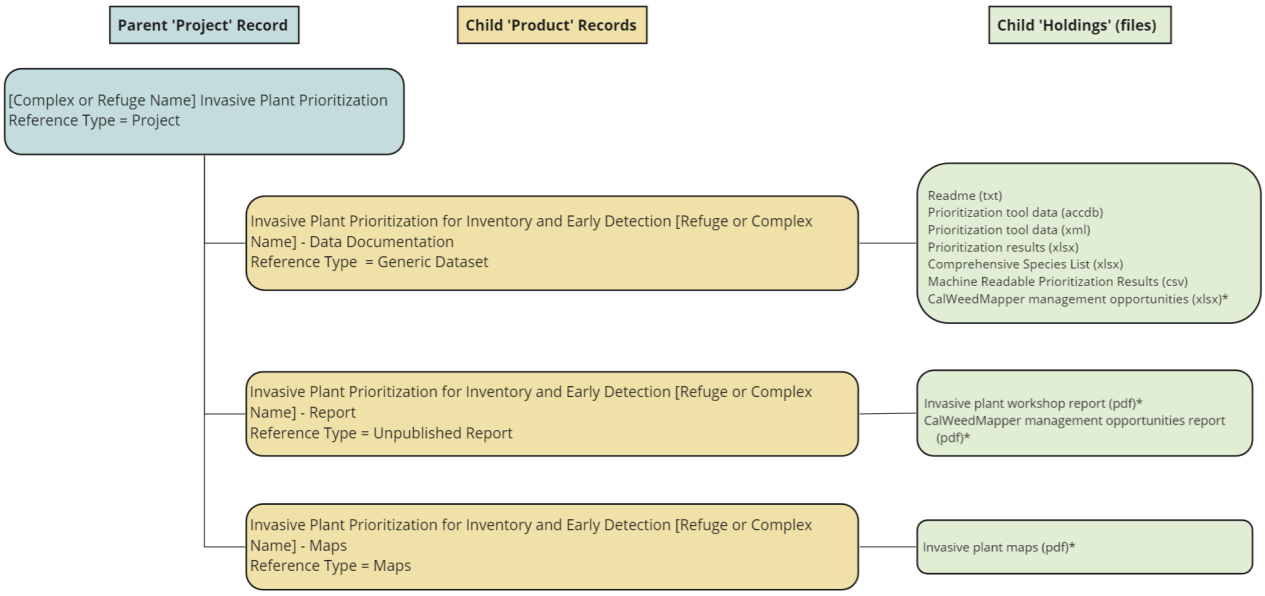


Figure 17 ServCat organization for Invasive Plant Prioritization Projects

Glossary of Terms

Area list. The list of areas for prioritization.

Comprehensive species list. The comprehensive list of non-native plant species to be considered for prioritization. This list include species that are known to occur plus species with the potential to occur (early detection species).

Early detection species. Species that do not yet occur within a defined area.

Early detection survey. A survey focused on detecting the location and abundance of highlyinvasive species that are not yet established within a defined area (but the potential for establishment exists).

Invasive species. An alien species whose introduction does or is likely to cause economic orenvironmental harm or harm to human health (Executive Order 13112, 1999).

Inventory. A survey that documents the presence, relative abundance, status, and/or distributionof abiotic resources, species, habitats, or ecological communities at a particular time.

Native species. With respect to a refuge, a species that, other than because of an introduction, historically occurred or currently occurs in that ecosystem.

Non-native species. With respect to a refuge, an organism, including its seeds, eggs, spores, or other biological material capable of propagating that species, that occurs outside of its natural range

Origin. Origin describes whether species occur naturally on the refuge or if they occur because of human activities.

Project scope. The spatial extent under consideration for inventory or early detection. The scopemay consist of a single defined area or set of areas (i.e., management units/sub-units).

Resources of conservation concern. Plant or animal species (such as any federally or state listed or regionally important species), or any unique environmental features that are consideredeconomically or ecologically valuable. The USFWS defines a Resource of Concern as 'all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, state, or ecosystem conservationplans or acts' (620 FW1.4G).

Species list filter. A list of invasive species that are otherwise managed or of concern with associated rank or significance used to select species for prioritization.

Survey. A specific data-collection effort to complete an inventory or conduct monitoring ofbiotic or abiotic resources (701 FW 2).

Target area. A geographic boundary within the project scope that is under consideration forinventory.

Vector (aka transport vector). The conveyance (e.g., wind, water, animal, human, mechanical,etc.) that moves a non-native propagule to its novel location (Lockwood et al. 2007).

Vector pathway (aka transport pathway). The route between the non-native propagule sourceand release location (Lockwood et al. 2007).

Appendix A: Area Prioritization Criteria

This appendix explains the criteria and associated scores used to prioritize areas using the Invasive Plant Inventory and Early Detection Prioritization Tool (IPPT).

Ecological Integrity

The overall structure, composition, and functions of an ecosystem(s) within the bounds of natural or historic disturbance regimes (Rocchio and Crawford 2011).

Rationale and Assumptions: Areas with high ecological integrity are relatively unimpaired (intact, not damaged) across a range of ecological attributes and spatial and temporal scales (De Leo and Levin 1997). Areas with relatively high ecological integrity have high conservation value and are a priority for preventing or reducing human-induced threats such as invasive species.

Scale Definition[1]	***Scale***	***Score***
Ecosystems of the area are believed to be, on a global or range-wide scale, among the highest quality examples with respect to major ecological attributesfunctioning within the bounds of natural disturbance regimes. Characteristics include: the landscape contains natural habitats that are essentially unfragmented (reflective of intact ecological processes) and with little to no human-induced threats (e.g., contaminants, invasive species, etc.); vegetation structure and composition, soils, and hydrology are within natural ranges of variation; invasive species are essentially absent or have negligible negative impact; key native plant and animal indicators are present.	Very good ecological integrity	10
Ecosystems of the area are not among the highest quality but exhibit favorablecharacteristics regarding major ecological attributes functioning within the bounds of natural disturbance regimes. Characteristics include: largely naturalhabitats with minimal fragmentation and few human induced threats (e.g., contaminants, invasive species, etc.); vegetation structure and composition, soils, and hydrology are within natural ranges of variation; invasive species are uncommon/rare and/or have minimal negative impact; many key plant and animal indicators are present.	Good ecological integrity	7
Ecosystems of the area contain several unfavorable characteristics interms of major ecological attributes and natural disturbance regimes. Characteristics of this ecosystem would include: moderately fragmented natural habitat with several human-induced threats; biotic and abiotic factors are outside their natural range of variation; a moderate number of human induced threats are present; invasive species are moderately abundant and/or have moderate negative impacts; many of the key plant and animal indicatorsare absent. Management is needed to maintain or restore major ecological attributes.	Fair ecological integrity	3
Ecosystem(s) of the area is severely altered with respect to major ecological attributes. Characteristics include: little natural habitat and very fragmented; biotic and abiotic factors are severely altered well beyond their natural range of variation; a relatively high number of human induced threats are present; invasive species exert a strong negative impact; most (if not all) key plant and animal indicators are absent. There may be little long-term conservation valuewithout intense management and restoration, and such restoration may be difficult or uncertain.	Poor ecological integrity	1
The ecological integrity of the area is unknown.	Unknown	3

[1] Table adapted from Faber-Langendoen et al. 2012a.

Importance to Priority Natural Resources of Conservation Concern

The relative importance of the area to natural resources that are a primary focus of conservation efforts within the project scope.

Rationale and Assumptions: Areas important to priority natural resources of conservation concern are a high priority for preventing, detecting, and removing invasive species. Priority resources include ecosystems, communities, species groups and species. Use the 'Documentation' field to record information about priority resources of conservation concern within the area.

Tip: Identify areas with the highest and lowest importance to priority natural resources of conservation concern within the project scope. Use this information to assign scores to other areas relative to these extremes.

Scale Definition	*Scale*	*Score*
The area currently supports priority natural resources of conservation concern and they are in 'good' or 'very good' health.	High importance	10
The area currently supports priority natural resources of greatest conservation concern and they are in 'fair' or 'poor' health.	Medium importance	7
The area currently does not support priority natural resources of conservation concern but is adjacent to an area that does.	Low importance	3
The area currently does not support priority natural resources of conservation concern and is not adjacent to areas that do.	**Very low importance**	1

Importance to Other Resources of Conservation Concern

The relative importance of the area to other resources of conservation concern within the project scope. Other resources may include lower priority natural resources of conservation concern, cultural resources, or other important area values. Resources considered when applying this criterion can be specified in the 'Documentation' field'.

Rationale and Assumptions: Areas important to other resources of conservation concern that can be harmed by invasive species are a high priority for preventing, detecting, and removing threats such as invasive plants.
Tip: Identify areas with the highest and lowest importance to other resources of conservation concern within the project scope. Use this information to assign scores to other areas relative to these extremes.

Scale Definition	*Scale*	*Score*
The area supports other resources of conservation concern and they are in 'good' or 'very good' health.	High importance	10
The area supports other resources of conservation concern and they are in 'fair' or 'poor' health.	Medium importance	7
The area does not support other resources of conservation concern but is adjacent to an area that does.	Low importance	3
The area does not support other resources of conservation concern and is not adjacent to areas that do.	Very low importance	1

Innate Resistance to Invasion

The innate (natural) capacity of an ecosystem to resist establishment of novel invasive species. Primary determinants of invasion success are biotic resistance, abiotic constraints, and propagule pressure (Catford et al. 2009, Miller et al. 2014). Here, we are focused biotic resistance and abiotic constraints to establishment of novel invasive species.

Rationale and Assumptions: In general, areas where native plants occupy most bare ground or capture almost all light at the soil surface can deter the establishment of invasive plants (Hobbs and Huenneke 1992). Areas with greater plant diversity occupy a greater variety of resources and thereby can limit the ability of non-native species to obtain resources that are not already occupied or used (Naeem 2000, Lockwood et al. 2010). Areas with relatively extreme abiotic conditions (such as low nutrients or water or saline conditions) constrain invasive plant establishment. Areas with frequent or intense natural disturbance regimes (such as fire or flooding) can often facilitate or create opportunities for invasion (Lockwood et al. 2010). Areas with low innate (natural, intrinsic) resistance to invasion are a priority for prevention, early detection, and rapid response because they are more likely to be invaded by novel species, some of which may be harmful.

Tip: If areas are scoring similarly (no distinction between areas) consider using a relative scoring approach. For example, identify which of your defined areas have the highest and lowest innate resistance and then assign scores to other areas relative to these extremes.

Scale Definition	*Scale*	*Score*
Two or more of the following characteristics are present: low plant species richness, >50% bare ground, high frequency, and intensity ofnatural disturbance events (e.g., fire, hurricanes, extreme tides), andrelatively non-stressful abiotic conditions.	Low resistance	10
Two or more of the following characteristics are present: moderate plant species richness, 10-50% bare ground, moderate frequency and intensity of natural disturbance events, neutral abiotic conditions.	Moderate resistance	5
Two or more of the following characteristics are present: high plantspecies richness, <10% bare ground, low frequency and intensity ofnatural disturbance events, abiotic conditions stressful (e.g., high salinity, low nutrient levels, regular flooding).	High resistance	1
The innate resistance to invasive plants is unknown.	Unknown	5

Terrestrial Pathways

The distribution and density of terrestrial pathways within the area. Examples of terrestrial pathways are highways, roads, trails, levees, berms, and parking areas.

Rationale and Assumptions: Terrestrial pathways provide a means for transport, establishment, and spread of invasive species. Areas where terrestrial pathways are widely distributed or occur at high density are at high risk for invasion and are therefore a high priority for invasive species detection, prevention, and removal.

Tip: Identify areas with the highest and lowest coverage and/or density of terrestrial pathways. Assign scores to other areas relative to these extremes.

Scale Definition	*Scale*	*Score*
Terrestrial pathway spatial coverage and/or density is high relative to other areas within the project scope.	High coverage and/or density	10

Scale Definition	*Scale*	*Score*
Terrestrial pathway spatial coverage and/or density is medium relative to other areas within the project scope.	Medium coverage and/or density	7
Terrestrial pathways spatial coverage and/or density is low relative to other areas within the project scope.	Low coverage and/or density	3
No occurrence of terrestrial pathways within the area.	No terrestrial pathways	1

Aquatic Pathways

The distribution and density of aquatic pathways within the area. Examples of aquatic pathways are rivers, sloughs, streams, canals, lakes, and reservoirs.

Rationale and Assumptions: Aquatic pathways provide a means for transport, establishment, and spread of invasive species. Areas where aquatic pathways are widely distributed or occur at high density are at high risk for invasion and are therefore a high priority for invasive species detection, prevention, and removal.

Tip: Identify areas with the highest and lowest coverage and/or density of aquatic pathways. Assign scores to other areas relative to these extremes.

Scale Definition	*Scale*	*Score*
Aquatic pathway spatial coverage and/or density is high relative to other areas within the project scope.	High coverage and/or density	10
Aquatic pathway spatial coverage and/or density is medium relative to other areas within the project scope.	Medium coverage and/or density	7
Aquatic pathway spatial coverage and/or density is low relative to other areas within the project scope.	Low coverage and/or density	3
No occurrence of aquatic pathways within the area.	No aquatic pathways	1

Transport Vectors

The presence, frequency, and duration of human-mediated transport vectors within the area. Vectors here include any means of human-mediated transport of invasive materials such as vehicles, boats, bicycles, clothing/shoes, construction equipment, livestock/cattle, livestock feed (such as hay), and transported soils or gravel.

Rationale and Assumptions: Transport vectors are entities that enable movement and spread of invasive propagules along terrestrial and aquatic pathways (Lockwood et al. 2007).
Areas that experience frequent or long duration vector events are at high risk to invasive species introduction and spread and are therefore a high priority for prevention, detection, and removal. Vector events are occurrences where a vector enters the area (e.g., for public use, routine maintenance, restoration, inventory, and monitoring).

Tip: Identify areas have the highest and lowest frequency or duration of vector events and then assign scores relative to these extremes.

Scale Definition	*Scale*	*Score*

Scale Definition	*Scale*	*Score*
Human-mediated vectors operate in the area AND frequency and duration of vector events is high relative to the other areas in the project scope.	High vector frequency/duration	10
Human-mediated vectors operate in the area AND frequency and duration of vector events is moderate relative to the other areas in the project scope.	Medium vector frequency/duration	7
Human-mediated vectors operate within the area, but frequency and duration of vector events is low relative to the other areas in the project scope.	Low vector frequency/duration	3
Human-mediated vectors are absent within the area.	No vector frequency/duration	1

Anthropogenic Disturbances

The intensity, duration, and frequency of anthropogenic (human-mediated) disturbance events within the area. Disturbance here is described as a "relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment" (Lockwood et al. 2007, White and Pickett 1985). Disturbance can intentionally or unintentionally result from human activities such as restoration, routine maintenance activities (such as mowing, mosquito abatement, fire management), inventory or monitoring, resource extraction or toxins.

Rationale and Assumptions: Disturbance facilitates species invasions (Lockwood et al. 2007, White and Pickett 1985). Areas exposed to intense, frequent, or long-duration human-mediated disturbance events are at high risk for invasion and therefore should be a priority for invasive species prevention, detection, and removal. Natural disturbance regimes are addressed by the 'innate resistance to invasion' criteria.

Tip: identify areas with the highest and lowest disturbance levels and then assign scores to other areas relative to these extremes.

Scale Definition	**Scale**	**Score**
The area has experienced high levels of anthropogenic disturbance (e.g., high intensity, duration, or frequency) relative to other areas within the project scope in the last 10years.	High anthropogenic disturbance	10
The area has experienced moderate levels of anthropogenicdisturbance (e.g., moderate intensity, duration, or frequency) relative to other areas within the project scope in the last 10 years.	Medium anthropogenic disturbance	7
Anthropogenic disturbance has not occurred in the last 5 years or the area experiences low levels of anthropogenic disturbance (e.g., low intensity, duration, or frequency) relative to other areas within the project scope in the last 10years.	Low anthropogenic disturbance	3
The area has not experienced anthropogenic disturbances.	No anthropogenic disturbance	1

Inventory and Monitoring

The level of evidence about invasive species abundance and distribution in the area.

Rationale and Assumptions: A clear understanding of where and how many invasive species populations occur (and do not occur) is essential to management because it 1) informs objectives (prevent, eradicate, contain, or suppress), 2) informs where actions should be taken, 3) helps estimate management cost, and 4) is used to evaluate management response, learn, and adapt. Mental models of the status and trends of invasive species cannot be passed down, making it hard for new staff to understand the history of the problem, what has worked (and not worked), and make informed decisions. Areas with little or no inventory or monitoring information are considered a high priority for inventory or early detection.

Scale Definition	***Scale***	***Score***
Data on the distribution and abundance of priority invasive plants has not been collected in the area in thelast 10 years.	No information in the last 10years	10
Data on the distribution and abundance of priority invasive plants have been collected in the last 10 years butthe effort was not comprehensive (e.g., limited in spatial scope, single species focus, etc.) and/or survey effort was not well documented.	Past 10 years but not comprehensive or documented	7
Data on the distribution and abundance of priority invasive plants has been collected in the area in the last 10years and the survey effort was comprehensive and well documented.	Past 10 years, comprehensive andwell documented	3
Data on the distribution and abundance of priority invasive plants has been collected in the area in the last 5years and the survey effort was comprehensive and well documented.	Past 5 years, comprehensive, well documented	1

Infestation Level

The status of invasive species infestations in the area based upon best available information (such as data or site-specific knowledge).

Rationale and Assumptions: The return on invasive species management investments is higher when resources are focused on preventing invasions, early detection, and rapid response (eradication), or containing novel or isolated or satellite invasive species populations. Returns on invasive species investments are generally lower when resources are focused on already heavily infested areas.
The value of collecting information (or return on management investment) is higher in areas specified as 'clean' or with minimal invasion because the information is essential to targeting efforts to prevent, eradicate, or contain invasive species populations, and ultimately reduce the likelihood of economic and ecological harm.

Scale Definition	***Scale***	***Score***
<1 % of the area is infested by one or more invasive species.	Trace (<1%)	10
1-5% of the area is infested by one or more invasive plantspecies.	Low infestation (1-5%)	7
6-25% of area is infested by one or more invasive plantspecies.	Moderate infestation (6-25%)	3
>25% of area is infested by one or more invasive plantspecies.	High infestation (>25%)	1
The status of invasive plant species in the area is unknown.	Unknown	3

Number of Invasive Species

The approximate number of invasive plant species infesting the area based upon best available information (such as data or site-specific knowledge).

Rationale and Assumptions: The value of collecting information on invasive plant status is lower in areas already heavily infested by one or more species. We assume here that early detection and rapid response of all invasive plant species is a priority, therefore, areas that have fewer types of invasive plant species will rank higher.

Scale Definition	*Scale*	*Score*
Invasive plant species are not known to occur in the area.	None	10
1-5 unique species occur in the area.	1 to 5 species	7
6-10 unique species occur in the area.	6 to 10 species	3
>10 unique species occur in the area.	>10 species	1
The number of invasive plant species in the area is unknown.	Unknown	3

Appendix B: Species Prioritization Criteria

This appendix explains the criteria and associated scores used to prioritize species using the Invasive Plant Inventory and Early Detection Prioritization Tool (IPPT).

Invasiveness Ranking

Species invasiveness scores generated from existing larger landscape invasive plant ranking systems.

Rationale and Assumptions: Species considered highly invasive by state or larger landscape ranking systems have the potential to cause significant ecological and economic harm at a localscale and should be considered a high priority for detection and subsequent eradication or control.

Invasiveness ranking systems pre-loaded in the tool:

Source Long Name	*Source Short Name*	*Year*	*Source Link*
California Invasive Plant Council	Cal-IPC	2021	https://www.cal-ipc.org/plants/inventory/
Arizona Wildlands Invasive Plant Working Group	azwipwg	2005	https://www.swvma.org/wp-content/uploads/Invasive-Non-Native-Plants-that-Threaten-Wildlands-in-Arizona.pdf
Alaska Center for Conservation Science	ACCS	2021	https://accs.uaa.alaska.edu/invasive-species/non-native-plant-species-list/
Virginia Department of Conservation and Recreation	Virginia	2015	https://www.dcr.virginia.gov/natural-heritage/invsppdflist
New York Invasive Species Information Clearinghouse	NYS	2013	http://nyis.info/wp-content/uploads/2017/10/NYS-INVASIVE-PLANT-RANKS_March-2013.pdf

Species Proximity

Proximity of the invasive species relative to the project scope. Select the statement that best describes the proximity of the species to the project boundary.

Rationale and Assumptions: Invasive species known to occur in the project scope, or in close proximity, should be considered as a target for inventory or early detection (and subsequent management).

Scale Definition	*Scale*	*Score*
The species has not been documented or is not believed to occurwithin 100 miles of the project scope.	>100 miles	1
The species has been documented or is believed to occur within100 miles of the project scope.	<100 miles	3
The species has been documented or is believed to occur within50 miles of the project scope.	<50 miles	5
The species has been documented or is believed to occur within10 miles of the project scope.	<10 miles	7
The species has been documented or is believed to occur within1 mile of the project scope.	<1 mile	9
The species is documented or is believed to occur within theproject scope.	Within the project scope.	10

Current Species Abundance

Abundance of the species within the project scope based on best available information (survey data, expert opinion, best professional guess).

Rationale and Assumptions: Detecting and eradicating invasive species in the early stages of invasion prevents future economic and ecological harm. Species that are not yet widespread or abundant are generally considered a higher priority for prevention, detection, and removal.

Scale Definition	*Scale*	*Score*
< 10% of the project scope is infested by the species.	Low abundance (<10%)	10
1-5% of the project scope is infested by the species.	Moderate abundance (1-5%)	7
>6-25% of the project scope is infested by the species.	High abundance (>6-25%)	3
>25% of the project scope is infested by the species.	Very high abundance (>25%)	1
The abundance of the species within the project scope is unknown.	Unknown abundance	7

Habitat Suitability

The proportion of additional suitable habitat within the project scope within which a species could spread if not managed. For species that do not yet occur within the project scope, the estimated amount of available suitable habitat within the project scope if it were introduced.

Rationale and Assumptions: Areas containing suitable habitat for an invasive species, but are not yet occupied, are at high risk for invasion and should be considered a priority for prevention, detection, and subsequent removal. Species with higher levels of unoccupied habitat will score higher.

Scale for species that are known to occur within the project scope:

Scale Definition	***Scale***	***Score***
No further suitable habitat is present within the project scope, or allavailable habitat is occupied.	No additional habitat	0
Additional suitable habitat is limited (<10% of project scope);species not likely to spread further.	Low available habitat	3
Additional suitable habitat for further spread is moderate (10-30%).	Moderate available habitat	7
Suitable habitat exists throughout the project scope (>30%) forfurther spread.	High available habitat	10
Unknown percent of available habitat for further spread within theproject scope.	Unknown available habitat	7

Scale for species outside the project scope (early detection species):

Scale Definition	***Scale***	***Score***
No suitable habitat present within the project scope.	No habitat	0
Limited suitable habitat within the project scope (<10% of scope).	Low suitable habitat	3
Moderate amount of suitable habitat within the project scope (10-30% of scope).	Moderate suitable habitat	7
High amount of suitable habitat within the project scope (>30% ofscope).	High suitable habitat	10
Unknown amount of suitable habitat within the project scope.	Unknown suitablehabitat	7

Ecological Impacts (current species)

The abiotic and biotic impacts to natural resources ofconservation concern within the project scope where the species occurs. This criterion applies only to species known to occur within the project scope.

Rationale and Assumptions: Species that already have a high negative effect are higher priority for inventory and management. Examples of negative impact on abiotic processes: change in firefrequency or intensity; alters hydrologic regimes; effects a change in salinity, alkalinity, or pH; changes erosion and sedimentation rates, etc. Examples of negative impact on community structure of composition covers canopy or creates new canopy; competition and/or suppression with native vegetation, etc. Definitions adapted from "An Invasive Species Assessment Protocol: Evaluating non-native plants for their impact on biodiversity, version 1" (Morse et al. 2004).

Scale Definition	*Scale*	*Score*
Very high level of harm to resources. Within the project scope, the invasive species is likely to destroy or eliminate priority resources of concern or reduce its population size (if a species) by 71-100% within ten years or three generations (if the priority ROC is a species) if left unmanaged.	Very high	10
High level of harm to resources. Within the project scope, the invasive species is likely to seriously degrade/reduce the priority resource of conservation concern or reduce its population (if a species) by 31-70% within ten years or three generations OR very high level of harm to other resources of conservation concern, infrastructure, human health, or public use where the species occurs within the project scope.	High	7
Medium level of harm to resources. Within the project scope, the invasive species is likely to moderately degrade/reduce the priority resource of conservation concern or reduce its population (if a species) by 11-30% within ten years or three generations OR moderate to high level of harm to other resources of conservation concern, infrastructure, human health, or public use where the species occurs within the project scope.	Medium	3
Low level of harm to resources. Within the project scope, the invasive species is likely to only slightly degrade or reduce the priority resource(s) of concern or reduce its population (if a species) by 1-10% within ten years or three generations OR low level of harm to other resources of conservation concern, infrastructure, human health, or public use where the species occurs within the project scope.	Low	1
No harm to priority resources of conservation concern; other resources of conservation concern; or infrastructure, human health, or public use where the species occurs within the project scope.	None	0
The current negative effect of the species on priority resources of concern or other resources within the project scope is unknown.	Unknown	7

Ecological Impacts (early detection species)

The harm likely to be caused by the invasive species to resources within the project scope if the species were to occur.

Rationale and Assumptions: Invasive species can directly or indirectly harm or stress natural resources of conservation concern in a variety of ways, such as alteration of ecological processes (such as fire, nutrient, or water regimes) and increased competition for resources. Species with a high likelihood of harm to resources of conservation concern within the project scope are a higher priority for prevention, detection, and removal.

Scale Definition	*Scale*	*Score*
If the species were to establish within the project scope, it would likely result in significant harm to resources of priority conservation concern (such as alteration of abiotic processes and community structure and composition) AND would cause significant harm to other resources of conservation	Very high	10

concern, infrastructure, human health or impairs public use.		
If the species were to establish within the project scope, it would likely cause significant harm to resources of priority conservation concern (such as alteration of abiotic processes and community structure and composition, ecosystem engineers) OR the species would significantly harm other resources of conservation concern, infrastructure, human health or impairs public use.	High	7
If the species were to establish within the project scope, it would likely cause moderate harm to resources of priority conservation concern (such as alteration of abiotic processes and community structure and composition, ecosystem engineers) OR the species would significantly harm other resources of conservation concern, infrastructure, human health or impairs public use.	Medium	3
Minimal harm is expected to priority resources of concern OR other resources of conservation concern, infrastructure, human health, or public use if the species were to establish within the project scope.	Low	1
No harm is expected to priority resources of concern, other resources of conservation concern, infrastructure, human health, or public use if the species were to establish within the project scope.	None	0
The projected negative impact of the species is unknown.	Unknown	3

Larger Landscape Management Importance

Consider whether the species has a noxious or other regulatory designation at a larger landscape scale (e.g., county, state, etc.) or is a priority for early detection or removal on lands surrounding the project scope (such as county watch lists).

Rationale and Assumptions: Species designated as noxious species or considered a high management priority by other local agencies and organizations should be considered for prevention, early detection, or removal.

Scale Definition	***Scale***	***Score***
The species is on a state noxious weed list AND is considered a high management priority by local county weed management area(s), early detection network, or other cooperative partnership.	High	10
The species is on a state noxious weed list, BUT not considered a high priority for removal by local county weed management area(s), early detection network, or other cooperative partnership.	Medium	5
The species is not on a state noxious weed list or considered a high priority by local county weed management area(s), early detection network, or other cooperative partnership.	Low	0

Appendix C: Obtaining Early Detection Data

CalFlora Spatial Data

Navigate to CalFlora Observation Search page (https://www.calflora.org/entry/observ.html) and select "Non-native" under "Native Status" then select the county of interest or zoom into the area of interest and make sure "in map area" is selected. Above the data fields, click "> customize" and add "Latitude", "Longitude", "Common Name" as data fields. Remove any unwanted fields. Then, at the top of the window in the green header click "TOOLS" then "DOWNLOAD RESULTS" as CSV or Shapefile: point as the data format.

EDDMapS Spatial Data

Navigate to the EDDMapS Advanced Query Tools page (https://www.eddmaps.org/tools/query/index.cfm) and select "Plants" under "Division" in Species Information. Under Location Information, select the state, county, and township if applicable of interest. Select other criteria if applicable. Select "Submit" and you will be navigated to a new page with a map of observations. Click the "Login to download data" button, log in or create a EDDMapS account. Select CSV, KML, or Shapefile where the "Login to download data" previously was. You will receive an email from EDDMapS with a link to access the requested data.

Calculate Distances from Refuge with ArcGIS

There are multiple options for calculating or estimating the distance of early detection observation points from the refuge of interest. If the user is unable to calculate distances from refuge, the distances should be estimated using best professional judgement. The IPPT includes a question about species proximity to refuge so estimates should be as informed as possible but obtaining exact results should not be a barrier of IPPT use.

One way to calculate distances of early detection observations to refuge is to categorize the distances from refuge with buffers in ArcGIS. Once you have obtained your early detection point data, add the data to a map. If using CSV format, right click the imported table and select "Display XY Data." Add the refuge boundaries (available from ArcGIS Online) and search for the Multiple Ring Buffer tool (Analysis tool). Select the refuge boundary as the input feature and add the distances of the buffers of interest. Set the Distance Unit to "Miles" and keep Dissolve Option set to "Non-overlapping (rings)." The IPPT references the following distances so they are recommended buffer distances: on refuge (0 mi), 1 mi, 10 mi, 50 mi, 100 mi, more than 100 mi (200 miles can be used for this buffer distance). Once the buffers are created, merge the buffer layer with the early detection point data layer using Spatial Join. Set the Target Feature as the early detection point data layer, the Join Features as the multiple ring buffer layer, the Join Operation to "Join one to many", check "Keep All Target Features", and Match Option as "Intersect." The output feature class from the join now has additional fields including "distance." This field will be used as the "distance from refuge" field in the Early Detection Template for Data Import. Export the output feature class by right clicking the layer, Data> Export Table, rename the file Output Name to include ".csv" extension. Before using the Early Detection Template for Data Import, remove all duplicate species observations leaving only the closest occurrences of each species. The data in the CSV file can now be used to complete the Early Detection Template for Data Import.

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