

Spatial Invasives Infestation and Priority Analysis (SIIPA) Model and Map

{ Debi Stone, Restoration Steward
The Nature Conservancy's Disney Wilderness Preserve

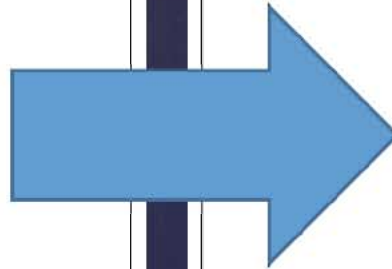
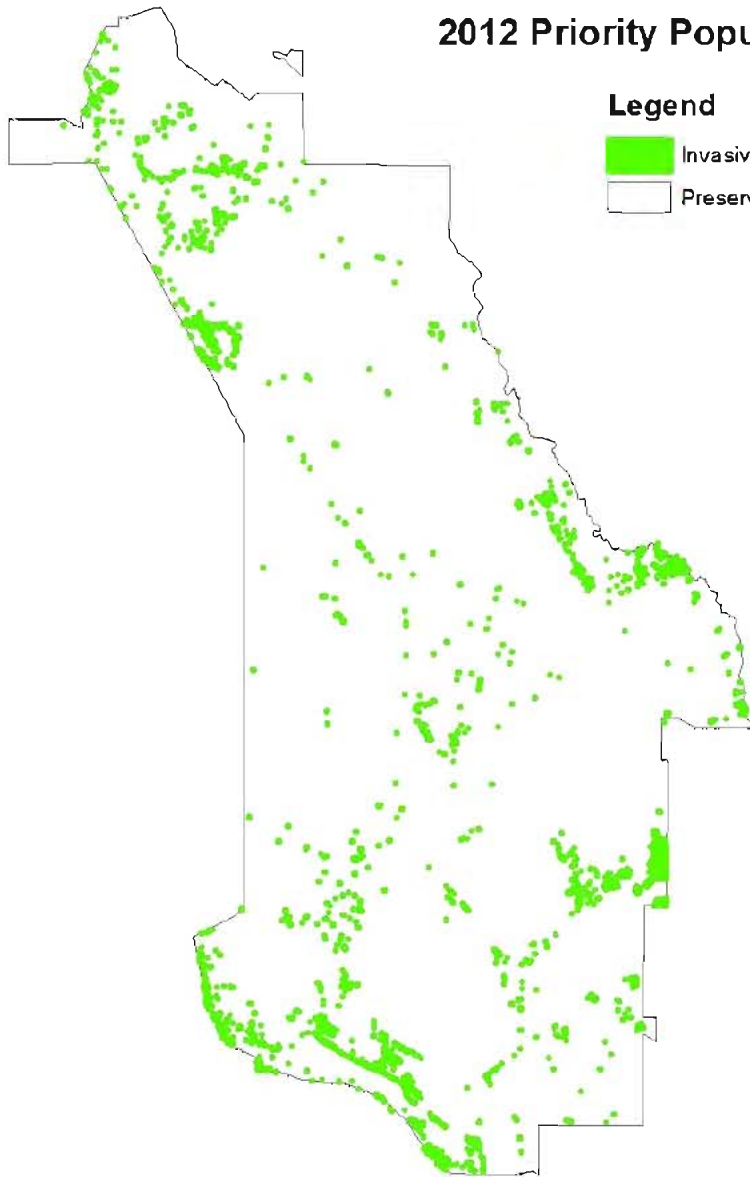
Project Beginnings

- ⌘ Most prioritization systems: theoretical but not practical
- ⌘ Consider individual populations rather than species as a whole
- ⌘ Use data to better direct treatments
- ⌘ Customizable product
- ⌘ Two GIS models based on TNC prioritization system to look at:
 - ⌘ Infestation level on preserve
 - ⌘ Priority invasives populations on preserve

2012 Priority Populations

Legend

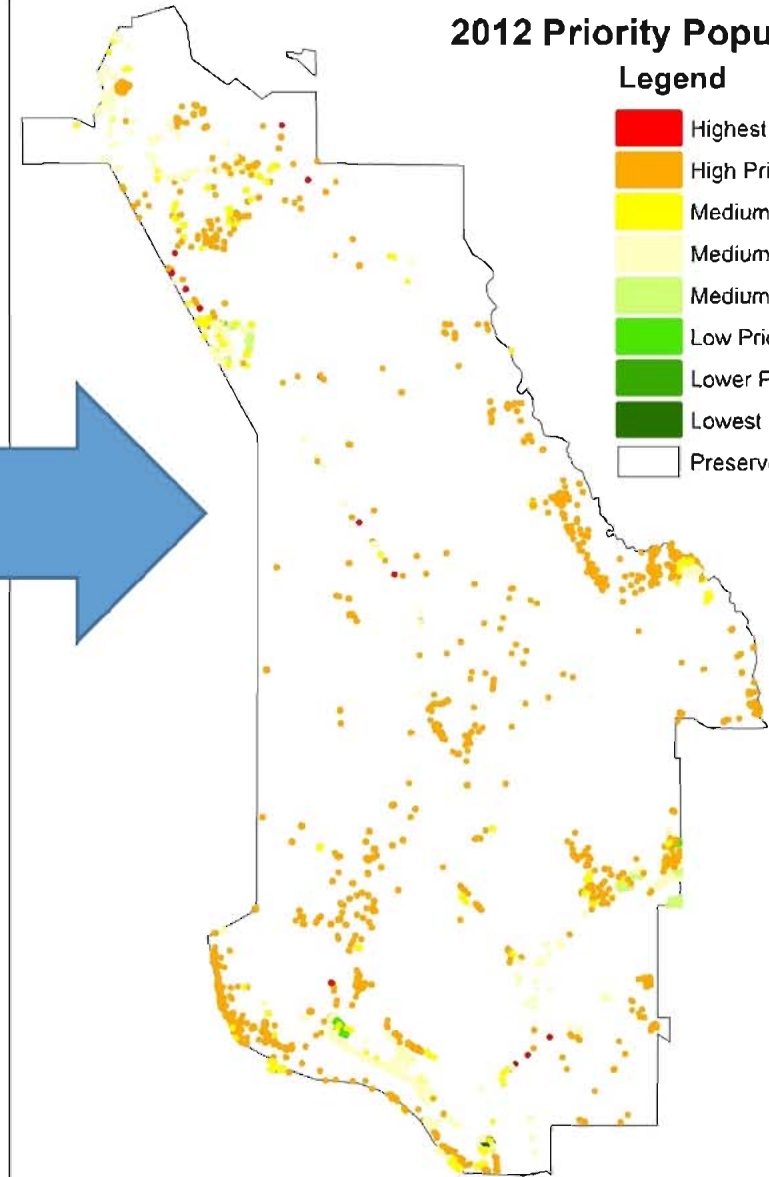
- Invasives
- Preserve Boundary



2012 Priority Populations

Legend

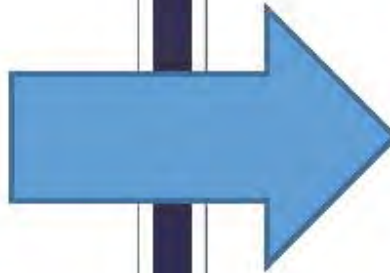
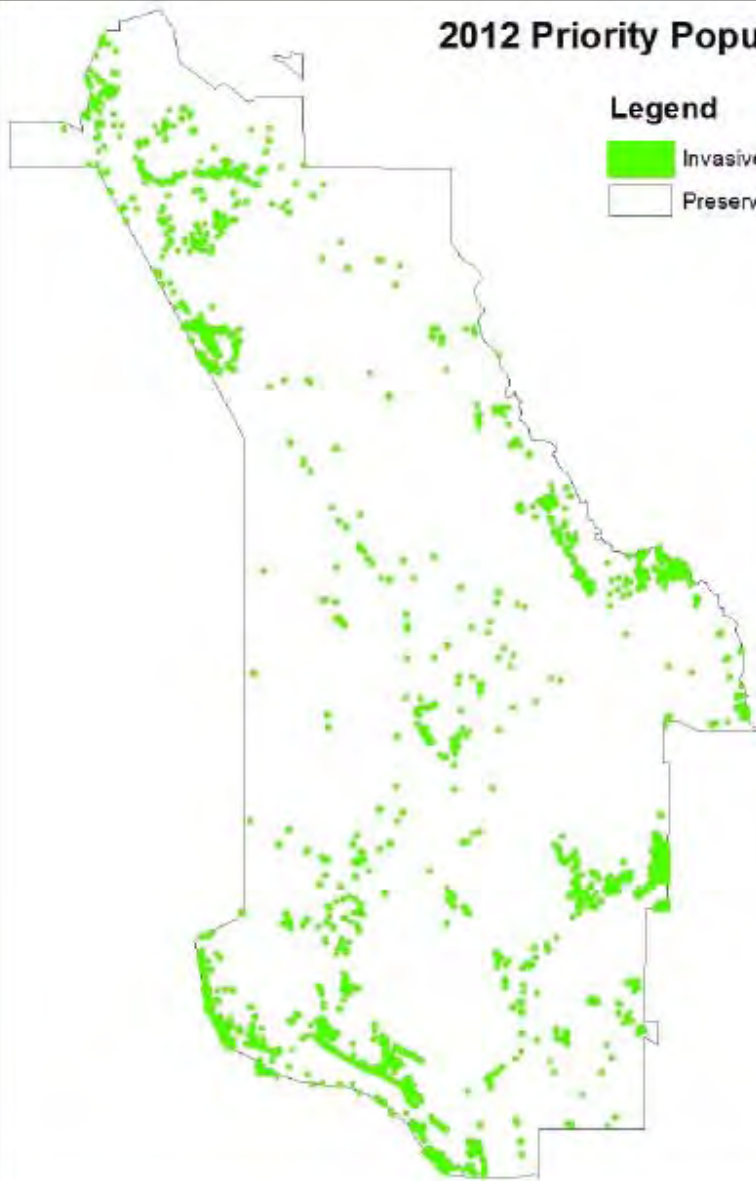
- Highest Priority
- High Priority
- Medium-High Priority
- Medium Priority
- Medium-Low Priority
- Low Priority
- Lower Priority
- Lowest Priority
- Preserve Boundary



2012 Priority Populations

Legend

- Invasives
- Preserve Boundary



2012 Priority Analysis

Ranking

- 0.000000 - 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 4.000000
- 4.000001 - 5.000000
- 5.000001 - 6.000000
- 6.000001 - 7.000000
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Prioritization Basis for the Model

TNC's Draft Weed Management Plan

Setting Priorities

The priority-setting process can be difficult, partly because you need to consider so many factors. We find that it helps to group these factors into four categories that you can think of as filters designed to screen out the worst weeds:

- I. current extent of the species on or near the site;*
- II. current and potential impacts of the species;*
- III. value of the habitats/areas that the species infests or may infest; and*
- IV. difficulty of control.*

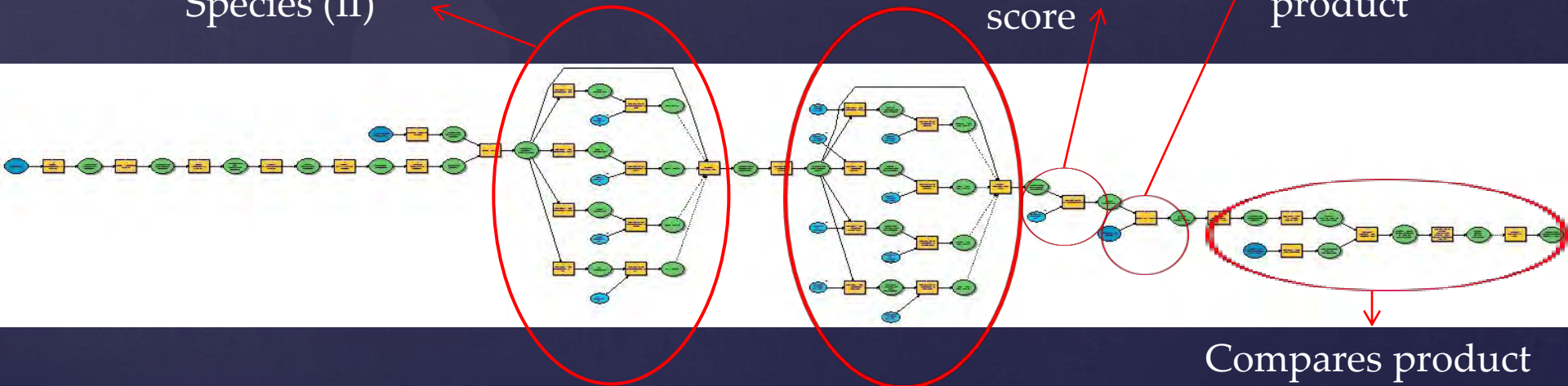
Invasive Infestation Model

⌘ Based on species and extent

Scores each
population on
Species (II)

Gives each
population
a final
score

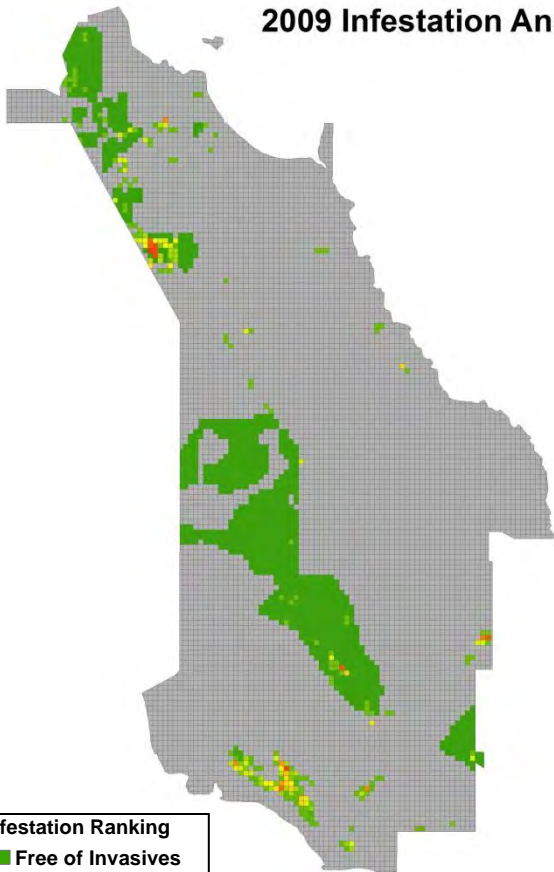
Creates a
grid based
product



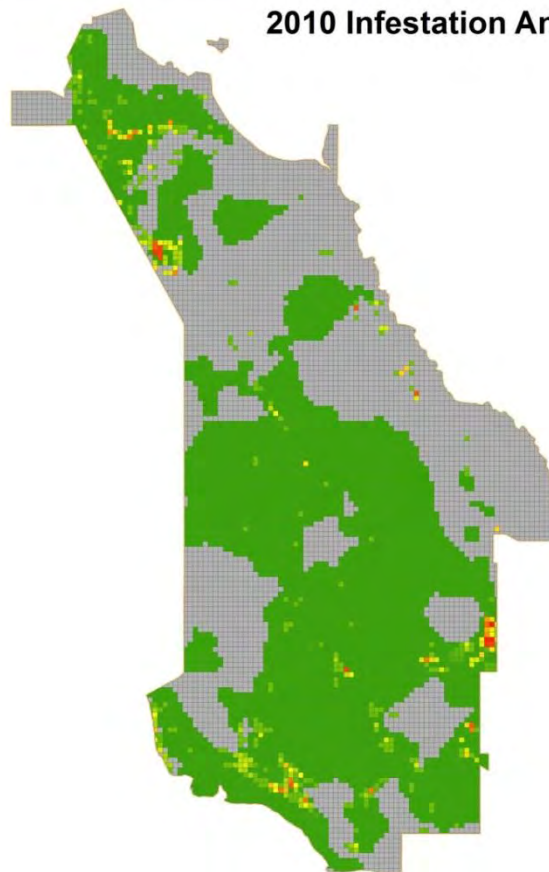
Scores each
population
on extent (I)

Compares product
with Survey
History

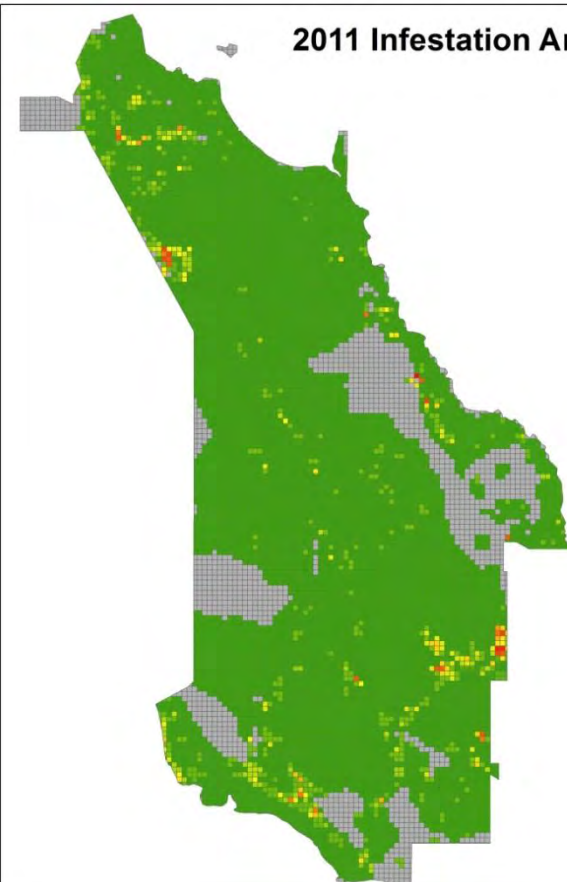
2009 Infestation Analysis



2010 Infestation Analysis



2011 Infestation Analysis

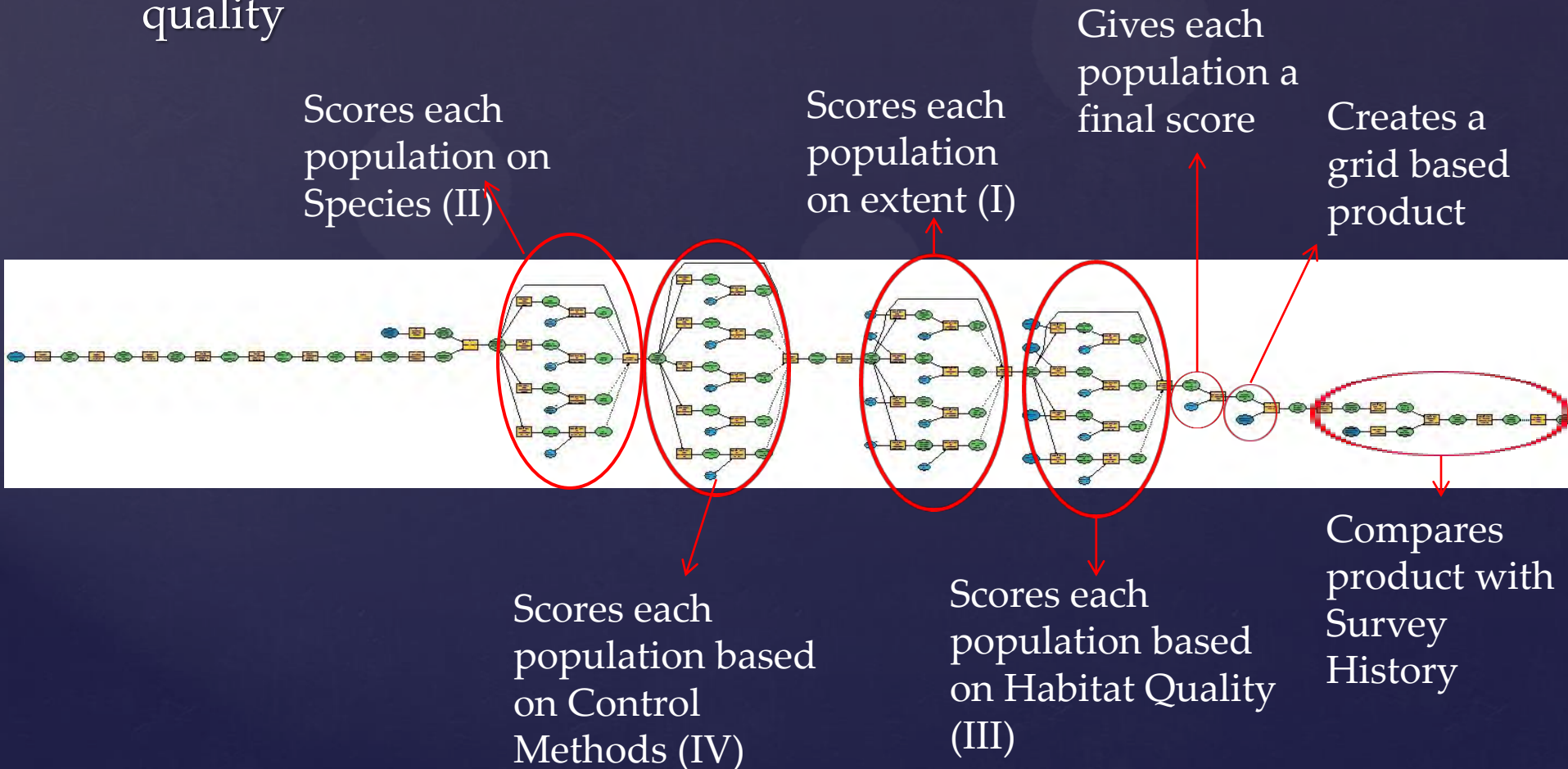


Applications

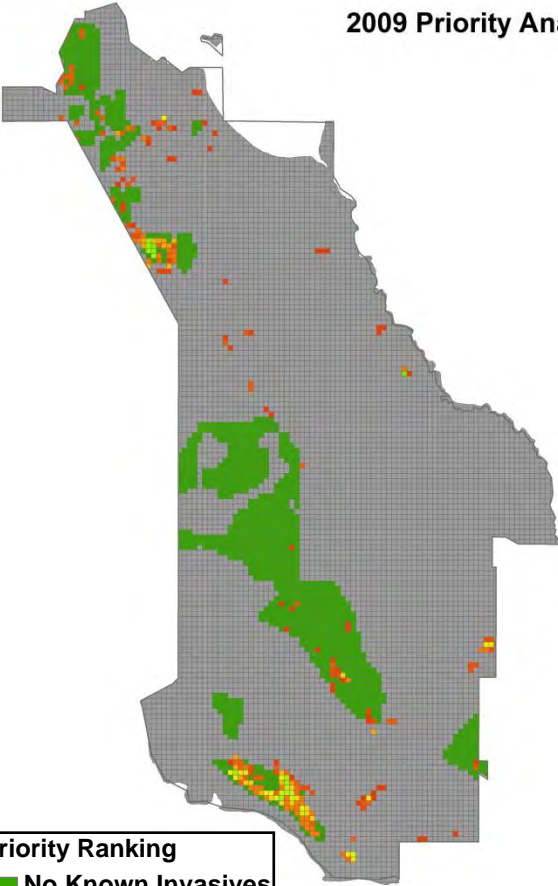
- ⌘ Easily understood maps
- ⌘ Helps maintain institutional memory
- ⌘ Uses data and your preferences to evaluate invasive levels
- ⌘ Evaluate the effectiveness of your treatments

Priority Analysis Model

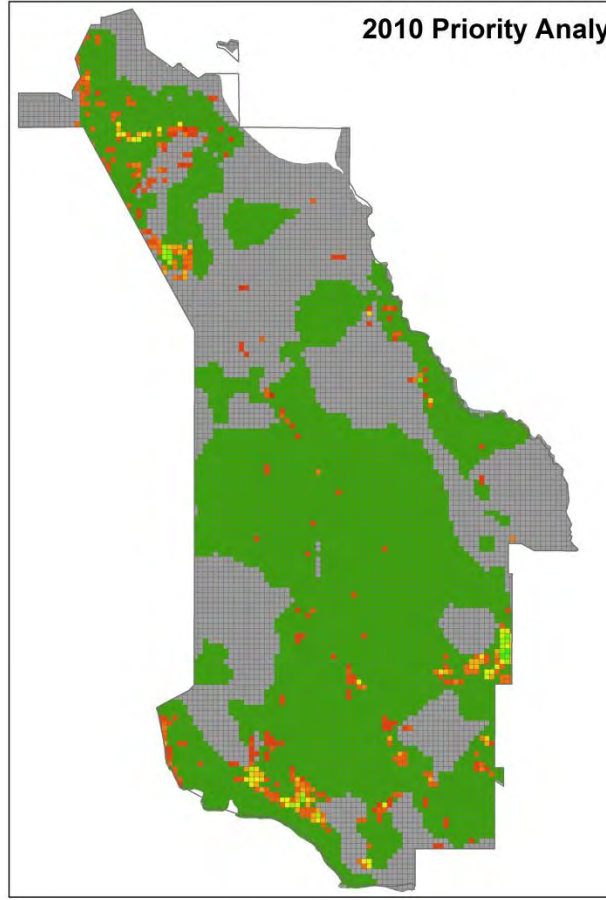
⌘ Based on species, extent, available control methods and habitat quality



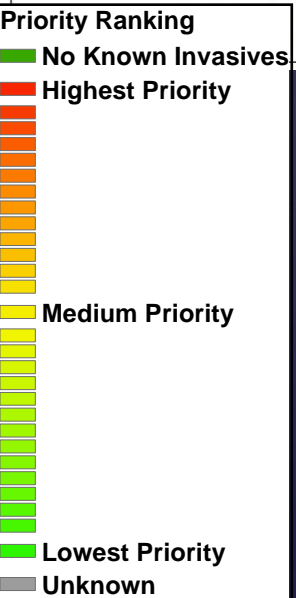
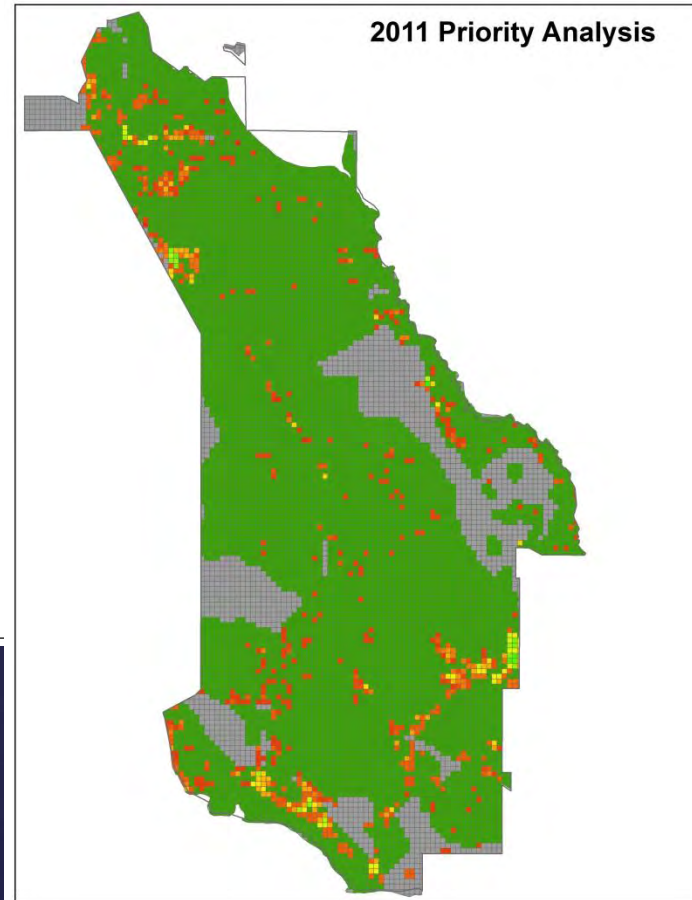
2009 Priority Analysis



2010 Priority Analysis



2011 Priority Analysis

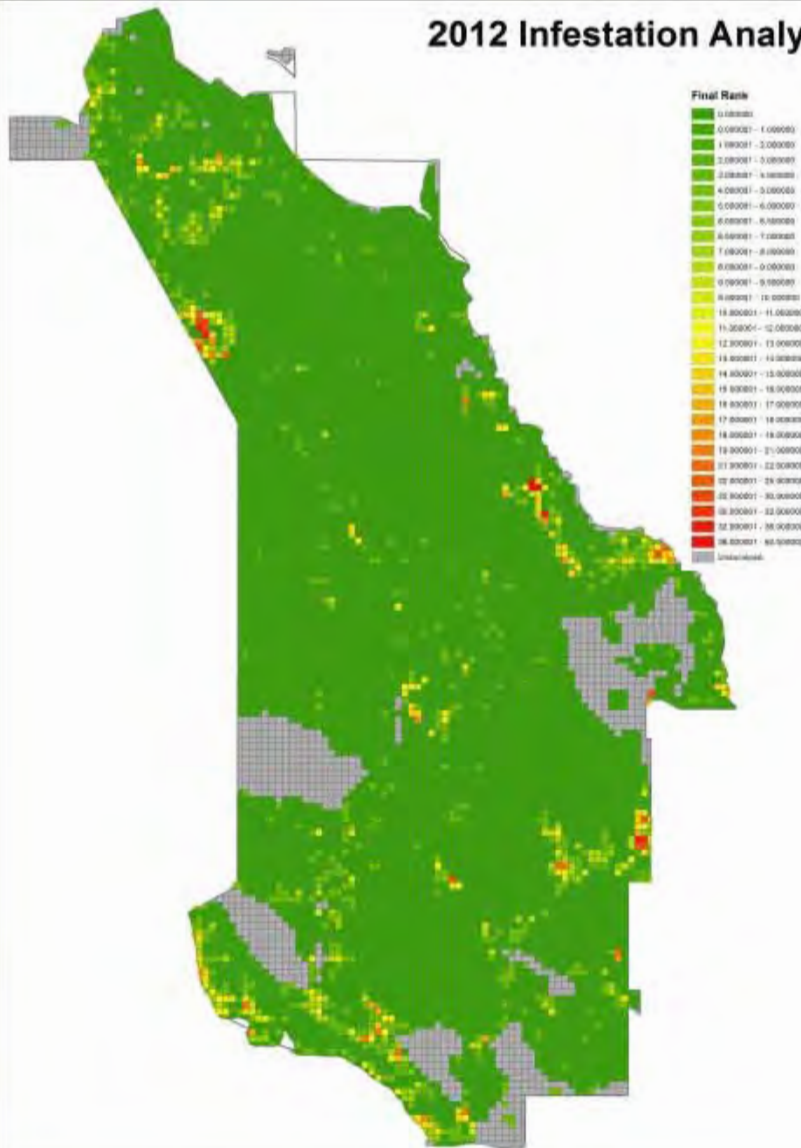


The Nature Conservancy

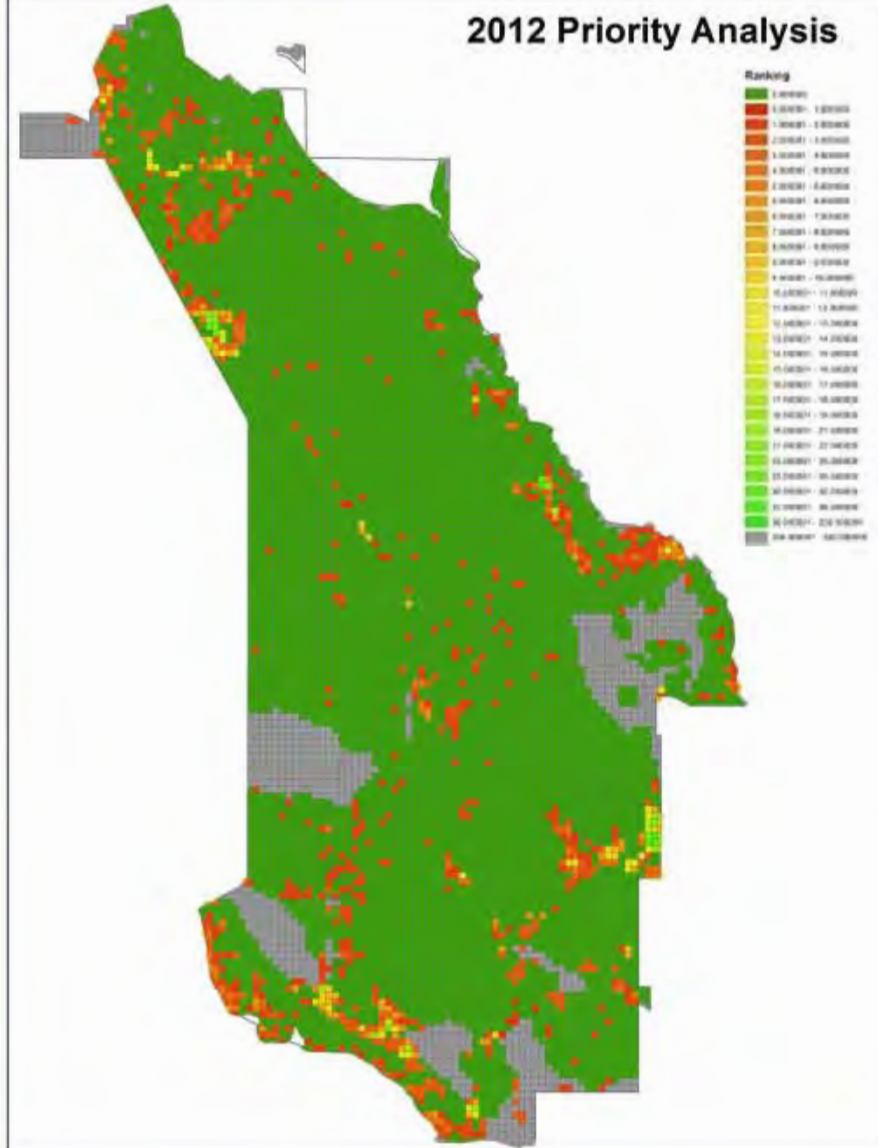


Protecting nature. Preserving life.™

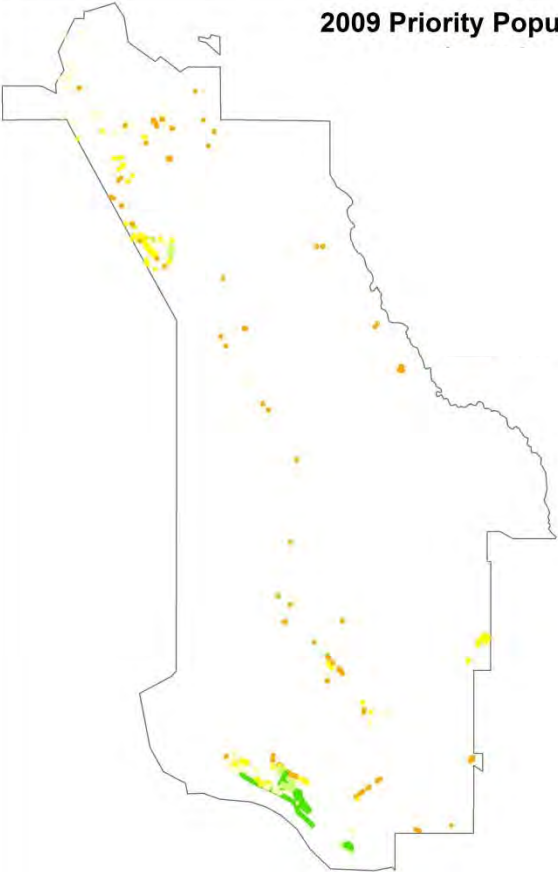
2012 Infestation Analysis



2012 Priority Analysis



2009 Priority Populations

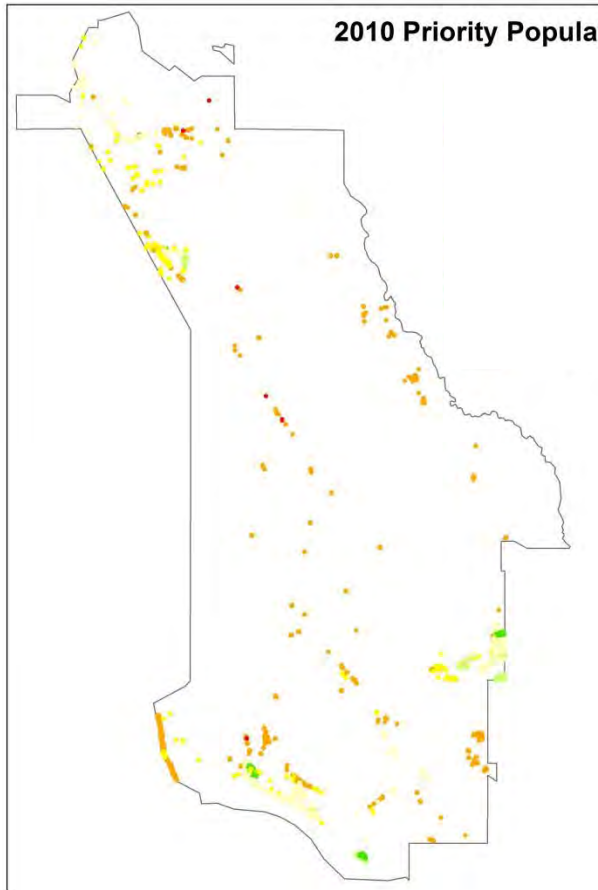


The Nature
Conservancy

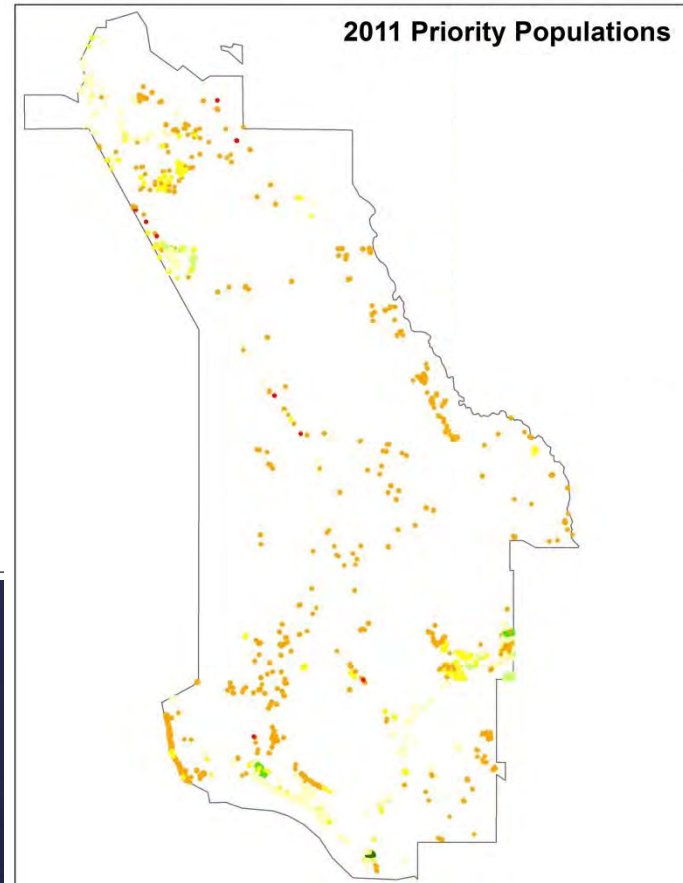


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2010 Priority Populations

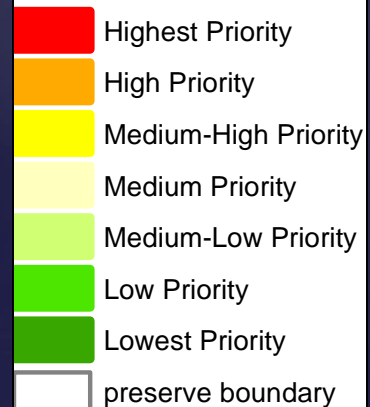


2011 Priority Populations



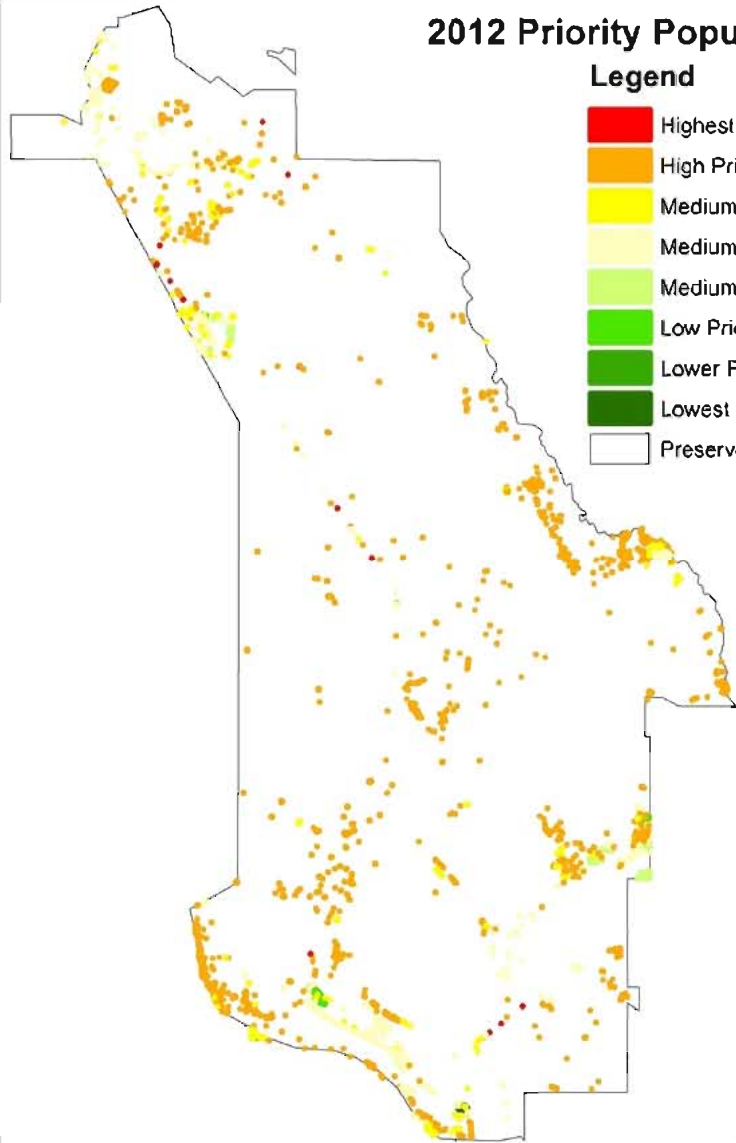
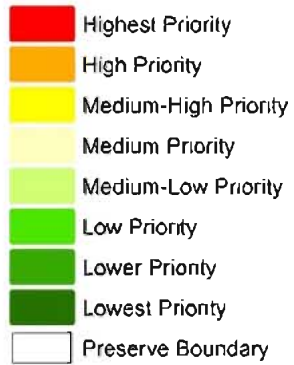
Legend

FINAL_RANK



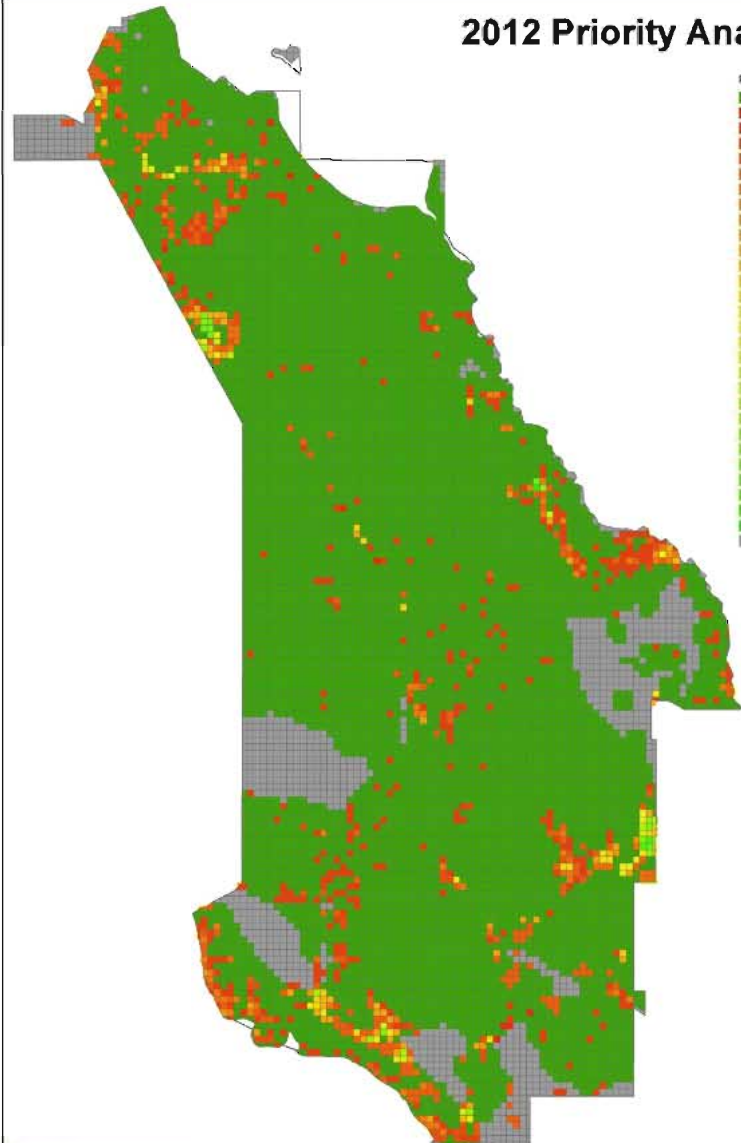
2012 Priority Populations

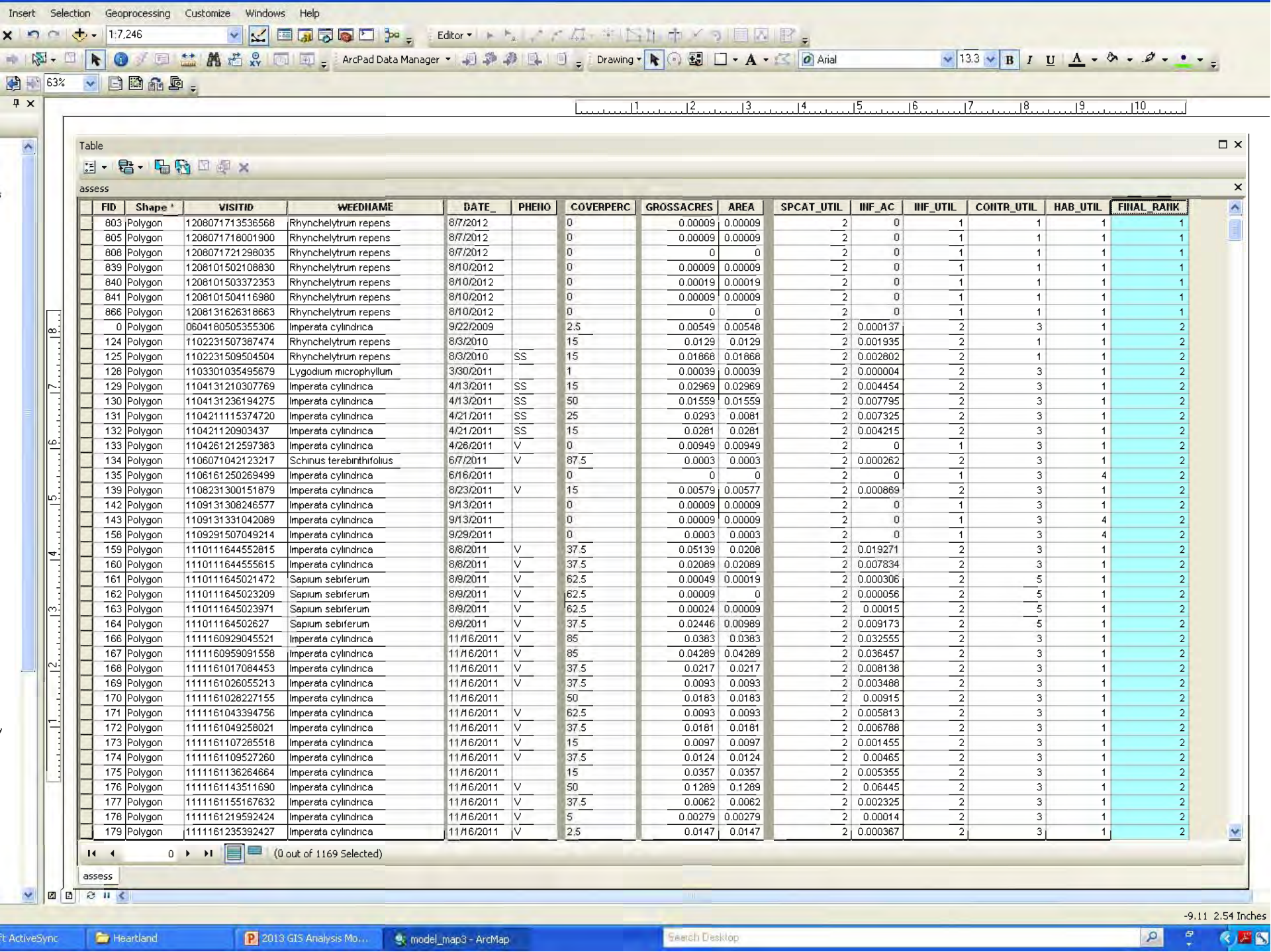
Legend



2012 Priority Analysis

Ranking

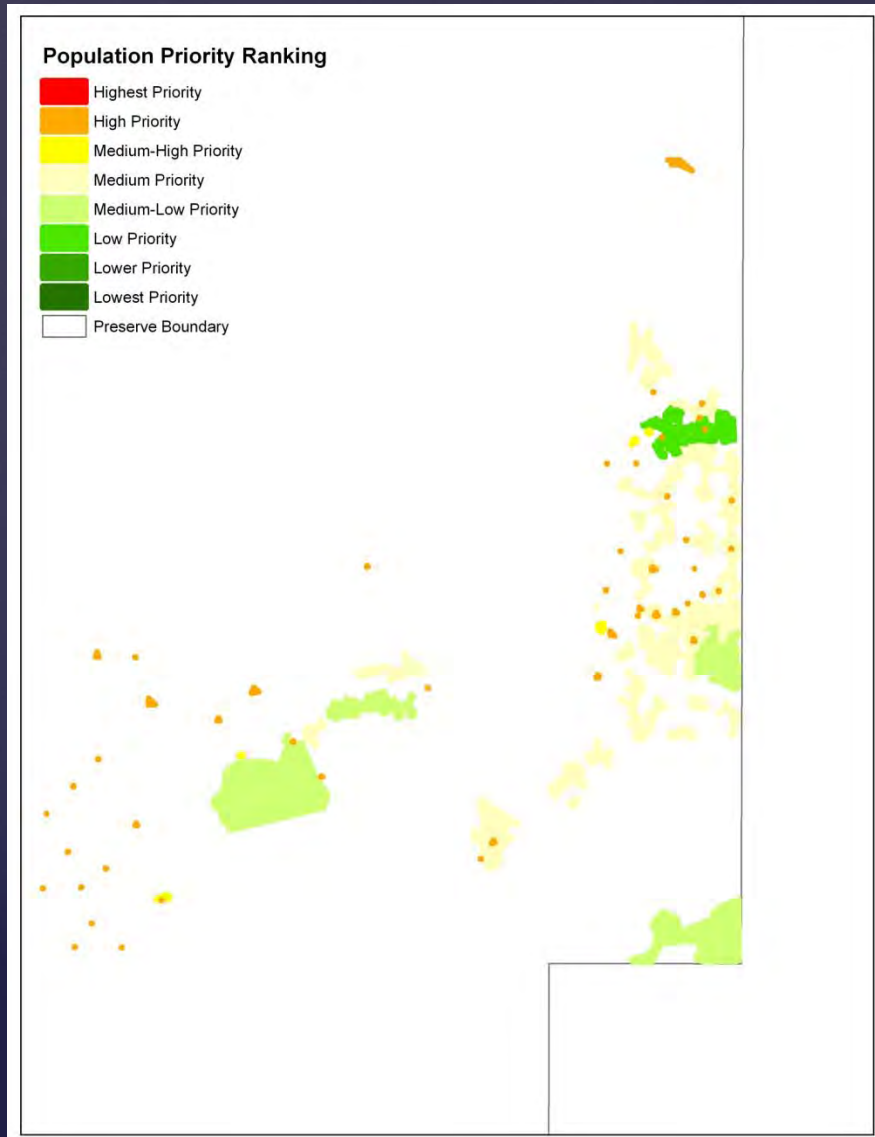




Applications

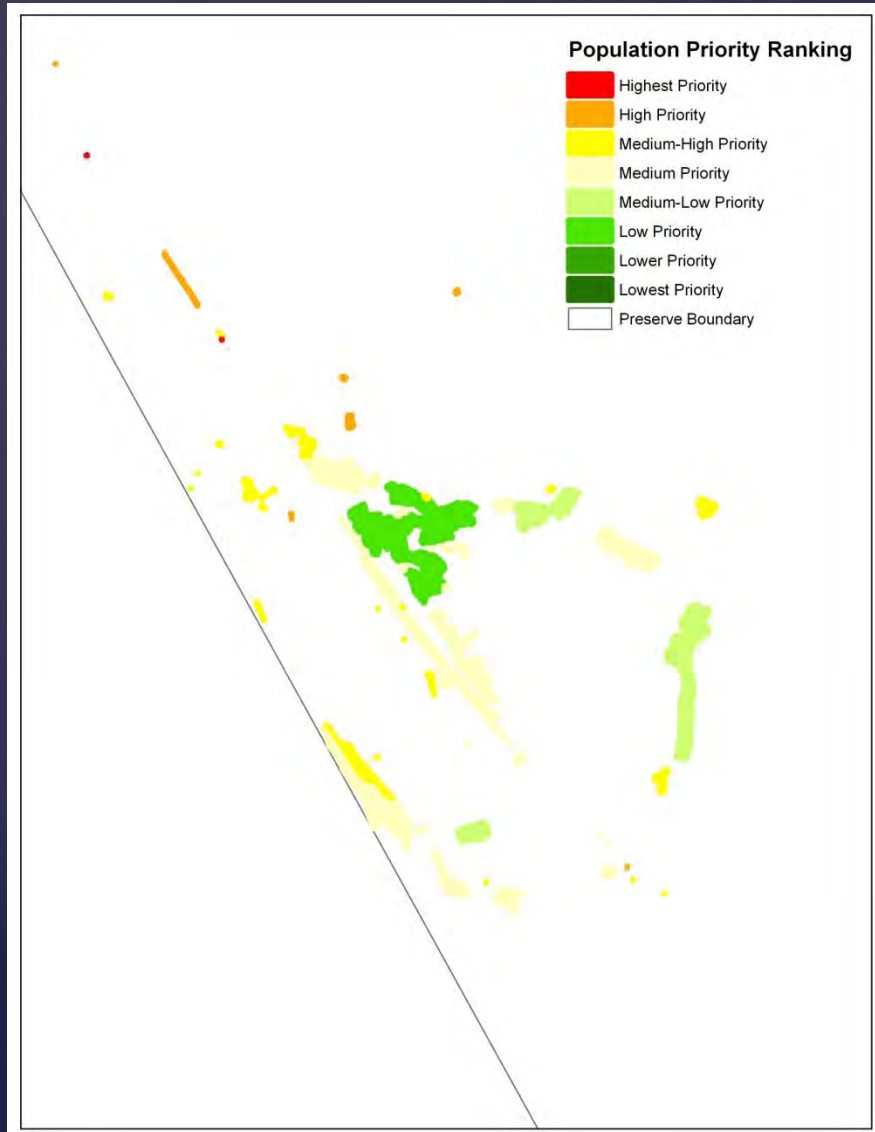
- ⌘ Help create an annual work plan
- ⌘ Application of prioritization scheme directly to individual populations
- ⌘ Better direct treatment efforts
- ⌘ Uses data and your preferences to identify the highest priorities
- ⌘ Re-evaluate prioritization decisions based on available data

Applications



& Re-evaluate
Prioritization Decisions:
⌘ Treatment of Bahia and
Torpedo in a restored
pasture

Applications



Re-evaluate
Prioritization Decisions:
Torpedo Treatment in
a slightly disturbed
marsh

Applications

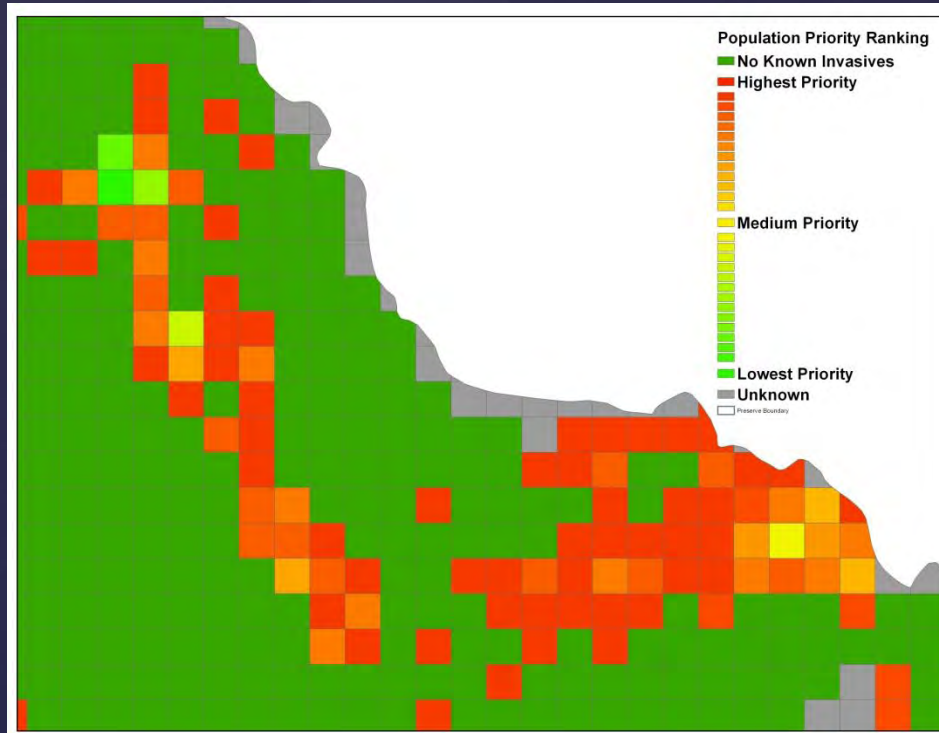
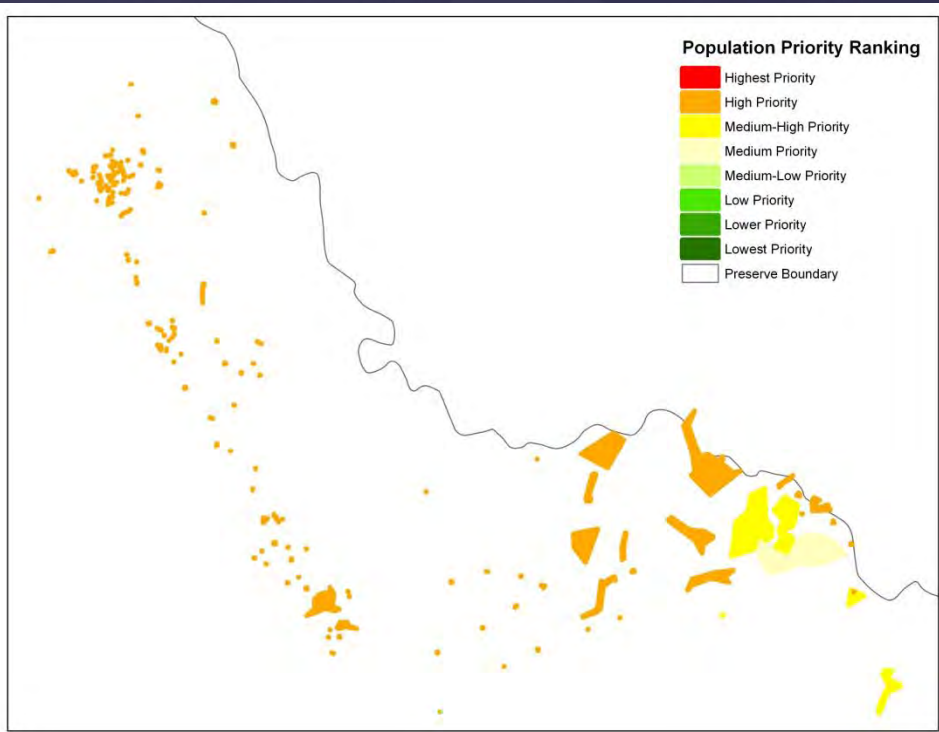
& Better Directed Treatments:

⌘ climbing fern and Chinese
tallow

The Nature
Conservancy



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Use at Apalachicola National Forest

The Nature Conservancy

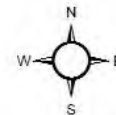
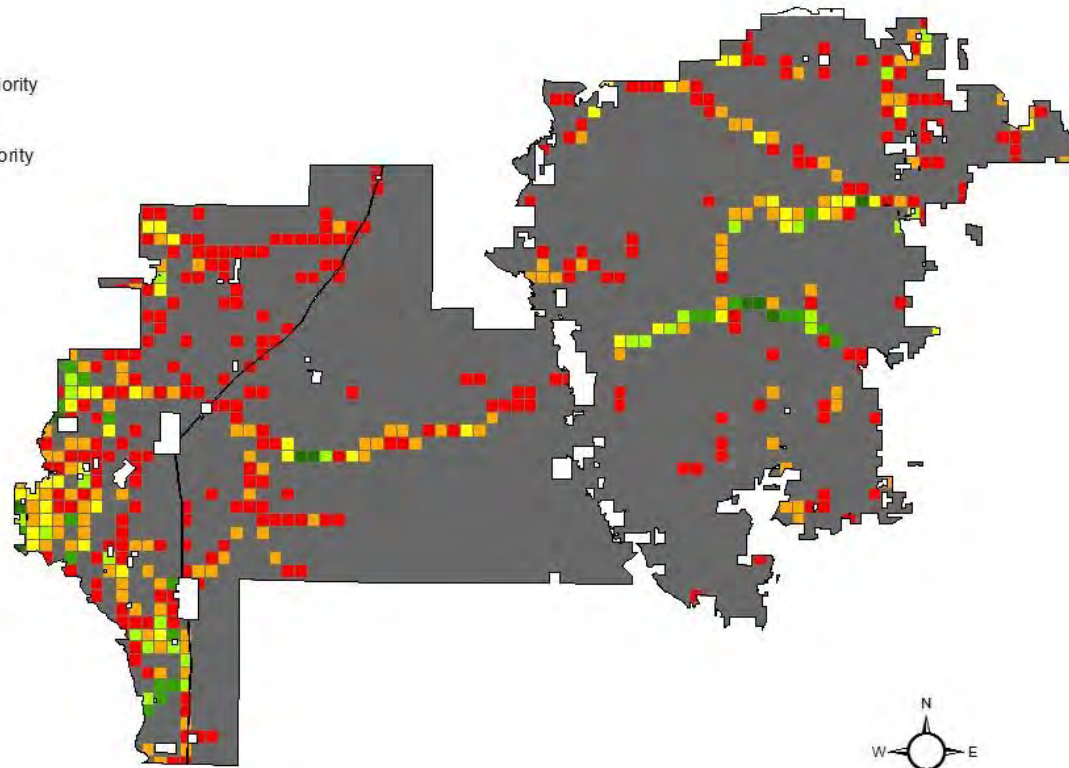


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Draft prioritized 1 sq km grid cells of invasive plants at Apalachicola National Forest, 4/4/13

Final rank

- No data
- Medium-High Priority
- Medium Priority
- Low-Medium Priority
- Low Priority
- Lower Priority
- Lowest Priority
- ANF_boundary



0 10 20 40 Kilometers

Use at Apalachicola National Forest

The Nature Conservancy

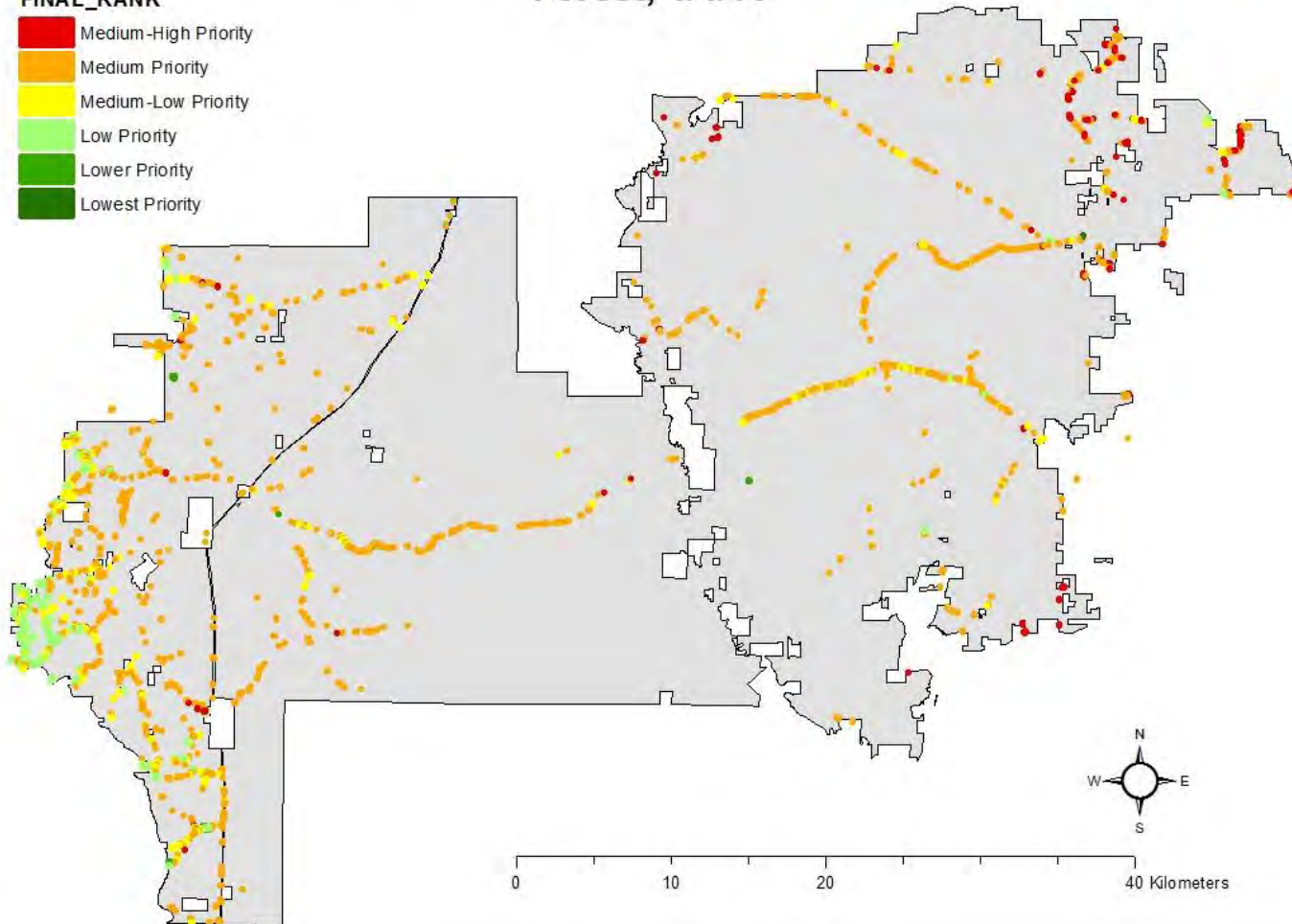


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Draft prioritized populations of invasive plants at Apalachicola National Forest, 4/4/13

FINAL_RANK

- Medium-High Priority
- Medium Priority
- Medium-Low Priority
- Low Priority
- Lower Priority
- Lowest Priority



Use at Apalachicola National Forest



- ⌘ Learning points from application process
 - ⌘ Easy to use
 - ⌘ Great documentation
 - ⌘ Some technical advice needed
- ⌘ How they plan on using the model:
 - ⌘ Add in data on land use
 - ⌘ Increase weight of habitat quality
 - ⌘ Use opportunistic survey methods
 - ⌘ Add 'risk of invasion' field to habitat map

Prioritization Basis for the Model

Setting Priorities

The priority-setting process can be difficult, partly because you need to consider so many factors. We find that it helps to group these factors into four categories that you can think of as filters designed to screen out the worst weeds:

- I. current extent of the species on or near the site;*
- II. current and potential impacts of the species;*
- III. value of the habitats/areas that the species infests or may infest; and*
- IV. difficulty of control.*

Extent

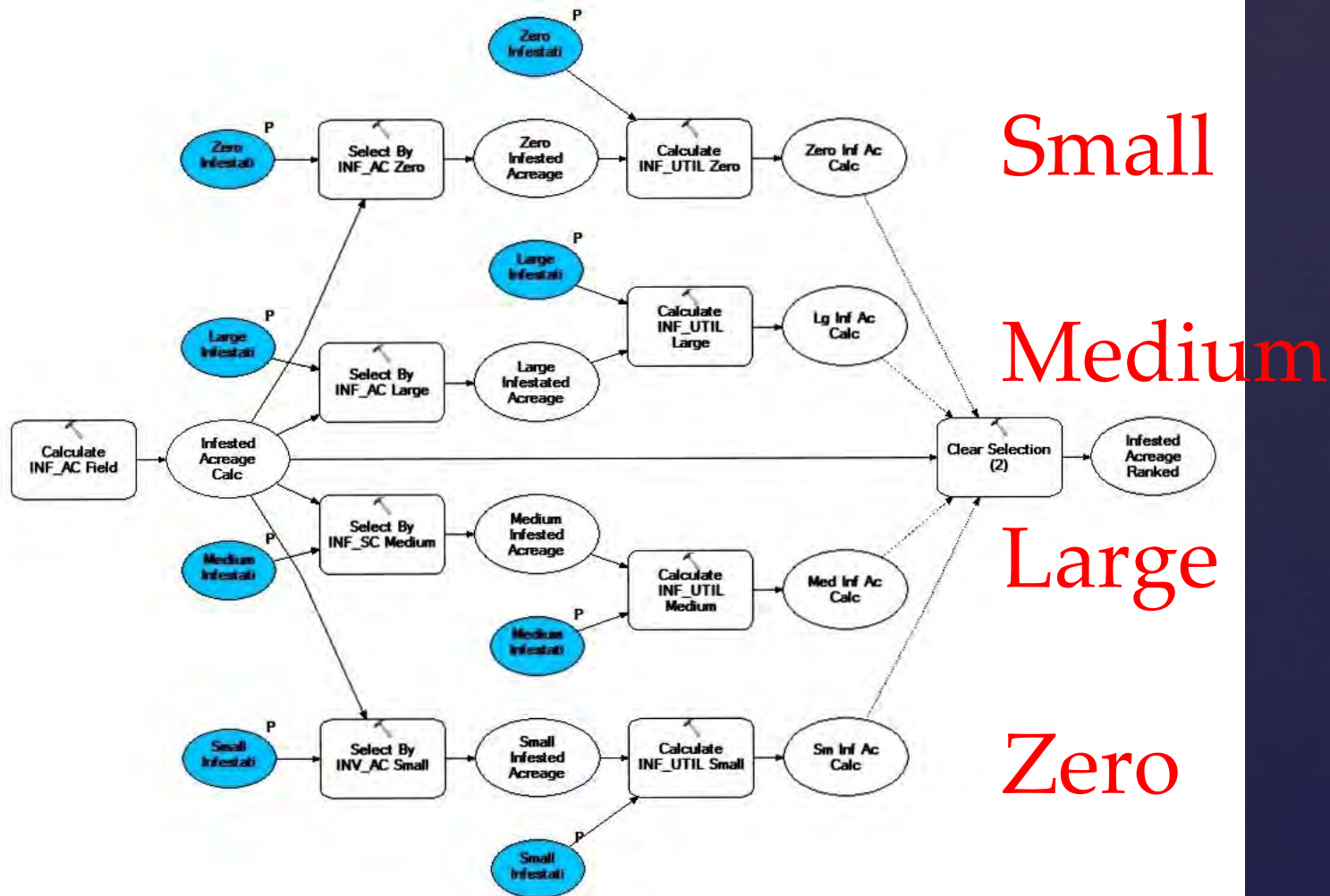
I. Current extent of the species: Under this category, priorities are assigned to species in order to first, prevent the establishment of new weed species, second, eliminate small, rapidly-growing infestations, third, prevent large infestations from expanding, and fourth, reduce or eliminate large infestations.

To do this, assign priorities in the following sequence:

- 1. Species not yet on the site but which are present nearby.** Pay special attention to species known to be pests elsewhere in the region.
- 2. Species present as new populations or outliers** of larger infestations, especially if they are expanding rapidly.
- 3. Species present in large infestations that continue to expand.**
- 4. Species present in large infestations that are not expanding.**

You may have to "live with" weeds/infestations you cannot control with available technology and resources. However, keep looking for innovations that might allow you to control them in the future.

Extent



Species

II. Current and potential impacts of the species: Order priorities under this category based on the management goals for your site. We suggest the following sequence:

1. *Species that alter ecosystem processes* such as fire frequency, sedimentation, nutrient cycling, or other ecosystem processes. These are species that "change the rules of the game", often altering conditions so radically that few native plants and animals can persist.

2. *Species that outcompete natives* and dominate otherwise undisturbed native communities.

3. *Species that do not outcompete dominant natives but:*

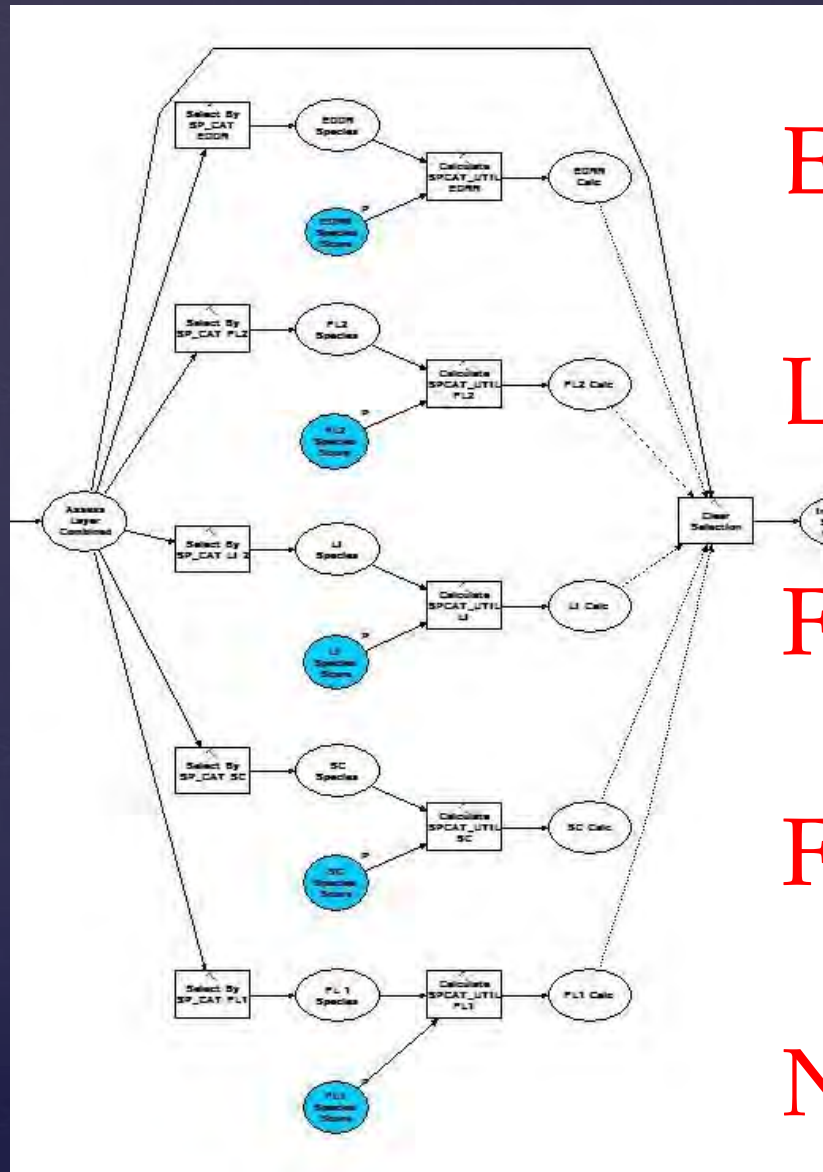
a. prevent or depress recruitment or regeneration of native species (for example, the forest understory weed garlic mustard may depress recruitment by canopy dominants);
OR

b. reduce or eliminate resources (e.g., food, cover, nesting sites) used by native animals; OR

c. promote populations of invasive non-native animals by providing them with resources otherwise unavailable in the area.

4. *Species that overtake and exclude natives following natural disturbances* such as fires, floods, or hurricanes, thereby altering succession, or that hinder restoration of natural communities. Note that species of this type should be assigned higher priority in areas subject to repeated disturbances.

Species



EDRR

Locally Important

FLEPPC Category 1

FLEPPC Category 2

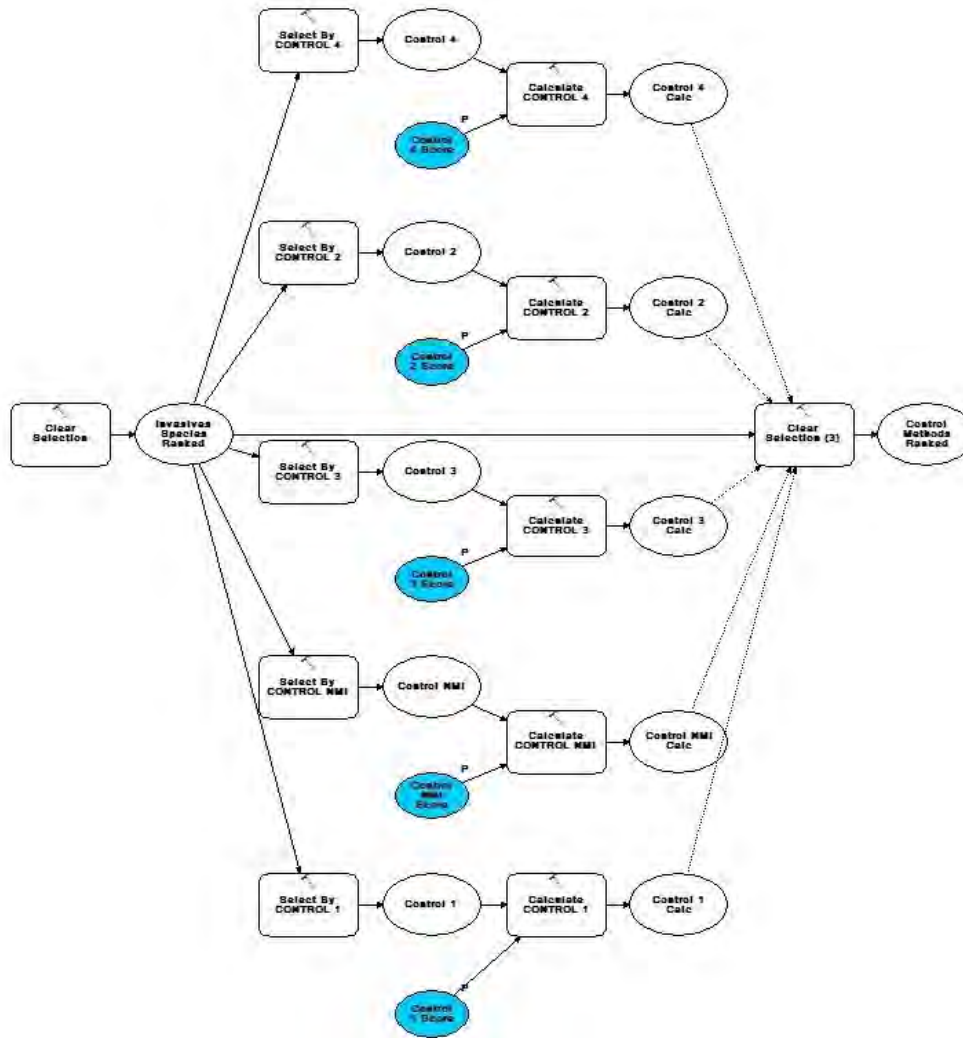
Nuisance Species

Control

IV. Difficulty of control and establishing replacement species: Assign priorities in the following order:

- 1. Species likely to be controlled or eliminated with available technology and resources and which desirable native species will replace with little further input.*
- 2. Species likely be controlled but will not be replaced by desirable natives without an active restoration program requiring substantial resources.*
- 3. Species difficult to control with available technology and resources and/or whose control will likely result in substantial damage to other, desirable species.*
- 4. Species unlikely to be controlled with available technology and resources.*

Control



Same
categories
but added
'Need More
Information'
category

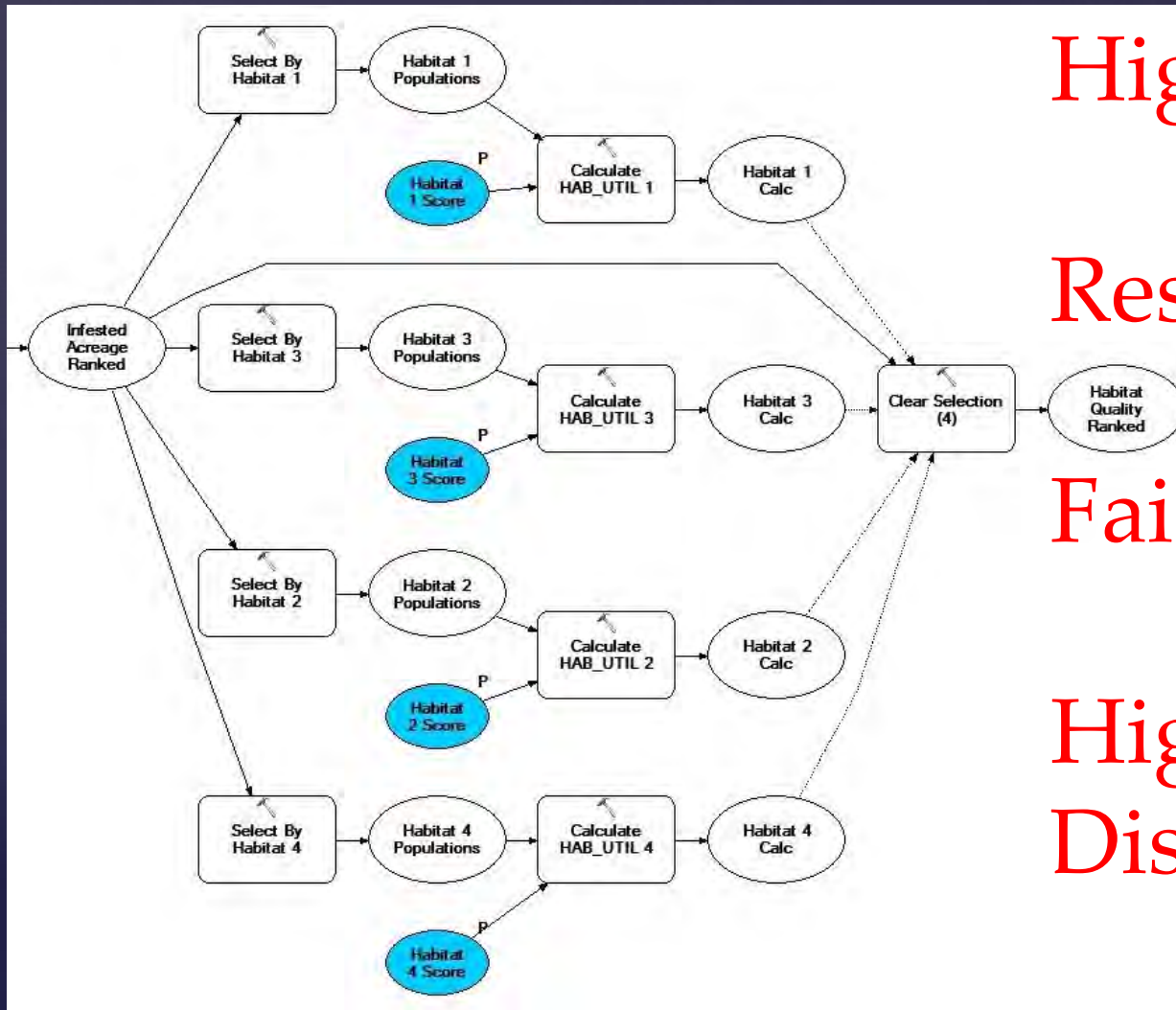
Habitat Quality

III. Value of the habitats/areas the species infests or could infest: Assign priorities in the following order:

1. Infestations that occur in the most highly valued habitats or areas of the site - especially areas that contain rare or highly valued species or communities and areas that provide vital resources.

2. Infestations that occur in less highly valued portions of the site. Areas already badly infested with other weeds may be given low priority unless the species in question will make the situation significantly worse.

Habitat Quality



High Quality

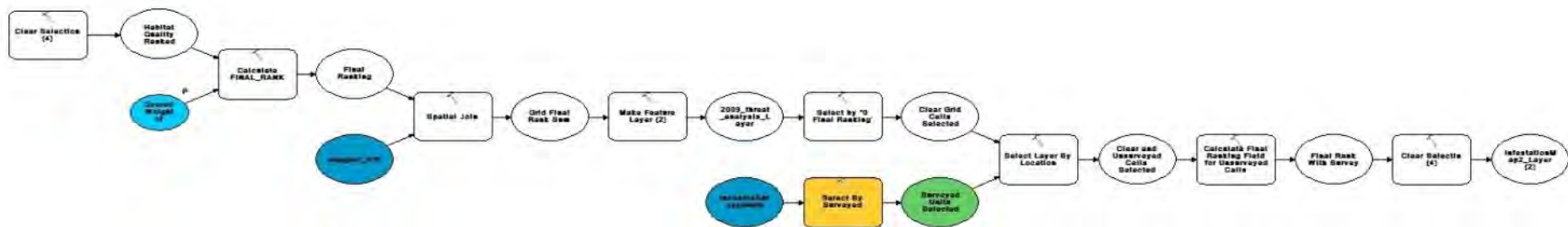
Restored

Fairly Disturbed

Highly Disturbed

Final Calculations

- Final ranking based on these 4 characteristics
 - Are some more important than others?
- To survey or not to survey?



Important

- ⌘ Customizable to YOUR preserve, YOUR needs, YOUR invasives
 - ⌘ Document your ranking system
- ⌘ Model is only as good your data
- ⌘ Requirements to use this model:
 - ⌘ Invasives, Habitat Map (and Survey) GIS data files
 - ⌘ ArcGIS software with basic licensing
 - ⌘ A few days to review and customize
- ⌘ NOW, EXACTLY WHAT WOULD WE NEED TO DO TO USE IT?



GreatAnalysisV1.1pt1\InvasivePriorityAnalysisV1.1

Contents Preview Description

Print Edit

Usage

Files you'll need to run the model

- One polygon shapefile containing all your invasives data
 - To add your shapefile to the model, first add it to the ArcMap document. Then open the model editor, double click the first step ("Add SPCAT_UTIL Field") and select your file from the drop down menu for "Input Table."
 - If you want to show the true change over time in the infestation level of your preserve, you will need to make sure your shapefile contains the most recent polygon for all known populations. If you have not been able to revisit a certain population within the last year, you cannot say for certain that it is gone; so excluding it may not accurately reflect its true status. This is one benefit of the Wisconsin Invasive Species Information Management System (WIMS) database, as it facilitates tracking individual populations over time.
- The Plants Table included with the model
- A grid shapefile of your preserve
 - You will need Geospatial Modeling Environment (formerly known as Hawth's Tools - the steps are very similar) to create a grid file in the shape of your preserve. From the Commands drop down menu, select "Sampling Tools," and then "Generate Vector Grid." This will give you the required code and descriptions for the needed inputs. Begin typing the code into the box and it will bring up automatic selections. Choose the appropriate code (genvecgrid...). For the Extent, choose a boundary shapefile for your preserve. In the Dimensions section, enter the value that you wish for the width of each side of the cell. Under Output, name the new file and choose the appropriate projection if necessary. There are several examples listed in the program on which you can base your code. Once the grid file is created, you will need to clip it to your property boundary using the Clip tool found in the Analysis tool box. Use the shapefile of the entire preserve boundary to create your final grid. Add the file to your map in ArcMap. Finally, double click the Spatial Join element in the model and in the drop down menu for Target Feature, select your final grid shapefile. Also, in the "Field Map" box, right click on the "Final Rank" and make sure that the "Merge Rule" is set to "Sum." Also ensure that the "Keep All Target Features" box is checked.
 - Try making a few different sizes of cells for your grid shapefile, running the model and seeing which gives the best results. We tried 75 m, 100 m, and 125 m and decided to use the 75 meters for our product (for reference, the preserve is 12,000 acres).
- A community map of your preserve
 - Make a copy of a community map of your preserve and add a field for Habitat Quality. You will then need to rank each polygon according to the current system (see the parameter explanations for "Habitat_X_Weight" for more information) or create an alternate system that better suits your site. After ranking each community/polygon, select by each rank and export the selection as a new shapefile named for that class. Add each shapefile to the map and then to the corresponding "Select by Habitat X" tool in the model.
- A survey history shapefile for your preserve (optional)
 - Without surveys of a particular area, we cannot say that it is clear of invasives. If you do not already have a protocol for surveys, now is a good chance to give it some thought. In the meantime, there are many different resources you could use to create some sort of survey history for your preserve- GPS tracklogs, workday report forms, or even hand drawn maps. However, the model can be run without this data by simply deleting the relevant elements.

What you'll need to review or edit

- Review the rankings in the Plants List (species and control)
 - The Plants List contains two columns that will need to be reviewed before adding it to your model. First is the Invasives Species ranking (see "X_Species_Score" parameter explanation for more information on the current categories). You can change the different available rankings and which ranking is assigned to each species; add or delete species; etc.
 - Second is the ranking of available Control Methods for each species (see "Control_X_Score" parameter explanation for more information on the current categories). You may want to use a different ranking system or to modify the ranks given to particular species.
 - Please review the Plant List and modify it to suit your site's needs and document accordingly.
- Create size rankings for your populations
 - The different Acreage Class rankings are parameters and can easily be changed each time the model is run, but you may want to consider different methods of classification initially. There are many different ways to determine the breaks for your size classes. In the "Layer Properties" dialog box for your invasives shapefile, go to the "Symbolology" tab and in the "Show" box on the left, choose "Quantity" and "Graduated colors." In the "Fields" box, choose the gross or infested acreage field from the "Value" drop down box. Click the "Classify" button to choose between the different classification techniques and number of classes. I chose the Natural Breaks method and three classes. This will give you the ranges that need to be entered for your different Infested Acreage Classes. If you are comparing multiple years or sites, it is a good idea to find breaks that work for all the data involved so you can use one system to compare year to year or site to site accurately.
- Gross acreage and Infested acreage
 - If your shapefile does not already contain a gross acreage column, it can be added to your shapefile using the X-Tools Pro add-on. From the drop down menu, select "Table Operations" then "Calculate Area"



vasive GIS AnalysisV1.1.tbx\InvasivePriorityAnalysisv1.1

Contents Preview Description

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As explained in other sections, the rankings for Invasive Species, Control Methods and Habitat Quality are not parameters and need to be determined outside of the model editor/running the model. The rankings can be changed fairly easily if you want to compare different scenarios. The rankings for Acreage, the scores of all rankings and the overall weights of each characteristic are all parameters.

What you might need to edit

- Ranks and Scores
 - You might decide to change the number of rankings for one or more of the characteristics in the model (Invasive Species Categories, Control Methods, Acreage Classes or Habitat Quality). You will need to edit the model accordingly. If you chose to add or delete rankings, you will need to add or remove the appropriate steps. Adding can easily be done by selecting all of the steps for one of the rankings and simply copying and pasting. Each item will need to be appropriately renamed, of course. Delete by selecting all of the steps for the appropriate ranking, right click and then select "Delete" (rename items if necessary)."
 - For Invasive Species and Control, you will need to edit the scoring section of each in the model editor (as well as separately modifying the data contained within the Plants List).
 - For Habitat Quality, you will need to edit the scoring section of each in the model (as well as separately modifying the data contained within your community shapefile).
 - For Acreage Classes, the limits of each size class are parameters (they can be changed when the tool is run in ArcMap); therefore you do not have to change them here in the Editor. See the page for an explanation of "X_Infestation_Selection" to learn how to determine how many size classes you want and what their limits should be.
- Symbology of Final Product
 - To get comparable products from year to year or property to property, it is a good idea to come up with one symbology system and use it for every project. Feel free to use the symbology layer I came with this tool or create your own. The included layer was created using the Graduated Colors choice in Quantities and using Final Rank for the Value. I originally used the Natural Breaks method with 32 classes to get the baseline breaks and then edited it as a Manual method as follows: the color ramp is "red to green" with zero being changed to the darkest green and the unsurveyed (no data) cells given a rank of 500 in the model) being changed to grey.

Common Problems and their Solutions

- Naming of invasives shapefile and subsequent queries
 - One of the most frequent problems that prevents the model from running properly is naming of the associated files. The model is designed so that the invasives shapefile is named "assess." If you are working with different years, preserves, etc., the system I have found to work best is to create a new folder for each project and place the invasives shapefile re-named assess (as well as the associated products) in this folder. This will allow you to run the model using a variety of inputs with minimal work in between. The most common steps to have this issue are the Calculate Field Names tool, Select By tools and the Spatial Join.
- Select by Survey Year
 - If you do not collect survey history data, you can delete everything from the "Make Feature Layer (2)" step on. However, I highly recommend keeping some kind of survey data, as one cannot tell if an area is clear of invasives if it has not been checked.
 - If you do take survey data, you must change the expression in the Select by Survey Year tool each time you re-run the model with new data.
- Designating location and name of final file
 - It is important to ensure that the correct output folder is listed in the Spatial Join tool as this will decide where your final product ends up and what it is named. Re-running the model without changing this file location and name can result in the previous output being overwritten and lost. Also, ensure that in the Field Map box, you choose FINAL_RANK, right click and for Merge Rule, select Sum of Values. You will also need to make sure all the tools following this step contain the appropriate file names as well. Also make sure that the "keep all" box is checked.
- Habitat quality selection
 - Occasionally some polygons will be left out during this selection process, especially if you are working with a large data set. To reduce or eliminate this possibility, ensure that all shapefiles are in the same projection. You may also need to modify which relationship method is used for the "Select by Location" steps. It is currently set to 'intersects' but another method may provide you with better results. Some polygons might still be left out; find which method minimizes this number and then you may have to fill the rest in manually.
- Saving the final grid based file
 - Sometimes the final product will disappear when I continue working with the same model and a different file. What I have found to work in making the grid based shapefile "permanent" is to save the model once it has run, and to add the file to ArcMap and save the map document.

Syntax

InvasiveAnalysisModel532 (LI_Species_Score, FL1_Species_Score, FL2_Species_Score, SC_Species_Score, Medium_Infestation_Selection, Small_Infestation_Selection, Large_Infestation_Selection, Large_Infestation_Score, Medium_Infestation_Score, Small_Infestation_Score, Overall_Weight_of_Parameters, Control_NMI_Score, Control_1_Score, Control_2_Score, Control_3_Score, Control_4_Score, Zero_Infestation_Selection, Zero_Infestation_Score, Habitat_4_Score, Habitat_3_Score, Habitat_2_Score, Habitat_1_Score, EDRR_Species_Score)



vasive GIS AnalysisV1.1.tbx\InvasivePriorityAnalysisv1.1

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Parameter	Explanation	Data Type
LI_Species_Score	<p>Dialog Reference</p> <p>This is the weight given to the Invasive Species ranking "Locally Important"- those species we determined to be the biggest potential threats at our preserve. This designation can be found in the Plant List. These species get the second lowest score because they have the greatest potential to negatively impact the preserve.</p> <p>There is no python reference for this parameter.</p>	SQL Expression
FL1_Species_Score	<p>Dialog Reference</p> <p>This is the weight given to the Invasive Species ranking "FLEPPC Category 1"- those species listed as Category 1 invasives by the Florida Exotic Pest Plant Council, excluding those already designated as Locally Important. This designation can be found in the Plant List.</p> <p>There is no python reference for this parameter.</p>	SQL Expression
FL2_Species_Score	<p>Dialog Reference</p> <p>This is the weight given to the Invasive Species ranking "FLEPPC Category 2"- those species listed as Category 2 invasives by the Florida Exotic Pest Plant Council. This designation can be found in the Plant List.</p> <p>There is no python reference for this parameter.</p>	SQL Expression
SC_Species_Score	<p>Dialog Reference</p> <p>This is the weight given to the Invasive Species ranking "Special Concern"- those species we determined to be minor nuisances at our preserve but wanted to collect more information on. This designation can be found in the Plant List. These species get the highest score because evidence indicates they do not tend to compete well and therefore will not have a large impact the preserve.</p> <p>There is no python reference for this parameter.</p>	SQL Expression
Medium_Infestation_Selection (Optional)	<p>Dialog Reference</p> <p>This selects populations with a moderate infested acreage. See the Usage section for more information on determining these size limits.</p> <p>There is no python reference for this parameter.</p>	SQL Expression
Small_Infestation_Selection (Optional)	<p>Dialog Reference</p> <p>This selects populations with a small infested acreage. See the Usage section for more information on determining these size limits.</p>	SQL Expression

& Any Questions?

& More info: Contact me at debi.stone@tnc.org