



Habitat Priority Planner:

Enhancing Participatory GIS in Conservation Planning

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August, 2008

Habitat Priority Planner Overview and Introduction

Background

The Habitat Priority Planner (HPP) tool was developed by the NOAA Coastal Services Center (the Center) and released to the public on September 15th, 2007. HPP is a spatial decision support tool designed to assist users in the prioritization of important areas in the landscape or seascape for conservation or restoration action. It is a map-based planning tool designed with stakeholder engagement in mind. Use of the tool is intended to bring greater confidence in decisions by increasing the level of transparency, objectivity, and repeatability in the decision-making process.

The development of the HPP tool represents over four years of work in tool design, testing, and research. In 2003, the Center, in close partnership with the Great Lakes Commission, developed the Integrated Coastal Management (ICM) tool, the immediate predecessor to the Habitat Priority Planner. Lessons learned from user experience with the ICM tool, in addition to new information gleaned from the review of over 230 existing spatial decision support tools, informed the design and development of the Habitat Priority Planner.

Although HPP can be used with a limited knowledge of Geographic Information Systems (GIS), the most accurate interpretation of analysis results requires a full understanding of the concepts and limitations of **landscape ecology** and **ecological spatial** analysis. This can be accomplished either by the user having sufficient professional spatial analysis knowledge or working with a professional who has specific knowledge. Ideally a team of experienced users with varied skill sets would collaborate in the use of HPP to generate habitat priorities and guide the operation of the tool.

Software Concept

HPP was created as a toolbar for the Environmental Systems Research Institute's (ESRI) ArcGIS and designed to help planners, ecologists, and coastal managers make and prioritize decisions about habitat restoration and conservation. HPP is composed of three modules: Habitat Classification, Habitat Analysis, and Data Exploration. The tool calculates basic ecological statistics that are used to examine how habitats function within a landscape. The tool pre-packages several useful ecological metrics into a user friendly interface to serve intermediate GIS users. In addition, HPP allows the user to interactively build queries using a graphical interface to demonstrate criteria selections quickly in a visual manner that is useful in stakeholder interactions.

Examples of applications:

- Screening-level assessments of habitat for habitat restoration, land conservation, and general resource planning
- Results that are consistent, repeatable, and transparent
- Assess and inventory site-specific issues and conditions

- Utilize interactive mapping and prioritization
- Provide spatial support to natural resource strategic planning efforts
- Identify and rank potential restoration and conservation sites
- Analyze “what if” scenarios for proposed changes in land use or land cover
- Create maps, reports, and data tables

Three Modules of the Habitat Priority Planner

1. Habitat Classification

The Habitat Classification module uses raster land cover data to create classified habitat “patches” based on the user’s needs. The term “patch” refers to an individual polygon of a particular habitat, such as wetland or deciduous forest, as defined by the land cover layer and classification scheme used. Land cover types may be assessed individually, grouped together in a logical format, or simply classified as habitat and non-habitat for analysis. The result is a polygon feature-class layer that allows users to view the habitats they wish to consider in their area. Habitat classification will differ between users and sites based on project goals and objectives.

HPP has a companion ArcToolbox tool and script for incorporating existing vector data directly for use within the second module. This script prepares the data by adding attribute columns used within the core and custom analyses. The script was developed for users that had previously identified habitat patches through other channels such as head’s up digitizing of orthophotos of field GPS data collection.

- Outputs: Habitat Patch File

Define Land Use Change Scenarios

The habitat classification module contains an optional step that allows for the definition of land use change scenarios. Using a supporting polygon dataset, this module gives users the ability to create “what-if” scenarios that update the land cover data. For example, a parcel dataset can be used to define new land cover changes based on future growth patterns of a study area. If the user chooses this step, the resultant patch file will contain the user defined classification scheme *and* the post-change state of the landscape (see page 22 for more information on land use change scenarios).

- Optional Outputs: Habitat Patch File with Land Use Scenario Change

2. Habitat Analysis

The Habitat Analysis module pre-packages several important ecological measures into a wizard interface. This second module uses the habitat patch file created in the first step to run “core analyses,” which include: core area, perimeter-area ratio, proximity, and nearest neighbor. These basic ecological analyses may provide insight on how each patch of habitat may function as part of a larger landscape. Additionally, HPP can be

used to perform “custom analyses,” which considers habitat patches against features in the landscape that can be captured as a point, line, or polygon file. Examples of such ancillary features include roads, land ownership parcels, streams, or nesting sites (see page 26 for more on Habitat Analysis).

- Output: Habitat Analysis Patch File
- Optional Output: Habitat Priority Planner Report

3. Explore Data

The Explore Data module provides an interactive method for exploring, querying, and visualizing patch attribute data. Users can choose a field for analysis, view an associated histogram, and observe basic statistics related to the selected field. This will allow the user to quickly visualize the distribution of the data. Using the histogram, the user can interactively select data pertaining to a specific range of values. The patches (individual polygons) corresponding to the selected data range are then highlighted on the map.

In the advanced mode of the Explore Data component, queries can be constructed using a selected range of data in the histogram. This process can be repeated on multiple fields, using “AND” and “OR” constructors, until the desired query has been established. The histogram is updated showing the data distribution of the selected features. When a user is finished creating a query, a new data layer can be created matching the query criteria using the “Save As...” button (see page 38 for more detail on Data Exploration).

- Output: Prioritized Habitat Layer
- Output: Selection Query Definition

Using the Tool

System Requirements

Below is listing of the system requirements for HPP. If users import vector patch data using the HPP companion ArcToolbox tool, the Spatial Analyst extension is not required.

- ESRI's ArcGIS: Minimum version: 9.2 with Service Pack 3
- Spatial Analyst Extension
- Microsoft .NET Support for ArcGIS
- Microsoft .NET 2.0 Framework

Installing the Tool

The Habitat Priority Planner may be downloaded from the Coastal Services Center Web site at the following location: www.csc.noaa.gov/hpp/.

Data Requirements and Format

1. Required

- Raster land cover data
 - The raster must have a *numeric value field* and an associated *text description field* (see Figure 2).
- File geodatabase
 - This will be used to store outputs.

OID	Value	Count	Red	Green	Blue	Class_name	Opacity
0	0	0	0	0	0	Background	0
1	1	0	0	0	0	Unclassified	1
2	2	111133	0.95	0.95	0.95	Developed, High Intensity	1
3	3	568145	0.67	0.62	0.67	Developed, Medium Intensity	1
4	4	882498	0.57	0.47	0.51	Developed, Low Intensity	1
5	5	307269	0.76	0.8	0.24	Developed, Open Space	1
6	6	2314506	0.35	0.14	0	Cultivated Crops	1
7	7	2015558	0.76	0.64	0.32	Pasture/Hay	1
8	8	891680	0.95	0.74	0.55	Grassland/Herbaceous	1
9	9	17261649	0	0.95	0	Deciduous Forest	1
10	10	21100557	0	0.24	0	Evergreen Forest	1
11	11	29227785	0.04	0.64	0.24	Mixed Forest	1
12	12	7474857	0.44	0.44	0	Scrub/Shrub	1
13	13	5934723	0	0.38	0.38	Palustrine Forested Wetland	1
14	14	2047410	0.95	0.44	0	Palustrine Scrub/Shrub Wetland	1
15	15	1219157	0.95	0	0.95	Palustrine Emergent Wetland	1
16	16	0	0.99	0.99	0	Estuarine Forested Wetland	1
17	17	399	0.44	0	0.44	Estuarine Scrub/Shrub Wetland	1
18	18	131070	0.7	0	0.7	Estuarine Emergent Wetland	1
19	19	264307	0	0.95	0.95	Unconsolidated Shore	1
20	20	472857	0.95	0.95	0	Bare Land	1
21	21	13825088	0	0	0.44	Open Water	1
22	22	7863	0	0	0.93	Palustrine Aquatic Bed	1
23	23	113496	0.85	0.44	0.84	Estuarine Aquatic Bed	1

Figure 2. Example raster layer attribute table with required fields highlighted.

2. Supporting Data

Support data can be a point, line, or polygon datasets that might help define your habitat or answer your questions.

Examples of Supporting Data:

Point Data Layers

- Threatened and endangered animal and plant species
- Critical vegetation
- Community-defined values (e.g., points of historical interest)
- Outfalls (e.g., pollution, treated effluent)
- Invasive species
- Important structures (e.g., schools, churches, shelters)
- Organism population study points
- Water-quality sampling point data

Line Data Layers

- Hydrologic data
- Roads
- Streams
- Elevation
- Sampling transects

- Utilities

Polygon Data Layers

- Parcel data
- Wildfire management
- Land-use types
- Zoning
- Model outputs
- Forecast outputs – threat ratings
- Communities and habitats
- Recreational use areas
- Impervious surfaces
- Flood zones
- Soils
- Census data
- Community-defined landscape values
- Political and voting boundaries
- Socioeconomic data
- Hazardous waste sites

Module 1: Habitat Classification

The following is an excerpt from the HPP tutorial that ships with the product. This will take the reader through a step by step example of how the tool is used.

3.2 Window 1: Habitat Patch File Type

1. From the Habitat Priority Planner toolbar, **Select** Classify Habitats.

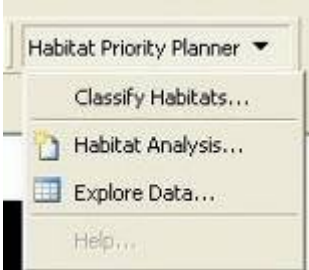


Figure 4. The Habitat Priority Planner Toolbar and its three associated modules

2. **Select** either “Create a new habitat patch file,” or “Import setting from a previous run,” which will be listed in the dropdown menu.

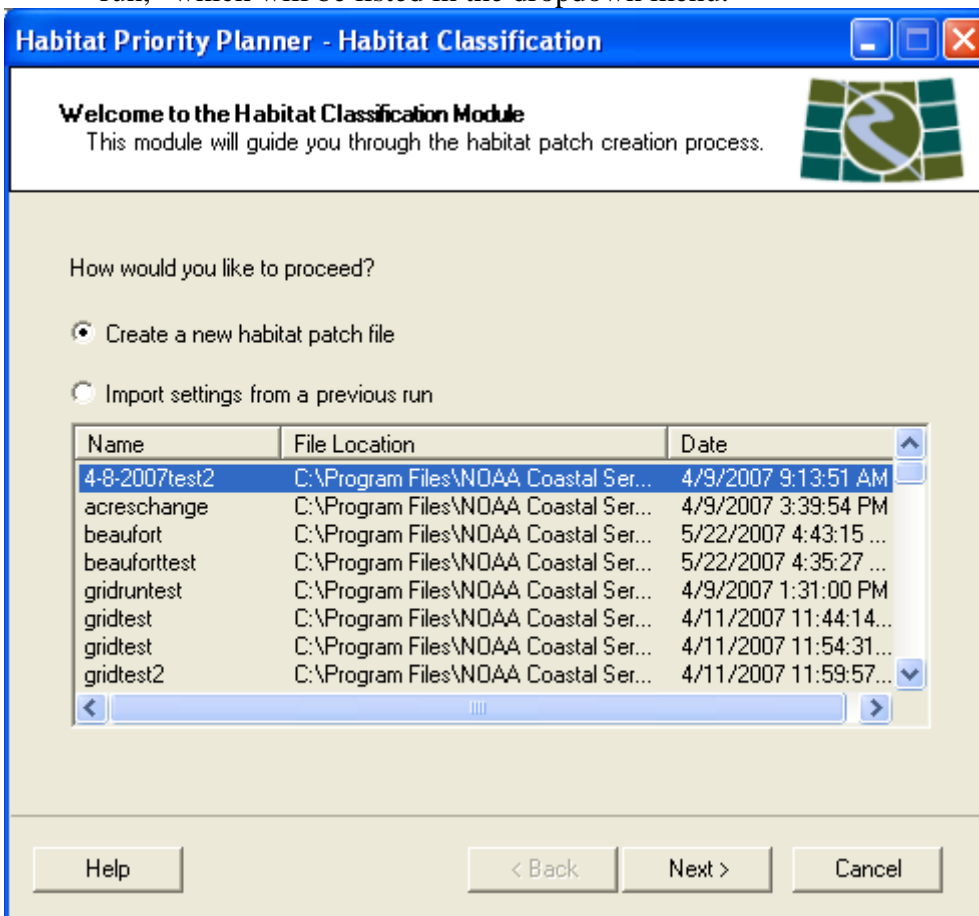


Figure 5. Window 1 of the Habitat Classification Module.

Existing Settings

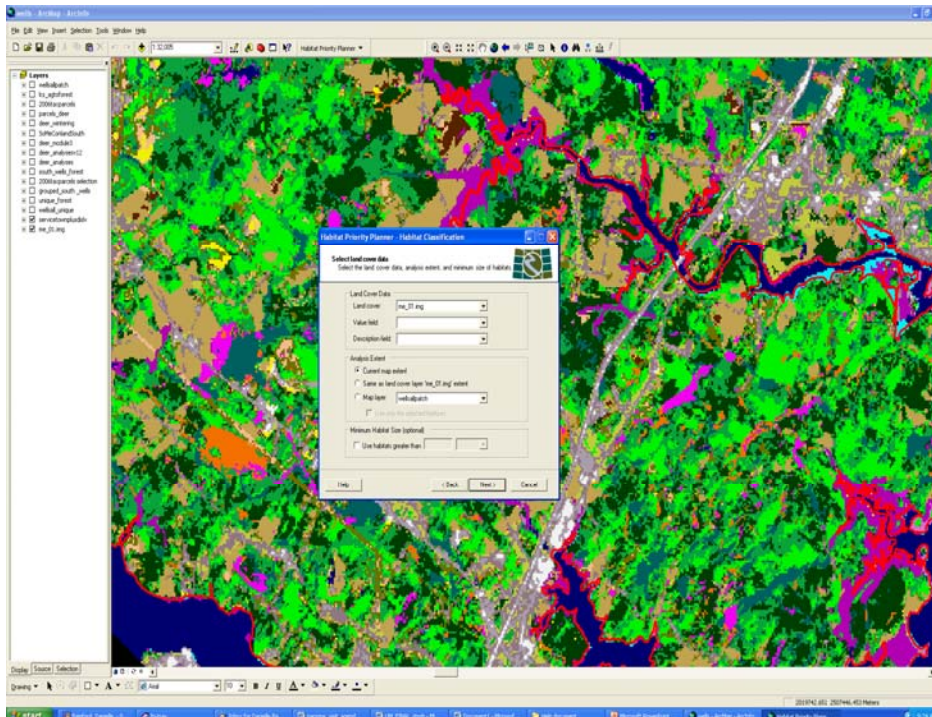
- If using existing settings, HPP will retrieve those settings from a previous run.
- Existing settings are useful if you need to re-run data for reasons such as changing your classification scheme or running a land-use scenario change.
- The Existing Settings list will be empty until you have completed at least one run.
- Completed runs of the first module are automatically saved and will appear in this list.

3. Click Next.

2.1 Window 2: Land Cover Data/Analysis Extent

The second window will allow the user to select the data and the extent of the area to be analyzed.

1. **Select** your desired land cover layer from the Land Cover dropdown menu.
 - The dropdown menu will list raster layers present in your current map. After selecting the land cover layer, the Value Field and Name Field dropdown menus will be populated with the “field names” in your land cover layer.
2. **Select** a value field from the Value Field dropdown menu.
 - The “value field” is a numerical value assigned to each land cover type in the layer.
3. Next, **select** a name field from the Name Field dropdown menu.
 - The “name field” is the text description corresponding to the value.
 - The example shown here uses Coastal Change Analysis Program (C-CAP) data, an .img file.



Accessing C-CAP data: Coastal Change Analysis Program (C-CAP) data is a NOAA CSC product. C-CAP products are part of a nationally standardized database of land cover and change information, developed using remotely sensed imagery for the coastal regions of the U.S. To download C-CAP data for free from the NOAA Web site please go to: <http://www.csc.noaa.gov/crs/lca/ccap.html>

Figure 6. Window 2 of the Habitat Classification module. The yellow box delineates the “current extent” option.

- In C-CAP, the field representing the numerical value is called “Value,” and its corresponding descriptive field is “Class_names.”

4. **Select** your analysis extent. Users have three options when choosing the analysis extent.
 - Current Map Extent will create a habitat patch file of the portion of the land cover layer that is visible in ArcMap, as outlined in yellow in the figure above (Figure 6).
 - Same as Land Cover Layer option will analyze the entire land cover layer that you have selected. Using this analysis extent is recommended for land cover layers covering smaller areas (a county or watershed, for example) (Figure 6).

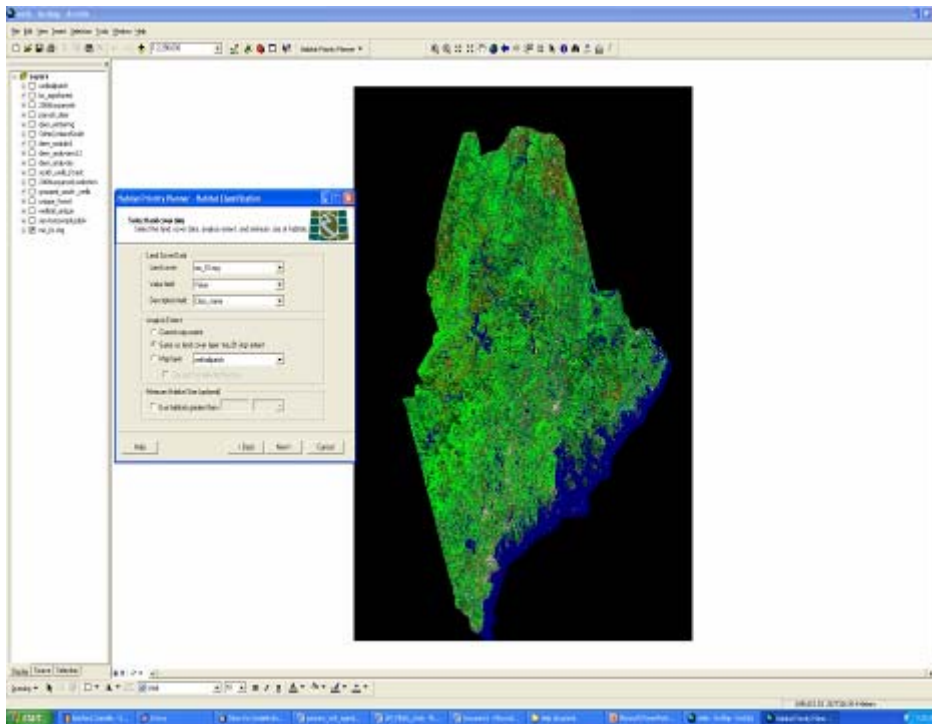


Figure 7. C-CAP data showing “same as land cover layer” extent.

Raster layer tip-CAUTION
 Do not use the option “same as land cover layer” for C-CAP or other large data sets. The largest set that the tool has successfully classified contained 250,000 records. However, **small focused study areas** are recommended as this is a process-intensive step. Polygon complexity slows this step also, so focus your work!

- Map Layer allows users to set the analysis extent of a polygon map layer. The polygon layer used must have a single polygon, or have multiple, adjacent polygons (see description and figures below) (Figures 9a and 9b).

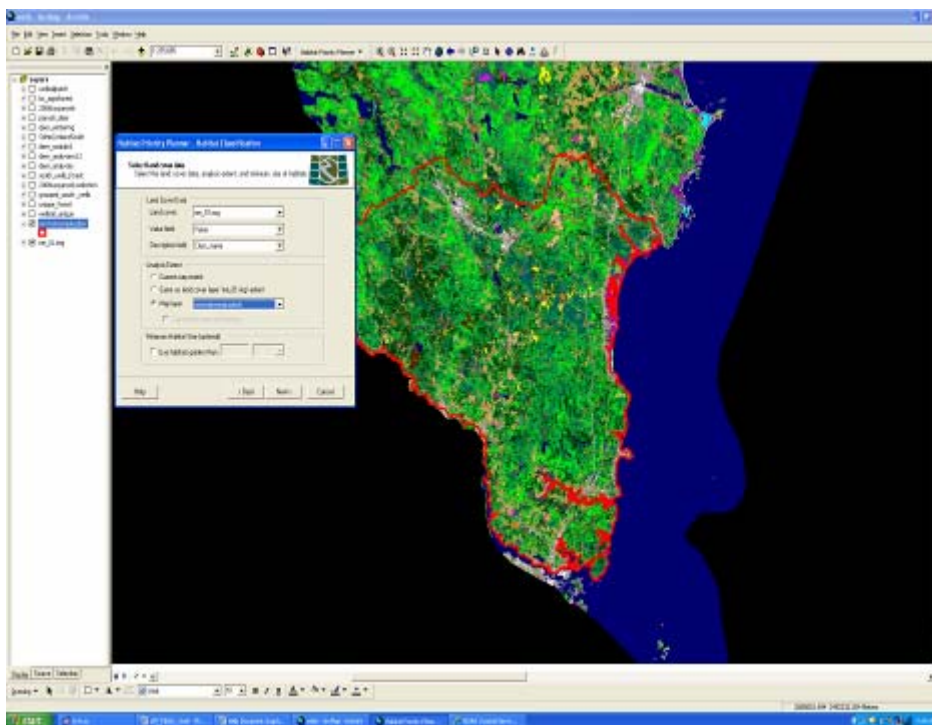


Figure 8. The red line outlines an appropriate “map layer” extent for analysis. The minimum patch size is also selected at the bottom of the HPP window, this is optional.

Layer tips – CAUTION
 Using an entire map layer may result in similar extended processing times as those encountered in using entire land cover datasets. It is recommended that you limit your study area. You also have the option of using only selected features for your layer. Selected polygons **must be adjacent**.

Using Polygon Layers for your Analysis Extent

- If you have an existing polygon layer, **add** it to the map. If you do not have a polygon layer, but would like to create one, see the tip to the right.
- Polygon layers can have more than one polygon, but the polygons must be **adjacent** to one another for ArcMap to make the necessary calculations.



Figure 9a. A polygon layer with non-adjacent polygons **cannot** be used to define the analysis extent.



Figure 9b. A polygon layer with adjacent polygons **can** be used to define the analysis extent.

Creating a Shapefile

Open ArcCatalog. In the Catalog Tree, navigate to the folder where you will store your data. Click on the folder name. In the main Catalog view, right click and select New from the menu, then select Shapefile. Give the file an appropriate name, and select whether it will be a point, polygon, line, or polyline file. To give the shapefile a spatial reference, click Edit. If you know the Coordinate System for your study area, you may click Select and locate the correct Coordinate System. If you would like to use a coordinate system established in another shapefile, click Import, and you can navigate to a shapefile in your study area.

4. **Select** a minimum patch size (*optional*)
 - Checking this box and entering a number and desired units will eliminate patches that the user deems too small to be useful.
5. If you want to analyze habitat patches of all sizes, simply leave the box unchecked and click **Next**.

Example: your project goals may only be interested in patches of habitat that are 25 acres in size or larger. Smaller patches of habitat may not be applicable to your project.

- **Enter** 25 in the text box and select “acres” from the units dropdown menu to remove analysis patches that are less than 25 acres in your final habitat patch file.

Window 3: Classification Type

The third window allows users to select how they would like to classify the habitat in their study area.

Simple Classification – The selected land cover classes are designated as “habitat,” any that are not selected **will not** be analyzed (Figures 10 and 11).

6. **Select** the “Simple” for classification type. HPP will populate a list of all of the land cover types based on the name field that you selected in the first page which corresponds to your raster layer.
7. **Check** a box/boxes next to land cover types that represent your habitats for analysis. These land covers will be considered “habitat” in the simple classification.
8. **Unchecked** land cover types will *not* be considered in the analysis; they will be removed as non-habitat.

Example: your group may be interested in habitat for the endangered red-cockaded woodpecker. This bird species nests in mature pine forests, so you may wish to choose “Evergreen Forest” as the type of habitat that you would like to consider. All other land cover types will be excluded.

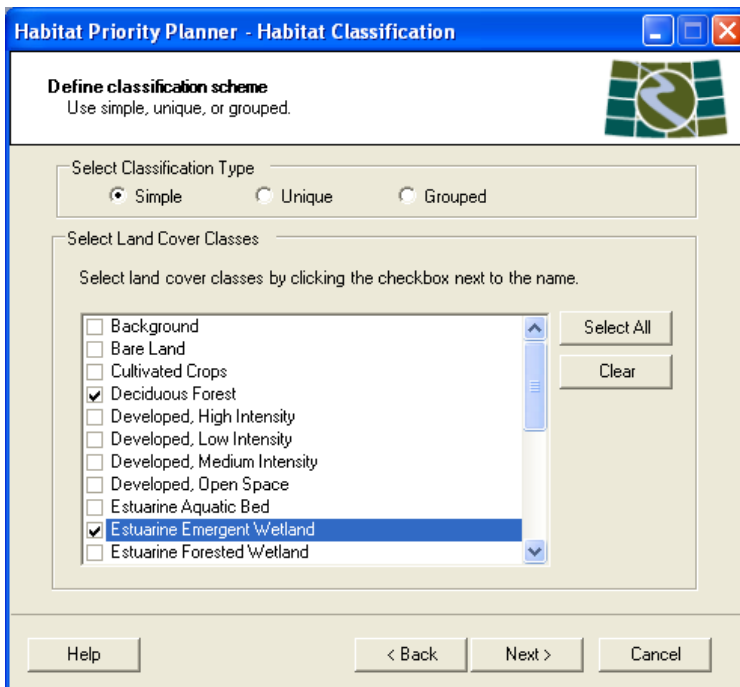


Figure 10. Simple classification window

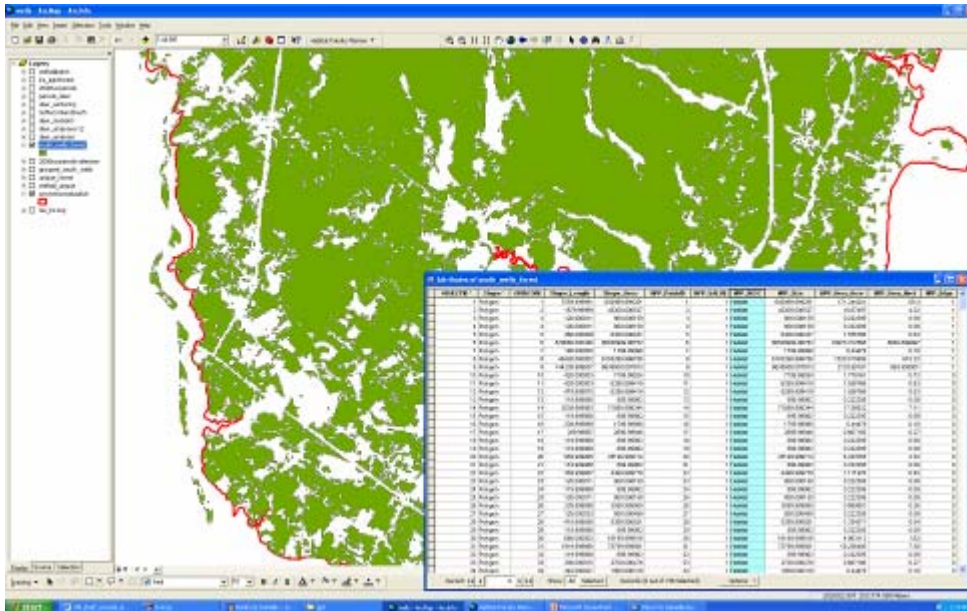
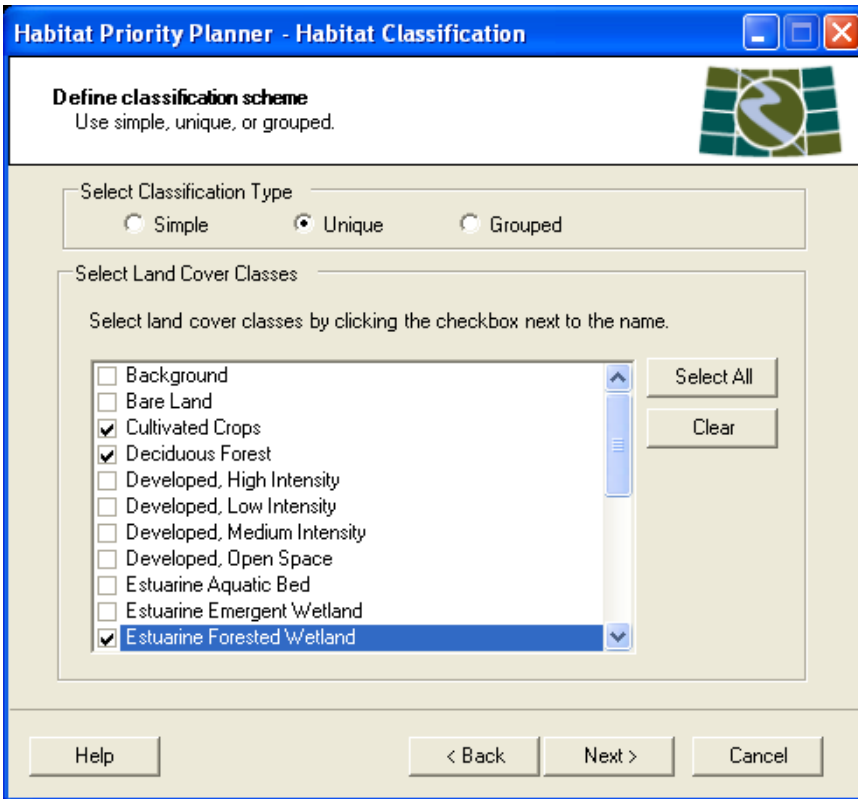


Figure 11. The output of a simple classification: a habitat patch file. The attribute table displays the “habitat” designation in the field HPP_DESC.

Unique Classification – the unique classification scheme will consider all *selected* land cover types to be “habitat.” This may be used in several ways.

1. **Select** “Unique” for classification type.
2. **Check** a box/boxes next to land cover types that meet define your habitats, these land covers will be considered “habitat” in the simple classification.
 - If you wish to perform a detailed analysis of your study area, the unique classification may be used to examine *all* of the land cover classes and the names will be preserved “as is” from the raster layer.
3. **Unchecked** land cover types will *not* be considered in the analysis; they will be removed as non-habitat.

Example: you may wish to consider the various levels of developed spaces in your study area. Check the boxes next to High Intensity, Medium Intensity, and Developed Open Space if you are using C-CAP data. This will give you the maximum classification detail regarding development from your raster layer in your final classified habitat patch file.



Tip: When running a detailed unique classification, removing background, unclassified, and open water fields can save on processing time.

Figure 12. Unique classification.

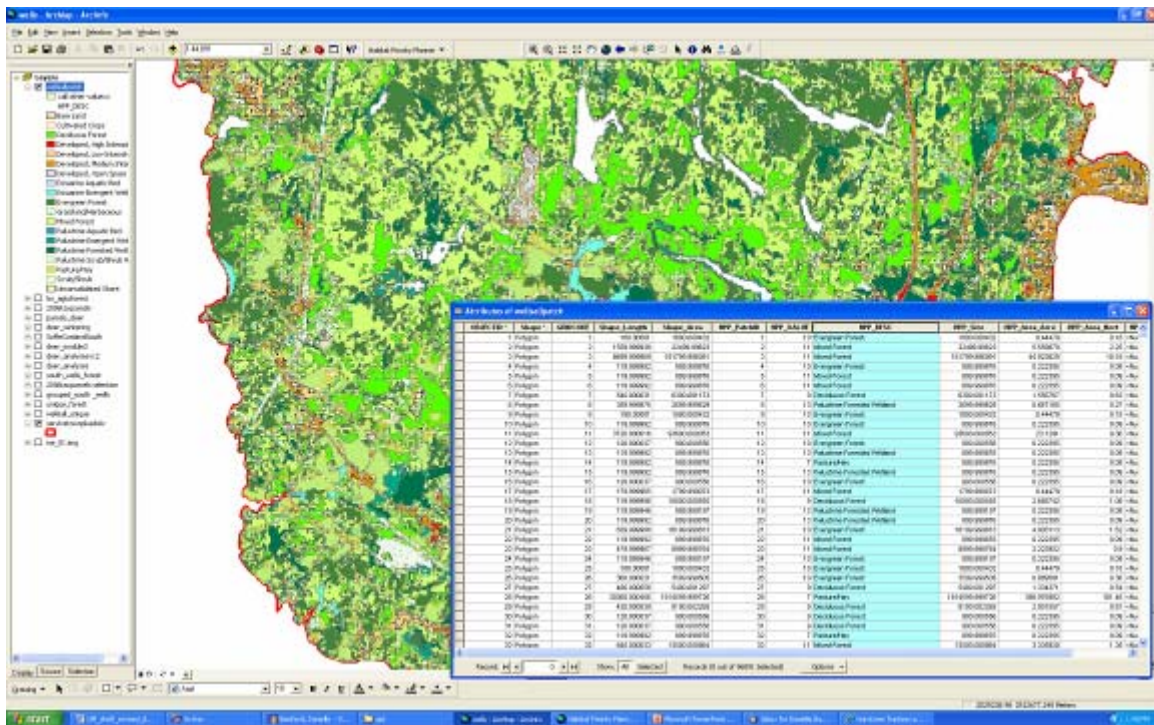
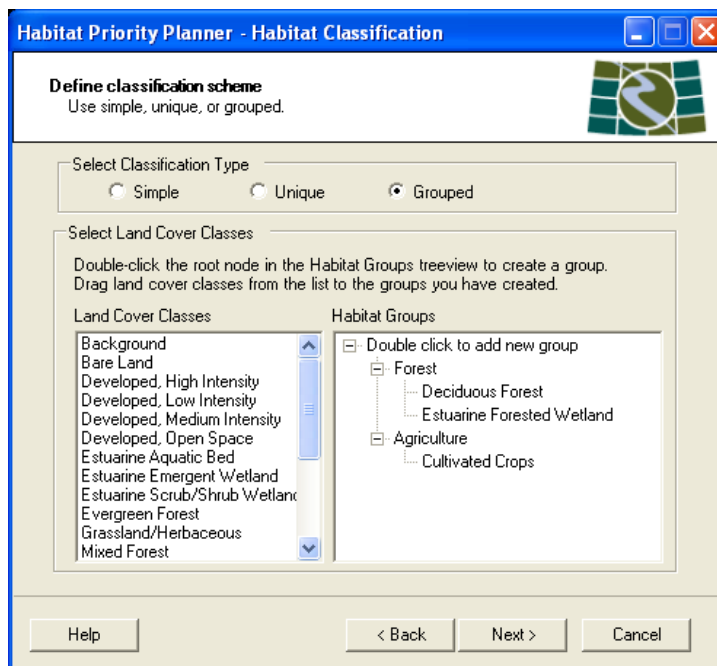


Figure 13. The output of a unique classification: a habitat patch file. The attribute table displays the text descriptions in the field HPP_DESC, these are identical to the raster layer.

Grouped Classification – the grouped classification gives users the opportunity to compile land cover types into logical groups.

1. **Select** “Grouped” for classification type.
2. In the “Habitat Groups” box, **double click** to add new group.
3. **Name** your new group with a logical name (e.g., “forest”).
 - Be sure to name each group in a unique manner, the attribute table will use this name in the HPP Description field (HPP_DESC).
4. **Drag and drop** the desired land cover types over to the group name to add them to that group.
5. To **remove** a land cover type from a group, right click on the desired land cover type and **select** delete or press the delete key.

Example: you may wish to consider all developed land together as one class, all upland forest types together as one class, or all agricultural land cover types as one class. You would create three groups; “developed,” “forest,” and “agriculture.” Then you would drag and drop the relevant land cover classes into each group.



Tip: When running a grouped classification, drag the land cover classes **directly over** your group name to add to a group.

Figure 14. Grouped classification.

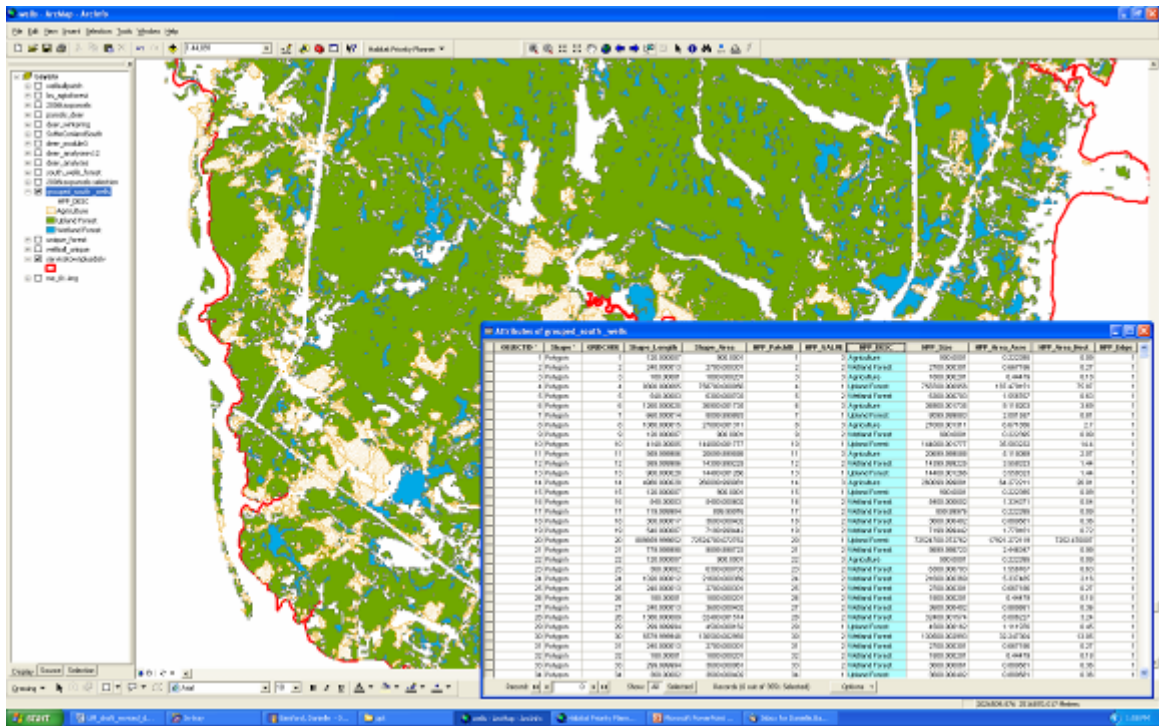


Figure 15. The output of a grouped classification: a habitat patch file. The attribute table displays the group names as designated in the field HPP_DESC, these are identical to the raster layer.

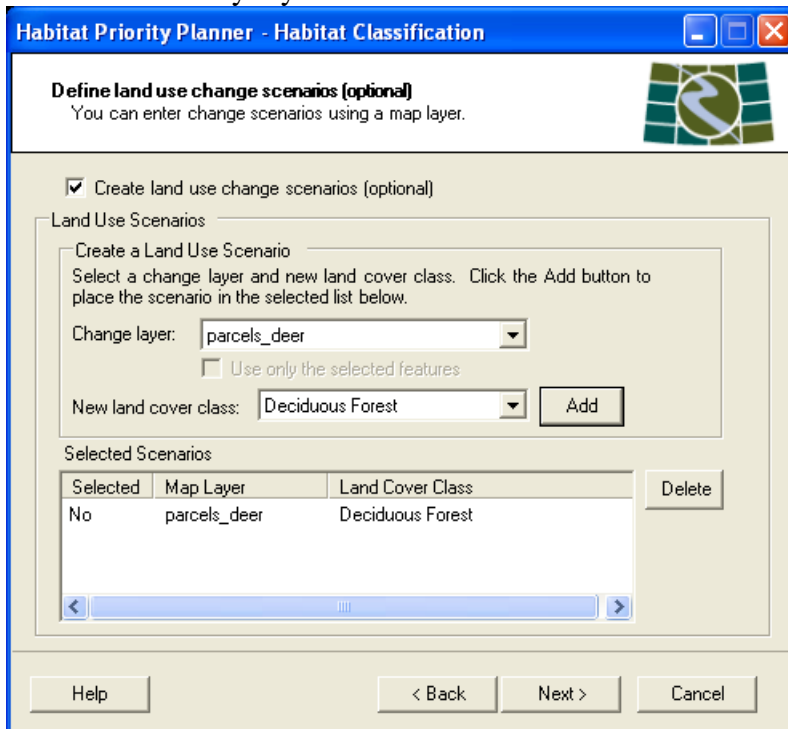
Window 4: Land Use Change Scenario (optional)

This method will use a polygon layer to apply a selected change to the land cover layer. This process does not edit your raster layer; the changes are made to the habitat patch file, and the resultant layer displays the change.

Example: change scenarios may be useful for planning purposes. You may wish to examine how restoring pastures to forest will affect the landscape. Or, you may want to see how proposed development in areas with rare species may affect the landscape.

Creating a land use scenario:

1. **Click** the “Create land use change scenarios” box.
2. **Select** a polygon layer from the “Change layer” dropdown menu.
 - This dropdown will populate from layers already loaded into ArcMap.
 - The layer you select will denote the area to be reclassified.



Tip: To look at specific features in a layer, click the box next to “Use only the selected features.” For example, you may know that development is being planned in a specific area where rare wildlife has been sited, so you don’t have to look at every location that rare species have been sited.

Figure 16. The land use scenario change window.

3. **Select** the new land cover class by selecting a value in the “New land cover class” dropdown. The new land cover class options will populate from the land cover raster that you loaded in Step 1.
 - **It is important that the new land cover class be one that was included in your classification.**

Example: if you completed a unique classification, and only selected deciduous forest and mixed forest, you would choose one of those land cover types in your land use change scenario.

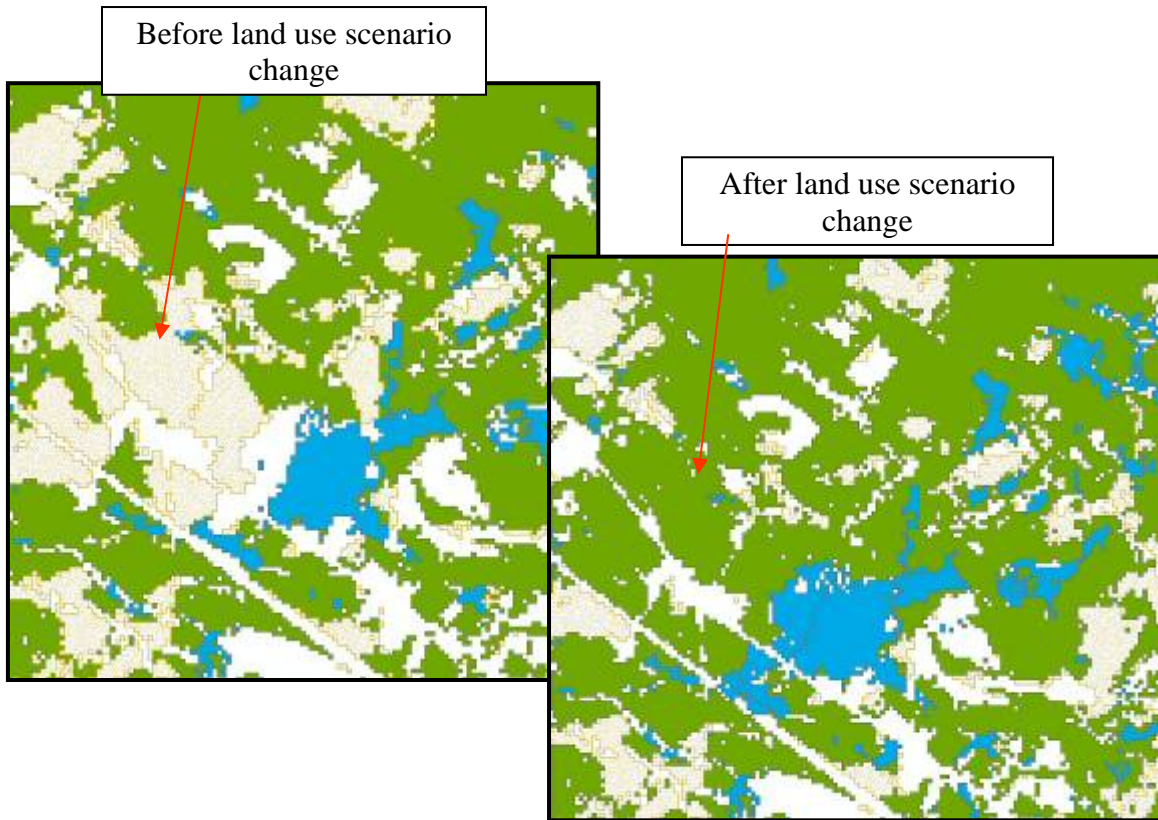


Figure 17. Land use scenario change example. The classified habitat patch file on the left is prior to change. The habitat patch file on the right is post-change, where several agricultural patches were changed to forest.

3.6 Window 5: Save Your Work

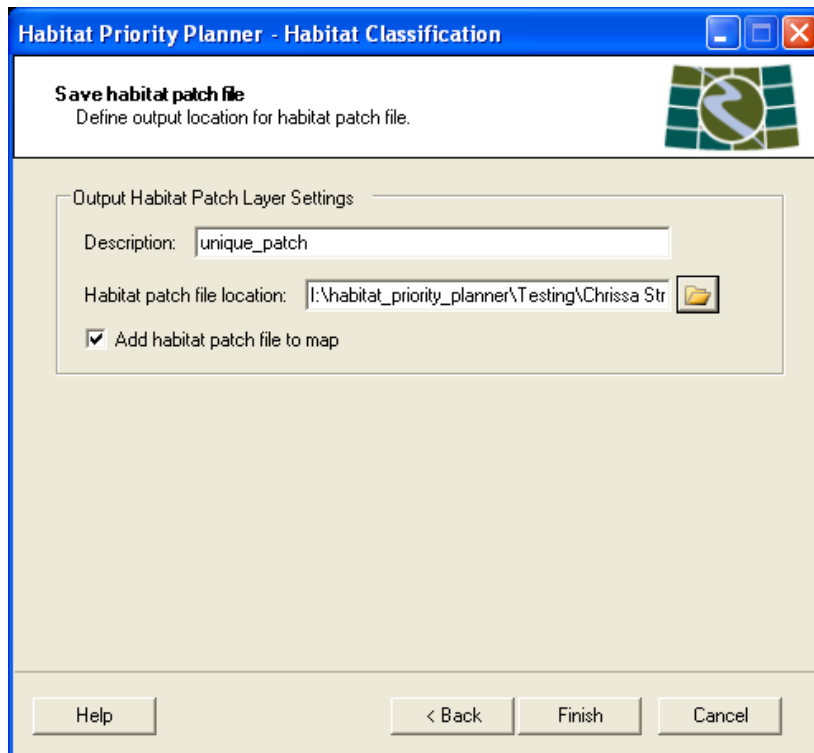
This window allows the user to select an output file location, and designate an appropriate name for the habitat patch file.

HPP outputs must be stored in a file geodatabase.

1. **Name** the habitat patch file using the “Description” box.
 - This will name the layer as it will appear in the Table of Contents of the ArcMap window.
 - Naming conventions should allow users to relocate files.

Example: if you run a unique classification on three types of developed land cover, you might name the file “unique_developed.”

2. **Navigate** to or **type** the location where the habitat patch file will be saved.
 - **Click** on the file folder to navigate to your file geodatabase to save the habitat patch file (see page 10 for a review of creating and using the file geodatabase).
3. The box for “add habitat file to map” will automatically be checked, this will create a new map layer of your data.
4. **Click** finish, and HPP will process the data to create the habitat patch file.



Tip: After clicking the finish button, please be patient! Depending on the analysis area selected, the run may take some time. Also, limit the use of other applications at this time. If you are running a very large or complex analysis area, leave the application to run overnight.

Figure 18. Saving your habitat patch file.

Outputs of Habitat Classification – Module 1

The Habitat Patch File

- After completion of the habitat classification module, the user will have a classified polygon layer based on their defined classification scheme.
- The example below highlights a unique classified patch file, where four types of forest were selected: deciduous, evergreen, mixed, and palustrine forested wetland.

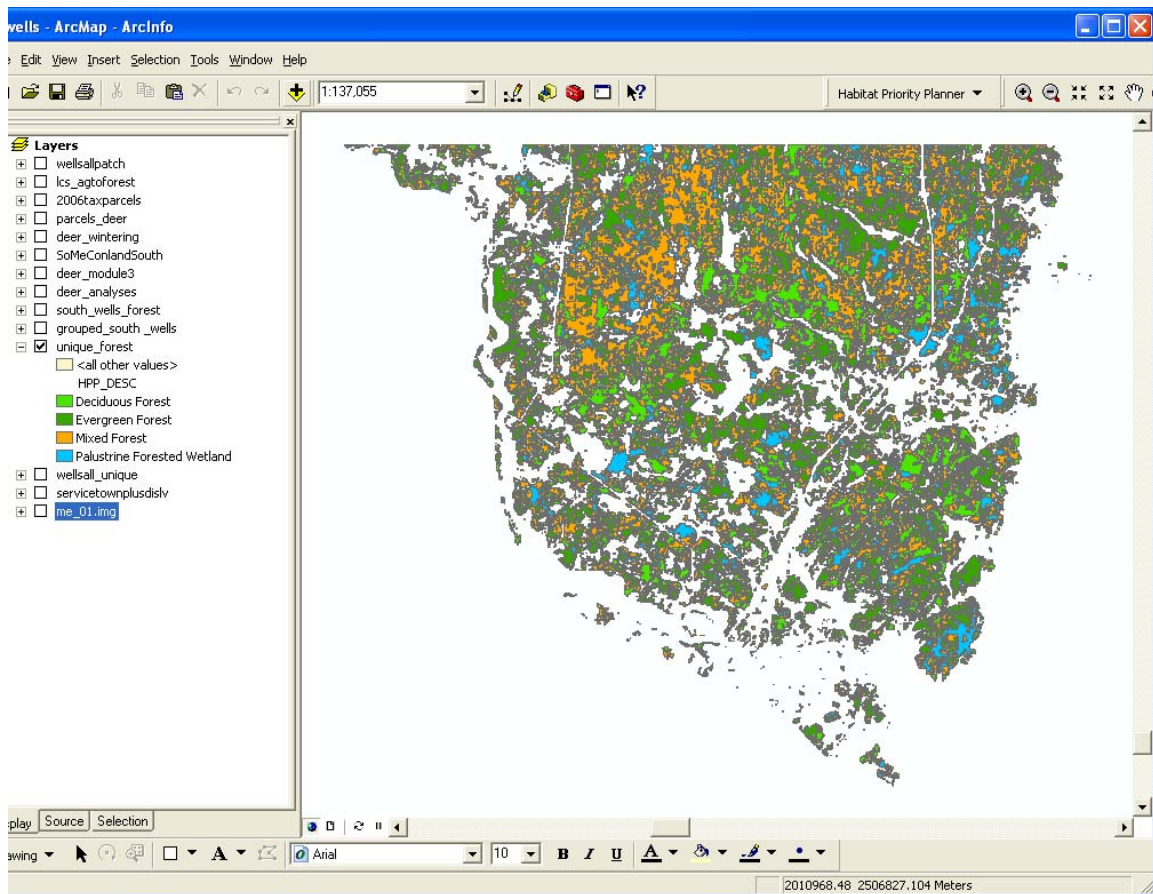


Figure 19. A completed, unique classified, habitat patch polygon file.

- The Attribute table of the Patch file will now have several appended fields to reflect the additional information generated by the Habitat Priority Planner.
- These appended fields provide the user with more information and the fields necessary for the Habitat Analysis module.

OBJECTID	Shape	GRIDCODE	Shape_Length	Shape_Area	HPP_PatchID	HPP_VALUE	HPP_DESC	HPP_Size	HPP_Area_Acre	HPP_Area_Hect	HPP_Edge
1	Polygon	1	119.999977	899.99965	1	13	Palustrine Forested Wetland	899.99965	0.222395	0.09	1
2	Polygon	2	240.000002	1800.000029	2	9	Deciduous Forest	1800.000029	0.44479	0.18	1
3	Polygon	3	240.000002	1800.000029	3	13	Palustrine Forested Wetland	1800.000029	0.44479	0.18	1
4	Polygon	4	120.000001	900.000015	4	10	Evergreen Forest	900.000015	0.222395	0.09	1
5	Polygon	5	179.999989	1799.999665	5	11	Mixed Forest	1799.999665	0.44479	0.18	1
6	Polygon	6	360.000003	3599.999694	6	10	Evergreen Forest	3599.999694	0.889581	0.36	1
7	Polygon	7	179.999989	1799.999665	7	9	Deciduous Forest	1799.999665	0.44479	0.18	1
8	Polygon	8	298.999998	2700.000044	8	10	Evergreen Forest	2700.000044	0.667186	0.27	1
9	Polygon	9	240.000002	1800.000029	9	13	Palustrine Forested Wetland	1800.000029	0.44479	0.18	1
10	Polygon	10	119.999977	899.99965	10	9	Deciduous Forest	899.99965	0.222395	0.09	1
11	Polygon	11	599.999981	8099.999404	11	11	Mixed Forest	8099.999404	2.001557	0.81	1
12	Polygon	12	179.999989	1799.999665	12	10	Evergreen Forest	1799.999665	0.44479	0.18	1
13	Polygon	13	119.999977	899.99965	13	10	Evergreen Forest	899.99965	0.222395	0.09	1
14	Polygon	14	179.999989	1799.999665	14	10	Evergreen Forest	1799.999665	0.44479	0.18	1
15	Polygon	15	179.999989	1799.999665	15	11	Mixed Forest	1799.999665	0.44479	0.18	1
16	Polygon	16	659.999993	6299.999739	16	11	Mixed Forest	6299.999739	1.556766	0.63	1
17	Polygon	17	240.000002	2700.000044	17	9	Deciduous Forest	2700.000044	0.667186	0.27	1
18	Polygon	18	120.000001	900.000015	18	11	Mixed Forest	900.000015	0.222395	0.09	1
19	Polygon	19	1020.000002	12600.000205	19	13	Palustrine Forested Wetland	12600.000205	3.113533	1.26	1
20	Polygon	20	240.000002	3600.000059	20	10	Evergreen Forest	3600.000059	0.889581	0.36	1
21	Polygon	21	1440.000012	34199.999101	21	10	Evergreen Forest	34199.999101	8.451017	3.42	1
22	Polygon	22	119.999977	899.99965	22	11	Mixed Forest	899.99965	0.222395	0.09	1
23	Polygon	23	179.999989	1799.999665	23	11	Mixed Forest	1799.999665	0.44479	0.18	1
24	Polygon	24	659.999993	14400.000235	24	10	Evergreen Forest	14400.000235	3.558323	1.44	1
25	Polygon	25	119.999977	899.99965	25	9	Deciduous Forest	899.99965	0.222395	0.09	1
26	Polygon	26	239.999978	2699.999316	26	9	Deciduous Forest	2699.999316	0.667186	0.27	1
27	Polygon	27	179.999989	1799.999665	27	9	Deciduous Forest	1799.999665	0.44479	0.18	1
28	Polygon	28	120.000001	900.000015	28	11	Mixed Forest	900.000015	0.222395	0.09	1
29	Polygon	29	119.999977	899.99965	29	9	Deciduous Forest	899.99965	0.222395	0.09	1
30	Polygon	30	240.000002	2699.99968	30	10	Evergreen Forest	2699.99968	0.667186	0.27	1
31	Polygon	31	240.000002	1800.000029	31	10	Evergreen Forest	1800.000029	0.44479	0.18	1
32	Polygon	32	5819.999987	107099.999925	32	11	Mixed Forest	107099.999925	26.465028	10.71	1
33	Polygon	33	179.999989	1799.999665	33	9	Deciduous Forest	1799.999665	0.44479	0.18	1
34	Polygon	34	119.999977	899.99965	34	11	Mixed Forest	899.99965	0.222395	0.09	1

Figure 20. The completed attribute table from a unique classified habitat patch file. Note the fields that have been added by HPP.

HPP Appended Fields and their Descriptions:

- **HPP_PatchID:** unique ID field
- **HPP_Value:** the value (numeric) field of the original land cover dataset
- **HPP_Desc:** the new description field, depends on type of classification selected
- **HPP_Size:** the area of the patch in original area units (i.e., if your land cover dataset was in meters, this represents square meters)
- **HPP_Area_Acre:** size of the patch in acres
- **HPP_Area_Hect:** size of the patch in hectares
- **HPP_Edge:** a true/false value that determines whether or not a patch falls on the edge of the analysis extent

HPP_Edge: This field does not refer to the ecological definition of Edge. This “edge” refers to border patches on your analysis extent. It is recommended that if your patch of interest falls on this edge, you increase your area of analysis to obtain full statistics for these patches.

4Module 2: Habitat Analysis

As described in the introduction, the Habitat Analysis module allows the user to analyze pre-packaged ecosystem parameters, or core metrics, and allows the consideration of supporting data for under custom metric analysis. *Analyses in this module are optional.*

Window 1: Habitat Analysis Patch File Type

1. From the Habitat Priority Planner toolbar, select “Habitat Analysis.”

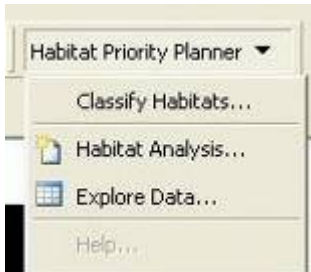


Figure 21. The Habitat Priority Planner Toolbar and its three associated modules.

2. Select either, “Perform a new analysis,” or “Import settings from a previous analysis,” which will be listed in the dropdown menu.

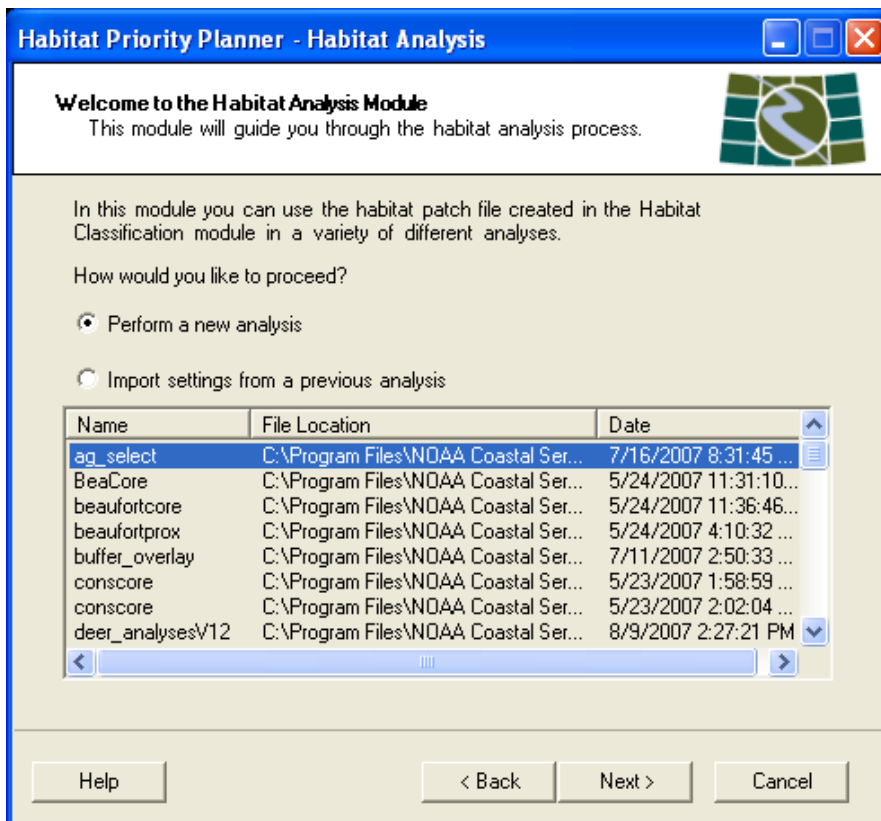


Figure 22. The Habitat Analysis opening window.

4.2 Define Analysis Settings

This window allows users to set up general properties of the project, including name, file location, and units.

1. **Enter** an appropriate description in the “name” box.
 - This entry will also serve as the layer name of the completed habitat analysis patch layer.
2. **Select** the habitats layer from the dropdown.
 - This is the layer created in the Habitat Classification Module named by user specification.
3. **Select** distance units from the dropdown.
 - The distance units selected are used in the core and custom metric calculations.
4. **Select** the appropriate area units from the dropdown.
 - The area units selected are used in the core and custom metric calculations.

Habitat Priority Planner - Habitat Analysis

Define analysis settings
Select your habitat patch file and distance and area units.

Analysis Properties

Name:

Habitats layer:

Use selected features only

Distance units:

Area units:

Help < Back Next > Cancel

Figure 23. Define analysis settings for the entire wizard.

4.3 Core Analyses Description

The core analyses that HPP calculates are focused on analyzing the characteristics of individual patches and their relationship to other patches of the *same* habitat type. There are four core analysis metrics that may be calculated in this module: perimeter to area ratio, nearest neighbor, core area, and proximity. Size is calculated during the Habitat Classification module.

Spatial Analysis Definitions

In the Habitat Analysis module, HPP calculates four standard landscape metrics for each patch. Three of the metrics measure characteristics internal to the habitat patch and the other two measure connectivity (or network importance) of the habitat patch to other habitat patches of the same type. *Size is not calculated during module 2, it was automatically calculated for all habitat patches during module 1 habitat classification.*

Habitat Quality

- *Perimeter/Area Ratio*
- *Core Area*
- *Size*

Habitat Connectivity

- *Proximity*
- *Nearest Neighbor*

Window 3: Core Analyses

Users may choose to calculate all of the core metrics, or simply those that apply to their project.

1. **Select** a core analysis by **clicking** the associated checkbox.
2. For Nearest Neighbor, **select** “From center of patch” or “From edge of patch.”
3. For Core Area and Proximity, **select** the box and **enter** a buffer distance.
 - Units for these buffers are dependent on the distance selected in the Define Analysis Settings window.

Habitat Priority Planner - Habitat Analysis

Core analyses (optional)
Core analyses describe patches and their relationships to other patches.

Core Analyses

To run any of the core analyses, click the checkbox and enter associated parameters

Perimeter-Area Ratio

Nearest Neighbor

From center of patch

From edge of patch

Core Area

Buffer distance: meters

Proximity

Buffer distance: meters

Help < Back Next > Cancel

Tip: Due to the intensive nature of the buffering analyses (nearest neighbor, core area, and proximity) it is not recommended to analyze extremely large datasets due to processing time. Run the analyses on subsets, or areas of interest for best results. Or use the Perimeter to Area Ratio, a numeric description of size to core area, with a quick process time.

Figure 24. The core metrics window.

Window 4: Custom Analyses

Users also have the option to create custom analyses using point, line, or polygon layers of interest. The table below lists the types of custom analyses available for point, line, and polygon layers.

Point	Line	Polygon
Count	Linear distance within patch	Polygon overlay
Distance to feature	Distance to feature	Distance to feature
Presence/absence	Presence/absence	Presence/absence

Table 1. Available custom analyses.

Note: The custom analyses help the user quantify the association between supporting data and the habitats or sites of interest. The types of supporting data are limited only by what can be represented as a point, line, or polygon file within ArcMap.

For detailed information on the custom metrics, please see Appendix B.

D.5.1 To Create a Custom Analysis

These analyses are optional, and there is no limit to the number of analyses that the user may add. *Also, remember these analyses are always conducting measurements or analyses from your classified habitat patches to the ancillary data.*

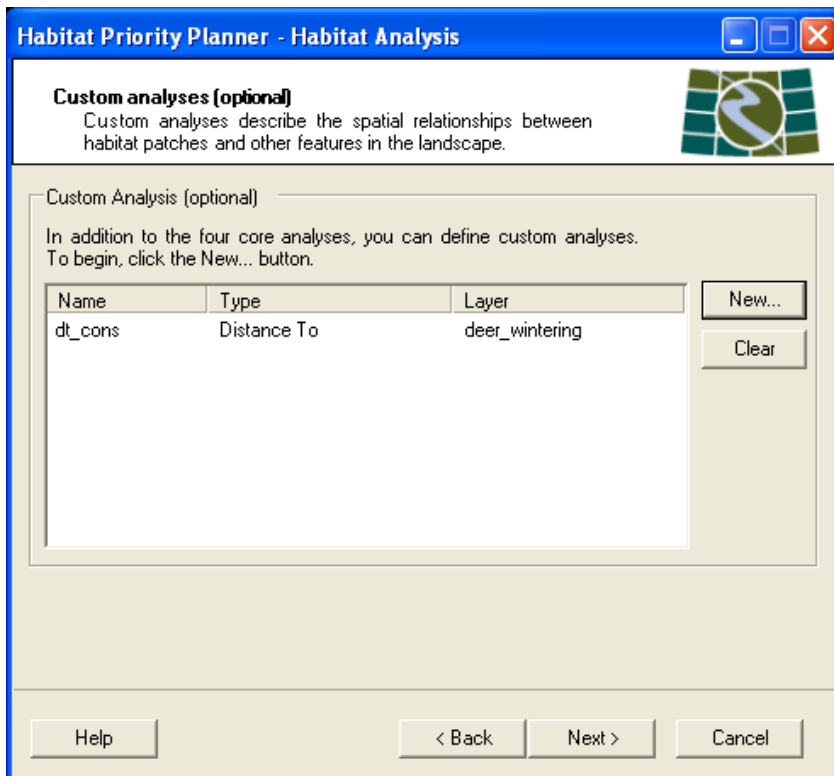


Figure 25. The custom analysis window.

1. **Click** the New button. The Add New Analysis window will open.
2. **Enter** the name of the analysis in the Field name textbox.
 - This name should be short and descriptive, as it will also serve as the field name in the attribute table of the completed patch file.
3. **Select** the Analysis type from the dropdown.
4. **Select** the Analysis layer from the dropdown.
 - Note that only layers pertaining to the selected Analysis type will appear in the Analysis layer dropdown (see Table 1). *For example, if you choose “count” as the Analysis type, only point layers will be listed in the Analysis layer dropdown.*
5. **Click** OK and the Custom Analysis list will be updated.

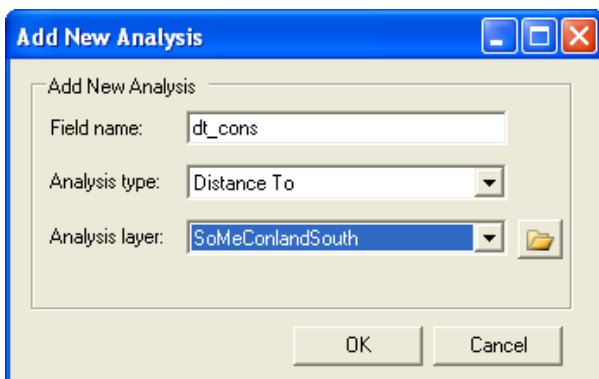


Figure 26. Adding a new custom analysis.

6. Repeat steps 1-5 to add additional custom analyses.

Example 1. You may want to determine how far your habitat patches are from rare species.

1. **Select** the **Distance To** analysis from the dropdown menu.
2. **Select** 'rare_sp' from the analysis layer dropdown list.
3. **Name** the analysis “dt_rare.” The name will appear in the attribute table as the title of the new field.

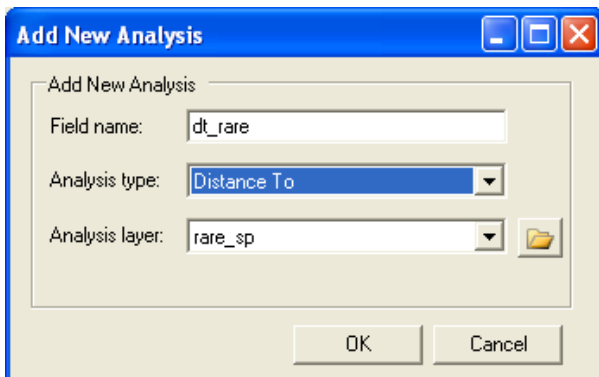


Figure 27. Example 1, “distance to” analysis example.

Example 2. You may want to consider the polygon overlay of your patches with currently conserved lands. This will return both a numeric value and a percentage.

1. **Select** the **Polygon Overlay** Analysis type.
2. **Select** the conservation lands polygon layer, in this example, “SoMeConlandSouth.”
3. **Name** your field as you would like it to appear in the final habitat analysis patch layer.

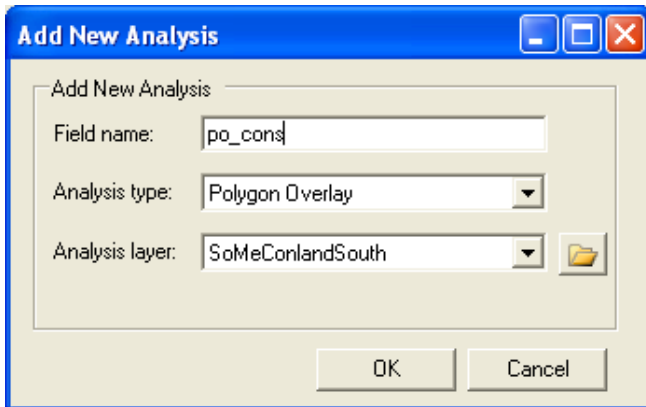
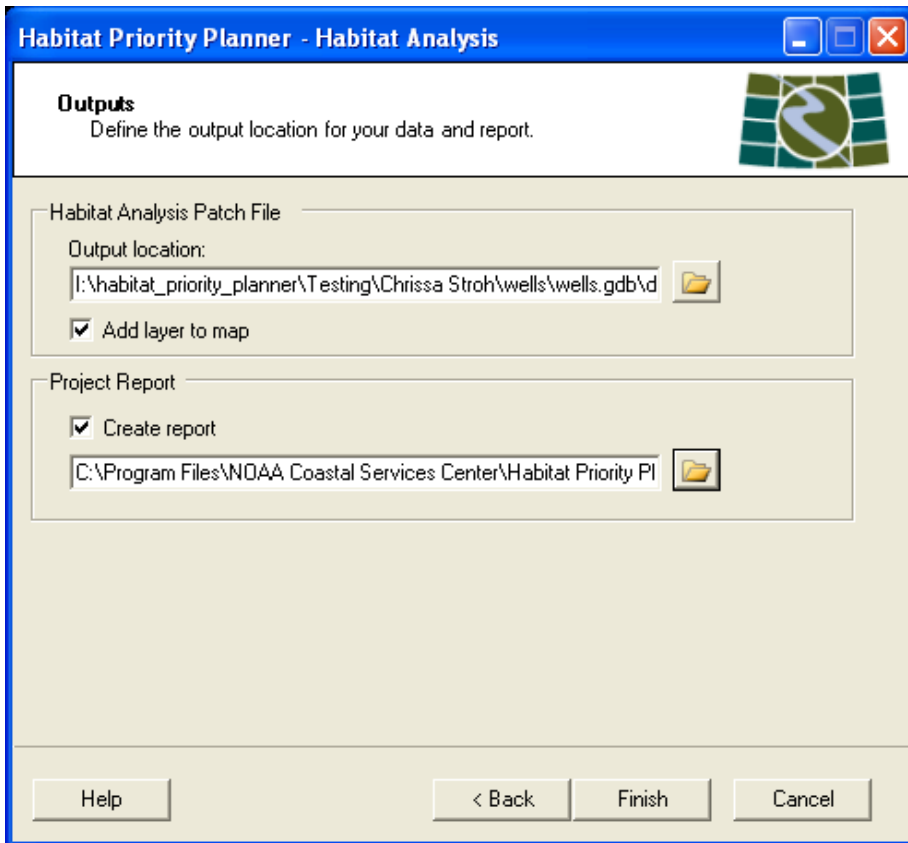


Figure 28. Example 2, polygon overlay analysis.

2.2 Window 4: Save Your Work

1. **Click** on the browse button to select a location and name for your output.
 - Save in your file geodatabase.
2. The “Add completed habitats layer to map” box will automatically be checked.
 - **Uncheck** the box if you *do not* want to add the layer to the map.
3. A report can be created that lists the files used in running core metrics, input parameters such as buffer distances used, and statistics on the results.
 - To create a report, **check** the “create report” box, and select the output location. This will save a copy of the report in PDF format. When the analysis run is complete, the report will be displayed for viewing or printing.



Tip: At times during analysis, the tool may appear to stall on particular patches, but you can watch the progress on the patch counter during processing. The tool *is still working*, so please be patient. Large patches and those that are more complex will take additional time to analyze. *Again, we recommend either leaving the analyses overnight or on a separate machine for large analyses.*

Figure 29. The final window in the analysis module.

4.7 Habitat Analysis Outputs

Running the Habitat Analysis module results in two forms of outputs:

- Habitat Analysis Patch file
- Habitat Priority Planner Report

D.7.1 Habitat Analysis Patch File

The resulting patch file will look identical in the map view to the patch file that was a result of the Habitat Classification module, however, the attribute table will display several appended fields based on user specified analyses.

Below is an example of what the appended attribute table might look like.

HPP_Edge	Shape_Length	Shape_Area	HPP_PerimeterArea	HPP_NearestNeighbor	HPP_Proximity	HPP_Core_Area	HPP_pa_deer	HPP_dt_cons	HPP_dt_deer
1	119.99977	899.99965	7.499999	67.082043	0	0	0	3190.661978	8128.430153
1	240.000002	1800.000029	7.5	180.000001	0	0	0	3072.270716	8009.694142
1	240.000002	1800.000029	7.5	29.999994	3.149066	0	0	3042.206092	7983.838947
1	120.000001	900.000015	7.5	29.999994	3.415949	0	0	3040.241547	7999.105447
1	179.999989	1799.999665	9.999999	89.999995	0	0	0	2980.07969	7947.585925
1	360.000003	3599.999694	9.999999	29.999994	3.542472	0	0	2889.844377	7870.53941
1	179.999989	1799.999665	9.999999	60	0	0	0	2829.692845	7819.333807
1	299.99999	2700.000044	9	29.999994	4.497359	0	0	2769.545917	7762.51419
1	240.000002	1800.000029	7.5	240.000002	0	0	0	2739.474268	7742.769811
1	119.99977	899.99965	7.499999	60	0	0	0	2589.135962	7615.836757
1	599.999981	8099.999404	13.499999	30.000005	1.304291	0	0	2529.010807	7565.307204
1	179.999989	1799.999665	9.999999	29.999994	2.70156	0	0	2468.892101	7514.921109
1	119.99977	899.99965	7.499999	60	0	0	0	2318.626845	7389.60274
1	179.999989	1799.999665	9.999999	60	0	0	0	2078.31633	7191.115718
1	179.999989	1799.999665	9.999999	90.000007	0	0	0	2018.265495	7141.903171
1	659.999993	6299.999738	9.545454	29.999994	6.063211	0	0	1718.226264	6863.07871
1	240.000002	2700.000044	11.25	152.970562	0	0	0	1661.745123	6832.472032
1	120.000001	900.000015	7.5	29.999994	11.92197	0	0	1650.275195	6850.336424
1	1020.00002	12600.000205	12.352941	329.999987	0	0	0	1551.321762	6700.541286
1	240.000002	3600.000059	15	29.999994	4.297073	0	0	1538.440389	6738.530762
1	1440.000012	34199.999101	23.749999	29.999994	2.254274	0	0	1179.767947	6449.937246
1	119.99977	899.99965	7.499999	108.166544	0	0	0	1149.959101	6444.262171
1	179.999989	1799.999665	9.999999	60	0	0	0	823.608752	6167.208141
1	659.999989	14400.000235	21.818183	90.000007	0	0	0	733.215577	6022.000924
1	119.99977	899.99965	7.499999	174.928567	0	0	0	708.106867	6093.97944
1	239.999978	2699.999316	11.249998	30.000006	8.224538	0	0	365.564902	5821.617089
1	179.999989	1799.999665	9.999999	90.000007	0	0	0	242.34931	5690.712027
1	120.000001	900.000015	7.5	29.999994	15.707454	0	0	188.616382	5645.570753
1	119.99977	899.99965	7.499999	42.426416	0.369534	0	0	177.448743	5623.903892
1	240.000002	2699.99968	11.249999	60	0	0	0	148.29404	5474.449963
1	240.000002	1800.000029	7.5	60	0	0	0	0	5327.983848
1	5819.999987	107099.999925	18.402062	29.999994	1.88431	0	0	0	5201.990424
1	179.999989	1799.999665	9.999999	30.000006	3.217437	0	0	0	5206.26778

Figure 30. The habitat analysis patch file with attribute table. Note the core and custom analyses.

Analysis Patch Results Tips: Notice the zeros in the Core Area and Proximity fields. This is possible depending on the buffer used. The appearance of zeros does not mean failure to run analysis. It means the patch was outside your buffer values. However, “null” values may indicate a problem with data used or tool analysis.

D.7.2 Habitat Priority Planner Report

The report generated by the Habitat Priority Planner is very useful for documenting your work in a concise and complete manner. The report contains information from both the Habitat Classification and Habitat Analysis modules, and provides the user with the following information:

- The project name
- Where the settings and layers are saved
- The raster land cover used for analysis
- The classification type, as well as the names and values
- The core analyses run, and their corresponding buffer distances
- The custom analyses, type of analysis, and layer used
- Statistics for each land cover class
- Number of features in each class

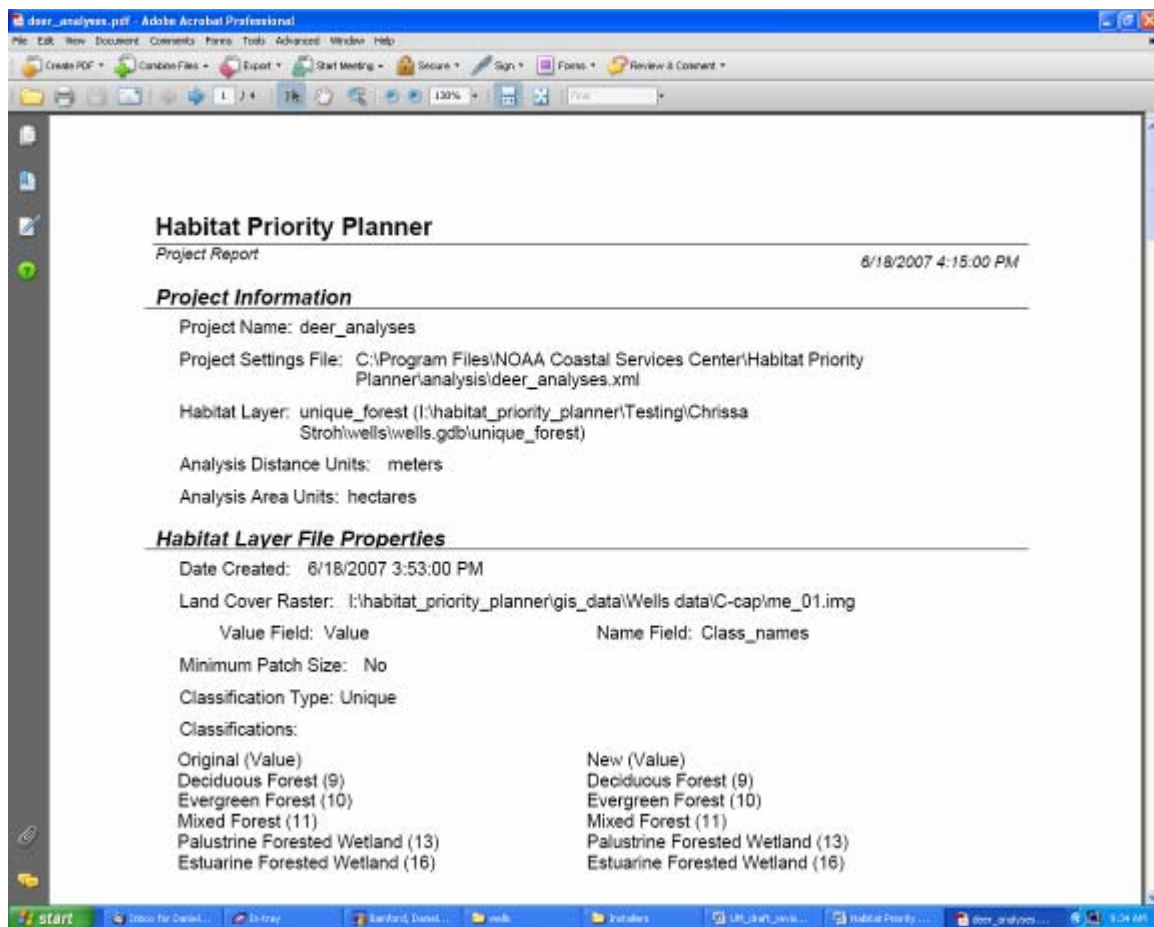


Figure 31. An example report.

Module 3: Explore Data

The Explore Data module allows users to visualize data created in the first and second components in both graphical and mapping contexts. Using logical selections on fields of interest, users can create a query that will narrow down the data to help define project goals.

Input Data

1. From the Habitat Priority Planner toolbar, **select** Explore Data.

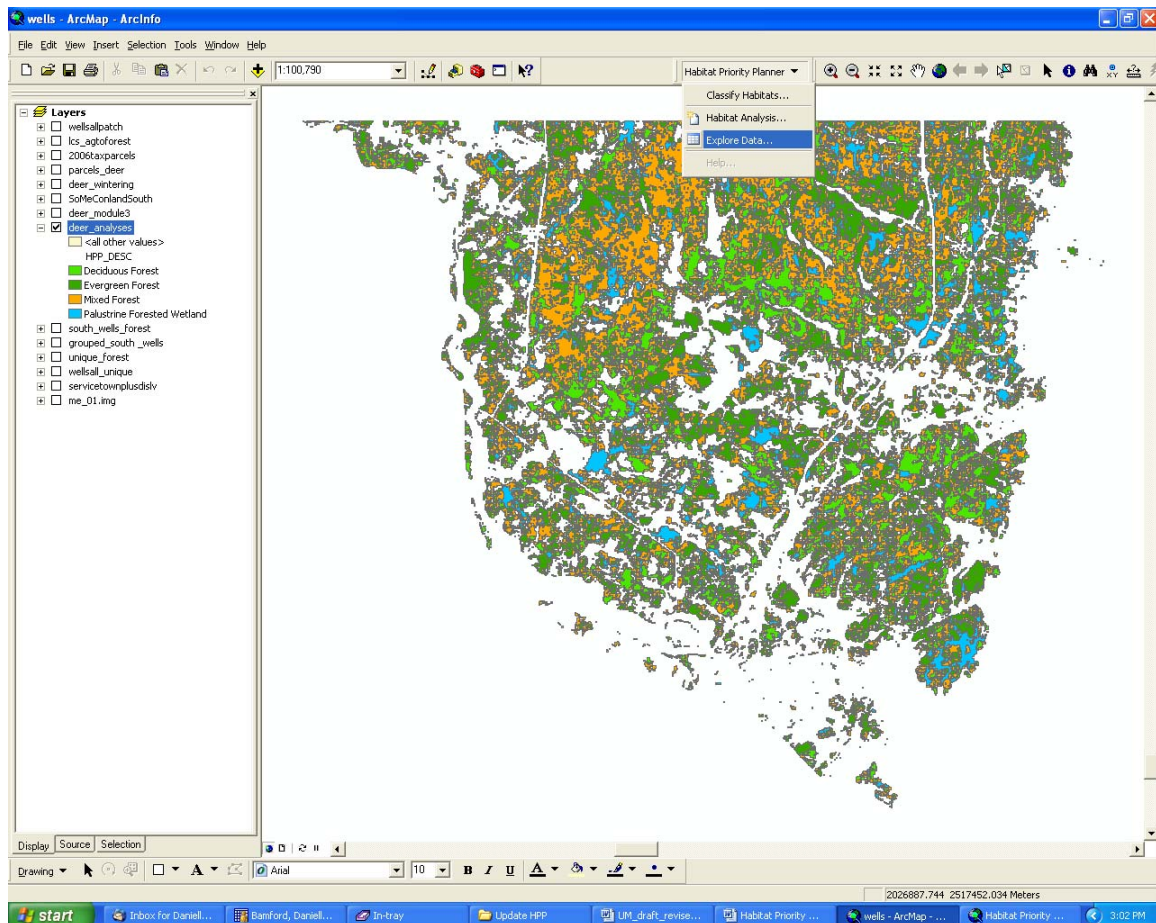


Figure 33. Opening the Explore Data window.

2. **Select** a layer to explore from the Map Layer dropdown menu.
 - Only feature layers will be available to select. The Explore Data module does not work on raster data.
 - Ideally, the user would select the habitat analysis patch file, containing all the core and custom metrics. The user may, however, apply any feature layer.

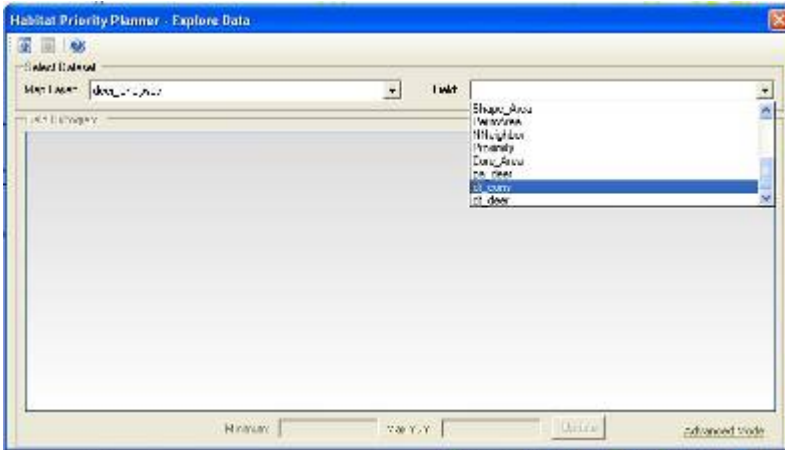


Figure 34. Explore Data - select field name.

3. Select a field from the “field” dropdown menu.

- The fields are associated with your selected map layer.
- When a field is selected, HPP will produce a histogram that shows the distribution of the data in this field as shown below (Figure 35).
- Histogram units for the x and y axes.
 - The x (horizontal) axis represents the values of the distance of the patches to conservation areas.
 - The y (vertical) axis represents the number of patches and the percent of total.

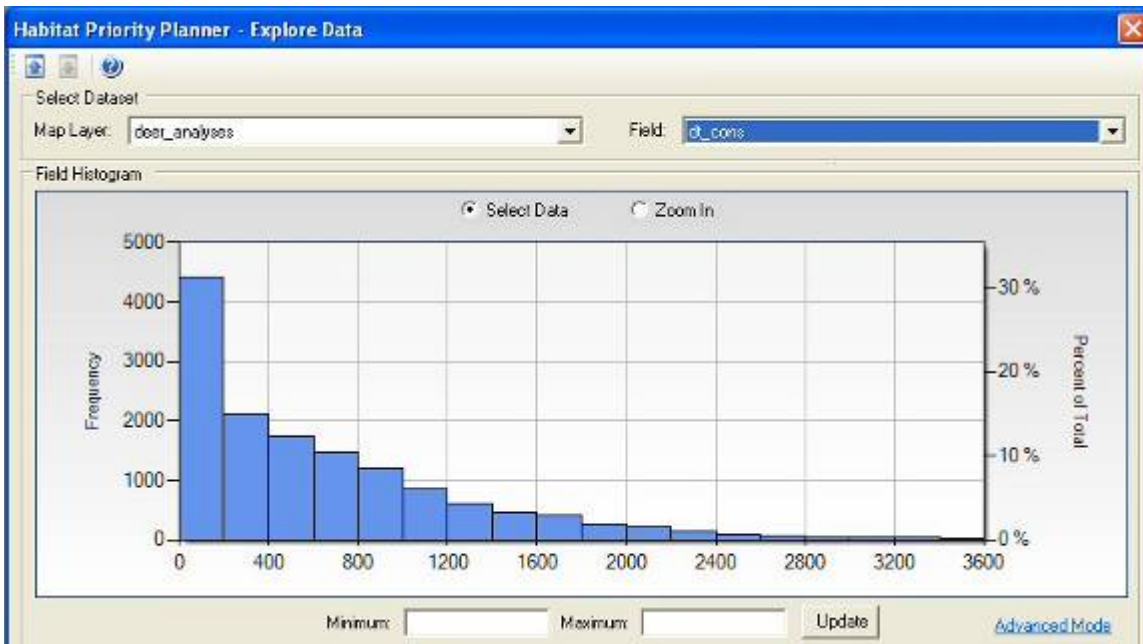


Figure 35. Explore Data Component.

5.2 Using the Histogram

1. Select the desired range of data by dragging the cursor over the histogram...
2. Or, type values into the minimum or maximum boxes under the histogram.
 - If the user clicks the Update button, the selection on the histogram will be displayed on the map.

Be sure to turn on the layer on which the selections are based.

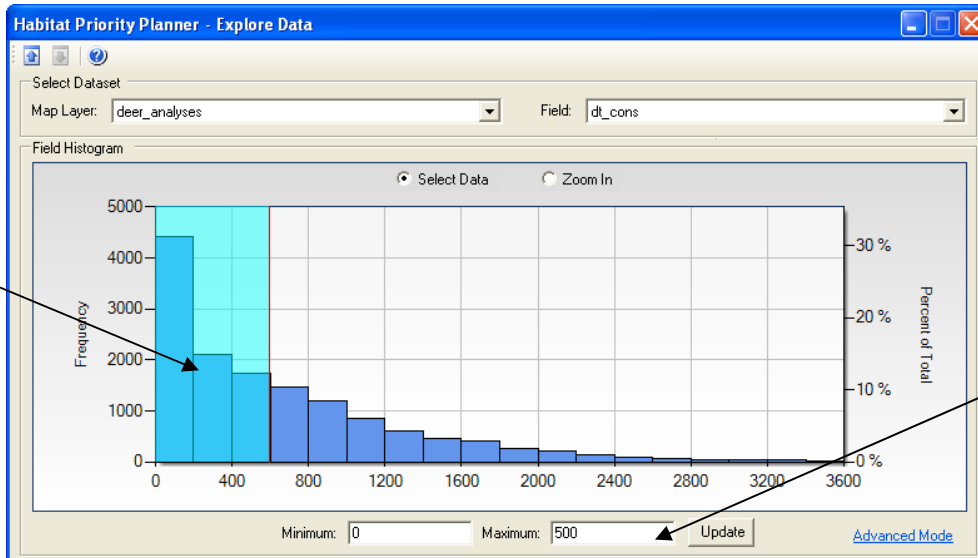


Figure 36. Selecting a range of data for your field.

- The zoom in feature allows the user to **zoom** to the selected area on the histogram.

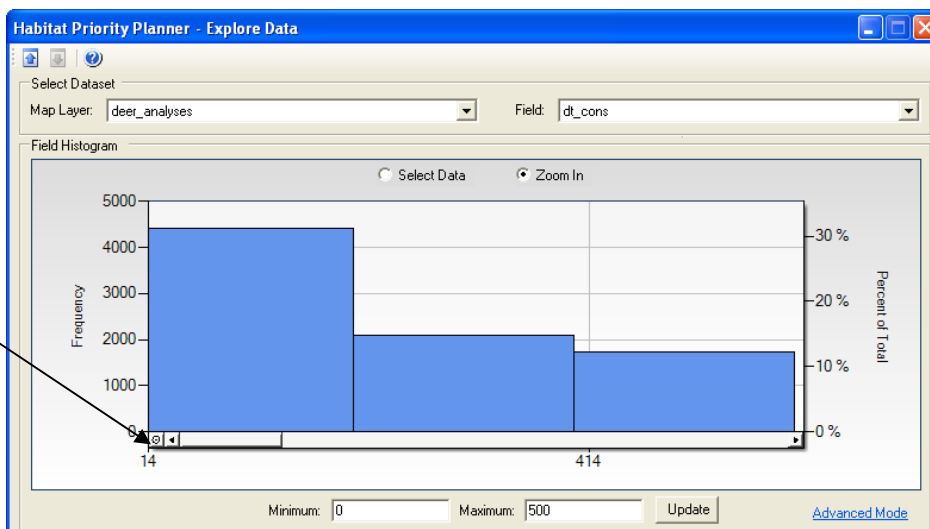


Figure 37. The zoom feature.

- The map below displays the selection that was made above. Notice the Explore Data module window minimized.

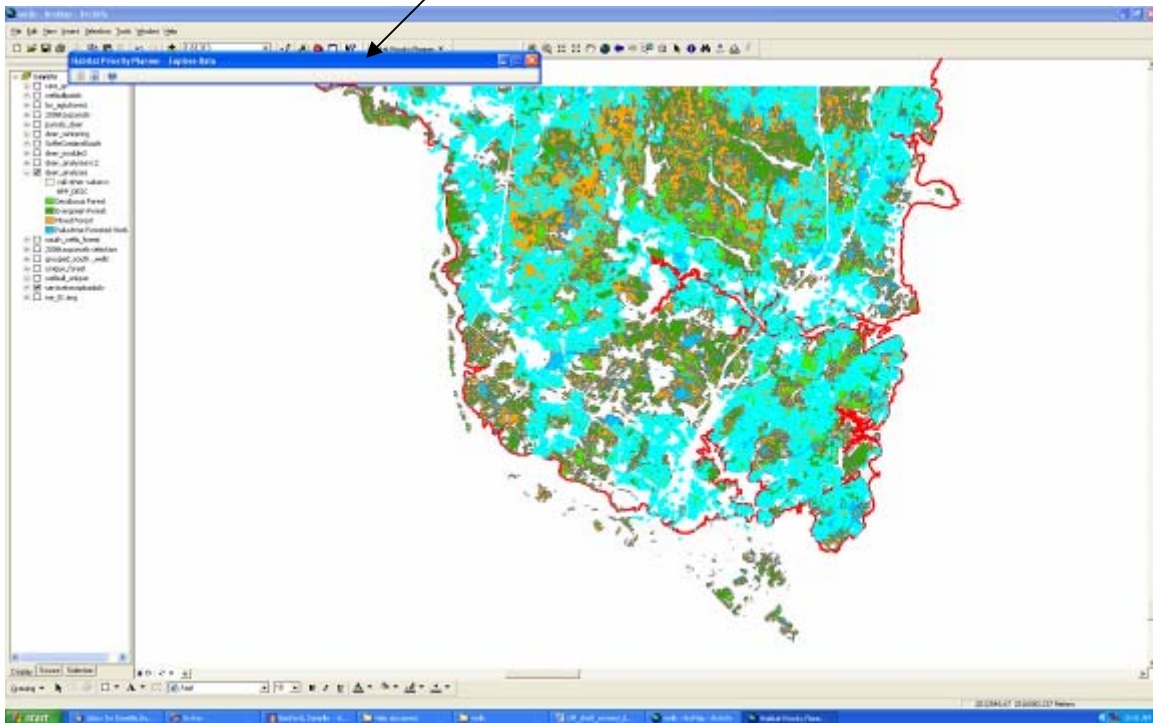
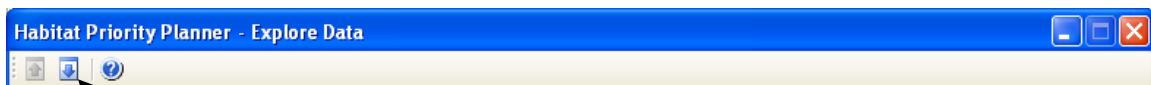


Figure 38. A selection as completed in the Explore Data module.

- The Explore Data window may be minimized using the arrows at the top left of the window. This feature is useful when the tool is being used in a group setting to minimize its impact on the map view.



The arrows are used to minimize and maximize the window view.

Figure 39. Explore Data minimize and maximize buttons.

The Advanced Mode – Explore Data

If you click on the “advanced mode” of the Habitat Priority Planner, the statistics box and query builder windows will be available.

If you are satisfied with your selection,

1. Click the “Add Selection to Query Builder” box below the statistics box.
 - The selection will then appear in the query builder box to the right.

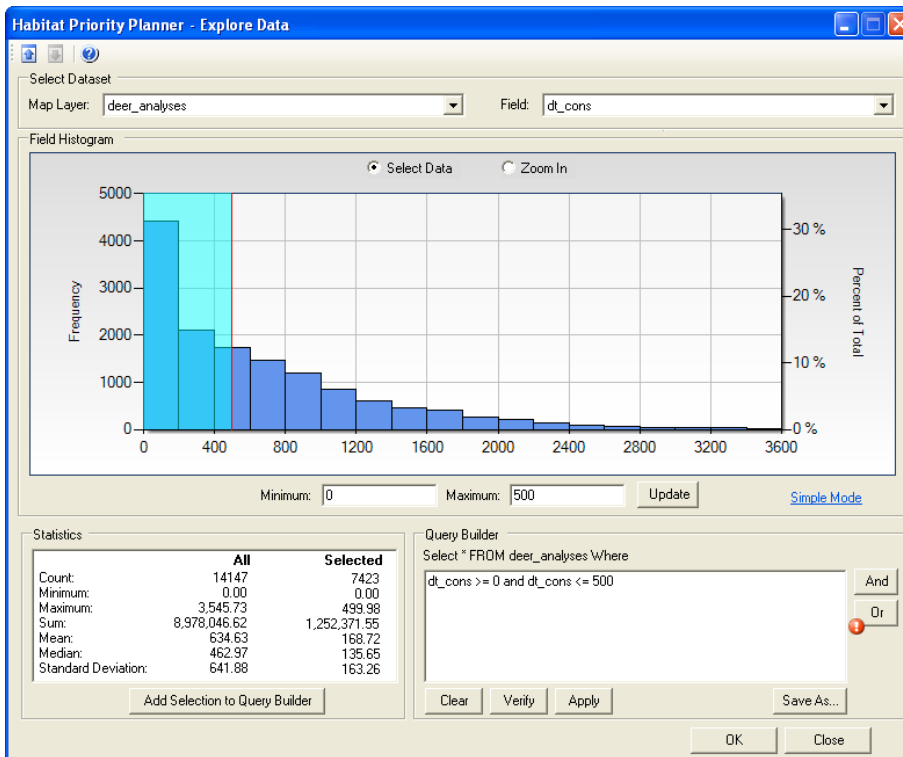


Figure 40. The results of a query.

2. Click Verify to ensure that the query was written correctly.

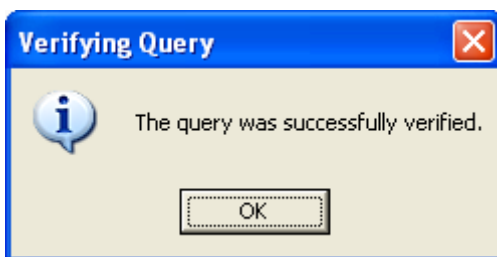


Figure 41. Successful verification.

3. Click Apply to confirm the selection on your dataset.
 - Instead of a visual outlined in blue, the user now has a live selection displaying *only those patches* that fit the user-specified criteria.

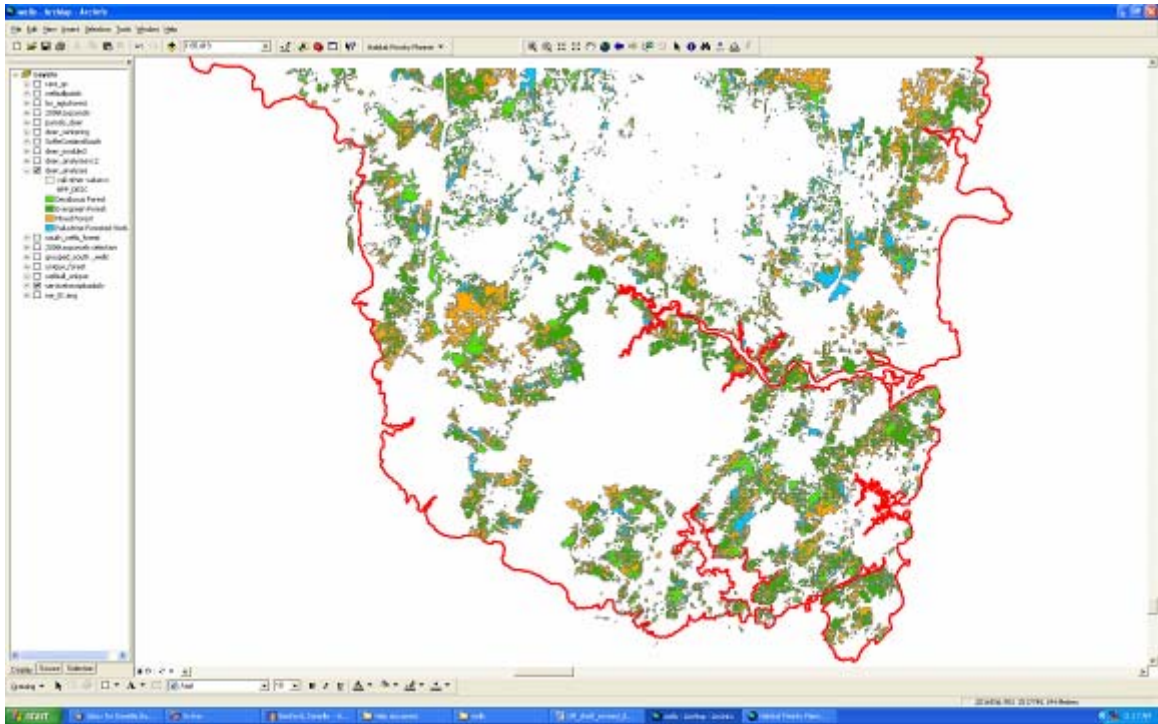


Figure 42. The applied selection in Explore Data.

- 4. Click Save As,** and save the new layer in your file geodatabase.
- 5. Click OK,** to create your new Explore Data Selection layer.

6 Interpreting Results from the Habitat Priority Planner

Although HPP can be used with a limited knowledge of GIS, the most accurate interpretation of analysis results requires a full understanding of the concepts and limitations of landscape ecology and ecological spatial analysis. This can be accomplished either by the user having the sufficient professional spatial analysis knowledge or working with a professional who has specific knowledge. *Ideally a team of experienced users with varied skill sets would collaborate in the use of HPP to generate habitat priorities and guide the operation of the tool.*

The priority habitat areas that you select using the Explore Data module results in a map of those places in the landscape or seascape which match your chosen criteria. This map will help you target only those geographic areas that are deemed important by you and your stakeholder group to inform ongoing conservation and restoration action planning. HPP helps users focus on specific locations for planning “on the ground” actions, ultimately saving you time and money through screening level assessment.

Specific result interpretation will vary by user purpose, the classified raster layer, supporting data, and metrics used for analysis. We are willing to provide limited assistance to partner organizations and users in application development where appropriate. For tool support and to connect with other users please join our electronic mailing list on the HPP Web site (<http://www.csc.noaa.gov/hpp/>).

6 Conclusions

Appendix A: Core Metrics

This appendix contains a description of each of the core and custom metrics that are available for analysis in the Habitat Priority Planner. The basic model that was used to build these queries is also available for several metrics.

A.1 Size

Ecological Importance:

- The size of a contiguous habitat patch helps determine the contribution of the patch to overall ecosystem and species health.
- Generally, the larger the area of continuous habitat, the better the habitat quality.

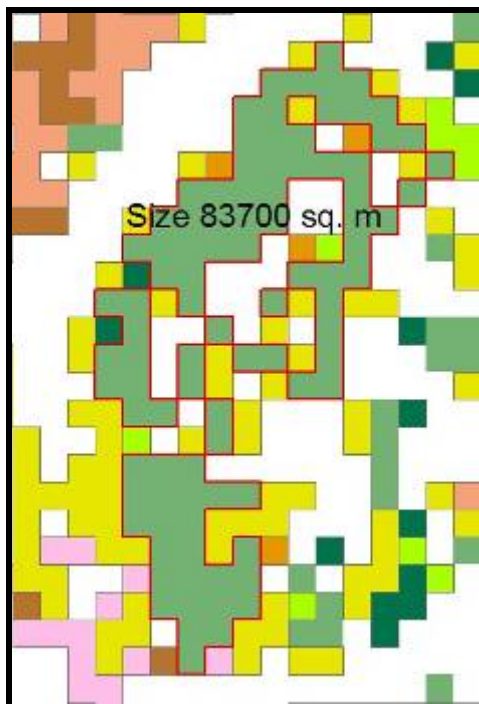


Figure 1. Size of the patch outlined in red.

Process:

- Size is automatically calculated during the raster to polygon conversion in the Habitat Classification module. In the attribute table, both metric (hectares) and English (acres) area units are available for the size calculation.

A.2 Core Area

Ecological Importance:

- For many species, the core area of connected habitat patches (the area inside an exterior buffer) is critical.
- Core area provides information about patch shape, and the ratios of patch edge to internal area. A patch may have a substantial size but no significant core area (e.g., a patch shape which is long and narrow).

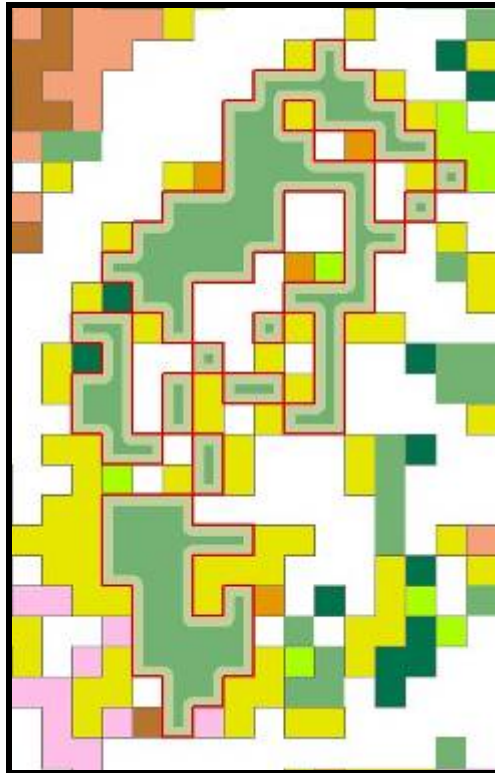


Figure 2. Core area graphic.

Example: Core area is calculated based on the remaining green area of the patch after subtracting out the area of the user-defined internal buffer.

Process:

- Core area is calculated by performing an internal buffer on each patch polygon and then subtracting the area of that buffer from the area of the original polygon. The units for this metric is returned in the units (hectares or acres) defined by the user in the wizard.

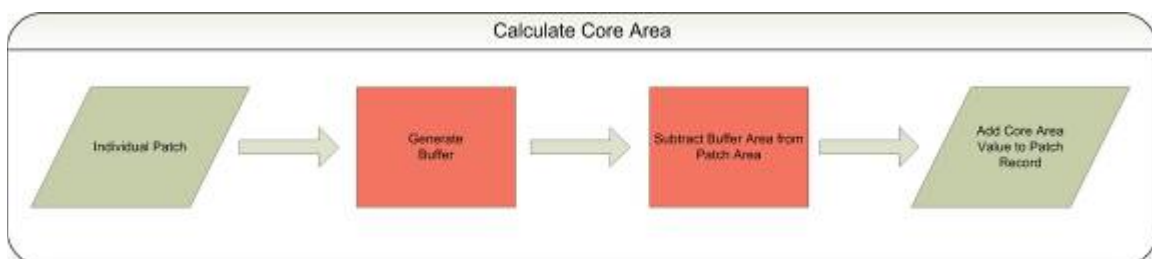
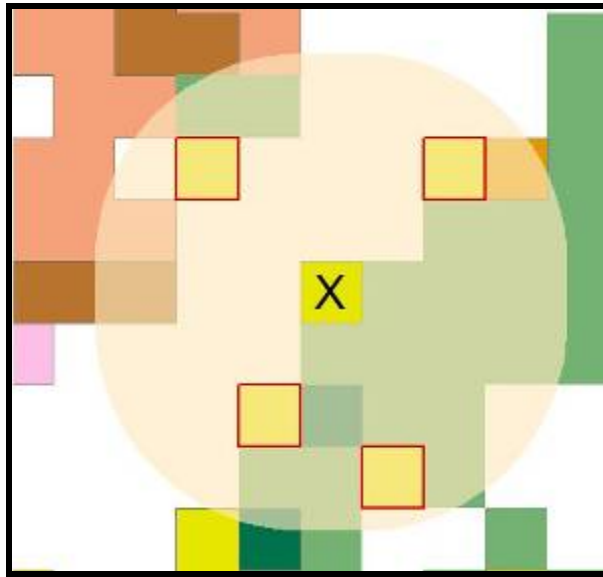


Figure 3. Core area logic model.

A.3 Proximity

Ecological Importance

- This metric assesses the quantity of like-typed habitats within a user-defined buffer distance from the patch of interest, a robust measure of connectivity among habitats.
- Proximity is one measure of landscape configuration, in this case how dispersed or clumped patches are on the landscape.



Example: Proximity buffer of 100 meters from the yellow patch with the X in it.

Figure 4. Proximity graphic.

Process:

The proximity measurement is generated by creating a buffer (the radius of the buffer is defined by the user in the wizard) around the edge of each patch polygon. The intersected area of like-typed patches inside the resulting buffer is used to generate the raw area value for returned in this metric. The percent area of like-typed habitat in the buffer is calculated by dividing the raw area identified above by the area of the buffer. The values returned for this measure are the raw area (acres or hectares) of like-typed habitat within the buffer and the percent area of the buffer that is like-typed habitat.

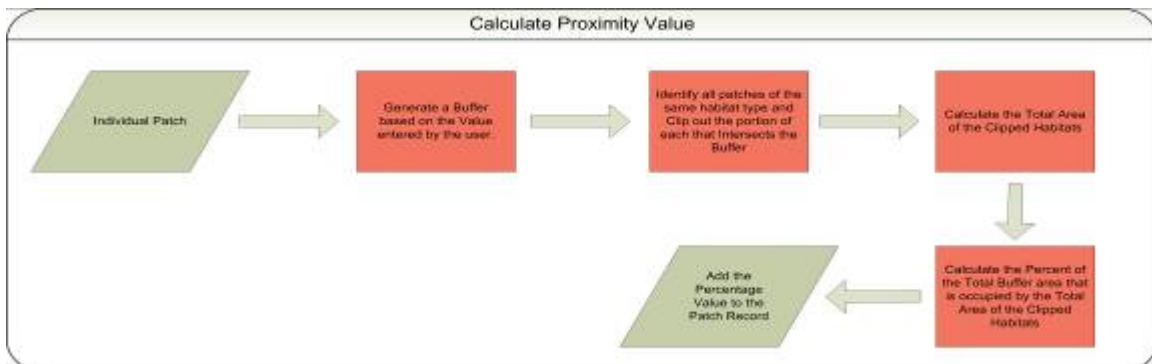
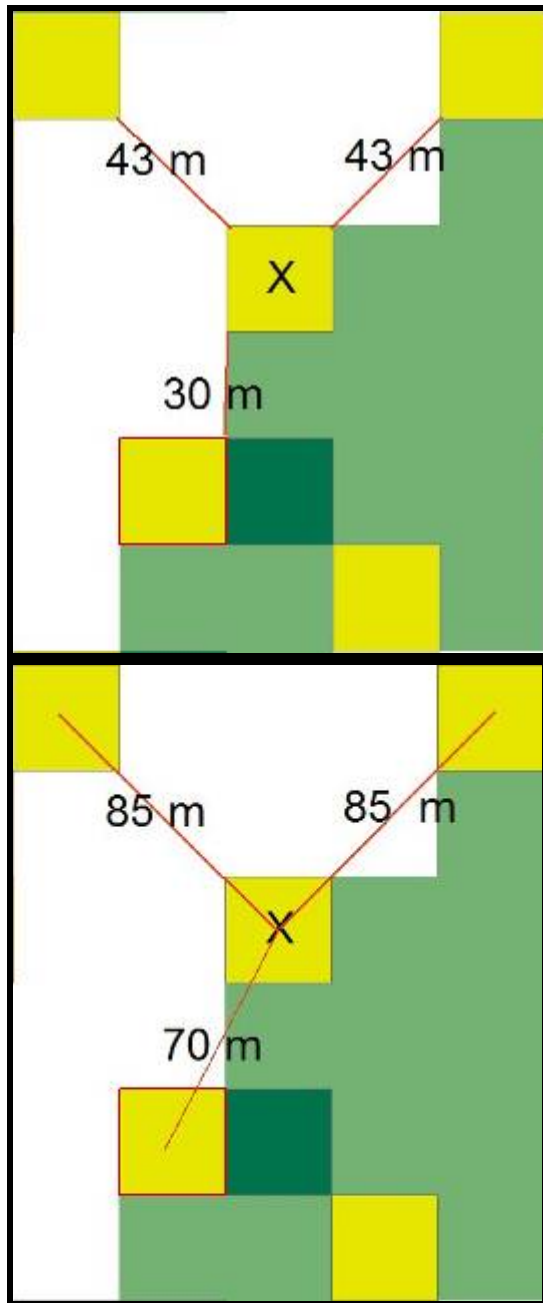


Figure 5. Proximity logic model.

A.4 Nearest Neighbor

Ecological Importance:

- This metric answers the question: “How close is the nearest habitat that matches the type of habitat in the focal patch?”
- A nearest neighbor is the neighbor with the least physical separation.



Example: Edge to edge measurement.

Example: Center to center measurement.

Figure 6. Nearest Neighbor graphic.

Process:

- The units for this metric is returned in the units (hectares or acres) defined by the user in the wizard.

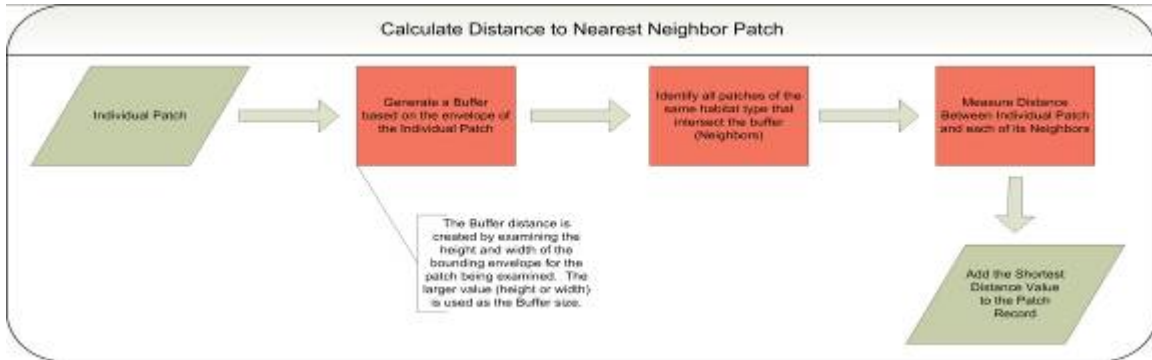


Figure 7. Nearest Neighbor logic model.

A.4 Perimeter to Area ratio

Ecological Importance:

- Reflects both the area and shape of a patch, is a strong predictor of both individual species presence and overall species richness.
- Presence Absence is calculated by averaging the perimeter to area ratio for all polygons present.

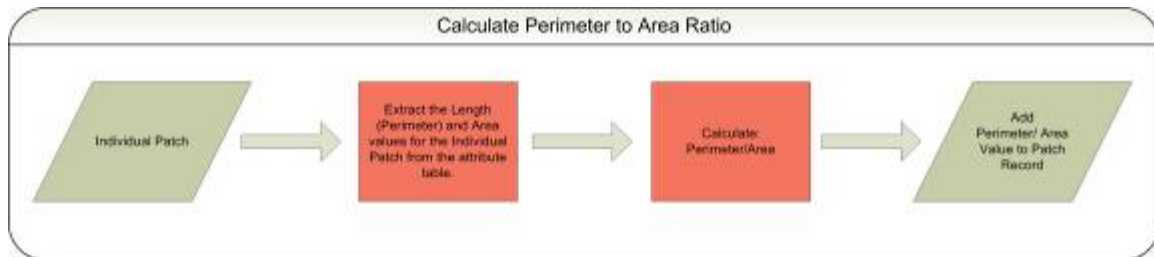


Figure 8. Perimeter to area logic model.

Appendix B: Custom Metrics

B.1 Definitions by Feature Type

- **Point**

Count: A count of the number of points from the user-defined point layer that fall within the patch.

Distance to feature: Linear distance from the edge of the patch to the nearest point feature.

Presence/Absence: Indicates whether a user-defined point feature is present *within* the boundary of the patch. Values: True or False.

- **Line**

Linear distance within patch: Summation of the length of user-defined linear feature that falls entirely within the patch. The value is listed in user-defined units of feet or meters.

Distance to Feature: Linear distance from the edge of the patch to the nearest user-defined linear feature. The value is listed in user-defined units of feet or meters.

Presence/Absence: Indicates whether a user-defined linear feature is present *within* the boundary of the patch. Values: True or False.

- **Polygon**

Overlap area: Summation of the area of overlap between the patch and a user-defined polygon file. This area is provided in either acreage or hectares and percentage of overlap.

Distance to feature: Linear distance from the edge of the patch to the edge of the nearest user-defined polygon. The value is listed in user-defined units of feet or meters.

Presence/Absence: Indicates whether a user-defined polygon feature intersects the boundary of the patch. Values: True or False.

B.2 Custom Metric Logic Models

1. *Count*

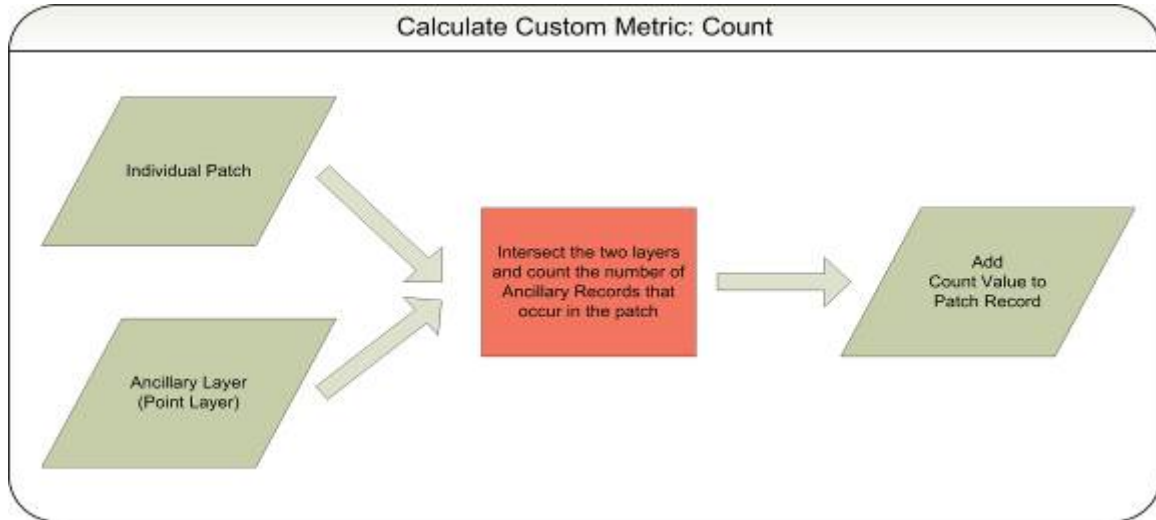


Figure 1. Custom metric, count, model calculation.

2. *Distance To*

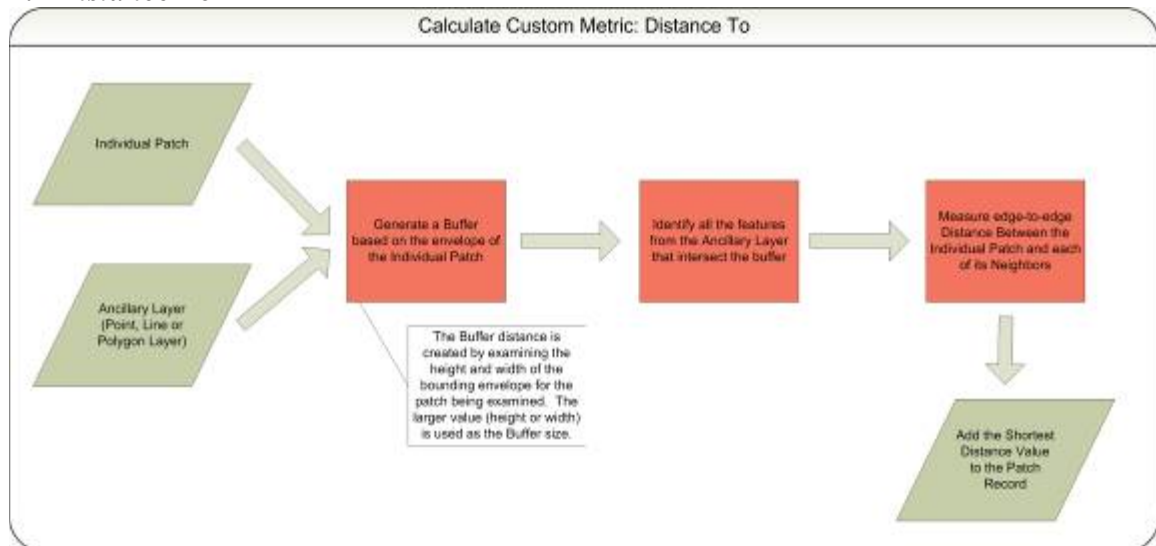


Figure 2. Custom metric, distance to, model calculation.

3. Presence/Absence

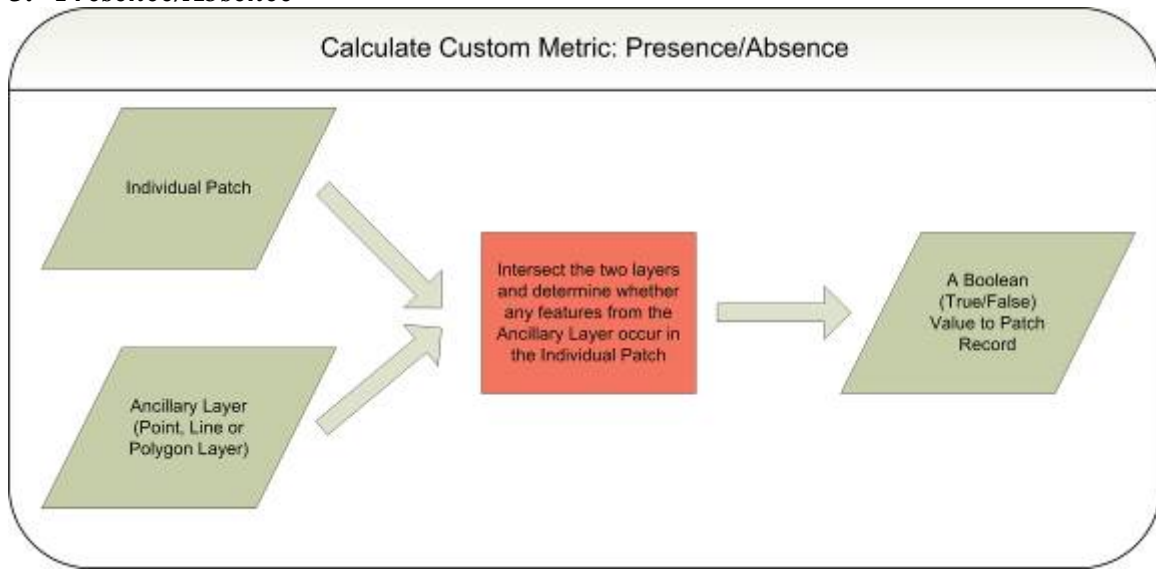


Figure 3. Custom metric, presence/absence, model calculation.

4. Polygon Overlay

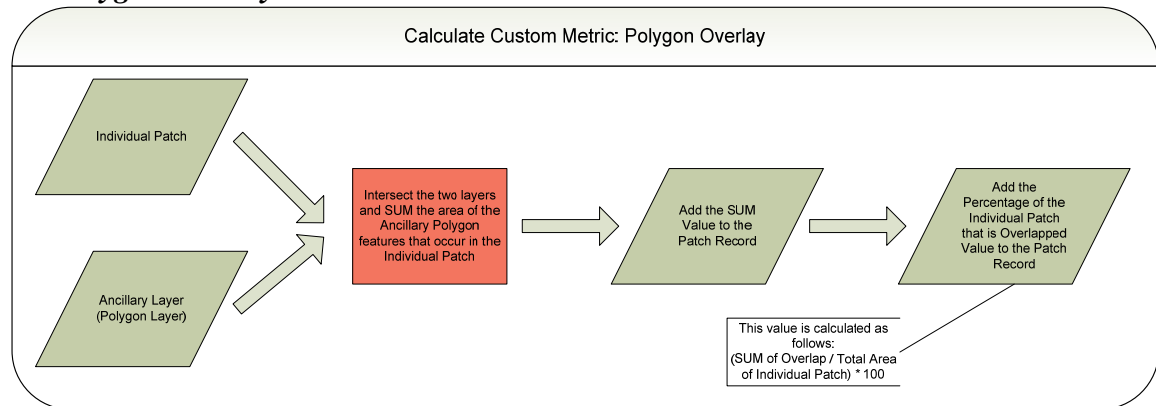


Figure 4. Custom metric, polygon overlay, model calculation.

Appendix C: A List of Resources to Get You Going

C.1 FRAGSTATS: Giving Credit Where it is Due

Most of the inspiration of exploring landscape pattern metrics in computer-based analysis environment goes to Dr. Kevin McGarigal and Barbara Marks and their seminal software tool called FRAGSTATS, originally developed in 1995. Please visit the [FRAGSTATS Web site](#) to learn more about this tool. Those users who wish to further explore the world of landscape metrics will want to download and use FRAGSTATS.

The Habitat Priority Planner tool computes a very simplified subset of the habitat metrics available in FRAGSTATS, but unlike FRAGSTATS it allows the user to bring a number of other spatial datasets into the analysis. Most importantly, it provides an easy way to explore the data with a group of stakeholders in a map-based environment, a much-needed enhancement to assist with tool deployment in the field.

C.2 Landscape and Ecological Spatial Resources

The following list of resources is meant to provide a basic introduction to the concepts that are incorporated into the Habitat Priority Planner. These resources are also provided to generate confidence in the use of spatially-centric methods and to provide avenues for further exploration.

Non-NOAA Web Resources:

- [Glossary of Landscape Ecological Terms](#)
- [An Overview of Landscape Metrics](#)
- [The Nature Conservancy's Conservation By Design Gateway](#)
- [Conservation Measures Partnership](#)
- [Landscape Ecology from Wikipedia](#)

Supporting Literature

Overview and Introductory Materials

Meffe, G.K., L.A. Nielsen, R.L. Knight, and D.A. Schenborn. 2002. *Ecosystem Management: Adaptive Community-Based Conservation*. Island Press. ISBN 1-55963-824-9. See Chapter 8: Landscape Level Conservation.

Andren, H. 1994. Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: A review. *Oikos* 71:355-365.

Allen W.J. and M.J. Kilvington. 2005. Getting technical environmental information into watershed decision making. In *The Farmer's Decision: Balancing Successful Agricultural Production with Environmental Quality*. Ed. J.L. Hatfield. Soil and Water Conservation Society. pp. 45-61.

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Forman R.T.T. 1995. Some general principles of landscape and regional ecology. *Landscape Ecology* 10(3).

Salafsky, N. et al. 2002. Improving the practice of conservation: a conceptual framework and research agenda for conservation science. *Conservation Biology* 16(6).

Journal Articles Exploring the Spatial Approach to Habitat Prioritization

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- Fred, M.S. and J.E. Brommer. 2003. Influence of habitat quality and patch size on occupancy and persistence in two populations of the Apollo Butterfly (*Parnassius Apollo*). *Journal of Insect Conservation* 7(2).
- Freudenberger, D. and L. Brooker. 2004. Development of the focal species approach for biodiversity conservation in the temperate agricultural zones of Australia. *Journal of Biodiversity and Conservation* 13(1).
- Grober-Dunsmore R. et al. 2007. Reef fish and habitat relationships in a Caribbean seascape: the importance of reef context. *Coral Reefs* 26(1).
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- Hines, J. et al. 2005. Sap-feeding insect communities as indicators of habitat fragmentation and nutrient subsidies. *Journal of Insect Conservation* 9(4).
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Zollner, P.A. Comparing the landscape level perceptual abilities of forest sciurids in fragmented agricultural landscapes. *Journal of Landscape Ecology* 15(6).