

# Forest Planning for Sensitive Wildlife Species

— by Alexandra Locher

## Introduction

---

### Problem

In many instances, natural resource managers and planners must consider the presence—and vegetation use by—threatened, endangered, or sensitive species. In this lab, presence of a sensitive (fictitious) species, the brown-winged owl, at a hunting club in northern Michigan imposes additional criteria necessary to develop and implement forest management plans for timber and game species. In this lab, students will assess habitat use by the owls and develop forest management considerations for conserving habitat.

Specifically, forest managers would like to know what vegetation types the owls are using for nesting; what percentage of nest locations are found within each cover type; where possible foraging sites are; the average, minimum, and maximum distances of nest sites from foraging sites; and how much forest is unavailable for timber harvesting due to presence of the nests.

### Location

The spatial data is in northern Lower Michigan. Brown-winged owls are fictitious, however. Thus, the coordinates of nesting locations are made up for the purpose of demonstrating geographic information system (GIS) techniques for solving problems related to sensitive wildlife species and forest management planning. The processes used to answer the spatial questions are applicable to any area where timber harvesting or wildlife management occurs.

### Time to complete the lab

This activity should take approximately one to three hours depending on technical experience.

*Keywords: forestry; land-use planning; sensitive wildlife species; timber harvest; wildlife habitat management; attribute queries; buffer; coordinate systems; creating map layouts; field calculator; geographic coordinate system; location queries; projections; proximity tools; spatial join; vector*

## Prerequisites

This exercise is intended for introductory- or intermediate-level students with limited background in GIS.

## Data used in this lab

- Land\_cov: Land cover (vector)
- Owl\_nest\_locs: Brown-winged owl locations (fictitious) (comma-delimited file)
- Land-cover information obtained from the Michigan Geographic Data Library (<http://www.mcgi.state.mi.us/mgdl>)
- Geographic coordinate system: GCS\_North\_American\_1927  
Datum: D\_North\_American\_1927
- Projection: Hotine\_Oblique\_Mercator\_Azimuthal\_Natural-Origin  
Name: NAD\_1927\_Michigan\_Georef\_Meters
- Projection information for fictitious owl locations  
Geographic coordinate system: Undefined  
Datum: WGS84  
Projection: Undefined  
Name: Undefined

## Student activity

---

In natural resources management, the presence of sensitive, threatened, or endangered species must be considered when developing land-use or management plans. Many private landowners who harvest timber want their property to be sustainable or certified under programs like the Sustainable Forestry Initiative. As such, landowners must ensure they are conserving habitat for wildlife species. In this scenario, pretend that you are the forest manager at a privately owned hunting club called Windfall Trails. The hunting club's land consists primarily of forest that is managed for timber and wildlife habitat (mainly deer and turkey). During your routine timber inspections, you observe a sensitive species, the brown-winged owl (a fictitious species) nesting in some forested stands adjacent to openings. You are aware that this owl lives in only a few counties within the state. You and your field technicians conduct a property-wide survey to assess the number and locations of brown-winged owls on the property. Governmental policies state that to protect habitat of this particular sensitive species, timber harvesting must not occur within a 10-hectare (ha) buffer of known nesting locations unless population densities exceed and remain above threshold levels.

As the forest manager at Windfall Trails, you would like to assess the owls' habitat use on your land—useful data to consider when developing management plans. Specifically, you are interested in understanding

- What vegetation types are the owls using for nesting?
- What percentage of nest locations occurs in each cover type?
- Where are possible foraging sites?
- What are the average, minimum, and maximum distances of nest sites from foraging sites?
- How much forested area is unavailable for timber harvesting due to presence of owl nests?


In addition, your supervisor and the club members would like to have a map illustrating all the above information.

Important information needed to solve the spatial problem includes

- All known nesting locations were recorded with a GPS receiver in units of decimal degrees using the WGS84 datum.
- Literature and prior research on brown-winged owls suggest that they forage for mice and other small rodents in herbaceous openings that are at least 0.4 ha (~1 acre) in size.
- Their home ranges are approximately 10 ha.

## ASSESS VEGETATION AND SPATIAL CHARACTERISTICS ASSOCIATED WITH BROWN-WINGED OWL NESTING LOCATIONS

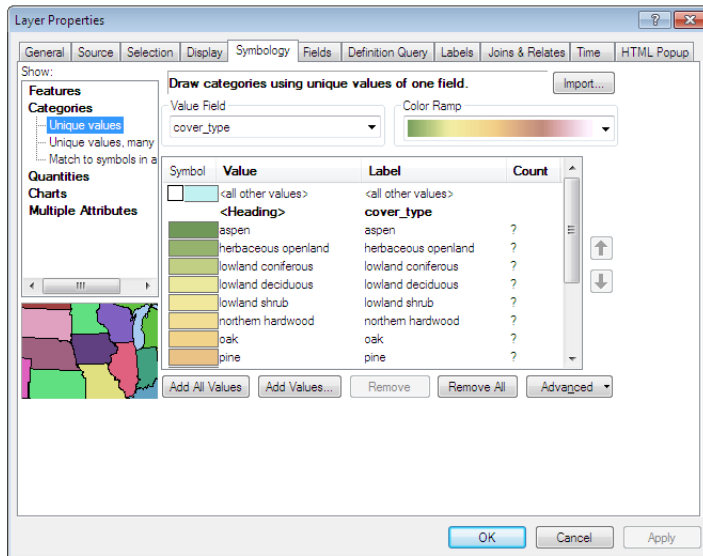
### ADD SPATIAL DATA TO ARCMAP

- 1 The only shapefile that you have to work with at this point is the *land\_cov.shp* file for Windfall Trails Hunt club. Add this file to ArcMap by using the *Add Data* button  or by dragging it from ArcCatalog.

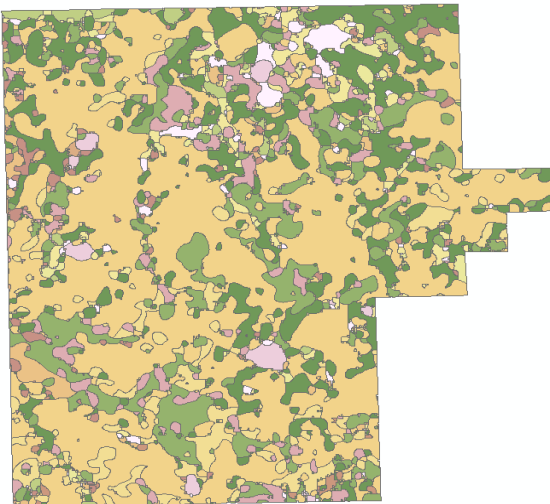
Once it is in ArcMap, change the colors to represent different vegetation types.

- 2 Right-click the shapefile name in the table of contents and select *Properties*.
- 3 On the *Layer Properties* dialog box, make sure the *Symbology* tab is selected.
- 4 On the left side of the box, click *Categories* and make sure *Unique values* is selected.
- 5 In the Value Field box, select *cover\_type*.
- 6 At the bottom of the window, click *Add All Values* and select the color ramp of your choice.

7 Uncheck the box next to <all other values> and click OK.



The map should resemble this:



### GET ALL DATA INTO A SPATIAL FORMAT

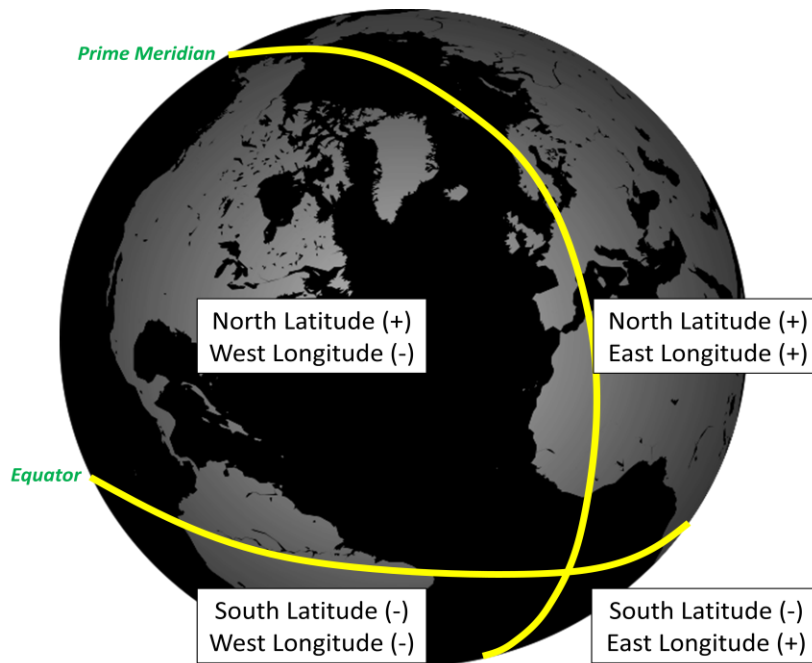
For this exercise, you have two datasets. One dataset is a land-cover shapefile that identifies the location of different vegetation types within the study area. The other dataset is a comma-delimited file that contains the locations of owl nesting locations.

As a GIS expert, you occasionally will receive nonspatial tabular data that you will need to incorporate into your GIS analysis. This is ordinarily not a problem, but there are certain


requirements that determine whether the nonspatial tabular data is useful. You can view the data using Microsoft Excel, another spreadsheet program, or ArcCatalog. First, ask yourself if there are any x,y coordinates in the table. If there are, you can use them to project the data spatially. If there are not any coordinates, can the data be joined to another spatially referenced table based on a common field? If not, the data is probably not going to be useful to you. In this case, the comma-delimited file does contain x,y coordinate information. There are two fields, latitude and longitude.

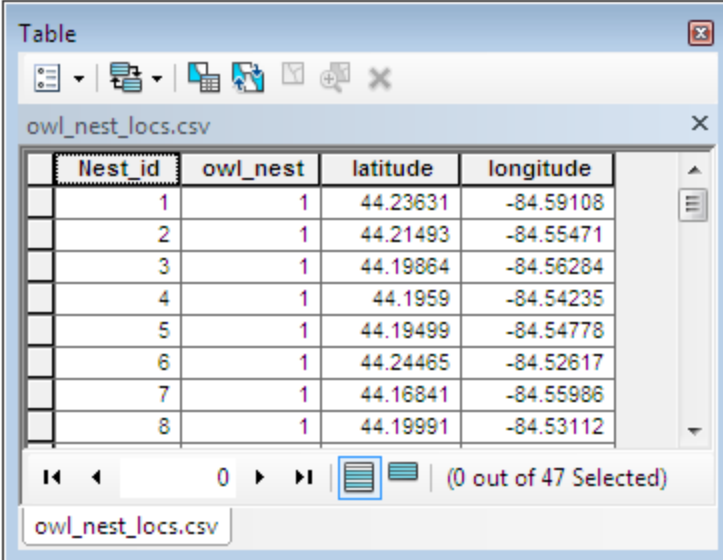
	A	B	C	D
1	Nest_id	owl_nest	latitude	longitude
2	1	1	44.23631	-84.5911
3	2	1	44.21493	-84.5547
4	3	1	44.19864	-84.5628
5	4	1	44.1959	-84.5424
6	5	1	44.19499	-84.5478
7	6	1	44.24465	-84.5262
8	7	1	44.16811	-84.5599

Notice that the longitude field is negative. This is because latitude and longitude divide the earth into hemispheres and indicate location in different hemispheres with either positive or negative coordinates. Latitudes north of the equator (the northern hemisphere) are positive; latitudes south of the equator (the southern hemisphere) are negative. Longitudes west of the prime meridian are negative; those east of the prime meridian are positive. Because the hunting club is located in Michigan, USA, which is in the northwestern quadrant of the earth, latitude is positive and longitude is negative.



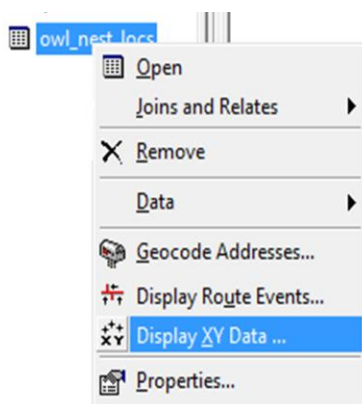
Now, you are ready to project the owl locations spatially and create a shapefile. This is accomplished by completing the following steps:

- 1 Add the owl nest location data into ArcMap by clicking the *Add Data* button  in ArcMap or simply dragging it from ArcCatalog.
- 2 Right-click the file to view the table and make sure that the data loaded correctly. The table should look like this:



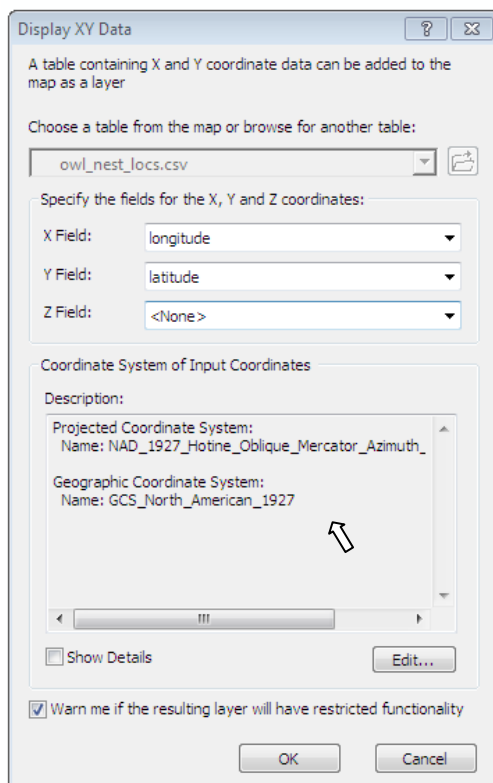
Nest_id	owl_nest	latitude	longitude
1	1	44.23631	-84.59108
2	1	44.21493	-84.55471
3	1	44.19864	-84.56284
4	1	44.1959	-84.54235
5	1	44.19499	-84.54778
6	1	44.24465	-84.52617
7	1	44.16841	-84.55986
8	1	44.19991	-84.53112

- 3 Right-click the file in the table of contents and select *Display XY Data*.

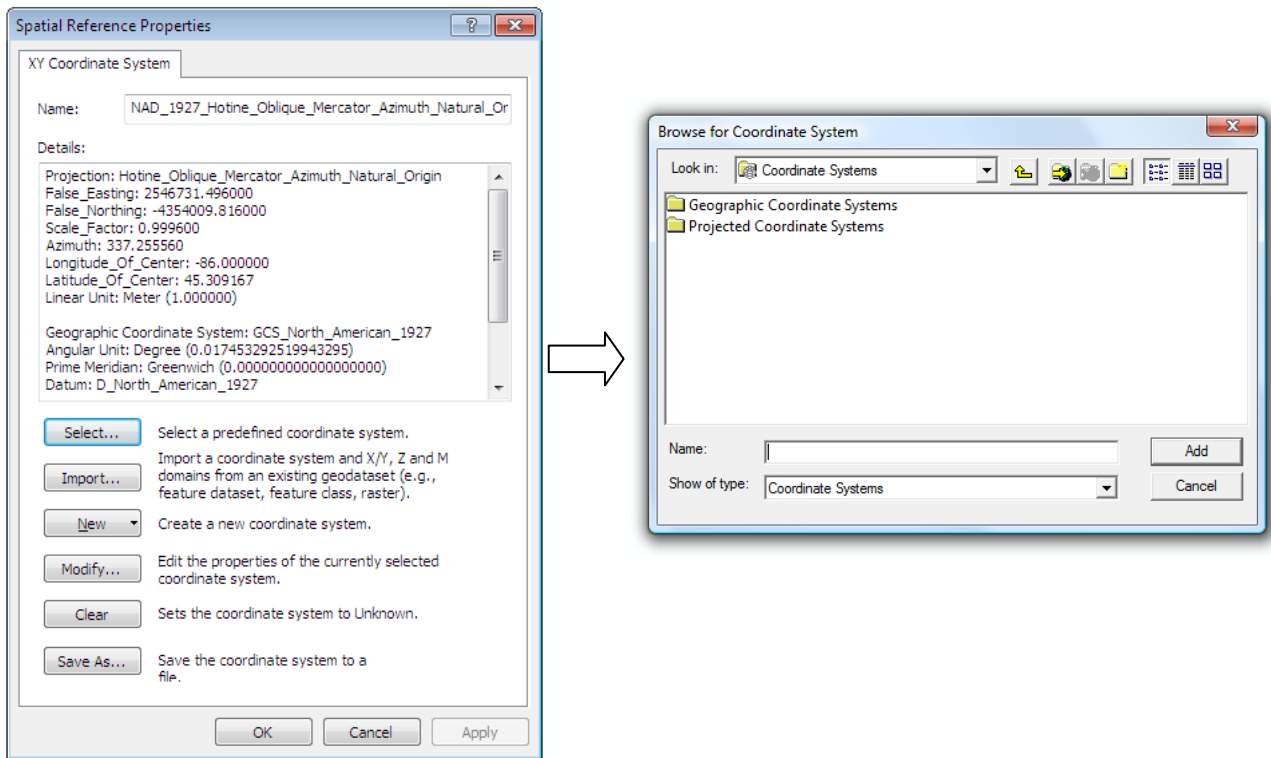


- 4 On the dialog box, specify the X field as *longitude* and the Y field as *latitude*. Because you want to make sure that the data is projected correctly, you need to define the coordinate system. Currently, the coordinate system is defined the same as the data frame, but this is not correct. You know this is not correct, because the nesting locations were recorded with a GPS receiver in

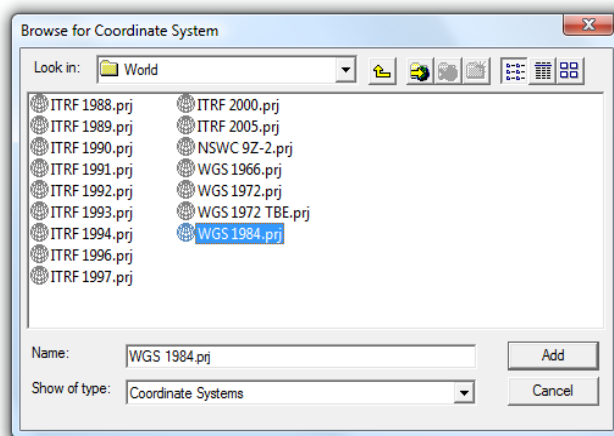
units of decimal degrees using the WGS84 datum. To fix the coordinate system, click the *Edit* button.



- On the *Spatial Reference Properties* dialog box, click the *Select* button to select a predefined coordinate system.



- Select *Geographic Coordinate Systems* » *World* » *WGS 1984.prj*. How do you know this? In the introductory information for this lab exercise, you were informed that the data was collected with a GPS receiver in units of decimal degrees using the WGS 1984 datum.

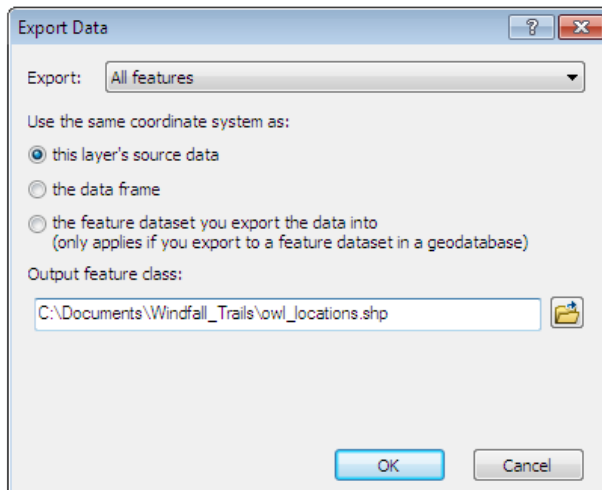


- Click *Add*. Click *OK*, then *OK* again.

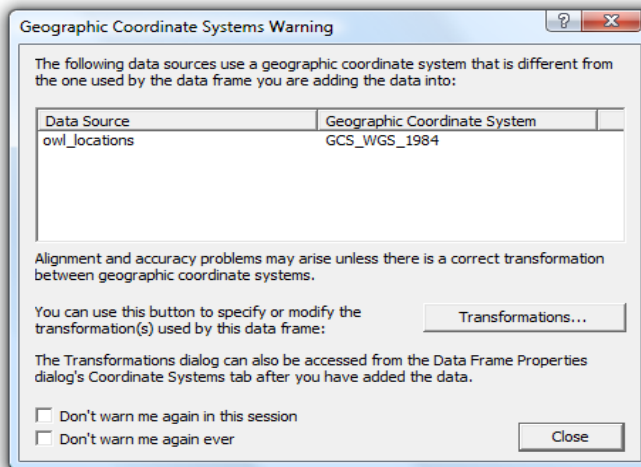


You may be wondering what the difference is between a geographic coordinate system and a projected coordinate system. This distinction is *very* important to understand. Geographic coordinate systems use angular measurements on a sphere to define location. Usually, these angular measurements are recorded in units of latitude and longitude. Because the earth resembles a sphere, lines of longitude converge at the poles. Thus, if the earth were flattened out or projected onto a flat surface, there would be some distortion in size, shape, area, or distance of the earth's features. Because of this, projected coordinate systems are used to mathematically convert locations on a spherical surface (geographic coordinate system) to locations on a flat surface (projection).

- 8 A box may now appear that indicates *Table Does not Have Object-ID Field*. Click *OK*. What you have created is an event layer. If you look at the name of the new file in the table of contents, you will see that it reads *owl\_nest\_locs.csv Events*. This is not a true shapefile. *Events* is a term given to point files that were created from x,y coordinates.
- 9 To create an actual shapefile, right-click the Event layer and select *Data » Export Data*. Then, specify the path where you would like to save the file and name the file something descriptive such as *owl\_locations.shp*. Accept the default for the coordinate system—*this layer's source data*.



- 10 Indicate that you would like the shapefile added to the view. Everything appears okay. The nesting locations seem to overlay nicely on the land-cover map of Windfall Trails. However, everything is not quite okay; you may even have gotten a message similar to the one below telling you that the coordinate system is different from the other data in the view.





Even if you did not get this message, it is very important that you make sure the coordinate systems of all your spatial data match. Otherwise, when you start geoprocessing or conducting advanced spatial analyses, results could be erroneous. The reason that the data appears to overlay correctly is because ArcMap projects on the fly, which means that if there is a defined coordinate system—even if it is different from the projection in the data view or the other shapefiles—the data overlays for visual purposes. Mathematically, however, the data may not line up correctly. So it's best to project the data into a coordinate system that corresponds to the other datasets.

In step 9, if you specified that ArcMap use the same coordinates as the data frame, your new shapefile would have the same coordinates as the *land\_cov* shapefile. The coordinate system of the data frame is the same as the first layer added to the data frame.


Because you do not have the same coordinates as the data frame and the *land\_cov* shapefile, you will go through the steps to project spatial data.

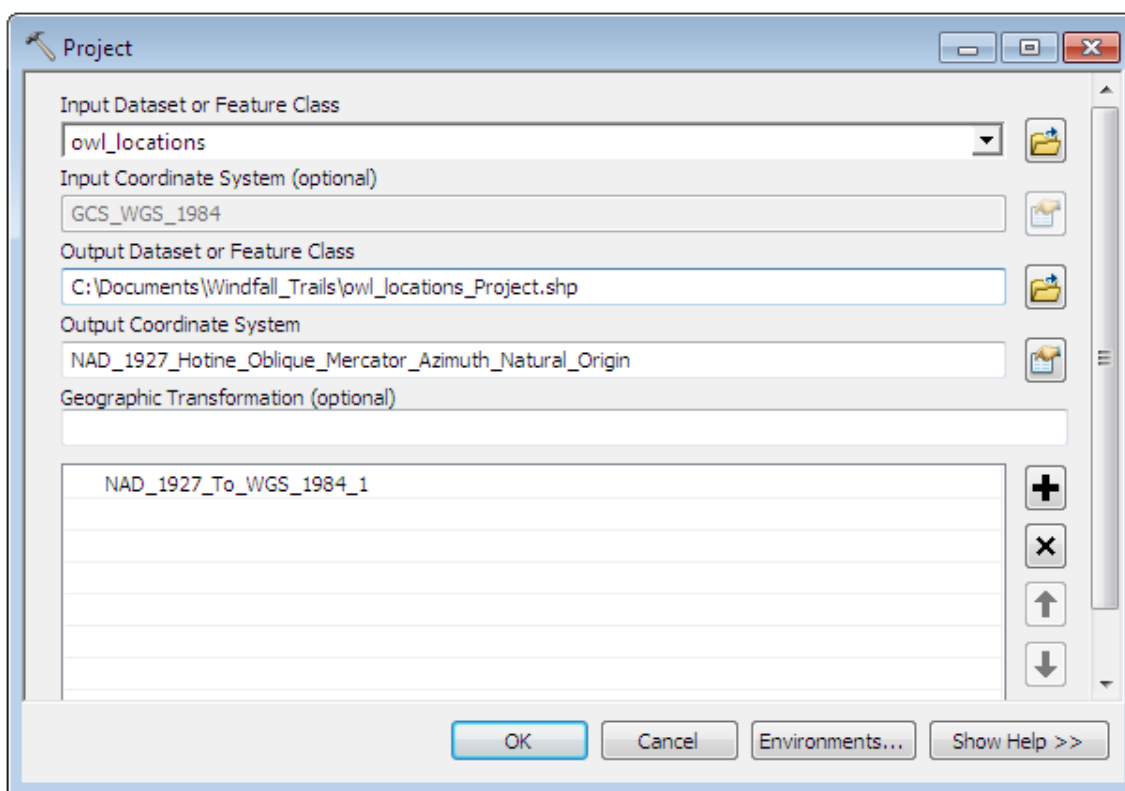
## Projecting spatial data

- 1 If ArcToolbox isn't displayed, click the button with the little red toolbox on it: .
- 2 Navigate to *Data Management Tools* » *Projections and Transformations* » *Feature* » *Project*.
- 3 Alternatively, you could search for the correct tool if you did not know what tool to select. To search for tools, click this button: .
- 4 You are interested in projecting the spatial data, so type the keyword *Project* into the search box and click *Search*. The first two tool options (indicated by the hammer icon) are *Define Projection* and *Project*.

*Note: It's a common mistake to select Define Projection. The reason that it is not appropriate to define the projection in this case is that you already defined a coordinate system when the file was*

created (see step 6 in the previous section). What you need to do now is reproject the data so that the coordinates are the same as the land-cover shapefile.

- 5 Select the *Project* tool.
- 6 On the *Project* dialog box, do the following:
  - a. Input the *owl\_locations* shapefile and specify where you would like to save the new projected shapefile (under *Output Dataset or Feature Class*). Name the file *owl\_locations\_Project.shp*.
  - b. To make sure you have the correct output coordinate system, click the  button to the right of the box, select *Import*, and navigate to the space where the *land\_cov.shp* shapefile is stored. After selecting *Add*, the new coordinate system should be indicated in the box. Click *OK*.
  - c. Finally, specify a geographic transformation. The first option will do, so select it and click *OK*.



Voila! You have a new projected shapefile in the same coordinate system as the rest of your data.

- Now, to remain organized, you can delete extraneous files from the project. You can remove *owl\_locations*, *owl\_nest\_locs.csv Events*, and *owl\_nest\_locs.csv* by right-clicking the file in the table of contents and selecting *Remove*.

### SPATIAL ANALYSIS TO UNDERSTAND OWL NESTING HABITAT CHARACTERISTICS

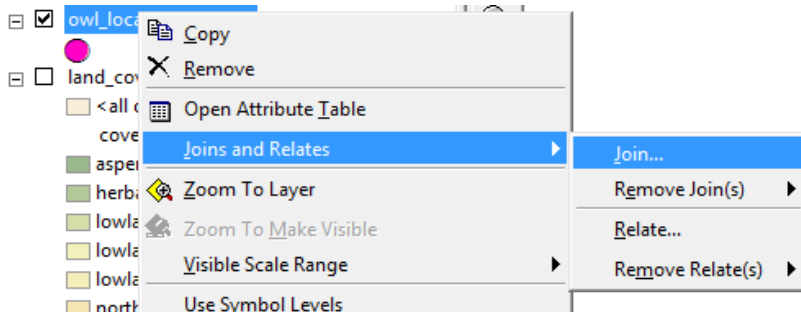
To understand what vegetation types the owls are using for nesting and what percentage of nests are found in different vegetation types, visualize what type of information you would need in the end product. Visualizing the end product might make a solution easier to identify. For instance, you probably are visualizing a table that is constructed similarly to this:

Vegetation Type	Number of Nests	Percentage of Nests

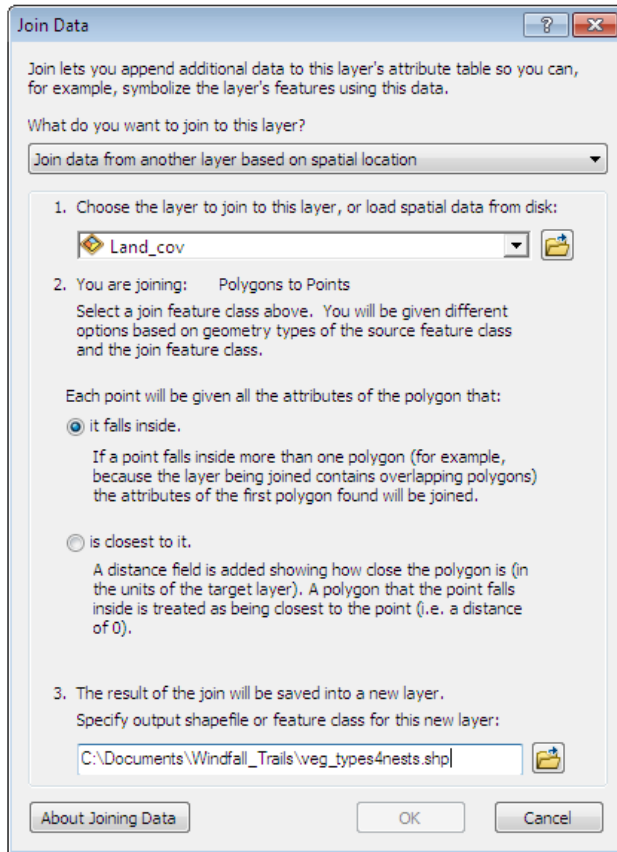
A good way to get a result like this is to use a spatial join. There are multiple ways to conduct a spatial join. The steps below describe one way.

#### Spatial Join

- Right-click the *owl\_locations\_Project* shapefile. Select *Joins and Relates » Join*.



- You will perform a spatial join based on the location that two different shapefiles have in common. So, on the dialog box, choose *Join data from another layer based on spatial location*. The layer you want to join is, of course, the *land\_cov* shapefile. Make sure to specify *it falls inside* so that each point will be given the attributes of the polygon it is inside of.
- Name the new file something descriptive, such as *veg\_types4nests.shp*. Click *OK*.



- 4 Open the attribute table of the new layer. Data from the land cover and owl nesting locations shapefiles are combined into one table. You can scroll through it and see what vegetation types the owls are using for nesting (oak, northern hardwood, upland mixed, and aspen). It should resemble the illustration below:

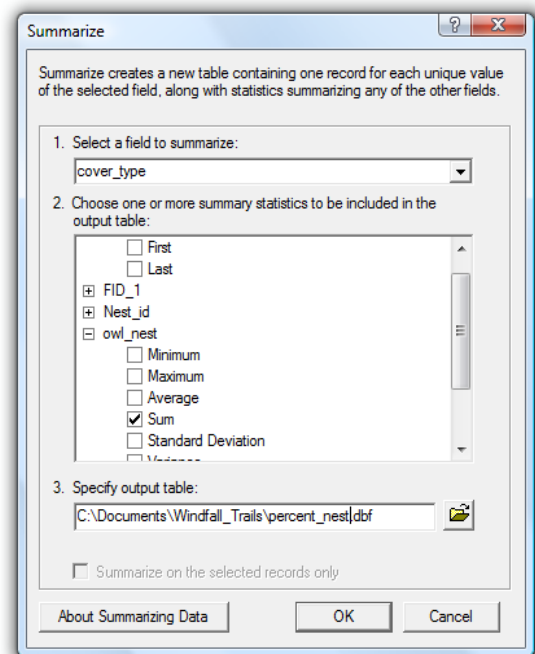
FID	Shape	OBJECTID	Nest_id	owl_nest	latitude	longitude
0	Point	36	36	1	44.24141	-84.54879
1	Point	22	22	1	44.24174	-84.57319
2	Point	6	6	1	44.24465	-84.52617
3	Point	1	1	1	44.23631	-84.59108
4	Point	25	25	1	44.23839	-84.57291
5	Point	26	26	1	44.23476	-84.57448
6	Point	15	15	1	44.23131	-84.52034

So, now you have answered the first question. Here are some additional things to think about with regard to the biology of the owls. You know what vegetation types the owls are using for nesting. How many vegetation types are they using in relation to the total number of available vegetation types? Do the owls use upland (dry) or lowland/wetland areas? How do you suppose the owls select vegetation types?

### Summarize

From the spatially joined table, you can easily determine the percentage of owl nesting locations within each cover type. The capability to summarize lets you do that easily.

- 1 Right-click the *cover\_type* field and select *Summarize*. Click the plus sign (+) next to *owl\_nest* and select *Sum* to be included in the output table. This option will tabulate the total number of nests within each cover type. Name the file *percent\_nest*. Make sure that it is saved as a dBASE Table.

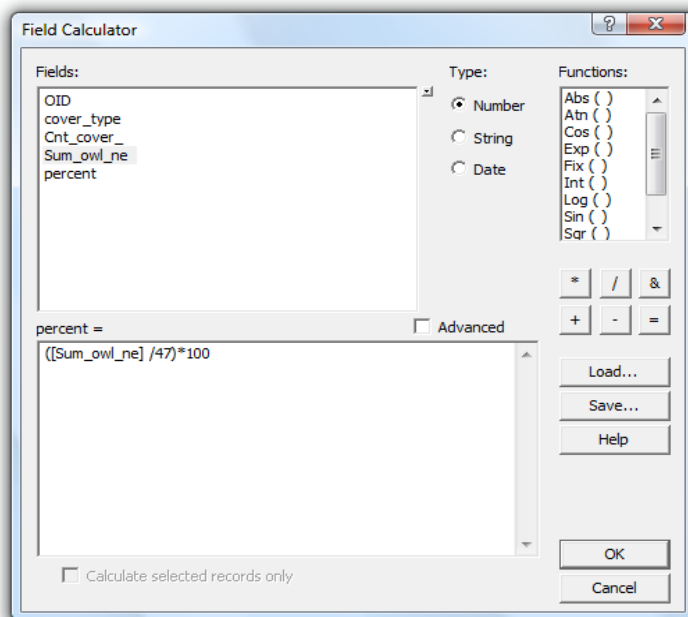


- 2 Click *yes* to add the resultant table to the map.

OID	cover_type	Count_cover_type	Sum_owl_nest
0	aspen	11	11
1	northern hardwood	3	3
2	oak	32	32
3	upland mixed	1	1

Looks good, but you need percentages of nests within each cover type. You will use the Field Calculator. But first, you need to create a new field.

- 3 Click the *Table Options* at the upper left side of the table and select *Add Field*.
- 4 On the dialog box, name the new field *Percent*, specify the *Type* as *Float* with a *Precision* of *10* and a *Scale* of *2*. Select *Float*, because you need decimal places in the value. Precision indicates the number of digits the field can hold; Scale indicates the number of digits to the right of the decimal.
- 5 Click *OK*.
- 6 Right-click the new *Percent* field and select *Field Calculator*.
- 7 You know that there are 47 total nests. So, to get a percentage of nests within each cover type, divide the number of nests within each cover type by 47 and multiply by 100. Click *OK*.



Now you have successfully determined the percentage of nest locations in each vegetation type. What might be an effective way to represent this information? You might include this information in the map layout, or you might append a table to a report document.

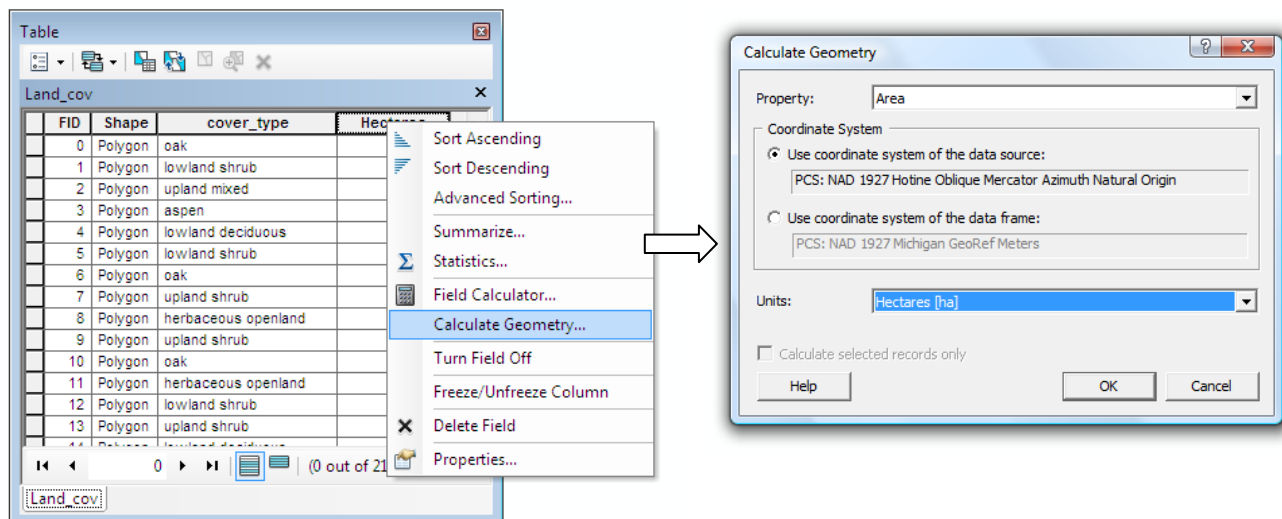
What do you suppose the percentages mean? What land-cover type has the highest percentage of nesting use? What characteristics of the vegetation might affect whether an owl selects it for nesting?

## ATTRIBUTE QUERIES AND PROXIMITY ANALYSIS TO UNDERSTAND SPATIAL RELATIONSHIP BETWEEN NESTING AND FORAGING HABITATS

You want to determine possible foraging locations and the maximum distance from a nesting site to a foraging site. You know that the owls forage in herbaceous openings at least 0.4 ha in size. Therefore, you can identify foraging locations using a simple attribute query to select all herbaceous openings  $\geq 0.4$  ha. But first, you need an attribute that indicates area. Fortunately, you can do this using *Calculate Geometry*.

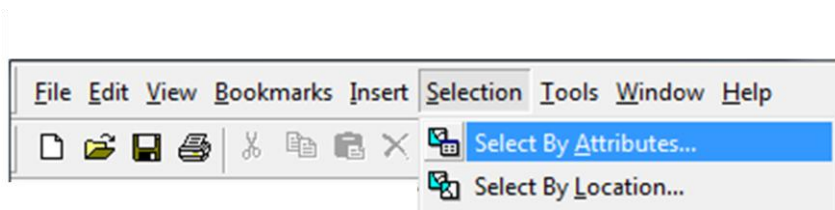
### Determine area using *Calculate Geometry*

- 1 Add a new field to the attribute table of the *land\_cov* shapefile. Name it *Hectares* and specify the type as *Float* with a precision of *10* and a scale of *2*. Click *OK*.
- 2 Right-click the *Hectares* field and select *Calculate Geometry*. A new box will pop up where you will specify that you want to calculate area in units of hectares.



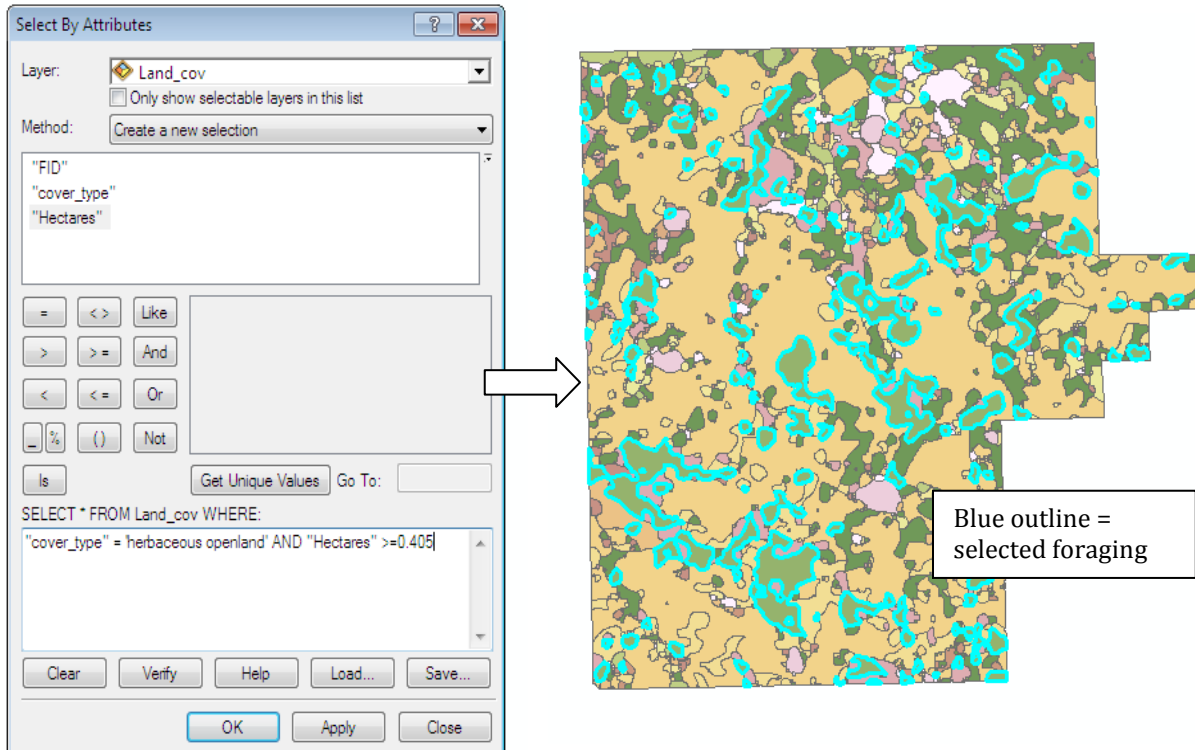
### Attribute query

- 1 You can conduct your attribute query to find foraging sites. In the menu options at the top of the screen, navigate to *Selection » Select By Attributes*.






- 2 You need to identify areas with two properties: cover type = herbaceous openland (in the *land\_cov* layer) and hectares  $\geq 0.4$ . This query should result in 139 records being selected from the *land\_cov* shapefile. You can look at the map and see which polygons have been selected that meet the foraging habitat criteria.

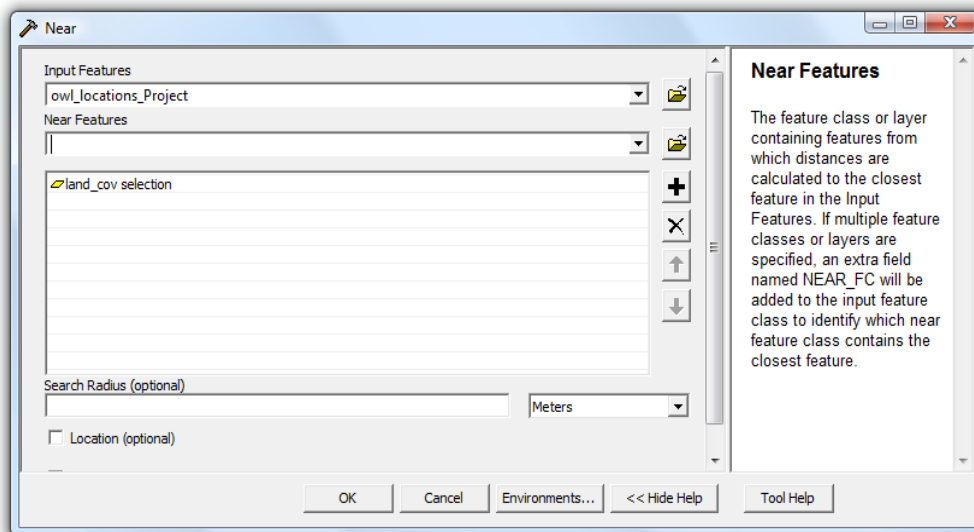


- 3 Make a new layer from the selected polygons by right-clicking the *land\_cov* shapefile and selecting *Selection » Create layer from selected features*. This essentially hides everything else that is not selected so that you can use the selected features for further analysis. The name of this file is *land\_cov selection*. You can rename it if you wish. Be sure to clear all selections.

Thought question: What do you notice about the distribution of foraging areas in relation to nesting areas? In the next several steps, you will determine the distances between nesting locations and foraging sites. Often, wildlife biologists are interested in knowing this type of information to create habitat management plans.

## Proximity

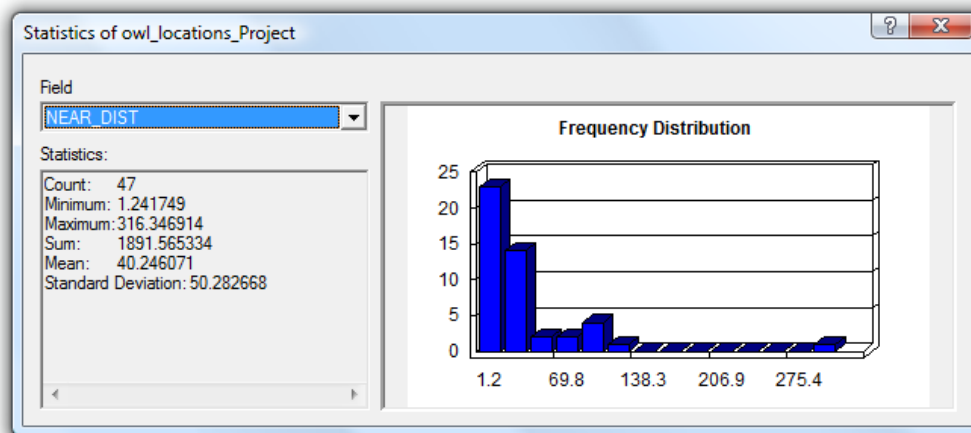
- 1 To determine the maximum distance from a nest site to a foraging site, you can conduct another spatial join or use the *Proximity* tool *Near*. An ArcInfo license is required to use this tool. If you do not have access to this tool, you can conduct another spatial join on the *owl\_locations\_Project* shapefile. You would join it to the *land\_cov* shapefile, and on the *Join Data* dialog box, you would specify *Each point will be given all of the attributes of the polygon that is closest to it.* (See "Spatial Join," step 4, for an illustration. Once completed, resume with "Statistics," step 1.) If you do have access to use the *Near* tool, proceed with step 2, below.
- 2 Using the search button (  ), conduct a search for *near*. Select the *Near* tool—it should be close to the top. You can also locate the tool by navigating to *Analysis Tools* » *Proximity* » *Near*.
- 3 On the *Near* dialog box, make sure your input features are the owl locations and the near features are the foraging sites. Click *OK*.



- 4 If you open the attribute table of the shapefile containing owl locations, you will notice that the *Near* tool created two new fields: *NEAR\_FID* and *NEAR\_DIST*. The *NEAR\_FID* field is a numerical identification for each record. The *NEAR\_DIST* field contains the distance from each nesting site to the nearest foraging site. Now you can determine the average, minimum, and maximum distances from nesting sites to foraging sites by using *Statistics*.

## Statistics

- 1 Right-click the *NEAR\_DIST* field and select *Statistics*. The minimum distance is 1.24 m, the maximum distance is 316.35 m, and the average distance is 40.25 m.

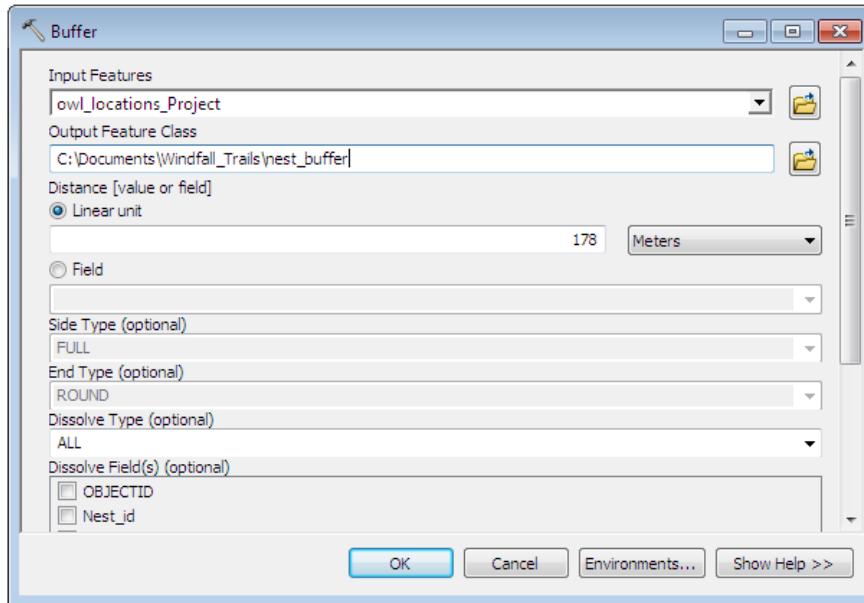


So, now you have determined the distances between nesting and foraging sites. If you were creating a habitat management plan to increase habitat availability for brown-winged owls, what should be the spatial arrangement of vegetation types to provide the best habitat?

## DETERMINE HOW MUCH FORESTED AREA IS UNAVAILABLE FOR TIMBER HARVESTING

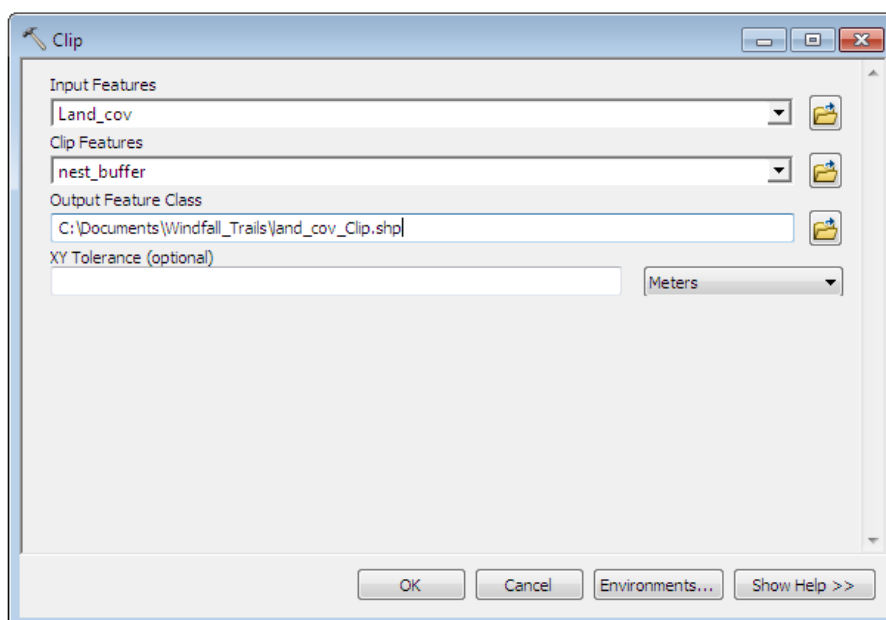
### Buffer

- 1 To determine how much forested area is unavailable for timber harvesting, you must create a 10 ha buffer (i.e., the governmental stipulation for protecting nesting sites) around nesting sites. Fortunately, there is a buffer tool you can use. Search for the *buffer* tool and select the *Buffer* tool within the *Analysis* tools or navigate to *Analysis Tools » Proximity » Buffer*.
- 2 The input features are the owl nest locations. Specify where you would like to save the buffer shapefile under *Output Feature Class*. A 10 ha area has a radius of 178 m. Also, specify *Dissolve Type* as *All*. You want to make sure that if buffers overlap, you are not counting that area twice. Click *OK*.



## Clip

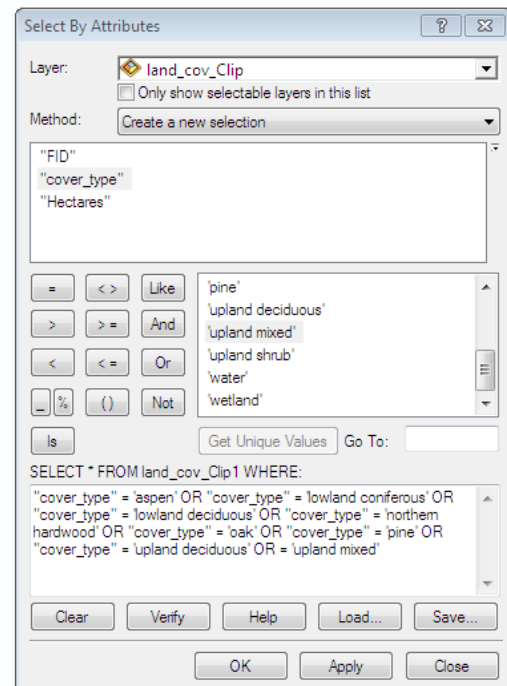
- 1 Now, you need to determine how much forested area corresponds with the buffered area that is unavailable for harvest. *Clip* sounds like a handy tool to answer this question. Now you can search for *clip* or navigate to *Analysis Tools » Extract » Clip*.
- 2 The input features are contained in the *land\_cov* shapefile, and the clip features are the nest buffers. Specify the name of the output shapefile (e.g., *land\_cov\_Clip*) and the folder where you want to save it.



## Determine area of forested vegetation types within the clipped area

Now you must conduct another attribute query to select all forested polygons and then add the total area (hectares). But first, you need to recalculate hectares, because area is not automatically updated when conducting geoprocessing.

- 1 Open the attribute table for the *land\_cov\_Clip* shapefile and right-click the *Hectares* field. Select *Calculate Geometry* and make sure that the units are in hectares.
- 2 Now, you can query all forested polygons. Forested cover types include aspen, lowland coniferous, lowland deciduous, northern hardwood, oak, pine, upland deciduous, and upland mixed. Make sure you have the correct Boolean operator (i.e., *OR*) between query statements.
- 3 Now, in the attribute table, right-click the *Hectares* field and select *Statistics*. You will see that *Sum* is approximately 288 ha. This is the total forested area that is unavailable for timber harvesting due to the presence of owl nests. Therefore, the hunting club will not gain revenue for the timber on the 288 ha of land.



## INTERPRET RESULTS

Now that you have completed the analysis, think about what your results mean in terms of habitat conservation for the brown-winged owls and forest management. How do you think this information might be valuable for members of the hunting club?

Often, the presence of sensitive, threatened, or endangered species requires special consideration in management activities. For instance, in the case of brown-winged owls, timber cannot be harvested within a defined area surrounding known nesting locations. If a landowner depends on timber revenue, alternatives must be considered. Therefore, it is not uncommon for sensitive, threatened, or endangered species to acquire a bad image in the eyes of some people who do not want to deal with adjusting management plans or land-use activities. Presence of sensitive, threatened, or endangered species can also be a very valuable asset to landowners concerned about maintaining biodiversity. Some timberlands may be certified as sustainable through programs such as the Sustainable Forestry Initiative or the Forest Stewardship Council.

Natural resources management agencies and organizations have to devise creative solutions to overcome some challenges of managing threatened or endangered species. For example, you may have heard of some festivals or special days devoted to celebrating the existence of threatened or

endangered species. The Kirtland's warbler in northern Michigan is celebrated each year with the Kirtland's Warbler Wildlife Festival (<http://warbler.kirtland.edu/>). At this festival, people can learn about the warbler, purchase artwork or other paraphernalia, and participate in guided tours to view the bird. An entrance fee is used to help fund costs of conserving habitat. Thus, if hunting club members decide that they need to replace revenue lost from not harvesting timber in owl habitats, they may organize a Brown-Winged Owl Festival to earn money that will help maintain the land and conserve habitat.

Because of your GIS skills, you have provided Windfall Trails Hunt Club with some valuable information. You mapped out the nesting locations of the owls and conducted some spatial analyses that will help managers understand owl habitat characteristics and develop forest management activities that will allow not only timber harvesting but also habitat conservation. You have provided information such as selected vegetation types for nesting and distance between nesting and foraging sites. A manager could easily make recommendations on how to conserve owl habitat by making sure that preferred nesting cover types (e.g., aspen, oak) are maintained as well as ensuring that these preferred nesting cover types are within approximately 40 meters of foraging areas.

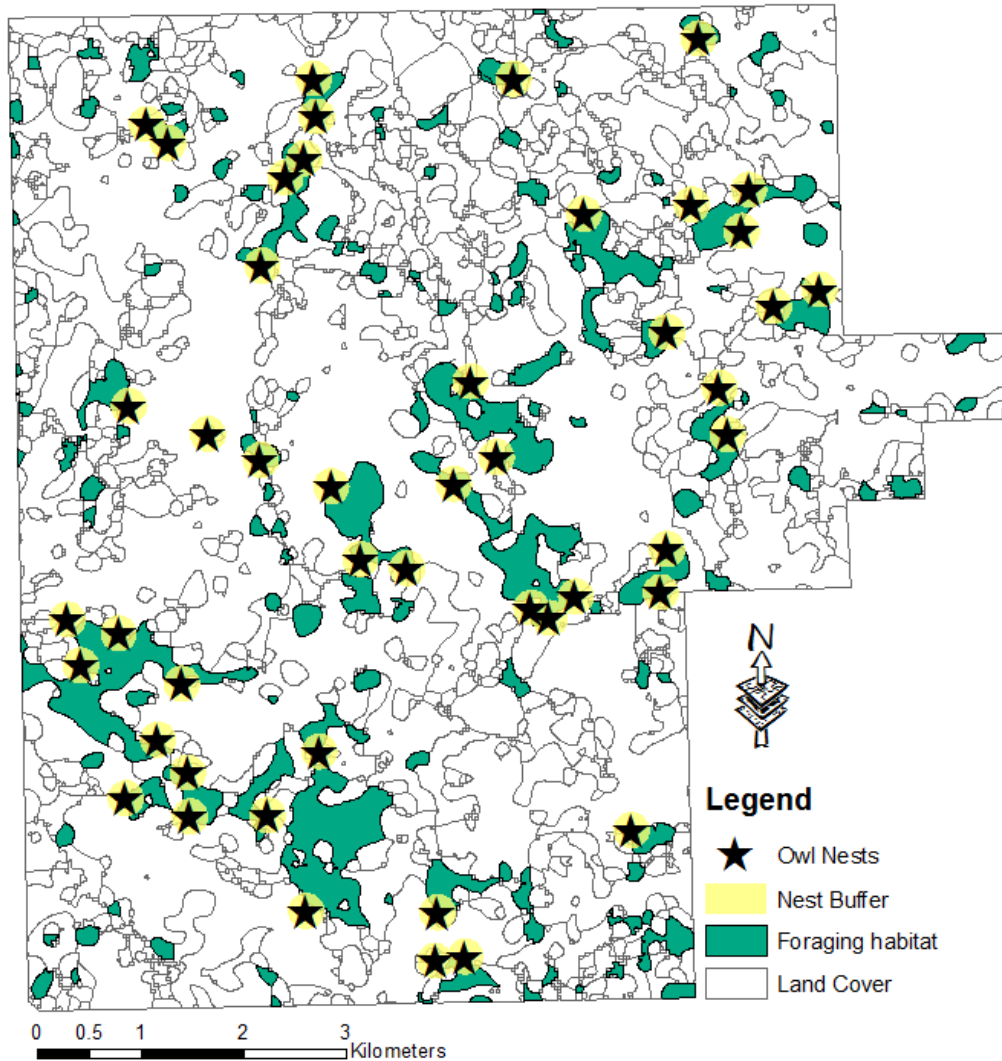
This exercise was one example of how GIS may be used in wildlife and forest management. But hopefully, you can understand how spatial skills might help you be marketable for careers in natural resources and how those skills will be valuable in developing management plans for land-use activities such as timber harvest and wildlife conservation.

### CREATE A MAP LAYOUT ILLUSTRATING THE RESULTS OF THIS ANALYSIS

Use your previous GIS knowledge to create an aesthetically pleasing map for the members of the hunting club. A summary of your habitat analysis could be printed on the back of the map. An example is below.

<b>Number and Percentage of Nesting Sites within Vegetation Types Used by Brown-Winged Owls at Windfall Trails Hunt Club</b>		
<b>Vegetation type</b>	<b>Number of nests</b>	<b>Percentage of nests</b>
Aspen	11	23.4%
Northern hardwood	3	6.4%
Oak	32	68.1%
Upland mixed forest	1	2.1%

### Brown-winged owl nesting locations at Windfall Trails Hunt Club



Distance from Nest Sites to Foraging Sites  
Average: 40.25 m  
Minimum: 1.24 m  
Maximum: 316.35 m

Forested area unavailable  
for timber harvest  
288 ha

Map Created By:  
A Locher  
Windfall Trails Hunt Club  
June 17, 2010

## CRITICAL THINKING

**Question 1:** *Wildlife management and timber harvest often do not occur independently of each other. Do you think that management for wildlife species always results in a decreased amount of area for timber harvest? If timber harvest ceased on the property, would the amount of available habitat for the brown-winged owls increase or decrease? (Hint: think about succession—over time fields would grow trees).*

**Question 2:** *What might be some implications on the brown-winged owl population of developing a forest management strategy if all nesting locations are not documented? Should all locations be documented in order to sustain a population?*

**Question 3:** *What data might you collect to monitor the brown-winged owl population? How might you determine if your forest management strategies are benefitting the population?*

## Submit your work

---

Submit the following:

- Illustration of results in a map layout
- Written summary of results (1-2 pages)
- Responses to critical thinking questions

## Glossary

---

**Cartesian coordinate system** Uses positions along two or three orthogonal (right-angle) axes to define location

**Datum** A reference position to minimize distortion from a projection

**Geographic coordinate system** Also referred to as spherical coordinate system; uses angular measurements on a sphere (usually latitude and longitude) to define location

**Home range** The area typically used by an individual mobile organism to meet its life requisites (Home range analysis is common in wildlife-related fields to understand how different wildlife species are using vegetation or moving throughout landscapes.)

**Land cover** A classification used to describe the type of vegetation or land use that occurs in a particular geographic area (examples: deciduous forest, herbaceous open land, water, or urban)



**Sensitive species** A species that is vulnerable to ecological change through land-use practices, natural disturbances, or other factors affecting the environment

**Vegetation type** A classification used to describe the composition of vegetation growing in a particular area; usually named for the dominant overstory plant species or type (e.g., trees such as pine, oak, aspen, or other vegetation such as upland shrub or herbaceous open land)

## Credits

---

### Images

Hemispheres and coordinates: Created by the author

Owl drawing: Created by the author

Ruffed grouse: Photo taken by the author

### Sources of supplied data

Land\_cov.shp, courtesy of Michigan Department of Technology, Management & Budget, Michigan Geographic Data Library

owl\_nest\_locs.csv, created by author

# Instructor resources

---

## Updates for 2013

Screen captures and methods have been revised as of June 8, 2012 using ArcGIS 10.1. Primary differences between previous versions and version 10.1 include the display of attribute tables and some dialog boxes.

## Additional information

This lab is intended for introductory or intermediate GIS students who have limited backgrounds in geoprocessing. Students should have experience with map layouts, though.

This lab is relevant for instructors who wish to demonstrate an application of GIS for wildlife or forest management. It can also be used to demonstrate how GIS users might use data collected by field personnel to answer a spatial question. It presents good practices in integrating GPS data (i.e., field data typically collected by workers in natural resources-related jobs).

Instructors who would like to demonstrate more in-depth wildlife or forestry analysis can use the data to answer wildlife-habitat selection questions or timber volume questions. For instance, instructors can demonstrate how to create random points and compare location characteristics of nesting sites to random sites to determine what spatial features are affecting owls' selection of nesting sites. For timber harvest, instructors can add a field to the *land\_cover* shapefile and specify some volume estimates. Students can then calculate how much volume may be lost due to establishing no-harvest buffers around nesting sites.

Advanced students might be encouraged to develop a spatially explicit forest management plan to maintain owl nesting and foraging habitat as stands age over time.

## References and further reading

A challenging concept for students to grasp is the difference between geographic coordinate systems and projected (Cartesian) coordinate systems. Below are some websites that may be helpful in teaching the relationships and differences between the two:

[http://www.nationalatlas.gov/articles/mapping/a\\_projections.html](http://www.nationalatlas.gov/articles/mapping/a_projections.html)  
[http://gisremote.blogspot.com/2008\\_02\\_10\\_archive.html](http://gisremote.blogspot.com/2008_02_10_archive.html)

## Data information

The following files are important for completing this lab exercise:

<u>Data File</u>	<u>Description</u>
Land_cov.shp	<p>This is a shapefile of land-cover and vegetation types that occur at Windfall Trails Hunt Club. Land-cover categories include</p> <ul style="list-style-type: none"> <li>Aspen: Dominant species</li> <li>Herbaceous open land: Fields or openings dominated by grass/forbs</li> <li>Lowland coniferous: Swamp conifers such as cedar, spruce</li> <li>Lowland deciduous: Includes ash or silver maple</li> <li>Lowland shrub: Dominated by shrubs adapted to wet areas</li> <li>Northern hardwood: Includes maple, beech, basswood</li> <li>Oak: Primarily oak species</li> <li>Pine: Pine species such as white pine or red pine</li> <li>Residential: Housing</li> <li>Upland deciduous: Other upland species (not oak, aspen, or northern hardwoods)</li> <li>Upland mixed: Includes deciduous and coniferous trees</li> <li>Upland shrub: Dry, shrubby areas</li> <li>Water: Open water</li> <li>Wetland: Poorly drained areas or standing water with emergent vegetation</li> </ul>
Owl_nest_locs.csv	This is a comma-delimited file with latitude and longitude coordinates of owl nesting sites at Windfall Trails Hunt Club.

- Land-cover information was obtained from the Michigan Geographic Data Library (<http://www.mcgi.state.mi.us/mgdl>). The file was 2001 Land Cover (Lower Peninsula).

### Reference:

Michigan Department of Natural Resources (MDNR). 2003. *IFMAP/GAP Upper Peninsula Land Cover* (map). 1997–2001. 1:64,000; created by Forest, Mineral, and Fire Management Division, MDNR, using ERDAS IMAGINE 8.5.

[http://www.dnr.state.mi.us/spatialdatalibrary/sd12/land\\_use\\_cover/2001/IFMAP\\_lp\\_landcover.htm](http://www.dnr.state.mi.us/spatialdatalibrary/sd12/land_use_cover/2001/IFMAP_lp_landcover.htm) (1 April 2003).

Projection information for land cover data  
 Geographic coordinate system: GCS\_North\_American\_1927  
 Datum: D\_North\_American\_1927  
 Projection: Hotine\_Oblique\_Mercator\_Azimuthal\_Natural\_Origin  
 Name: NAD\_1927\_Michigan\_Georef\_Meters

- Brown-winged owl locations were created specifically for the purposes of this lab activity.

Projection information for owl locations  
Geographic coordinate system: Undefined  
Datum: WGS84  
Projection: Undefined  
Name: Undefined