CHAPTER 4  

Weighted Co-occurrence

In this exercise, you will conduct a co-occurrence analysis to evaluate areas of high natural resource value for future protection. The inputs you will use are proximity to existing conservation land, large unfragmented tracts, and land cover type (with greater weight given to wetlands and forested areas).

Please note that the options used in this exercise were intended only to illustrate the process of conducting a weighted co-occurrence analysis. The methodology for any analysis must be determined based on project-specific data, needs, and priorities.

1. Set Up Map Document
   a) Open ArcMap with a new empty map.
   b) Right click on the data frame “Layers” and select PROPERTIES.
   c) Click the COORDINATE SYSTEM tab and select New Hampshire’s standard coordinate system (NH State Plane NAD 1983 feet).
   d) Click the GENERAL tab and name the data frame Lamprey River Watershed.
   e) Confirm that the Map and Distance Units are set to FEET.
   f) Click OK.
   g) From the FILE menu, choose SAVE. Save your map in the C:\Community-Mapping\Cooccurrence\ directory with the name cooccurrence.mxd.
   h) Click the ADD DATA button and add:
      lamprey_cons from C:\CommunityMapping\Cooccurrence\Data\Conservation
      roads_buf1000 from C:\CommunityMapping\Cooccurrence\Data\Unfragmented
      lamprey_nwi from C:\CommunityMapping\Cooccurrence\Data\NWI
      wshedp from C:\CommunityMapping\Cooccurrence\Data\Watersheds
   i) Open the PROPERTIES window for wshedp and click the DEFINITION QUERY tab.
   j) Click the QUERY BUILDER button.
   k) Build the query “HU_10_NAME” = ‘Lamprey River’.
2. Calculate Proximity to Conservation Lands

The first step will be to calculate how close areas are to conservation lands, because areas near or adjacent to conservation lands will be given a higher priority for protection.

a) Open ArcToolbox.

b) Expand the **SPATIAL ANALYST TOOLS -- DISTANCE** section of ArcToolbox, and double click on **EUCLIDIAN DISTANCE**.

c) Set the input feature data to *lamprey_cons*, and name the output raster *dist_cons*. Leave the maximum distance blank, and set the cell size to 100.

d) Click **OK**.

Notice that the output has filled the entire extent rectangle, exceeding the boundaries of the Lamprey River watershed. Rather than have those areas contribute to your analysis, you can clip this raster with the Lamprey River watershed.

e) Expand the **SPATIAL ANALYST TOOLS -- EXTRACTION** section of ArcToolbox, and double click on **EXTRACT BY MASK**.
f) Set the input raster to **dist_cons**, the input mask feature to **wshedp** (make sure you have already limited this data set to the Lamprey River), and name the output raster **lamp_distcons**.

![Image of Extract by Mask tool]

To extract the data, you need to:

- Ensure you have already limited the data set to the Lamprey River.
- Name the output raster **lamp_distcons**.

- Click **OK**.
- Right click on **dist_cons** and select **REMOVE**.

3. **Reclassify Distance from Conservation Lands**

The result of the Euclidian Distance analysis tool is a raster of continuous data, not classified data. That is, the value of each cell in the raster represents the actual distance (in feet or fractions of feet) of that cell from the nearest conservation land. We want the data to be classified so that when we overlay it with other data sets, their cell values will all be on the same value scale.

The next step is to reclassify the distance from conservation lands. If you look at the values for lamp_distcons shown in the Table of Contents, you can see that the values range from 0 to 13,767 feet. You will reclassify this range into 6 classes:

- 0 (conservation lands)
- 0.1 - 500 ft
- 500 - 2640 (0.5 mi)
Weighted Co-occurrence

2640 - 5280 (1 mi)
5280 - 7920 (1.5 mi)
7920 and up

a) Expand the **Spatial Analyst Tools -- Reclass** section of ArcToolbox and double click on **Reclassify**.

b) Set the input raster to **lamp_distcons** and the field to Value.

c) Click the **Classify** button next to the reclassification table to open the Classification dialogue.

The classification method defaults to manual and number of classes defaults to 10. For some reason, you cannot change the number of classes until you first change the classification method.

d) Change the classification method to Equal Interval.

e) Change the Number of Classes to 6.

f) Change the classification method back to Manual.

g) Type in the break values as listed above: 0.1, 500, 2640, 5280, 7920, and 13767.12...

h) Click OK.
i) Change the new values so they range from 0 to 5. Remember that you will want the areas closest to conservation lands (0.1 - 500) to have the highest value, so reclass them to 5, and work down from there. Conservation lands themselves are already protected, so you can give them value = 0.

![Reclassify dialog box](image)

j) Name the output raster `nearcons`.

k) Click OK.

l) Remove `lamp_distcons` by right clicking and selecting REMOVE.

4. **Reclassify Large Unfragmented Lands**

Another priority for conservation will be distance from roads. Areas that are 1000 feet or more from roads will be less impacted by human activities. The `roads_buf1000` data set represents tracts of land that are 1000 feet or more from roads (except Class 6 roads, which in general yield little human impact).

a) From the **Spatial Analyst** menu, select **Convert > Features to Raster**.

b) Set the input layer to `roads_buf1000.shp`, the cell size to 100, and name the output data set `roads_buf1000`. 
5. Prepare Wetlands Data

For this exercise, we will consider all wetlands as important natural resources for future protection, except for Lacustrine wetlands (lakes). Our first step will be to dissolve out unnecessary wetland boundaries (such as between Palustrine Forested...
wetlands and Palustrine Scrub-Shrub wetlands), and then to convert the feature dataset to a raster. Then we will reclassify the data.

a) From **ArcToolbox**, expand **Data Management > Generalization**, and double click on **Dissolve**.

b) Set the input data set to **Lamprey_NWI**, and the dissolve field to NWITYPE. Name the output data set *C:\CommunityMapping\Cooccurrence\Data\NWI\Lamprey_NWI_Dissolve*.

c) Leave the rest of the defaults, and click **OK**.

d) If the output data set was not automatically added to your map, add it now.

e) From the **Spatial Analyst** menu, select **Convert > Features to Raster**.

f) Set the input layer to **Lamprey_NWI_Dissolve**, the cell size to 100, and name the output **Lamprey_NWI**.
g) Click **OK**.

h) When the process is finished, a raster with five classes will have been created. Use *Lamprey_NWI_Dissolve* to figure out which NWI type each of those five classes corresponds to.

i) Remove *Lamprey_NWI* (the shapefile) from the table of contents by right clicking on it and choosing **REMOVE**.

**NOTE:** If you do not complete step i, you will not be able to perform step 6cs because the **RECLASSIFY** wizard will get confused between the two layers and will not find any Values for your to modify.

### 6. Reclassify NWI Data

We will now reclassify the NWI data so that uplands receive 0 points, lacustrine wetlands receive 2 points, and palustrine, estuarine, and riverine wetlands receive 4 points.

a) From **ARCTOOLBOX > SPATIAL ANALYST TOOLS > RECLASS**, double click on **RECLASSIFY**.

b) Set the input raster to *Lamprey_NWI*, the field to Value, and the output to *C:\CommunityMapping\Cooccurrence\Data\NWI\NWI_rec*. 
c) Set the reclass values as described above, using Lamprey_NWI_Dissolve to figure out which values represent each of those wetland categories.

![Reclassify dialog box](image)

- **d)** Click OK.
- **e)** If the output raster was not automatically added to your map, add it now.
- **f)** Remove Lamprey_NWI_Dissolve and Lamprey_NWI.
- **g)** Save your map.

### 7. Conduct Weighted Overlay

Now that your data sets are prepared, you can add them to the Weighted Overlay tool. A helpful document called “How Weighted Overlay works” is available in ArcGIS Desktop Help.

- **a)** Expand the **Spatial Analyst Tools -- Overlay** section of ArcToolbox, and double click on **Weighted Overlay**.
- **b)** Set the evaluation scale to **0 to 5 by 1**.
- **c)** Click the plus sign and add the raster **near_cons** to the table.
d) Change the scale value for near_cons = 0 to Restricted. Each other scale value should be the same as its input value, since you already gave it appropriate classes during the reclassification.

e) Click the plus sign and add `unfrg_rec` to your analysis table.
f) Give `unfrag_rec` value of 0 a scale value of 0, and value 1 a scale value of 3.

![Weighted Overlay](image)

```
% Influence | Field | Scale Value
----------- | ---- | ---------
    100      | 0    | Restricted
        1  | 1    | 1
        2  | 2    | 2
        3  | 3    | 3
        4  | 4    | 4
        5  | 5    | 5
      0     | NOGATA | NOGATA
```

g) Click the plus sign and add `nwi_rec` to your analysis table.

h) The values for NWI_rec do not need to be changed.

i) Click the little arrows to the left of each of the raster names in your analysis table to hide all their rows.
j) For this analysis, it was decided that the wetland type should have twice the importance of either unfragmented lands or proximity to conservation lands. Therefore, set the % Influence for `nwi_rec` to 50%, and to 25% for `near_cons` and `unfrag_rec`.

![Weighted Overlay Table](image)

k) Click the Save button to save your overlay table set-up. This way, if you want to go back and re-conduct your analysis, it will be easy to access this table as a template. Save the overlay table in `C:\CommunityMapping\Coocurrence\Data\Overlay` as `cons_overlay`.

l) Name the output raster `overlay` and save it in `C:\CommunityMapping\Coocurrence\Data\Overlay`.

m) Click OK to process the analysis.

n) Change the symbology of your cooccurrence raster so that areas with 0 co-occurrence are transparent, while areas of higher co-occurrence are progressively brighter colors.

o) Save your map document.