

# MODULE 6

## PLANNING FOR WILDLIFE AND BIODIVERSITY

<b>SUMMARY:</b>	Students will assess the locations of a few different wildlife habitat types and identify where wildlife habitat overlaps for the purpose of wildlife conservation.
<b>ACTIVITIES:</b>	Evaluate the locations of aquatic and riparian habitat. Examine the distribution of wildlife habitat for common species. Use geospatial tools to identify overlapping and critical wildlife habitats.
<b>SCIENCE STANDARDS:</b>	Utah Science Core 9-12 - Earth Science: Standard 5, Objective 2c Utah Social Studies Core 9-12: Utah Studies Strand 5, Standard 5.2 Utah Social Studies Core 9-12: World Geography Strand 1, Standards 1.2 and 1.4
<b>MODULE LINK:</b>	<a href="https://arcg.is/14mfjS">https://arcg.is/14mfjS</a>

## GLOSSARY

<b>Avian Habitat:</b>	The natural environment in which a bird lives that includes food, water, shelter, and nesting areas.
<b>Aquatic Habitat:</b>	Habitat that is permanently or occasionally covered by water.
<b>Biodiversity:</b>	The variety of life in a particular habitat or ecosystem.
<b>Corridor:</b>	A strip of natural habitat connecting populations of animals, plants, and organisms.
<b>Ecosystem:</b>	A biological community of interacting animals, plants, and organisms within their physical environment.
<b>Endangered Species:</b>	An animal, plant, or organism that is seriously at risk of extinction.
<b>Erase:</b>	An ArcGIS Online tool that removes or deletes geographic features from another overlapping geographic feature.
<b>Habitat Connectivity:</b>	The degree to which different habitat areas and types are connected.
<b>Intersect:</b>	An ArcGIS Online tool in which two or more objects are compared in order to identify the shared or overlapped locations.
<b>Riparian Habitat:</b>	A habitat area located between land and a river or stream.
<b>Threatened Species:</b>	An animal, plant, or organism that may become endangered in the near future.
<b>Union:</b>	An ArcGIS Online tool in which two or more objects are merged. The result will contain features from both the input layer and the overlapping layer.
<b>Wildlife:</b>	All wild and undomesticated animals, birds, reptiles, insects, plants, fungi, and microscopic organisms.
<b>Wildlife Habitat:</b>	The natural home or environment in which an animal, plant, or organism lives. The habitat of a species is one where it can find food, water, shelter, mates for reproduction, and protection against predators and competitors.
<b>Wildlife Conservation:</b>	The practice of protecting wildlife through legislation and the establishment of protected areas and wildlife preserves.

## INTRODUCTION

The term **wildlife** includes all wild animals as well as all undomesticated life forms such as birds, reptiles, insects, plants, fungi, and microscopic organisms. Each wildlife species plays an important role in the **ecosystem**, or biological community, in which it lives. Wildlife provide a range of ecological, economic, scientific, and recreational benefits.

Wildlife species balance ecosystems and they provide stability to the variety of natural processes. For example, large carnivores maintain healthy ecosystems by regulating deer, elk, and small mammal populations. Wildlife species, including wild game and marine life, are a significant source of food and clothing for humans. Certain wildlife species, such as bees, bats, and birds, enrich food production through pollination and seed dispersal. Wildlife is a source of medicine and more than one third of pharmaceuticals originated from wild plants. Lastly, wildlife species provide recreational opportunities through hunting, fishing, birdwatching, and photography.

While wildlife provide numerous benefits, several species are becoming **threatened** or **endangered** due to wildlife habitat loss and degradation. **Wildlife habitat**, or the natural home or environment in which an animal, plant, or organism lives, is being lost due to land development, conversion to agricultural land uses, and harmful practices associated with natural resource development and extraction. Consequently, the **biodiversity**, or the variety of life, within ecosystems is declining.

Due to habitat and biodiversity loss, **wildlife conservation** is becoming an important measure to maintain or improve populations of threatened and endangered species. Wildlife conservation is the practice of protecting wildlife through legislation, such as the Endangered Species Act, or through the establishment of protected areas and wildlife preserves. Comprehensive urban and regional plans should account for wildlife habitat and biodiversity by including measures that protect and preserve valuable and critical wildlife species.

In this module, a few different wildlife habitat data layers will be evaluated, including aquatic and riparian habitat, mule deer habitat, Rocky Mountain elk habitat, and sharp-tailed grouse habitat. These habitat data layers only show a portion of the total wildlife habitat in Cache County, Utah. To support a more thorough wildlife conservation plan, a planner or administrator would want to include all available habitat data layers, including those of threatened and endangered species.

## INTERACTION

Open the map titled *Module 6 - Planning for Wildlife and Biodiversity* (<https://arcg.is/14mfjS>). This ArcGIS Online map contains six data layers: *Cache County*, *Cache Cities & Towns*, *Cache Aquatic & Riparian Habitat*, *Cache Mule Deer Habitat*, *Cache Rocky Mountain Elk Habitat*, and *Cache Sharp Tailed Grouse Habitat*.

The *Cache County* data layer depicts the Cache County boundary. The *Cache Cities & Towns* data layer depicts the city and town boundaries. The *Cache Aquatic & Riparian Habitat* data layer represents important habitat areas associated with rivers, streams, reservoirs, lakes, floodplains, and wetlands. **Aquatic habitat** and **riparian habitat** serve as critical habitat for migrating wildlife, including many migratory bird species. Therefore, these habitat types provide valuable **avian habitat**. Riparian habitat also frequently serves as **corridors**, or strips of natural habitat that connect populations of wildlife. These areas are ecologically important because they protect stream banks from erosion, they provide a storage area for flood waters, and they provide food and shelter for a variety of species. In Cache County, aquatic and riparian habitat support several forms of recreation for residents and tourists, including fishing, hunting, birdwatching, photography, water sports, and hiking.

The *Cache Mule Deer Habitat* data layer represents the areas in Cache County that are used by mule deer (*Odocoileus hemionus*) for crucial summer and winter habitat. These areas, especially the lower elevation winter habitat, is under threat from expanding urban development. The development of these areas reduces available wintering habitat for deer and forces the deer into smaller and fragmented areas. Smaller habitat areas lead to decreased winter forage and increased transmission of diseases. Further, development of crucial winter habitat forces deer into urban neighborhoods and increases the occurrence of human-wildlife interactions. These interactions include vehicle-animal collisions and destruction of urban landscaping.

The *Cache Rocky Mountain Elk Habitat* data layer represents the areas in Cache County that are used by Rocky Mountain elk (*Cervus canadensis nelsoni*) for summer, winter, spring, and year-long habitat. As with mule deer habitat, these areas are under pressure from expanding urban development, especially the crucial winter and spring habitat areas.

The *Cache Sharp Tailed Grouse Habitat* data layer represents important year-long habitat for the Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*). While not a threatened or endangered species, such as the greater sage grouse, sharp-tailed grouse populations are declining as their habitat is being lost due to development and fragmentation. In Cache County, the sharp-tailed grouse represents a wildlife species of importance to hunters

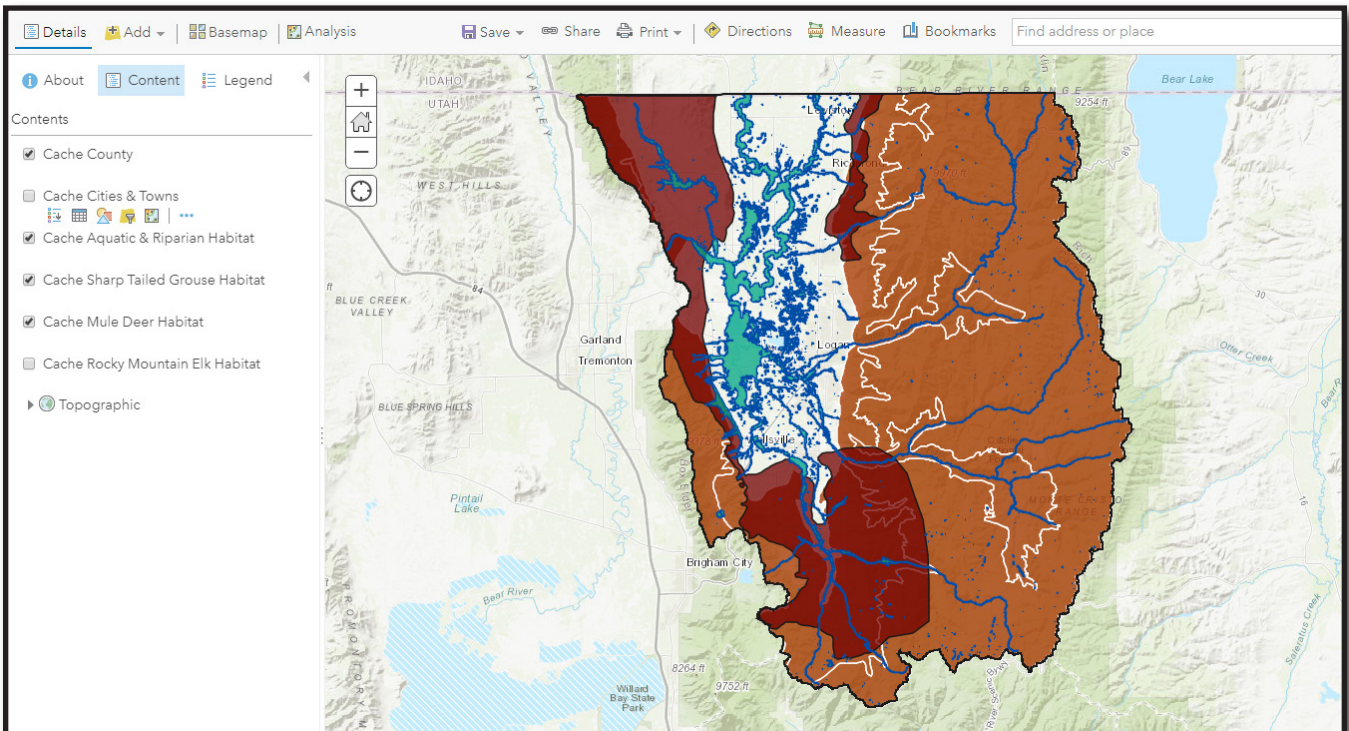
and birdwatchers and has been subject to habitat protection and improvement by local land owners and wildlife managers. As a recreational hunting species, the sharp-tailed grouse is critically important to some land managers as a source of income.



When you open the map, the *Cache County* and *Cache Cities & Towns* data layers should be the only data layers that are turned on. To familiarize yourself with the map and the spatial data, turn the other data layers on and off to identify any general patterns or relationships. Consider how the locations of these features affect urban planning, development, and conservation recommendations. First, identify what urban areas will experience significant wildlife traffic and sightings? Second, identify where these habitat data layers overlap. In terms of habitat integrity and connectivity, where do you think urban planners and government officials should recommend conservation measures? Overall, these data layers serve as an important guide for planners, administrators, land managers, and wildlife scientists in recommending and establishing open space and conservation plans.

After you have introduced yourself to the data, visually inspect each of the layers and identify where these four habitat types overlap. While each of these habitat areas are independently important, they become more important when they overlap each other. The overlapping areas may serve as critical areas for multiple species and they could represent areas of high biodiversity. These areas may also become important for wildlife conservation and recreation.

Visual inspection reveals that the mule deer and Rocky Mountain elk habitat areas overlap significantly, while the sharp-tailed grouse habitat is much more limited to lower elevations and valley foothills. The aquatic and riparian habitat covers a large portion of the valley bottom, but also includes areas within canyons and other depressions or lakes at higher elevations.



If an urban planner was interested in identifying the most critical locations where mule deer, Rocky Mountain elk, and sharp-tailed grouse spend different times of the year, they could take the three habitat data layers and find out where they overlap, or intersect, using some of the analysis tools in ArcGIS Online. To do this, click on the *Analysis* button. Click on *Manage Data* and then click on *Overlay Layers*. The *Overlay Layers* tool combines two or more layers into a single layer using one of three options: *Intersect*, *Union*, or *Erase*. The *Intersect* function will overlay the layers of interest and return those areas where all features overlap. The *Union* function will merge features from all data layers. The result will contain features from both the input layer and the overlapping layer. The *Erase* function will remove or delete geographic features from another overlapping feature.

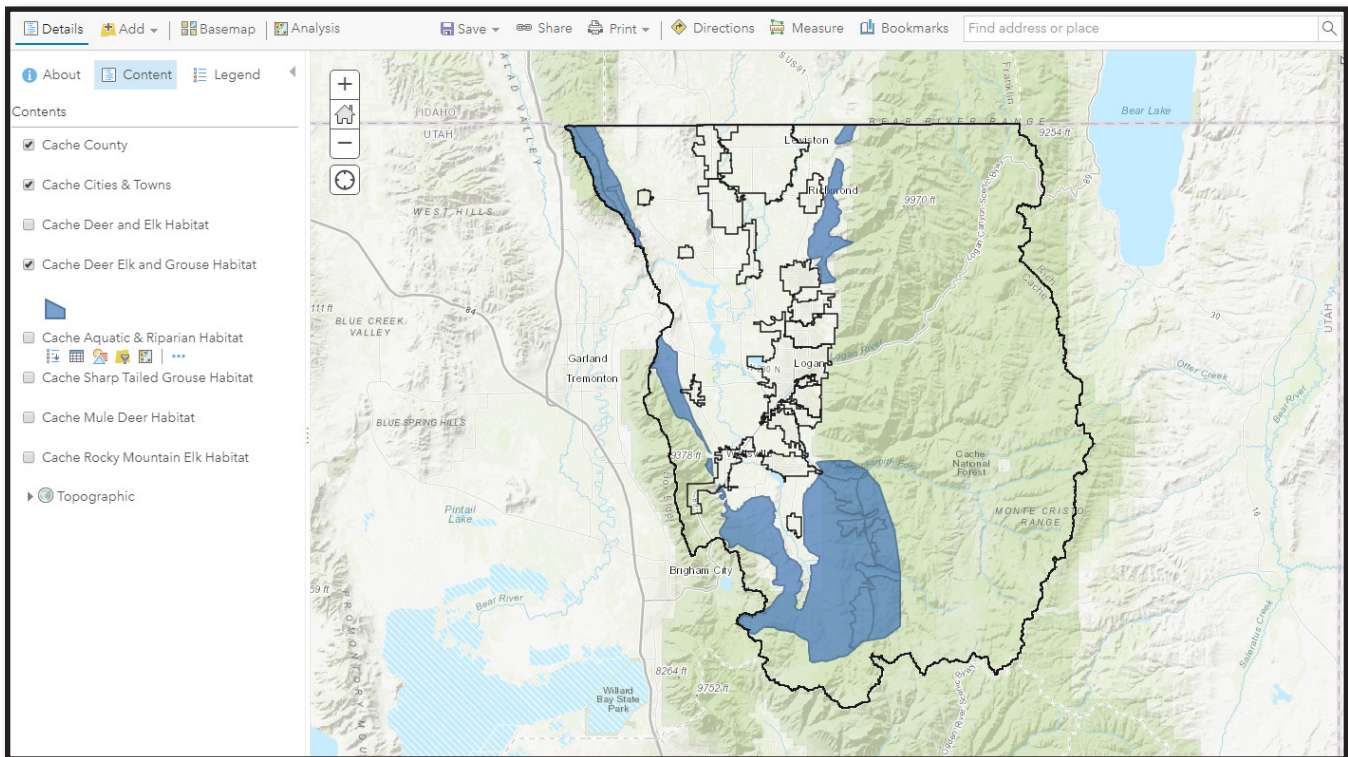
To determine where mule deer, Rocky Mountain elk, and sharp-tailed grouse habitats intersect, the analysis must be completed in two steps. First, a new data layer is created that includes both mule deer habitat and Rocky mountain elk habitat. To do this, below (1) *Choose input layer*, select *Cache Mule Deer Habitat*. Below (2) *Choose overlay layer*, select *Cache Rocky Mountain Elk Habitat*. Below (3) *Choose overlay method*, select *Intersect*. Next to *Output*:, select *Areas*. Below (4) *Result layer name*, type in *Cache Deer and Elk Habitat*. Uncheck the box next to *Use current map extent*. Click on *RUN ANALYSIS*.

Compare the *Cache Deer and Elk Habitat* data layer to the *Cache Mule Deer Habitat* and *Cache Rocky Mountain Elk Habitat* data layers. The areas where mule deer and Rocky Mountain elk habitat did not overlap have been removed the new data layer includes only those areas where to the two habitat types overlapped.

The screenshot displays the ArcGIS Online 'Analysis' interface. The 'Overlay Layers' tool is selected, and the 'Intersect' method is chosen. The input layers are 'Cache Mule Deer Habitat' and 'Cache Rocky Mountain Elk Habitat'. The output is set to 'Areas' and the result layer name is 'Cache Deer and Elk Habitat'. The 'Use current map extent' checkbox is unchecked. The 'RUN ANALYSIS' button is highlighted. The map on the right shows the resulting intersection of the two habitat layers, highlighted in dark blue, over a topographic map of the region including cities like Garland, Tremonton, Logan, and Brigham City.

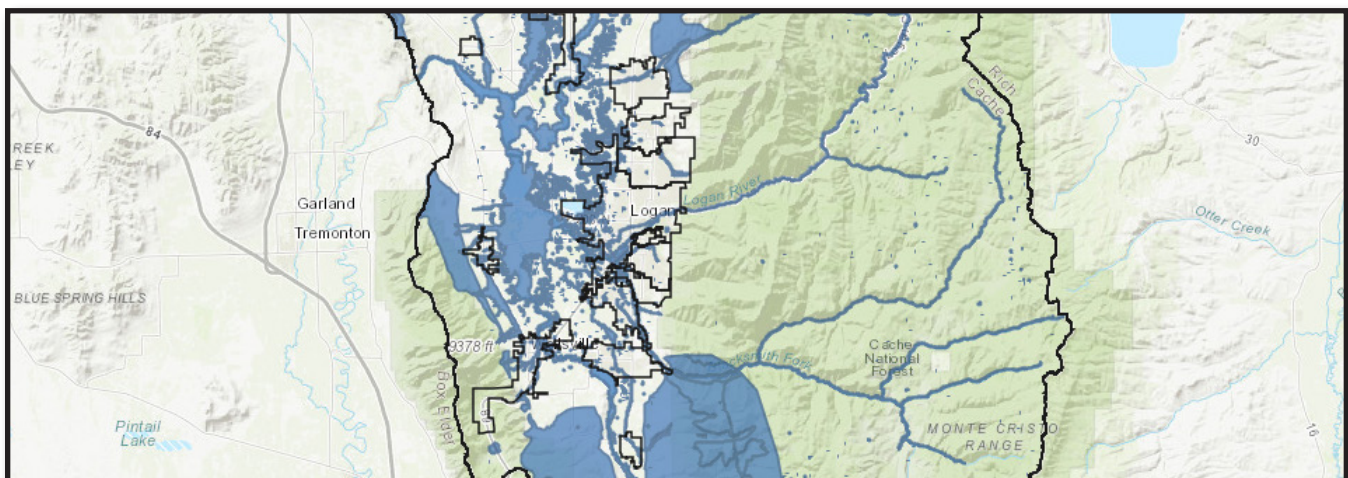
The second step of the analysis is to intersect the newly created *Cache Deer and Elk Habitat* data layer with the *Cache Sharp Tailed Grouse Habitat* data layer. To do this, click on the *Analysis* button. Click on *Manage Data* and then click on *Overlay Layers*. Below (1) *Choose input layer*, select *Cache Deer and Elk Habitat*. Below (2) *Choose overlay layer*, select *Cache Sharp Tailed Grouse Habitat*. Below (3) *Choose overlay method*, select *Intersect*. Next to *Output*:, select *Areas*. Below (4) *Result layer name*, type in *Cache Deer Elk and Grouse Habitat*. Uncheck the box next to *Use current map extent*. Click on *RUN ANALYSIS*.

Turn off the the *Cache Deer and Elk Habitat*, *Cache Mule Deer Habitat*, and *Cache Rocky Mountain Elk Habitat* data layers if they are being displayed. The new data layer, *Cache Deer Elk and Grouse Habitat*, displays those areas that are critical to all three species. Therefore, these areas may be important in wildlife conservation.



Intersecting data layers is extremely useful and beneficial. Similarly, the *Union* and *Erase* functions are useful for adding or subtracting data layers from one another. For example, if a wildlife manager or urban planner was interested in finding all the those areas that include overlapping mule deer, Rocky Mountain elk, and sharp-tailed grouse (*Cache Deer Elk and Grouse Habitat*) as well as those areas that are identified as aquatic and riparian habitat in the *Cache Aquatic & Riparian Habitat* data layer, the *Union* function could be used to add those two data layers together.

To add the *Cache Deer Elk and Grouse Habitat* data layer with the *Cache Aquatic & Riparian Habitat* data layer, click on the *Analysis* button. Click on *Manage Data* and then click on *Overlay Layers*. Below (1) *Choose input layer*, select *Cache Deer Elk and Grouse Habitat*. Below (2) *Choose overlay layer*, select *Cache Aquatic & Riparian Habitat*. Below (3) *Choose overlay method*, select *Union*. Below (4) *Result layer name*, type in *Cache Important Habitat*. Uncheck the box next to *Use current map extent*. Click on *RUN ANALYSIS*. The new data layer, *Cache Important Habitat*, shows the intersecting areas from *Cache Mule Deer Habitat*, *Cache Rocky Mountain Elk*, and *Cache Sharp Tailed Grouse Habitat* and all areas from the *Cache Aquatic & Riparian Habitat*.



## INVESTIGATION

In this module, you assessed the locations of a few different wildlife habitat types and you began to understand the importance of identifying where wildlife habitat types overlaps. You spent some time learning the overlay functions in ArcGIS Online so you could assist wildlife managers and urban planners in identifying important locations for wildlife conservation. Using the skills you have learned, please answer the following questions.

1. Urban planners and wildlife managers in Cache County are interested in the area of different habitat types, specifically crucial habitat. By opening up the attribute table associated with each habitat data layer, identify the area of each specified habitat type.

**What is the total area (in acres) of crucial summer and crucial winter mule deer habitat?**

**What is the total area (in acres) of crucial Rocky Mountain elk habitat? This includes crucial summer, crucial winter, and crucial winter/spring habitat.**

**What is the total area (in acres) of crucial year-long sharp-tailed grouse habitat?**

2. Using the the *Cache Important Habitat* data layer that you created, identify the total area of important habitat in square miles and square kilometers. To do this, you will need to use another tool within the *Manage Data* tools. First, open up the attribute table associated with the *Cache Important Habitat* data layer. You will notice that there are 13 features. If you examine the area fields, it appears that there are duplicate values. You will need to combine all the features, remove (or dissolve) the boundaries, and create one single polygon feature.

To do this, click on the *Analysis* button. Click on *Manage Data* and then click on *Dissolve Boundaries*. The dissolve tool merges together overlapping features to create a single area. Below (1) Choose area layer whose boundaries will be dissolved, select *Cache Important Habitat*. Below (2) Choose dissolve method, select *Areas that overlap or are adjacent*. Make sure that the box next to *Create multipart features* is checked. You can skip (3) *Add statistic (optional)*. Below (4) *Result layer name*, type in *Cache Important Habitat Area*. Uncheck the box next to *Use current map extent*. Click on *RUN ANALYSIS*.

Details Add Basemap Analysis

Dissolve Boundaries

1 Choose area layer whose boundaries will be dissolved

Cache Important Habitat

2 Choose dissolve method

Areas that overlap or are adjacent

Areas with same field value

FID\_JBF1FC8ECA30B4D799D3505

FID\_JA50E6D1A4C2441F7B487B9

FID\_EPA\_CACHE\_MULE\_DEER\_HA

TYPE

SEASON

Create multipart features

3 Add statistic (optional)

Field Statistic

4 Result layer name

Cache Important Habitat Area

Save result in Module6\_Data\_Map

Use current map extent [Show credits](#)

RUN ANALYSIS

When the analysis is complete, open up the attribute table associated with the new data layer, *Cache Important Habitat Area*. You will notice that there is now just one feature with the total area identified in square mile.

**What is the total area (in square miles) of important habitat in Cache County?**

**What is the total area (in square kilometers) of important habitat in Cache County? You will need to calculate this value by creating a new field within the attribute table.** You may need to refer to *Module 3 - Understanding Population Dynamics* to review how to add a new field to the attribute table. Hint: Square Kilometers = Square Miles \* 2.58999.

3. Now that you have created a single-feature data layer that includes important wildlife habitat in Cache County, urban planners and wildlife managers are interested in identifying which cities or towns have the greatest area within their municipal boundaries. You will have to review some of the work you did in previous modules to do this. You will need to click on the *Analysis* button, then click on *Summarize Data*, and then click on *Summarize Within*.

Below (1) Choose an area layer to summarize other features within its boundaries, select the *Polygon* option. Below Choose the polygon layer, select the *Cache Cities & Towns*. Below (2) Choose a layer to summarize, click the dropdown menu and select *Cache Important Habitat Area*. Below (3) Add statistics from the layer to summarize, next to *Sum Area in*, click the dropdown menu and select *Acres*. You can leave the default settings for the *Field* and *Statistic* fields. You may leave the default setting on (4) Choose field to group by (optional). Below (5) Result layer name, type in *Summarize Cache Habitat*. Uncheck the box next to *Use current map extent*. Click *RUN ANALYSIS*.

A new field will be generated in the attribute table that will allow you to determine what three cities or towns include the greatest area of important wildlife habitat.

**What three cities or towns encompass the greatest area of important wildlife habitat? Include the names of the cities/towns and the area in acres.**