Grizzly Bear Habitat Spatial Modelling
Final Lab Paper

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Intro to GIS
March 18, 2021

Grizzly bears are currently located mainly in Idaho, Montana, Washington, and Wyoming in mostly undisturbed areas due to a combination of factors. These bears have a fairly specific set of requirements when it comes to habitat, including givens such as food and somewhere to shelter and hibernate, but also solitude and a large area to romp around. The diet of these bears consists of a broad variety of berries, insects, roots, roadkill, and other things along these lines that change seasonally. The bears don't want humans in their habitat, so their ideal home has lots of space from human development. With all of these things in consideration, grizzly bears tend to live in high altitude forests, meadows, grasslands, and mixed conifer forests.

I used GIS in order to find out where in Colorado bears could be introduced and thrive based off of the previously mentioned criteria. This software was the most beneficial as I was able to layer multiple datasets on top of each other and see how different criteria excluded different areas. Using GIS allowed me to look at how each layer of habitat requirement rendered a certain area of the state uninhabitable until each layer was applied and I could see essentially a summary of available space for the bears. I was able to use a plethora of GIS tools to alter the display of layers and make them more applicable to the project and useful.

The objective of the analysis was to find suitable grizzly bear habitat in Colorado in case, and possibly in support of reintroduction. As previously mentioned, grizzly bears have a very specific sort of habitat, so I had to use a list of criteria to determine where they should be introduced. The list of criteria that the habitat needed to fit was as follows:
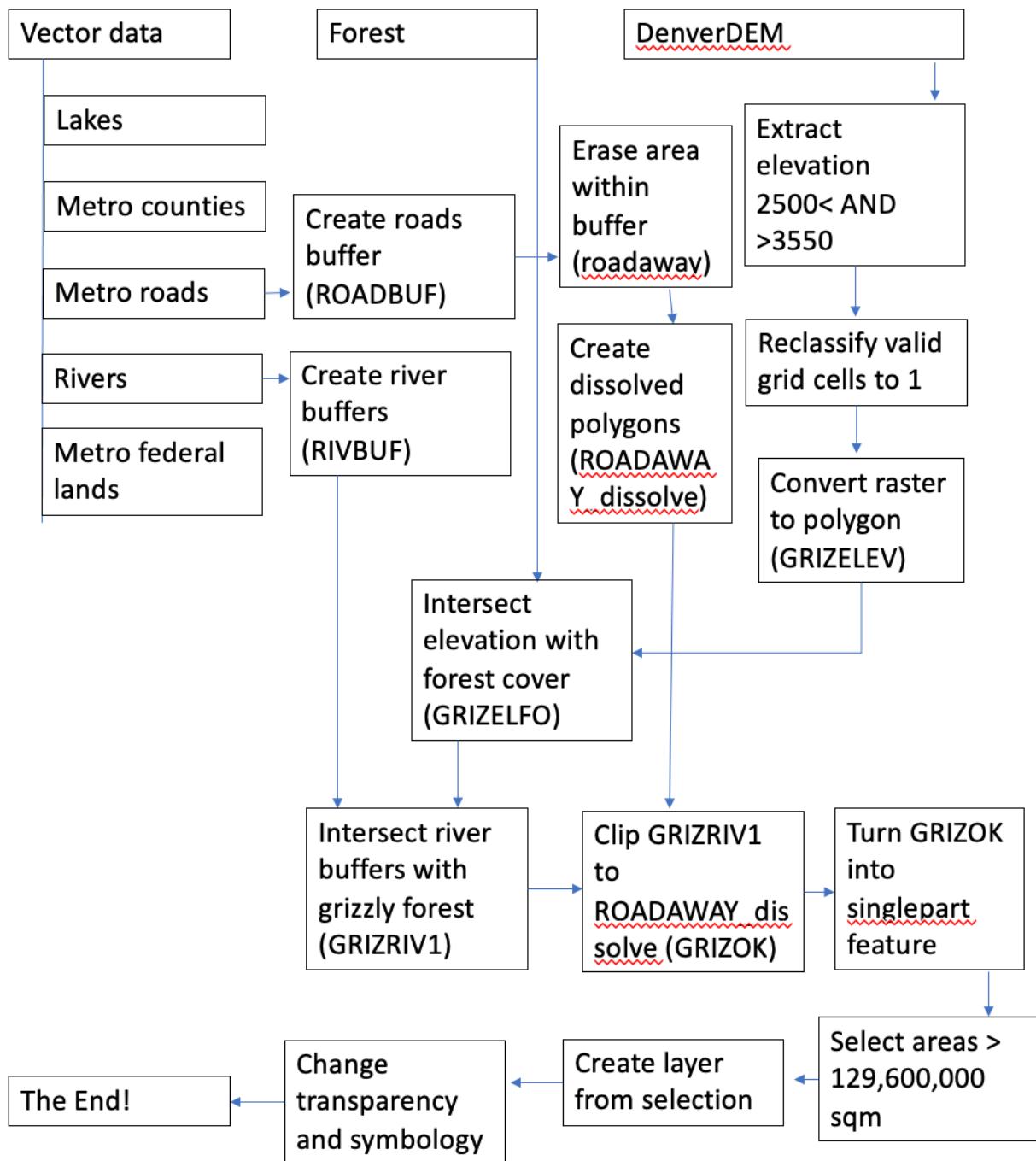
- Mountain environment
- Elevation above 2500 meters
- Elevation below 3550 meters
- Forest cover
- Within five miles of a major stream
- At least three miles from major federal, state or county roads
- Home range must be fifty square miles
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These criteria covered the more physical aspects of the habitat. It may be useful to have data on what sort of food options are available for bears. This may be difficult to find as they eat a variety of things, but that is a main criterion that I can think could be considered missing. Another thing we may want to consider is unimproved roads and things like that where humans may frequent but not in a public or official way. Since the environment we are looking at or these bears is mountainous, I worry about places like hiking or bike trails existing where we map the grizzly bear habitat because they aren't mapped as major roads and may not be documented in datasets that we download and take into consideration.
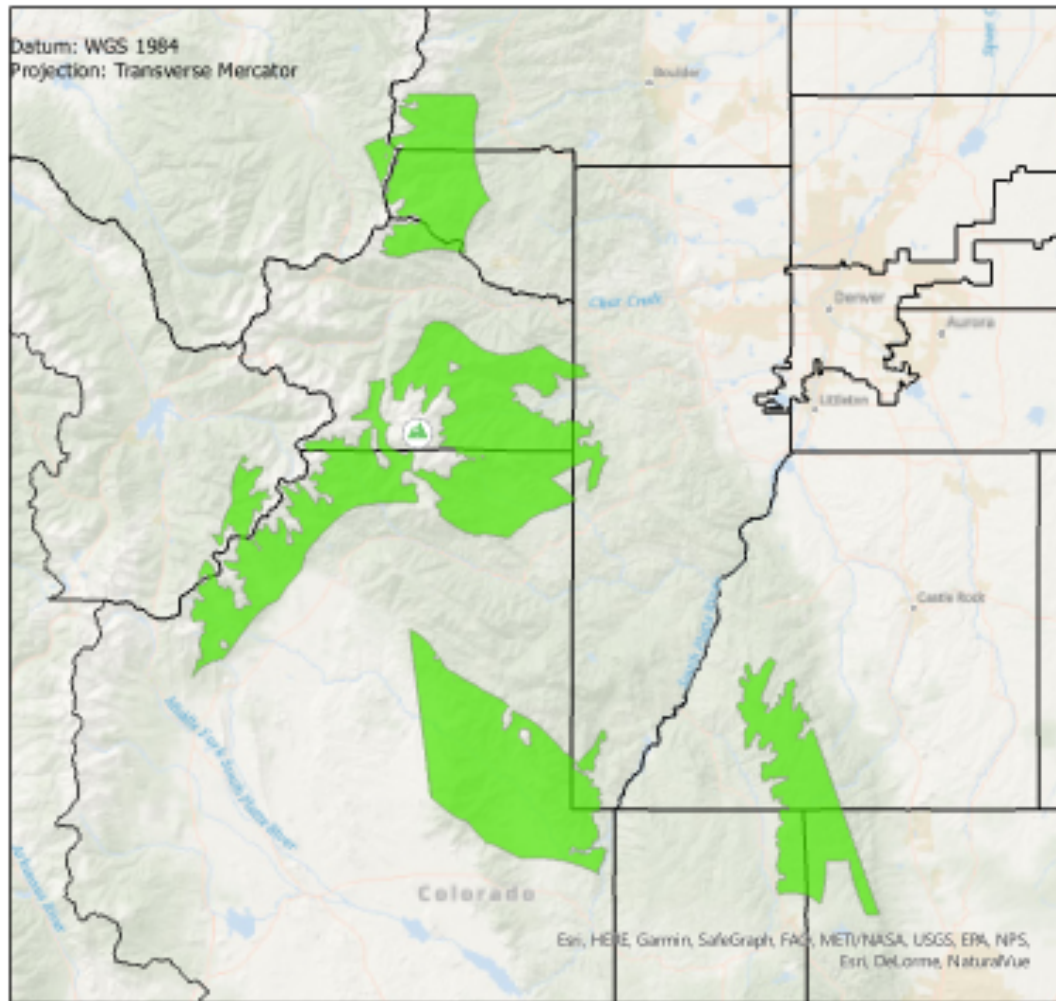
The data used for this project came from three main sources. The source of the vector data I used was 1:100,000 Digital Line Graph (DLG) data, which was provided by my professor and assumed reliable. Forest cover data was derived by approximate heads-up digitizing from 1:100,000 USGS topographic map by Steven Hick, Professional Cartographer. The map mentioned is from USGS which is a verified top GIS provider, and the digitizing was done by a reliable professional cartographer. Lastly, the DEM source was USGS 1:250,000 30-arc second DEM, which is valid for reasons explained earlier, and provided the level of detail that I needed. The project area was the Central Front Range of Colorado, so it made sense to use UTM projection. The datum used was WGS 1984 which is a very typical datum used worldwide. Colorado falls into UTM zone 13, so that is the coordinate system used.

I have included a flowchart outlining the different steps that I completed in order to identify my final habitat area. I started by separating the different data sources that I had, the vector data, forest cover, and DEM. Starting with the DEM layer, I used the "Extract by Attributes" tool to select only the elevation that I wanted. Our criteria is elevation less than 3550 m and greater than 2500 m, so this step was meant to isolate those elevations. I then used the "Reclassify" tool in order to change the grid cell values to 1 since we know that they are fit our criteria and won't need to be reevaluated. Now that all of the grid cells were 1, my next step was to convert the raster data to polygon and make it easier to manage. Next I wanted to find the area that fits our criteria for elevation and also forest cover, so I used the "Intersect" tool to find shared area between the forest cover layer and our new elevation layer and named it GRIZELFO. Next I switched gears to look at the rivers layer and used the "buffer" tool to map the area within 5 miles of a river. I then used "Intersect" again to find the shared space between my river buffer of 5 miles and my GRIZELFLO layer and created GRIZRIV1. After that I used the "Dissolve" tool to create a single polygon layer so it is easier to work with. Then I shifted gears again to work with roads, creating a buffer of 3 miles from the roads. We were looking for spaces 3 miles AWAY from roads not WITHIN 3 miles of roads, so I used the "Erase" tool to remove the area in the buffer. Once I had that area gone, I used "DIssolve" again to create the dissolved polygons like I've been using. Next I needed the updated roads layer I had created to fit into the other criteria, so I clipped it to the extent of my GRIZRIV1 layer. Now that I had all of my criteria fit except the homerange area I used "Multipart to Singlepart" in order to separate everything out into individual features. After that I was able to select by attributes to find where the shape area was greater than 129,600,000 sqm. This selection showed the final suitable habitat for grizzly bears, so I created a layer from that current selection. The last thing I did was change the transparency of the layer so that the geography underneath could be seen and altered the symbology so that my map made more sense. And with that I called it a day!

Based off of my analysis I would say that I do have a suitable habitat for grizzly bears in Colorado. There are four separate spaces on my map that show a significant area that fits all of the criteria for a Grizzly Bear habitat. The biggest concern that I see on my map is the proximity to human contact in the Mount Evans area. I am not very familiar with the area, but I could see the possibility of more unimproved roads and trails and such in that area that are uncharted having an impact on the bears. With this map we can't see the unofficial areas humans occupy and avoid them. We are counting on humans to not interfere with bear habitats when we introduce them, which will be difficult if we designate a popular park as bear habitat.

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Vector data          Forest              DenverDEM
                                                              │
   │                                                          ▼
  Lakes                                  Erase area    Extract
                                         within        elevation
  Metro counties     Create roads        buffer        2500< AND
                     buffer              (roadaway)     >3550
  Metro roads    →   (ROADBUF)               │              │
                                             ▼              ▼
  Rivers         →   Create river         Create        Reclassify valid
                     buffers              dissolved      grid cells to 1
                     (RIVBUF)             polygons          │
  Metro federal                          (ROADAWA          ▼
  lands                                  Y_dissolve)    Convert raster
                                                         to polygon
                                                         (GRIZELEV)

                                    Intersect
                                    elevation with
                                    forest cover
                                    (GRIZELFO)

            Intersect river       Clip GRIZRIV1    Turn GRIZOK
            buffers with          to               into
            grizzly forest    →   ROADAWAY_dis  →  singlepart
            (GRIZRIV1)            solve (GRIZOK)    feature

                                                   Select areas >
  The End!  ←  Change          ←  Create layer  ←  129,600,000
               transparency        from selection    sqm
               and symbology
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Optimal Grizzly Bear Habitat in Colorado

Work Cited

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"Natural History." *Natural History*, www.biologicaldiversity.org/species/mammals/grizzly_bear/natural_history.html#:~:text=HABITAT%3A%20Grizzlies%20are%20highly%20adaptable,conifer%20forests%20and%20coastal%20areas.