Assessing Burn Amounts of Bastrop County, TX Canopy Cover Before and After the Bastrop Complex Fire of 2011

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Background and Introduction:

In 2011, the most destructive wildfire in Texas history struck the area of Bastrop County, TX. The wildfire started on September 4, 2011 and went until October 10, 2011. According to authorities, three separate fires started and the results of strong winds caused by nearby Tropical Storm Lee, blew the fires around and local fire departments lost control of the fire. These fires were started by knocked down electrical lines that fell from large 30-mile-per-hour gusts. The electrical lines sparked fires that later could not be contained, which in turn started one of the biggest wildfires in Texas history. In total the Bastrop County Complex Fire caused a total of $325 million worth of damage. In my experience, driving through Bastrop to get to Austin from Houston after the fires was very interesting to see the bare trees that are still standing and trees with no canopy. Seeing how much canopy cover that was lost in the largest wildfire in Texas history would be very important to the surrounding community

Problem:

I wanted to see how much of the canopy/tree cover was burned in the fire and try to find an exact percentage of the amount of trees burned in the fire. Doing this, I would need canopy/tree cover data before 2011 and canopy/tree cover data after 2011 when the fire was extinguished and compare the two layers using the raster calculator or using the Zonal Geometry tool (Spatial Analyst) to determine the area of forest that was lost in the large fire.

Figuring out the canopy layer area loss would be crucial to figuring out later on what impacts that would have on the surrounding areas for later studies. Other studies to base off canopy cover loss would include, but are not limited to, soil analysis, biological effects such as mammal homes and shelter, soil health, surrounding plant life, etc.

Data Collection:

The base map and reference labels were downloaded from https://www.ArcGIS.com and these are cited on the bottom right corner of the map.

The Bastrop State Park Boundary was downloaded directly from the Texas Parks and Wildlife website, https://tpwd.texas.gov/gis/

Texas political boundaries were downloaded from Texas Natural Resources Information System, https://tnris.org/data-download/#!/statewide .

General information about the Bastrop County Complex Fire was found on multiple websites linked below to gain better knowledge about the fire in general.

https://earthobservatory.nasa.gov/images/52137/bastrop-county-complex-fire-burn-scar

https://www.statesman.com/news/20160915/five-years-after-devastating-fire-bastrop-county-still-recovering

Data Pre-Processing:

The Base Map layer was downloaded from the ArcGisOnline website and it was not in the correct data frame so I exported it to NAD 1983 UTM Zone 14 to make sure it fit with my map. A warning message appeared on the screen when you tried to add a layer to ArcMap and the layer was not in the same geographic coordinate as the ArcMap file (Figure 1).
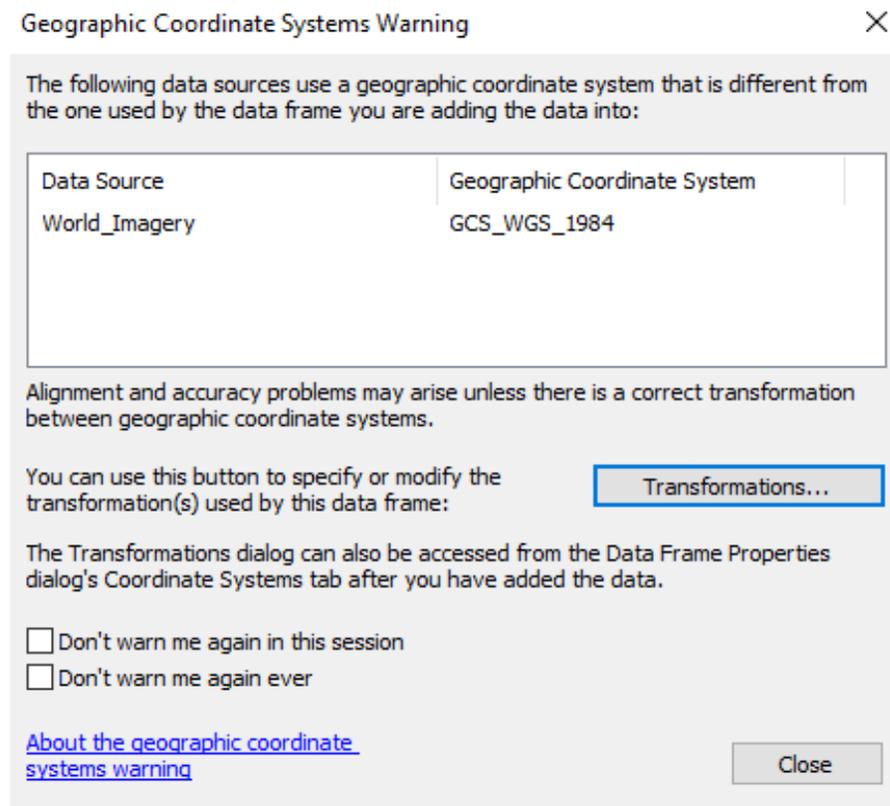
Figure 1: Warning message that popped up as you added a new layer to the ArcMap file you were working in.

Canopy Coverage Rasters:

The files that I downloaded from the internet were from ArcGIS online and were online pictures that you could not do much in terms of analysis or any calculations. I had to take a screenshot of the County Complex Trees 2010 and 2014 and convert them into a .tif file. After I converted the screenshots into a .tif file, I then uploaded the screenshots of the County Complex Trees 2010 and 2014 into Adobe Photoshop 64 bit so I could edit the screenshots to get the best resolution possible to upload into ArcMap (Figure 2). I made sure to edit with indexed color

using three colors (black and white) and made sure transparency was turned on for both as seen in Figure 2.

I then georeferenced these photos to make them fit to the Fire Perimeter layer by dragging many points of the photos to the outline of the Fire Perimeter of 2011 layer to make sure it had the best fit possible (Figure 3). After I updated the georeferenced photos, I had to "Extract by mask" (Figure 4) to take away a large white border (Figure 3) that was around the County Complex Trees 2010 and 2014 layers. The extract by mask used tool allowed me assign zeros to areas with no canopy cover and ones to areas with canopy cover. This helped me see the change in canopy cover from 2010 before the fire to 2014 after the fire.
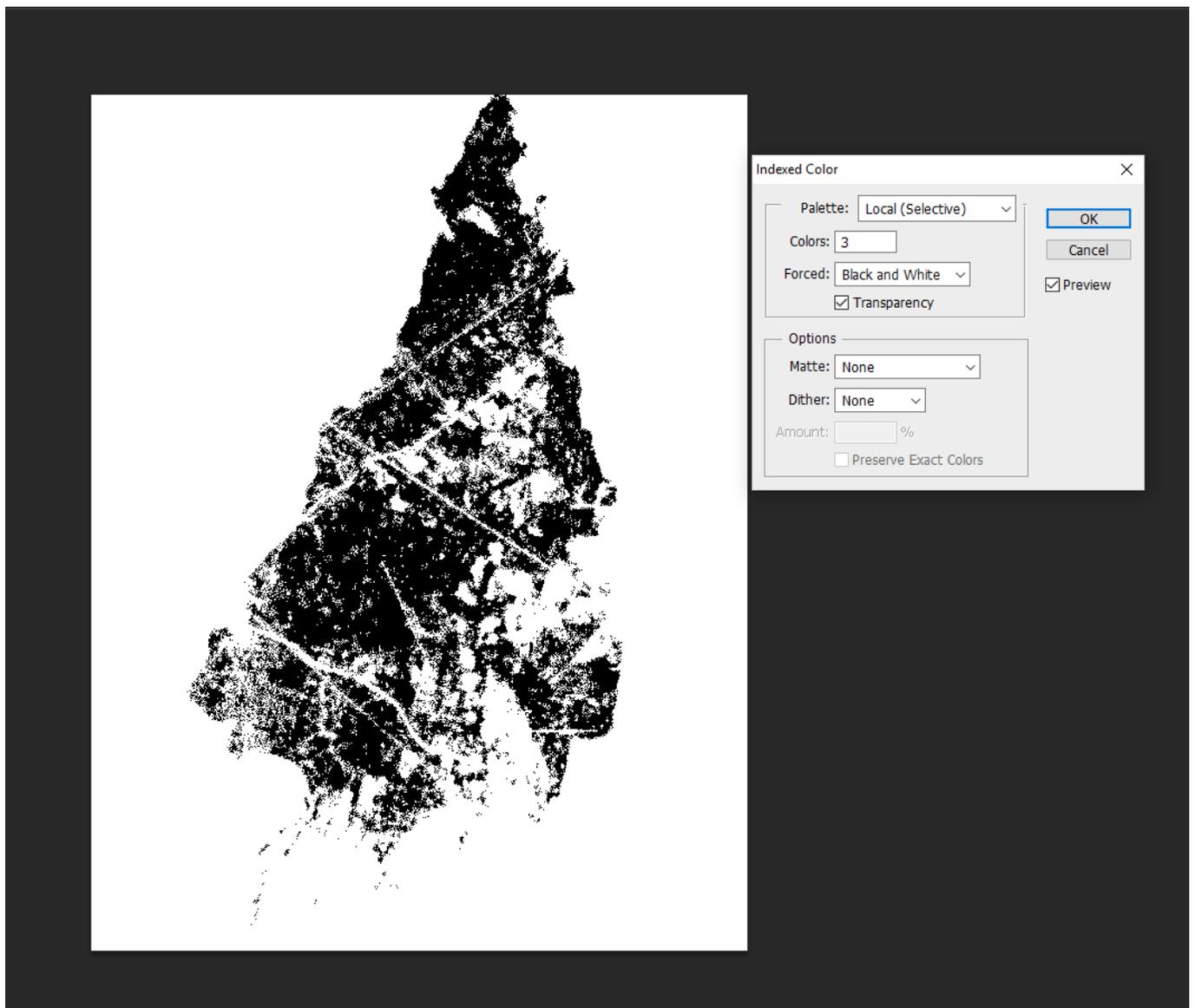
Figure 2: *Use of Adobe Photoshop 64 bit to convert pictures to the best resolution possible. This process was the same for both 2010 and 2014 layers.*
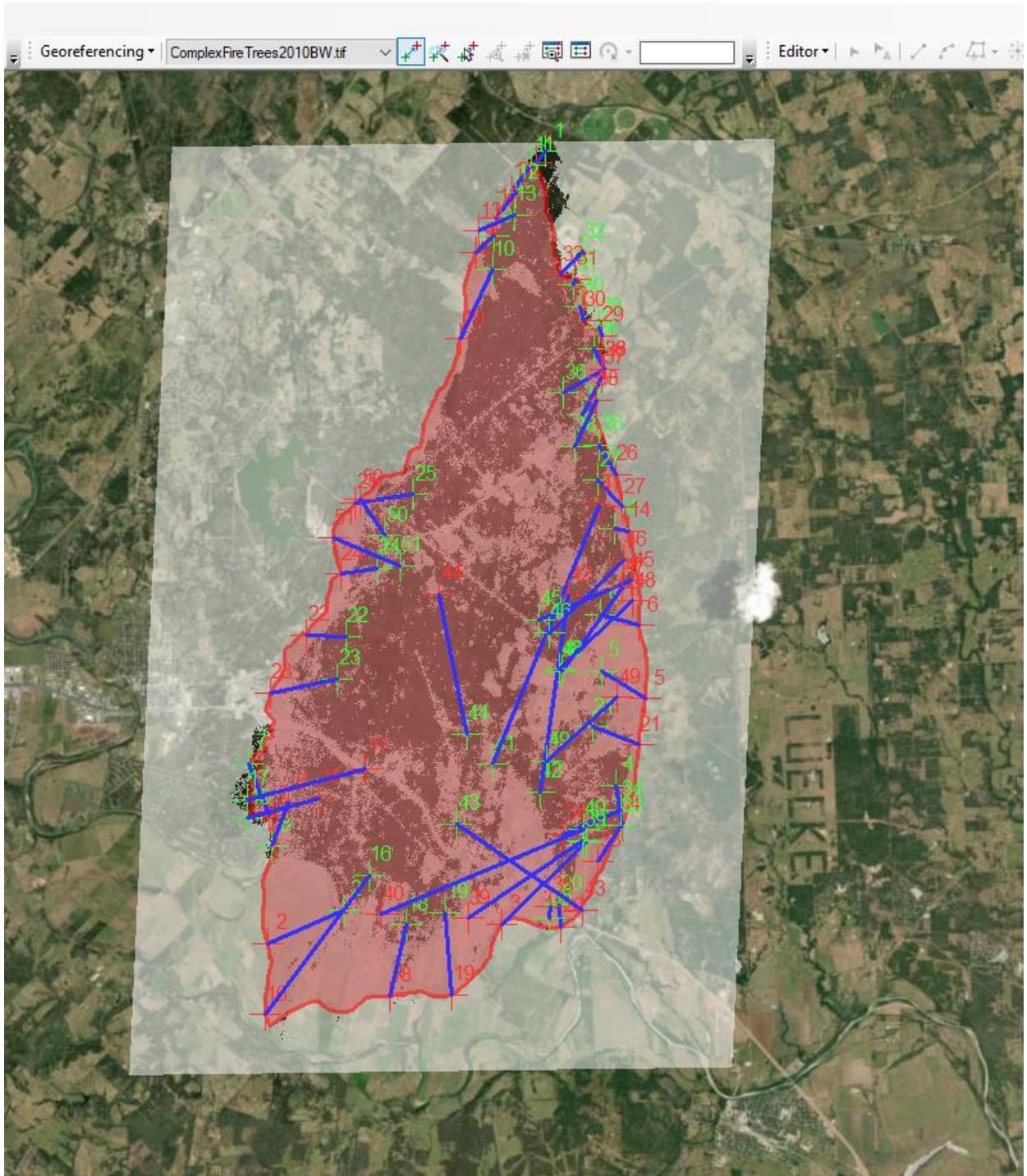
Figure 3: *Georeferencing 2010 and 2014 County Complex Tree data to fit the Fire Perimeter Layer. Also includes a large white outline that was later cropped out.*
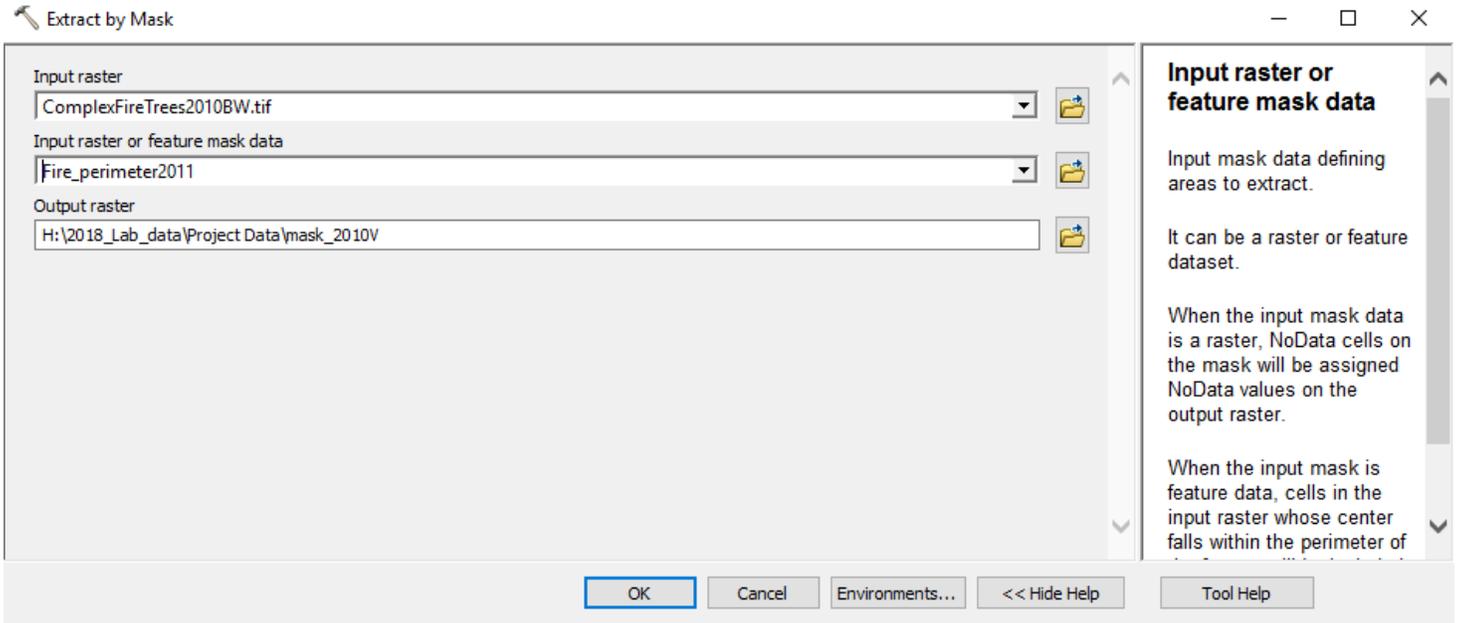
Figure 4: *Extract by mask for Complex Fire Trees 2010 to the layer Fire_perimeter2011*

Data Processing:

Canopy Cover Analysis:

The method I used for the canopy cover analysis was using a new tool I have not ever used before called the Zonal Geometry (Spatial Analyst) tool (Figure 5). This was a very useful tool and I used it to make a whole new layer that would give me the area with canopy cover and area without canopy cover. We had not used this tool in class and gave it try and found that it produced the exact data I needed while creating another layer to see data rather than just looking at the attribute table.

For the input raster or feature I put the raster layer that I wanted to find the area of, which was either the 2010 layer or the 2014 layer (Figure 6). The zone field used was "VALUE", the geometry type was "AREA" to find the area of the raster layer, the "Output raster" was some name saved to your flash drive or campus drive, and the "output cell size" was the size of the layer that you were put as your input raster.
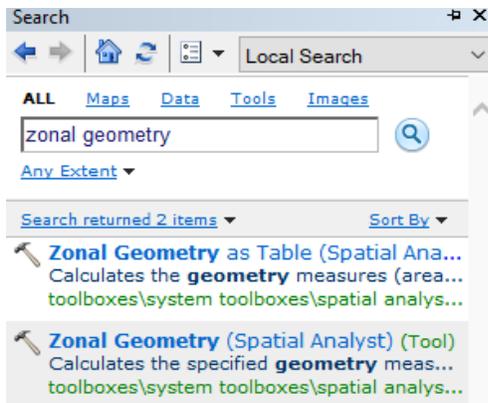
Figure 5: To calculate the area of the masked layer, I used Zonal Geometry to find the area of the canopy cover.
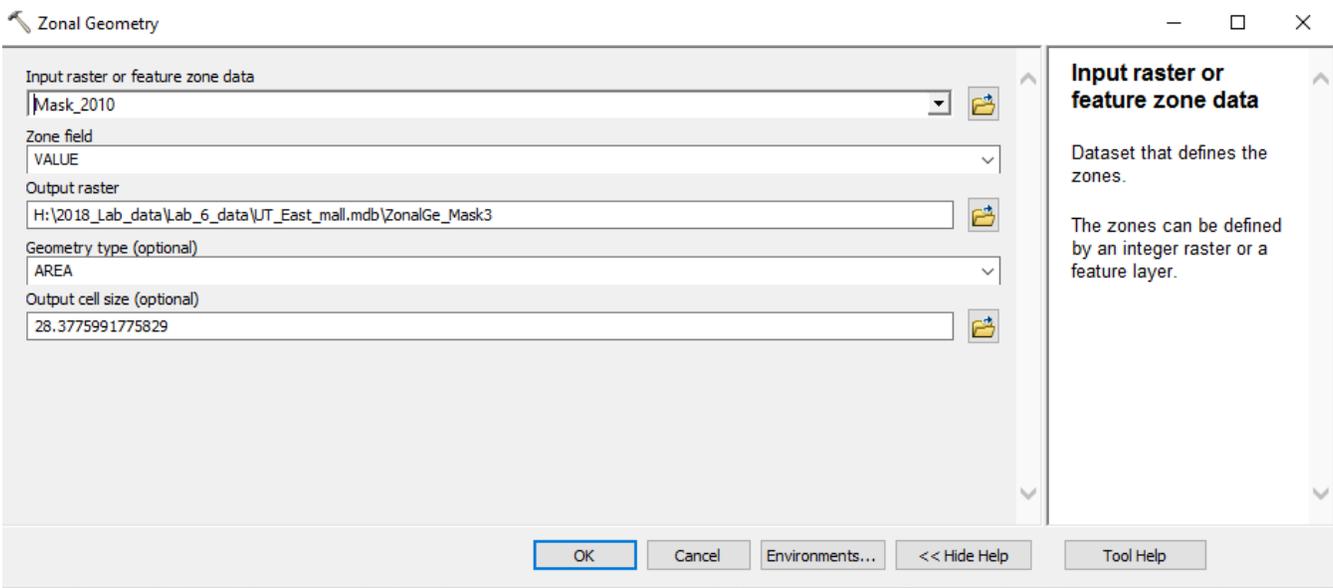
Figure 6: Input of the two mask layers into Zonal Geometry to calculate the area
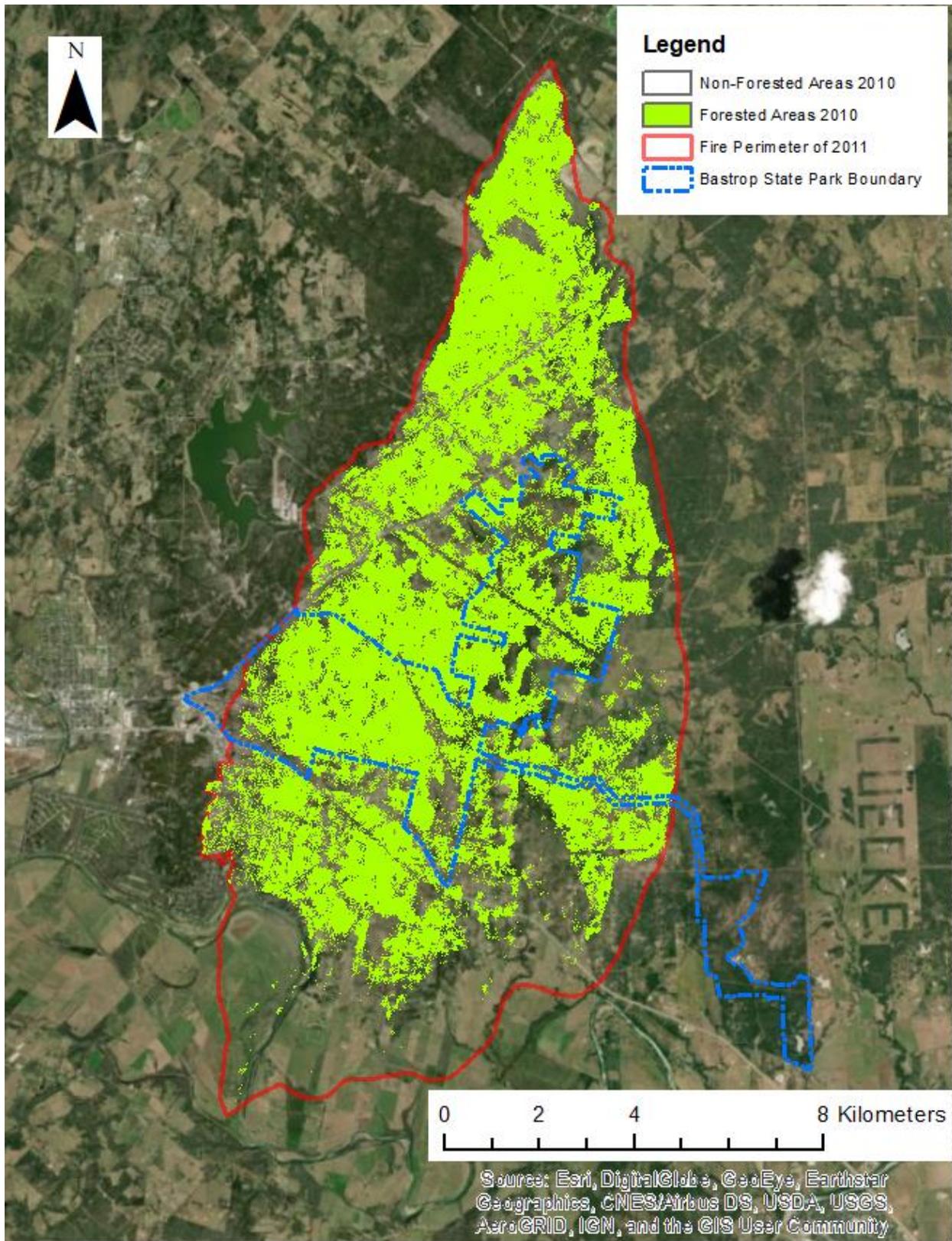
Figure 7: *2010 Map of Pre- Fire Forested and Non-Forested Areas*
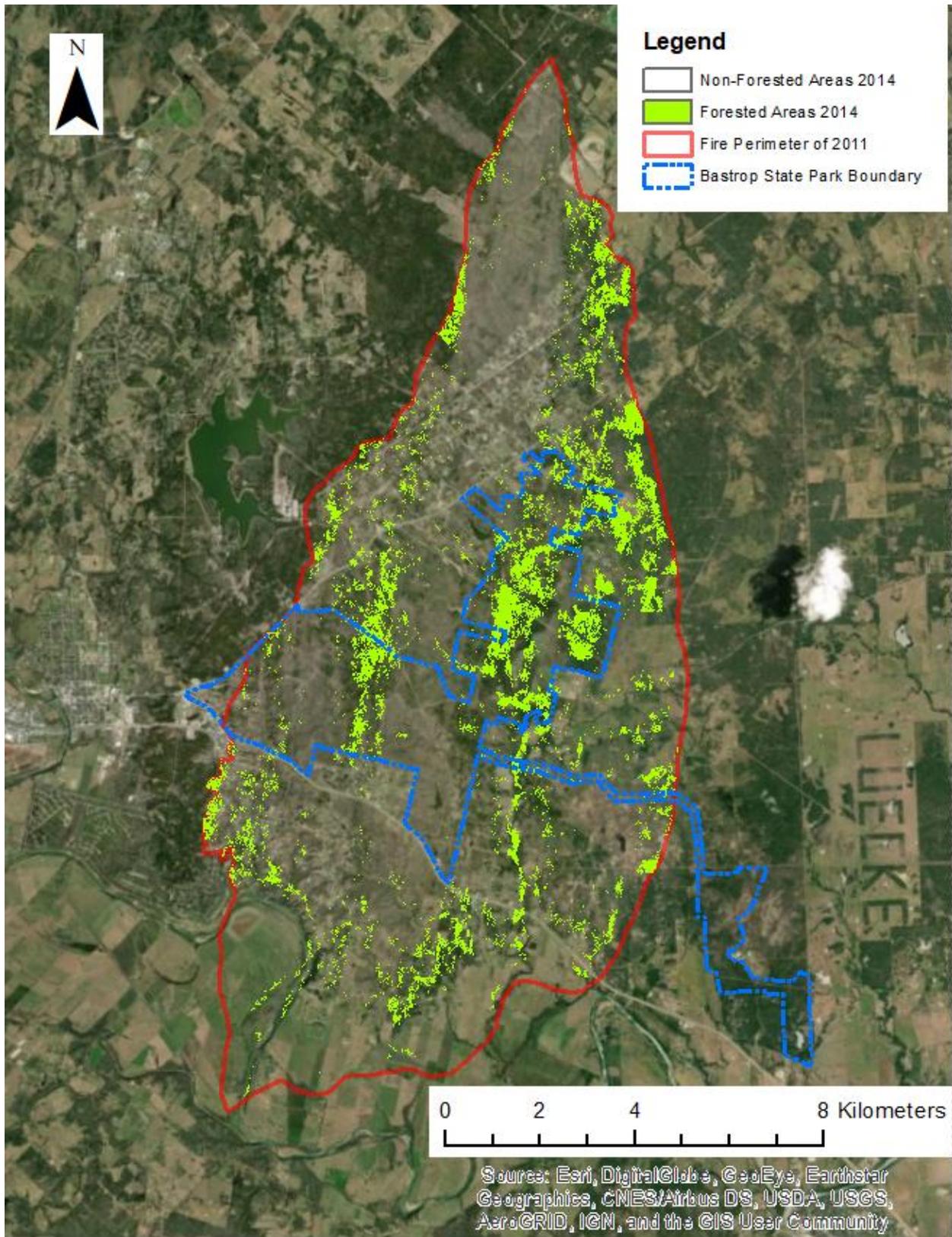
Figure 8: *2014 Map of Post- Fire Forested and Non-Forested Areas*

The canopy cover maps show how devastating the 2011 Bastrop County Complex fire was to the forested areas in the county and in the state park (Figures 7 & 8). The lime green areas show the areas that have canopy cover and everything other than the lime green areas shows areas that did not or do not have trees/canopy cover within the fire perimeter of 2011 (Figures 7 & 8). The area of the forested and non-forested areas is located in the symbology tab of these two layers. The maps also display the boundary of Bastrop State Park in a blue dashed line (Figures 7 & 8).

Results:

Layer	Forested/Canopy Areas	Non-Forested/Non-Canopy Areas	% of Forest	% of Forest Lost
2010 Pre- Fire Canopy Cover	65,923,304 m^2	68,664,504m^2	96 %	N/A
2014 Post-Fire Canopy Cover	12,770,492 m^2	121,944,528m^2	11%	85%

Table 1: Areas of Forested and Non-Forested portions of each map.

The amount of forest that was lost was calculated to be about 85% and this is quite a substantial amount (Table 1). In the Fire Perimeter of 2011, about 96% of the area was concluded to be forested/canopy areas according to the zonal geometry layer properties that was created in Figure 6. After the 2011 fire there was roughly about 11% of forest/canopy areas left at the time and this was quite substantial for the community of Bastrop and the surrounding areas. Much of the Bastrop State Park was affected and much of the trees in the park were burned according to real life reports and the data I have gathered.

Canopy Cover before and after Bastrop County Complex Fire of 2011

By: Tyler Nguyen
Date: 12/4/2018

Pre-Fire

Post-Fire

Legend

Non-Forested Areas

Forested Areas

Fire Perimeter of 2011

Bastrop State Park Boundary

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
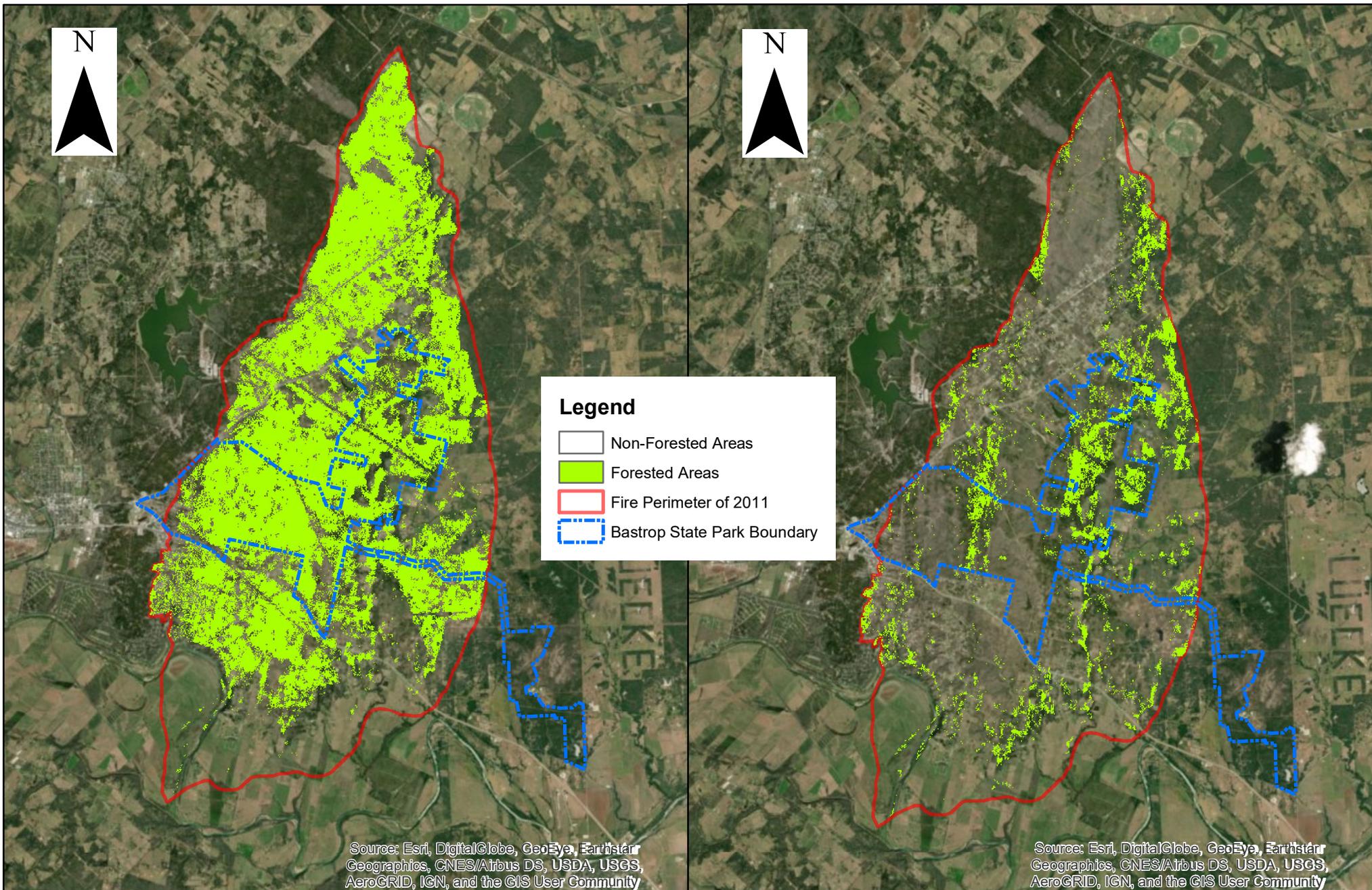
0   2.5   5   10 Kilometers

Coordinate System: NAD 1983 UTM Zone 14
Projection: Transverse Mercator