

The Effect of Prescribed Burns on Arthropod Presence



Figure 1: Image obtained from Lady Bird Johnson Wildflower Center [webpage](#) on prescribed fire research

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Introduction

For 50 years, the US had a policy of wildfire suppression that led to a buildup of fuel and has resulted in numerous devastating uncontrolled fires, such as that in Yellowstone in 1910. This policy began to shift in the 1950s and by 1967, the National Park Service began to experiment with fire management by using prescribed burns. The Lady Bird Johnson Wildflower Center (LBJWFC) has been studying fire ecology using a collection of 18 burned, 24 mowed, and 12 control plots for the past 17 years. The LBJWFC also believes that a consistent fire regime can be used to increase biodiversity by opening up space for a variety of plants to grow in.

Problem

I am interested in testing whether arthropod presence varies between these plot types because insect diversity can be used as a bio-indicator for ecosystem health. In the interest of time, I will use arthropod density within a plot as a proxy for insect diversity by taking a lower density to be representative of a lower biodiversity. I believe this will be roughly accurate as I would expect a more biodiverse ecosystem to have more insects. I will compare the densities of insects found in control plots to the densities of insects found in burned plots.

Hypothesis

I hypothesize that the control plots that I survey will have a lower arthropod density than burned plots that I survey, based on the LBJWFC's belief that fire regimes increase biodiversity.

Data Resources

Texas Natural Resources Information System: <https://tnris.org/data-download/#!/statewide>

- Aerial imagery of LBJWFC: Oak Hill quadrangle and Signal Hill quadrangle "2015 Texas Orthoimagery Program 50cm NC/CIR"

Michelle Bertelsen: via email on April 20, 2018

- Map of plots and corresponding treatments

On the ground data collection: sweep netting on April 25, 2018

- Arthropod collection in each plot

Methods

I opened a blank map in ArcMap and saved it as Long_GIS_Project in a new folder named Independent_Project in S:\gtl278\GEO327G. I loaded my aerial photographs and grouped them under the label "Orthophoto" (Figure 2).

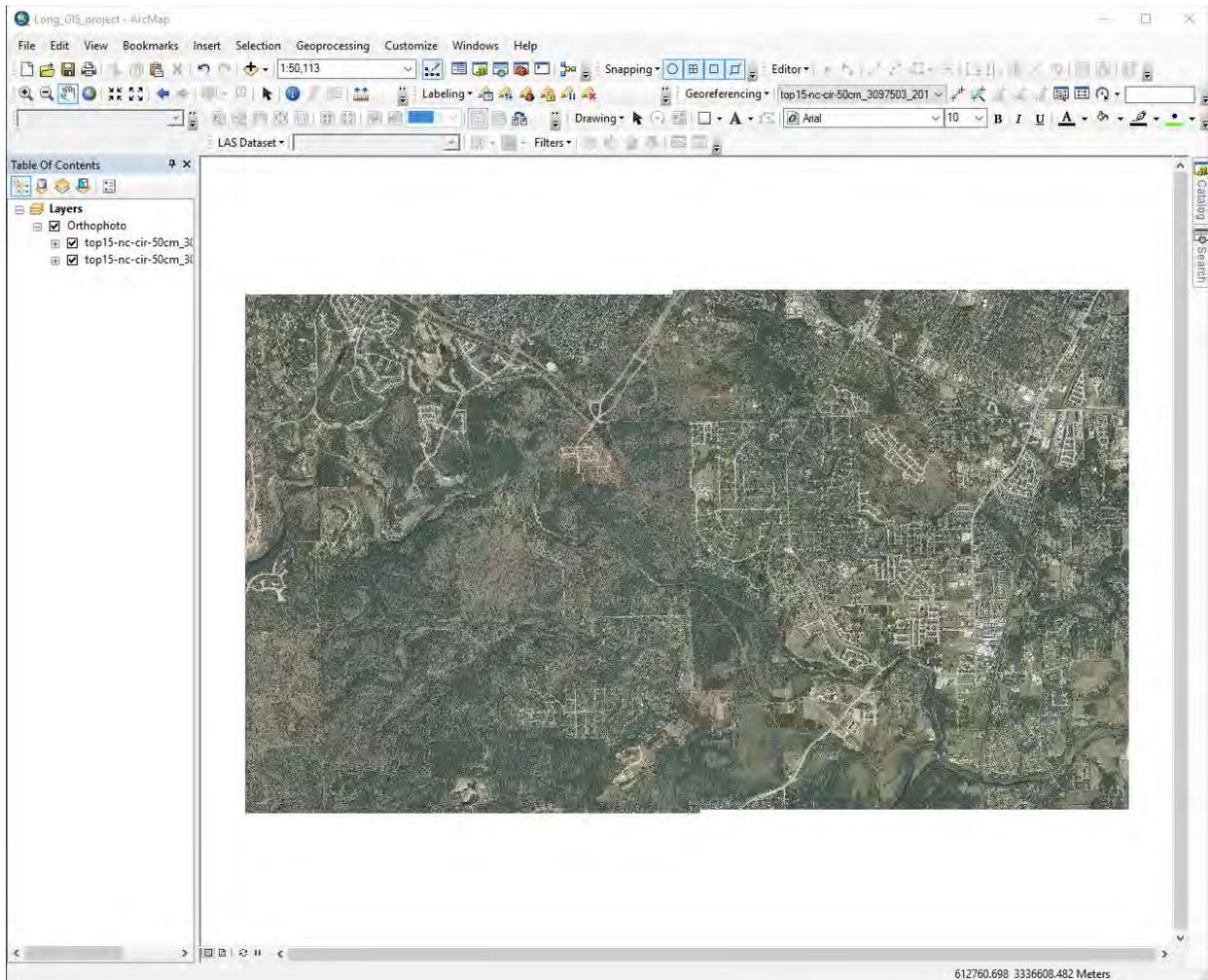


Figure 2: Aerial imagery loaded into map

Under Layers>Properties>Coordinate System, I set the coordinate system of my project to NAD 1983 UTM Zone 14N, which was also the coordinate system under which the orthophotos were referenced (Figure 3).

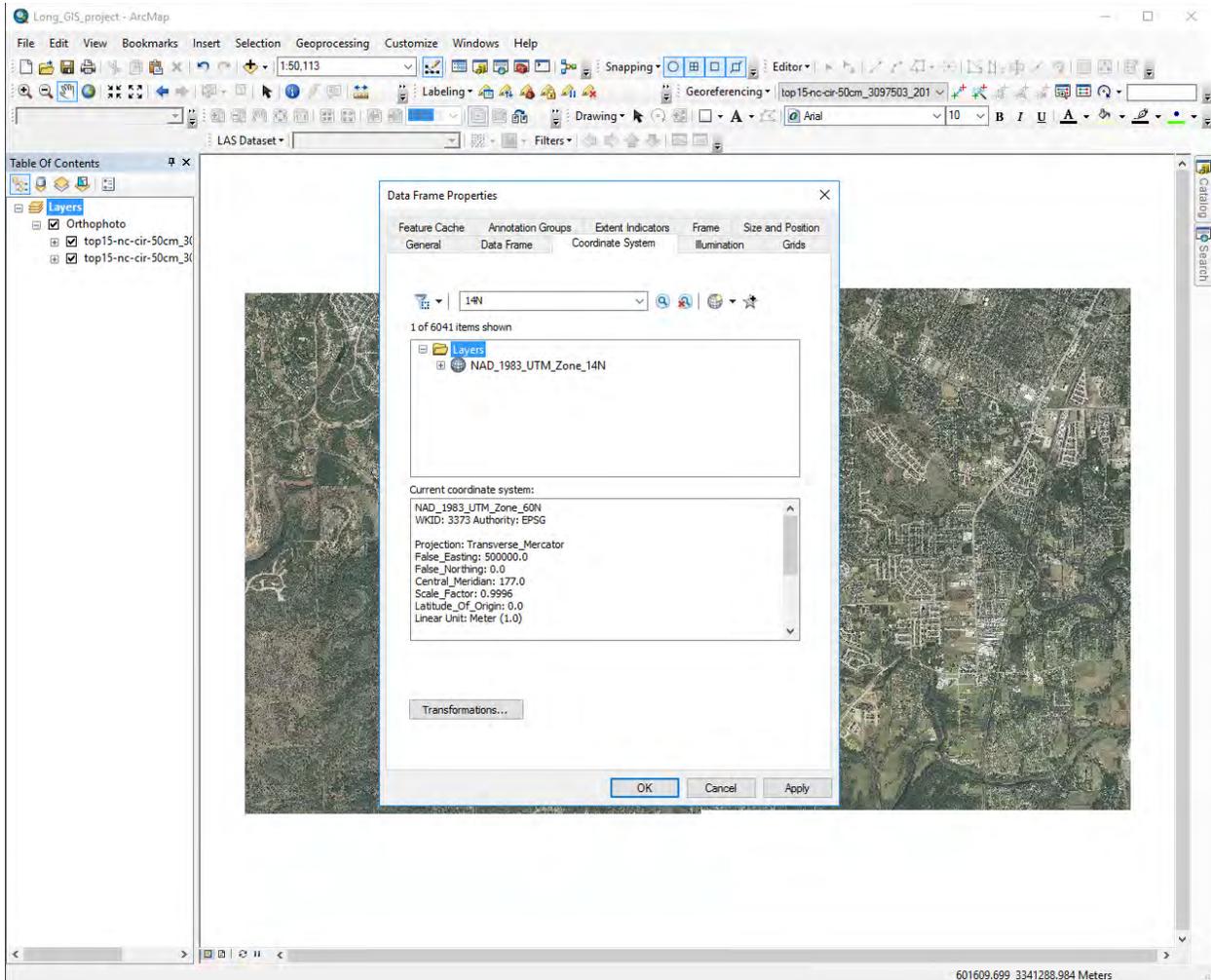


Figure 3: Set project coordinate system

I created a personal geodatabase to house my project by right clicking on my Independent_Project folder in the catalog tree>New>Personal Geodatabase and named it lbjwfc. By right clicking on lbjwfc>New>Feature Class, I created a new point feature class called location so that I could mark the LBJWFC headquarters (Figure 4), again setting the coordinate system to NAD 1983 UTM Zone 14N.

New Feature Class

Name:

Alias:

Type

Type of features stored in this feature class:

Geometry Properties

Coordinates include M values. Used to store route data.

Coordinates include Z values. Used to store 3D data.

< Back Next > Cancel

Figure 4: Feature class creation

I added the location feature class to the table of contents from the catalog tree and started editing in the Editor toolbar. I clicked through Editor>Editing Windows>Create Features and selected my location feature class and the Point Construction Tool. I added a point to the LBJWFC buildings, changed the symbology to be more visible, and entered “LBJWFC Headquarters” in the space “Label appearing next to the symbol in table of contents:” (Figure 5). I made sure the point was above the orthophotos in the table of contents.

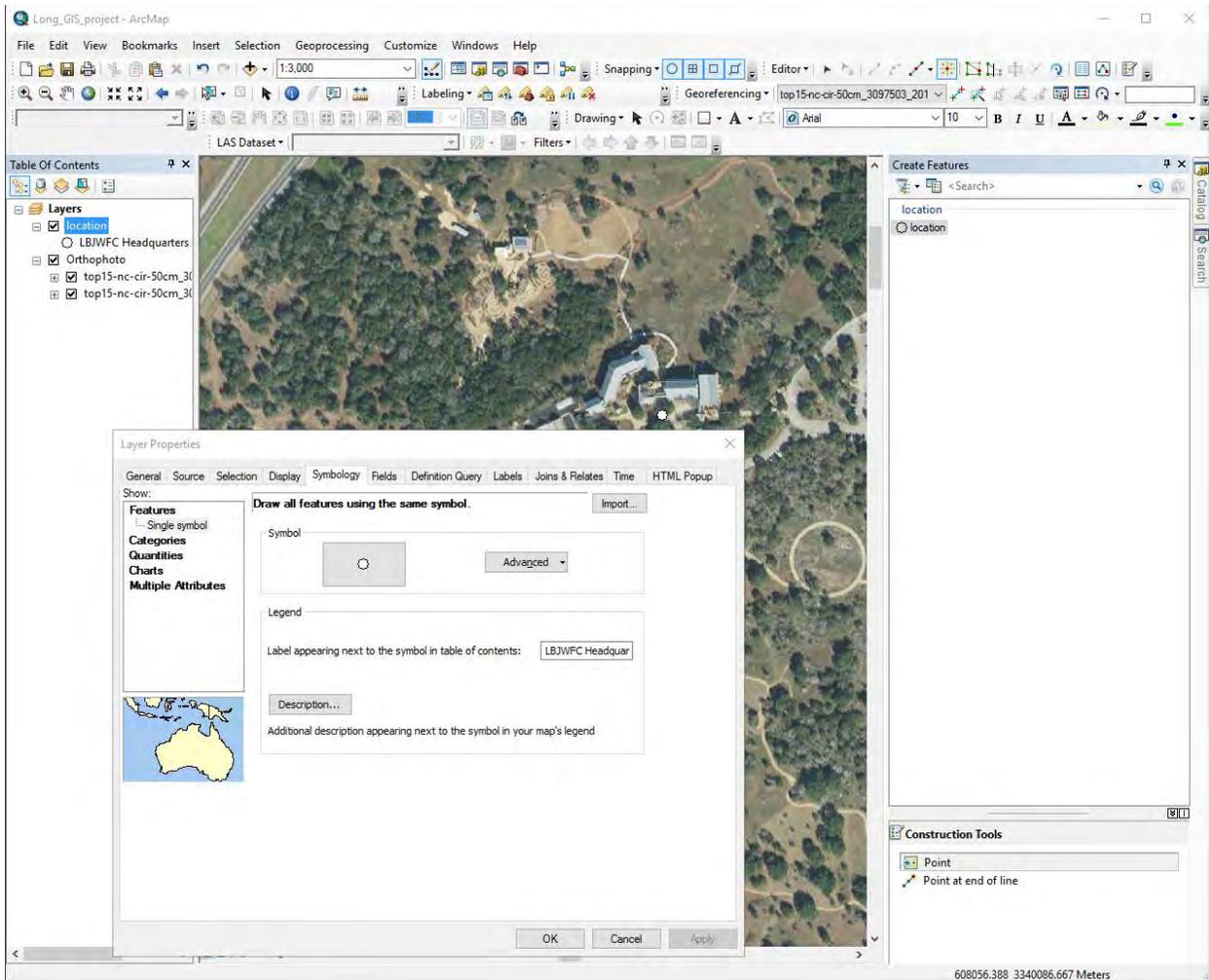


Figure 5: Feature creation and editing

I added my map of the plots and treatments to the project and had to georeference it via the Georeferencing toolbar. Using Add Control Points, I aligned the map to the orthophotos using 4 reference points (Figure 6), then clicked through Georeferencing>Update Georeferencing.

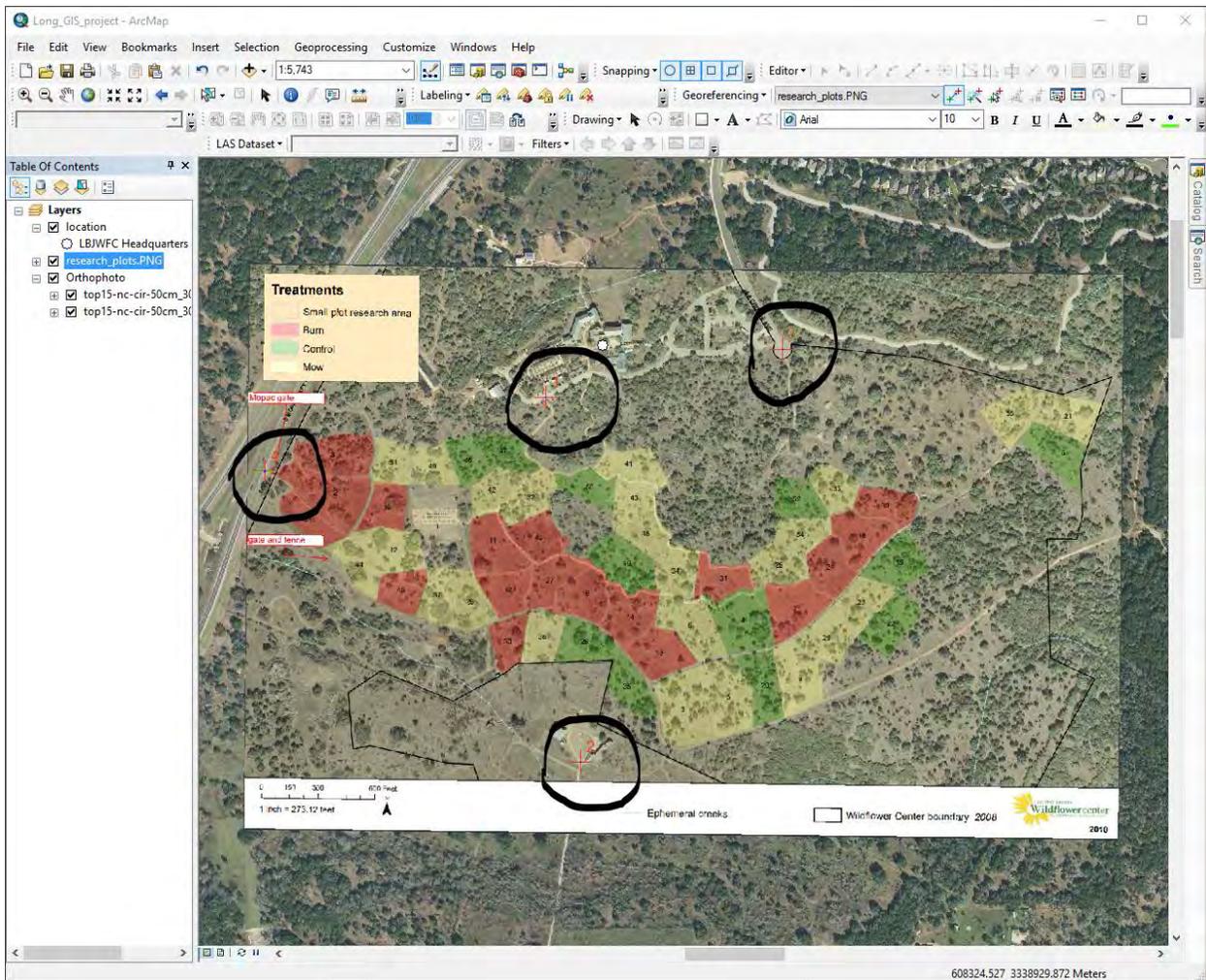


Figure 6: Georeferencing map with reference points circled for visibility

I created a surveys feature class in the same way that I created my location feature class (Figure 4) except that for “Types of features stored in this feature class,” “Line features” was selected. I added the text field “COMMENT” with 10 characters and the double field “mass.” I edited the symbology of surveys in the same way that I edited that of locations (Figure 5) so that features in this class were represented by a black line and “Label appearing next to the symbol in table of contents:” was filled with “Survey Lines.”

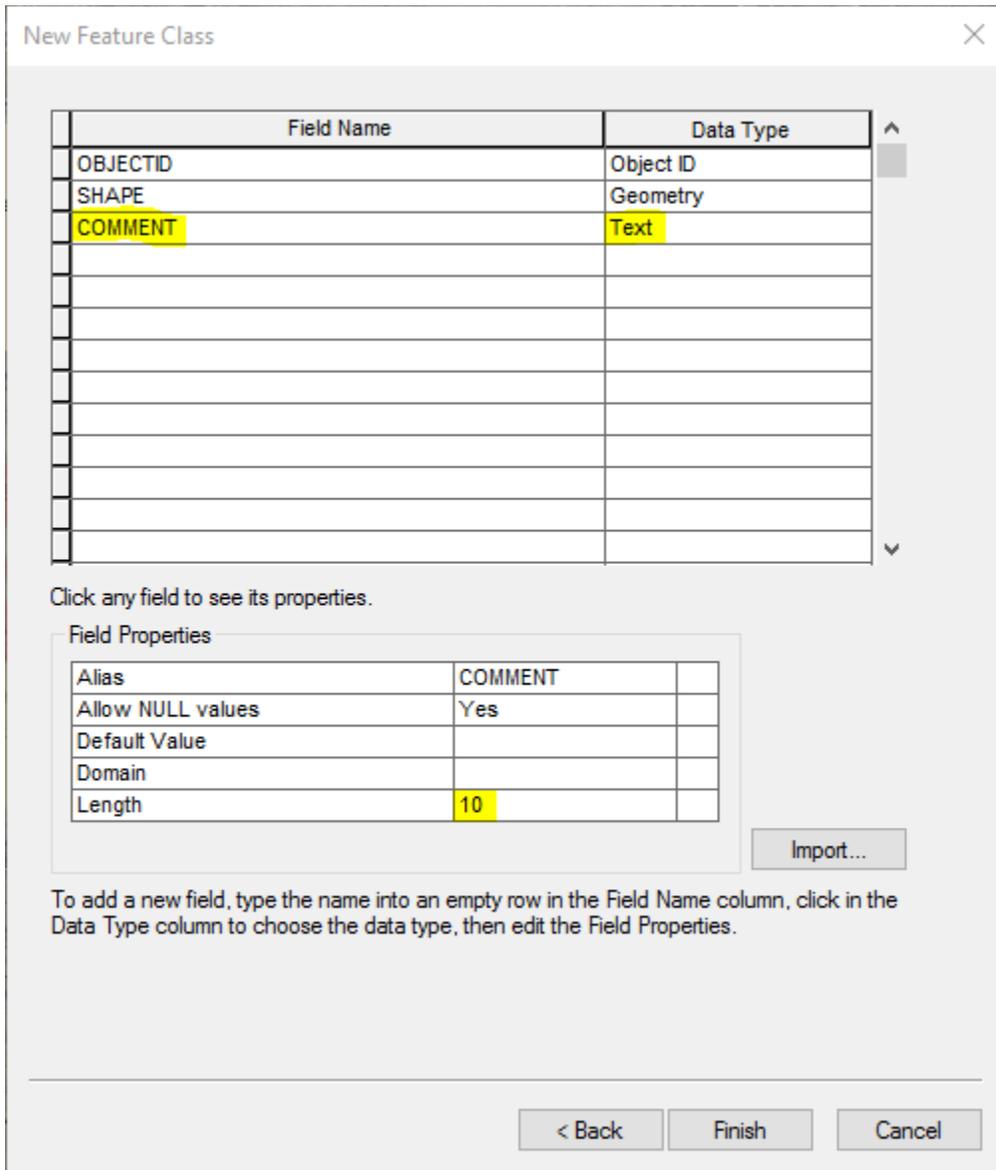


Figure 7: Adding a field to a feature class. The fields that required editing are shown highlighted with the appropriate entries.

I created a domain within my geodatabase by right clicking on lbjwfc and clicking through Properties>Domains. Under Domain Name, I entered "TREATMENT," with "treatment" in the Description field next to it. I selected Text as the Field Type and Coded Values as the Domain Type. In the Coded Values box, I entered the Code "burned" with the Description "burned," "control" with the Description "control," and "mowed" with the description "mowed" (Figure 8).

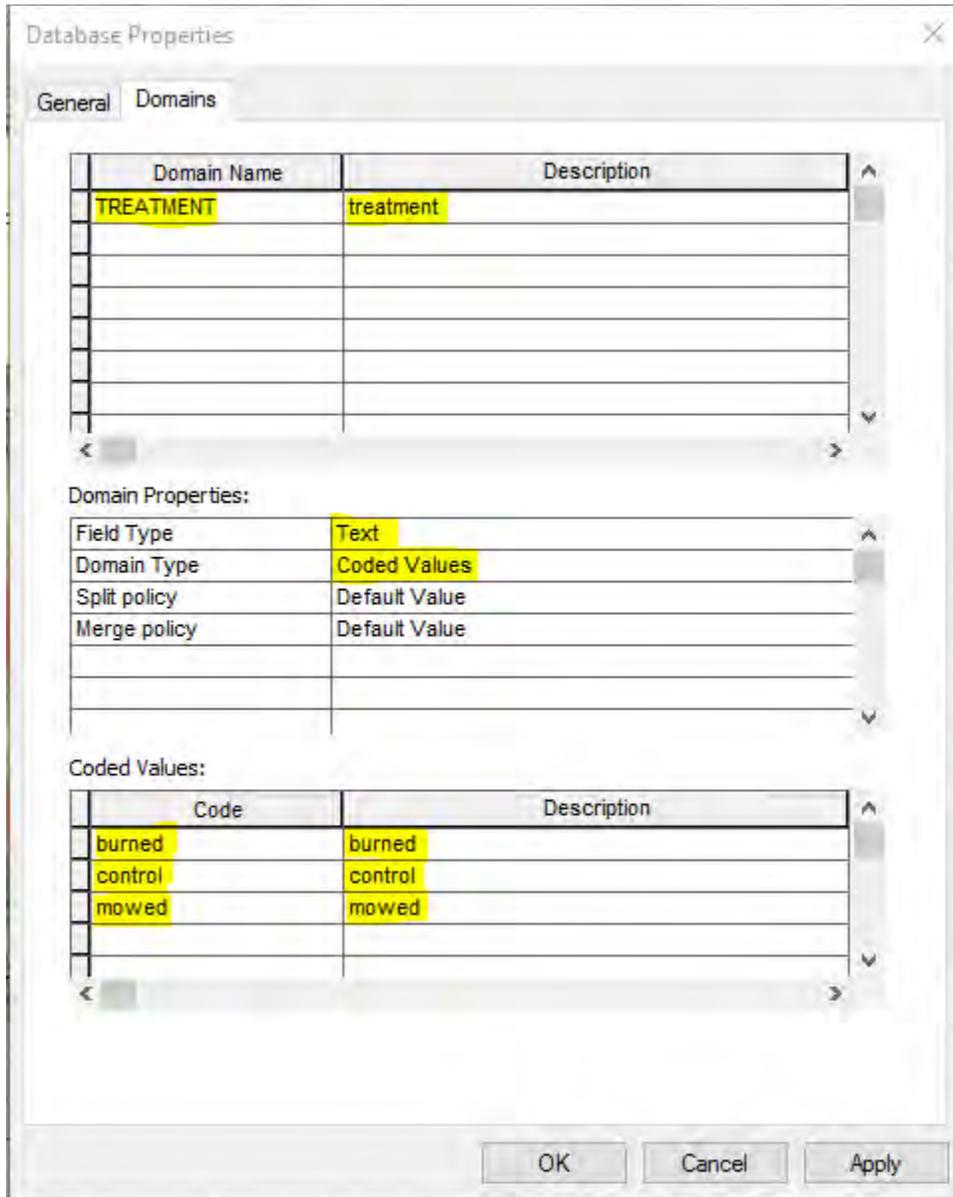


Figure 8: Domain creation with edited fields highlighted

I added a plots feature class in the same way that I added a point feature class (Figure 4) and added the text field TREATMENT. In field properties, I edited the Default Value to “burned” and set the Domain to TREATMENT (created in the previous step) (Figure 9).

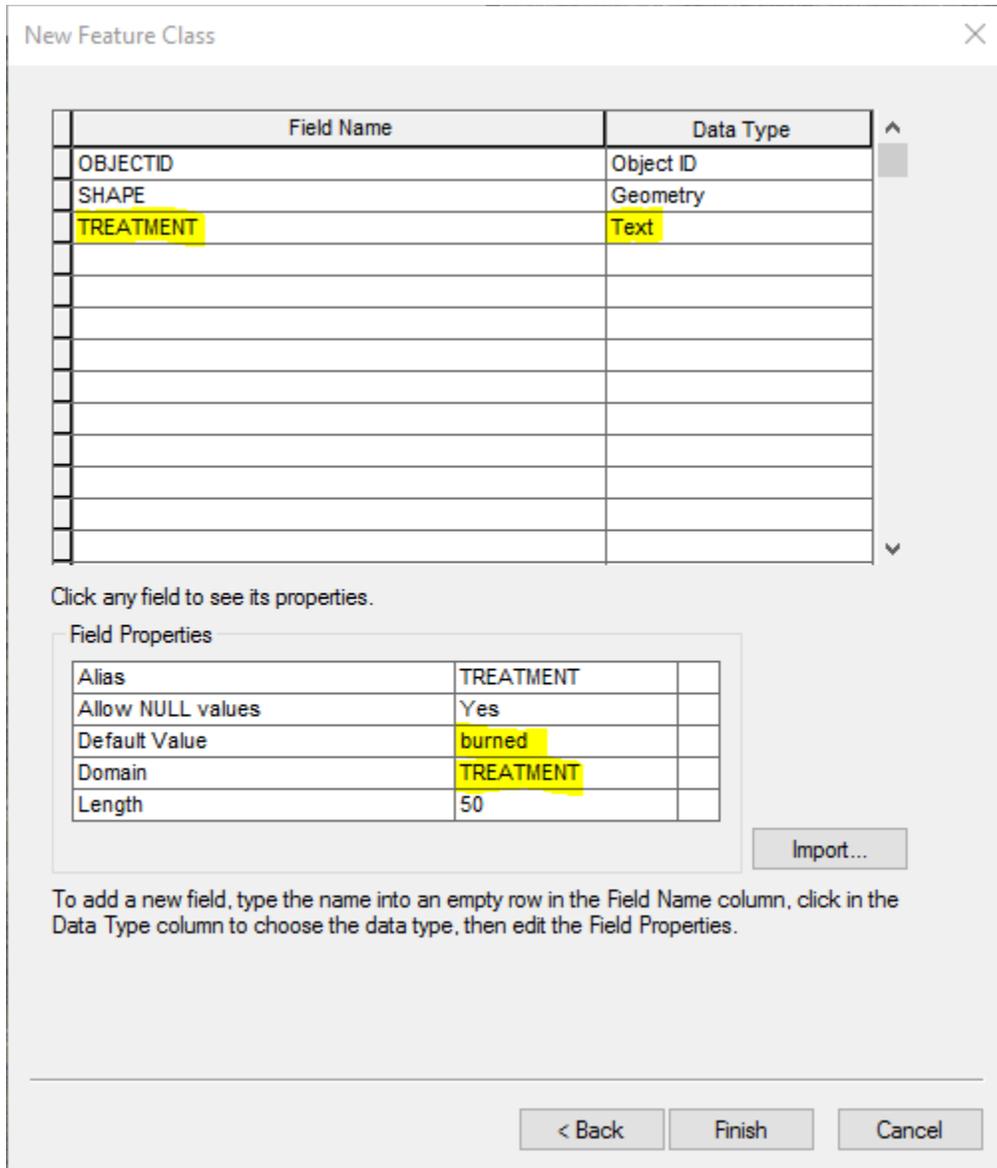


Figure 9: Creating a field in a feature class with a selectable menu of values

I opened the Create Features in my plots feature class (Figure 5) and traced the outline of the two independent plot areas on the map using the Polygon Construction Tool. I then used the Cut Polygons tool () in the Editor toolbar to divide the two areas into their individual plot components. I labelled which plots underwent which treatments by clicking through Editor>Editing Window>Attributes, selecting each polygon in turn and choosing the appropriate treatment from the TREATMENT menu. I then edited the symbology of plots based on category so that burned plots were red, control plots were green, mowed plots were yellow, and other plots were white (Figure 10). I removed the map from Michelle Bertelsen afterwards.

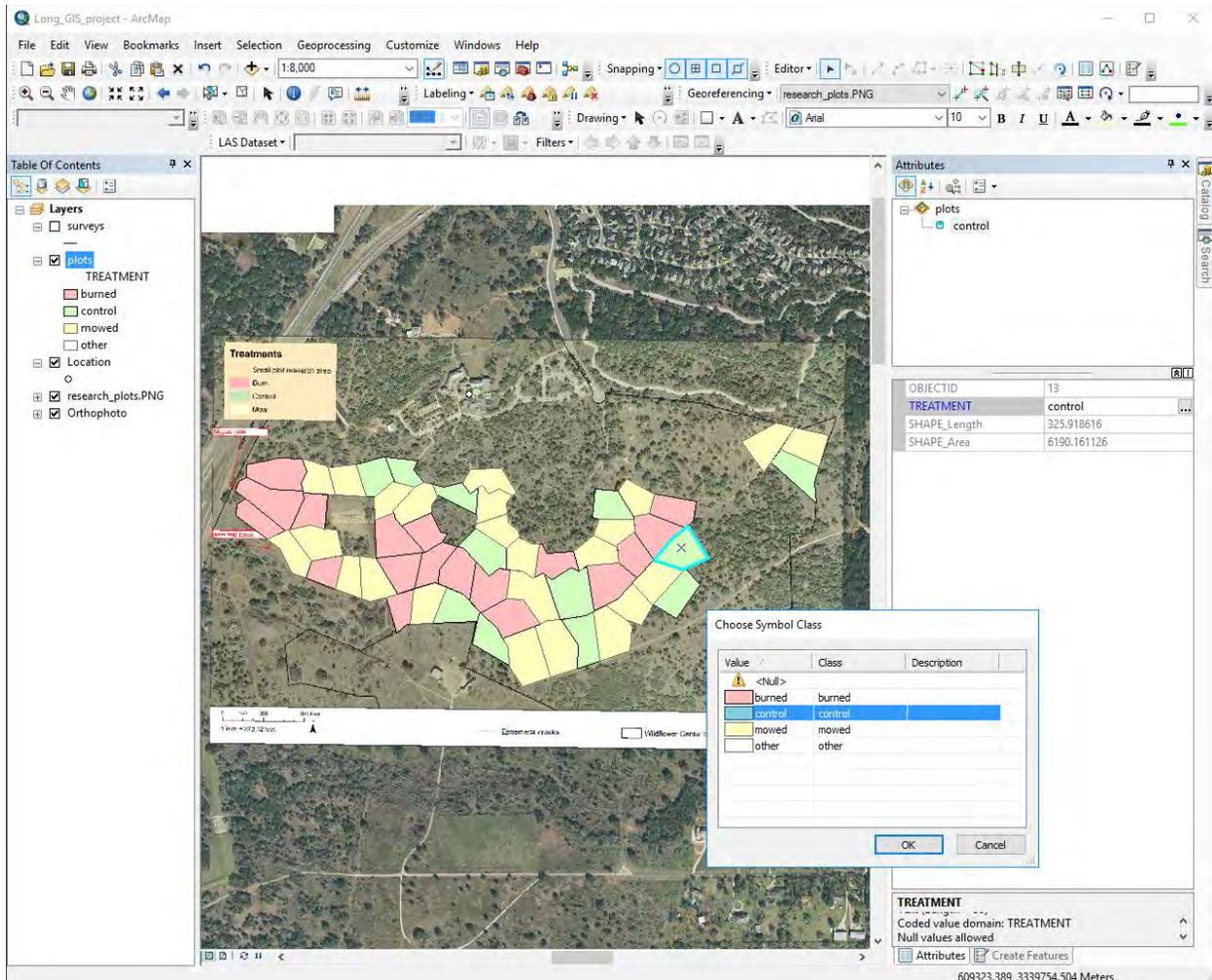
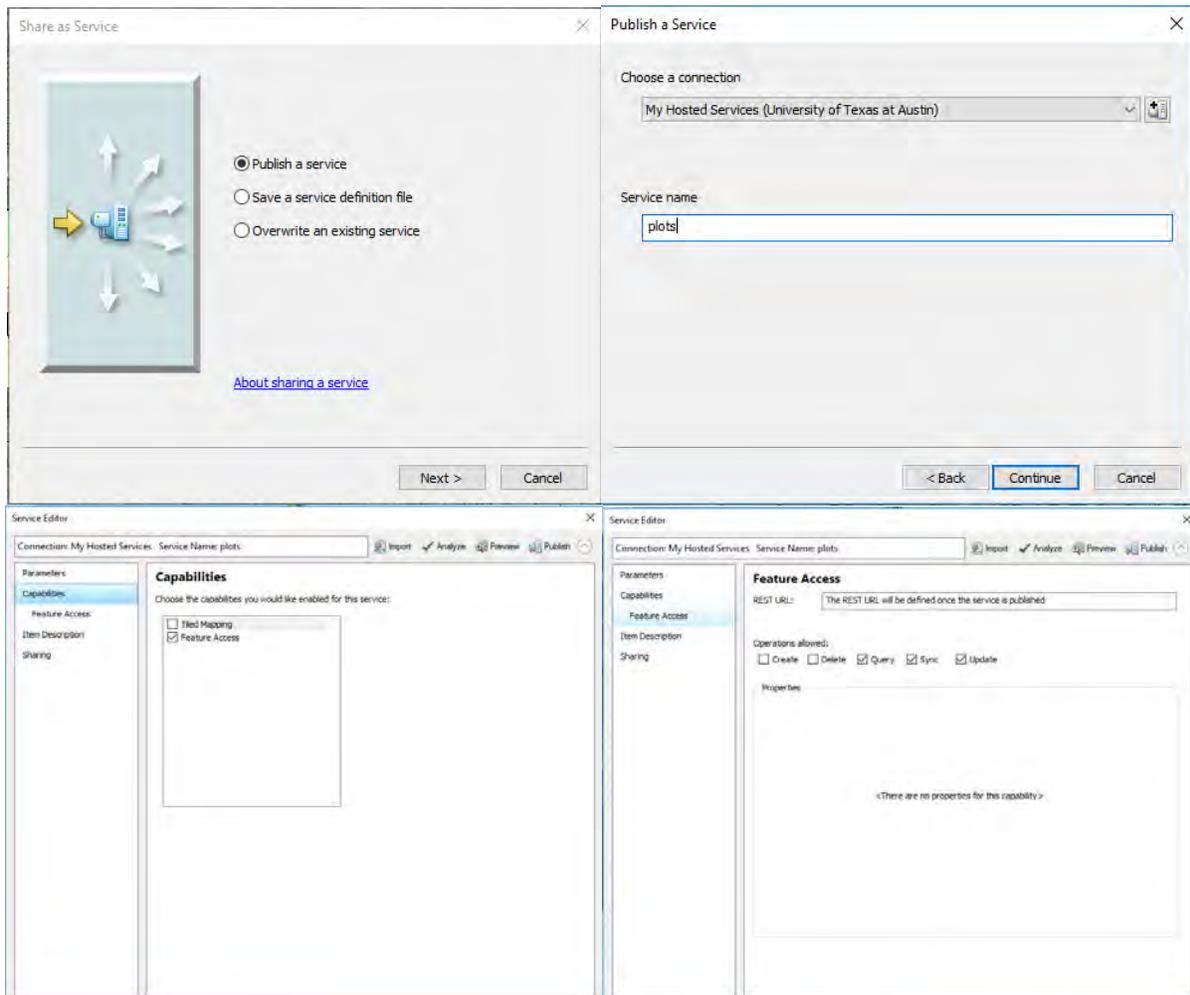
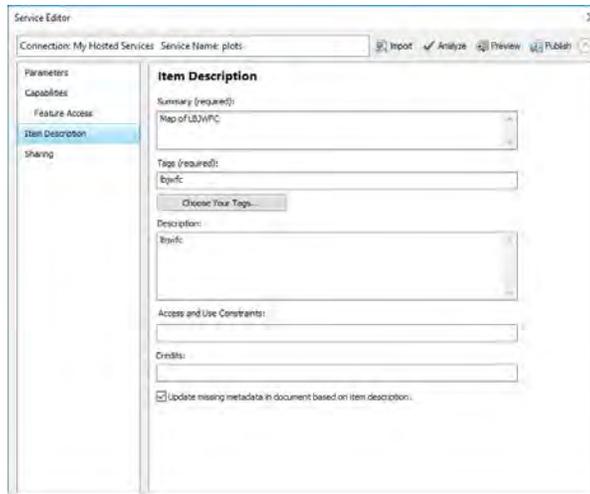


Figure 10: Plots feature creation and editing

I published a map containing the plot feature class and the location feature class (noneditable) to ArcGIS online by ensuring they were the only layers in my table of contents and clicking through File>Share As>Service... I clicked Publish a service then Next, and selected My Hosted Services as my chosen connection and named this map Long_GIS_Map. Under Capabilities, I ensured Feature Access was checked and that Tiled Mapping was not. Under Feature Access, I checked Query, Update, and Sync. Under Item Description, I entered something into each of the following fields: Summary, Tags, and Description—the content in each was irrelevant. I clicked Analyze at the top right of the window, which returned 0 errors, so I clicked Publish at the top right of the window. I followed the same steps to publish a map containing the surveys feature class (editable), naming this map Long_GIS_Surveys. However, under Feature Access, I checked all of the boxes. All of the steps are shown in Figure 11.





Prepare

0 Errors 5 Warnings 12 Messages Search Analyze Results

Severity	Status	Code	Description	Name	Type	Data...
Medium	Unresolved	24035	Not supported for Feature Services(4 items)			
Medium	Unresolved	10045	Map is being published with data copied to the server using data frame full extent	Layers	Data Frame	Layers
Low	Unresolved	30003	Layer draws at all scale ranges(12 items)			

Status: Complete 17/17 Items Show only unresolved items

Figure 11: The process of publishing a map to ArcGISonline. In the fourth frame, editable maps would have all boxes checked.

In ArcGIS online, I signed in and browsed to My Content. I clicked the three dots next to Long_GIS_map and clicked Add to new map (Figure 12). Under Add, I clicked Search for Layers, selected Long_GIS_surveys, and clicked Add to Map (Figure 12). I saved the map as Long_Independent_Project.

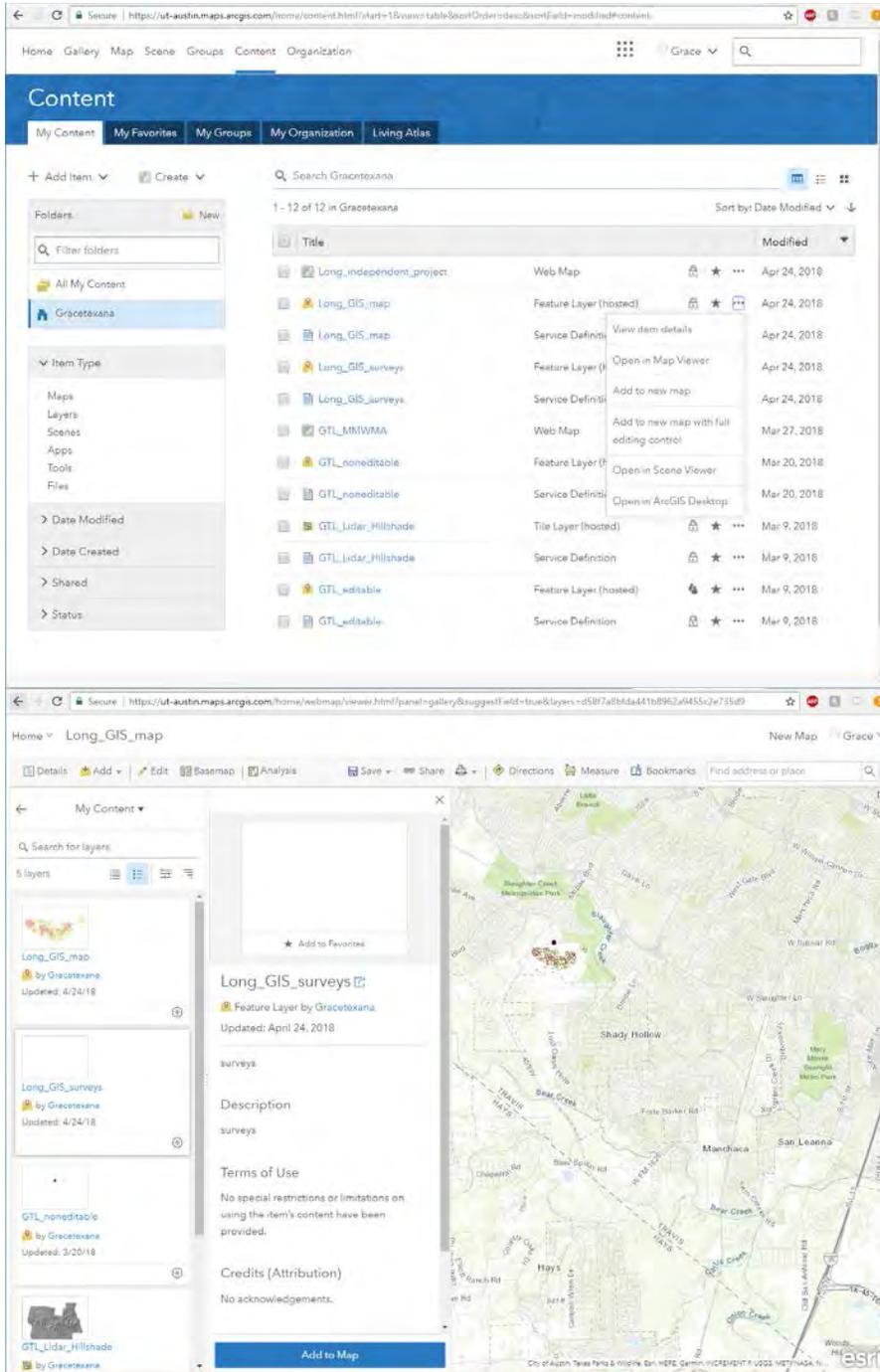


Figure 12: Preparing a map on ArcGIS online to be used in the field

I downloaded the Collector app to my phone and downloaded Long_independent_project. I went to the LBJWFC and used a sweep net to sample 7 burned plots and 6 control plots. I used the collector app to track the paths I followed in each plot and labelled them numerically (e.g. 1, 2, 3) in the comment field (Figure 13). I synced these paths on the Collector app so that they would be available online.



Figure 13: Surveys mapped using Collector app

I opened Long_GIS_project on my desktop. I browsed to My Content in ArcGIS Online, clicked on Long_GIS_surveys, and clicked on Open in ArcGIS Desktop (Figure 14). When I clicked on the download, the layer (with the survey paths) opened in Long_GIS_project.

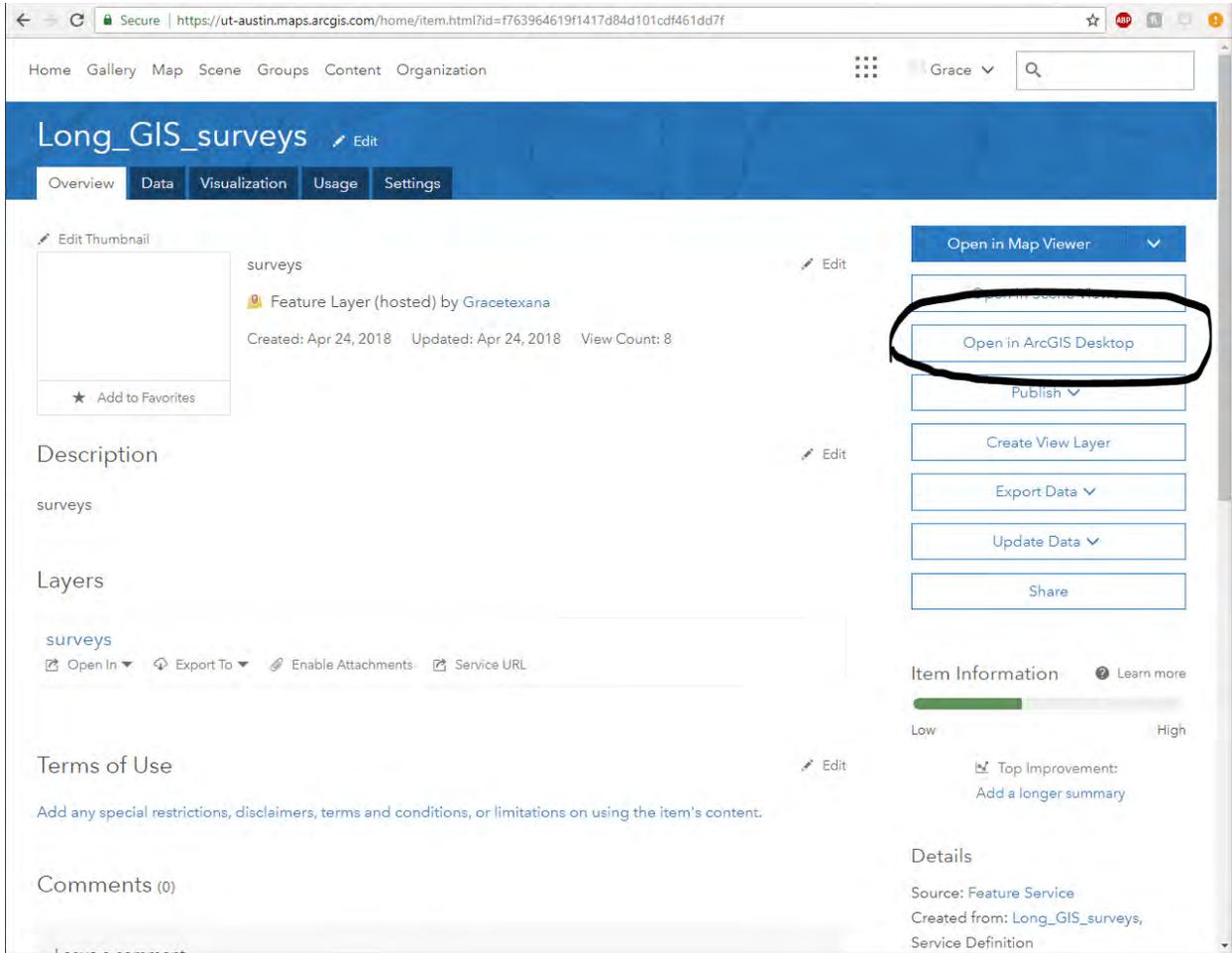


Figure 14: Opening collected data on desktop

I used the Feature Class to Geodatabase (Conversion) tool to add the collected survey paths to lbjwfc (Figure 15). This ensured that the data was stored locally, as opposed to being pulled from ArcGIS online.

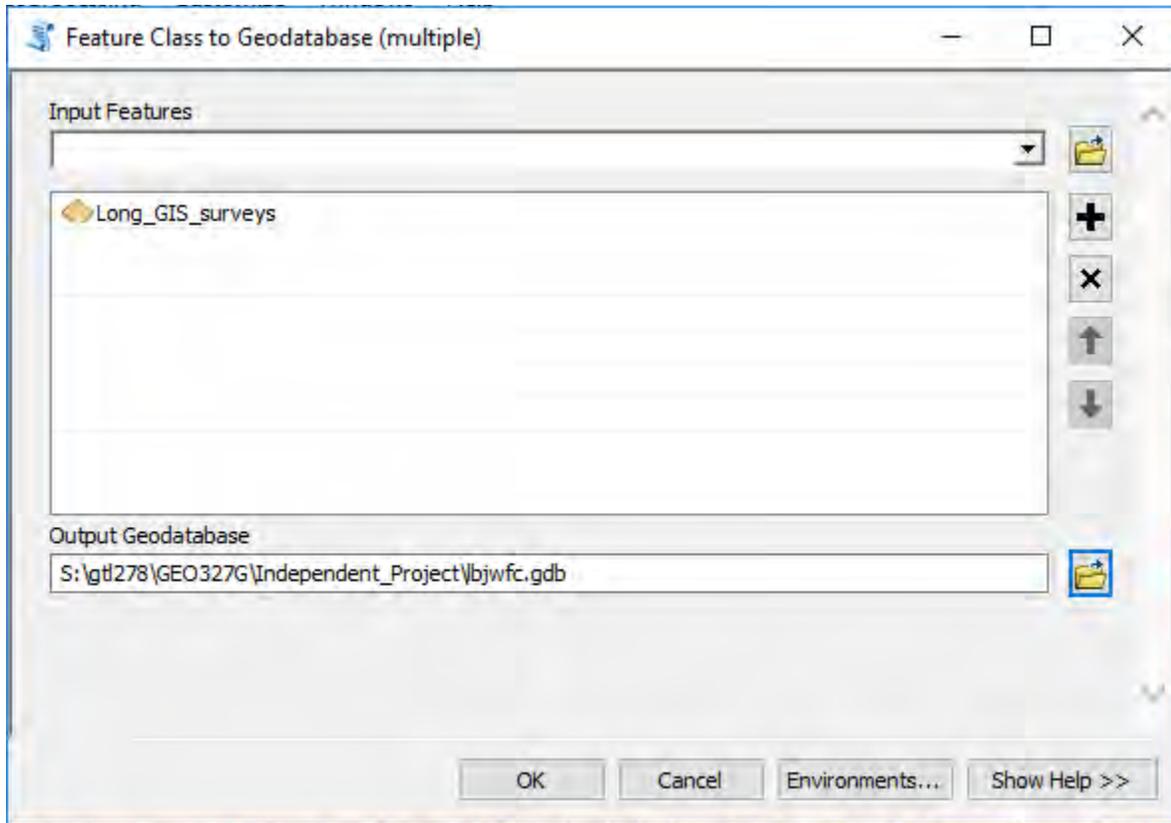


Figure 15: Adding GPS data to map

I prepared the arthropods that I collected in each plot and used a mass (supplied by Dr. Helper) to determine each of the samples' total mass. I opened Editor for Long_GIS_surveys, opened its attribute table, and entered the appropriate mass for each survey.

COMMENT_	GlobalID	Shape_Len	mass
1	{e582301a-ebd3-4c63-a4af-749dc0fdaeab}	83.341598	0.84
2	{6705af53-34d0-4bde-a3e2-9e952d3550e9}	73.784504	1.2
3	{2702a02b-59a1-4f5c-bb80-4f1c794ad2b7}	62.091701	0.4
4	{5a8d240c-557f-41d8-aeaa-ea2d9e93d4ad}	61.215637	0.83
5	{4a7c1f23-602f-47d6-97cd-2682357ed6f6}	62.498107	0.46
6	{398c65c7-ed8f-41a5-97b6-9915edadd203}	67.757957	0.3
7	{be984803-1d72-44e0-b8ab-664971da8f96}	65.122681	0.53
8	{3a004ebc-f651-4909-9dca-549dcdc38cc5}	65.142371	0.32
9	{19ca5b59-4ef3-4ff4-93a9-cdc2228a56c}	64.666667	0.21
10	{4a969757-7816-48b6-904e-39b6fc289369}	69.016421	1.04
11	{8b2a4c3e-3aaa-4d64-9eb2-4ad90958dc99}	56.433415	0.5
12	{fb092fb8-cb0d-4cad-a3be-77df63278315}	61.512487	2.08
13	{28444d34-3d89-4e03-bd6f-b6994b2559fd}	62.505158	0.13

Figure 16: Adding mass to the surveys attribute table

I created a new point feature class called density and added a text field comment, and a double field density. Using Editor>Create Features, I added a point in approximately the center of each plot that I surveyed. I labelled each point with the same label as the survey contained in the same plot (e.g. 1, 2, 3, etc). I joined density to Long_GIS_survey by right clicking density>Joins and Relates>Join... and selecting comment under “Choose the field in this layer that the join will be based on,” Long_GIS_surveys under “Choose the table to join to this layer, or load the table from disk,” and OBJECTID for “Choose the field in the table to base the join on” (Figure 17). I changed the symbology of density to proportional symbols (represented by black circles) based on the density field of the survey feature class.

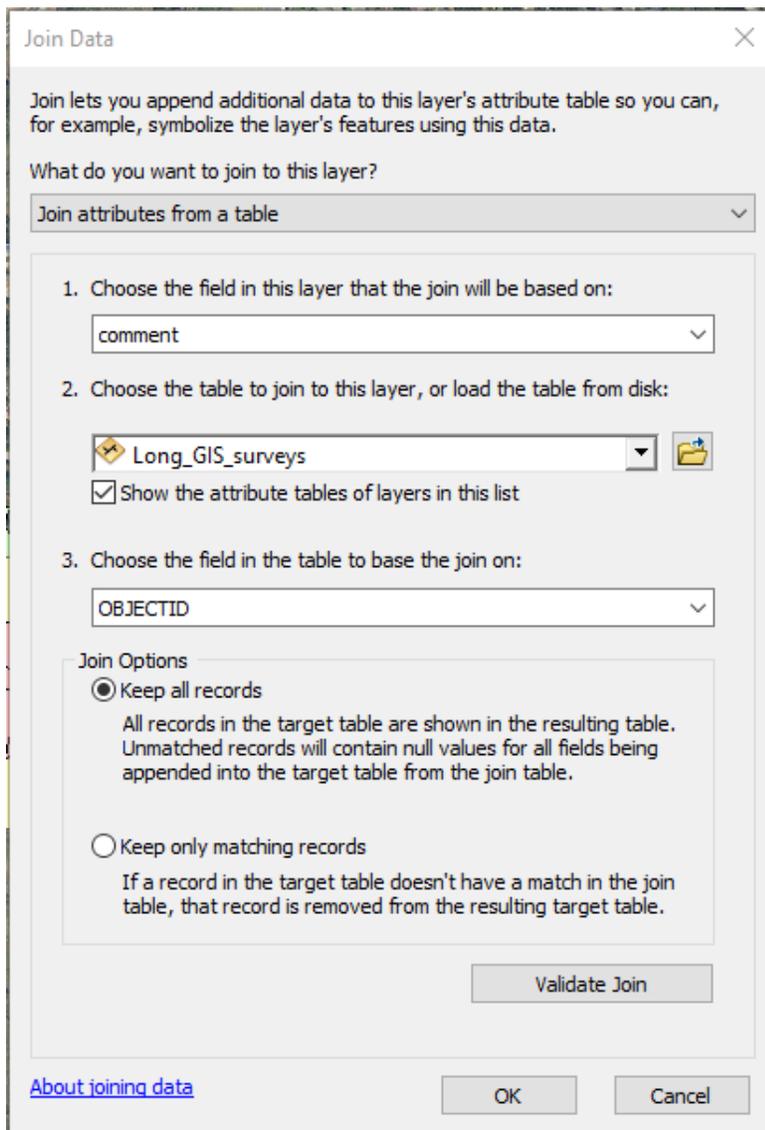


Figure 17: Joining density to Long_GIS_surveys

In the density attribute table, I right clicked the density field and used the Field Calculator to calculate the arthropod density of each plot (). I took my sample area to be approximately 1 meter wide (based on how far I swung the sweep net), so the length of the survey paths was a good approximation of the area from which I collected bugs.

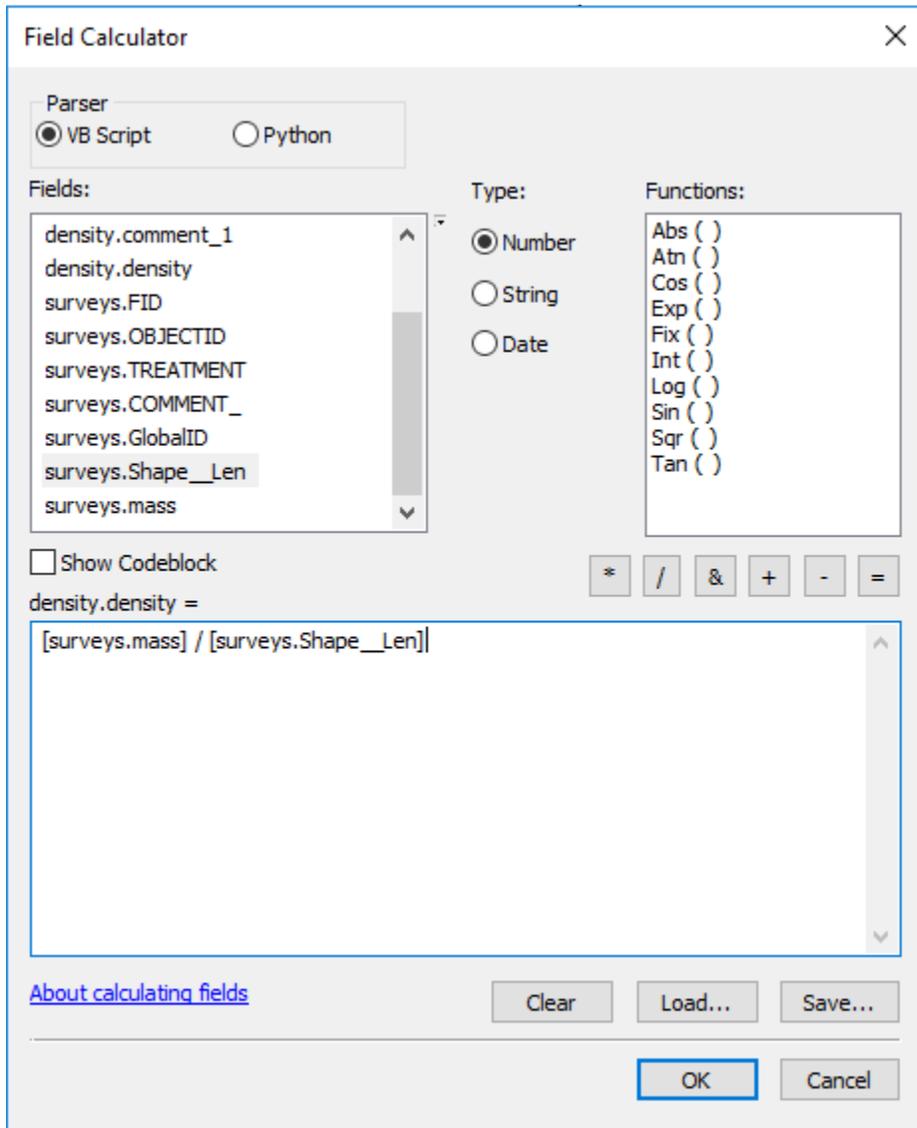


Figure 18: Field calculator with an expression to calculate arthropod density

I exported the density feature class's attribute table to excel and created two box and whisker plots of the calculated density—one for the burned plots and one for the control plots (Figure 18). I symbolized them according to the colors of the plots in ArcMap.

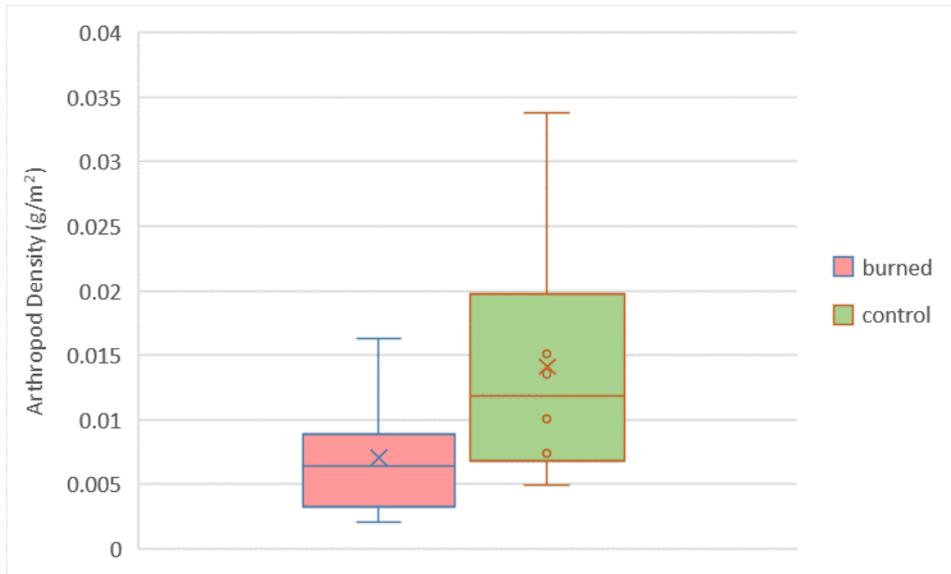
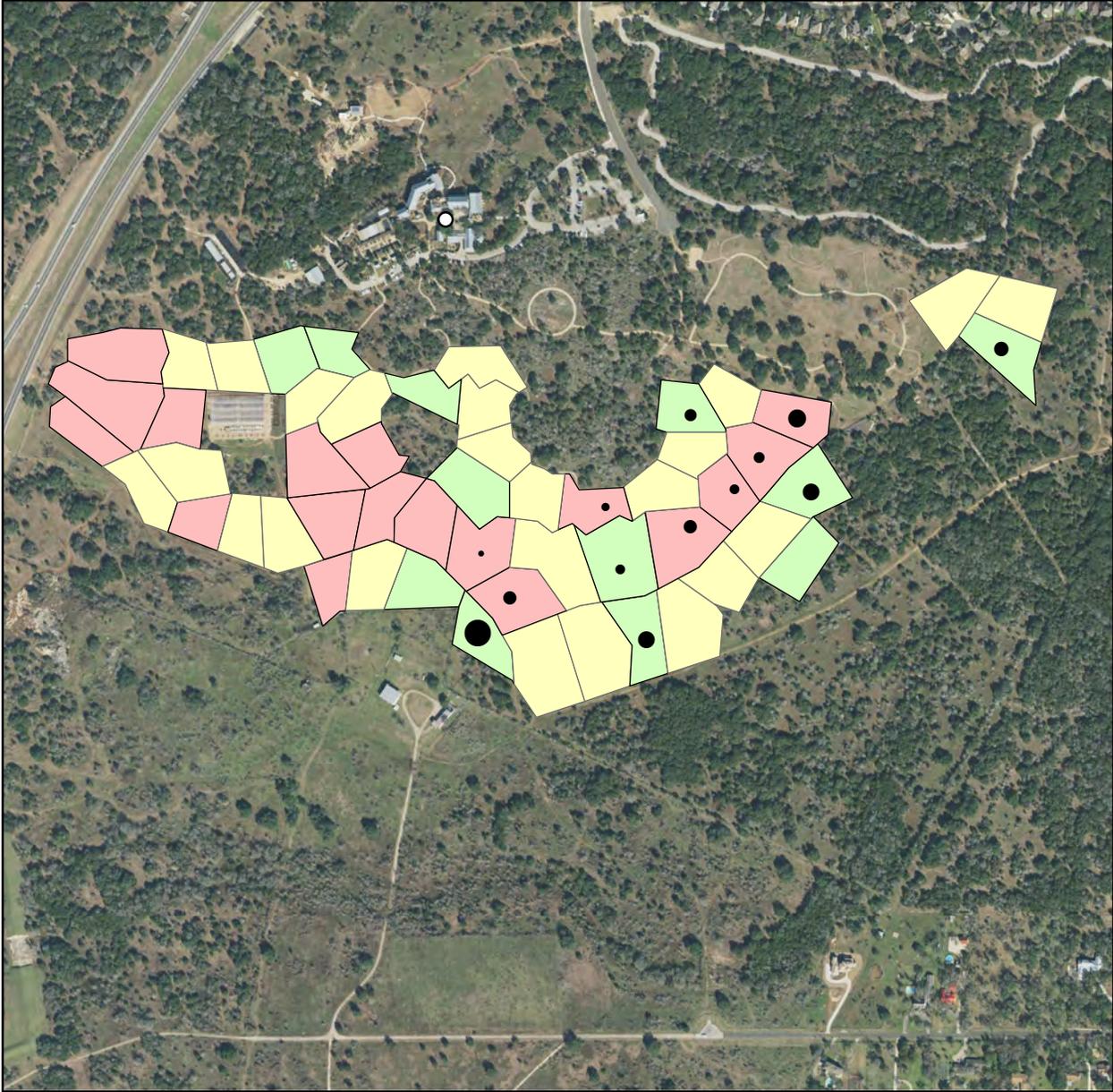


Figure 19: Box and whisker plots of arthropod density

Analysis

Based on the box and whisker plot, arthropod densities in burned plots were actually less than arthropod densities in control plots, contradicting my hypothesis. This could be because the plots were recently burned (in January), and consequently the plant life has not yet had a chance to recover—there was some charred vegetation in the plots. If the plots have not yet recovered, then there would be a limited number of resources for arthropods to feed on, consequently limiting the population that could be supported within a plot.

Arthropod Density Variation in Burned and Control Plots



Legend

Treatment

- Burned
- Control
- Mowed

Arthropod Density

- LBJWFC Headquarters
-

