

A Ten-Year Comparison of the Flagstaff Social Trail Network in the Mount Elden Dry Lake Hills

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A Practicum
Submitted in Partial Fulfillment
Of the Requirements for the Degree
Master of Science
In Applied Geospatial Sciences

Department of Geography, Recreation and Planning
Northern Arizona University
December 2018

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Abstract

Flagstaff is a rapidly growing city, and this growth can put pressure on its natural resources. Among these resources are its outdoor spaces where locals and tourists can recreate in many ways. Common recreational uses include hiking, mountain biking, climbing and horseback riding. This practicum discusses the impact of the social trail network – trails which are created by visitors and not an overseeing agency – around the base of Mount Elden and their growth from 2008 to 2018. Using various ESRI products including ArcGIS online, ArcMap, ArcCatalog, and ArcCollector for Android, the trails were mapped and compared to trail data from 2008. According to the 2018 data collection, 23% of the existing trails are new when compared to 2008 trail data. It was also found that 1% of the 2008 trails have been reclaimed by nature through disuse. The Coconino National Forest oversees this area, and their 2018 management plan recognizes that these trails can have a negative environmental impact. They plan to mitigate these trails wherever possible.

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Introduction

This practicum will identify and discuss changes in the presence of social trails from 2008 to 2018 in the southern section of the Mount Elden Dry Lake Hills (MEDLH). Social trails are user created trails that are not planned or maintained by a land agency. When these trails proliferate, environmental resources are compromised for the local flora and fauna, and the land becomes difficult to navigate for travelers. The MEDLH has an extensive network of social trails which has grown substantially in the last 10 years. Understanding both the location of growth and the types of uses that lead to the creation of new social trails can help the Coconino National Forest Service eradicate these trails in line with their 2018 Coconino National Forest Management Plan.

Study Area

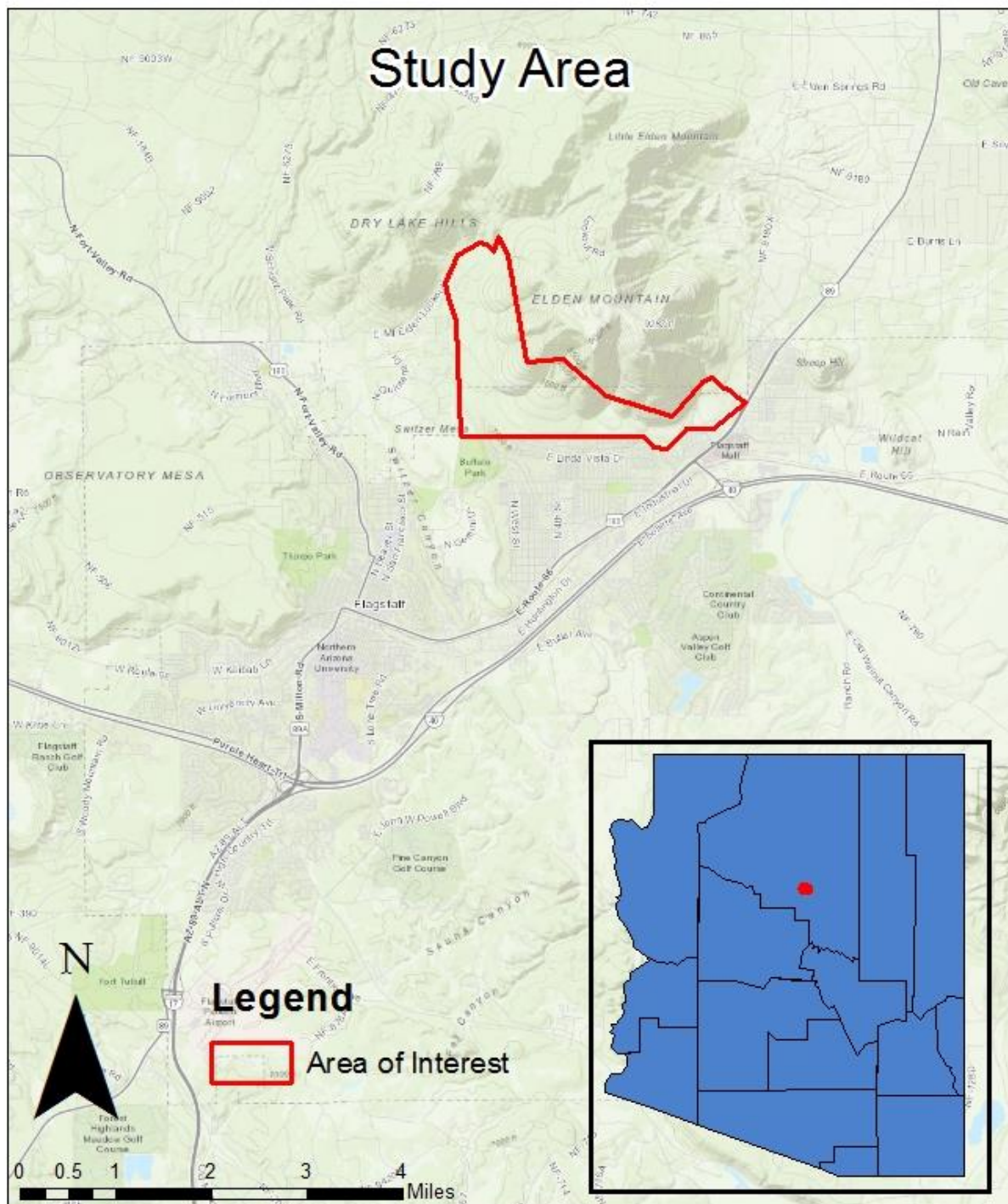


Figure 1 - Study Area. Source: Author

The area of study for this project is bound by the neighborhoods to the west and south of Mount Elden, the base of Mount Elden to the north, and the Fatmans Loop trail in the east. The bounding neighborhoods include: Mount Elden Foothills, Mobile Haven, Swiss Manner, Shadow Mountain, McMillan Mesa, and an unnamed county Neighborhood north of McMillan Mesa, shown in Figure 2 (“City of Flagstaff Neighborhoods & Street Map”, 2009).

CITY OF FLAGSTAFF NEIGHBORHOODS & STREET MAP

PRODUCED FEBRUARY 24th 2009

0 2,000 4,000 6,000 8,000 10,000 FEET

Figure 2 - Flagstaff Neighborhood and Street Map. Source: City of Flagstaff

This small, 1,585-acre area is considered the southern section of the Mount Elden Dry Lake Hills (MEDLH) and falls within the greater 1.8 million acre Coconino National Forest (USDA, 2018). Although some of this area does fall within the Flagstaff City limits, all of it falls under the jurisdiction of the Coconino National Forest with special rules and restrictions for the areas that fall within city limits. Figure 3 shows the city limits of Flagstaff.

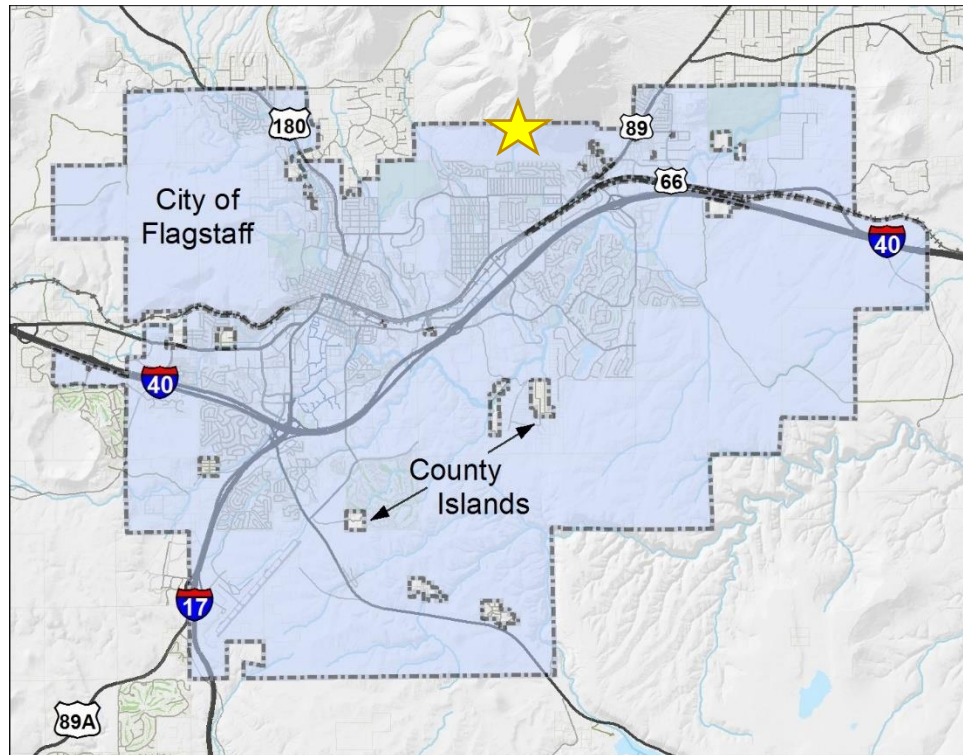


Figure 3 - Flagstaff City Limits. Source: City of Flagstaff

This study area was chosen to understand how the social trails interact with the neighborhoods between the years 2008 and 2018. Within this area, there are only four trails that are identified on USFS maps, shown in Figure 4. These trails are: Lower Oldham Trail, Pipeline Trail, Forces of Nature Trail, and The Arizona Trail section #33. Oldham Trail follows the border to the west of the study area, while Pipeline parallels the southern border of the study area. Both the Elden Lookout Trail and the Fatmans Loop Trail run north to south forming the eastern border of the study area.

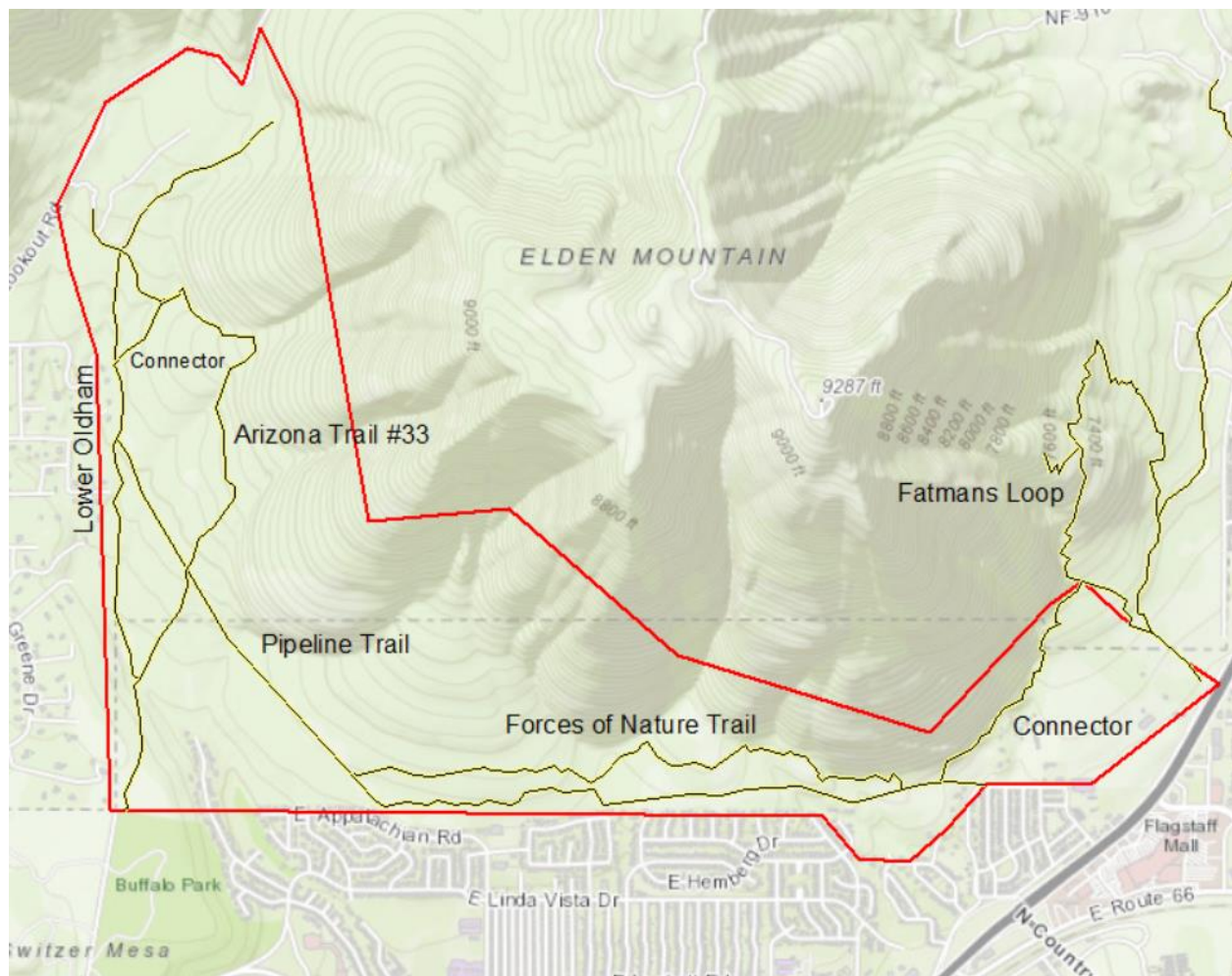


Figure 4 - Existing Forest Service Trails. Source: Hiking Project

There are three official access points to this study area: Buffalo Park, Fatmans Loop/Elden Lookout Trailhead, and the eastern terminus of the Pipeline trail. These access points are at the easternmost and westernmost corners of the study area, and there is a two mile gap between entryways. This lack of access points has helped drive the increase in social trails as entry points from the local neighborhoods.

Within the study area, there are hundreds of social trails branching off the four main trails. Some of these trails are more established and have names and signage, while others are shorter trails which serve many different purposes for those who travel them.

Geology

The surrounding area includes the volcanic field of the San Francisco Peaks on the Colorado Plateau. The northern border of the study area is bound by cliffs (rock faces that are vertical or near vertical [USDA, 2018]). The study area is made of Holocene to Middle Pliocene Volcanic Rocks (Figure 5), which are hard and easily form cliffs due to their formation from lava flows.

These cliffs are difficult to breach and are unlikely to show wear from recreational use due to the volcanic nature of the rocks. For this reason, the study area was restricted to only the foothills of Mount Elden.

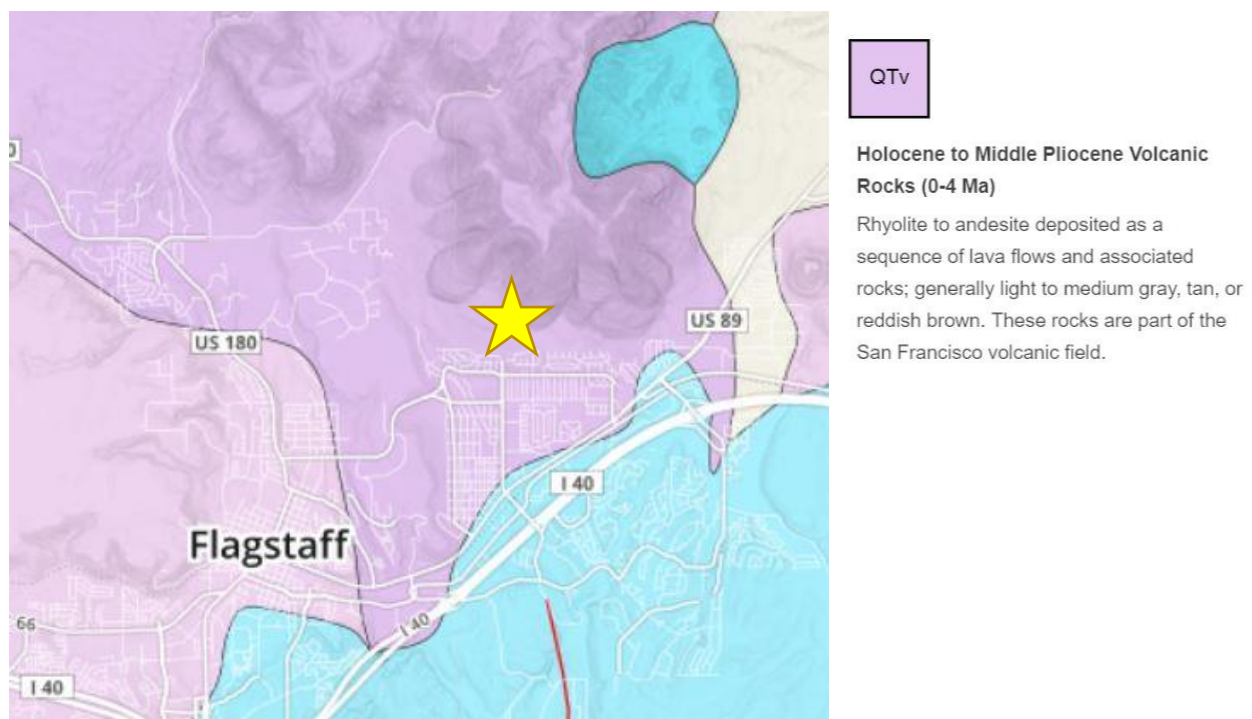


Figure 5 - Geologic Map of Flagstaff. Source: Arizona Geological Survey 2013

Flora

The biotic community for the study area is Petran Montane Conifer Forest which is significantly comprised of Ponderosa Pine (The Nature Conservancy in Arizona, 2004; U.S. Geological Survey Gap Analysis Program, 2005). Ponderosa Pines thrive in this environment because they receive most of their moisture from winter snow, while the rest of the year is drier (Wrangle, 2018). Since the non-winter seasons can be so dry, and the Ponderosa Pine's rate of decomposition at the ground level is slower than the rate of biological production above ground (Graham & Jain, 2005). The earth in the decomposition area becomes soft, and trampled vegetation slowly breaks down – two key factors in the creation of social trails. As the climate becomes drier, the plants will be prone to more trampling impacts due to increased recovery time and domination of other plant species. When current plants are extinguished from trampling and replaced by other plants, the impact is even greater.

Fauna

The Coconino National Forest is home to up to 20% of Arizona's bald eagle population, and its biotic diversity allows it to be home to 19 species of bats. Tanks, diverse flora, and springs within the Coconino National Forest are all part of the reason for this biological diversity. Of the 200 springs in the Coconino National Forest, at least one presents itself in this study area as Little Elden Spring (USDA, 2018). This spring can be found on most forest maps, however no official trails lead to it.

The Mexican Spotted Owl is also found in the Coconino National Forest. It is a threatened species in both the U.S. and Mexico, and it is an important factor in the Coconino National Forest's Management Plan (Palumbo & Johnson, 2010). The owl finds its habitat in

riparian forests associated with canyons, ponderosa pine-gambel oak, and mixed conifer forest (USDA, 2018). Figure 6 shows the Mexican Spotted Owl's habitat as it overlaps with the study area.

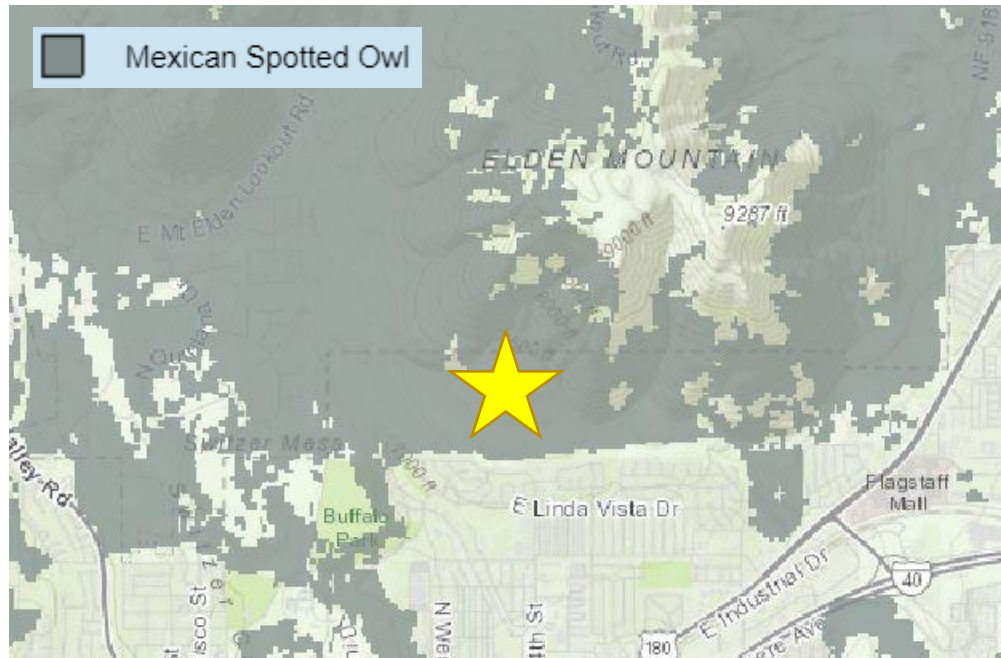


Figure 6 - Mexican Spotted Owl Habitat. Source: Arizona Game and Fish 2011

In addition to the Mexican Spotted Owl, the Arizona Game and Fish Department has created a list of the “Species of Greatest Conservation Need” as outlined in the Arizona State Wildlife Action Plan (Arizona Game and Fish Department, 2011). From this list, the following species are found within the study area:

Birds: American Peregrine Falcon, Common Nighthawk, Evening Grosbeak, Ferruginous Hawk, Golden Eagle, Magnificent Hummingbird, Lincoln’s Sparrow, Northern Goshawk, and Pinyon Jay.

Mammals: Allen’s Big Eared Bat, American Pronghorn, Arizona Myotis, Black-Footed Ferret, Coues White Tailed Deer, Gray-Collared Chipmunk, Gunnison’s Prairie Dog, Jaguar, Long-tailed Vole, Mexican Free-tailed Bat, Mexican Vole, Pale Townsend’s Big-eared Bat, Spotted Bat, Stephen’s Woodrat, and Yuma Myotis

Reptiles: Arizona Black Rattlesnake

Considering all the above species, the study area has a dense population of species of conservation need. Nearly the entire study area has a “high” density of species of great conservation need (Figure 7).



Figure 7 - Species of Greatest Conservation Need. Source: Arizona Game and Fish 2011

In addition to the species requiring conservation, the study area also has a dense distribution of Species of Economic and Recreational Importance (SERI), which are more commonly called “game species.” There are thirteen SERI species in Arizona, as defined by the Arizona Game and Fish, and ten are found within the study area.

Species of Economic and Recreational Importance: Band-tailed Pigeon, Black Bear, Elk, Mountain Lion, Mule Deer, Pronghorn, Red Squirrel, Tassel-eared Squirrel, Turkey, and White-tailed Deer.

The Impact of Social Trails

Social trails are, “discernible and continuous trail segments that were created by visitors and which do not follow a park’s formal trail system” (Leung, et. al, 2002). Because these trails were created by visitors, they receive no formal maintenance, are often poorly located, and can cause habitat fragmentation which can have a negative impact on local flora and fauna (Tollfeson & Cann, 2007). Additionally, the landscape created by a web of poorly planned and eroding social trails is visually unappealing. For all these reasons, the USFS makes plans to monitor and manage these trails.

The Forest Service provides developed recreation areas for visitors to promote comfort and convenience. These developed areas and amenities range from camp grounds, to reservoirs, picnic areas, and trails. They are developed:

1. To avoid ecologically sensitive areas, and to protect natural species.
2. To avoid culturally sensitive areas, and to protect historical sites.

3. By creating hardened surfaces on which to recreate to promote the longevity and viability of the developed area.
4. To promote safety by avoiding areas within flood plains or with rock fall concerns.
5. To promote natural looking landscapes.
6. With human health and safety in mind.

Coconino National Forest considers their trails to be “well planned and maintained” (USDA, 2018: 112). When trails are created by visitors, the benefits of developed trails can fall apart. The current management plan for the forest states, “Unplanned, user-created trails should be managed to prevent future access. Resources damaged by unplanned, user-created trails should be rehabilitated to accelerate recovery and to prevent further resource impacts” (USDA, 2018: 116). The plan recognizes the negative impact and creates the opportunity to mitigate these trails. Additionally, other recreational associations also have regulations about the formation of social trails. The International Mountain Biking Association (IMBA) implores cyclists to stay on the trails by riding through standing water and riding or walking technical sections instead of going around them. They also discourage creating unauthorized trail features, such as berms, with the acknowledgement that these impacts can make trail-access more difficult for bikers as the land agencies make efforts to protect their land (IMBA, 2018). Other recreational groups, such as the American Hiking Society (AHS) have similar rules. The AHS encourages hikers not to travel off trail, even when conditions on the trail are poor, because widening trails is bad for trail sustainability (AHS, 2018).

One of the reasons that social trails are growing is because of a shift from commodity-based industry to a recreation-based economy (USDA, 2018). With more people recreating

outdoors and more businesses profiting from outdoor recreation, the impact of recreation is increasing as well. When this impact affects local fauna, it is called habitat fragmentation. This happens when trails cut off areas of habitat making it difficult for animals to navigate their home. Habitat fragmentation caused by unnecessary social trails can be a significant issue for threatened species like the Mexican Spotted Owl, in addition to other avian, reptilian, and mammalian species in the area. The fragmentation can significantly stifle their foraging and hunting grounds making it difficult for them to find food. Since the Mexican Spotted Owl already has such a specific habitat, there are not very many other places the bird could migrate to avoid this human impact.

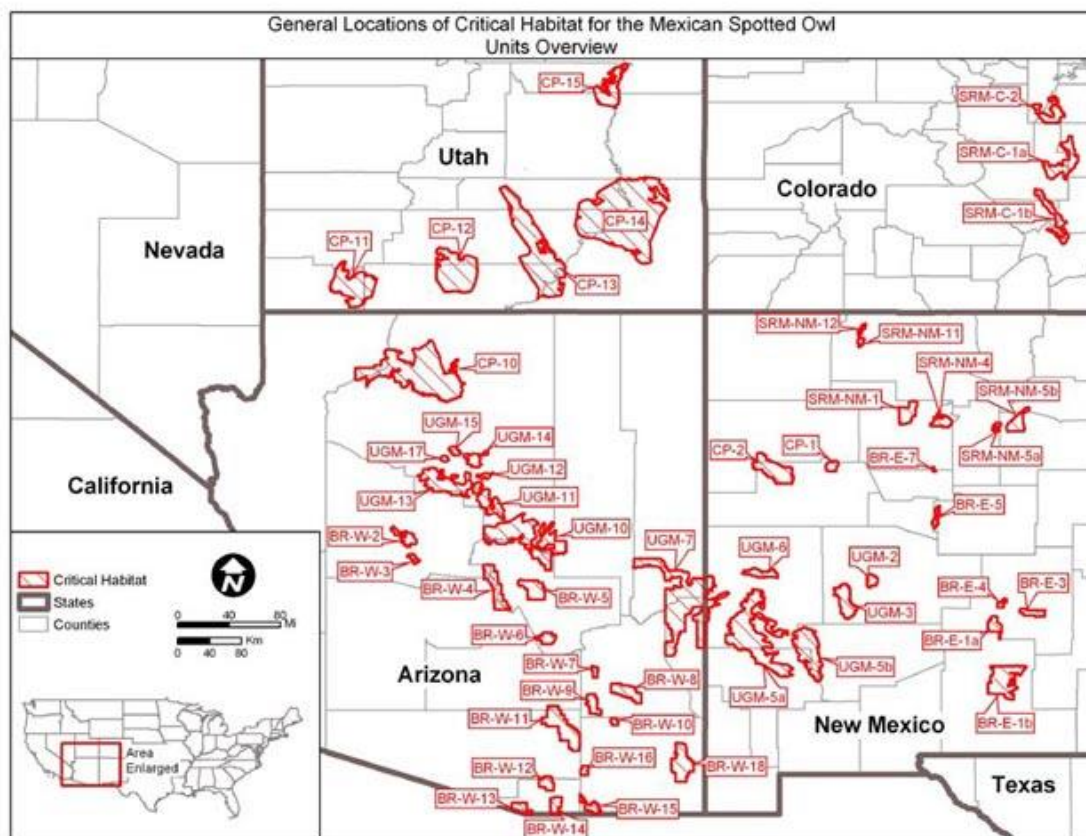


Figure 8 - Mexican Spotted Owl Habitat. Source: Palumbo & Johnson 2010

Another challenge found in the area surrounding and including the study area is forest fires. The Coconino National Forest had the highest natural forest fire occurrence rate in the United States for 18 out of 23 years and was at least in the top 6 highest occurrences during the other 5 years (USDA, 2018). When land has been scorched by fire, it becomes more fragile and susceptible to additional trails. These trails also make it more difficult for the land to recover from fires.

Recreational Usage

Climbers, hikers, cyclists, and equestrians all utilize the trails in the study area regularly. While most of the land falls within the city limits of Flagstaff, most of the study area is under the jurisdiction of the Flagstaff District of the Coconino National Forest and the USFS. According to the USDA Coconino National Forest Management Plan for 2018, the top five uses of the Coconino National Forest are: 1, Viewing natural features (83.9%) 2, Hiking/walking (79.1%) 3, Viewing wildlife (70%) 4, Relaxing (64.8%) and 5, Driving for pleasure (54.8%). Additionally, mountain biking, climbing, hunting, and horseback riding are all permitted. Camping is also permitted within the forest, outside of the city limits (“Dispersed Camping Guidelines,” 2018).

Throughout this research, signs of several of these activities were observed. Most of the trails are bustling with hikers, especially during the spring and fall months when prescribed burn smoke and monsoon weather has subsided. Additionally, bike tire tracks are abundant on the trails closer to the neighborhoods where the grade is less steep. These trails also have user created berms and ramps to provide extra interest for mountain bikers. Many trails leading to the

base of Mount Elden end at rocks that are covered in chalk marks left by climbers, and occasionally the trails lead to bolted climbing routes. Although no horses were seen on the trail during data collection, there were several instances of horse manure on the trails. Some of the trails lead from the USFS boundary directly towards residential backyards, indicating that some of the social trails are used by only a few people, residents of these homes.

Social trails (sometimes called “bootleg trails” or “goat trails”) can create a tension between the USFS and the visitor (Schmitt, 2016). The forest service cites concerns about safety and preservation, while hikers and users cite concerns about access to places with which they have a connection. This connection may be nostalgic (e.g., they may have grown up hiking on these trails); routine; or exploratory (e.g., they are from out of town and looking for new places to visit.). Once a social trail is established, it is very difficult for the land management agency to reclaim the land. This difficulty comes, in part, because of the ownership that people feel for their national public lands. This sense of ownership leads people to believe that their impact is less and that they are free to use every part of the land including the parts that do not have trails. If the USFS wants to take control of the social trails, they will have to take back ownership of the land in the eyes of the recreators.

Personal History

When I first moved to Flagstaff, I lived on the east side of town within walking distance from the trails below Mount Elden. With a volunteer event on the Sandy Seep trail quickly approaching, I decided to hike around the area and see what sort of trail work we would be doing. Almost immediately, I became very lost as I had managed to walk onto a trail that was not

on my map. There were many trails that were unmapped. This posed a couple of problems: the immediate issue that the area can be confusing to hikers, as well as the long-term issue of environmental resource degradation. The area was easily navigable as Mount Elden is a large point of reference for gaining direction, and I soon found my way home. However, this moment stuck with me because such a small area having so many social trails can have an incredible impact on the environment for current residents and for future generations.

I started this project with the help of Dr. Jessica Barnes. She taught the class “Geographic Thoughts and Methods” as an introduction to practicum preparation, and I conceived of this idea to satisfy the credit for her class. Through my time and coursework at Northern Arizona University (NAU) I have developed an interest in recreational planning through Geographic Information Systems (GIS). From computer-based GIS courses to more abstract planning courses, and mixed with my natural interest in outdoor activities and education, this became a natural topic for a practicum.

During an outreach event at the retailer where I work, REI, I met Martin Ince, the Transportation Planner for the City of Flagstaff. He expressed that the City is always interested in graduate students to help them research, and upon hearing my topics of interest, he suggested I reach out to Sean Murphy, the Trails and Wilderness Coordinator for the Coconino National Forest – Flagstaff District. Incidentally, Sean Murphy was the liaison for the original Sandy Seep trail building project that I participated in when I first moved here.

Sean was excited to hear that I wanted to help the Forest Service map social trails, and he suggest that the most helpful area would be the Mount Elden Dry Lake Hills section of the San Francisco Peaks. Because of the nearby neighborhoods, the trails are constantly changing and

expanding, and they are incredibly difficult to manage. He had data in the form of shapefiles collected in 2008 and was interested to find out what the trails looked like in 2017/2018.

This project was started in 2017. I was unable to complete it in the spring of 2018 due to time constraints, so the project went on longer than planned. During the summer of 2018, the forest was closed for several months in order to help prevent fires. While the fires were successfully prevented, this caused another delay in the project timeline. After several delays and modifications to the timeline, this project has reached completion.

Methods

Tools

ArcCollector for Android was used for this project because of its ability to capture real-time data while out in the field. Several steps of groundwork needed to be put in place in order to utilize ArcCollector. First, an empty line feature was created in ArcCatalog. This original line feature was set in the NAD 1983 State Plane Arizona Central FIPS 0202 (US Feet) coordinate system. Three attributes were created that could be edited in the field: Name, Type, and Use. The Name attribute was set to collect data about existing signage that may appear on the trail to track the names of the trails. The Type attribute was used to collect information about the size of the trail. Some of the trails that were not on the map were roads which were being used for the Flagstaff Watershed Protection Project which was occurring separately but simultaneously with this project. Other trails were classified as single track or faint social trails, or trails that ended abruptly. The third editable attribute was Use, which tracked different events that were witnessed on the trails. Many trails had bike tire tracks, human built berms, or people actively mountain biking on them. Some trails had horse manure, while others approached popular climbing areas. For these, the uses were classified as bike, horse, climb, or hike. If the use was not immediately obvious, this attribute was left blank.

Once the groundwork creating the line feature was laid, the feature was uploaded into the NAU Grail ArcGIS online organization and was able to be edited using the ArcCollector app on a cellular phone. For this project, an LG G6 and a Samsung Galaxy Note 9 were used for data collection, with ArcCollector Version 18.0.3, Build 1033. Other layers were also uploaded into this map for reference, including data from the USFS from 2008 which mapped the previous

social trails and data from a collection of outdoor use apps including: Hiking Project, MTB Project, Trail Run Project, and Strava. The “Project apps” source data from recreators about trail use in the area, and the data for each trail is all available for free download as a GPX file. Once the line features from the Project Apps GPX files were overlaid on a topographical base map and uploaded into ArcCollector, it was possible to begin data collection.

Strava Global Heatmap was another tool used for this study (Figure 9). Strava is a mobile application, much like the Project apps, which collects user data over time. Strava uses crowdsourced data to create a heatmap of usage. The bright lines indicate that the trail is heavily traveled, while the darker lines indicate that the trail may only be traveled by a few people. Many of the trails indicated by the Strava Global Heatmap for the Study Area do not show up on ground level due to the incline of the terrain and durability of the cliffs at the base of Mount Elden. However, many of the fainter trails in the flatter sections of the study area do show up as social trails. This indicates that even when only a few visitors travel a certain trail, they still leave a noticeable impact.

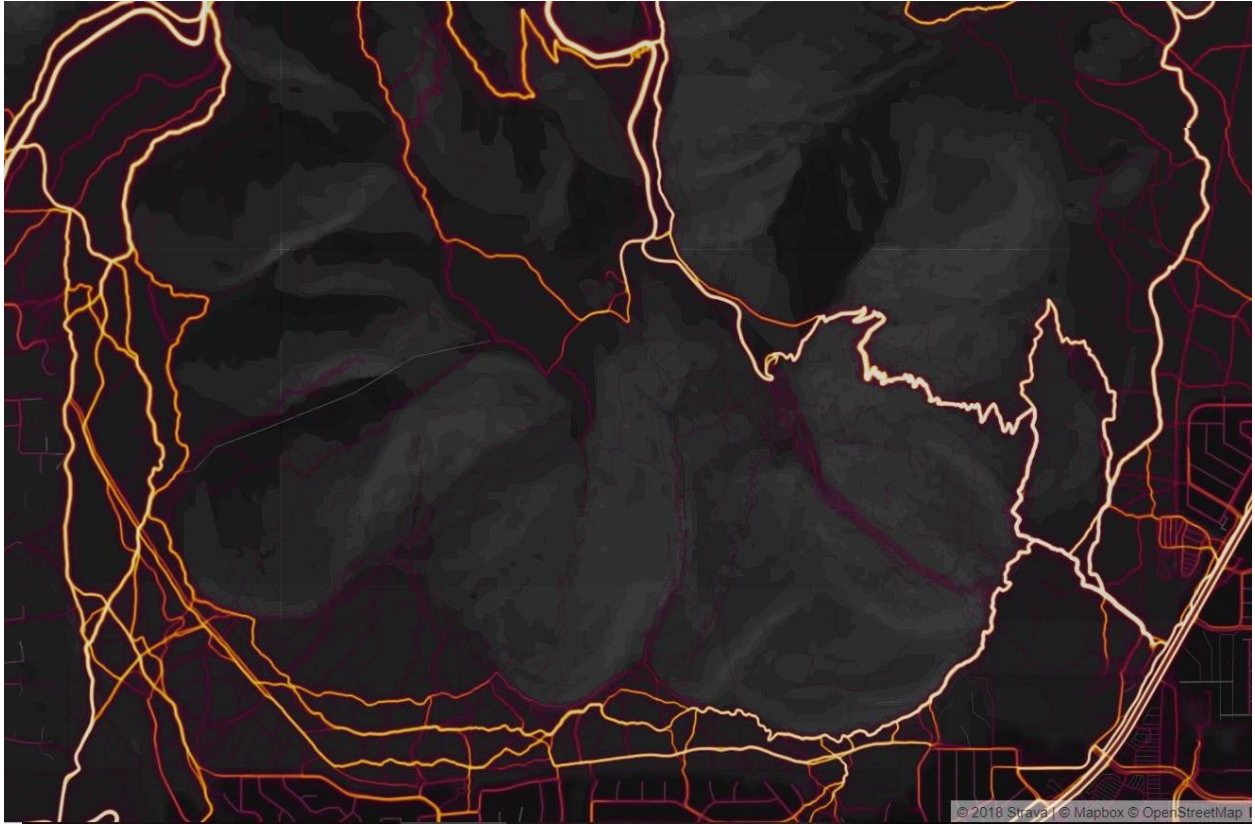


Figure 9 - Strava Global Heatmap of Mount Elden. Source: Strava

Technique

ArcCollector for Android offers the user several options for data collection. Because it is a mobile application, data can be uploaded immediately to servers which reduces the amount of post processing work. The application also has the option to use the maps in an offline mode and upload later if the cell signal is not strong enough. Another benefit of using a cell phone application is that photo technology is integrated into the device. It was easy to take pictures of the trails and interesting landmarks to have the photos georeferenced immediately.

The data collection was done by opening the ArcCollector application on the phone, starting a new line feature and walking the length of the trail. When the end of the trail was

reached, the data was uploaded to the servers, and a new trail could be started. For data collection, ArcCollector was set at a 5 second streaming interval with a minimum accuracy of thirty feet. In real time, the accuracy fluctuated between four and twelve feet. Data collection occurred between October 2017 and October 2018.

Often trails had other social trails branching from them. Through ArcCollector it is possible to upload a trail and then edit it in the future. This way, if a new trail needed to be collected in the middle of another trail, the first trail could be paused and the line feature could be returned to later. This is an important feature of ArcCollector because it is much easier and accurate to connect singular trails at the time of data collection than it is to connect them in ArcMap after the data has already been collected.

Data was collected beginning with the nest of trails north of Buffalo Park. This is a popular recreational location for Flagstaff locals and visitors, and a surprising number of trails begin here even though there is no neighborhood directly connected to the forest boundary. While walking the length of each trail and looking for additional off-shoot trails, backtracking was frequently necessary. In areas where the trails were dense, this could cause a problem. Since the GPS accuracy ranged from 4-12 feet, the trails that were close together could appear to be two separate trails. This issue mostly occurred in the area near Buffalo Park and was able to be fixed in post processing. For data collection, trails were either followed to their end, or until the end of the trail was visible. When it was clear that there were no other trails connected to the one that was being walked, the line was uploaded to ArcCollector.

When walking the trails, many signs of human impact were discovered. These impacts ranged from manmade berms for mountain bike jumps, to chalk stained rocks where climbers

boulder, campsites where people have dragged old mattresses and other bedding materials, graffiti, and other teepee like structures built from fallen trees.

2008 Data

The data from 2008 was provided by Sean Murphy, the Trails and Wilderness Coordinator of the Coconino National Forest, USFS. This data came in the form of several shapefiles with no metadata, and a minimally useful attribute table. This lack of metadata caused institutional knowledge to be lost.

It is unclear how most of the data was collected or who collected it. Some of the data was “Digitized from NAU GMAIL website” according to its source attribute, but other data was collected by “Brad” and “Andrew Johnson.” Without knowing who the data was collected for or why originally, it is now impossible to contact these two contributors. Most of the line segments did not have any source identified within the attribute table. Some of the trails had names attached to their file, but these were mostly colloquial names given by recreators and not official trail names. Additionally, there was a “Trl_Class” attribute which used the values: 0, 2, and 3. However, there was no metadata explaining what these trail classes meant. The attribute table for the 2008 data that did have names or sources is in Appendix A.

To assist future users, additional metadata was included in the 2018 “allsocclip.shp” file. The time period of collection, method, tools, settings, author, and University were added, as well as a brief description of the “New” attribute field. The metadata for the 2018 data is shown in Figure 10, and more information about this data can be found in Appendix B.

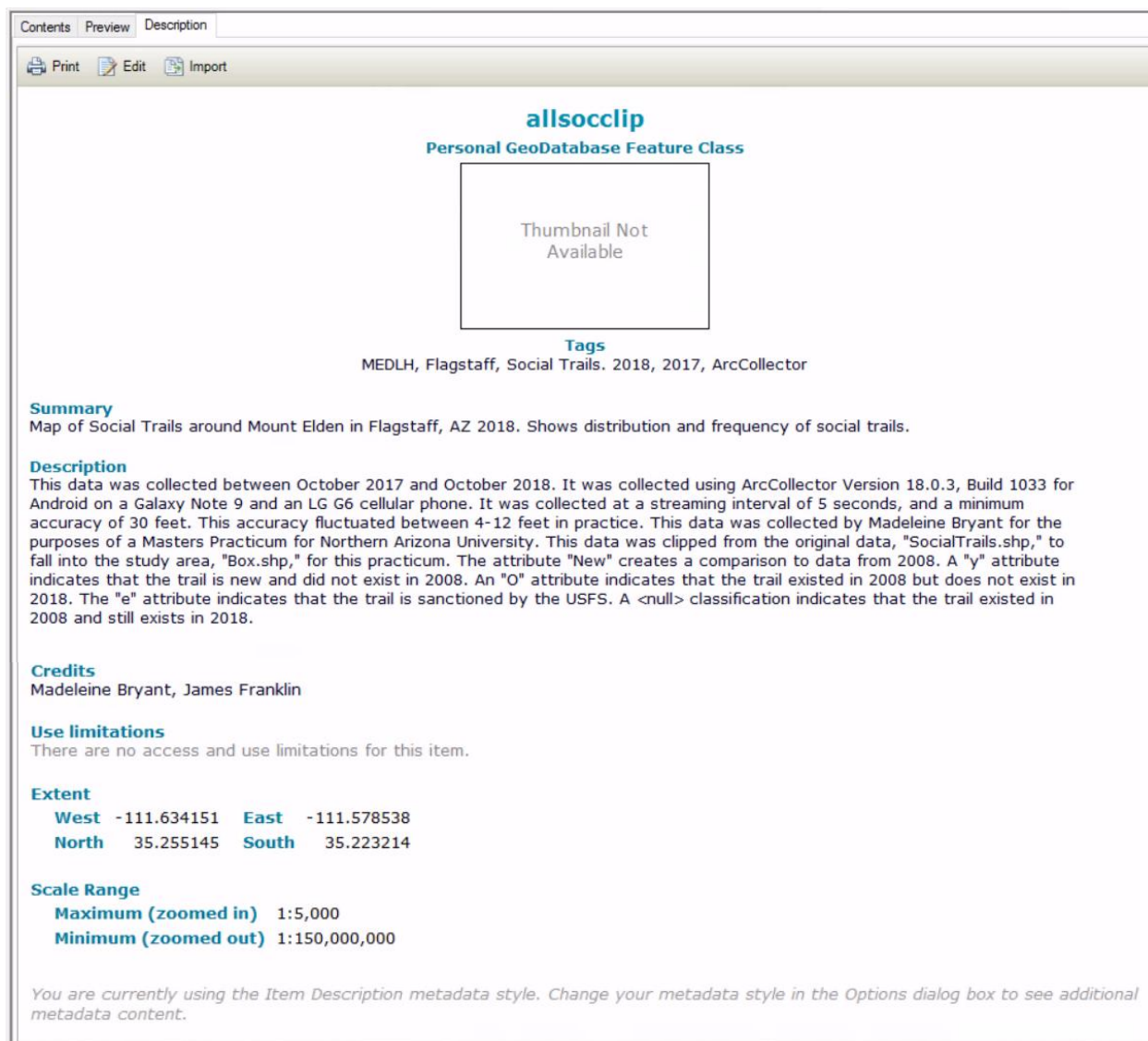


Figure 10 - Metadata for "allsocclip.shp" Source: Author

The 2008 data was projected in a similar coordinate system, but it did not match up exactly with the NAD 1983 State Plane Arizona Central FIPS 0202 (US Feet) coordinate system. To fix this, the data was selected using the editing toolset and dragged to match up with the base map using Mount Elden Lookout Road as a point of reference. After fixing the coordinate system mismatch, the 2008 trails were locationally accurate to the 2018 trails. Almost every trail was

able to be located during the 2018 data collection, and these trails provided a broad foundation for locating new social trails.

Data Processing

Once all the data was collected, it was uploaded into the MEDLH.mdb personal geodatabase and projected into ArcMap overlaying a topographic basemap. In ArcMap, the finalized data appears as four separate files:

1. The data from 2008 provided by the USFS called “fentr_soc_trl.shp”
2. The data collected from the various “Project” phone apps of existing official trails which was called “Existing.shp”
3. The data collected by ArcCollector and clipped by the bounding box, called “allsocclip.shp”
4. And a fourth, user created file, called “boundingbox.shp” which was created in order to clip data to the correct shape.

As mentioned above, the data from 2008 needed to be adapted to the NAD 1983 StatePlane Arizona Central FIPS 0202 (US Feet) coordinate system. This data was selected and dragged, using the editing toolbox, to match closely with the Mount Elden Lookout Road so that it could reflect the trails that existed in 2008 with a reasonable degree of accuracy. Since this data was only used for reference and not in the final calculations, the accuracy at which the trails were projected was less important.

The data from the project apps came in single line shapefiles which needed to be merged in ArcMap. To create one layer out of these multiple line segments, they were all selected, and the geoprocessing tool under General > Merge was used (Appendix A).

Once all three datasets were compiled, it was easier to see which trails were new compared to which ones existed in 2008. Using the editor feature, the attribute “New” was added to the attribute table for the 2018 data. This attribute is a text attribute with a length of 1. An attribute of “Y” denotes that yes, the trail is new compared to the 2008 data. It quickly became apparent that this attribute needed to contain more information, so the attributes “O” and “E” were added. “O” denotes that the trail is old; it existed in 2008 but no longer exists now. And the attribute “E” denotes that the trail is an existing trail created by the USFS. The <null> classification signifies that a trail is a social trail from 2008 with no change between then and 2018.

During data collection, it was not always obvious which trail should be contiguous with another trail. During post processing in ArcMap, it was possible to disconnect erroneously connected lines so that each line falls neatly into one of the four categories. It was also possible to connect lines that may not have been connected in ArcCollector.

In order to connect and disconnect the line segments, the following method for decision making and technique for processing were used. (Figure 11)

Prepare ArcMap:

- ✓ Make “allsocclip.shp” the only selectable layer
- ✓ Enable: End, Vertex, and Edge Snapping

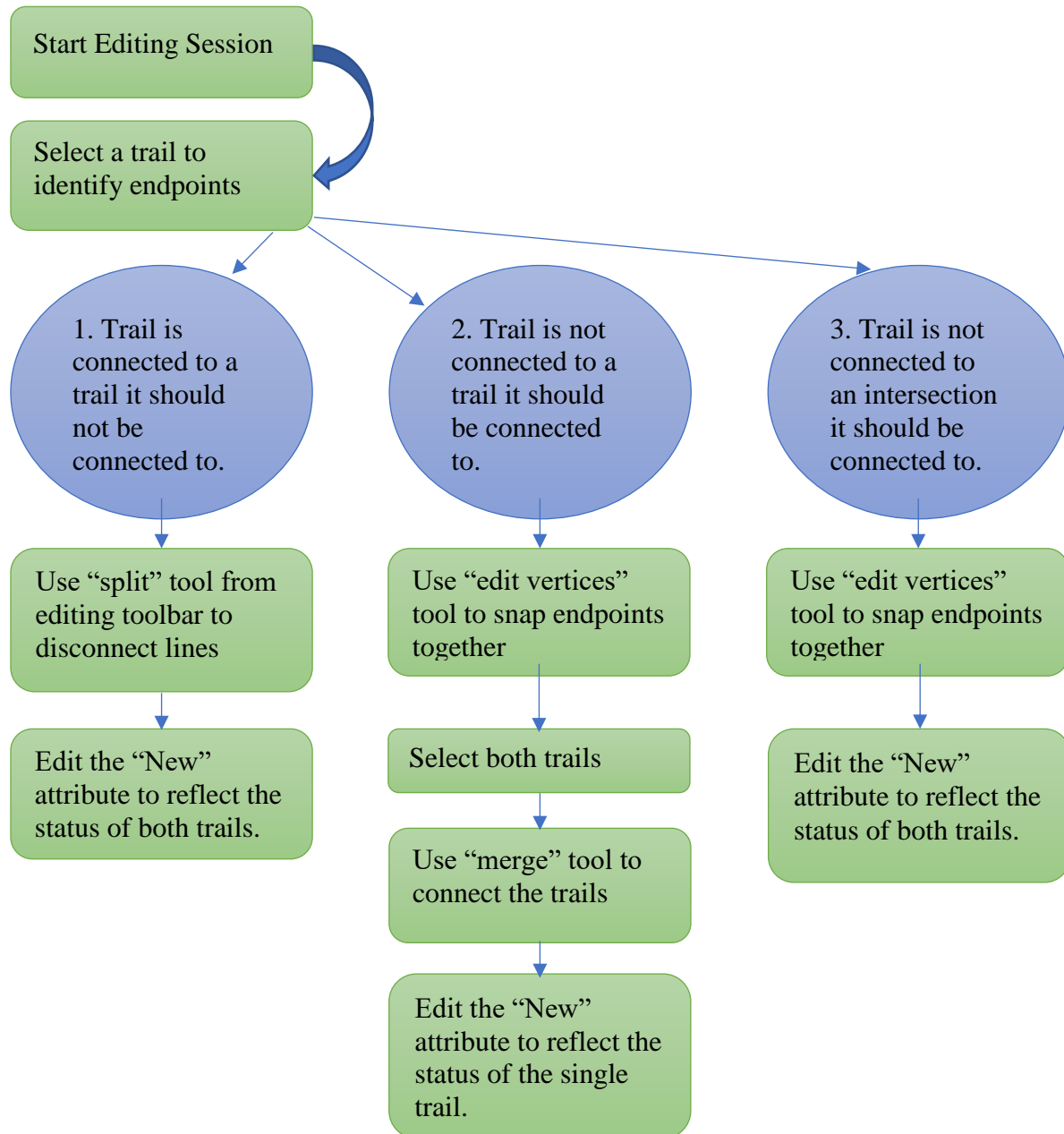


Figure 11 – Flow Chart of Common Issues. Source: Author

Figure 12 is an example of a common issue. These line segments are supposed to intersect, but one node has gone beyond the intersection and one node does not reach the intersection. An intersection could look like this:

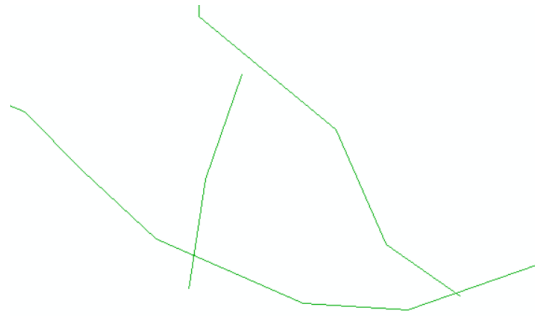


Figure 12 - Disconnected Nodes. Source: Author

Using the snapping features, and the “edit vertices” tool, it is possible to snap the endpoints to the line which they intersect.

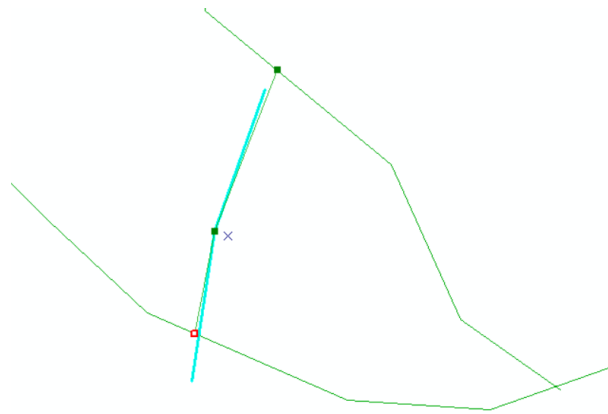


Figure 13 - Edit Vertices. Source: Author

Once the lines were connected or disconnected, and attributed with the four categories, “Y,” “E,” “O,” and “<null>,” it was possible to calculate statistics for the new and old social trails. By connecting the lines and making the trails continuous where necessary, the data was more accurate to the length and direction of trails in the area.

Results

USFS Trails

There are 6 trails in this study area which are signed and sanctioned by the USFS. These trails are: Lower Oldham Trail, Pipeline Trail, Arizona Trail Section #33, The Forces of Nature Trail, and two connector trails. One of these connector trails connects the Pipeline Trail to the Mount Elden Lookout trail at the top of Fatmans Loop, the Eastern Boundary of the study area. The other connector trail connects Lower Oldham Trail to the Arizona Trail Section #33 which is sometimes referred to by locals as Upper Oldham Trail.

The trails sanctioned by the USFS are on average far longer than the social trails in the area. The shortest trail is 1,106 feet, or 0.21 miles long, and the average length of these 6 trails is 8,895 feet, or 1.68 miles. The longest trail in the study area, the Pipeline Trail, also falls under this category of trails. Table one shows the attribute table for the USFS trails.

OBJECTID	Name	Type	Use_	New	Shape_Length
33		Connector	USFS	E	1106.46
371		Connector	USFS	E	4124.09
369	Forces of Nature		USFS	E	9747.53
11	Lower Oldham		USFS	E	10123.40
70	Upper Oldham/AZ Trail 33		USFS	E	11997.18
374	Pipeline		USFS	E	16272.89

Table 1 - USFS Trails, Name and Length. Source: Author

Table 2 - USFS Statistics. Source: Author

USFS Trails	"E"
Count:	6.00
Minimum:	1106.46
Maximum:	16272.89
Sum:	53371.54
Mean:	8895.26
Standard Deviation:	4995.26
Nulls:	0.00

2008 Totals

In 2008 there were 164 trails in addition to the 6 above mentioned USFS trails. These trails include the shortest of the confirmed Social Trails which is only 16 feet in length. This trail is part of a common social trail structure where at the junction of two to three trails, there is a triangle shaped network of trails with greenspace and plants in the middle of the triangle. These triangles serve a similar purpose as a traffic circle in that each side of the triangle is virtually one directional in terms of usage. An example from the study area is below. Highlighted is the shortest social trail of the project.

Triangular Trail Junction

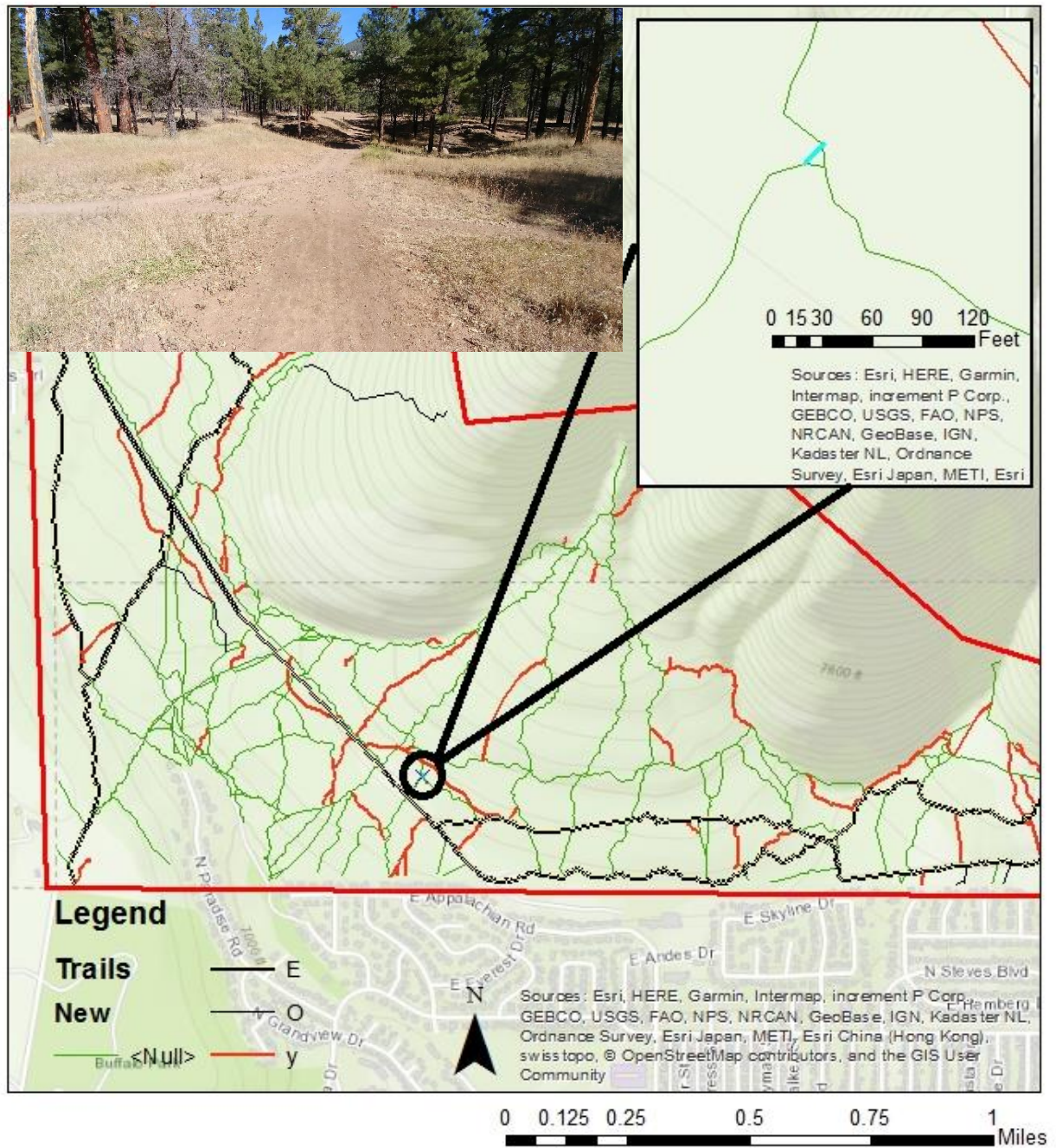


Figure 14 - Triangular Trail Junction. Source: Author

The statistics for the social trails from 2008, including the social trails which no longer exist in 2018, are in Table 3.

Table 3 - 2008 Data. Source: Author

All 2008 Social Trails	"Null" & "O"
Count:	164
Minimum:	16.161958
Maximum:	6234.557629
Sum:	109257.1467
Mean:	666.202114
Standard Deviation:	986.331105
Nulls:	0

2018 New Additions

There are 109 new trails as of the 2018 data. This is an increase of nearly 68.5% in number of trails, and a 45.9% increase in overall length. The average length of the new trails is 33% shorter than the average length of the trails in 2008 – the new social trails are much shorter than the old ones. This could be because the study area was so saturated with trails in 2008 that the space between trails could not support longer trails. When a new social trail forms, it can only be so long before it crosses over another trail. The statistics for the 2018 social trails which are new compared to the 2008 social trails are found in Table 4.

Table 4 - New 2018 Social Trails. Source: Author

New 2018 Trails	"Y"
Count:	109.00
Minimum:	23.94
Maximum:	4381.49
Sum:	48726.63
Mean:	447.03
Standard Deviation:	593.06
Nulls:	0.00

Reclaimed Trails

Of the 2008 trails, 5 trails have been reclaimed as of 2018. Highlighted in Figure 14 are the trails that have disappeared. For reclaimed "Trail 1," the grade of the trail was to blame. The trail started up the slope, but due to the rocky nature of the earth and the grade of the terrain, the trail was not visible above the 7400ft contour line. This trail does show up on the most recent Strava Heatmap, but because there was no visible impact to the land, the trail was considered to be terminated at this contour line.

Reclaimed "Trail 3, 4, & 5" are trails which previously lead from the residential area to the forest boundary. It can be assumed that the residents of these homes have changed and that the new residents do not use these social trails to enter the forest. Since we have no data about how deep or wide the social trails were in 2008, it is difficult to say whether these ceased to be used between 2008 and 2018. It is safe to say that within the last 20 years, these trails have been reclaimed and are no longer impactful to the environment. Although this was the reason for the disappearance of three trails, it is also the reason for the appearance of several more trails during the study period.

The reason for the disappearance of reclaimed “Trail 2” is the most difficult to discern. It appears that it disappeared because of its repetitive nature with the trails around it. It is also possible that deadfall blocked the trail which made it more difficult to locate, and therefore travelers ceased using this trail.

The statistics for the 5 reclaimed trails are found in Table 5.

Table 5 - Reclaimed Social Trails. Source: Author

Trails which have Disappeared	"O"
Count:	5.00
Minimum:	92.28
Maximum:	1617.91
Sum:	3180.06
Mean:	636.01
Standard Deviation:	612.67
Nulls:	0.00

Reclaimed Trails

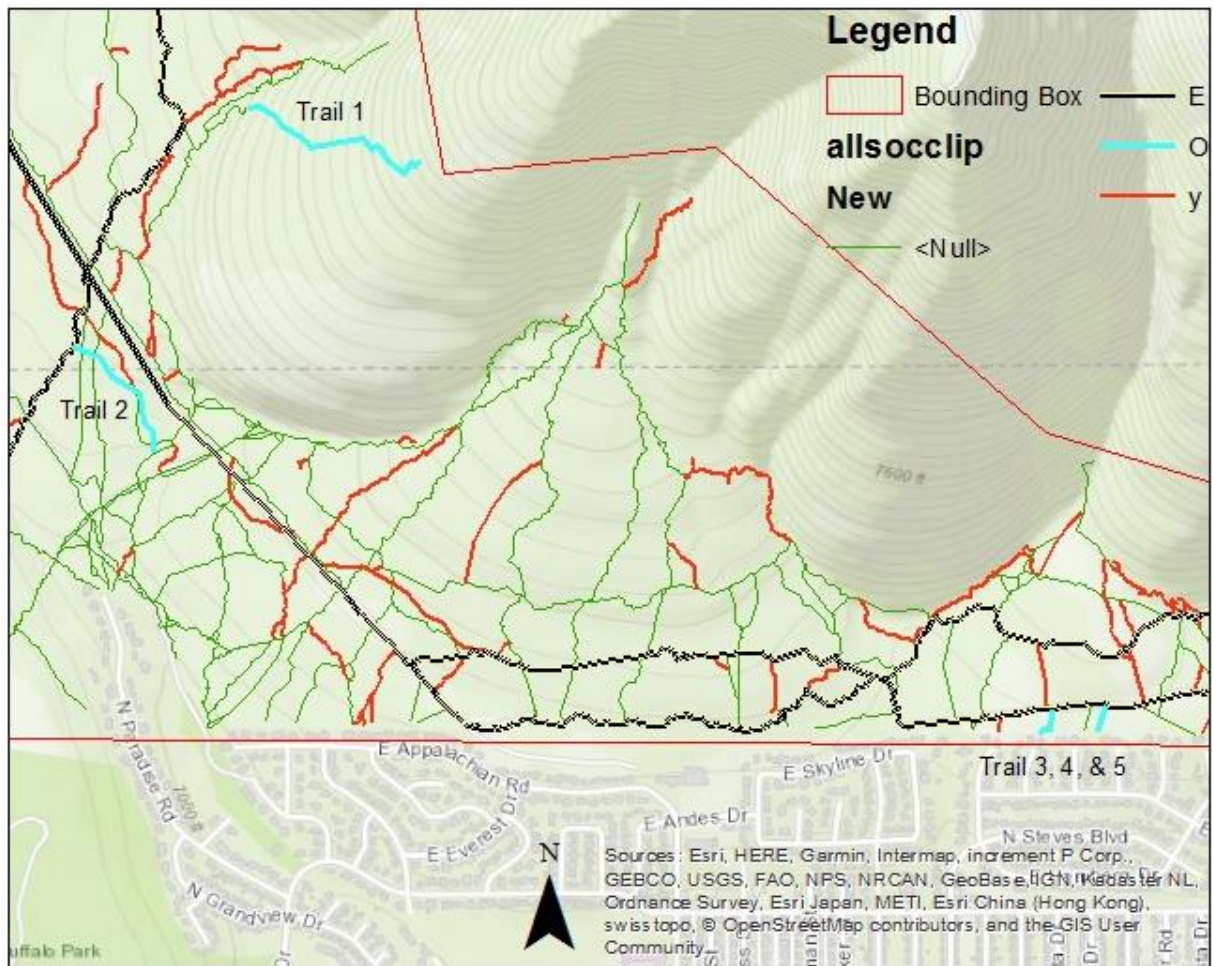


Figure 15 - Reclaimed Trails. Source: Author

2018 Totals

As of 2018 there are 279 distinct trails in the study area. These trails range from just over 16ft in length – typically connector trails and trails that lead from residential areas to the forest – to over 16,000ft – trails which run almost the full length of the study area as an extensive transit network. On average, the trails are 757.55ft in length. Statistics for All Trails Combined in 2018 are shown in Table 6.

Table 6 - All Trails Combined. Source: Author

Count:	279.00
Minimum:	16.16
Maximum:	16272.89
Sum:	211357.50
Mean:	757.55
Standard Deviation:	1647.00
Nulls:	0

By Madeleine Bryant



Discussion & Findings

Statistics

It was found that, by length, only 25% of the trails in the study area are supported by the USFS. This percentage has decreased since 2008 when approximately 34% of the existing trails were supported by the USFS and 66% were considered social trails. From 2008 to 2018, 1% of the social trails have disappeared due to disuse; however, 23% of the existing trails today are new compared to 2008. The social trails have increased by approximately 44.7% in this area in ten years.

Is it likely that in 2028 the trails will see another 44.7% increase? With the saturation of trails in the area, it is unlikely that it would be possible for the trails to expand that much. The fact that the new trails are much shorter than the older ones also suggests that the rate of increase is declining.

Uses

Hiking

Aside from creating new trails, the main visible impact that hikers leave are called cairns or blazes. A cairn is a stack of at least three rocks that is used to show which way the trail goes in places where it may not be obvious. Frequently, hikers build cairns where they are not necessary, or they build incredibly large cairns at trail junctions or sites of interest. All cairns leave an impact. When the rocks are moved, the insects that live beneath them are disturbed, and often

hikers will need to travel off trail to collect enough rocks to build the cairn. Since cairns are not naturally occurring structures, they can also detract from the natural appearance of the land.



Figure 17 - Cairned Wash. Source: Author



Figure 18 - Cairned Site with Trash. Source: Author



Figure 19 - Large Cairn. Source: Author

Blazes are another way that hikers mark trails. Blazes are typically either carved into or painted onto trees to show which direction the trail goes. In this case, the blazes were painted onto rocks. For this trail, painted white rocks led the way down into a wash.



Figure 20 - Trail Blazes. Source: Author

Biking

Signs of bicycle use were most prevalent in the south and southwestern corner of the study area. Tire tracks and human created berms were the main signs that bikers were using the trails. Mountain bikers will often move dirt around to create small hills that they can jump over. These impact the plants that are in the area, and they can cause the trail to be significantly wider than a standard single-track trail.



Figure 21 – Double Wide Bike Berm. Source: Author



Figure 22 - Bike Berm that Splits the Trail. Source: Author



Figure 23 - Bike Berm that Bypasses Downed Log. Source: Author

Climbing

Climbers also have an impact on the study area trail system. A common theme was that several social trails would converge at a climbing spot at the base of Mount Elden. The climbing locations are split into two categories: bouldering and sport climbing. Typically, bouldering areas are low on the cliffs of Mount Elden. Bouldering is a form of climbing without using ropes, where the climbers stay within 20 feet of the ground. This form of climbing has a relatively low environmental impact, and the most noticeable marks leftover are the chalk on the rocks. After a heavy rain, there may be no signs that a bouldering spot exists, once the chalk is washed away. The most noticeable impact from the bouldering sites are the nests of trails that lead to them. A popular bouldering spot is known as “The Brain” at the base of Mount Elden. In addition to the trails leading up to it and the chalk left on the rocks, there is a significant amount of graffiti at this spot. The graffiti does not appear to be left by climbers. Since the location is so accessible, any number of visitors may have caused the graffiti related damage.



Figure 24 - The Brain. Source: Author



Figure 25 - Graffiti behind The Brain. Source: Author



Figure 26 - Other Boulderer Chalk Marks. Source: Author

Sport climbing is the other type of climbing found in the foothills of Mount Elden. Sport climbing uses ropes and bolted anchors for the climbers to clip into in case of a fall. Sport climbing is much more impactful than bouldering because of the need to permanently bolt anchors into the rockface. The most popular sport climbing area in the study area is called, “Solitude Canyon” the base of which starts at 7,700 ft elevation.

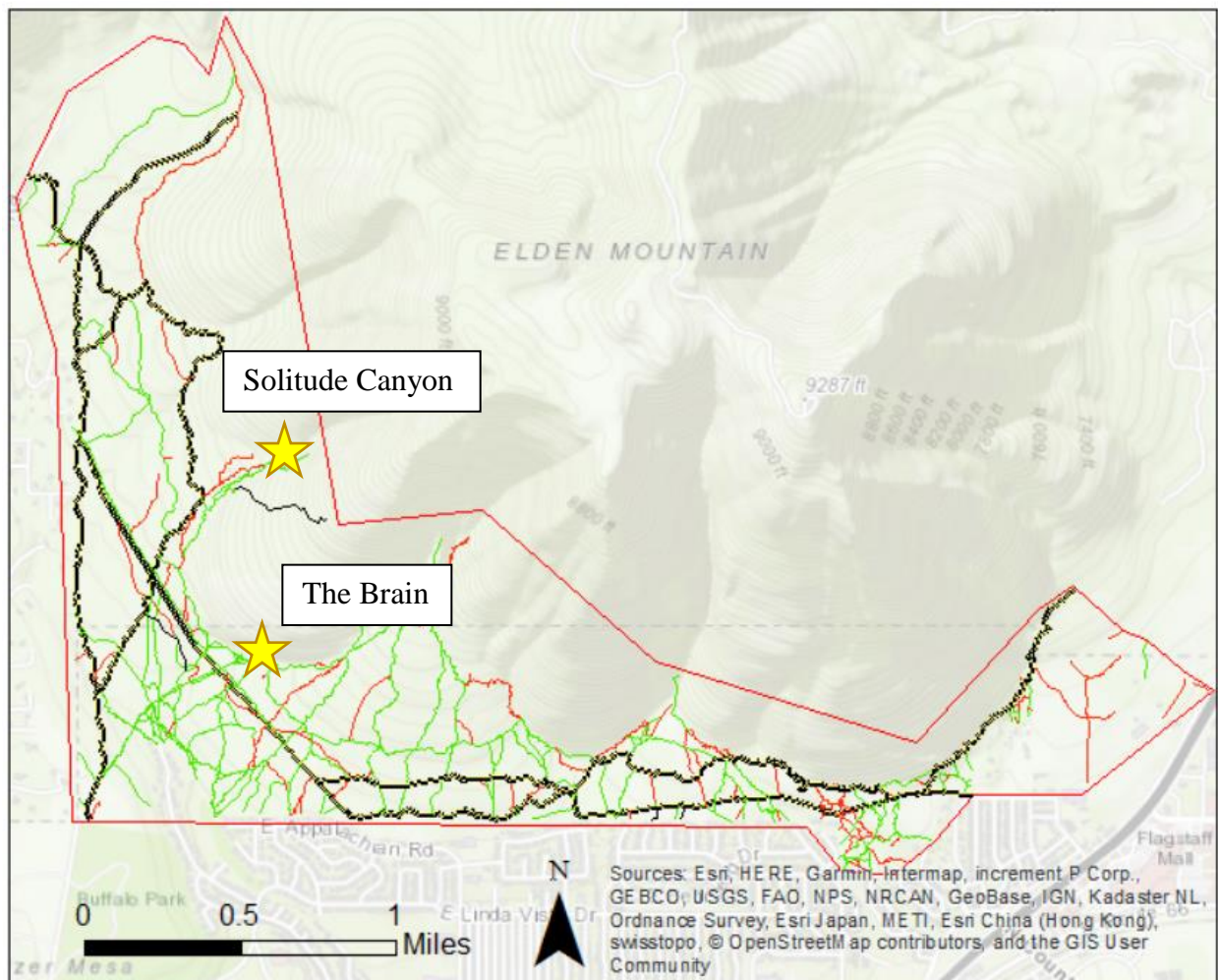


Figure 27 - Solitude Canyon & The Brain Locations. Source: Author

Camping

Several campsites were found during the data collection for this study. These campsites ranged from neat, flattened earth with a fire ring to old mattresses molding into the earth. Although camping on forest service land within the city limits is illegal, most of these campsites fell within city limits and were only a few hundred yards within the forest service boundary. These campsites appeared mostly to be utilized by the homeless population as the equipment left behind was not designed for camping, but was typically items that could have been found and collected for free around the city. These sites were vacant when discovered, but it was not possible to tell when the most recent resident may have used them.



Figure 28 - Illegal Campsite with Trash. Source: Author



Figure 29 - Illegal Campsite with Trash #2. Source: Author



Figure 30 – Legally Located Leave No Trace Campsite. Source: Author

Other Uses

Some of the impacts did not fall neatly into a user category. For these, it is difficult to presume which visitor may have left the impact. At the north end of Mount Elden Foothills neighborhood, there was a cultural site just a few yards inside the forest boundary. This site has a large cross positioned above dozens of wooden stakes with names and dates on them. (Figure 31)



Figure 31 - Cross and Stakes. Source: Author

Other areas had tee-pee like structures created from logs stacked in a way that made a shelter. Several sites like these existed, and one of these sites had a bench under the shade structure. (Figure 32)



Figure 32 - Tee-Pee and Bench. Source: Author

Finally, in addition to the graffiti in “The Brain” bouldering location, there was also graffiti in several other locations around the base of Mount Elden where the cliffs were still accessible for non-technical ascent. (Figure 33)



Figure 33 - Graffiti. Source: Author

Future Research Directions

If it were possible to skip ahead to the year 2028 and do this project again, it would provide more depth to the knowledge of where Flagstaff’s social trails may be headed. The data presented forms a line with two data points. From data point one, 2008, to data point two, 2018, there is a 44.7% increase in trails, by length. This line is most likely not sustainable at a 44.7% increase over another 10 years, so it would be useful to have a third datapoint to compare and create a bell curve from which to predict future trail growth.

Additionally, with all the information collected by this practicum, it would be interesting to quantify the impact that the social trails have on their environment. How are the flora and fauna affected? Would it be beneficial for the forest service to close off repetitive social trails in order to restore them over 10 to 20 years? Or is keeping this area so dedicated to recreation preserving other nearby areas which serve a wilderness purpose to the local fauna? This data collection is the beginning in answering these questions.

It would also be beneficial to collect point data for locations with significant human impact. These impacts could be litter, cairns, berms, and graffiti. This information would help the Forest Service target areas of environmental impact so that they can make decisions about where and how to use their resources.

Mitigation Techniques

In Kenai Fjords National Park (KFNP), Alaska, crews monitor the social trails yearly and assess each trail for growth (Kriedeman, 2013). They rate the trails from one to three, with one being the least impactful and three having the highest impact and trampling, and they compare their findings to previous years data and photographs. They find out if the trails are improving or worsening, and they predict reasons for off-trail use so that they can find ways to prevent further damage. Some common reasons for trail widening and the creation of new trails include: the trail was muddy or had an obstruction that the user needed to avoid, the user was looking for a place to rest off-trail, or the user was avoiding steep or rocky terrain. They have found success in mitigating these trails through education and through creating physical barriers. When they place signs requesting that hikers not take a particular trail and explain, on the sign, that the land is

fragile and needs to recover, the trails typically are able to recover rather than worsen over time. If the signage and education fail, they may place physical barriers such as log fences or rocks (Kriedeman, 2013). If the Coconino National Forest were to have the resources and decide to act to mitigate these trails, they could model their plan from the KFNP. By placing signs informing travelers of the negative impact of social trails, and by creating natural physical barriers to prevent easy access to social trails, the Coconino National Forest may be able to help areas recover for the benefit of the local flora and fauna, and to protect the visual resource that a natural forest provides.

One of the possible reasons for the trail growth is the availability of information on social media that exists in 2018 and was not fully developed in 2008. For example, the cell phone application, Mountain Project, was founded in 2005 but became more widely used in 2015 when it was purchased by REI (Mountain Project, 2018). Mountain Project gives users crowdsourced data as point locations for climbing areas. These point locations do not have trails associated with the climbing areas, and the climbers must find their own route to the boulders. If the Forest Service worked with Mountain Project to create and advertise sustainable trails to lead to the most popular climbing spots, they could close the extra social trails that lead to these spots.

Another cause of social trail growth is that the demand in the study area exceeds what the current USFS trails can support. It would be wise for the Forest Service to approve and maintain more trails in order to preserve the area as a whole, and they could identify trails that lead to unique locations by using the data collected from this practicum. Many of the trails in the study area are repetitive in nature. By identifying the purpose that several trails serve and endorsing only one of the repetitive trails, the USFS would have more success in closing the extra social

trails. One example of a heavily used social trail that could be integrated into the Forest's plan is the trail that circumnavigates the base of Mount Elden. There is a continuous trail at the base of the mountain which accesses numerous climbing locations. If this trail was official and maintained, then other more sensitive areas could be avoided.

Another addition that the Forest Service can make to help get rid of social trails is to add more official entrances to the area. Since the study area is mostly accessible by vehicle, an entrance every half mile could be enough to keep people from creating their own entrances to the forest, which creates more social trails.

Project Limitations

The project was limited by the original 2008 data, the available data collection techniques, and the weather. The original data did not have much information attached to it. With no author and no information about the status of the trails in 2008 other than their location, it is difficult to draw comparisons other than location and added length. Additionally, the methodology set for collecting 2018 data was lacking. Because there was not a set methodology before data collection began, there were gaps once the analyzation process started. The main thing missing was a definition for the trail "type." This project could have been more thorough if there had been information collected about the type of trail and the impact of each trail. This could have been on a numbered scale from one to three with definitions for the impact of each level of trail. Since this methodology was not set before data collection began, the information was not collected, and the 2018 data is missing some of the same data as the 2008 data.

The 2008 data also had fewer vertices per line. The 2018 data collected through ArcCollector was collected in 5 second intervals, which meant that it was affected by GPS wandering and by the very specific twists and turns of each trail. Because of the different number of vertices per line segment, the 2018 data appeared to be far longer than the 2008 data. For this reason, the 2018 data was clipped and measured against itself rather than comparing it directly to the 2008 data. Neither dataset is entirely accurate by length, but when each dataset is compared to itself, it is inaccurate to the same amount as the data it is being compared to.

Finally, the weather became a large barrier for data collection. Because of the high fire danger during the summer of 2018, the forest was closed for several weeks, barring all access for data collection. After the forest was reopened, there were many days where the air quality (due to the smoke from local fires) was so low that it was a health hazard to hike. When the smoke cleared up, monsoon season began, and the afternoon lightning created additional safety concerns for hiking around the base of volcanic cliffs.

Acknowledgement

After taking 3 years off school to work and reassess my priorities, it was incredibly difficult to jump into an online master's program here at Northern Arizona University, but I am so thankful to be where I am and to all the people who helped me get here. I would like to give a huge thank you to Dr. Alan Lew for generously taking me on as an advisee after my original advisor had to transition out of her role. I would also like to thank Dr. Dawn Hawley for her help on my committee and for recommending an undergraduate NEPA class to fill my credits. Without her, I would not have known about the class which helped steer my project significantly. Also, thank you to Corryn Smith, whose kind guidance and educational nature helped encourage me throughout this process.

I would also like to thank James Franklin for hiking with me and helping me collect data. He and our dog Carlos walked many miles to help me with this project, and to them, I am grateful.

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- “What Is GIS?” *Turning Analysis into Action*, www.esri.com/en-us/what-is-gis/overview.

Wimpey, Jeremy. (2011). A spatial exploration of informal trail networks within Great Falls Park, VA. *Journal of Environmental Management* Volume 92 (Issue 3). Pp 1012-1022.

DOI: <http://dx.doi.org.libproxy.nau.edu/10.1016/j.jenvman.2010.11.015>

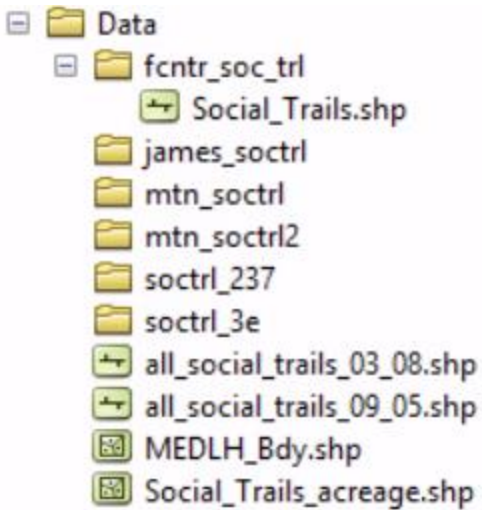
Wimpey, Jeremy & Marion, Jeffrey. (2010) The influence of use, environmental and managerial factors on the width of recreational trails. *Journal of Environmental Management* Volume 91 (Issue 10). Pp. 2028-2037. DOI:

<http://dx.doi.org.libproxy.nau.edu/10.1016/j.jenvman.2010.05.017>

Wrangle. (2018). North American Ponderosa Pine Woodlands. Retrieved November 17, 2018, from <https://wrangle.org/ecotype/north-american-ponderosa-pine-woodlands>

Appendices

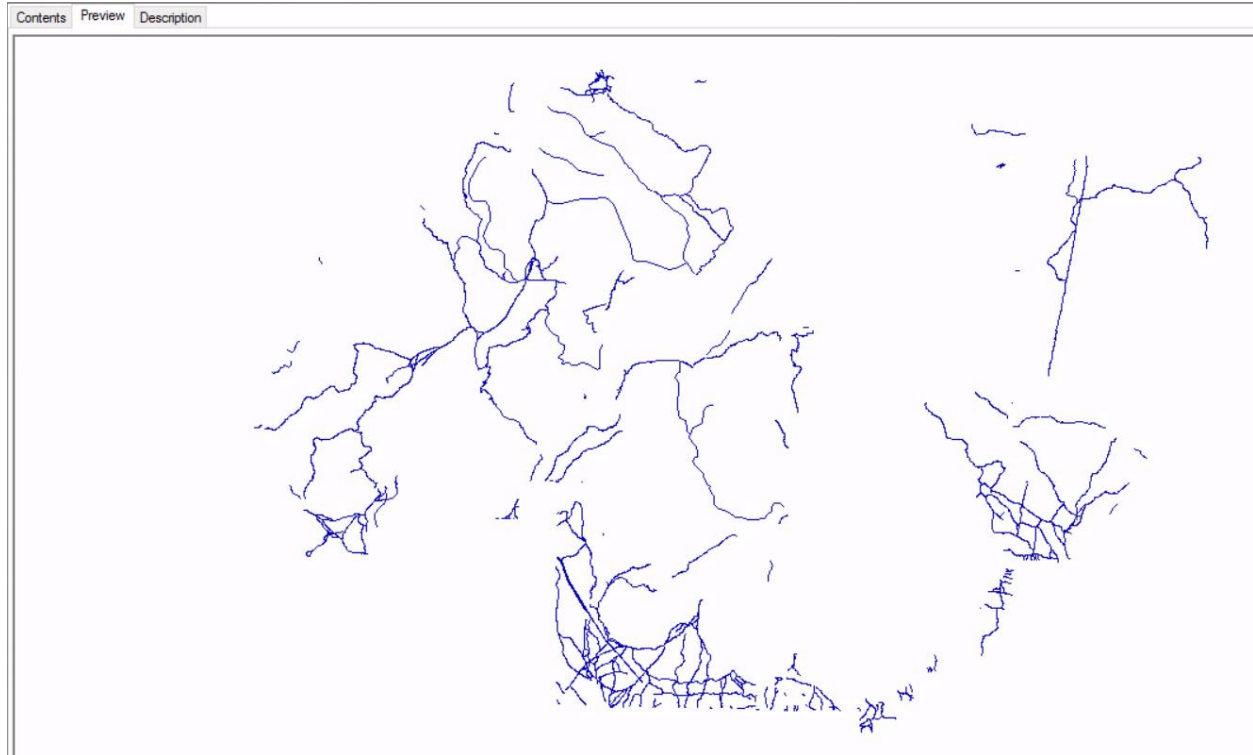
Appendix A: Original Data Provided



File fcntr_soctrl, “Social_Trails.shp” were provided by Sean Murphy of the USFS. These data files matched the “all_social_trails_03_08.shp” and “all_social_trails_09_05.shp” files closely, and were in a more useful coordinate range.

The info for “Social_Trails.shp” is as follows:

Geography:



Attribute Table for Social_Trails.shp (incomplete: includes all trails with Name or Source):

Contents Preview Description					
FID	Shape *	gis_miles	Trl_Class	Name	Source
362	Polyline	0.234143	2	Little Gnarly	Name from: Flag Rec Atlas NAU GRAIL
367	Polyline	0.216533	2	Jedi	Name from: Flag Rec Atlas NAU GRAIL
436	Polyline	0.298321	2	Soaring Eagle	Name from: Flag Rec Atlas NAU GRAIL
480	Polyline	0.483281	2	Red Onion	Name from: Flag Rec Atlas NAU GRAIL
483	Polyline	0.662338	2	Wassabi	Name from: Flag Rec Atlas NAU GRAIL
536	Polyline	0	0		FRD Rec GPS Data - Day 8
538	Polyline	0	0	Middle Oldham	FRD Rec GPS Data - Day 8
539	Polyline	0	0	Middle Oldham	FRD Rec GPS Data - Day 8
540	Polyline	0	0	Middle Oldham	FRD Rec GPS Data - Day 8
541	Polyline	0	0	Middle Oldham	FRD Rec GPS Data - Day 8
0	Polyline	0.004371	2		FRD Rec GPS Data - Brad'sFinal.shp
2	Polyline	0.051898	2		FRD Rec GPS Data - Brad'sFinal.shp
3	Polyline	0.054536	2		FRD Rec GPS Data - Brad'sFinal.shp
520	Polyline	0	0		FRD Rec GPS Data - Brad's 4th & 5th Day
521	Polyline	0	0		FRD Rec GPS Data - Brad's 4th & 5th Day
522	Polyline	0	0		FRD Rec GPS Data - Brad's 4th & 5th Day
523	Polyline	0	0		FRD Rec GPS Data - Brad's 4th & 5th Day
524	Polyline	0	0		FRD Rec GPS Data - Brad's 4th & 5th Day
525	Polyline	0	0		FRD Rec GPS Data - Brad's 4th & 5th Day
1	Polyline	1.647315	2	Private Reserve	FRD Rec GPS Data - all_social_trails_03_08.shp; Name from Flag Rec Atlas NAU GRAIL
526	Polyline	0	0		FRD Rec GPS Data - 2nd Day
528	Polyline	0	0		FRD Rec GPS Data - 2nd Day
529	Polyline	0	0		FRD Rec GPS Data - 2nd Day
530	Polyline	0	0		FRD Rec GPS Data - 2nd Day
531	Polyline	0	0		FRD Rec GPS Data - 2nd Day
512	Polyline	0	2	Pickle	Digitized from NAU GRAIL website
513	Polyline	0	0	Unknown	Digitized from NAU GRAIL website
514	Polyline	0	0	Dry Lakes	Digitized from NAU GRAIL website
515	Polyline	0	2	Weenie Walk	Digitized from NAU GRAIL website
516	Polyline	0	2	Climb 3	Digitized from NAU GRAIL website
517	Polyline	0	2	Climb 3	Digitized from NAU GRAIL website
518	Polyline	0	2	Red Onion	Digitized from NAU GRAIL website
537	Polyline	0	0		Digitized from aerial imagery
76	Polyline	0.153783	2	Lost Burrito	Data: FRD Rec GPS - Brad'sFinal.shp; Name: NAU GRAIL website
519	Polyline	0	0		Andrew Johnson's Data - social_trails
532	Polyline	0	0		Andrew Johnson's Data - social_trails
533	Polyline	0	0		Andrew Johnson's Data - social_trails
534	Polyline	0	0		Andrew Johnson's Data - social_trails
535	Polyline	0	0		Andrew Johnson's Data - social_trails
75	Polyline	0.418565	2	Lost Burrito	
361	Polyline	0.26972	2		

1 (of 566)

Preview: Table

Metadata:

Contents

Preview

Description

Print

Edit

Import

Social_Trails

Shapefile

Thumbnail Not Available

Tags

There are no tags for this item.

Summary

There is no summary for this item.

Description

There is no description for this item.

Credits

There are no credits for this item.

Use limitations

There are no access and use limitations for this item.

Extent

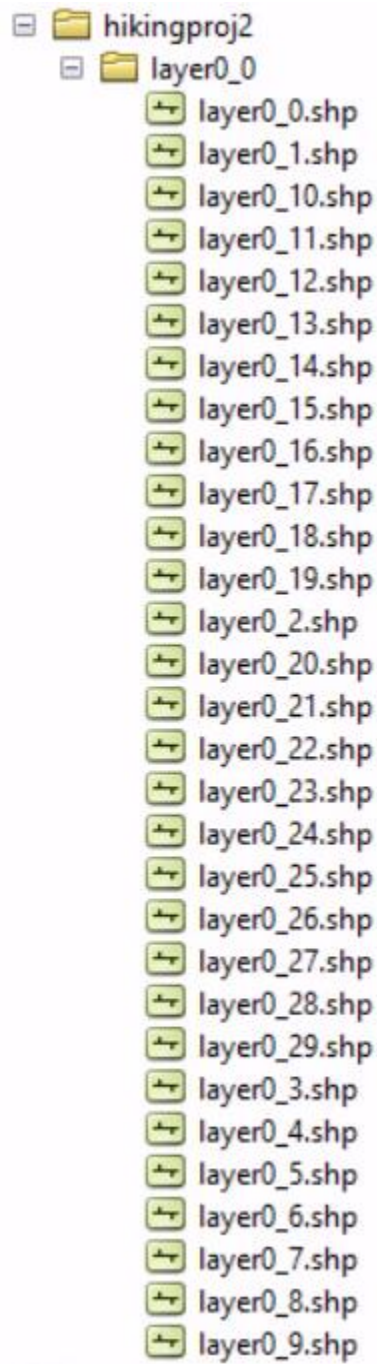
West	-111.667145	East	-111.555150
North	35.286824	South	35.222881

Scale Range

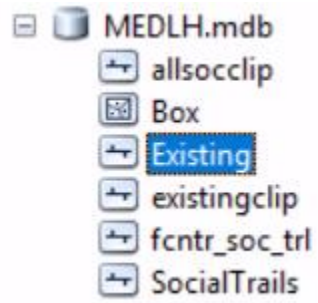
There is no scale range for this item.

You are currently using the Item Description metadata style. Change your metadata style in the Options dialog box to see additional metadata content.

Hiking Project Data:



Hiking Project Data was merged into a single layer called “Existing.shp”:



Geography:



Table:

Contents	Preview	Description	OBJECTID *	Shape *	name	link	Shape_Leng	Transparency	Symbol	Shape_Length
			1	Polyline	Pipeline Trail	http://www.hikingproject.com/trail/7003028	0	<Null>		5817.975591
			2	Polyline	Poker Trail- drop into a gully parallel to Moto	http://www.hikingproject.com/trail/7003061	0	<Null>		542.623088
			3	Polyline	Rocky Ridge - Schultz Creek Loop	http://www.hikingproject.com/trail/7003682	0	<Null>		17553.115336
			4	Polyline	Christmas Tree	https://www.trailrunproject.com/trail/7003036/christmas-tree	0	<Null>		2847.964453
			5	Polyline	Chimney Trail	http://www.hikingproject.com/trail/7003059	0	<Null>		2192.293339
			6	Polyline	AZT - passage 34 - San Francisco Peaks	http://www.hikingproject.com/trail/7015611	0	<Null>		68745.114003
			7	Polyline	Flue Trail	http://www.hikingproject.com/trail/7003060	0	<Null>		1804.923014
			8	Polyline	Fatman's Loop Trail #25	https://www.trailrunproject.com/trail/7034351/fatmans-loop-trail-25	0	<Null>		4444.852685
			9	Polyline	Eden Lookout Trail	https://www.trailrunproject.com/trail/7037160/elden-lookout-trail	0	<Null>		3265.606906
			10	Polyline	Forces of Nature	http://www.hikingproject.com/trail/7003029	0	<Null>		3398.324384
			11	Polyline	Damper Trail - short easy connector between	http://www.hikingproject.com/trail/7003062	0	<Null>		565.212231
			12	Polyline	Schultz Creek Trail	https://www.hikingproject.com/trail/7035236/schultz-creek-trail	0	<Null>		2762.499211
			13	Polyline	Kachina Peaks Wilderness Loop	http://www.hikingproject.com/trail/7013496	0	<Null>		43924.400293
			14	Polyline	Dry Lakes Vista	http://www.hikingproject.com/trail/7002952	0	<Null>		1695.024635
			15	Polyline	Sunset	http://www.hikingproject.com/trail/7002917	0	<Null>		9125.625703
			16	Polyline	AZT - Passage 32 - Elden Mountain	http://www.hikingproject.com/trail/7015613	0	<Null>		26233.355463
			17	Polyline	Upper Brookbank Trail	https://www.trailrunproject.com/trail/7035827/upper-brookbank-trail	0	<Null>		4080.187361
			18	Polyline	Elden Lookout Road	https://www.hikingproject.com/trail/7031850/elden-lookout-road	0	<Null>		10497.539003
			19	Polyline	Easy Oldham to Lower Oldham Connector	http://www.hikingproject.com/trail/7003033	0	<Null>		544.743495
			20	Polyline	Easy Oldham	http://www.hikingproject.com/trail/7003034	0	<Null>		3528.771888
			21	Polyline	Waterline Road (Trail)	https://www.hikingproject.com/trail/7039212/waterline-road-trail	0	<Null>		27819.381791
			22	Polyline	AZT - Passage 33 - Flagstaff	http://www.hikingproject.com/trail/7015612	0	<Null>		28708.598247
			23	Polyline	Lower Brookbank	http://www.hikingproject.com/trail/7002953	0	<Null>		2967.27164
			24	Polyline	Little Bear	http://www.hikingproject.com/trail/7003035	0	<Null>		6666.727677
			25	Polyline	Moto Trail (lower)	http://www.hikingproject.com/trail/7003055	0	<Null>		5290.012529
			26	Polyline	Moto Trail (upper)	http://www.hikingproject.com/trail/7003057	0	<Null>		3417.154007
			27	Polyline	Pipeline to Fat Man's Loop	https://www.trailrunproject.com/trail/7003038/pipeline-to-fat-mans-loop	0	<Null>		1492.599271
			28	Polyline	Weatherford Trail #102	http://www.hikingproject.com/trail/7013507	0	<Null>		20266.962542
			29	Polyline	Weenie Walk	https://www.trailrunproject.com/trail/7035825/weenie-walk	0	<Null>		2545.650588

Metadata:

[Contents](#) [Preview](#) [Description](#)

[Print](#) [Edit](#) [Import](#)

Existing

Personal GeoDatabase Feature Class

Thumbnail Not Available

Tags

Hiking Project, Trail Run Project, MTB Project, Flagstaff, Mount Elden

Summary

This data was sourced from the Hiking Project, Trail Run Project, and MTB Project apps to project popular trails within the Mount Elden Dry Lake Hills area in Flagstaff, AZ. It was downloaded as GPX files in 2017.

Description

There is no description for this item.

Credits

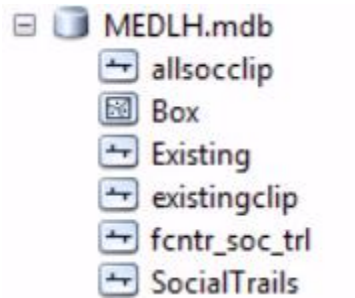
There are no credits for this item.

Use limitations

There are no access and use limitations for this item.

Appendix B: Personal Geodatabase and Other User Created Data

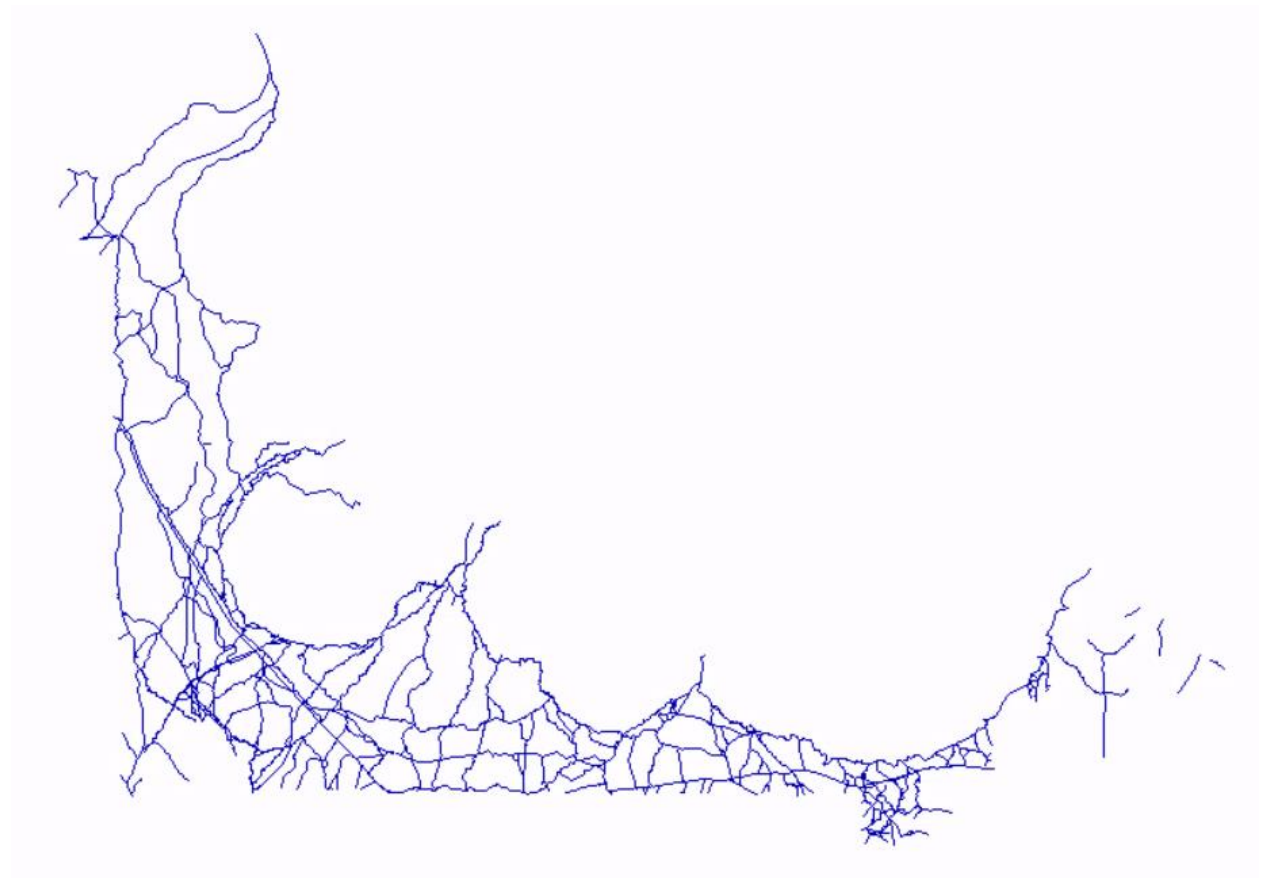
Personal Geodatabase:



“SocialTrails.shp” is all the data imported directly from ArcCollector online. This data was clipped by the bounding box to create “allsocclip.shp” which was used for the purposes of this practicum.

“allsocclip.shp”

Geography:



Metadata:

Contents

Preview

Description

Print

Edit

Import

allsocclip

Personal GeoDatabase Feature Class

Thumbnail Not Available

Tags

MEDLH, Flagstaff, Social Trails. 2018, 2017, ArcCollector

Summary

Map of Social Trails around Mount Elden in Flagstaff, AZ 2018. Shows distribution and frequency of social trails.

Description

This data was collected between October 2017 and October 2018. It was collected using ArcCollector Version 18.0.3, Build 1033 for Android on a Galaxy Note 9 and an LG G6 cellular phone. It was collected at a streaming interval of 5 seconds, and a minimum accuracy of 30 feet. This accuracy fluctuated between 4-12 feet in practice. This data was collected by Madeleine Bryant for the purposes of a Masters Practicum for Northern Arizona University. This data was clipped from the original data, "SocialTrails.shp," to fall into the study area, "Box.shp," for this practicum. The attribute "New" creates a comparison to data from 2008. A "y" attribute indicates that the trail is new and did not exist in 2008. An "O" attribute indicates that the trail existed in 2008 but does not exist in 2018. The "e" attribute indicates that the trail is sanctioned by the USFS. A <null> classification indicates that the trail existed in 2008 and still exists in 2018.

Credits

Madeleine Bryant, James Franklin

Use limitations

There are no access and use limitations for this item.

Extent

West

-111.634151

East

-111.578538

North

35.255145

South

35.223214

Scale Range

Maximum (zoomed in)

1:5,000

Minimum (zoomed out)

1:150,000,000

You are currently using the Item Description metadata style. Change your metadata style in the Options dialog box to see additional metadata content.

“Box.shp”

Table:

Contents Preview Description				
	OBJECTID *	SHAPE *	SHAPE_Length	SHAPE_Area
▶	1	Polygon	52480.766634	69037280.58312

Geography:

