

Troy Espe<sup>1</sup>

7 August 2011

## Be Bear Aware: Grizzly Maulings in Yellowstone National Park, 2005-2011

### Introduction

Near midday July 6, 2011, a California couple were hiking on the Wapiti Lake Trail at Yellowstone National Park when they encountered a grizzly sow and its cubs. According to the park's official news release, the adult bear pursued the couple down the trail (Nash, "Identity of Bear Mauling Victim Released"). The grizzly bit the woman's daypack, lifting her off the ground, the news release stated. The animal killed the husband, who suffered multiple bite and claw injuries, according to the news release. It was Yellowstone National Park's first fatal bear attack since 1986.

Although extremely rare, this incident and previous maulings inspired me to create a map displaying historical locations of bear attacks within the United States' oldest national park. I aspired to determine if there was a geographical pattern to violent bear-human encounters inside the park's 2.2 million acres (nps.gov/yell, "Yellowstone Fact Sheet"). The map, titled *Be Bear Aware*, could serve as a safety guide to the park's 3.6 million annual visitors (nps.gov/yell, "Yellowstone Fact Sheet"). Hikers, backpackers, and campers particularly could find the map useful for selecting trails and campsites.

### Geographic Information System (GIS) Data

I primarily collected Yellowstone National Park datasets via these websites: Wyoming State Geological Survey, geodata.gov, National Biological Information Infrastructure, National Park Service, and U.S. Geological Survey (USGS). Except for USGS, the sites largely served as portals to shapefiles. The sites retrieved geospatial data from several sources including the

Yellowstone National Park Spatial Analysis Center and Montana State Library. Some datasets originated from USGS and the National Park Service.

I downloaded a base-map vector file from Montana State Library. However, I preferred an orthoimage to serve as the base map. I obtained a raster file by entering boundary coordinates into The National Map Seamless Server. After securing a base map, I downloaded a layer (.lyr) file of hiking trails, an .e00 file of backcountry campsites, a shapefile (.shp) of roads, and an .e00 file of streams from Yellowstone National Park Spatial Analysis Center. From USGS, I downloaded a layer file containing 928 points of interests including mountain peaks, campgrounds, geysers, and ranger stations. I discovered a hydrographic dataset containing the park's water bodies from the National Park Service Water Resource Division. In all, I downloaded more than thirty datasets containing features such as bear management units and patrol cabins.

For locations of bear attacks, I collected global positioning system (GPS) waypoints via email from Kerry Gunther, a wildlife biologist at the Yellowstone National Park Bear Management Office (Gunther, "Re: GIS Class"). I entered the waypoints into a Microsoft Excel spreadsheet and exported the data in a comma-separated values (.csv) file.

*Metadata.* Metadata were inconsistent. The Wyoming State Geological Survey and geodata.gov provided detailed metadata before downloading zip (.zip) files. National Biological Information Infrastructure offered no metadata. The National Park Service Natural Resource Information Portal supplied minimal metadata prior to downloading zip files. Regardless of the source, metadata were included all zip files but often were written in extensible markup language (XML), which can be difficult to read. When evaluating metadata, I verified that shapefiles were published by reputable sources, preferably government agencies. I also checked for dates, which

sometimes were difficult to distinguish because of the markup language. I reasoned that dates were not essential because national parks change little over time. When importing files into ArcMap, I consulted metadata to ensure map projections matched.

## Processes

After downloading thirty-two datasets, I initially imported a vector file to serve as the base map of Yellowstone National Park. Disliking the flat polygon, I added a tagged image file format (TIFF) to ArcMap. The image fit precisely over the polygon. I then removed the vector file. I placed park boundary lines atop the image by importing a layer file from the National Park Service.

Satisfied with the base map, I continued to add layers. I loaded roads, backcountry campsites, ranger stations, mountain peaks, lakes, streams, hiking trails, bear management units, patrol cabins, avalanches, bear ranges, silt, mountain ranges, faults, glaciers, flood channels, geothermal areas, and other features. I converted .e00 files using the To Converse feature in ArcToolbox.

I judged layers based on visual appeal and contribution to the map's theme of bear awareness. If layers failed to meet these criteria, I removed them from the table of contents. I also sought to reduce clutter by removing layers that might dominate the map. I ultimately retained ten layers.

I edited attribute tables to confine features to the base map. For example, the roads shapefile contained 170,173 highways throughout the United States and Canada. In the attribute table, I deleted all rows except for roads located in Wyoming, Montana, and Idaho. To ease recognition, I changed the names of Yellowstone roads to their U.S. highway numbers. Likewise, I edited a 928-row attribute table of points of interest to include only summits, campgrounds, and

park entrances. Sorting by acreage, I reduced an attribute table of 3,435 water bodies to five major lakes.

### ArcGIS Features

I accessed multiple ArcGIS features to improve map readability. I adjusted labeling for individual layers. Although I kept the Arial font, I increased font sizes. I also added a halo effect to labels. I selected symbols to reflect corresponding layers. For example, I chose the U.S. highway symbol for roads. I also manipulated symbol sizes for emphasis. In the points-of-interest layer, I assigned symbols based on category values. For example, I selected a blue triangle for the campground value. I increased the transparency of the TIFF base map to accent cartographic elements. I also set the transparency to seventy-five percent for the park's 13,284 streams.

I explored several ArcGIS features in layout mode. I inserted a north arrow, scale bar, scale text, author, date, and map datum. I inserted a legend and then converted it to a graphic to adjust symbol sizes. I placed a border around the legend and inserted a buffer to prevent symbols and labels from touching rules. I set the data-frame background to yellow. Using the Draw toolbar, I inserted a rectangular text box to display sources. I selected brown for the legend and sources titles. I changed the font, increased the point size, switched the color, bolded, and shadowed the map title while widening character and word spacing.

I employed the Go To XY feature to add Yellowstone National Park landmarks to the map. The points-of-interest shapefile omitted three park entrance stations. Thus, I looked up the latitude and longitude waypoints on the Yellowstone National Park website and manually entered the coordinates in the Go To XY tool ([nps.gov/yell](http://nps.gov/yell), "Yellowstone Fact Sheet"). After

adding a labeled point, I ungrouped the elements to adjust the symbol and label. I followed a similar process to add markers for bear attacks. I will explain that process in the next section.

### Difficulties

My main difficulty involved obtaining and loading points of bear attacks inside Yellowstone National Park. This information was crucial to the map. I thoroughly searched the internet for shapefiles or GPS waypoints of violent bear-human encounters. Although I found a table of bear-related injuries on the Yellowstone National Park website, the table contained no geospatial data (nps.gov/yell, "Bear-related Injury Table"). On July 14, 2011, I emailed Gunther to inquire about the availability of such data. He responded that day, writing that he could provide shapefiles (Gunther, "Re: GIS Class"). He asked for a timeframe. I specified that I would appreciate locations from as many years as possible. On July 29, 2011, Gunther emailed GPS coordinates of bear-related injuries for the years 2005 through 2010. I asked for additional years but did not receive any. I also requested 2011 incidents, but Gunther explained that he could not provide the location of this year's fatality because it remained under investigation.

I entered the coordinates into a Microsoft Excel spreadsheet and exported the data as a .csv file. I loaded the spreadsheet into ArcMap. I attempted to display the XY data, but the points did not appear on the map. However, the process allowed me to assign a label and symbol to the layer, which then would appear in the legend. As with park entrances, I relied on the Go To XY tool to add points where maulings had occurred. I also inserted callouts to indicate the year and severity of attacks. I changed the point to a bear symbol and increased the size substantially. Because I did not have the coordinates of the 2011 fatality, I consulted the official press release to plot my best estimate of the location (Nash, "Identity ...").

Besides securing bear-attack locations, I struggled with basic layout functions such as sizing and moving the base map. Although I have a graphic-design background, ArcGIS's features were counterintuitive to me. I relied on this course's ArcMap tutorial and the ArcMap quick-reference guide. I often queried the ArcGIS Desktop Help Library. I gleaned advice from classmates' posts in online discussion threads. I reviewed course PowerPoint lectures. I emailed questions to Geospatial Alliance volunteers at the University of Wisconsin-Madison. University of Wisconsin-Madison map librarian Jaime Stoltenberg also assisted me.

### Learning Experiences

Although I found the software cumbersome, I have gained a working knowledge of ArcGIS. As a reference librarian, I now can answer basic questions about the program and refer patrons to helpful resources mentioned in the previous section. Despite downloading extra datasets, the process introduced me to a wealth of websites that offer free geospatial data. I can refer library patrons to these portals as well.

Most importantly, I experienced the power of GIS. My map provided a visual answer to my initial question: is there a historical pattern to bear attacks at Yellowstone National Park? In the last six years, there appears to be a concentration of bear-related injuries between Old Faithful geyser and Yellowstone Lake. People, more than bears, likely are to blame for this pattern. Old Faithful and Yellowstone Lake are two of the park's most popular attractions. The influx of visitors to these landmarks undoubtedly increases the likelihood of bear encounters. I would not have drawn this conclusion before creating this map.

Notes

1. The author is a graduate student in the School of Library & Information Studies at the University of Wisconsin-Madison. Contact him at [espe0005@umn.edu](mailto:espe0005@umn.edu).

Works Cited

“Bear-related Injury Table.” *Yellowstone National Park*. Yellowstone National Park, n.d. Web.

12 July 2011.

Gunther, Kerry. “Re: GIS Class.” Message to the author. 14 July 2011. Email.

—. “Re: GIS Class.” Message to the author. 29 July 2011. Email.

—. “Re: GIS Class.” Message to the author. 3 Aug. 2011. Email.

Nash, Al. “Identity of Bear Mauling Victim Released.” *Yellowstone National Park*. Yellowstone National Park, 7 July 2011. Web. 6 Aug. 2011.

“Yellowstone Fact Sheet.” *Yellowstone National Park*. Yellowstone National Park, n.d. Web. 30 July 2011.