Ranger Station Allocation in Yellowstone National Park

final project by
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GEOG 492
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Study Area

Research Question

- With park visitation on the rise there is a need for more rangers to protect the wildlife and natural areas. Locate areas using GIS that would benefit by having more rangers.

Why is it important?

- Vandalism to the park has been on the rise.
  - CHEYENNE – "A Washington man pleaded guilty for driving his pickup truck across fragile soil near a Yellowstone National Park geyser. "
  - "Yellowstone Webcam Catches Men Using Old Faithful as Toilet "
- Because the park is part of our National identity and it is important to protect this unique environment for future generations.
- Having more rangers will allow for more frequent patrols of attractions and backcountry areas.

Cheyenne: Associated Press http://billingsgazette.com/news/state-and-regional/wyoming/article_0027f6d1-fca6-56fa-9ff1-9e50f6c7-e57.html#ixzzpqqpNd19

Webcam: http://calgary.confidential.com/2012-05-23/yellowstone-webcam-catches-men-using-oi-faithful-as-toilet/

Methods

- Create a Euclidean Allocation of the Ranger Stations within the park.

- Use this distance to determine the Campgrounds and Attractions each station is responsible for.

- Create Kernel Density of Point of Interest.

- Create Kernel Density of the Campgrounds that host the most visitors.

- Spatial Join the data to identify locations in the park that could benefit from more Ranger coverage.

Data Used

- **Yellowstone Boundary**
- **Hydroography:**
  - Lake Bathymetry
  - Lakes
  - Streams
- **Park information:** http://www.wsgs.uwyo.edu/Yellowstone/GIS.aspx
- Points of interest
  - Roads, Hiking trails, Ranger stations
- Yellowstone visitation & employee statistics
  http://www.nps.gov/yell/planyourvisit/factsheet.htm
  - 3,394,321 people visited in 2011-6.8 percent lower than 2010
  - 2010-2011 winter: 88,804 recreational visits
    - Employees: http://www.nps.gov/yell/planyourvisit/facisheet.htm
  - During the summer Approximately 780 National Park Service (about 400 year-round)
  - Lodge visitor information: http://www.usparklodging.com/yellowstone/
  - Campground Information: http://www.yellowstone.co/camping.htm
- Top Ten list http://www.yellowstone.net/topten.htm

Yellowstone Visitor Information

Year	Visitors
2000	2,838,233
2001	2,758,526
2002	2,973,677
2003	3,019,375
2004	2,868,317
2005	2,835,651
2006	2,870,295
2007	3,151,343
2008	3,066,580
2009	3,295,192
2010	3,640,205
2011	3,394,322

Visitors Per Year

$y = 60918x + 3E+06$

Note: 2010-2011 winter: 88,804 recreational visits

http://www.yellowstone.co/stats.htm

Employees

- Currently the park employs only 780 National Park Service Rangers during the summer months
- 400 National Park Service Rangers during the winter months.
- 4,351 visitors to every Ranger during the summer months.
- 222 visitors to every Ranger During the winter months.

http://www.nps.gov/yell/planyourvisit/factsheet.htm

Assumptions

- We are assuming that the visitors in the park will be concentrated near and around the points of interest and around the campgrounds and lodges.
- The areas generated by Euclidean Allocation are the areas that each Ranger Station is responsible for.
- Visitation will continue to increase.
- That the park wants to build a new Ranger Station to facilitate more Rangers.
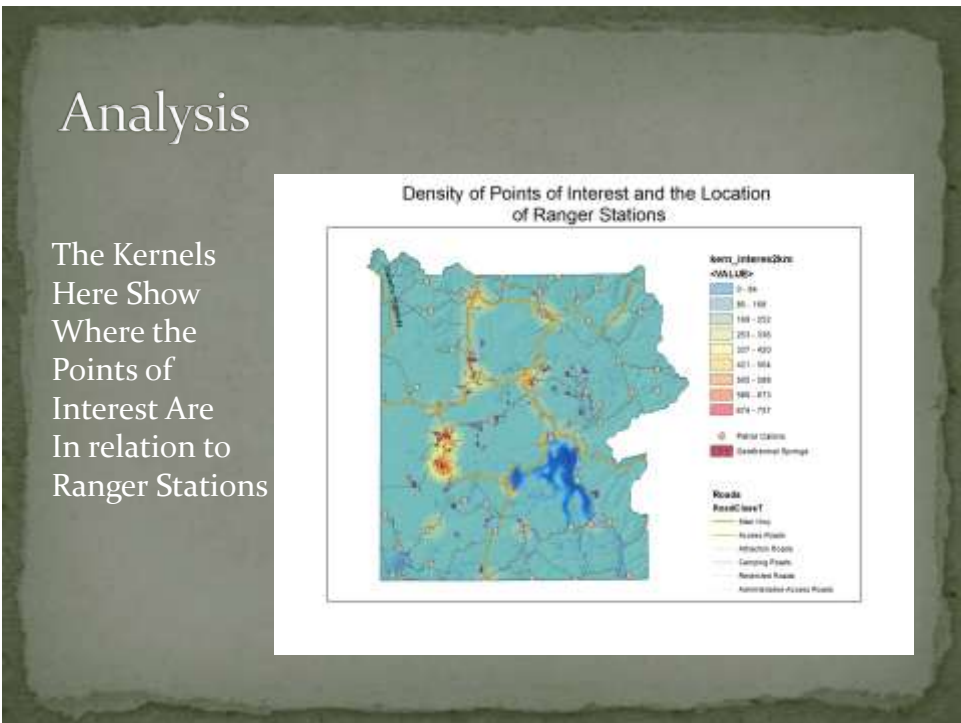- Each Ranger Station host the same amount of rangers.

Yellowstone's Top 10

Most Visited Attractions
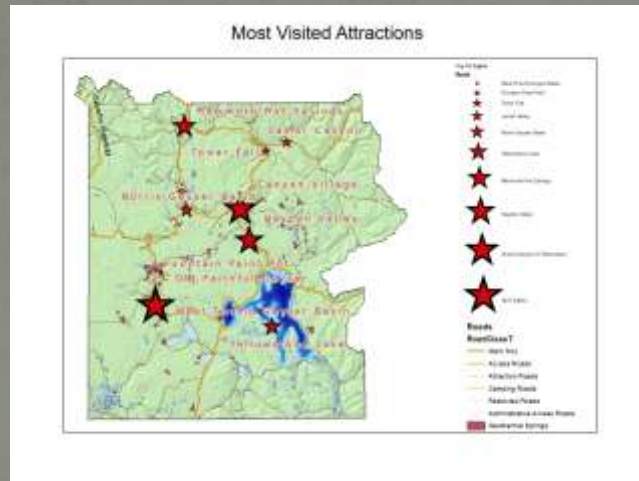
Analysis

This allowed us to see the area that each ranger station was responsible for

Patrol Stations & Euclidean Allocation
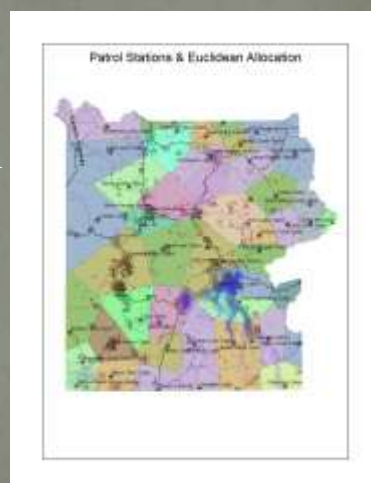
Analysis

This provided a visual for where Attractions are the most Dense

Kernel Density of Points of Interest

Analysis

The Kernels Here Show Where the Points of Interest Are In relation to Ranger Stations

Density of Points of Interest and the Location of Ranger Stations

Analysis

Kernel Density
Showing The
Highest
Concentration
Of Campsites

Areas of the Park Where the
Campsites are Concentrated

Graduated Symbols of Lodge Occupancy

Conclusion

Areas To Beef Up Ranger Patrol
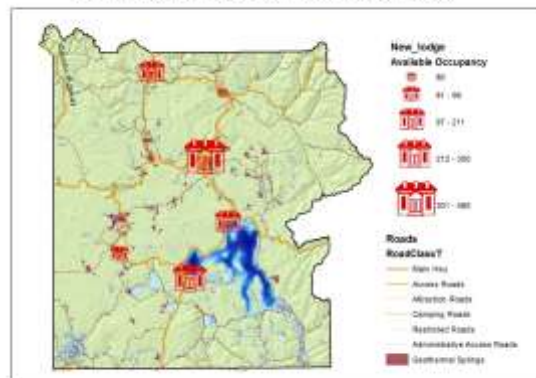
Limitations and Future Considerations

- Where do I begin?
- Determining population of visitors was difficult
  - Some enter park but don't stay over night
  - Visitors will travel between attraction
  - Geography did not play a role in area that each ranger station covered.

- Existing ranger stations a mystery????
  - existing use and occupancy unknown

References (data source)

- National Park Service Dataserver (https://irma.nps.gov/) → Yellowstone National Park boundary, roads, rivers, populated areas, bear mgmt areas, campsites, patrol cabins, bathymetry, trails.

- National Atlas (http://www.nationalatlas.gov/mld/statesp.html) → State boundaries

- Wyoming State Geological Survey (http://www.wsgs.uwyo.edu/Yellowstone/GIS.aspx sites/Metadata-DEM-10M.asp) → Hillshade 10m, points of interest, Old Faithful Volcanic Springs, Geothermal Springs, Caldera Boundaries, Earthquakes - 1963 to 2010,

- Yellowstone National Park (http://www.yellowstone.net/topten.htm) → Top Ten list

- National Park Service, Yellowstone-Plan your visit (http://www.nps.gov/yell/planyourvisit/factsheet.htm) → Yellowstone visitation & employee statistics
  - 3,394,321 people visited in 2011-6.8 percent lower than 2010
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References (review articles)

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- Plumb, G. E., White, P. J., Coughenour, M. B., & Wallen, R. L. (January 01, 2009). Carrying capacity, migration, and dispersal in Yellowstone bison. *Biological Conservation, 142,* 11, 2377-2387.

- Garrott, R. A., White, P. J., & Watson, F. G. R. (2009). *The ecology of large mammals in central Yellowstone: Sixteen years of integrated field studies*. San Diego, CA: Academic Press.

- Craighead, J. J., Sumner, J. S., & Mitchell, J. A. (1995). *The grizzly bears of Yellowstone: Their ecology in the Yellowstone ecosystem, 1959-1992.* Washington, D.C: Island Press.

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Questions?