Data Visualization and Interactive Web App Design Project

Biodiversity in US National Parks

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Introduction, Inspiration, & Purpose

For our project, we wanted to investigate endangered species. We understand the importance of biodiversity and our role in preserving it as stewards of our planet, so we looked to expand our knowledge of the distribution of species and conservation efforts around the country, which is catalogued in our national parks. Our primary analysis focused on the populations of endangered species in each park. When a species is labeled as "endangered," it is at a high risk of extinction in all or most of its habitat in the near future, and action must be taken to preserve these species in order to prevent their extinction (OneVet). This is why we deemed the endangered species of high importance when constructing our web application.

The dataset we used contains two csv files from the US National Park Service, compiled in 2016. The parks.csv file contains information about 56 of the US national parks in 27 states, and the species.csv file contains information about all observed species in each park, categorized by their taxonomic classification, conservation status, and other variables. We chose to compare elements such as size of park, distribution of species, and parks per state around the country to create visualizations that would demonstrate the prevalence of endangered species in America.

Research Questions and Design Concepts

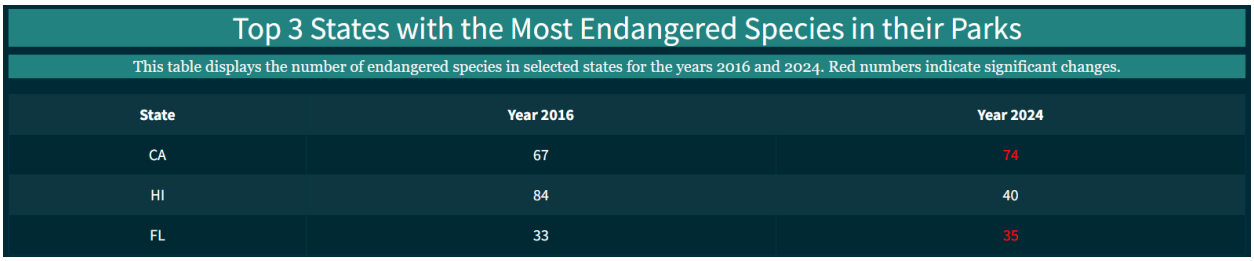
In our initial data review, we discovered several questions we wanted to explore through the visualizations we planned to create. First, where are the national parks located in the US? Second, which states have the most endangered species in their national parks? Third, is there any correlation between the number of endangered species and the size of each park? These queries commanded our data organization and graph development.

Based on the context of our study, for our design we decided to go mostly with earth colors that resonate with the nature aesthetic. We also included pictures from some of the parks in the study organized next to different visualizations, including dynamic charts and tables as well as an interactive map where our research questions were supported. We converted our datasets into a SQLite database, which we connected to through the Flask application found in the app.py file. Here we created each page of our website, which would populate with the data from our JavaScript and SQLhelper files, along with the

styling from the html files found in the templates folder. The website is hosted publicly and can be viewed here: https://redrajah13.pythonanywhere.com/.

Home page

The home page of our website includes a short summary to give the user some context about what they will find there, as well as two different visualizations. The first is a table that shows how the number of endangered species has increased between the year this dataset was created and the current year in each of the three states with the highest numbers of endangered species in their parks: Hawaii, California, and Florida (NPS).

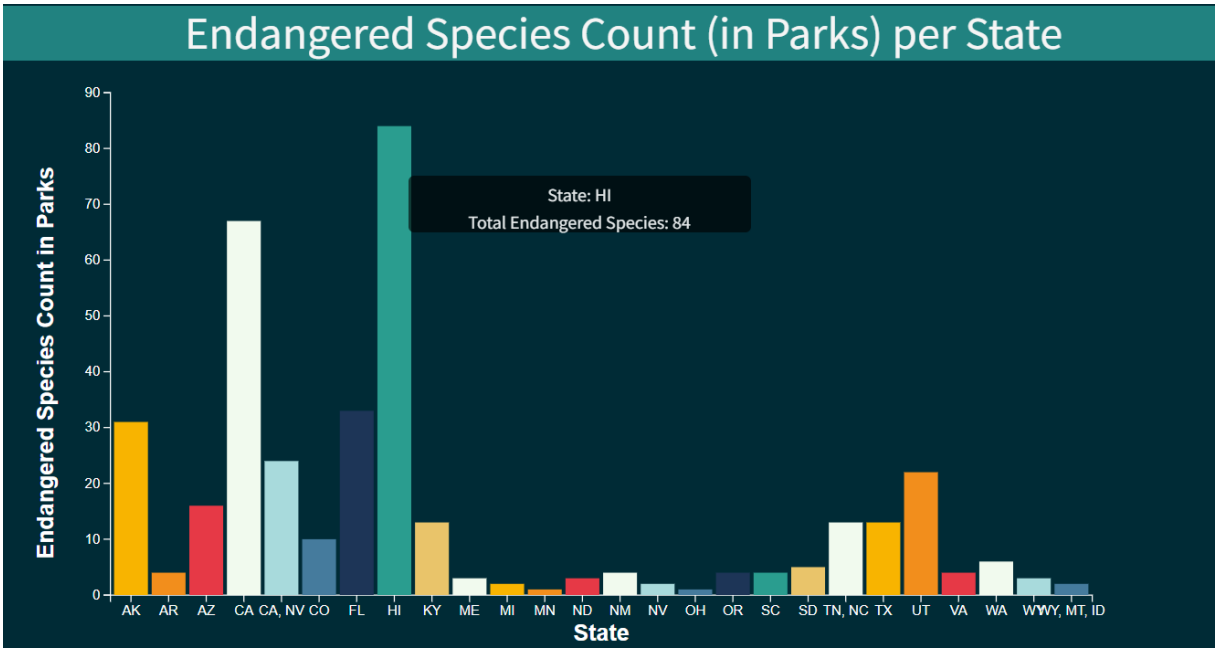


Top 3 States with the Most Endangered Species in their Parks

This table displays the number of endangered species in selected states for the years 2016 and 2024. Red numbers indicate significant changes.

State	Year 2016	Year 2024
CA	67	74
HI	84	40
FL	33	35

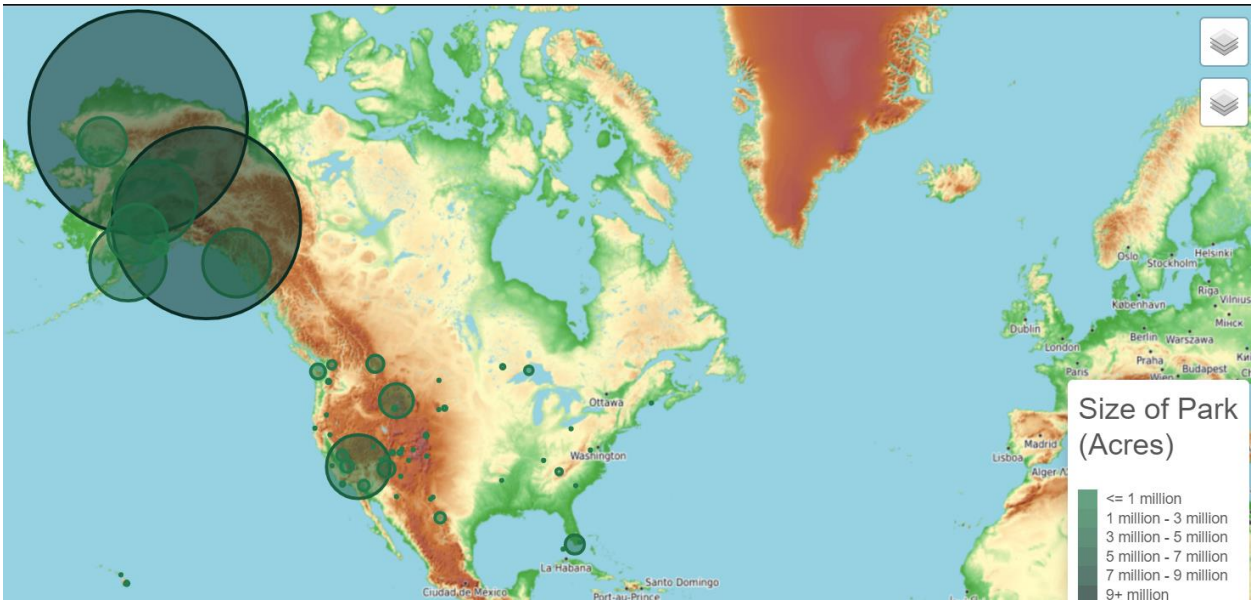
The second is a bar chart that shows the total count of endangered species in parks per state, confirming that the top three states match the preceding table. The bar graph shows a tooltip for each bar when hovered over, dictating the state and total endangered species for that state.



Each page of the website includes the navigation bar at the top, highlighting which page is currently being shown. The tree icon on the left side is a link that takes the user back to the home page.

Map page

To answer our first research question, we created the map page of our website. This page loads a topographical view of the world, centered on the continental United States, with circles showing the location of each park in our dataset. As noted in the legend, the circles are in varying shades of green based on park size, with parks over nine million acres in the darkest green while parks under one million acres are in the lightest green. As dictated above the map on the webpage, the circle markers are only indicative of each park's size relative to the other parks, rather than their exact geographical layout on the map.



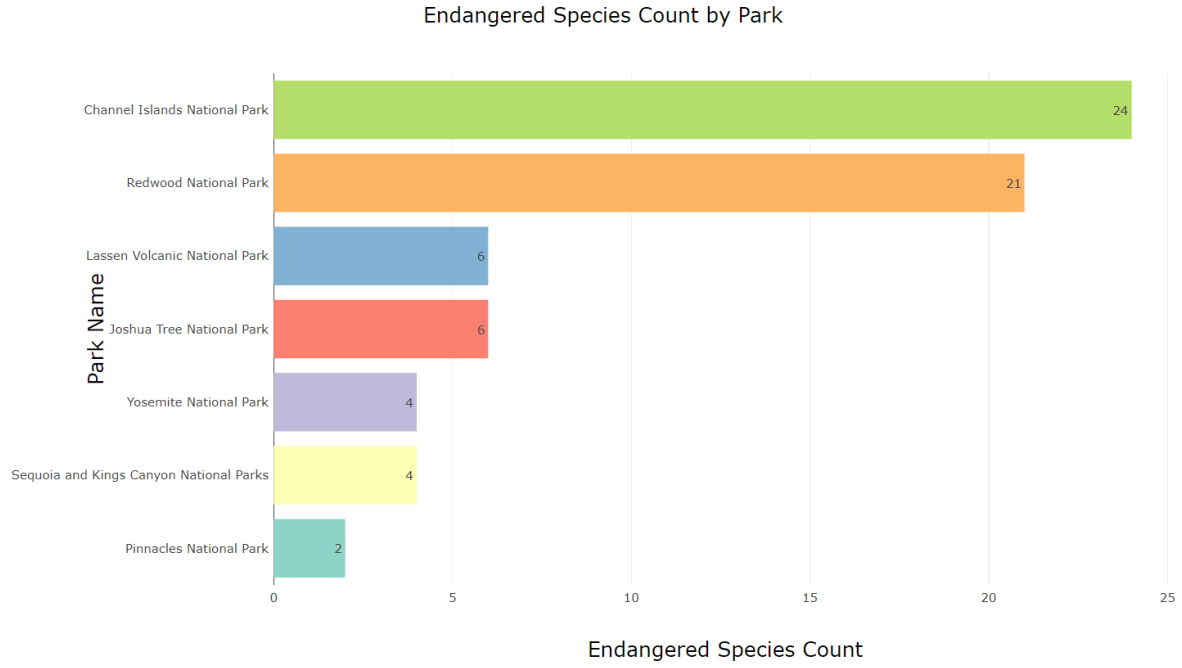
For easier viewing of the circle layer and also the included heatmap layer, the user can toggle to street view in place of the default topographical view. The map also includes a marker cluster layer, which shows the precise central coordinates of each park. When clicked, each marker or circle shows a popup describing the name of that park, which state(s) it is in, and its exact size. By comparing the sizes of each park around the country, we can begin our analysis of whether or not size of park relates to number of endangered species in each park.

Dashboard

The dashboard page includes the interactive visuals with which the user can explore our second and third research questions. During the creation of the dashboard, we decided to incorporate two types of graphs and a table that apply filters focusing on state and minimum endangered species count. In the comments next to the filters, we specify that the filter dropdown for state includes only the states that list national parks in our dataset. There is also a comment defining "endangered," with a link to the OneVet article that

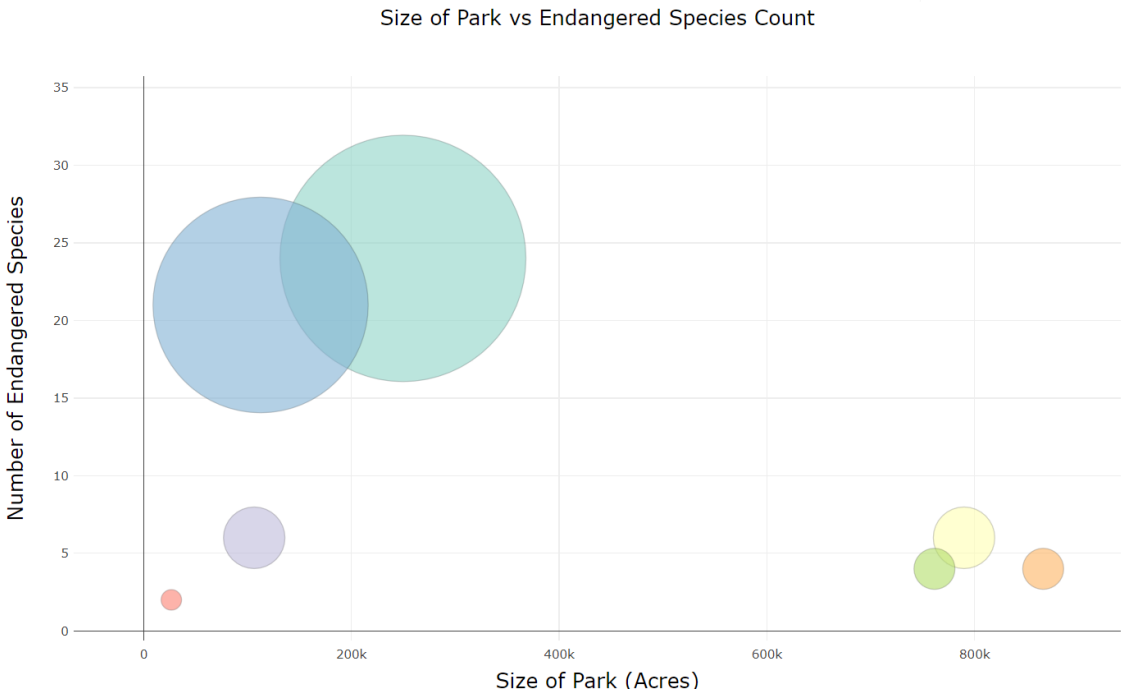
explains endangered status and describes how the user can take action to protect endangered species in the US.

The first graph is a bar chart showing the endangered species count by park. By selecting a state and specifying a minimum endangered species count using the filters, as illustrated in the following image, the chart updates accordingly. Hovering over one of the bars reveals the number of endangered species in and the name of that park. In this example, with a minimum endangered species count of 0, all the parks from the state of California show up in the image. Between this graph and the bar graph on the home page, we can explore which states have the highest count of endangered species in their national parks.



Next, we have a bubble chart that shows the size of each park compared with its endangered species count. The size of each bubble correlates with the value of the endangered species count on the y axis. Hovering over each bubble also produces a tooltip stating that park's name and number of endangered species. Using the same filters as the above example, we can see in the image below that the larger parks in California have fewer endangered species than some of the smaller parks, though not all of them. This is one

example showing that there is not a correlation between the number of endangered species and the size of each park, which answers our third research question.



The last visualization on our dashboard is the National Park Overview table, which details the geographical information for each park. By interacting with the filter, the image below shows data for all of the parks in California, allowing the user to further study size and location while pondering the relationships shown in the graphs above.

National Park Overview

State	Park Name	Size (Acres)	Latitude	Longitude
CA	Channel Islands National Park	249561	34.01	-119.42
CA	Joshua Tree National Park	789745	33.79	-115.9
CA	Lassen Volcanic National Park	106372	40.49	-121.51
CA	Pinnacles National Park	26606	36.48	-121.16
CA	Redwood National Park	112512	41.3	-124
CA	Sequoia and Kings Canyon National Parks	865952	36.43	-118.68
CA	Yosemite National Park	761266	37.83	-119.5

About Us and Resources pages

The last two pages of our website show the contributors to our creation. The about us page lists each of our team members along with links to our GitHub and LinkedIn pages, and it shows a collage of all of our pets, who serve as our inspiration for exploring this data and creating this web application. The resources page has links to the source for our dataset and other websites we used to learn more about our cause.

Conclusions and Limitations

For the most part, the number of endangered species in our national parks has increased over the years. The visualizations on the home page of our website show the states with the highest numbers of endangered species in their national parks as of this dataset's creation in 2016. Using the circle layer of our map and the bubble chart on our dashboard, we found no direct correlation between park size and the quantity of endangered species in each park. Through further research via the resources we listed, we know that national parks provide a safe place for the preservation of these species.

The biggest limitation of our dataset is that the data does not include all of the national parks in the country. National parks missing include Kings Canyon National Park in California, Indiana Dunes National Park in Indiana, Gateway Arch National Park in Missouri, White Sands National Park in New Mexico, New River Gorge National Park and Preserve in West Virginia, the National Park of American Samoa in American Samoa, and Virgin Islands National Park in the Virgin Islands. According to the National Park Service, this research database is always in progress, and "The absence of a species from a list does not necessarily mean the species is absent from a park. The time and effort spent on species inventories varies from park to park, which may result in data gaps" (Larion). Since our data contains a lot of information about the species and parks it includes, we can still gather conclusions using what we have, while knowing that variables such as the parks with the highest numbers of endangered species could change if the data was updated.

Also worth noting is that the national parks do not necessarily include all of the species found in each state, especially for states large enough to encompass different terrains and climates, so our results regarding species per state are inconclusive. We can use the parks as a model of the diversity in each state, but researching actual populations across entire states may be impossible. We also focused our analyses on species categorized as endangered, though our data included other conservation status options such as "threatened" and "in recovery". Including these species in our overall counts per park may give us a more accurate image of the success or failure of conservation efforts around the country.

Future work & Call to action

For future work with this dataset, we suggest continuously updating the data to ensure proper follow-up from future analysts. This should include species counts over time to compare results of conservation programs. The contribution of more variables such as climate data, environmental factors like severe weather events, and human effects on habitats could lead to conclusions about why the species numbers may be changing and lead us toward a plan of action to help preserve specific species.

As an individual user of our website, you can find information about what you can do for conservation of endangered species, including how to support conservation and preservation organizations, in several of the resources listed.

Project deployment: "Biodiversity in US National Parks" web application. https://redrajah13.pythonanywhere.com/

Resources and Works Cited

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