Visualizing the Effect of Global Warming on Wildlife

Team 76

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Objectives

(1) What are you trying to do?

Global warming's negative impacts on wildlife and ecosystems is evident through data that is collected by various government, science, and engineering agencies worldwide [13] [14]. Understanding the impact of global warming on animal species can play a crucial role in predicting endangerment and extinction patterns [3]. Rapid climatic changes impact the range of species [1] [16]. Our project will provide a data visualization tool linking endangerment and extinction data to various climate factors and species interactions[11]. Wildlife enthusiasts and conservationist could use this visually intuitive tool to build the case for treating the root cause of species endangerment and to preserve the larger ecosystem.[2].

Related Work

(2) How is it done today, what are the limits of current practice?

Studying climate change and its impacts have been a popular topic among scientists since the highly cited paper about increasing atmospheric carbon and rising global temperatures was published [4]. Frehner *et al.* proposed the Virtual Database method using advanced web-based data retrieval, analysis, and visualization [7]. Mainly, this method utilizes spatial analysis to understand the ecological data collected in relation to the environment and landscape data. Kernohan *et al.* study and analyze statistical models of animals to understand these animal movements from one place to another [8]. Like the Virtual Database method, this study focuses on the spatial analysis of animal species within the ecosystem. Since the effects of animal movements are not due entirely to global warming, relationships between animal movements and global warming have not really been visualized properly in this study. Similarly, solely relying on Virtual Database retrieval does not seem to help visualize and analyze the effects of global warming on local wildlife.

SOCPROG program by Whitehead *et al.* analyses animal social structures by using network statistics and a few other statistical methods and visualizes certain relationships between social interactions and population dynamics of animal species [9]. The model used by this group does not really help in understanding the effects of climate data but are essential for understanding important factors in ecological data for endangered species.

Morik*et al.* used data mining techniques to retrieve and analyze spatial/temporal data related to the environment for applications of sustainability to local environments and proved that spatial/temporal data are important factors for determining the likelihood of species going extinct [10]. The other study from Elmendorf *et al.* suggest using data visualization and other analytics tools to show how tundra temperature change affects the local vegetation [12]. Sheppard et al. and Neelin et al. also presented visualization to increase public awareness of climate change [15] [17].

Much of the research revolves around refining our understanding of the contributing components and psychological effects of climate change focusing on what species people care about [2] [5] [6]. This tendency to focus on a few species limits the impact of conservation efforts [18]. Our effort, a larger scale visualization of the interdependency between species, ecosystems, and climate can bridge the current limited focus on few species and required systemic view needed for impactful change. Also, most of these papers do not list specific tools used for data collection and visualization. More research is required to find related data between global warming and climate change.

Our Approach

(3) What's new in your approach, why it will be successful?

We aim to overcome the limitations of focusing on one specific species or only one aspect of climate change. We will be looking at various climate data, geolocation data and endangered/extinct species to understand correlations and interdependencies. We plan to collect large data through BISON API, U.S. FWS Threatened & Endangered Species and web crawling/scraping to visualize the endangered and extinct species together with climate change data over a period in a specific region. We can then tie individual endangered/extinct species to the holistic impact of climate change on their ecosystems. Some potential techniques we would like to propose is the use of Python, D3, and SQLite to collect, visualize, and query important relationships between global warming and U.S. wildlife data.

(4) Who cares?

Visualizing and presenting an ecosystem level impact of climate change and its link to species extinction will actualize climate change for many people to whom it continues to feel like a lofty concept, and this may speed up conservation efforts across the US, so we expect to find a significant appetite for this tool with environmentalists and conservationists.

(5) Difference and impact.

If this project is successful, we hope to come up with an intuitive tool for environmentalists and conservationists to reference in their education of the impact of climate change on the broader population of species. For various global regions, we can model the impact of climate change on the ecosystem and tie this to specific endangered or extinct species.

(6) Risks and payoffs.

Risks include sparse data, lack of quality or useful data, and data scraping. The complete data is not available in one place and we might have to stitch data from different sources which is a challenge. Another risk is that many variables related to climate change are interrelated among themselves (auto-correlated) thereby making our analysis harder. Some payoffs include having a method for determining important factors that relate to global warming and animal endangerment, tools for visualization of country data that end-users can understand, and finally, offer a strong start to better models for discussing the relationships between climate change and animal behaviors.

(7) Cost.

The cost will likely be minimal due to the availability of APIs and open source datasets from around the world. Our primary costs will be in labor hours as the scraping and stitching of the data may be difficult.

Plan of action/Duties

Each team member equally contributed to the literature survey, coming up with the proposal drafting/editing and giving feedback on each other's contributed parts. We discussed our project in several online meetings using Microsoft Team. Future duties are divided as follows.

(8) How long will it take?

We plan to do the project in 6 weeks.

Week 1 (March 3 - March 10)(Qixuan, Karthik, Archit)

- Collect weather data
- Write script for web crawling endangered species data

Week 2 (March 11 - March 18) (Karthik, Prashant, Archit)

- Data cleansing
- Explore and design visualizations

Week 3 (March 19 - March 26)(Justin, Qixuan, Man)

- Use various data analysis such as regression, time series and other machine learning techniques.

Week 4 (March 27 - April 3) (Everyone will contribute)

- Design and build interactive visualizations, graphs of the result.

Week 5 (April 4 - April 11)(Man, Justin, Prashant)

- Write the report

- Design the poster
- Work on slides for the project

Week 6 (April 12 - April 19)(Everyone will contribute)

- Work on project presentation videos individually

(9) What are the midterm and final "exams" to check for success? How will progress be measured.

The midterm specifically would include sample data collection, basic visualization using Tableau, SQLite, and Python. The final would include D3 representations using heatmaps, choropleth maps, and some bar graphs so that uninitiated user is able to employ the tool to better understand the linkage between climate change and species level impact. Progress will be measured by surveys and ease of understanding for those visualization techniques.

Contributions

Each participant equally contributed to the literature survey and everybody is actively involved in data exploration, collection and cleaning.

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