Conserving Cave Species

End of Project Report

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Project Summary

No one has synthesized the available data on the conservation status of subterranean cave species in the past 20 years. Because of this, the Sewanee Datalab has partnered with Dr. Kirk Zigler, who is interested in researching cave species biodiversity across North America. Working with Datalab and Dr. Zigler, the goal of this project will be to obtain the available data on a specific list of subterranean cave species and analyze them to highlight trends among different species of varying endangerment in different locations of North America. The final product of this project will be an interactive dashboard with an undecided long-term use, along with an academic paper that will be written following the conclusion of the data lab and the results that came from it.

Background

Recently, reviews have been done on the biodiversity of certain cave species in the United States and Canada. Niemiller et. al (2019) published a paper that includes Troglobionts (terrestrial obligate cave species), the particular species that we are interested in, noting that this species, along with stygobionts (aquatic obligate cave species), make up more than 50% of the imperiled United States fauna that is tracked in the central databases of the Natural Heritage Program. Along with this, Niemiller et. al (2019) states that 71% of troglobionts and stygobionts are of conservation concern and at a risk of extinction based on NatureServe criteria.

NatureServe criterion is a key to understanding how at risk a given species is. Niemiller's work begins with a literature review discussing the challenging environment of caves and associated subterranean habitats in karst and non karst terrain areas. These environments have caused parallel and convergent evolution of many characteristics and traits of these species. Parallel evolution refers to independent species acquiring similar characteristics by evolving simultaneously while also in the same environment. In relation to parallel evolution, convergent evolution occurs when the descendants of a certain species resemble each other even more than their ancestors did. The main factors of these types of evolution for the cave species are the complete absence of light and limited food resources. This evolution has also caused a change in how we see these subterranean cave species as they lose their pigmentation from the lack of light, making them almost see-through.

NatureServe

"NatureServe is a nonprofit organization that provides the scientific bases for effective conservation action. NatureServe and its hemisphere-wide network of natural heritage programs are the leading sources of information about rare and endangered species and threatened ecosystems" (NatureServe 2012). NatureServe is a database we have used to gather the data to form our dataset for this project. They provide a wide variety of information on each species, including global and regional status, which are extremely important for gauging the current state of a species. Even with the importance of these ranking systems, NatureServe has discussed possible issues with the system. "It is important to remember, however, that regardless of improvements to the assessment method and use of the rank calculator, resulting calculated ranks are only as good as the quality of information used to assign ratings to the underlying individual

status factors"(NatureServe). Of course, it would be impossible to have a completely accurate method to rank subterranean species, so NatureServe continues to be one of the most, if not the most, valuable resources regarding data on cave species. Their global status ranking system is as follows: G1: Critically imperiled, G2: Imperiled, G3: Vulnerable, G4: Apparently secure, G5: Secure. Along with those five rankings, NatureServe has others, including GX, GH, GNR, and GU, for presumed extinct, unranked, or unrankable species.

Previous Projects

This project will not necessarily be one of a kind, but it will address vulnerabilities and conservation of cave species in greater detail than other previous works, such as Neimiller's paper, that were discussed above. While NatureServe is providing our data that is already available on the internet, it is only raw data that lacks some aspects of analysis, including grouping the species by taxonomic categories and comparing their risk as a whole across the United States and Canada.

Client Perspective

No one has specifically synthesized the available conservation data for North American cave species over the past twenty years. While this is the case, the website Nature Serve is periodically updated with information on various species' topics, such as regional status, global status, range extent, and taxonomic data, which I hope to compile into a data set for analysis. In

fact, this is what I aim for this project to succeed in doing; synthesizing and analyzing conservation data for 1200 species or more of cave animals from within the United States and Canada.

What I see as an end goal for this project is using the data that would be collected and analyzed to write an academic paper covering the topic of the conservation status of cave species across North America. Through collecting this data, I hope to explore and find many different trends that serve a purpose even further than an academic paper. It is uncertain at the moment, but I am open to ideas in which one would be building an interactive dashboard that displays any trends or maps of the data that we collect in hopes that this could possibly be used as a database for conservation data to be used by but not limited to Sewanee students and Professors in the future.

I am extremely interested in this field and have a strong passion for conserving the biodiversity of cave species and aim for the product of this research to support conservation planning by highlighting species in need of conservation and as well as regions with high numbers of imperiled cave species.

Data Description

Caves Dataset

- 10 Columns, 1628 Rows
- Species
    - This column contains every species that was gathered from the API on NatureServe (Original list from Niemiller 2019)
- Common Name

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    - ■ This column gives the common name for each species that was pulled from NatureServe
  - ○ Kingdom
    - ■ Taxonomic description
  - ○ Phylum
    - ■ Taxonomic description
  - ○ Class
    - ■ Taxonomic description
  - ○ Order
    - ■ Taxonomic description
  - ○ Family
    - ■ Taxonomic description
  - ○ Global Status
    - ■ This column contains a global status for each species varying from G1: Critically Imperiled all the way to GU: Unrankable
  - ○ Region
    - ■ This column gives the region in which the species is located
  - ○ Region Status
    - ■ This is a similar criterion to Global Status but only applies to the region/state so that the rankings may vary from the global status

The purpose of this dataset is to be used for analysis to see trends in which region/species/family is the most at risk or secure. After finding these trends, the dataset should be used to generate graphs/tables that can be inserted into an academic paper that will be written on the topic that encompasses all of the data.

Product/Outcome

Thus far, all of the project's outcomes have been variations of maps, tables, and bar plots that will be included in the final academic paper. Along with these visualizations being used for a paper in the future, we also built an interactive dashboard to display different trends that we observed throughout our research.

Cave Species in NatureServe (G1-G5, 94%)

3% 3% 11%

Global Status
- G1: Critically Imperiled
- G2: Imperiled
- G3: Vulnerable
- G4: Apparently Secure
- G5: Secure

17%

66%

Cave Species Global Status

Number of Species

716

600

400

200

183
119
37
36
6
72
1
3

G1: Critically Imperiled
G2: Imperiled
G3: Vulnerable
G4: Apparently Secure
G5: Secure
GH: Possibly Extinct
GNR: Unranked
GU: Unrankable
GX: Presumed Extinct

Global Status

Figure 4. Shown on the map is the geographical distribution of G1: Critically Imperiled Species.

These visualizations that are included on the interactive dashboard were used to highlight specifically how many endangered cave species are currently at risk, as well as to evaluate the specific high-density areas of the United States that are contributing the most to the level of Critically Imperiled subterranean cave species. The data that has been analyzed and the visualizations created will be seen in the academic paper written in the fall of 2022.