Conserving Cave Species

Fellow
Carter Trapeni
The University of the South

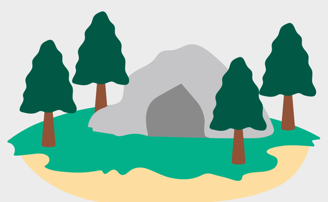
Mentor
Matthew Rudd
Chair and Professor of Mathematics

Partner
Kirk Zigler
Professor of Biology

Cave Species

Introduction

Animals restricted to caves are one of the planet's most imperiled groups of organisms. In spite of this, the available data on the conservation status of cave species across the United States and Canada have not been synthesized for over 20 years. The importance of this issue lies in the possible detrimental effects on an ecosystem following the extinction of a species.



Our project partner Dr. Kirk Zigler, a professor of biology at Sewanee, has a special interest in cave species conservation and has previously completed research in this area. In collaboration with Dr. Zigler, this project aims to analyze the available data on the conservation status of cave species in order to highlight specific species and regions that are the most endangered.

Approach

Knowing that NatureServe, a non-profit organization dedicated to species conservation, contains all current cave species data, our approach to this issue was to first use an API to harvest this data. We plan to take an exploratory approach to the data and hope that analyzing this data will allow us to find trends in different variables including region, global status, and taxonomic data. We aim to use these trends and visualizations to produce a dashboard that will serve multiple functions including general public education.

Data

NatureServe has allowed us to use an API to obtain all current cave species data which includes rows representing over 1100 unique cave species obtained from previous research.

NatureServe is a crucial repository of varying types of species conservation information, which is done by a long process that begins with receiving notice of a species spotting and ends with being updated to the NatureServe explorer with various descriptions such as global status. The data collected was formatted into a dataset that took little to no cleaning before use. Along with the dataset containing the variables below, a second dataset was made that includes a record of every single endangered species in NatureServe, excluding cave species for comparison.

Variables

- Species
- Common Name
- Kingdom
- Phylum
- Class
- Order
- Family
- Region
- Global Status
- Regional Status
- Range Extent
- ESA

Conservation Status [G1,G2,G3] at risk

G1: Critically Imperiled	**Very high** risk of extinction or elimination
G2: Imperiled	**High** risk of extinction or elimination
G3: Vulnerable	**Moderate** risk of extinction or elimination
G4: Apparently Secure	**Fairly low** risk of extinction or elimination
G5: Secure	**Very low** risk of extinction or elimination

Method

In using data that is available to the public, it is important to understand what is already known, along with what has already been seen. NatureServe provides details on each specific species while our approach was to collectively compile this data to find noticeable trends that have not been analyzed before. Visualization is an extremely important aspect of highlighting important differences, which we plan to capture when comparing cave species alone to all other species recorded in NatureServe.

We used R programming to analyze the dataset, produce these visualizations, and ultimately format them into an interactive dashboard to provide new insights to the general public on the current status of cave species. An interactive dashboard was chosen for its multiple uses of educating, highlighting important trends, and flexibility for other cave species researchers who may not be experienced with data science.

All of these elements together will be components in writing an academic paper that will outline important data showing the immediate need for attention in multiple regions of North America regarding endangered cave species.

Visualizations

- Map (States most densely populated with cave species at risk (G1-G3))
- Charts (Cave species vs. Non-cave species available in NatureServe)
- Map (Breakdown of taxonomy to highlight specific families that are at greater risk)

Results

When considering the conservation status of cave species, we grouped ranks G1-G3 together to label them at risk. Next, we wanted to analyze how cave species endangerment compares to the endangerment of all other species that are recorded in the NatureServe (G1-G5) database. We found that **30%** of all non-cave species in NatureServe are at risk of extinction (Figure 1). Comparatively, **94%** of the cave species within G1-G5 rankings lie within the G1 to G3, labeling them at risk for extinction or elimination (Figure 2). This finding is eye-opening to the current danger cave species face and prompted us to dig deeper into the percentage at risk (Figure 3).

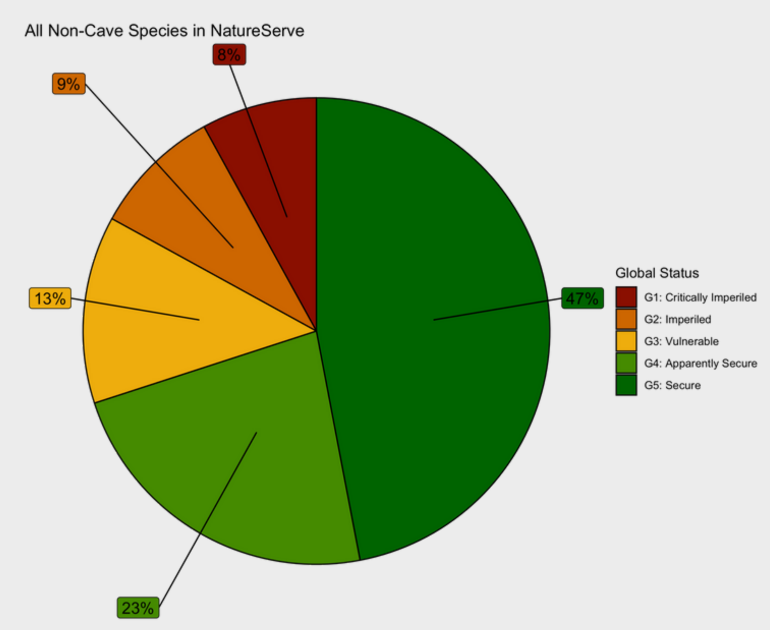


Figure 1. Conservation Status of all non-cave species from NatureServe (only G1-G5).

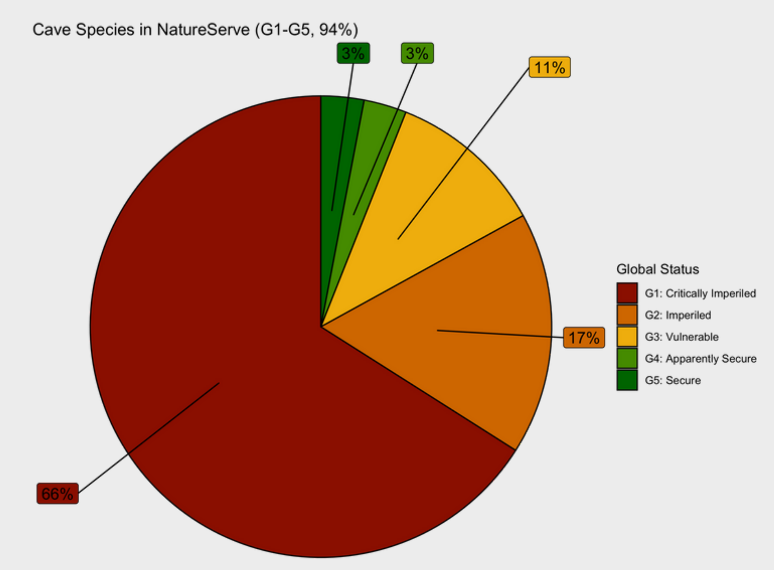


Figure 2. Conservation Status of cave species from NatureServe (only G1-G5).

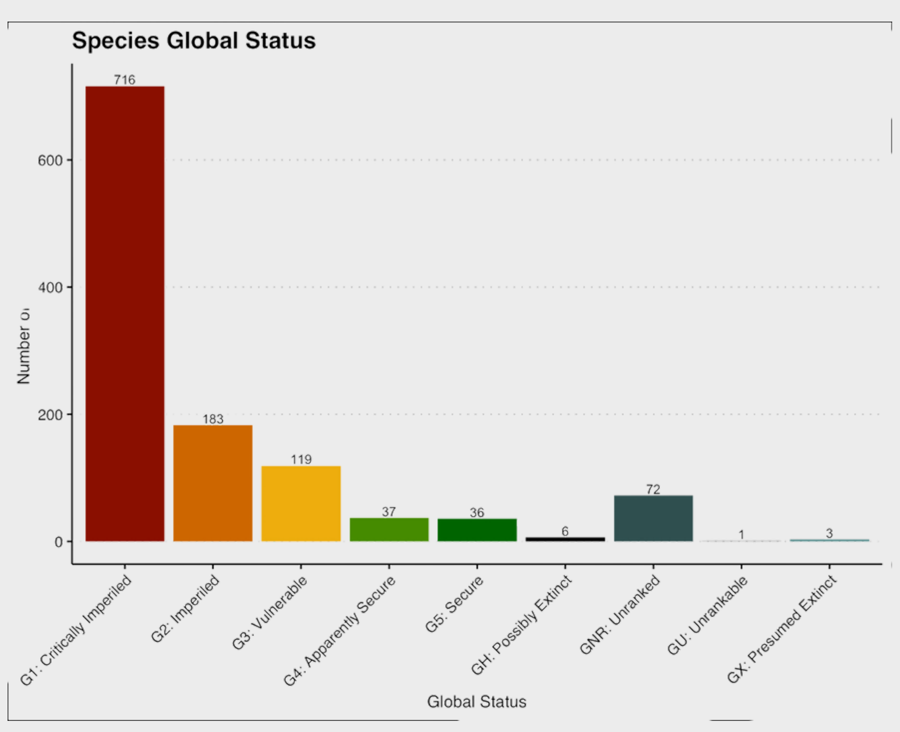


Figure 3. Conservation Status of all cave species from NatureServe (G1-GX).

Looking at the conservation status (Figure 3) of all cave species that were taken from NatureServe, it is apparent that attention is needed to the astounding ratio of cave species that are at risk, compared to those that are apparently secure (G4) and secure (G5). This graph highlights how vulnerable these species are. It also leads to the question of how many others in this condition are not receiving attention, as the number of unranked (GNR) species is approximately equal to the number of combined secure species.

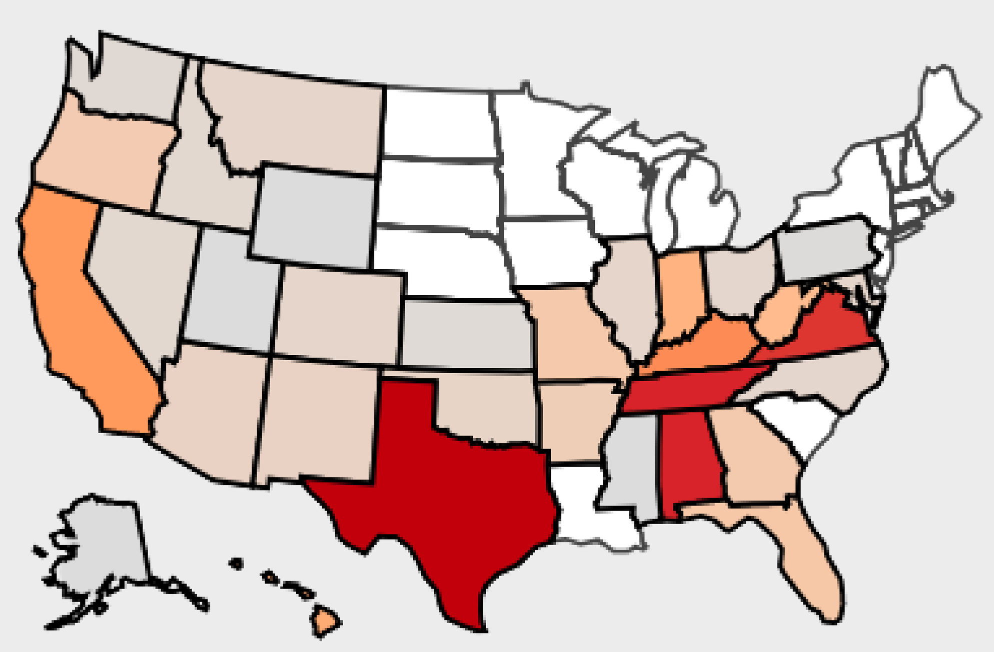


Figure 4. Shown on the map is the geographical distribution of G1: Critically Imperiled Species.

Arguably the most important visualization we have from analyzing this data is the geographical distribution of all 716 Critically Imperiled species seen in figure 3. Alabama, Tennessee, Texas, and Virginia are clearly states that are currently in need of the most protection as each has **at least 85** species at a very high risk of extinction or elimination. Without even looking into G2 and G3 species, there is a clear path where future researchers and cave species conservatives need to focus their attention.

Impact

With this project's completion, we hope its impact spreads in many different directions. First, our immediate plan is to take the trends that we have gathered and use them to write an academic paper that will summarize our findings and contribute to everything currently known about cave species' conservation status.

Secondly, we hope that the interactive dashboard that has been created will be used by others for education, cave species endangerment awareness, and even by other researchers in the future who are hoping to make a difference in conserving cave species.

After publishing the academic paper and launching the interactive dashboard, our goal is that the information provided in both is unique to this topic and brings new insights while highlighting the importance of subterranean cave species that have been ignored for too long.

Along with reaching a greater audience, we have contacted NatureServe to collaborate on our findings with the possibility of using these methods for many different types of species.

This work was completed with Sewanee DataLab during summer 2022 at the Universtity of the South. https//datalab.sewanee.edu