Sociotechnical Synthesis

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Samuel Veliveli

Fall 2024

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Kathryn A. Neeley, Associate Professor of STS, Department of Engineering and Society

Table of Contents:

Samuel Veliveli

Kathryn Neeley

11:00-12:15

Sociotechnical Synthesis

(Executive Summary)

Understanding How Competitive Culture Prevents Collaboration in Conservation

Conservation efforts with regard to invasive species removal are endeavors that must be done effectively and efficiently. Researchers and scientists are often running a race against time to protect ecosystems and the native species they hold. The effort to remove the Burmese Python in the Florida Everglades has been a long and arduous process. As a result, native species in the Everglades have seen drastic declines in population. My STS research focused on why python removal efforts have been ineffective and slow so far. I hypothesized that current removal techniques may be outdated and small-scale, so the technical side of my research focused on employing machine learning techniques to aggregate python location data to find hotspots of python travel and activity. While there was some evidence that removal techniques were outdated, a far larger problem I discovered using Geels' multi-level analysis was a competitive culture between private and public entities involved in invasive species removal. A lack of resources with regards to funding and competition for notoriety has contributed to a slowing down of progress with regard to removing pythons in the Everglades.

My technical research focused on ways python removal techniques were outdated. Past efforts included going out into the Everglades and trying to locate pythons manually and

rewarding citizens for removing and killing pythons. With the way the python population was exploding in the Everglades, these efforts simply were not sustainable long-term. I proposed using existing data with regard to the pythons' location and funneling it into machine learning algorithms that specialize in discovering underlying patterns within datasets. An example of such algorithms includes k-means clustering, an unsupervised learning algorithm that finds averages within clusters of data. My research focused on employing this algorithm with geospatial data (coordinates of python locations) to find hotspots for python activity. The goal of this technical research was so researchers could concentrate their efforts and resources on hotspot locations rather than trying to manually locate and capture pythons.

While there were technical challenges in the python removal effort, my instructor encouraged me to use Geels' multilevel analysis to discover further problems in the python removal system beyond the technical. As I looked at the regime, landscape, and niche levels of this system, it became clear that there was a lack of resources for funding and competition for notoriety and acknowledgment in all 3 levels of this system. This lack of resources and competition created a culture of isolation between the various organizations involved in the removal effort such as government organizations (Florida Fish and Wildlife Commission) and private universities. It became clear that there was a rift between the python removal effort between public and private entities. Because of this, I researched cases in the past where private and public entities were able to work together to successfully remove invasive species. I came across an interesting case in the 1950s with the Sea Lamprey Control Program. The government and private sector came together to remove lampreys in the Great Lakes. The key method to collaboration was the governments' willingness to seek help from private organizations who

were more advanced technically. This framework of combining technical resources and a culture of humility and collaboration is something that I believe can be applied to the python removal effort.

What I gained most from a sociotechnical perspective is the realization that insights are not at the surface. In my research, I could have simply said that a lack of modern techniques and technologies is why the python removal effort was ineffective. However, incorporating a sociotechnical research perspective allowed me to discover hidden relationships that were not present at the surface. The biggest challenge we face as engineers is to understand why things are the way they are, and that is something that goes far beyond a technical perspective. Sociotechnical research allows us to find insights that go beyond the technical perspective and give us a holistic view of the problem.