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University of North Texas-Using Trait Mining to Create Heuristic Food Webs

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Internship Title: Using Trait Mining to Create Heuristic Food Webs

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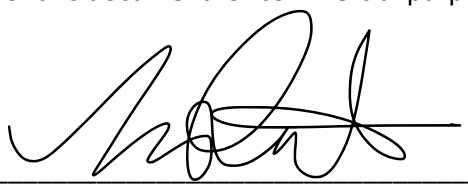
STUDENT SIGNATURE 

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Using Trait Mining to Create Heuristic Food Webs

Madison Peters – Western Washington University
Internship Supervisor – Zacchaeus Compson
Data collected by Morgan Bucher and Zacchaeus Compson – University of North Texas

Introduction

I was fortunate enough to work with Zacchaeus Compson and his graduate student, Morgan Bucher, at the University of North Texas for the past six months. The main objective of my internship was to assist in data mining for Morgan's graduate thesis and to create a project from the data that is pertinent to my own studies. Morgan collected ecological data from around the country at various National Ecological Observatory Network (NEON) streams, which are founded and maintained by the National Science Foundation. The data collected included macroinvertebrates and fish in the wadable NEON streams. Morgan then identified the family, genus, and species of each organism they collected, if possible, and entered them into a spreadsheet for a team to analyze.

The trait-mining team, the team I am a part of, is tasked with data mining to find information about each of the organisms that we will then turn into heuristic food web models. Once the models are created, we will be able to identify the key drivers and the functionality of the food web. After creating the models, we will be writing a published paper to present at a conference.

Trait Mining

Once the data was input into the spreadsheet, my team and I started the data analysis. There were approximately four hundred entries to analyze. The data mining we performed was specifically called trait mining, which is the process of using a literature search to identify the tropic information for a specific organism. This data is important when building food webs because it helps expand the chain of connections from the abiotic systems into the biotic.

To start off the trait mining, each organism was entered into the Global Biotic Interactions Network. GLOBI is an expansive source of trophic information that is used to identify organisms and their place in food webs. To create a strong basis for the heuristic food webs, three strong pieces of evidence about the food types were needed. Additionally, we remarked if the organisms were feeding on specific things in the larval or adult phase. This is important because many macroinvertebrates do not feed as adults, but the adults may need to be included in the food web as a food source for another organism.

If there was no data about the specific organism in the GLOBI network, a Boolean search was used to find credited papers that detailed the functional feeding group of the organism and the specific food(s) that the organisms consume. The Boolean search we used was:

"[Family]" AND "[Genus]" AND "[Species]" AND "feed" OR "consume" OR "prey"

The first twenty results from the Boolean search were read and any information concerning the functional feeding group or feeding of the organisms was recorded. The sources were also cited in order to reference later when creating the heuristic food webs. If no discernable information was available in the first twenty results, the organism is noted as incomplete.

A second round of trait mining was done to fill out the missing information, focusing on the functional feeding group of the organism. If no information on the specific species is available, the feeding habits of the species' genus is considered, as many macroinvertebrates have not had their feeding habits researched specifically. Once all of the organisms had trophic information, Morgan is able to utilize the data for her thesis. Additionally, my team and I are able to begin our project building and comparing heuristic food webs.

Heuristic Food Webs

A heuristic food web is a food web that is created from collected data, instead of theoretical data. Creating heuristic food webs can help deepen our understanding of an ecosystem because it shows the actual food web at a specific place and a specific time compared to a theoretical food web. It is important to understand the interconnectedness of an ecosystem because, as our world is everchanging with anthropogenic influence, organism presence shifts. The NEON streams are protected by the National Science Foundation and are meant to represent a "natural" ecosystem with limited human influence. That makes these streams ideal for recording and studying the impacts of climate change on natural ecosystems.

The purpose of the heuristic food webs is to understand the key components and functions of the ecosystem as a whole. Additionally, we will be comparing this data to previous data from the NEON streams and identify they key drivers of the food webs.

Impacts on my Education

Throughout this experience, I was able to connect with the lab group at the University of North Texas who are all working for Morgan or using Morgan's data for auxiliary projects. There are two groups that are using the data: the trait mining group and the metabarcoding group. I am working with two others on the trait mining and heuristic food webs, and the others in the lab group are working on metabarcoding. At the start of this internship, one of my main goals was to connect with other scientists and students who will help me grow into my career. I have successfully created a network of peers and advisors that I can turn to for questions or guidance as I enter my career. Additionally, I am able to reciprocate and be a helping hand for my peers as they are graduating and moving into their careers as well.

The second goal I set for myself at the beginning of this internship was to connect the work I was doing in trait mining and heuristic food webs to forestry and soil science, my passion at the time. My career goals have changed since I made this goal, but I do believe I am still able to translate trait mining to this field. I am planning on pursuing a career in soil toxicology, focusing specifically on emerging contaminants. I am also considering a graduate program focusing on the research of micro- and nanoplastics. Trait mining and heuristic food webs are a large part of tracking bioaccumulation and bioamplification of contaminants in organisms. The source of

many contaminants, like microplastics, is water or soil. Both of which are key components of the heuristic food webs made this data.

Lastly, I was able to take the knowledge that I learned in class, specifically ecology and the movement of nutrients through a trophic food web. I was also able to watch the main ideas of biology be implemented in data collection and analysis. I now have a true understanding of how previous knowledge of something like theoretical food webs can be built upon and expanded to discover new ideas.

Future Work

Luckily, the end of my formal education does not mark the end for this internship for me. I am continuing to work with my team to finish the trait mining and creation of the heuristic food web models. The list of organisms is still expanding as Morgan identifies more of the specimens, which will add more layers to the heuristic food webs. When all of the data is fully collected and analyzed, my team and I will be authoring a research paper to send to a publisher.

The main goal my internship supervisor had for my team and I was to present our techniques and findings at a conference. We will be accomplishing this after we start writing the final paper and we will hopefully be presenting at a national conference next year. I am excited to finish this research and apply the knowledge I have gained, both at Western and through this internship, to my future career.