Title of Your Paper Goes Here

Identifying Key Species in a Food Web using Network Analysis

Yadder Joshua Aceituno González
Maastricht University
Network Science

December 6, 2025

Abstract

Food webs represent the trophic interactions among species within an ecosystem. This paper investigates methods for identifying key species using network analysis tools such as centrality metrics, trophic levels, and structural importance. We apply these methods to a dataset obtained from iNaturalist to highlight the role of influential species within the community.

1 Introduction

Food webs describe who eats whom in an ecosystem. Identifying key species helps ecologists understand ecosystem resilience, stability, and energy flow.

This paper explores network-theoretic methods to detect influential species, such as:

- Degree centrality
- Betweenness centrality
- Keystone species detection
- Community structure

2 Background and Related Work

Provide ecological background: trophic levels, predator-prey dynamics, ecological networks.

Cite prior work on network analysis in ecology.

3 Dataset

The data used in this paper comes from the iNaturalist project "Who Eats Whom". This project collects predator and prey interactions that are uploaded by active users in the iNaturalist community. To access the dataset, it is necessary to create an account on the platform.

In total, the project contains nearly 13,000 observations, where each observation represents an interaction between two species, one acting as the predator and the other as the prey.

Before downloading the dataset, iNaturalist allows users to select the features they want to export. For this paper, we downloaded the following fields:

- Observation ID
- Scientific name of the species
- Common name of the species
- Taxon name
- Interaction type (whether the species is eating or being eaten)
- Partner species ID

Because the dataset does not provide much biological information beyond taxonomic identifiers, we created a script that queries the Gemini API to gather additional ecological attributes for each species. The information requested from the API included:

- Average weight of the species
- Average size of the species
- Diet classification (herbivore, carnivore, omnivore, insectivore)
- Average life span
- Typical habitats
- Continents where the species is commonly found

The original dataset from iNaturalist was mainly used to construct the food web and perform the first exploratory analyses. The augmented dataset, enriched with biological features from the Gemini API, allowed us to train a Graph Neural Network (GNN) that helped predict potential missing links in the food web. The details of this model and its performance are described in later sections.

4 Methods

Explain the network modeling approach:

- Directed/undirected representation
- Weighted or unweighted interactions
- Defined metrics: degree, betweenness, PageRank, etc.

Optionally include equations:

$$C_B(v) = \sum_{s \neq v \neq t} \frac{\sigma_{st}(v)}{\sigma_{st}}$$

5 Results

Include figures:

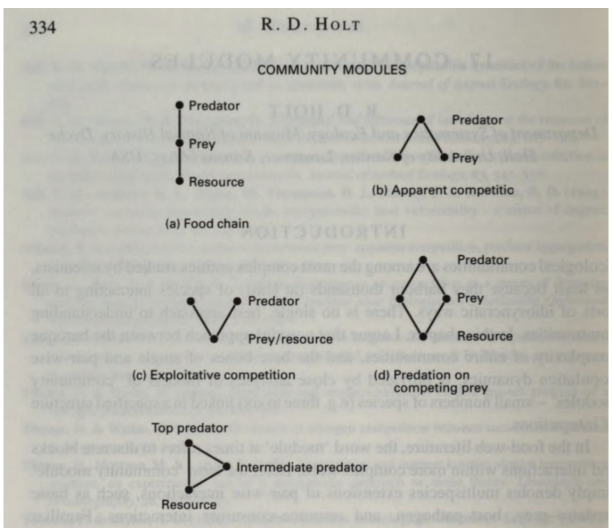

Figure 1: Community modules.

Summarize key findings:

- Which species are most central?
- Are there keystone species?

6 Discussion

Interpret the results:

- Ecological implications
- Limitations of the dataset
- Whether centrality = ecological importance?

7 Conclusion

Summarize your goals and findings. Suggest future work, dataset improvements, or validation with field ecology.

Acknowledgments

(Optional) Thank advisors, data providers, open-source tools.