Patterns in Introduced Species Dispersal

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Some Background

- An introduced species is simply a species that exists in a specific location and is non-native
- There is disagreement about what exactly qualifies a species as “invasive” but it most often refers to introduced species that adversely affect the habitats and bioregions they invade
- Approximately 42 percent of threatened or endangered species are at risk due to invasive species.
- The US spends about $120 billion each year fighting the impacts of invasive species
- Globally, that number is about $1.4 trillion

The Cane Toad

- Introduced around the world in an attempt to control sugar cane eating pests
- Lack of natural predators, a voracious appetite and incredibly fast breeding have caused it to thrive
- One of the most hated pests in Australia
- Widespread introduction catalyzed by a scientific paper written by Raquel Dexter in the 1930s (my great grandmother)

The Cane Toad (*Rhinella marina)*

Cane Toad Infested Countries

American Samoa, Anguilla, Antigua and Barbuda, Aruba, Australia, Bahamas, Barbados, Belgium, Bermuda, Canada, Dominican Republic, Egypt, Fiji, Germany, Grenada, Haiti, Jamaica, Japan, Marshall Islands, Mauritius, Micronesia, Palau, Papua New Guinea, Philippines, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Solomon Islands, Spain, Taiwan, Tuvalu

Project Goals

- Identify dispersal patterns in invasive species
- Try to link causation to the patterns
- Identify country-level factors that make a particular country susceptible to invasive species

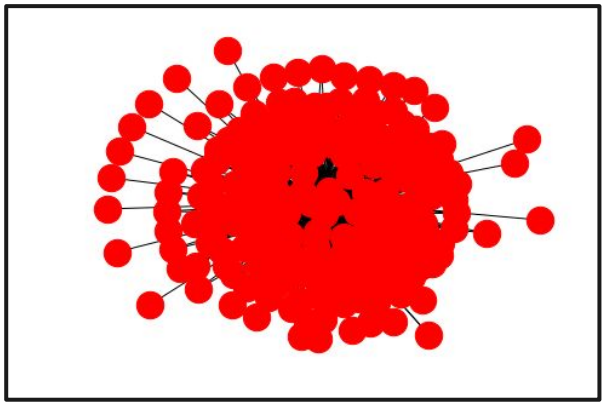
Data Sources

- The Global Register of Introduced and Invasive Species
- The CIA World Factbook
- The Catalogue of Life

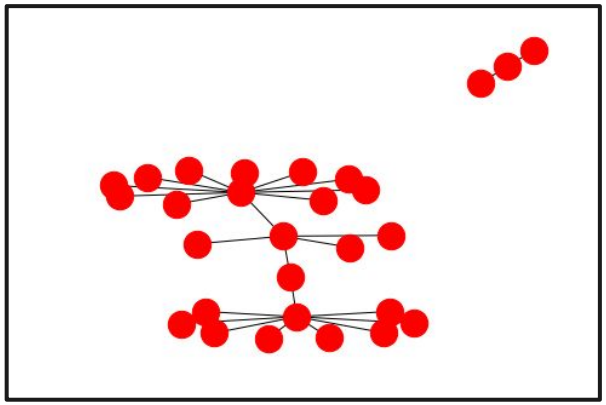
Process

- Preliminary data cleaning to identify origin countries of species
- Used the readily available regarding the current location of invasive species to track the ‘species invasion’
- Used NetworkX to visualize the graph
- Used the Community Package to implement the Louvain Method of Community detection

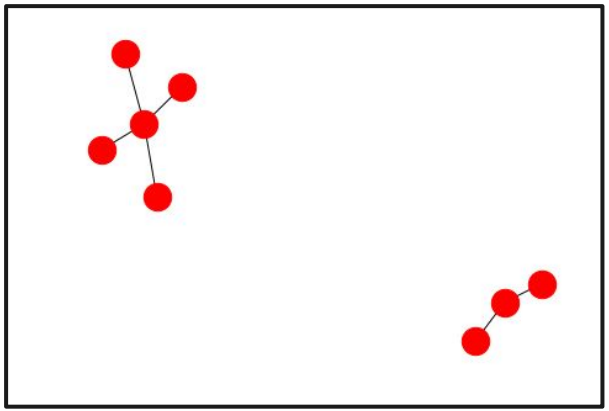
Initial NetworkX Graphs



All Connections



5 Connections

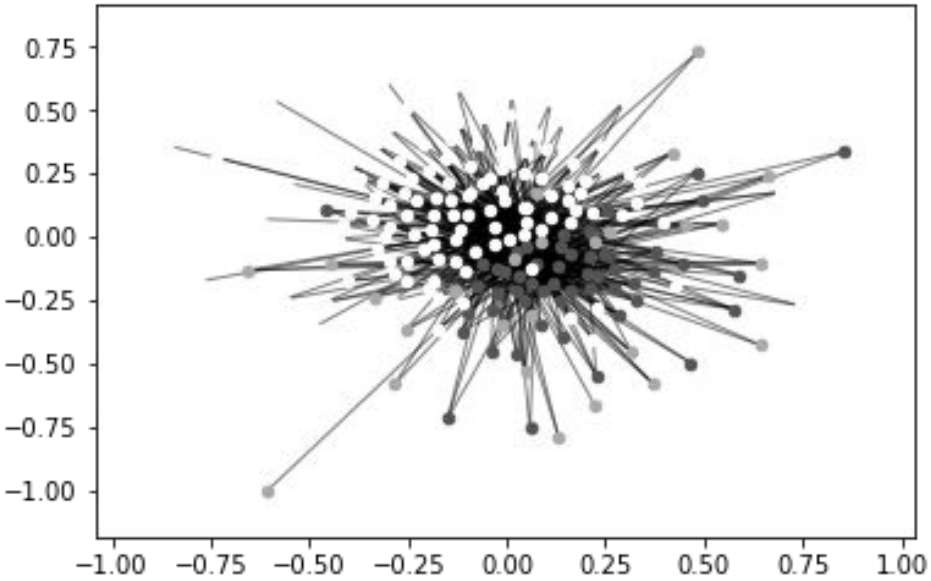


10 Connections

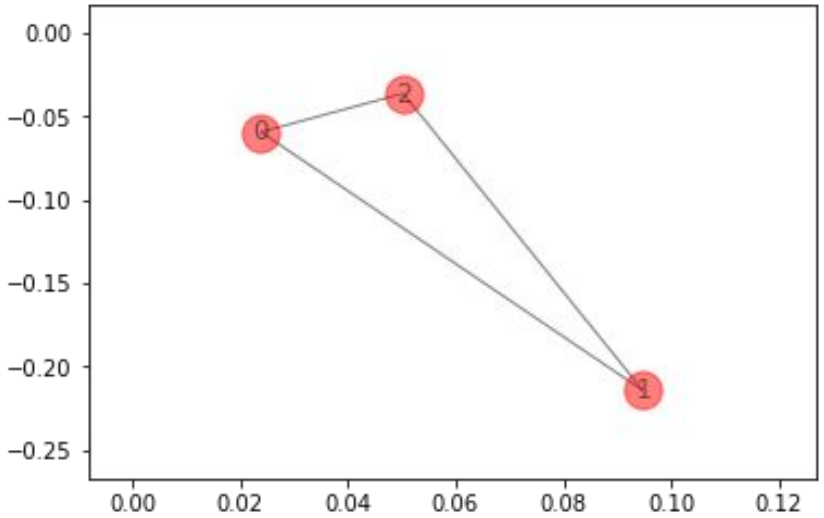
The Louvain Method for Community Detection

- Seeks to maximize the modularity score
- Modularity is a scale value between -1 and 1 that measures the density of edges inside communities to edges outside communities.
- Optimizing modularity could theoretically give you the best possible community grouping within a network, however, it is computationally intensive
- The Louvain method iteratively optimizes local communities until global modularity can no longer be improved given perturbations to the current community state
- Implemented in Python through the Community Package

Community Partitioned Graph

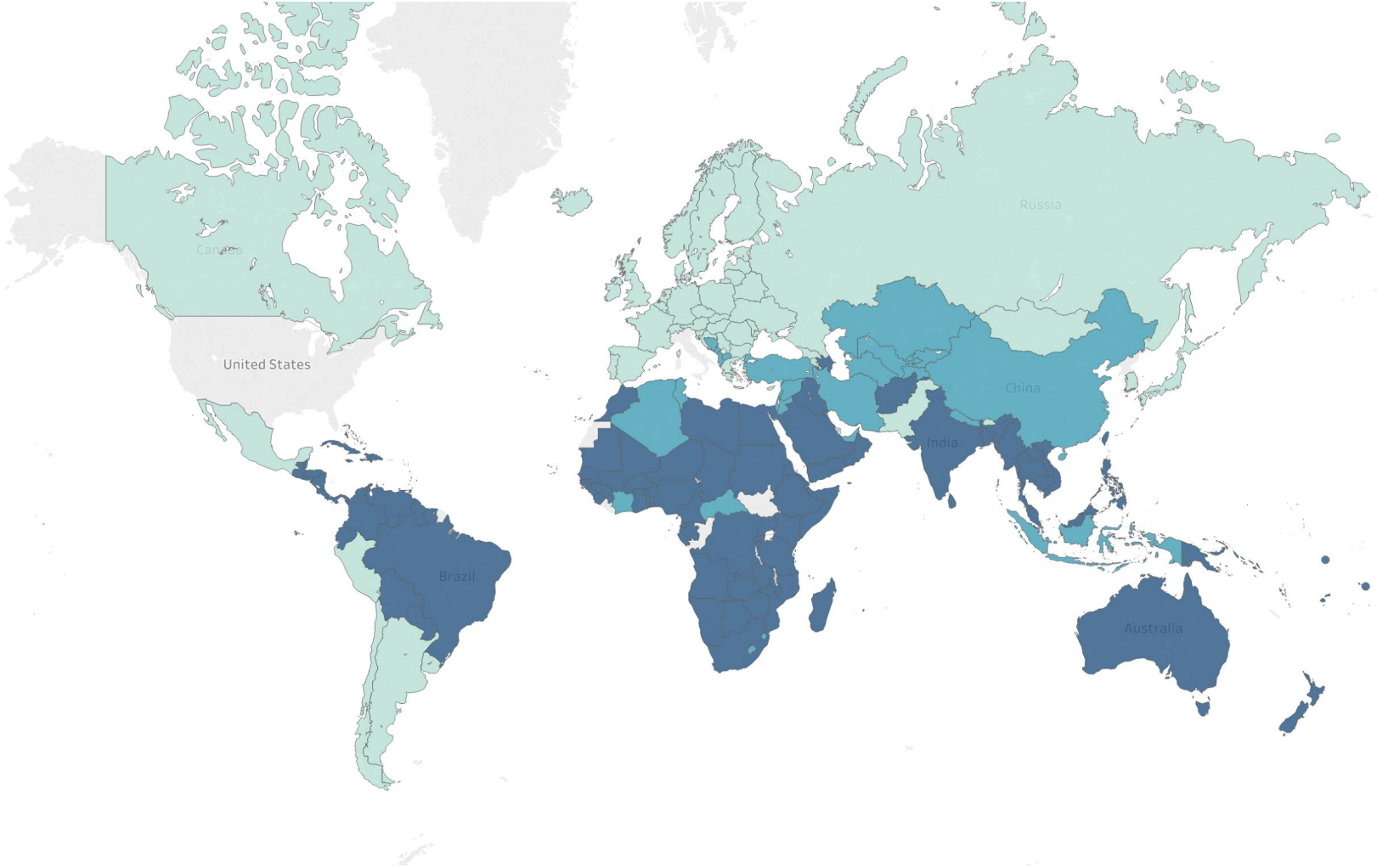


Communities as Nodes



“Not particularly useful”

- *Matt Brems, 2018*


Russia
United States
China
India
Brazil
Australia

- Community analysis of the network yielded a modularity score of 0.194
- Better than you would expect at random, however not particularly impressive

Next Steps

- More data cleaning!
- Whether or not the modularity score improves as I am able to add more data to the network should be telling
- Use the country level data from the CIA world factbook to identify trends in the identified communities