Bird Network

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Here's a Little Refresher

Our Subnetwork

Birds that live in:

- Habitat: Open Ocean
- Region: All

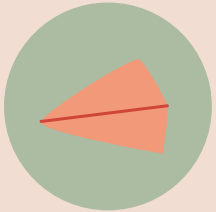
108 Total Birds

Nodes: Bird Species

Weighted Edges: Shared Traits

Analyzed Traits

- Conservation Status
  - Endangered, Vulnerable, Near Threatened, and Least Concern
- Size
- Main Color
- Behavior
- Beak
- Feet
- Call Pattern
- Call Type
- Tail
- Wings
- Legs
- Flock



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Features

Network Features

Network Diameter: 4

Average Degree: 29.741
Average Weighted Degree: 404.778

Graph Density: 0.278

Network Features

Average Clustering Coefficient: 0.609

Modularity: 0.263

Resolution: 0.75
New Modularity: 0.144

Average Path Length: 1.824

Betweenness Centrality

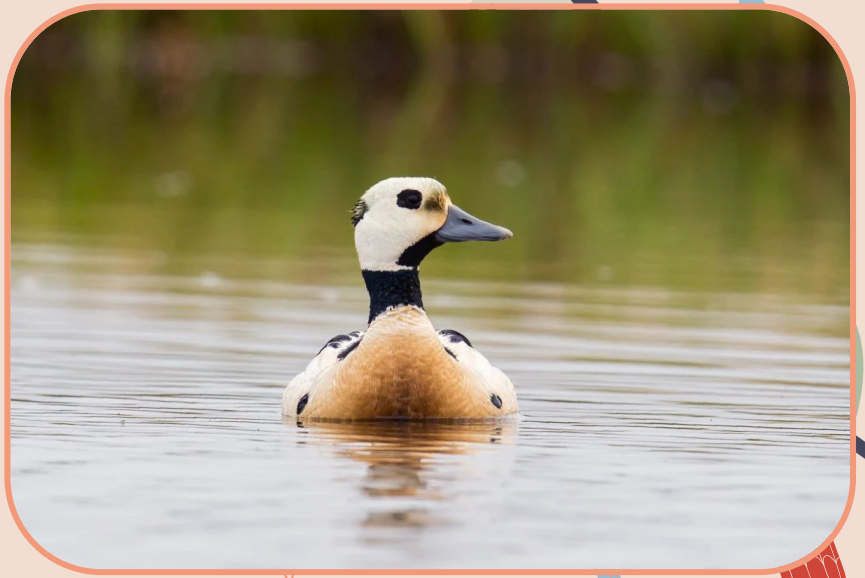
Top 5 Birds:

- Red Phalarope
  - Least Concern
- Pink-Footed Shearwater
  - Vulnerable
- White-tailed Tropicbird
  - Least Concern
- Cory's Shearwater
  - Least Concern
- Great Shearwater
  - Least Concern

Closeness Centrality

Top 5 Birds:

- Pink-footed Shearwater
  - Vulnerable
- Red Phalarope
  - Least Concern
- Steller's Eider
  - Vulnerable
- Leach's Storm-Petrel
  - Vulnerable
- Cory's Shearwater
  - Least Concern



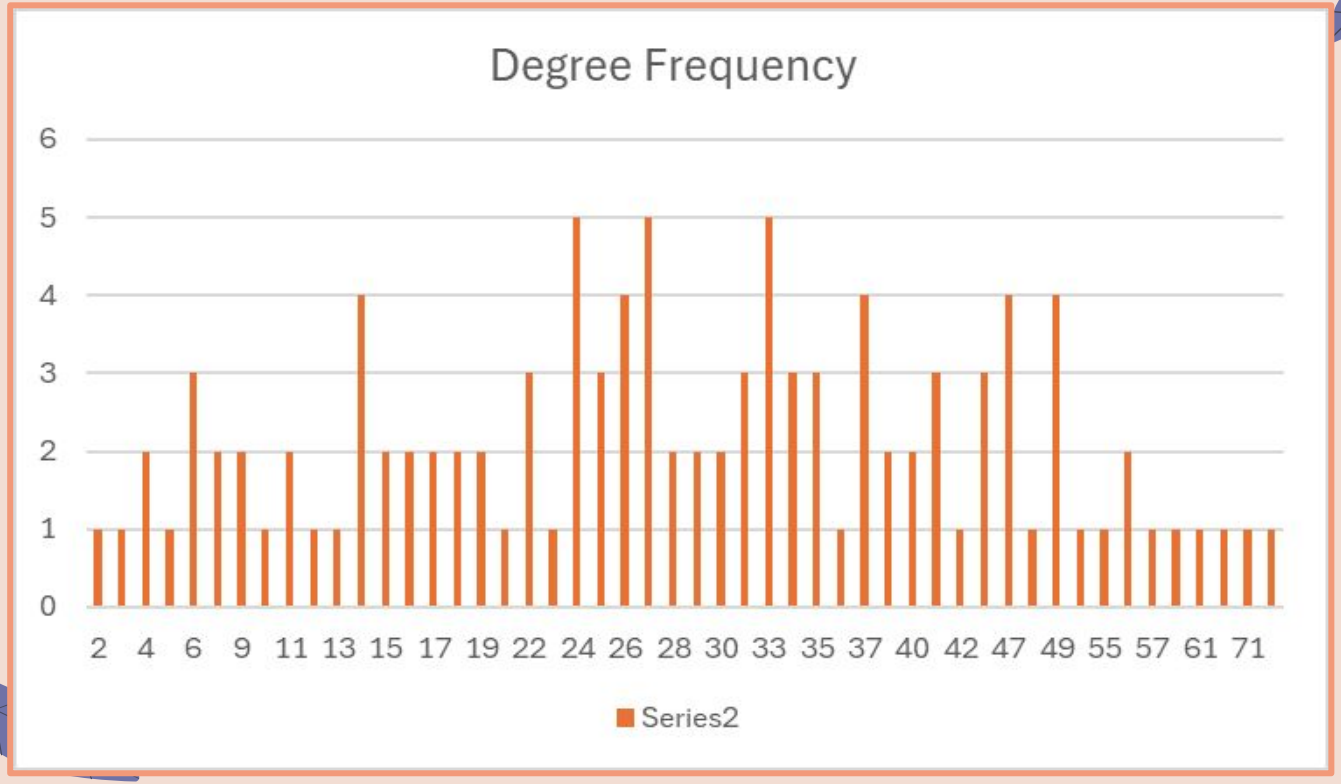
Degree Centrality

Top 5 Birds:

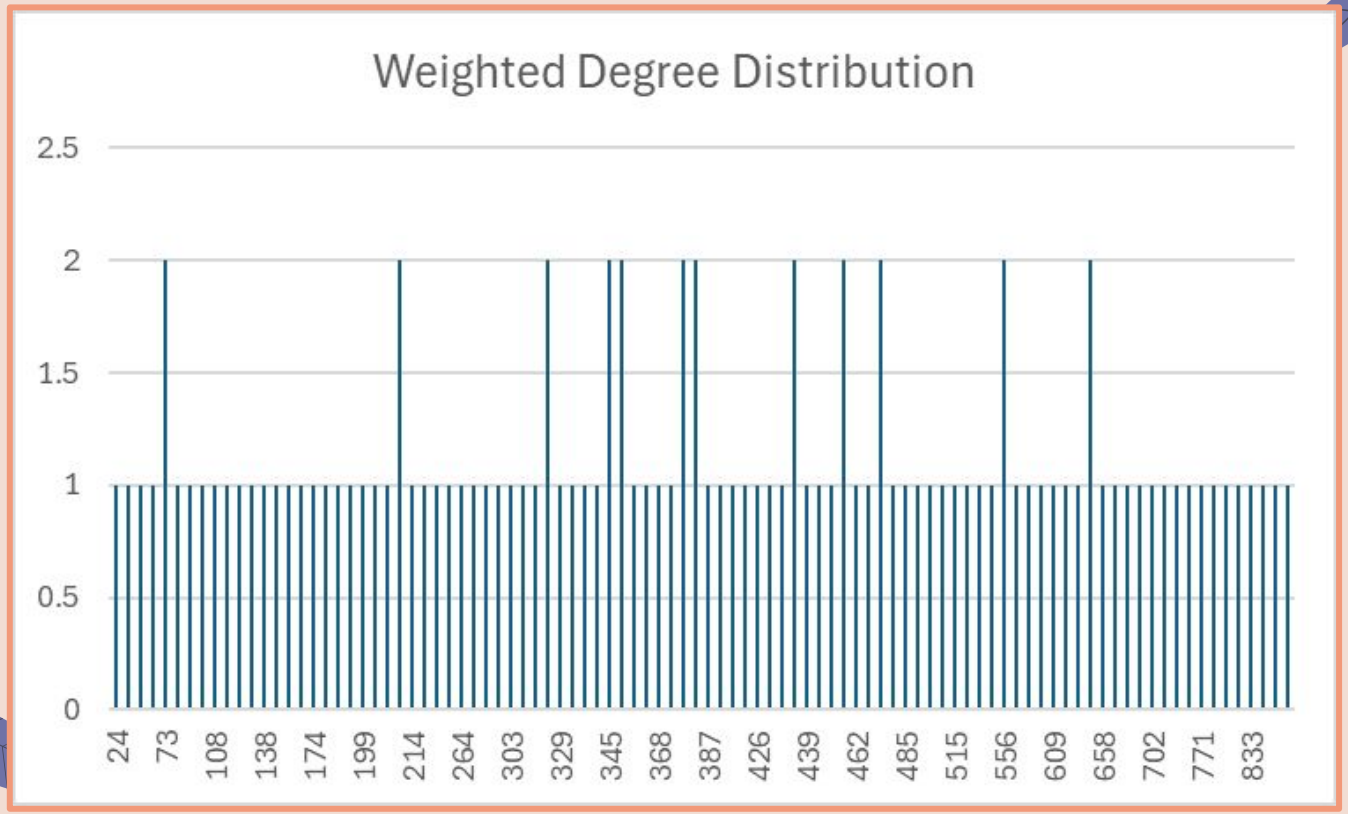
- Pink-footed Shearwater
  - Vulnerable
- Red Phalarope
  - Least Concern
- Steller's Eider
  - Vulnerable
- Leach's Storm-Petrel
  - Vulnerable
- Cory's Shearwater
  - Least Concern

Pink-footed Shearwater

Degree Frequency Chart

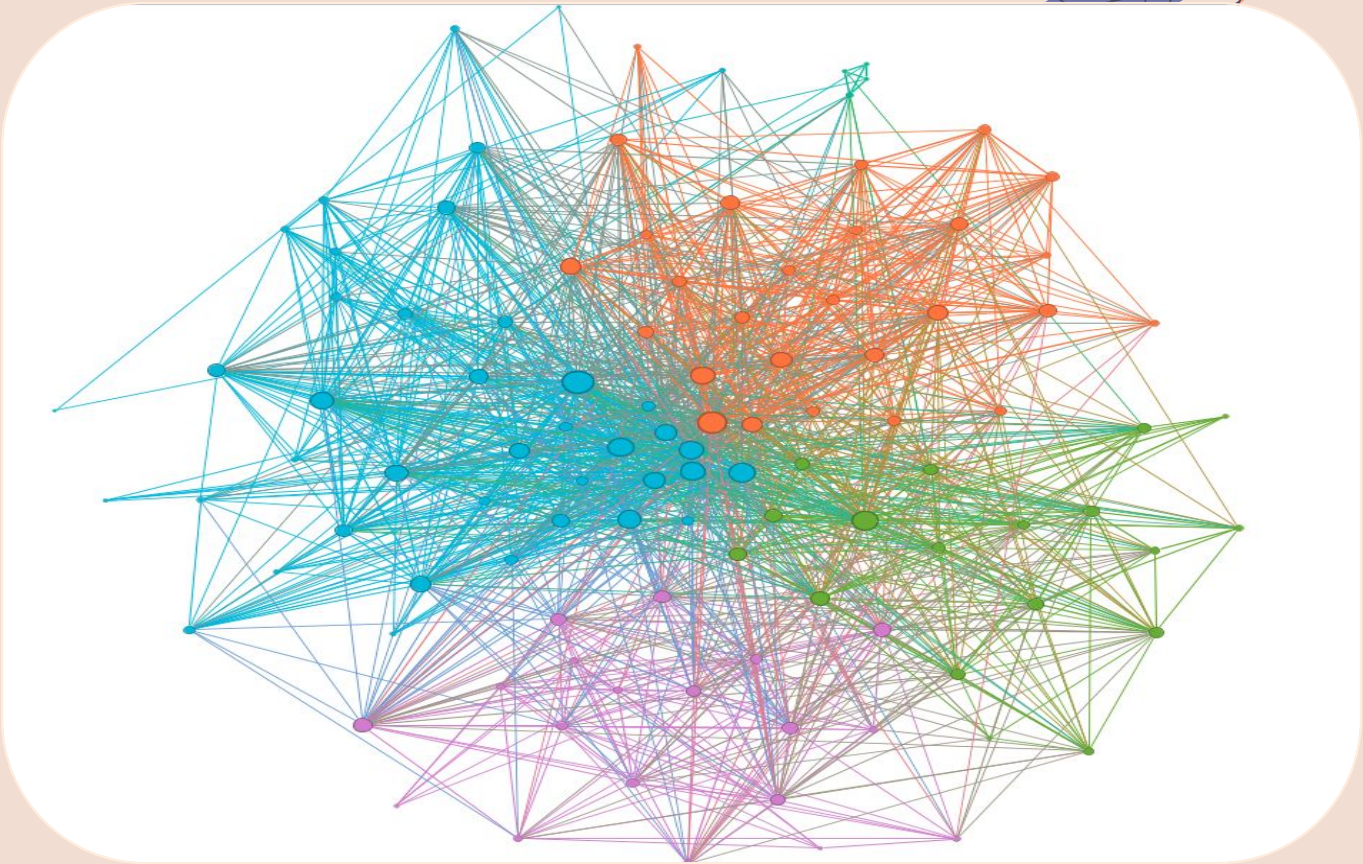


Weighted Degree Frequency Chart



02 Comparisons

Our Network

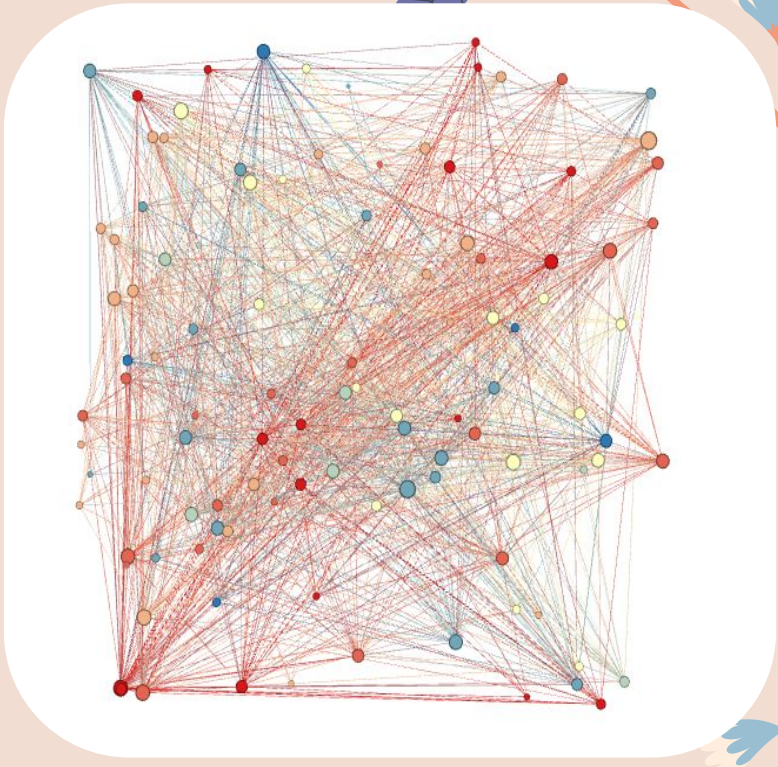


Configuration Model

Density: 0.226

Average Clustering Coefficient: 0.313

Average Shortest Path: 1.828

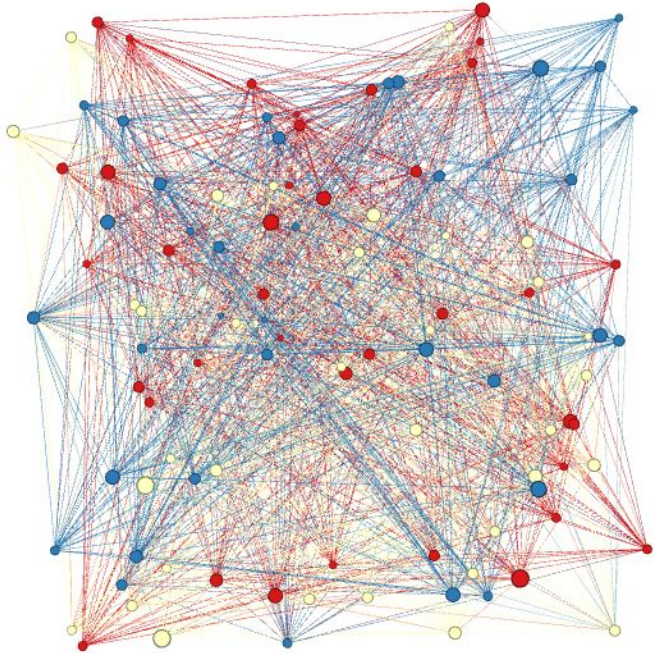


Watts-Strogatz Model

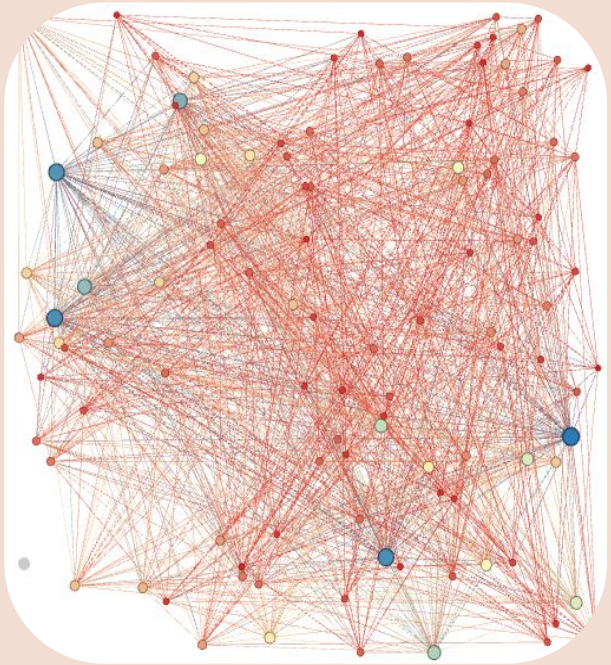
Density: 0.262

Average Clustering Coefficient: 0.550

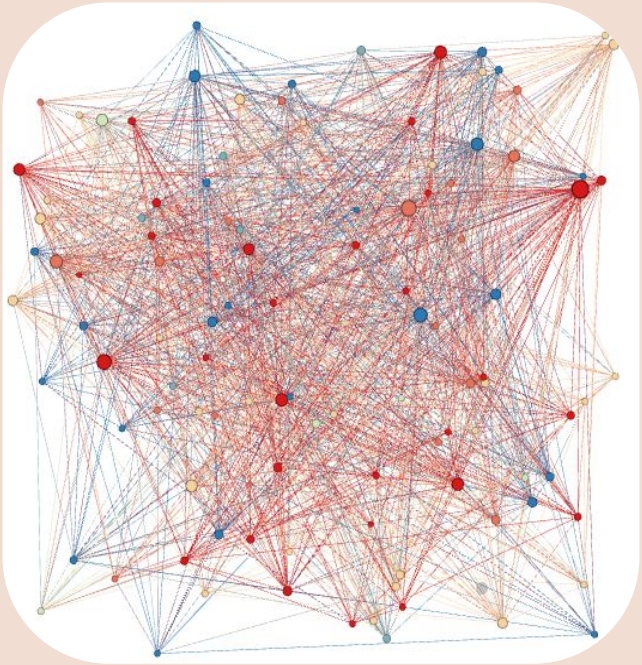
Average Shortest Path: 1.801



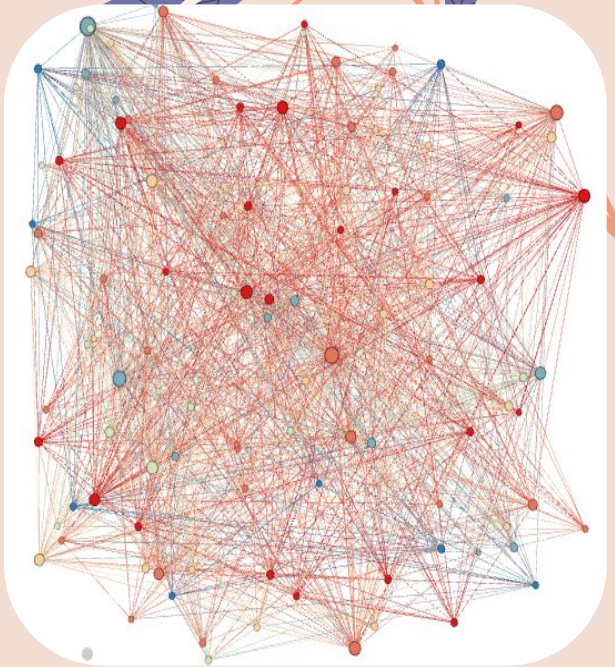
Scale Free



Density: 0.228
Average Clustering Coefficient: 0.323
Average Shortest Path: 1.779

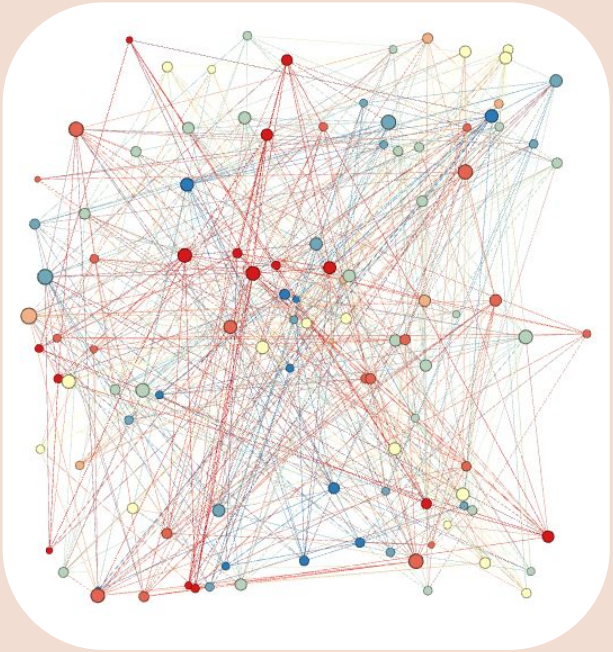


Density: 0.228
Average Clustering Coefficient: 0.330
Average Shortest Path: 1.779

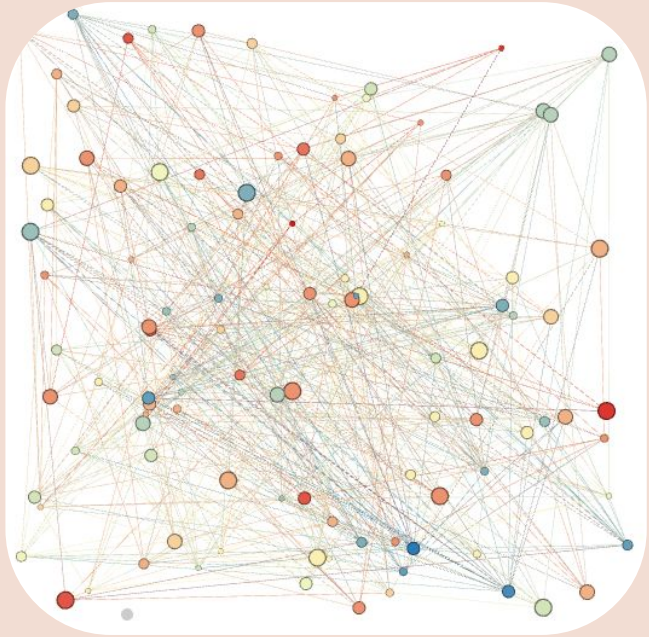


Density: 0.228
Average Clustering Coefficient: 0.330
Average Shortest Path: 1.779

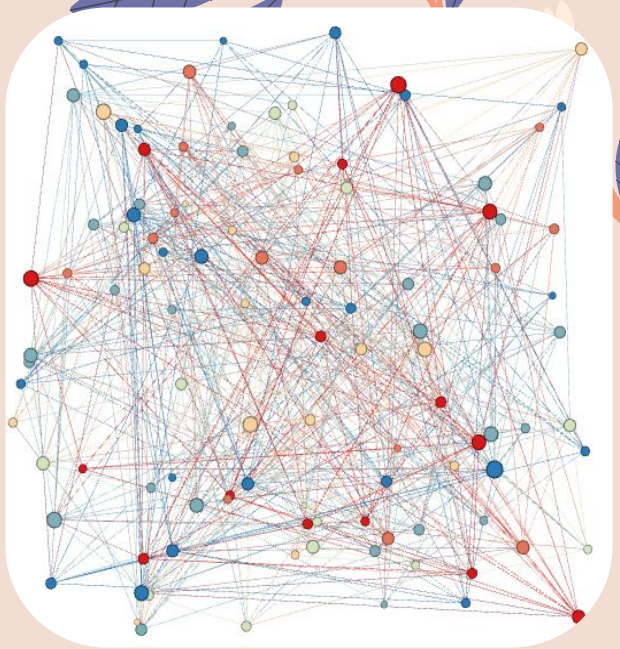
Random Networks



Density: 0.102
Average Clustering Coefficient: 0.111
Average Shortest Path: 2.19



Density: 0.102
Average Clustering Coefficient: 0.111
Average Shortest Path: 2.191



Density: 0.102
Average Clustering Coefficient: 0.111
Average Shortest Path: 2.191

Summary:

Most Similar To:

- Watts-Strogatz Model
  - About the same clustering coefficient, average shortest path, and density
- Generated scale-free networks
  - About the same density and average shortest path

Least Similar To:

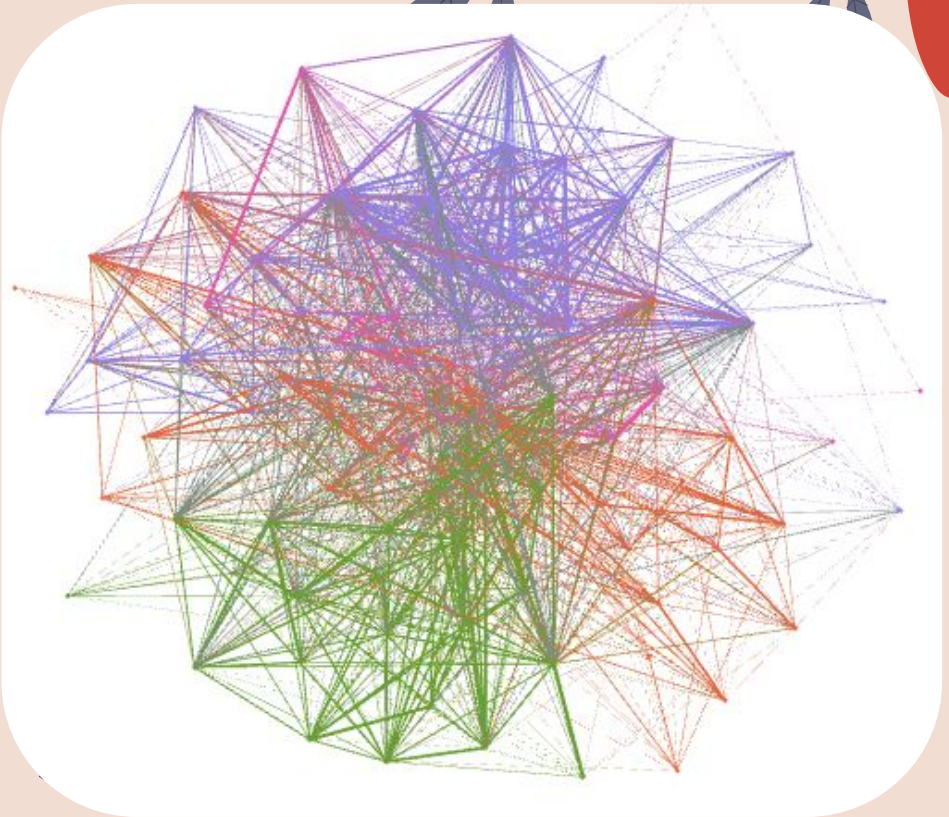
- Generated random networks

03

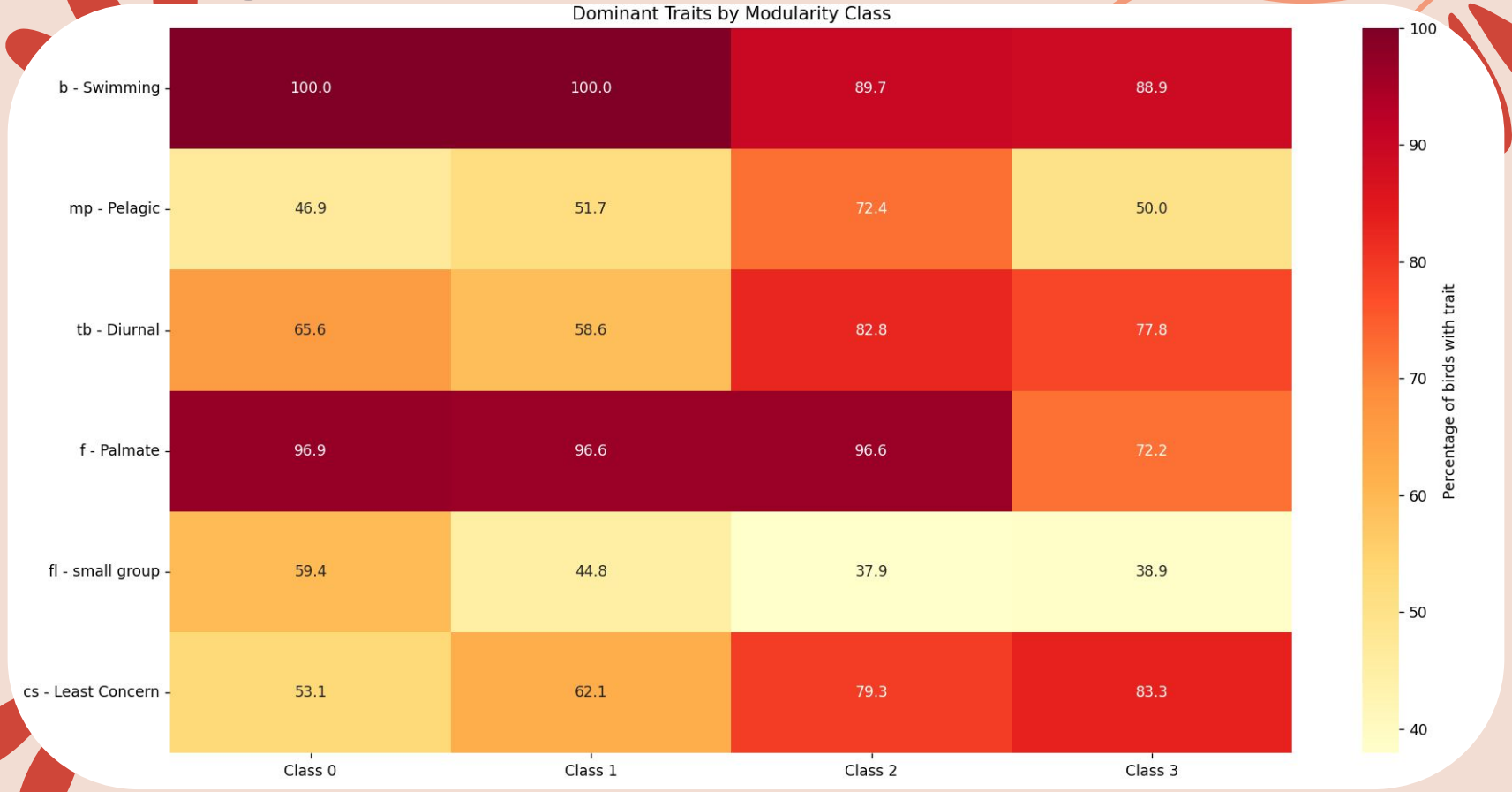
Cluster Analysis

Clustering from Gephi

Number of Communities: 4
Modularity: 0.27



Clustering from Gephi



Info About Each Community (Modularity Class)

Class 0:

- Number of Birds: 32
- Average Weighted Degree: 478.41
- Size: Crow
- Behavior: Swimming
- Beak-Type: Surface-picker
- Foot: Palmate
- Migration Pattern: Pelagic
- Time Behavior: Diurnal
- Plumage: Plain
- Leg Type: Short
- Wing Type: Pointed and Tapered
- Tail Type: Pointed
- Call pattern: flat
- Call Type: Raucous
- Flock: small group
- Conservation Status:
  - Around 50% least concern
  - Around 50% threatened

Class 1:

- Number of Birds: 29
- Average Weighted Degree: 349.10
- Size: Robin
- Behavior: Swimming
- Beak-Type: Diving-specialist
- Foot: Palmate
- Migration Pattern: Migrant
- Time Behavior: Diurnal
- Plumage: Plain
- Leg Type: Short
- Wing Type: Pointed
- Tail Type: Short
- Call pattern: flat
- Call Type: Odd
- Flock: small group
- Conservation Status:
  - Around 60% least concern
  - Around 40% threatened

Info About Each Community (Modularity Class)

Class 2:

- Number of Birds: 29
- Average Weighted Degree: 467.28
- Size: Crow
- Behavior: Direct Flight
- Beak-Type: Surface-picker
- Foot: Palmate
- Migration Pattern: Migrant
- Time Behavior: Diurnal
- Plumage: Plain
- Leg Type: Medium-Length
- Wing Type: Tapered
- Tail Type: Square-tipped
- Call pattern: flat
- Call Type: Scream
- Flock: large group
- Conservation Status:
  - Around 80% Least Concern

Class 3:

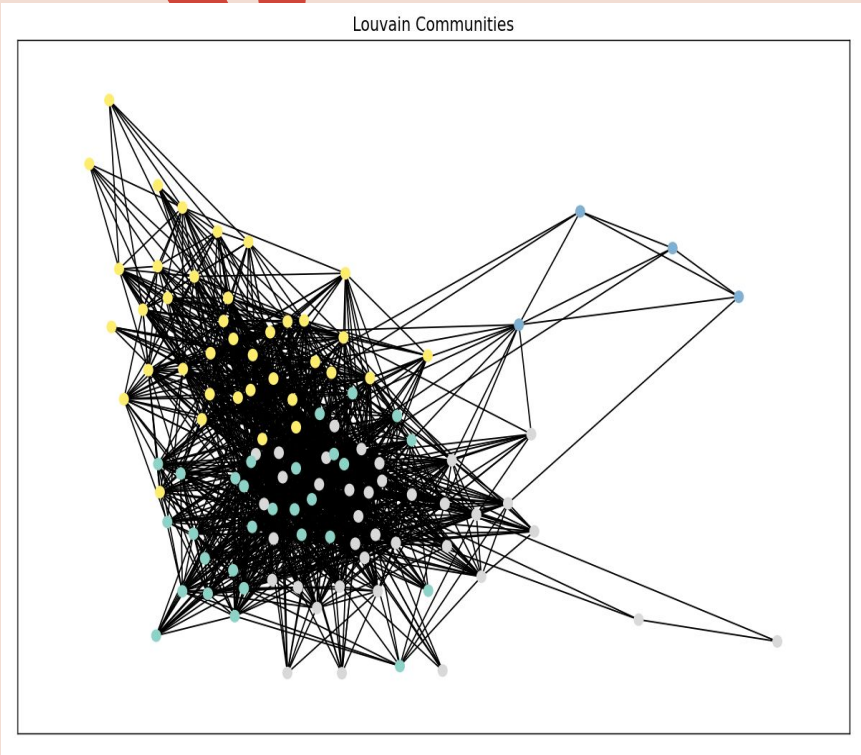
- Number of Birds: 18
- Average Weighted Degree: 262.89
- Size: Crane / Mallard
- Behavior: Swimming
- Beak-Type: Strainer
- Foot: totipalmate
- Migration Pattern: Pelagic
- Time Behavior: Diurnal
- Plumage: Plain
- Leg Type: Medium- Length
- Wing Type: Long
- Tail Type: Wedge-Shaped
- Call pattern: flat
- Call Type: Raucous
- Flock: Small and Large Group
- Conservation Status:
  - Around 83% Least Concern

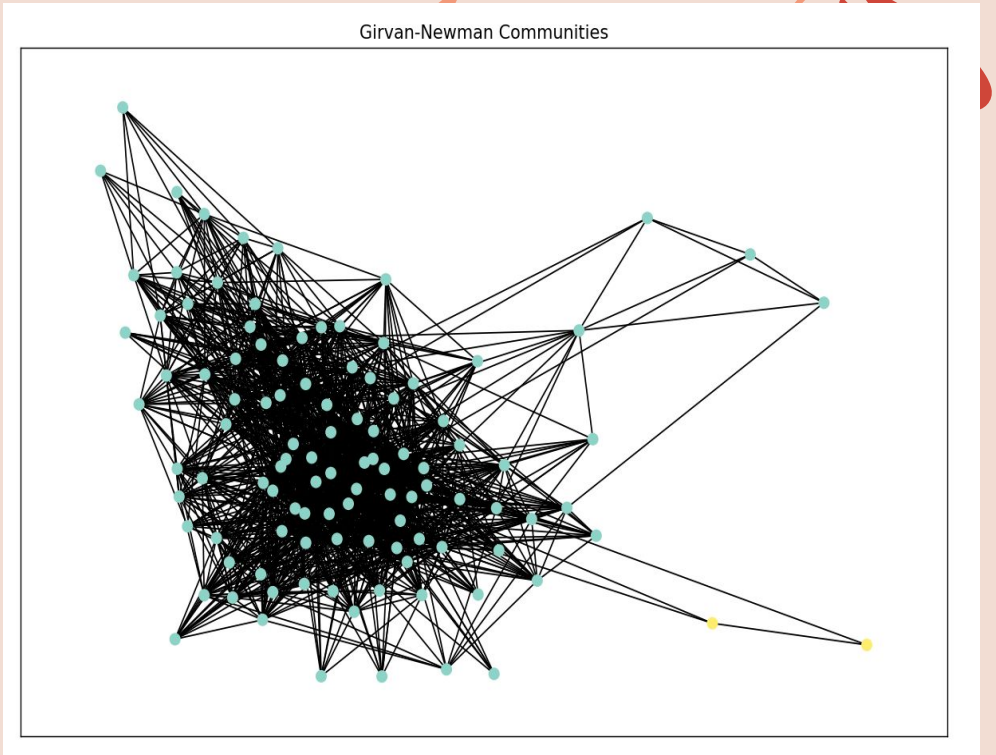
Some Key Observations

Most common attributes of threatened birds:

- Size: Crow and Robin
- Behavior: Swimming
- Beak-Type: Surface-picker and diving-specialist
- Foot: Palmate (webbed)
- Migration Pattern: Migrant and pelagic (live in open ocean)
- Time Behavior: Diurnal
- Plumage: Plain
- Leg Type: Short and thin
- Wing Type: Pointed and tapered
- Tail Type: Pointed, short, and wedge-shaped
- Call pattern: Flat
- Call Type: Raucous and odd
- Flock: small group

Clustering using Louvain Model & Girvan-Newman Model

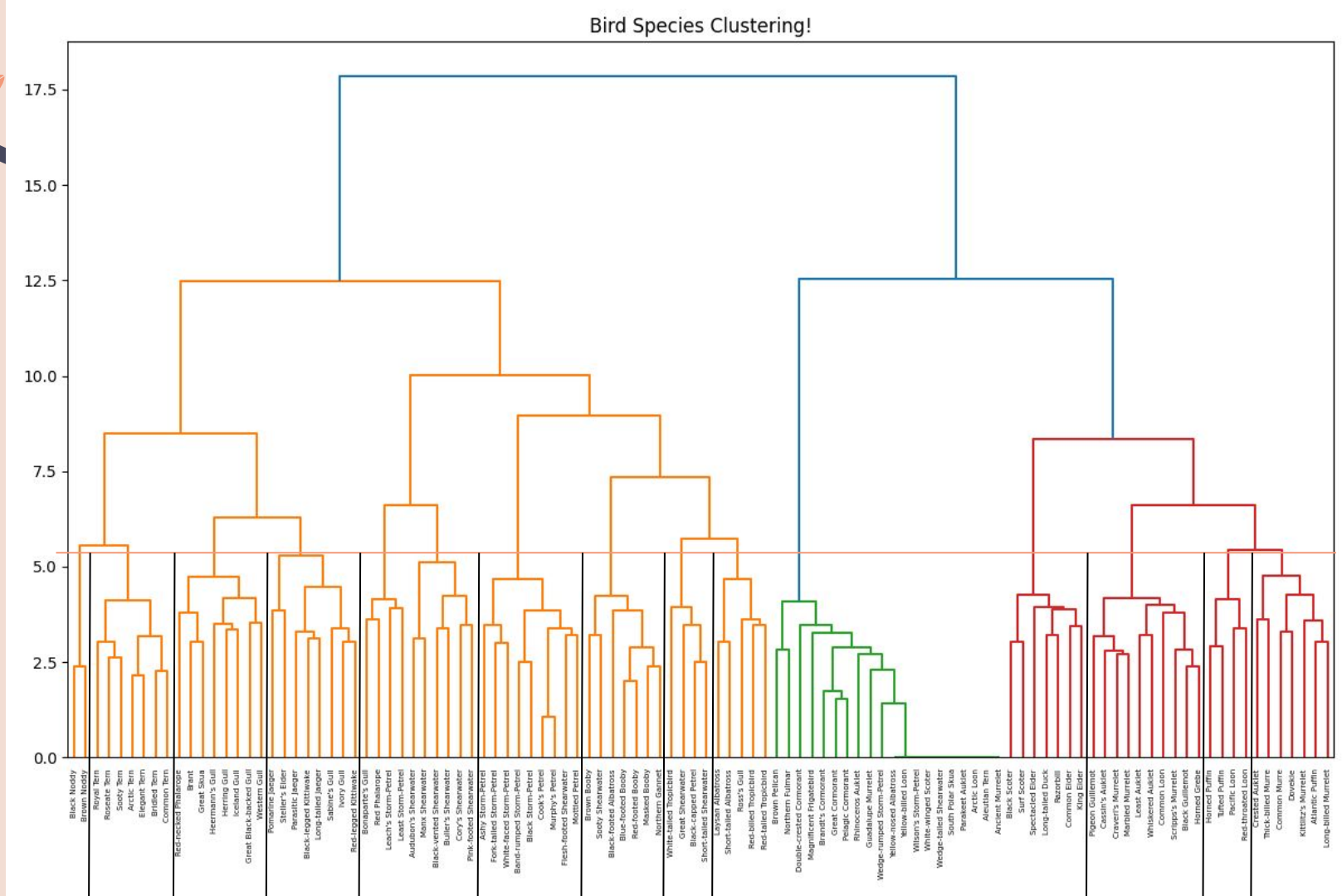




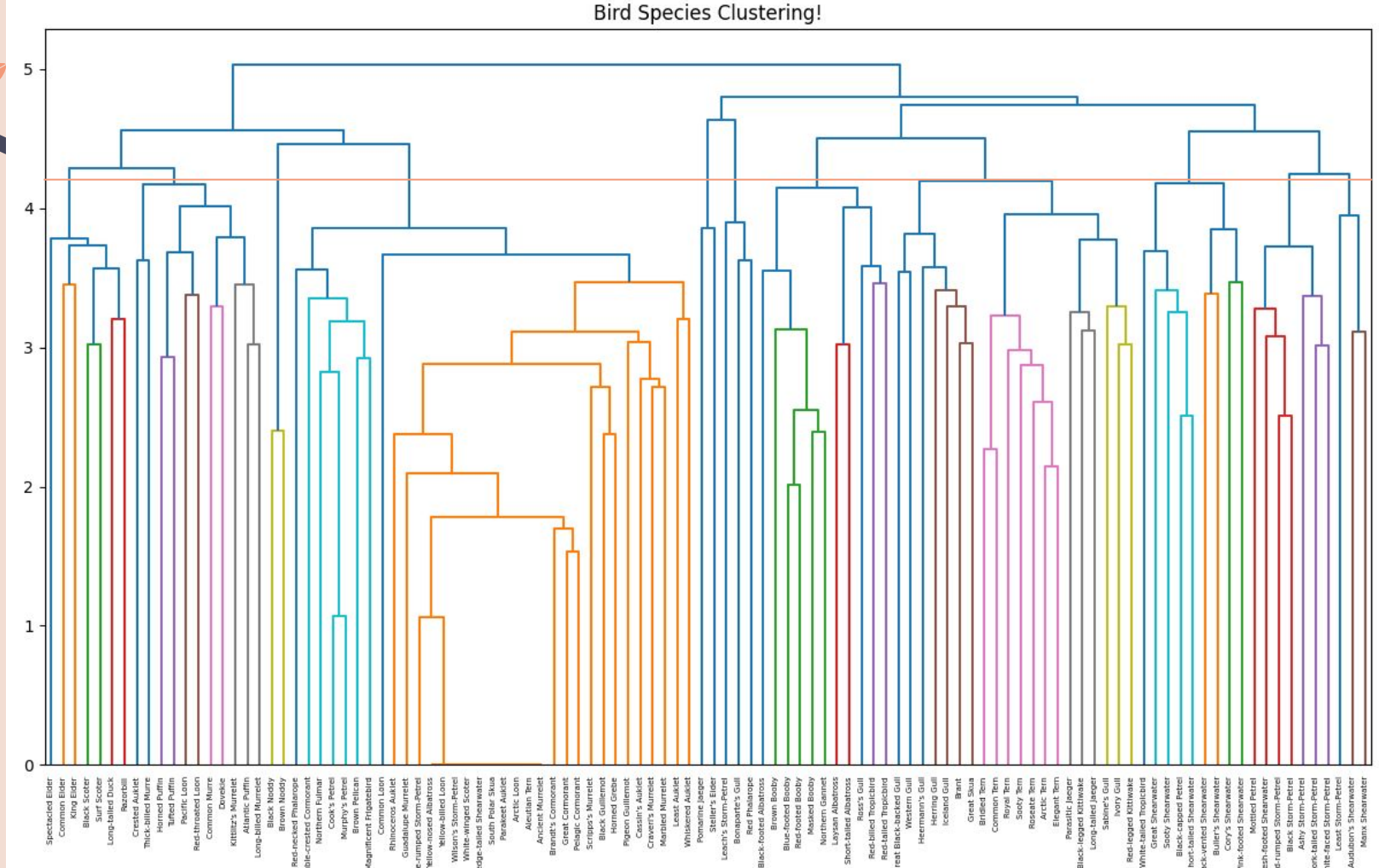
Number of Communities: 4
Modularity: 0.2577

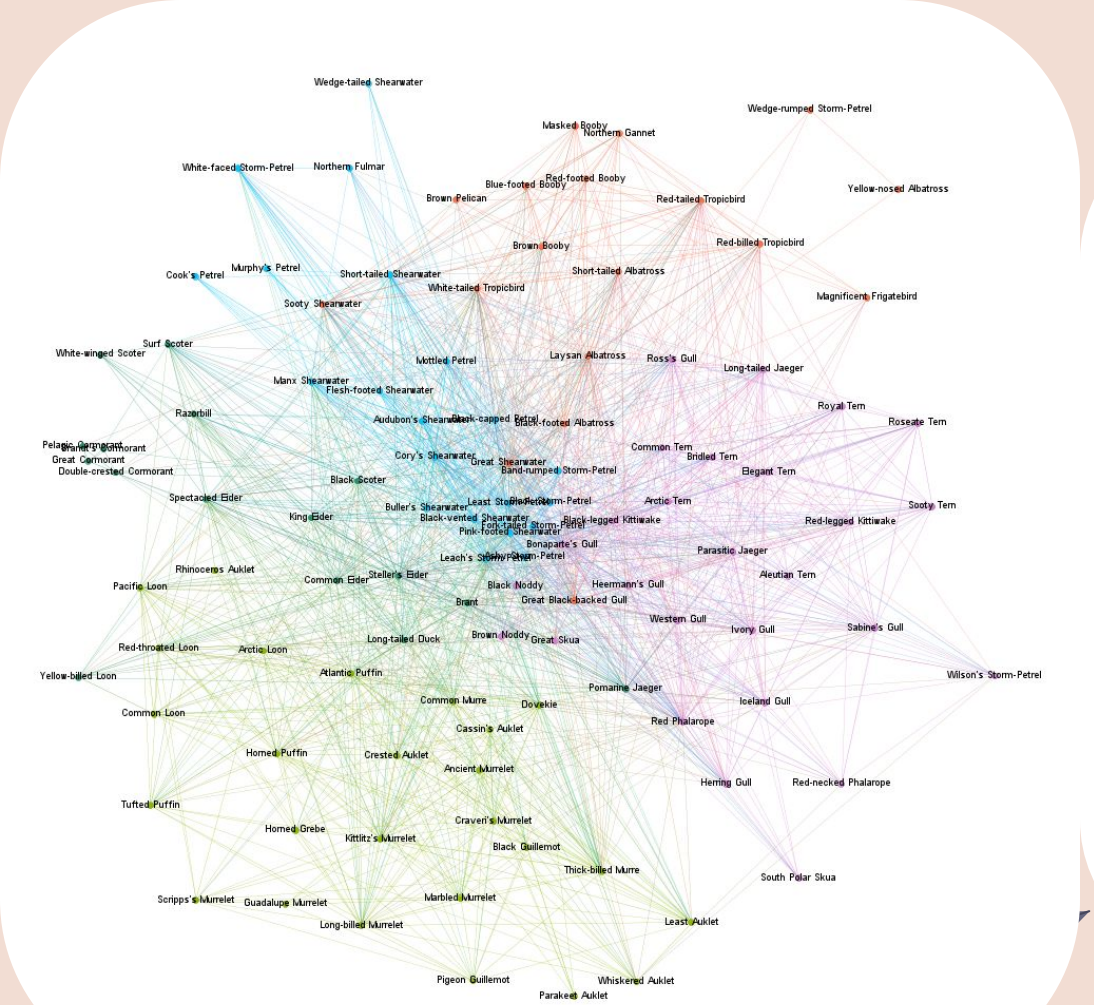
Number of Communities: 2
Modularity: 0.0012

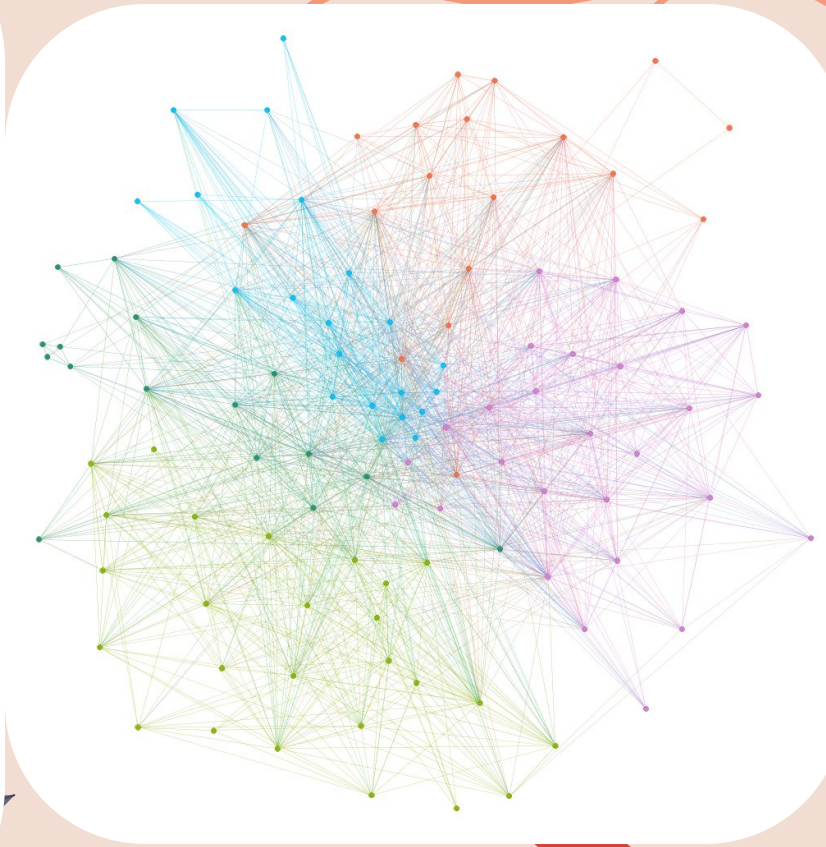
Ward's Algorithm



Weighted average linkage




Wedge-tailed Shearwater
Wedge-rumped Storm-Petrel
Masked Booby
Northern Gannet
White-faced Storm-Petrel
Northern Fulmar
Blue-footed Booby
Red-footed Booby
Yellow-nosed Albatross
Brown Pelican
Red-tailed Tropicbird
Brown Booby
Red-billed Tropicbird
Murphy's Petrel
Cook's Petrel
Short-tailed Shearwater
Short-tailed Albatross
White-tailed Tropicbird
Sooty Shearwater
Magnificent Frigatebird
Surf Scoter
White-winged Scoter
Laysan Albatross
Ross's Gull
Mottled Petrel
Long-tailed Jaeger
Manx Shearwater
Flesh-footed Shearwater
Razorbill
Audubon's Shearwater
Black-capped Petrel
Black-footed Albatross
Royal Tern
Roseate Tern
Pelagic Cormorant
Great Cormorant
Double-crested Cormorant
Common Tern
Bridled Tern
Cory's Shearwater
Great Shearwater
Band-rumped Storm-Petrel
Elegant Tern
Black Scoter
Spectacled Eider
Buller's Shearwater
Least Storm-Petrel
Arctic Tern
Sooty Tern
King Eider
Black-vested Shearwater
Black-legged Kittiwake
Red-legged Kittiwake
Pink-footed Shearwater
Bonaparte's Gull
Parasitic Jaeger
Leach's Storm-Petrel
Rhinoceros Auklet
Aleutian Tern
Common Eider
Steller's Eider
Pacific Loon
Black Noddy
Heermann's Gull
Brant
Great Black-backed Gull
Western Gull
Ivory Gull
Sabine's Gull
Red-throated Loon
Arctic Loon
Long-tailed Duck
Brown Noddy
Great Skua
Yellow-billed Loon
Atlantic Puffin
Wilson's Storm-Petrel
Pomarine Jaeger
Common Murre
Dovekie
Iceland Gull
Common Loon
Red Phalarope
Cassin's Auklet
Horned Puffin
Crested Auklet
Ancient Murrelet
Herring Gull
Red-necked Phalarope
Tufted Puffin
Craveri's Murrelet
Horned Grebe
Kittlitz's Murrelet
Black Guillemot
Thick-billed Murre
South Polar Skua
Scripps's Murrelet
Guadalupe Murrelet
Marbled Murrelet
Long-billed Murrelet
Least Auklet
Pigeon Guillemot
Whiskered Auklet
Parakeet Auklet



04

Robustness

Strictly Theoretical Network Science Approach

Attacks:

- Remove 10 highest unweighted degree nodes at a time
- Remove 10 highest betweenness nodes at a time
- Remove 10 highest closeness nodes at a time

Failures:

- Remove 10 random nodes at a time

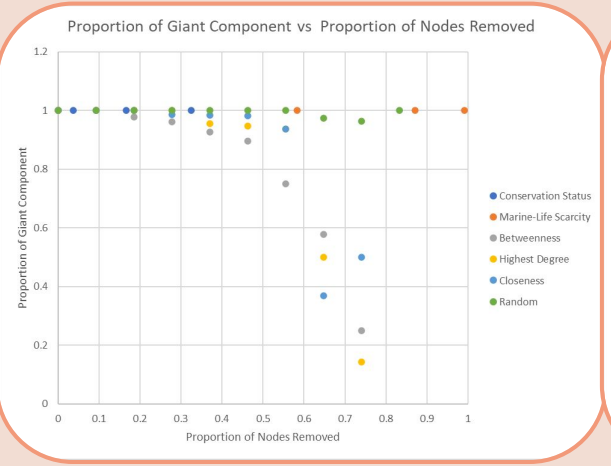
Some more logical approaches to robustness.

Attacks:

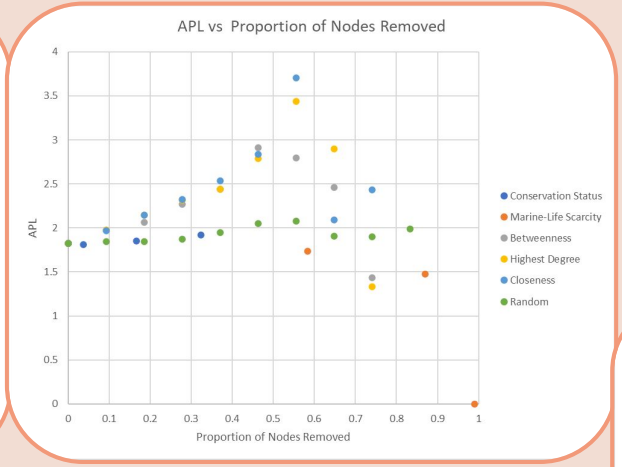
- Remove All that eat Marine Life (Polluted ocean):
  - Remove birds that **only** eat marine life(58.33%)
  - Then, remove birds that **mainly** eat marine life(28.70%)
  - Then, remove birds that **enjoy** marine life(12.04%)
- Remove in order of conservation status:
  - Remove endangered species(3.7%)
  - Then Vulnerable(12.96%)
  - Then Near Threatened(15.74%)

Robustness Data

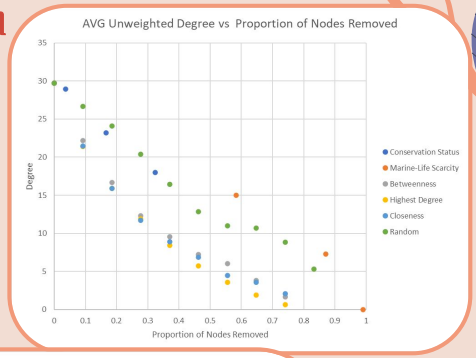
Giant Component vs Nodes Removed

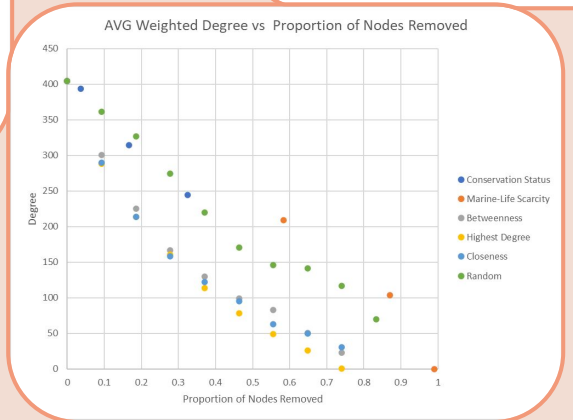


APL vs Nodes Removed



AVG Degree vs Nodes Removed





At 65% nodes removed, closeness actually gets two giant components of an equal 14 node size

Some Conclusions...

Any relation with conservation status and traits?

What type of graph is this?

Is it robust?

What are the Important Nodes?
Do the Clusters Make Sense?
Is it representative of the Small World Property?
Ultra-Small World Property?