Saco River Estuary Food Web

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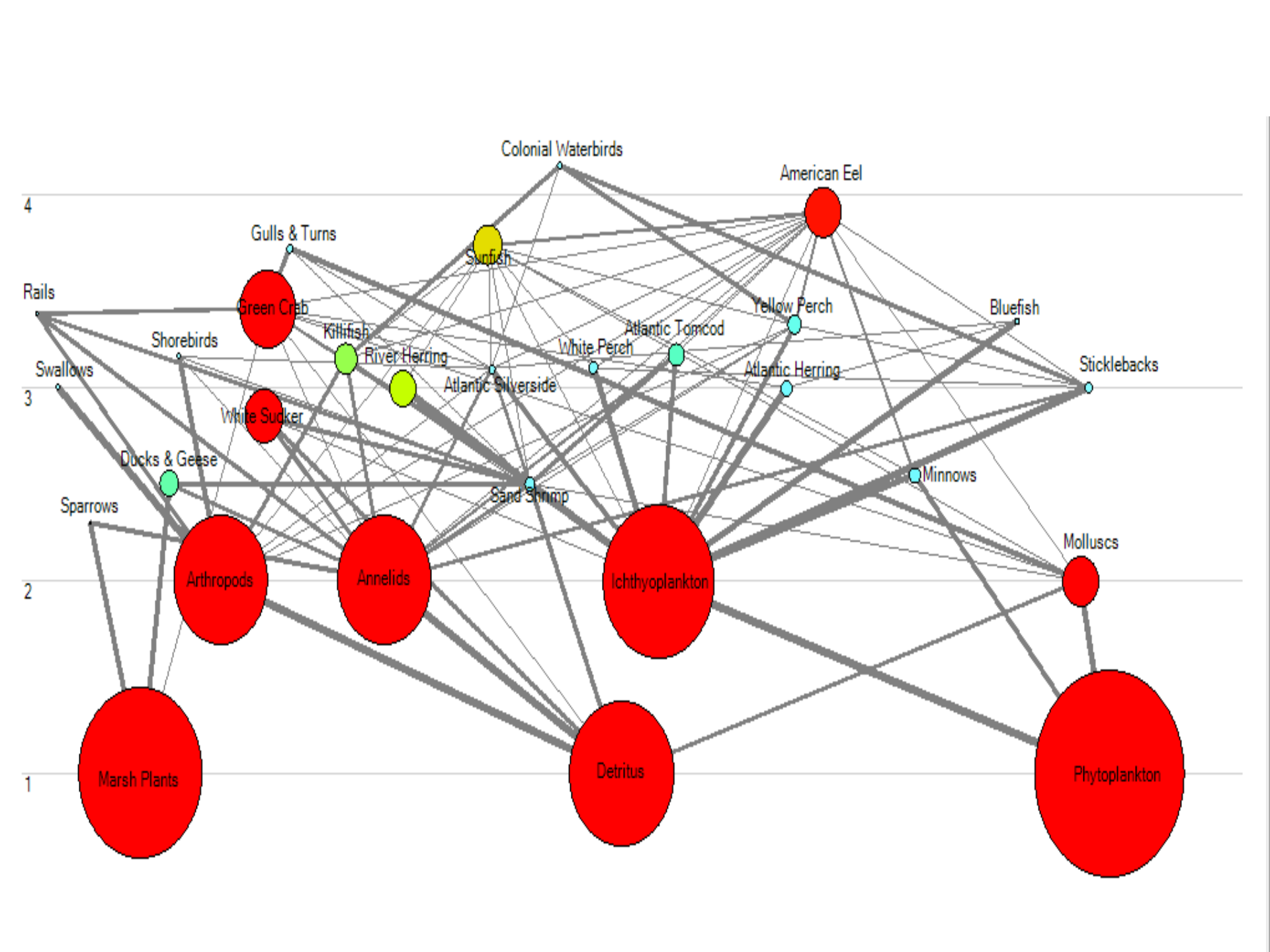
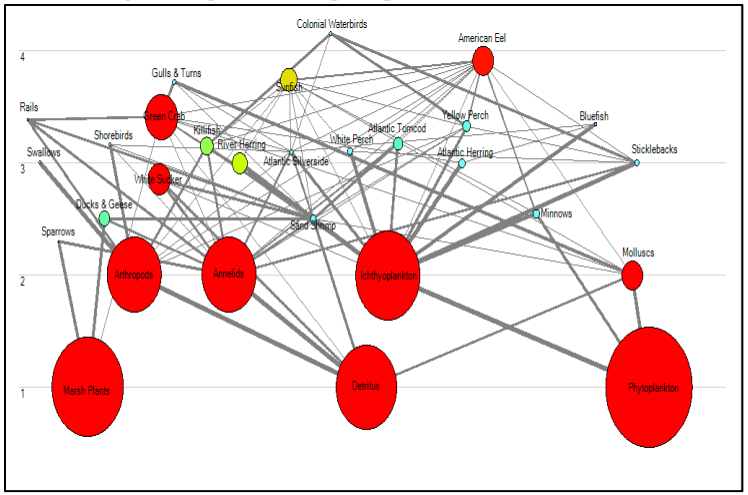

Colonial Waterbirds
American Eel
4
Gulls & Turns
Sunfish
Rails
Green Crab
Yellow Perch
Bluefish
Killifish
Shorebirds
Atlantic Tomcod
White Perch
River Herring
Swallows
Atlantic Herring
Sticklebacks
Atlantic Silverside
3
White Sucker
Ducks & Geese
Minnows
Sand Shrimp
Sparrows
Molluscs
Arthropods
Annelids
Ichthyoplankton
2
Marsh Plants
Detritus
Phytoplankton
1

Ecopath

"All living organisms are linked together"

http://www.ecopath.org/

Establish Mass-Balance



1. biomass
2. consumption/biomass
3. production/biomass
4. ecotrophic efficiency (proportion of production used in the system)

- Sets up series of linear equations to solve for unknown values

5. diet composition

Master Equations

Describes the production term for each group:

Production =

catches +

predation mortality +

biomass accumulation +

net migration +

other mortality

Based on conservation of matter within a group:

Consumption =

production +

unassimilated food +

respiration

Energy Balance

Active Metabolism
→ Costs from activity

Consumption

ΔBiomass
→ Growth

Respiration
→ Basal Metabolism

Egestion-F & Excretion -U

Specific Dynamic Action
→ Costs from digestion

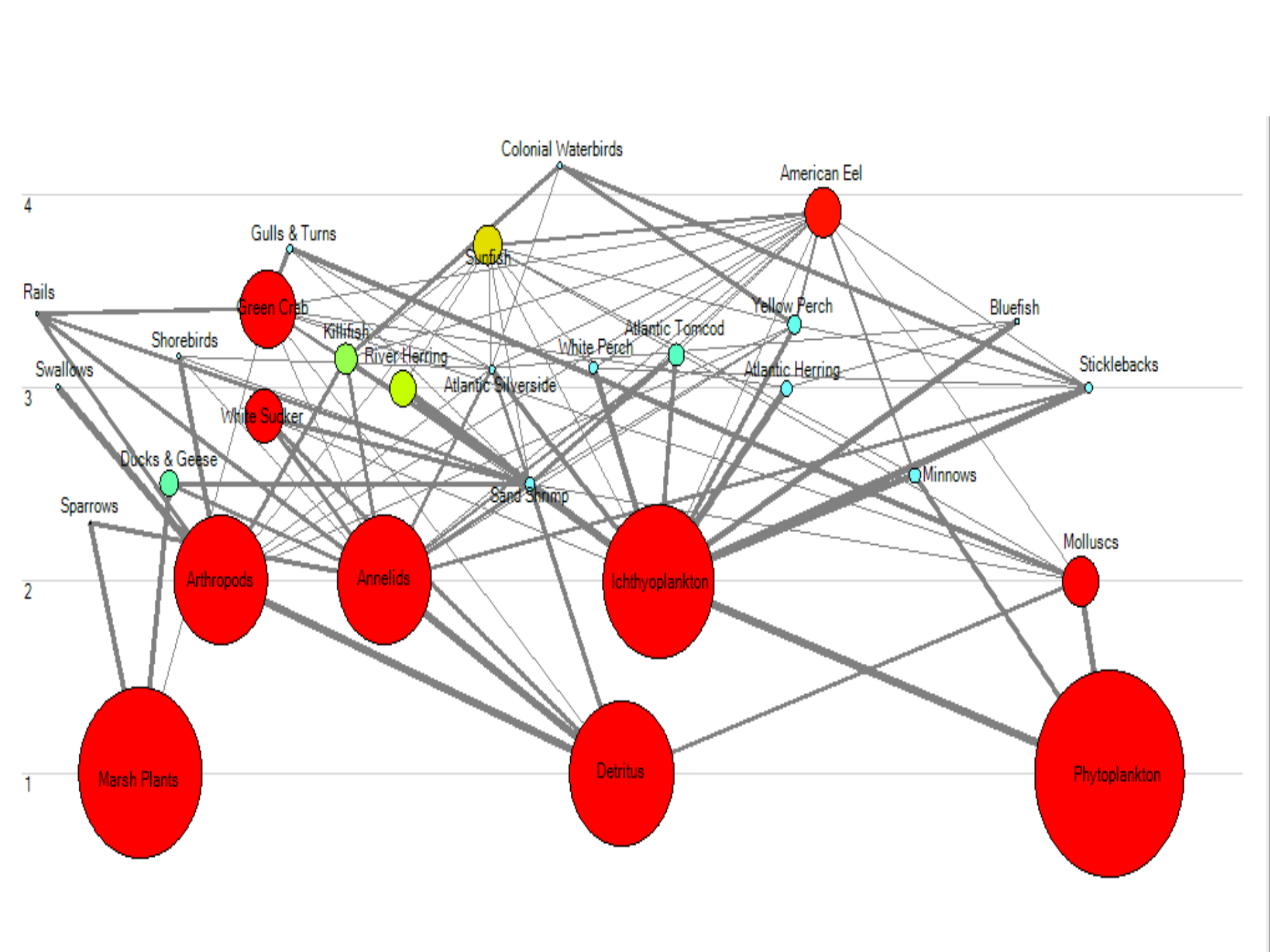
Consumption = production + unassimilated food + respiration

$$C = (\Delta B) + (F + U) + (R + A + S)$$

modified from Kitchell

Methods

- Focused on **Marsh habitat species** monitored in the Sustaining Saco Project.
- Biomass per area, live weight
- 2010-2013
- Production & Consumption rates & Diet Composition ***parameter values taken from*** literature & Fishbase & Cornell Ornithology Lab.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Ecosystem Health

Costanza & Magneau 1999

- An ecosystem must be free to develop in the absence of serious perturbation to realize its full potential while maintaining adequate resilience to insure against stress and vigor to quickly recover from small scale perturbation.

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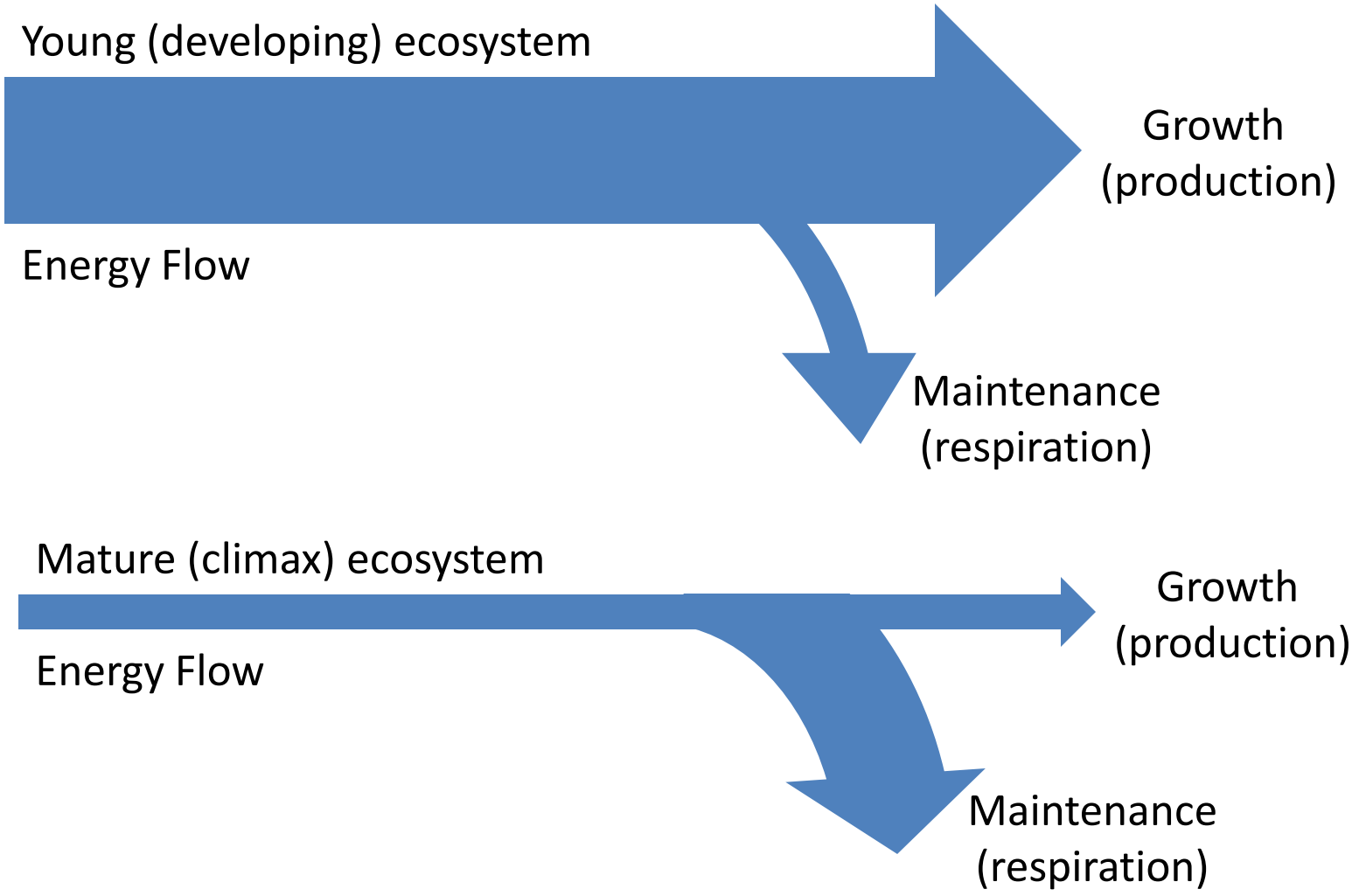
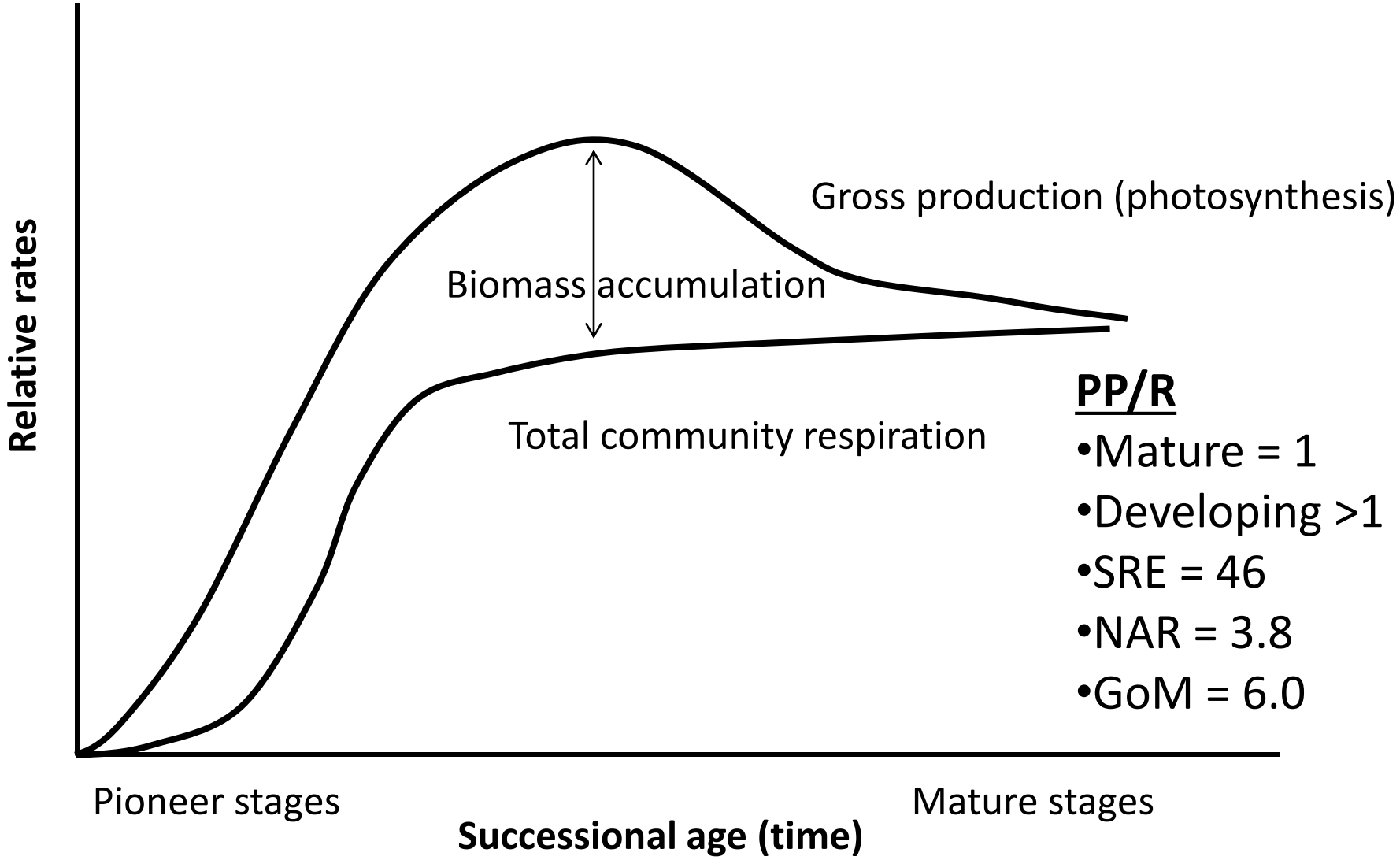
Ecosystem Development

Energy Flow



Ecosystem Development

Succession

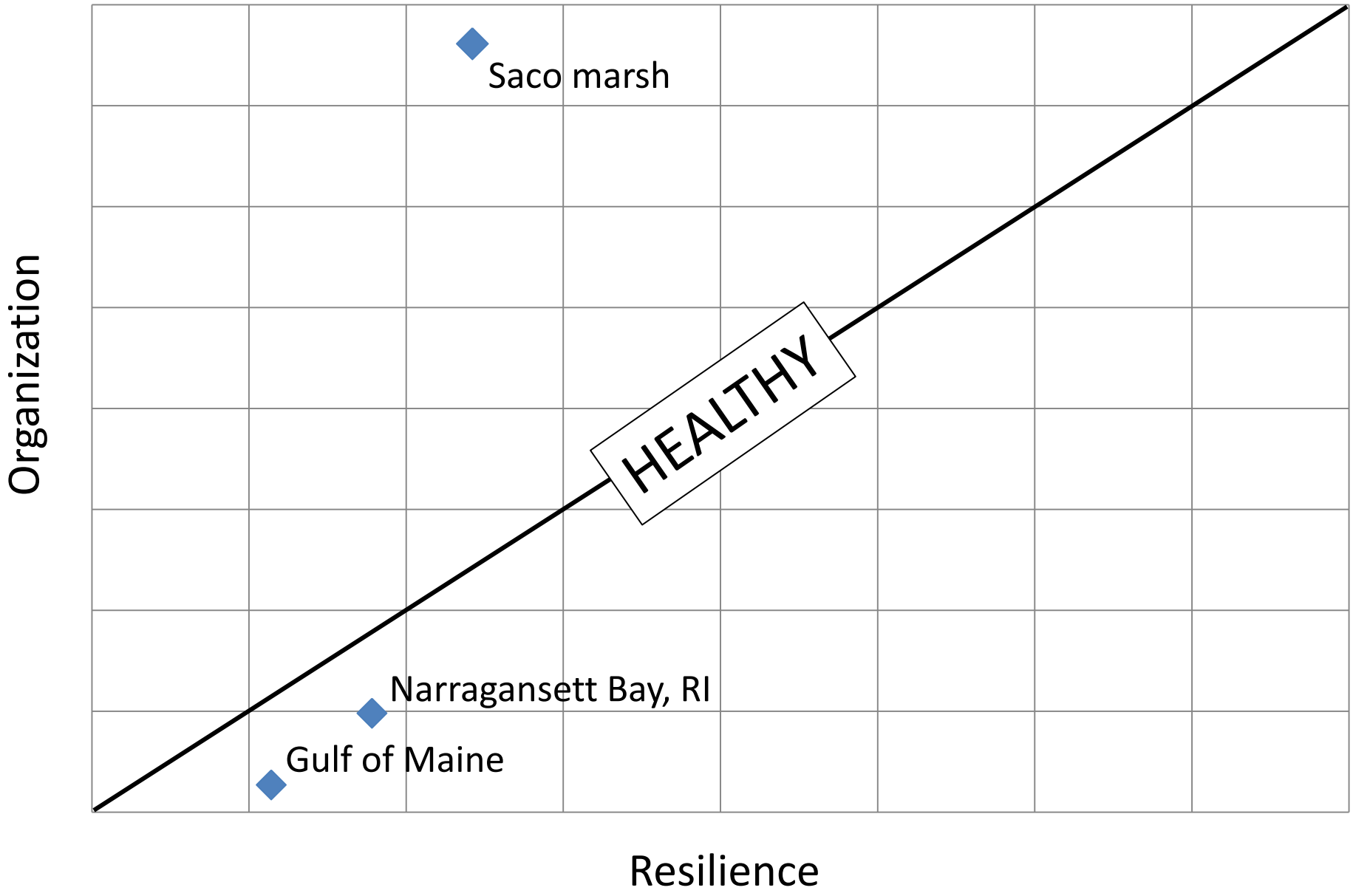


Ecosystem Health

Costanza & Magneau 1999

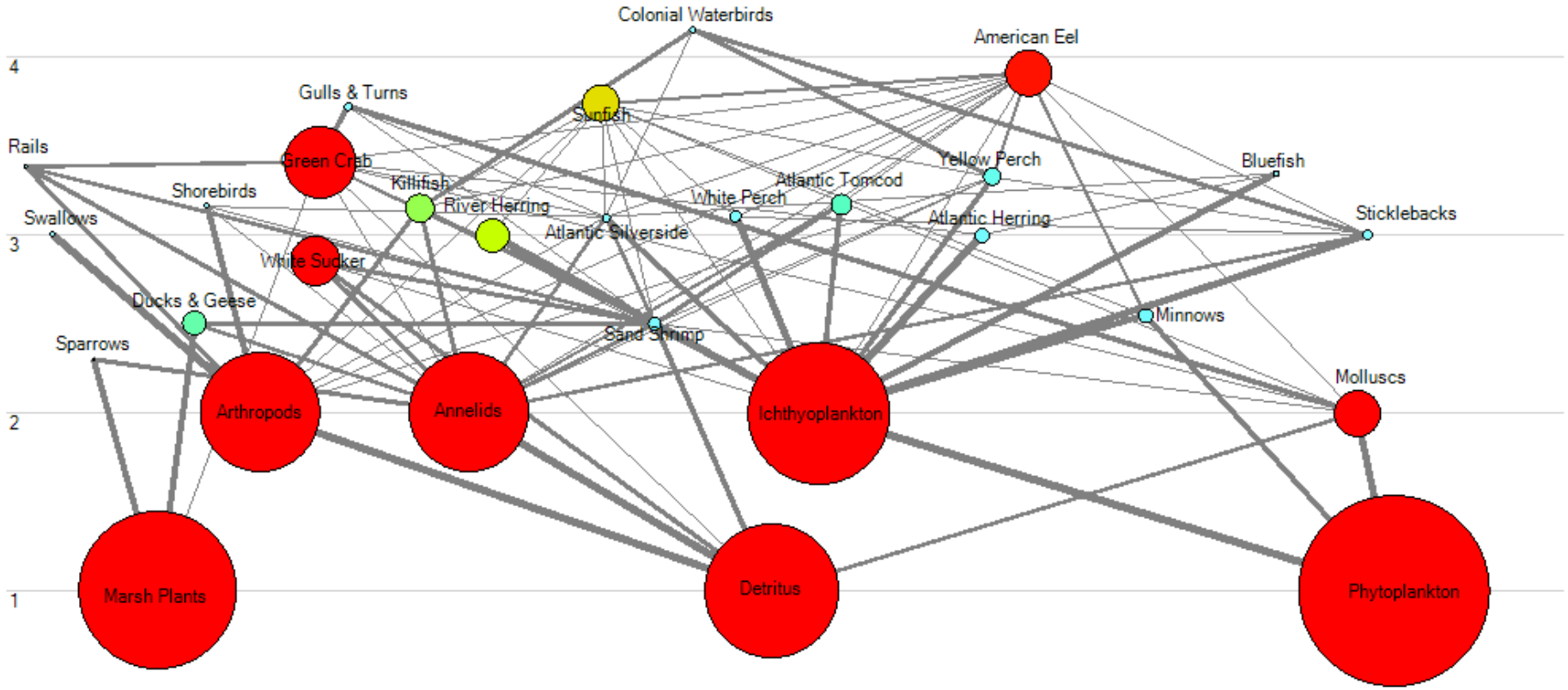
- An ecosystem must be free to **develop** in the absence of serious perturbation to realize its full potential while maintaining adequate resilience to insure against stress and vigor to quickly recover from small scale perturbation.
- Hypothesis: systems with balance between organization and resilience within a given range of system vigor can be characterized as “healthy”.

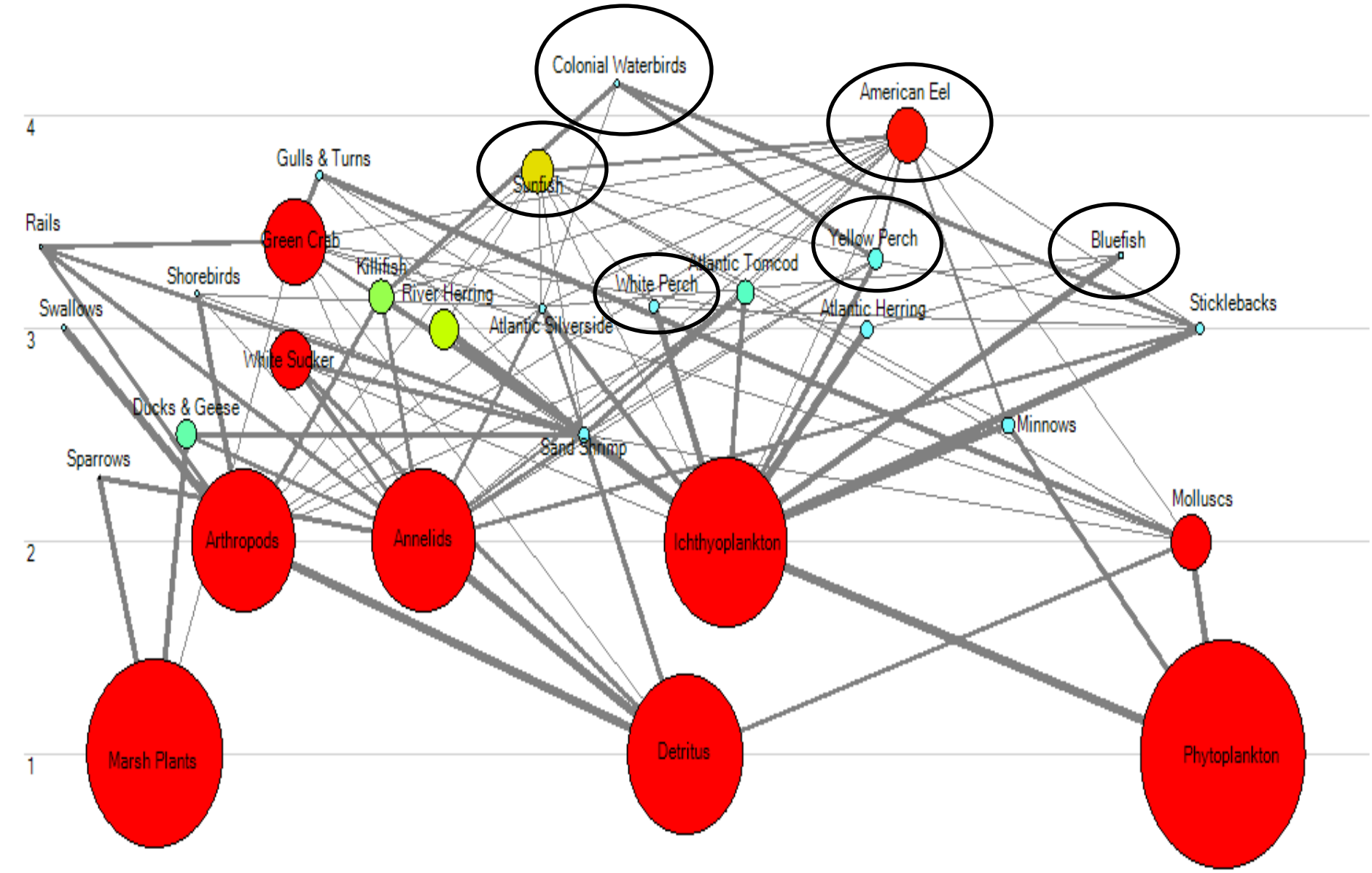

Highly Organized
HEALTHY
Highly Resilient
Organization
Resilience


Saco marsh
HEALTHY
Narragansett Bay, RI
Gulf of Maine
Organization
Resilience

Sensitivity Analysis

1. Model Parameterization
2. Species Interactions

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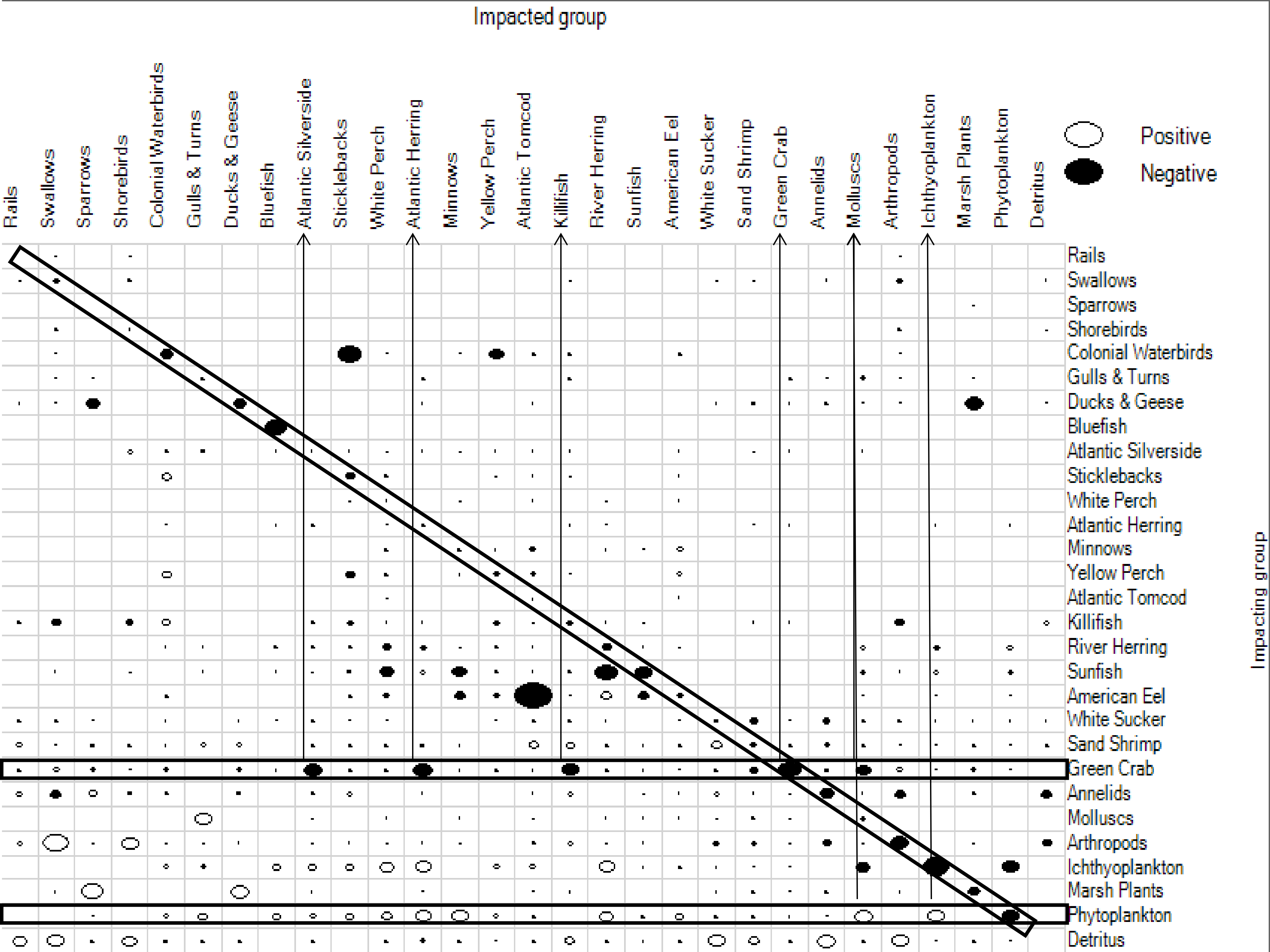

Impacted group
Rails
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Sparrows
Shorebirds
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Gulls & Turns
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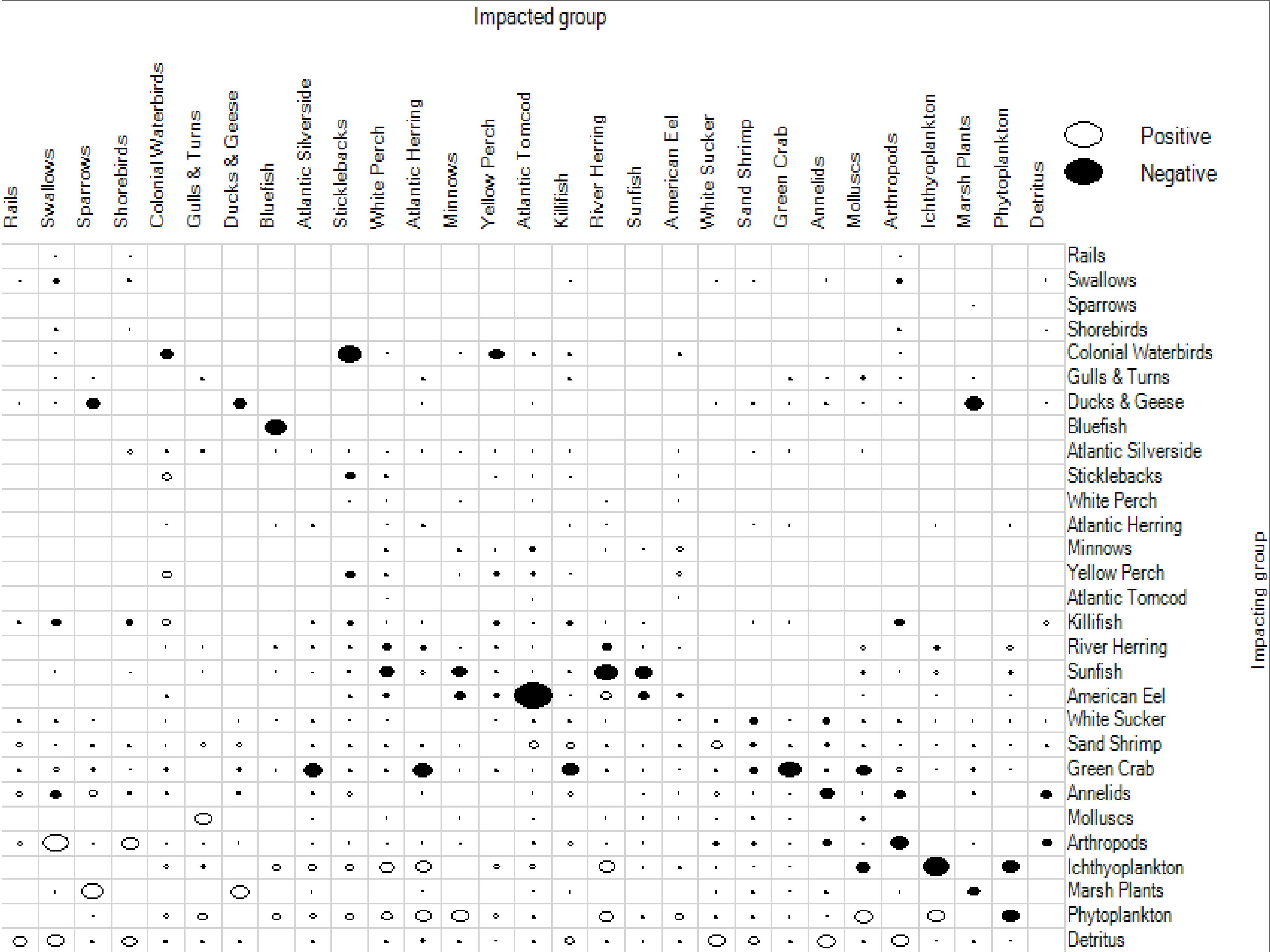
Detritus
Positive
Negative
Impacting group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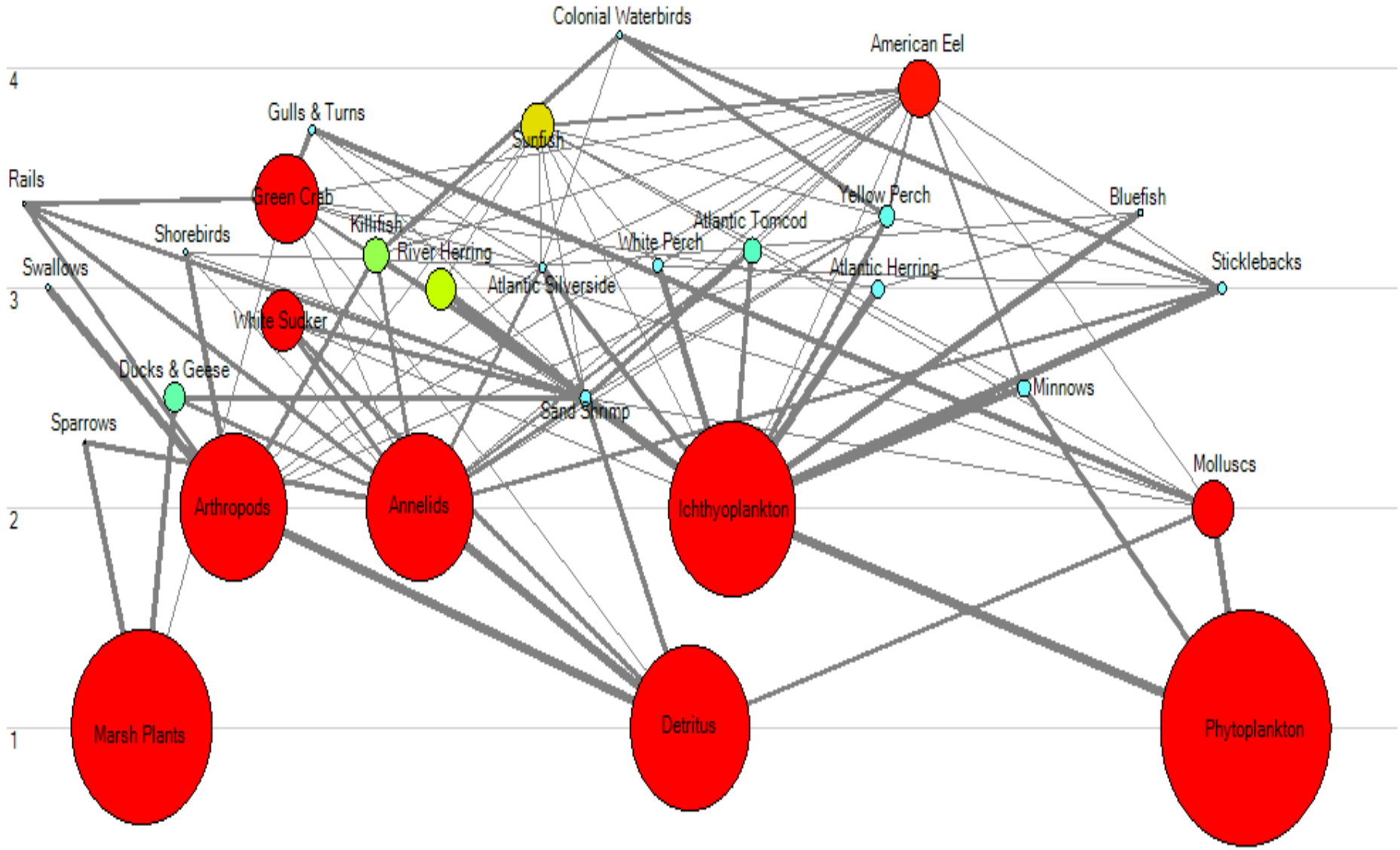
Policy implications

Applications of Ecopath food web modeling:

- ask ‘what if’ type questions
  - e.g. What if biomass of green crabs increases?
- calculate carrying capacity of specific species
  - define upper limits to inform conservative approach to resource management
- compare SRE to other estuarine systems

Questions?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