Selection – Ecological Interaction Networks

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OUTLINE

- Introduction
- Ecological (Interaction) Networks
- Trophic Networks (including Food webs)
- Summary, Questions, and Readings

DARWIN'S *Gedankenexperiment*

...the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice and then of bees, the frequency of certain flowers in that district!

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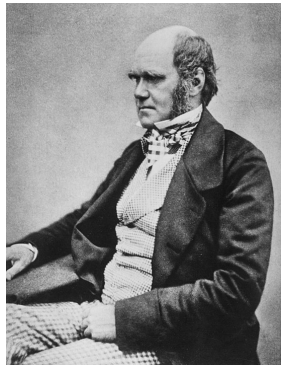

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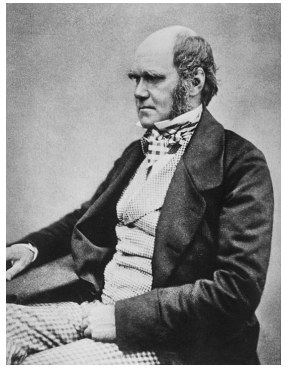

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- Complex interaction networks between species' populations underpin ecosystems

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- Mutualistic Networks coming up in next lecture

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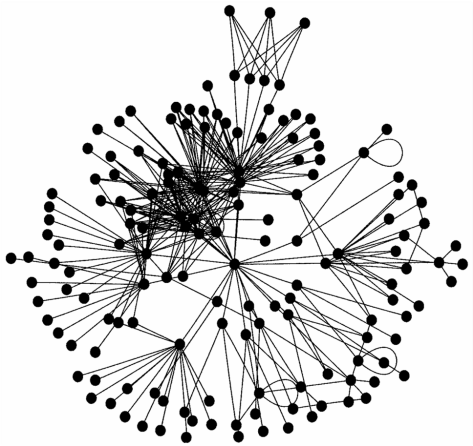
The Silwood Park Food web



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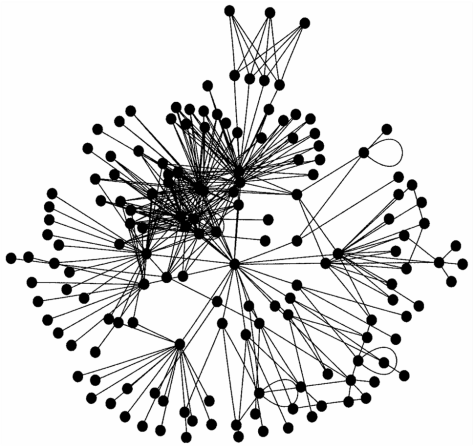

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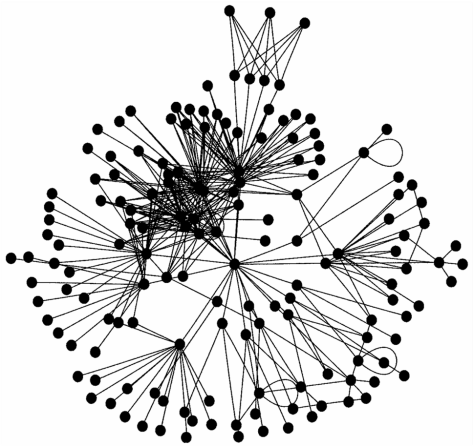

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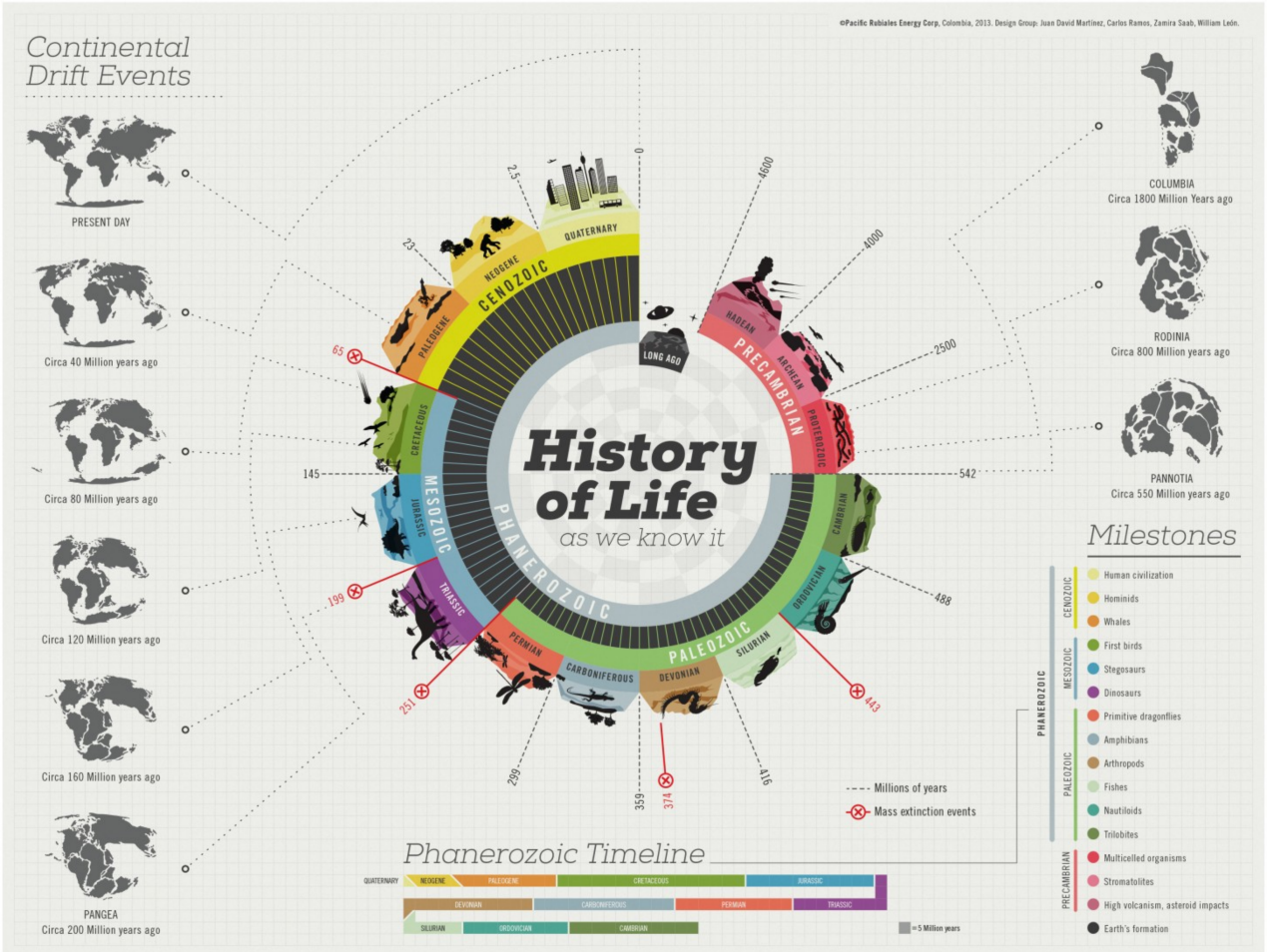
- Types:
  - Trophic networks (+/−) (e.g., food webs)
  - Mutualistic networks (+/+) (e.g., plant-pollinator networks) – *next lecture*
  - Competitive networks (−/−) (e.g., plant-plant or microbe-microbe)
  - Behavioural networks (+/−, +/+,+/−) (e.g., social networks)

ORIGIN OF ECOLOGICAL NETWORKS



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  - *Ancient microbes had trophic interactions*

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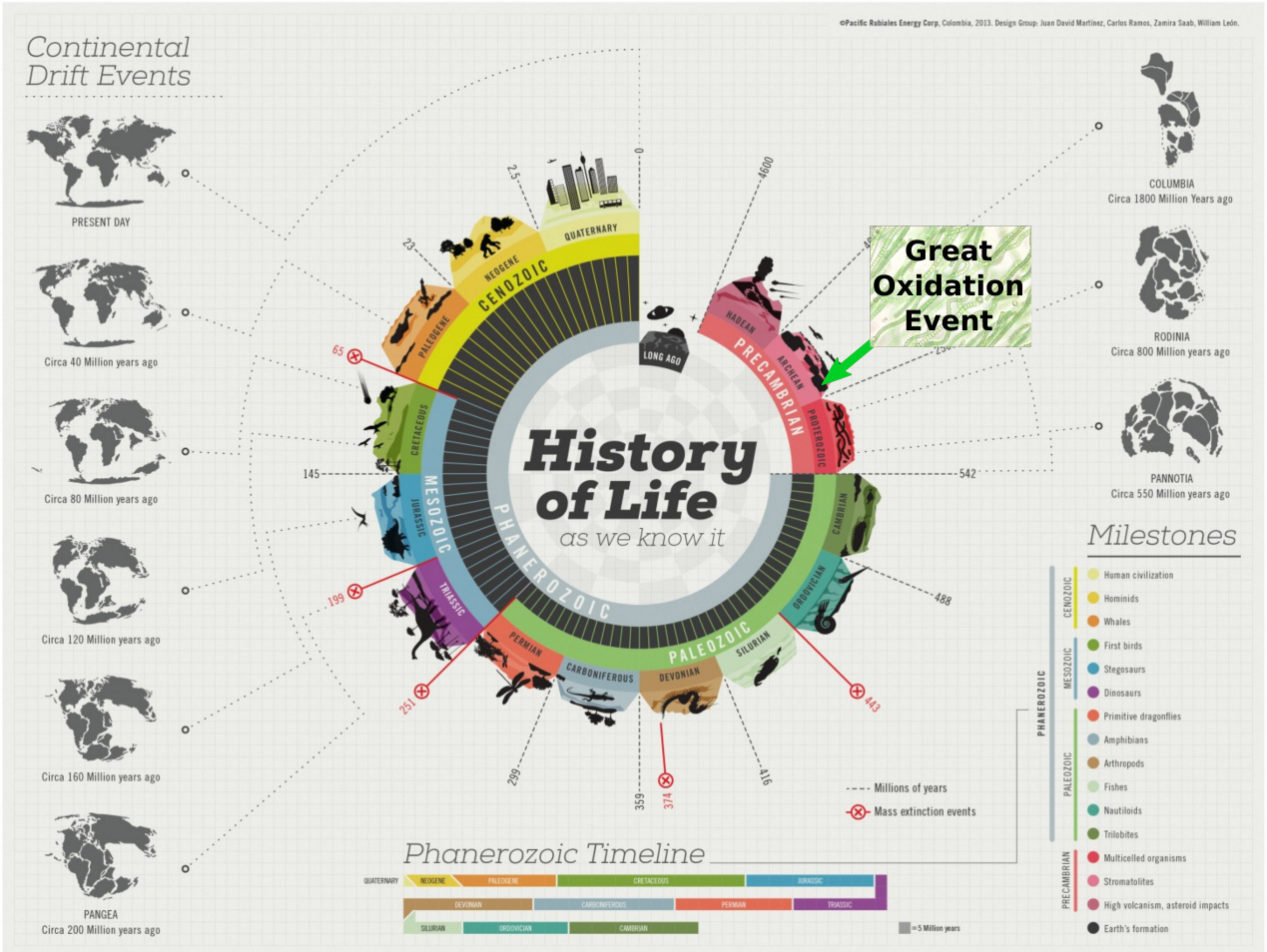

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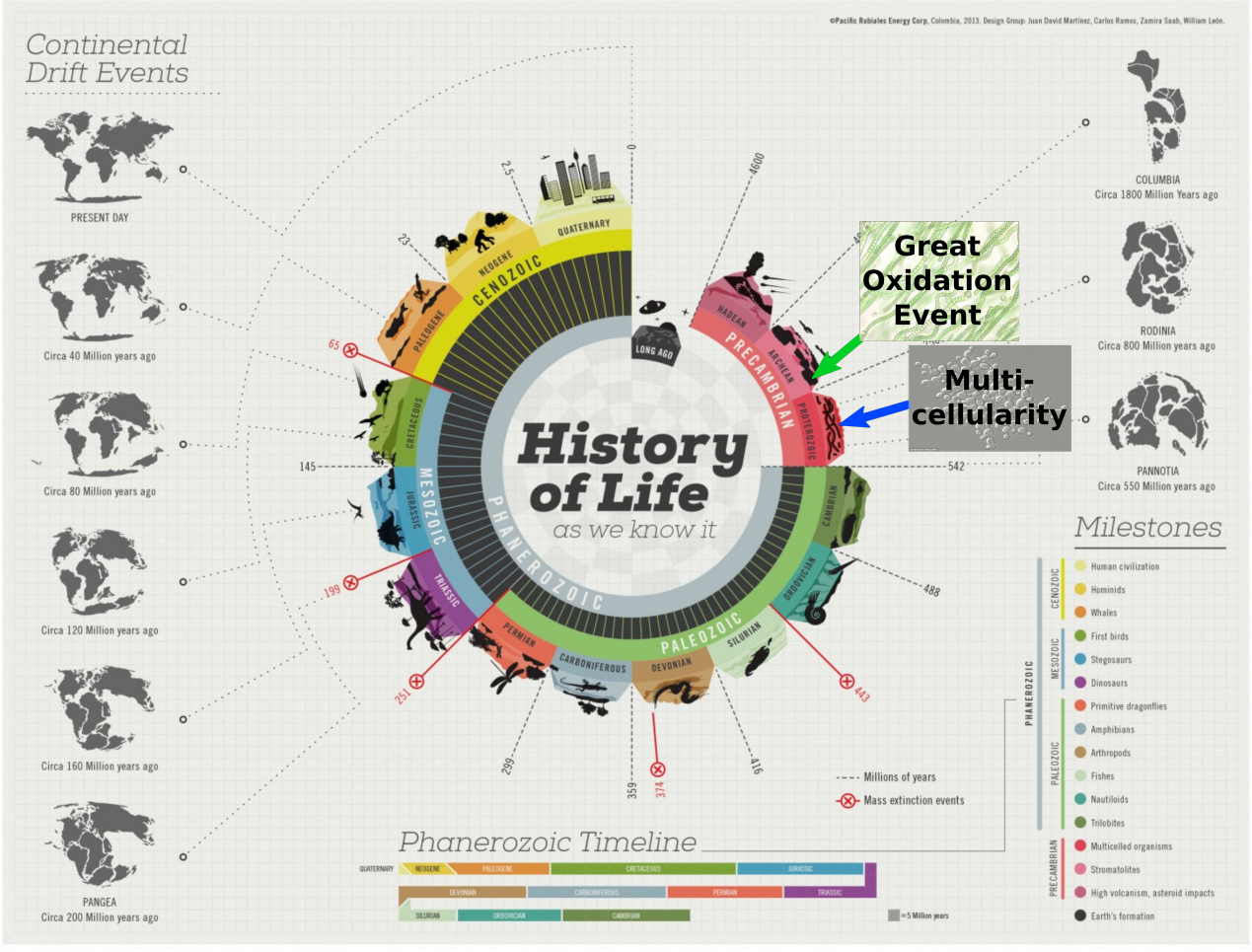

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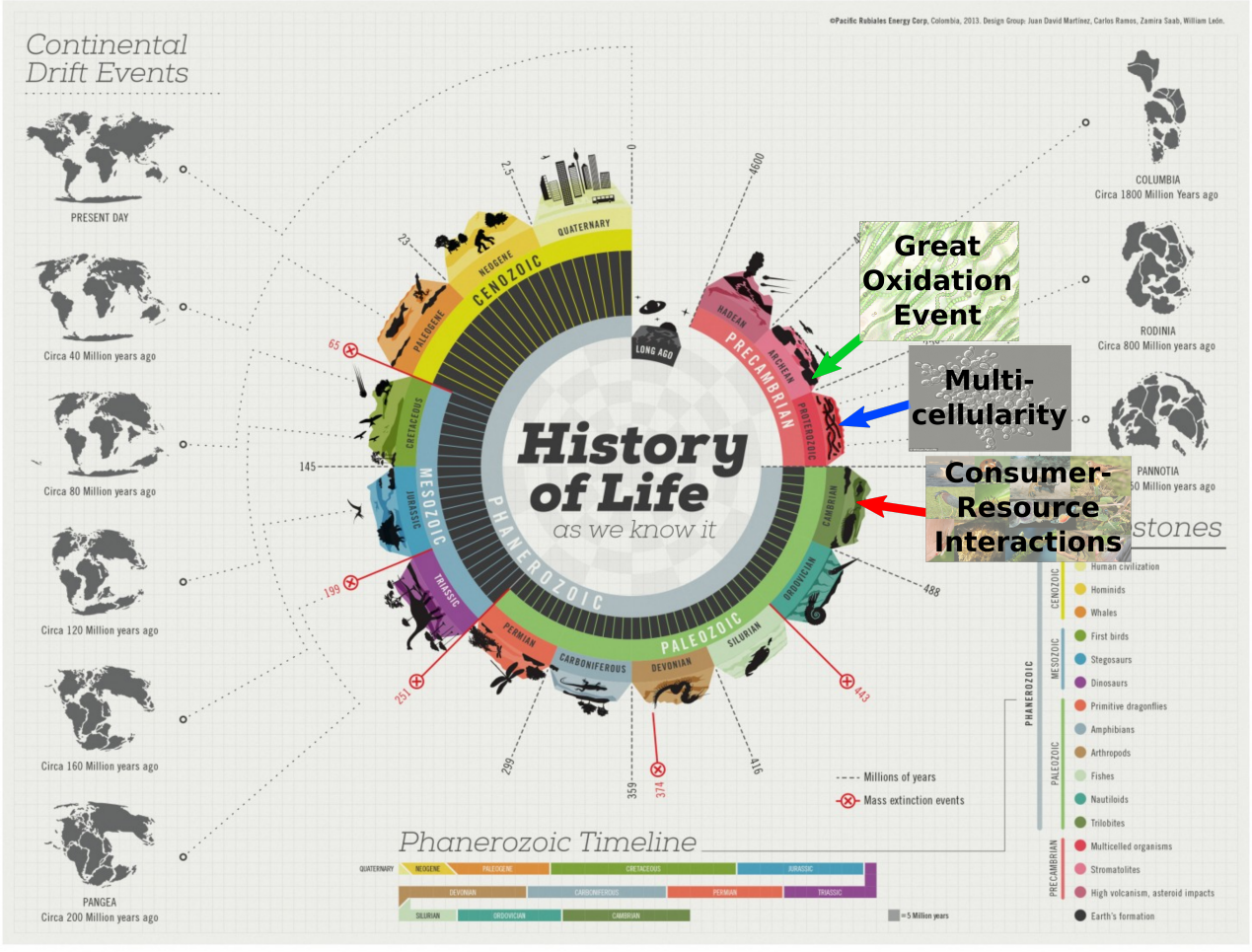

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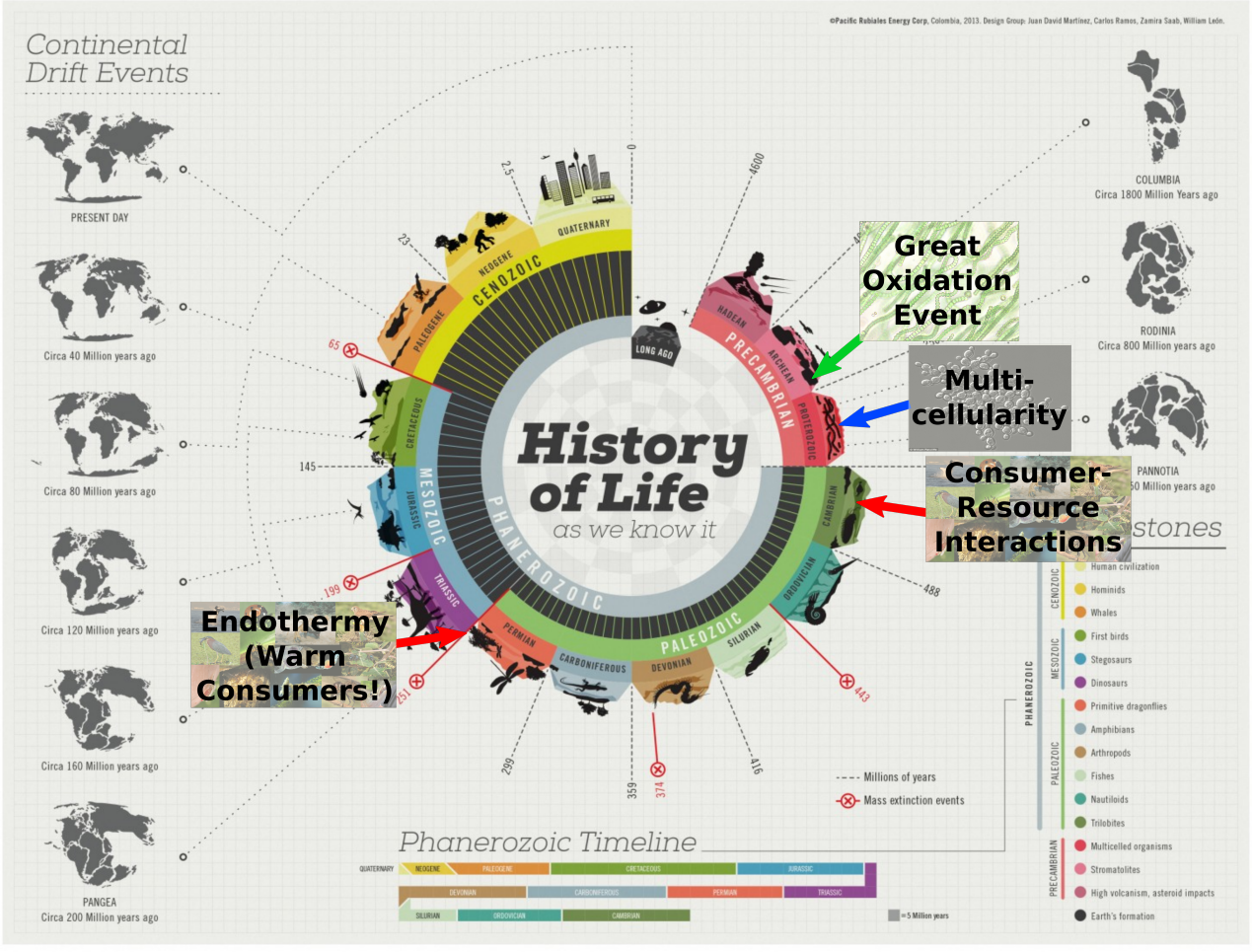

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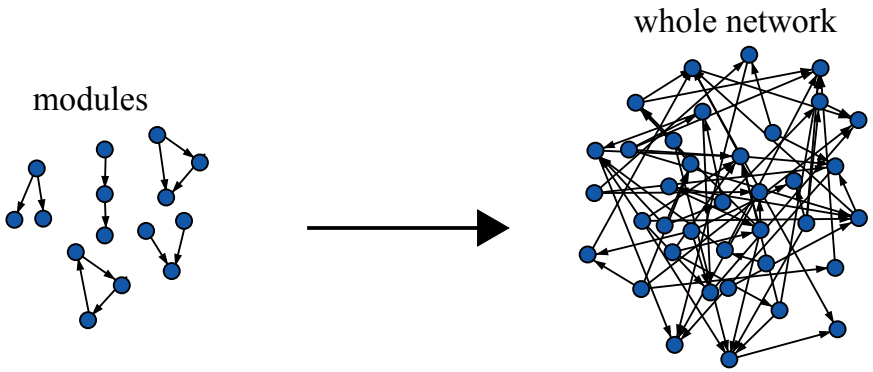

Bascompte & Stouffer Phil Trans Roy Soc B 2009

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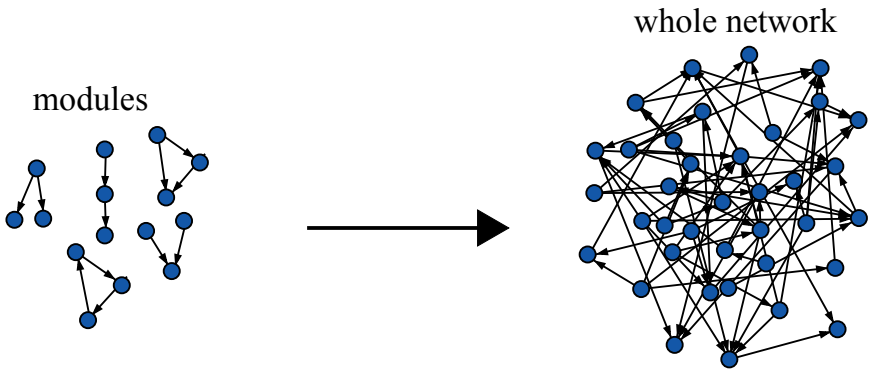

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- Certain modules may be selected (or de-selected) over time because they increase (or decrease) stability of the network / system (species in them go extinct — "species sorting")

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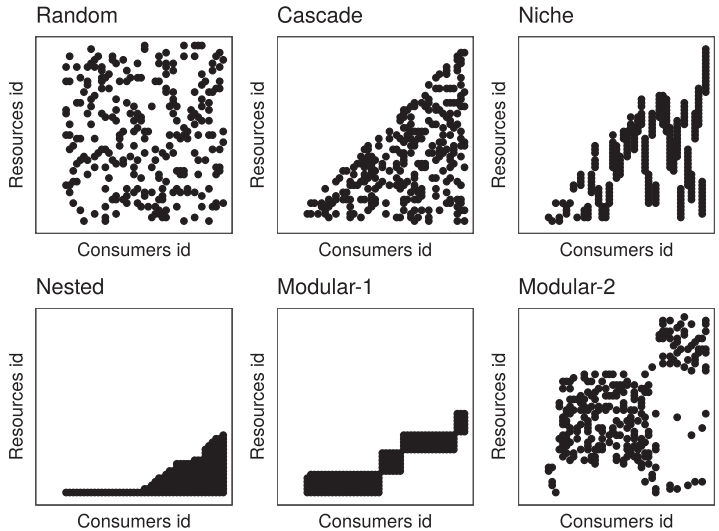

Ho et al Ecology Letters 2021

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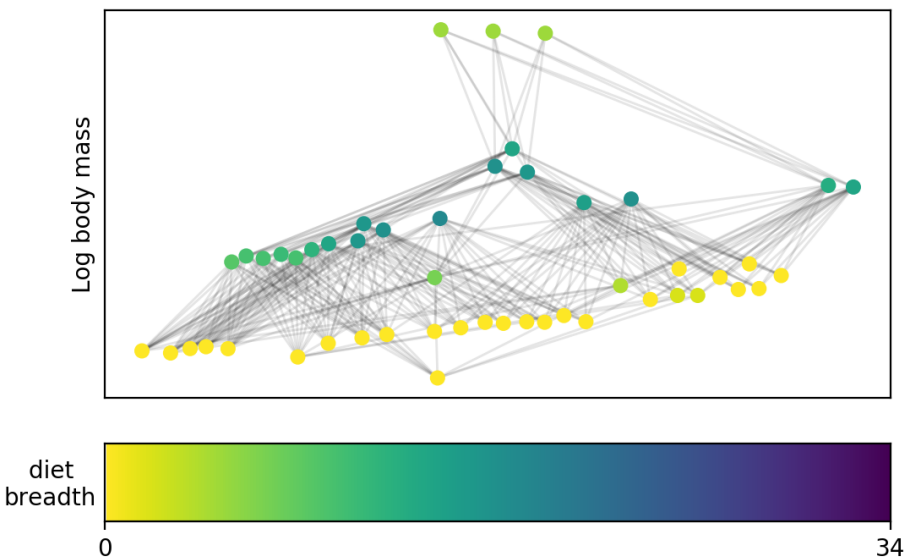

Ho et al Ecology Letters 2019

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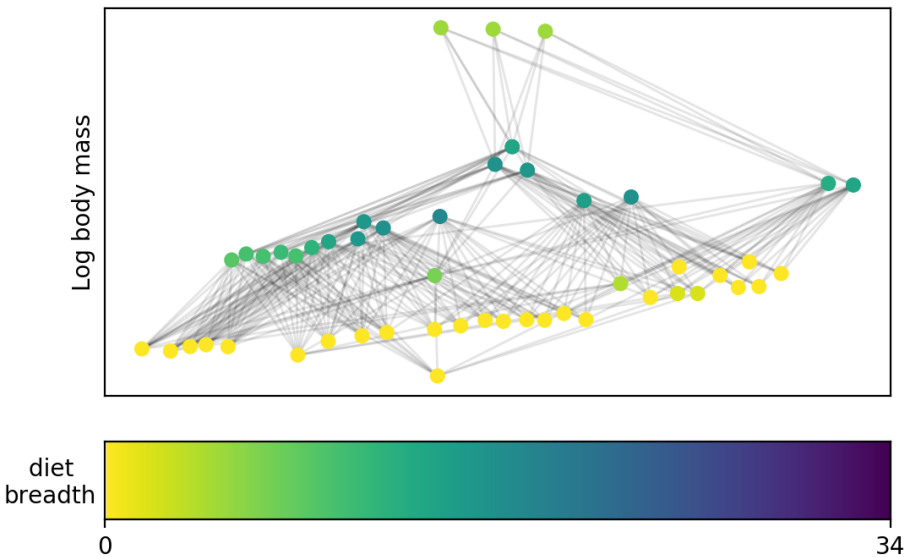
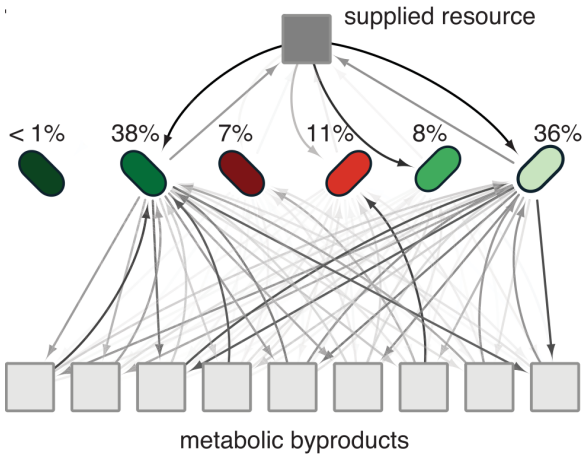


Ho et al Ecology Letters 2019

- **Microbial networks**: "who-eats-what" interactions of Consumers feeding on organic carbon sources

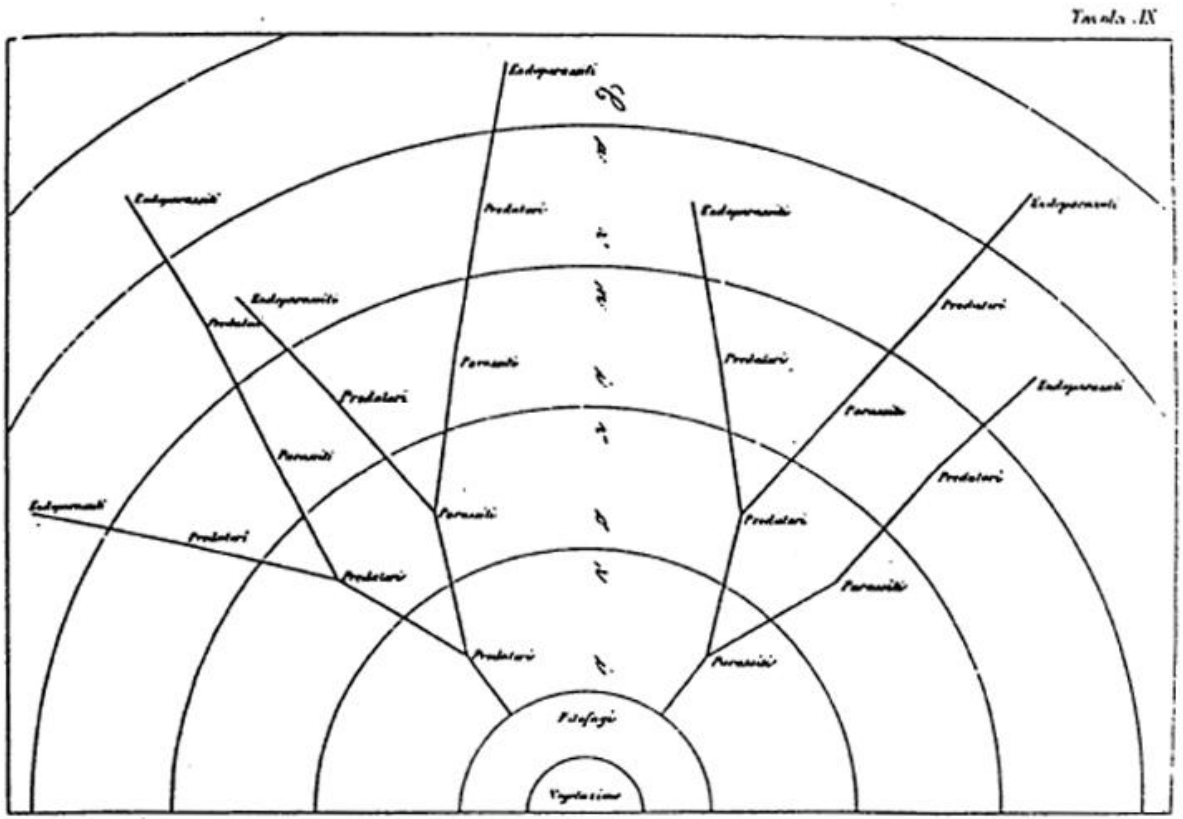


Goldford et al Science 2018

EARLY WORK ON TROPHIC NETWORKS

Plate I
vegetazione = vegetation
predatori = predators
parassiti = parasites
endoparassiti = endoparasites
carnivori = carnivores

From:
Camerano 1880 Atti Reale Acc Scienze Torino 1880



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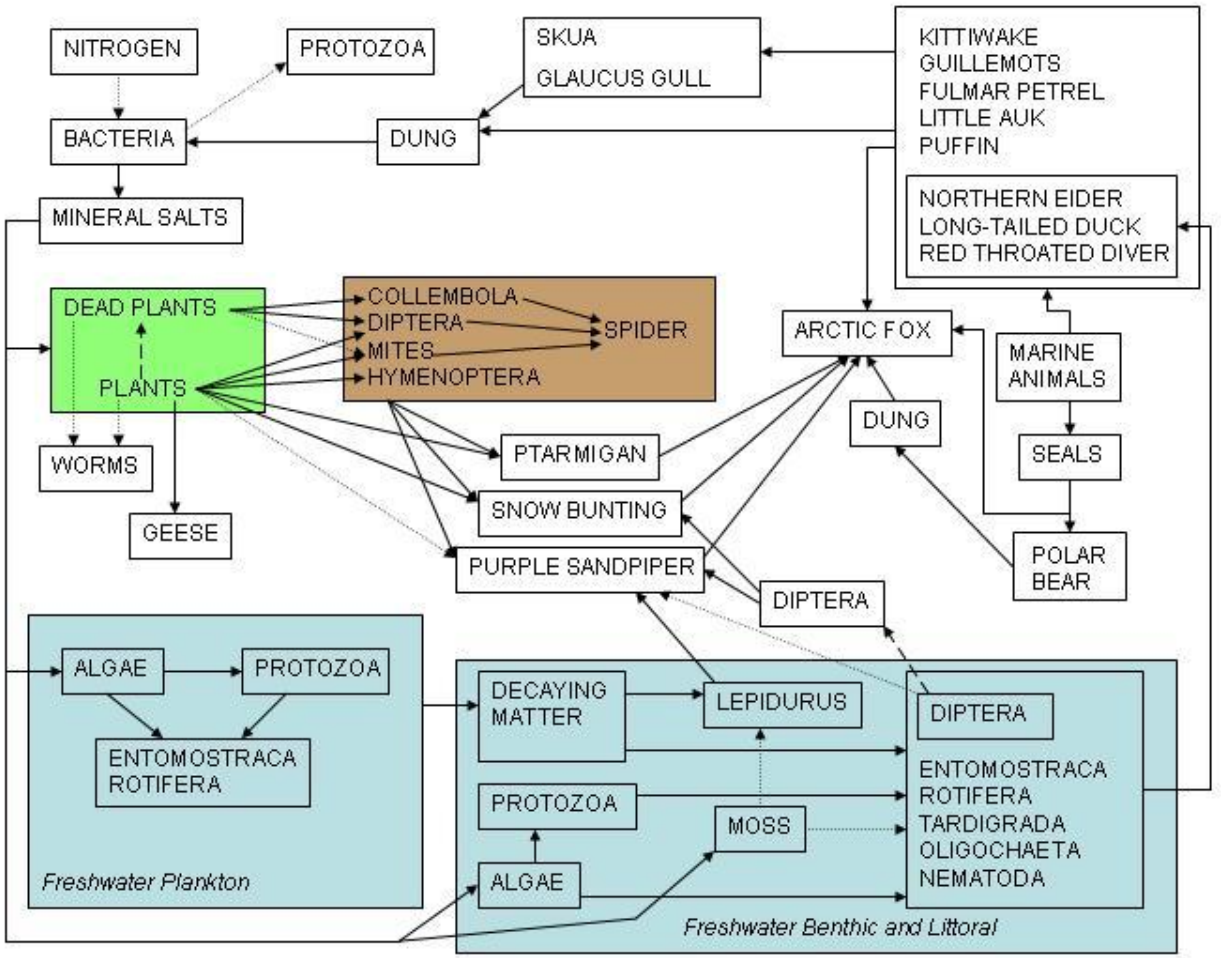

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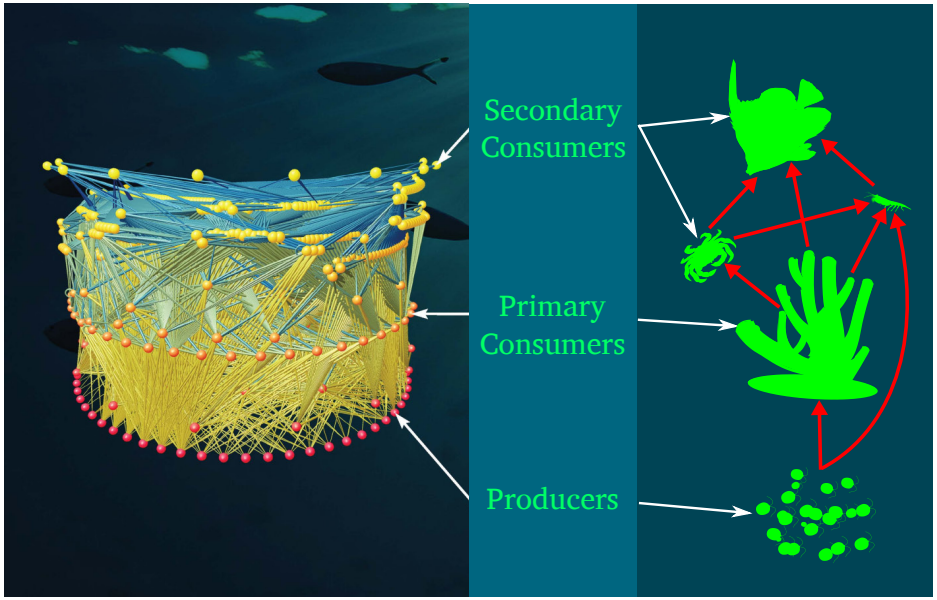

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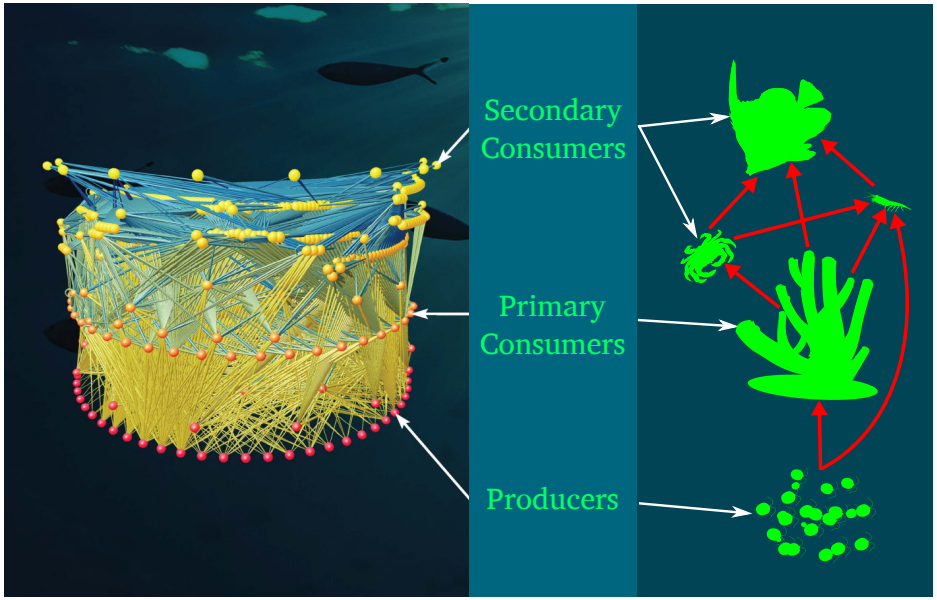

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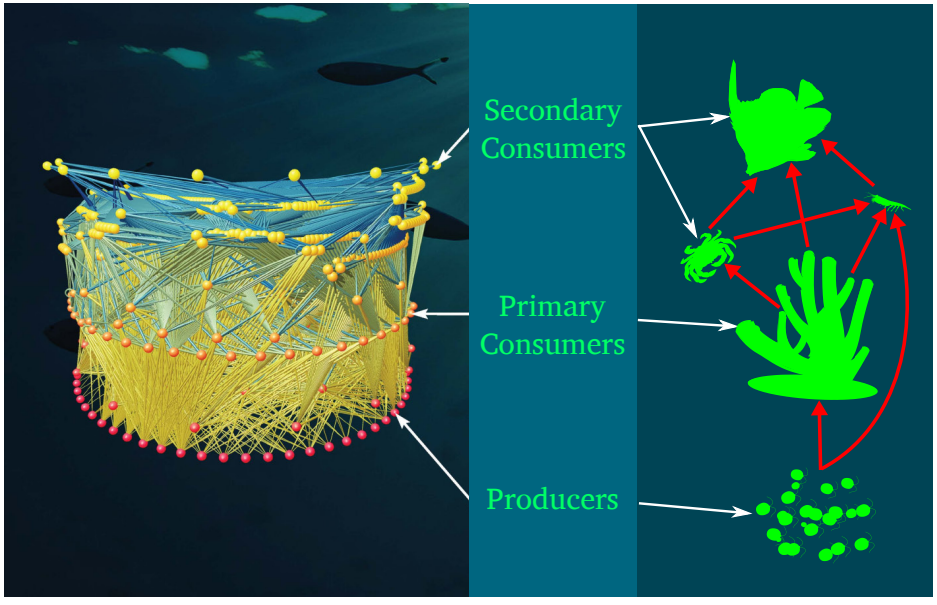

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- Food webs have systematic body size structure (e.g., size increases with trophic level)[2]
- There are consistent efficiencies of energy transfer across trophic levels (only $\approx 10 - 20\%$ per level)

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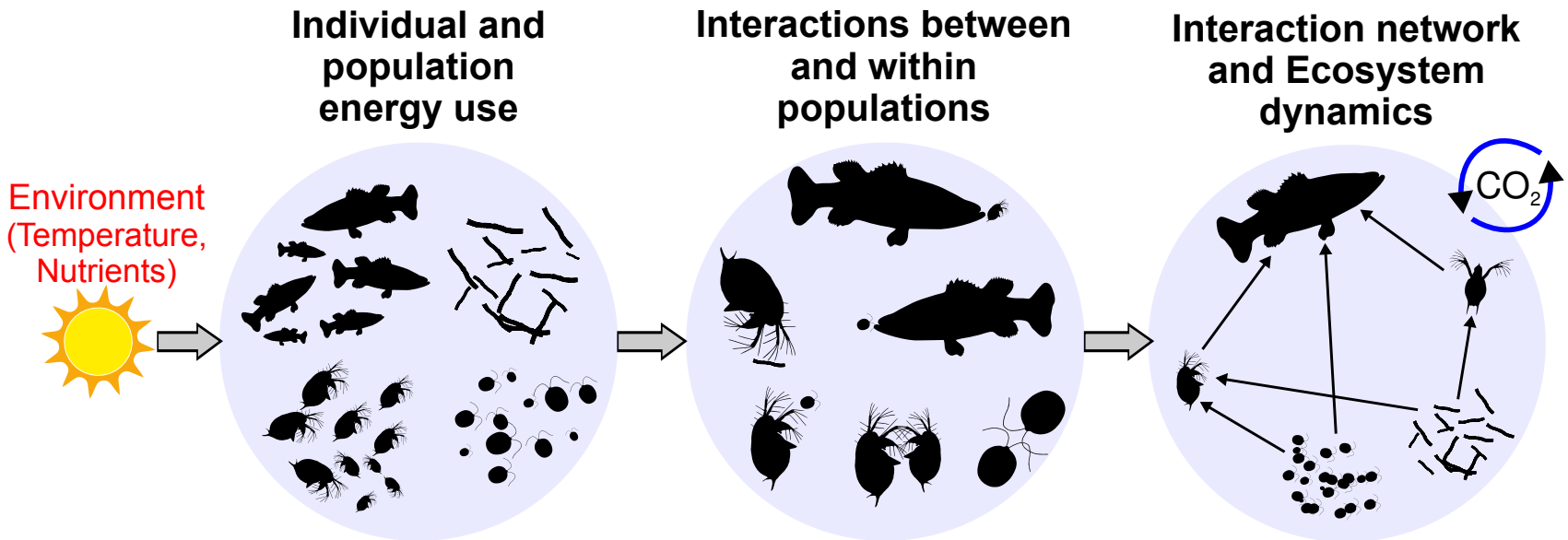

- Individual-level metabolism, through species interactions, determines trophic network structure and dynamics

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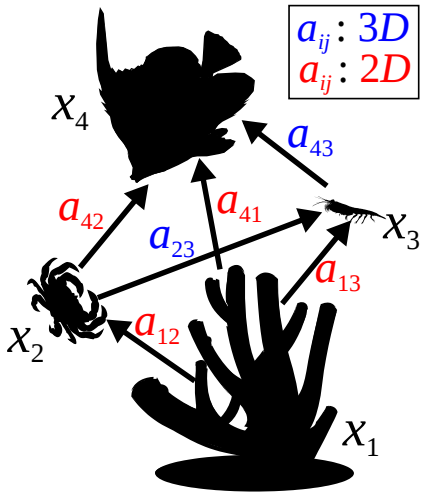

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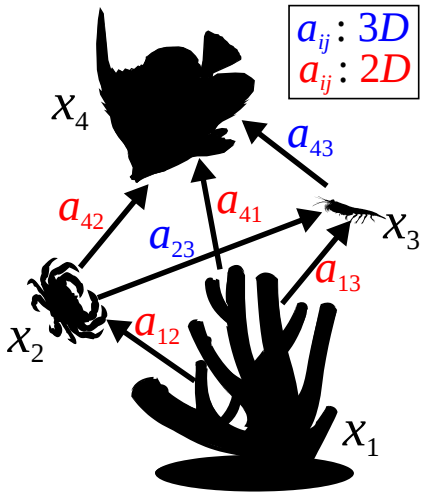
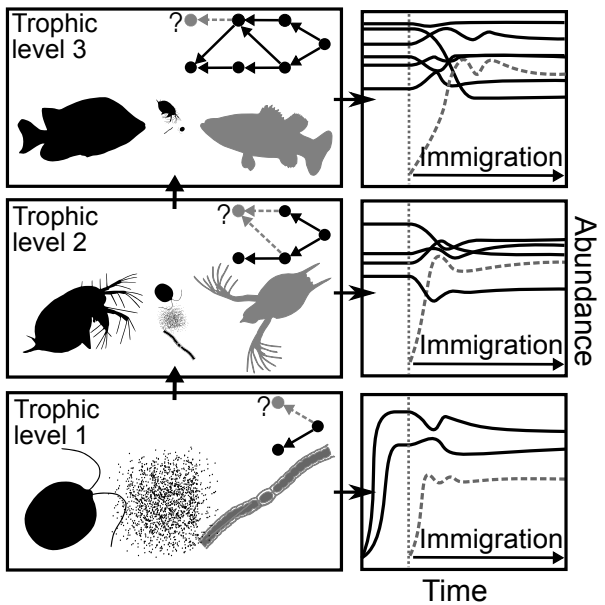


- These factors also influence community assembly/recovery rate



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THE FINAL ECOBUILDER CHALLENGE

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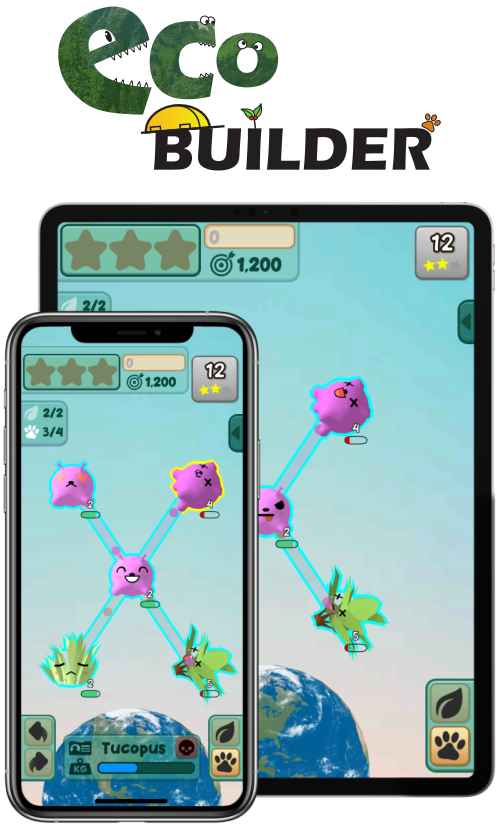

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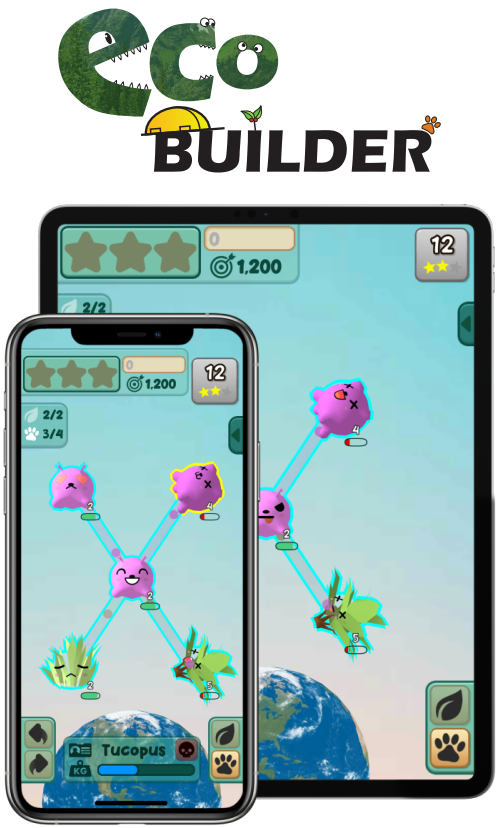

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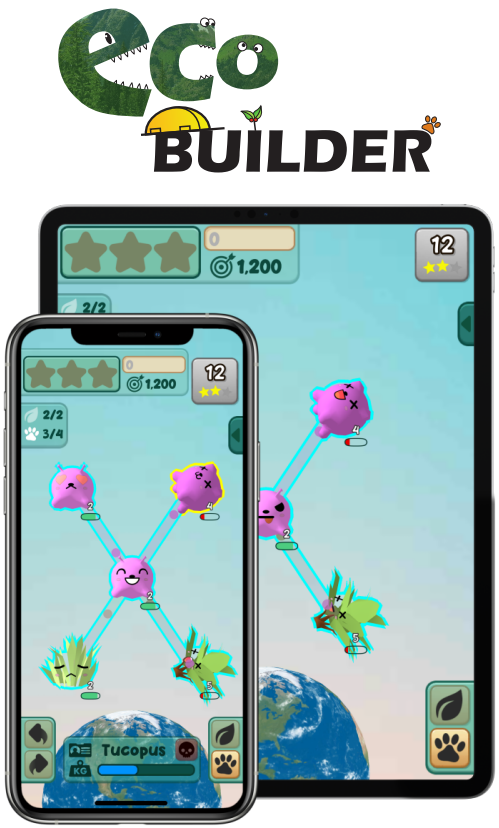

- `https://ecobuildergame.org` (to play in web browser: `https://ecobuildergame.org/Beta`
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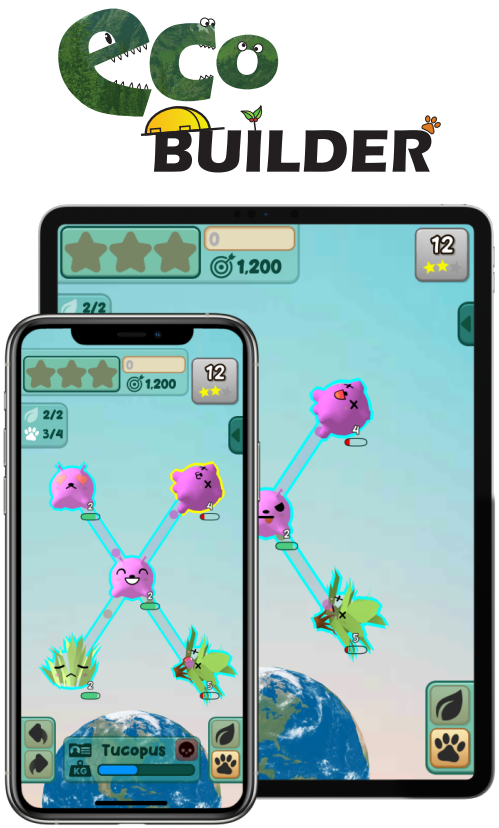
THE FINAL ECOBUILDER CHALLENGE

- How complex a network can you build?
- *Who can get the highest score in the class?*



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- You will have to get through the *Learning World* to get to the *Research World*
- In the *Research World*, try and maximize your score!

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  - Important for understanding the many effects of of global change
- Metabolism is key for understanding trophic networks and the emergent ecosystem dynamics

DISCUSSION QUESTIONS

1. What sorts of interactions might ancient microbes have had? What type(s) of Ecological Network(s)?
2. What are the differences and similarities between microbial networks (who-eats-what type) and food webs (who-eats-whom type)?
3. What did you learn about types of building blocks of food webs from the EcoBuilder game? What types of trophic interaction modules?
4. What role do indirect interactions play in trophic network / food web dynamics?
5. How are trophic/biomass/ecological pyramids related to body size structure in food webs?
6. How do you think climatic temperature (and warming) affects trophic networks / food webs?

READINGS

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