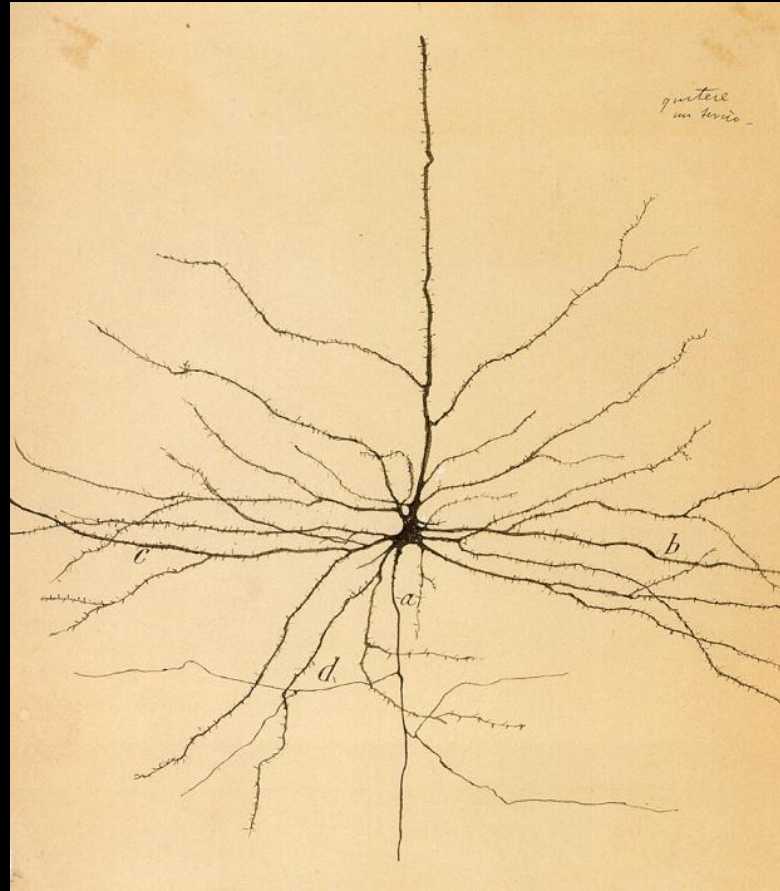


the Architecture of
Biodiversity:
Who eats whom?

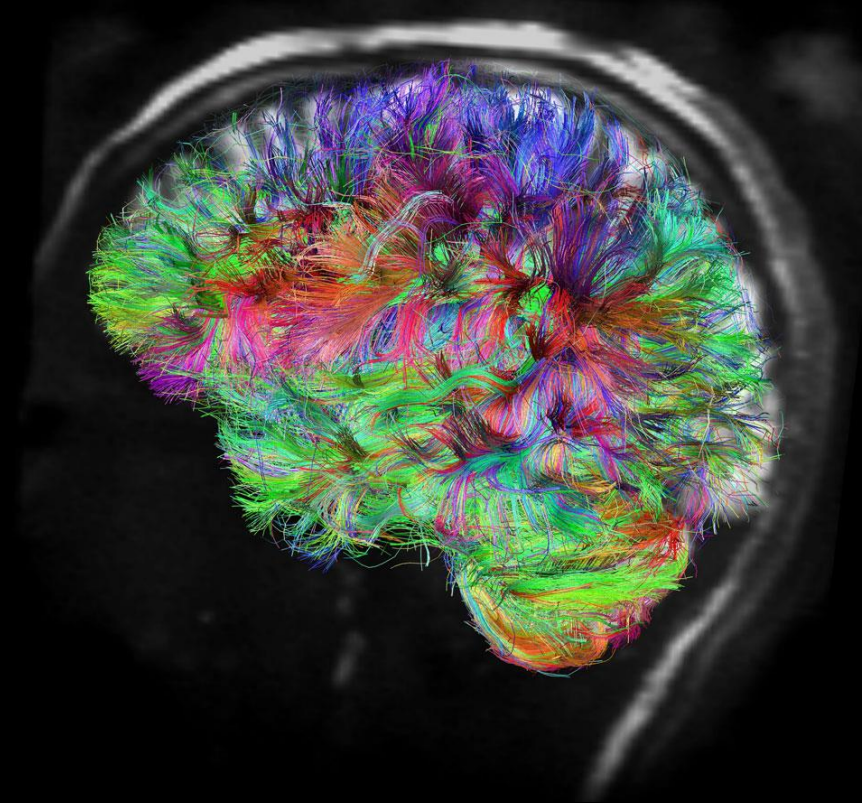
Individual Neuron



Brain



Brain Connectome



Bank



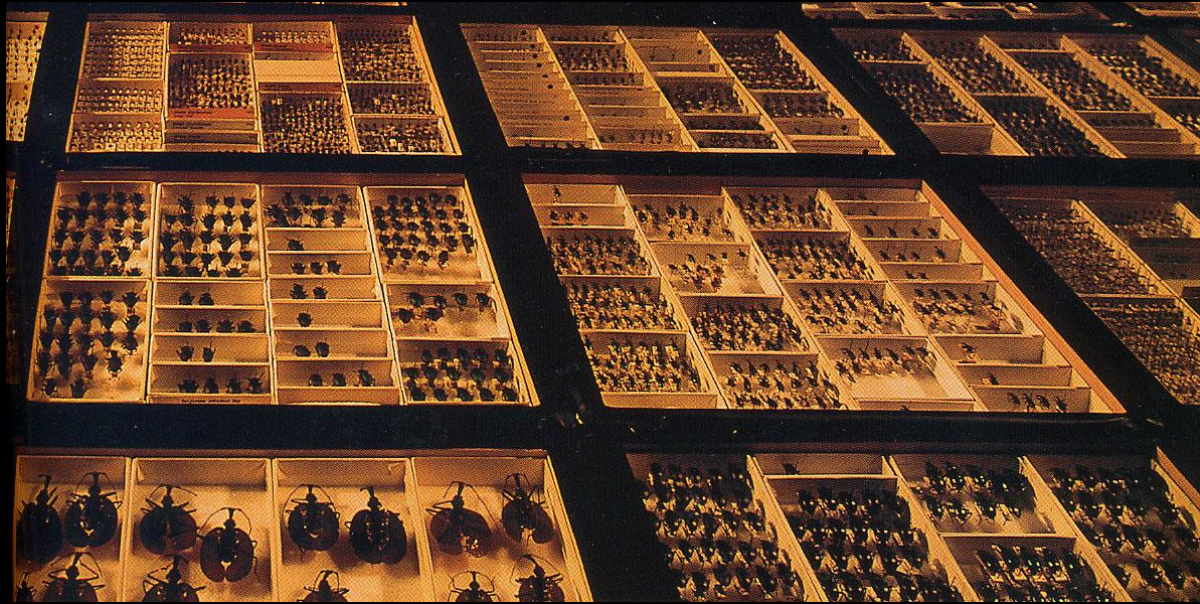
Interbank Market Flows



Individual Species



Biodiversity



Species interact



Neurons are connected
Companies are connected
Species are connected

·
·
·

And genes, and people, and
airports, and proteins, and
websites, and servers, and
scientist...

So What?

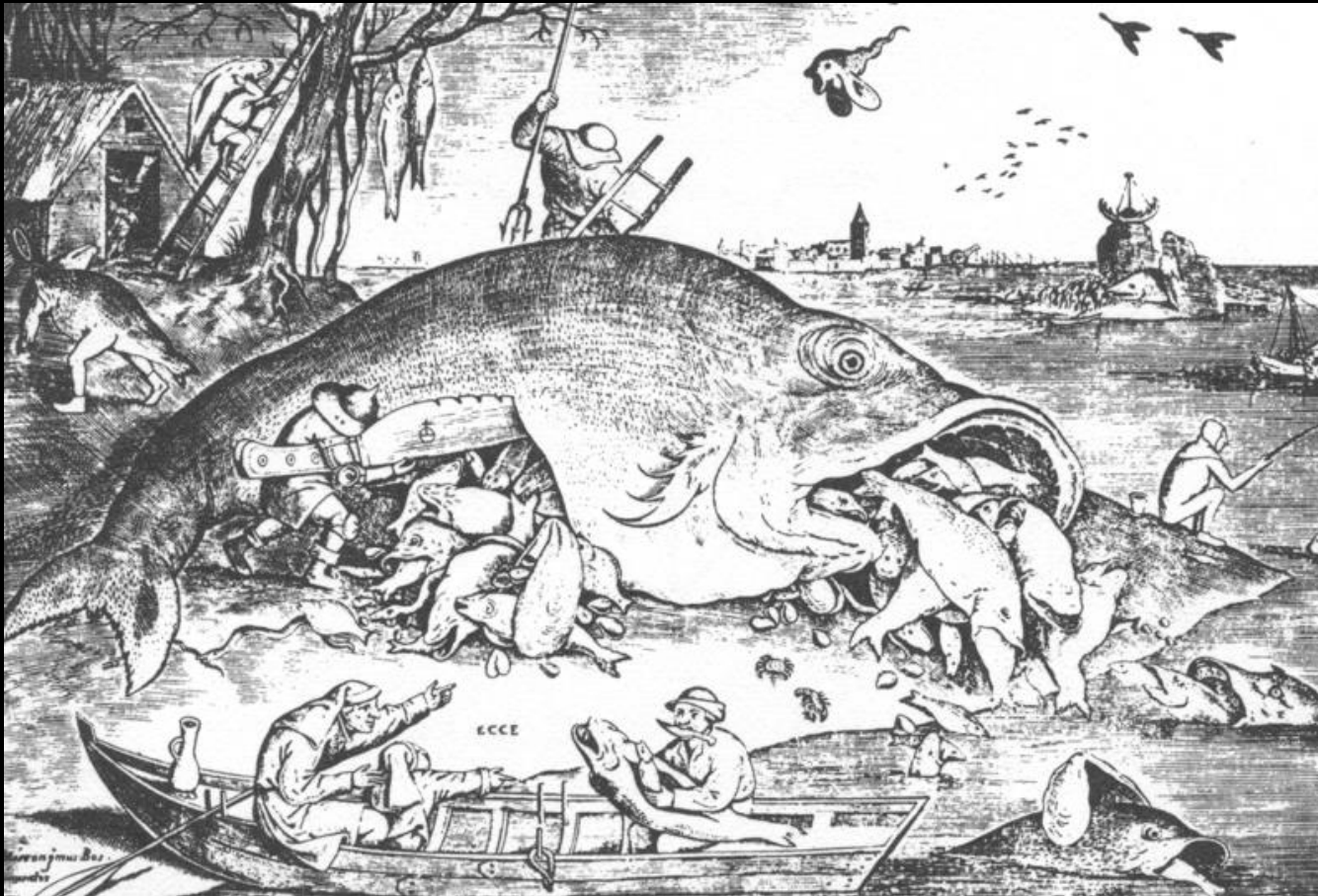
We cannot understand these systems if we don't account for interactions

There are commonalities in all these systems

Interdisciplinary science. Same currency, nodes and links



Networks in Ecology: Global Change and Biodiversity



How is network topology
going to affect
the spread of a perturbation?

Which species are more likely
going to be extinct?

How network structure changes in
time and space?

How are human impacts affecting
network structure and system
dynamics?

Types of interactions
between species:

Mutualistic

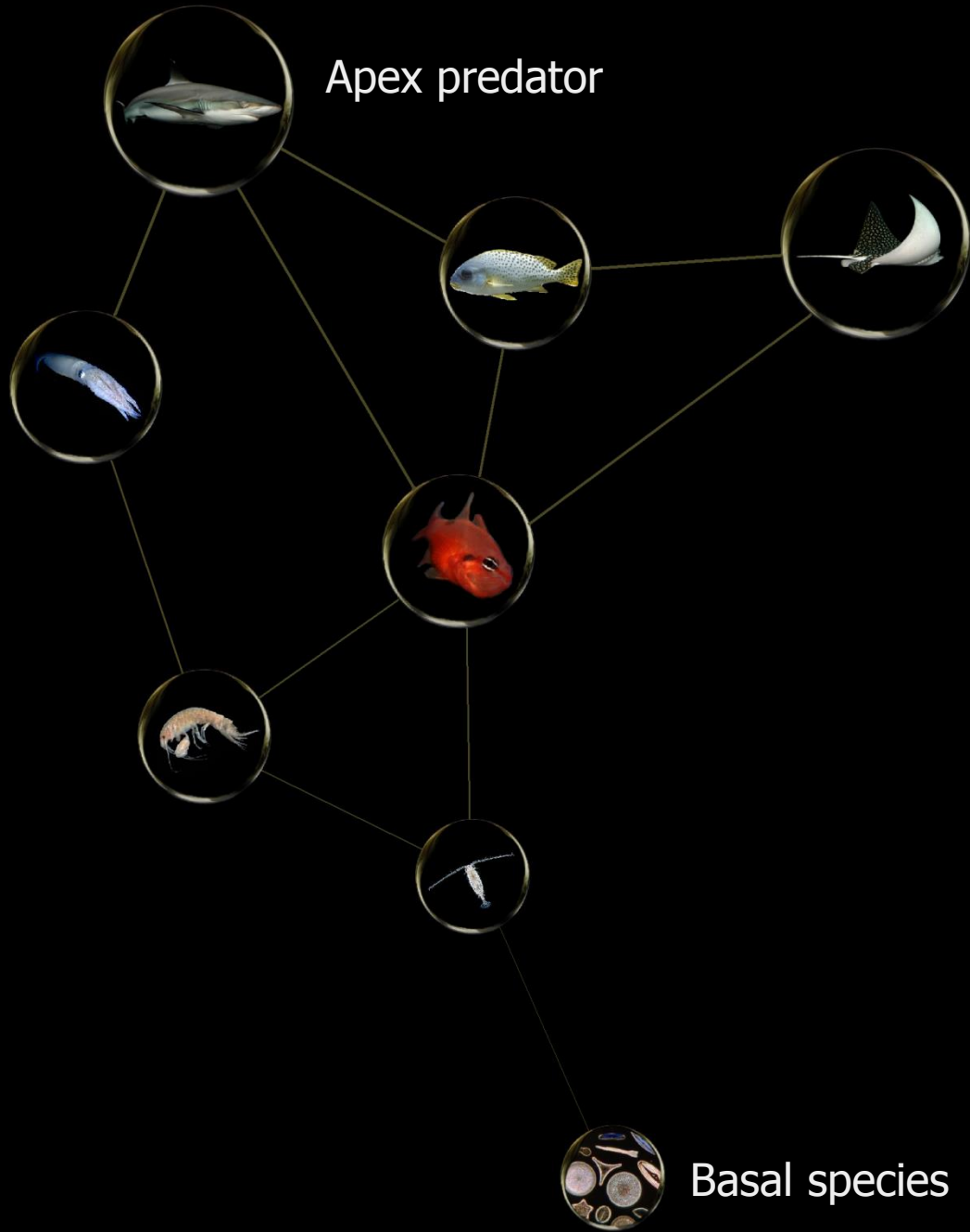


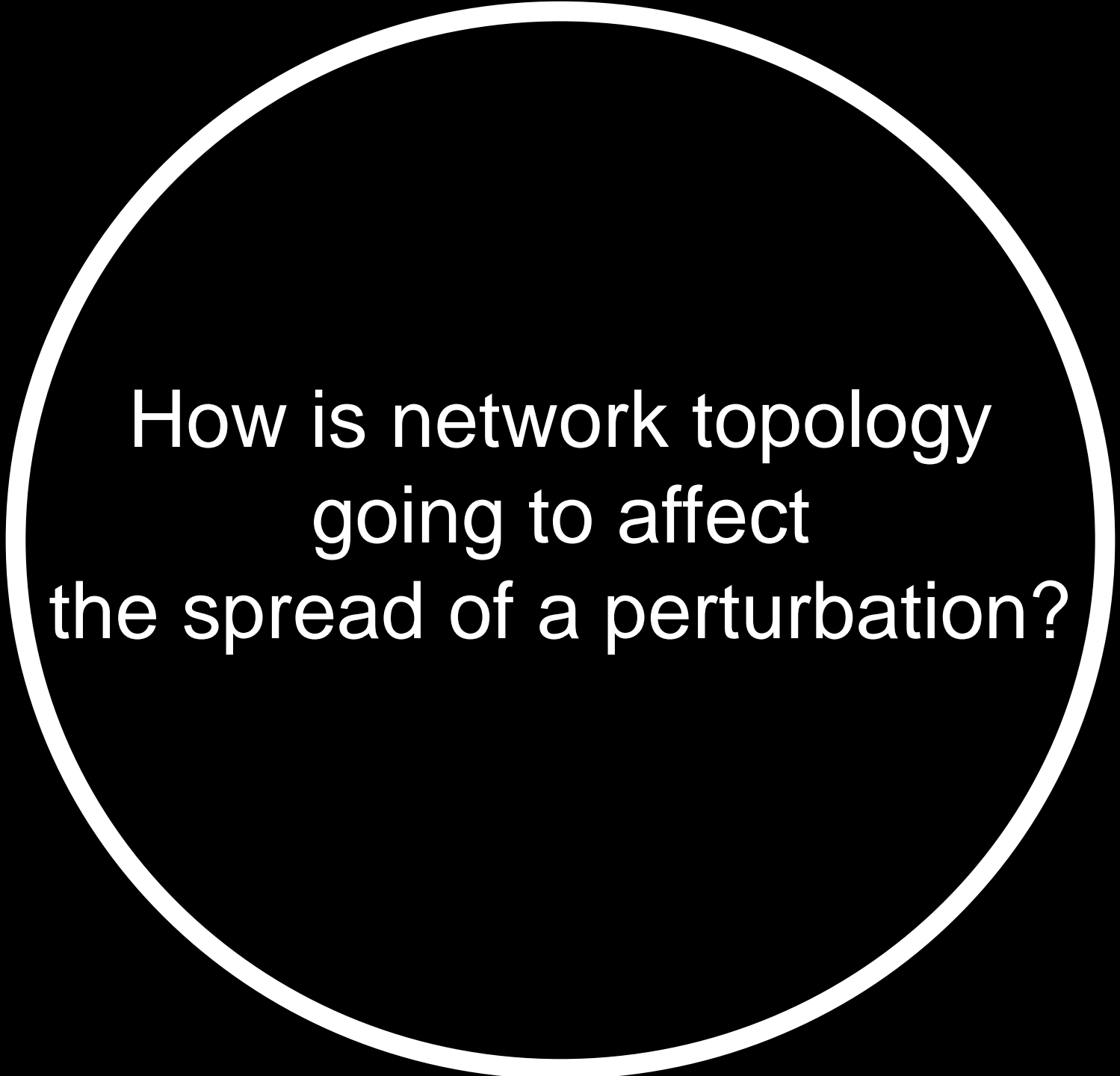
Trophic



Food webs: structure and dynamics

Energy flow



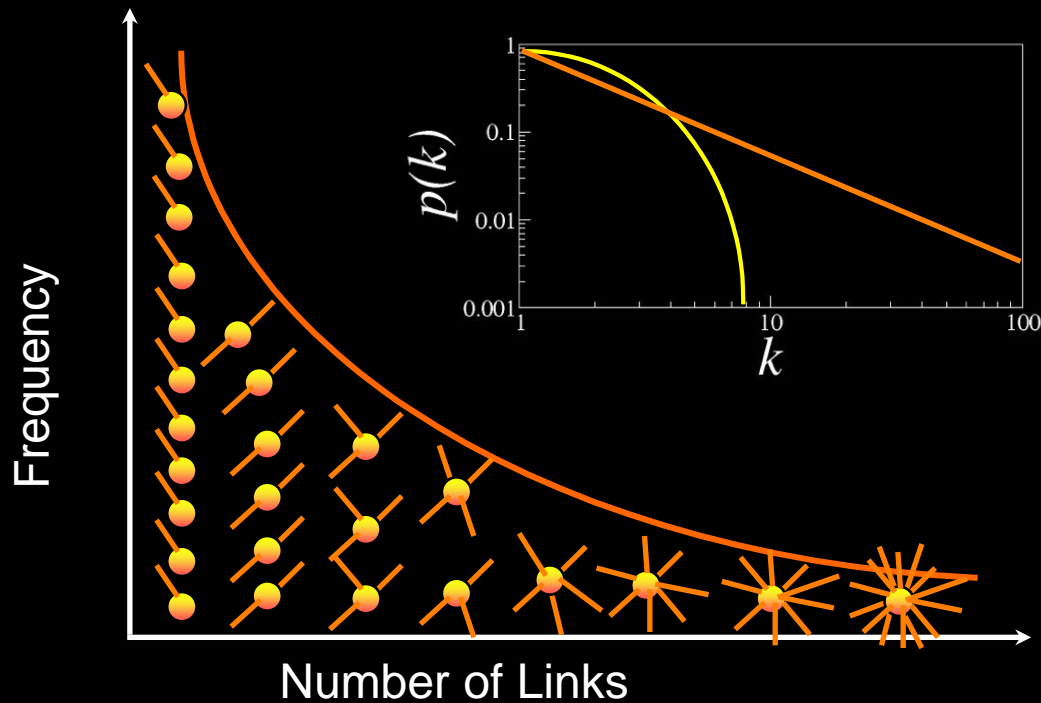


How is network topology
going to affect
the spread of a perturbation?

Complex Networks are Heterogeneous

$$P(k) = ck^{-\gamma}$$

$$P(k) = ce^{-\gamma k}$$



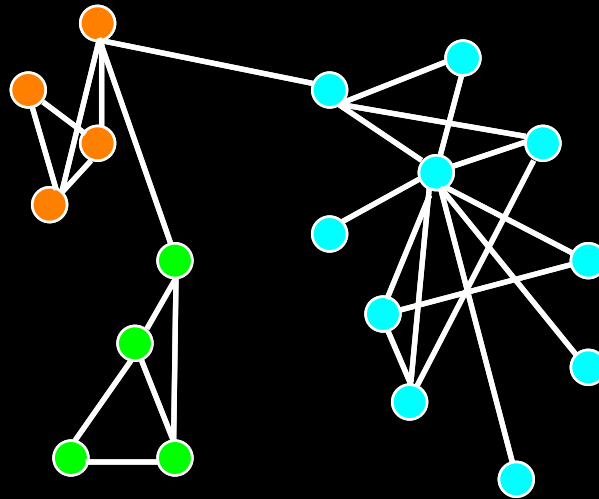
Perturbation Spread



Perturbation Spread



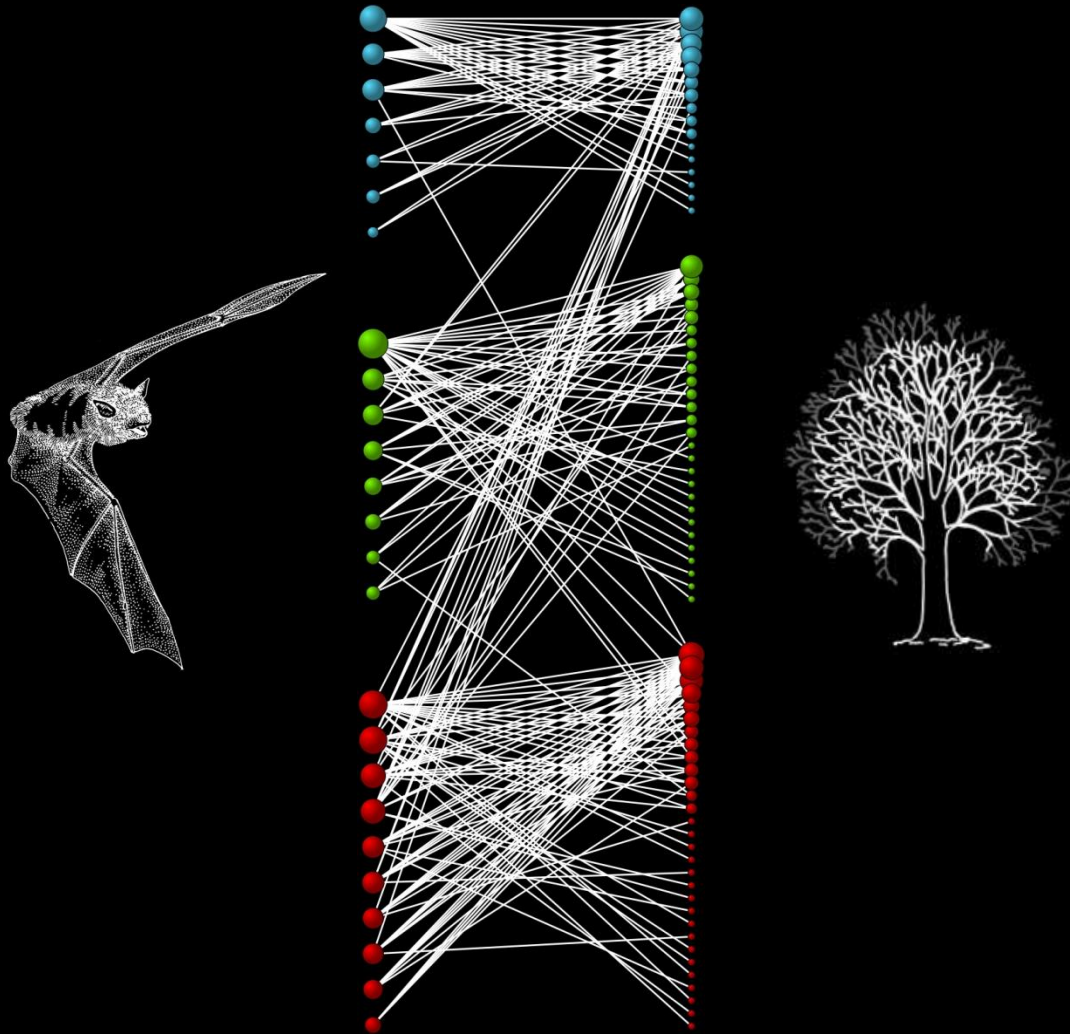
Complex Networks are Organized in Compartments



Newman and Girvan (2004). *Phys. Rev. E* 69: 026113

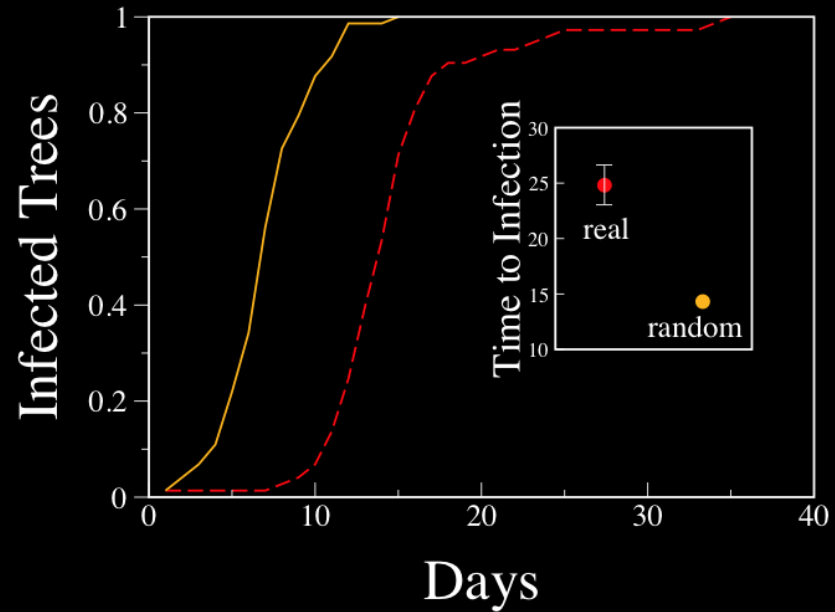
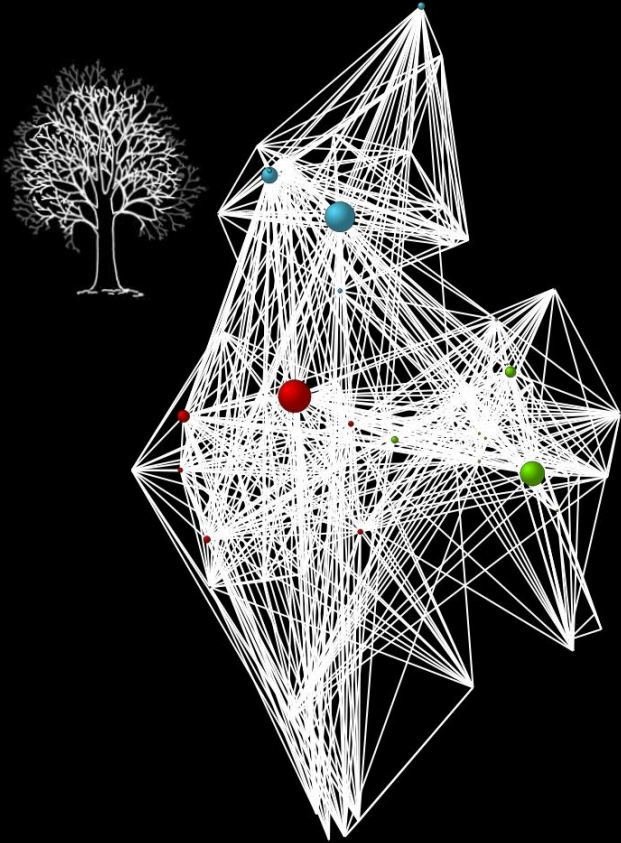
Guimerà and Amaral (2005). *Nature* 433: 895-900

Bats' Social Network



Fortuna, Popa-Lisseanu, Ibañez, and Bascompte (2009). *Ecology*, 90: 934-944

Delay in Perturbation Spread



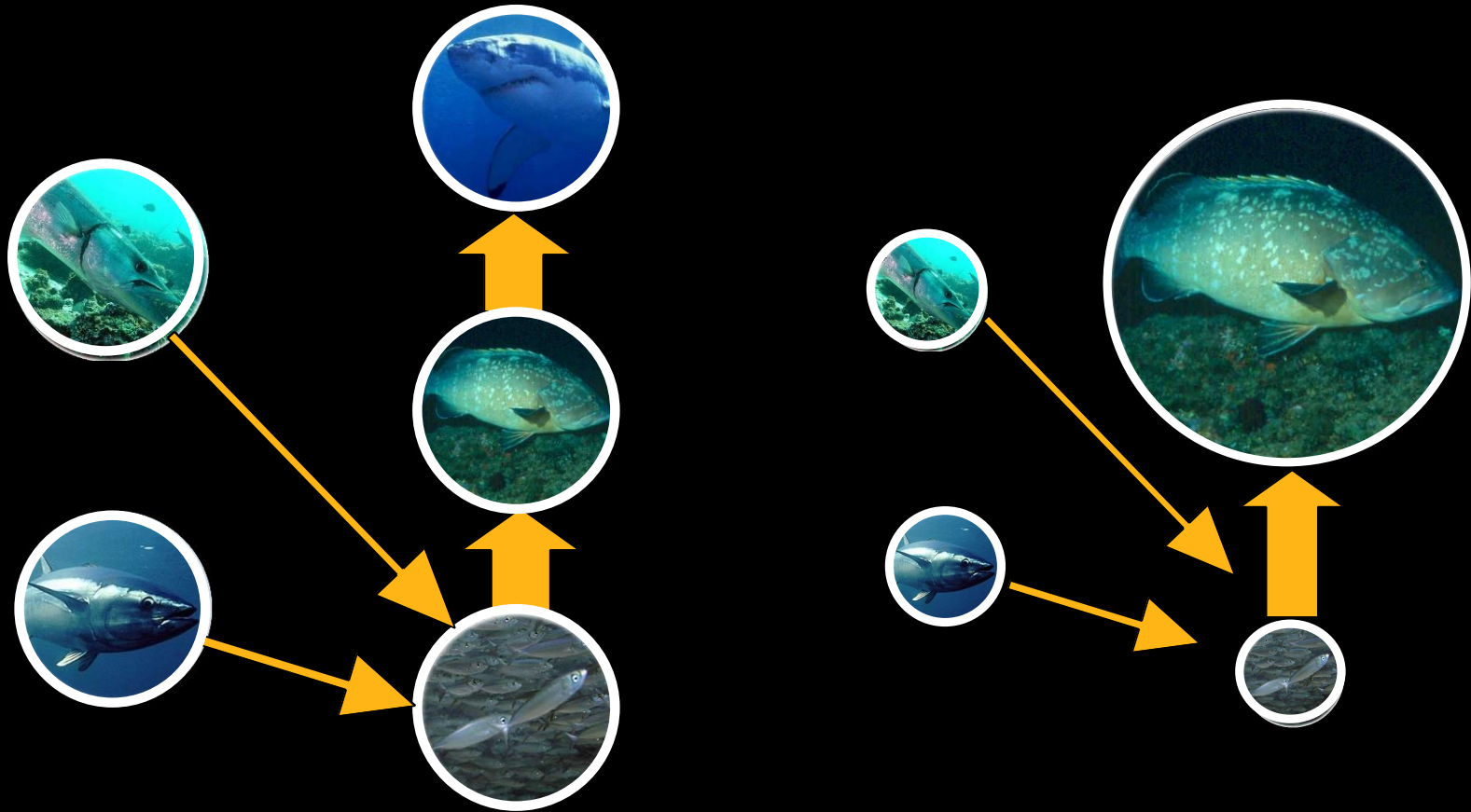


Which species are more likely going to be extinct?

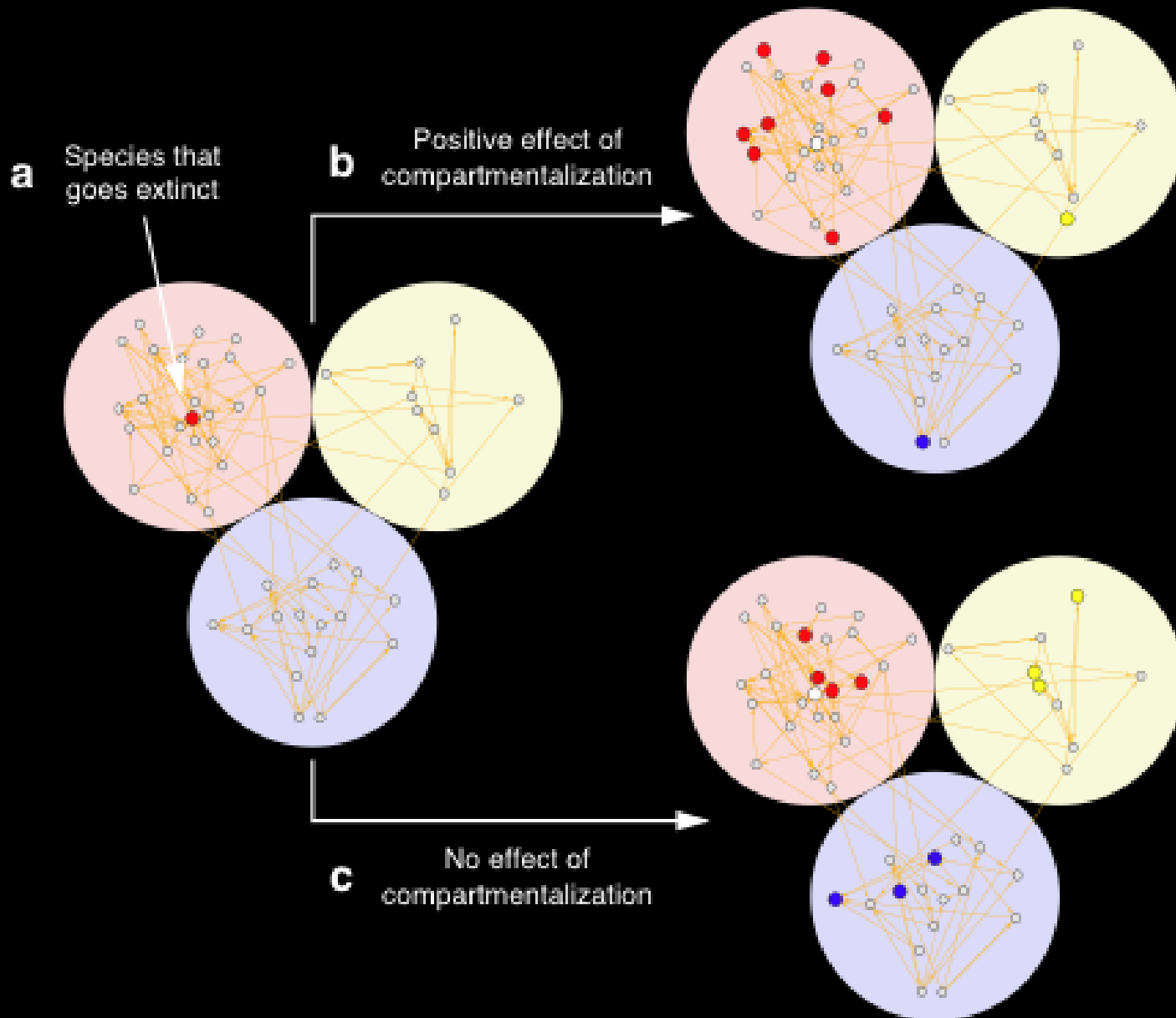
Species Biomass change in time

$$\frac{dB_i}{dt} = \underbrace{r_i G_i B_i - x_i B_i + x_i B_i}_{\text{Metabolic Growth}} \underbrace{\sum_{j \in \{\text{prey of } i\}} y_i F_{ij}}_{\text{What species } i \text{ eats from other species}} - \underbrace{\sum_{k \in \{\text{predators of } i\}} \frac{x_k y_k B_k F_{ki}}{e_{ki}}}_{\text{What other species eat from species } i}$$

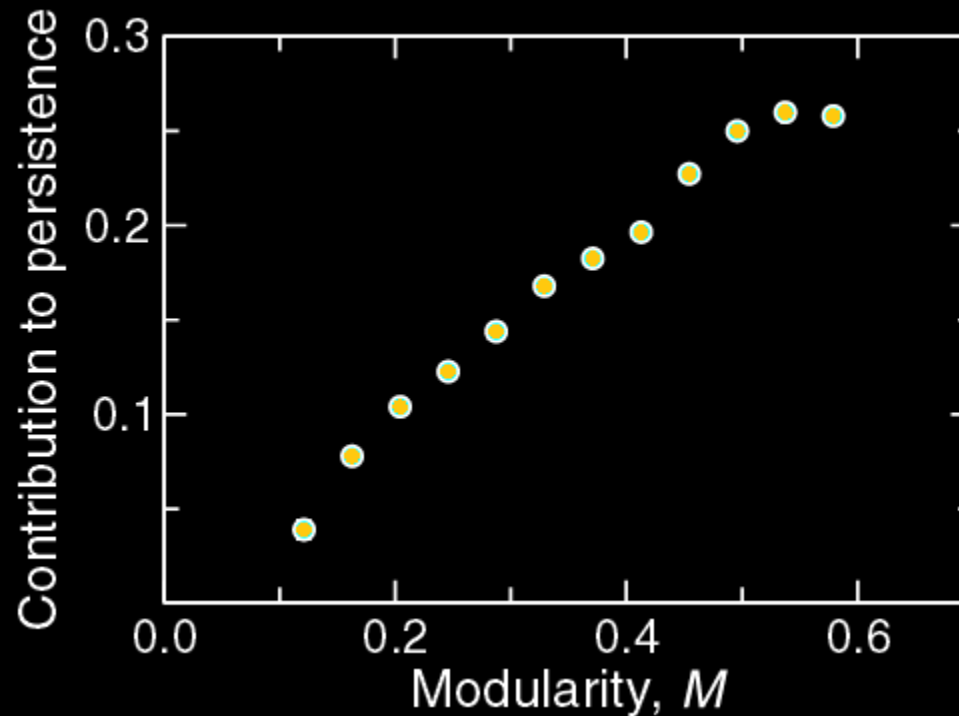
Trophic cascades

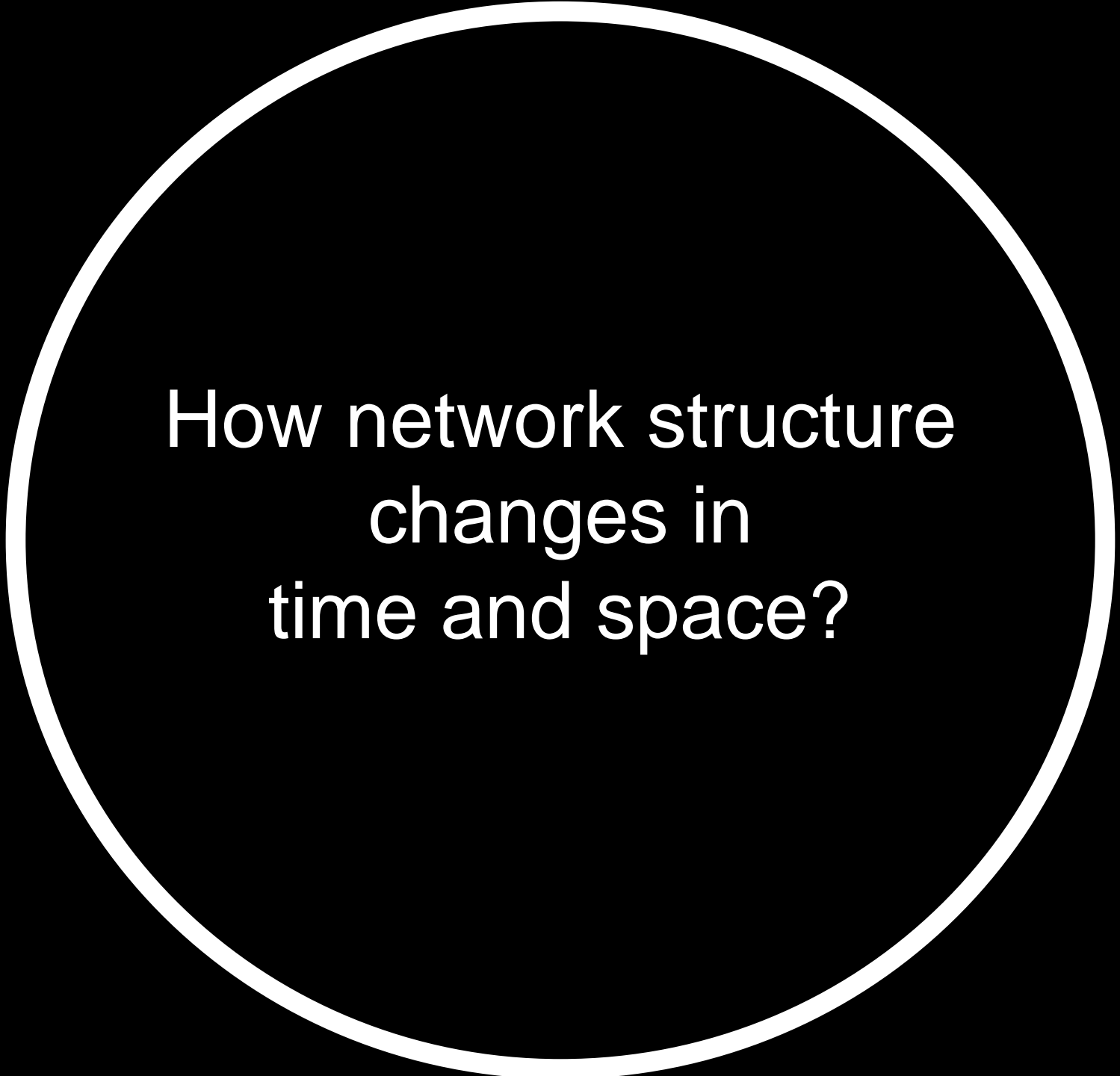


(Bascompte, Melián and Sala 2005, *PNAS* 102: 5443-5447)



Modularity decreases the risk of loosing species



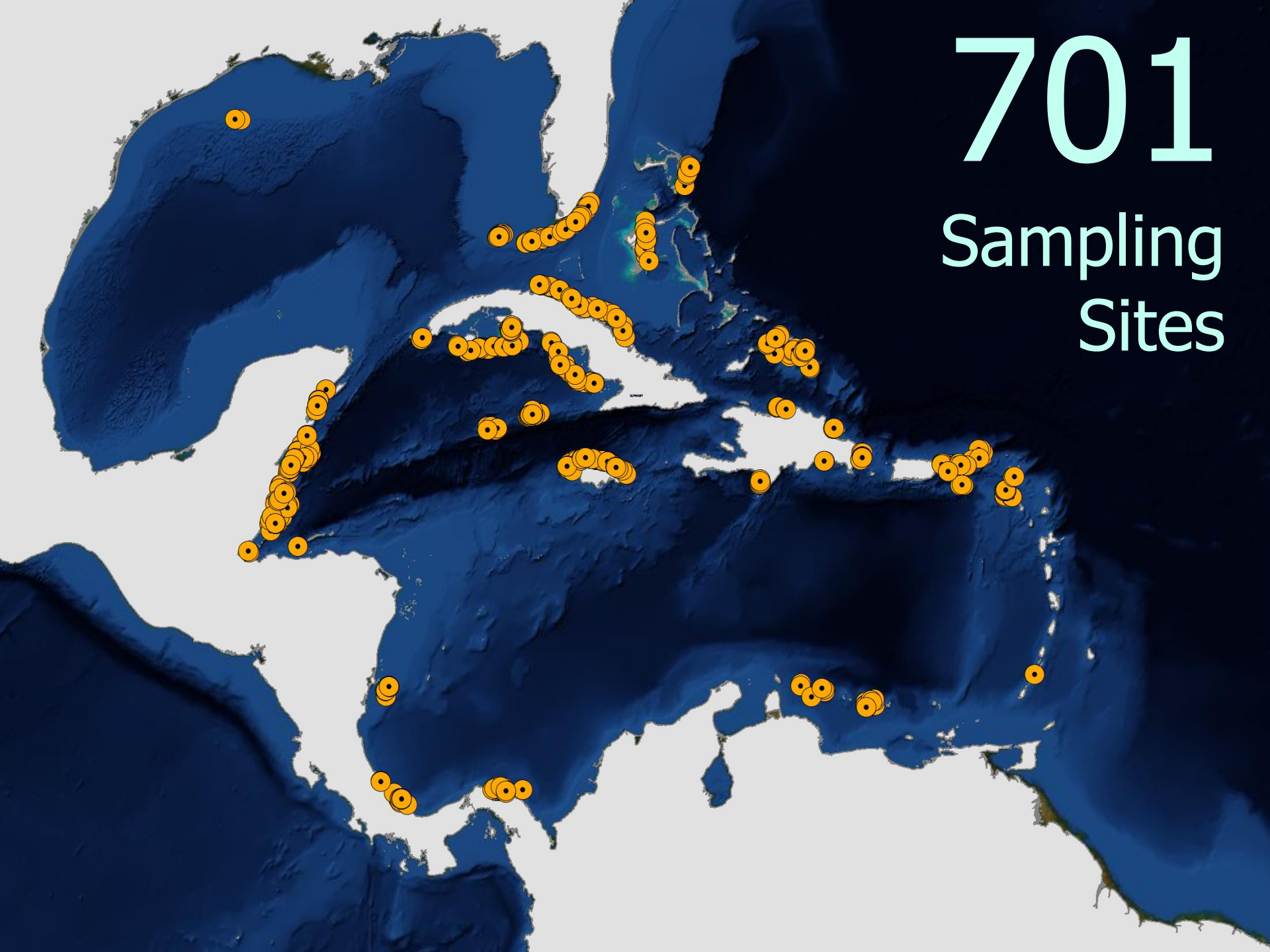


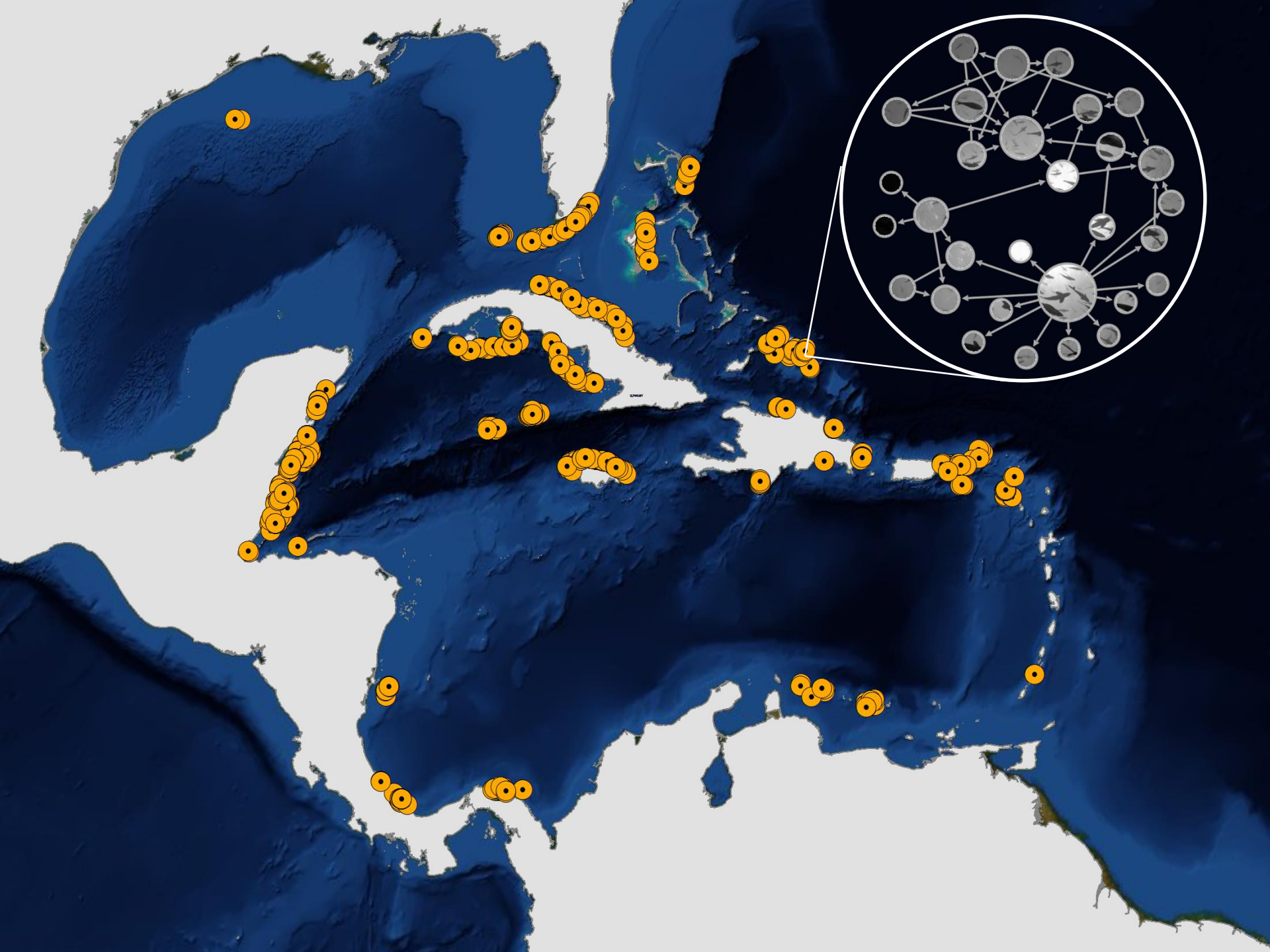
How network structure
changes in
time and space?

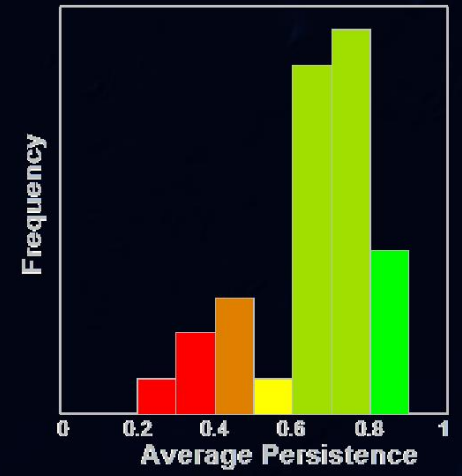
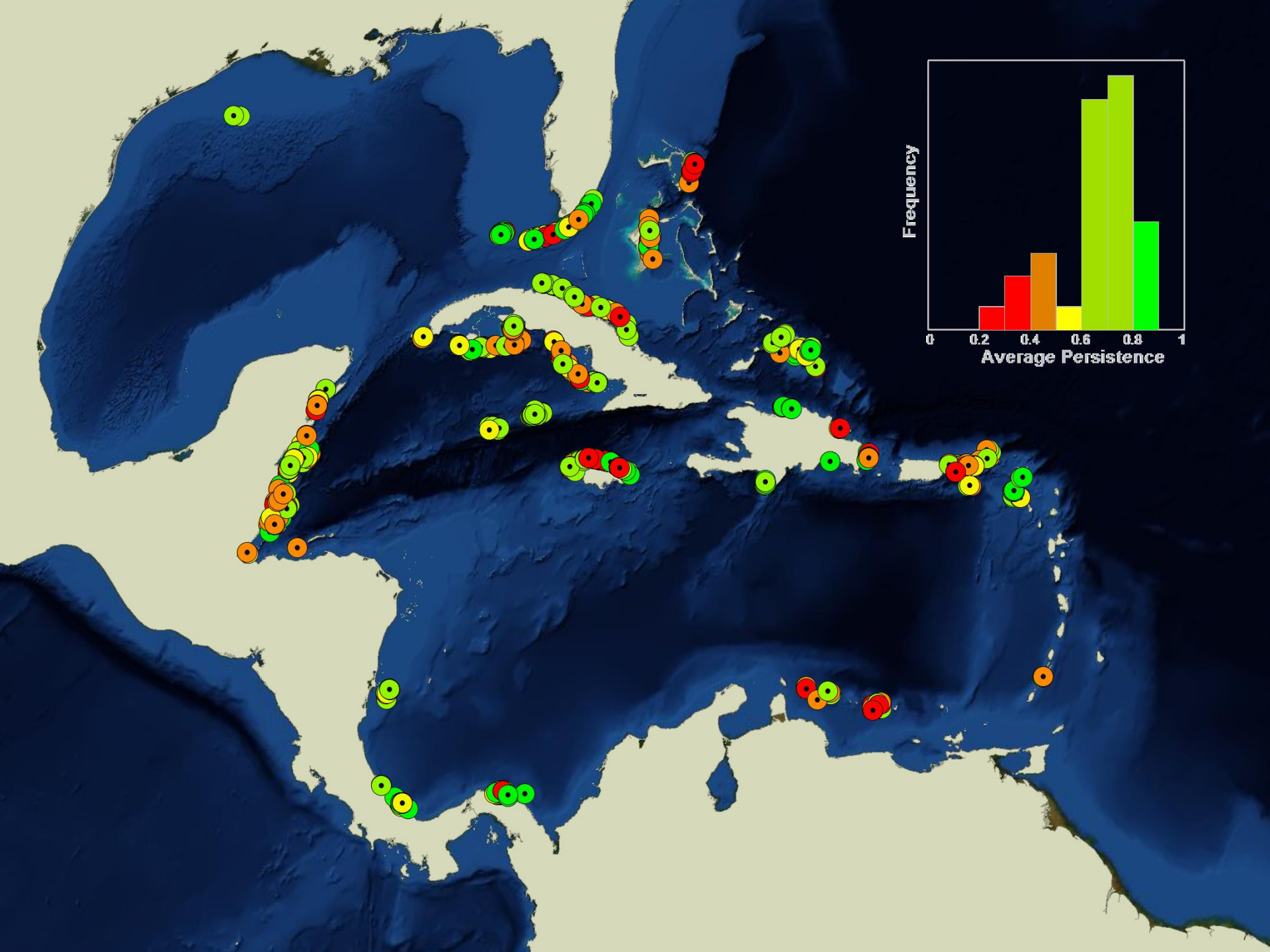


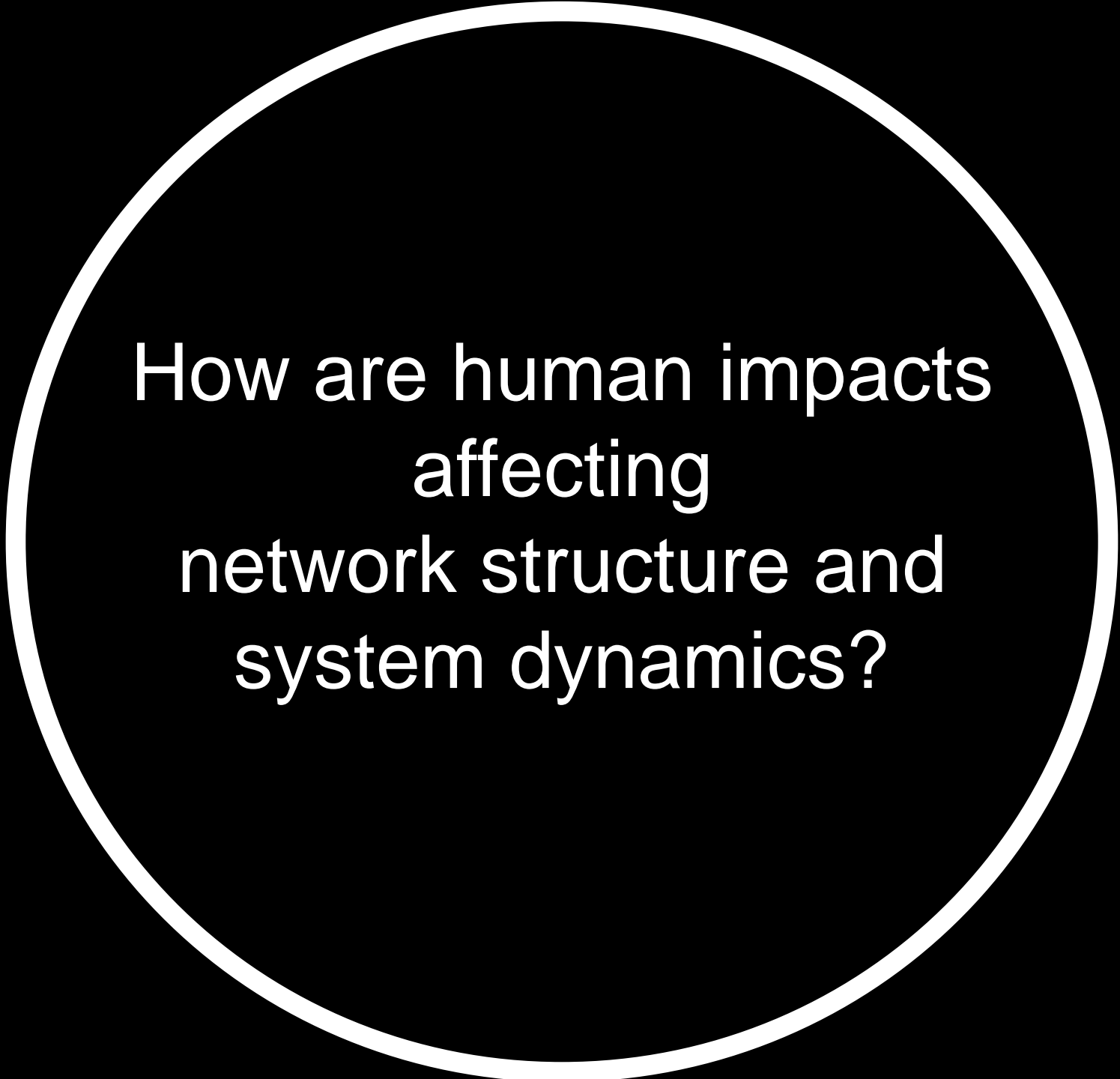


701 Sampling Sites



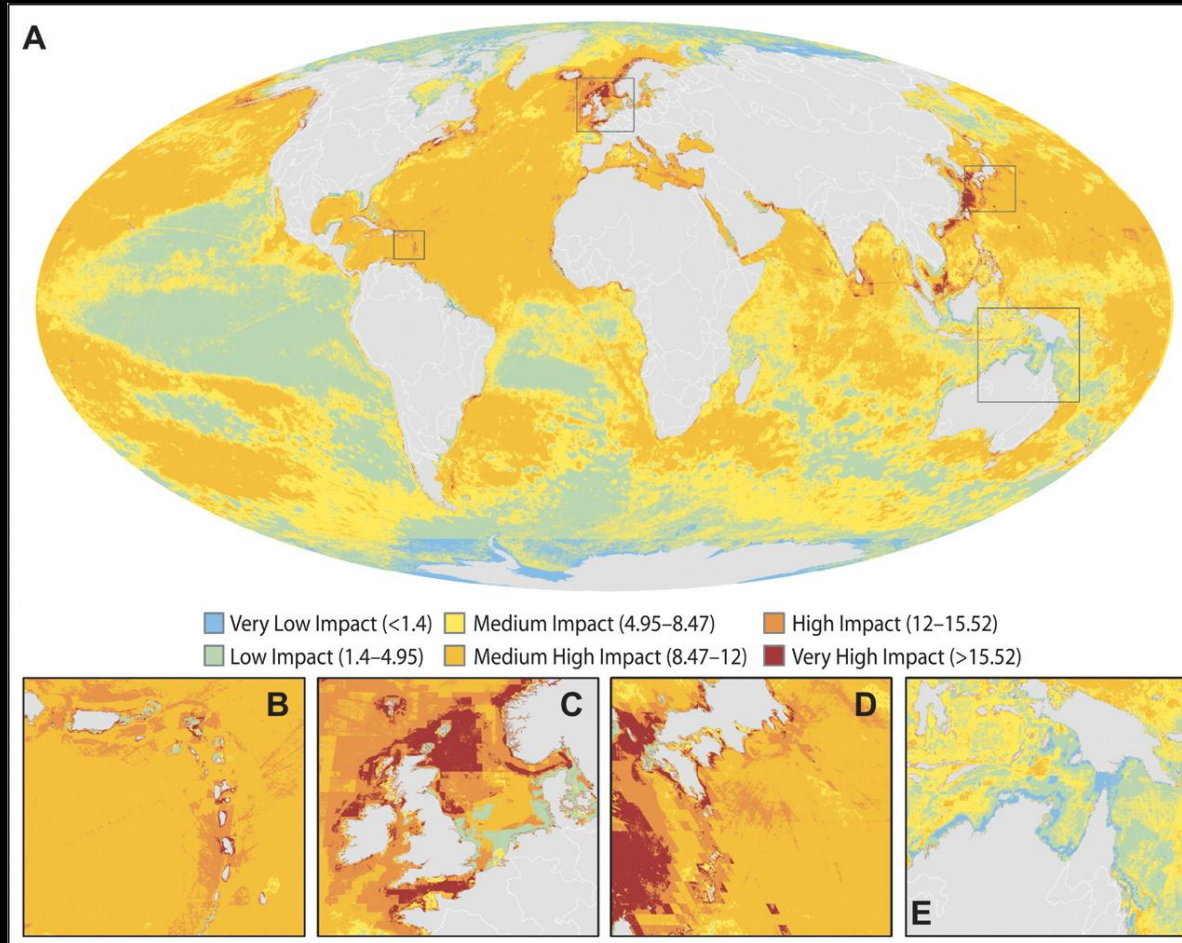






How are human impacts
affecting
network structure and
system dynamics?

Impacts are unevenly distributed in space



Halpern et al (2008). *Science*, 319: 948-952



More impacted
regions have
lower persistence

More impacted
regions have
lower modularity



Food webs are heterogeneous
and organized in compartments

Network structure
Influences its dynamics

Human impacts modify network structure
reducing its species persistence