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School of Biology and Environmental Science

The contribution of rare species to community resilience



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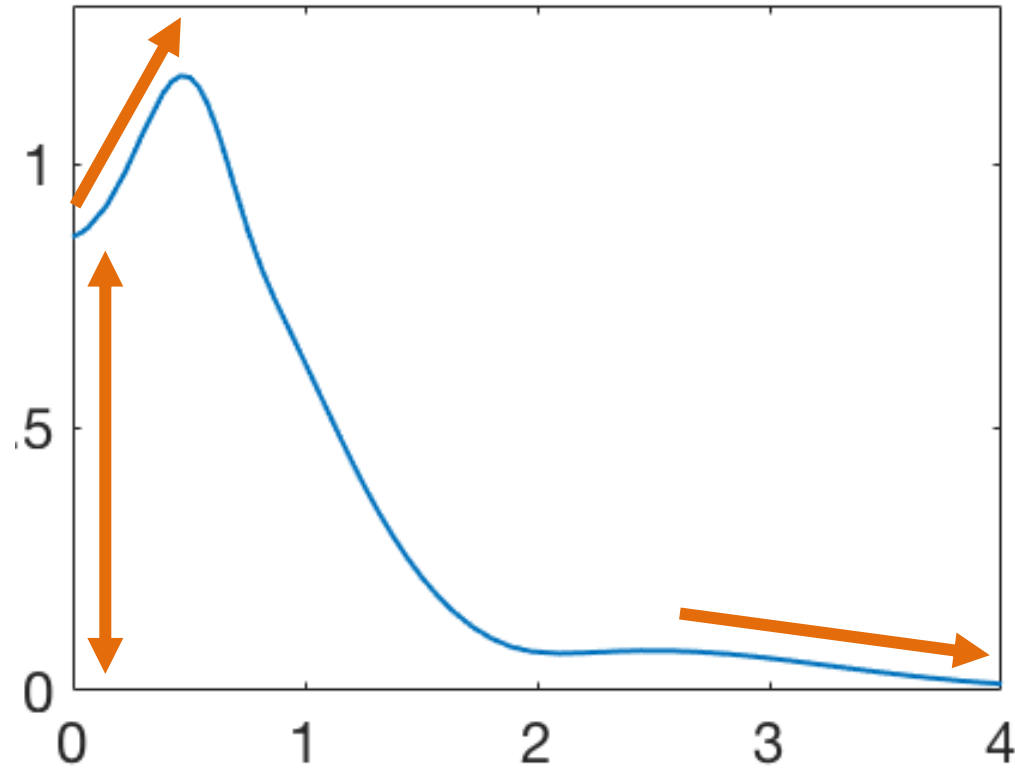
Fondúreacht Eolaíochta Éireann
Dá bhfuil romhainn
Science Foundation Ireland
For what's next



Resilience

Food web dynamics:—

$$\frac{dN^i}{dt} = N^i \left(r_i + \sum_j A_{ij} \frac{N^j}{N^i} \right)$$



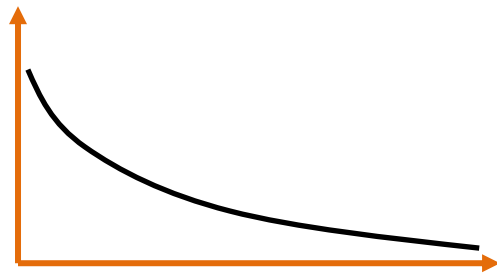
- ↕ Resistance
- ↗ Reactivity
- **Recovery**
(return time)

How do rare species affect the return time?

$$T \sim \sum_i \frac{w_i}{N_{*i}}$$

N_{*i} is equilibrium abundance of species i

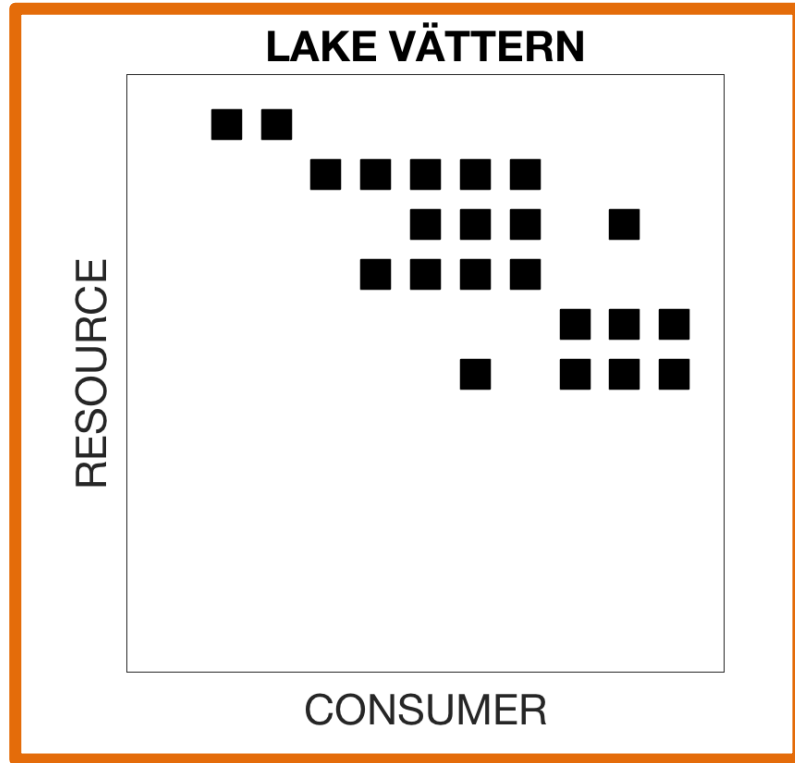
$$T \sim \frac{w'_i}{N_{*i}^2}$$



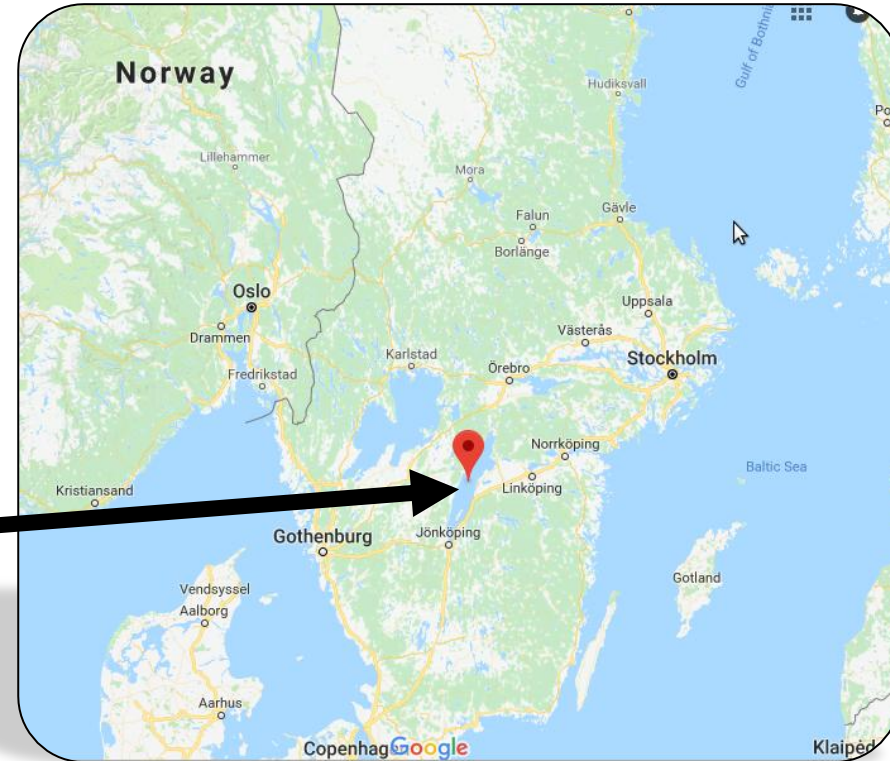
w_i are weights given by species interaction strengths

A Real Community

$$\frac{dN_i}{dt} = N_i r_i + \sum_j A_{ij} N_j$$

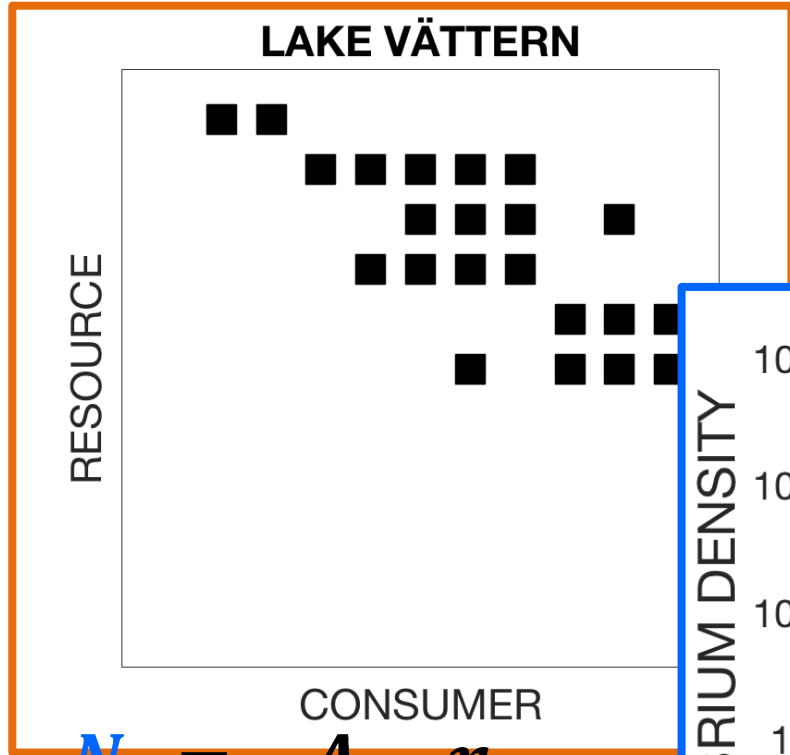


Lake Vättern



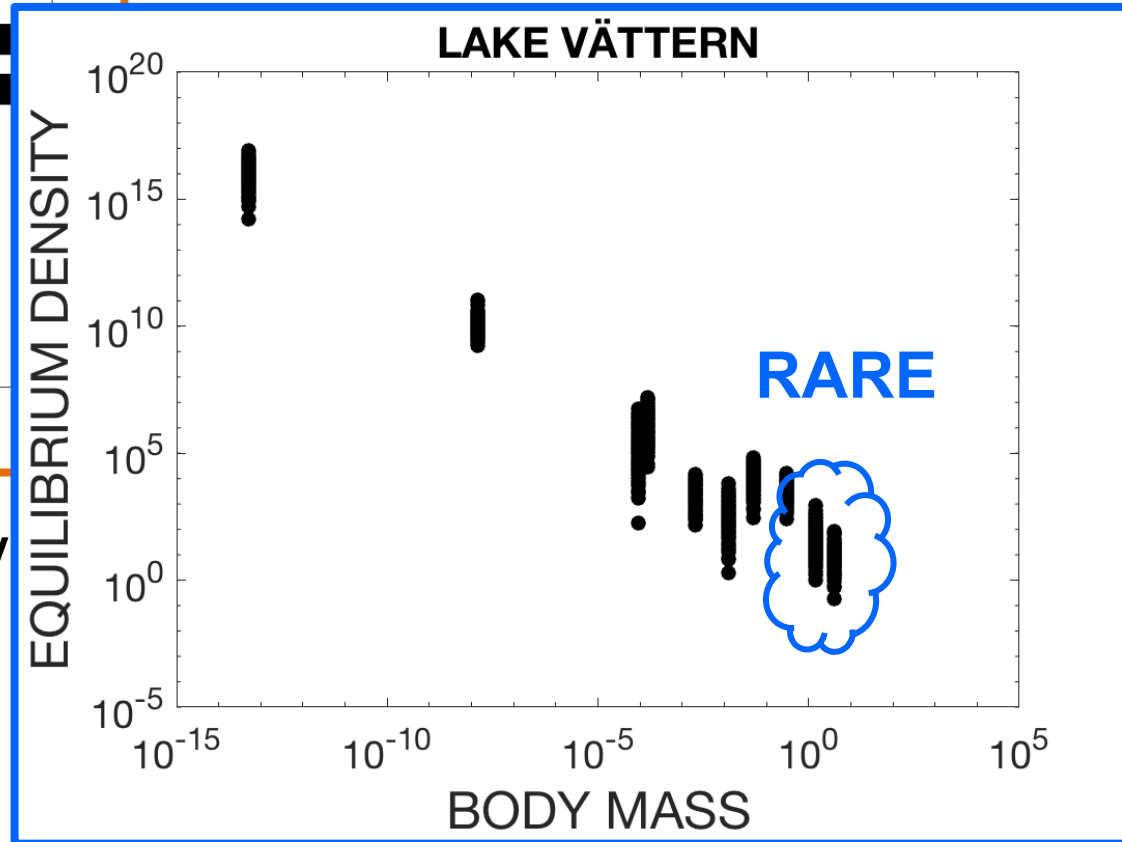
A Real Community

$$\frac{dN^i}{dt} = N^i \left(r_i + \sum_j A_{ij} \frac{N^j}{N^i} \right)$$



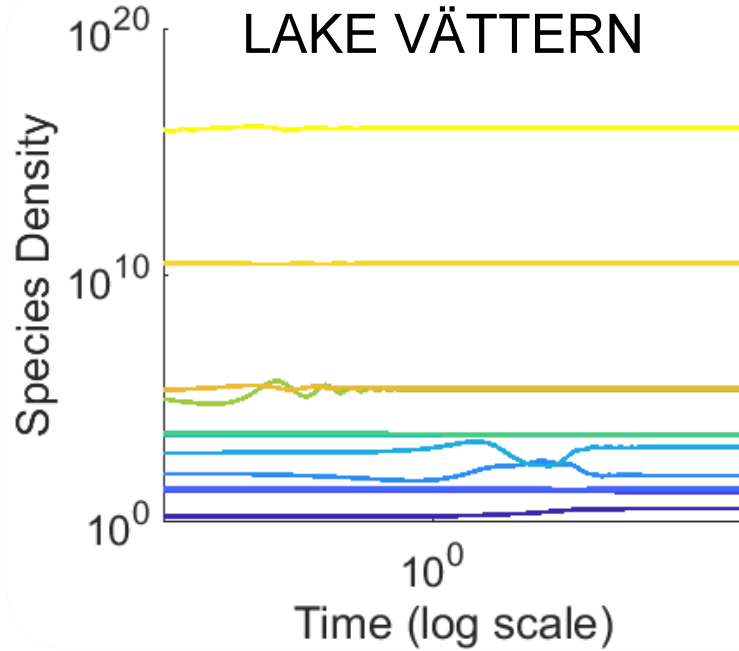
$$N_* = -A_{-1}^{-1} r$$

Equilibrium Density



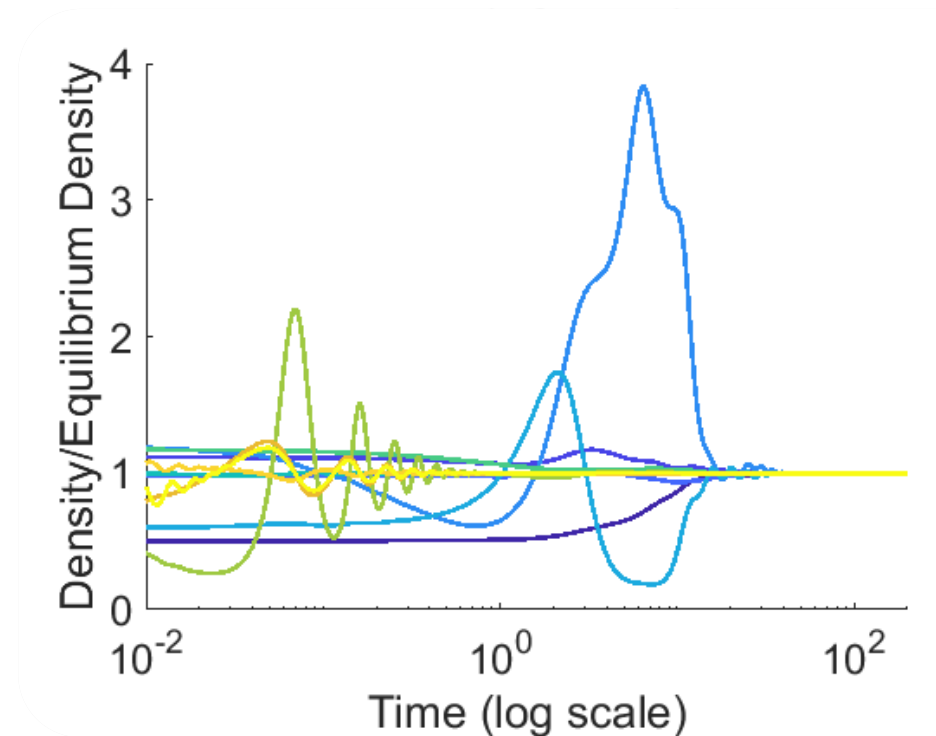
Resilience to Perturbations

$$\frac{dN_i}{dt} = N_i \left(r_i + \sum_j A_{ij} \frac{N_j}{N_i} \right)$$



$$N_* = -A_{-1} r$$

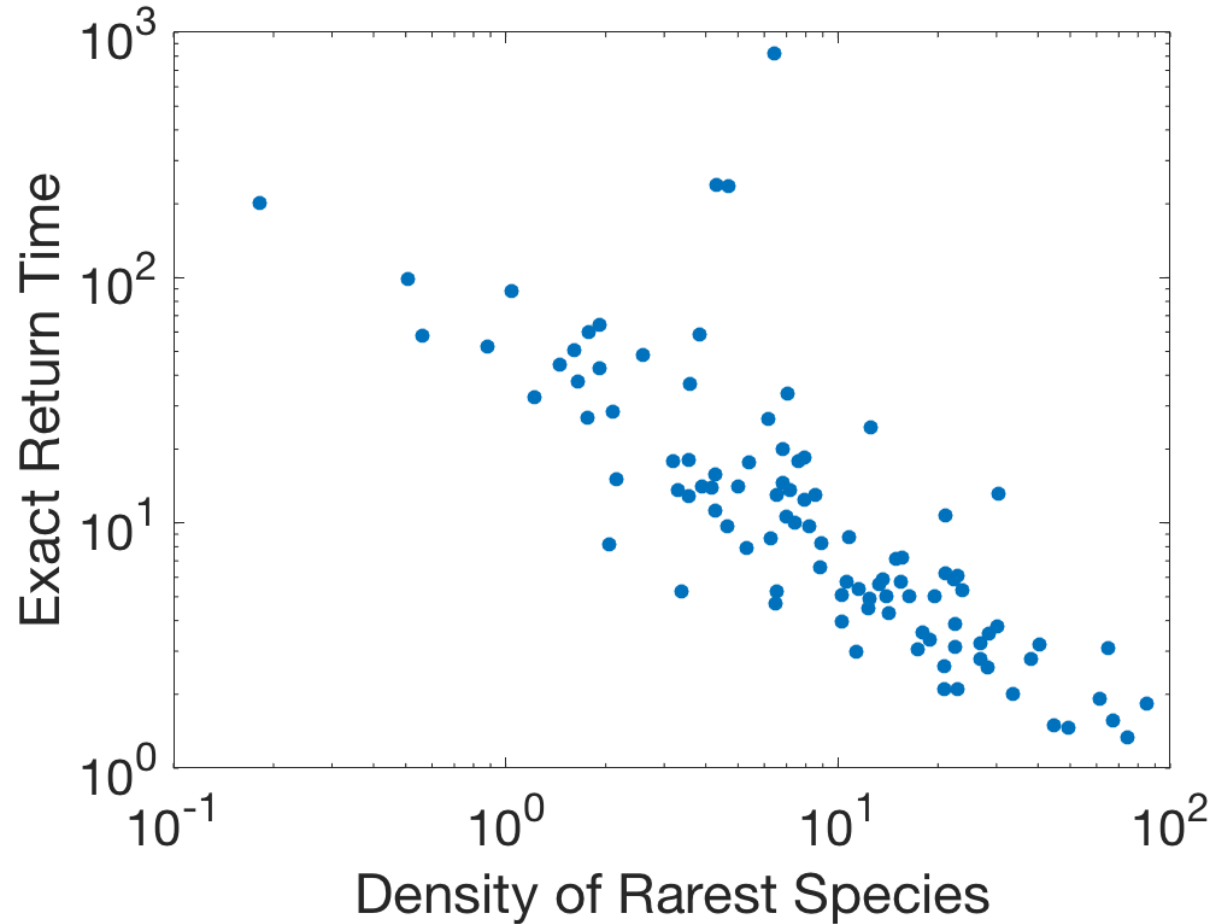
Equilibrium Density



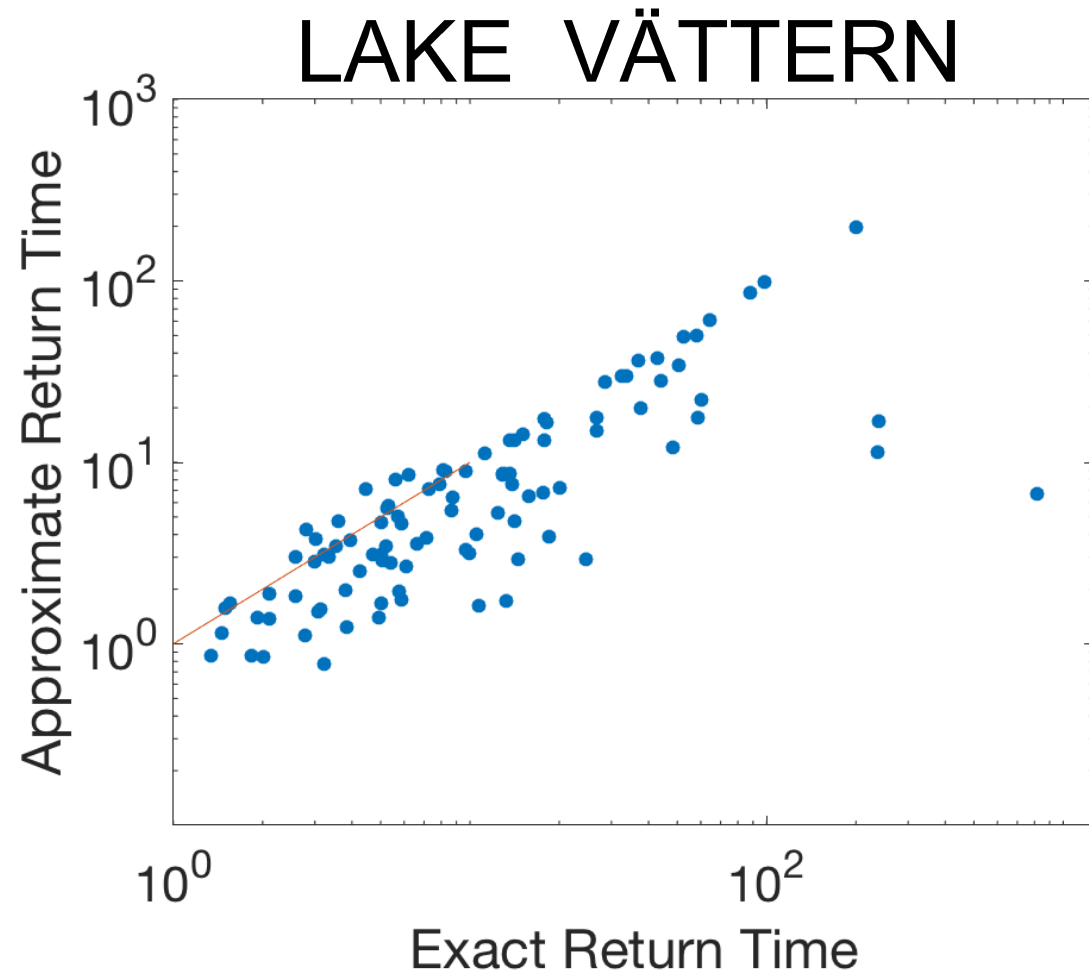
Dark colours are rare species

Lake Vättern

Rarer species give longer return times



Approximation improves as species become rarer



Measures of resilience

