# **Ecosystem Vulnerability to Species Loss**

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## **Motivation and main purposes**

Species losses have always occurred as a natural phenomenon, but the pace at which species are going extinct has recently accelerated dramatically as a result of human activities. The disappearance of a species can have far-reaching and often unexpected consequences for other species, since changes can propagate throughout ecosystems. Hence, the following questions arise:

## **Modelling concepts**

- Ecosystems are represented by directed network models.
- Starting with an ecosystem at equilibrium, a selected compartment collapses (is removed).
- The changes propagate through the ecosystem over time due to the following rules:
- How does the collapse of one ecosystem compartment (species or functional groups) influence the remaining ecosystem compartments?
- How is an ecosystem's structure related to its vulnerability to compartment collapses?
- The magnitude of the flows within the system and the flows to the external environment depends on the donor species' biomass.
- Incoming flows from the external environment are recipientcontrolled.



#### **Statistical analysis**

**Simulations** 

The structure of the ecosystem before compartment collapse is described by structural indicators

The vulnerability of the ecosystem to compartment collapse is assessed by the vulnerability indicators (based on the concepts of secondary species extinctions and biomass changes)



Correlations between structural indicators and vulnerability indicators are determined based on systematic investigations of collapse dynamics in the studied ecosystems

#### **Examples of ecosystems**



### Results

- Ecosystems with less connectance and richer trophic structure tend to have the dominated compartment (collapse of this element exerts significant influence on the other compartments' biomasses).
- > Ecosystems with more compartments are more vulnerable.
- > More connected ecosystems with lower number of compartments suffer less extinctions.
- > The results show no effect of cycling flows and ecosystem's total biomass on vulnerability indices.