

Animal Diversity and Global Change

When and why do species go extinct?



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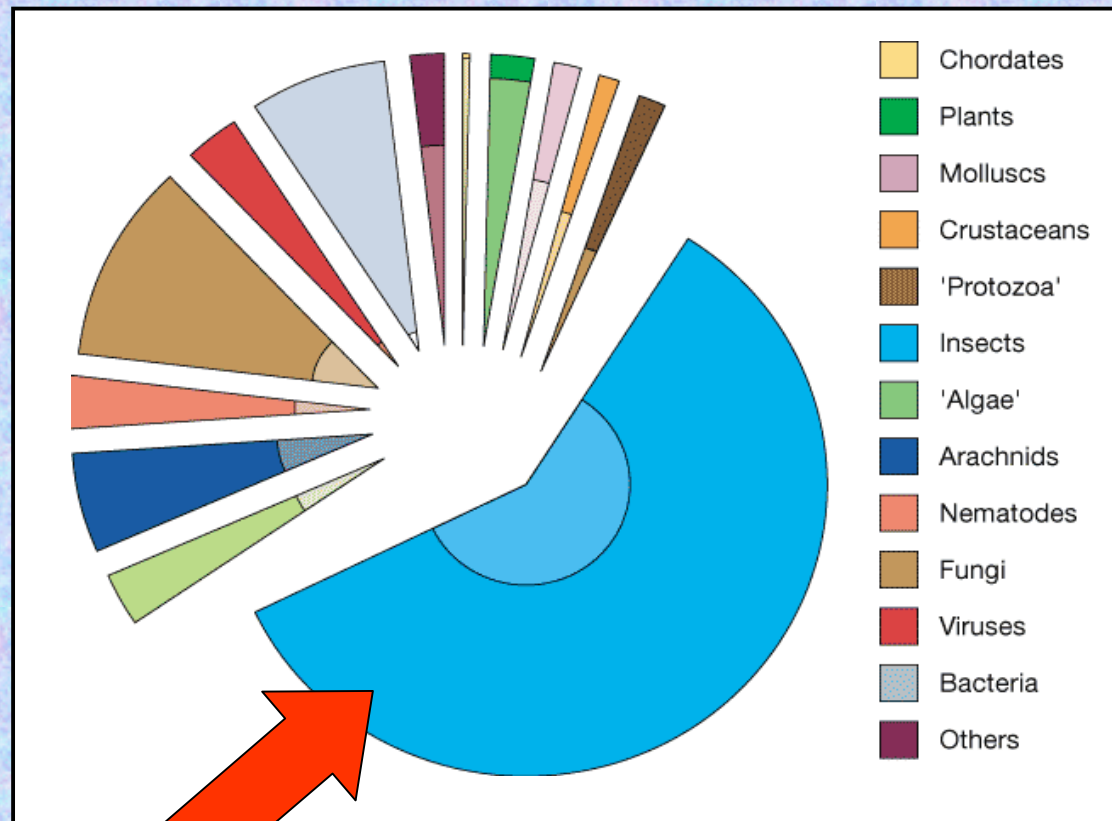


How many species are there?

- 1.5 Million species are known
- 10–50 Million species are assumed to exist



Most species are animals - in particular insects



What is the problem?

Washington Post

Tuesday, April 21, 1998



Mass Extinction Underway

Results of a poll among 400 biologists



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Washington Post

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Mass Extinction Underway

- A majority of 400 biologists are convinced that a "mass extinction" is underway.
- Up to 20% of all living species could disappear within 30 years.
- Many believe that the rate of loss is greater now than at any time in history.
- All consider the rapid disappearance of species as one of the planet's gravest environmental worries.



Extinction risk

A simple simulation game:

1. Your start population is 1
2. If tossing a Euro yields „head“ then colonize a new habitat
3. If tossing yields „number“ then you loose 1 sub-population
4. Record the number of tosses your population survives before it goes extinct



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X 7

Alternatively, start with a population of 4

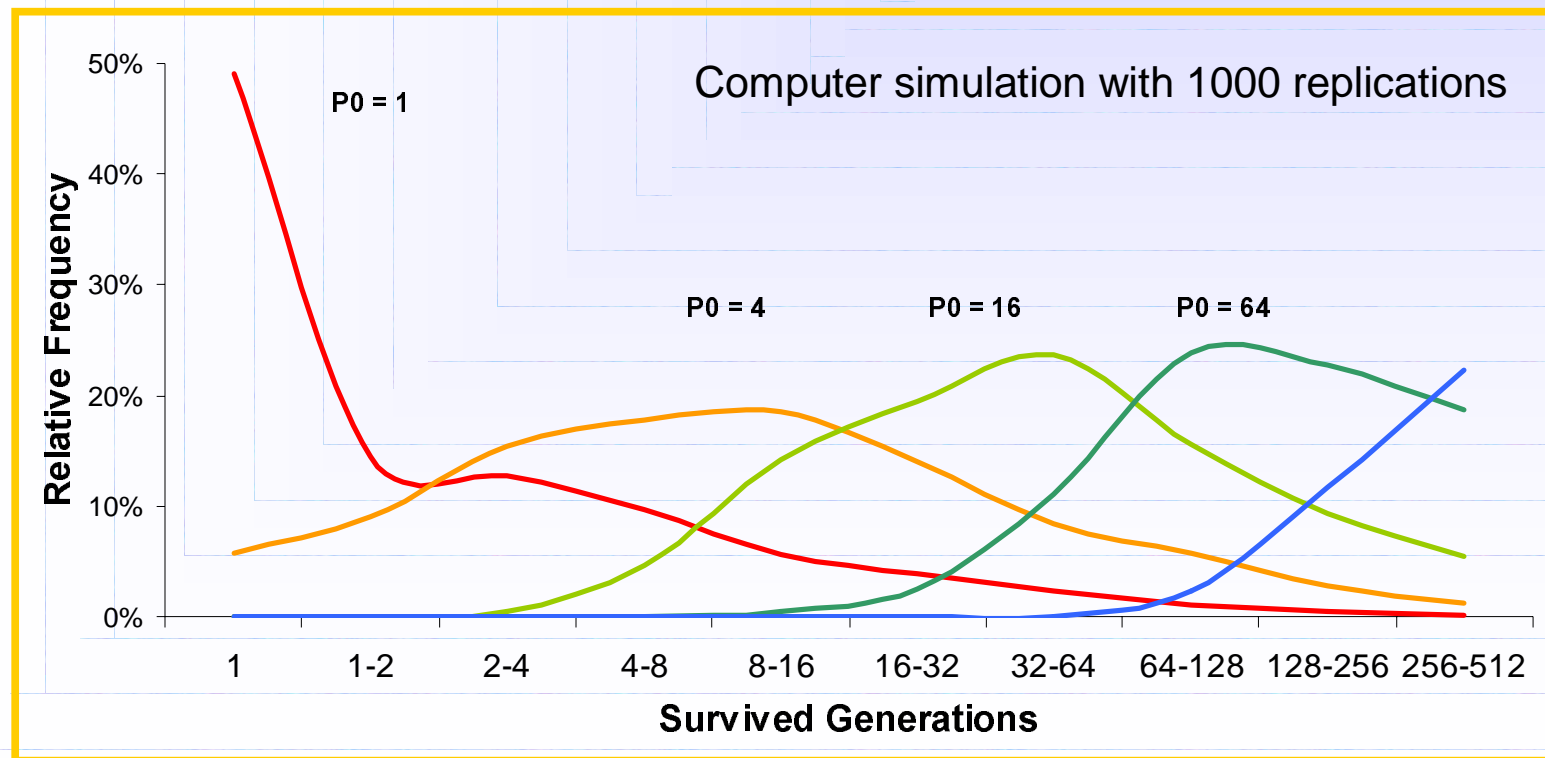


Stochastic extinction



In the game, gains and losses are balanced 50/50, i.e., the populations are in equilibrium.

Nevertheless any population has obviously a chance to go extinct. Rare populations are highly endangered.



Landscape colonisation model

The landscape is represented by a grid of cells.

Each cell is characterised by a habitat type (e.g. forest) and by several environmental parameters (e.g. climate).

The community is represented by a set of species.

Species differ in their affinities to habitat types and environmental variables.

For each species and each landscape cell, a probability is calculated that the species will be present in the cell.

Colonisation is stochastic, according to the probabilities.

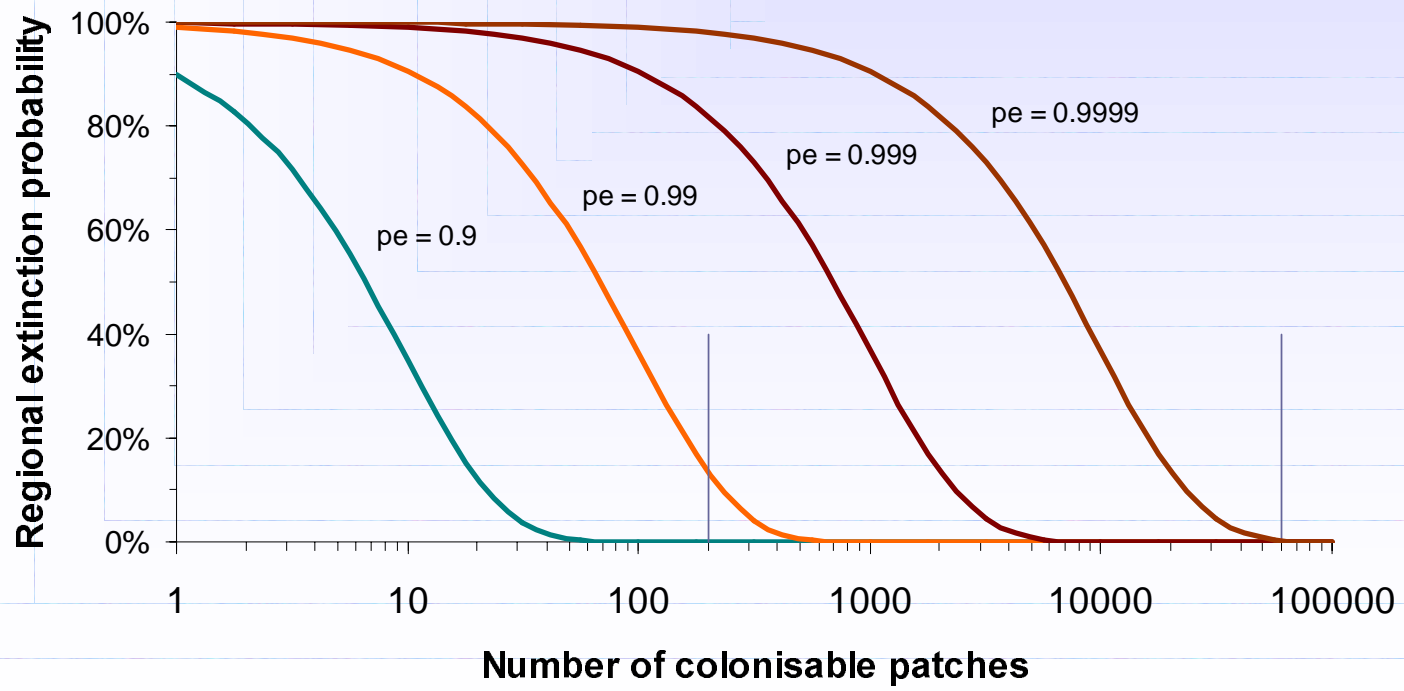
Species can be recorded in a simulated sampling campaign.



Stochastic Extinction 2

Regional extinction occurs if all local sub-populations go extinct simultaneously. Therefore, regional extinction probability can be calculated as follows:

$$pr \left[\begin{array}{c} \text{pl}_1 \\ \text{pl}_2 \\ \text{pl}_3 \\ \dots \\ \text{pl}_n \end{array} \right] = \prod_{i=1}^n pr \left[\text{pl}_i \right] = \left(\prod_{i=1}^n pr \left[\text{pl}_i \right] \right)^{1/n}$$



Conclusions from the landscape model

1. In a large region, species must be extremely scarce to be eradicated by stochastic extinction.
2. Conversely, species suffer a higher risk of stochastic extinction if they are confined to small regions.
3. Even in large regions, species are endangered if resources, requisites or conditions change beyond the species' tolerance limits (deterministic extinction).
4. Perceived species richness may considerably underestimate existing species numbers, particularly so if species incidences are low.

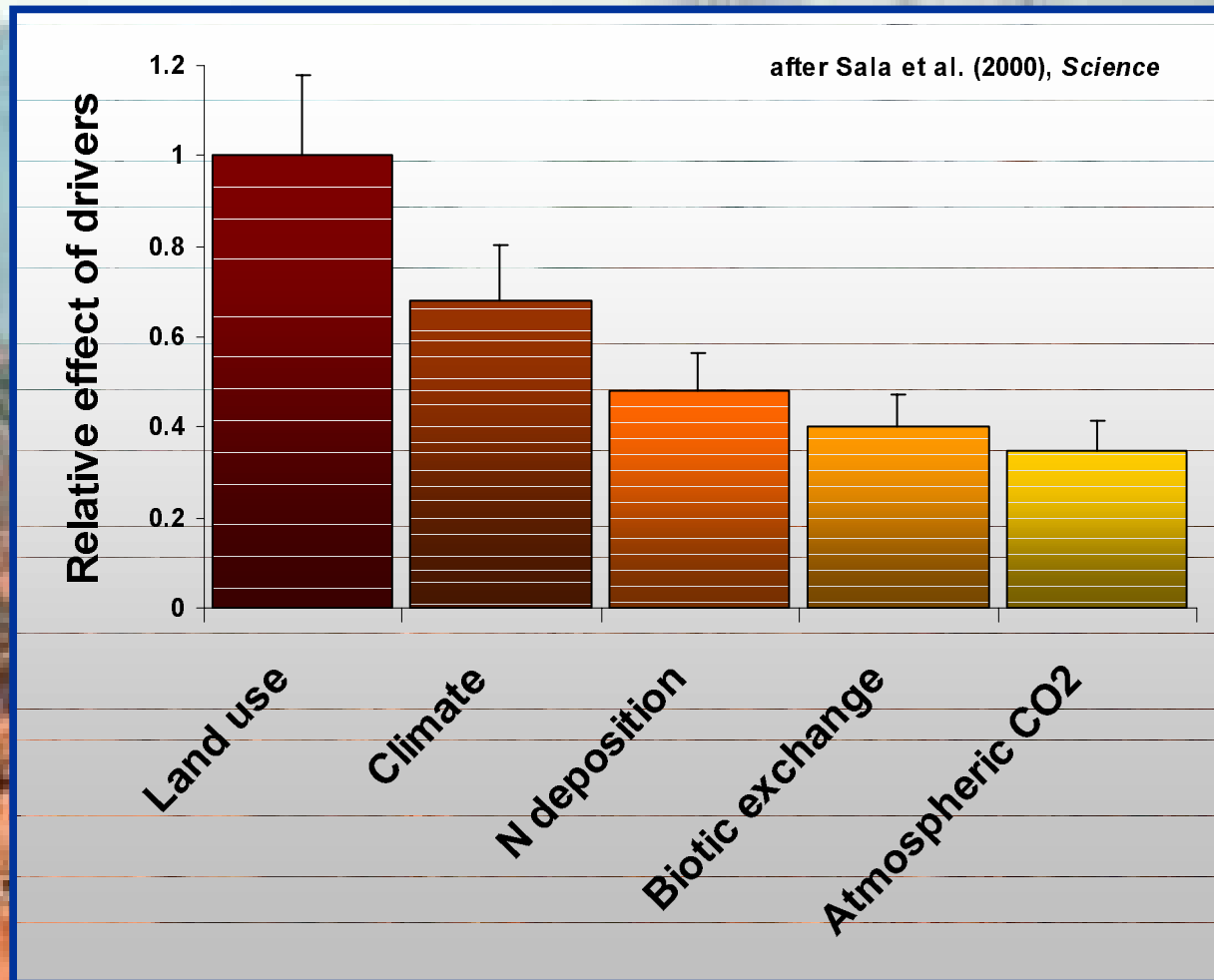


Changes causing a decline of biodiversity

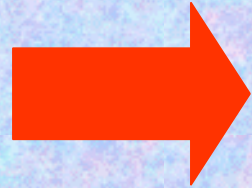
- Loss and destruction of habitats
 - Change of ecosystem structure
 - Invasion of non-native species
 - Exploitation & over-harvesting
 - Pollution & contamination
 - Climate change
-



What are the driving forces?



Which species are endangered?



- **Rare species**
- Long-lived species
- Species depending on keystone species


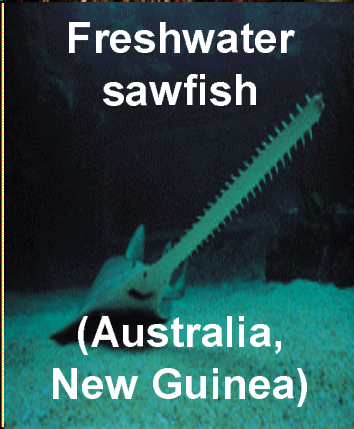
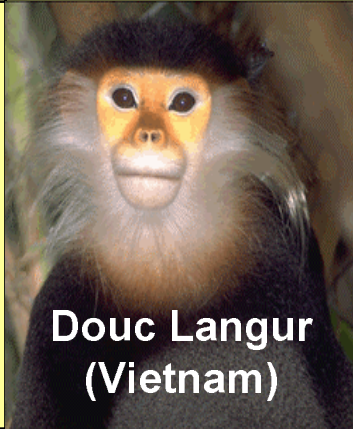


What is a rare species?

- * Limited geographical distribution
- * Small population density
- * Confined to one habitat type

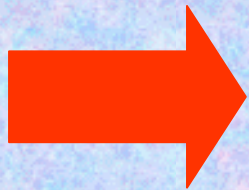




		Geographical distribution			
		wide		limited	
Population size	somewhere large	not rare	 <p>Red Mangrove (Trop. America, West. Africa)</p>		
	everywhere small	non-existent?	 <p>Freshwater sawfish (Australia, New Guinea)</p>		 <p>Douc Langur (Vietnam)</p>
		low	strong	low	strong
		Habitat specialization			

Which species are endangered?

- Rare species



- Long-lived species

- Species depending on keystone species



Long-lived species...

- adapted to a constant environment
- late sexual maturity
- low fertility
- care for offspring
- do not reproduce under adverse conditions

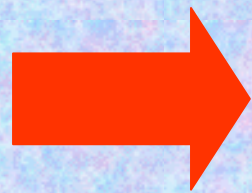


...can not respond to rapid changes of their habitat!



Which species are endangered?

- Rare species
- Long-lived species

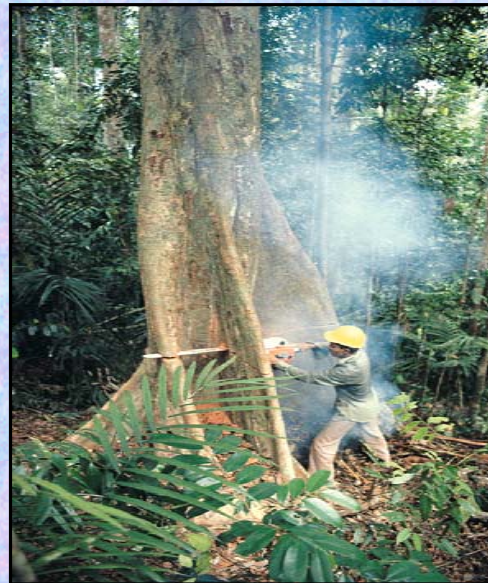


- Species depending on keystone species



Which species are endangered?

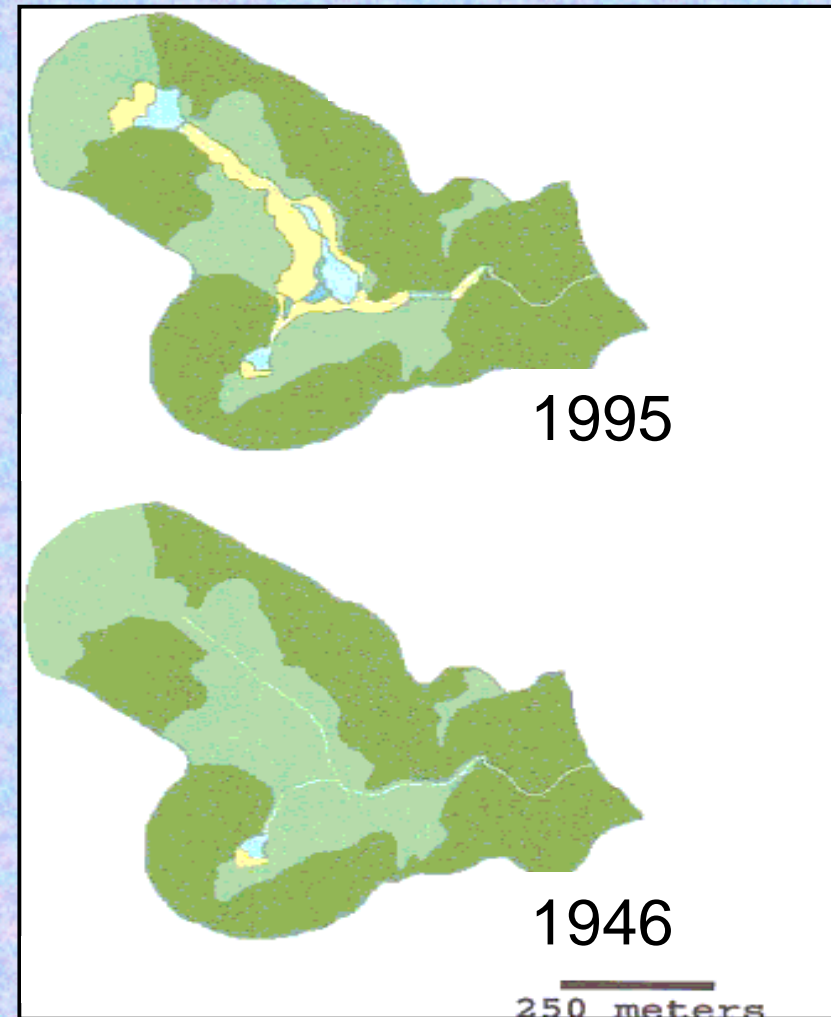
Loss of keystone species....



...may cause the loss of habitats for many other species.



Example: Beaver



**Re-establishment
created new habitats**



"Death is one thing, an end to birth is something else."



Soulé & Wilcox

