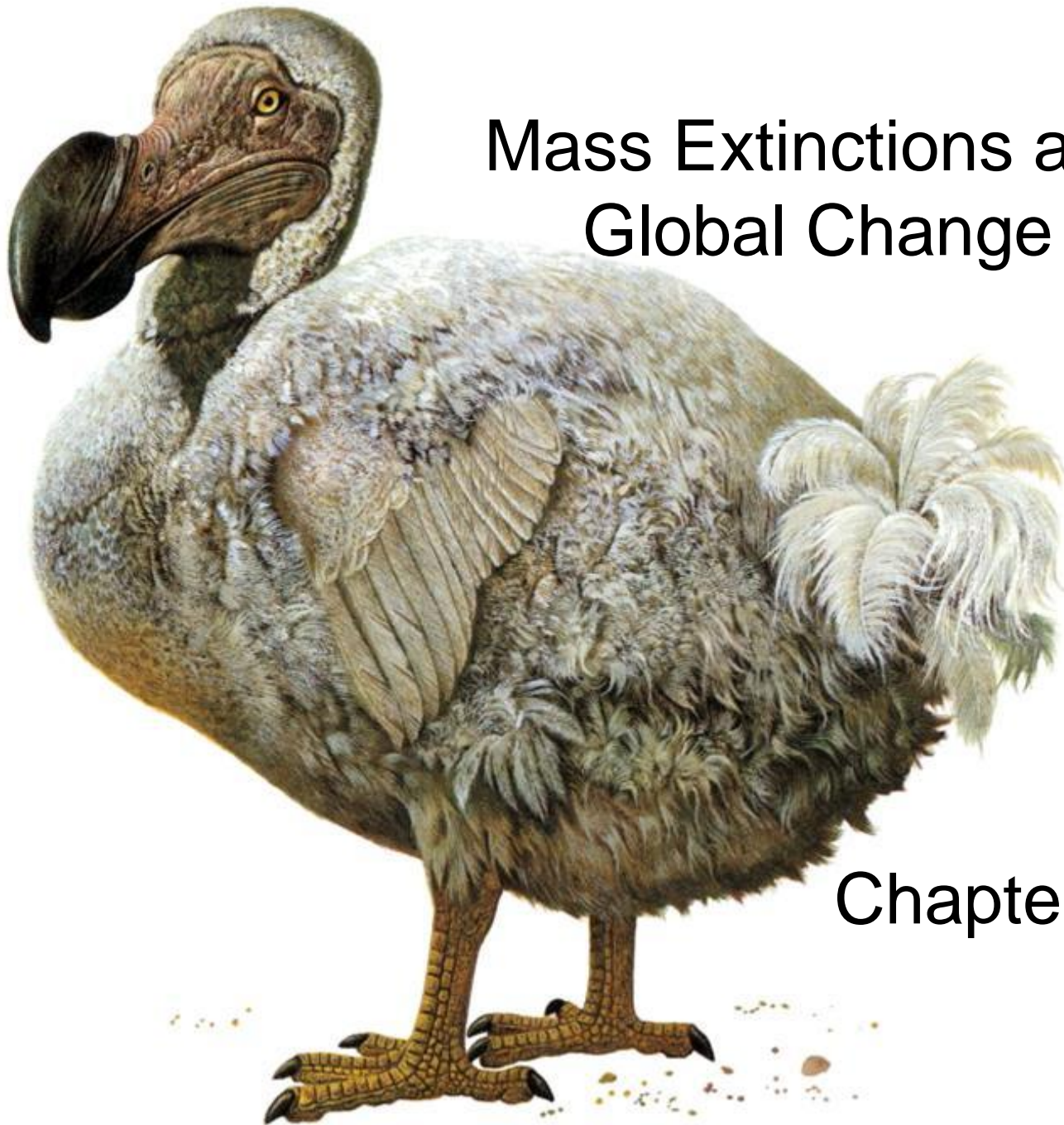


# Mass Extinctions and Global Change



Chapter 6.

# Introduction



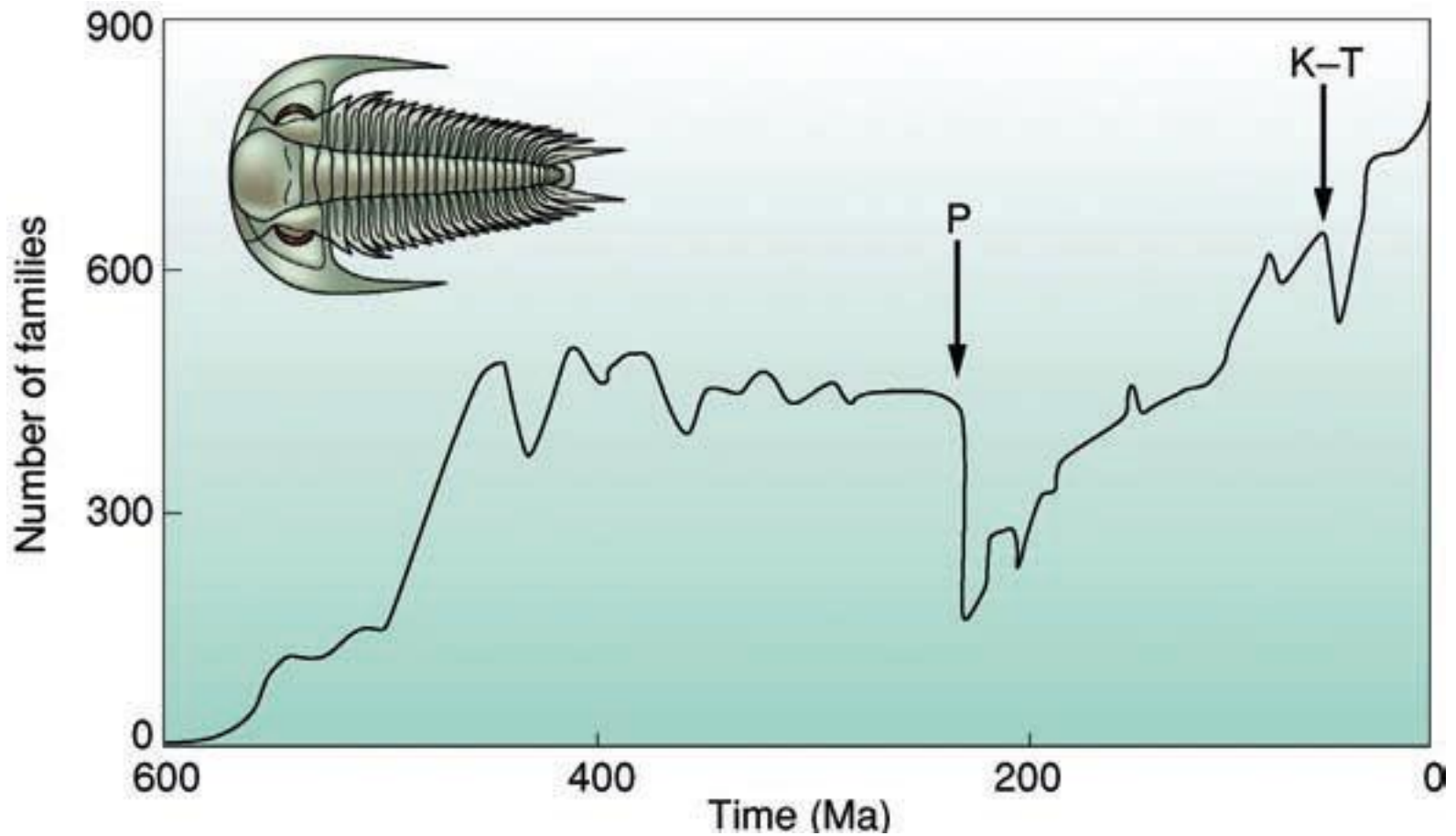
- Just as death is the inevitable fate of every individual, extinction is the fate of every species.
- Of all the species that have ever lived on earth, about 99.9% have gone extinct.
- A typical “life span” of a species is roughly one million years.
- There have been at least five periods when huge numbers of species have vanished.

# Extinction Episodes of the Past



- 600 million years ago great proliferation of macroscopic species occurred and produced a fossil record that allows us to track the rise and fall of biodiversity.
- Since the Cambrian period, there were at least five periods of mass extinctions around the globe.
- **The Cretaceous–Tertiary Extinctions**
  - Dinosaur extinction
  - Occured some 65 million years ago
  - “K–T boundary” – large scale iridium deposits in the sediment (Meteorite impact?)

**Figure 6.1** The rise and occasional fall of biodiversity as indicated by the fossil record of families of marine organisms



- **The Permian Extinctions:**
- 251 million years ago (End of Permian period)
- Over half of the 500 families of marine vertebrates and invertebrates capable of forming fossils became extinct
- 77–96% of all marine animal species were lost
- Anoxic water conditions leading to extensive CO<sub>2</sub> poisoning and CO<sub>2</sub>-induced climate change as a result of increased volcanic activity or some other factor???

# Estimating the Current Rate of Extinction

- Ask conservation biologists about current rates of extinction, and they are likely to start rolling off statistics about the thousands of species that are being lost each year.
- Yet ask that same group to name ten species that have gone extinct in the last year, and they will probably struggle to name any.
- Why?
- It is often hard to say with conviction that a species *has* become extinct

# Reasons



## 1. Difficult to locate

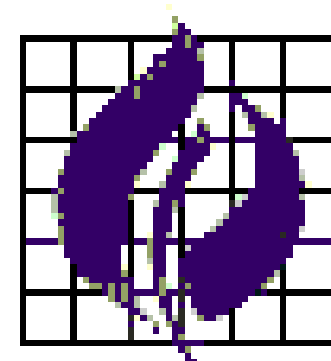
- Habitats are hard to survey (such as marine environments or soils)
- Shifted their range to a different, unexpected

## 2. Most of the world's species (perhaps 85–99%) have never been described by scientists.

- *Centinelan extinctions* - phenomenon of species becoming extinct before they are described
- More likely in the marine realm than in freshwater or terrestrial systems

# Recent extinctions


- World Conservation Monitoring Centre - lists 90 species of plants and 726 animals that probably have become extinct, at least in the wild, since 1600
- **Table 6.1**

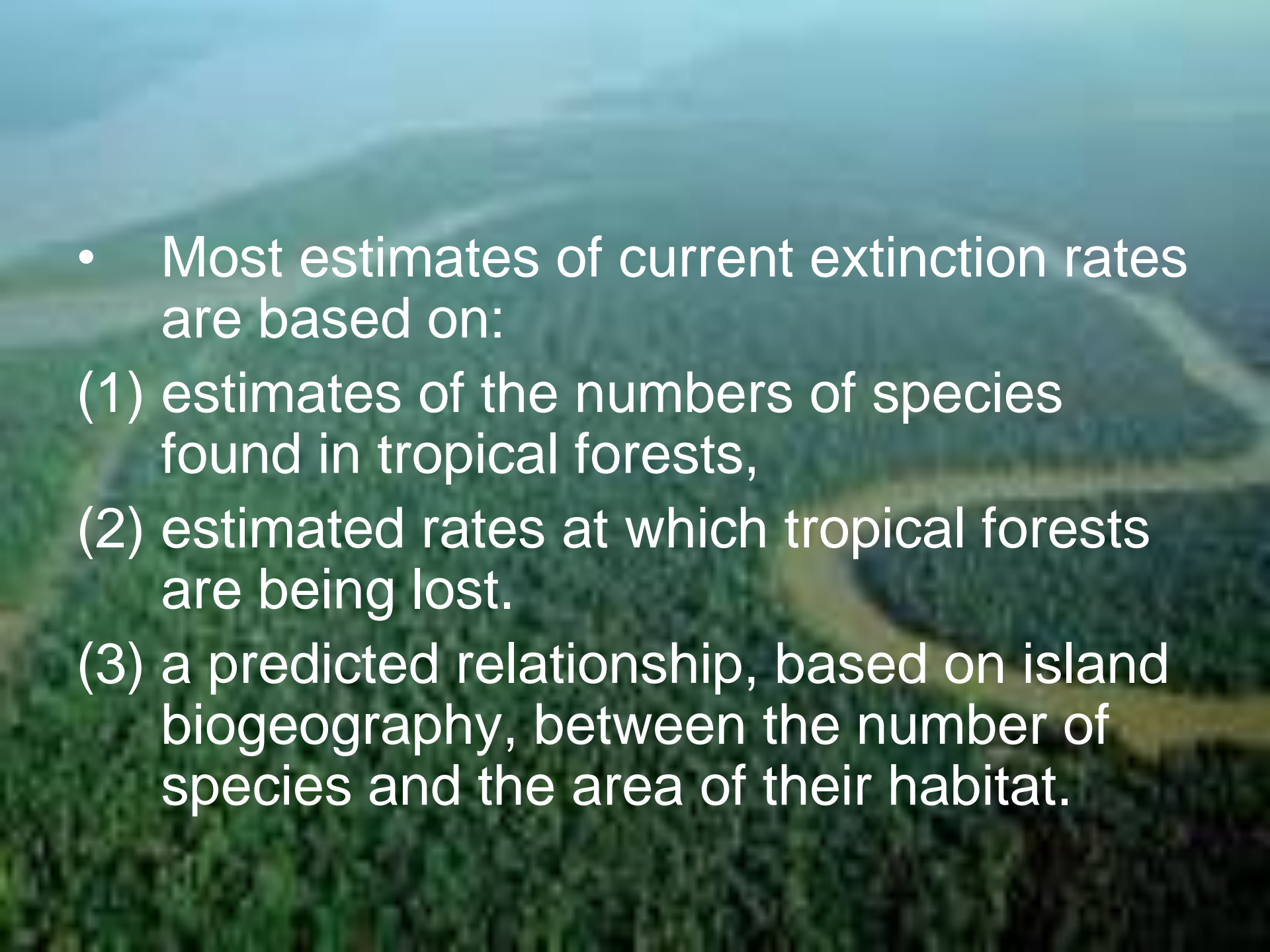


WORLD CONSERVATION  
MONITORING CENTRE



<b>Animals</b>		<b>Plants</b>	
Molluscs	303	Mosses	3
Crustaceans	9	Gymnosperms	1
Insects	73	Angiosperms	
Other invertebrates	4	Dicots	83
Fishes	92	Monocots	3
Amphibians	5		
Reptiles	22		
Birds	131		
Mammals	87		
Totals	726		90
This list includes 40 species that still survive in captivity.			

- 
- How many species will be lost in total?
  - In the next 50–100 years it is believed widely we will lose 10–25% of our biota.
  - Numbers of threatened species in most countries will rise by 7% by 2020 and 14% by 2050 based on current projections of human population growth.

- 
- An aerial photograph of a lush tropical forest. A winding road or path cuts through the dense green canopy, curving from the upper right towards the lower right. The terrain appears to be hilly or mountainous, with the road following the contours of the land. The overall scene is a vibrant green, suggesting a healthy, undisturbed forest environment.
- Most estimates of current extinction rates are based on:
    - (1) estimates of the numbers of species found in tropical forests,
    - (2) estimated rates at which tropical forests are being lost.
    - (3) a predicted relationship, based on island biogeography, between the number of species and the area of their habitat.




- Global changes leading to mass extinctions may be relatively infrequent, but changes in global climates are occurring constantly.
- These changes are mainly caused by cyclical changes in the earth's movements around the sun, but recent human activities (e.g. adding greenhouse gases to the atmosphere and degrading the ability of ecosystems to store carbon) are now playing a major role.
- Species have generally been able to adapt to moderate climate change by shifting their geographic ranges, but under current conditions (small, stressed populations and fragmented landscapes) some species may be unable to shift their ranges and thus may become extinct.

A large, glowing meteorite streaks across the dark sky above the Earth's horizon. The meteorite is elongated and has a bright orange and yellow core, surrounded by a white and grey outer layer. The Earth's blue and brown surface is visible in the lower-left corner.

# Extinction Processes

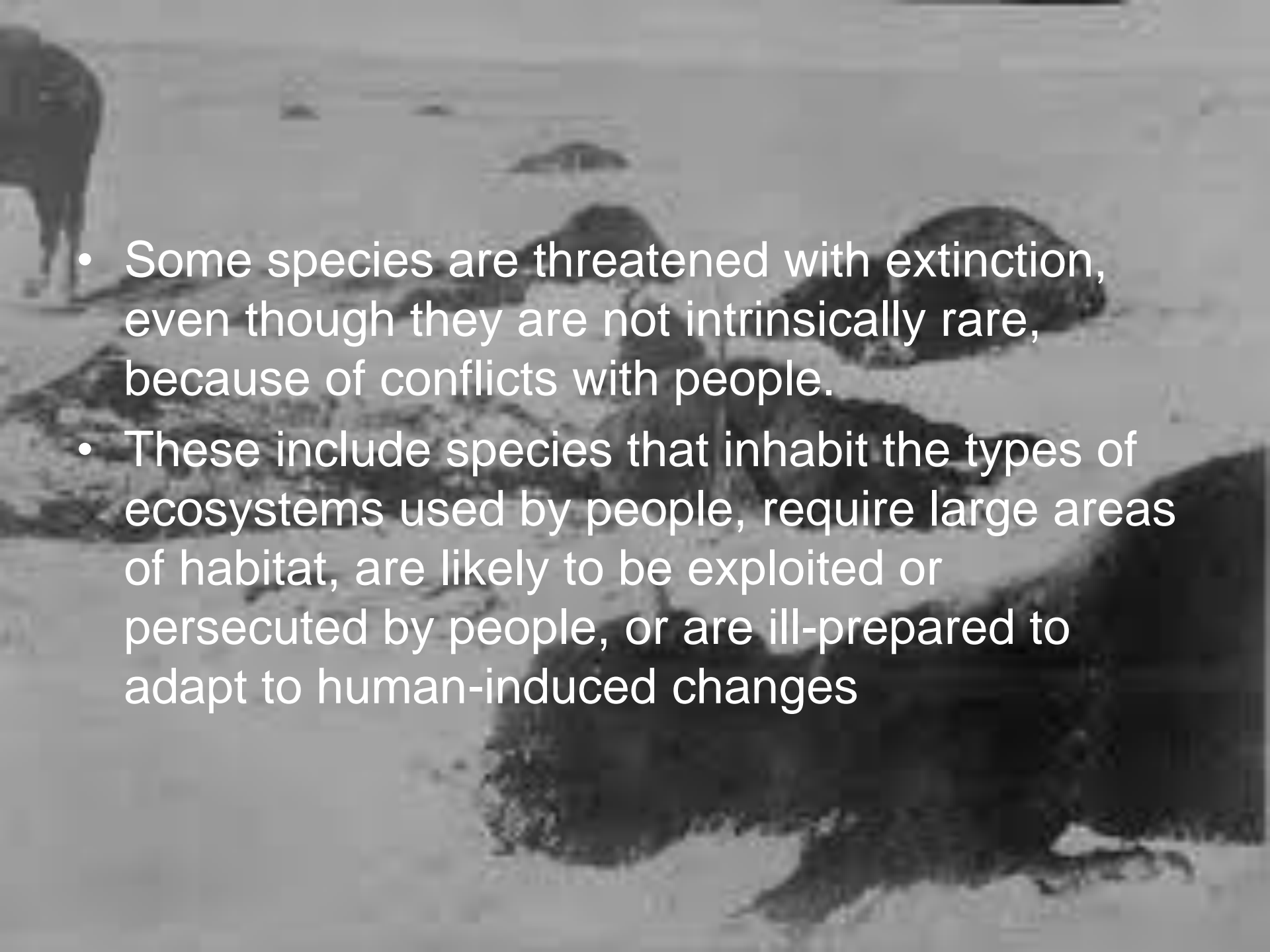
## CHAPTER 7

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- A tiger is walking through shallow water, splashing. The tiger is the central focus, with its head and front legs visible. The water is dark and turbulent around the tiger's legs. The background is a soft, out-of-focus natural setting with warm tones.
- Some species are more vulnerable to extinction than others.
  - Rare species are particularly vulnerable to extinction, especially those that are rare because they are confined to a small geographic range such as a single island or lake.

# Reasons

The processes that can drive a rare species into extinction include:

- a) changes in the environment (broadly defined to include physical feature such as climate
- b) interacting species such as predators, competitors, and pathogens
- c) demographic effects
- d) genetic problems

- 
- Some species are threatened with extinction, even though they are not intrinsically rare, because of conflicts with people.
  - These include species that inhabit the types of ecosystems used by people, require large areas of habitat, are likely to be exploited or persecuted by people, or are ill-prepared to adapt to human-induced changes



# Populations

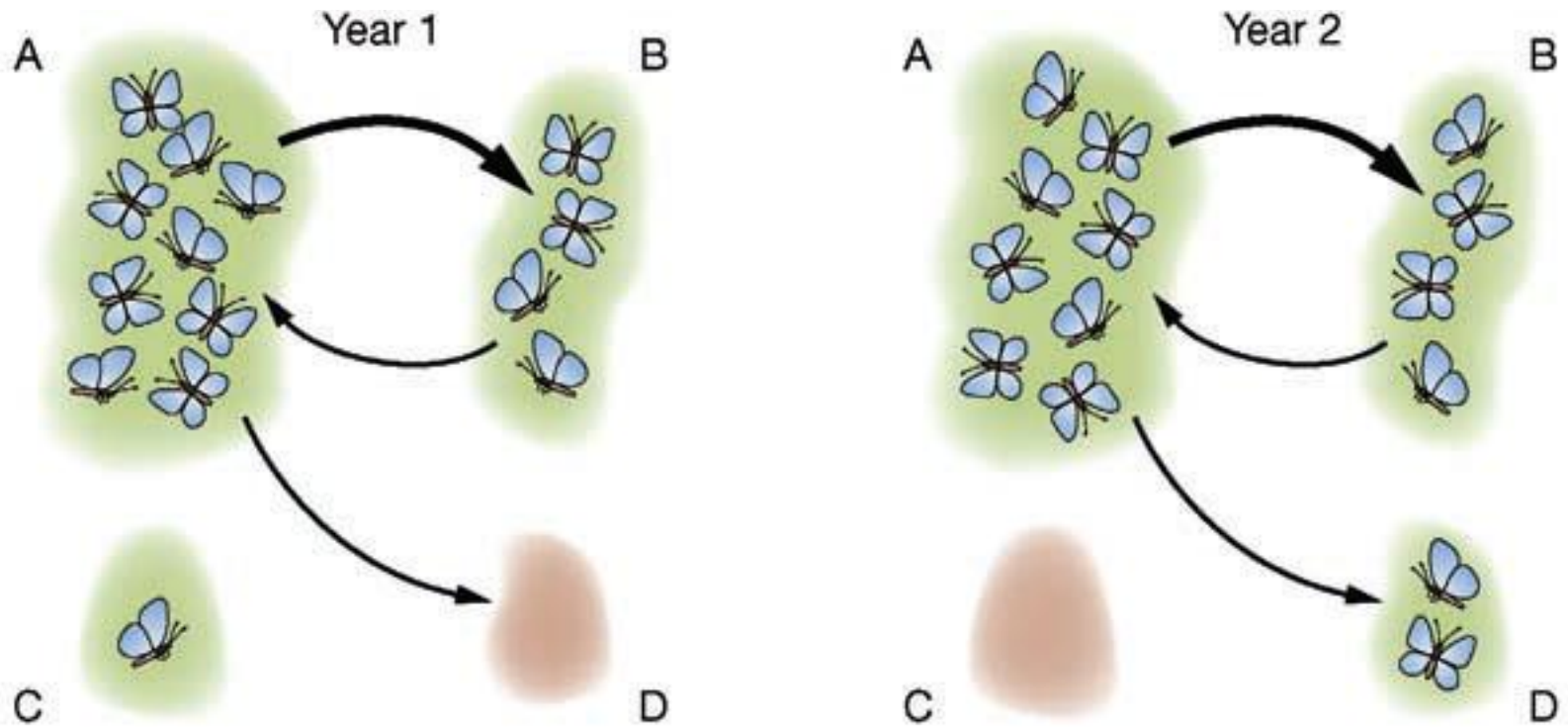
- Definitions:
  1. Area based – a group of individuals of the same species occupying a defined area at the same time.
  2. Based on demographics – group of interacting individuals of the same species whose population structure and dynamics are relatively independent of other groups.
  3. Genetically – two groups can be distinguished as separate populations if one has an allele not shared with the other group.



# Metapopulation structure

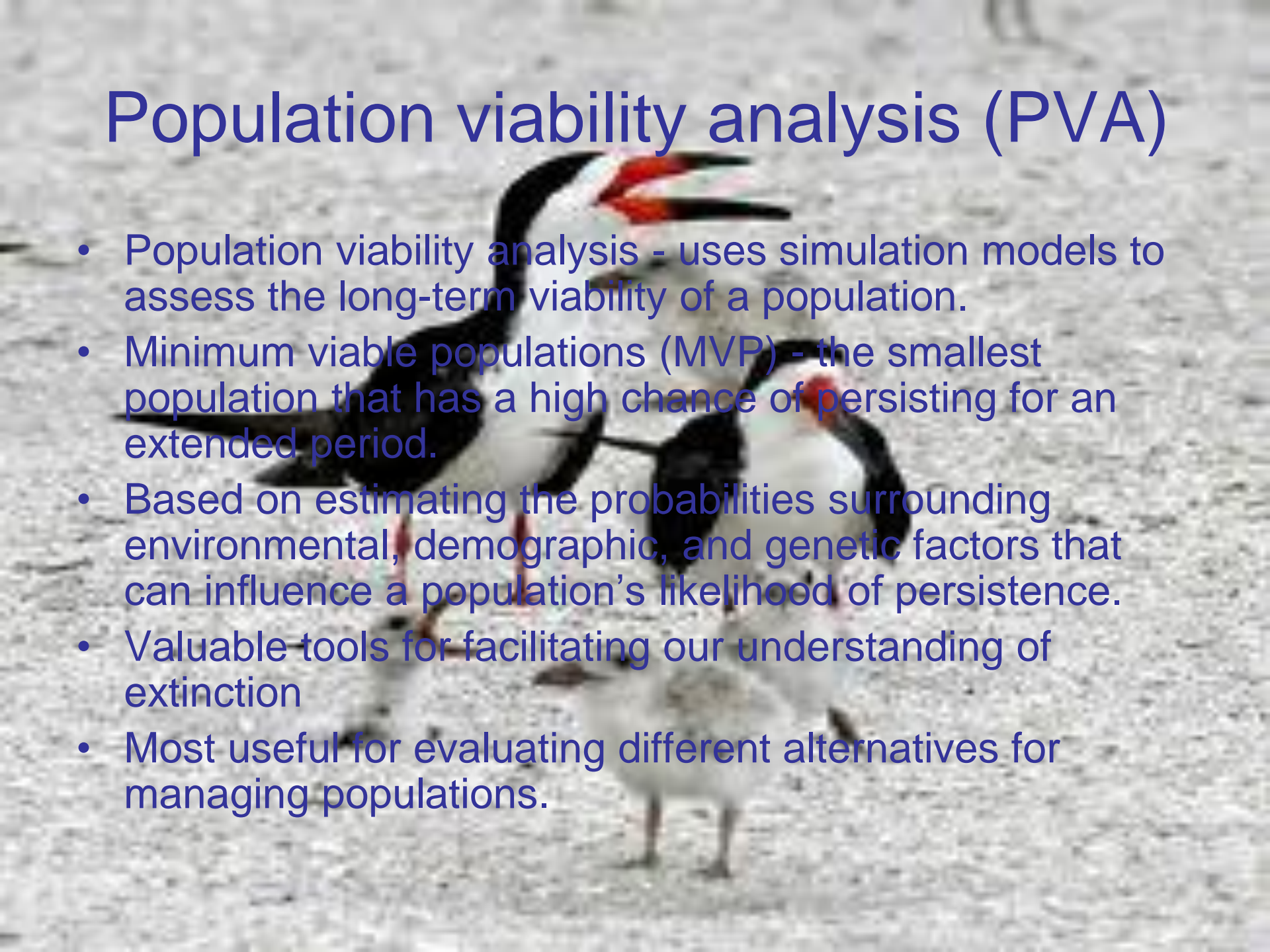
- To understand extinction processes we need to understand population structure, especially metapopulation structure in which populations are subdivided into semi-isolated subpopulations occupying patches of habitat in a matrix of nonhabitat.
- In this context, a key question becomes whether the rate at which new subpopulations are created by colonization exceeds the rate at which existing subpopulations are lost to extinction.
- Striking this balance depends on understanding both changes occurring within subpopulations (changes in birth rates, site quality, etc.) and changes in the number of individuals moving among subpopulations.

**Figure 7.5** A schematic depiction of a metapopulation



# Population viability analysis (PVA)

- Population viability analysis - uses simulation models to assess the long-term viability of a population.
- Minimum viable populations (MVP) - the smallest population that has a high chance of persisting for an extended period.
- Based on estimating the probabilities surrounding environmental, demographic, and genetic factors that can influence a population's likelihood of persistence.
- Valuable tools for facilitating our understanding of extinction
- Most useful for evaluating different alternatives for managing populations.



# Pitanja

- Koje je prosječno trajanje vrste (godina)?
- Koliko je do sada zabilježeno masovnih izumiranja?
- Definicije populacije.