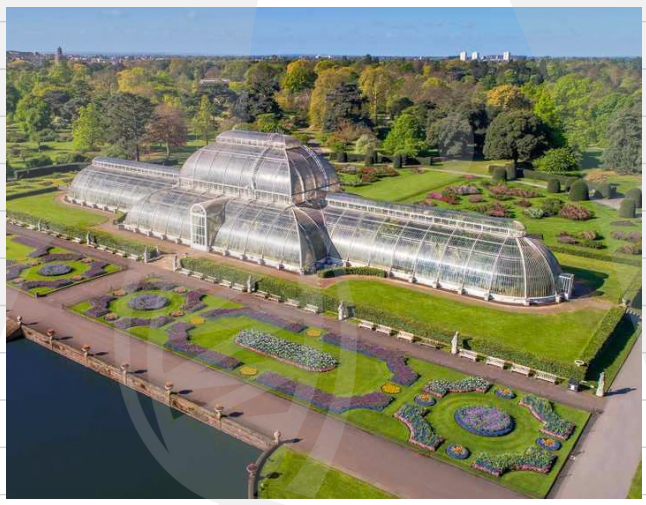
Conservation of Biodiversity

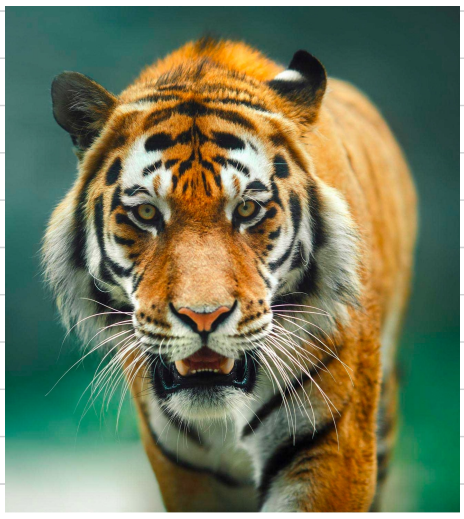
Learning outcomes

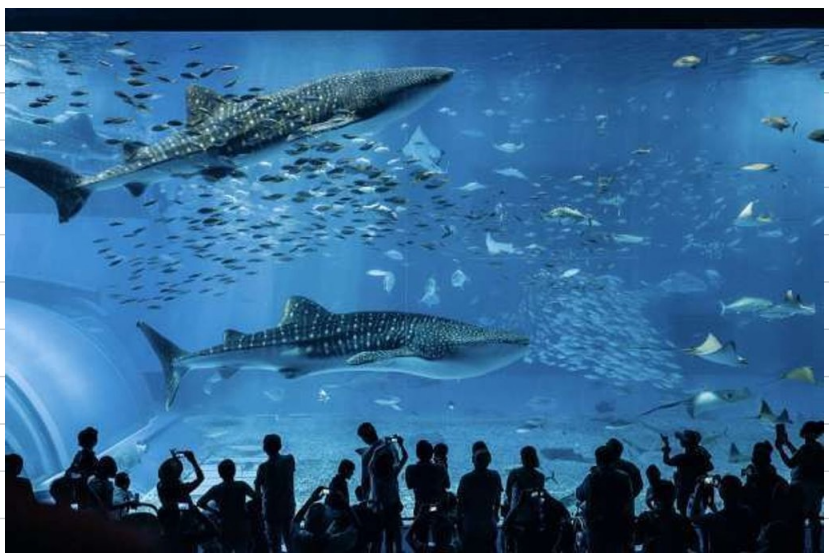
- ☑ Understand arguments about conservation can be based on aesthetic, ecological, economic, social and ethical justifications
- ☑ Understand the factors that make species more vulnerable and at risk for decline and extinction
- ☑ Understand the purpose and function of habitat-based approach of conservation
- ☑ Understand what features are beneficial for protected areas
- ☑ Understand species-based strategies of conservation including examples :
  - Zoos / aquariums
  - botanical gardens
  - Keystone species
  - captive breeding and reintroduction
  - frozen zoos / seed banks
  - Flagship species
  - CITES
- ☑ Evaluate different conservation approaches by weighing pros and cons

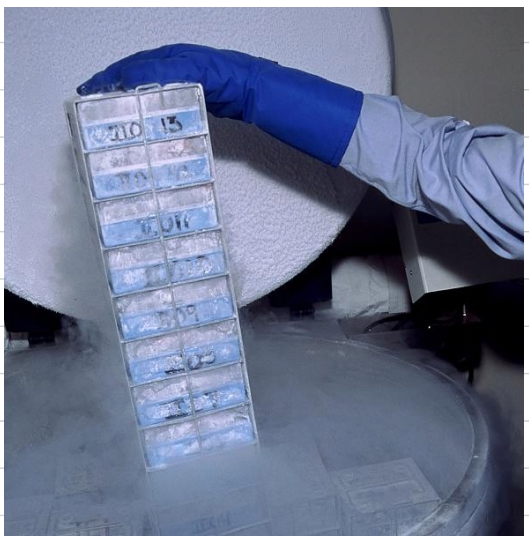
Key terms

- conservation
- endemic species
- Habitat-based (in-situ) conservation
- edge effect
- species-based (ex-situ) conservation
- flagship species
- Keystone species









Why and Who to Conserve

Conservation: preservation, protection and restoration of the natural environment and wildlife

Conserve biodiversity
Why or Why not

Aesthetic
- Natural beauty - animals + plants
- Human environment more pleasing

Ecological
- Ecological services (pollination, carbon sinks, climate regulation decomposers, soil quality) biodiversity maintains ecosystems
- species may be harmful to humans
- species may eat same food we do (crops)

Economic
- Food sources. Need to preserve old varieties of crops. Medicines, fertilizers, pesticides from plants + animals. Ecotourism. Plant + animal products (clothes, building materials)
- Areas needed for human population (housing, farming, mining, transport)
- Conservation is expensive
- Some species have no economic benefit for humans

Ethical
- Every species has the right to live. Our responsibility to protect resources for future generations
- Prioritizing the survival + wellbeing of animals or plants over people is unethical

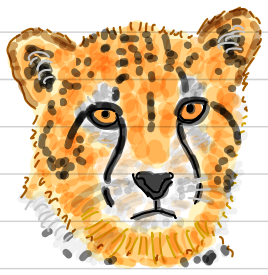
Social
- Knowledge through study of environment human rights of indigenous people (home, source of livelihood + culture)
- People have the right to develop (which takes space)
- Some animals may threaten humans

The "Red List of Threatned Species" is published by the International Union of Conservation of Nature (IUCN)
→ assesses conservation status of particular species in order to determine which species are at risk and need help

Least Concern → Near threatned → Vulnerable → Endangered → Critically Endangered → Extinct in wild → Extinct

How is this status determined? **What factors put species at risk?**

Population size



small population size leads to a reduced gene pool ∴ more prone to inbreeding + disease + susceptible to change

ex: Cheetahs and other big cats

Degree of Specialization

Species with a specific diet or habitat requirements are more vulnerable as if this is threatned, so are they. Less adaptable

ex: Koalas mainly eat Eucalyptus leaves

Distribution and range

Species that live in a small area are more vulnerable than those with a large range. Loss of this area leads to loss of species

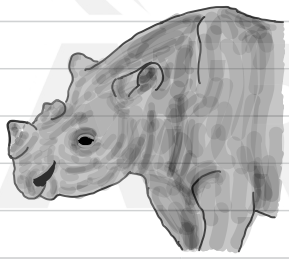
ex: Golden Lion Tamarins only found in small area of Brazil

Reproductive potential and behaviour

Animals which are long-lived and long gestation times (low reproductive rates) can take a long time to recover and are vulnerable to low pop.

ex: Orangutans have 1 offspring / 6-8 years

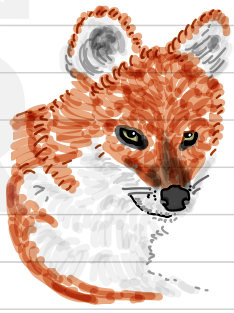
Degree of Fragmentation



Species that live in fragmented habitats may not be able to maintain large population sizes

ex: Sumatran Rhino live in tropical rainforest which is fragmented

Trophic level



Top predators and carnivores are at higher risk as they are affected by changes lower down food chain. Also they tend to be in smaller numbers

ex: Dhole is endangered due to lack of prey

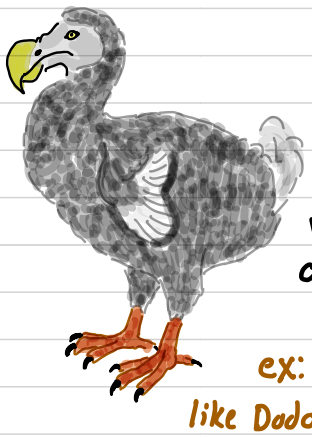
Seasonal migrants

species that migrate have long hazardous journeys and require habitats at both ends of the route. May also have barriers alon the journey

Ex: Songbirds in Canada

ex: Salmon migrate upstream to spawn

Poor dispersal



Species that cannot move easily to new areas / habitats are vulnerable to change

ex: Flightless birds like Dodo are trapped to their areas

Island species

Island organisms are highly vulnerable
why?
- populations are small
- many **endemic species:** only found in one geographic location
- reduced ability to disperse

60% of all extictions in last 400 years were island-dwelling species

Habitat vs Species-based Conservation

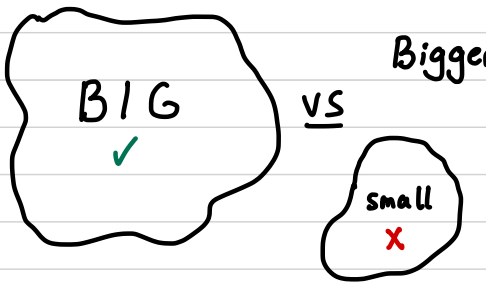
Habitat-based (in-situ) conservation: species are conserved in their naturally-occuring habitats. Habitats and ecosystem conservation is the focus → protected areas

↳ protected areas should aim to preserve the greatest amount of natural habitat within an ecosystem (thus maintaining complex ecological interactions which maintain equilibrium and biodiversity)

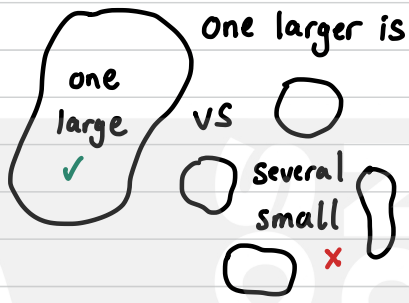
↳ may require active management.
- controlled grazing
- controlled poaching
- re-introduction of locally extinct species
- removal of invasive species
- controlled access to visitors
- legal action against human impacts

Problem: in most countries, protected areas are islands surrounded by areas of disturbance → leading to smaller, disturbance prone populations

↳ what are the best features for a protected area?

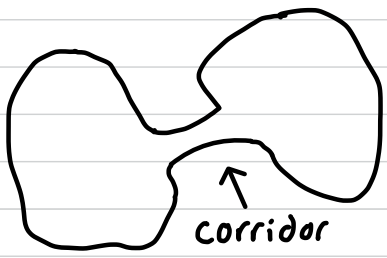


Bigger is better!
- ✓ larger habitats – ↑ biodiversity
- ✓ more resources + breeding sites
- ✓ more space for larger species
- ✓ allows some migration
- ✓ less edge effect

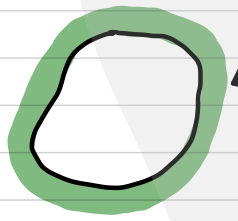


One larger is preferred → reduced edge effect

when two habitats meet at edges it leads to more disturbance and competition from outside areas → reduced biodiversity



corridors join fragmented areas
- ✓ gene flow – immigration/emigration
- ✓ seasonal migration/movement
- ✓ reduced disturbance/death from roads/boundaries



buffer zones surrounding conservation areas
- ✓ physical barrier for intruders (ex: prickly palm)
- ✓ protection from storm damage
- ✓ reduce edge effects

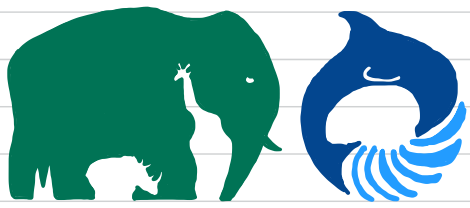
other important features: $ funding and resources ♡ public support provide education carry out research protected by legislation

Ex: Kabili-Sepilok reserve (Borneo), Selous Game reserve (Tanzania), Chitwan National Park (Nepal), Ras Mohammed National Park (Egypt) Yellowstone National Park (USA), Serengeti National Park (Tanzania), Great Barrier Reef Marine Park (Australia)

Species-based (ex-situ) conservation: preservation of species outside their natural habitats

↳ focuses on vulnerable species. Often used to backup in situ or when species cannot safely remain in their natural habitats

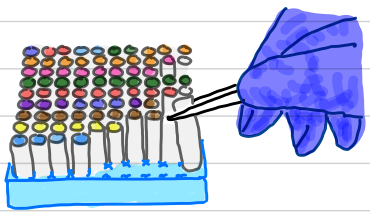
Zoos and Aquariums → Provides habitats, food and care for species while allowing visitors to observe them and ecologists to study them



- ✓ allow education through visits – ↑ public interest
- ✓ close monitoring (like genes) can occur
- ✓ ↑ number of offspring surviving to adulthood
- ✓ close study: ↑ understanding + improving conservation
- ✓ act as 'ark' preserving species until habitats restored
- ✓ allow captive breeding + reintroduction

- ✗ ethical arguments about animal captivity
- ✗ if not properly managed – poor/cruel conditions for animals
- ✗ tend to focus on flagship species and not those in greater need
- ✗ preserving an animal in zoos – less priority in conserving habitat
- ✗ zoo animals may be unable to adapt to wild

Frozen Zoos store genetic material of animals (sperm, eggs, embryos) at very low temperatures

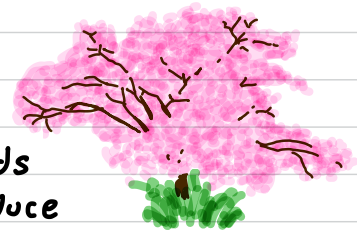


- ✓ preserve DNA from animals extinct in wild or extinct
- ✓ used in in vitro fertilization

Seed Banks store plant seeds in either frozen or dried state

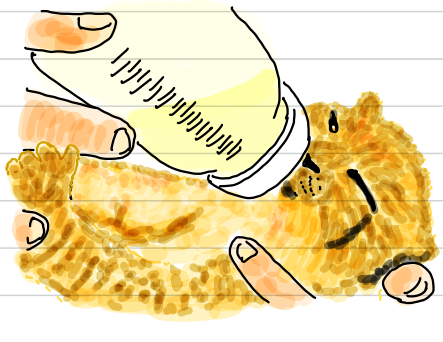
- ✓ preserve genetic diversity for species
- ✓ used to develop new breeds
- ✓ used to grow + re-introduce

Botanical Gardens like the 'zoos' of plants



- ✓ allow for growth research, education of plant species

Captive Breeding and Reintroduction → allow species in captivity to breed (naturally or artificially) Once adults, animals released into reserves



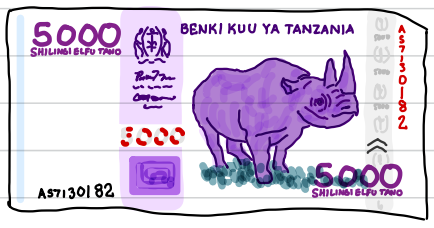
- ✓ populations can build up quickly as care and protection provided
- ✓ no competition/predation/poaching
- ✓ increase genetic diversity by tradings
- ✓ allow control and treatment of disease
- ✓ artificial insemination can be used

- ✗ not all species breed successfully in captivity
- ✗ released organisms may be unsuccessful
- ✗ if populations are rare can lead to inbreeding
- ✗ habitat conservation needs to also be done if reintroduction is to occur

Habitat vs Species-based Conservation

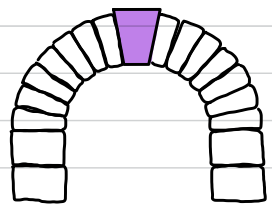
flagship species: 'charismatic' species selected to appeal to the public and raise support for biodiversity conservation

- ✓ used as 'umbrella' species where by helping this species, it can help others in same area
- ✓ used to raise public interest and funds which can be used to protect others
- ✓ used as marketing for conservation awareness, ecotourism, fundraising
- ✗ take priority over other species, which may be more in need
- ✗ if they do go extinct, message is 'we failed'



ex: Giant Pandas, Bengal Tigers, Whales, Elephants, Great Apes

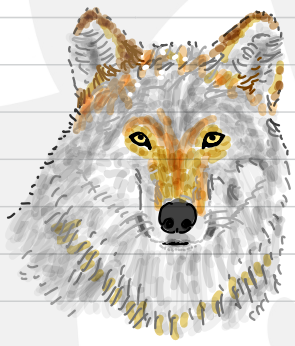
Keystone species: a species that plays a critical role in maintaining the structure of the ecosystem in which they live



* regardless of abundance, these species have huge impacts on their ecosystem
* decline/loss of one may cause ecosystem collapse

→ tend to be predators or 'engineers' who transform their environment

a loss of sea otters saw a destruction of Kelp forests



Loss of Grey wolf caused an ↑ in herbivores which over-grazed many plant species
Also prevented herbivores from grazing in new areas, impacting beavers and the flow of water

Beavers are ecosystem engineers - cut down older trees to build dams. This alters water flow and transforms habitats

CITES (Convention on International Trade of Endangered Species)

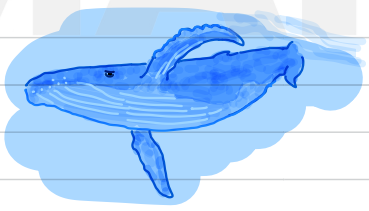
An international accord that countries sign into voluntarily

aim: ensure international trade in specimens of wild animals and plants does not threaten their survival

→ monitors illegal trade in threatned species and confiscates them

→ ~6000 species of animals and ~33,000 species of plants

- ✓ reduces the demand for exploitation and trade
- ✓ supported by many countries allowing international cooperation
- ✓ many species included on list



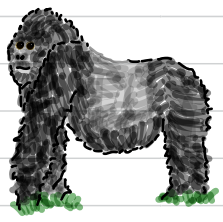
Species are grouped into appendices according to threat level:
* can include whole groupes (primates, whales)

Appendix I - species cannot be traded internationally except for research

Appendix II - species can be traded with strict regulations

Appendix III - species included at the request of countries in order to promote collaboration to manage species

- ✗ enforcement is difficult
- ✗ fines may be too small to deter poaching
- ✗ not all countries signed, allowing trade to occur
- ✗ treaty favours large, attractive organisms



"If we can teach people about wildlife they will be touched.
Share my wildlife with me,
because humans want to save things that they love"

– Steve Irwin