Biodiversity

The Lifeblood of Earth

Conservation

The Earths' Best Chance

Biodiversity

- What is biodiversity?
- Why it is so important?
- What are the threats?
- What can we do about it?

What is Biodiversity?

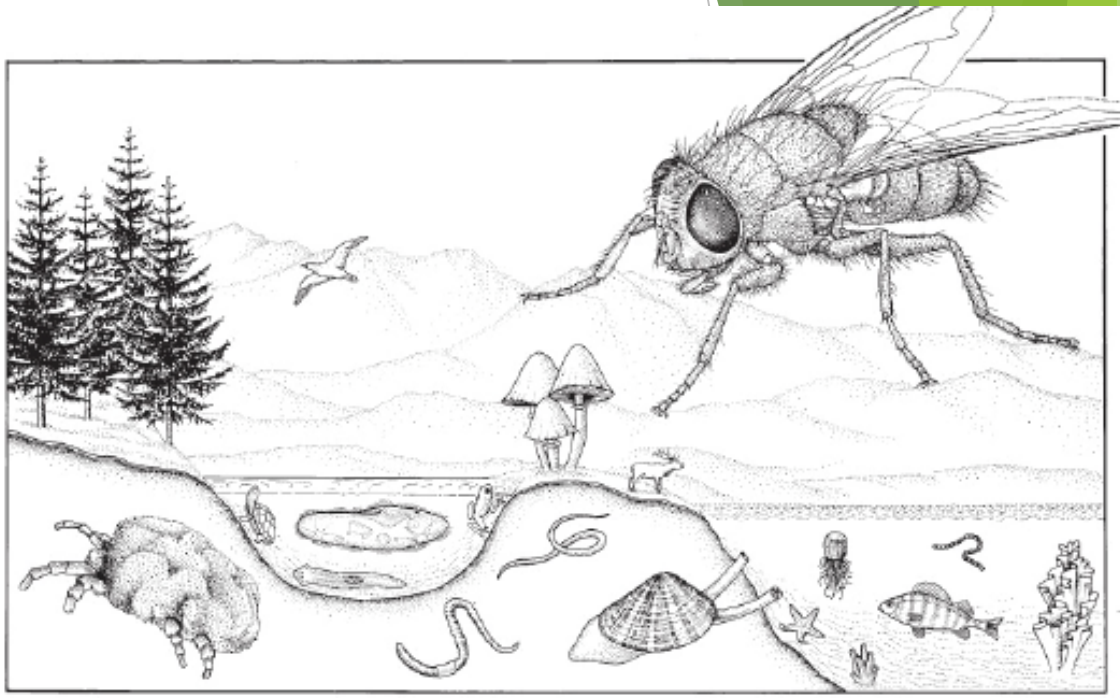
- **Biodiversity** is a term used to describe the enormous variety of life on Earth

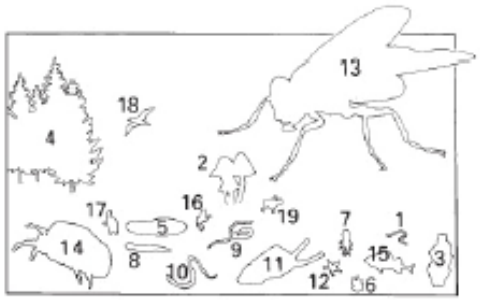
plants, bacteria, animals, humans and everything else!

8.7 million species estimated- 1.2 million identified

Types of diversity

- Genetic Diversity
- Species Diversity
- Ecosystem Diversity
- Global Diversity





1 Prokaryotes
2 Fungi
3 Algae
4 Plantae (multicellular plants)

5 Protozoa
6 Porifera (sponges)
7 Cnidaria (jellyfish, corals, etc.)
8 Platyhelminthes (flatworms)
9 Nematoda (roundworms)
10 Annelida (earthworms, leeches, etc.)
11 Mollusca (snails, bivalves, octopus, etc.)
12 Echinodermata (starfish, sea urchins, etc.)
13 Insecta
14 Non-insect Arthropoda
15 Pisces (fish)
16 Amphibia (frogs, salamanders, etc.)
17 Reptilia (snakes, lizards, turtles)
18 Aves (birds)
19 Mammalia (mammals)

Fig. 1.1 Speciescape, in which the size of individual organisms is approximately proportion to the number of described species in the higher taxon that it represents. (After Wheeler 1990.)

Why is biodiversity important?

- It might be easy to think that we don't need all this diversity

- Complexity brings stability.
- Stability brings us security.

- And there are many, many functions of this biodiversity

Why is biodiversity important?

- Biodiversity conservation is important for economic growth and poverty reduction
- Supports Ecological balance

- the survival of various ecosystems globally

- Aesthetic and Cultural value

- Its' beauty and traditional/cultural role

- Ethical value for every form of life in the environment
- Ecosystem services worth billions of dollars

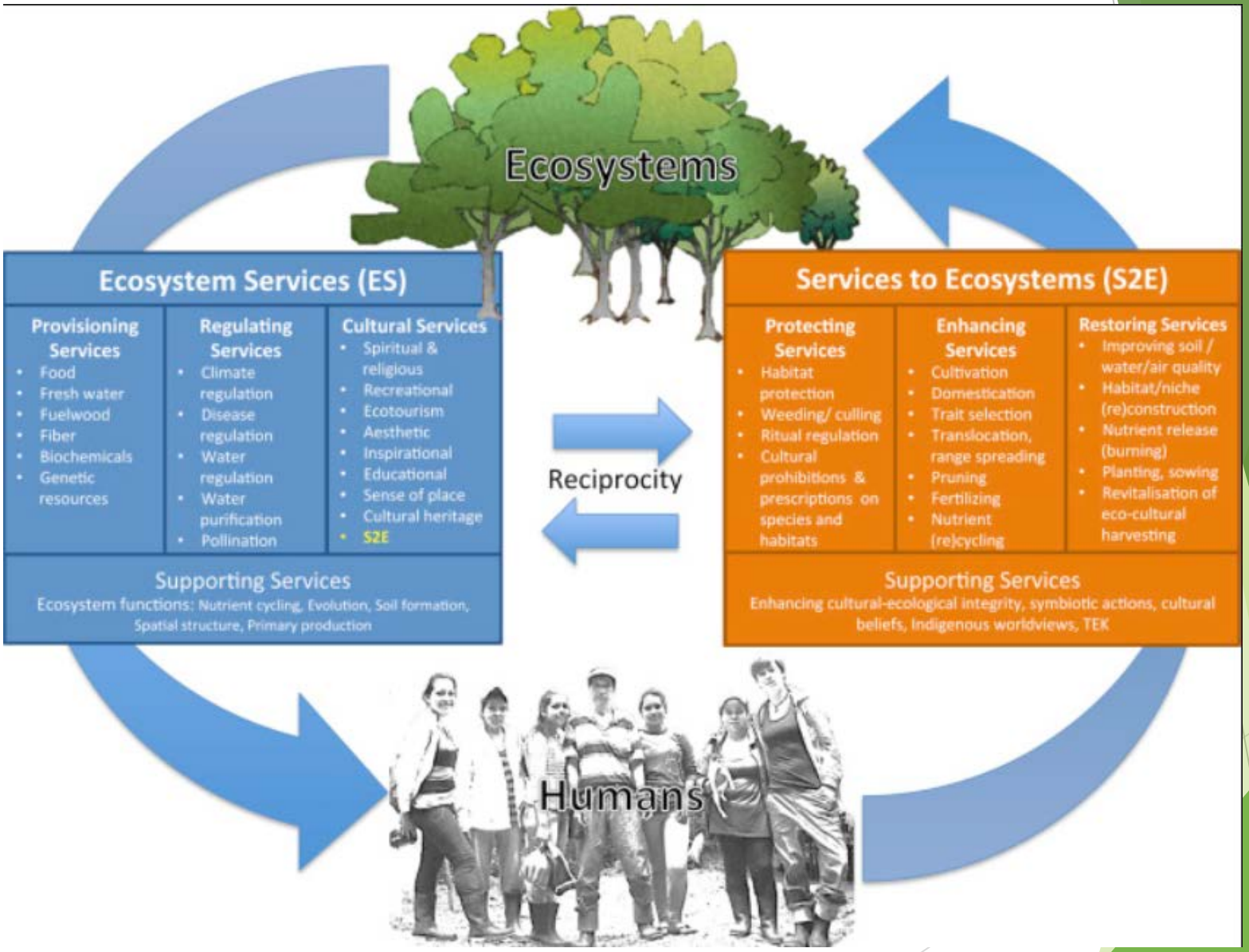
Ecosystem Services

- **Ecosystem services**

-Many and varied benefits to humans provided by the natural environment and from healthy ecosystems

We usually break these down into four group

- Provisioning
- Regulating
- Cultural
- Supporting



Comberti, Claudia, et al. "Ecosystem services or services to ecosystems? Valuing cultivation and reciprocal relationships between humans and ecosystems." *Global Environmental Change* 34 (2015): 247-262.

Lets look at one example- Crop pollination

- 87 of leading food crops dependent on pollination, 28 not
- Crops: fruit, nut, vegetable, forage, oil

  e.g. tobacco, coffee, orange, mango, clover, bean, tea, olive…
- 35% of production from animal pollinated species, 1 in 3 bites
- Balanced diet, 90% vitamin C
- Improves quantity, quality & genetic diversity

(Klein et al. 2006, Eilers et al. 2011)

Pollination value

- So how much are pollinators ‘worth’ to humans?
- Scientists estimate that 200,000 - 350,000 different animal species help with pollination.

Pollination value

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- Scientists estimate that 200,000 - 350,000 different animal species help with pollination.
- Take a guess…

-Between $235 and $577 billion

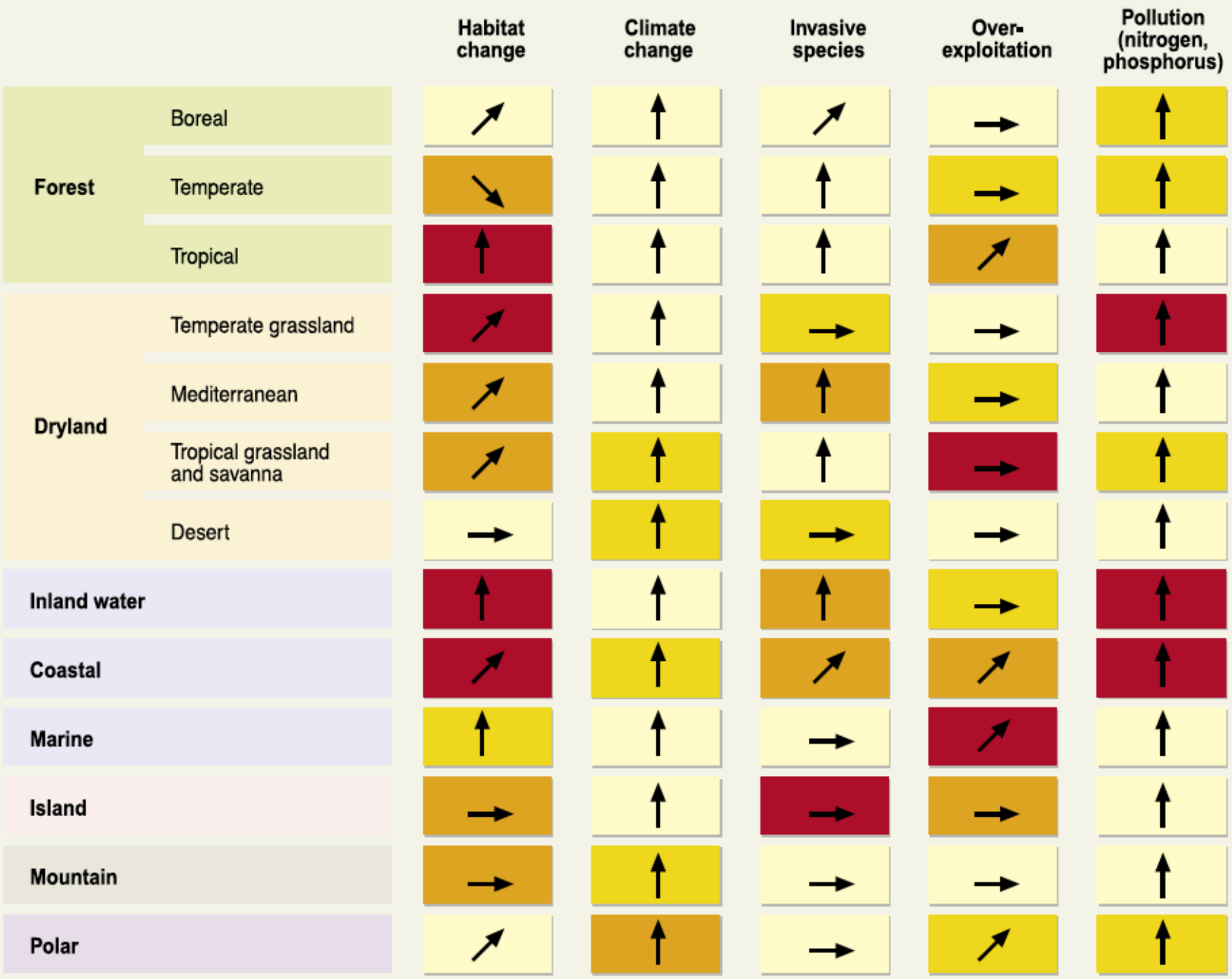
- For comparison,

GDP of PNG- $24.83 billion

So that's between 10 and 20 times more….

Threats to Biodiversity

- Habitat Change, fragmentation and loss of connectivity
- Exotic Species
- Climate Change
- Pollution
- Over-exploitation


Habitat change
Climate change
Invasive species
Over-exploitation
Pollution (nitrogen, phosphorus)
Forest
Boreal
Temperate
Tropical
Dryland
Temperate grassland
Mediterranean
Tropical grassland and savanna
Desert
Inland water
Coastal
Marine
Island
Mountain
Polar

Habitat Change, fragmentation and loss of connectivity

Soil erosion, Pitcairn island

Exotic Species

- Plants and Animals that come from another place.
- We call species that belong to a place – NATIVE
- And those from another place

  - Exotic/Non-Native/Introduced

PNG- For example

Piper Aduncum

Spathodea campanulata

Many grasses

South East Asia and Pacific Islands- Lantana camara - a noxious weed

Can also be animals

For Example

- Fish- Since 1950s, 26 freshwater fish species introduced

- Started with Rainbow Trout

(Oncorhynchus mykiss)

- Also includes Mozambique Tilapia

(Oreochromis mossambicus)

- Cane Toads (Bufo marinus)-

First introduction to East New Britain

80 years ago

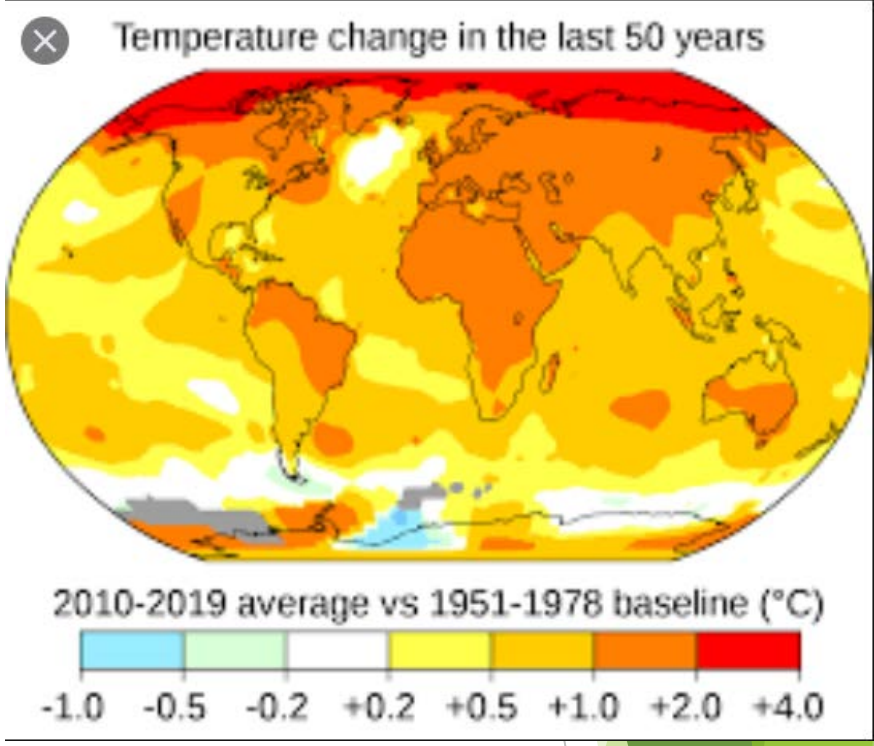
Climate change

- Change environment can directly and indirectly impact biodiversity

1- Environment can change so that the species can no longer live there.

E.G. Shellfish in the sea.

A butterfly on top of a mountain



2- Environment can change and worsen the effect of natural disasters

Australian 2020 wildfires

The potential future effects of global climate change include more frequent wildfires, longer periods of drought in some regions and an increase in the number, duration and intensity of tropical storms. Credit: Left - Mellimage/Shutterstock.com, center - Montree Hanlue/Shutterstock.com.

Pollution

- Pollution can come from many sources
- Chemicals, gases and physical objects
- Cars, Factories, Animals in Agriculture, Resource extraction industries, regular people.
- One significant concern and one that we can see, is PLASTICS
- The world now produces more than 380 million tonnes of plastic every year

Pollution of the environment is one of the biggest threats to lifeforms on Earth today. Image credit: Martina Badini/Shutterstock.com

The pathway by which plastic enters the world's oceans

Our World in Data

Estimates of global plastics entering the oceans from land-based sources in 2010 based on the pathway from primary production through to marine plastic inputs.

Conservation of Biodiversity

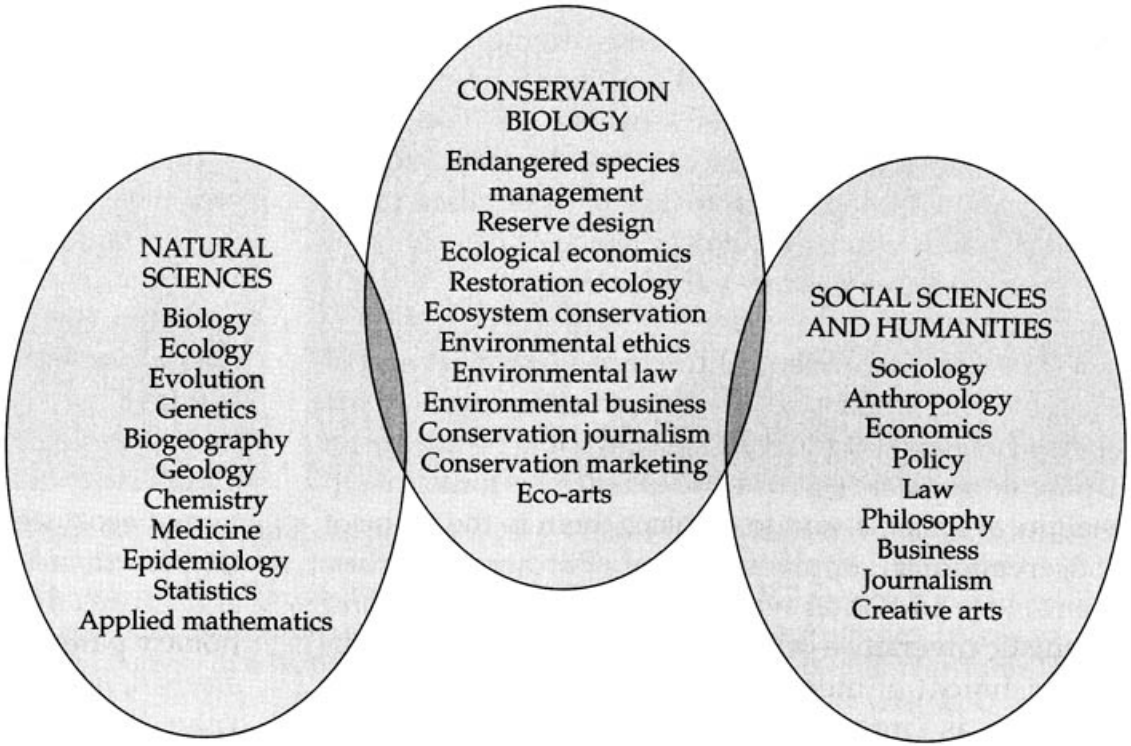
- What do we mean by conservation?
- It is all about protecting organisms and species within their natural habitats with the aim of ensuring intragenerational and intergenerational equity.

‘’We should preserve every scrap of biodiversity as priceless while we learn to use it and come to understand what it means to humanity.’’

– E. O. Wilson

Summary:
A multidisciplinary effort

- Bridges the gap between social and natural sciences



Conservation can slow extinction rates…

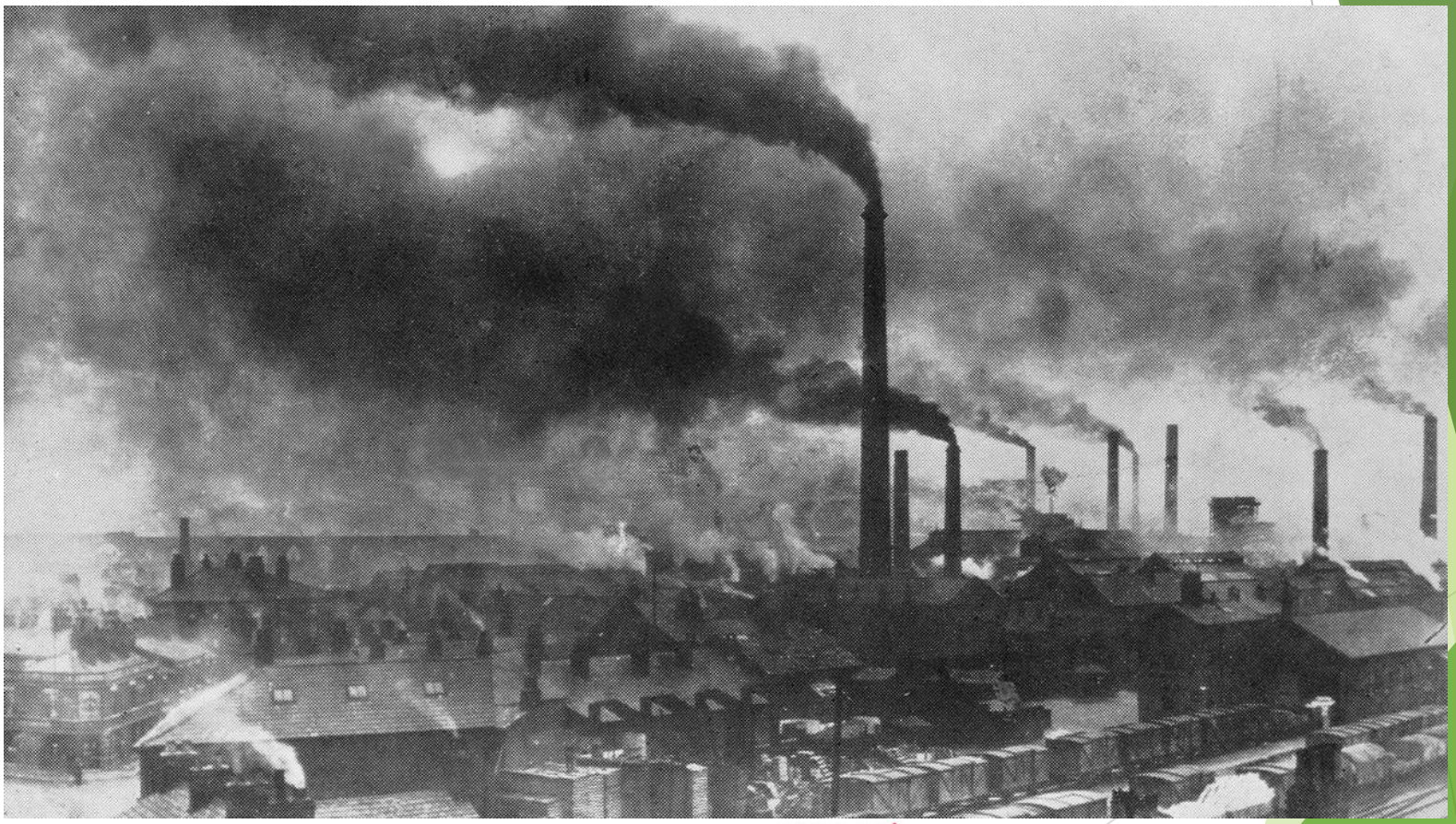
- There has been 5 mass extinction events through the history of the Earth….
- Caused by

- Massive volcanoes and other processes changing the atmosphere composition
- Asteroids hitting earth

With these leading to

- The planet cooling dramatically
- The planet warming dramatically

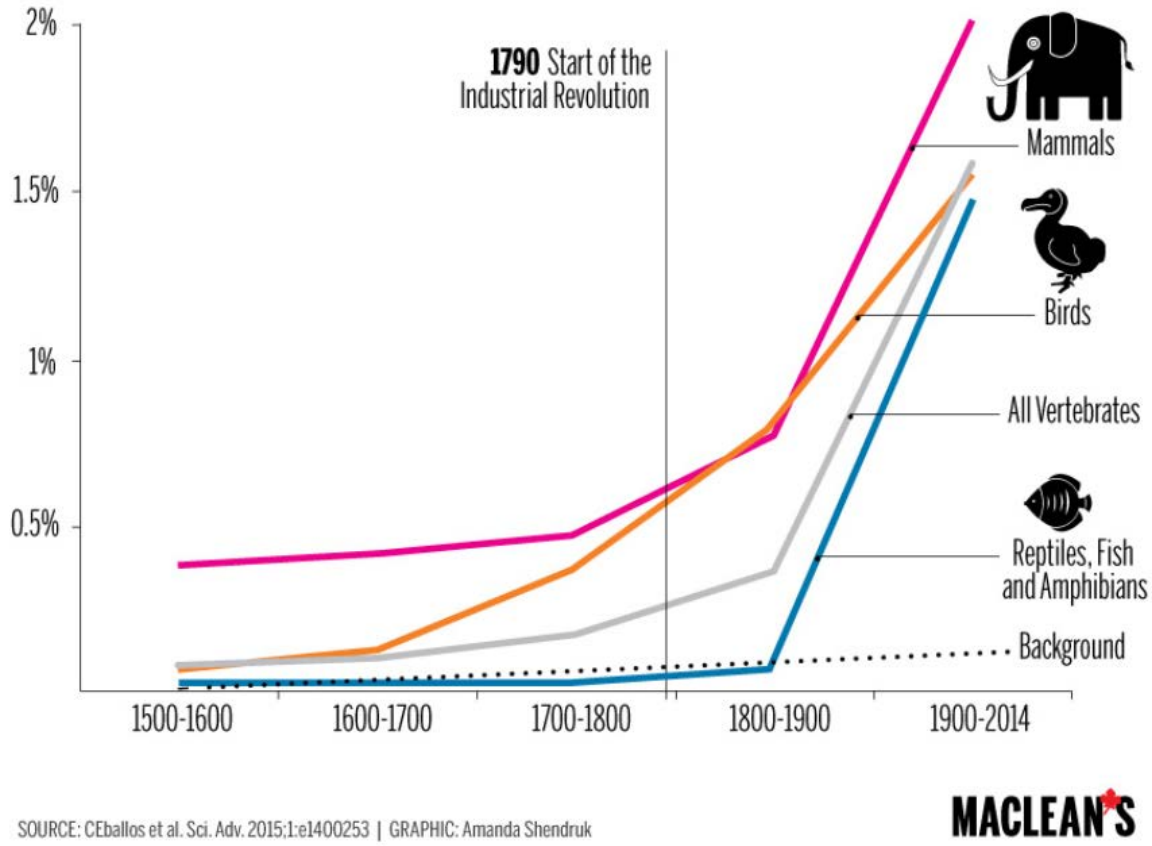
The sixth mass extinction event…. Humans…



SOURCE: CEballos et al. Sci. Adv. 2015;1:e1400253 | GRAPHIC: Amanda Shendruk

MACLEAN'S

The sixth mass extinction event…. Humans…



How we fight this?
As individuals

- Participating in Biodiversity Conservation
- Eradicate and control introduced weeds
- Monitor and assess your pets' impact on biodiversity
- Leave native plants undisturbed, and landscape using native trees and vegetation
- Maintain wetlands
- Construct fences to protect sensitive habitats from trampling and other disturbances

How can we do this? As individuals (2)

- Maintain old standing dead trees and mature forest stands
- Reduce use of pesticides in farming
- **Learn as much as you can about nature and share your knowledge with others**
- Encourage and support local government initiatives
- Recycle, reuse and reduce
- Drive less, walk, ride or carpool more

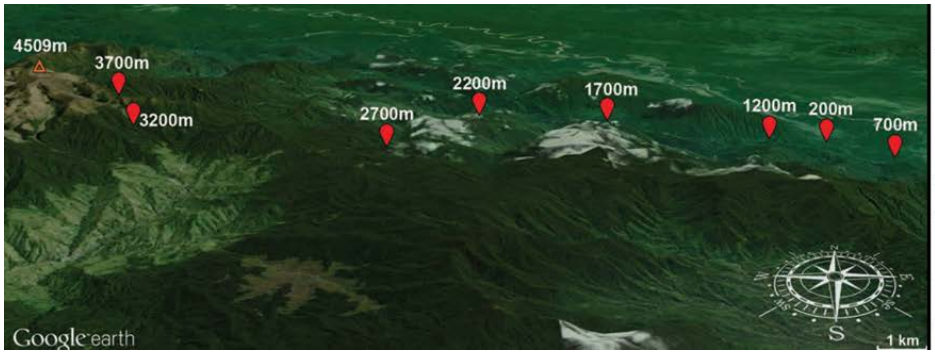
How can we do this? As community conservationists

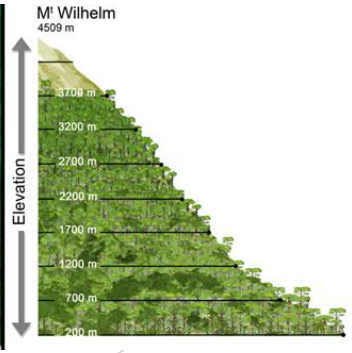
- Let's talk about conservation techniques
- We can break this into 2 categories

Protecting species (Flagship or Keystone Species)

Protecting places

Fig. S1. Mt. Wilhelm massif, Papua New Guinea





Techniques

- There are methods that we can use that are unique to each strategy
- But actually many of the techniques are the same
- These two ideas weave together.
- Think of it like a house.

If we take care of our **whole** house, then we take care of what's inside the tables, the fire and so on.

But we can also focus on just taking care of **the floor**, and if we do that, it should also take care of the table, chairs, the bed and so on….

Conserving species

- Can be used to prioritise those which need saving urgently before they go extinct
- National and Local legislation, Or community rules

e.g. CITES (international)

e.g. Local community rules (limited hunting)

- Run monitoring programs to check on the size of the population – number of individuals in your area

IUCN red list categories

- Species Survival Commission
- Standardised method for documenting extinction threat
- Measures risk of extinction (or tries to)
- Does NOT give an assessment of conservation priority

Categories

- Extinct (EX)
- Extinct in wild (EW)

- Critically Endangered (CR)
- Endangered (E)
- Vulnerable (V)

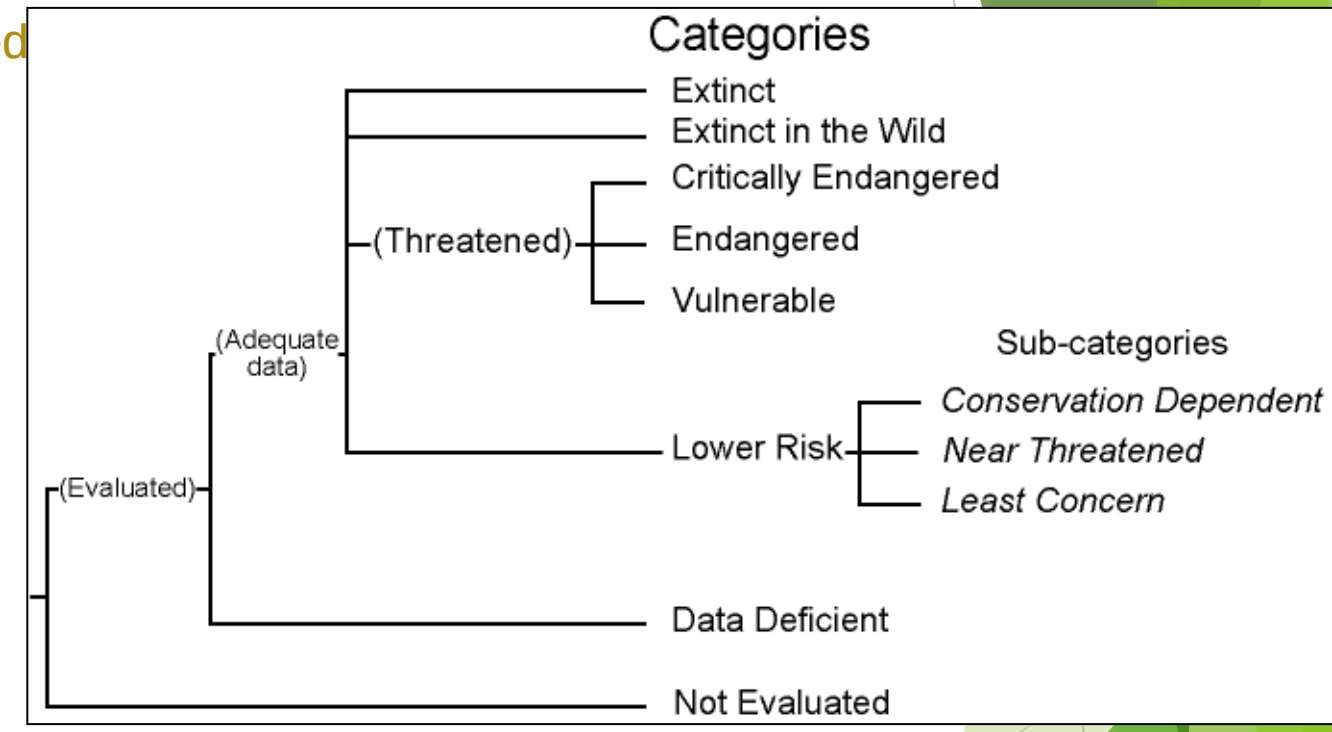
- Lower Risk (LR)

-Conservation Dependent (cd)

-Near Threatened (nt)

-Least Concern (lc)

- Data Deficient (DD)
- Not Evaluated (NE)



The criteria

A - Declining population (past, present and/or projected)

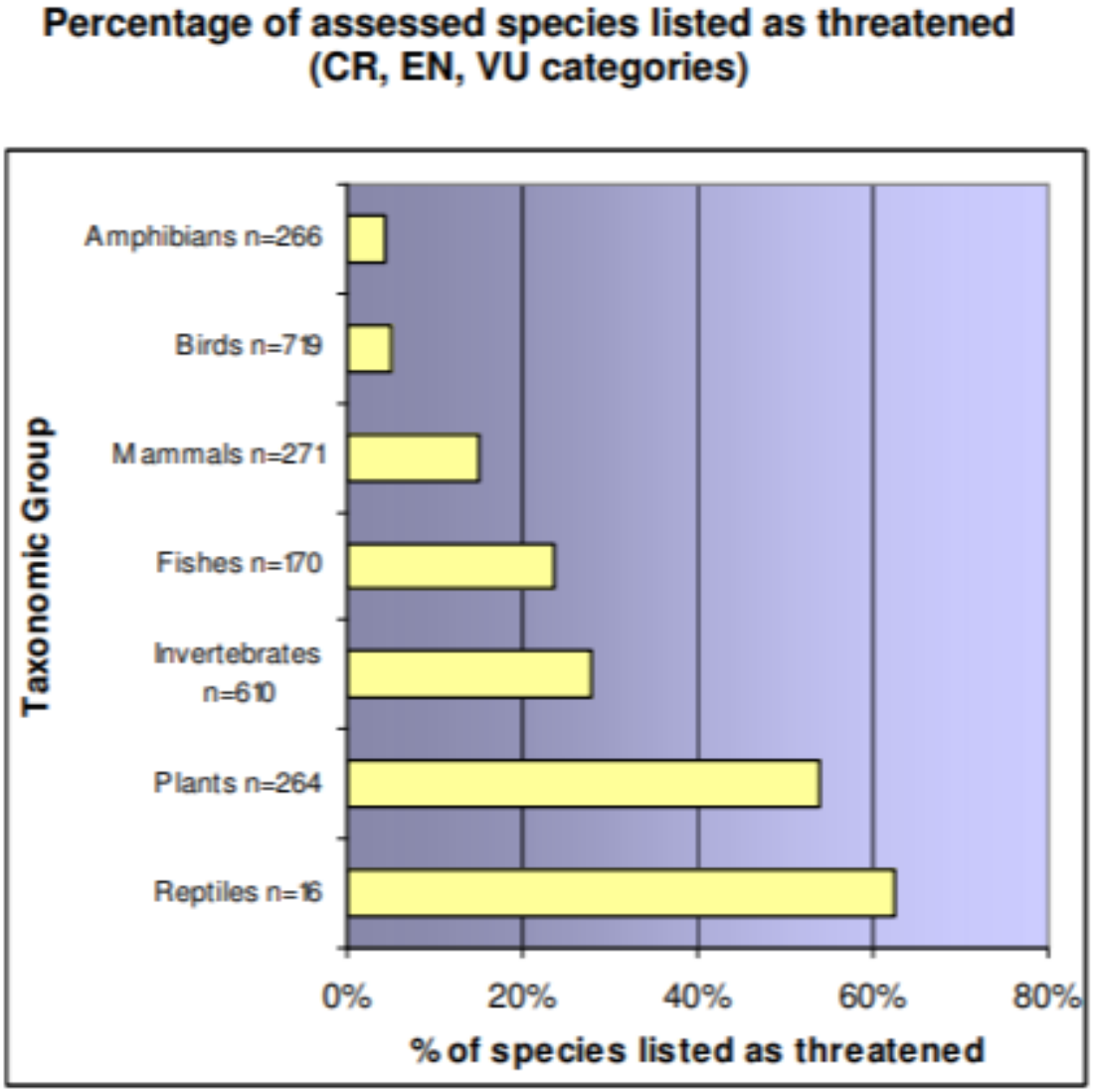
B - Geographic range size and fragmentation, decline or fluctuations

C - Small population size and fragmentation, decline or fluctuations

D - Very small population or very restricted distribution

E - Quantitative analysis of extinction risk (e.g. PVA)

IUCN Redlist PNG



Ex situ conservation of species

- Botanic gardens
  - Advantages
  - Problems
- Zoological gardens
- Genebanks

Biodiversity conservation in botanic gardens

- Approx. 300,000 higher plant species; perhaps one third in BGs
  - Kew -England
  - Missouri- United States
  - Bogor- Indonesia
- But few genetically representative collections

Hyophorbe amaricaulis

- Sole surviving tree
- Inside a Botanic Garden Curepipe, Mauritius
- Conservation?

Extinct in the wild

- 29 vascular plants extinct in wild (2009 red list)
  - Exist in cultivation
- E.G. *Sophora toromiro*
  - Endemic to Easter Island (Rapa Nui)
  - Grown in a handful of botanic gardens from seed originally collected by Thor Heyerdahl
  - Maunder *et al.* (2000) *Conservation Biology*, **14:** 1341-1350.

Zoos and captive breeding

- Started a little later than botanic gardens,
- Developed out of menageries
- *Menagerie du Jardin des Plantes* first public zoo (1794)
- Zoos usually well-organised to share animals for captive breeding programmes

Education

Seedbanks and Genebanks

- Places where scientists can

  store seeds or plant cuttings for a long time
- Can use this as a ‘back up’ in case of environmental disasters of extinctions.
- Svalbard Global Seed Vault, Spitsbergen Norway

Images: https://www.seedvault.no/

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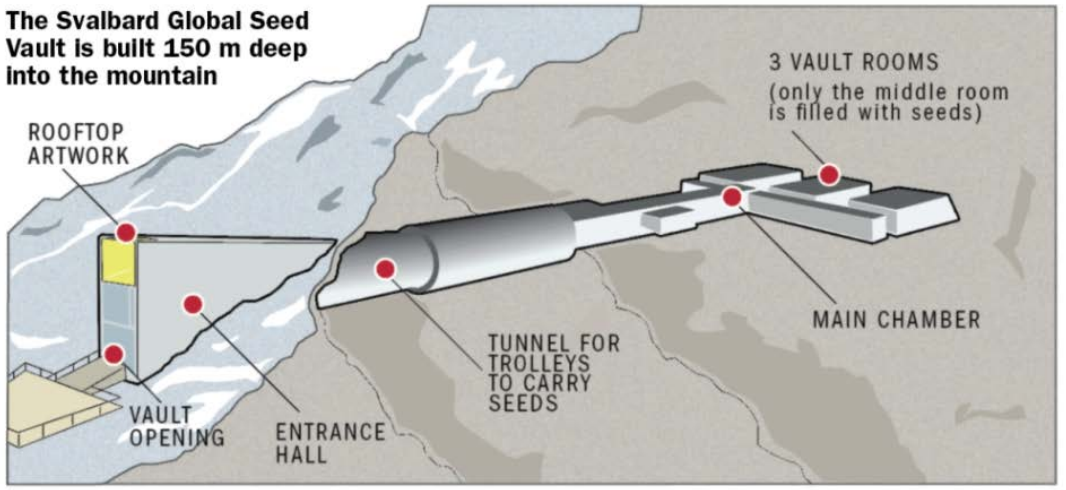
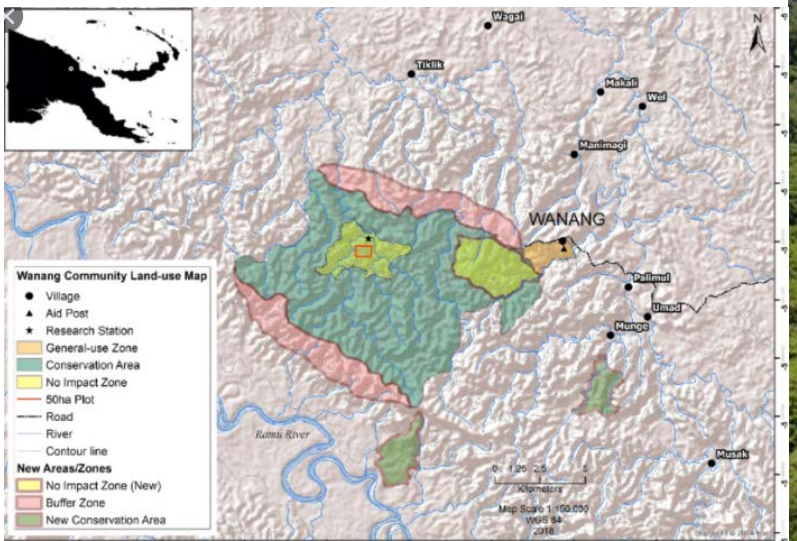


Protecting habitats

The ecosystem approach

- Conserve entire, functioning ecosystems
- Maybe more cost effective than conserving single species
- E.G. Wanang Conservation Area



Some principles…

- Management objectives are a matter of societal choice.
- Management should be decentralized to the lowest appropriate level.
- Ecosystem managers should consider the effects of their activities on adjacent and other ecosystems.
- A key feature of the approach includes conservation of ecosystem structure and functioning.

More principles….

- Objectives for ecosystem management should be set for the long-term.
- Management must realize that change is inevitable.
- There must be a balance between conservation and use.
- All forms of relevant information should be considered, including scientific and indigenous and local knowledge, innovations and practices.
- All relevant sectors of society and scientific disciplines should be involved.

IUCN reserve categories

Ia *Strict Nature Reserve* - managed for scientific research

Ib *Wilderness Area* - wilderness protection

II *National Park* - ecosystem protection and recreation

III *Natural Monument* - specific natural features

IV *Habitat/Species Management* - conservation through management intervention

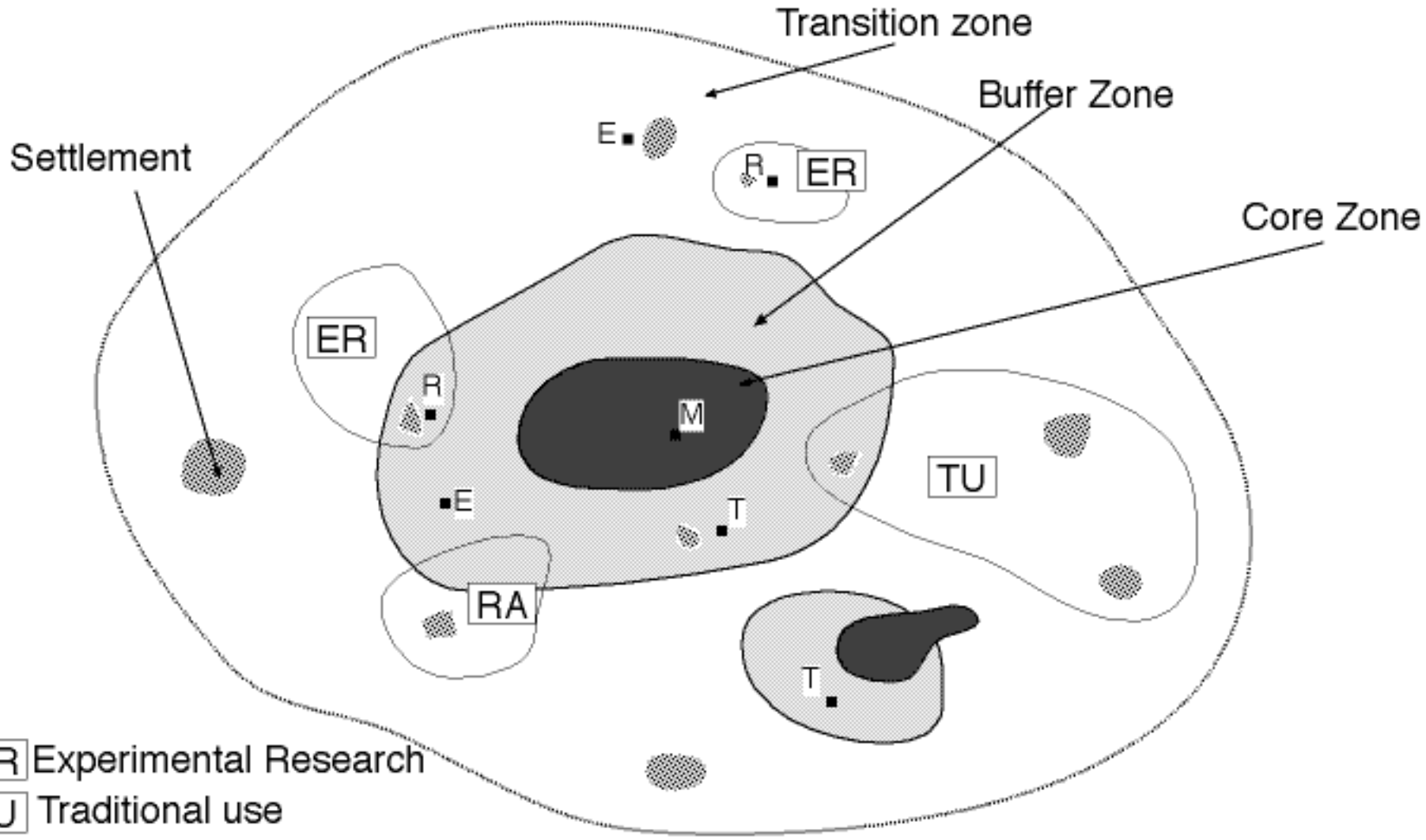
V *Protected Landscape/Seascape* - landscape/seascape conservation and recreation

VI *Managed Resource Protected Area* - sustainable use of natural ecosystems

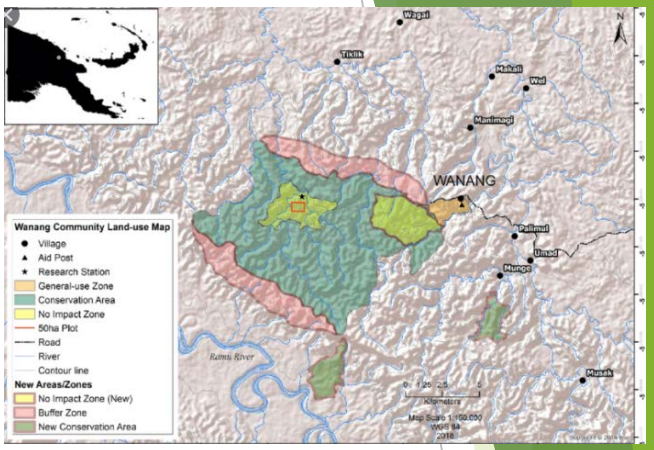
Reserve design

- Core areas
  - Strictly preserved minimum viable population
- Buffer zones
  - Extension buffer - same management as core
  - **But also** Socio-buffer - allows controlled & monitored exploitation
- Transition zone
  - Limited settlement, research, rehabilitation, sustainable exploitation

Model Reserve Design (based on Batisse, 1986)



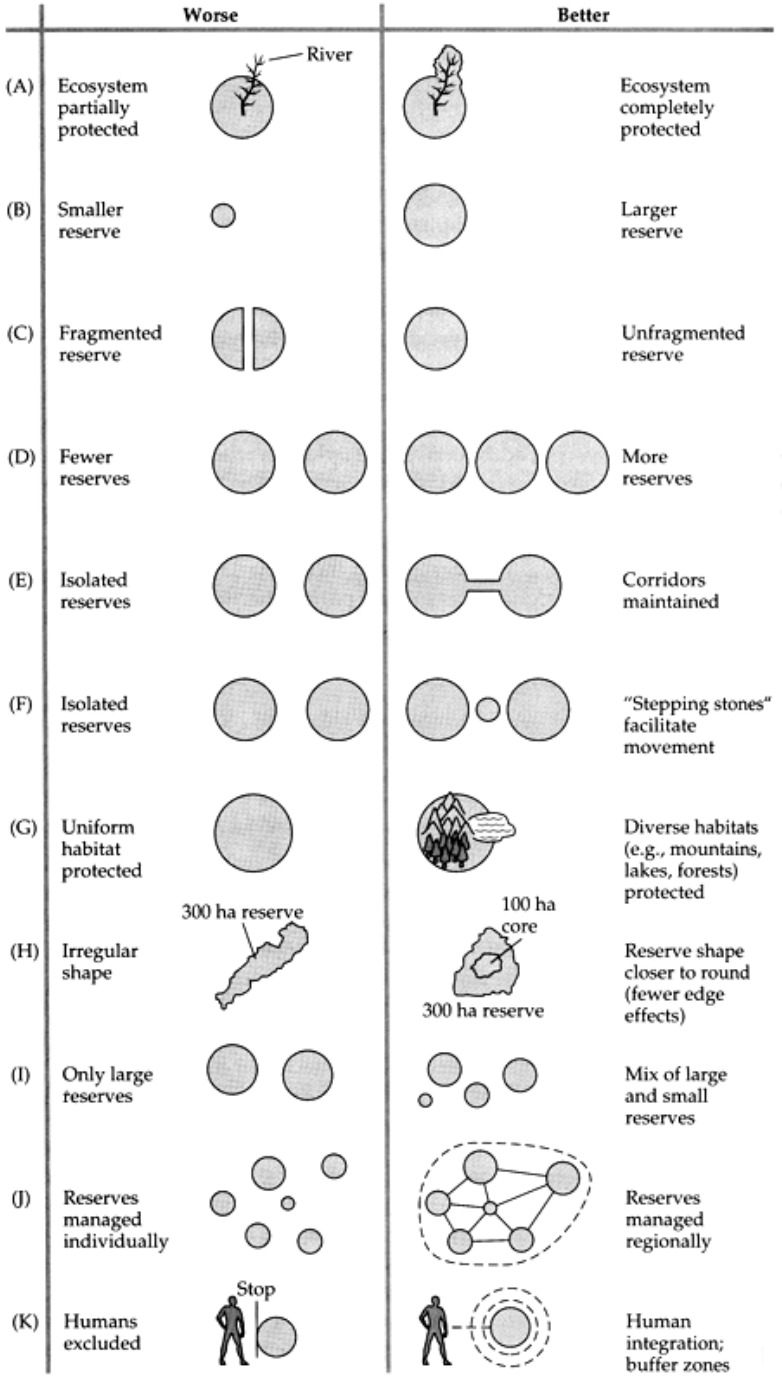
Biological and social benefits of buffer zones



- Protection of core
- Extension of core
- Provides natural boundaries
- Area for replenishment of populations
- Allows traditional use
- Provides local compensation
- Available for education, tourism
- Protects traditional rights
- Increased conservation-related employment

Reserve design

- These points have been hotly debated, but let's look through the general consensus



Micro reserves

- Largely developed for plants
  - -Valencia, Crete, Slovenia
  - -PNG
  - Queen Alexander Birdwing Butterfly Project (QABB)
  - Oro Province, PNG
- 2-20 ha - but aim to secure populations
- Main aims are inventory, monitoring, experimental conservation, seed collection etc.
- Not seen as a substitute for larger reserves, but compliment
- Maybe good also for arthropods?

Conclusions

- Biodiversity is absolutely critical to the world
- We need it for food, medicine, building, and on and on..
- It is enormous, but shrinking far too quickly
- The cause is human activity

BUT

- Humans can find solutions too
- Community conservation projects are a key part of the effort
- The work you do, is vital
- Without conservation efforts, we, and the next generations, face an uncertain future

- https://www.youtube.com/watch?v=kHhspf5IfdE