Fundamentals of digital and ecological transitions

Applied ecology and climate change

Lesson 3

Dr. Chiara MANFRIN

cmanfrin@units.it

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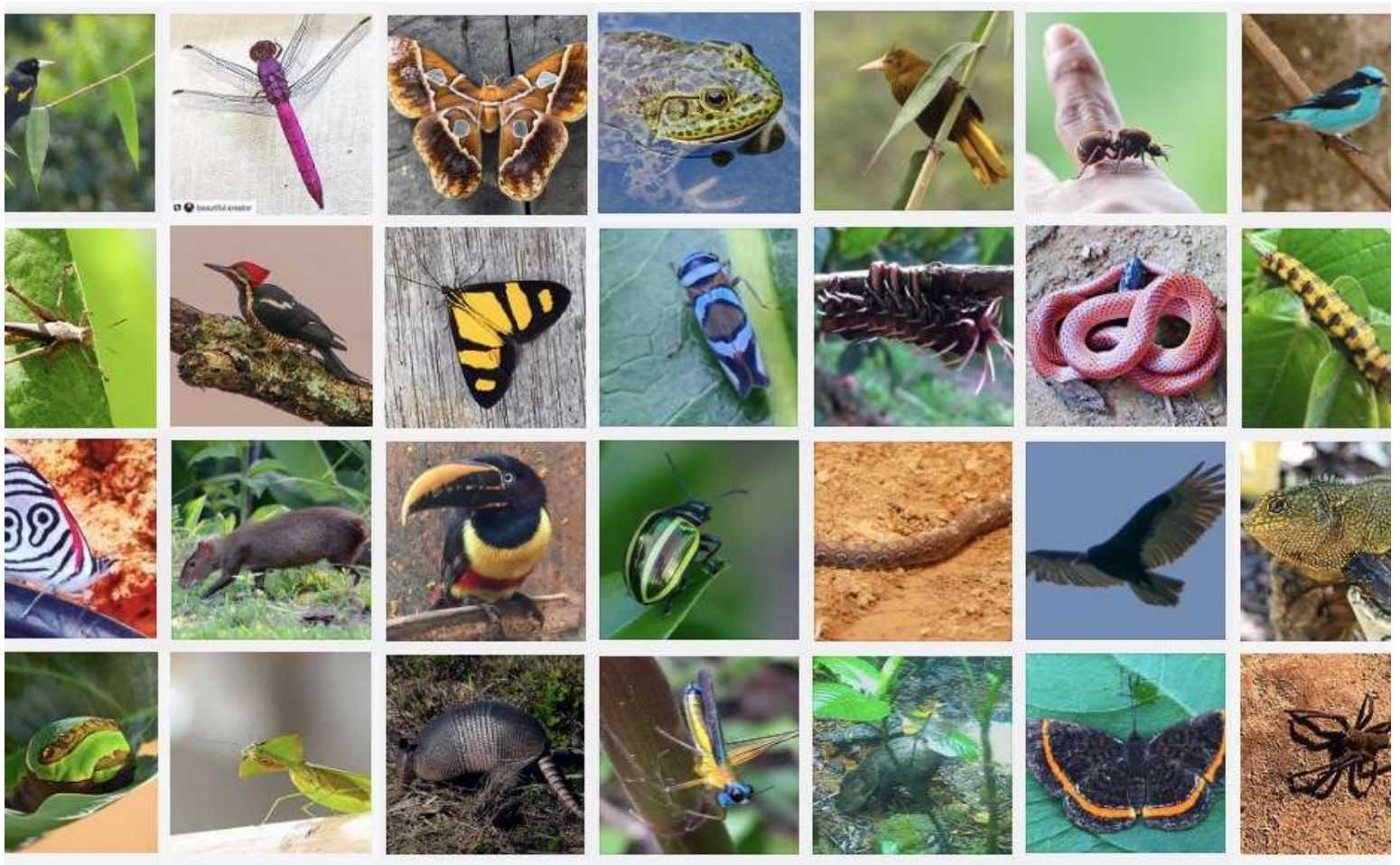
Biodiversity Conservation in a Changing Climate

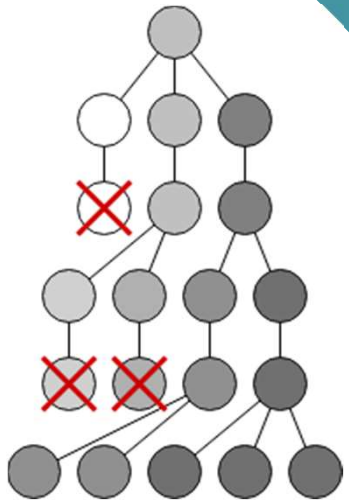


Objectives

1. Describe how the theory of natural selection influences biodiversity and the stability of all organisms.

2. Identify the various defense mechanisms developed by different species.

3. Explore the significance of biodiversity in relation to species adaptation and survival.



Biodiversity

Biodiversity is all the different kinds of life in one area – the variety and variability of animals, plants, fungi, and even microorganisms like bacteria that make up the natural world. It can be measured on various levels. There is for example genetic variability, species diversity, ecosystem diversity and phylogenetic diversity.

Biodiversity

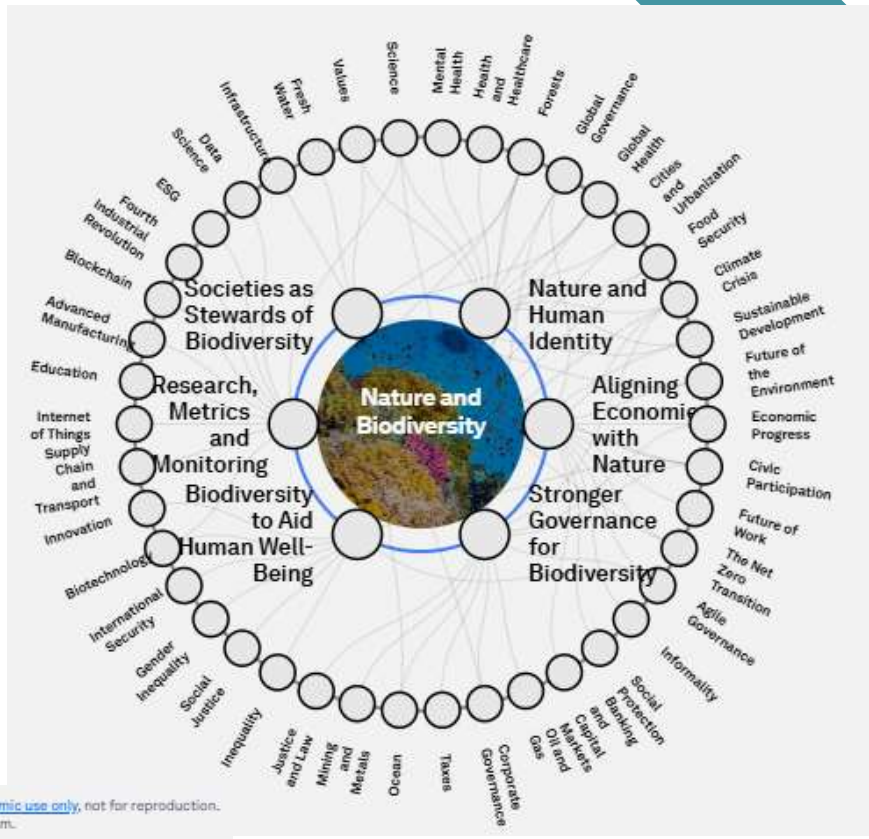
It is a boundless network of an undetermined number of species - estimates range from about **five million to one trillion** - though the concept extends well beyond that.

An abundance of ecosystems provides us withclean water, air, fertile soil, climate control, medicines, food, recreation, and inspiration.

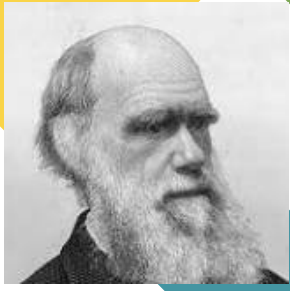
Millions of species are at **risk of extinction** (we are said to be in the midst of the “sixth mass extinction”), and the intensive extraction of certain components of biodiversity has come at the expense of everything else.

Biodiversity

At least 50% of the global economy and 80% of the basic needs of the poor rely on biological resources. Furthermore, a richer diversity of life enhances opportunities for medical breakthroughs, economic growth, and adaptive responses to emerging challenges like climate change.



Factor of Darwinism



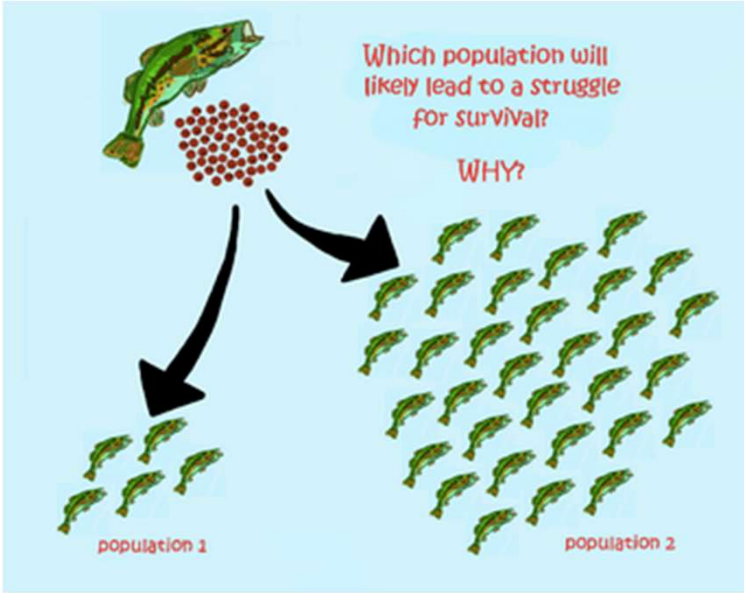
- Rapid multiplication
- Limited environmental resources
- Struggle for existence
- Variation
- Survival of the fittest
- Inheritance of the useful variation
- Formation of the new specie

1. Rapid multiplication (over production)

- Any pair of animals or plants produces far more offspring than would be needed simply to replace that pair

e.g. cod fish may produce over a million egg in a year, If all the eggs developed into fishes, the whole Atlantic Ocean will be full of cods in 5 years

- There must be competition for survival among the offspring
- Furthermore, these offspring are not identical to one another



2. Limited environmental resources (space and food)

- Increase population in animal and plants requires more space and food but the universe remain constant.
- Individuals compete for limited resources:
  - Food,
  - Water
  - Spaces
  - mates

3. Struggle for existence (competition)

- Competition among memebers of a species for food, living space, and other necessities of life
  - Intraspecific struggle
  - Within species
  - Interspecific struggle
  - Different species
  - Environmental struggle
  - Change in environmental factors (heat, cold, flood, etc)

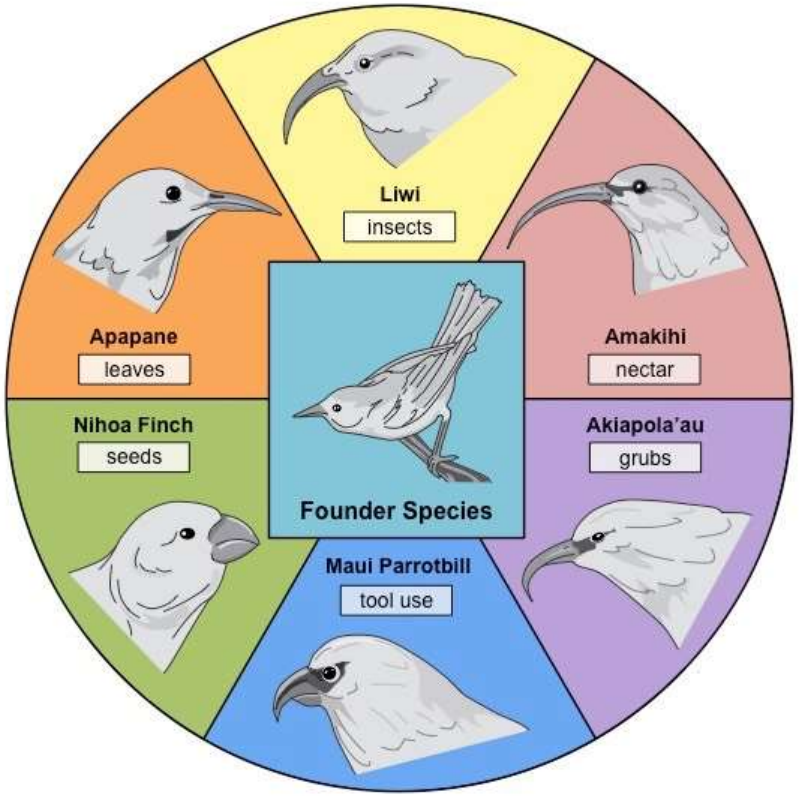
4. Variation and Adaptation

- Understanding how individuals of the same species vary was key to Darwing developing his theory

- Because the invironment changes, the more **variation** within a species, the more likely it will survive.

+ Each individuals has a unique combination of inherited traits.

+ An inherited traits that increase an organism's change of survival is called «Adaptation».



Types of adaptations of every animals

1- Structural or Physical or using body structures to help animal survive

CAMOUFLAGE: a defense mechanism or tactic that organisms use to disguise their appereance, usually to blend in with their surroundings

1- Structural or Physical or using body structures to help animal survive

MIMICRY – ability of an organism to imitate and copycat another species in terms of sound appereance, smell behaviour or location to protect itself.

It also refers to the resemblance of an animal species to another species or to natural objects.

1- Structural or Physical or using body structures to help animal survive

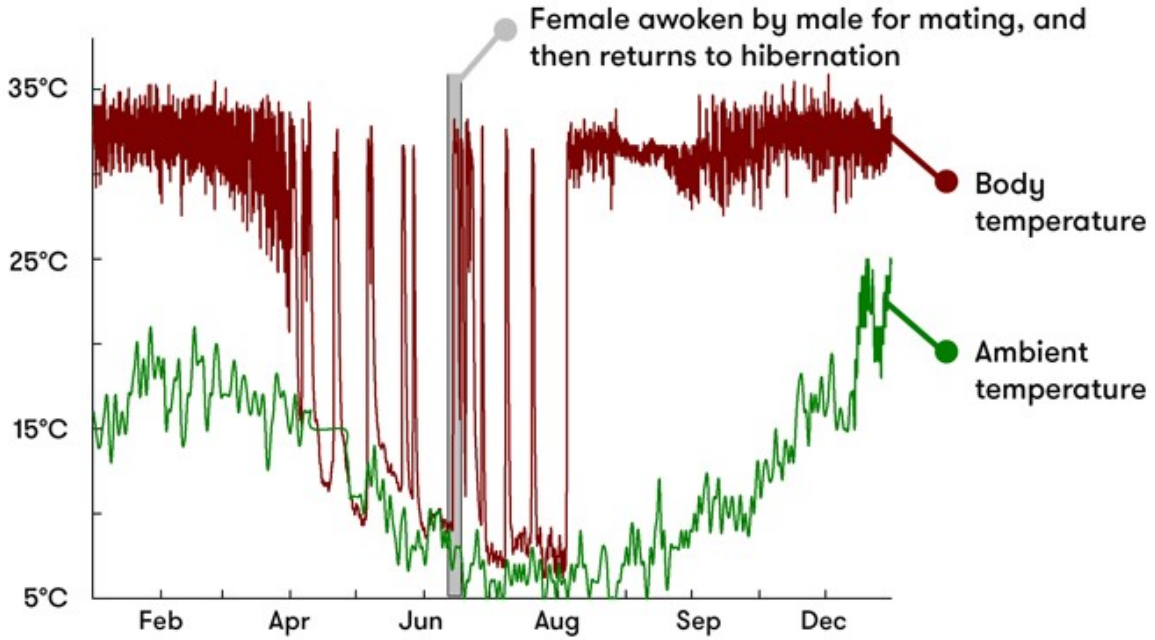
CHEMICAL DEFENCE – include substances used by prey which are harmful to invading organisms

1- Structural or Physical or using body structures to help animal survive

BODY COVERING- cover the body and protect itself from external factors

2- Behavioural or how animals respond or act to life needs. Behavioural adaptation could be instinctive or happen naturally

HIBERNATION when animals bare sleep as a response to cold weather and survive the cold winter



e.g. Adaptations: How do animals survive in the desert


Falco mexicanus

- Burrowing activity during the most hot daytime hours.
- Nocturnal or crepuscolar activity
- for Animals and birds that do not exhibit burrowing activity: choose distinct microclimates
- hibernation to survive the hottest months
- Migration


Gophents agassizii

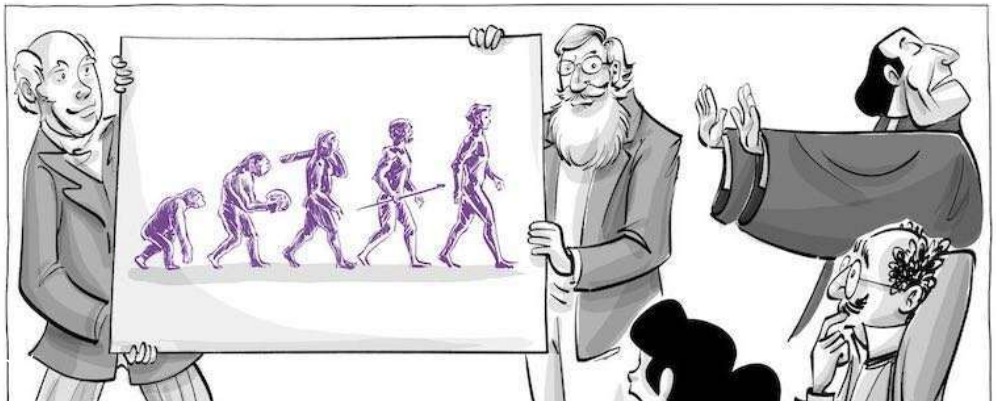
2- Behavioural or how animals respond or act to life needs. Behavioural adaptation could be instinctive or happen naturally

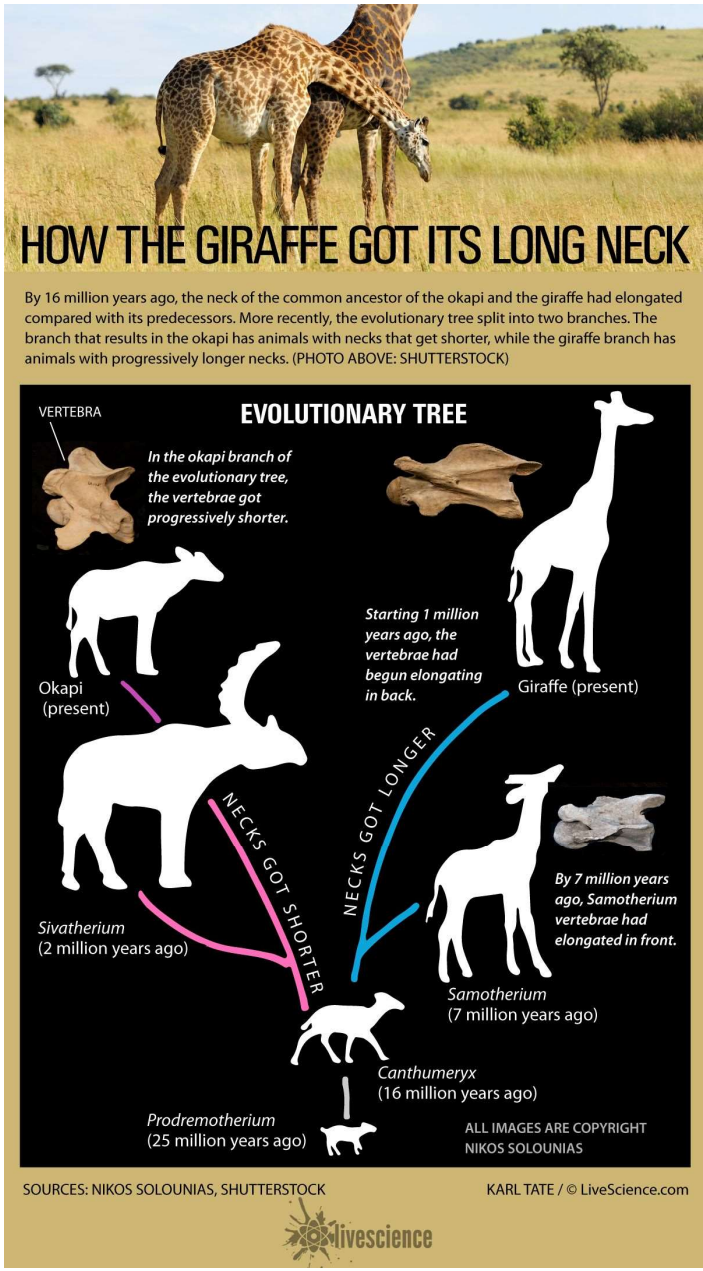
MIGRATION- a behavioural adaptation that involves an animal or group of animals travelling from one place to another and then back again when seasons change

5. Survival of the fittest (natural selection)

- The individuals with the best traits/adaptations will survive and have the opportunity to pass on its's traits to offspring

- Natural selection acts on the **phenotype** (physical appereance), not the genotype (genetic makeup)

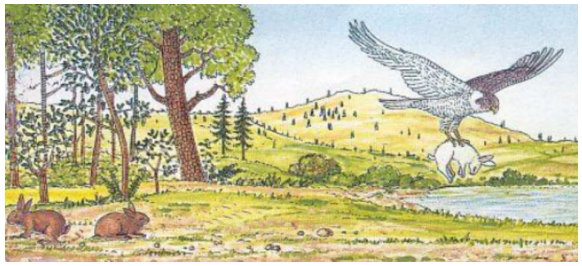


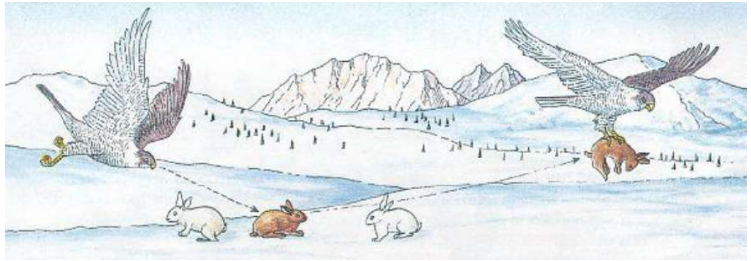


6. Inheritance of the useful variation

- The individuals, selected by nature, pass on their useful variation to the next generation.

- Thus, offspring of fit individual also be fit.

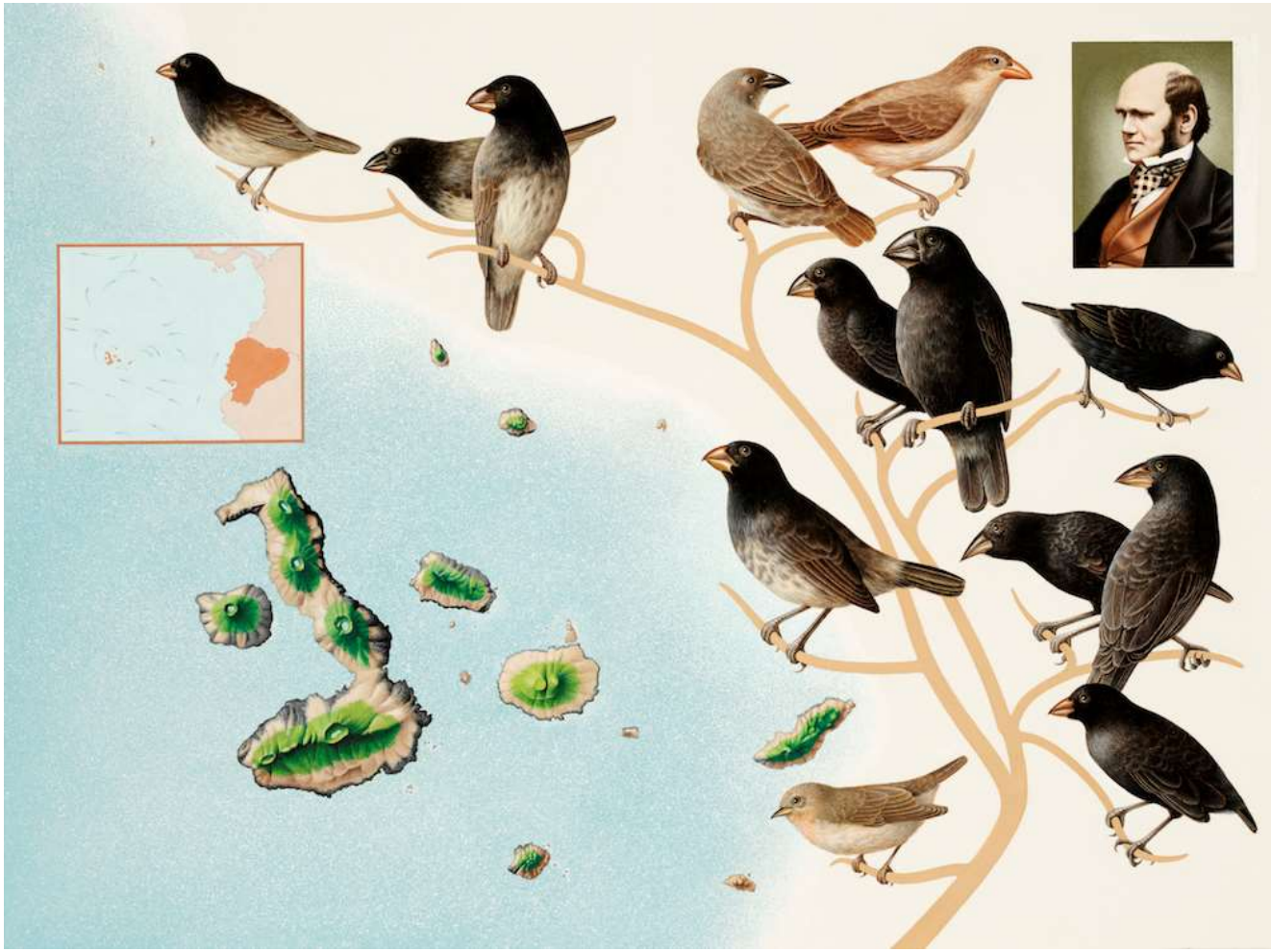




7. Formation of new species

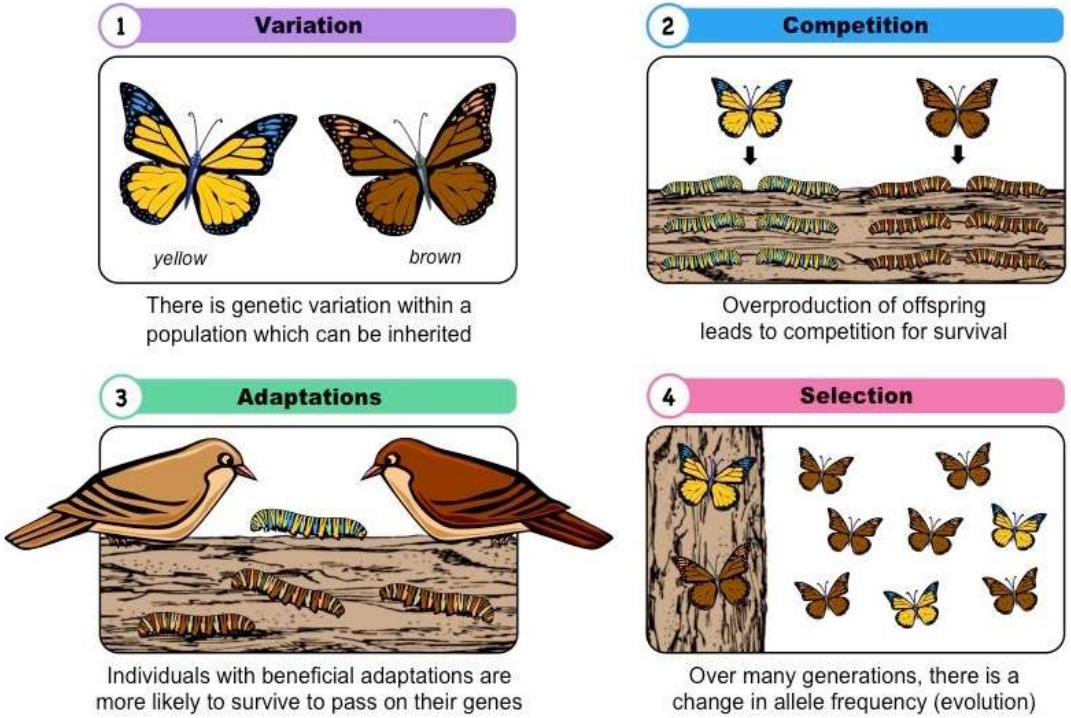
- In each generation, new favorable variations appear an supplement the favorable.

- After a number of generation the variations become so many which generate a new species



Natural selection

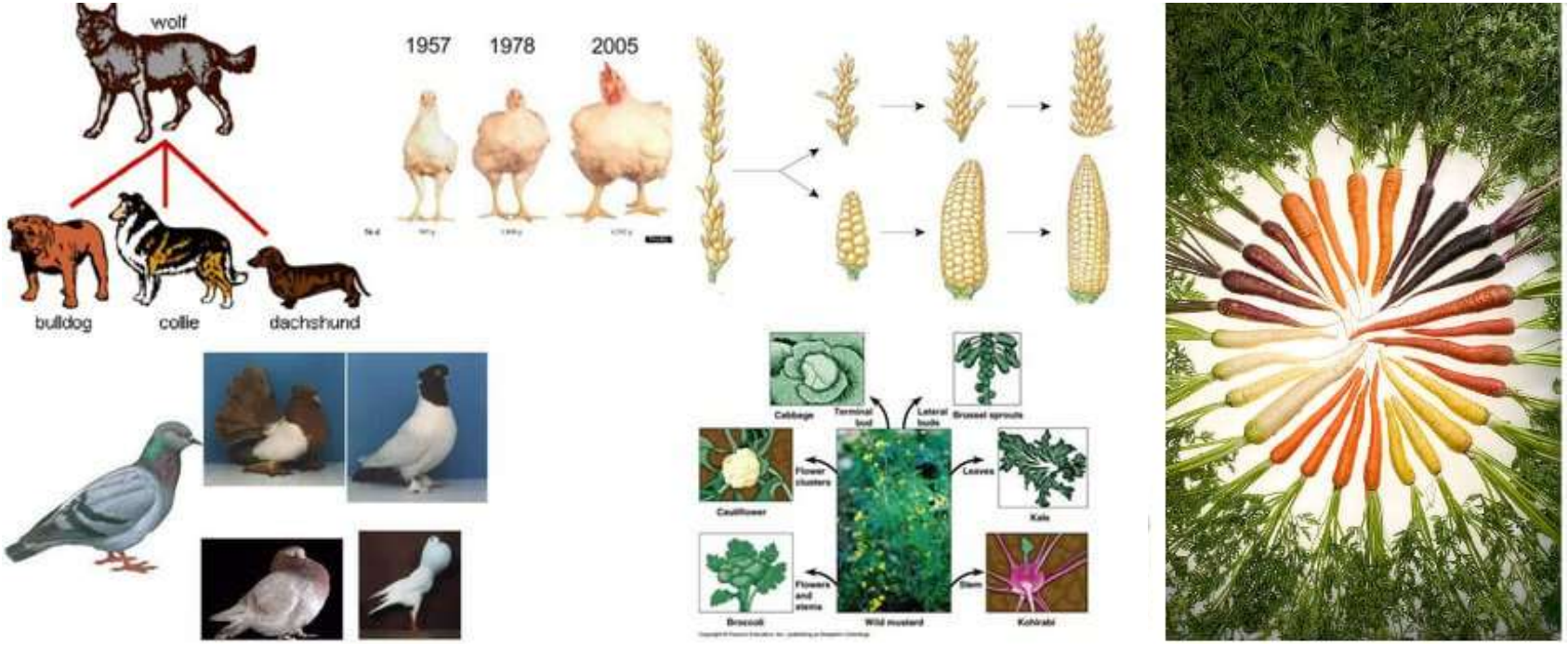
Natural selection is a mechanisms of evolution. Species of today have been shaped by natural selection.

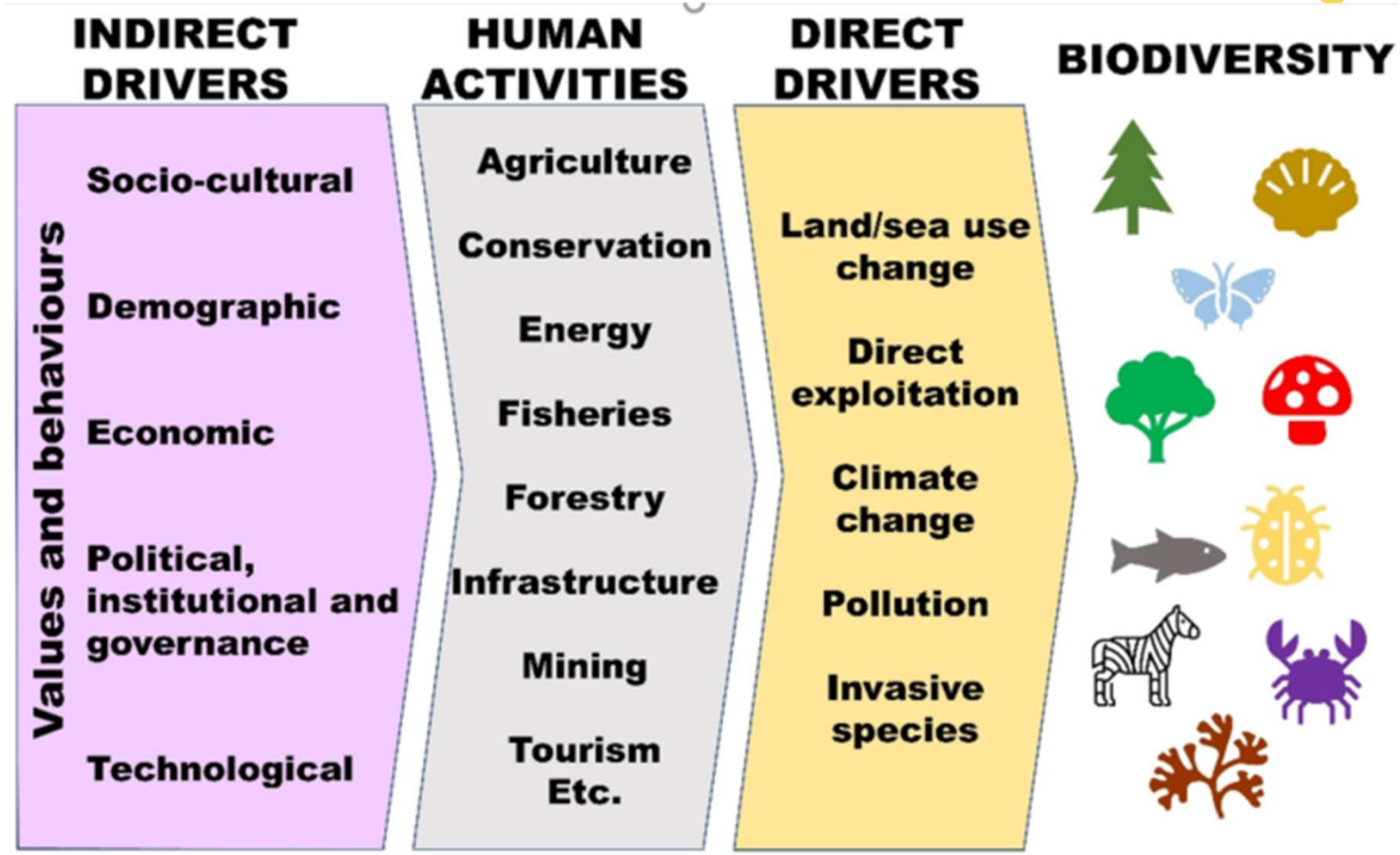


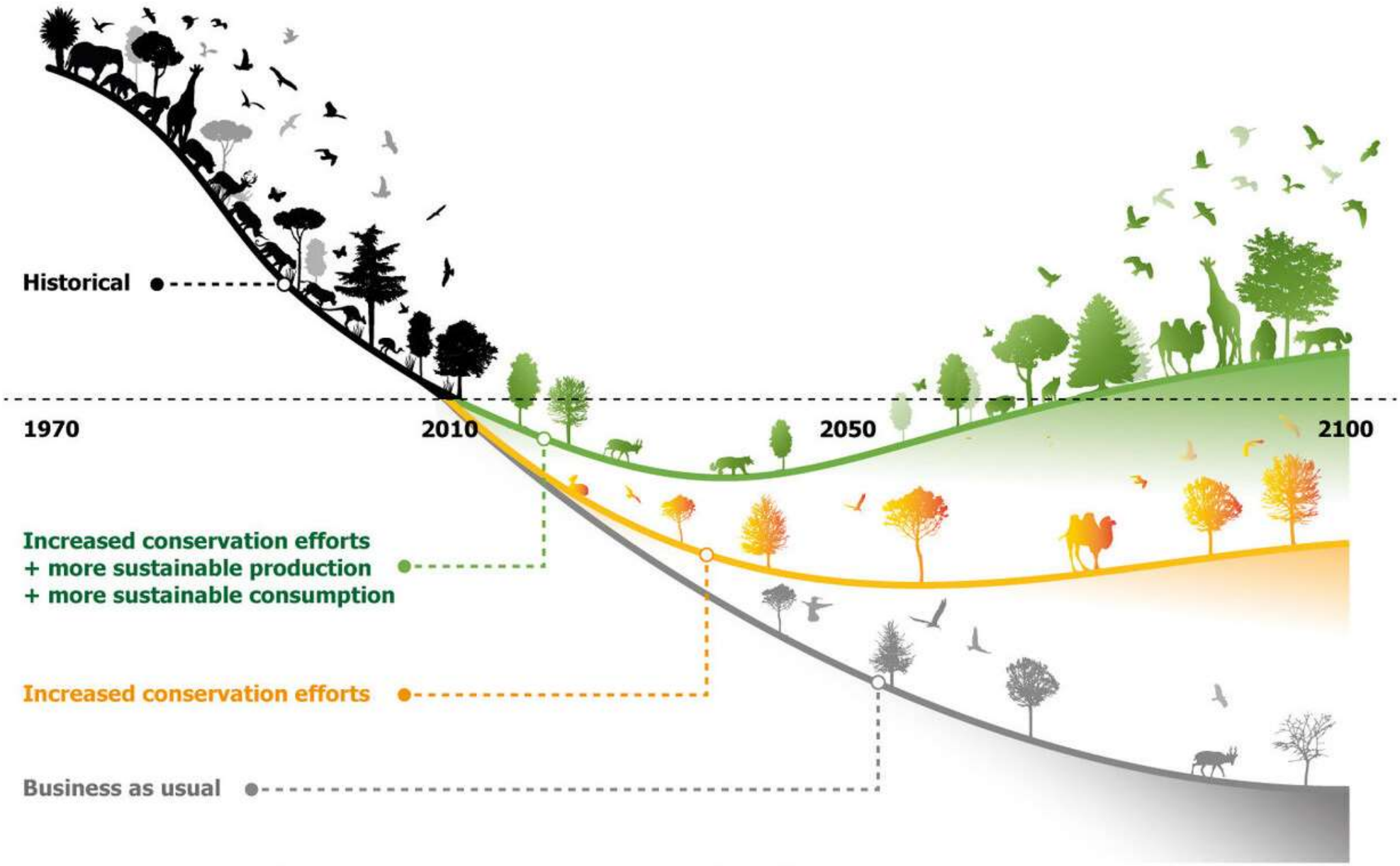
Artificial selection

is the process by which humans choose individual organisms with certain phenotypic trait values for breeding

- Darwin's studies supported animal breeders in being able to modify the anatomical and behavioural characteristics of dogs and pigeons providing a neat parallel to what he believed had happened in nature over long periods of time.




INDIRECT DRIVERS
HUMAN ACTIVITIES
DIRECT DRIVERS
BIODIVERSITY
Values and behaviours
Socio-cultural
Demographic
Economic
Political, institutional and governance
Technological
Agriculture
Conservation
Energy
Fisheries
Forestry
Infrastructure
Mining
Tourism
Etc.
Land/sea use change
Direct exploitation
Climate change
Pollution
Invasive species



This artwork illustrates the main findings of the article, but does not intend to accurately represent its results (https://doi.org/10.1038/s41586-020-2705-y)

Key indicators

- **8 million**: estimated total number of **animal and plant species** on Earth

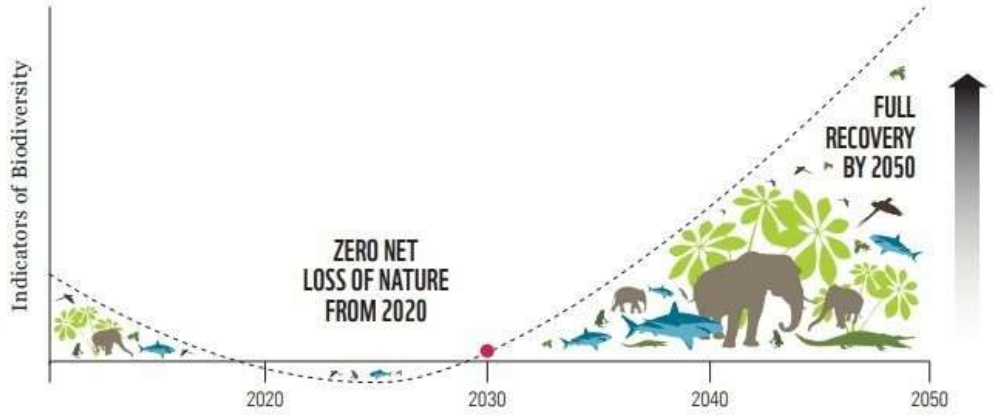
- **1 million**: estimated total number of **species threatened** with extinction

- **75%: Earth's environment 'severely altered'** by human actions

- **66%: marine environment 'severely altered'** by human actions

- **1000 x:** current rate of **biodiversity loss** compared to natural rate

Figure 23: Nature Positive by 2030
A measurable global goal for nature. Source: Locke et al. (2021)[60].



Five direct elements of nature's change, in order of relative global impact:

1. Changes in land and sea use

2. Direct exploitation of organisms

3. Climate change

4. Pollution

5. Invasive alien species.

Indicators used to measure biodiversity health:

Species richness

Population number

Genetic diversity

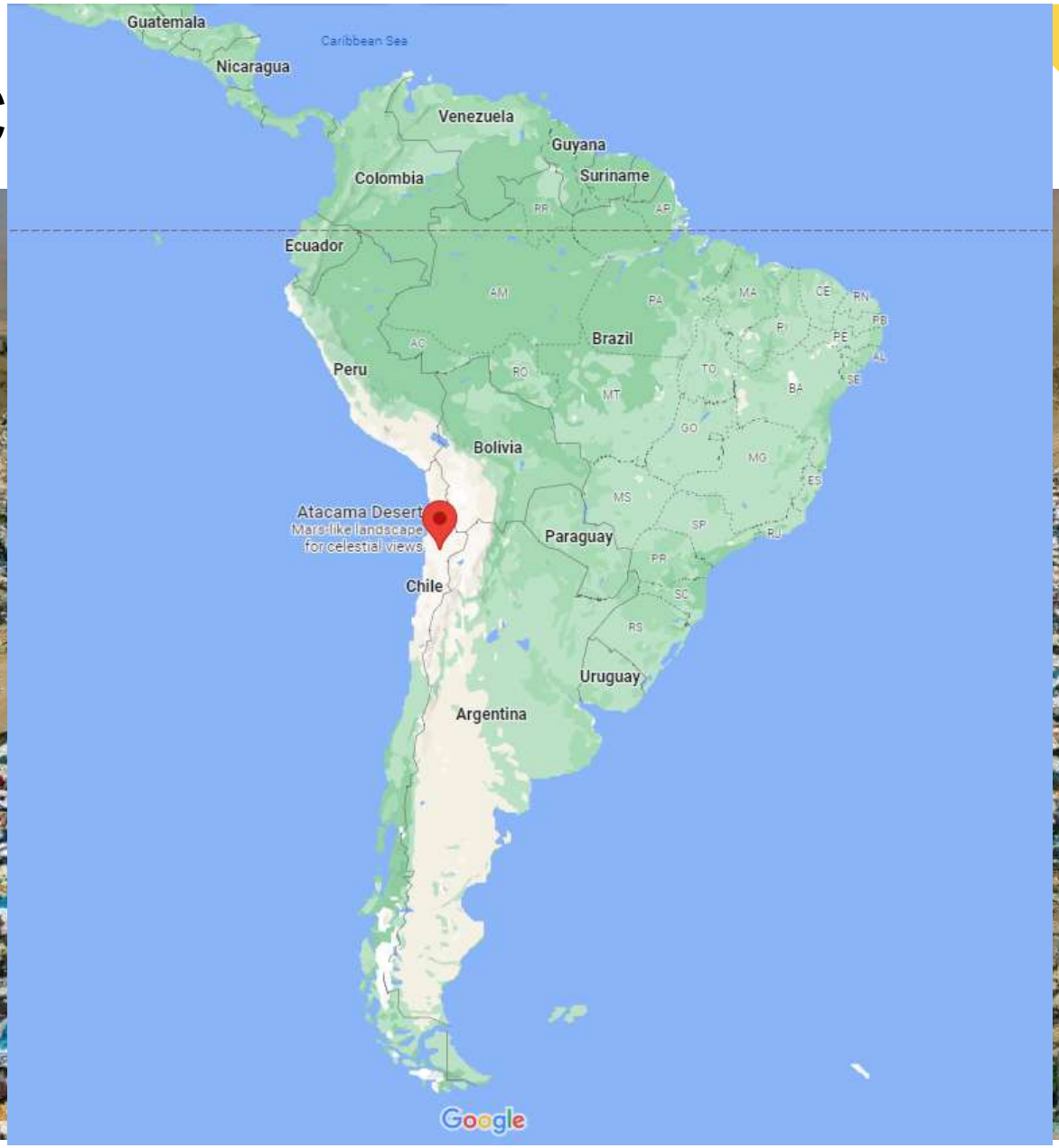
Species uniformity

Phenotypic variance

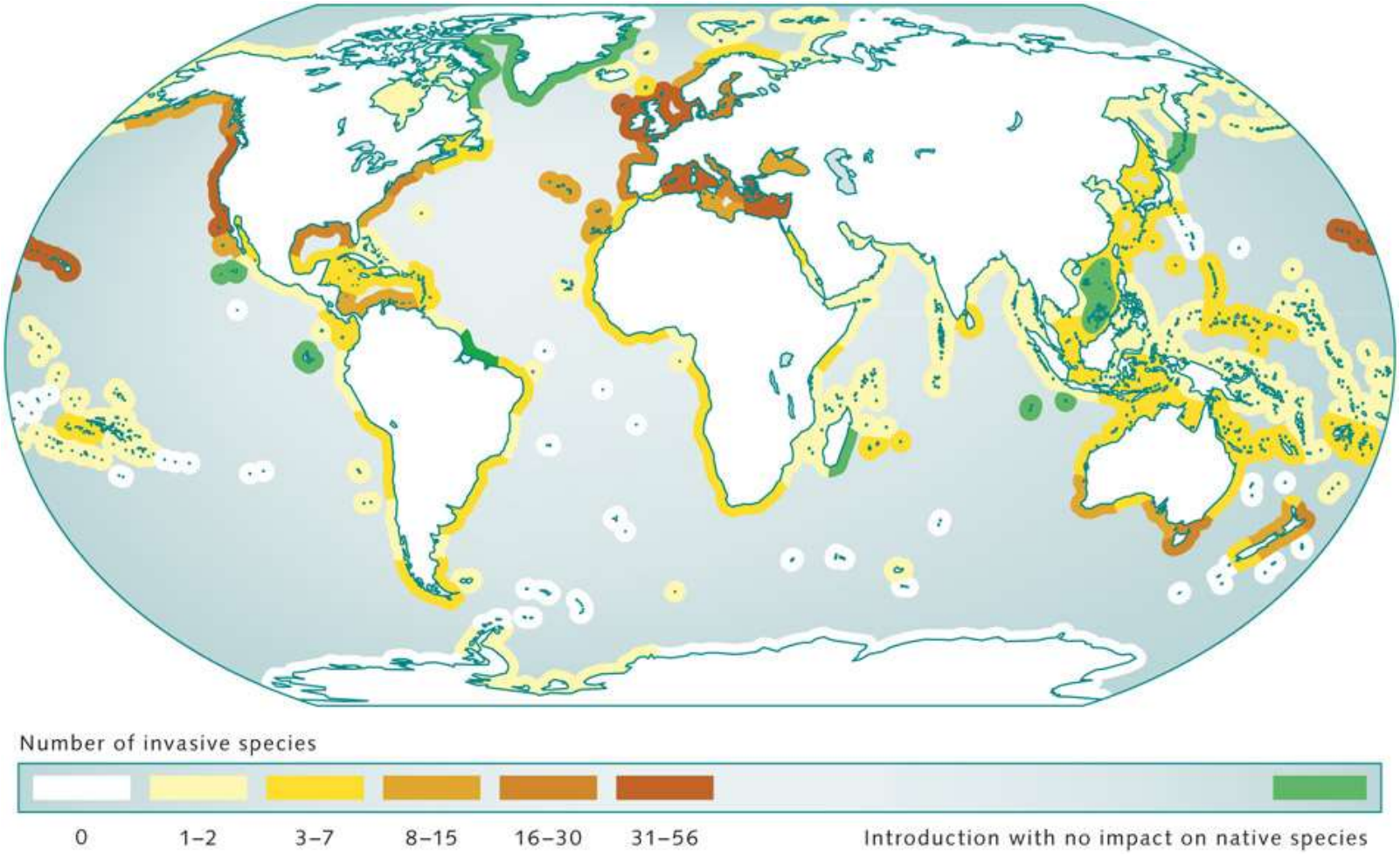
In città, gli alberi fanno la differenza

Changes in land use

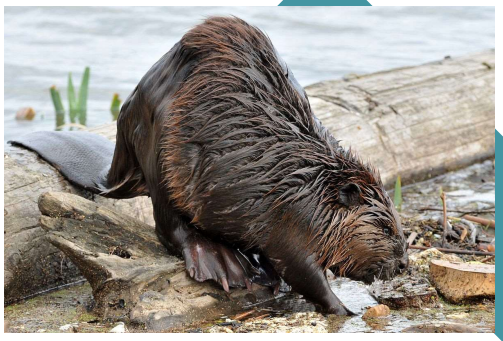
C


Guatemala
Caribbean Sea
Nicaragua
Venezuela
Guyana
Colombia
Suriname
Ecuador
Brazil
Peru
Bolivia
Atacama Desert
Mars-like landscape
for celestial views
Paraguay
Chile
Uruguay
Argentina
Google

Alien and Invasive species



The American beaver (*Castor canadensis*), introduced to South America is responsible for the disappearance of 17 million hectares of forest that have become, meadows, peat bogs and shrublands



Mnemiopsis leidyi,
In Adriatic sea since 2016

The Heaven tree,
Ailanthus altissima