

Ecossistemas e Biodiversidade:

Biodiversidade e suas métricas | Fatores antrópicos e impactos | Valorização da Biodiversidade

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FCUL – Faculdade de Ciências da Universidade de Lisboa



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cE3C – Centre for Ecology, Evolution and Environmental Changes



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Biologia

Investigador no cE3c-FCUL em ecologia urbana



BiNatUr, CircularCity, Biodivercities
were funded by the European Union



Bringing nature back: biodiversity-
friendly nature-based solutions in cities



Circular City
circular-city.eu



COST Action CA17133 | Implementing nature-
based solutions for creating a resourceful circular
city



BiodiverCities is funded by the European Union

Biodiversity as key to create a more **sustainable** planet in a world under **global change**

- (1) Biodiversity and its multiple facets
- (2) Anthropogenic drivers and impacts
- (3) Valuing biodiversity

sustainability

includes the ecological, political, cultural and economical aspects, to

promote the

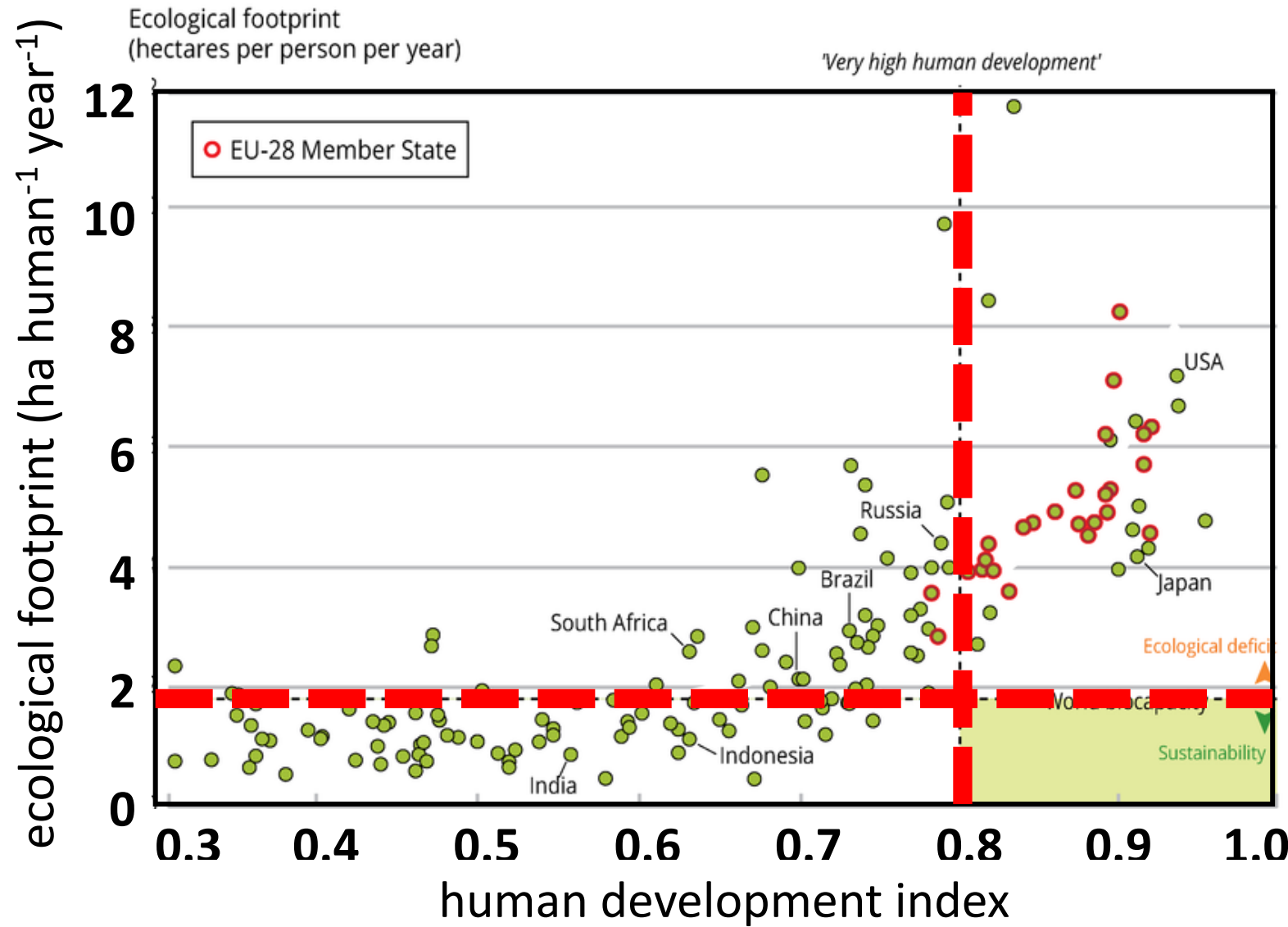
sustainable development goals



 **OBJETIVOS**  **DE DESENVOLVIMENTO SUSTENTÁVEL**

ecological sustainability

includes the consumption of resources and the production of waste within the ecological limits

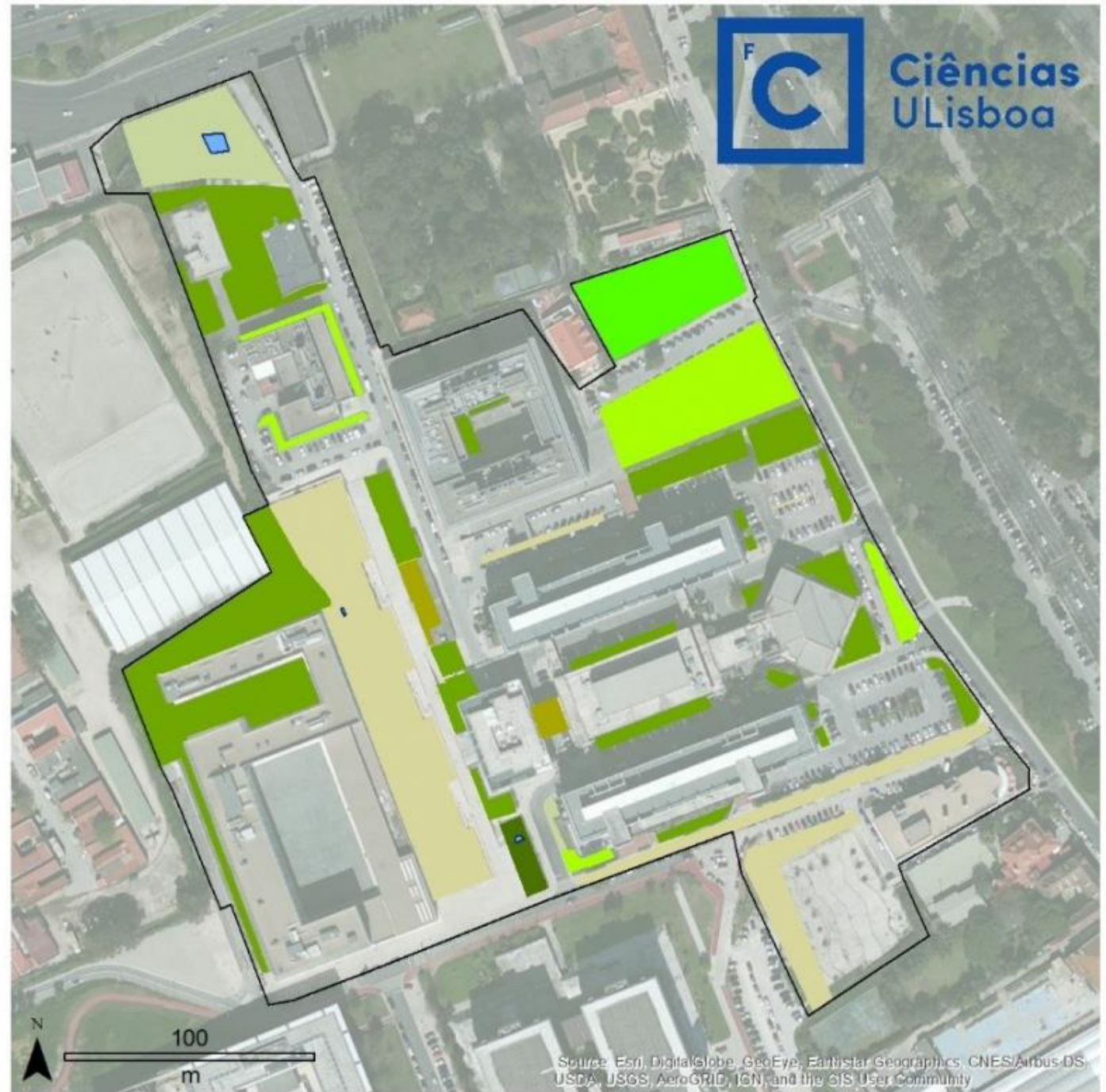


biodiversity

The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes variation in genetic, phenotypic, phylogenetic, and functional attributes, as well as changes in abundance and distribution over time and space within and among species, biological communities and ecosystems.

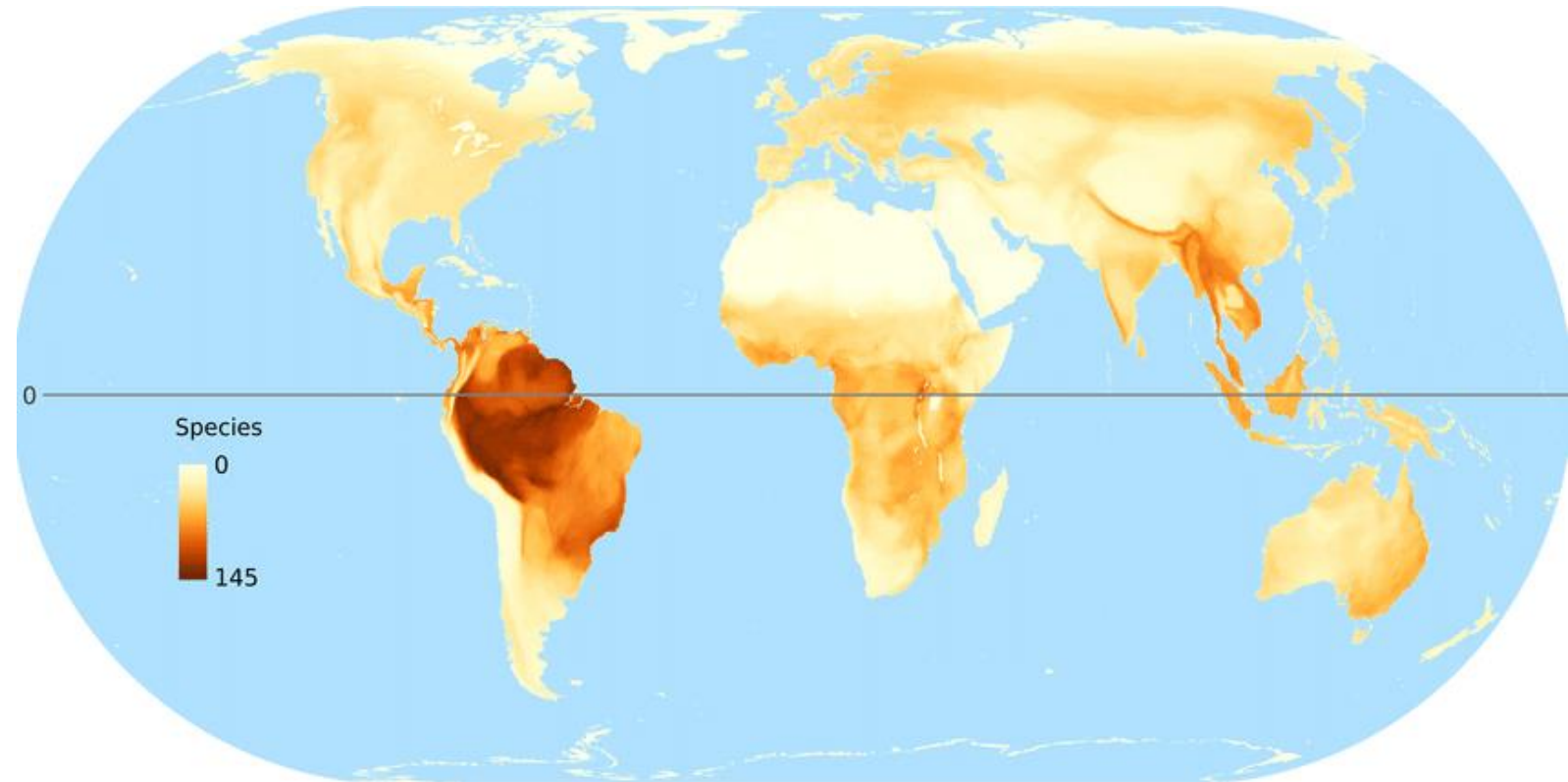
biodiversity

FCUL green & blue
infrastructure



number of species
or species richness is a
critical measure of
biodiversity

Number of tree-cavity-nesting birds of the world



land-cover or land-use is also a way to measure biodiversity, focused on habitats

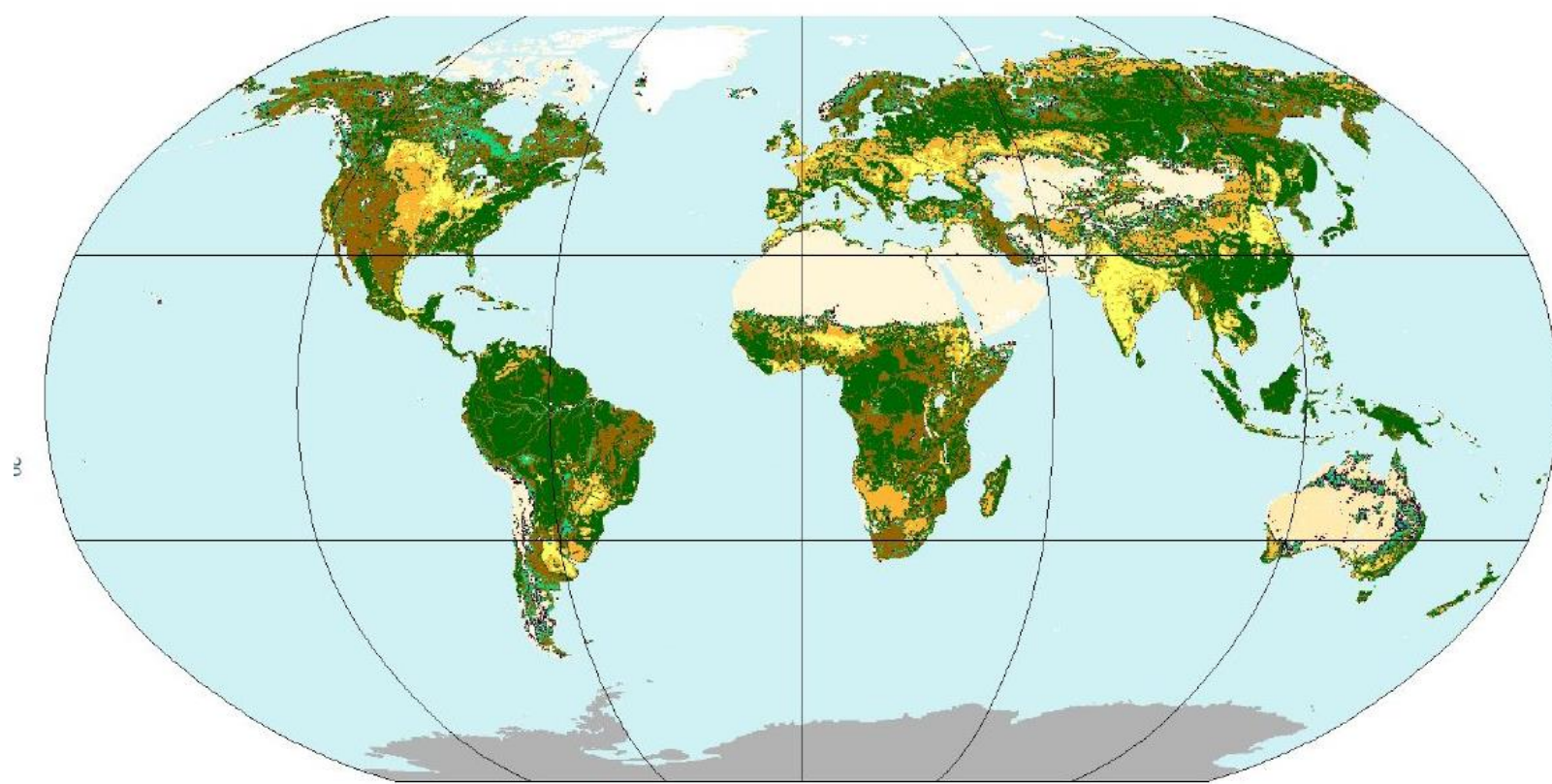


Figure 3 – Distribution of dominant GLC-SHARE Land Cover Database.



Land Cover types	Label
Artificial Surfaces	01
Cropland	02
Grassland	03
Tree Covered Areas	04
Shrubs Covered Areas	05
Herbaceous vegetation, aquatic or regularly flooded	06
Mangroves	07
Sparse vegetation	08
Baresoil	09
Snow and glaciers	10
Water bodies	11

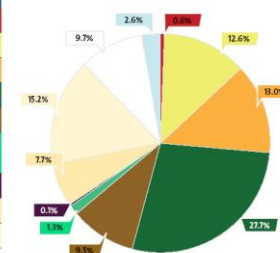


Figure 5 – GLC-SHARE distribution of land cover types

Table 1 – GLC-SHARE land cover legend

traits and functional groups

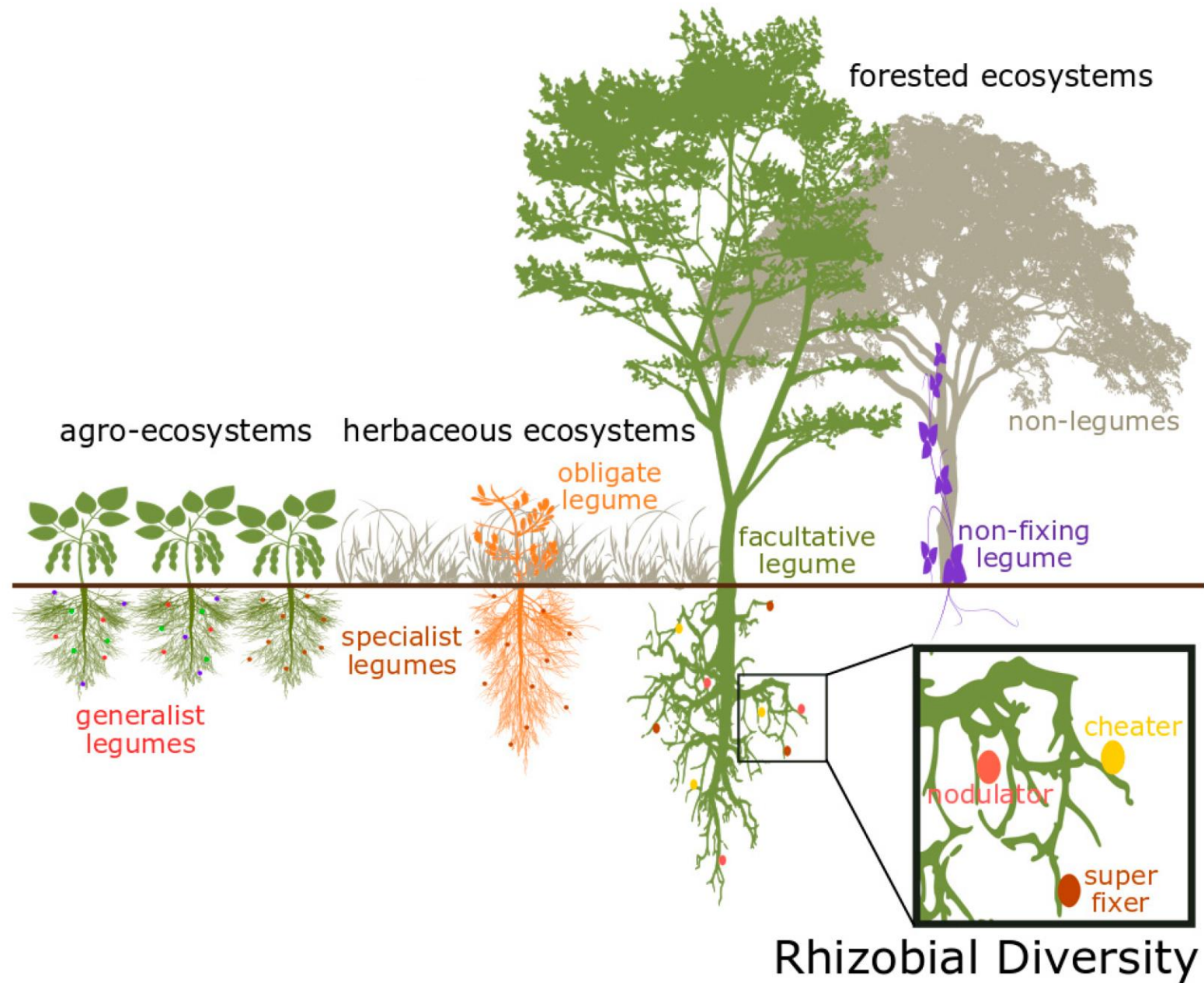
traits are characteristics of species that may influence its function or response to the environment, and species with the same characteristics can be grouped into functional groups



traits and functional groups

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functional diversity in the legume–rhizobia mutualism, in a variety of habitat types

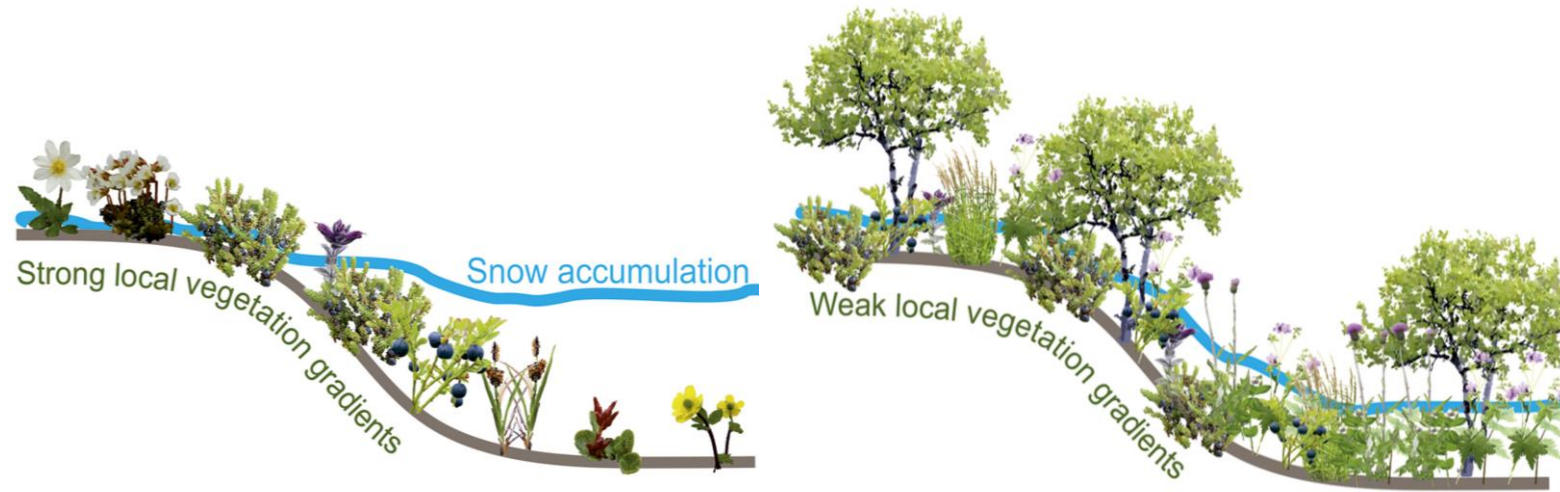


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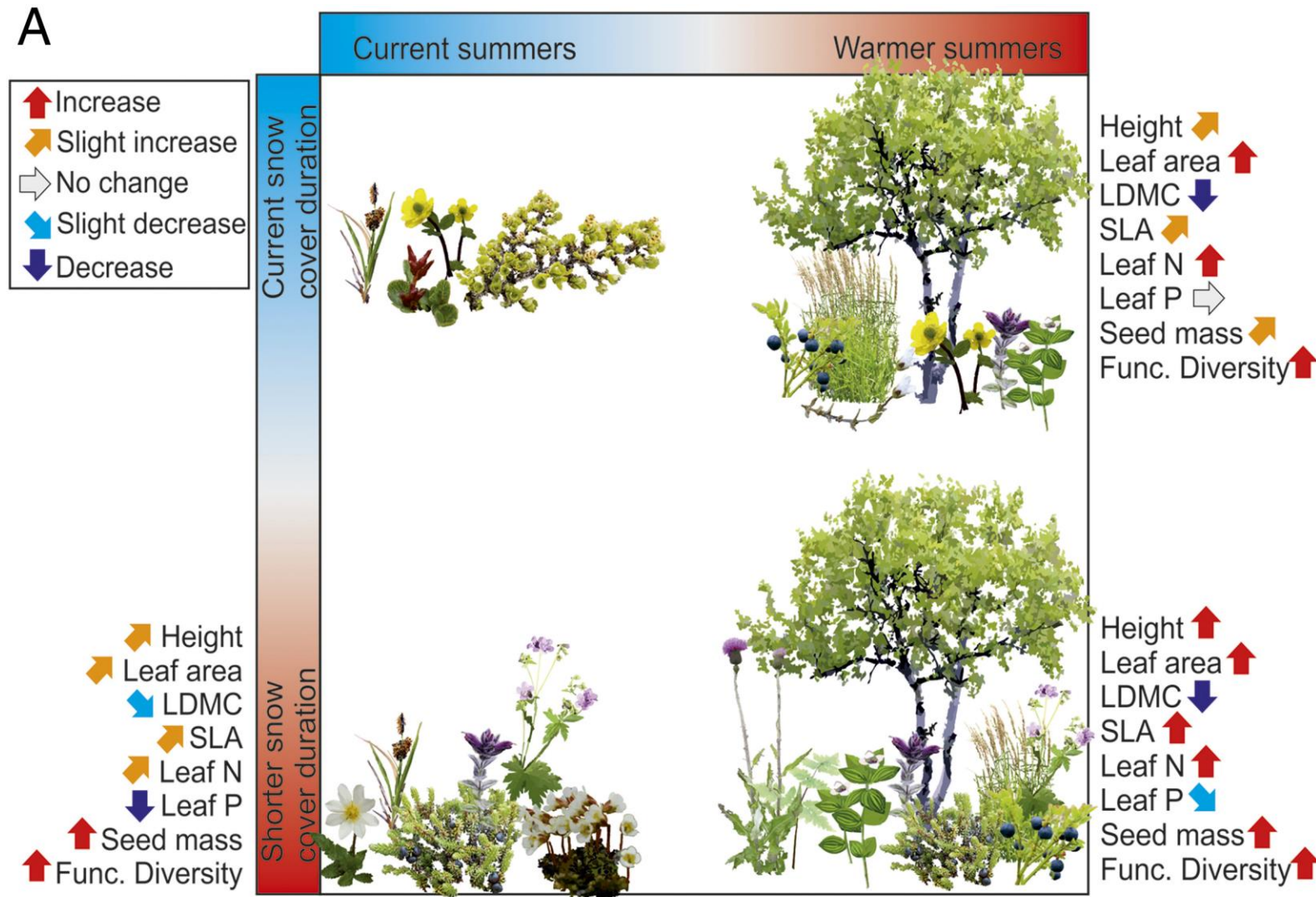
variations in functional diversity in tundra driven by changes in snow cover

PhotosyntheticPathway
Respiration LeafArea NfixationCapacity
SLA RegenerationCapacity PlantLifespan
WoodDensity GrowthForm
PhenologyType LeafN
LeafP LeafLongevity PhotosyntheticCapacity
MaxPlantHeight SeedMass



traits and functional groups

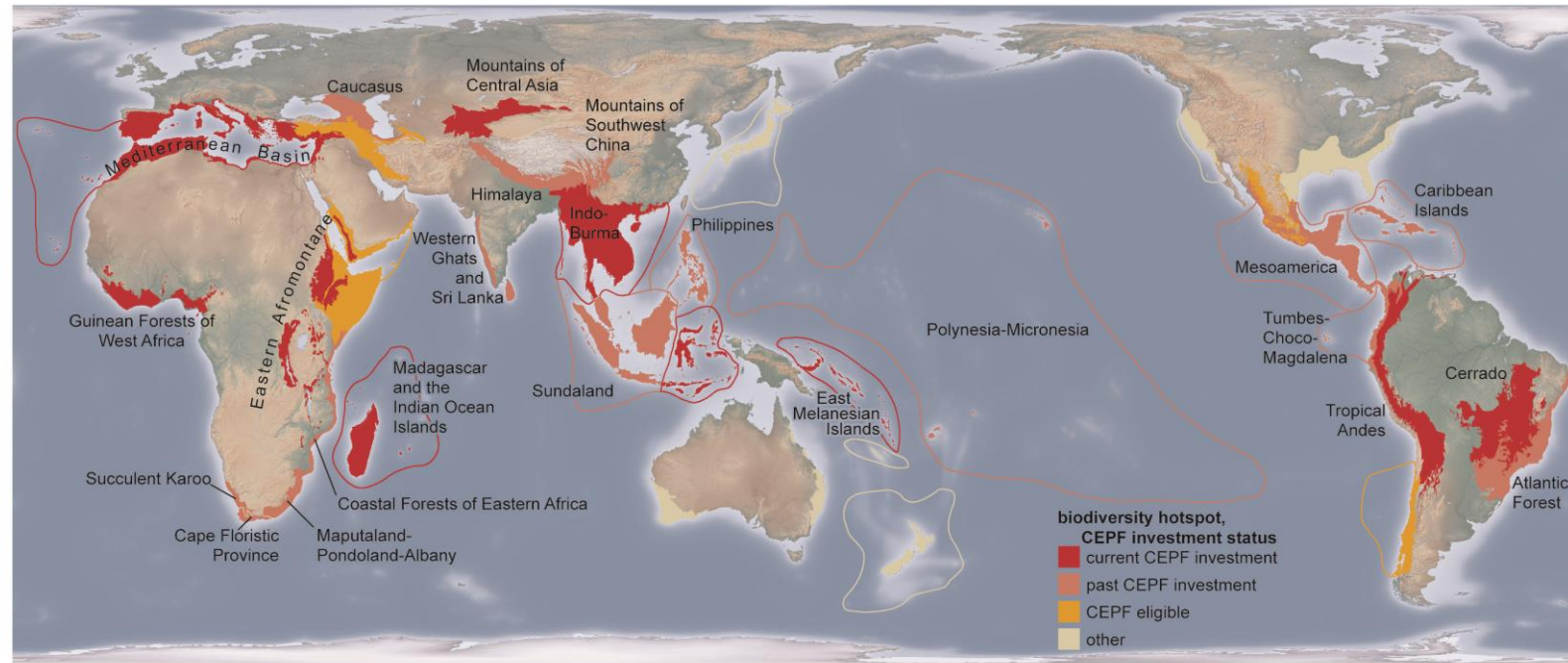
changes in functional diversity measured by the dominance of different functional groups in tundra caused by climate change



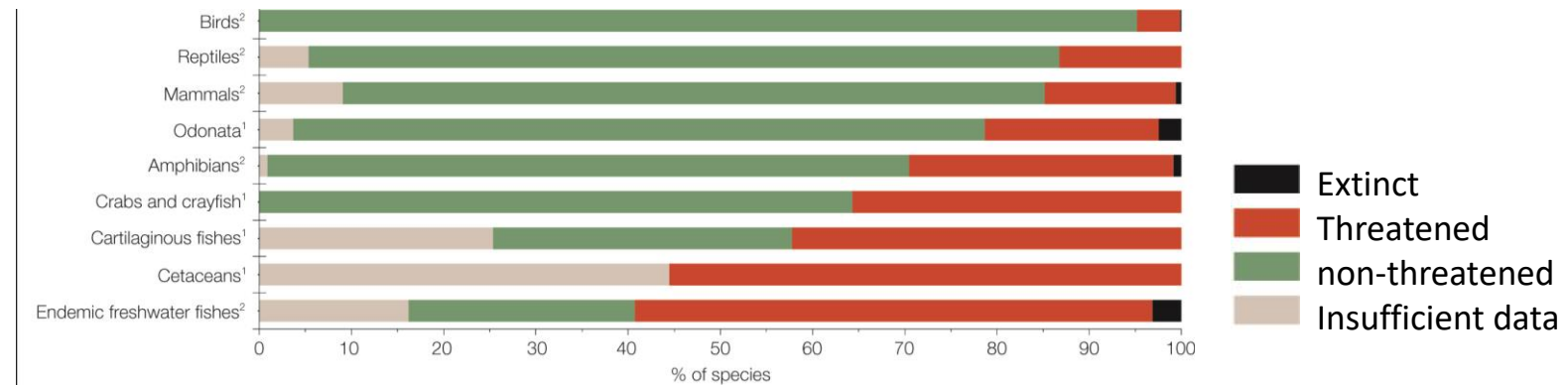
[TRY database of plant traits](#) | [Decreasing snow cover alters functional composition and diversity of Arctic tundra](#)

biodiversity hotspots shows sites that are simultaneously biodiversity rich and under threat

World Biodiversity Hotspots



Species conservation status – Mediterranean basin

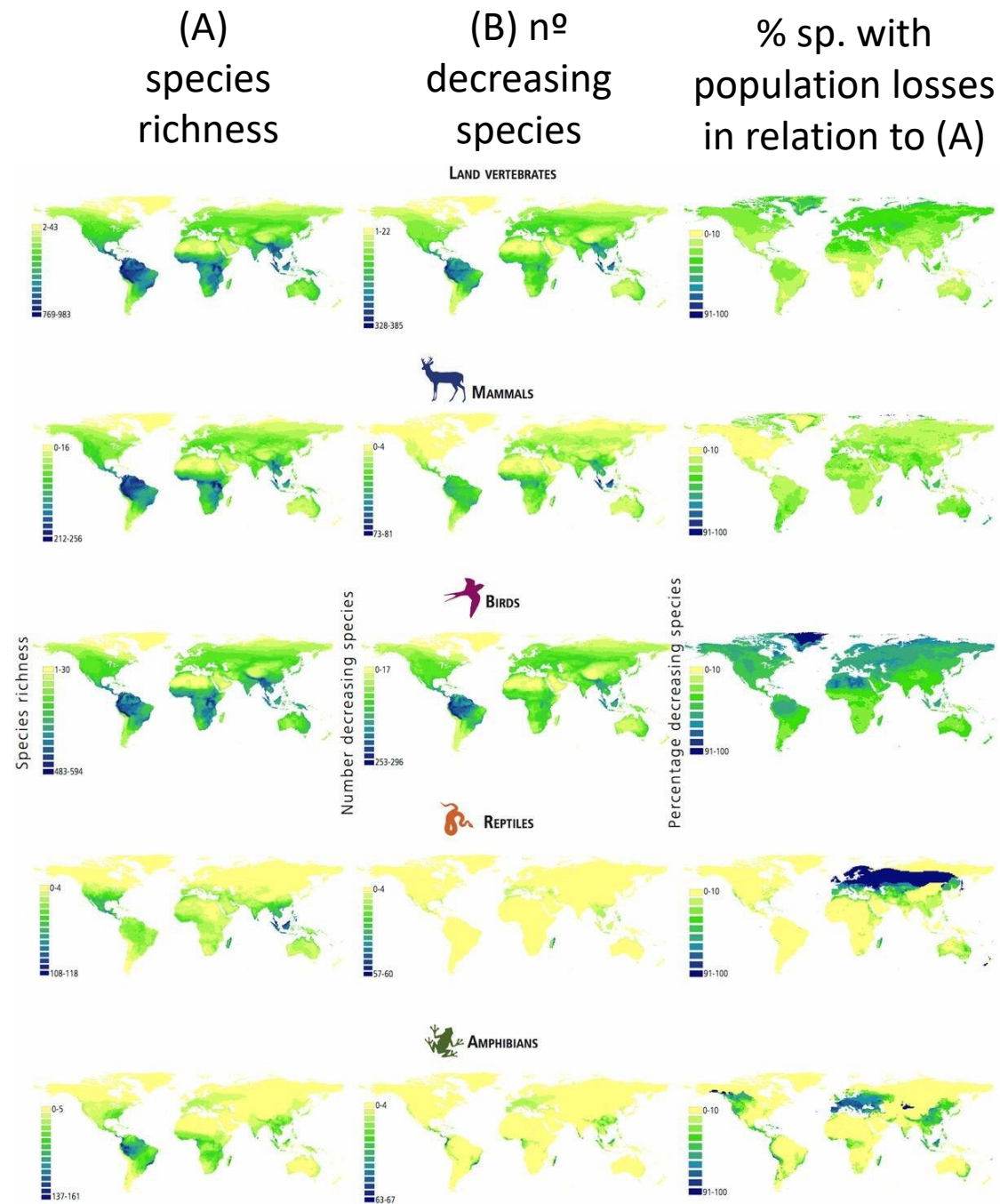


[European Commission - Biodiversity Hotspots](#) | [Biodiversity hotspots for conservation priorities](#) | [IUCN – The Mediterranean: a biodiversity hotspot under threat](#)

number of species

or species richness is a critical measure of biodiversity

global distribution of land vertebrate's species richness, decreasing species number and number species suffering species losses relative to the species richness, by 10 000 km²



Convention on Biological Diversity

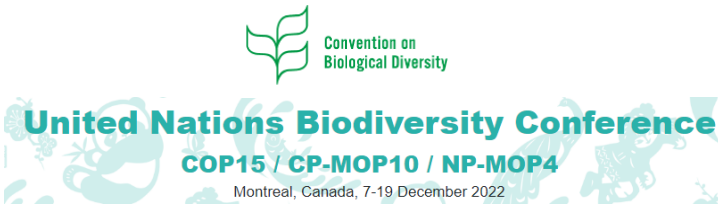
a multilateral treaty between parties, aiming at (1) the conservation of biological diversity, (2) the sustainable use of biodiversity components and (3) the fair and equitable sharing of benefits from biodiversity

Aichi targets were objectives to achieve by 2020



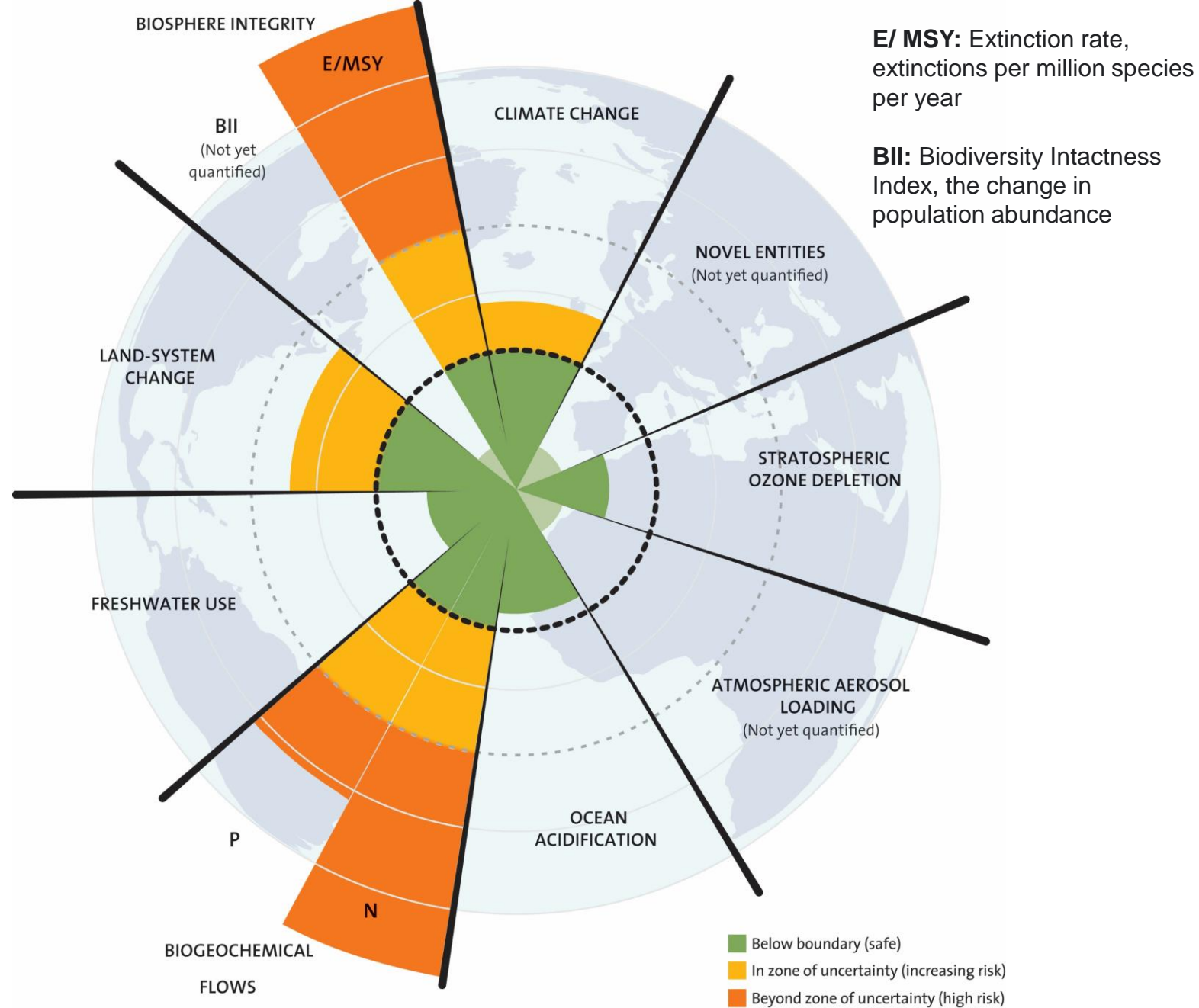
Convention on Biological Diversity

- Aichi Targets**
- | | | | | | |
|--|-------------------------|--|----------------------|--|-------------------------|
|  1 | Understand values |  8 | Reduce pollution |  15 | Enhance resilience |
|  2 | Mainstream biodiversity |  9 | Reduce invasive spp. |  16 | Implement Nagoya Prot. |
|  3 | Address incentives |  10 | Minimize reef loss |  17 | Revise NBSAPs |
|  4 | Sustainable production |  11 | Protected areas |  18 | Respect and conserve TK |
|  5 | Halve rate of loss |  12 | Prevent extinctions |  19 | Improve knowledge |
|  6 | Sustainable fisheries |  13 | Conserve gene pool |  20 | Mobilize resources |
|  7 | Manage within limits |  14 | Restore ecosystems | | |



nine planetary boundaries

rate of change of planetary systems and risk of change

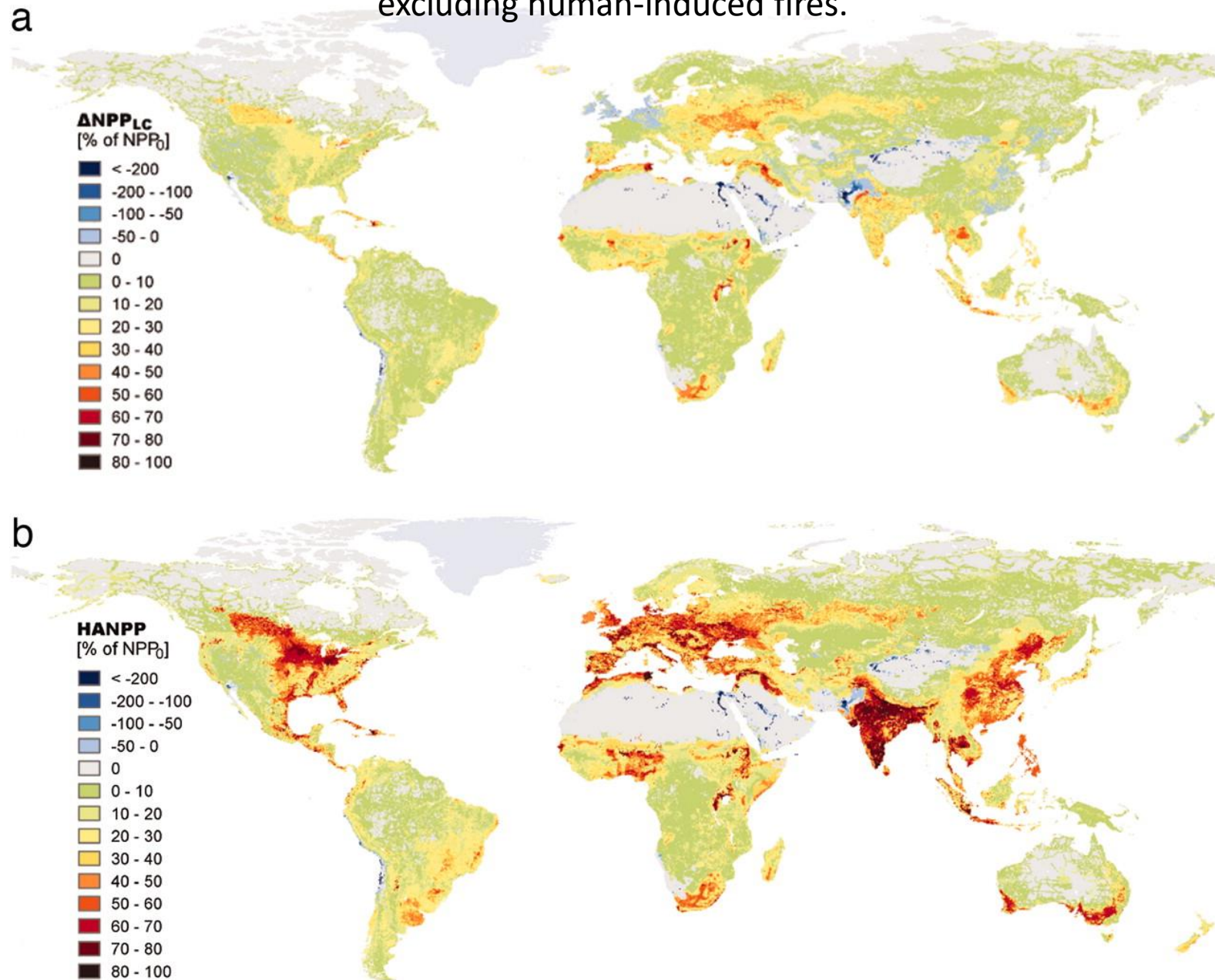


appropriation of net primary production from alterations in land-use

Land-use-induced changes in NPP as a percentage of NPP₀.

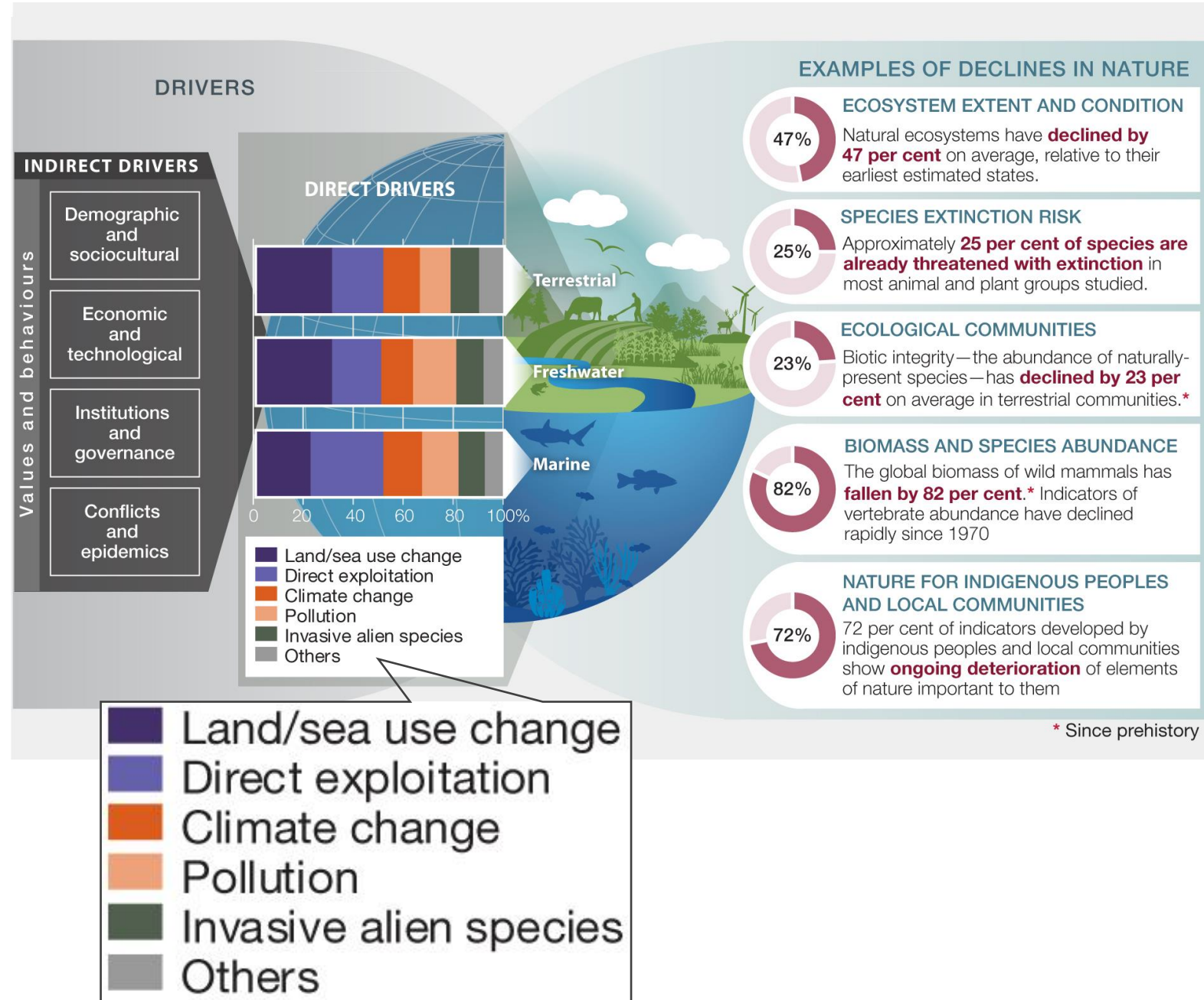
Total HANPP change as a percentage of NPP₀.

Maps of the human appropriation of net primary production (HANPP), excluding human-induced fires.



drivers of change

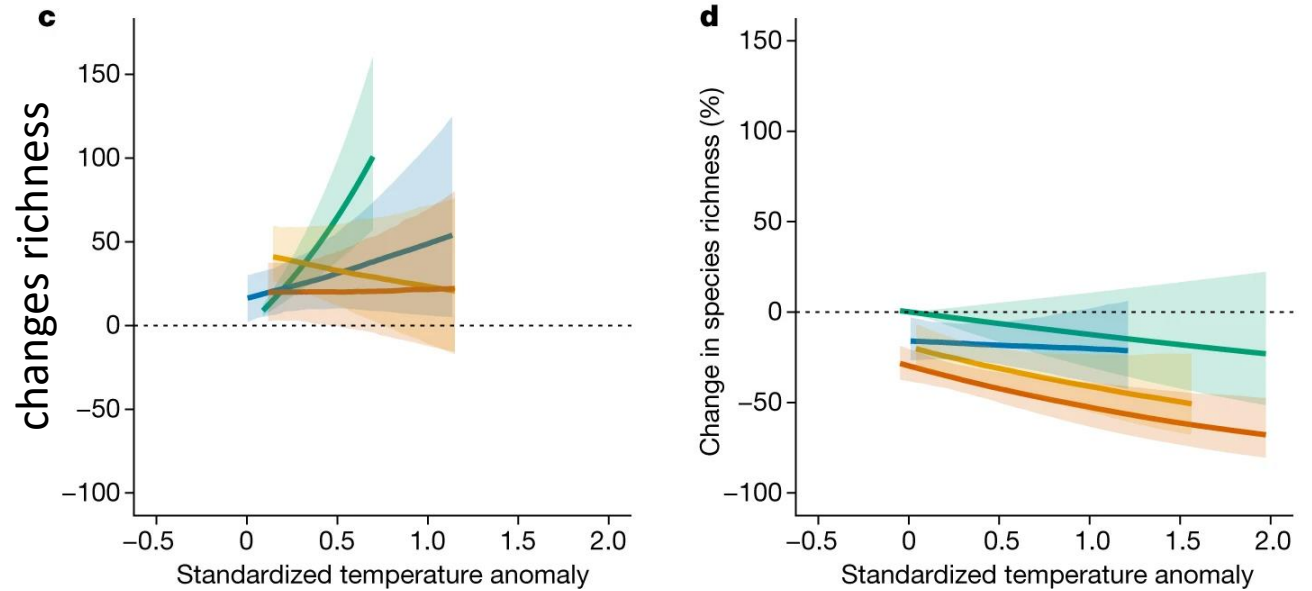
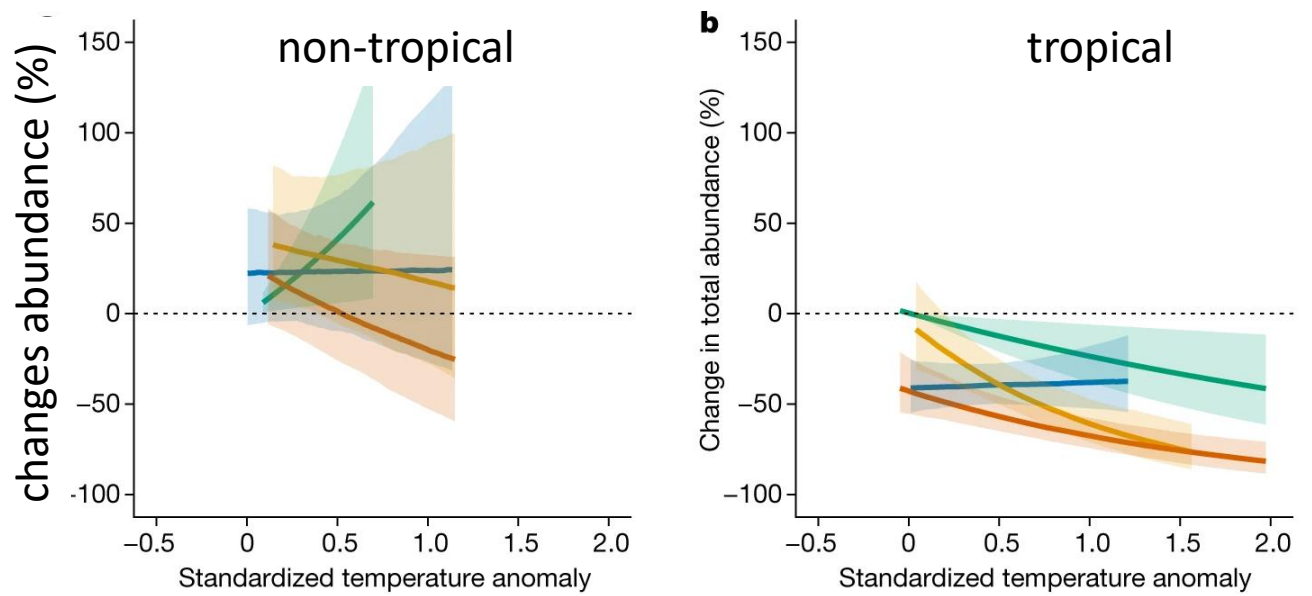
examples of global declines in biodiversity cause by direct and indirect drivers



drivers of change

decline of insect's abundance and richness resulting from the interaction between climate anomaly and land-cover change

Response of insect to the interaction between land use and climate change



Primary vegetation Secondary vegetation Agriculture_low Agriculture_high

biodiversity

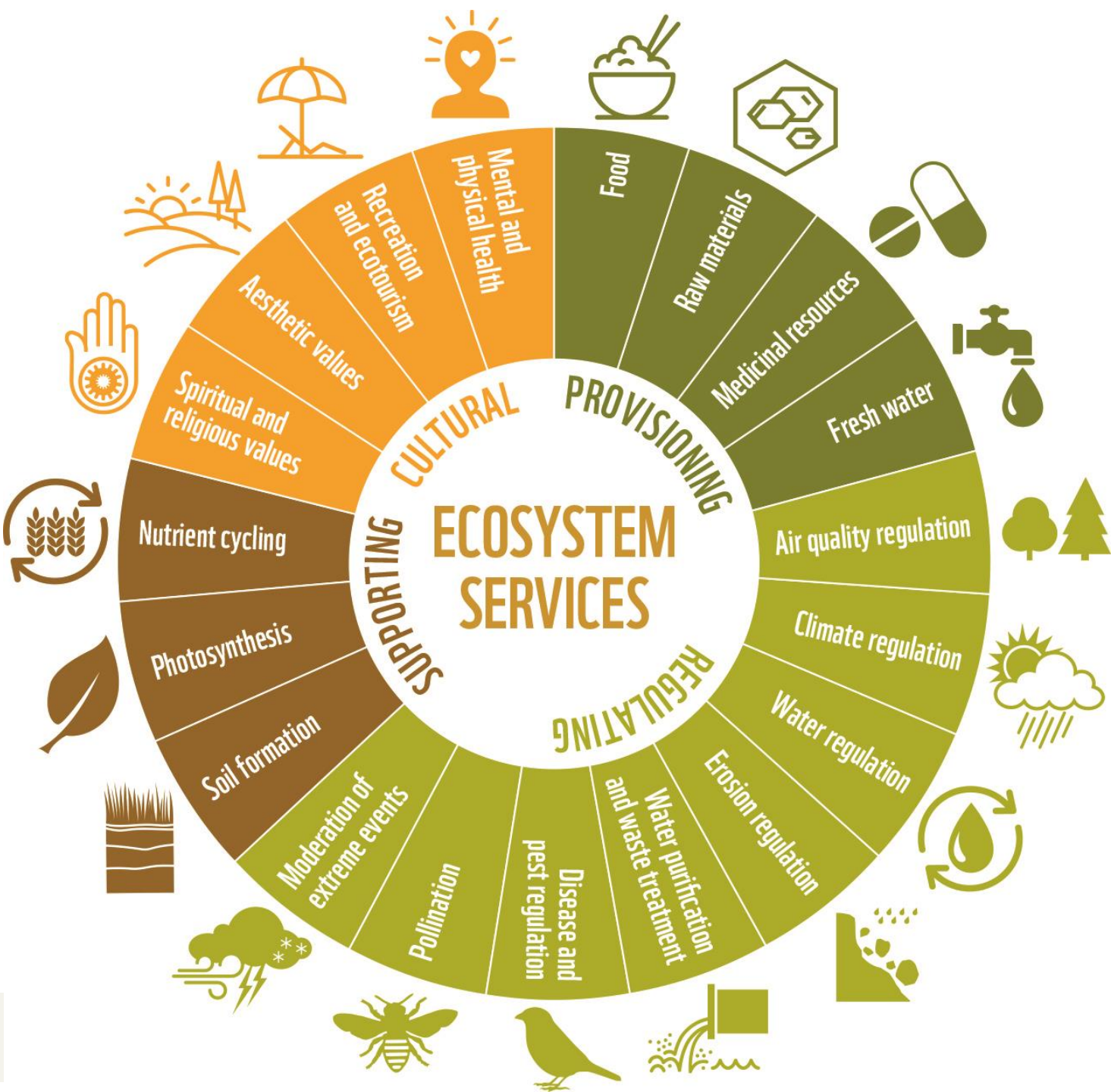
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ecosystem services

The benefits people obtain from ecosystems. Nature's contributions to people (NCP) are all the contributions, both positive and negative, of living nature to the quality of life for people. Many NCP may be perceived as benefits or detriments depending on the cultural, temporal or spatial context.

ecosystem services

classification by the MEA



Building a future in which people live in harmony with nature.

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ecosystem services

common classification of
ecosystem services used by
MAES

Provision Services

All nutritional, non-nutritional material and energetic outputs from living systems as well as abiotic outputs (including water).

Regulation & Maintenance

All the ways in which living organisms can mediate or moderate the ambient environment that affects human health, safety or comfort, together with abiotic equivalents.

Cultural

All the non-material, and normally non-rival and non-consumptive, outputs of ecosystems (biotic and abiotic) that affect physical and mental states of people.

CICES

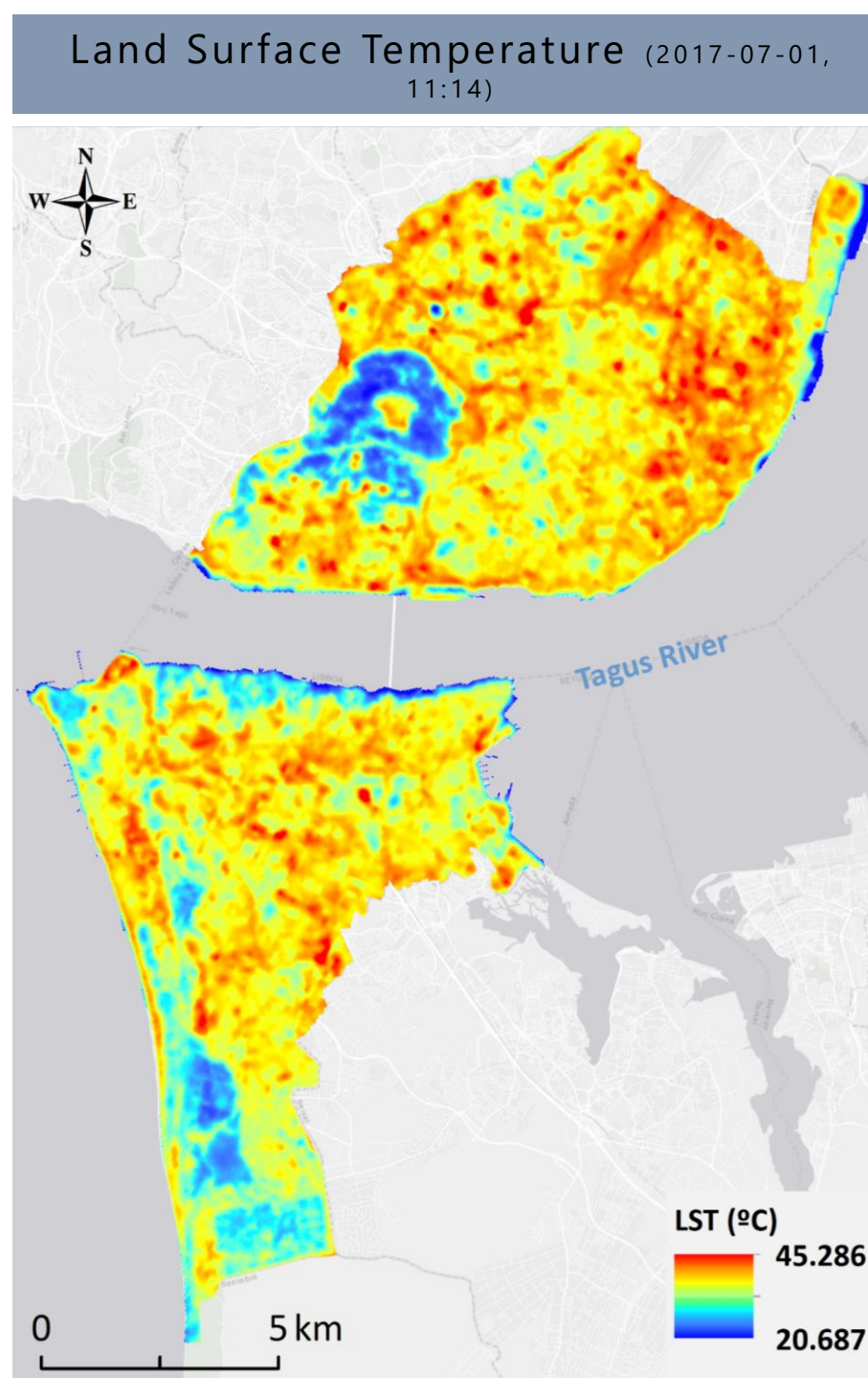
European Environment Agency



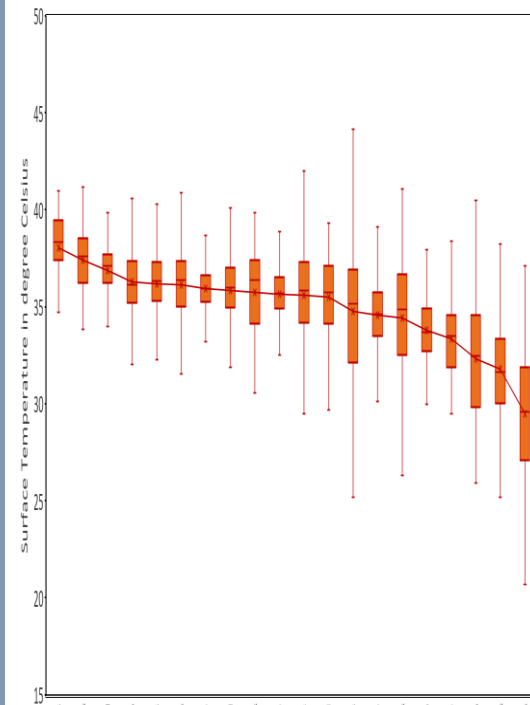
Towards a common classification of ecosystem services

measuring ecosystem

services using earth observation data



Land Surface Temperature (°C)



Land-cover classes
(urban atlas)

ecosystem services

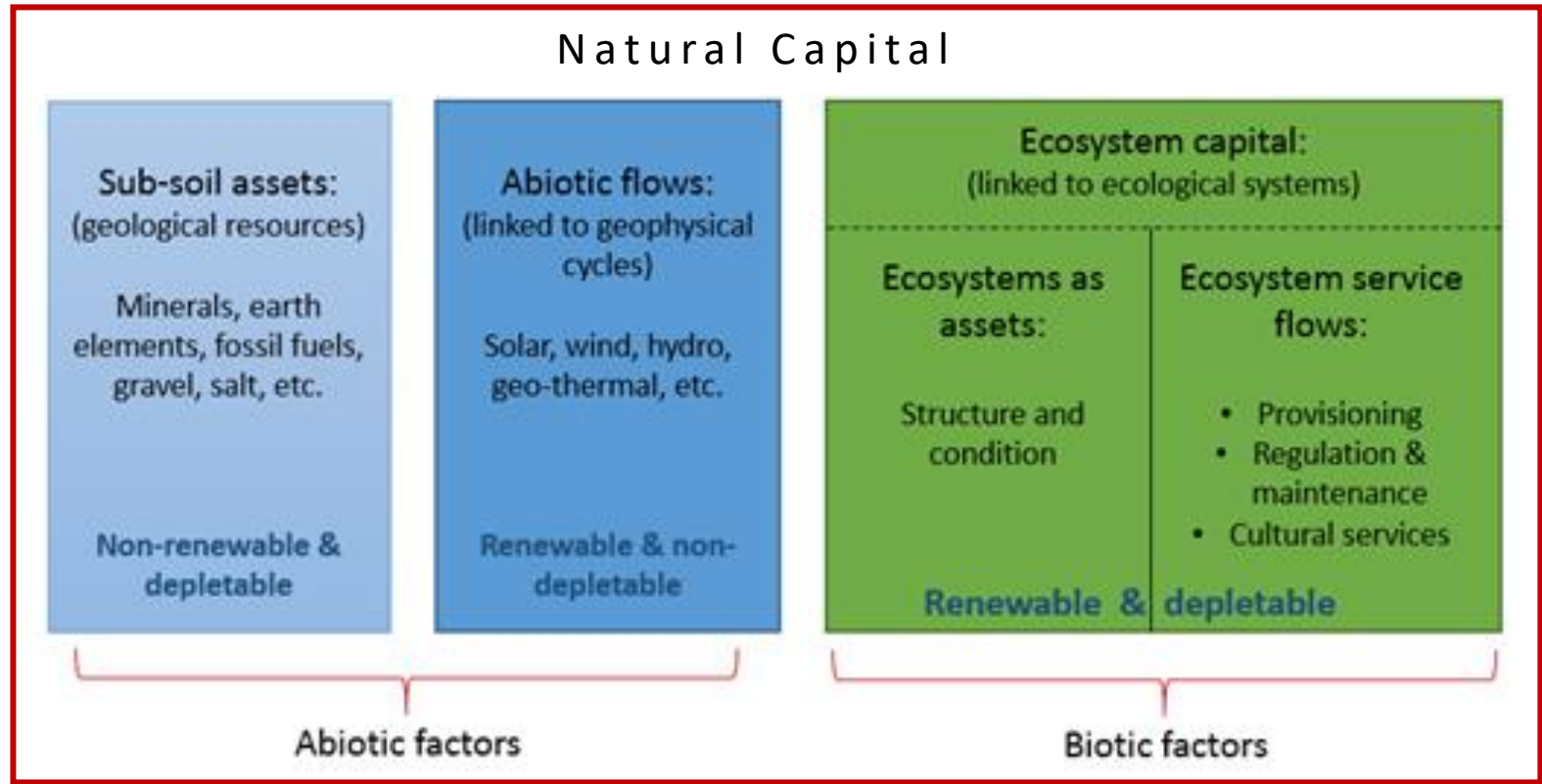
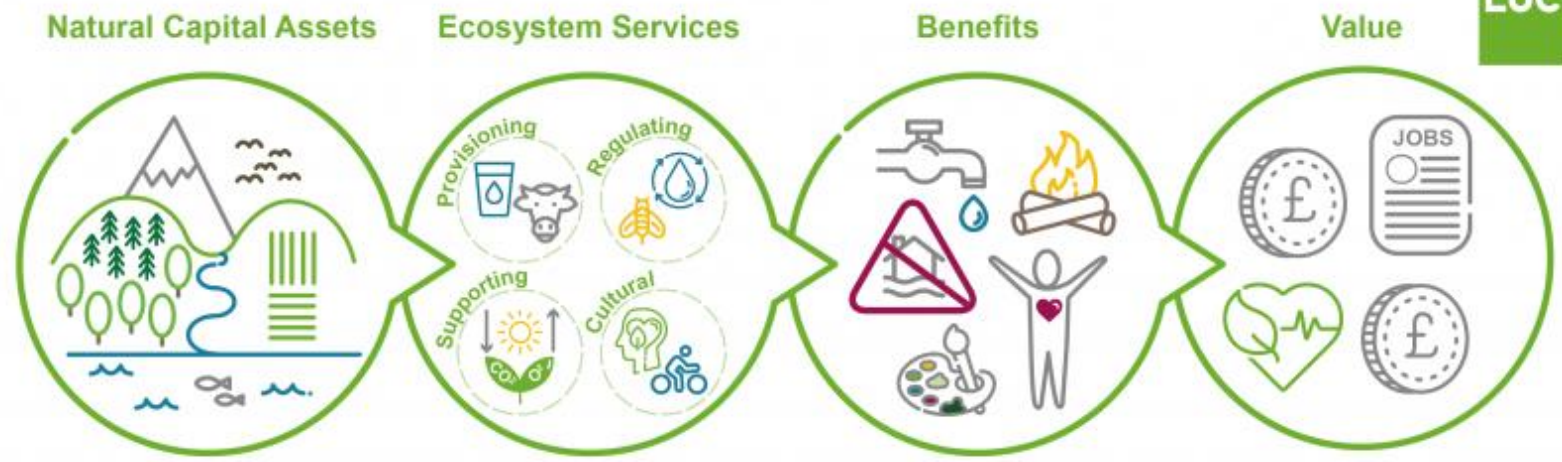
trends from 1970 to 2018, and
the level of uncertainty

	Nature's contribution to people	50-year global trend	Directional trend across regions	Selected indicator
REGULATION OF ENVIRONMENTAL PROCESSES	1 Habitat creation and maintenance	↓	○	• Extent of suitable habitat • Biodiversity intactness
	2 Pollination and dispersal of seeds and other propagules	↓	○	• Pollinator diversity • Extent of natural habitat in agricultural areas
	3 Regulation of air quality	↘	↕	• Retention and prevented emissions of air pollutants by ecosystems
	4 Regulation of climate	↘	↕	• Prevented emissions and uptake of greenhouse gases by ecosystems
	5 Regulation of ocean acidification	→	↕	• Capacity to sequester carbon by marine and terrestrial environments
	6 Regulation of freshwater quantity, location and timing	↘	↕	• Ecosystem impact on air-surface-ground water partitioning
	7 Regulation of freshwater and coastal water quality	↘	○	• Extent of ecosystems that filter or add constituent components to water
	8 Formation, protection and decontamination of soils and sediments	↘	↕	• Soil organic carbon
	9 Regulation of hazards and extreme events	↘	↕	• Ability of ecosystems to absorb and buffer hazards
	10 Regulation of detrimental organisms and biological processes	↓	○	• Extent of natural habitat in agricultural areas • Diversity of competent hosts of vector-borne diseases
MATERIALS AND ASSISTANCE	11 Energy	↘	↕	• Extent of agricultural land—potential land for bioenergy production • Extent of forested land
	12 Food and feed	↓	↕	• Extent of agricultural land—potential land for food and feed production • Abundance of marine fish stocks
	13 Materials and assistance	↘	↕	• Extent of agricultural land—potential land for material production • Extent of forested land
	14 Medicinal, biochemical and genetic resources	↓	○	• Fraction of species locally known and used medicinally • Phylogenetic diversity
NON-MATERIAL	15 Learning and inspiration	↓	○	• Number of people in close proximity to nature • Diversity of life from which to learn
	16 Physical and psychological experiences	↘	○	• Area of natural and traditional landscapes and seascapes
	17 Supporting identities	↘	○	• Stability of land use and land cover
	18 Maintenance of options	↓	○	• Species' survival probability • Phylogenetic diversity



natural capital

“it represents ‘biodiversity, including ecosystems that provide essential goods and services, from fertile soil and multi-functional forests to productive land and seas, from good quality fresh water and clean air to pollination and climate regulation and protection against natural disasters”.



EU environment: state and outlook

metrics to monitor natural capital, circular economy, risks for humans

Theme	Past trends and outlook		Prospects of meeting policy objectives/targets		
	Past trends (10-15 years)	Outlook to 2030	2020	2030	2050
Protecting, conserving and enhancing natural capital					
Terrestrial protected areas	Improving	Improving	✓		
Marine protected areas	Improving	Improving	✓		
EU protected species and habitats	Mixed	Mixed	✗		
Common species (birds and butterflies)	Deteriorating	Deteriorating	✗		
Ecosystem condition and services	Deteriorating	Deteriorating	✗		
Water ecosystems and wetlands	Mixed	Mixed	✗		
Hydromorphological pressures	Deteriorating	Deteriorating	✗		
State of marine ecosystems and biodiversity	Mixed	Deteriorating	✗		
Pressures and impacts on marine ecosystems	Mixed	Deteriorating	✗		
Urbanisation and land use by agriculture and forestry	Deteriorating	Deteriorating			✗
Soil condition	Deteriorating	Deteriorating	✗		
Air pollution and impacts on ecosystems	Mixed	Mixed	□	□	
Chemical pollution and impacts on ecosystems	Mixed	Deteriorating	✗		
Climate change and impacts on ecosystems	Deteriorating	Deteriorating	✗		
Resource-efficient, circular and low-carbon economy					
Material resource efficiency	Improving	Improving	✓		
Circular use of materials	Mixed	Mixed		□	
Waste generation	Mixed	Mixed	□		
Waste management	Improving	Improving	□		
Greenhouse gas emissions and mitigation efforts	Improving	Mixed	✓	✗	✗
Energy efficiency	Improving	Mixed	□	✗	✗
Renewable energy sources	Improving	Mixed	✓	✗	✗
Emissions of air pollutants	Mixed	Mixed	✓	□	
Pollutant emissions from industry	Improving	Mixed	□		
Clean industrial technologies and processes	Improving	Mixed	□		
Emissions of chemicals	Improving	Deteriorating	✗		
Water abstraction and its pressures on surface and groundwater	Improving	Deteriorating	✗		
Sustainable use of the seas	Mixed	Mixed	□		
Safeguarding from environmental risks to health and well-being					
Concentrations of air pollutants	Improving	Mixed	✗	✓	
Air pollution impacts on human health and well-being	Improving	Mixed		✓	
Population exposure to environmental noise and impacts on human health	Mixed	Deteriorating	✗		
Preservation of quiet areas	Mixed	Mixed	✗		
Pollution pressures on water and links to human health	Mixed	Deteriorating	✗		
Chemical pollution and risks to human health and well-being	Mixed	Deteriorating	✗		
Climate change risks to society	Deteriorating	Deteriorating	□		
Climate change adaptation strategies and plans	Improving	Improving	□		
Indicative assessment of past trends (10-15 years) and outlook to 2030			Indicative assessment of prospects of meeting selected policy objectives/targets		
Improving trends/developments dominate	Year	✓	Largely on track		
Trends/developments show a mixed picture	Year	□	Partially on track		
Deteriorating trends/developments dominate	Year	✗	Largely not on track		

Protecting, conserving and enhancing Natural Capital

Resource-efficient, circular and low-carbon economy

Safeguarding from env. risks to health and well being

EU environment: state and outlook

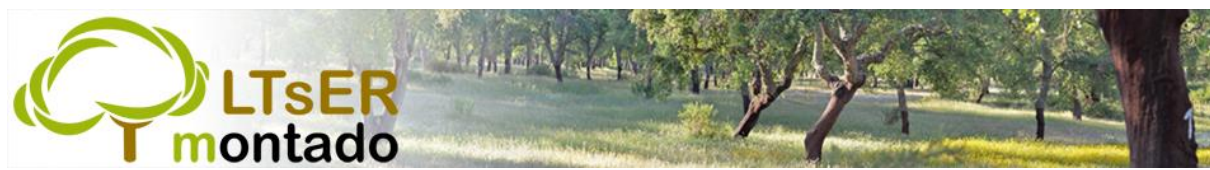
metrics to monitor natural capital

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Urbanisation and land use by agriculture and forestry		
Soil condition		
Air pollution and impacts on ecosystems		
Chemical pollution and impacts on ecosystems		
Climate change and impacts on ecosystems		

long-term monitoring

because many ecosystems
change over the long-term,
initiatives such as the Long-
Term Socio-Ecological
Research are required



ecosystem restoration

to reverse ecosystem
degradation to regain
ecological functionality and
promote resilience

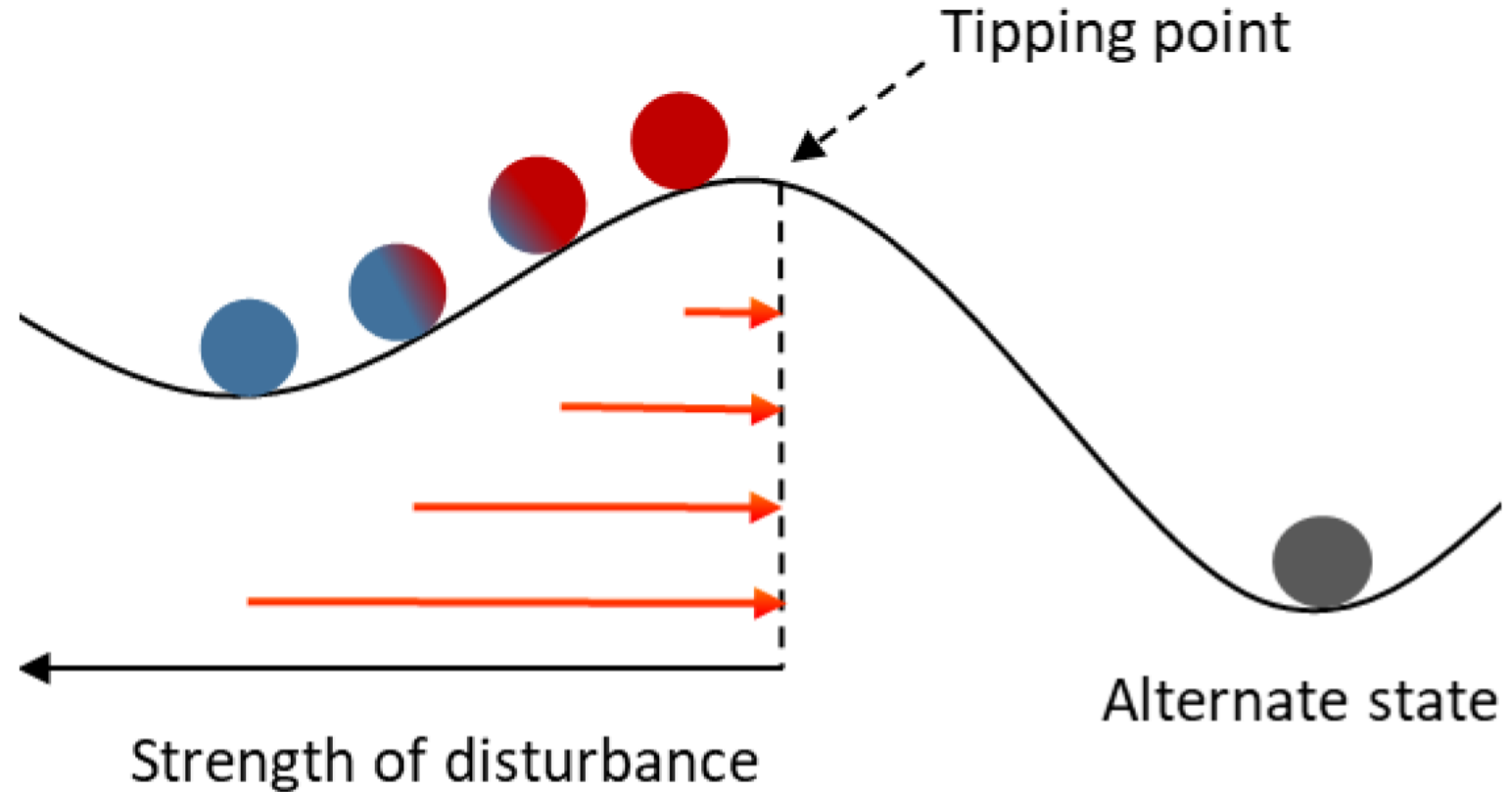
restoring coastal sand dunes after major storm for
coastal erosion protection, tourism, nursery habitats



Projeto ReDuna – Câmara Municipal de Almada

ecosystem resilience

the capacity of
an ecosystem to respond to a
perturbation
or disturbance by resisting
damage and recovering
quickly



[Ecological Resilience](#) | [Assessing the resilience of biodiversity-driven functions in agroecosystems under environmental change](#)

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nature-based solutions

Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Nature-based solutions must benefit biodiversity and support the delivery of a range of ecosystem services.

nature based solutions

definition agreed by the UN



United Nations
Environment Assembly
(UNEA), 2022

“actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits”

- I. actions to protect, conserve, restore, sustainably use and manage
- II. natural or modified terrestrial, freshwater, coastal and marine ecosystems
- III. which address social, economic and environmental challenges effectively and adaptively
- IV. simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits

nature-based solutions

targeting specific problems & promote biodiversity



land restoration

with multiple NBS, including infiltration ponds and swales, at FCULresta, Lisbon University, Portugal

green roofs to increase flood protection, building climate regulation, and aesthetical gains



FCULresta – FCUL

green roofs

a nature-based solutions to provide ecosystem services to buildings and cities

green roofs to increase flood protection, building climate regulation, and aesthetical gains



ETAR de Alcântara – Águas de Portugal

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