Introduction to the Red List of Ecosystems and the Kunming-Montreal Global Biodiversity Framework

Prof Emily Nicholson

AHTEG, IUCN Red List of Ecosystems thematic group

The University of Melbourne

emily.nicholson@unimelb.edu.au

What is the Red List of Ecosystems?

- Framework & criteria for assessing risk of ecosystem collapse
- Adopted as IUCN's global standard in 2014
- Change in distribution & ecological processes
  - Dependencies/interactions among species
  - Far-reaching changes in common species
- Complements species-level information & regulation, e.g. IUCN Red List of Threatened Species
- Applicable to all ecosystem types: Terrestrial, marine & freshwater
- http://iucnrle.org

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Scientific Foundations for an IUCN Red List of Ecosystems

David A. Keith[1,2*], Jon Paul Rodríguez[3,4,5,6], Kathryn M. Rodríguez-Clark[3], Emily Nicholson[7], Kaisu Aapala[8], Alfonso Alonso[9], Marianne Asmussen[3,5], Steven Bachman[10], Alberto Basset[11], Edmund G. Barrow[12], John S. Benson[13], Melanie J. Bishop[14], Ronald Bonifacio[15], Thomas M. Brooks[6,16],

Defining ecosystem & collapse

What is an ecosystem?

- Species/biota, environment, processes & interactions, place
- Defined by assessor for purpose, scale
- Global Ecosystem Typology (global-ecosystems.org)

What is collapse? Global and local

- Loss of defining features: species, structure, processes
- New ecosystem with new defining features. Can be valuable

Collapsed ecosystem: Aral sea

Characteristic native biota:

- 12 freshwater fishes
- diverse invertebrate fauna (~150 spp.)
- coastal wetlands used by migratory birds.

2005:

- volume and area reduced to fraction of original
- salinity increased 10 fold.
- coastal wetlands gone
- 28 aquatic species

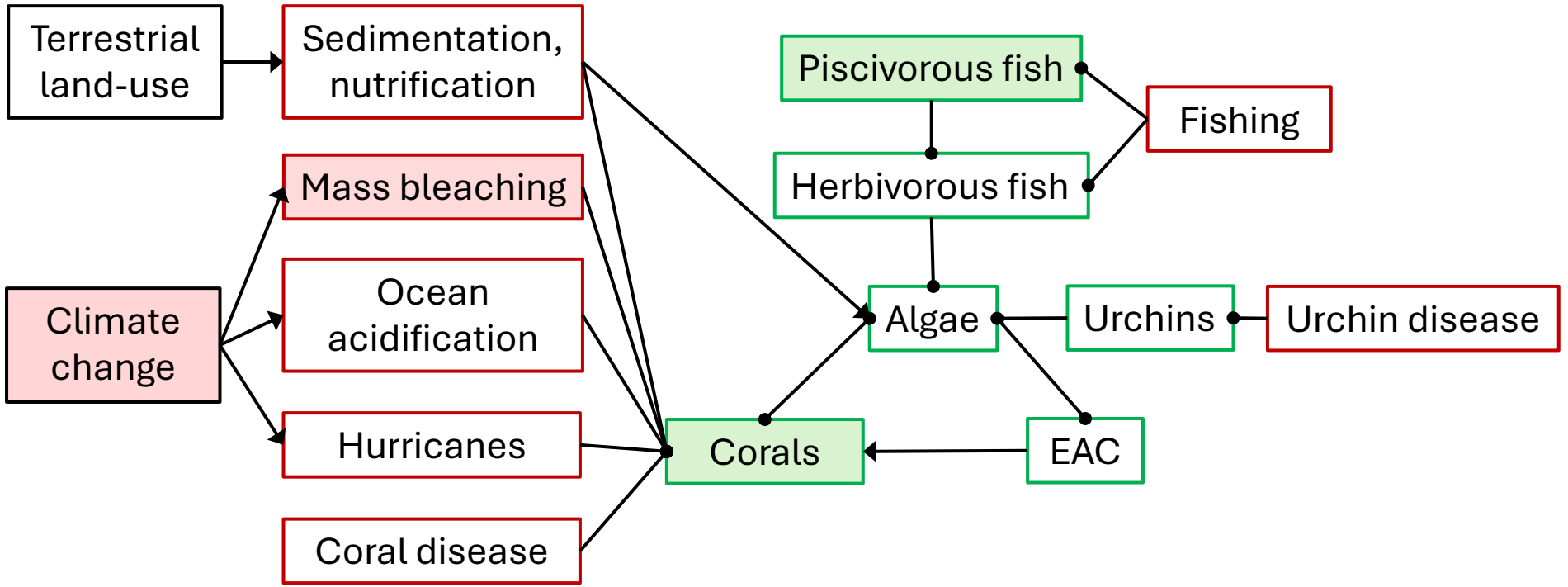
- Theoretically, it may be restorable.

Keith et al. (2013) PLOS ONE

Conceptual model: Meso-american coral reef

- Basis for risk assessment
- Shows key components and interactions
- Clarify assumptions and understanding, communication
- Identify key indicators of change
- Underpin quantitative ecosystem models

Bland et al. (2017)
Proc Roy Soc B

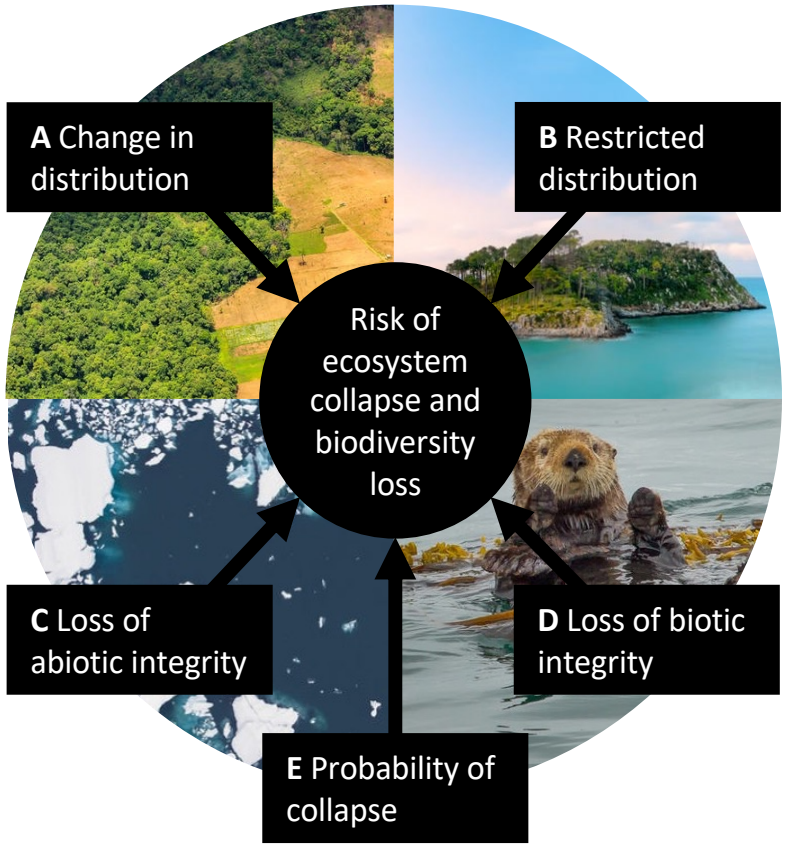


What is the Red List of Ecosystems?

Knowledge synthesis:

- Ecosystem maps (current, past)
- Ecosystem descriptions (characteristics, processes, functions)
- Threat diagnosis (conceptual model)
- Change in area & integrity

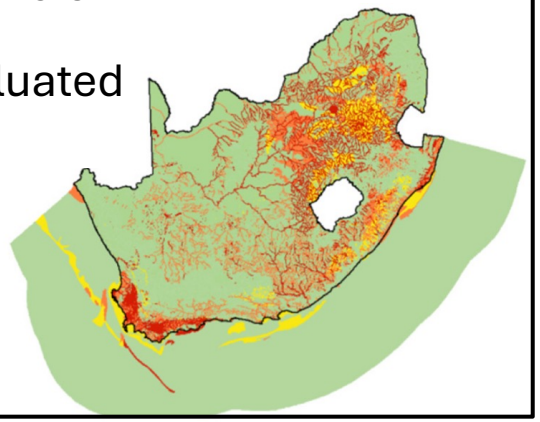
Assessment against criteria



Over 3 timeframes: 1) past 50 years, 2) up to 50 years into the future, 3) historic (~1750)

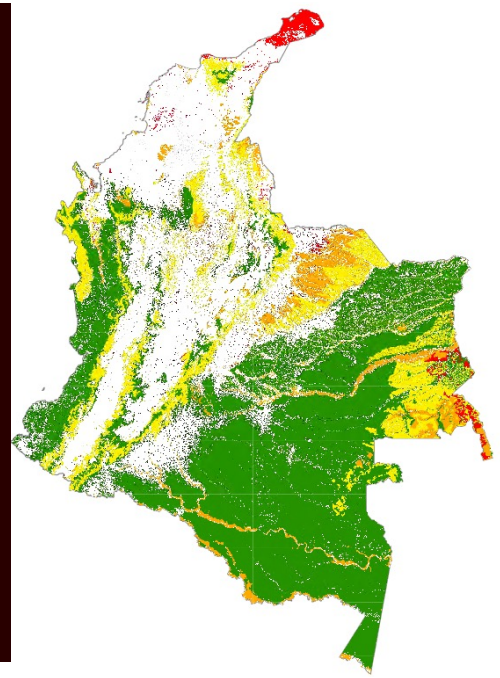
Risk assessment outcomes

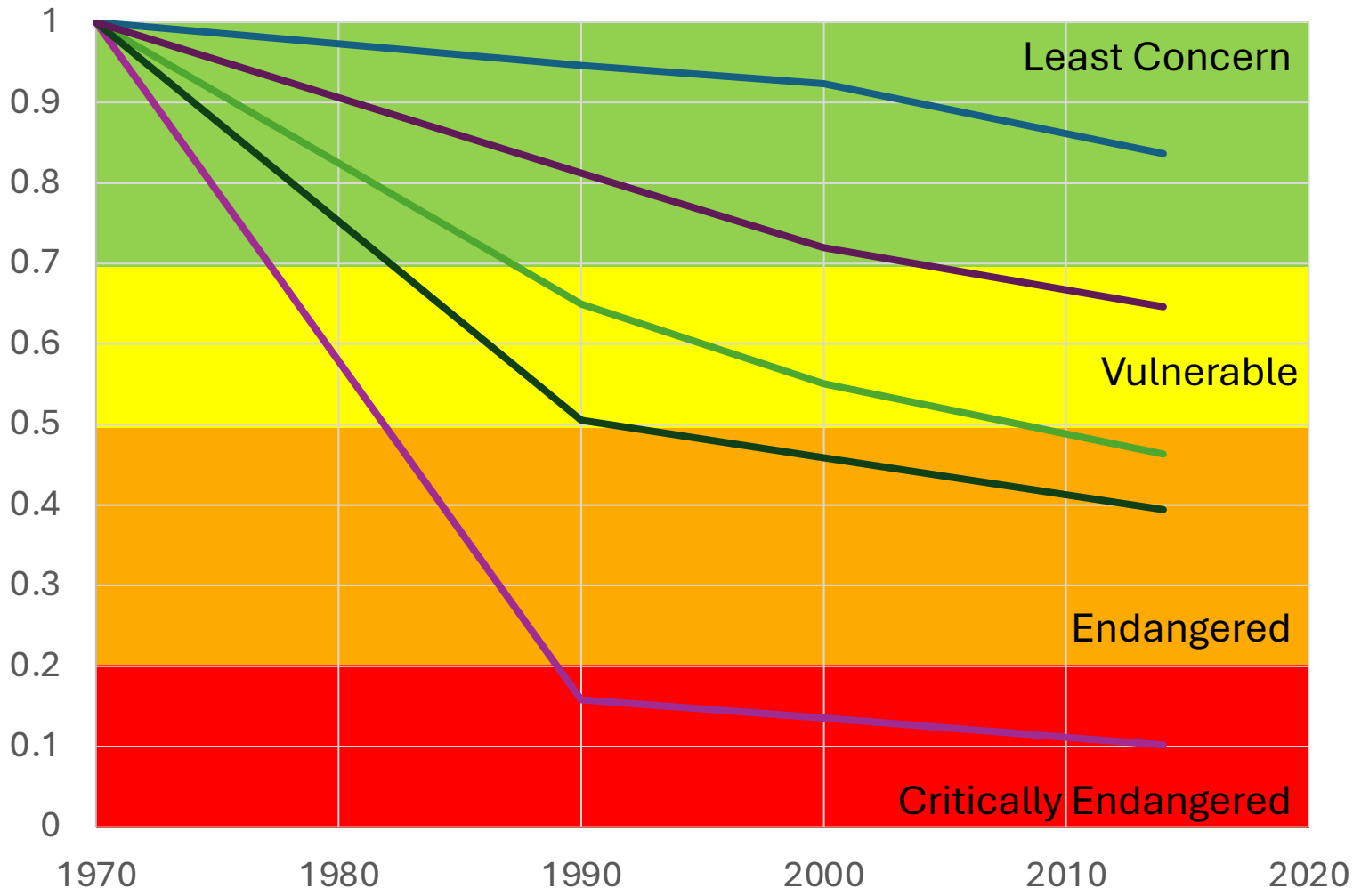
- **CO** Collapsed
- **CR** Critically Endangered
- **EN** Endangered
- **VU** Vulnerable
- **NT** Near Threatened
- **LC** Least Concern
- **DD** Data Deficient
- **NE** Not evaluated



What is the Red List of Ecosystems?

- Colombian terrestrial ecosystems
- Criterion A: Change in area 1970-2015



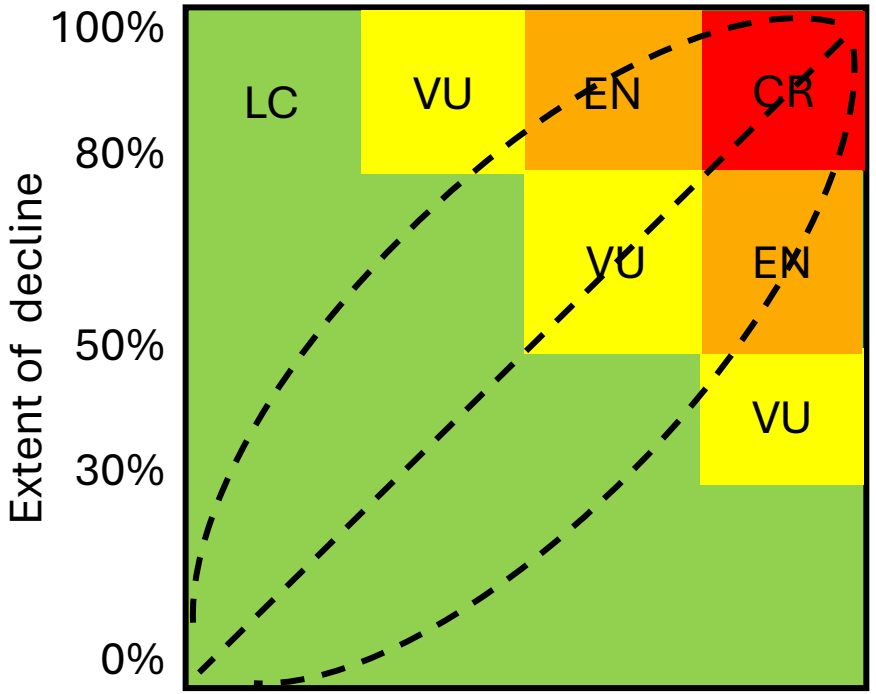


What is the Red List of Ecosystems?

C Environmental degradation

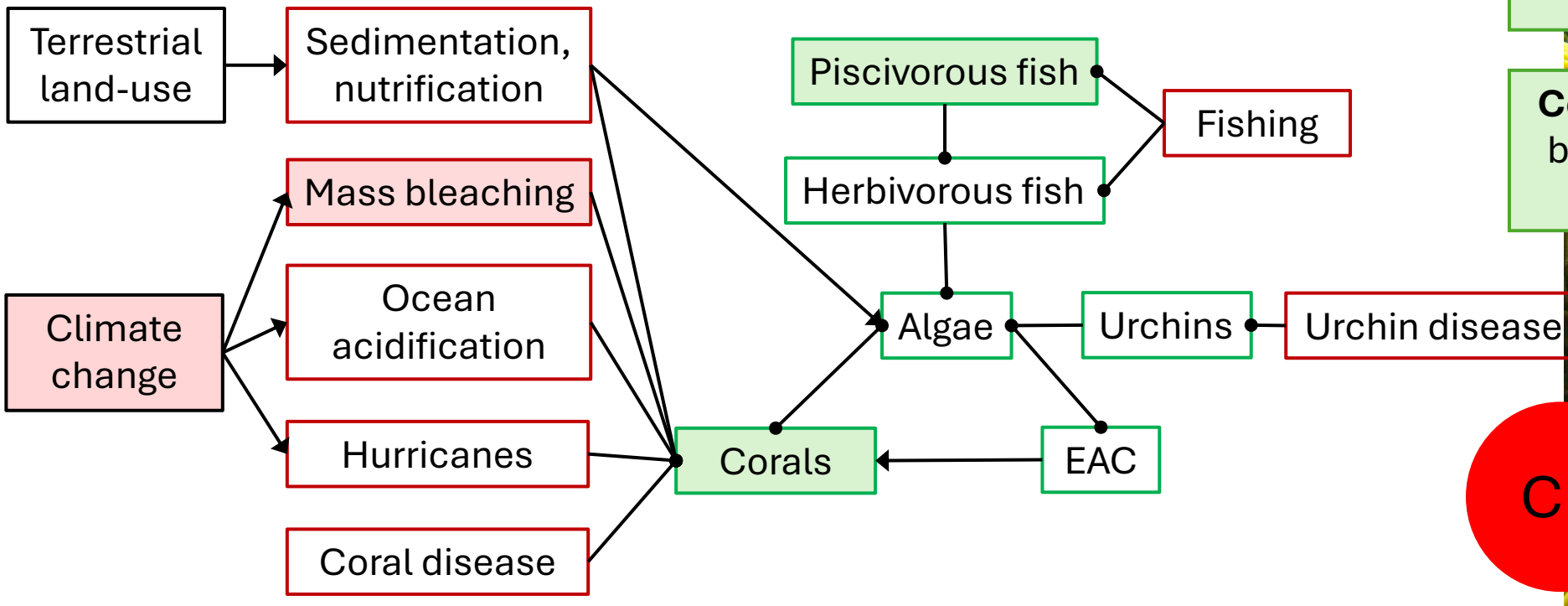
D Disruption of biotic processes

50 years (past, present & future)
(since 1750 with higher thresholds)



Meso-american coral reef

Bland et al. (2017)
Proc Roy Soc B



Collapse: live coral cover <1%; bleaching events leading to 1%

Collapse: D: piscivorous fish biomass <2 g.m^{-2}, based on the Reef Health Index

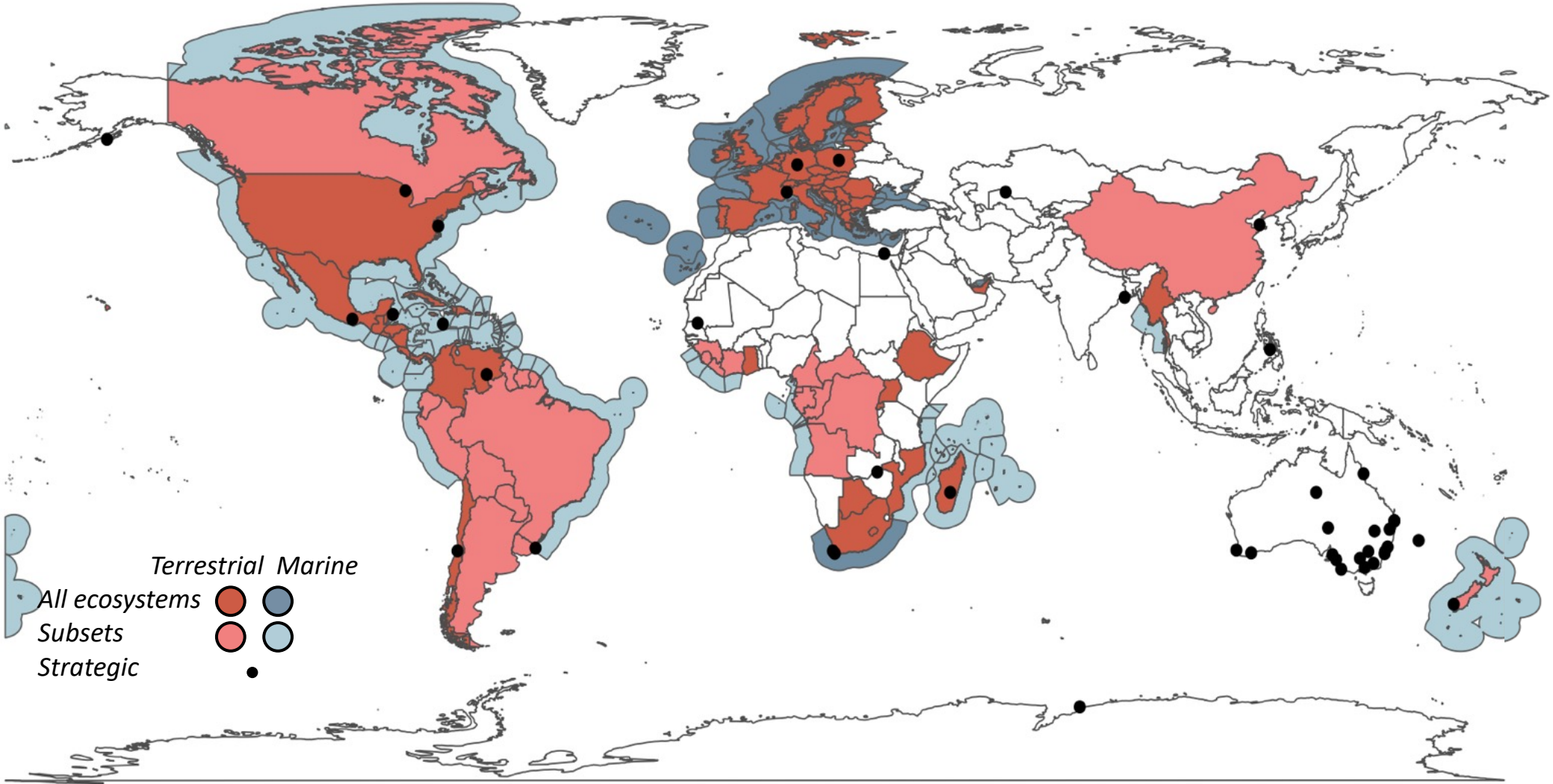
CR

	A. Declining distribution	B. Restricted distribution	C. Environmental degradation	D. Biotic disruption	E. Quantitative risk analysis
Past 50 y	DD	LC	EN	EN	EN (LC-EN)*
Future 50y	LC (LC-NT)*	LC	CR (VU-CR)	CR (VU-CR)*	
Since 1750	DD	LC	VU	VU	

Spatial coverage of Red List of Ecosystems assessments

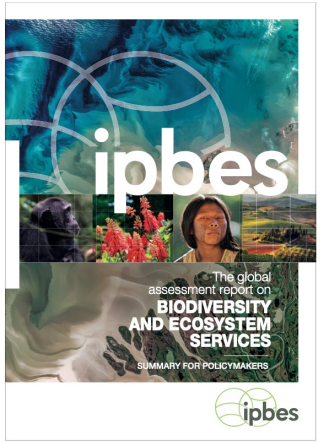
>5000 ecosystems assessed worldwide

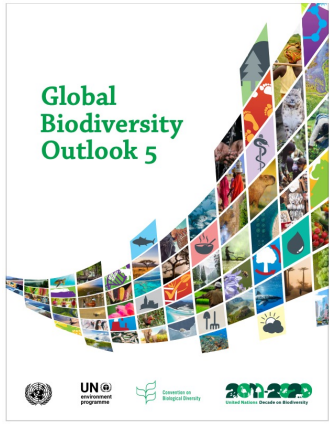
>609 countries all terrestrial ecosystems, subsets in a further 30 countries.



What is the Kunming-Montreal Global Biodiversity Framework?

Convention on Biological Diversity





Kunming - Montreal
GLOBAL BIODIVERSITY FRAMEWORK

- United Nations Convention on Biological Diversity, 1992
- Primary multi-lateral agreement for nature
- Iterative sets of goals for biodiversity conservation and sustainable development (mostly failed), including Aichi Targets (2011-2020)
- 4 outcome-oriented goals:
  A. safeguard biodiversity
  B. maintain nature's contributions to people,
  C. share of benefits from nature
  D. resource the GBF's implementation
- 23 targets for actions to achieve the goals
- Monitoring framework to track progress, including headline indicators

Ecosystem approach across the GBF

GOAL A: The integrity, connectivity and resilience of all ecosystems are maintained, enhanced, or restored, substantially increasing the area of natural ecosystems by 2050.

Multiple targets address ecosystems, especially Target 1 (planning to stem loss), Target 2 (restoration), Target 3 (30x30)

Ecosystem-related headline indicators make a **set**

- **A.1** Red List of Ecosystems
- **A.2** Extent of natural ecosystems
- **B.1** Services provided by ecosystems
- **2.1** Area under restoration
- **3.1** Coverage of protected areas and OECMs

If reported consistently across indicators and countries: Global Ecosystem Typology

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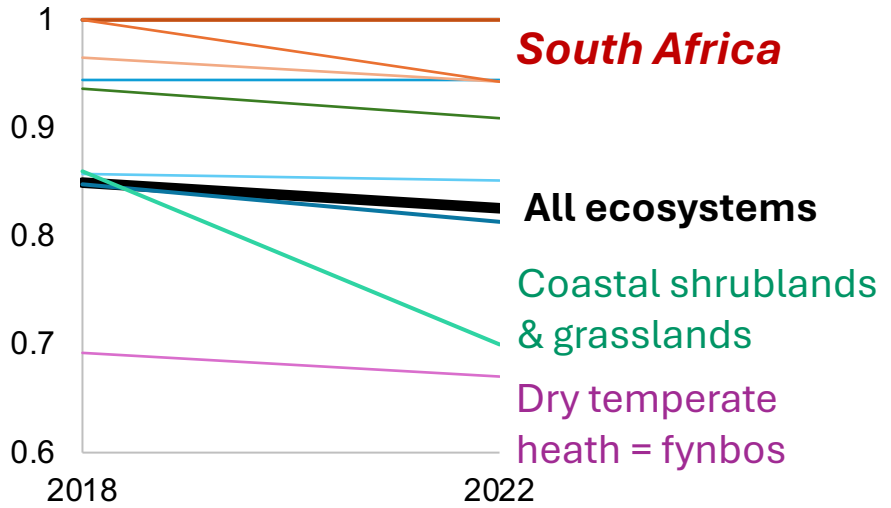
A.1 Red List of Ecosystems

If reported consistently across indicators and countries: Global Ecosystem Typology

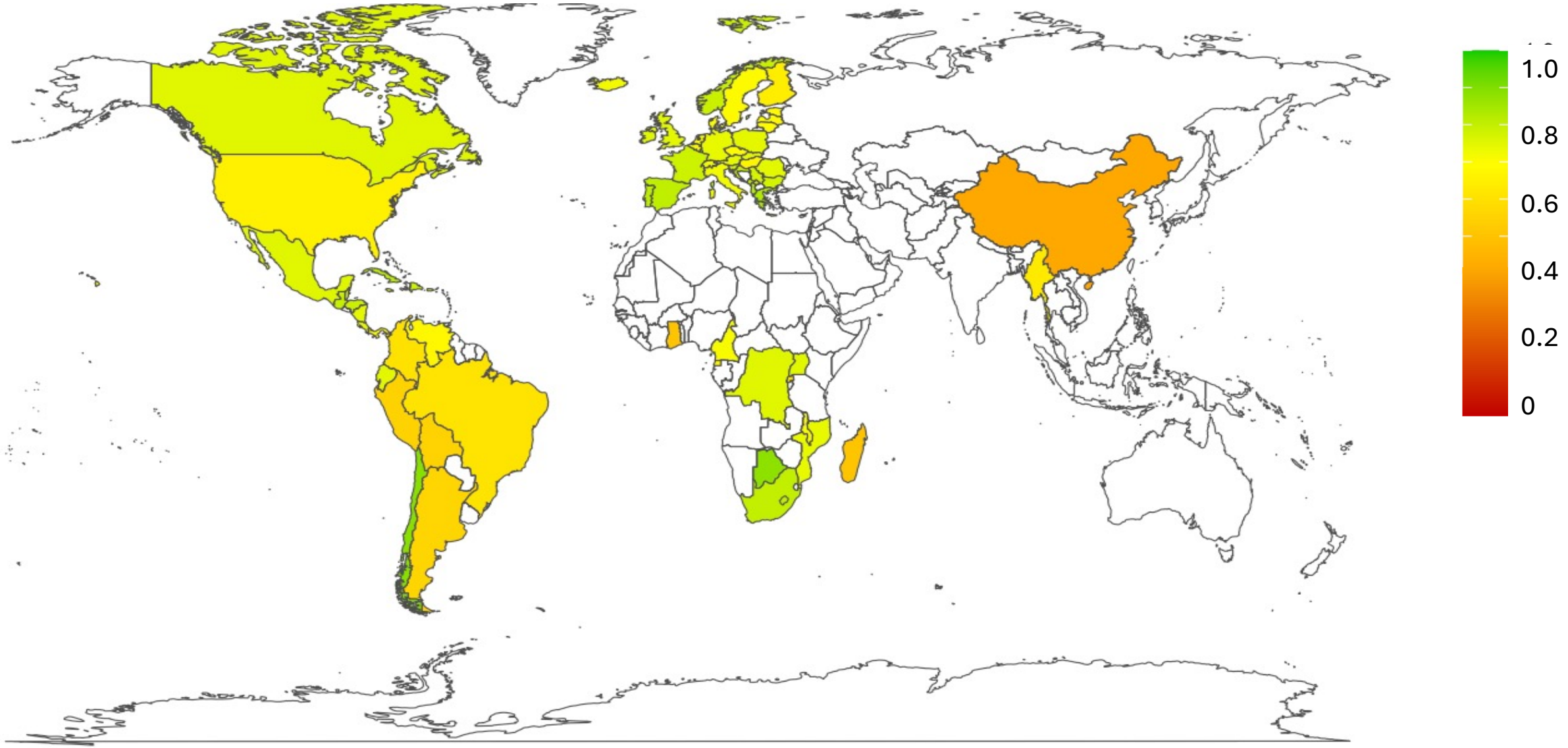
A.1 Red List of Ecosystems

Indicator A.1: Red List Index of ecosystems (RLIe)

- Comparable to A.3 Red List Index of species survival
- Countries report the number of ecosystem types per risk category in each ecosystem functional group
- A global indicator can be calculated from national data

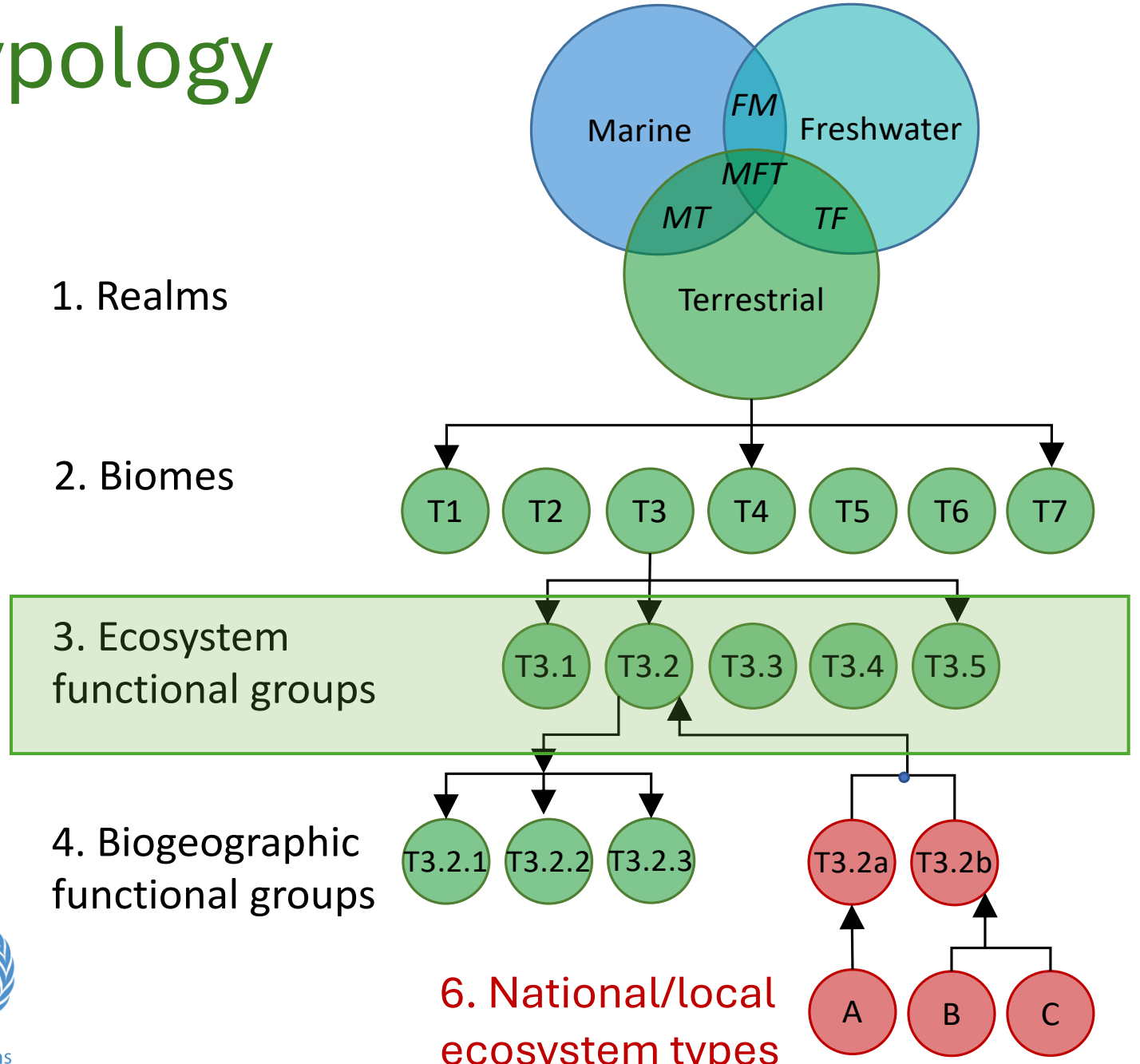


Preliminary Red List Index of Ecosystems



Global Ecosystem Typology

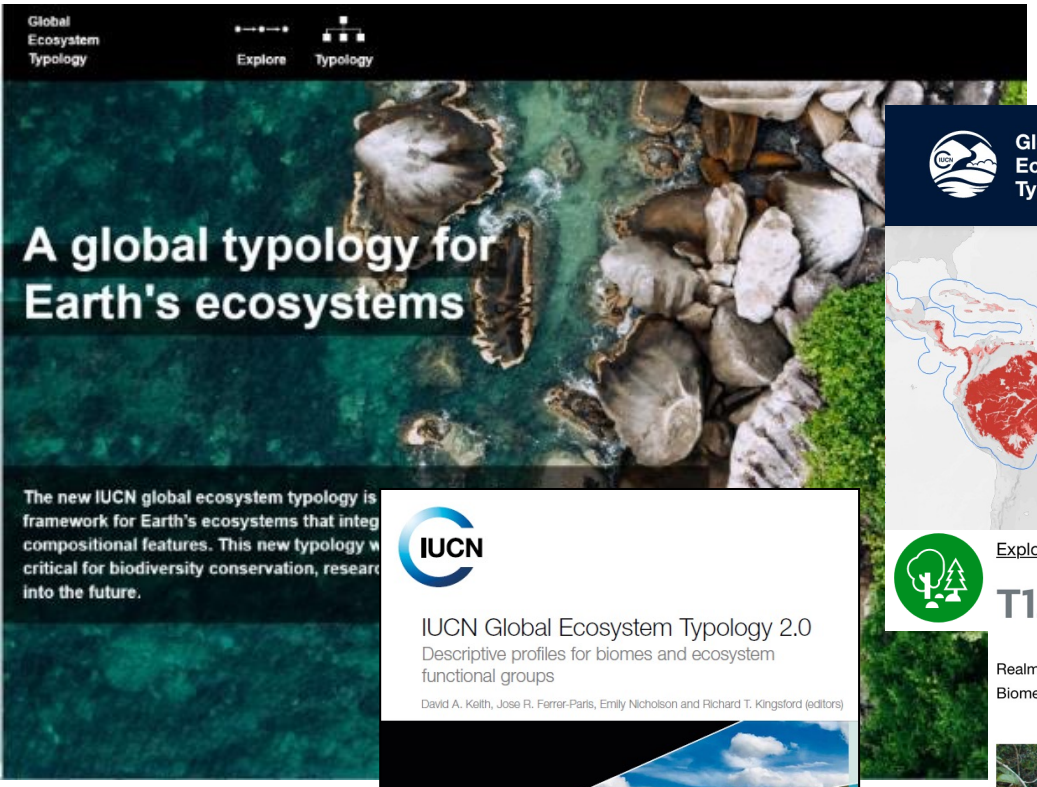
- Supports consistent global reporting
- ***Does not replace national data on ecosystems***
- Hierarchical
- Harmonizes existing national data by cross-referencing
- Supports development of new classifications

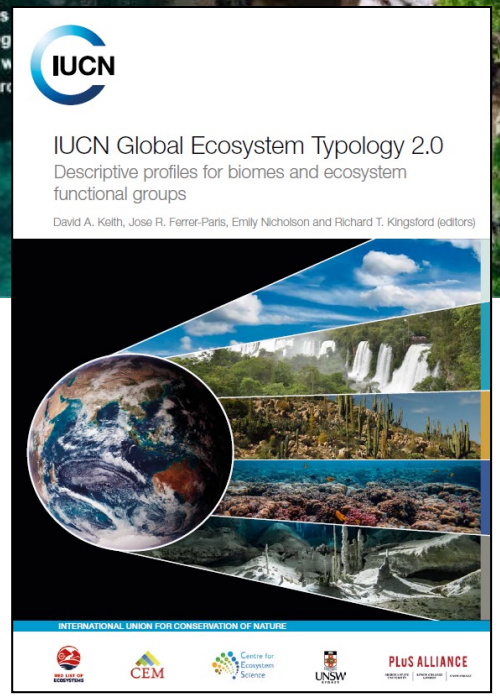


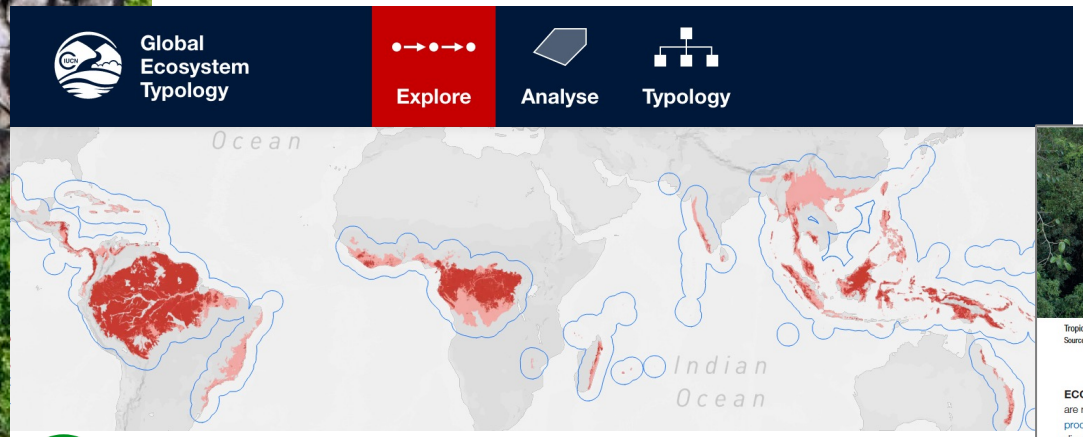
System of Environmental Economic Accounting

United Nations Statistics Division

IUCN Global Ecosystem Typology http://global-ecosystems.org





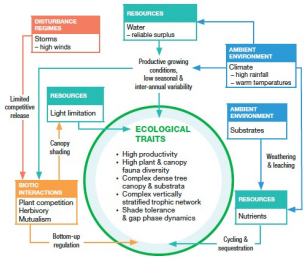


Tropical rainforest, Daintree, northeast Australia.
Source: David Keith (2009)

T1.1 Tropical subtropical lowland rainforests

BIOME: TROPICAL-SUBTROPICAL FORESTS
REALM: TERRESTRIAL

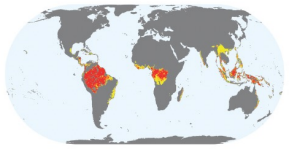
Contributors: D.A. Keith, K.R. Young, R.T. Corlett



ECOLOGICAL TRAITS: These closed-canopy forests are renowned for their complex structure and high primary productivity, which support high functional and taxonomic diversity. At subtropical latitudes they transition to warm temperate forests (T2.4). Bottom-up regulatory processes are fuelled by large autochthonous energy sources that support very high primary productivity, biomass and Leaf Area Index (LAI). The structurally complex, multi-layered, evergreen tree canopy has a large range of leaf sizes (typically macrophyll-notophyll) and high SLA, reflecting rapid growth and turnover. Diverse plant life forms include buttressed trees, bamboos (sometimes abundant), epiphytes, lianas and ferns, but grasses and hydrophytes are absent or rare. Trophic networks are complex and vertically stratified with low exclusivity and diverse representation of herbivorous, frugivorous and carnivorous vertebrates. Tree canopies support a vast diversity of invertebrate herbivores and their predators. Mammals and birds play critical roles in plant diaspore dispersal and pollination. Growth and reproductive phenology may be seasonal or unseasonal, and reproductive masting is common in trees and regulates diaspore predation. Fungal, microbial and diverse invertebrate decomposers and detritivores dominate the forest floor and the subsoil. Diversity is high across taxa, especially at the upper taxonomic levels of trees, vertebrates, fungi and invertebrate fauna. Neutral processes as well as micro-niche partitioning may have a role in sustaining high diversity, but evidence is limited. Many plants are in the shade, forming seedling banks that exploit gap-phase dynamics initiated by individual tree-fall or stand-level canopy disruption by tropical storms in near coastal forests. Seed banks regulated by dormancy are uncommon. Many trees exhibit leaf form plasticity enabling photosynthetic function in deep shade, dappled light or full sun, even on a single individual. Some species germinate on tree trunks, gaining quicker access to canopy light, while roots absorb microclimatic moisture until they reach the soil.

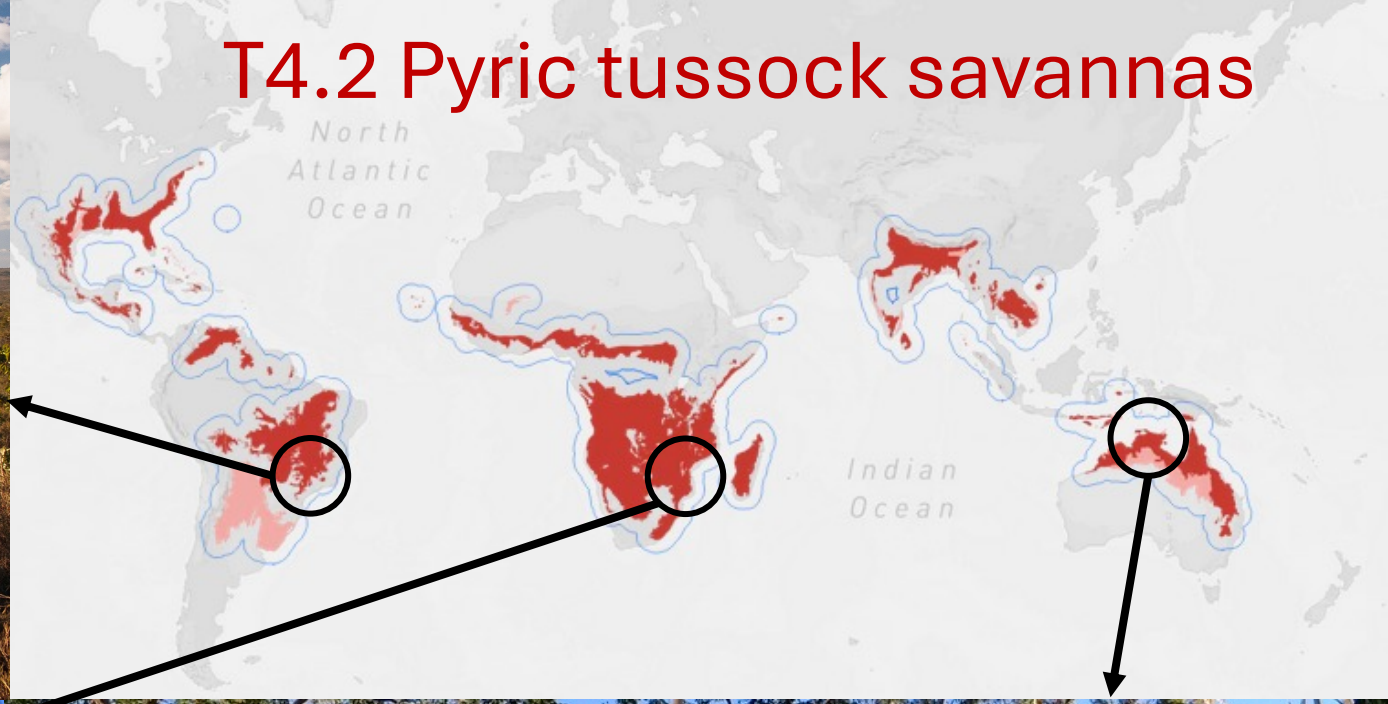
KEY ECOLOGICAL DRIVERS: Precipitation exceeds evapotranspiration with low intra- and inter-annual variability, creating a reliable year-round surplus, while closed tree canopies maintain humid microclimate and shade. Temperatures are warm with low-moderate diurnal and seasonal variation (mean winter minima rarely <10°C except in subtropical transitional zones). Soils are moist but not regularly inundated or peaty (see TF1.3) Most nutrient capital is sequestered in vegetation or cycled through the dynamic litter layer, critical for retaining nutrients that would otherwise be leached or lost to runoff. In some coastal regions outside equatorial latitudes (mostly >10° and excluding extensive forests in continental America and Africa), decadal regimes of tropical storms drive cycles of canopy destruction and renewal.

DISTRIBUTION: Humid tropical and subtropical regions in Central and West Africa, Southeast Asia, Oceania, northeast Australia, Central and tropical South America and the Caribbean.



Reference:
Ashton, P.S., Seidler, R. (2014). On the Forests of Tropical Asia: Lest the memory fade. Kew, UK: Royal Botanic Gardens.
Corlett, R.T., Primack, R.B. (2011). Tropical Rain Forests: An Ecological and Biogeographical Comparison. Second Edition. Chichester, UK: Wiley-Blackwell.

T4.2 Pyric tussock savannas



Brazil: ‘typical’ cerrado

J Santos

Mozambique: Mueda Mixed Dry Miombo

J Burrows

Australia: Tiwi islands Eucalypt forested savanna

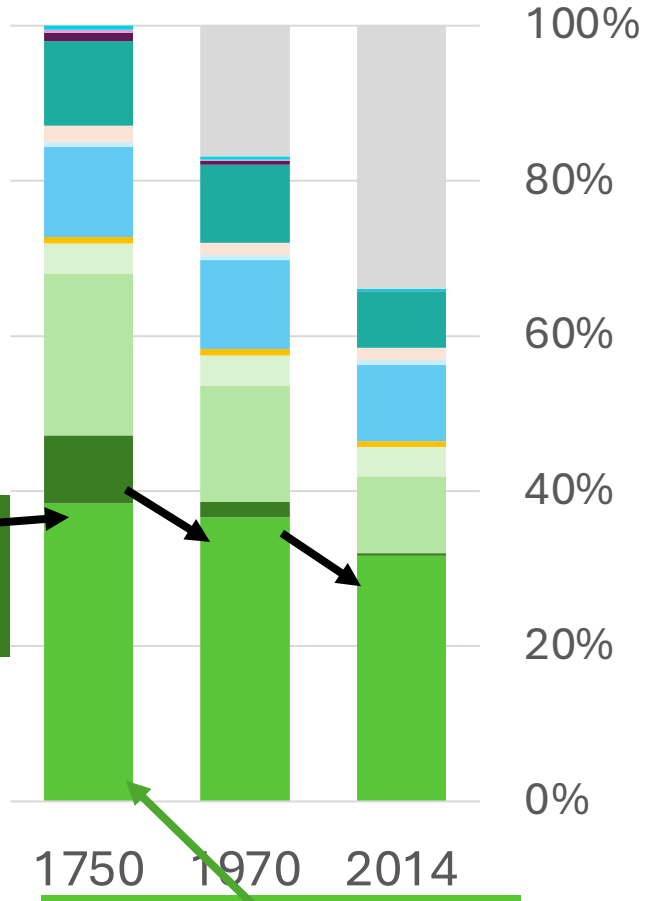
A Young

M1 Marine shelf biome

Colombia: indicative headline indicators

A1 Red list of Ecosystems

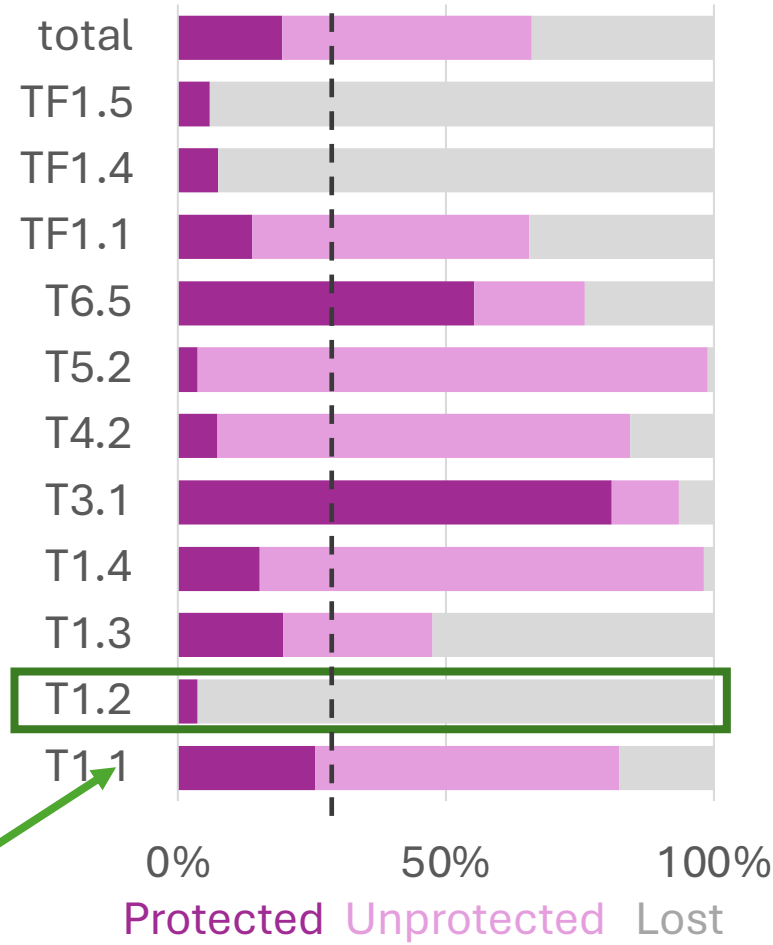
A2 extent of natural ecosystems



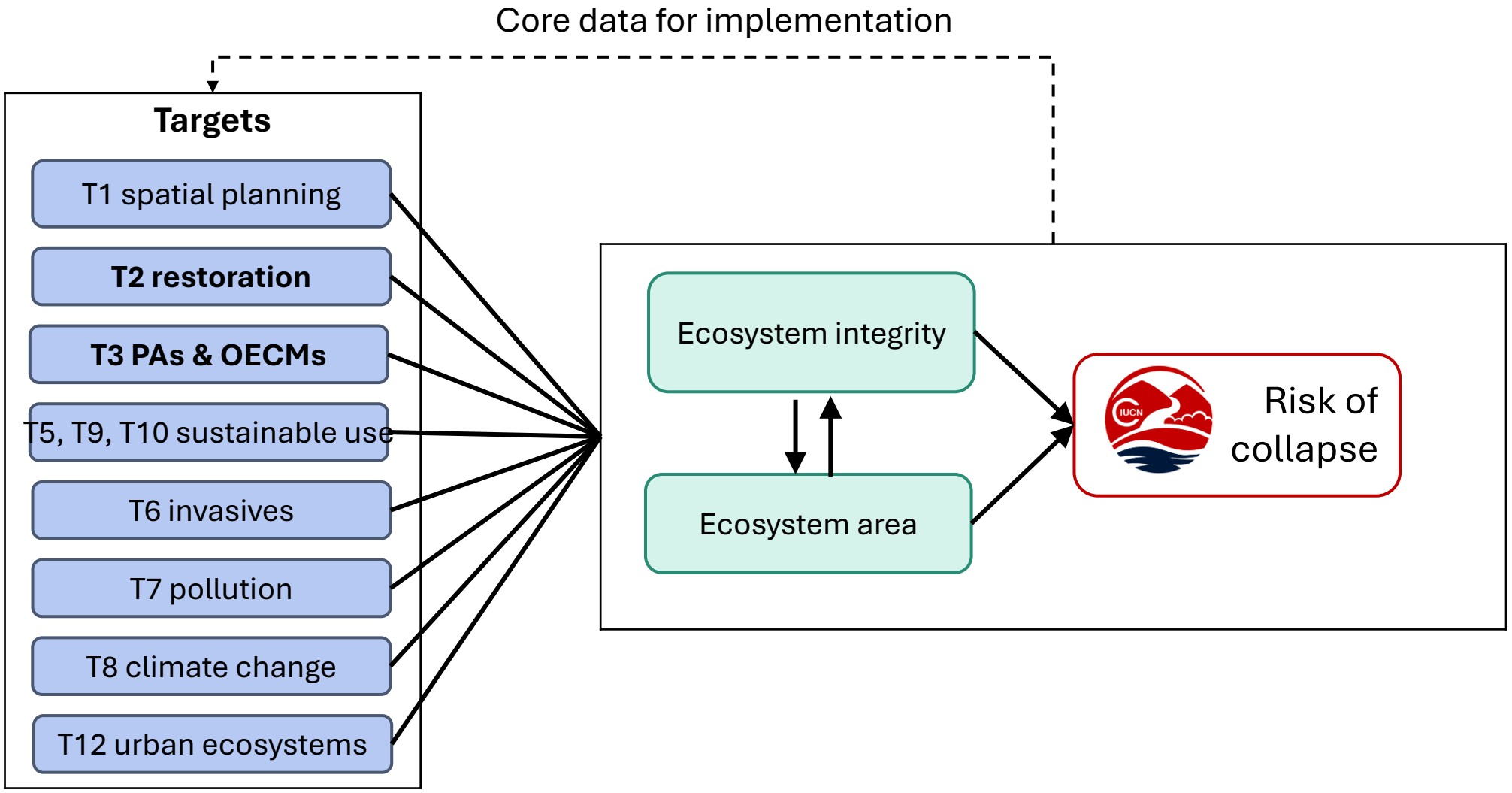
Tropical dry forests

Tropical lowland rainforests

3.1 protection



Roles of the Red List of Ecosystems in the GBF




Alys Young