Ecosystems in a global context: 
*The IUCN Global Ecosystem Typology*

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Needs for a globally consistent ecosystem typology

Why a functional approach?
• Sustaining ecosystem functions and services, irrespective of specific biota involved, depends on understanding the ecological processes and mechanisms that drive ecosystem change.

But... identity of biota is central to conservation concepts & cultural values.
Design criteria for a Global Ecosystem Typology

• represent both ecosystem functions and the biota engaged in them
• conceptually consistent throughout the biosphere
• a scalable structure
• spatially explicit, mutually exclusive units
• avoid superfluous complexity

We reviewed 21 typologies:
- None represented both functions & biota
- Only two encompassed whole biosphere
- Limited theoretical basis
- Some not mapped
Theoretical foundations

- Conceptual model based on community assembly theory
- Common ecological drivers shape ecosystems with shared functional traits
IUCN Global Ecosystem Typology: scope & structure

- All ecosystems of the biosphere
- Hierarchical structure
- Representation of function – upper levels, top-down
- Representation of composition – lower levels, bottom-up
<table>
<thead>
<tr>
<th>Terrestrial &amp; Subterranean</th>
<th>Freshwater &amp; transitional</th>
<th>Marine &amp; transitional</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 Tropical/subtropical forests</td>
<td>FT Palustrine wetlands</td>
<td>MF1 Shoreline systems</td>
</tr>
<tr>
<td>T2 Temperate-boreal forests &amp; woodlands</td>
<td>FT Palustrine wetlands</td>
<td>MF1 Shoreline systems</td>
</tr>
<tr>
<td>T3 Shrublands &amp; shrub-dominated woodlands</td>
<td>FT Palustrine wetlands</td>
<td>MF1 Shoreline systems</td>
</tr>
<tr>
<td>T4 Savannas and grasslands</td>
<td>FT Palustrine wetlands</td>
<td>MF1 Shoreline systems</td>
</tr>
<tr>
<td>T5 Deserts and semi-deserts</td>
<td>FT Palustrine wetlands</td>
<td>MF1 Shoreline systems</td>
</tr>
<tr>
<td>T6 Polar/Alpine</td>
<td>FT Palustrine wetlands</td>
<td>MF1 Shoreline systems</td>
</tr>
<tr>
<td>T7 Intensive anthropogenic terrestrial systems</td>
<td>FT Palustrine wetlands</td>
<td>MF1 Shoreline systems</td>
</tr>
<tr>
<td>S1 Lithic subterranean systems</td>
<td>FT Palustrine wetlands</td>
<td>MF1 Shoreline systems</td>
</tr>
<tr>
<td>S2 Subterranean freshwaters</td>
<td>FT Palustrine wetlands</td>
<td>MF1 Shoreline systems</td>
</tr>
<tr>
<td>S3 Tidal subterranean systems</td>
<td>FT Palustrine wetlands</td>
<td>MF1 Shoreline systems</td>
</tr>
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<td>S4 Anthropogenic subterranean systems</td>
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</tbody>
</table>

102 Ecosystem Functional Groups across 4 realms & their transitions

- 14 anthropogenic
- 88 natural/seminatural
- detailed descriptive profiles
- indicative global maps
Descriptive profiles

• Available for all 102 Ecosystem Functional Groups (Level 3 of Global Ecosystem Typology)

• Pitched at non-specialist users

• Content includes simplified explanations of ecological traits, key drivers, distribution, key references

• Illustrated with photograph, diagrammatic model of key components & processes, indicative maps
# Functional groups of ecosystem types

**Ecosystem Functional Groups**

- groups of related ecosystems sharing common ecological processes & major assembly filters (hence convergent biological traits and common threats)

<table>
<thead>
<tr>
<th>Archetype</th>
<th>Aral Sea</th>
<th>Mtn Ash forests</th>
<th>Alaskan kelp forests</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key processes</strong></td>
<td>Water volume-chemistry interactions &amp; trophic web</td>
<td>Vegetation-fire feedbacks, trees as foundation spp</td>
<td>Trophic web, interactions with pelagic system, foundation spp</td>
</tr>
<tr>
<td><strong>Ecosystem services</strong></td>
<td>Potable water, irrigation water, fishing, transport, climate, air quality</td>
<td>Recreation/tourism, water supply &amp; quality, carbon store, timber</td>
<td>Fishing, kelp products, storm surge risk reduction, blue carbon sequestration</td>
</tr>
<tr>
<td><strong>Key threats</strong></td>
<td>Water extraction</td>
<td>Logging &amp; fire regime shift</td>
<td>Exploitation of marine mammals &amp; fish</td>
</tr>
<tr>
<td><strong>Functionally similar</strong></td>
<td>Lake Chad, Salton Sea</td>
<td>Alpine ash, Blue mtns ash, boreal forests</td>
<td>Patagonian kelp forests, NZ kelp forests, Tasmanian kelp forests</td>
</tr>
<tr>
<td><strong>ecosystem types</strong></td>
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</tbody>
</table>
Marine & transitional biomes & Ecosystem Functional Groups

Terrestrial

Coastal shorelines - 4 EFGs

Marine

Marine shelves - 9 EFGs

Pelagic ocean waters - 5 EFGs

Deep sea floors - 7 EFGs

Marine anthropogenic - 2 EFGs

Freshwaters

Transitional waters - 3 EFGs
Coastal shorelines – 4 EFGs

TM1.1 Rocky shores

TM1.2 Sandy shores

TM1.3 Muddy shores

TM1.4 Cobble shores
Coastal shorelines – 4 EFGs

TM1.1 Rocky shores

TM1.2 Sandy shores

TM1.3 Muddy shores

TM1.4 Cobble shores
Marine shelves – 9 EFGs

M1.1 Seagrass meadows
M1.2 Kelp forests
M1.3 Photic coral reefs
M1.4 Oyster reefs
M1.5 Marine animal forests
M1.6 Rocky reefs
M1.7 Subtidal sandbeds
M1.8 Subtidal mudplains
M1.9 Upwelling zones
Spatial data: maps of Ecosystem Functional Groups

M1.3 Photic coral Reefs
Allen Coral Atlas: sub-10m reef maps

TM1.2 Muddy shorelines
Global map @30m resolution
30 year time-series

MFT1.2 Intertidal forests & shrublands
Global Mangrove Watch: mangroves @30 m resolution
Spatial data: maps of Ecosystem Functional Groups

New technologies: cloud computing, artificial intelligence, global environmental spatial data, deep time archives of satellite images

Pixel-based “ecosystem distribution models”
• Published proof of concept (Murray et al. 2018, *Nature*)
• Integrated spectral, topographic and climate covariates
Ecosystem mapping: ongoing upgrade

High-resolution global maps
• M3.4 Sea mounts & ridges

Indicative (low-res) global maps
• M1.2 Kelp forests
The way forward

• Global Ecosystem Typology Web site
  • user support to identify & explore Ecosystem Functional Groups
• High-resolution maps
• Defining links (cross-walks) with established national classifications
• Global ecosystem risk assessment (terrestrial)
• Linking ecosystem risk assessments with supply of ecosystem services & natural capital accounts
UN SEE-EEA Natural capital accounting

- A United Nations (Stats Division) initiative to account for extent & condition of ecosystem assets and the supply & use of ecosystem services
- Forum of Experts, Working Groups, project countries
- IUCN Global Ecosystem Typology provisionally adopted as the SEEA EEA reference classification
- Testing phase underway – correspondence between established national classifications & global units
IUCN global ecosystem typology website

In development:
- Identification guide
- Photographic content
- Links to references
- Supported by UNSW (RLE partnership)
Application: informing the development of new local classifications (Level 6)

- Myanmar *National* Ecosystem Assessment
- National ecosystem typology structured by IUCN Global Ecosystem Typology
  - c. 65 national units
  - 35 ecosystem functional groups
- GEF & Wildlife Conservation Society implementation
- Completion early 2020