System of Environmental Economic Accounting

# Exploring the relationship between ecosystem condition and ecosystem services

**Mandy Driver**
Chair: UNCEEA Technical Committee on SEEA Ecosystem Accounting

**Challenges in the Measurement of Nature in Official Statistics**

Istat workshop

25-26 May 2026, Rome

1926 | 2026 Istat Istituto Nazionale di Statistica

United Nations

# Five key inter-related messages

1. The relationship between ecosystem condition and ES flows is complex – not a simple matter of better condition supporting greater ES flows
2. The ecosystem condition account is intended to measure ecosystem integrity, not the capacity of ecosystems to supply ES
3. The ecosystem condition account is relevant for multiple value perspectives on nature, beyond instrumental values
4. For the condition account to be meaningful, condition measurement (including condition indicators) must be firmly grounded in ecosystem science
5. Measurement of condition and measurement of ES flows should be undertaken independently (although some data requirements may be common to both)

**Overall take-home:** The ecosystem condition account can give ecosystem science and the plurality of nature's values a recognised place in official statistics

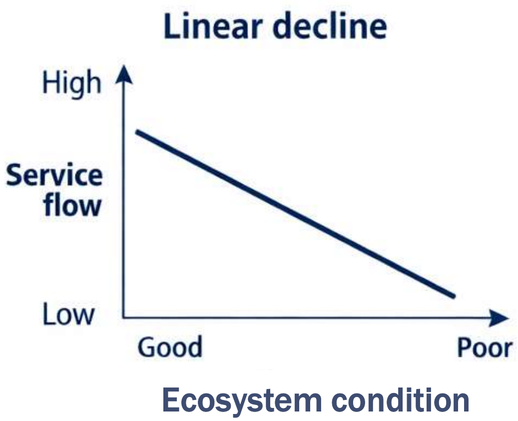
# 1. The relationship between ecosystem condition and ecosystem service flows is complex, not linear

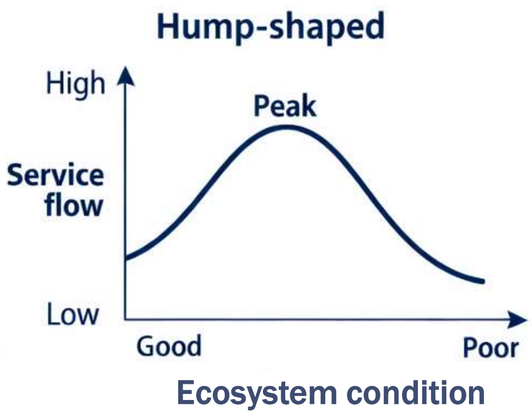
- **ES flows can go up as ecosystem condition goes down**
  - ES flows may generate pressure on ecosystems and act as drivers of biodiversity loss → They may directly result in decline in ecosystem condition and/or loss of natural ecosystems
- **ES flows may be sustainable even when ecosystems aren't in good condition**
  - Ecosystems can be quite far from a reference condition of high integrity and still continue to supply a sustainable flow of services, as long as critical condition thresholds are not crossed
- In other words, ES flows don't necessarily depend on good ecological condition, and better condition doesn't always imply increased ES flows

# Stylised relationships between ES flows and ecosystem condition

Service flow declines as ecosystem condition declines

Examples: Carbon storage and sequestration in forest ecosystems;
Soil retention and erosion control



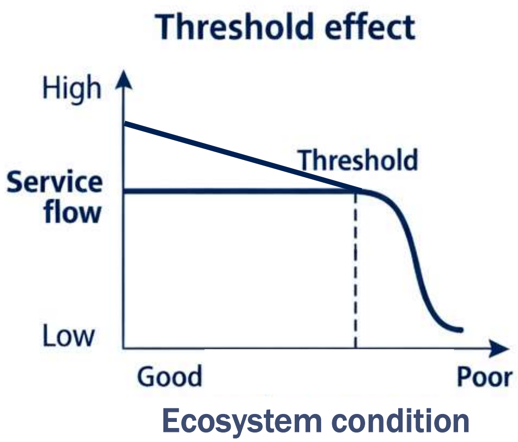



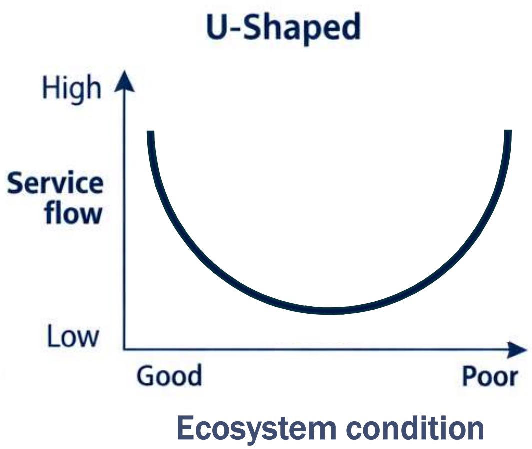

Service flow peaks at intermediate condition and is smaller toward both extremes

Example: Nature-based tourism

Service flow starts high when condition is good and continues as condition declines, but collapses once condition drops below a certain threshold

Examples: Wild-caught fish biomass;
Water purification services




Service flow is high when ecosystem condition is good, lower at intermediate condition, then increases as a result of human interventions that boost output but cause further decline in condition

Example: Grazed biomass in natural shrubland ecosystem

# 2. The ecosystem condition account is intended to measure ecosystem integrity

- The condition account is designed to **organise data on ecosystem characteristics** relative to a reference condition, to **provide insight into ecosystem integrity** (SEEA EA paragraph 2.40)
- The condition account is *not* designed to organise data on the capacity of ecosystems to supply services
  - Although some of the data used to compile the condition account may be relevant for this
- There are various options for selecting a reference condition, but typically it represents a state of high integrity

- The condition account is based on
  - **Condition variables**
  - Rescaled/normalised to provide **condition indicators** on a scale of 0 to 1
- Condition indicators may be combined into an overall **ecosystem condition index**

Table 2.3 in SEEA Ecosystem Accounting: Stylized ecosystem condition account

| Accounting entries | Stylized ecosystem types | | | | | |
|---|---|---|---|---|---|---|
| | Forests | Lakes | Cropland | Urban areas | Wetlands | Seagrass |
| Opening condition value | | | | | | |
| Change in abiotic ecosystem characteristics (physical and chemical state) | | | | | | |
| Change in biotic ecosystem characteristics (composition, structure and function) | | | | | | |
| Change in landscape/seascape characteristics | | | | | | |
| Net change in condition | | | | | | |
| Closing condition value | | | | | | |

# 3. The ecosystem condition account is relevant for multiple value perspectives on nature

- Section 2.4 of SEEA EA "Framing of values in ecosystem accounting" – 3 pages worth reading!
  - Recognises a range of value perspectives, including **anthropocentric and non-anthropocentric**
- Useful to consider **intrinsic, relational and instrumental values** of nature, recognised in the IPBES values typology
- Because the condition account reflects ecosystem integrity (rather than how well ecosystems supply services), it's relevant to a range of value perspectives, including intrinsic and relational values

Organising data on ecosystems in a statistical framework doesn't limit its application *only* to discussion and decisions related to instrumental values

Extent & condition accounts

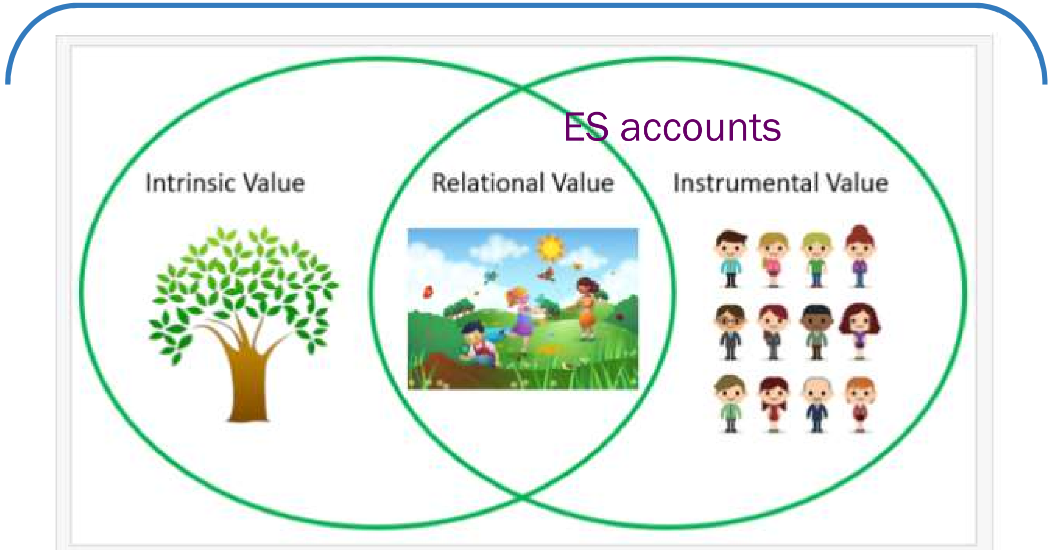
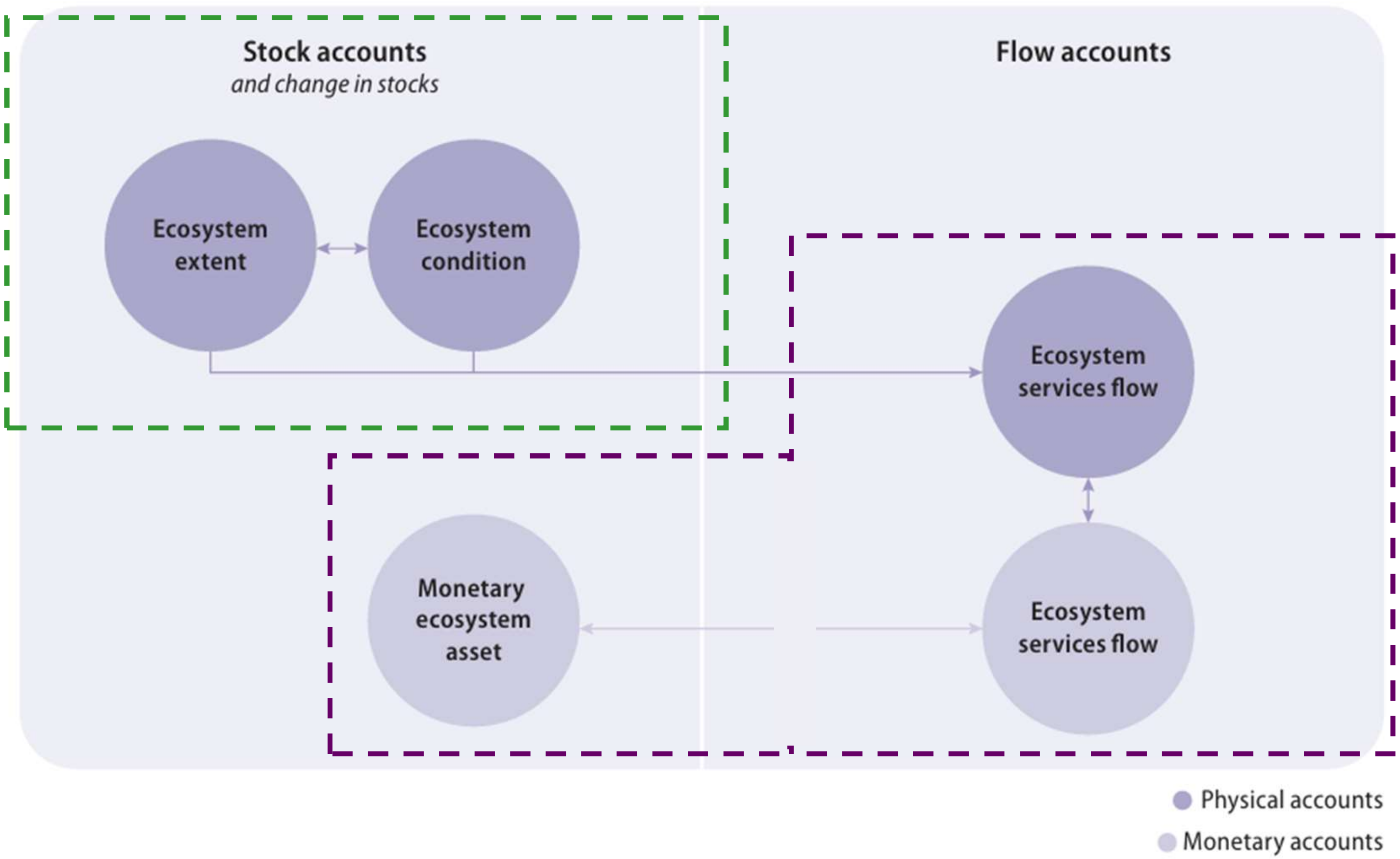



Figure 1: Intrinsic, instrumental and relational values can be thought of as a Venn diagram where intrinsic value focuses on nature, instrumental value focuses on people and relational value focuses on the interaction between nature and people. Figure credit: Michelle Goh.

Ecosystem extent and condition accounts are **value-agnostic / value-inclusive**

→ Values are introduced in the interpretation and application of the accounts, rather than being inherent in their compilation




Ecosystem services accounts and monetary ecosystem asset accounts foreground **instrumental values**

Figure 2.2 in SEEA Ecosystem Accounting:
Core set of ecosystem accounts and the connections between them

# 4. For the condition account to be meaningful, it must be firmly grounded in ecosystem science

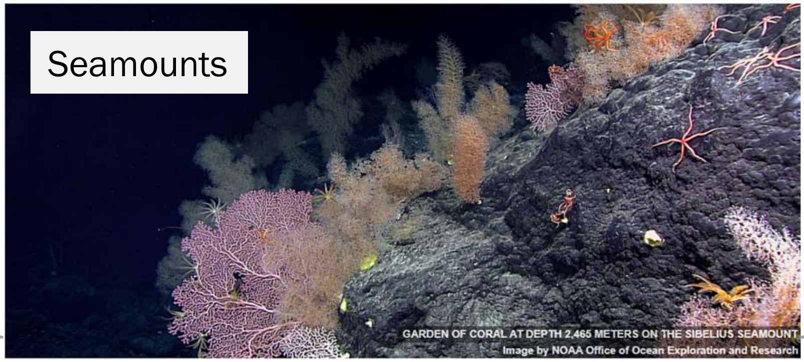
# There are no universal ecosystem condition indicators that apply to all ecosystem types

- Condition variables and indicators must relate to the **ecological characteristics** of specific ecosystem types


- Groups of similar ecosystem types might share condition indicators



- The same condition variable (e.g. NDVI or “greenness”) may need to be interpreted differently for different ecosystem types





SEEA

Photos from the IUCN Global Ecosystem Typology website

## SEEA Ecosystem Condition Typology guides the selection of ecosystem-specific condition indicators that represent ecosystem integrity

- In some cases, ecosystem condition indicators may also be relevant to ES flows, but this should not drive their selection

SEEA Ecosystem Accounting

Ecosystem Condition Typology

**Group A: Abiotic characteristics**
- A1. Physical state
- A2. Chemical state

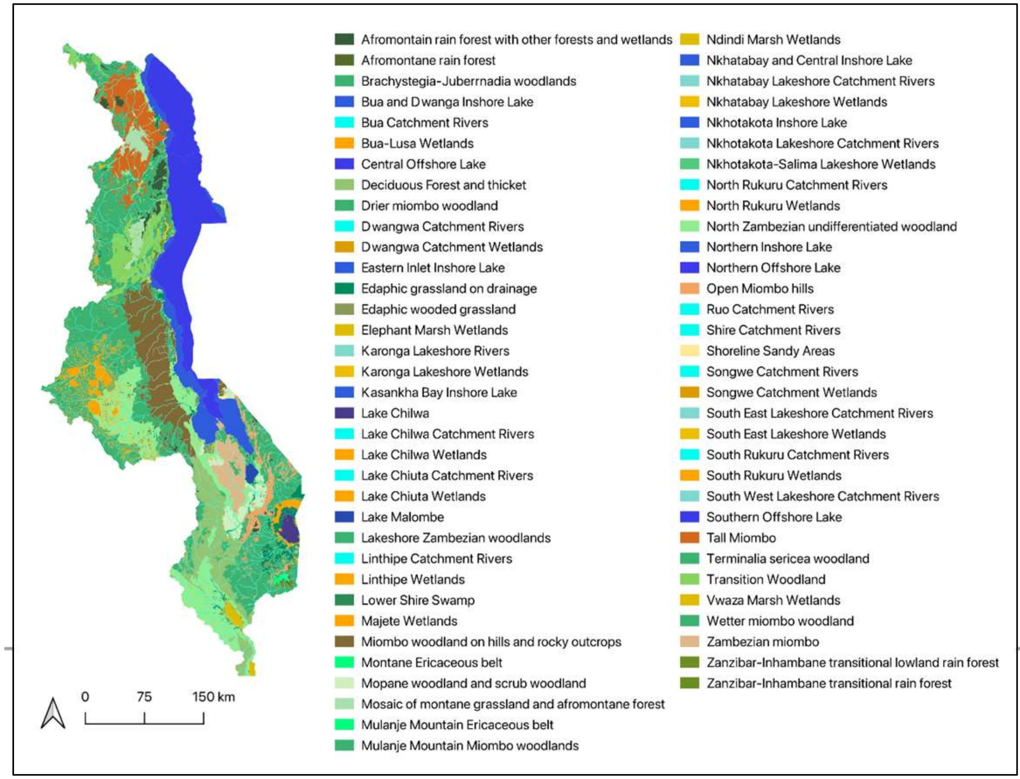
**Group B: Biotic characteristics**
- B1. Compositional state
- B2. Structural state
- B3. Functional state

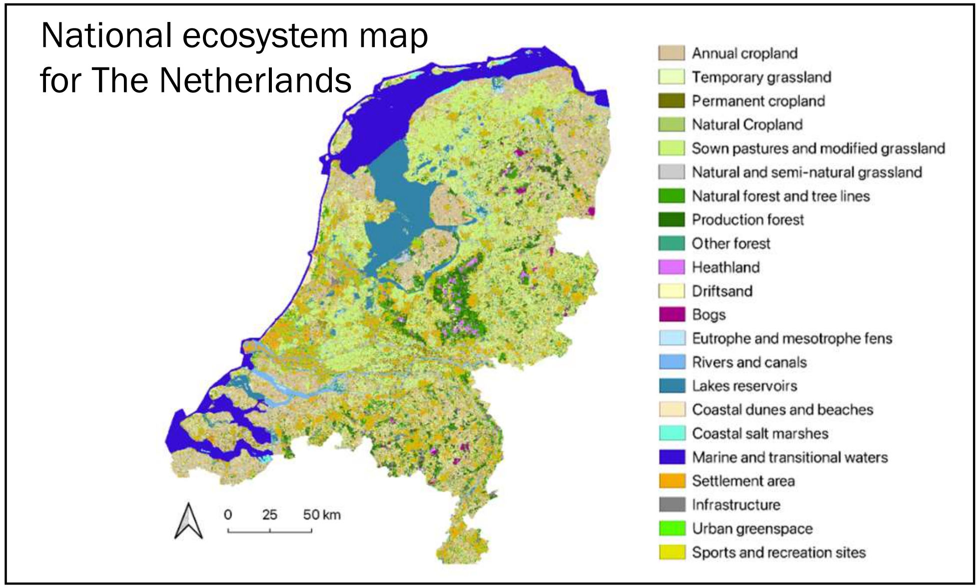
**Group C: Landscape-level characteristics**
- C1. Landscape/seascape characteristics that influence local condition

## Classification and mapping of ecosystem types is a fundamental starting point for selecting condition indicators.
## Also essential for connecting ES flows to ecosystem types.

→ Investing in good **national ecosystem maps** is a priority

National ecosystem map for Malawi



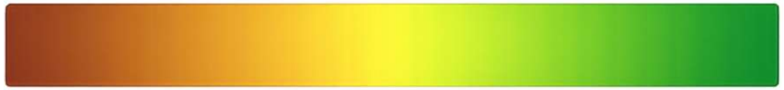




- **Hierarchical classification** of all ecosystem types in a country, with names and descriptions of each
- **Geospatial dataset** representing the spatial distribution of ecosystem types at a baseline date
- Integrates **various types of data**, e.g. historical maps, earth observation data, environmental variables and field data, together with expert and local knowledge
- Requires **collaboration** across ministries and disciplines

# 5. Measurement of condition and measurement of ES flows should be undertaken independently

- From a policy and management perspective, it's important to be able to **analyse the relationship between ES flows and ecosystem condition**. For example:
  - To provide information on which ES are associated with declines in condition of which ecosystem types and design appropriate interventions
  - To understand trade-offs between ecosystem condition and certain ES
- Accounts can be used for such analysis *only* if the ecosystem condition account and ES account are **compiled independently** of each other, not assuming any particular relationship from the outset
  - Accounts with independent measurement of ES and condition could provide a rich information base to build an understanding of these relationships over time
- Some ecosystem condition variables may also provide metrics/proxies for some ES flows, so the accounts are **not divorced from each other**, but their compilation needs to be approached separately

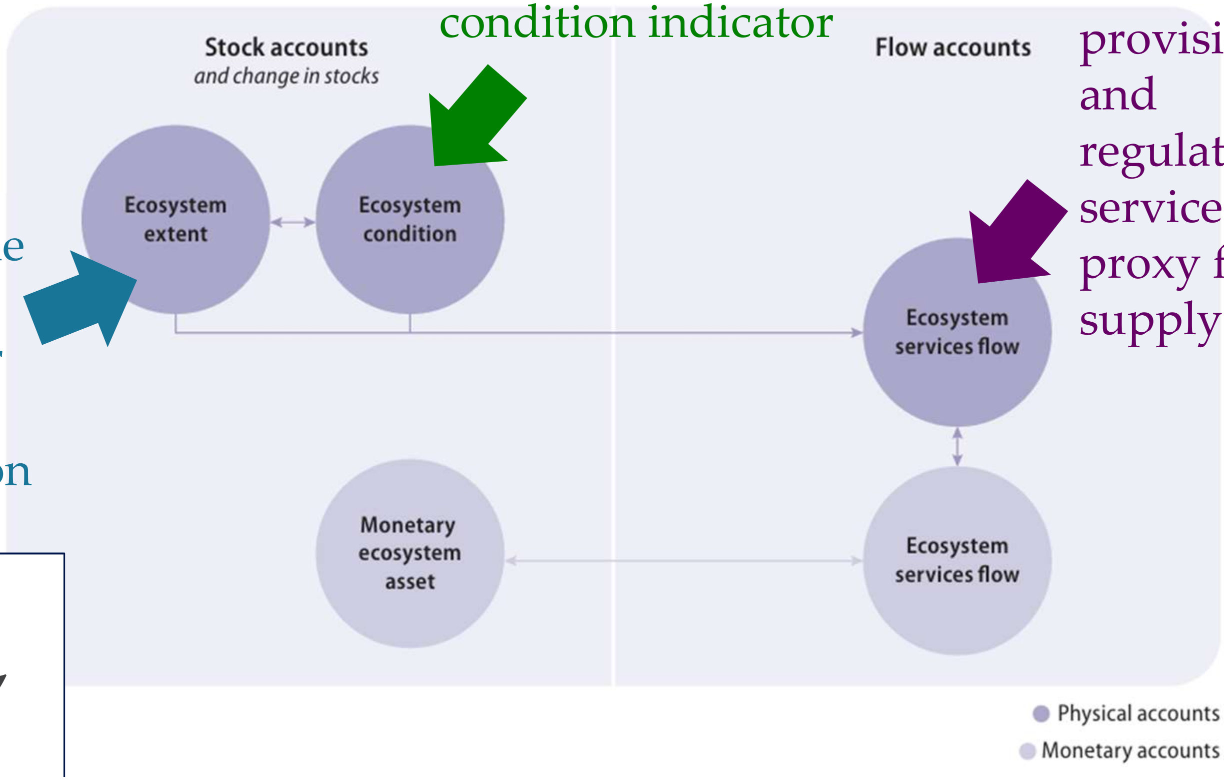
# Example of shared data used across different accounts: NDVI ("greenness", vegetation productivity)



Relevant to ecosystem integrity in some ecosystem types → condition indicator

Relevant to some provisioning and regulating services → proxy for ES supply

Relevant to mapping some ecosystem types and detecting changes in their distribution, along with other data and information




**However, interpretation of NDVI data needs to be tailored, depending on the account and the ecosystem type**

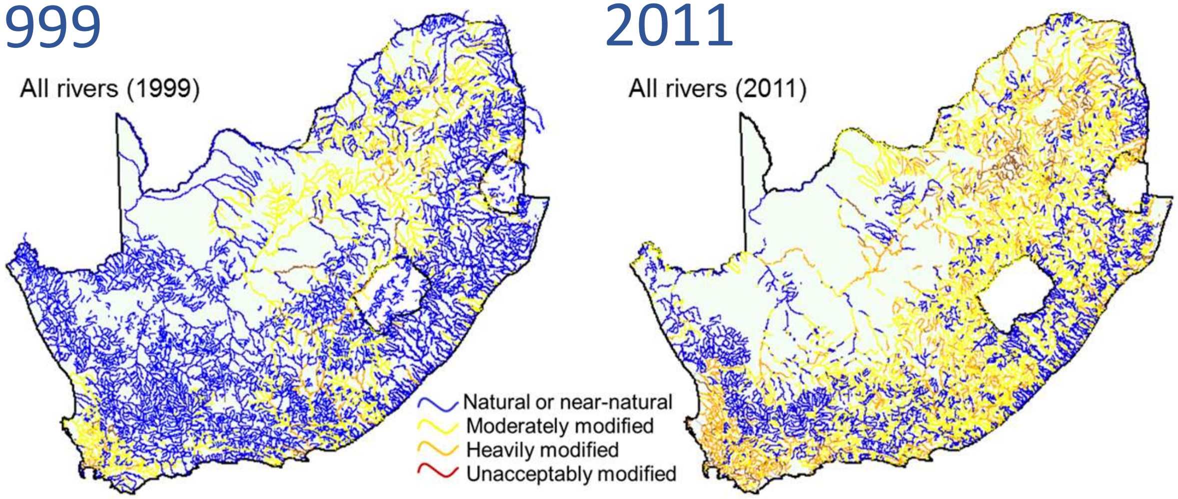
For example, higher NDVI values can signal improved condition and ES supply in some ecosystem types (e.g. forests), but in others (e.g. grasslands) may reflect processes such as bush encroachment, indicating condition decline and reduced grazing capacity.

# Take-home: The ecosystem condition account can be mechanism for mainstreaming ecosystem science and the plural values of nature in official statistics

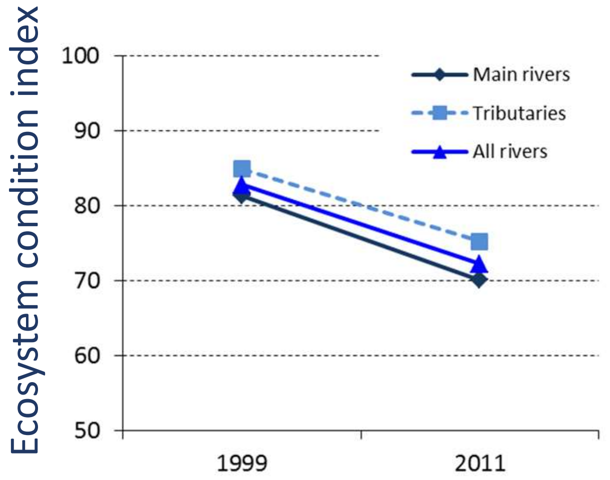
- Ecosystem condition accounts are **powerful in their own right**,
  - Provide valuable information for applications such as integrated land- and sea-use planning, identifying biodiversity priority areas, protected area planning, nature restoration planning and monitoring
- Capturing this biophysical information as part of a country's official statistics makes it **visible and accessible to a wide range of audiences and users**, including those focused on intrinsic and relational values, alongside the instrumental values foregrounded in biophysical ES accounts and monetary accounts
- Institutionalising condition accounting can stimulate investment in **foundational ecosystem condition data as a public resource**
  - Consolidate ecosystem condition data nationally (often fragmented)
  - Highlight gaps in current data on ecosystem condition
  - Support systematic and comprehensive measurement of condition
  - Ensure regular updates of condition datasets
- Information from condition accounts can be used at a **granular/sub-national level** or aggregated to **national level** for high-level policy messages

# South Africa's National River Ecosystem Accounts

1999 | 2011




Based on 4 condition indicators assessed at the level of sub-quaternary river reaches

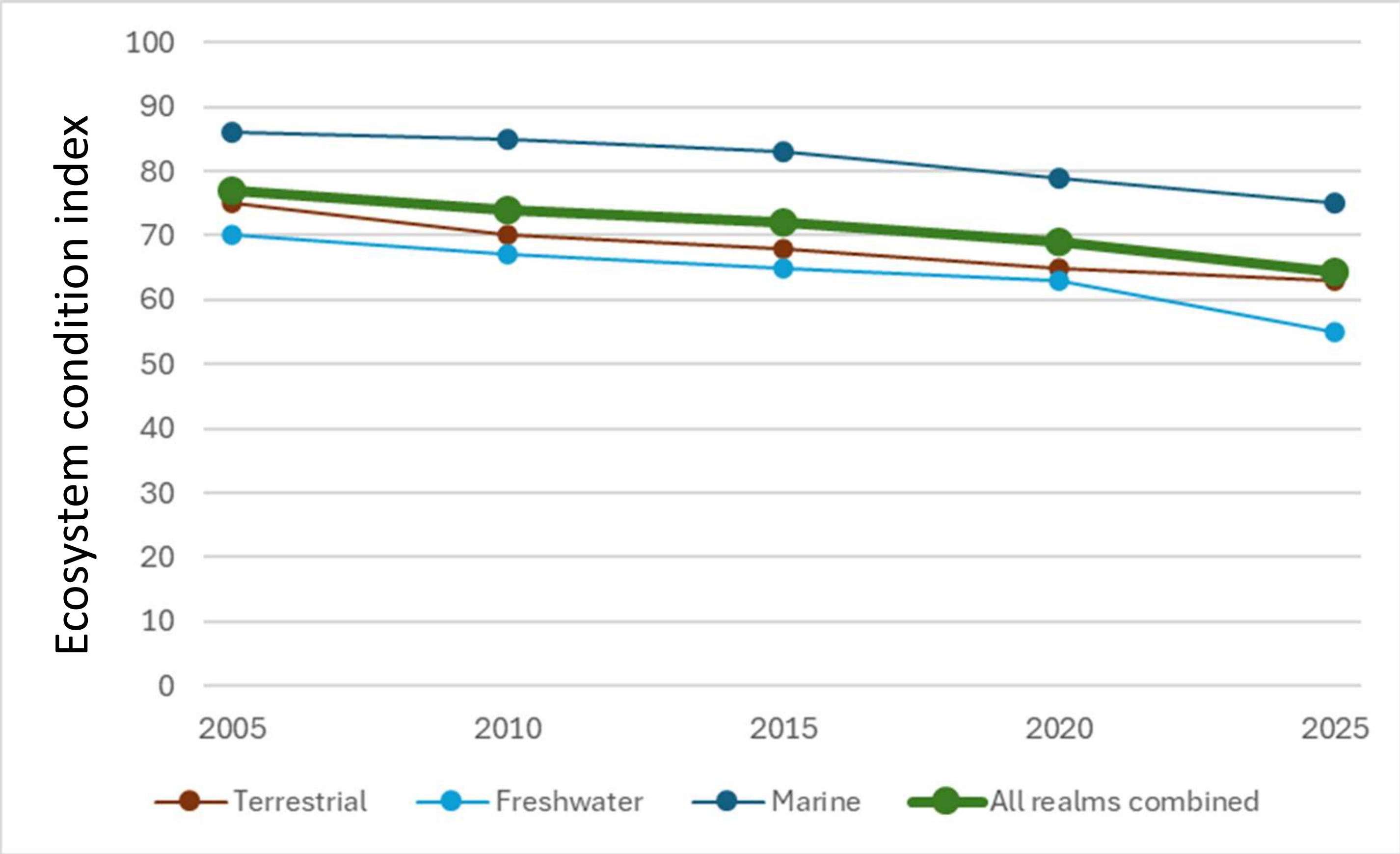



Overall
**10% decline**
in condition of river ecosystems
1999 - 2011

Relied on data and information gathered by the Department of Water Affairs over many years, mainly for management purposes, organised systematically in an accounting structure to show changes over time

Provided information for national policies, such as National Water & Sanitation Master Plan, pointing to priorities for action

# Hypothetical national ecosystem condition index drawn from ecosystem condition accounts




Ecosystem condition index could be compared against **critical thresholds** for **ecosystem services** and **persistence of biodiversity**; Could be used to set policy objectives e.g. for minimum desired condition index

Could sit alongside SEEA-based **headline indicators of the Global Biodiversity Framework**:
**A.2** Extent of natural ecosystems
**B.1** Services provided by ecosystems (index of trends in ES flows in biophysical terms)