An Index-Based Assessment of Ecological Condition in Norway

- a regional pilot project aimed for nation-wide implementation

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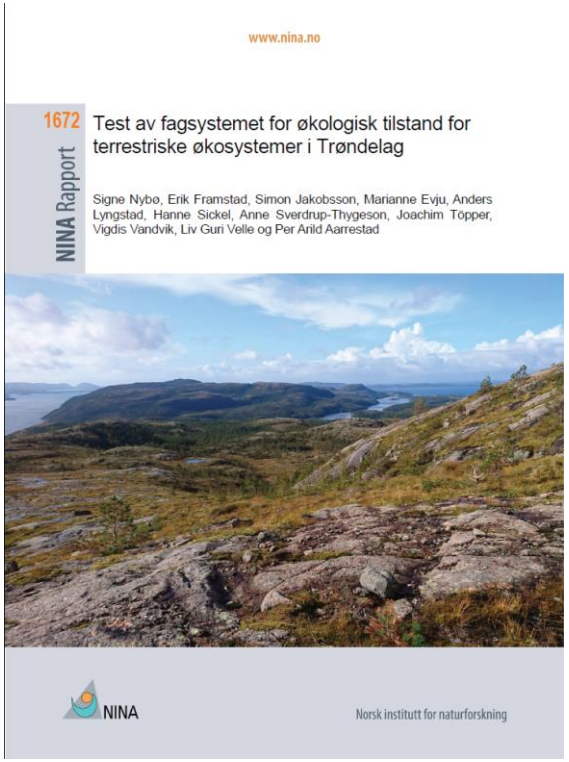
NINA
Norwegian Institute for Nature Research

Background

- National goal for biodiversity

"*Ecosystems should be in good ecological condition and deliver ecosystem services*"



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Background

- **Ecological condition**
  - *State and trends for functions, structures and productivity in an ecosystem, including an evaluation of pressures on these factors*
- **Reference condition**
  - *Intact nature with little human intervention*
  - *Complete food chains and nutrient cycles, intact species populations, overall intact ecosystem processes*
- **Good ecological condition**
  - *The ecosystem's structure, functions and productivity does not deviate substantially from the intact ecosystem (the reference condition)*
  - *May include human intervention, but not to an extent that changes the condition (resistance) or destroys essential internal processes for recovery (resilience)*

Background

A limited number of indicators that reflect the ecosystem's structure and function, and takes into account natural dynamics within the ecosystem

- **Indicator criteria**

GENERAL

- *Simple*
- *Respond to changes in the environment*
- *Defined reference and limit values*

THEORY

- *Good theoretical basis*
- *International standards*
- *Representative*

DATA

- *Accessible*
- *Well documented*
- *Continuously updated*

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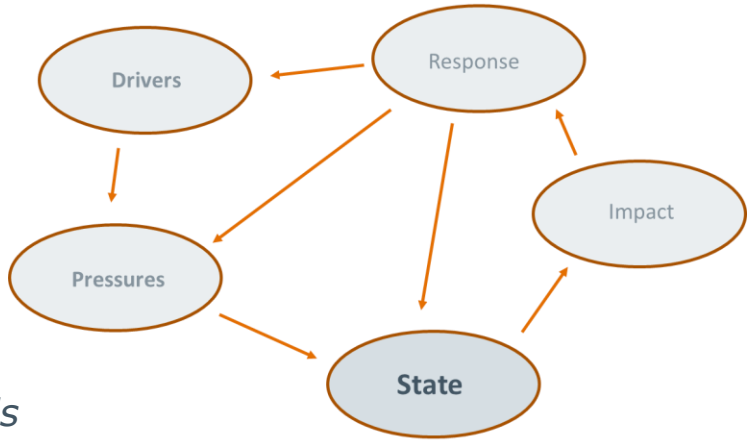

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Purpose of the pilot project

- Assess ecological condition by an index-based approach including scaling and aggregation of indicators
- …using available data where reference value and limit value for good ecological condition have been defined
- Illustration of results for management/policy
- Point out necessary improvements before full national scale implementation

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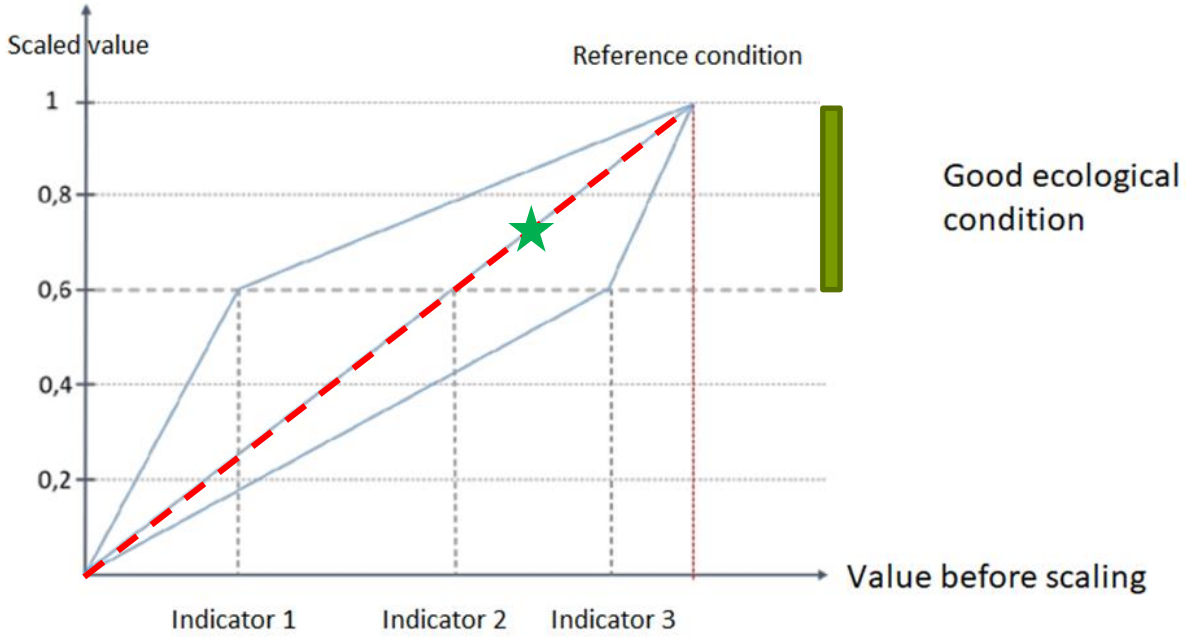
Scaling and aggregation

- **Why?**
  - Comparability => aggregation
- **Aggregated Ecological Condition**
  - (Weighted) average of scaled values
- **How?**
  - Reference level: 1.0
  - Worst: 0.0
  - Limit for good ecological condition: 0.6

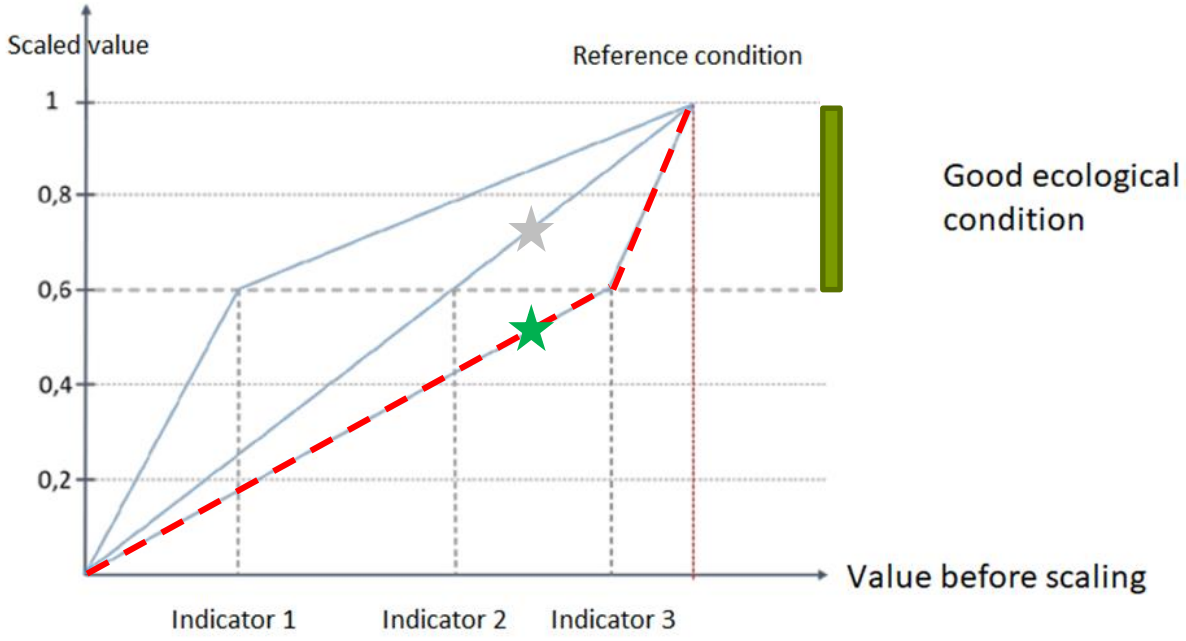
Scaling and aggregation

- **Example reference and limit**
  - Reference = 260 ind./ha
  - Limit = 156 ind./ha
- **Estimated value**
  - 193 ind./ha
- **Scaled value**
  - 0.74



Scaling and aggregation

- **Example reference and limit**
  - Reference = 260 ind./ha
  - Limit = **208** ind./ha
- **Estimated value**
  - 193 ind./ha
- **Scaled value**
  - **0.56**



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Reference values of indicators

- **Five approaches**
  - Defined clear absolute values (e.g. 100%)
  - Species composition index in reference condition
  - Data from reference areas
  - Expert-based models: habitat req. + demography
  - Expert-based models: data + ecosystem dynamics

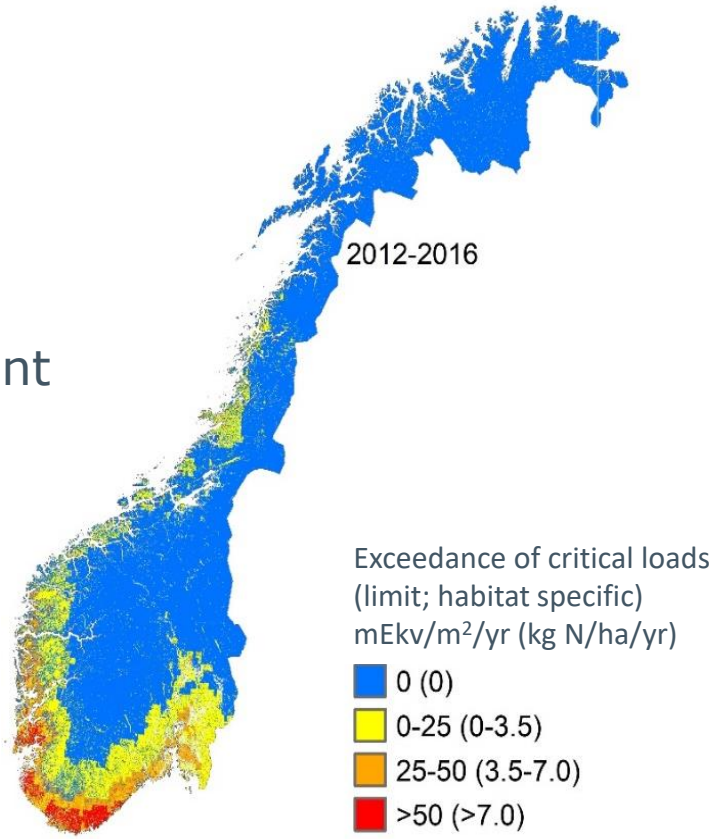
Limit values of indicators defining Good Ecological Condition

- **Three approaches**
  - Empirically estimated limit value
  - Assumed linear relationship; linear approximation between 0 and 1 (scaled value 0.6 = original 60%)
  - Assumed non-linear relationship; non-linear approximation between 0 and 1 (scaled value 0.6 ≠ original 60%)

Indicator: nitrogen deposition

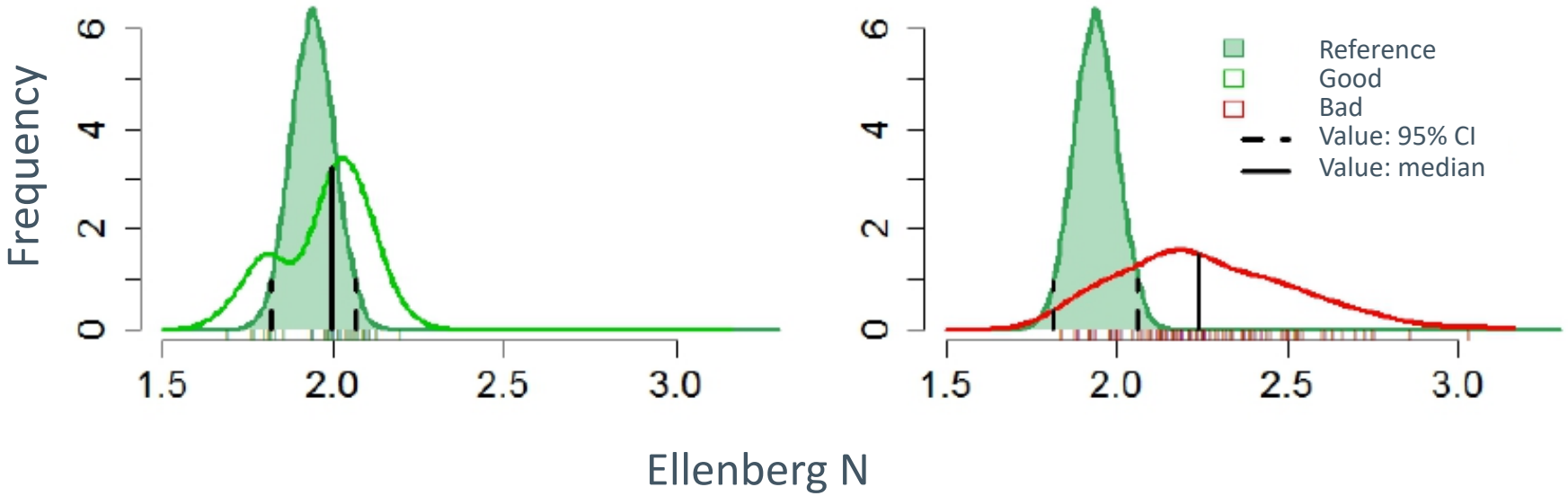
- **Reference**
  - 0 kg N/ha/year
- **Limit**
  - Empirically tested limit for different vegetation types

    (*critical loads*)



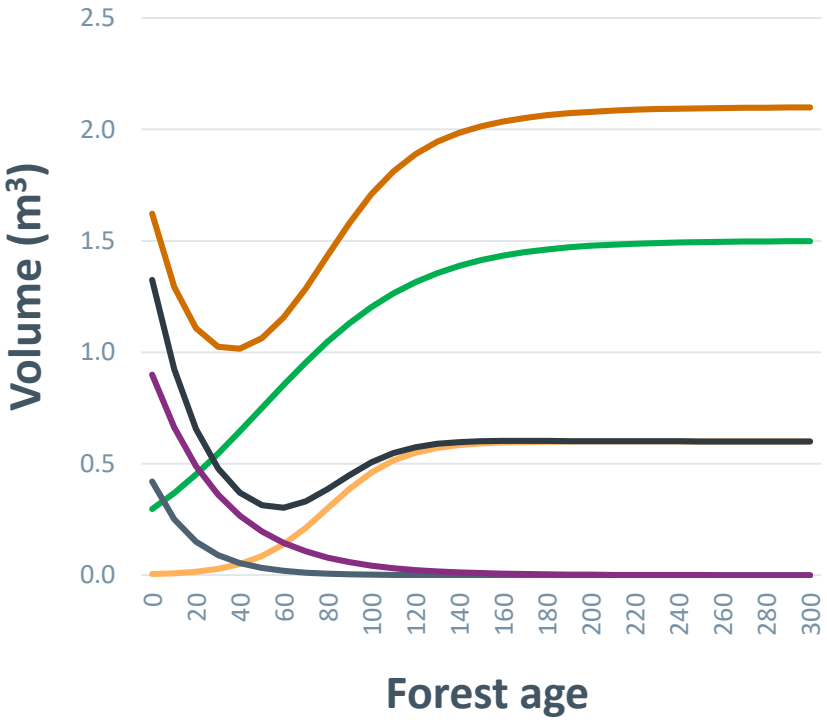
Indicator: species composition index

- **Reference**
  - Generalised species lists
  - Bootstrapped average Ellenberg value distribution
- **Limit**
  - 95% confidence interval
  - Two-sided



Indicator: Deadwood

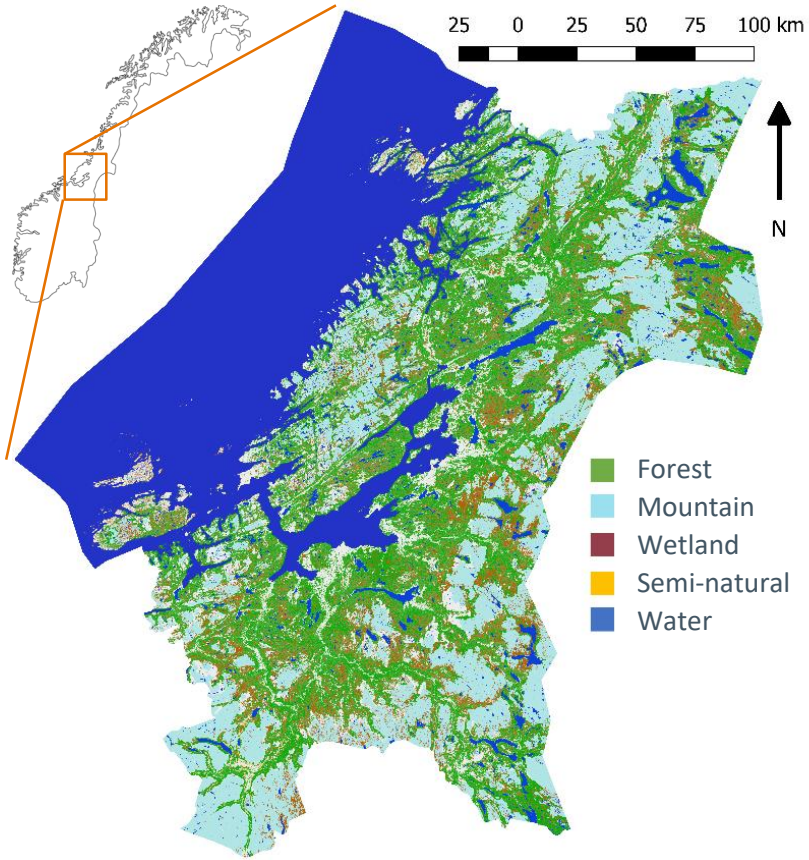
- **Reference**
  - 1) Deadwood in reference areas
  - 2) Deadwood ~ productivity + age
- **Limit**
  - Assumed linear relationship



The pilot project

Mountain

11 indicators



Wetland

8 indicators

Semi-natural systems

14 indicators

Forest

11 indicators

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Conceptual framework

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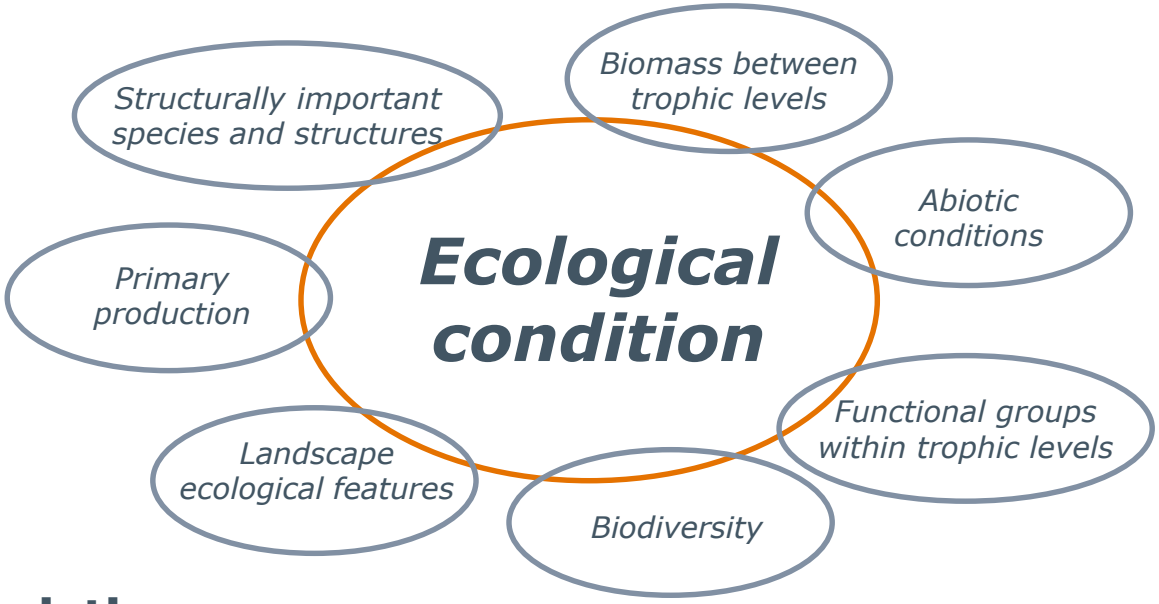
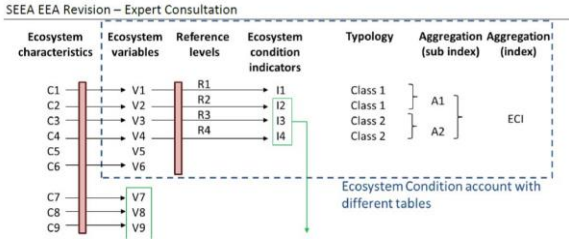
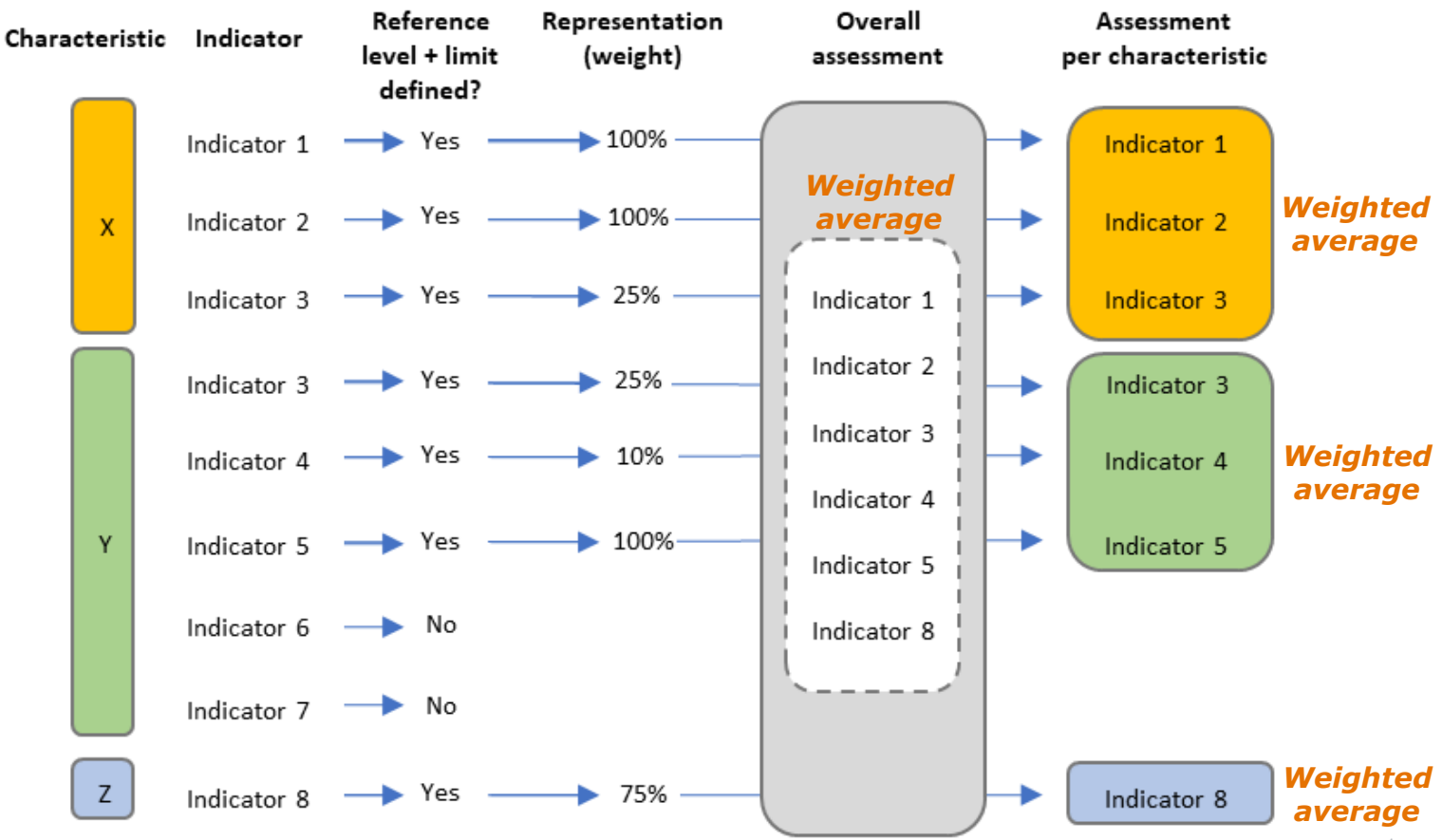


- **7 ecosystem characteristics**
- **Indicators aggregated per characteristic**
- **Characteristic aggregation NOT used for overall estimation**

Conceptual framework





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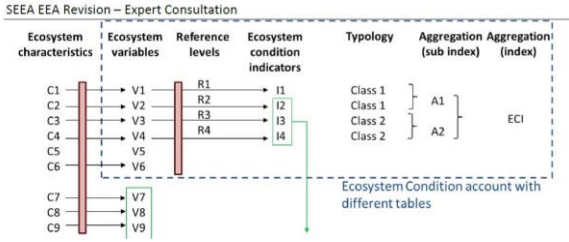

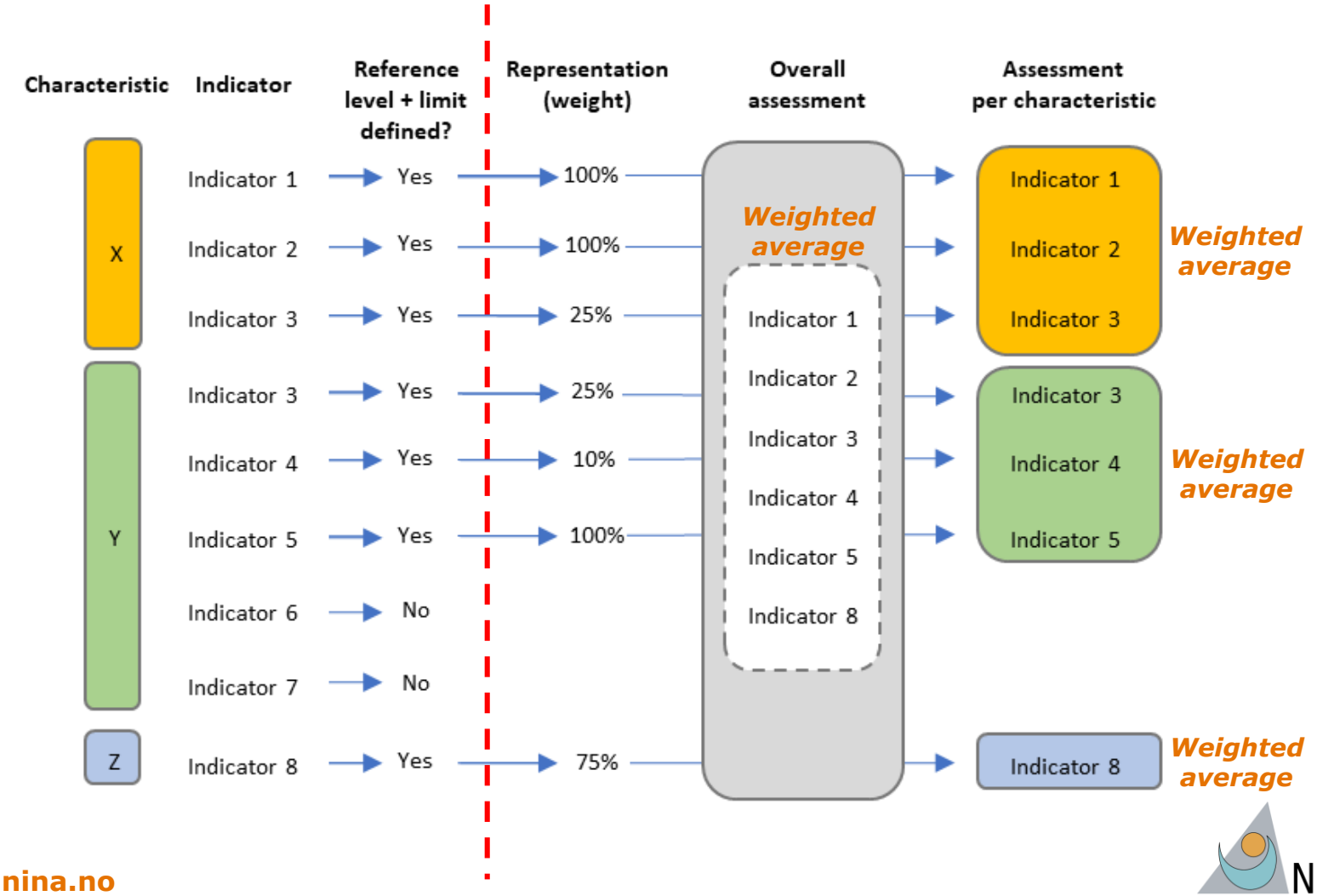

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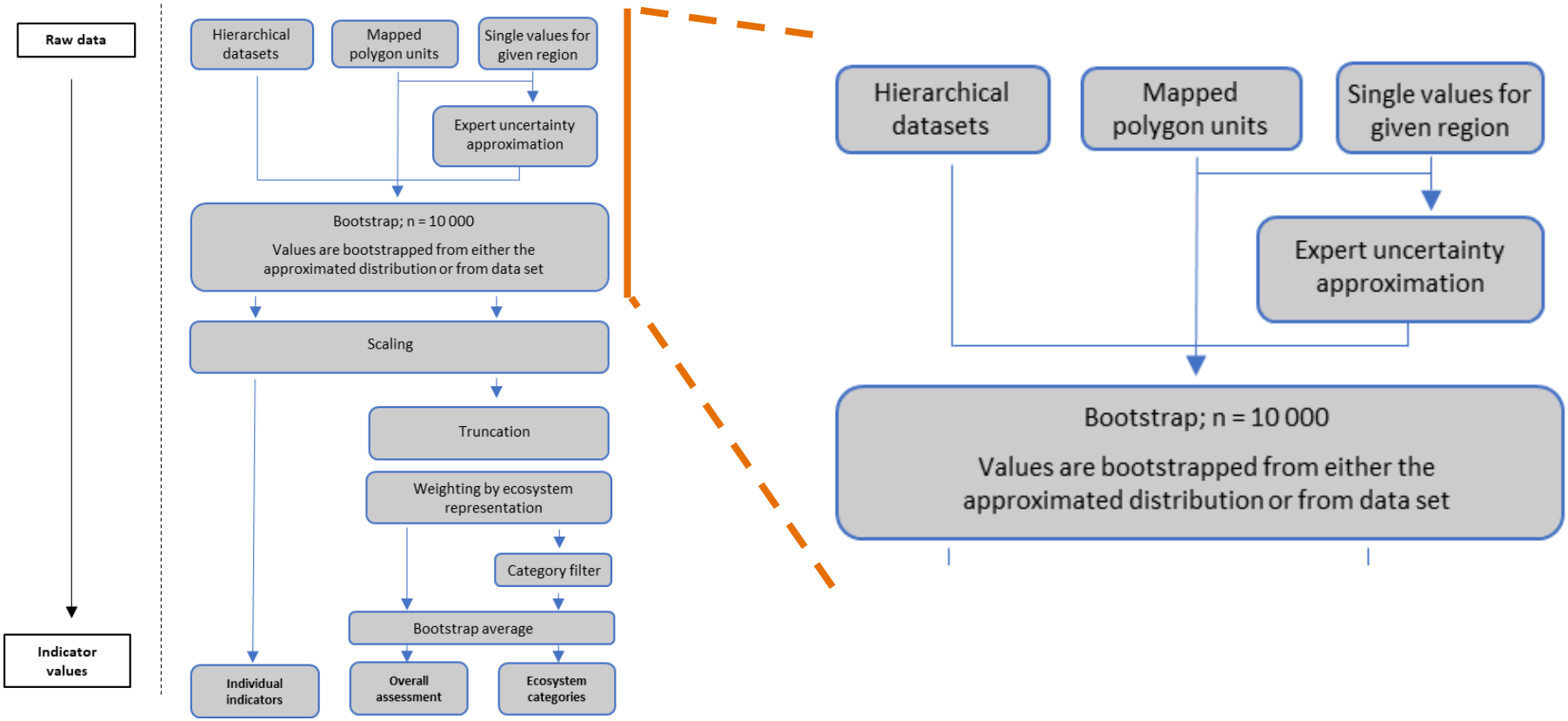
Data flow



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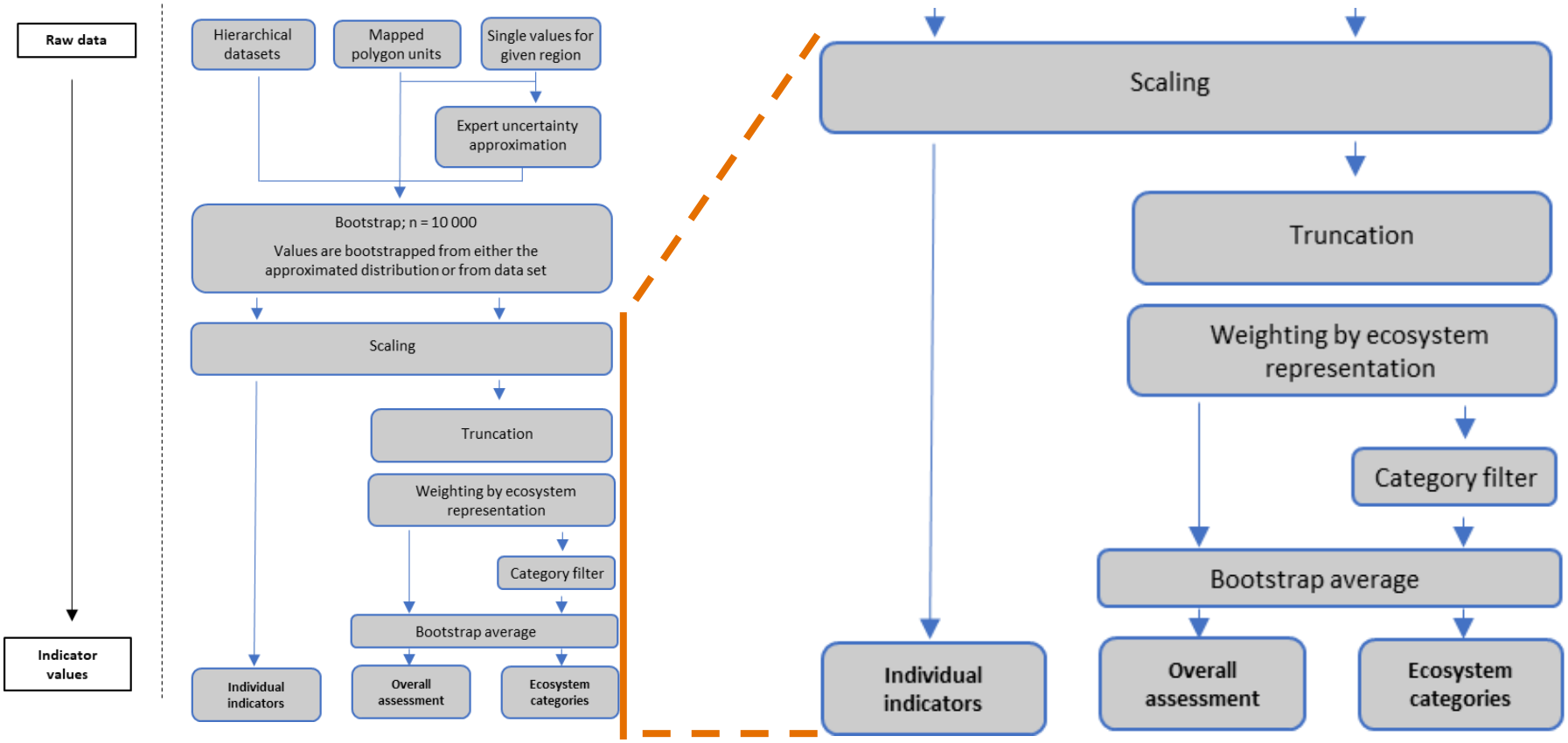

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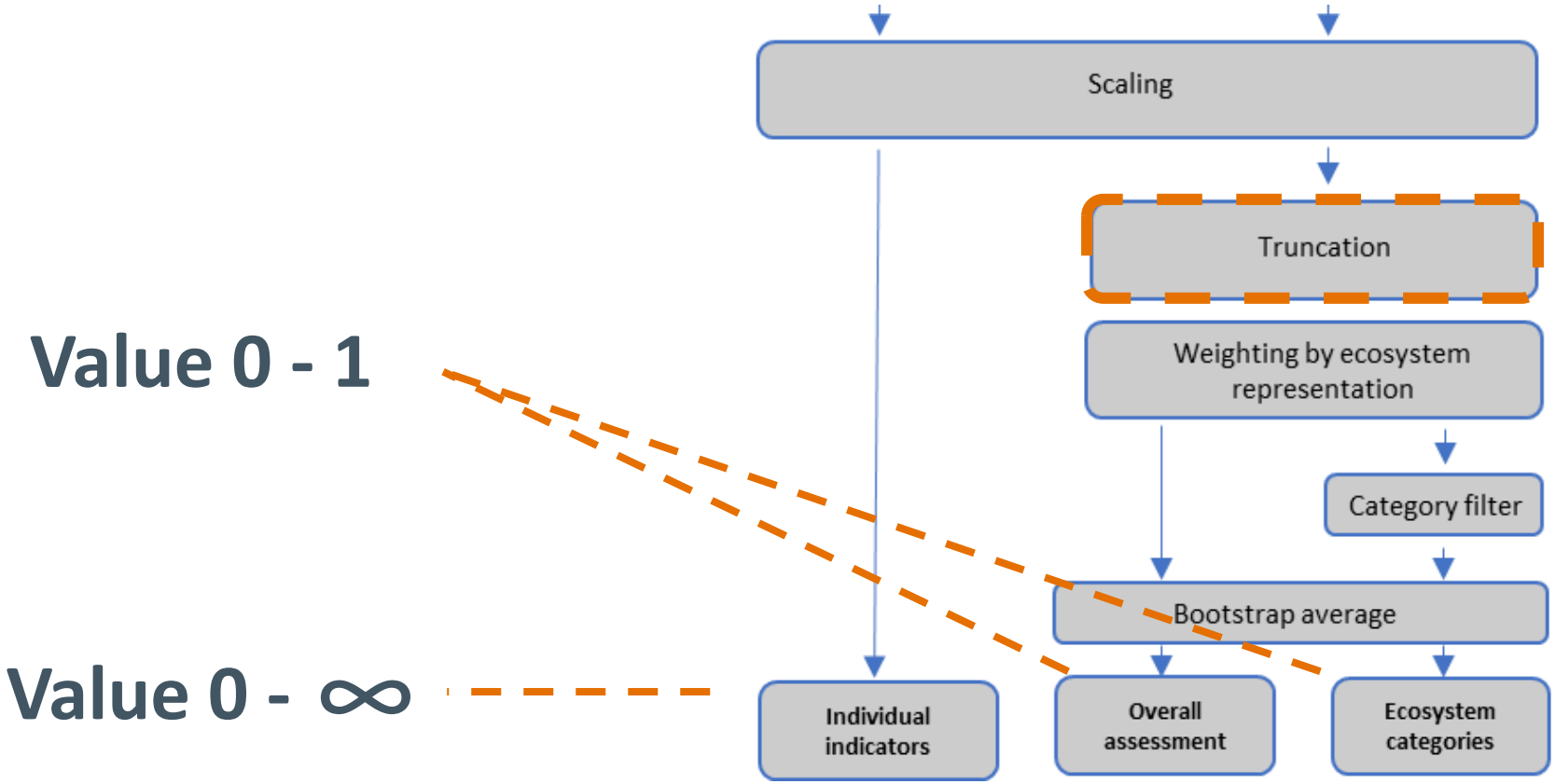

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Forest ecosystem

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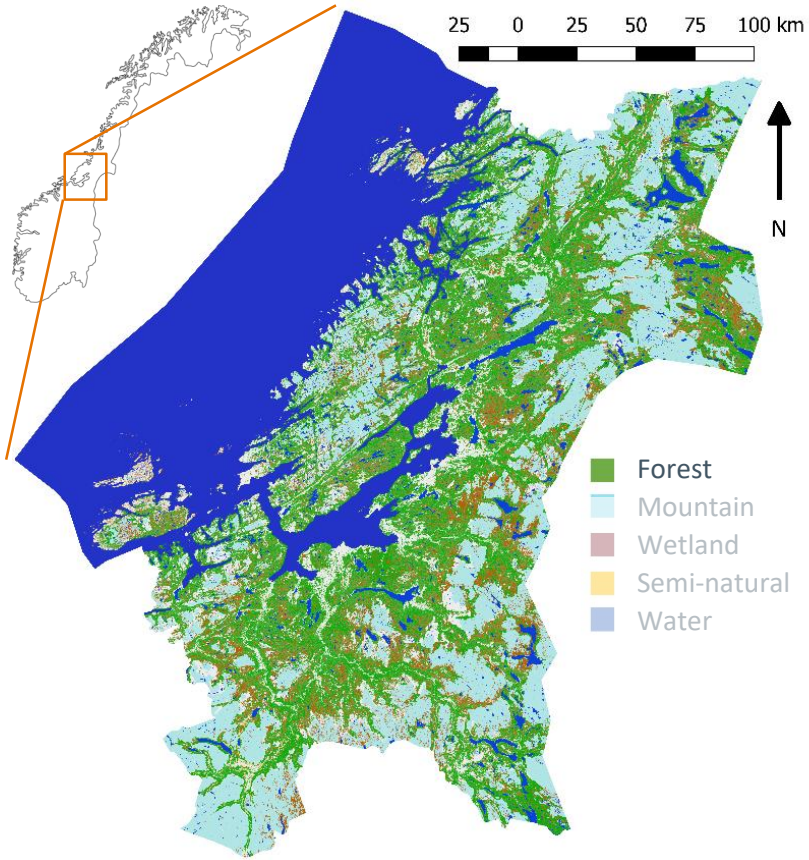

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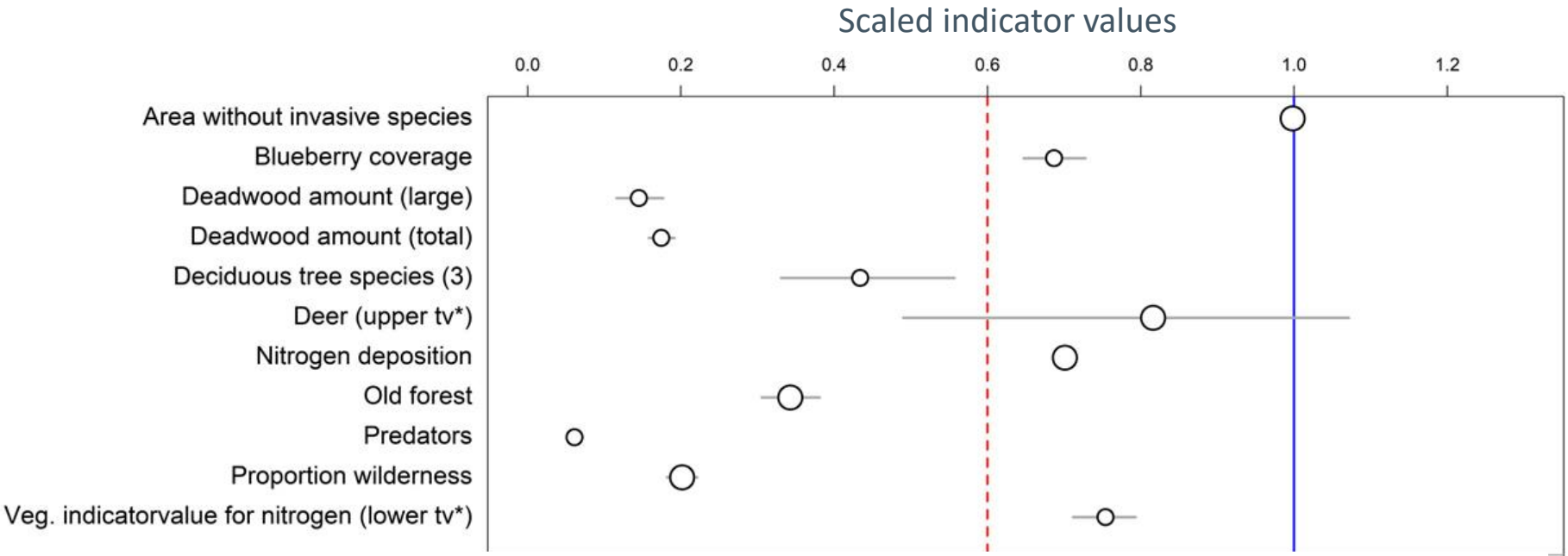
Results – forest



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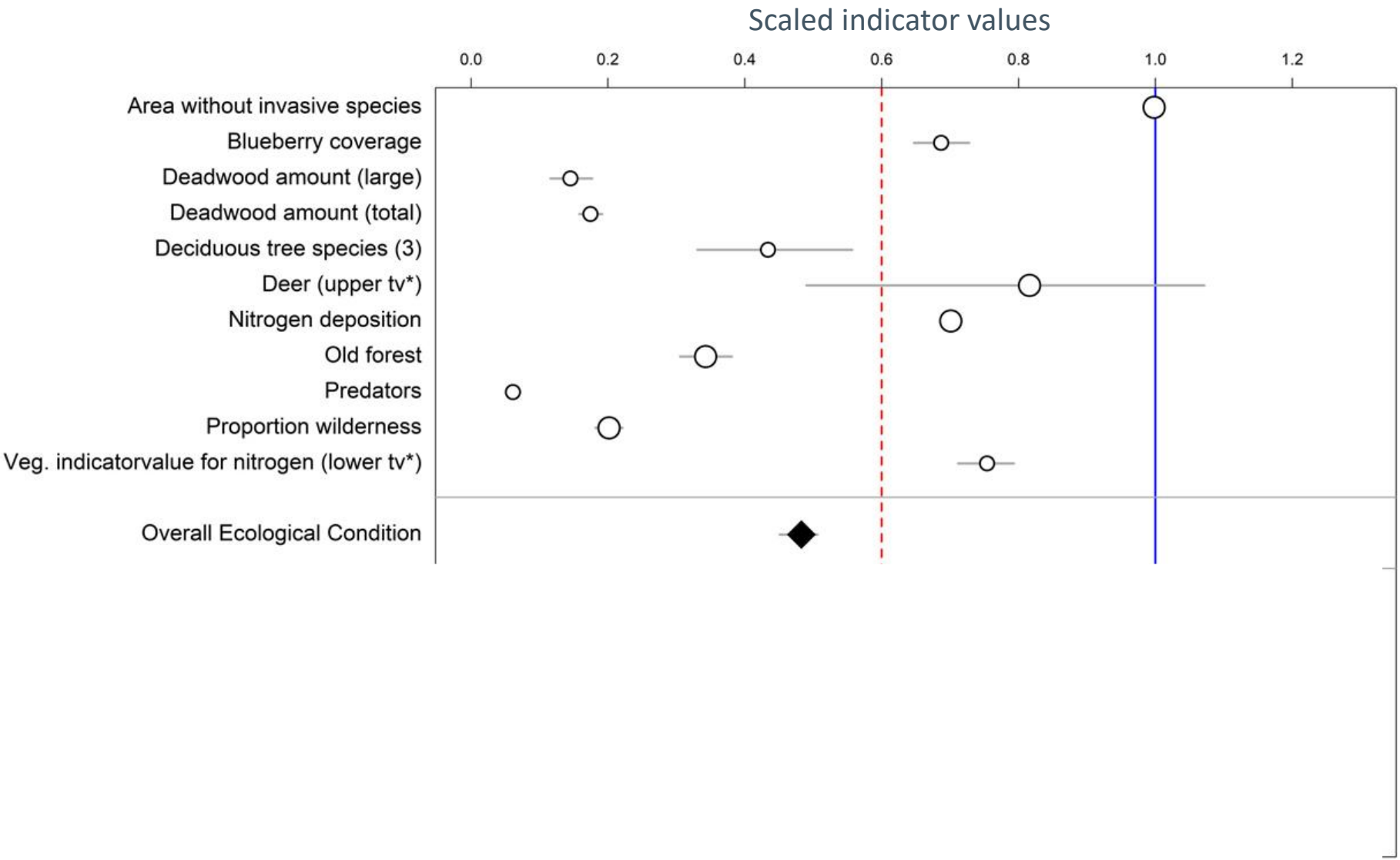

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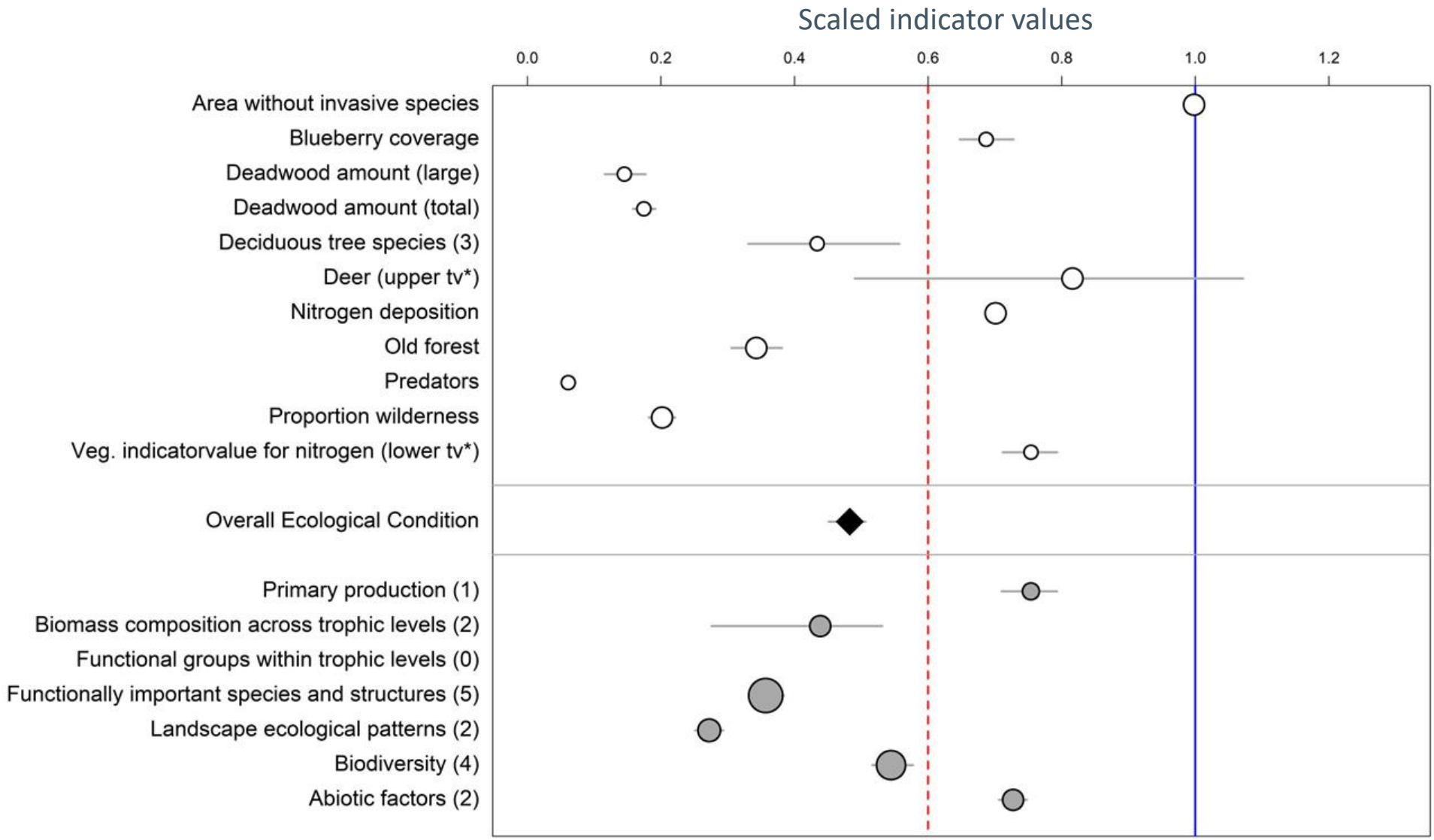

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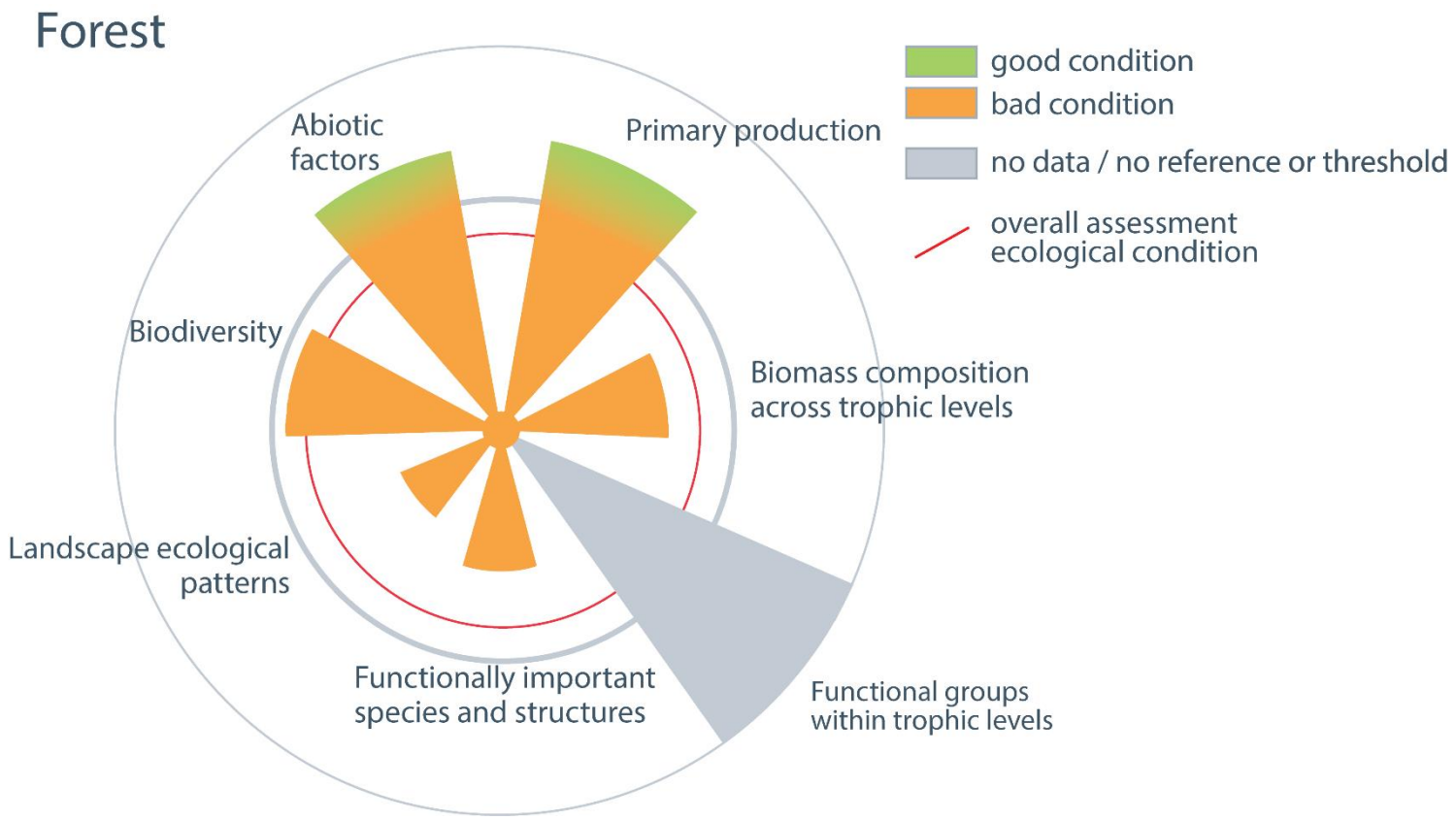


Index-Based Approach

- **Main advantages**
  - Quantitative estimates ± uncertainty
  - New monitoring data easily added to the framework
  - Updated reference-/limit values gives opportunity to update and upgrade historical assessments
  - Flexible
  - Condition estimate + extent will be reported

Index-Based Approach

- **Future challenges**
  - Representative indicators/data for all characteristics
  - Relies on new monitoring
  - Reference and limit values need to be defined for new indicators

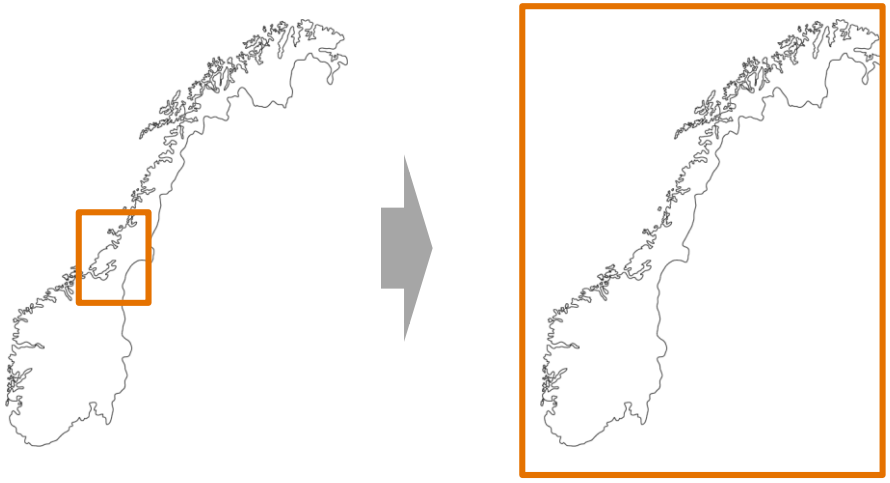
Next step

Mountain

Wetland

2020

Report on ecological condition at national scale



Semi-natural systems*

Forest

Cooperation and expertise for a sustainable future

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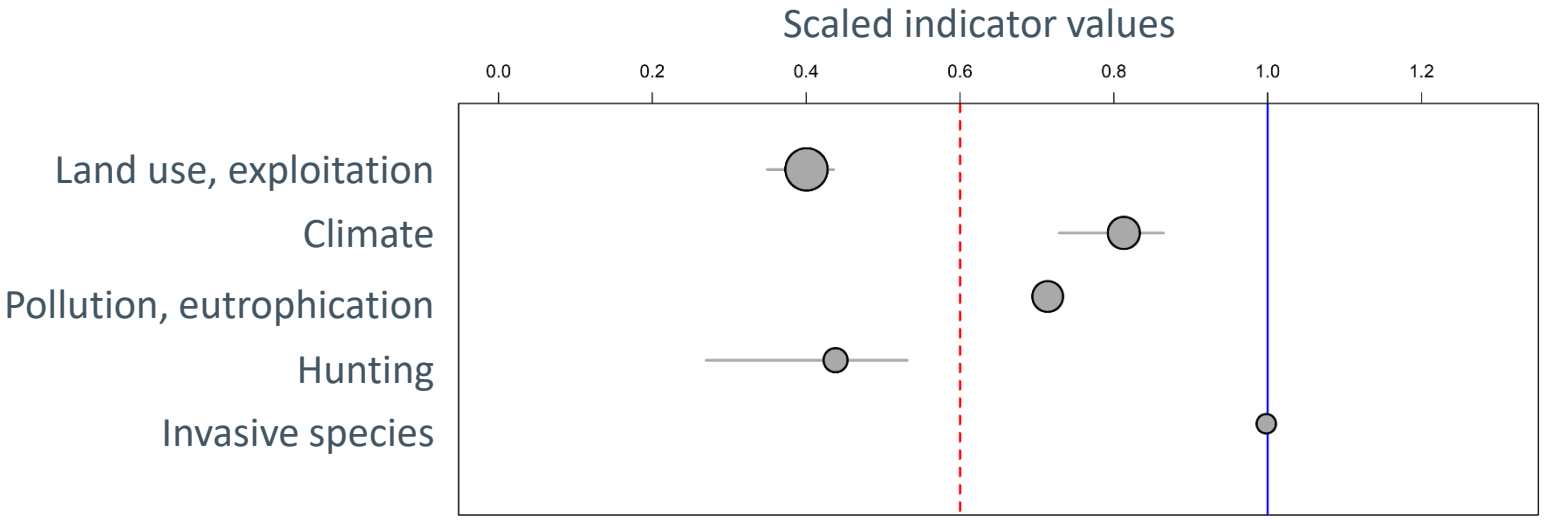
Results – forest



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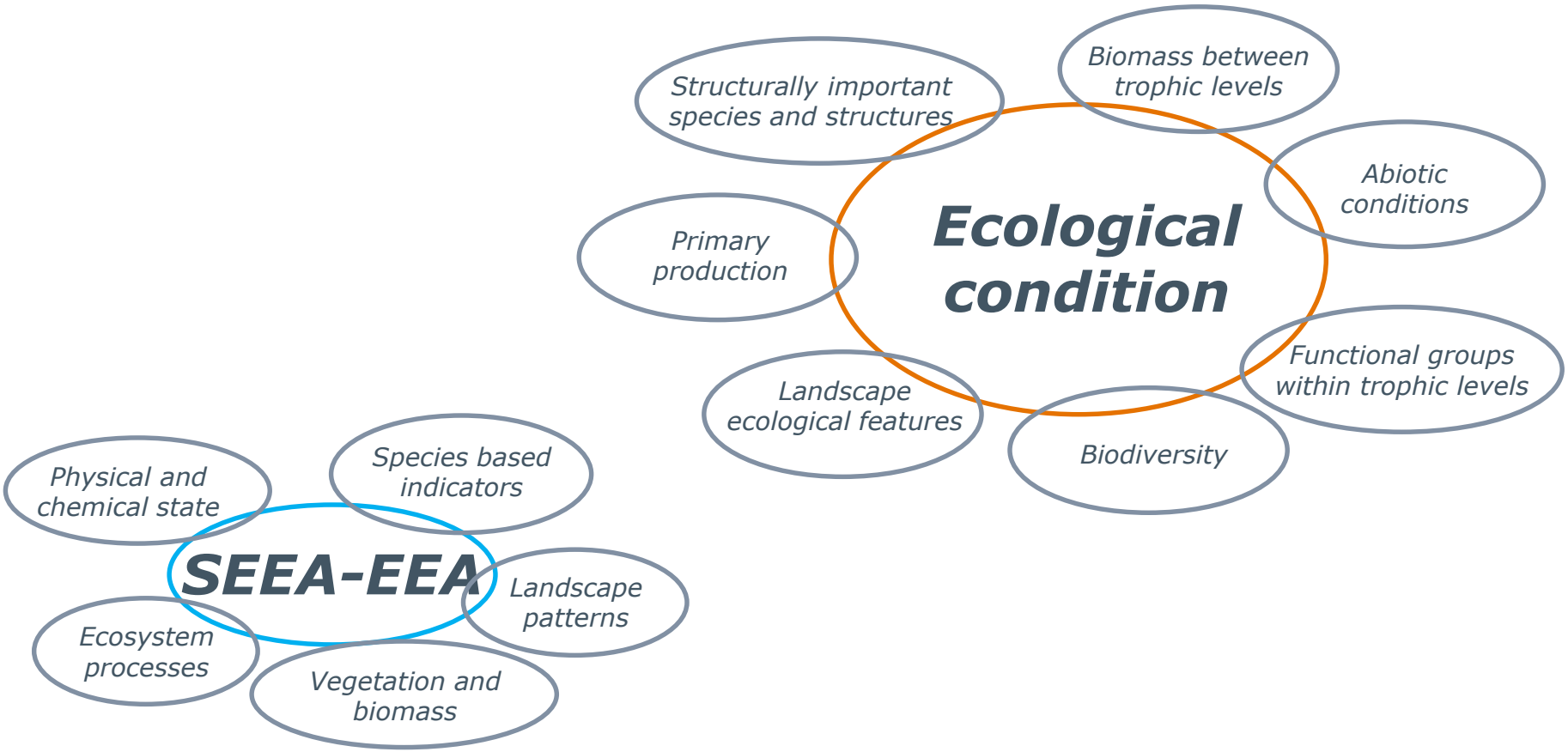

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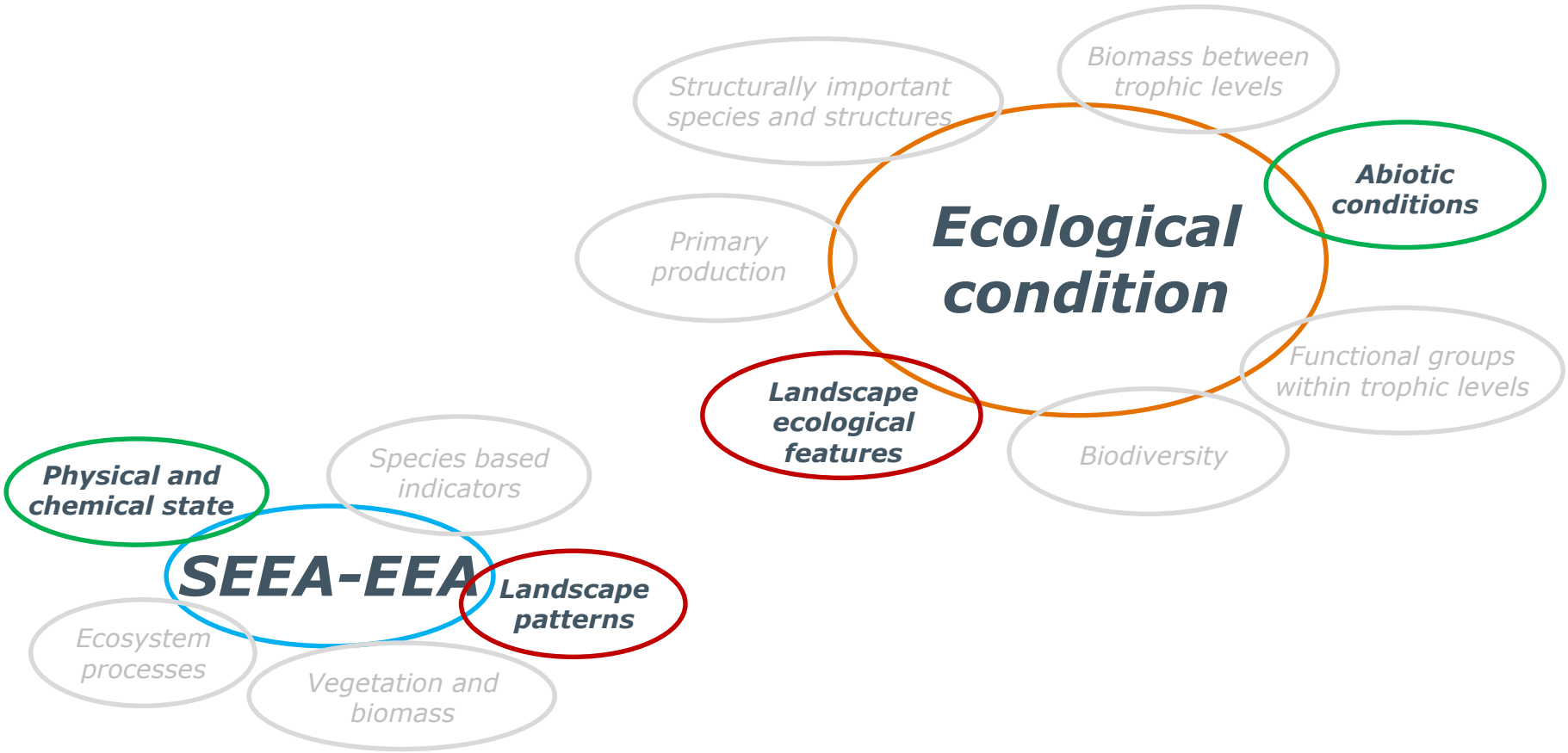

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