Moni-indeksi –

Biodiversity Indexing for Precision Forestry and Precision Nature Management to Support Timber Harvesting Planning

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Metsäteho

FINNISH FOREST FOUNDATION

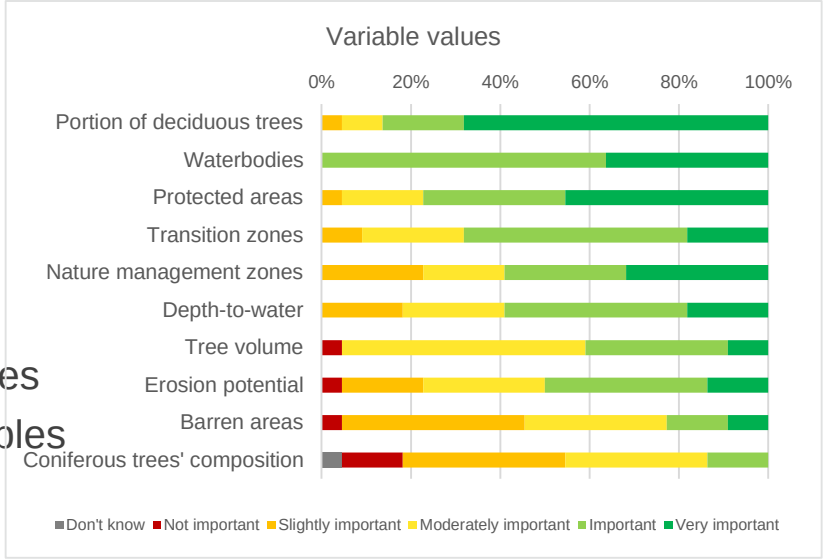
Moni-Indeksi project: background and objective

- Biodiversity Indexing for Precision Forestry and Precision Nature Management to Support Timber Harvesting Planning (Moni-Indeksi project)
  - Funded by the Finnish Forest Foundation (1/2024–6/2025)
- Background
  - Implementing precision measures in commercial forests requires the simultaneous use of various datasets. This presents a challenge for planners and operators (e.g., forest machine operators).
  - The implementation of precision forestry and nature management in commercial forests requires automated decision support systems based on diverse datasets.
- Objective
  - Produce biodiversity indexing to support the planning and implementation of timber harvesting operations on site level, particularly for automated strip road planning.
- Publications
  - Malm M, Riekki K, Strandström M ja Malinen J (2025): Metsäteho Report 274 and Metsäteho result series 10/2025.

Moni-Indeksi project: implementation

- Methods
  - Literature and information needs review
  - Workshops with forestry companies and research institutions
  - Expert survey

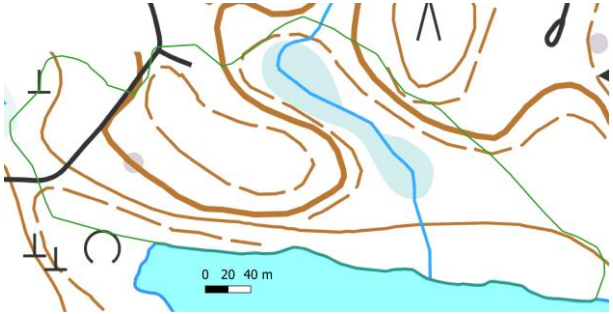
- Work stages
  - Mapping of current nature management practices
  - Identification and valuation of biodiversity variables
  - Mapping of geospatial datasets
  - Biodiversity index creation



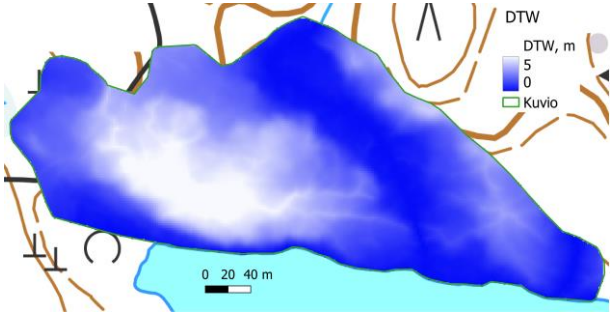
Geospatial datasets

- **Topographic Database**
  National Land Survey of Finland
  (Maanmittauslaitos)
  - Protected areas and other important nature reserves (also from Finnish Environment Institute [SYKE])
    - Archaeological cultural heritage sites, Finnish Heritage Agency (Museovirasto)
  - Transition zones (fields, undrained peatlands)
  - Cliffs
  - Barren areas (exposed bedrock, boulder fields)
  - Waterbodies (lakes, streams)
  - Avoided infrastructure (30-meter buffer zone)
- **Waterbodies**
  Finnish Environment Institute (SYKE)
  - Ranta10-datasets (rivers, channels, seas)
- **Habitats of special importance**
  The Finnish Forest Centre (Suomen Metsäkeskus)
- **Depth-to-water / moisture index** (4ha)
  Natural Resources Institute Finland
  (Luonnonvarakeskus)
  - Considered, if depth of water table is less than a meter from the surface
- **RUSLE erosion model**
  The Finnish Forest Centre (Suomen Metsäkeskus)
  - Considered, if a waterbody is up to 50 meters away
- **Forest inventory data**
  The Finnish Forest Centre (Suomen Metsäkeskus)
  - Stand volume
  - Tree species composition
  - Amount of deciduous trees

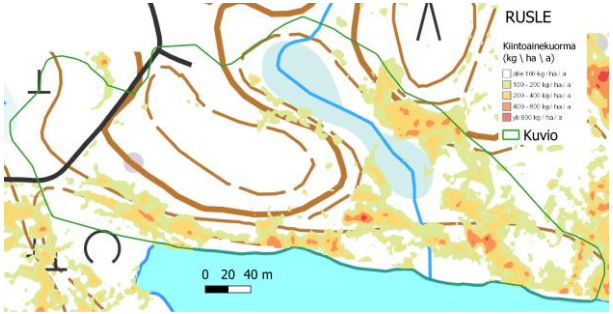
Geospatial datasets: examples



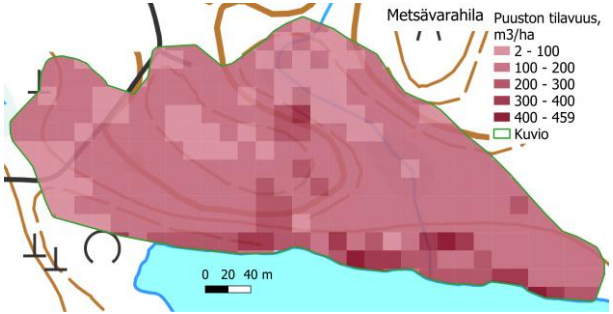
Topographic Database - Base Map



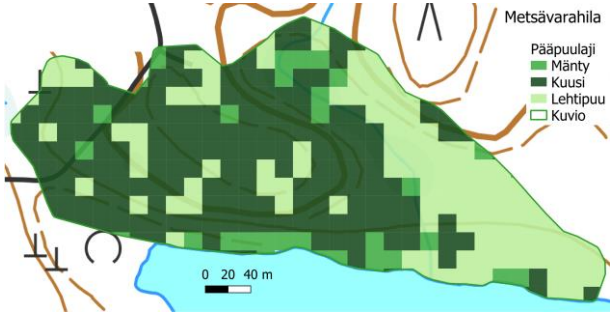
Depth-to-water / moisture index



RUSLE erosion model



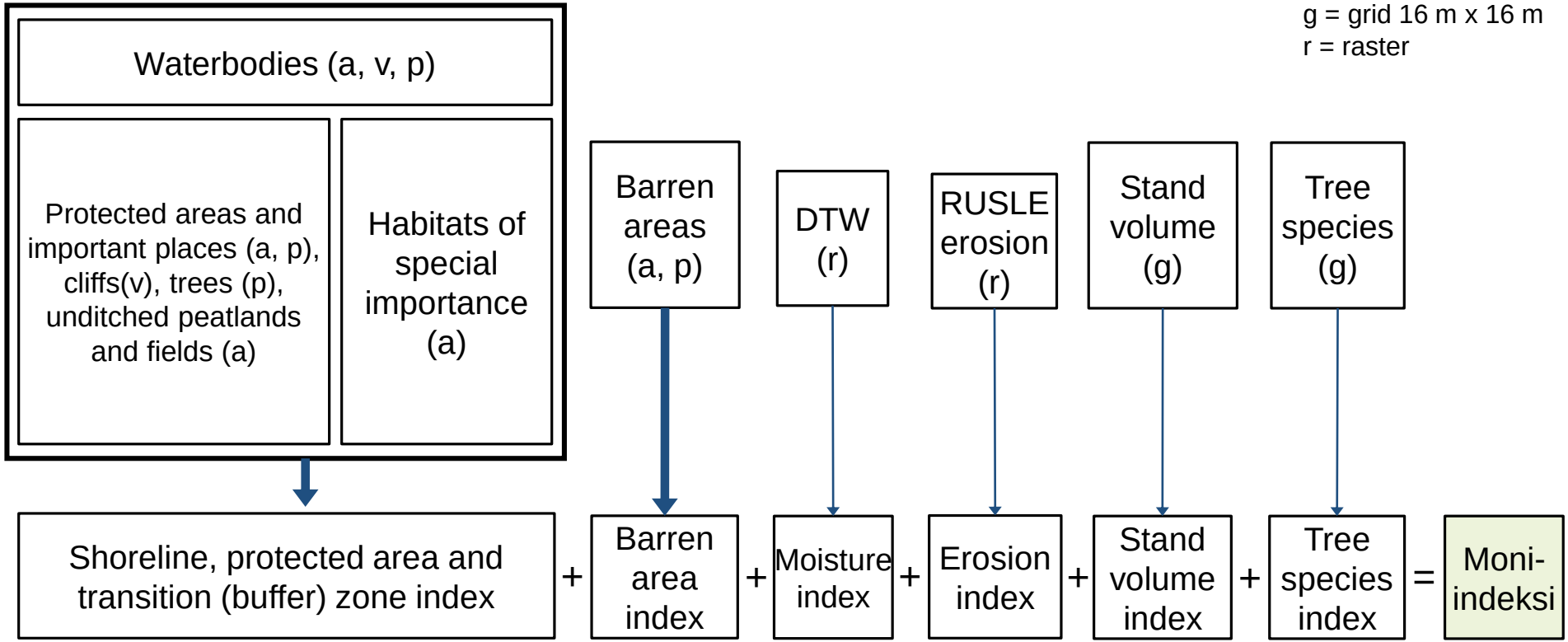
Forest inventory data - stand volume



Forest inventory data – main tree species

Biodiversity index creation

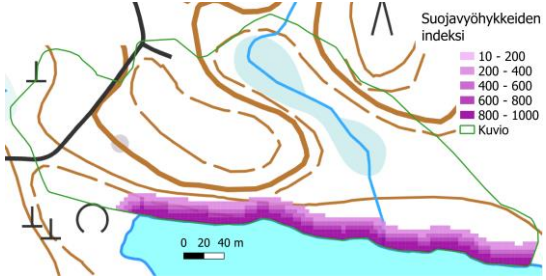
= buffer zone
a = vector, area
v = vector, line
p = point
g = grid 16 m x 16 m
r = raster



Index creation – variable values

- 4 m × 4 m grid covers the entire site.
- Index values vary between 0 and 1000 depending on the variable.
  - The weighting of variable valuations is based on literature and expert survey results.
- The zone index values decrease when moving away from the edge of the area (0–20 m).
- For stand attributes, the values take into account both the variability within grid and between grids across the site.
- The index calculation also takes into account a 30-meter zone around the site.

Variable	Index values
Shoreline, protected area and transition (buffer) zone index	300–1000
Barren area index	300; 500
Moisture index	0–1000
Erosion index	0–1000
Stand volume index	0–800
Deciduous trees' index	0–1000
Coniferous trees' variation index	0–700



Buffer zone index

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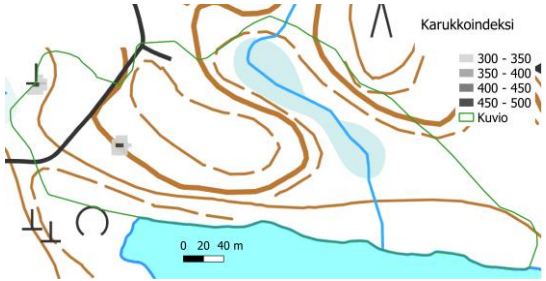

Barren area index

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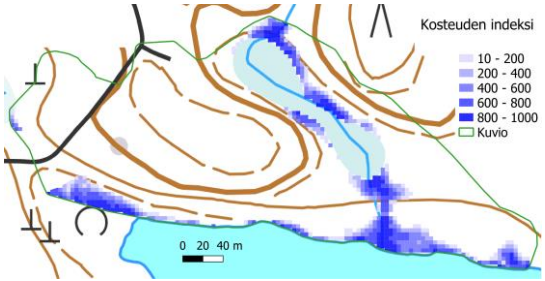
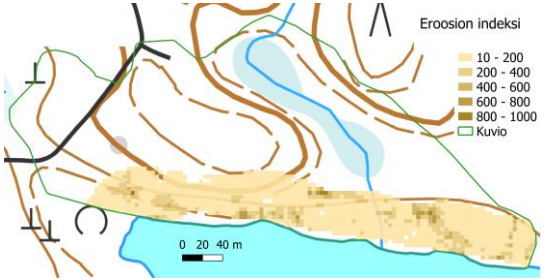


Moisture index



Erosion index

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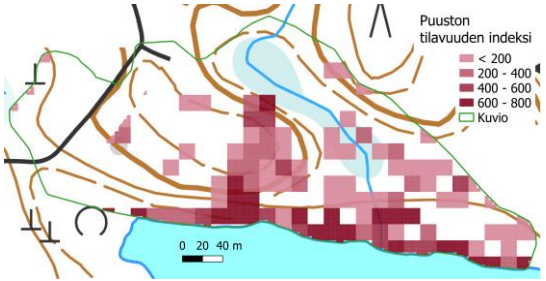

Stand volume index

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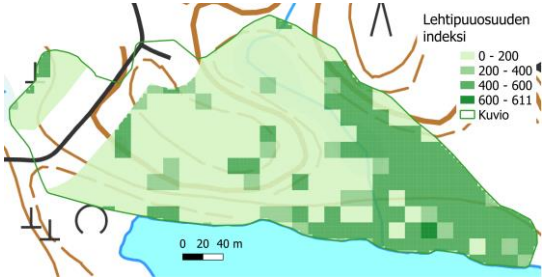
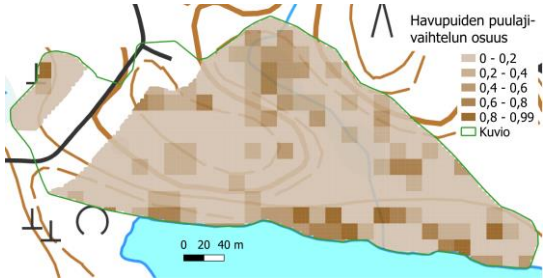


Deciduous trees' index



Coniferous trees' variation index

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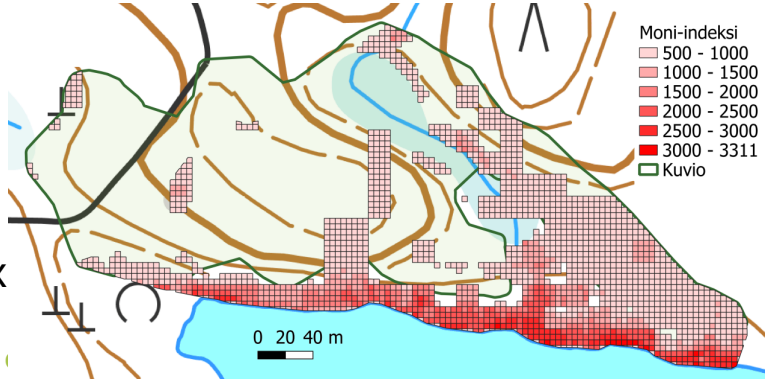
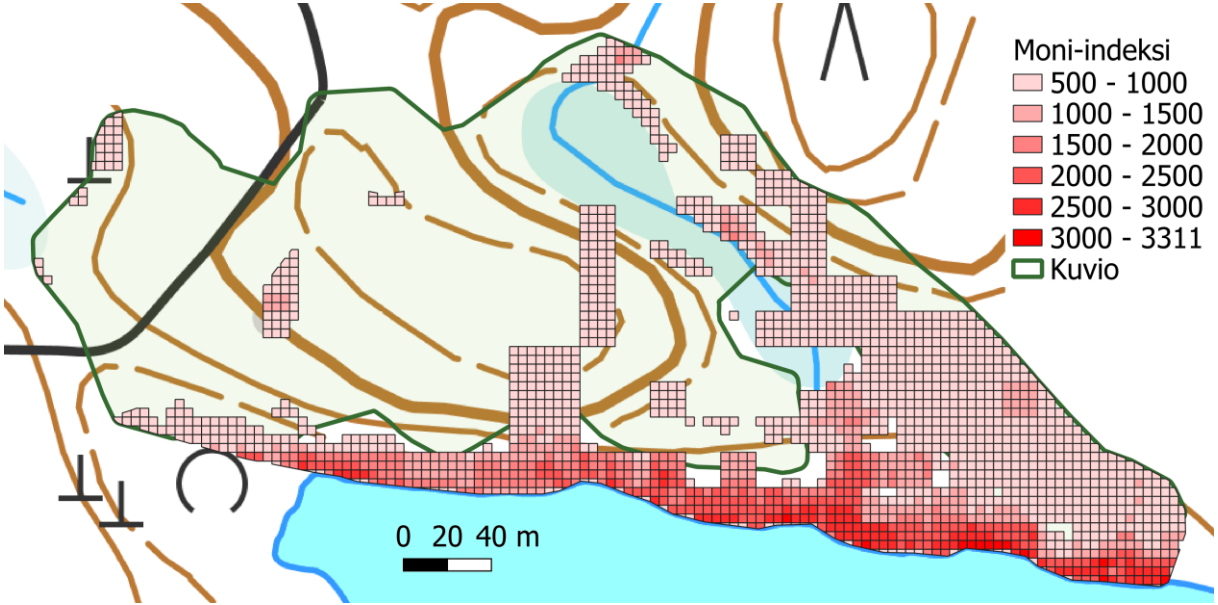
Moni-indeksi – Biodiversity index



Example 1

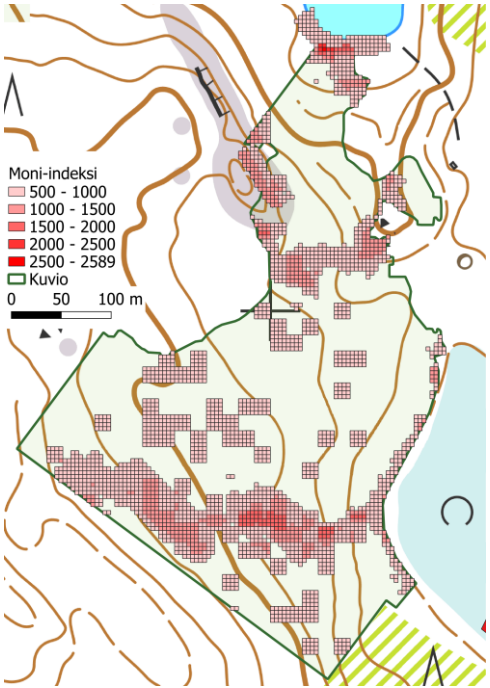
Planning a variable-width riparian buffer zone

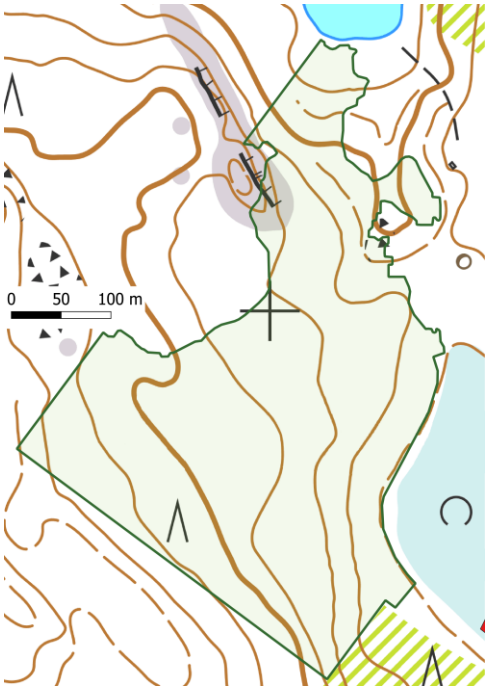


In the vicinity of a water body, its proximity and the high values of the moisture index, erosion index and stand characteristics index indices are emphasised.

Example 2

Consideration of the cliff and the moist area, increasing the proportion of deciduous trees

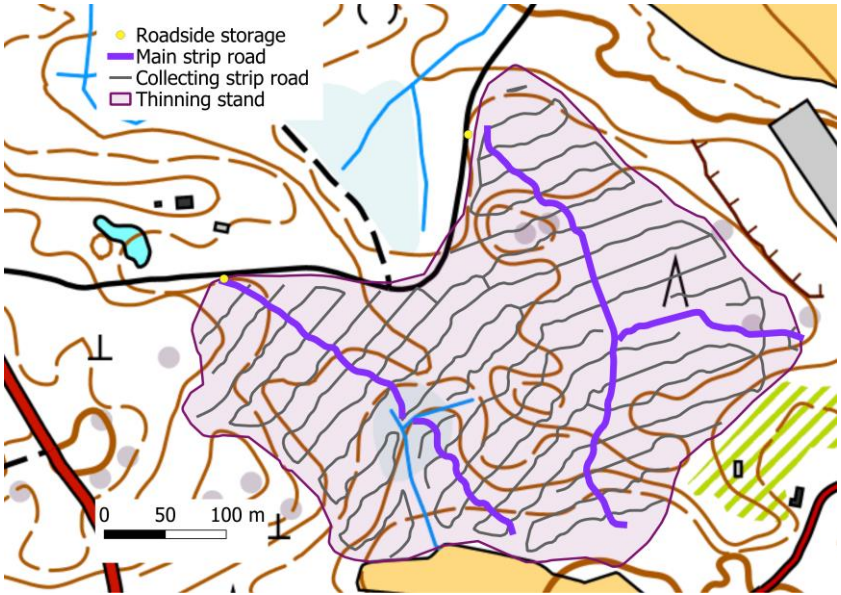


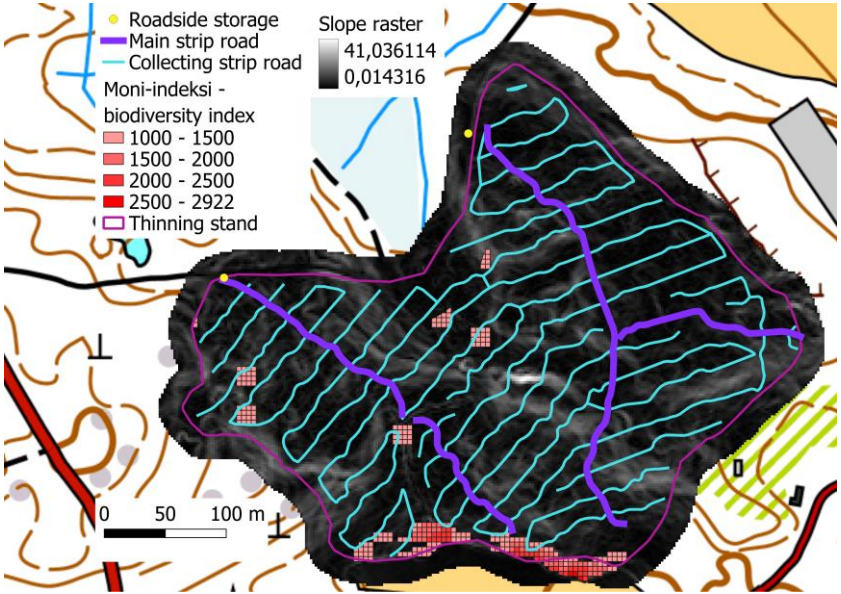


The area is characterized, among other things, by a cliff, a moist area in the south, and groups of deciduous-dominated trees in the center.

Example 3

Optimized strip roads





Summary

- A biodiversity index was developed in the Moni-Indeksi project to support the planning and implementation of timber harvesting operations.
- The index combines data on key biodiversity variables into a single numerical value for 4 * 4-meter grid cells.
- The indexing utilizes nationwide geospatial datasets commonly used in the forestry sector.
- The most significant known limitations of the index are due to the absence of geospatial data for certain variables or deficiencies in the available datasets (such as deadwood, vertical structure of forest and species information).
- The index is expected to perform well in precision forestry planning. Potential use cases include, for example, strip road planning, planning of nature management measures, and targeting of fieldwork.
- Currently, the index is being used in the development of an automatic strip road planning method. The automatically generated strip road network will be piloted in a follow-up project (OptiForValue project).
- The production of a nationwide biodiversity indexing / biodiversity index map is under consideration.

Thank you

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