

Land use biodiversity assessment in LCA – the case of the Finnish forests

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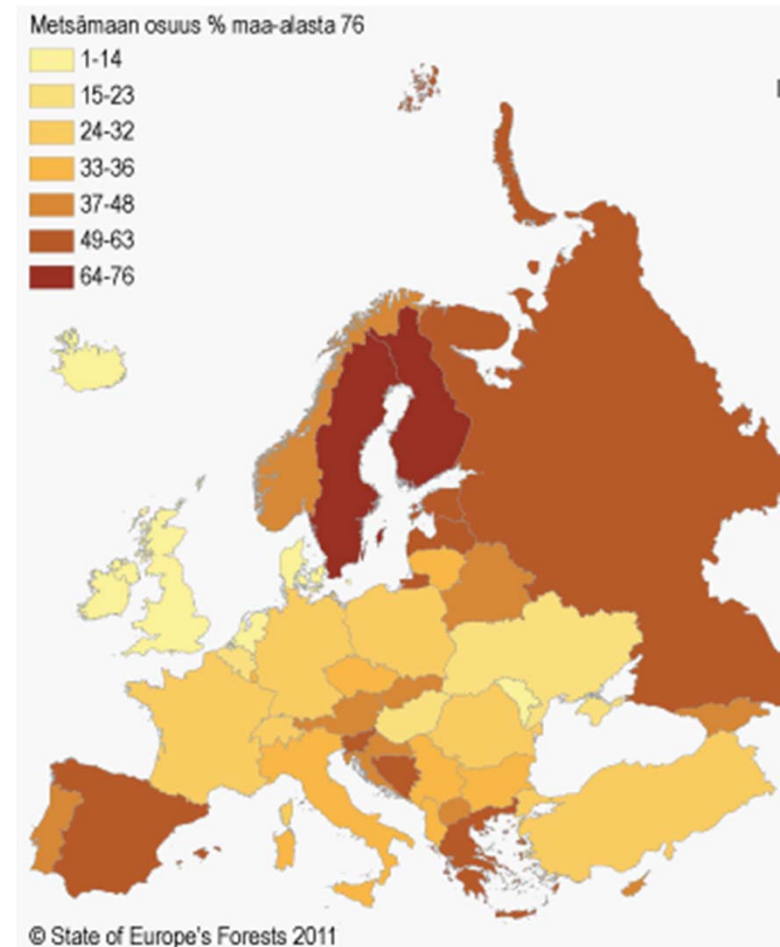
Aim of our study*

- is to test available methods and CF's and develop new CF's for boreal forests
- Methods should be applicable
 - in scenarios for future forest management
 - for comparison of global product systems
- What should be measured: what are the special features of boreal forests that should be taken into account in LCA methods?

* Project: Sustainable, climate-neutral and resource-efficient forest-based bioeconomy (Academy of Finland)

Features of boreal forests

- Mostly conifers
- Share of forest land of the total land area in Finland is 76 %
- Forest industries utilize more than 90 % of land area
- Forest at the age + 100 years can be considered old – most are logged before that: Rotation time of a commercial forest is 60 -100 years
 - Trees can grow even 400-800 y
- Low productivity
 - (NPP in Finland 340, globally 720 g C/ hectare/ year)



Special features of the biodiversity of boreal forests

- **Forestry measures** have decreased:
 - area of important habitats (natural-like old-growth forests)
 - the quality of common forest habitats
 - amount of decaying wood
- **Red-listed forest species**
 - **Forestry** is the primary cause of threat to 606 species (74% of all threatened forest species)
 - More than 1/3 are **old-growth** specialist - 1/3 live in young and middle aged **herb-rich forests (other habitats incl. Eskers, heaths)**
 - Threatened forest species incl. mushrooms +20%, beetles 17%, butterflies 16%, hymenoptera 11% and lichens 11 %

these are the taxa that we do not know so well
- Changes in forests are the cause of endangered status of 11 bird species + Siberian flying squirrel and the forest reindeer

→ mammals and birds may not be a good surrogate taxa to be used in the indicators

Forest management scenarios in Finland - as a background for indicator selection

- We will build scenarios (for years 2016-2075) to assess the impacts of forest management on
 - timber production
 - energy biomass production
 - carbon balance of forests (carbon in trees & soil) and wood products and
 - biodiversity
- Changing forest management practices:
 - The intensity of cuttings, initial stand density, rotation time, thinning method and intensity, fertilization, ditch cleaning, etc.
 - Selective logging vs current clear cuts
- Regions: southern, middle and northern Finland (southern, central and northern boreal forest vegetation zones)

What should be measured in boreal forest?
What is an optimal LCA BD method?

For scenario assessments

- **High resolution** in order to detect changes caused by forestry measures
- More **detailed forest land use types** than intensive and extensive
- Use of species richness as an indicator? –old forests are not the most species rich environment
 - If species richness is used, **other taxa than/in addition to vertebrates** or plants should be used – if data available
- Preferably **habitat quality with structural indicators**: age of trees, amount of dead wood, areas set aside, (sturdy) deciduous trees..
- Geographic coverage: **local, regional, (global)**
- Resolution: some national (pixel) classification
- Reference states: Current & PNV & nat.regeneration – **OR?**

- Take into account low growth rate and productivity
- Use of maps/GIS: fragmentation and connectivity of habitat patches
- Implemented conservation target
- Data used: National Forest Inventory (NFI), other national data

For globally comparable production systems

- Use both species richness and habitat quality to capture the big picture – eg. Boreal forests, even when used, maintain vertebrate and plant species richness – yet quality as a habitat decreases

Chosen methods

- Ecoregion-based SAR approach (Chaudary et al 2016)
- Habitat suitability models (HSM) (de Baan et al. 2015)
- "Ecosystem indicators" (Lindner et al. 2014)
- "Conditions for maintained biodiversity" (Coelho & Michelsen 2013)
- **What else?**

| (Table modified from de Baan et al 2015, table 1) | What we need? | Ecoregion-based SAR approach (Chaudary et al 2016) | Habitat suitability models (HSM) (de Baan et al. 2015) | "Ecosystem indicators" (Lindner et al. 2014) | "Conditions for maintained biodiversity" (Coelho & Michelsen 2013) |
|--|--|--|--|---|---|
| geographic coverage | local, regional, (global) | Regional and global | CFs for boreal region needed (global coverage possible) | Regional | independent of any particular biogeographic region |
| Resolution | some national (pixel) classification | Ecoregion | pixel (0.81 km ²) | Ecoregion | Ecoregion or smaller (national classification system) |
| Indicators: Habitat | Measuring habitat degradation/quality | local species loss, weighted with global threat and rarity status of species | weighted absolute local loss of species richness | age of trees, amount of dead wood, areas set aside, deciduous trees, etc. | hemeroby values |
| Indicators: Species /taxa | other in addition to vertebrates? | mammals, birds, reptiles, amphibians, and vascular plants | mammals/birds | not assessed | not assessed |
| land use classes (additional classes covered by the method) /sensitivity of the model | More LU classes for forestry | intensive forestry, extensive forestry | Closed broadleaved deciduous forest, needleleaved evergreen forest | intensive forestry, extensive forestry, other? | H1 primary forests, H2 extensively managed forests, H3 managed forests, H4 intensively managed forests, H5 site-atypical coniferous forests: change of 0,1 |
| Use of maps/GIS? | Used to detect fragmentation and connectivity of habitat patches | No? | Possible | Possible | Possible |
| reference states | Current & PNV & nat.regeneration | natural land /PNV baseline | natural land, and current land cover | hypothetic maximum biodiversity quality | Sahara as a proxy for ecosystem vulnerability |
| implemented conservation target | to be decided | avoid regional or global extinction | avoid global extinction | National or other conservation goals | National |
| data used | National Forest Inventory (NFI), other national data | for local CFs: Paillet, Y., et al. 2010, Rosensvald, R., & Lohmus, A. 2008, GLOBIO | IUCN Red List of Threatened Species, GlobCover v2.3 | Expert opinion. NFI | hemeroby, national datasets |

Thank you!



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