A conceptual landscape approach to assess impacts of forestry on biodiversity

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Purpose of the study

- We describe a conceptual approach that can be used to assess biodiversity impacts in LCA with a focus on Nordic managed forests using two reference levels to assess chacterization factors.
  - "Business-as-usual (BAU)" (midpoint)
  - "Target reference situation" (endpoint)
- The purpose of the approach is to evaluate the impact on biodiversity based on management choices by individual forest owners.
- We build on experience from the conceptual framework for land use impact assessment developed by UNEP-SETAC
- We examplify the BAU-approach with illustrative examples from two regions in Sweden

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Life cycle analysis – biodiversity

- Impact on biodiversity is seldomly included in standard LCA. This is due to due to methodological limitations and data scarcity including:
  - There are conceptual discussions which aspects and level of biodiversity that should be included (species, genetic , ecosystem) and which indicators that should be used to measure biodiversity change
  - Which scale to measure (local, regional, global)
  - Uncertainties regarding biological response, land use classification and traceability of supply chains
- The ideal biodiversity indicator for LCIA models would not only catch biodiversity complexity and the spatial and temporal characteristics of its attributes; it would also be easy to measure and simple to communicate.
- The choice of reference situation against which biodiversity impacts are measured has a decisive impact on how the impact of forestry on the quality of biodiversity is assessed.

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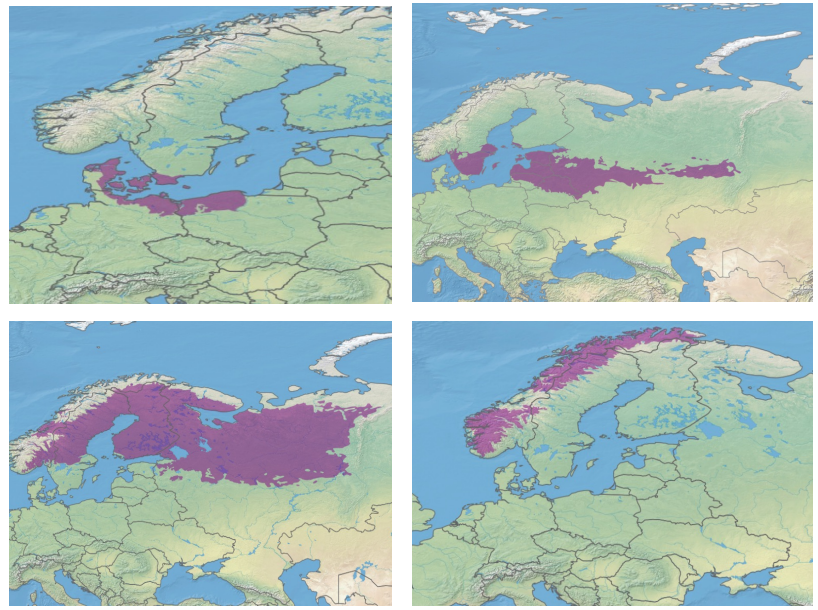
Our approach vs. UNEP-SETAC guidelines to measure biodiversity

- UNEP-SETAC has developed guidelines to measure biodiversity.
- Six land use types ("intensive forestry, "extensive forestry, "annual crops," "permanent crops," "pasture," and "urban");
- Five taxonomic groups (mammals, birds, reptiles, amphibians, and vascular plants),
- 804 different geographical resolutions, can be applied anywhere in the world. Only four ecoregions in Sweden.
- UNEP SETAC recommend measuring biodiversity impacts at the ecoregion level and therefore do not always have a sufficiently fine geographical resolution to capture aspects of management by individual forest owners
- In our study, we aim to evaluate how the choice of reference situation and impact assessment methodology provide different options, pathways and incentives for management options that could improve biodiversity with respect to forest management in the Nordic region.

Ecoregions



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Points of departure

Use of existing and established indicators

- Swedish environmental quality objectives “Living Forests’

System boundaries: total area of forest land under the responsibility of the forest owner

- Landscape perspective: at the landscape level felling and other silivicultural measures are conducted at different times on separate forest stands
- The indicators are allocated evenly on the forest products produced by the forest owner. Individual stands are not treated separately.
- ”Biodiversity indicator”, BDi, “Indicator or KPI” that follows sold/purchased forest-based raw materials and products through the value chain.

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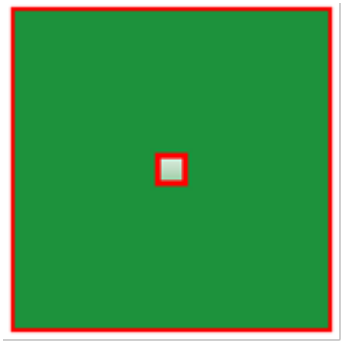
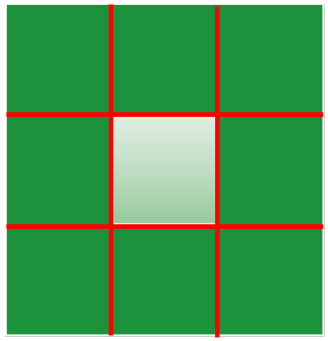
Reference levels

1 Business-as-usual (BAU) - "UNFCCC baseline midpoint approach"

- For indivudual forest owners the reference level is the mean present quality or state of the ecosystem on a regional level
- BAU used for international climate reporting



For example, region or country



For example, surrounding forest owners

2. Target reference situation -"The environmental quality objective (EQO) baseline endpoint approach"

- *describes the desired quality of the environment to safeguard species habitats and ecosystems*

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Indicators and criteria

(1) *Stands with old trees*. The average tree age in the stand should be above 140 years in northern Sweden and above 120 years in southern Sweden.

(2) *Stands with dead wood*. There should be more than 20 m^3 of dead wood per hectare, including only dead wood with a diameter greater than 20 cm.

(3) *Stands with large trees*. There should be more than 60 trees per hectare with a diameter greater than 45 cm for Norway spruce, Scots pine and 'noble broadleaves', and a diameter greater than 35 cm for the remaining tree species.

(4) *Mixed deciduous and coniferous tree species*. The average tree age in the stand should be above 80 years, and more than 3/10 of the basal area should be deciduous tree species.

- These four biodiversity indicators are used in the Swedish *Environmental Quality Objective 'Living Forest'*
- These are established indicators to assess the status of the Swedish forests in terms of their **structure**
- The indicators promote the positive development of biodiversity
- This is a first suggestion of indicators that will updated as new data and knowledge becomes available

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Illustrative examples of methodology

- We illustrate the BAU baseline approach with two examples from different counties in Sweden to calculate the biodiversity impact from wood production for individual forest owners
- For each county (Kronoberg in southern Sweden, the boreonemoral zone + Västernorrland in northern Sweden, boreal zone) calculations have been made for two forest owners
- Indicator values for the whole counties have been calculated which serve as reference values for indivudual forest owners within the county
- For the two different forest owners in each county, arbitrary values for the areas complying with the four biodiversity criteria were selected as examples.
- We have assumed that wood produced from the two forest owners are transported and used by just one industry in the county
- Statistical information for the two counties was collected from the official forestry statistics for Sweden (SLU 2020) and were valid for the 5-year period 2015–2019.

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		Reference county, Kronoberg	Reference county, Väster-norrland	Forest owner 1, Kronoberg	Forest owner 2, Kronoberg	Forest owner 1, Väster-norrland	Forest owner 2, Väster-norrland	Forest owners total, Kronoberg	Forest owners total, Väster-norrland
1	Productive forest land, ha	658 000	1 626 000	500	500	500	500		
2	Yearly harvest, m^3 ob/yr	3 374 473	6 898 003	2 564	2 564	2 121	2 121		
3	Cr 1, stands with old forests, ha	4 606	262 080	3	10	50	80		
4	Cr 2, stands with dead wood, ha	41 898	116 012	25	50	30	70		
5	Cr 3, stands with large trees, ha	19 045	10 196	10	30	5	15		
6	Cr 4, stands with mixed deciduous trees, ha	66 676	222 107	40	80	25	80		
7	ΣCr, Summed area that comply to any of the four criteria, ha	132 225	610 395	78	170	110	245		
8	BD_i, share of area that comply vs. total area, (ha/ha)	0.20	0.38	0.16	0.34	0.22	0.49		
	UNFCCC Baseline approach								
9	RCF_i, owner vs county reference value, 0-1, [-]			0.29	-0.41	0.71	-0.23		
10	Inventory mean RCF_i for wood arriving at industry:							-0.06	0.24
11	I_{BD} for wood arriving at industry, PBDe, * 10^{-3} [ha/m^3sk]							-11.8	+6.6

Conclusions and way forward

- We suggest a simple approach that could be used to evaluate the biodiversity impacts at the forest landscape level, with a focus on management options for individual forest owners.
- The method can be applied for forest owners in Sweden using already-established nationally agreed-upon indicators from the Swedish Environmental Objective, Living Forests.
- "UNFCCC baseline approach" evaluates the change in biodiversity for an individual forest owner where the mean present quality or state of the ecosystem on a regional level is the reference level.
- "EQO baseline approach" requires quantitative targets for each indicator. In the future such targets can be used to to evaluate management practices that is positive for biodiversity in relation to e.g. Environmental Targets.
- Next step will be to evaluate if the method can be used in combination with various remote sensing techniques.

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