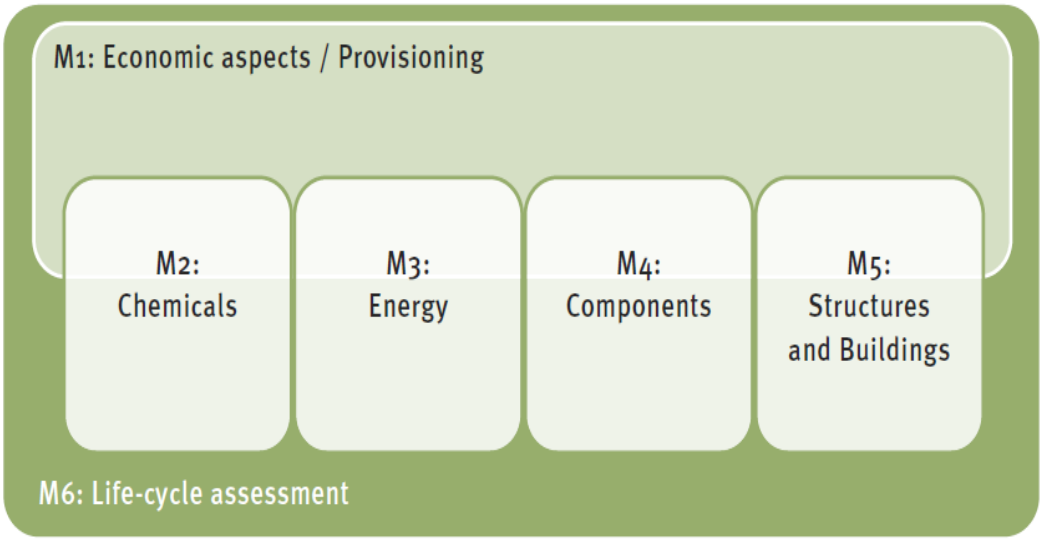
ETH zürich

The global impact of wood consumption on biodiversity

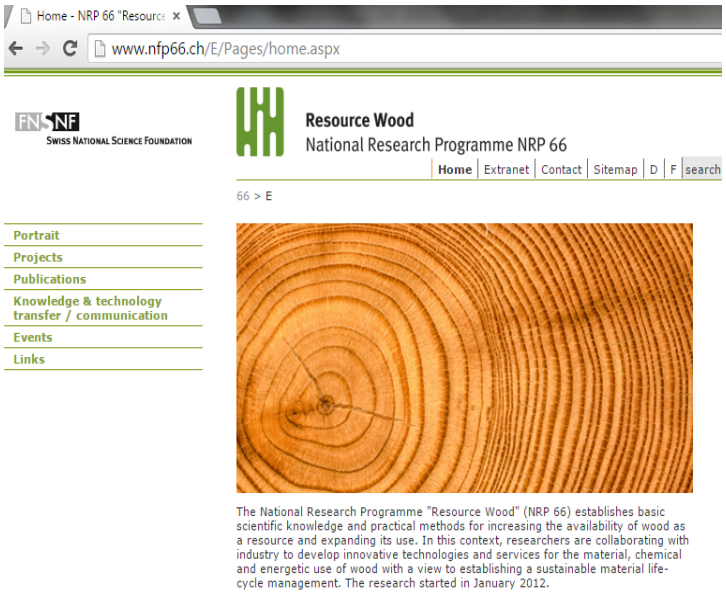
Abhishek Chaudhary

Context

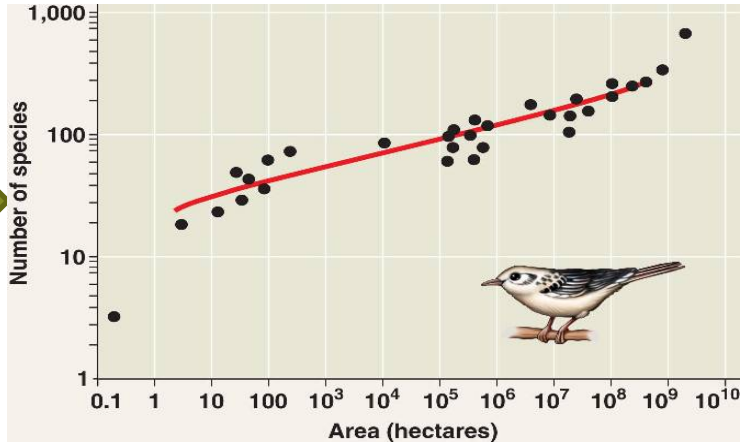
- This dissertation was conducted within the framework of Swiss National Science foundation's Research Programme called "Resource Wood"
- **To provide decision support and identify environmental strategies for a sustainable management of wood resources in Switzerland.**



Modules of NRP 66



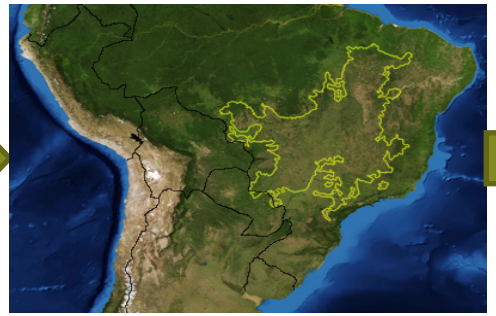
Scope



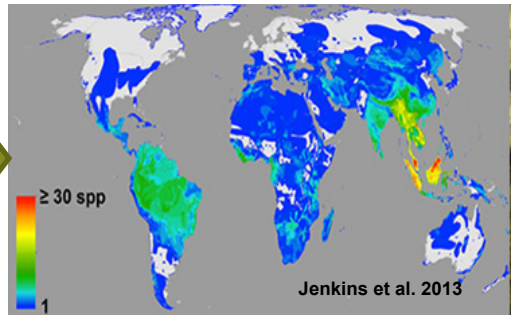
- Improved methods for quantifying land use biodiversity impacts of forestry products.
  - Existing LCA methods have high uncertainties
  - Local, regional and global species loss
- Case studies for product comparisons and other applications of results (e.g. impacts of 1 kg of soybean from USA compared with Brazil).

Presentation overview

Local impacts (plot-level, onsite; Part- 1)

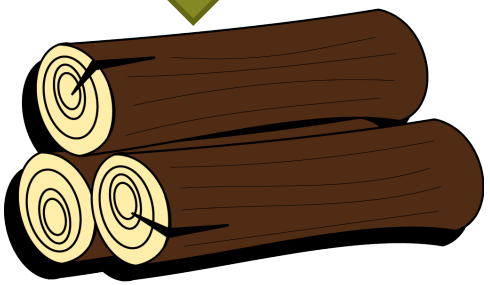


Regional impacts (Part- 2)



Global impacts (Part 2)

Impacts per m^3 per country (Part 3)

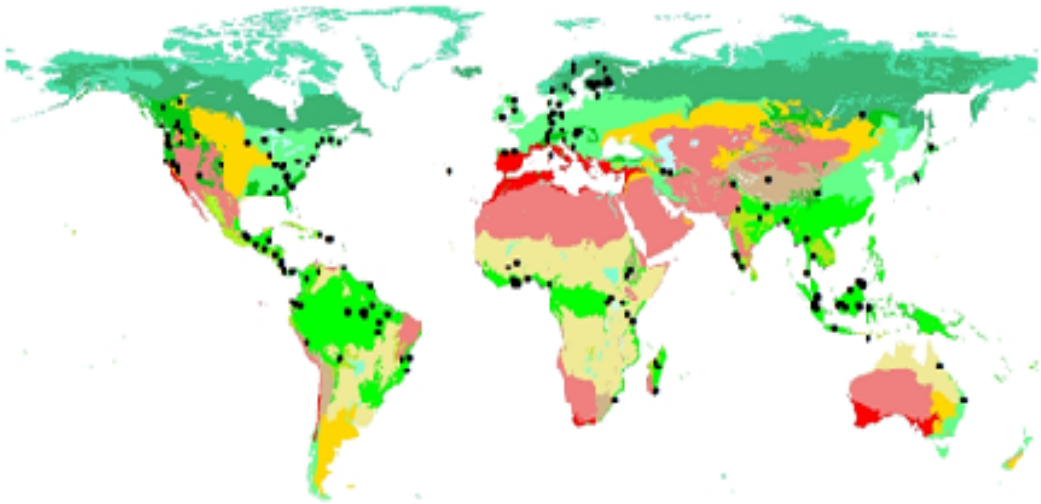


Part 1 - Impact of Forest Management on Local Species Richness: Global Meta-Analysis

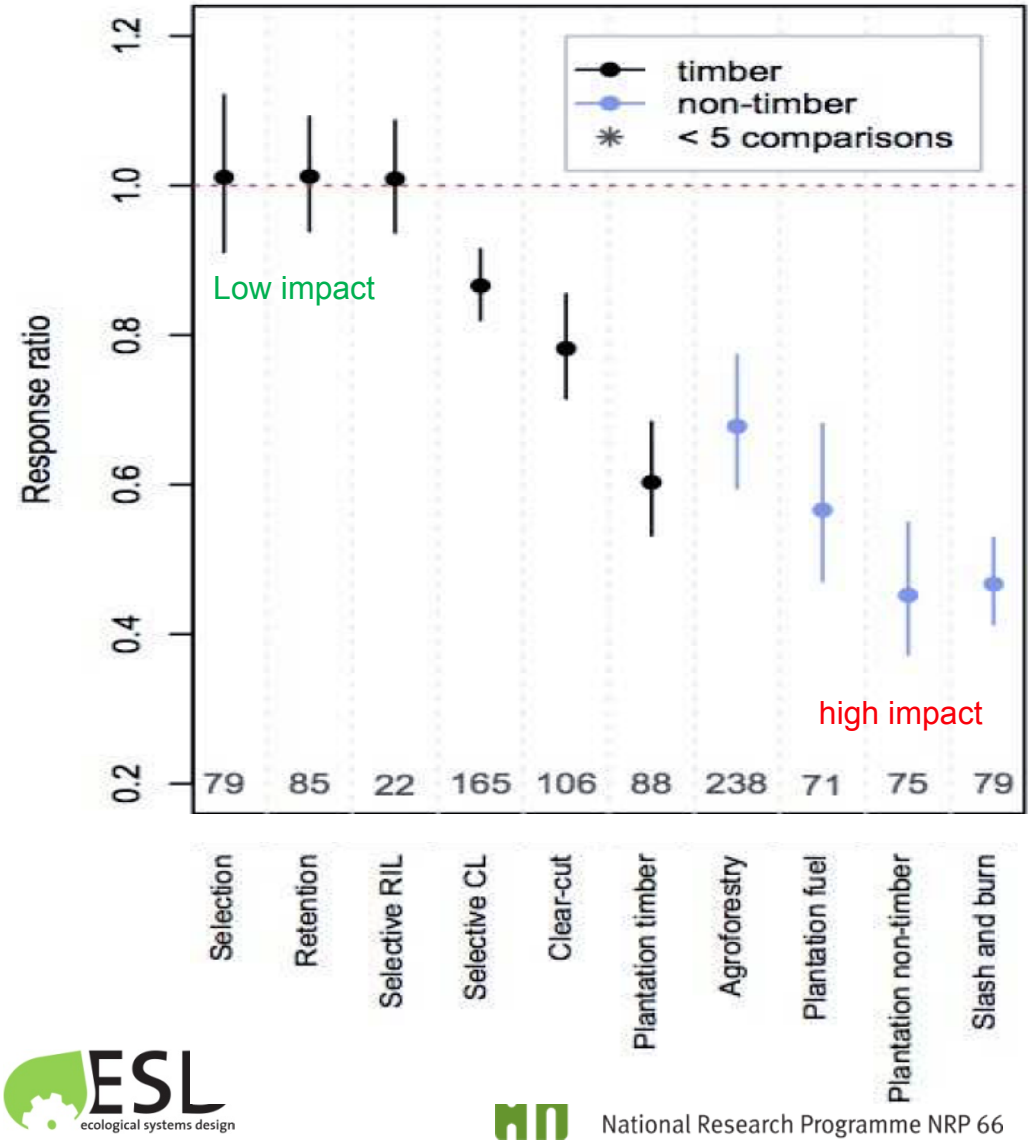
$S\downarrow natural$ $S\downarrow disturbed$

Part 1: Methodology – Local species loss

- $CF{\downarrow}local = 1 - (S{\downarrow}disturbed / S{\downarrow}natural\ )$ = 1 - RR = PDF
- Data imported from 287 publications - 1008 comparisons
- 10 management types, 7 taxa, 7 continents (submitted)
- Also provide a proxy for taxa sensitivity for use in predicting global extinctions

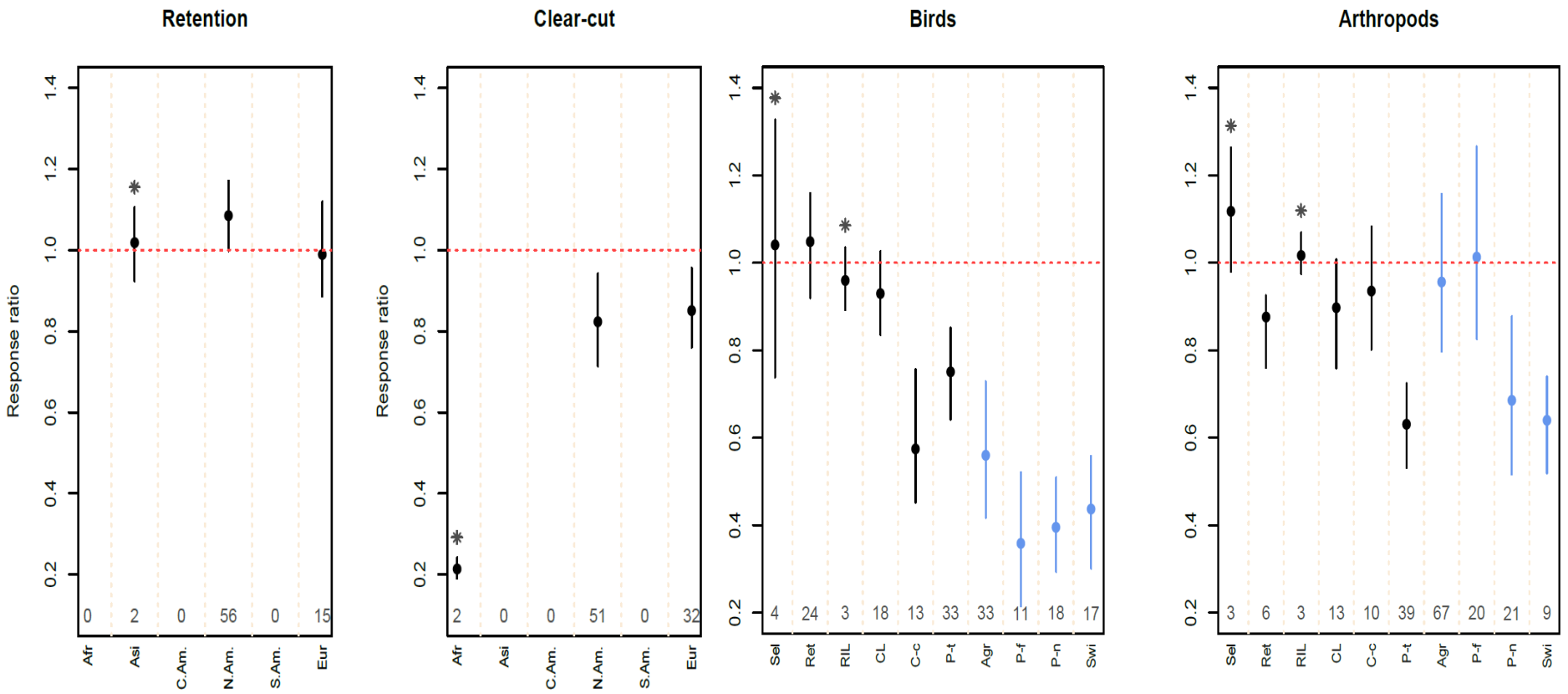


Meta-analysis summary- Local species loss



- $RR = (S{\downarrow}disturbed / S{\downarrow}natural)$
- Low RR => high impact
- RR =1, no reduction in richness
- Might still have composition changes
- Non timber uses more harmful

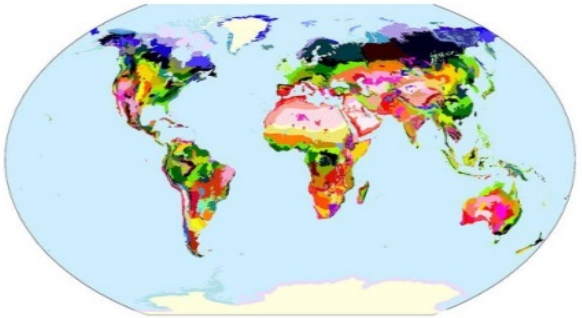
Two-way combinations

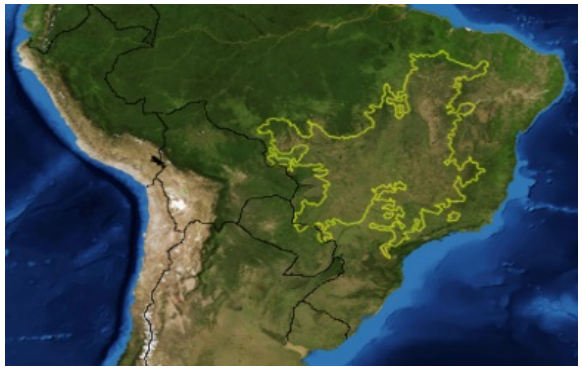


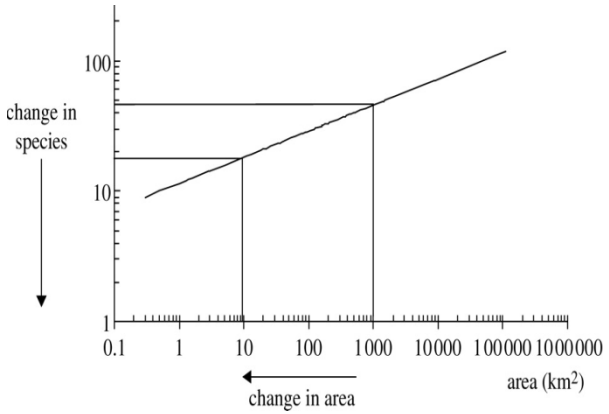
Three way combinations more relevant

Retention	Europe	Arthropods	6	0.85
		Plants	16	0.89
	North America	Birds	27	1.00
		Fungi	6	0.70
		Mammals	13	1.42
		Plants	13	1.12
Clear-cutting	Europe	Arthropods	5	0.83
		Fungi	6	0.66
		Lichens	9	0.80
		Plants	21	0.90
	North America	Birds	16	0.61
		Mammals	5	1.38
		Amphibians	5	0.54
		Plants	26	0.94

Part 2. Quantifying Land Use Impacts on Biodiversity: Combining Species-Area Models and Vulnerability Indicators







Part 2. Methodology – Regional species loss

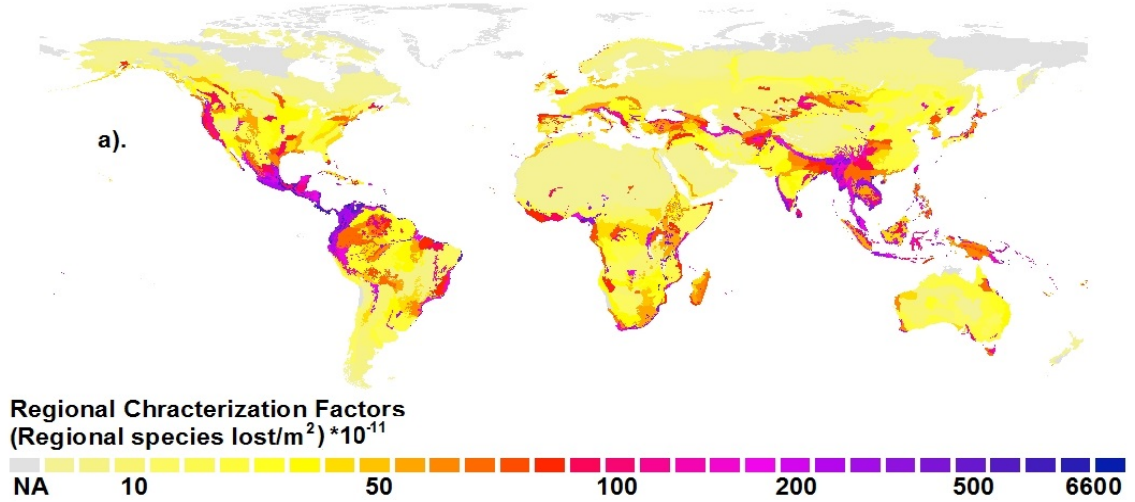
- $S\downarrow lost, g,j\uparrow countryside = S\downarrow org, j \cdot (1 - (A\downarrow new,j + \sum i=1 \uparrow n \blacksquare h\downarrow g,i,j \cdot A\downarrow i,j \ / A\downarrow org,j \ )\uparrow z\downarrow j \ )$
- Here *g* is taxa, *i* is land use type, *j* is region
- $A\downarrow new$ is remaining natural habitat, $A\downarrow i$ is area of other land use types – available from global maps
- $\text{Affinity}=h\downarrow g,i,j = (S\downarrow disturbed\ g,ij \ / S\downarrow nat, g,ij \ )\uparrow 1/z = (RR)\uparrow 1/z$
- New CFs:
  - Mammals, birds, plants, amphibians and reptiles
  - For each of 804 ecoregions
  - 6 land use types (annual crops, permanent crops, pasture, urban, extensive and intensive forestry).

Methodology – Global species loss

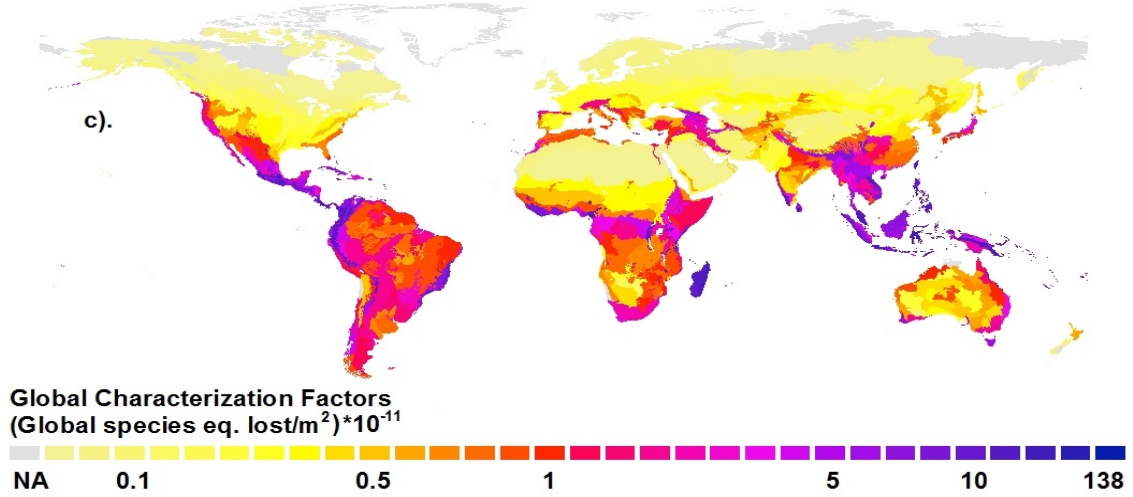
- $CF\downarrow global$ = $CF\downarrow regional$ x VS
- $VS\downarrow g,j$ = $\sum i=1\uparrow n$ ($TL\downarrow i$ * $RA\downarrow i,j$ / $RA\downarrow total$) / $S\downarrow org,g,j$ (0<VS<1)
- Here ($TL\downarrow i$) is IUCN threat level (converted to 0.2 to 1 scale)
- $RA\downarrow i,j$ / $RA\downarrow total$ is the proportion of habitat range of species *i* inside the region *j*.
- thus land use in an ecoregion that hosts more endemic and threatened species will have higher CF.
- Global CFs therefore flag vulnerable regions where the land use can lead to permanent (irreversible) damage

Results – Characterization Factors for Birds, Extensive forestry (land occupation)

Regional CFs



Global CFs



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Quantifying Land Use Impacts on Biodiversity: Combining Species-Area Models and Vulnerability Indicators

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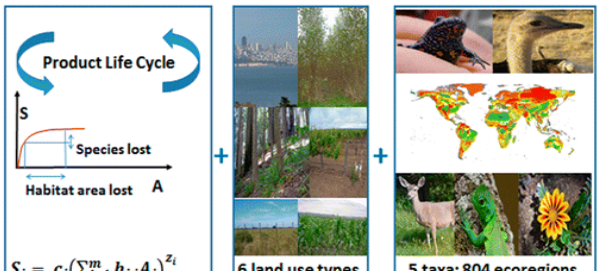
Abstract



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Article

Harmonizing the Assessment of Biodiversity Effects from Land and Water Use within LCA

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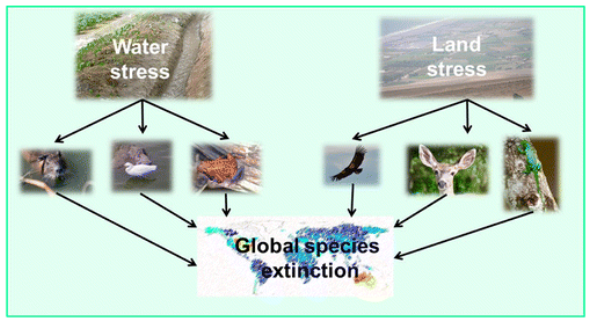
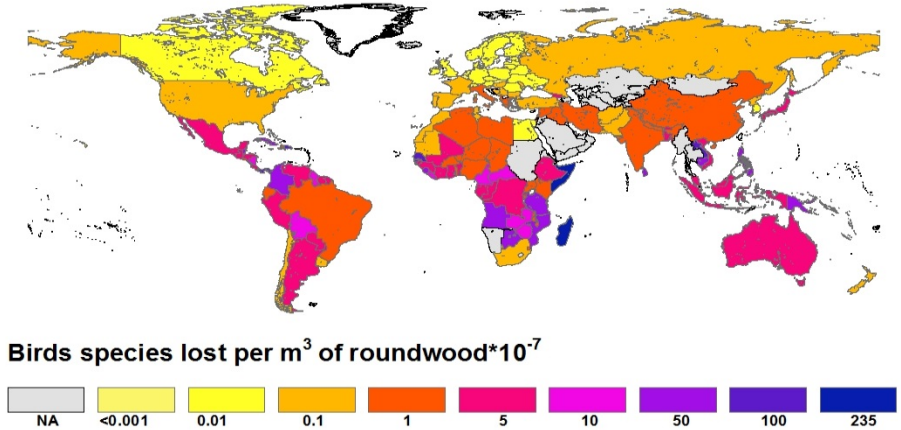
Abstract



Addressing biodiversity impacts in life cycle assessment (LCA) has recently been significantly improved. Advances include the consideration of several taxa, consideration of vulnerability of

Part 3: Impacts per m³ of round wood produced

- $BD\downarrow k,g = CF\downarrow ext,k,g \times 10000 \times (1-f\downarrow pla,k) / HI\downarrow ext,k + CF\downarrow pla,k,g \times 10000 \times f\downarrow pla,k / HI\downarrow pla,k$
- The impacts per m³ are highest in those tropical countries with both low yield per hectare and high CF per hectare.



Country	Total Rounwood (1000m³)	Yield (ext) m³/ha	Yield (pla) m³/ha	f(ext)	f(pla)	Rank birds	Type
Madagascar	281	0.031	0	1	0	9	Low yield, high threatened
USA	283549	0.59	6.10	0.43	0.57	99	High yield, low threatened
India	48758	0.07	3.80	0.07	0.93	66	High yield, high threatened

Limitations

- Lack of global forest land use intensity maps
- Data on other taxa e.g. fungi, bacteria not yet available
- CFs consider only species richness loss not taking into account impacts on species composition
- Other metrics of biodiversity need to be leveraged on global scale in future

Conclusions

- New local, regional and global extinction assessment
- Avoiding global extinctions to preserve earth's 'tree of life' but local/regional also important for ecosystem
- Relevant factors: Region (richness, endemicity, existing threat status), management regime & yields
- Impacts per m^3 enable assessing global trade of impacts and potential biodiversity savings that can be achieved
- Finally the dissertation results contribute significantly towards improving the LCA of wood products – relevant for Swiss NRP 66.

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Resource Wood
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Project partners

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