Finding the path in the forest – An Interdisciplinary Approach Towards Multifunctionality in Northern Forests (ForestPath)

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(Interdisciplinary: Forestry, Ecology, Physical Geography, Law and Environmental Psychology)

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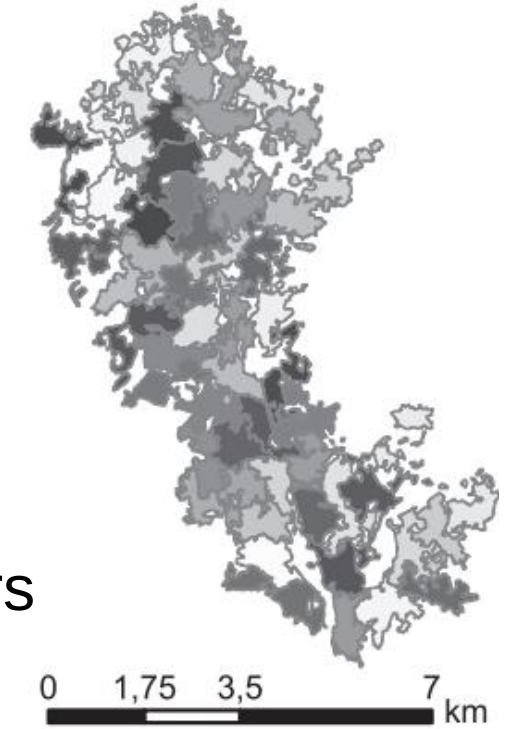
What is the problem?

- Forests generate many values that are not always compatible, leading to conflicts over the use
- Landscape scale planning can reduce trade-offs, but difficult in areas with small private forest owners
- The mix of private goods and public goods leads to ”The tragedy of Ecosystem services”



(From Bakx et al., 2023 Landuse Policy)

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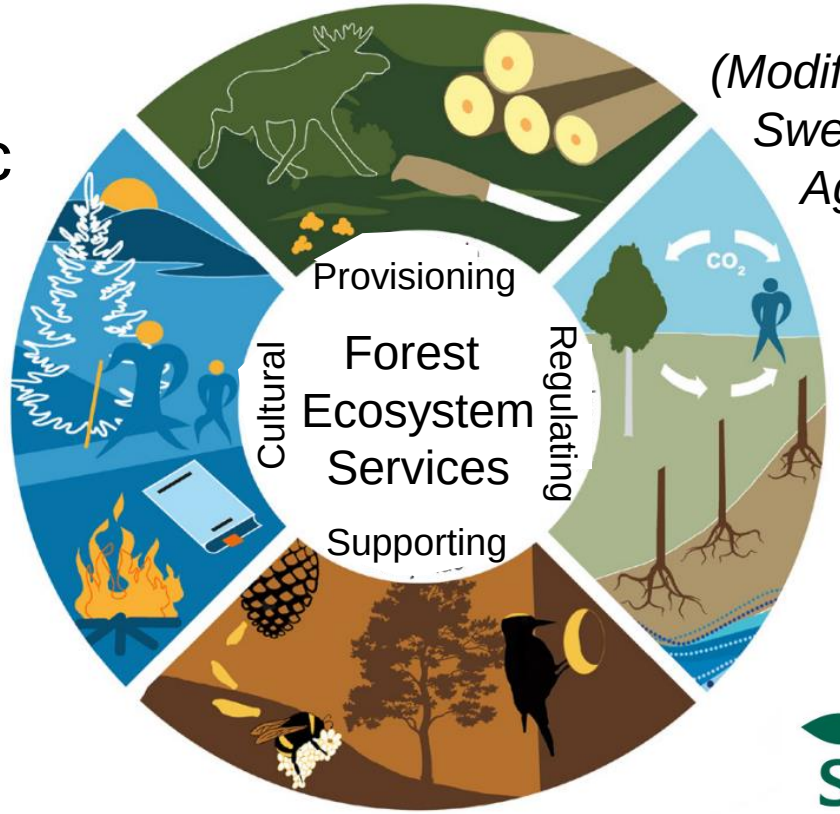
Tragedy of the Ecosystem services

(Lant et al., 2008. Bioscience)

- The conflict between maximizing private goods and maintaining public goods
- Private forest owners bears the cost for prioritizing public goods, the public experien-ces the benefits
- Lead to a risk of under-prioritization of public goods



(Modified from the Swedish Forest Agency)

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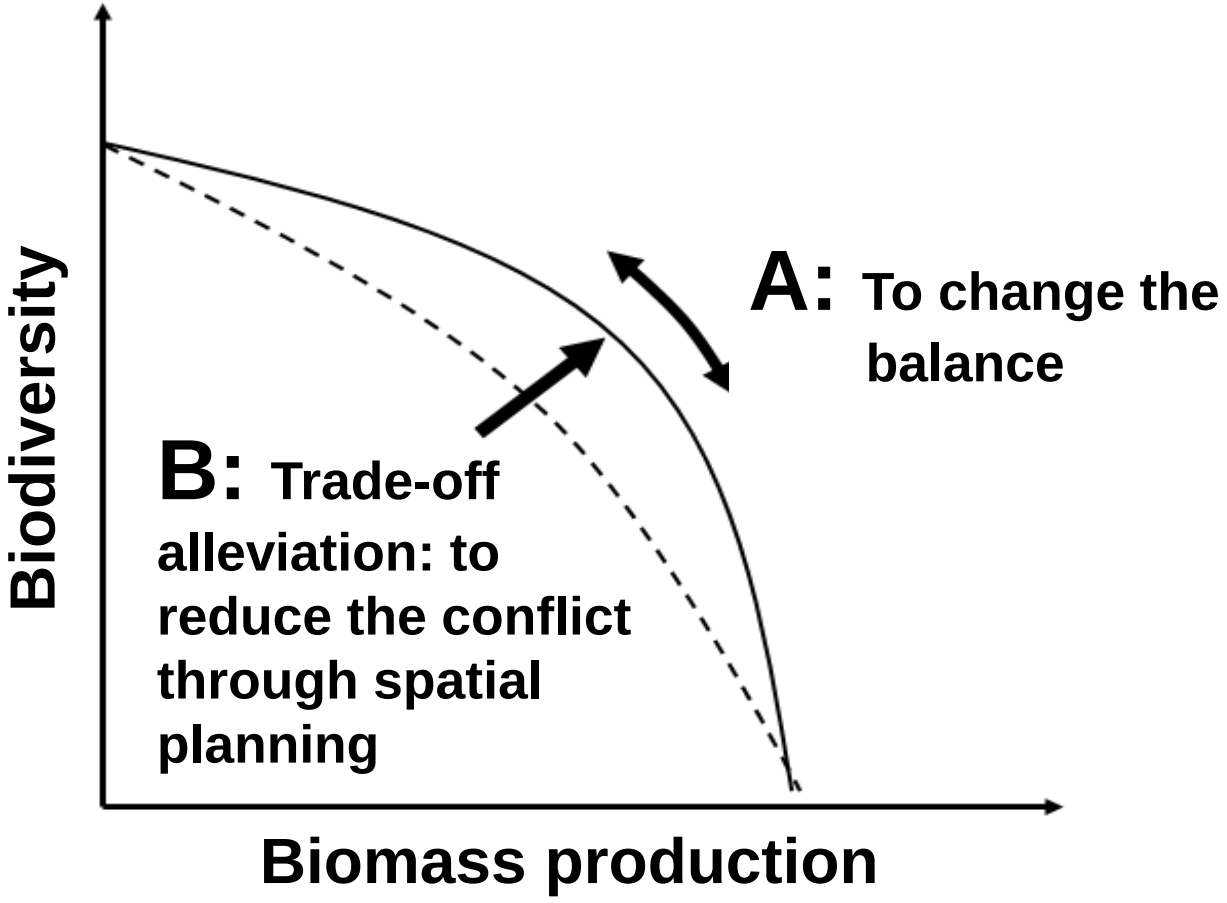
Ways to increase the underprioritized ES (illustrated by PPF)

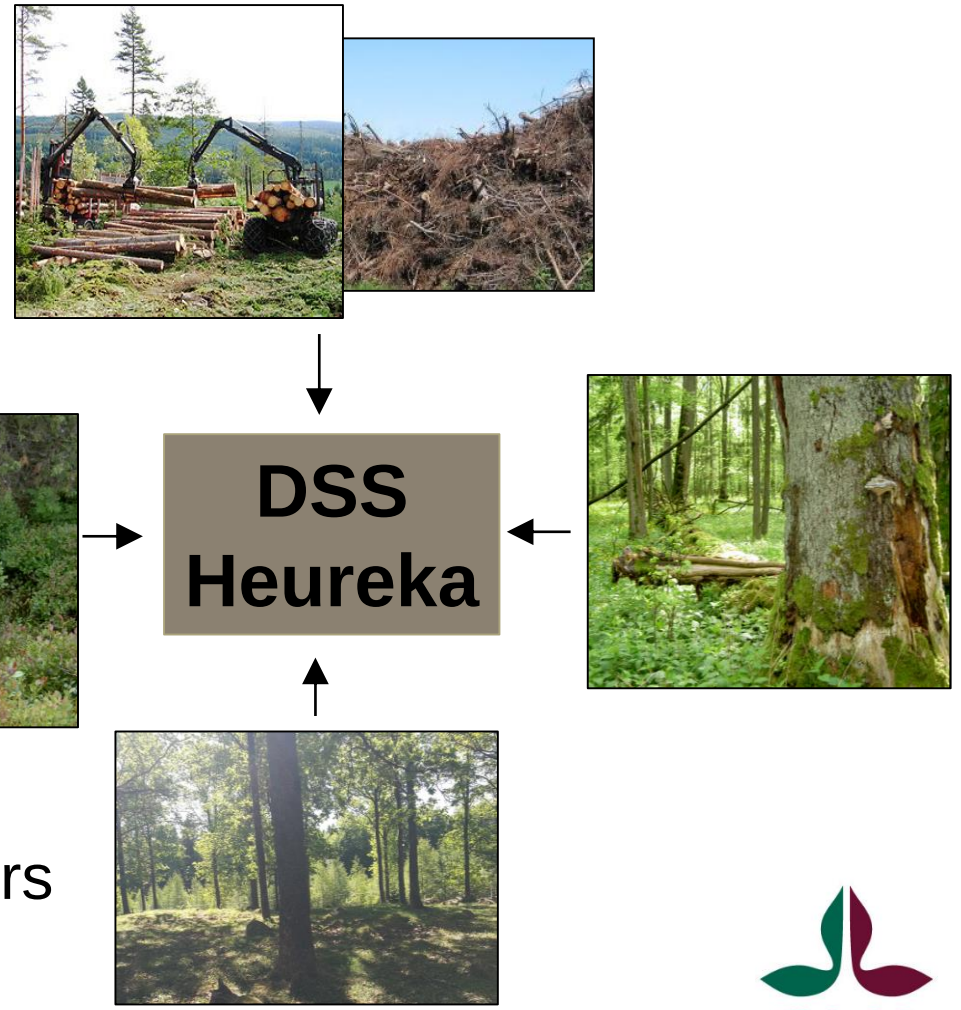


Production possibility Frontiers (PPF):
Possible combinations of the amounts of two ecosystem services that can be produced from a forest

(Figure by R. Trubins)

Methods overview

- Link forest structures to indicators (production, **biodiv-ersity**, climate mitigation and **well-being/recreation**)
- Evaluate policy instruments, study forest owners driving forces and acceptance
- Find potential solutions with DSS Heureka using the indicators
- Identify acceptable solutions in cooperation with stakeholders



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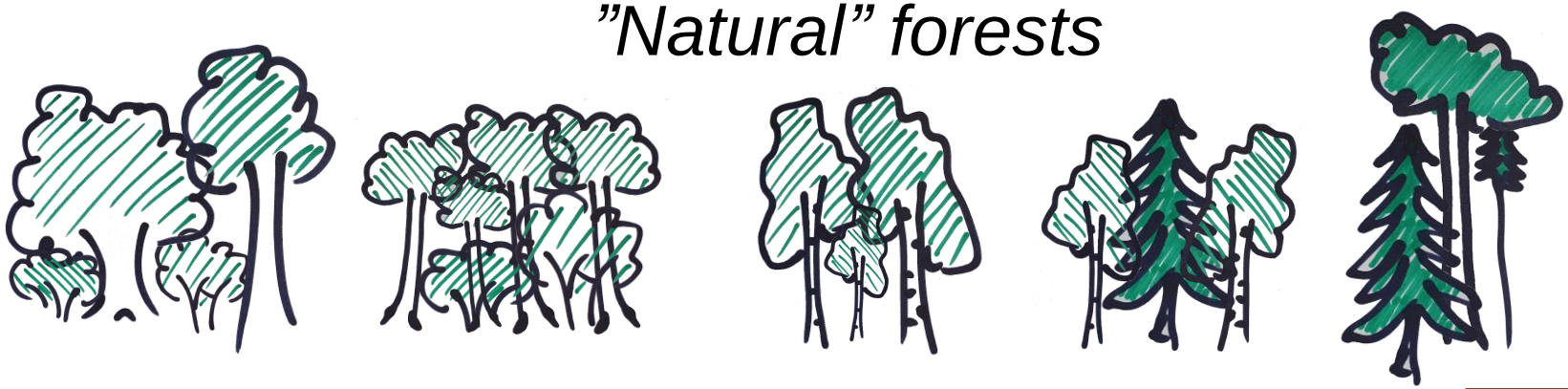
Linking forest structures to indicators

”Natural” forests



Managed forests

Biodiversity

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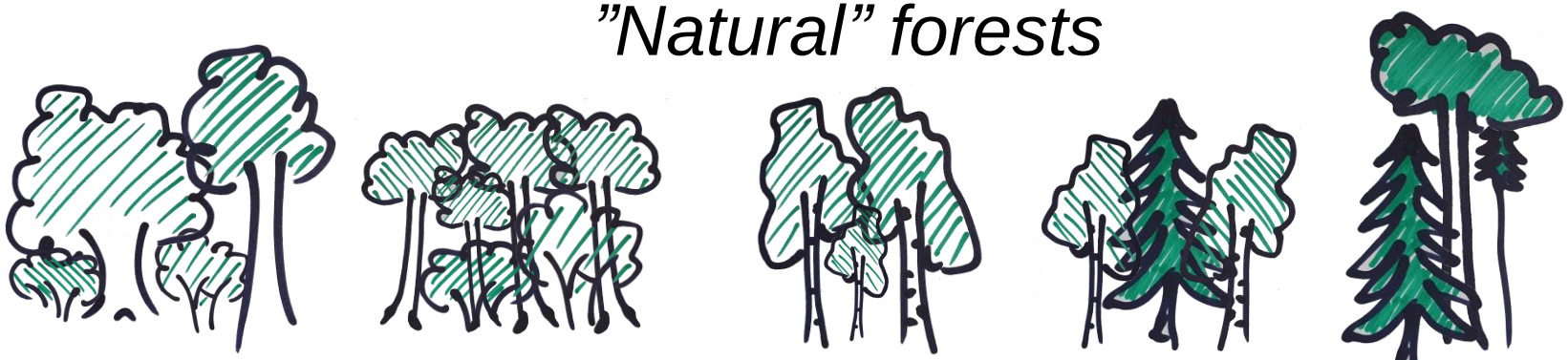
(Figure by O. Olsson)

Linking forest structures to indicators

”Natural” forests



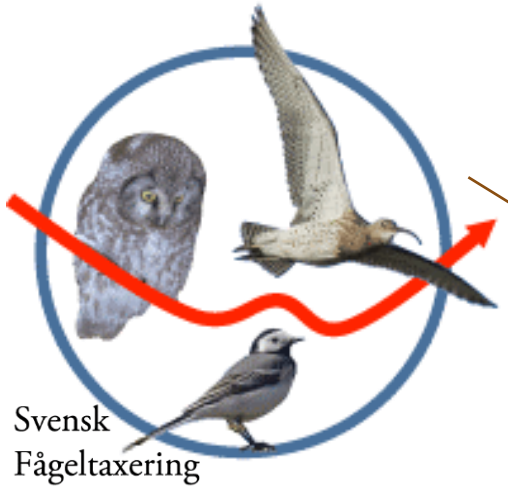
Managed forests

Well-being/recreation

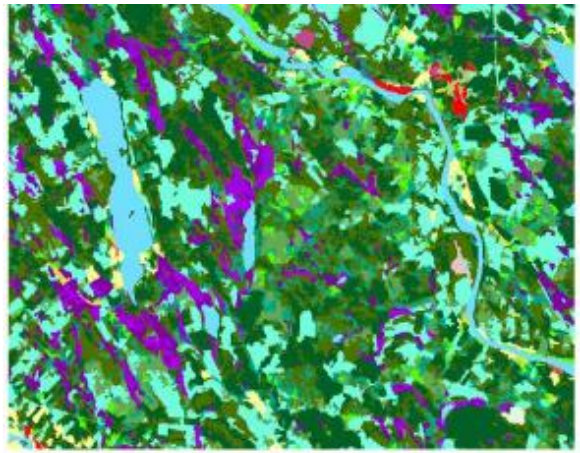
(Figure by O. Olsson)

Example: Modelling biodiversity

Monitoring data



Forest structure information

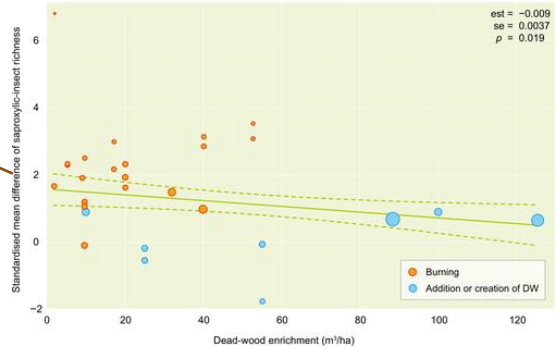


Biodiversity model

$$Y_{ij} \sim D(g(L_{ij}), \phi_j)$$
$$L_{ij} = L^F_{ij} + L^R_{ij}$$
$$L^F_{ij} = x_i \beta_j$$
$$L^R_{ij} \sim N(0, \Sigma)$$

Predicting

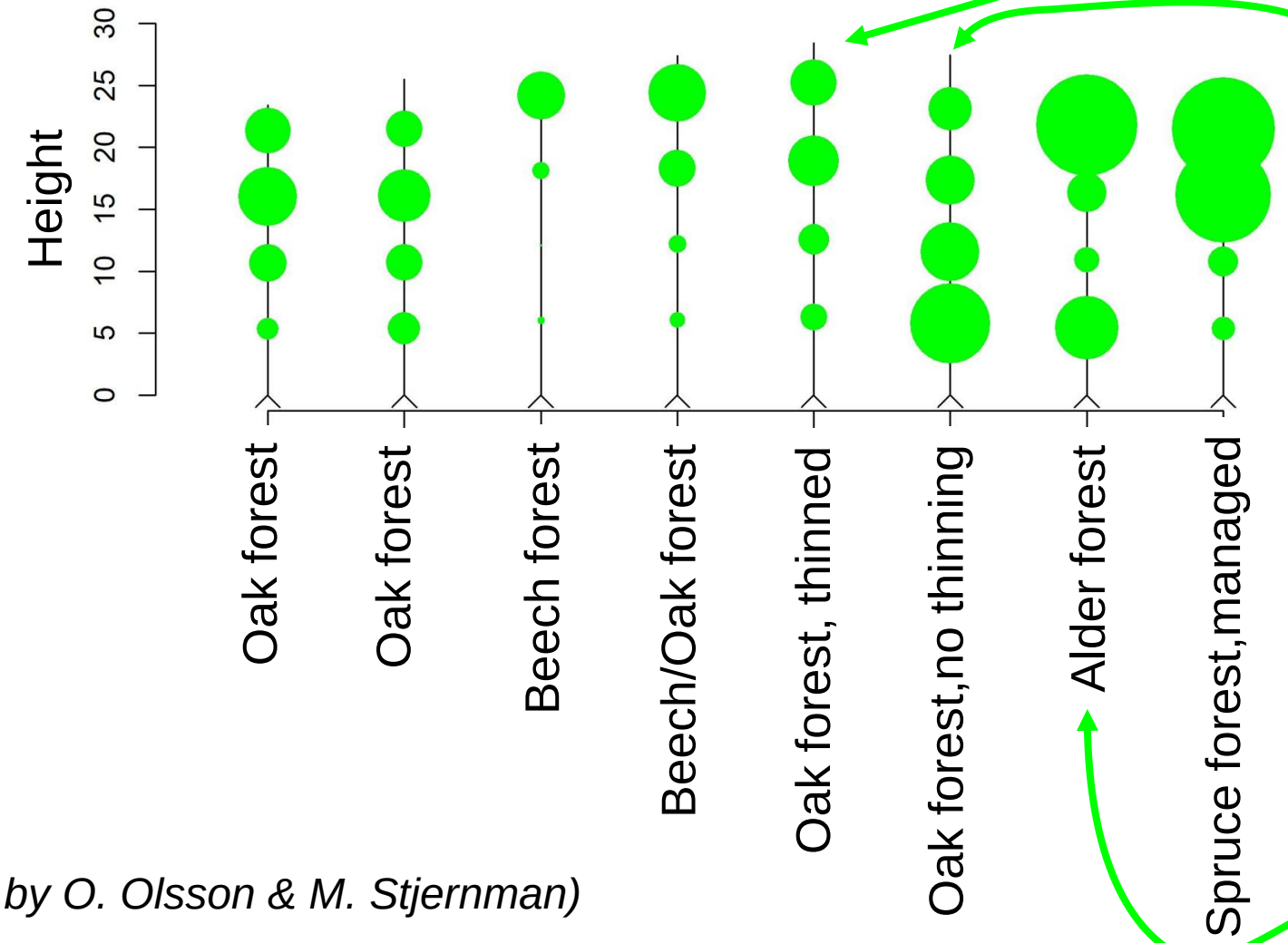
Simplified biodiversity model



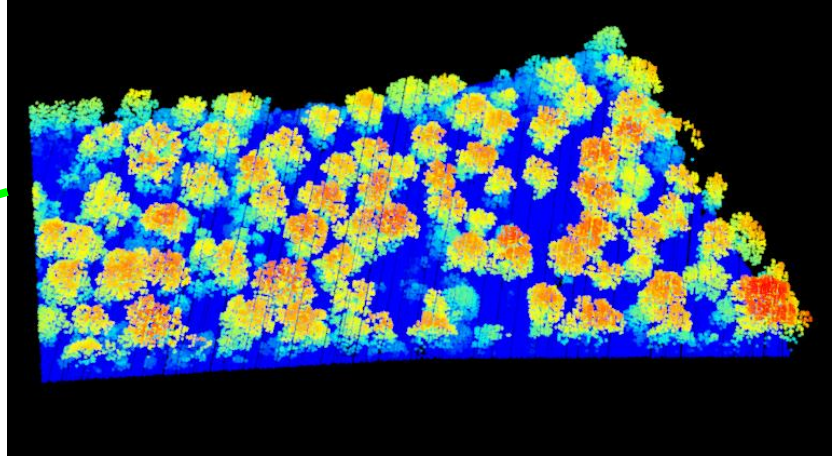
Understanding

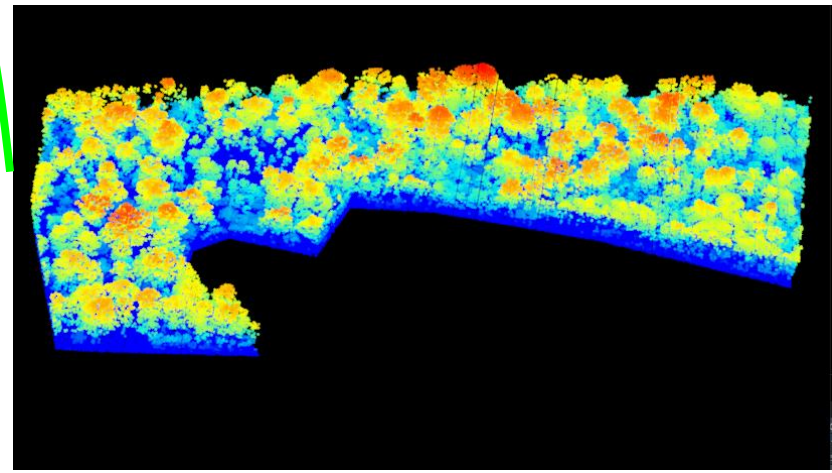
(Figure by H. Smith)

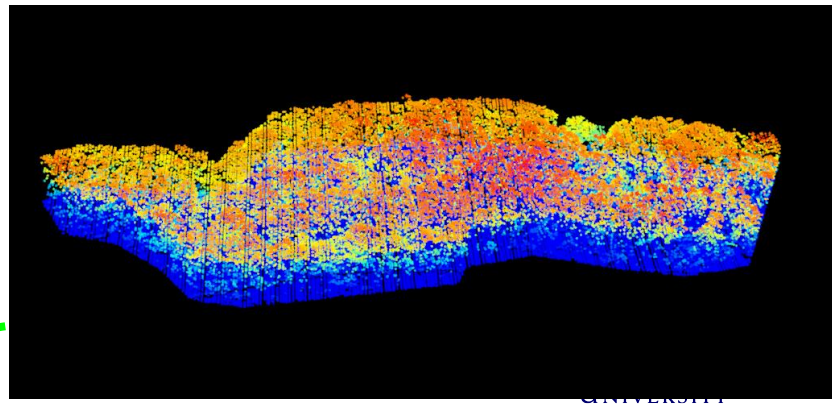
LiDAR data for forest structures



(Figure by O. Olsson & M. Stjernman)



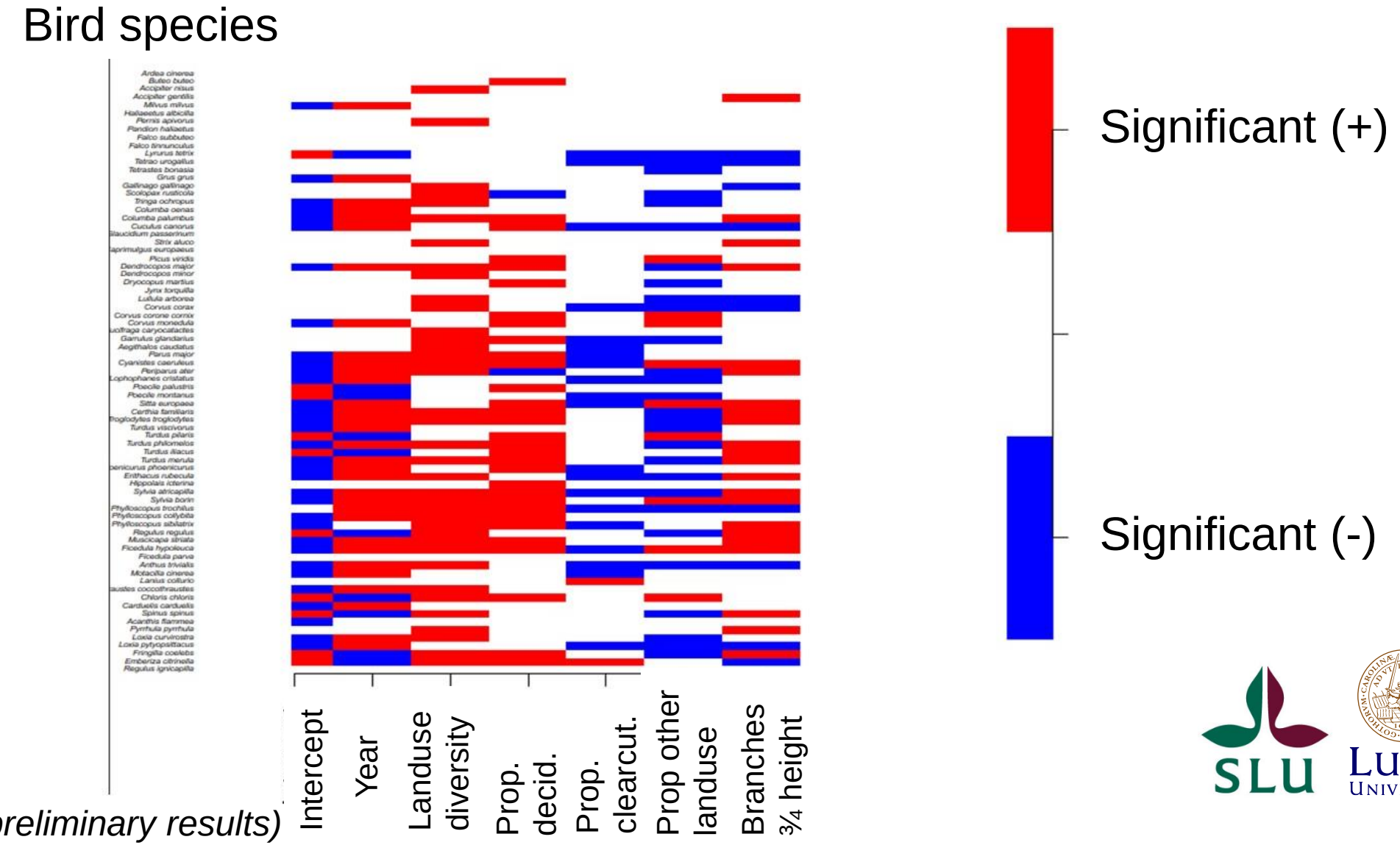




Roussel, J.R. et al. (2020). lidR : An R package for analysis of Airborne Laser Scanning (ALS) data. Remote Sensing of Environment, 251, 112061

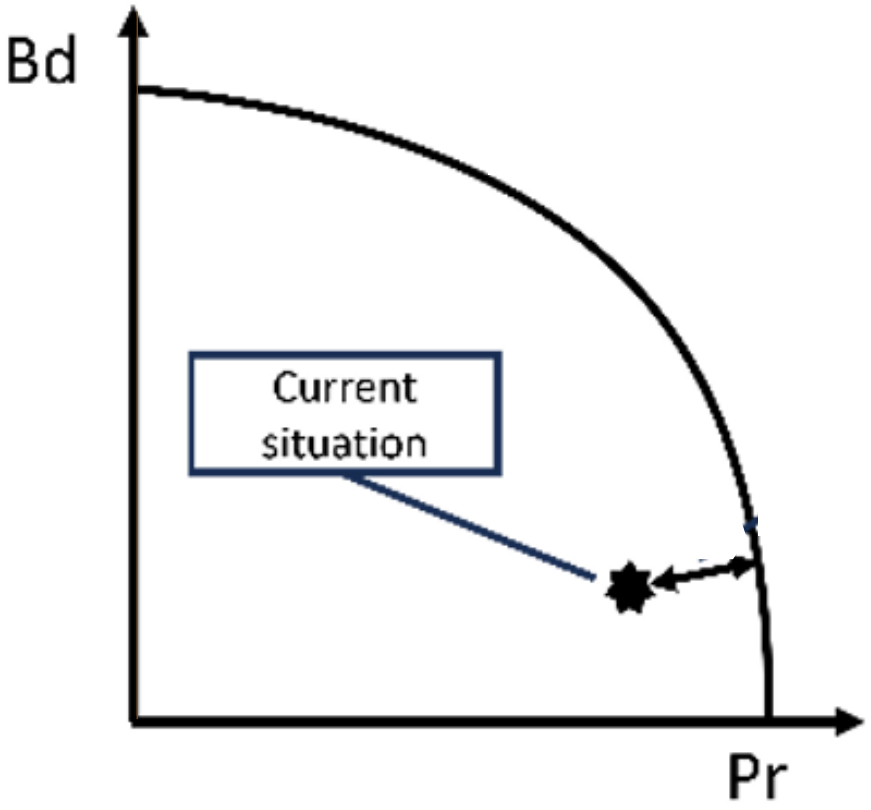
Roussel, J.R. et al. (2023). Airborne LiDAR Data Manipulation and Visualization for Forestry Applications. R package version 4.0.4.

Species niches – land use/forest structure dependence



(M. Stjernman, very preliminary results)

Possible solutions - In-sights from theories and review: Production vs biodiversity



(Figure by R. Trubins)

- Production close to its maximum, biodiversity is not.
- ”Collides” in 3 aspects: extraction of biomass, tree age, tree species distr.
- Possibility of trade-off alleviation theoretically high (spatial planning possible), but depends on choice of indicator

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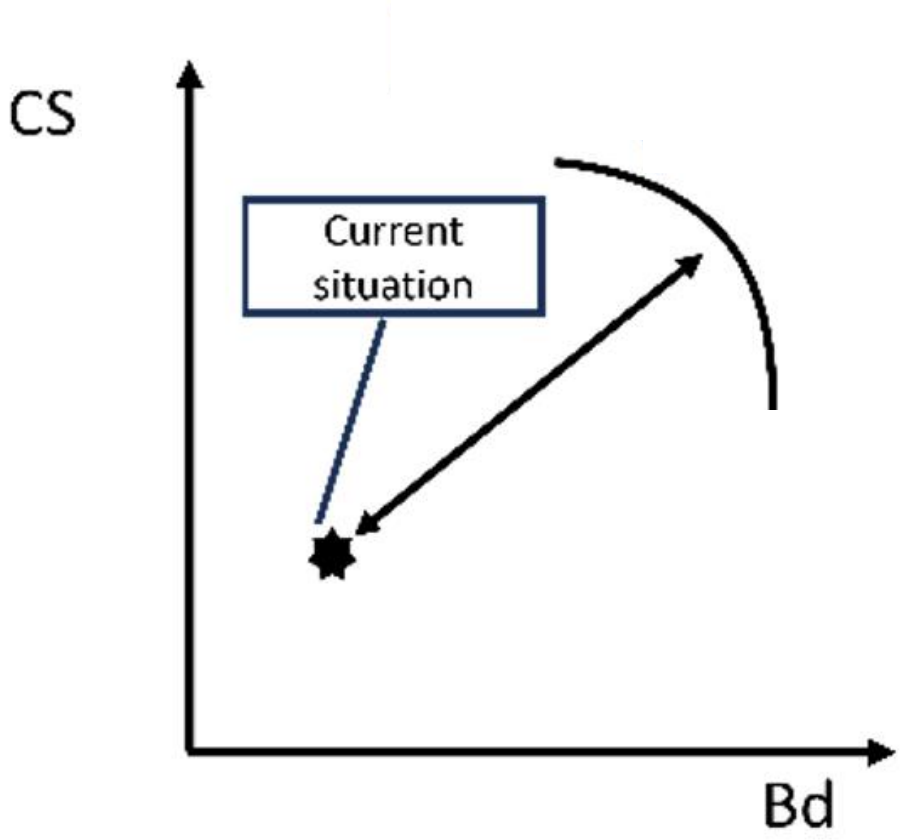
Possible solutions – In-sights from theories and review: Carbon storage vs biodiversity



(Figure by R. Trubins)

- Synergetic to a large extent due to the importance of old trees…
- …but biodiversity needs also succession and tree species diversity
- Management metods, e.g. fertilization, increases C storage but not biodiversity
- Big potential to increase both… but it will affect production

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Paper to be submitted soon: Akselsson et al: *Integrated consideration of private and public ecosystem services provided by forests – Pathways to multifunctionality*

Obrigado!