Connectivity and Habitat Suitability of Green Infrastructure in the Boreal Forest of Sweden

Ewa H. Orlikowska, PhD

Photo: G. Mikusiński

ewa.orlikowska@kau.se @ewa_orlikowska

Outline

1. Perspective: the Challenges
2. Green Infrastructure – Definition & Implementation
3. Aim & Objectives of the Study
4. Methods
5. Key Results
6. Conclusions
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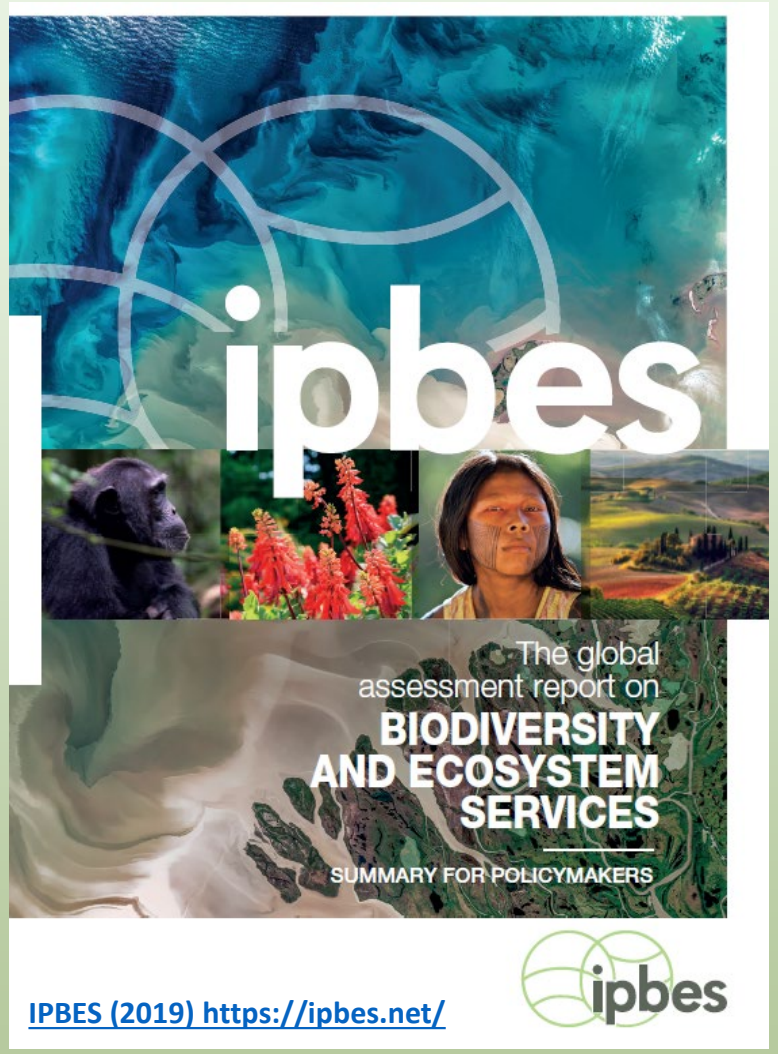
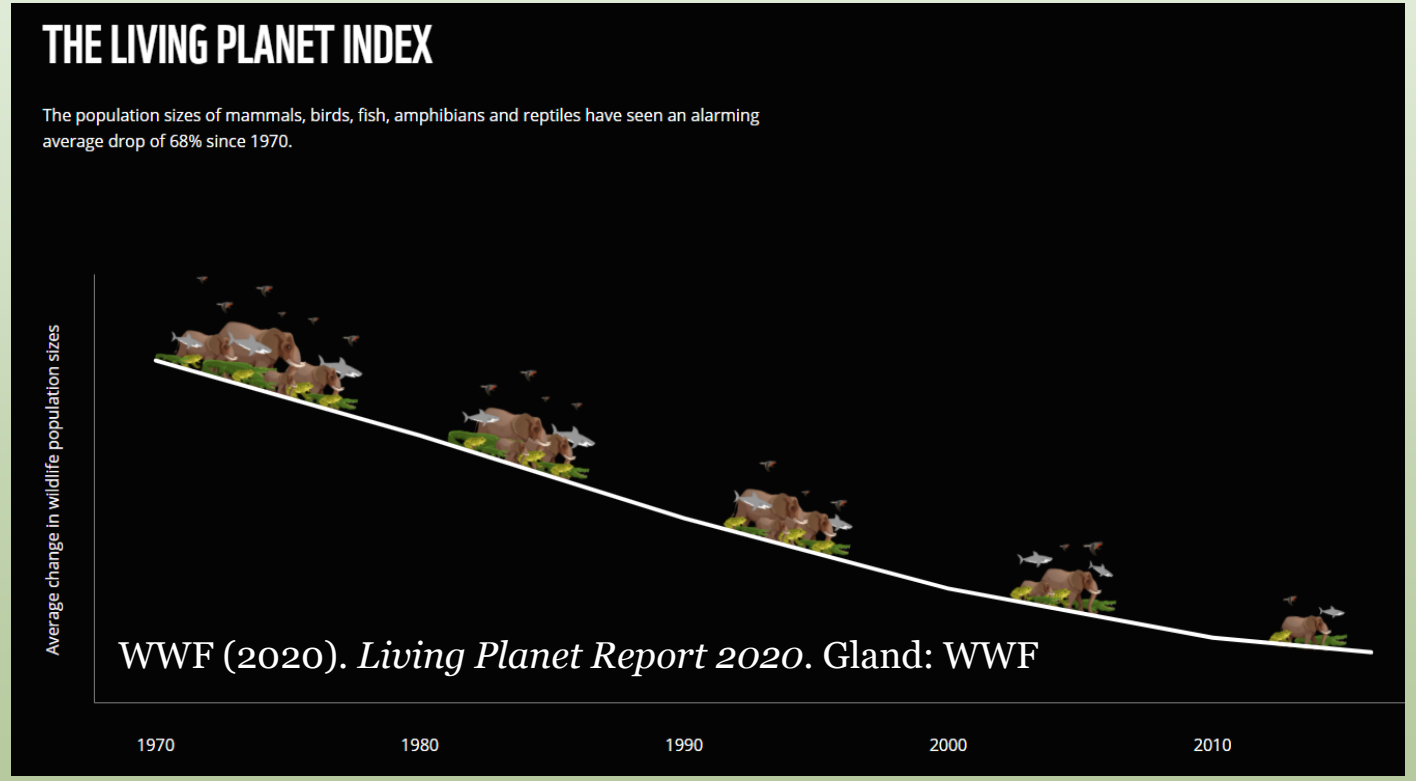
Challenges



IPBES (2019) https://ipbes.net/

Biodiversity Loss

Sixth Mass Extinction (Barnosky et al. 2012; Díaz et al. 2019)



WWF (2020). *Living Planet Report 2020*. Gland: WWF

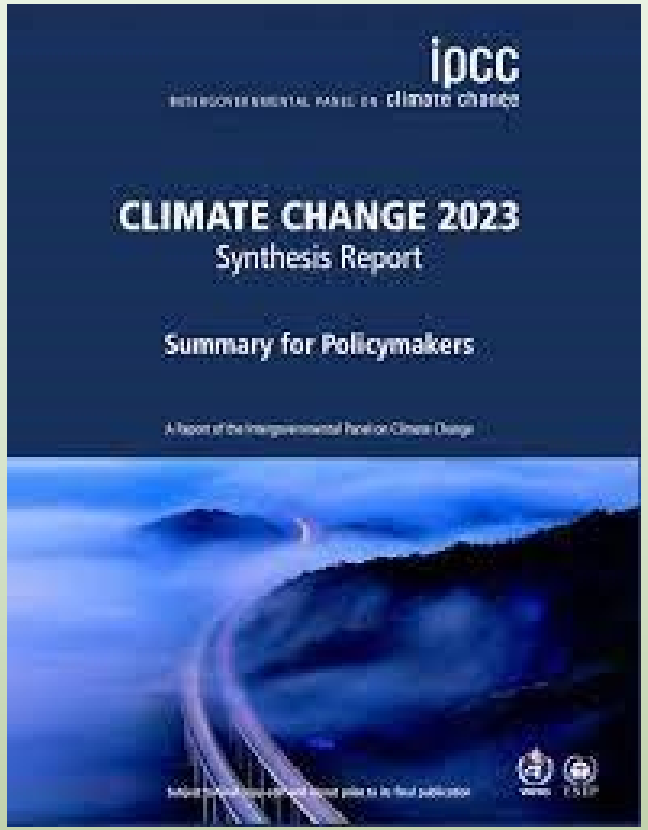
Challenges

Climate Change

Global warming of ~ 1.0°C above pre-industrial conditions
50% chance of 1.5°C warming 2021-2040 (IPCC 2023; Bradshaw et al. 2021).

Land-Use Change

Habitat loss - decreased species richness & population sizes, reduces genetic diversity within a species (Reidsma et al. 2006; Chazal and Rounsevell 2009; Hansen et al. 2012)



IPCC 2023 Synthesis Report

Solutions?

International and national goals for the future proposed - not met:

Aichi Biodiversity Targets for 2020 (Secretariat of the Convention on Biological Diversity; UNEP-WCMC and IUCN (2021) Protected Planet Report 2020)

Nature related United Nations Sustainable Development Goals (e.g., **SDGs 6, 13–15**; Wackernagel et al. 2017; Díaz et al. 2019; Messerli et al. 2019)

Swedish Environmental Objective "Sustainable Forests" (SEPA 2020)

Green Infrastructure (GI)

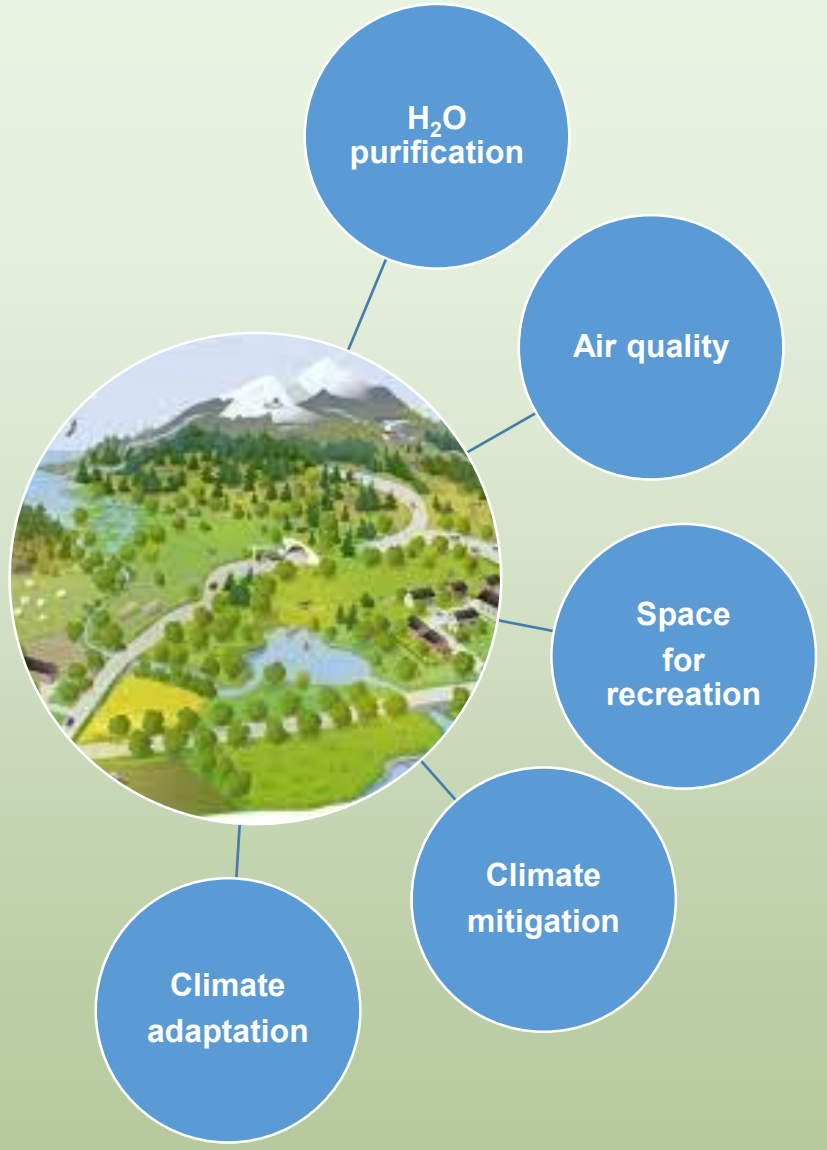
GI *sensu* EU 2013 – ”a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ES & to improve connectivity of protected areas in order to promote multifunctional landscapes”

Natura 2000 as a backbone of the EU GI (eur-lex.europa.eu, 2013)

GI implementation by the EU member states (Slätmo et al., 2019)

GI in Sweden - Strategy for Biodiversity and Ecosystem Services (2013)

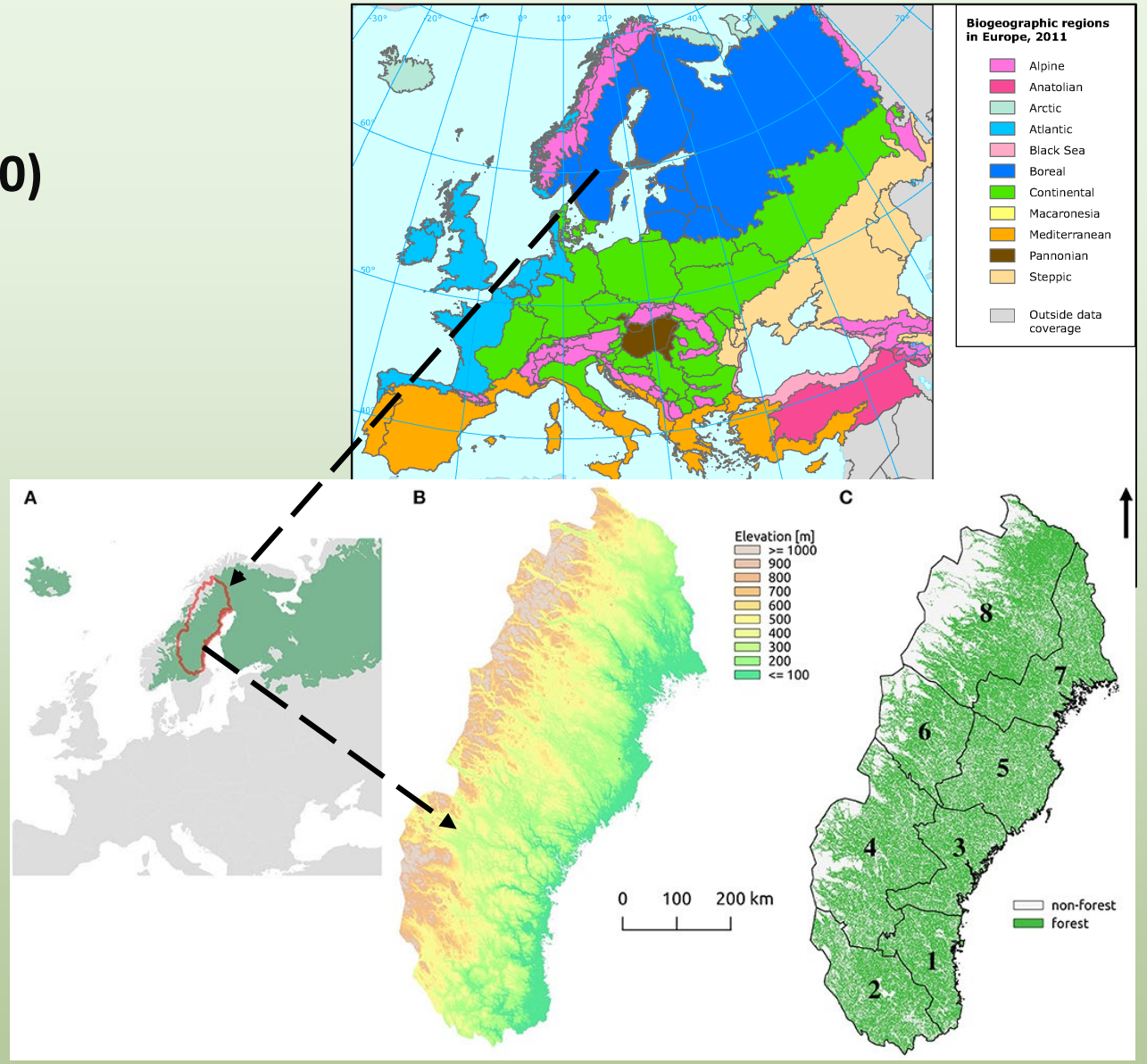
GI implementation in Sweden (SEPA, CABs)



Study Area

27.0 mln ha - 18.9 million ha forest (SLU, 2020)

- 67% of all forest land in Sweden
- 80% boreal forest
- 80% productive forest land
    - Scots pine (*Pinus sylvestris*) 44%
    - Norway spruce (*Picea abies*) 19.7%
    - Mixed coniferous forest 12.6%
    - subalpine mountain birch (*Betula pubescens* ssp. *czerepanovii*) 17.18%



Aim

to analyze and evaluate planning routes toward functional GI in boreal Sweden

- spatial relationships between unprotected & protected forests

Objectives

1) **spatial overlap of pCF and HCVF** & how it varies across the boreal region

2) **potential increase of habitat area for virtual species** for all identified primary forests

3) **assess how large-scale connectivity** patterns varies among the protected primary forests, all primary forests, and all forestlands used as the baseline reference

Methods

Data:

HCVF (protected and unprotected) - delineated based on forest cover of the national topographic terrain (1:50,000) and road maps (1:100,000), and their high conservation values validated via field surveys (Anon 2017)

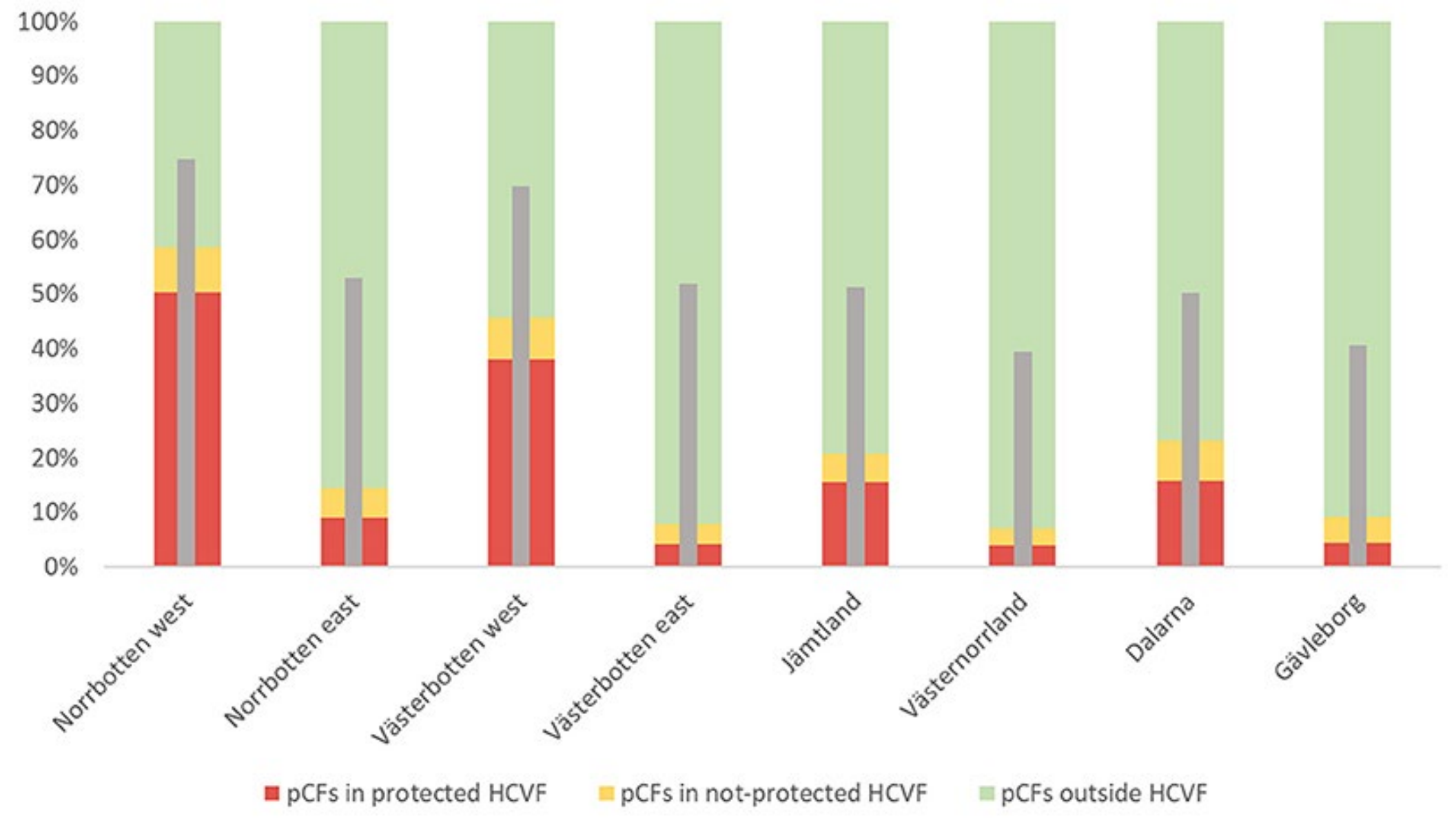
pCF - complete-coverage continuous raster with remnant forest patches not clearcut since the 1950s; automatic change-detection analysis of a time series of satellite images (1973 to 2016) + aerial photos (1950s &1960s) (Ahlcrona et al., 2017)

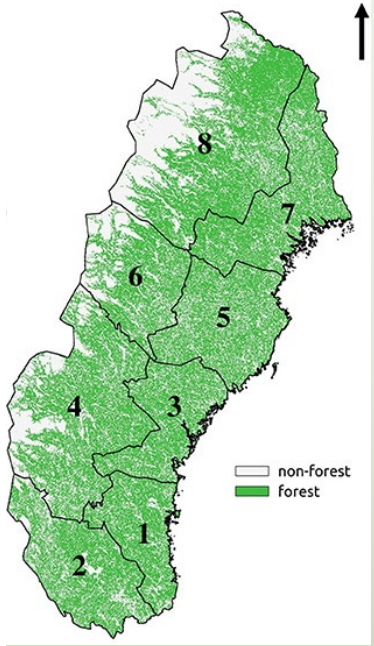
National land cover database (NMD) - forest environments are classified into seven main forest types & divided into stands located on upland soils and on wet soils (14 classes in total) (SEPA, 2019)

Analyzes:

Spatial overlap between pCF and HCVF; large-scale connectivity analysis; GIS-based HSI models for virtual species (pine, spruce, and broadleaf forests)

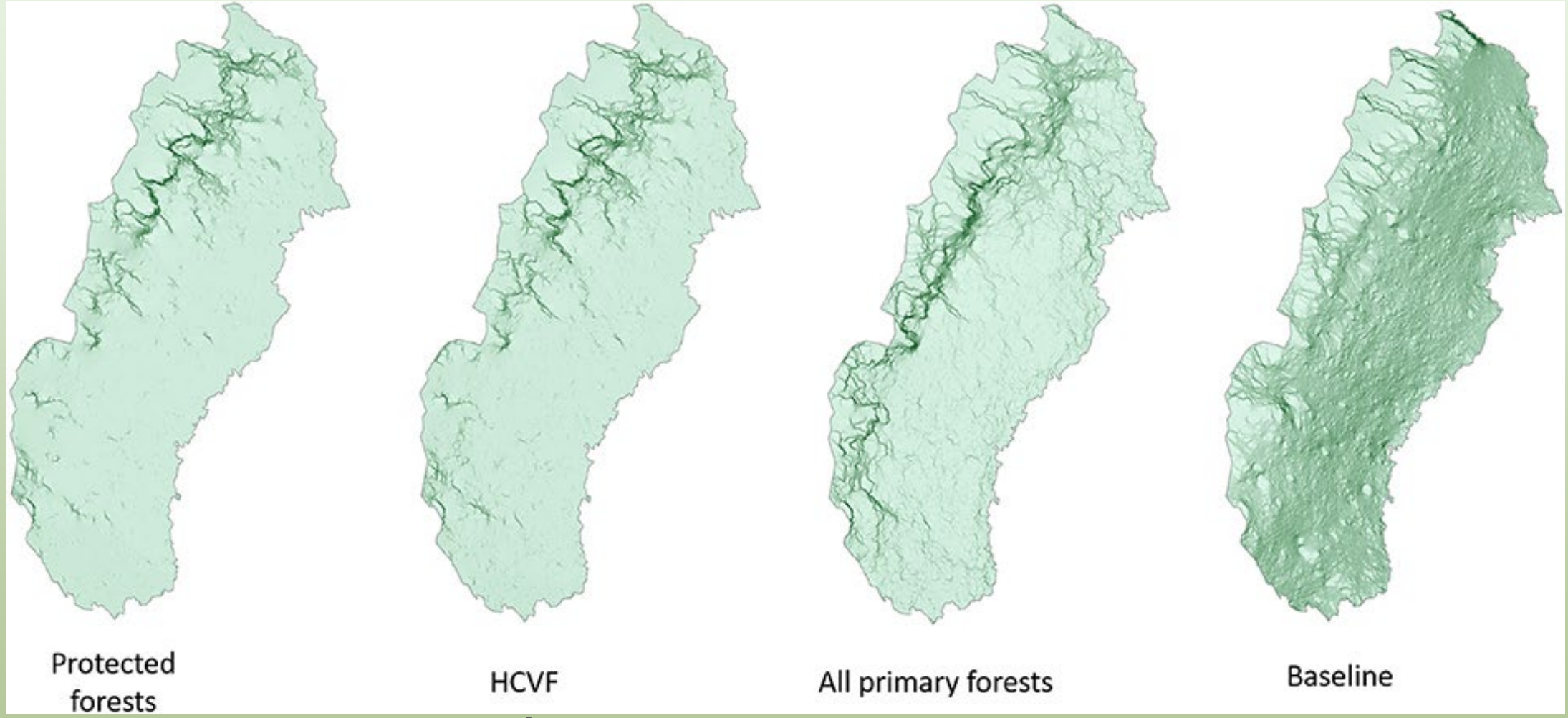
Spatial overlap of pCF and HCVF





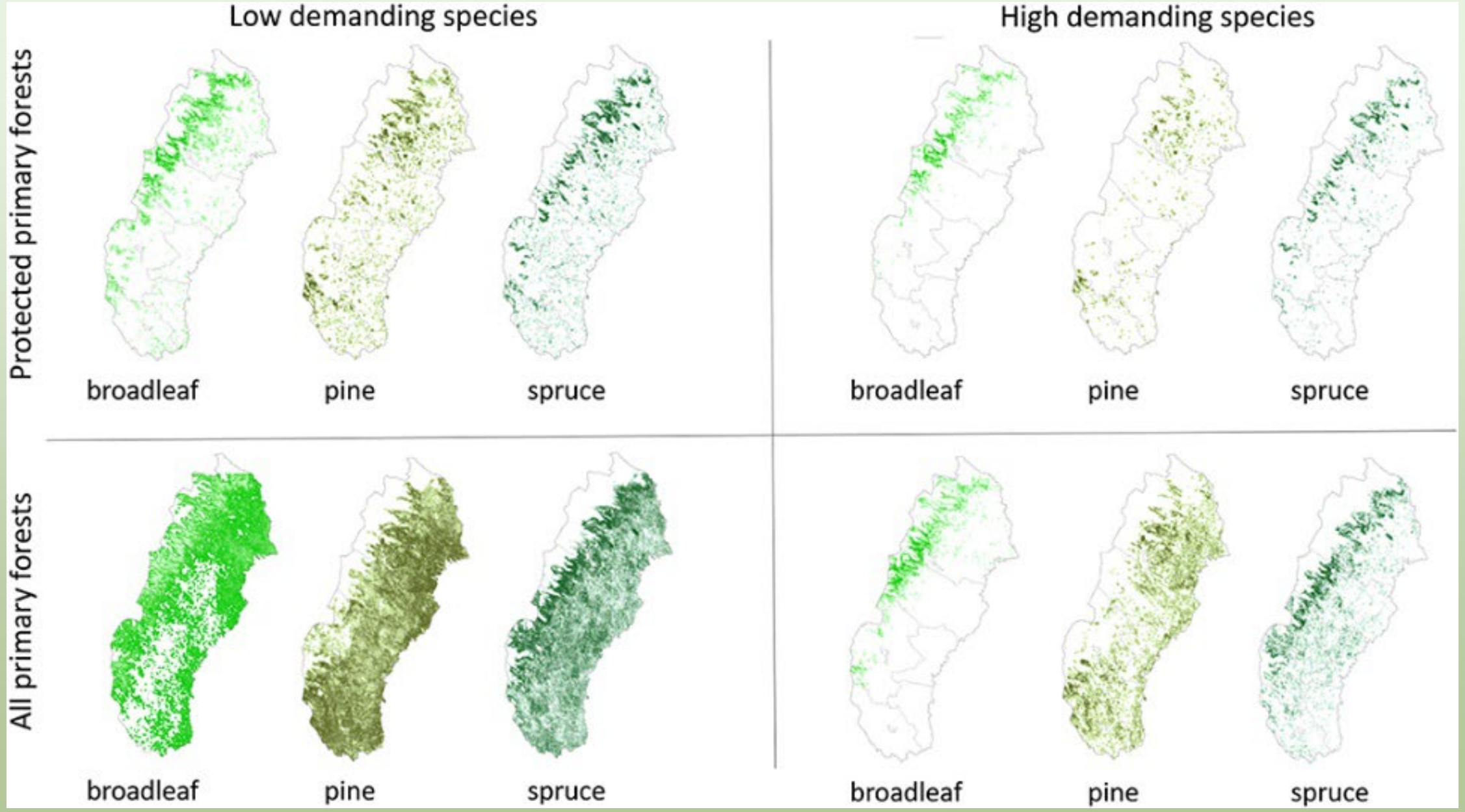
pCF (not clearcut since 1950s) **HCVF (protect.+non-protect.) - High Conservation Value Forests**

Connectivity of Boreal forests in Sweden



= HCVF protect. **= HCVF (protect.+non-protect.)** **= pCF+HCVF (protect.+non-protect.)** **= all forests**

Habitat Suitability in Boreal Forests in Sweden



Conclusions

1. Boreal Sweden - structural connectivity of the protected forests - improved when included forests with long temporal continuity (pCF) and non-protected forests with known high conservation values (HCVF)

2. Boreal Sweden - habitat area for low-demanding species dependent on spruce or pine forests - enlarged if continuity (pCF) and non-protected high-conservation forests (HCVF) included

3. Boreal Sweden - restoration needed in the landscape matrix for high-demanding species and broadleaf-dependent species - not enough broadleaf forests to provide suitable habitat for associated species

Contribution to Policy

Results can be used for:

a) planning and developing GI in Sweden

b) to provide information for fulfilling Sweden's obligations for the EU Biodiversity Strategy for 2030 to reach at least 30 % of protected terrestrial and marine areas & to restore at least 30 % of degraded ecosystems at the EU level by 2030

c) global goals (Achi Target 11, globally only 7.84% of the terrestrial surface protected & connected; Protected Areas 2020 report)

d) Swedish Environmental Objective "Sustainable Forests"

THANK YOU!

frontiers in Ecology and Evolution

ORIGINAL RESEARCH
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Paper III

Strengthening the Network of High Conservation Value Forests in Boreal Landscapes

Grzegorz Mikusiński[1,2], Ewa H. Orlikowska[2], Jakub W. Bubnicki[3], Bengt Gunnar Jonsson[4,5] and Johan Svensson[5]*

Main author

Grzegorz Mikusiński, PhD
School for Forest Management,
Skinnskatteberg, SLU, Sweden

Co-authors

Jakub W. Bubnicki, PhD
Polish Academy of Sciences
Białowieża, Poland

Bengt-Gunnar Jonsson, Prof.
Mid Sweden University
Sweden

Johan Svensson, PhD
Dept. of Wildlife, Fish and Environmental Studies (WF&ENVS), SLU, Sweden

ewa.orlikowska@kau.se @ewa_orlikowska