

# Critical biomass harvesting in policy support in northern forests

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# Goal conflicts related to harvesting of branches and tops (for renewable energy)

- Climate change increase the demand of renewable energy
- Harvesting of branches and tops may lead to negative effects for other goals, mainly biodiversity and acidification



# The acidification goal is not reached and lakes need to be limed

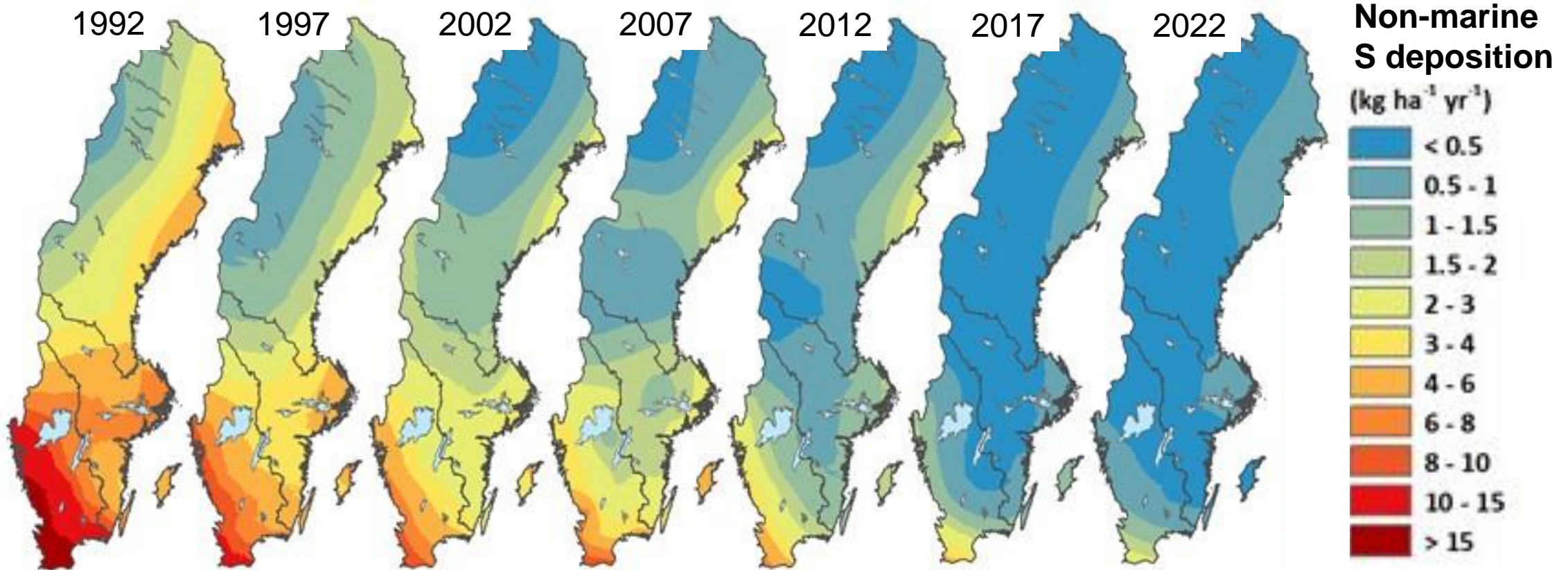
- The national acidification target will not be reached to 2030: ”...Nationally, measures are required mainly to reduce the impact of forestry.
- Liming of lakes in lakes in Sweden (ca 100 000 ton, 4500 lakes)



(Photo: Svenska Kalkföreningen)



# S deposition 1992-2022

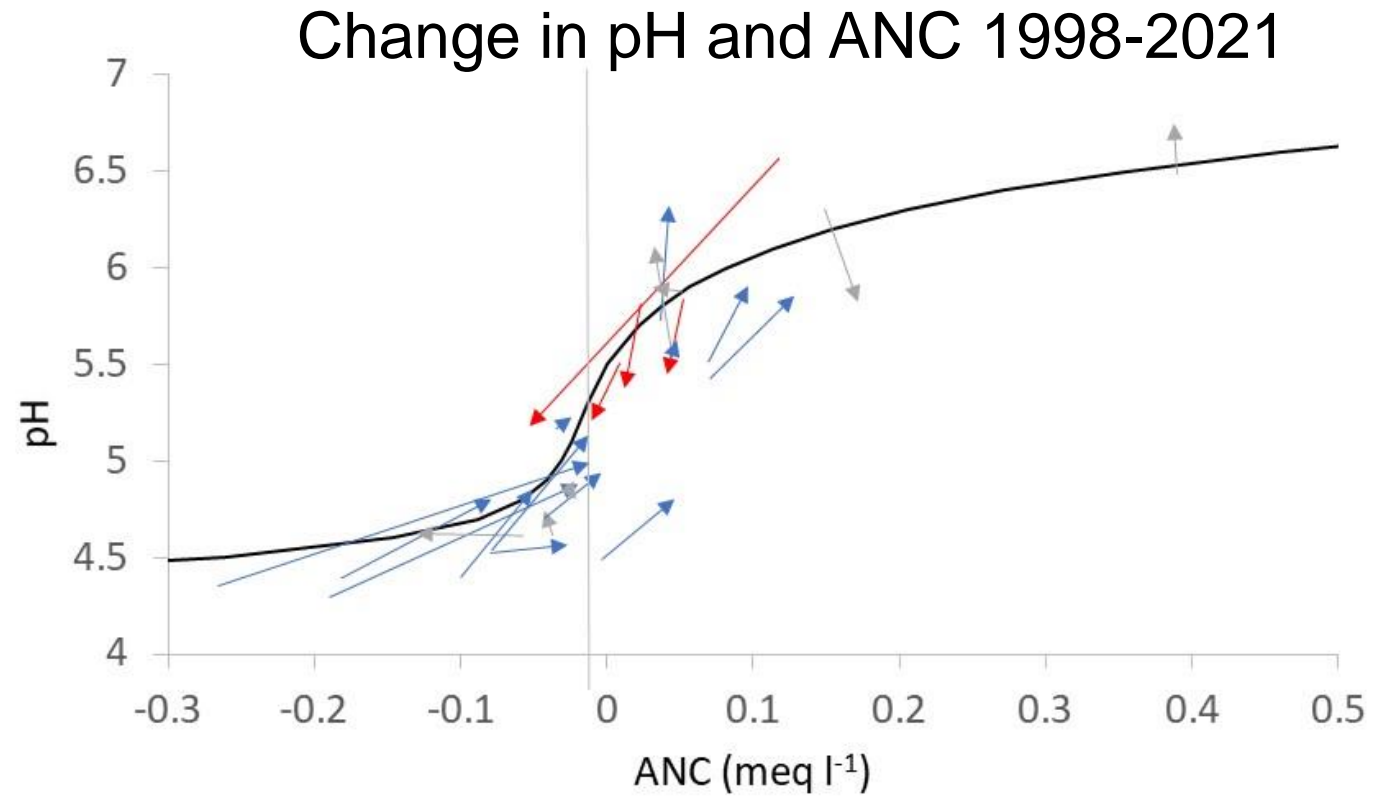
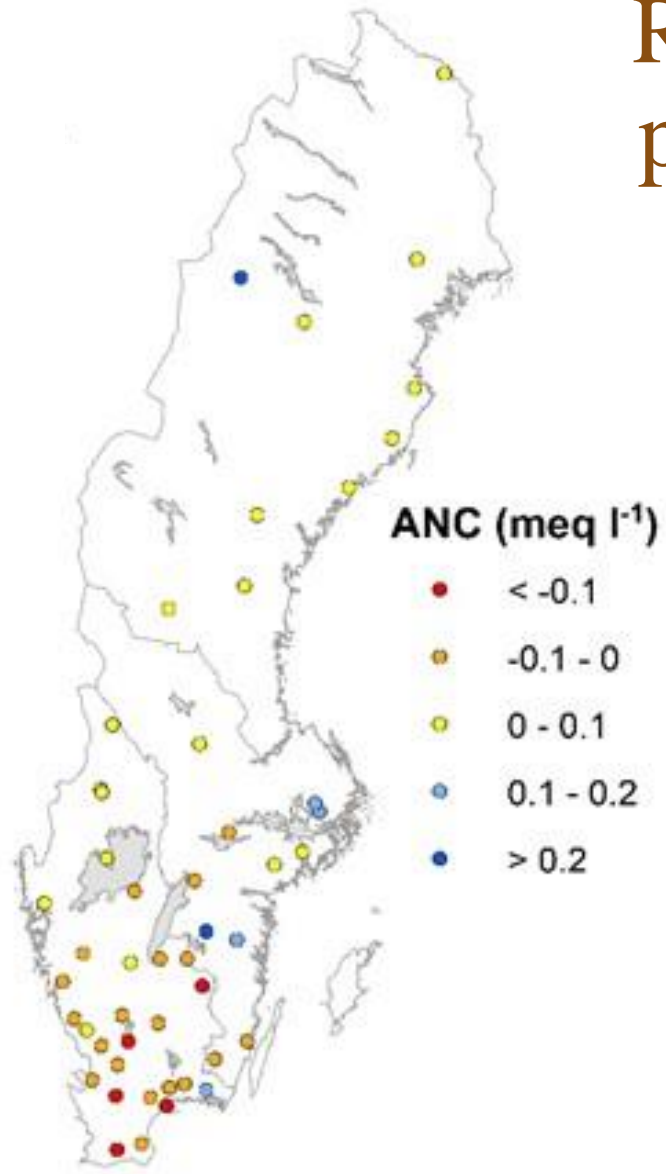


*Pihl Karlsson et al. (Manuscript)*



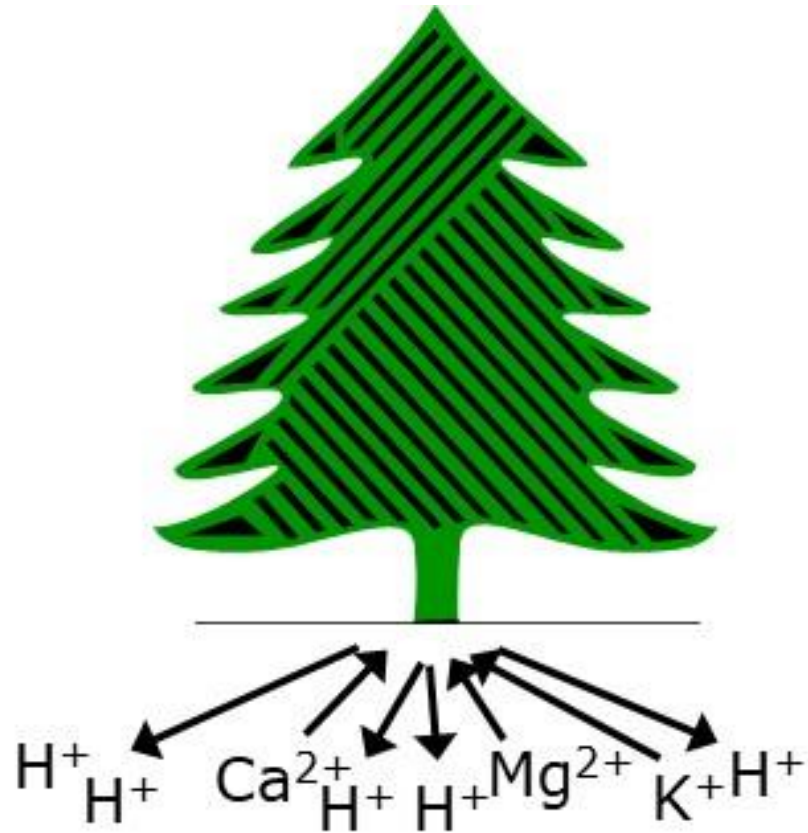
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# Recovery from acidification: pH and ANC in soil solution

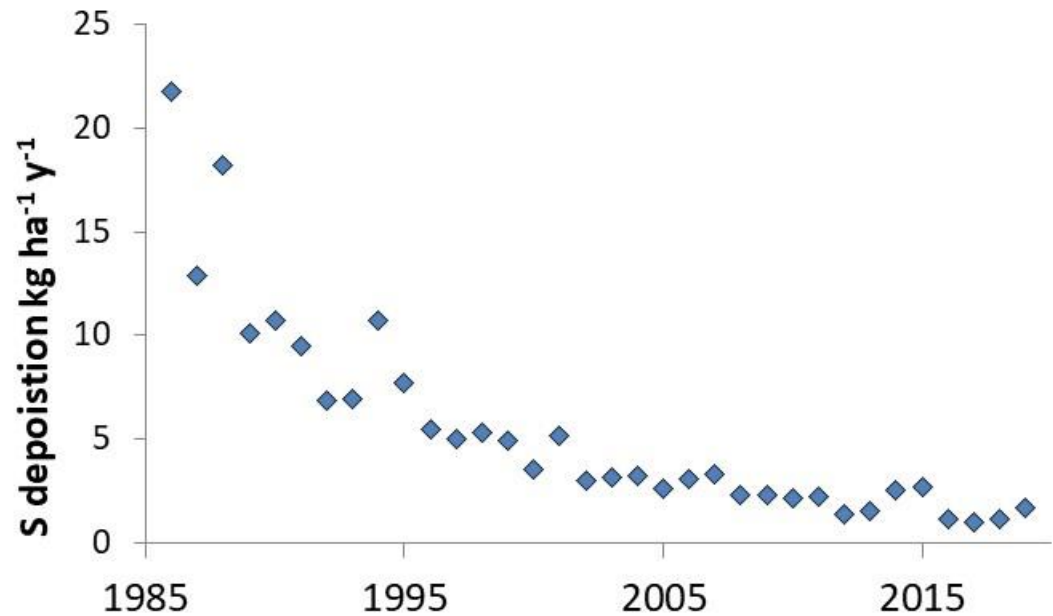


*Pihl Karlsson et al. (Manuscript)*

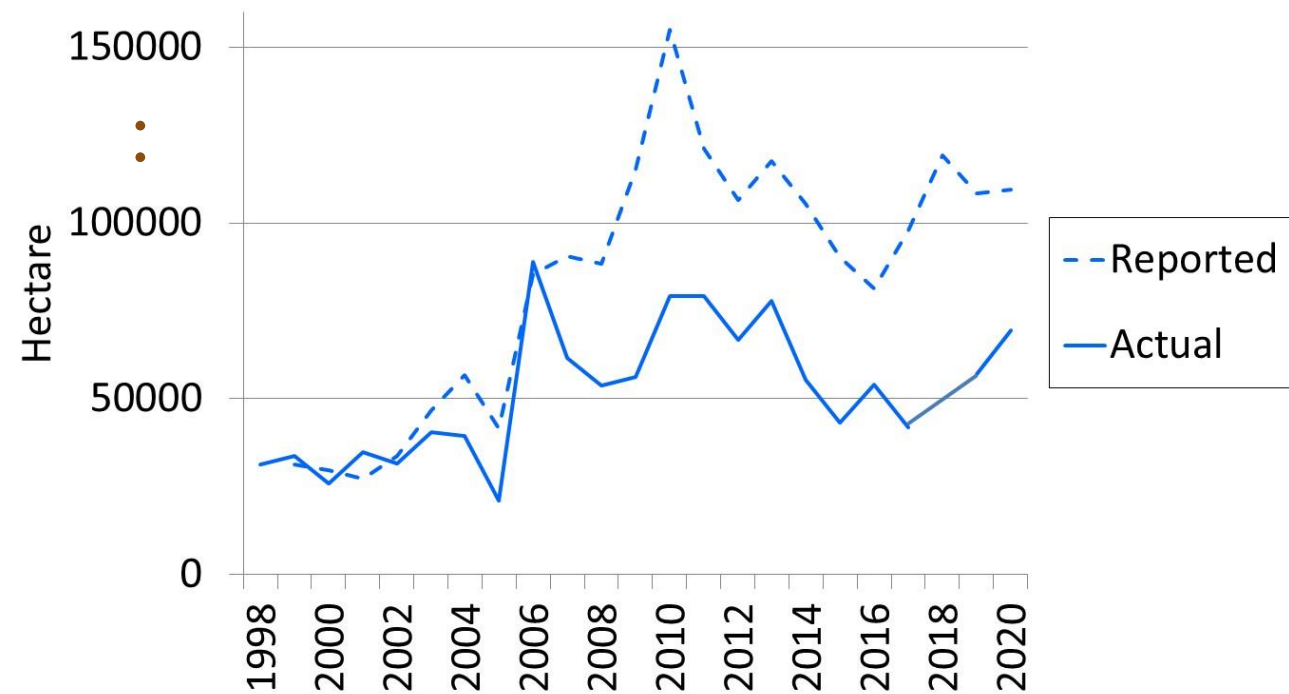
# Acidification from forestry



# The relative importance of harvesting increases: Need for an indicator for acidification from forestry



(Data from SWETHRO monitoring network, IVL)



(Data from Swedish Forest Agency)



# Point of departure for a new indicator: The critical loads concept

**The Critical loads concept: Based on equation balancing acidic inputs and outputs (derived from a charge balance):**

$$S_{\text{dep}} + N_{\text{dep}} + Cl_{\text{dep}} + BC_{\text{harv}} + Alk_{\text{leach}} = BC_{\text{dep}} + BC_{\text{weath}} + N_{\text{imm}} + N_{\text{harv}} + N_{\text{de}}$$

where

dep = deposition

BC = base cations (Ca, Mg, Na, K)

harv = harvesting of biomass

Alk<sub>utlak</sub> = alkalinity leaching

weath = weathering

imm = immobilization

de = denitrification

**Critical load formula:**

$$CL(S_{\text{dep}} + N_{\text{dep}}) = BC_{\text{dep}} + BC_{\text{weath}} + N_{\text{i}} + N_{\text{harv}} + N_{\text{de}} - Cl_{\text{dep}} - BC_{\text{harv}} - Alk_{\text{leach(crit)}}$$





# The concept “critical harvesting”

## Critical biomass harvesting:

$$\text{Critical BC}_{\text{harv}} = \text{BC}_{\text{dep}} + \text{BC}_{\text{weath}} - \text{S}_{\text{dep}} - \text{Cl}_{\text{dep}} - \text{NO}_3\text{-N}_{\text{leach}} + \text{NH}_4\text{-N}_{\text{leach}}$$

## Exceedance of critical harvesting:

$$\text{Exceedance} = \text{BC}_{\text{harv}} - \text{Critical BC}_{\text{harv}}$$

## Conditions and assumptions:

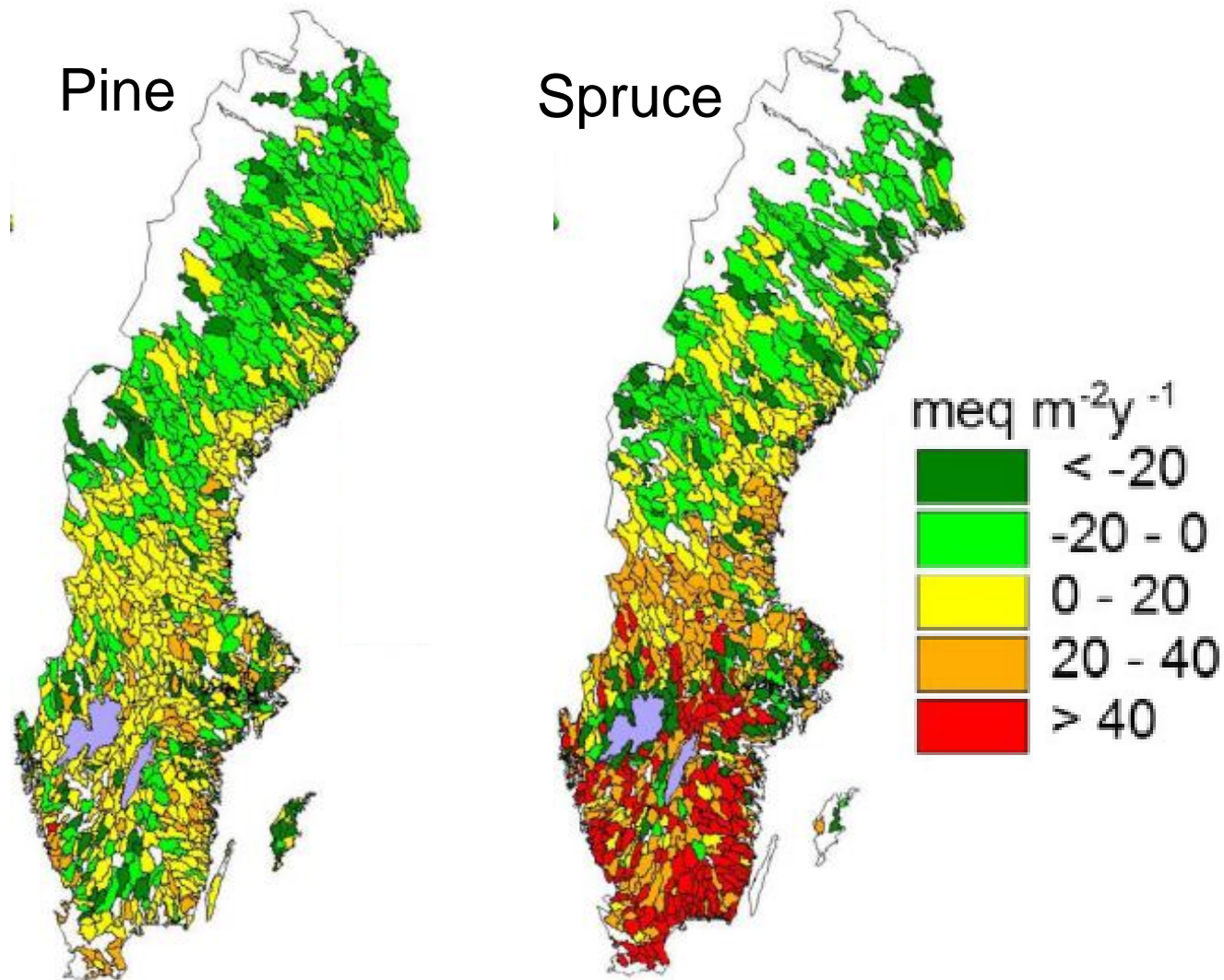
- Chemical criteria and critical limit: ANC below root zone=0
- S deposition at 2020 level
- Only the inorganic N that leaches affect acidification

*Akselsson et al., 2018 (Forest Ecology and Management)*



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# Exceedance of critical biomass harvesting if branches and tops are removed

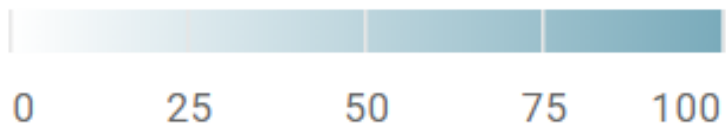


# Implementation in policies: Indicator for the acidification objective “Acidification from forestry”

- Fraction of final felled area where the harvesting of branches and tops leads to exceedance
- Areas with wood-ash recycling is subtracted



Försurning från skogsbruk 2020



# Going from research to policies: A few notes about the indicator and the process

- It took ca 10 years from idea to implementation (still discussed)
- Integrates info about the different conditions in different areas, frequency of harvesting of branches and wood ash recycling
- Exceedance after stem harvesting neglected (since it would be to “extreme” not to allow harvesting)
- Higher pressure on forest owners in the south to not harvest branches, and/or apply wood ash recycling (unequalities)
- Difficult to get good data (accurate information of reported harvesting of branches, but not the actual harvesting).

Thank you!



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