Ecological basis for preservation of forest biodiversity

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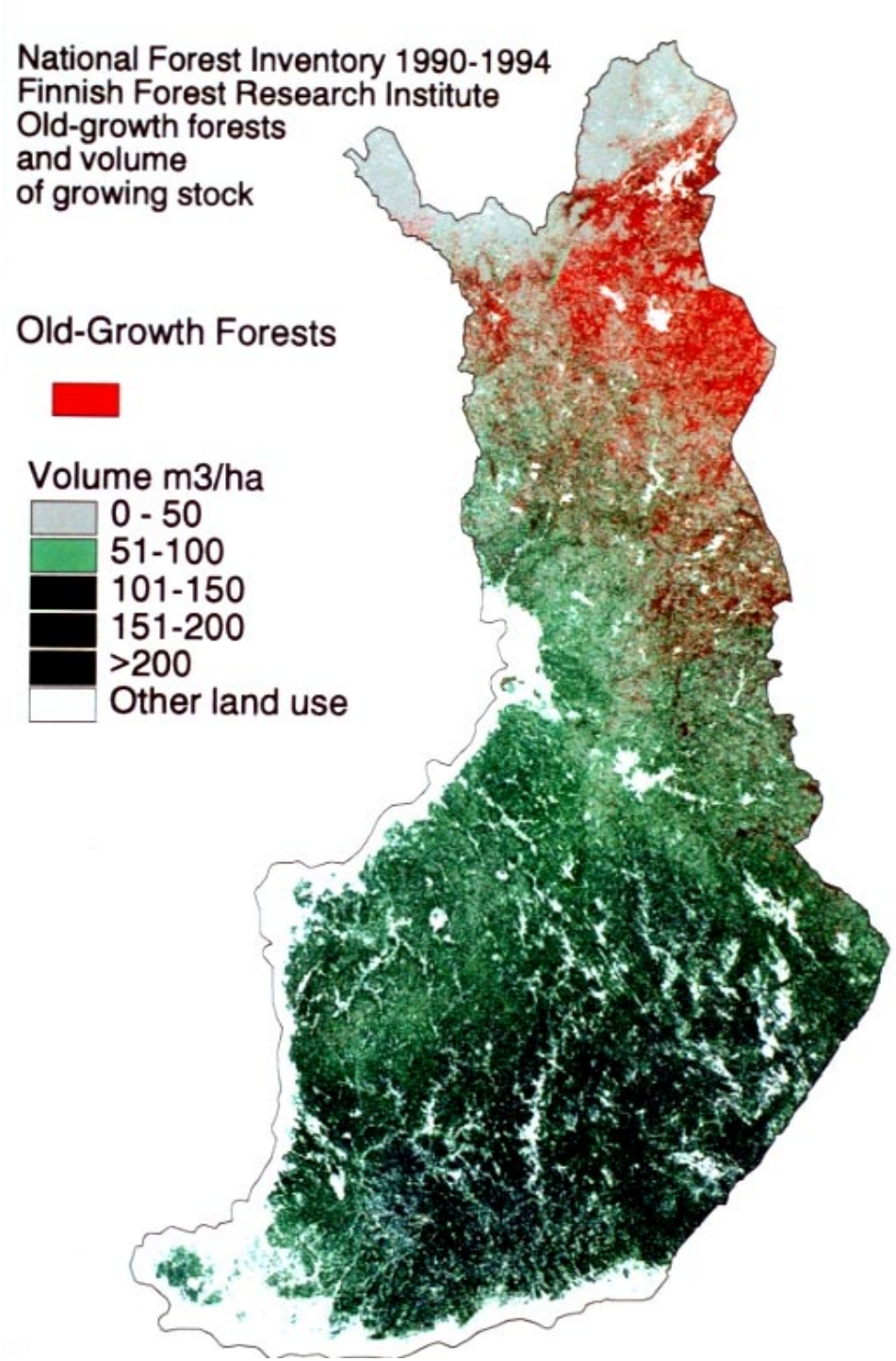
Contents

- How to assess the consequences of loss and fragmentation of natural forests?
- Time delay in the response of species to changing forest landscape
- Extinction thresholds and implications for biodiversity conservation
- Conclusion: What is needed to protect forest biodiversity?



Percentage of natural forests

S Finland	~ 1%
N Finland	~ 10%
Finland	~ 5%

Number of forest species in danger of going extinct - Estimate I

- About 20 000 forest species in Finland
- About 7 000 species have been classified, of which 62 (1%) extinct and 564 red-listed (8%)
- Assuming the same level of threat in all species, there are about 1 800 species that are either extinct or red-listed (in danger of going extinct) = 9%

The species-area relationship

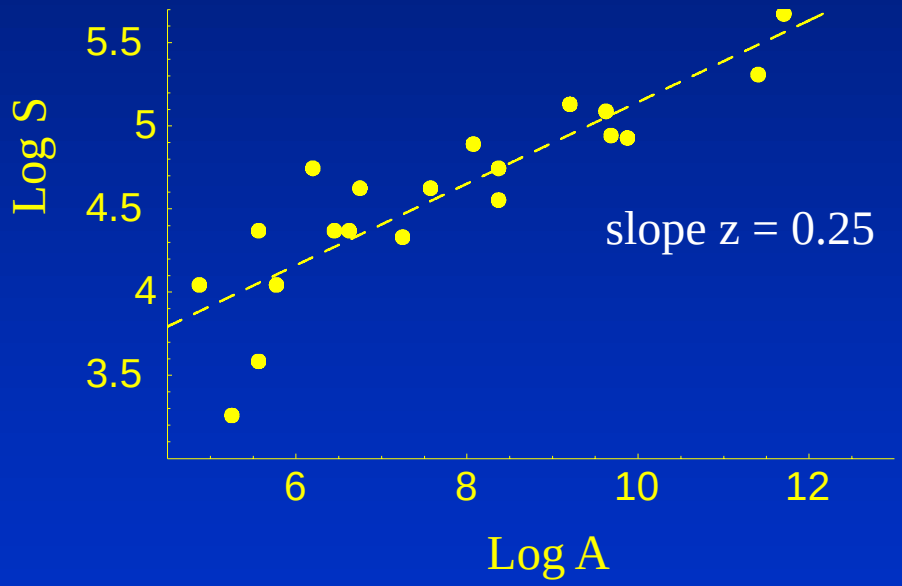
The Swedish ecologist Arrhenius suggested in 1921 that

$$S = kA^z$$

$$(\log S = \log k + z \log A)$$

In the formula,

- S is the number of species
- A is the amount of habitat
- k and z are constants



Example: birds on oceanic islands

Number of forest species in danger of going extinct - Estimate II

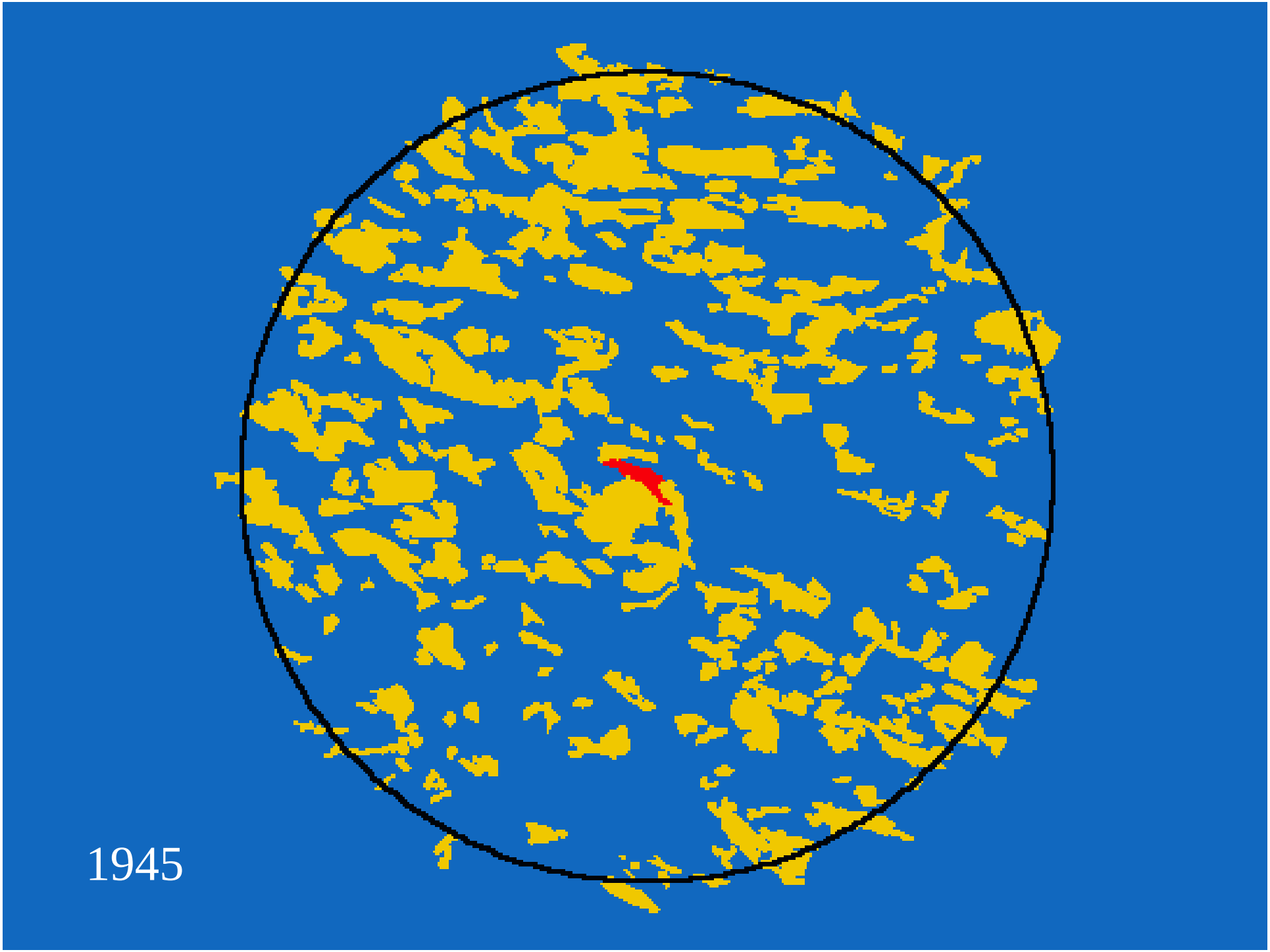
- About 20 000 forest species in Finland, of which 10% specific to natural-like forests
- The area of natural and semi-natural forests around 5% (or less) of their original extent
- Assuming z=0.25 in the species-area relationship ($S=kA^z$), 53% of species “committed to extinction”, which makes about 1 100 species

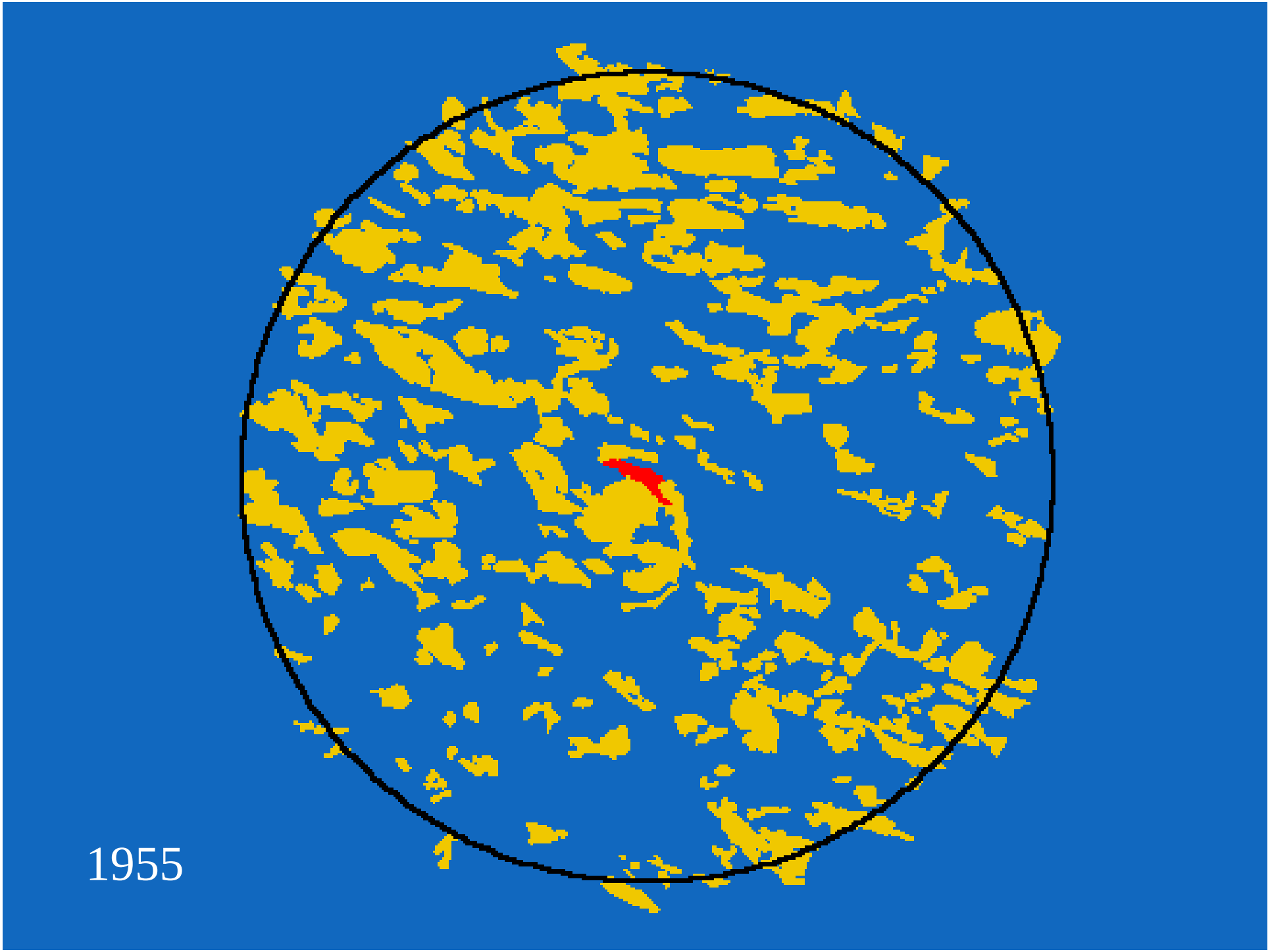
Message #1

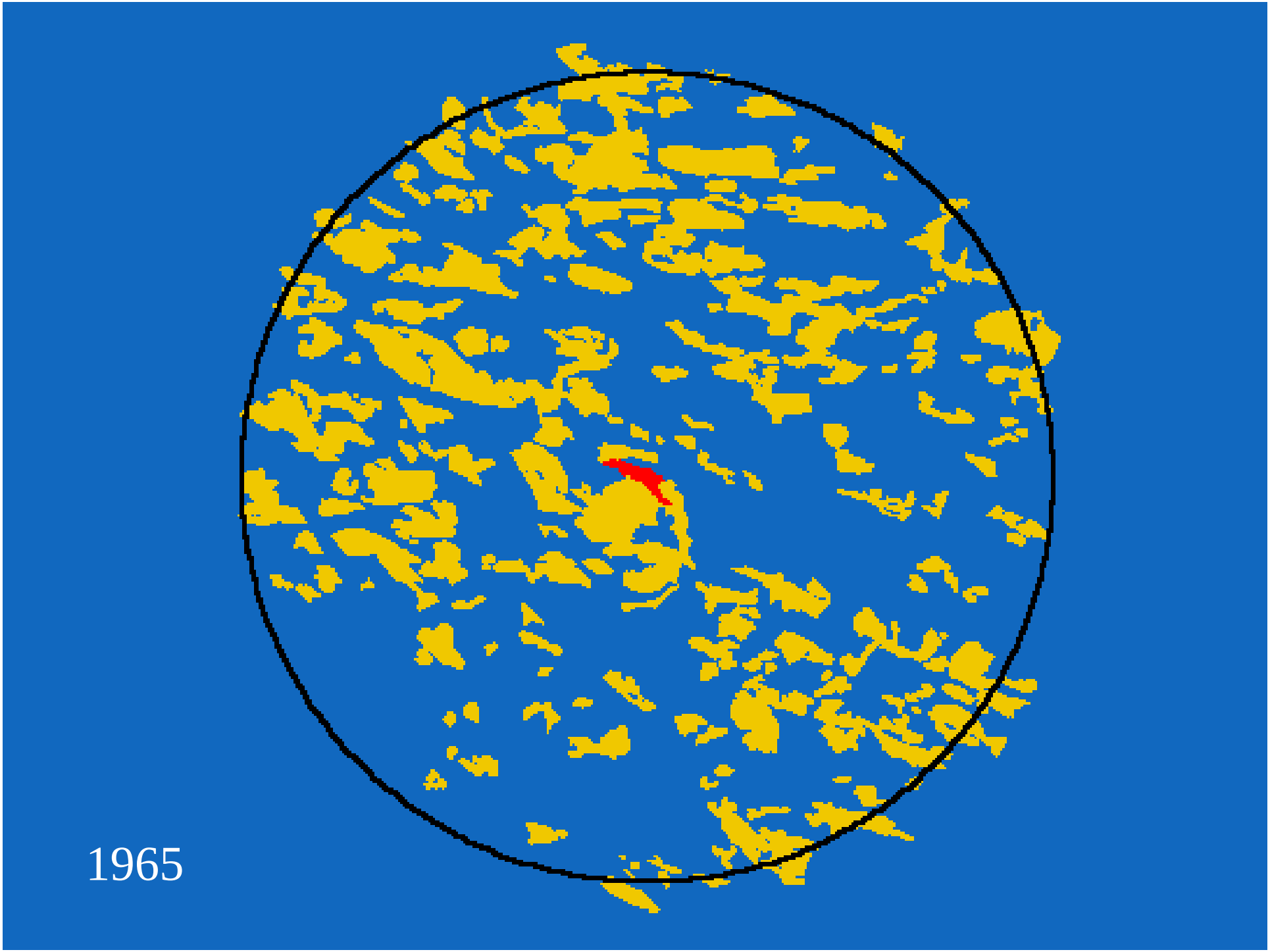
Successful protection of forest biodiversity at a national scale requires that a sufficient amount of natural or natural-like forests remains

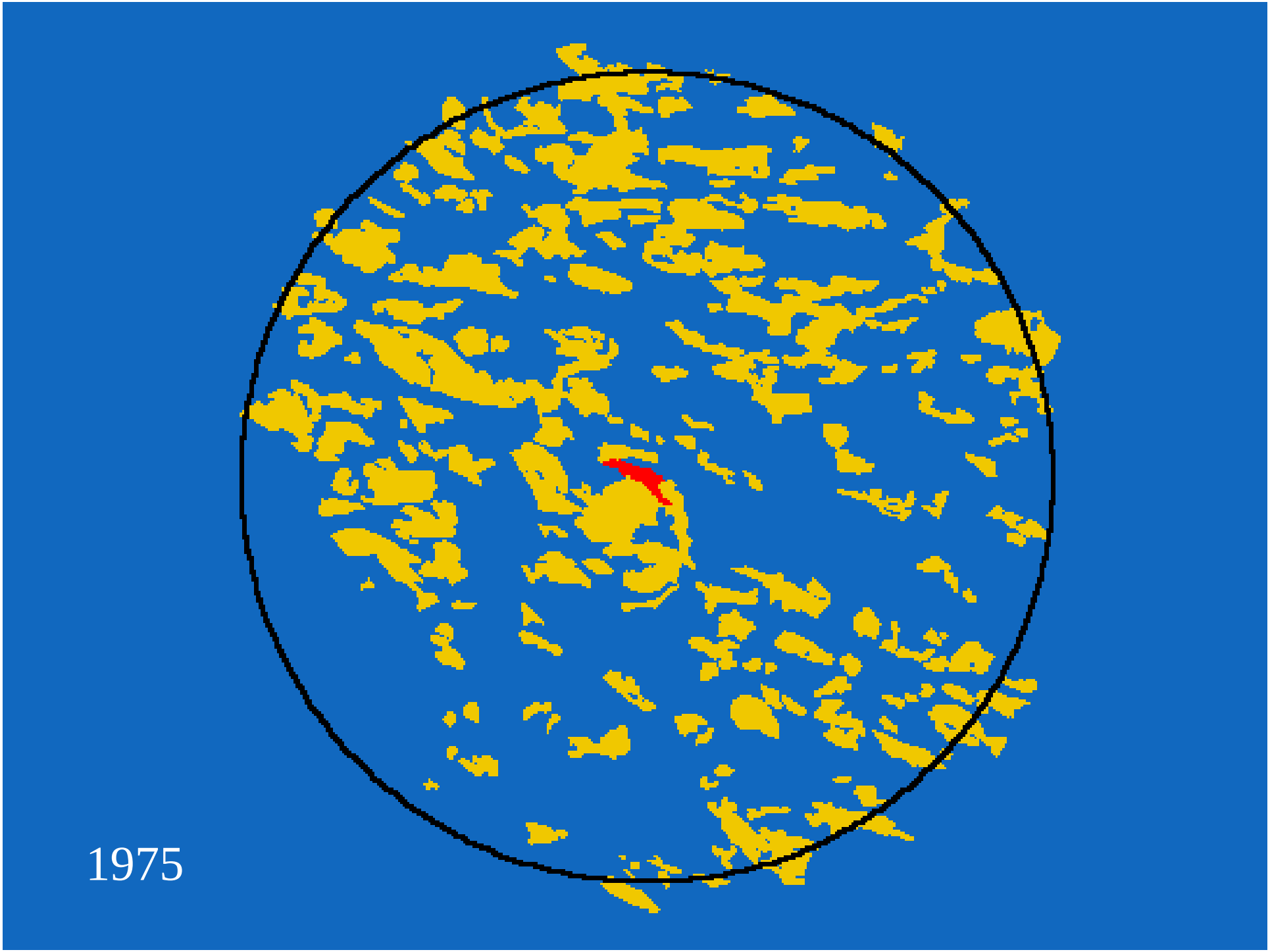
What is sufficient depends on many factors, but the minimum requirement is of the order of 10% of potential forest land

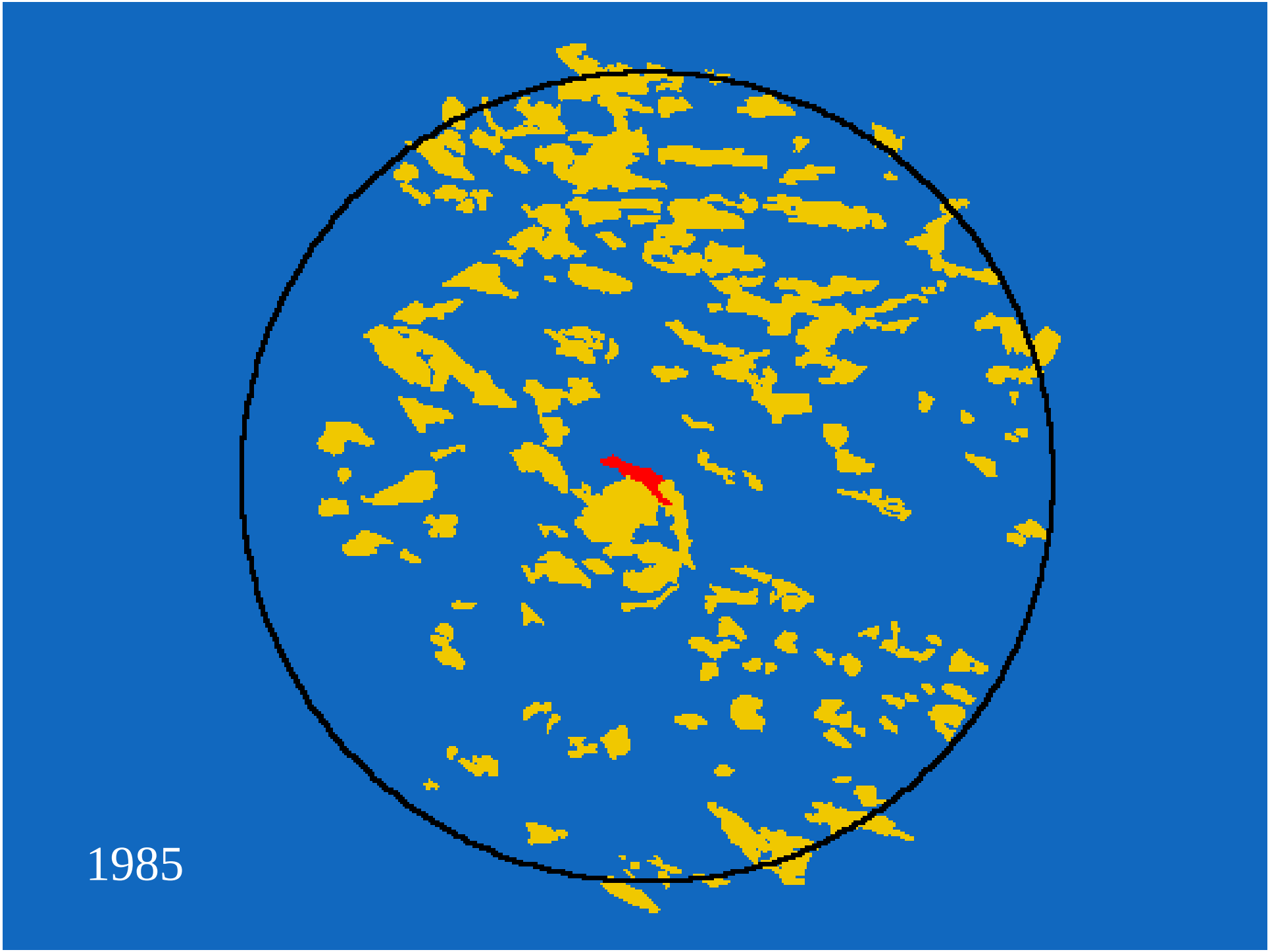

fragmentation threatens
biodiversity


1945


1955


1965


1975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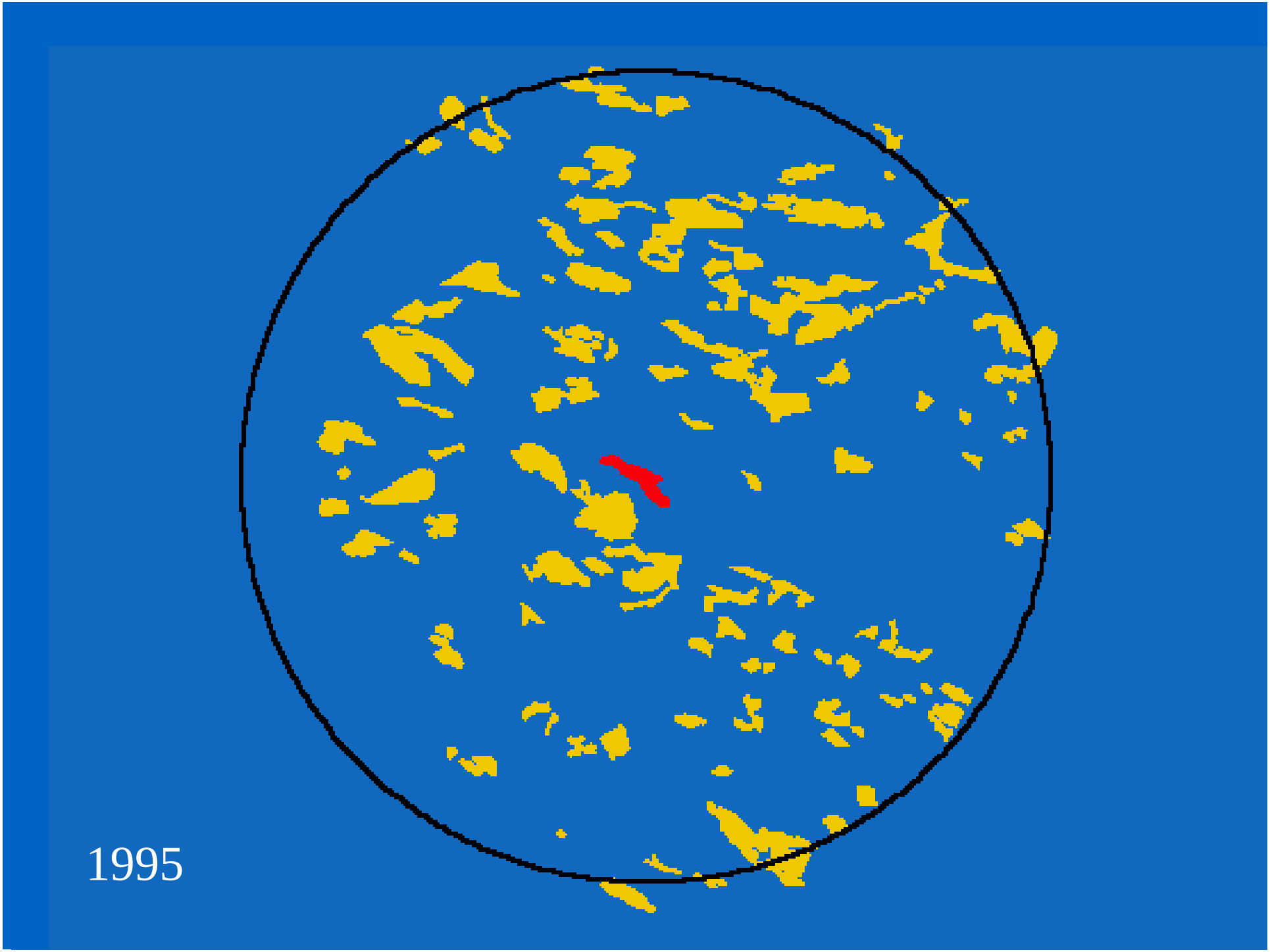
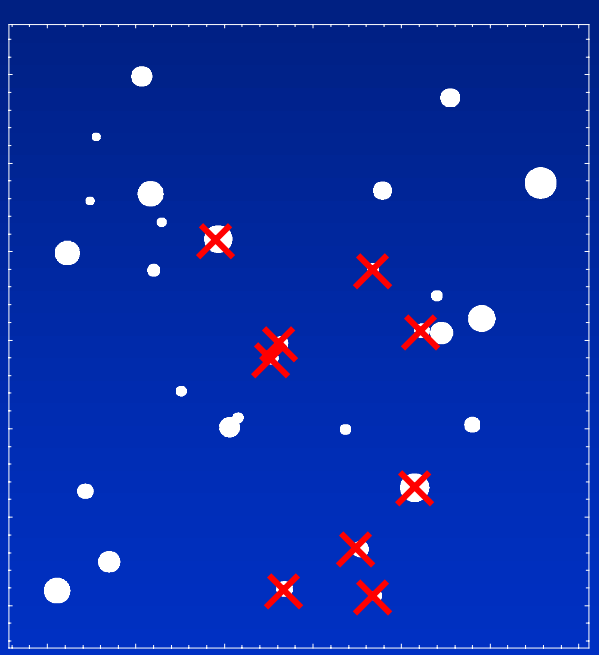
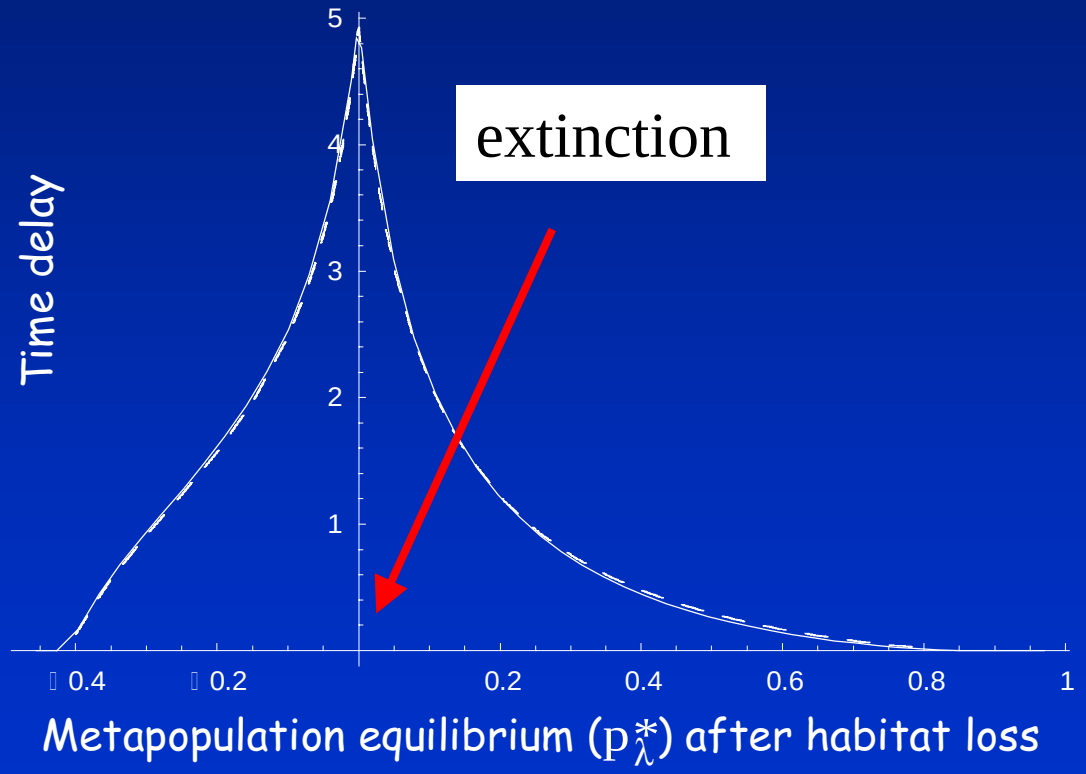
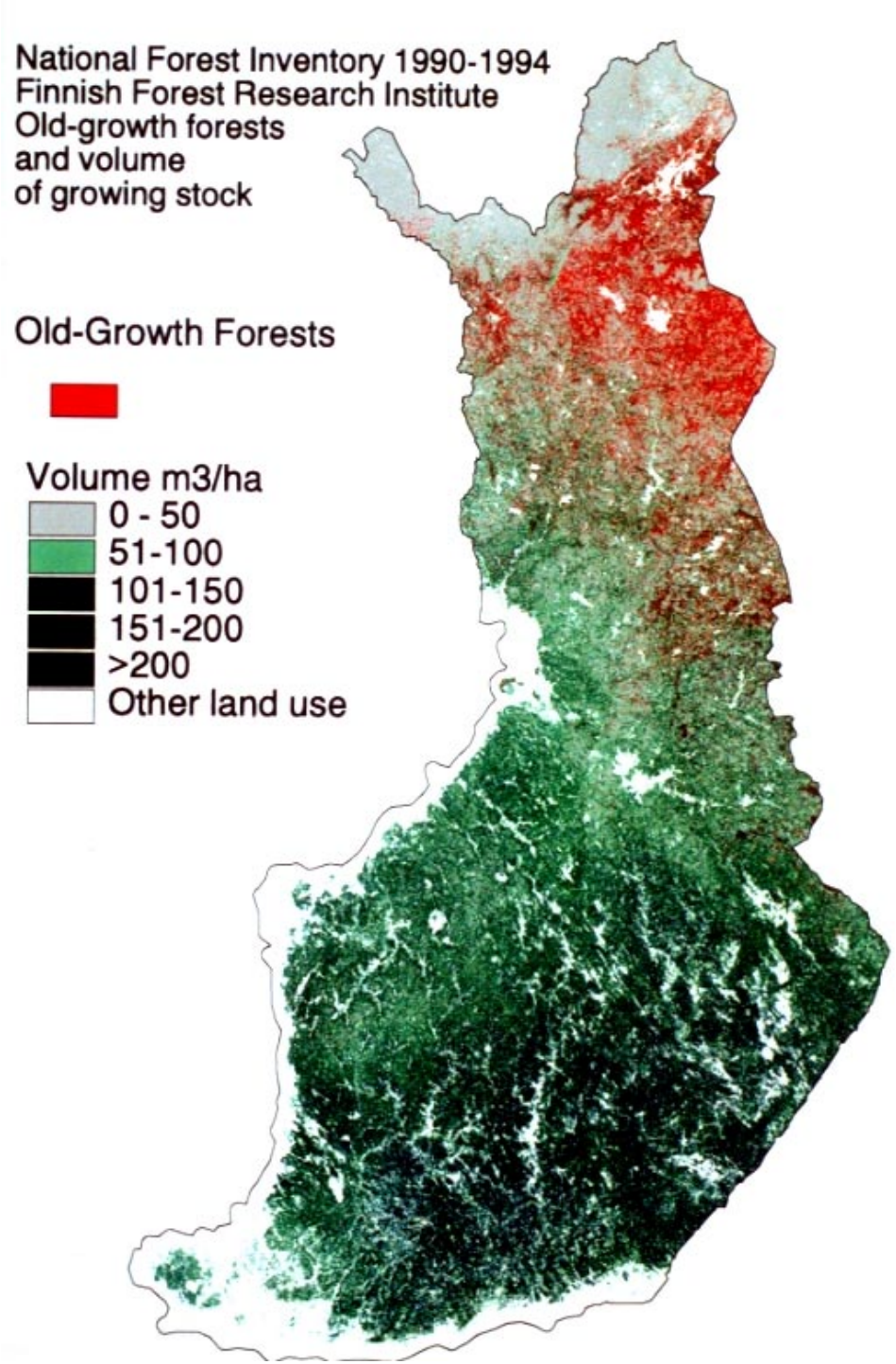

1995

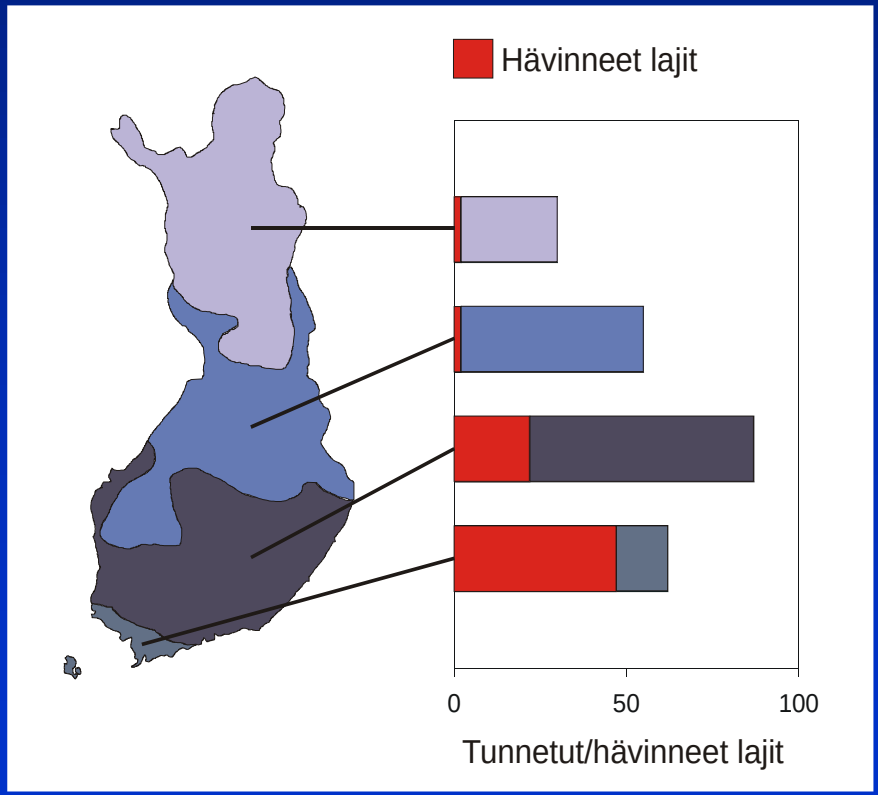
Transient time in metapopulation response to habitat loss







Red colour = proportion of regionally extinct species

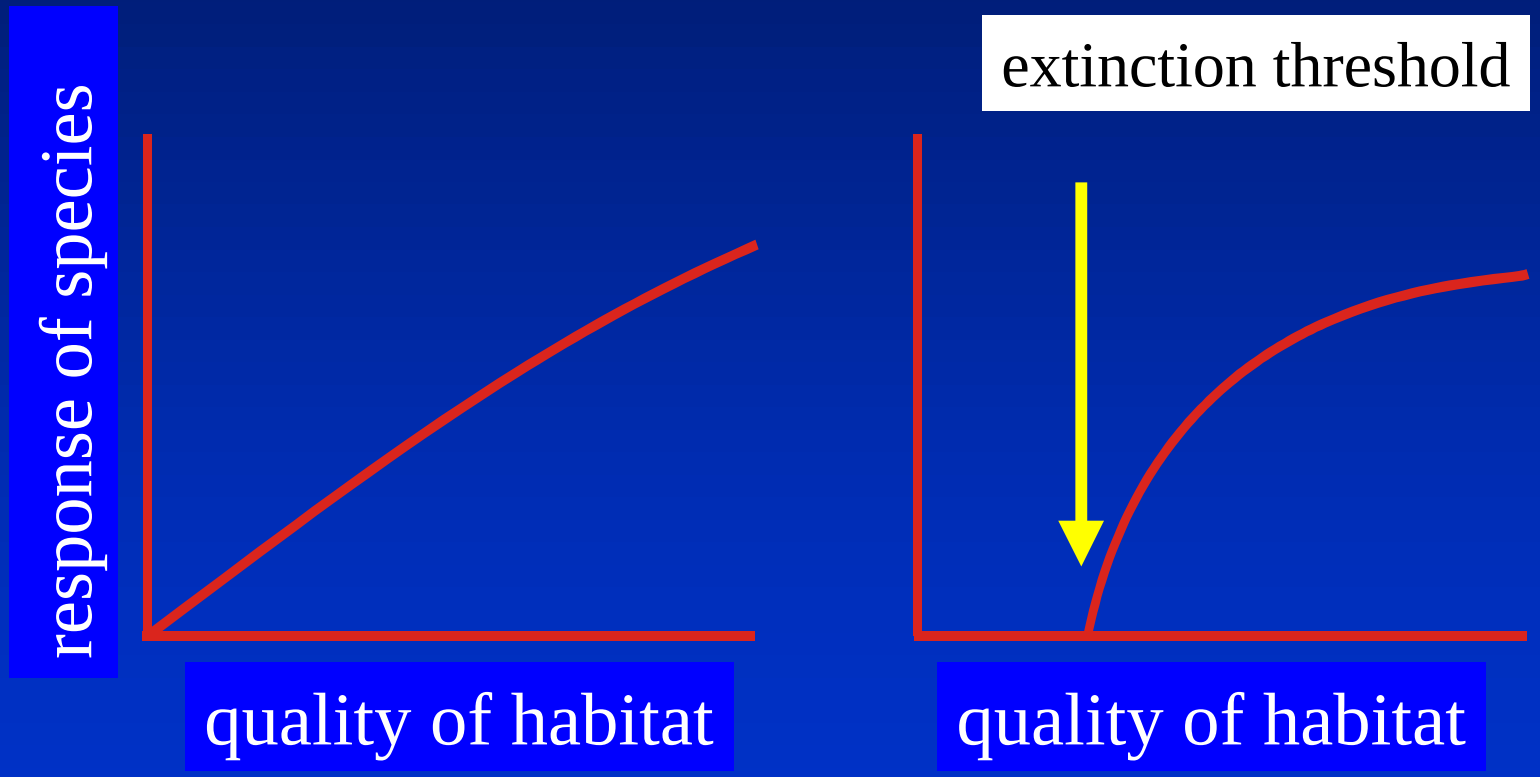


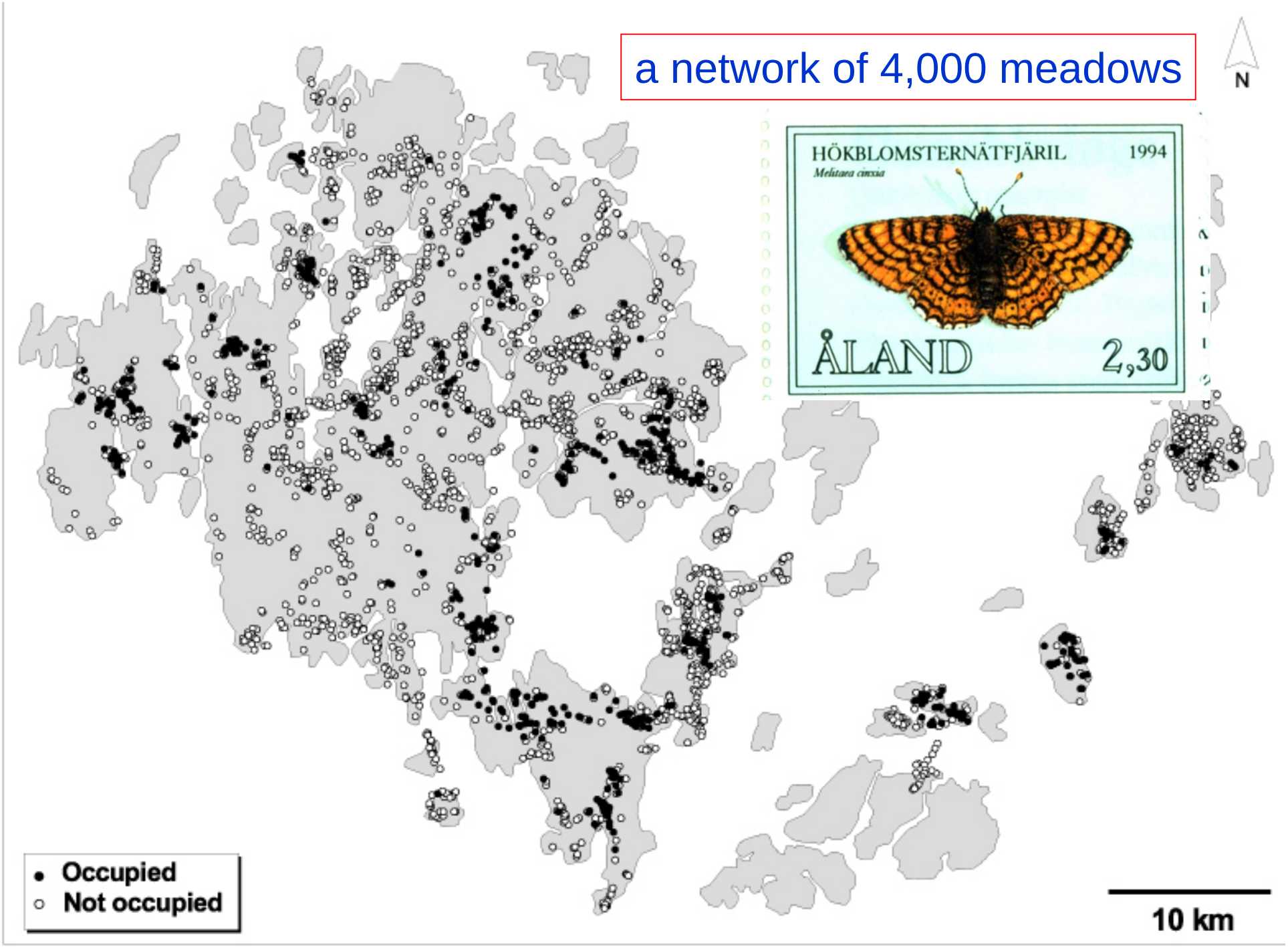
Message #2

At a large spatial scale, species track changing environmental conditions with a shorter or longer delay

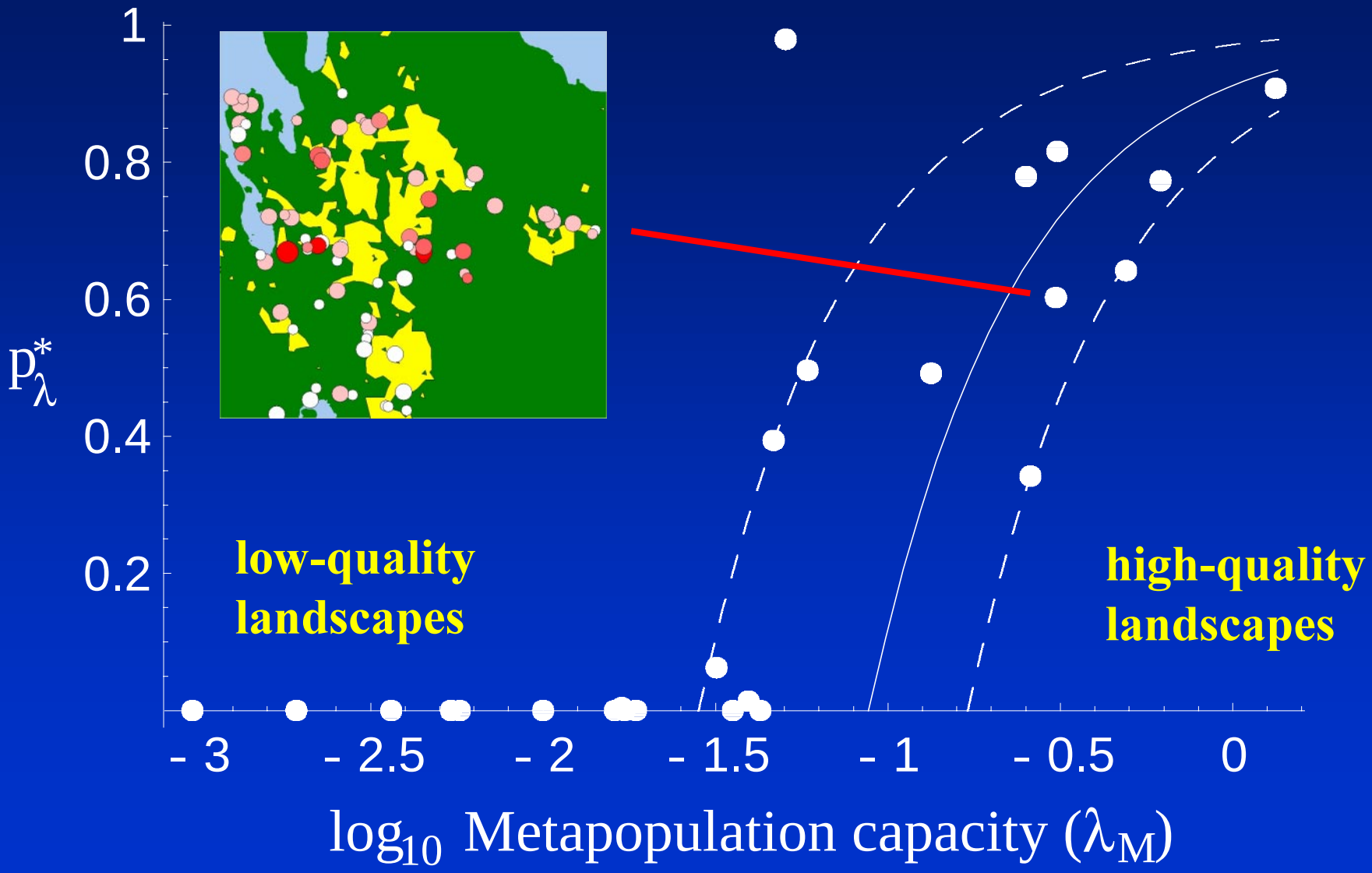
The delay is expected to be especially long for threatened species, hence we are likely to underestimate the current threat to biodiversity

The response of species to a change in habitat/landscape quality

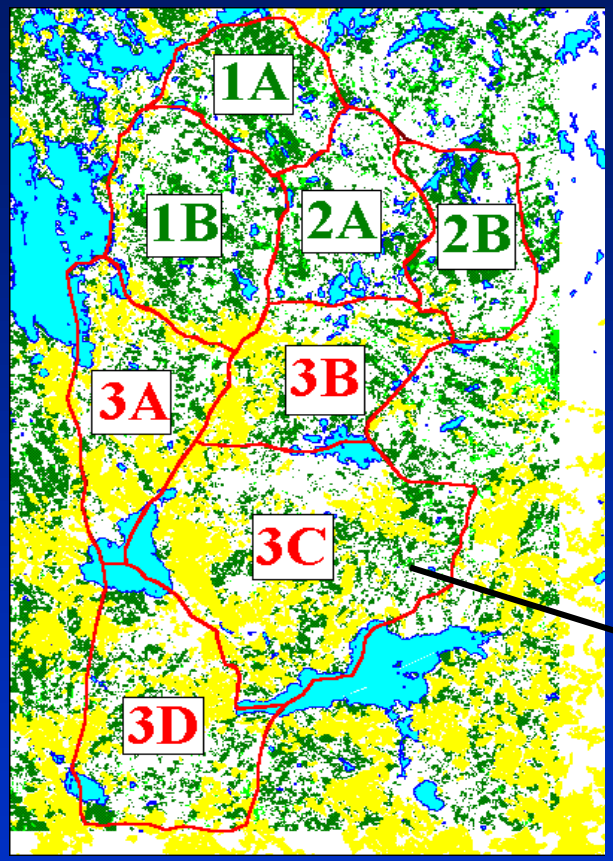



a network of 4,000 meadows
N
HÖKBLOMSTERNÄTFJÄRIL
1994
Melitaea cinxia
ÅLAND
2,30
Occupied
Not occupied
10 km

Extinction threshold in the Glanville fritillary



Extinction threshold in the three-toed woodpecker



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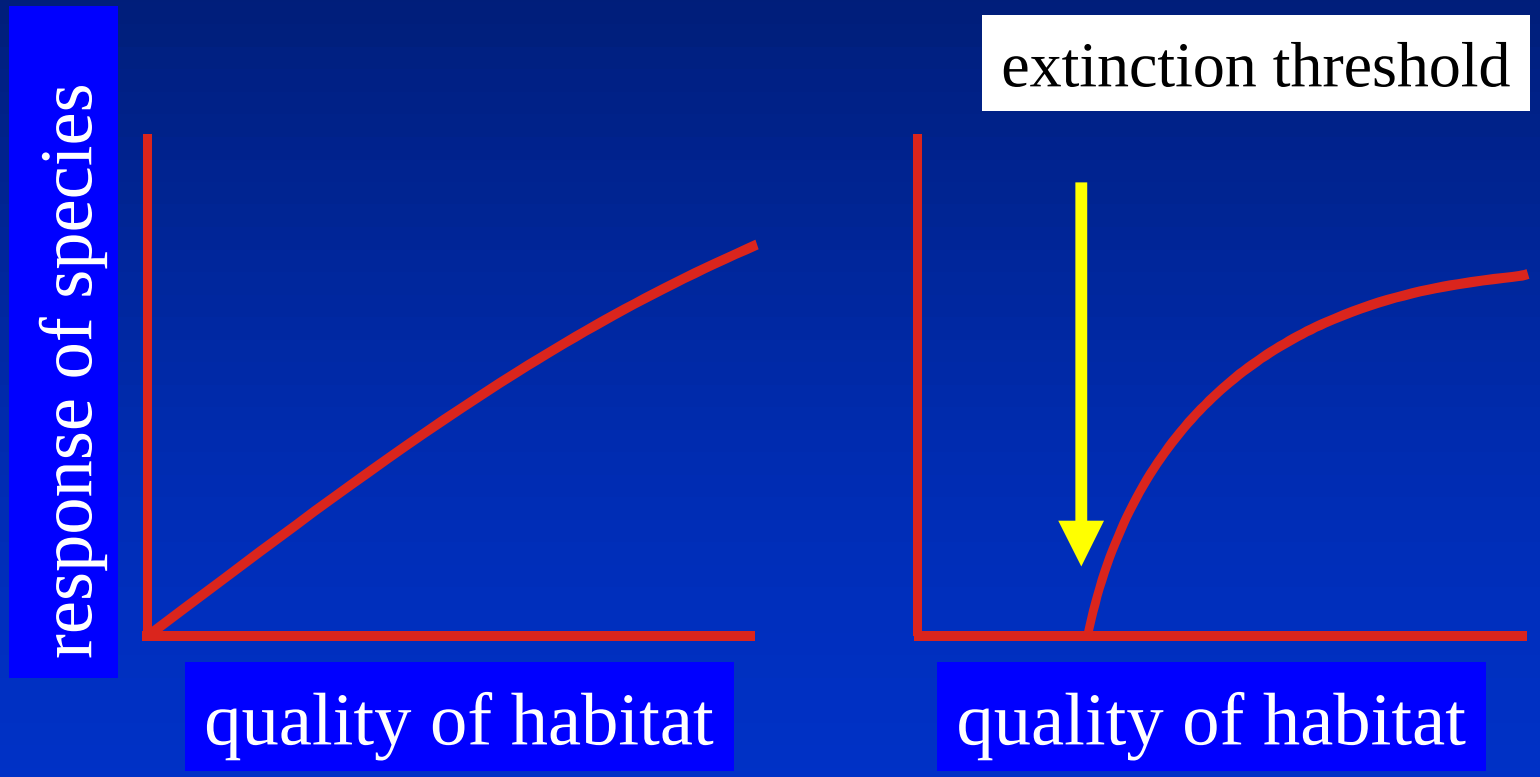
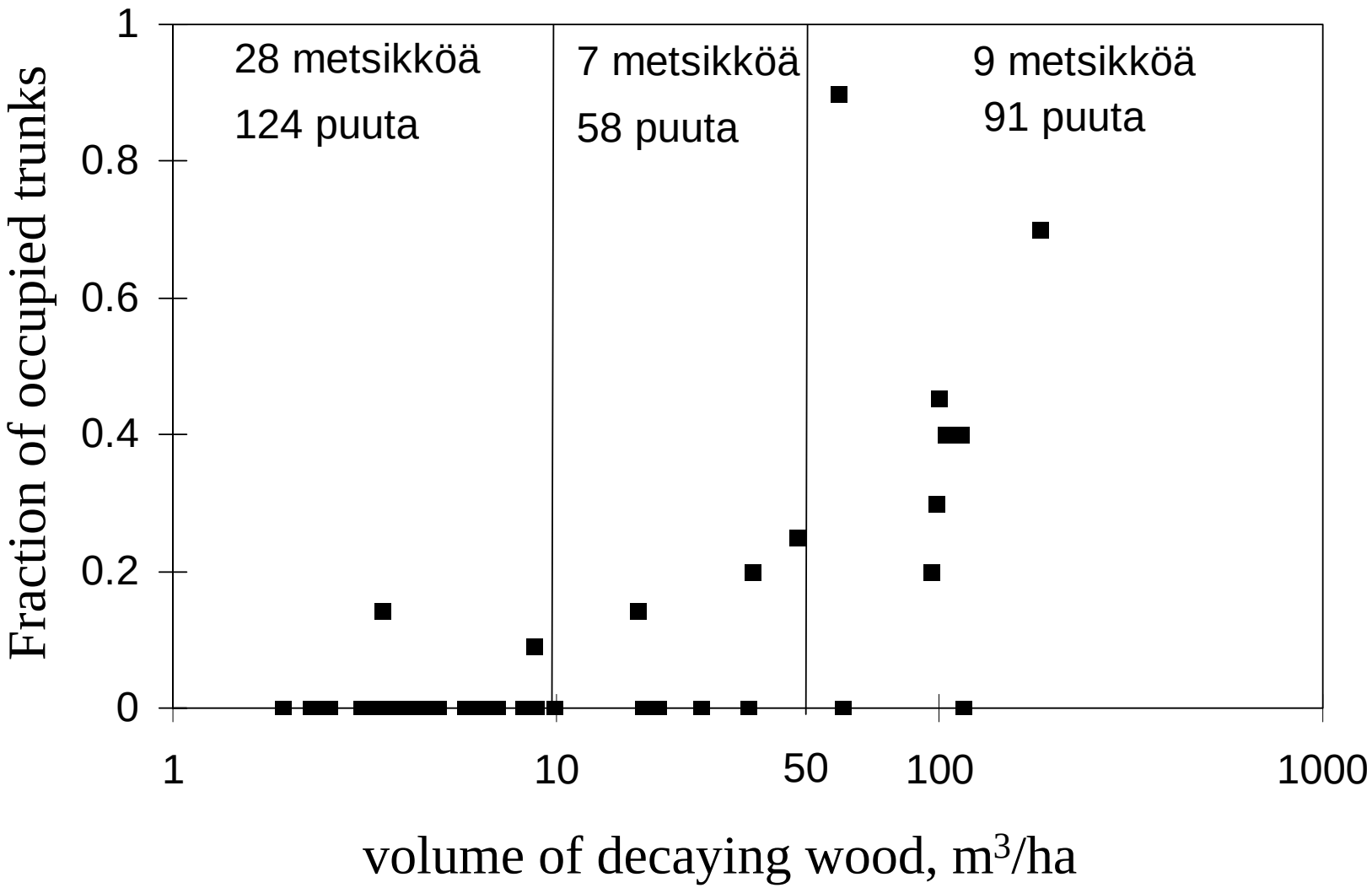


Stand-level extinction threshold in an endangered beetle



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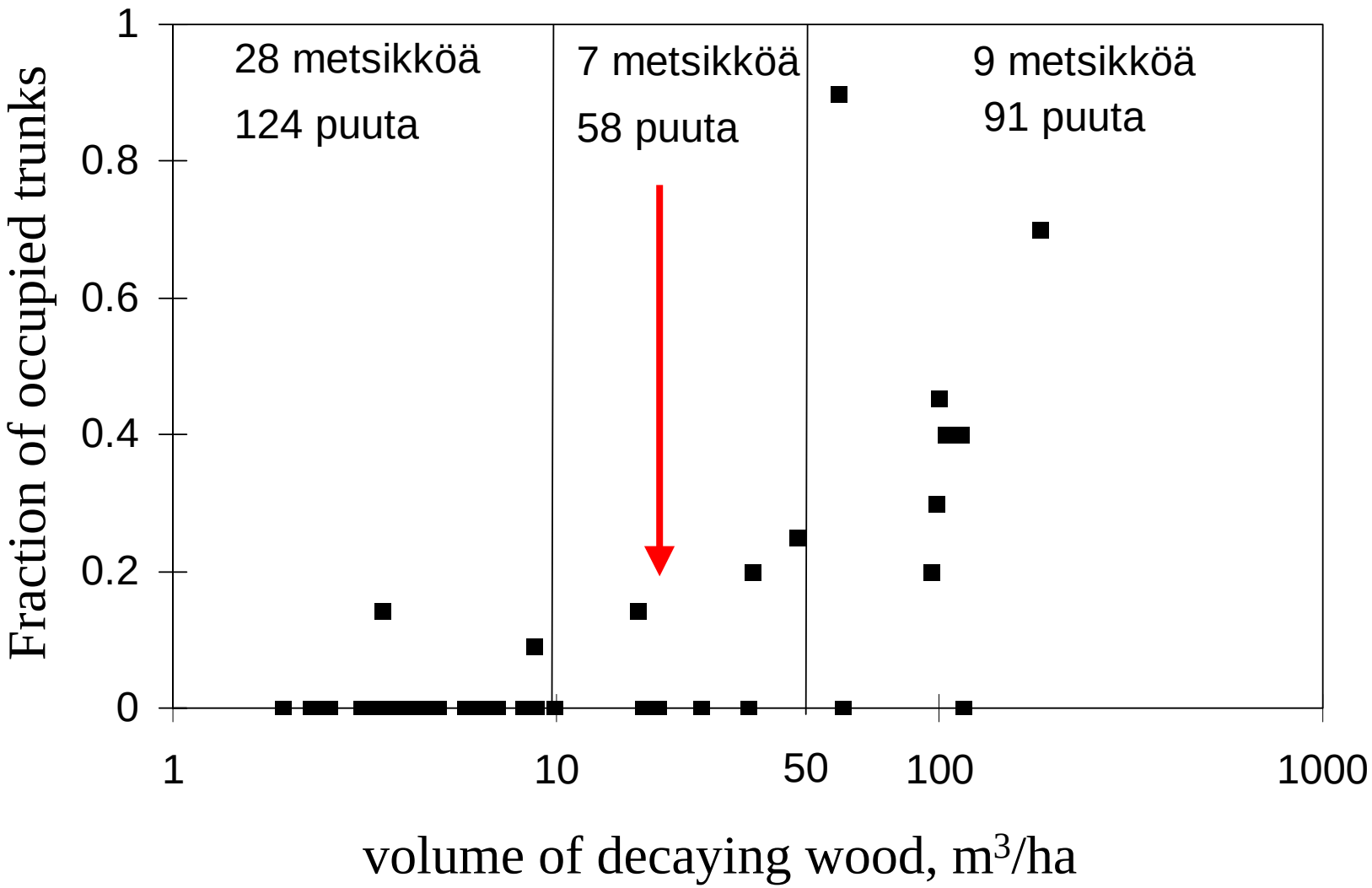

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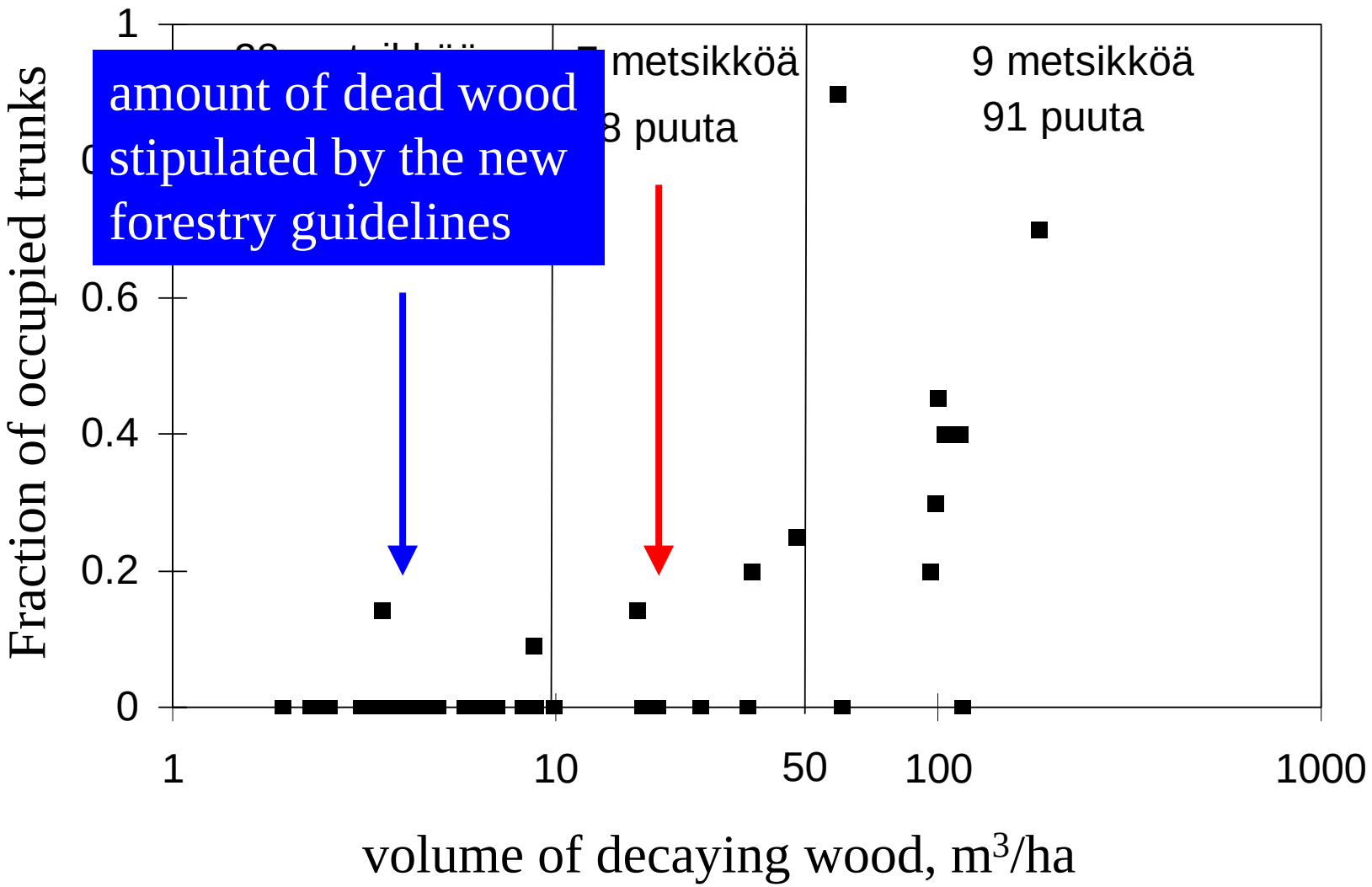
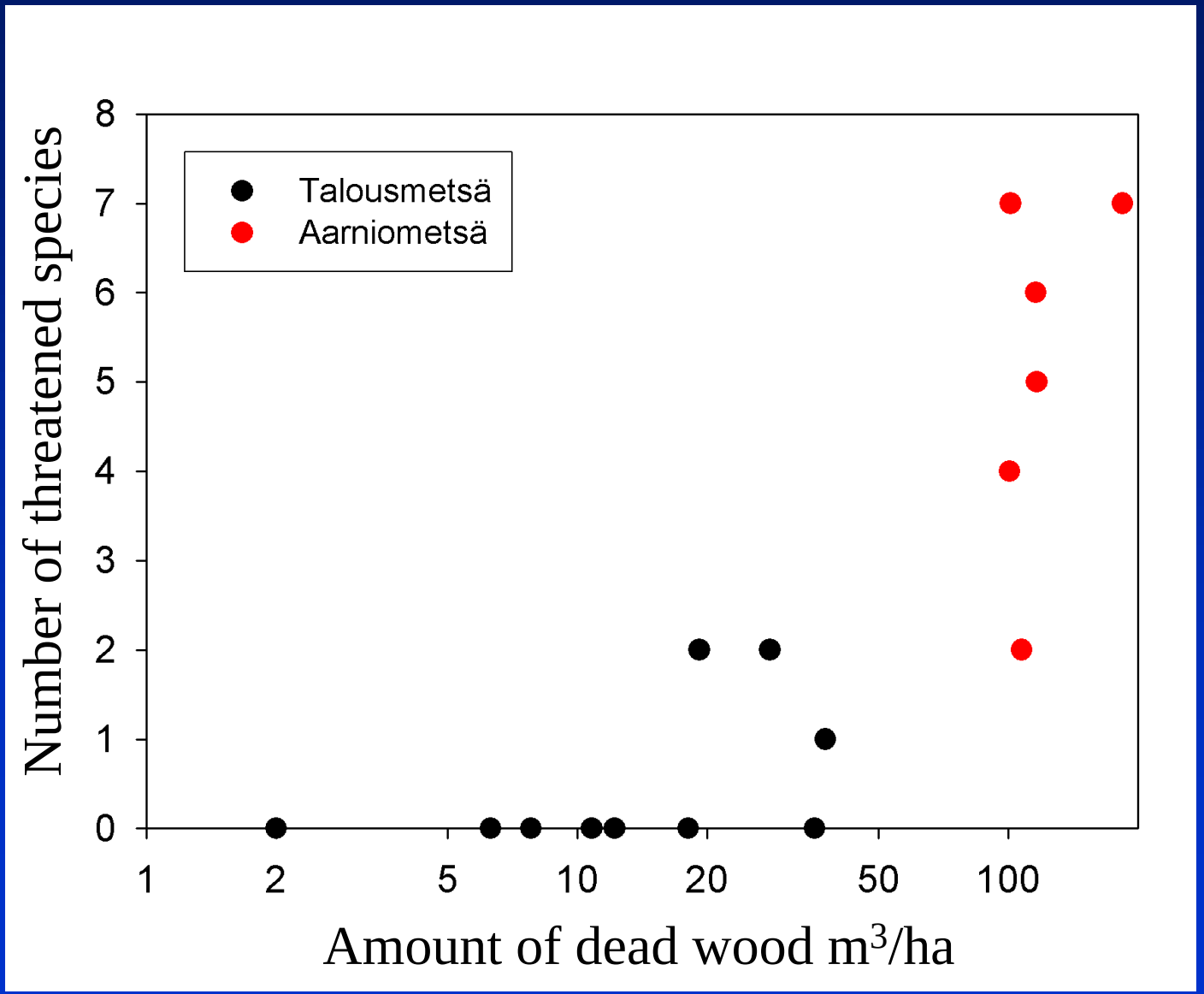
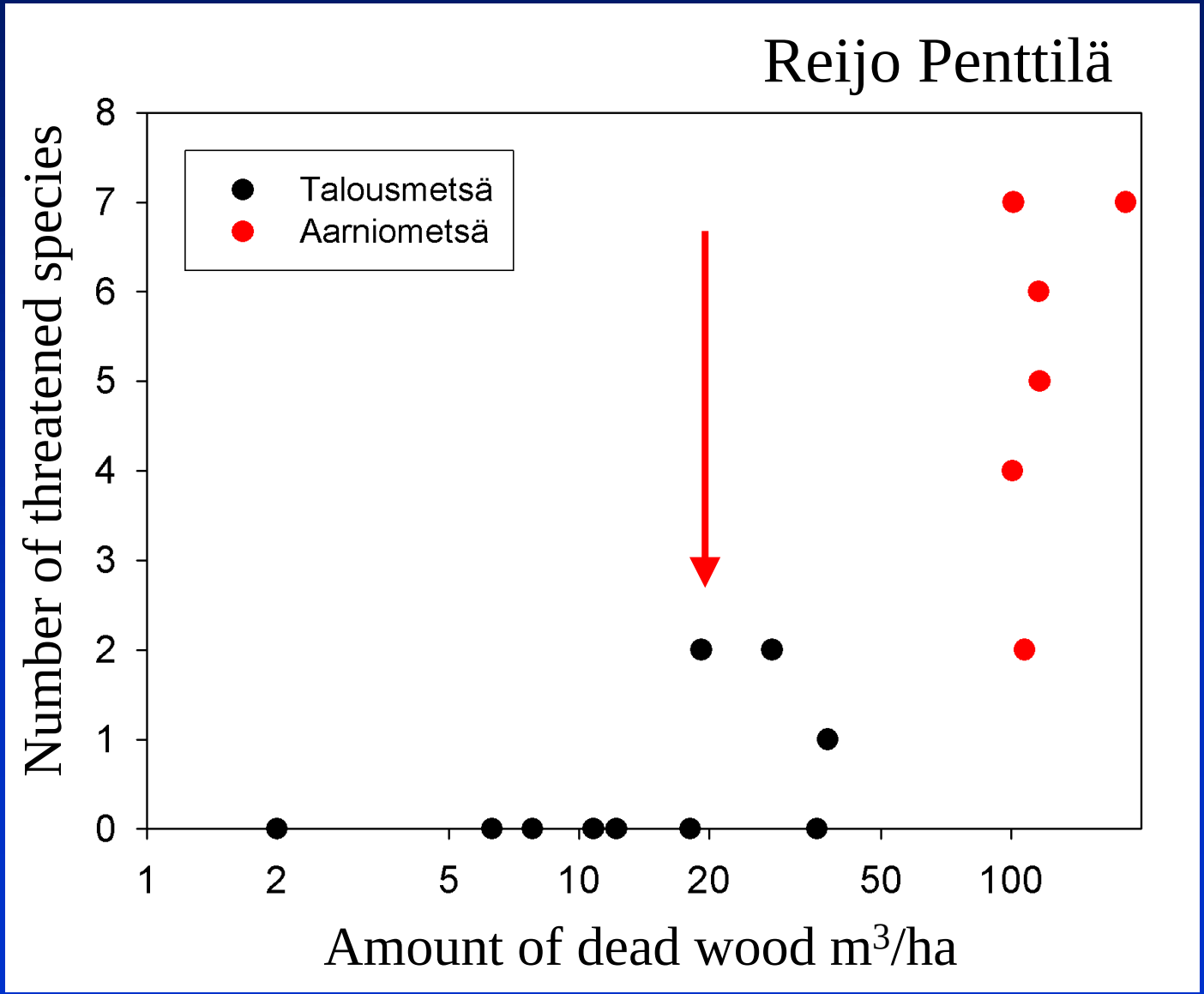


Stand-level extinction threshold for polyporous fungi

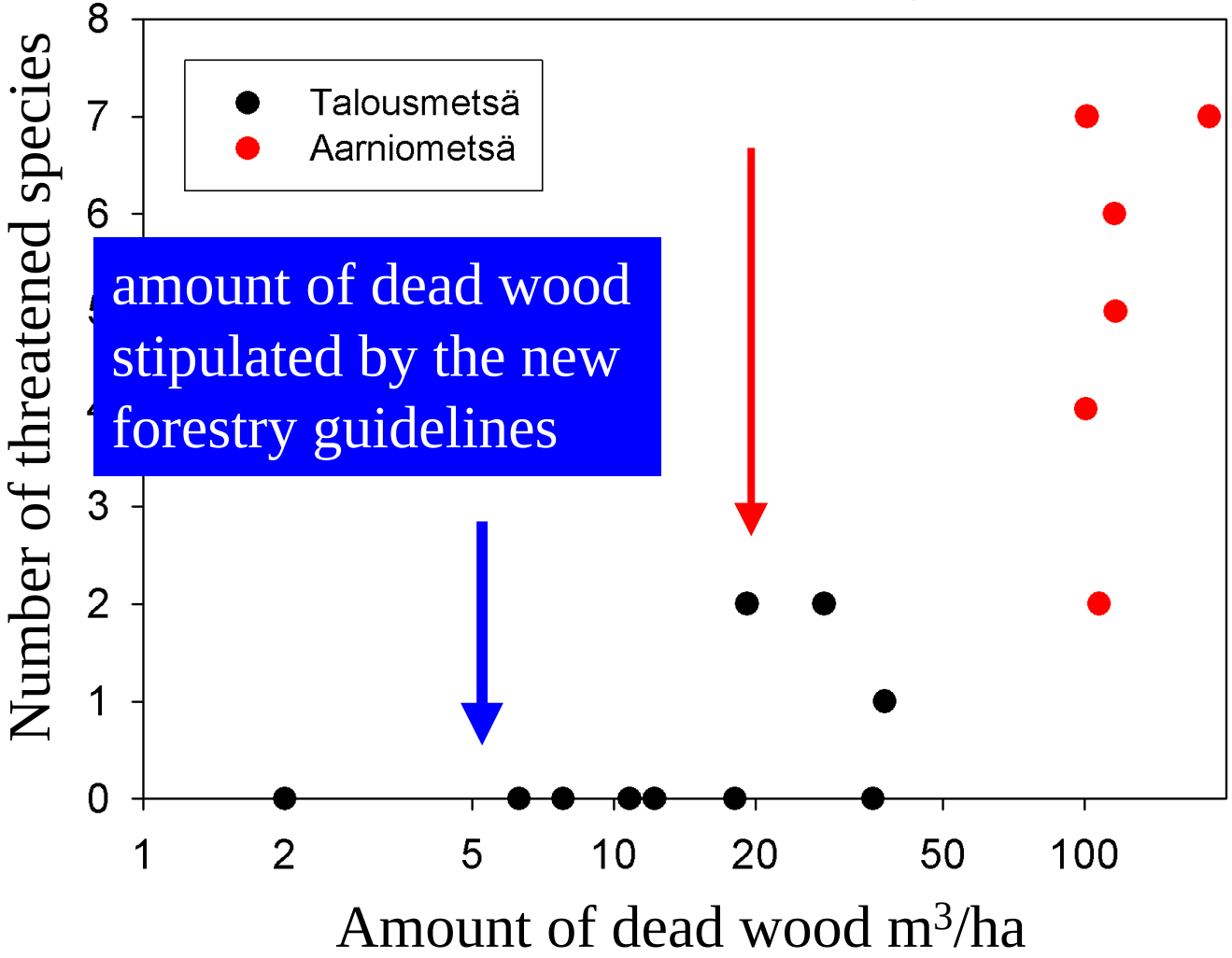


Stand-level extinction threshold for polyporous fungi



Stand-level extinction threshold for polyporous fungi

Reijo Penttilä



Message # 3

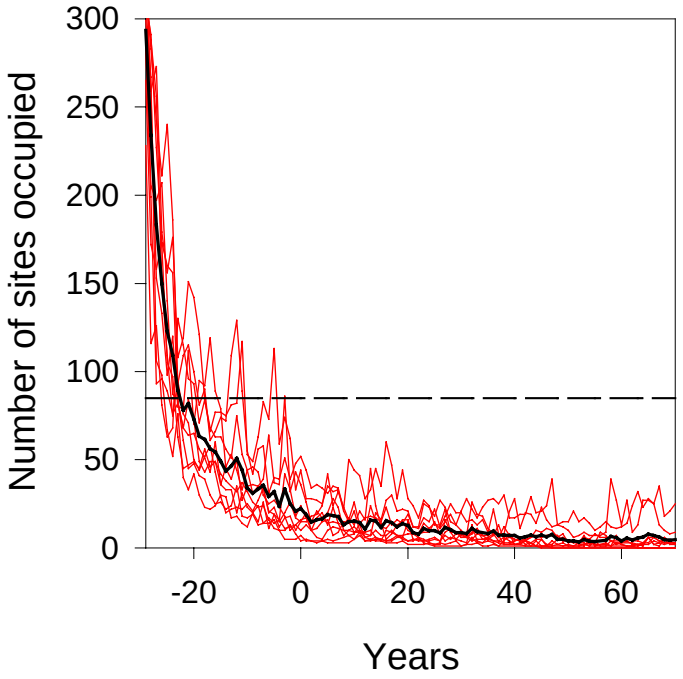
The response of species to a change in habitat quality is typically non-linear and involves a threshold

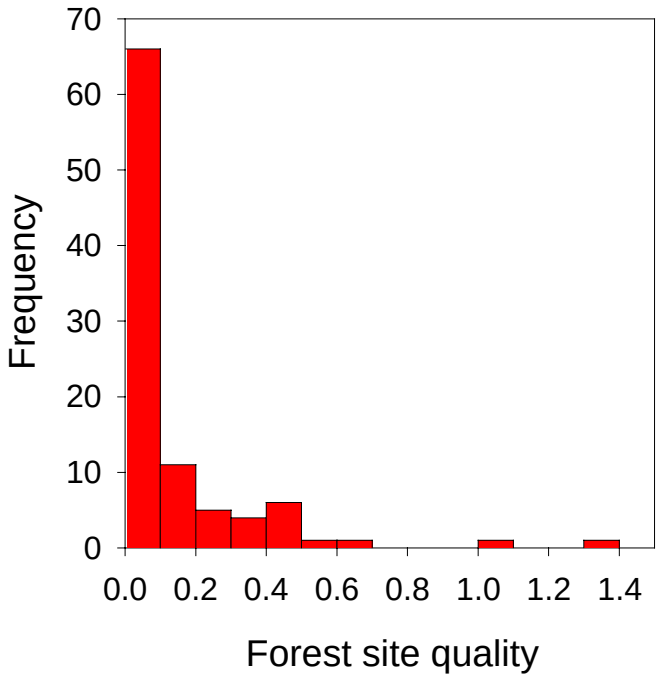
The new forestry guidelines - is this the solution?

In Finland:

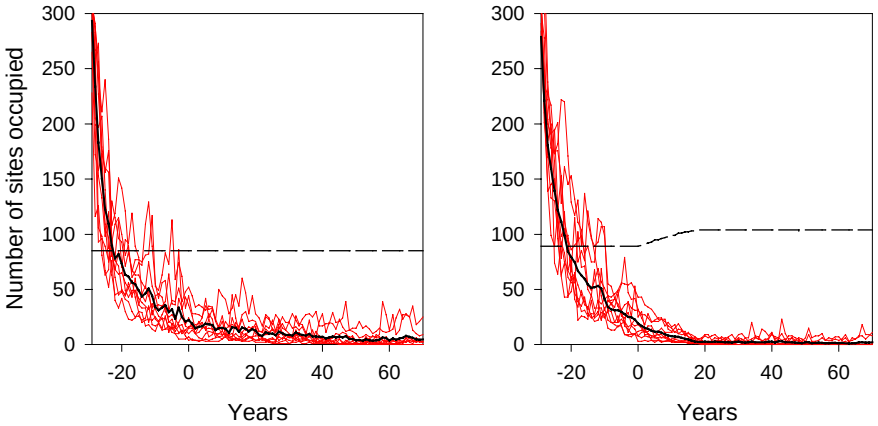
- key habitats, average area <0.5 ha
- green retention trees, a few per ha

The slow process of disappearence of endangered species in the current forest landscape

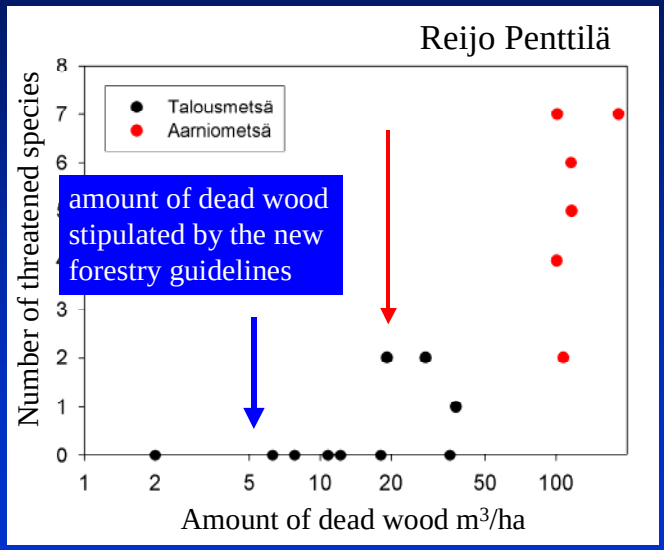




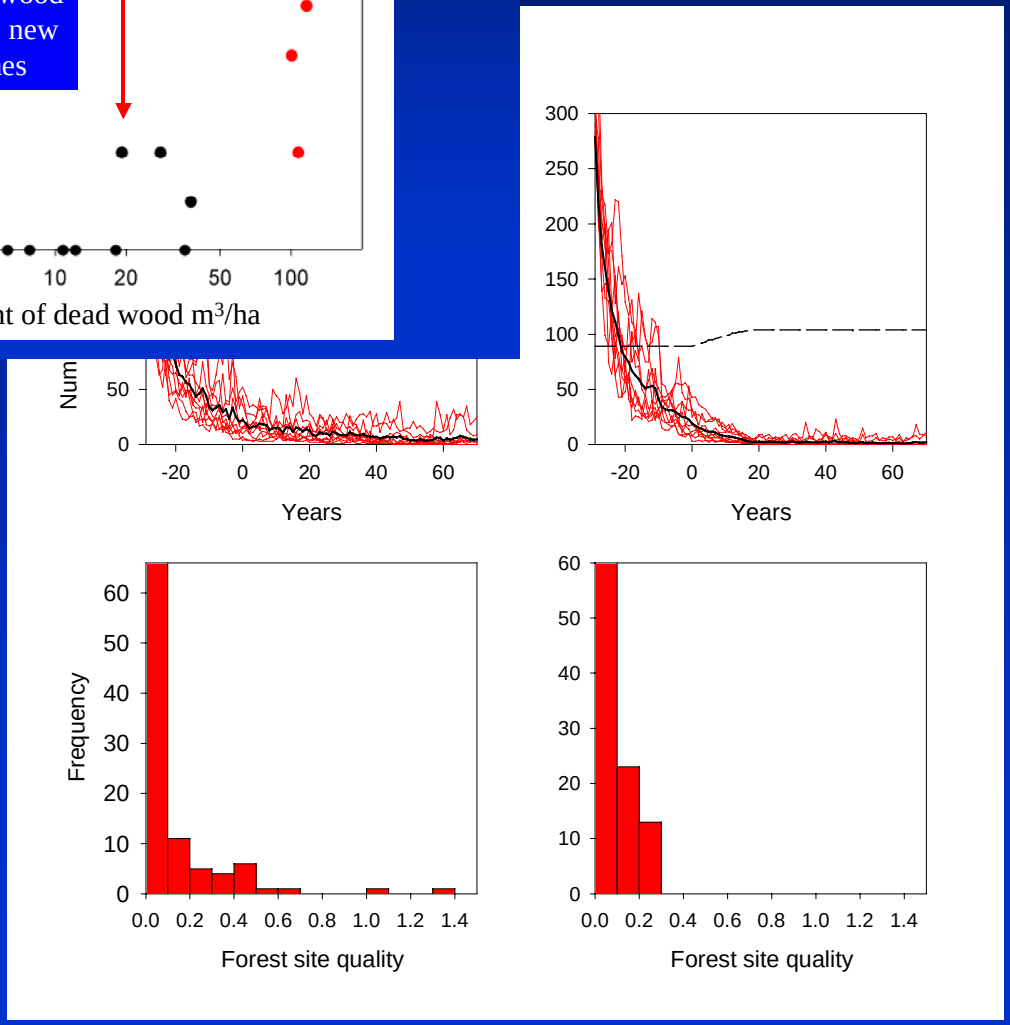
The outcome of comprehensive implementation of the new forestry practice



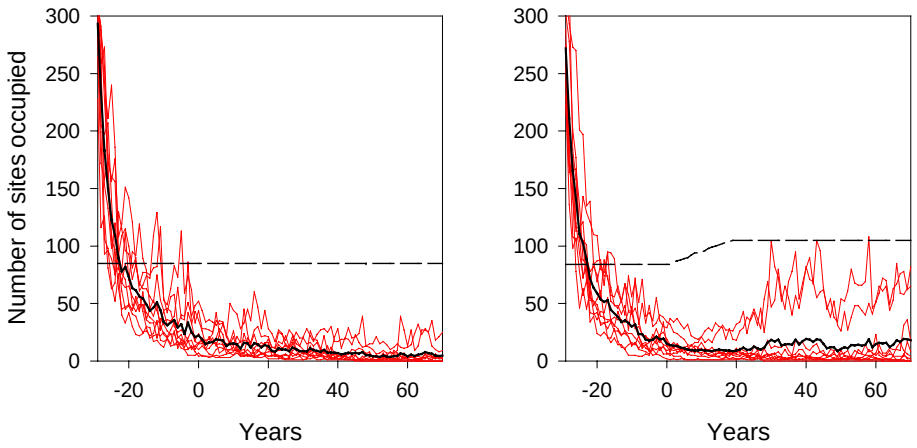
Stand-level extinction threshold for polyporous fungi

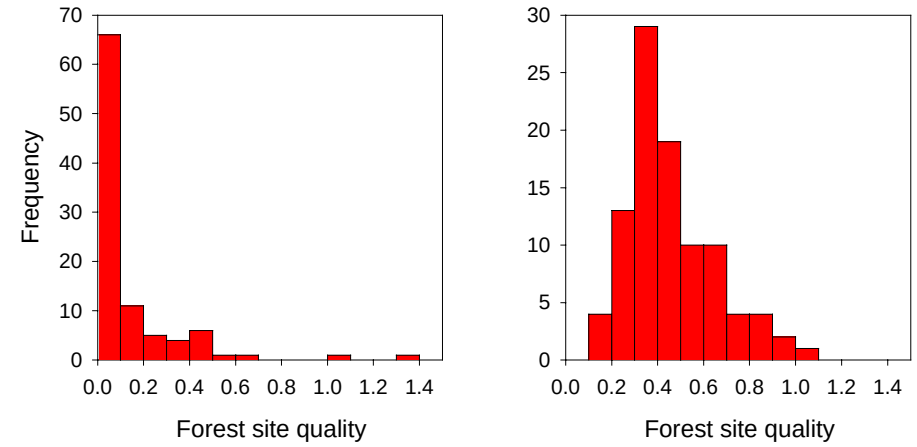


comprehensive new forestry practice

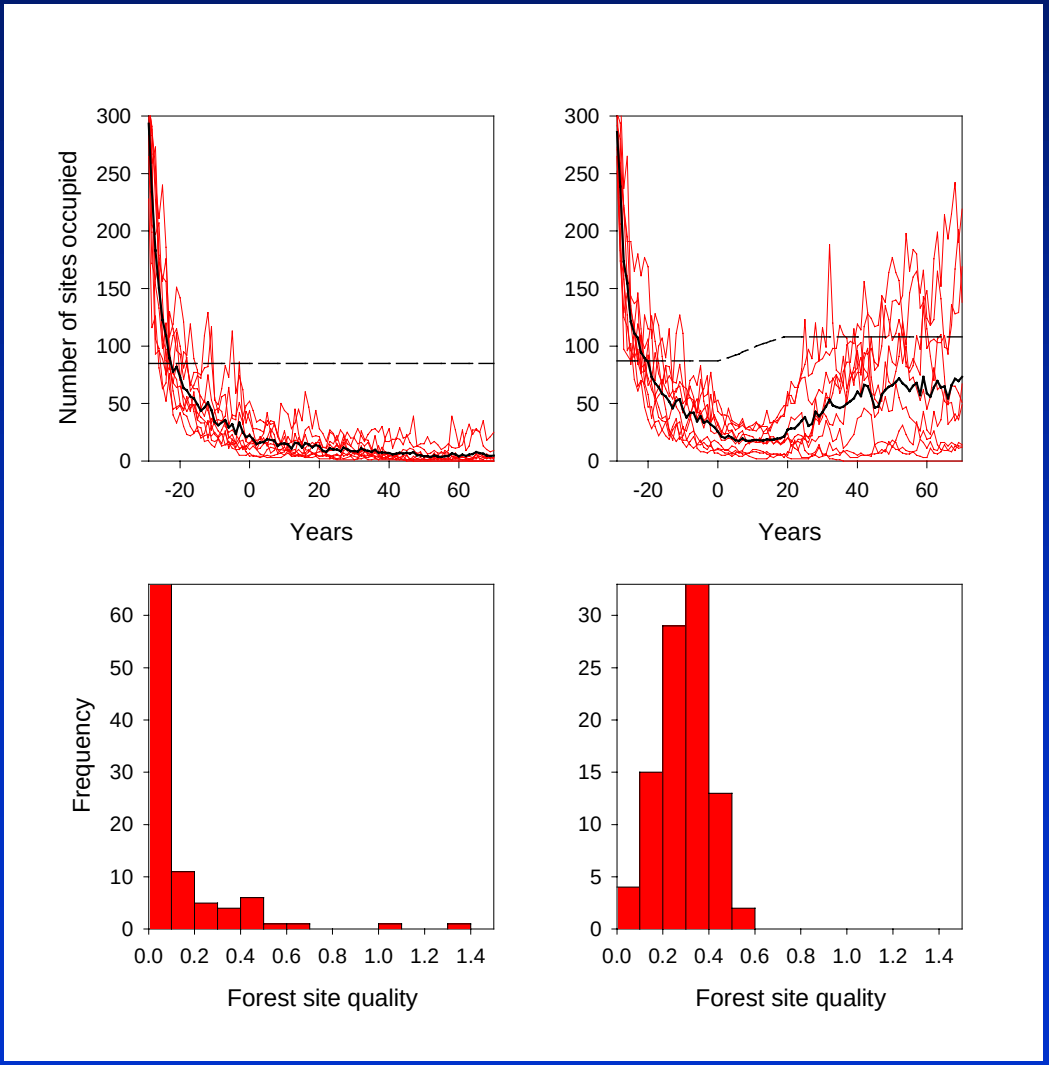


Let us focus the same conservation effort within 10% of forested land





Conservation measures within 10% of forested land but now located next to the currently most valuable forest stands



Message #4

The new forestry guidelines are not helpful

- if stand quality remains below the extinction treshold
- if all forested land is treated in the same manner (removing the currently existing stands of high quality)

Concluding messages:

- Around 10% of potential forest land should retain/regain natural/semi-natural forests
- Conservation measures in managed forests should increase quality beyond the extinction threshold of a large fraction of forest species (e.g. “key habitats” at least around 10 ha in size)