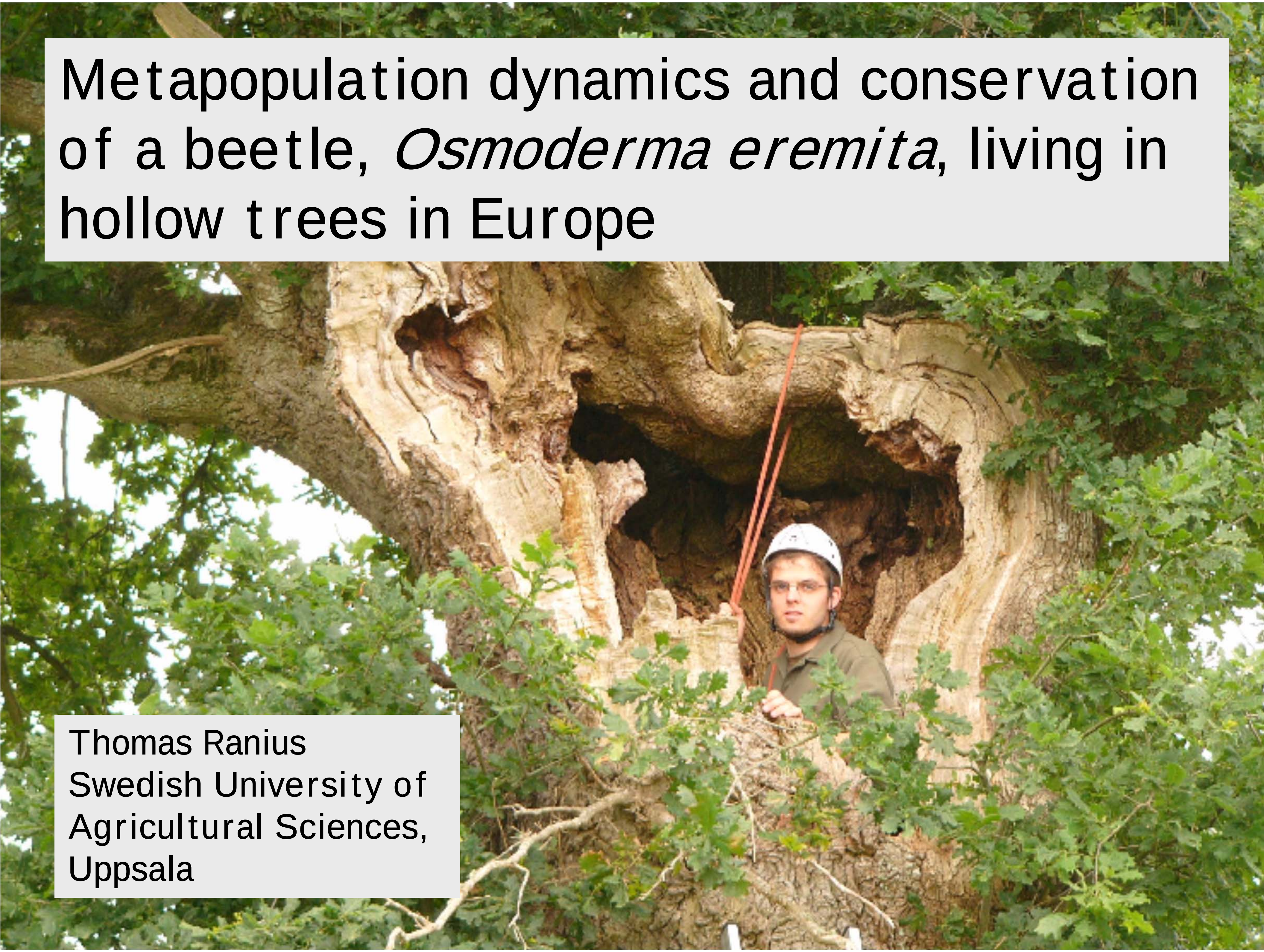
Metapopulation dynamics and conservation of a beetle, *Osmoderma eremita*, living in hollow trees in Europe



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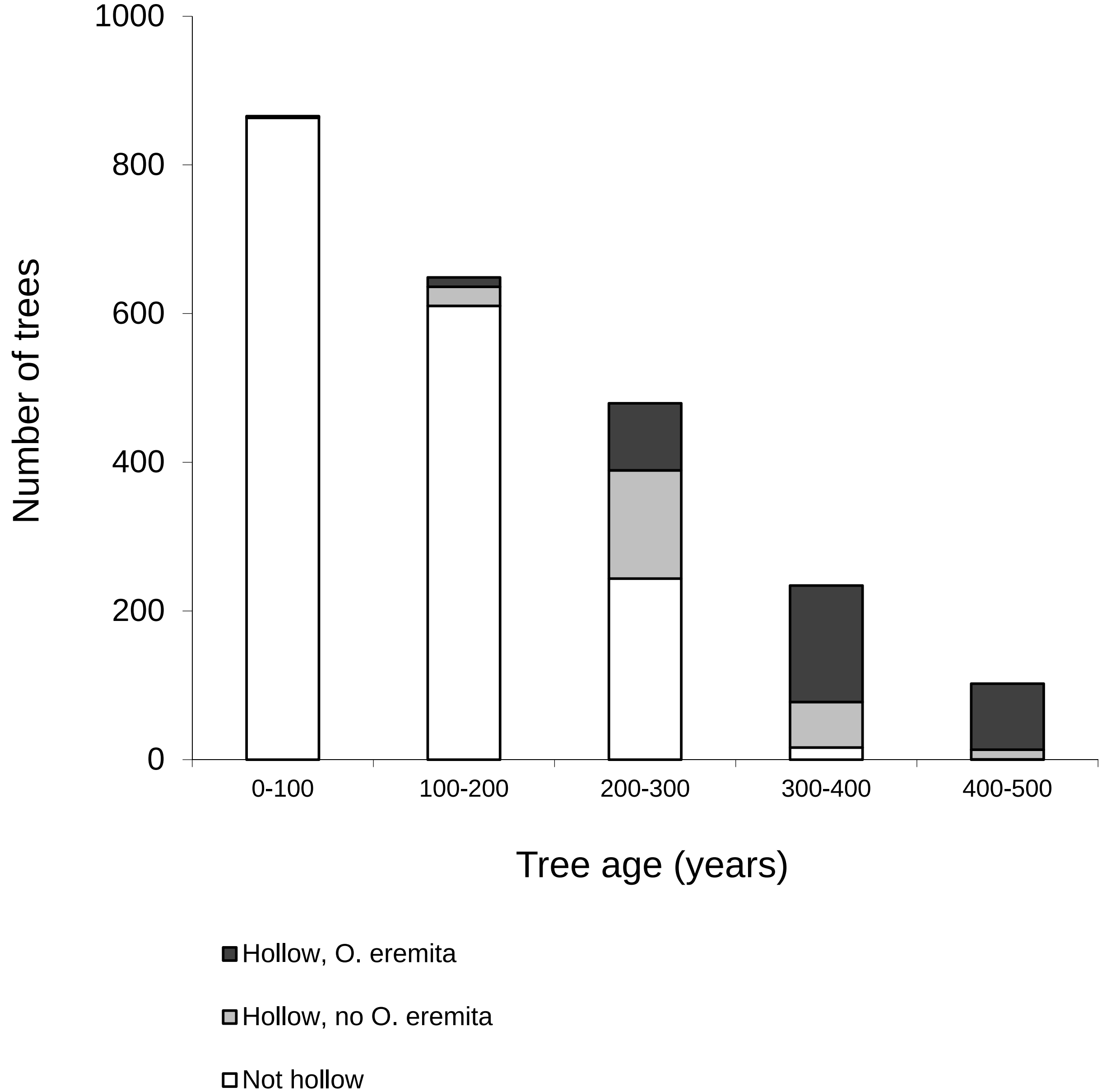
The Hermit (*Osmoderma eremita*)

Larvae develop in wood mould over three years

Adult beetle a few weeks in July and August



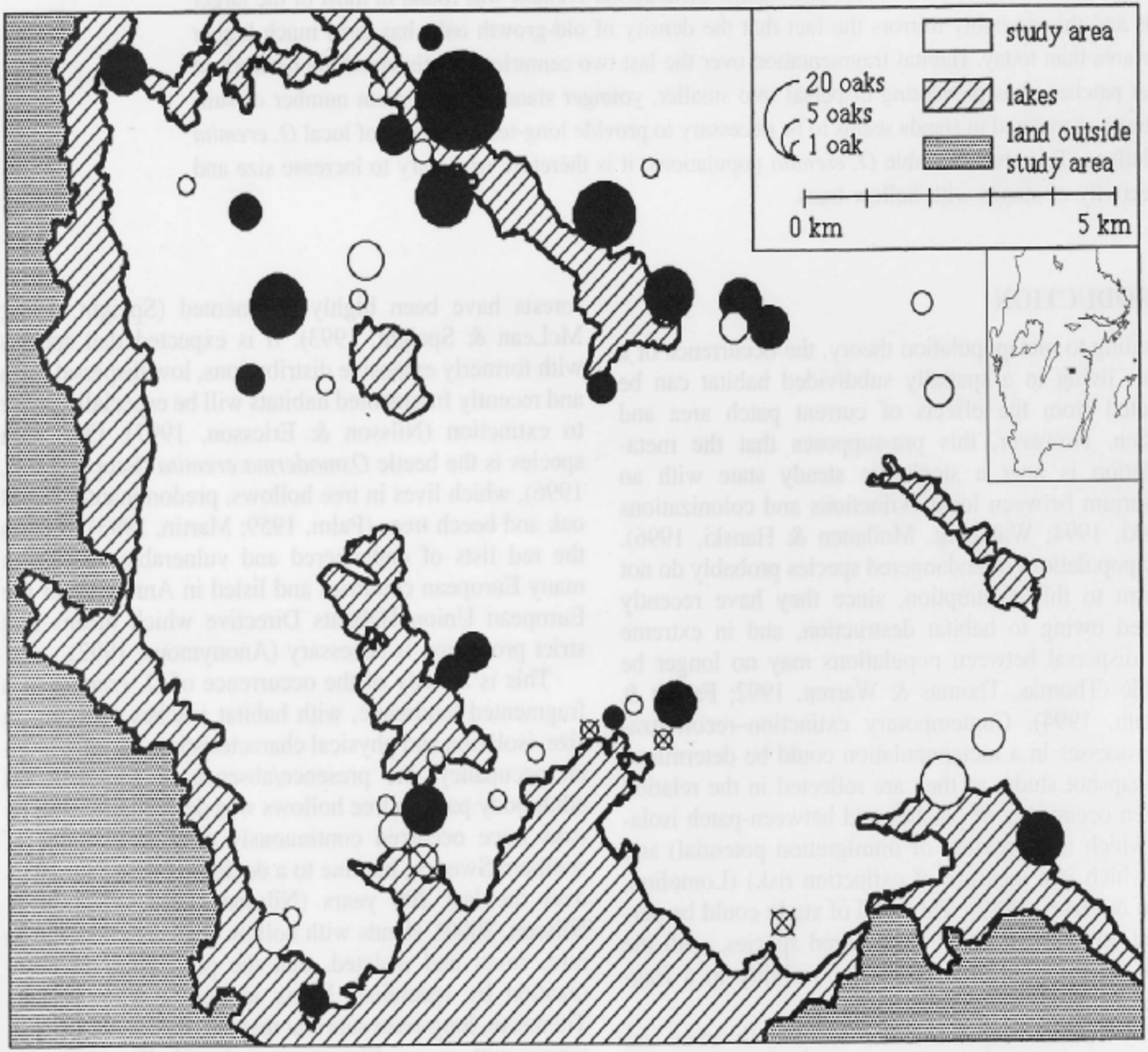
Proportions of oaks (*Quercus robur*) of different age classes with *O. eremita*.
Ranius et al. (*Annales Zoologici Fennici*, 46: 205-216)

Is *O. eremita* negatively affected by habitat fragmentation?

Isolated trees

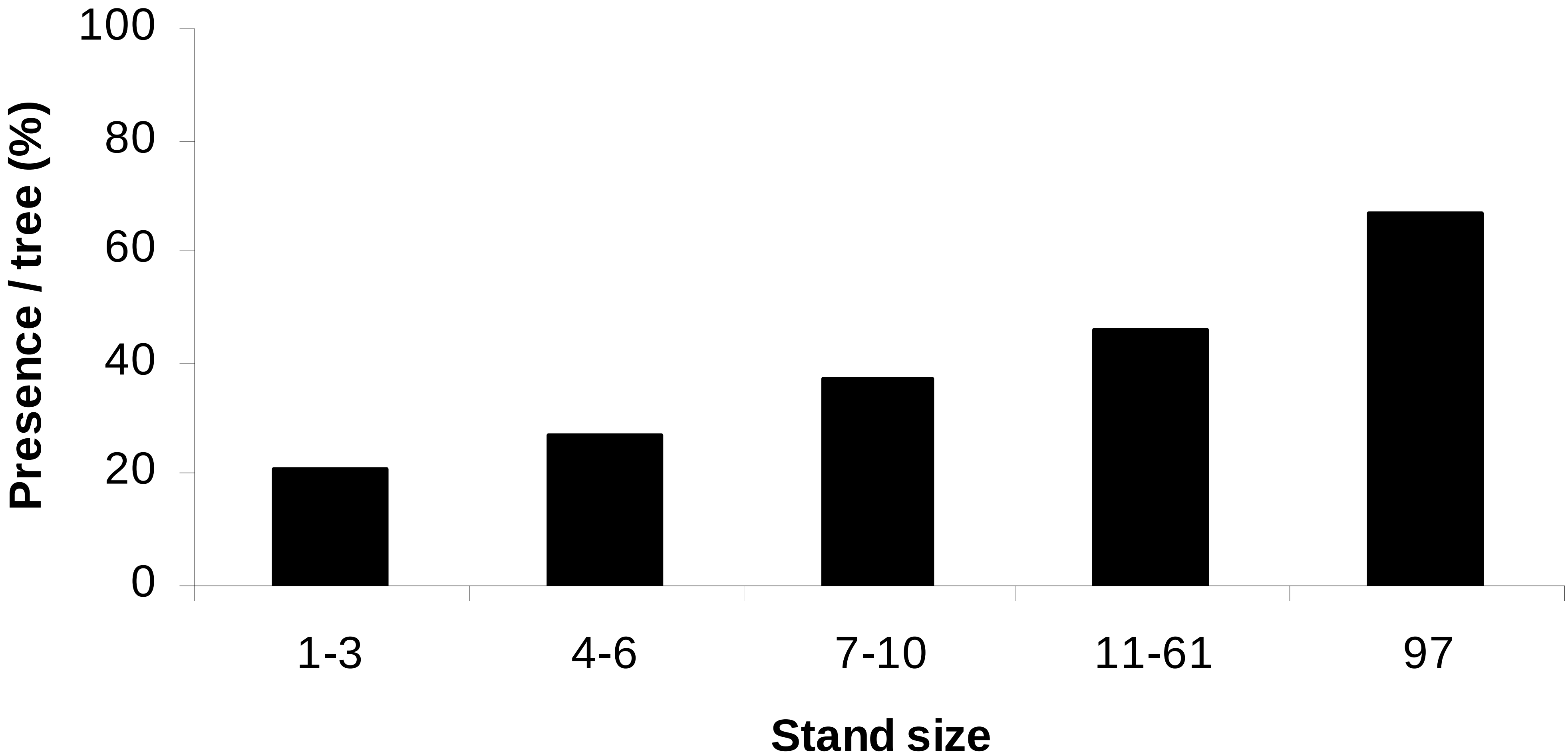
High density of suitable trees

8 litres of wood mould from each tree
Went through in the field for larvae, and remains of adult beetle body parts



study area
20 oaks
5 oaks
1 oak
lakes
land outside
study area
0 km
5 km

Frequency of occurrence / tree of *Osmoderma eremita* in relation to stand size. Stand size is defined as the number of hollow oaks within a cluster with a distance of < 250 m from one hollow oak to another



Ranius (2000) Anim. Conserv. 3: 37-43

Occupancy patterns resulting from a colonisation – extinction process

Colonisation relates to dispersal

Extinction relates to the population size and its fluctuations

We (Jonas Hedin and I) combined two methods to assess dispersal in the field: telemetry and capture-recapture.

Results from capture-recapture: population sizes

- on average 11 beetles per tree and year, wide variability between trees (0-85 beetles/tree and year)

- positive relationship between volume of wood mould (= loose material of dead wood) and population size

From 26 trees over five years. 723 beetles were captured 1,541 times.
Ranius (2001) Oecologia 126: 208-215.

Results from capture-recapture: dispersal rate

- Eleven dispersals observed (5 years)
- 85% of all adults remain in the same tree throughout their entire life (estimated with use of a computer simulation model that takes into account that beetles move before the first or after the last capture, or move to trees with no traps)

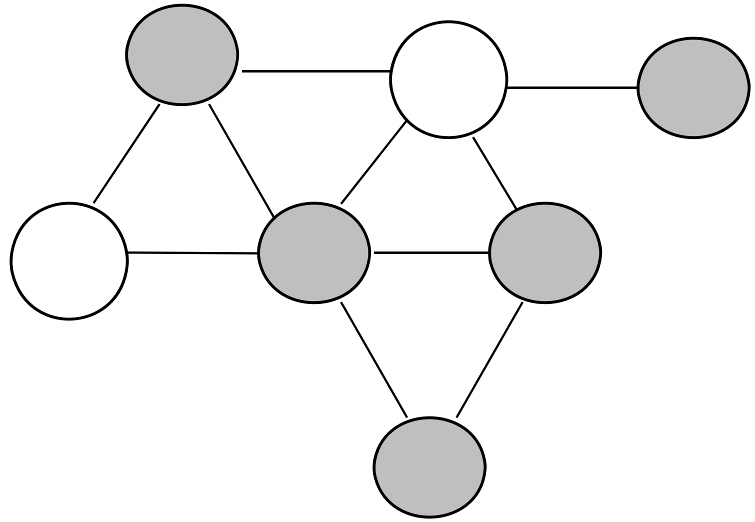
Ranius & Hedin (2001) Oecologia 126: 363-370

Telemetry

- moved between hollow oaks
- 72-94% remained in the same tree
- Dispersal range fits with a negative exponential function with a mean dispersal range of 60 m.

Hedin et al. (2008) 17: 675-684

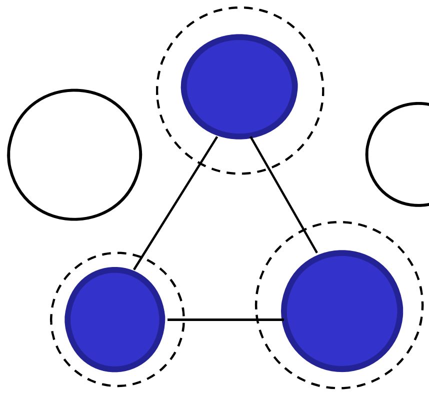
Classic metapopulation models



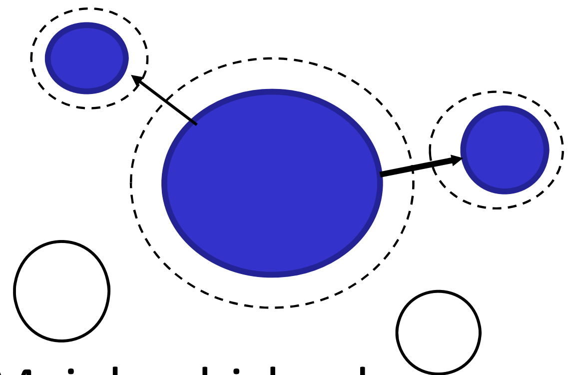
Every year local populations may go extinct, and empty patches may become colonised

Levins (1969; 1970)

Mainland-island metapopulations



Classic metapopulation



Mainland-island metapopulation

Harrison & Taylor (1997)

Habitat-tracking metapopulations affected by habitat patch dynamics

Thomas 1994

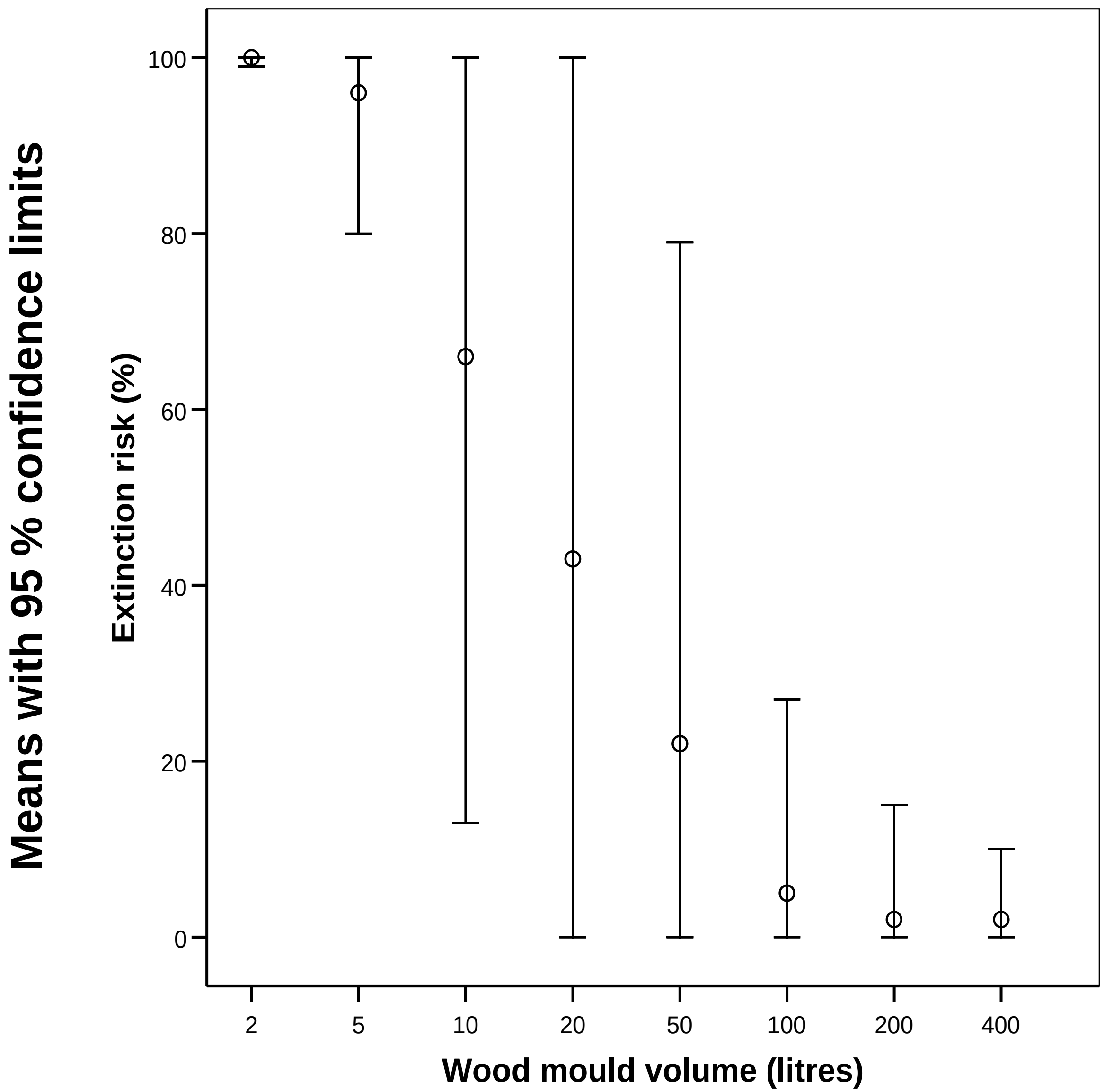
Extinction risks predicted

– by simulations of the population dynamics using Monte Carlo simulations and field data on population size fluctuations

- based on the Ricker function.

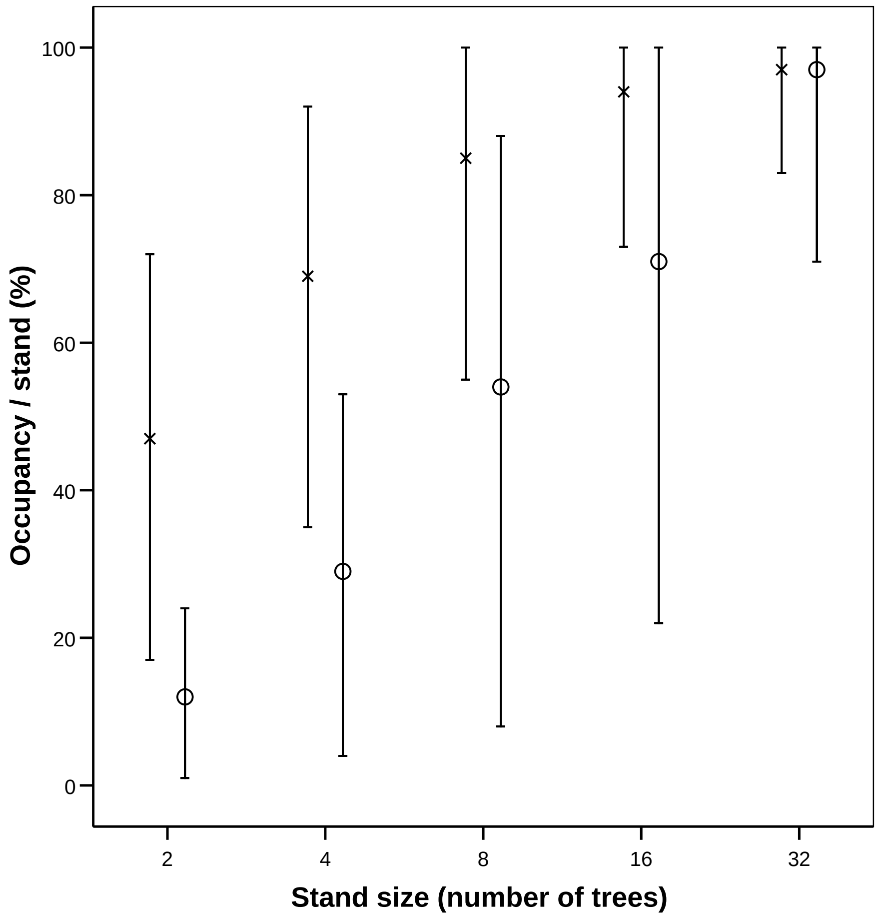
Ranius (2007) Ecography 30: 716-726

Relationship between wood mould volume and predicted extinction risk (%) of *Osmoderma eremita* over 100 years in individual trees assumed to host isolated populations.



Predicted occupancy of *Osmoderma eremita* after 200 years, in stands with differing mean numbers of hollow trees per stand. In one scenario (crosses) the number of trees and their carrying capacity was held constant, while in the other scenario (circles) the habitat dynamics were considered.

Occupancy/stand predicted



Ranius (2007) Ecography 30: 716-726

Conclusions

Rather far from a ‘classic’ metapopulation.

Mainland-island metapopulation (large differences between cavities with small and large volumes of wood mould)

Habitat-tracking metapopulations (populations go extinct when trees become unsuitable)

For the long-term persistence of species in hollow trees, the habitat dynamics and colonisation ability seem to be more important than demographic processes.

Conclusions for conservation

- Localities with 5-20 hollow trees may host only one or a few trees with large amounts of wood mould – high extinction risk

- Necessary to increase the number of suitable trees in many localities

- Do not try to save every single locality, but give priority to larger ones with a rich fauna, or localities with a potential for increasing the number of hollow trees.