Spatial occurrence patterns and decline of a threatened beetle, *Upis ceramboides*, in a managed boreal forest landscape

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Background

- Change in boreal forest disturbance dynamics; dramatic decrease of dead wood, snags, logs

  (Östlund et al. 1997, Siitonen 2001, Kuuluvainen 2009)

- Disturbance-favoured saproxylic forest species depend on dead wood on clear-cuts in the managed forest

  (Esseen et al. 1992, Berg et al. 1994, Kaila et al. 1997)

- Habitat fragmentation and importance of connectivity

  (Gu et al. 2006; Hanski 2008)

Aim

- Repeated surveys in the same landscape to understand colonisation – extinction dynamics of a threatened species
- Dependence on habitat density and quality (dead wood) at different scales

Study species

***U.ceramboides* (VU):**

- Boreal forests of Europe, Asia and North America
- Extremely cold-tolerant
- Sun-exposed dead birch wood
- Regionally extinct in southern Sweden since late 1800s

Platysoma minus (NT)

Rhagium mordax

Blackspotted Pliers Support Beetle

Rhagium inquisitor

Ribbed Pine Borer

Trichius fasciatus

Bee beetle

Study landscape

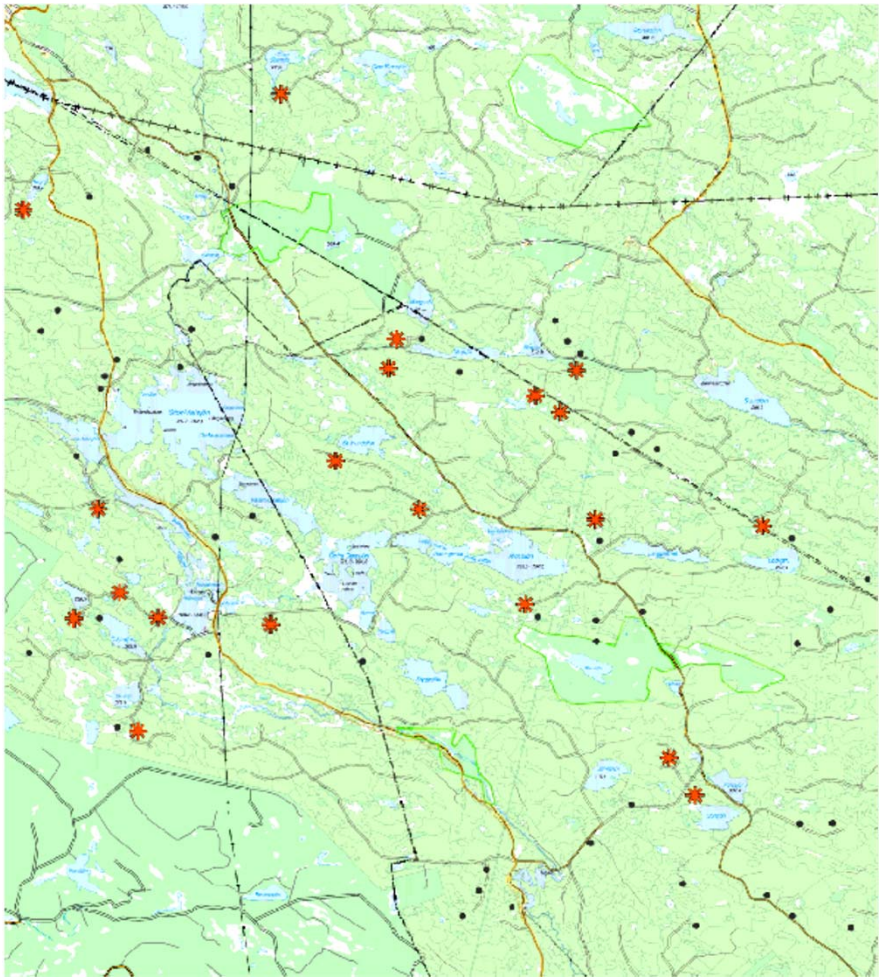
- Landscape in central Sweden (225 km^2)
- Altitude 250–500 m
- Boreal forest
- Historically strongly affected by forest fires and rich in deciduous trees
- Southernmost population of *U. ceramboides*

Methods

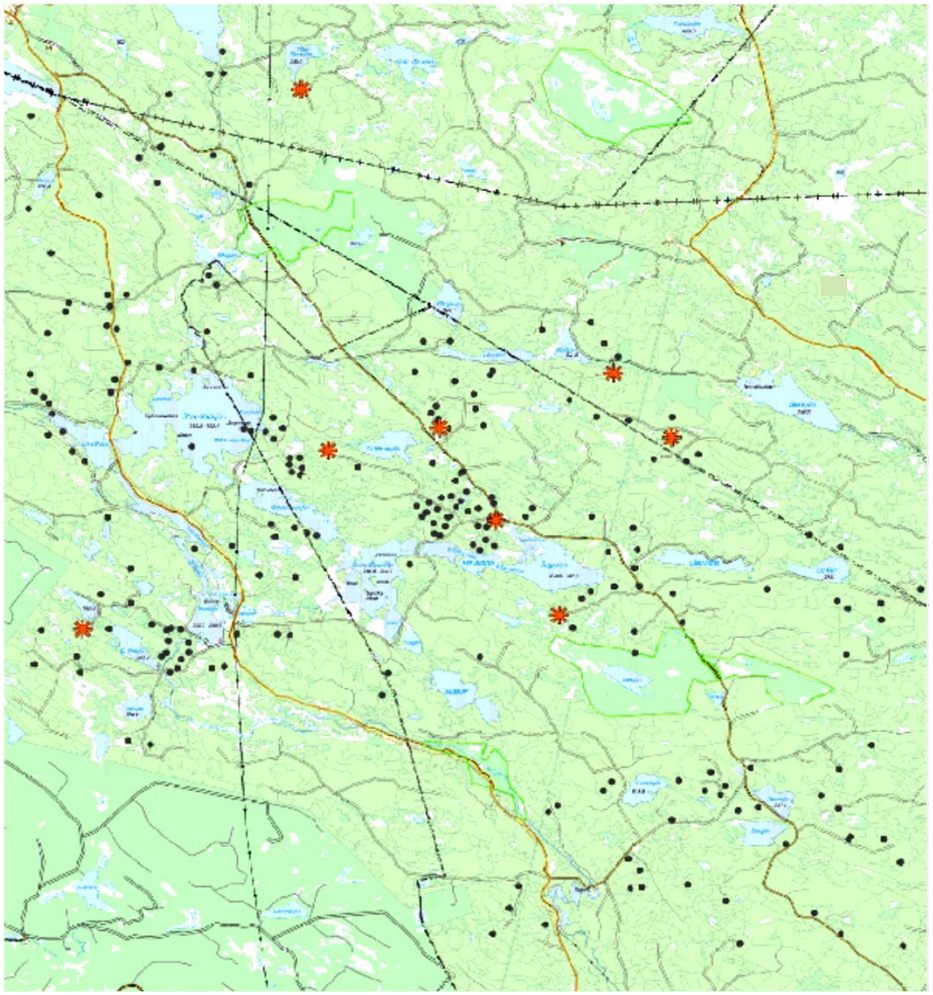
- All potentially suitable clear-cuts (age 3-14/20) surveyed in 2003 and 2010
- Highest density of dead birch wood
- Area where dead wood was present on clear-cuts estimated in 2010
- Habitat variables for each **clear-cut** and each dead wood **object**
- Connectivity

Results

2003



2010



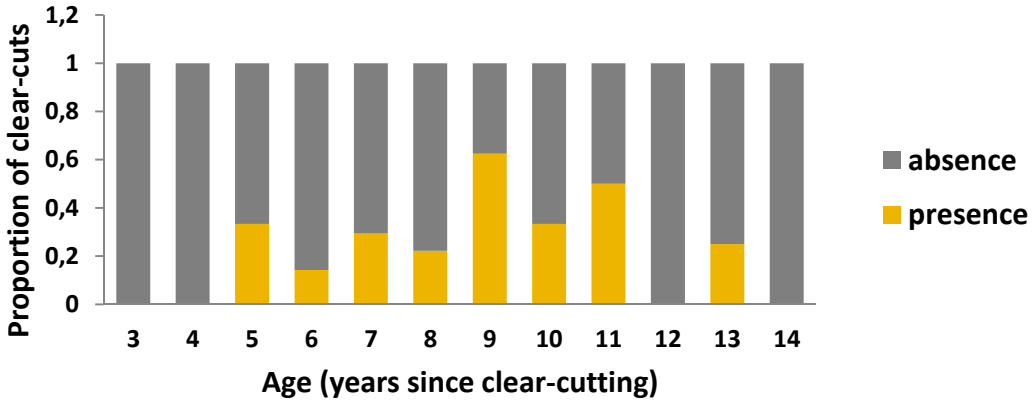
* Presence
● Absence

Occurrence

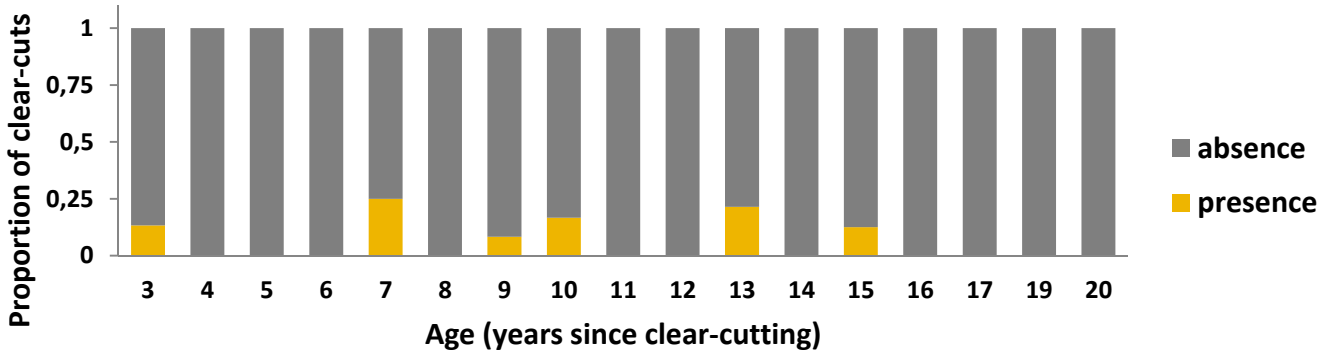
Species	Occupancy		No of clear-cuts		Colonisations	Extinctions
	2003	**2010**	**2003**	**2010**		
U. ceramboides	27 %	6 %	20	8	3	14
P. minus	25 %	49 %	18	68	60	10
R. mordax	40 %	31 %	29	43	24	17
R. inquisitor	19 %	24 %	14	34	29	9
T. fasciatus	36 %	44 %	26	61	41	7

Habitat

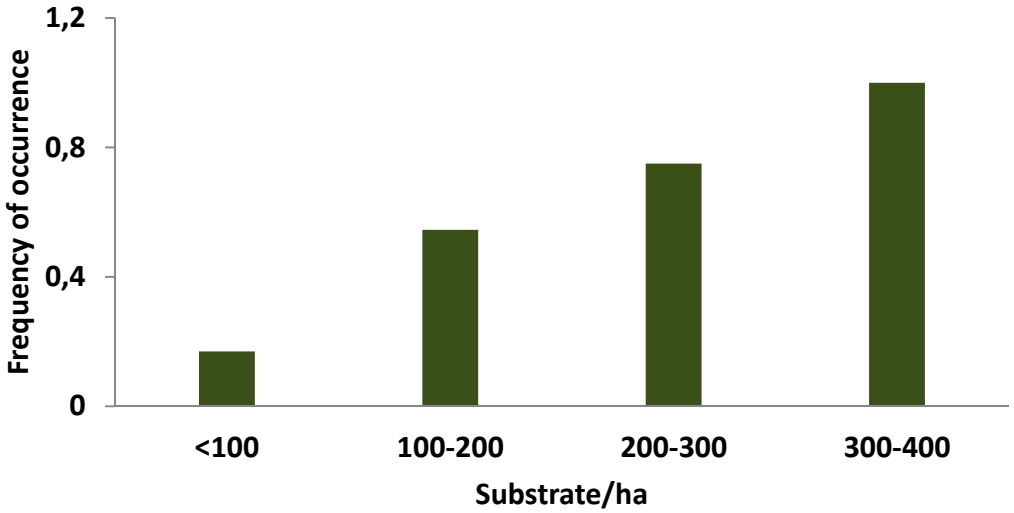
2003



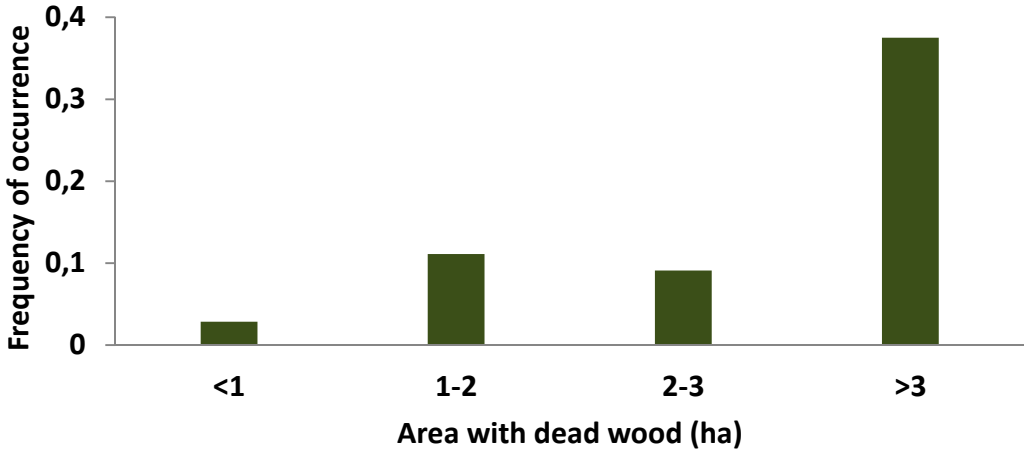
2010



2003


1,2
0,8
0,4
0
Frequency of occurrence
<100
100-200
200-300
300-400
Substrate/ha

2010


0,4
0,3
0,2
0,1
0
Frequency of occurrence
<1
1-2
2-3
>3
Area with dead wood (ha)

Results - habitat

Substrate level:

2003: Presence of white-rot fungi, intermediate decay class, ground contact (+), moisture (-)

2010: Clear-cut identity (random factor) had a major influence, contact with other dead wood objects (+)

Clear-cut level:

2003: Substrate density, age, substrate aggregation

2010: Area with dead wood, age

Connectivity:

No significant effect

Discussion

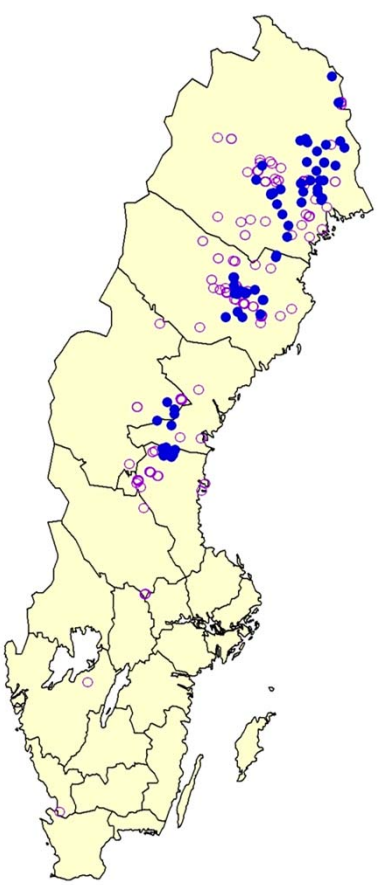
- Distribution area of *U. ceramboides* is shrinking in Sweden

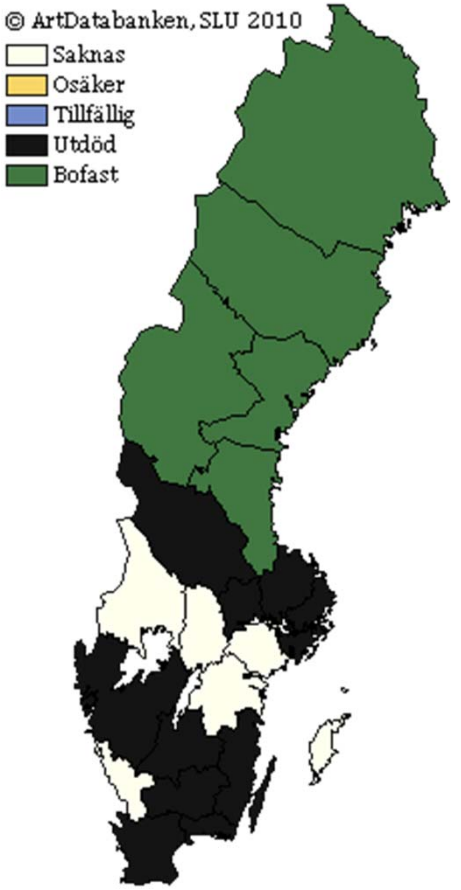
- Regional extinction from the south

- Land use (forestry)

- Climatic conditions

- Species interactions





Resident
Extinct
Absent

Discussion

- Occupancy of *U.ceramboides* has declined in the study landscape since 2003 survey (27% → 6 %)
- Decrease in amount of potential habitat (No, twice as many clear-cuts of suitable age in 2010)
- Degraded habitat quality on stand level (Maybe, average number of suitable substrates per clear-cut decreased from 13 to 6)
- Most stands with high proportion of deciduous trees already harvested in the landscape

Discussion

- Amount of deciduous trees has been increasing during last decades from a considerably lower level during 1950s-1970s (National Forest Inventory)
- The species has been declining for a long time, but has only now reached a threshold where it can no longer maintain a viable population in the area (?)
- The species community dependent on deciduous dead wood has an extinction debt and *U. ceramboides* responds with a time lag to the habitat degradation that has been occurring during the last century (?)

Thank You!
Project funding: FORMAS

Connectivity

Connectivity was calculated using

$$S_i = \sum_{j=1}^{n} \exp(-\alpha d_{ij}) p A_j$$

where S_i = habitat connectivity of surveyed area *i*; d_{ij} = distance between *i* and *j*; *n* = total number of sites with species presences in the landscape; *p* is species presence, with *p* = 1 at species presence, and *p* = 0 at species absence ; A_j = area of site *j* ; and α is a parameter controlling the rate with which the frequency of dispersal events decreases with distance.

References

- Berg, Å., Ehnström, B., Gustavsson, L., Hallingbäck, T., Jonsell, M. and Weslien, J. 1994. Threatened plant, animal and fungus species in Swedish forests: Distribution and habitat associations. Conservation Biology 8:718 – 731
- Esseen, P.-A., B. Ehnström, L. Ericsson, and K. Sjöberg. 1992. Boreal forests: The focal habitats of Fennoscandia. Pages 252- 325 in L. Hansson, editor. Ecological principles of nature conservation. Elsevier Applied Science, London, England.
- Gu, W., Heikkilä, R. and Hanski, I. 2002. Estimating consequences of habitat fragmentation on extinction risk in dynamic landscapes. Landscape Ecology 17:699 – 710
- Hanski, I. 2008. Insect conservation in boreal forests. J Insect Conserv 12:451–454
- Kaila, L., Martikainen, P. and Punttila, P. 1997. Dead trees left in clear-cuts benefit saproxylic Coleoptera adapted to natural disturbances in boreal forest. Biodiversity and Conservation6: 1 – 18
- Kuuluvainen, T. 2009. Forest management and biodiversity conservation based on natural ecosystem dynamics in northern Europe. The complexity challenge. AMBIO 38:309 – 315
- Siitonen, J. 2001. Forest management, coarse woody debris and saproxylic organisms: Fennoscandian boreal forests as an example. Ecological Bulletins 49:11 – 41
- Östlund, L., Zackrisson, O. & Axelsson, A.-L. 1997. The history and transformation of a Scandinavian boreal forest landscape since the 19th century. Canadian Journal of Forest Research 27:1198 – 1206.
- Pictures: www.zdjecia.polska.pl; www.aramel.free.fr; www.people.mokk.bme.hu; Wikipedia