Herbivore impact on landscape structure and biodiversity

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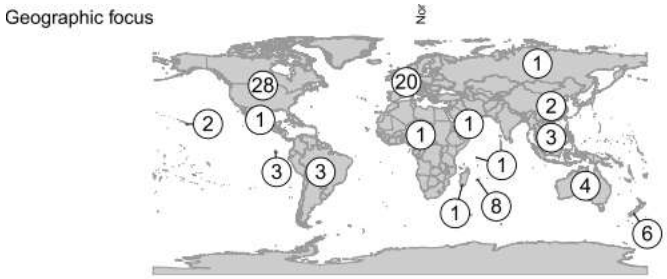
Rewilding = hot: multiple concept/opinion papers & sites

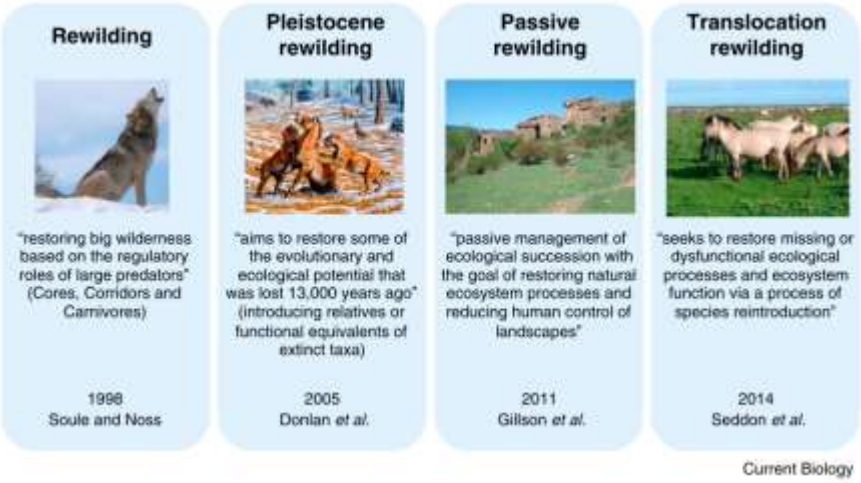
Table 1. A Taxonomy of the Major Terms Mentioned in this Review with a Brief Explanation of Their Recent Usage

Umbrella Term	Term	Key Element in Usage	Refs
Restoration	Restoration (in a strict sense)	Restoring original composition and function	[60]
	Functional restoration	Prioritizing function over species composition	[25]
	Reforestation	Restoring forest cover	[21]
	Revegetation	Restoring vegetation cover	[21]
	Rehabilitation	Returning highly degraded sites to usefulness	[60]
	Reclamation	Returning highly degraded sites to usefulness	[60]
	Ecological engineering	Creating sustainable ecosystems with both human and ecological value	[60]
Conservation Translocation	Reintroduction	Release within previous native range	[8]
	Reinforcement	Release into an existing population	[8]
	Assisted gene flow	Release within native range to assist adaptation	[61]
	Pleistocene reintroduction	Release within the Pleistocene range	[55]
	Conservation introduction	Release outside the native range	[8]
	Assisted colonization	To avoid extinction	[8]
	Assisted migration	To keep up with climate change	[9]
	Ecological replacement	To restore an ecological function	[8]
	Restocking	Mostly of harvested wild populations	[62]
Rewilding	Trophic rewilding	Introductions to restore top-down trophic interactions	[12]
	Pleistocene rewilding	Restoring to a pre-human Pleistocene baseline	[55]
	Ecological rewilding	Allowing natural processes to regain dominance	[13]
	Passive rewilding	Little or no human interference	[12]

Corlett 2016 (TREE)



Svenning et al 2016 (PNAS)



"Rewilding is the new Pandora's box in Conservation" Nogués-Bravo et al 2016 (Current Biol)

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What do we really know about the effects of rewilding?

- Long history of grazing with large herbivores for nature conservation purposes
- Large body of literature about the impact of large herbivores
- *To what degree does this apply to rewilding ??*

<u>This talk:</u>

- Impacts on landscape structure (shifting mosaics concept)
- Impacts on biodiversity (OVP as rewilding area)
- Role of predators for rewilding (with herbivores)

<u>Main messages</u>:

1. Despite multiple concept/opinion papers & rewilding sites….
2. **we lack empirical data on rewilding**
3. **available data is limited and (perhaps) site specific**


















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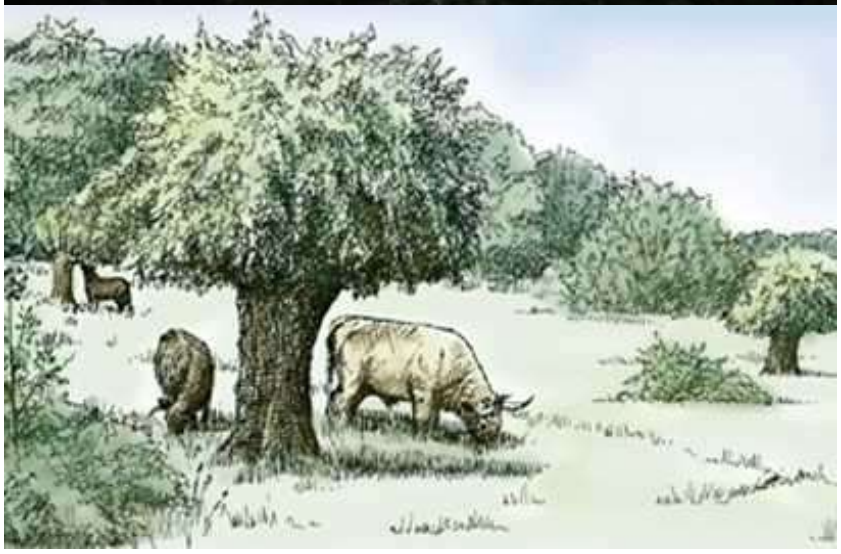
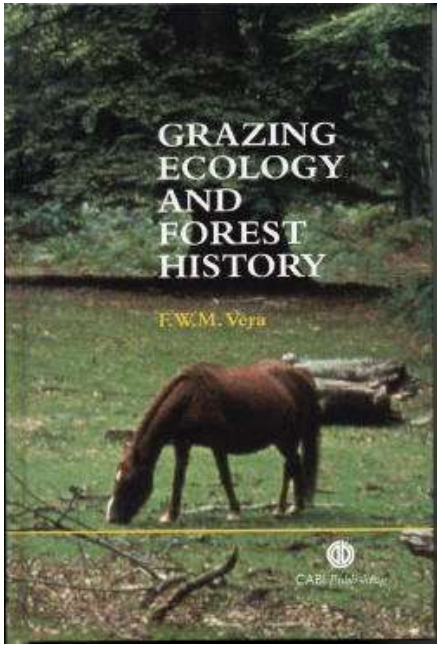
Our primeval landscape?





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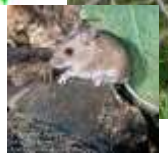
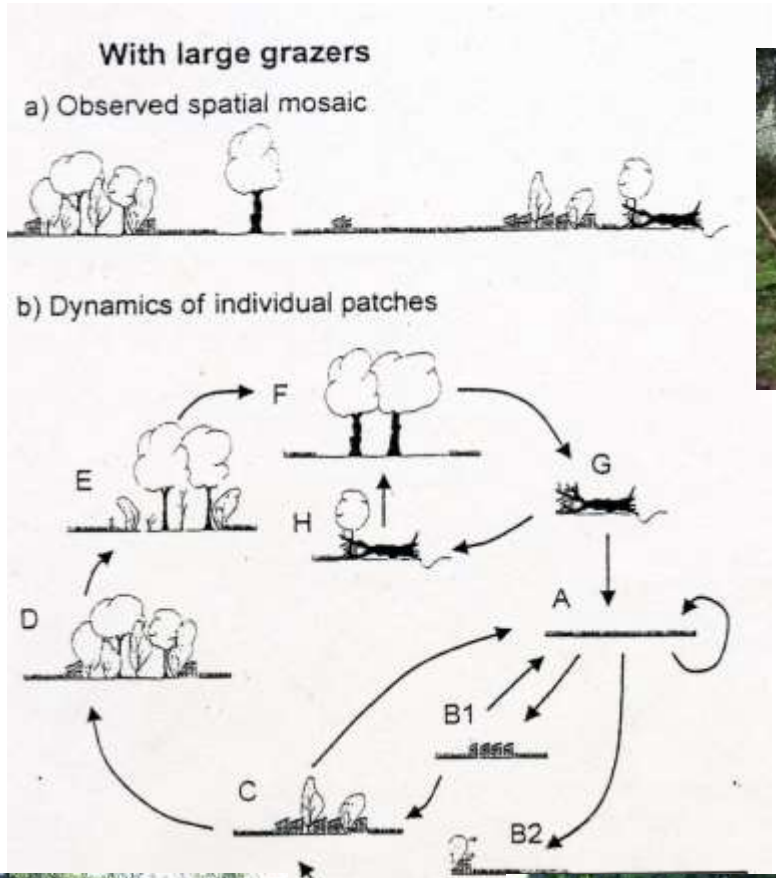
Shifting mosaics concept





(Plant Biol)

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Mechanisms apply to several grazed systems




Smit et al. 2005 (JVS), 2006 (JAPPL), 2008 (JVS), ...

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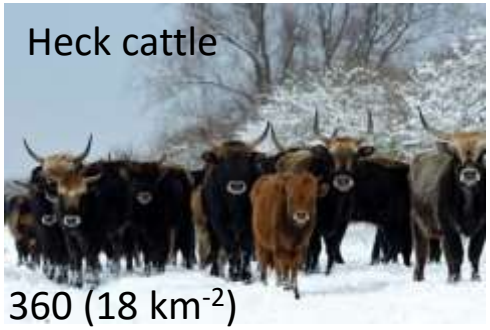
Oostvaardersplassen: rewilding with large herbivores



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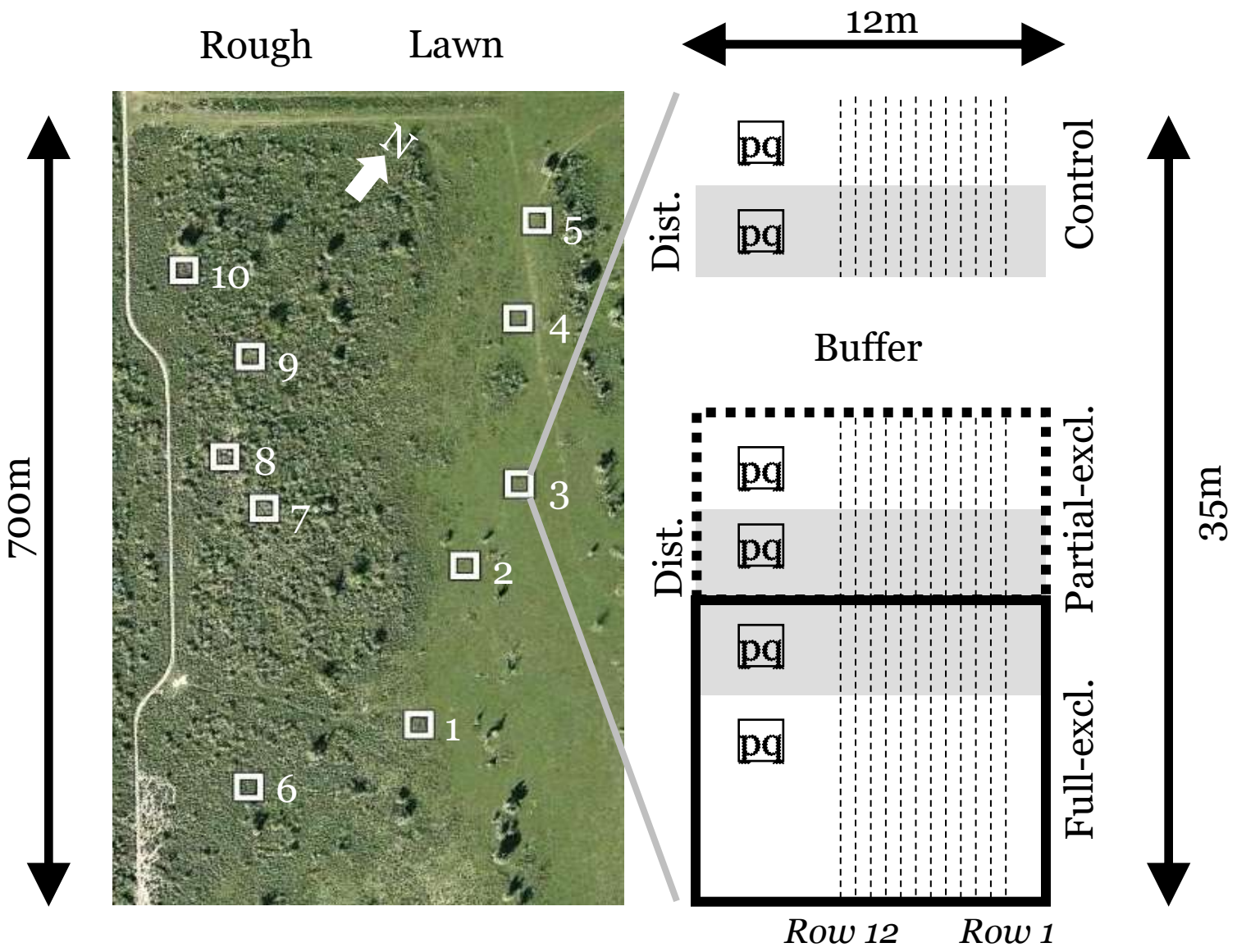
Tree establishment

Jasper Ruifrok



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After 3 years

Photo's: Jasja Dekker

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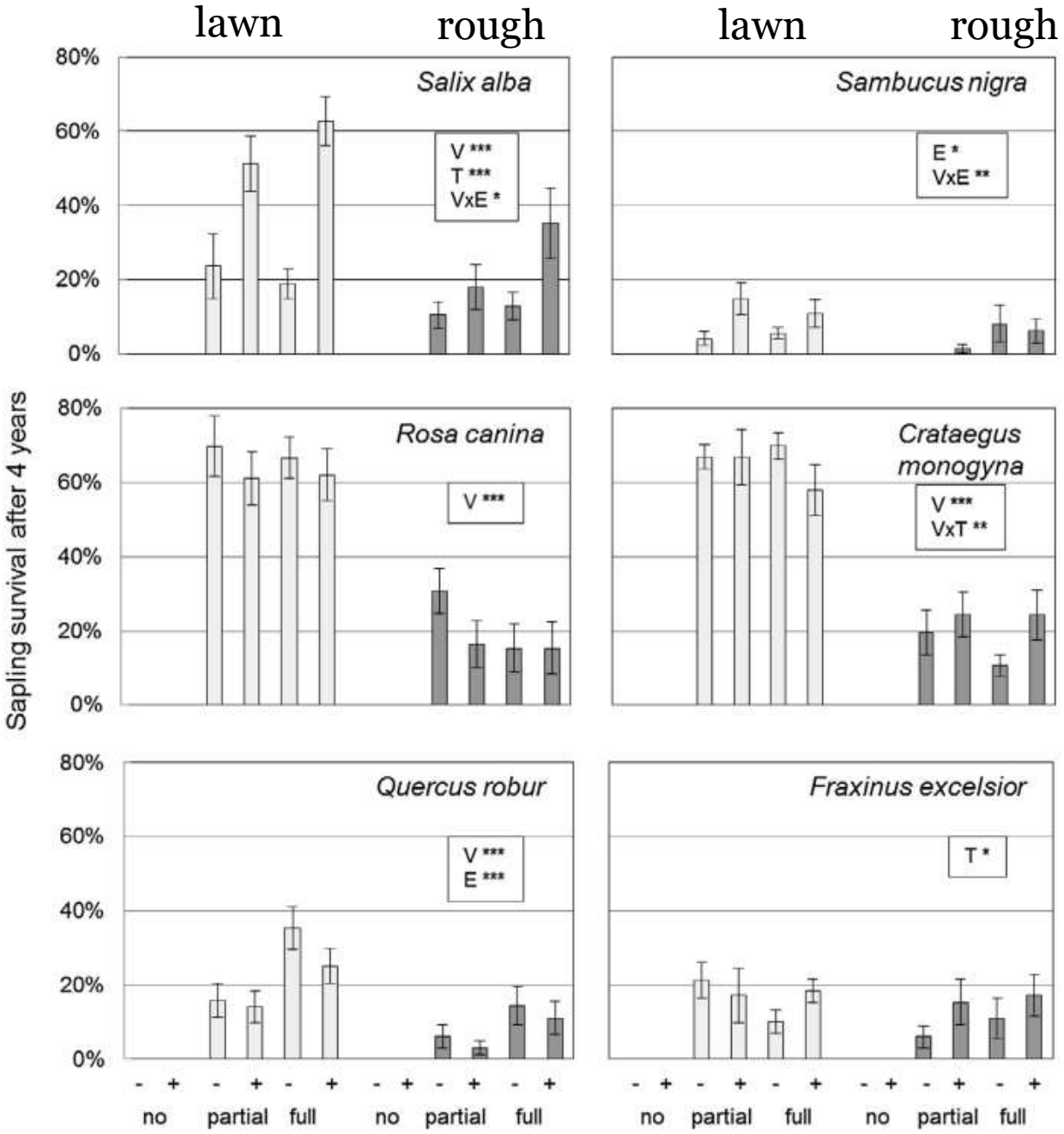
Survival after 4 years



1. Species differ
2. Little difference partial-full
3. Survival in lawn >> roughs
4. Impact soil tillage

Grazing refugia important for establishment of woody species!

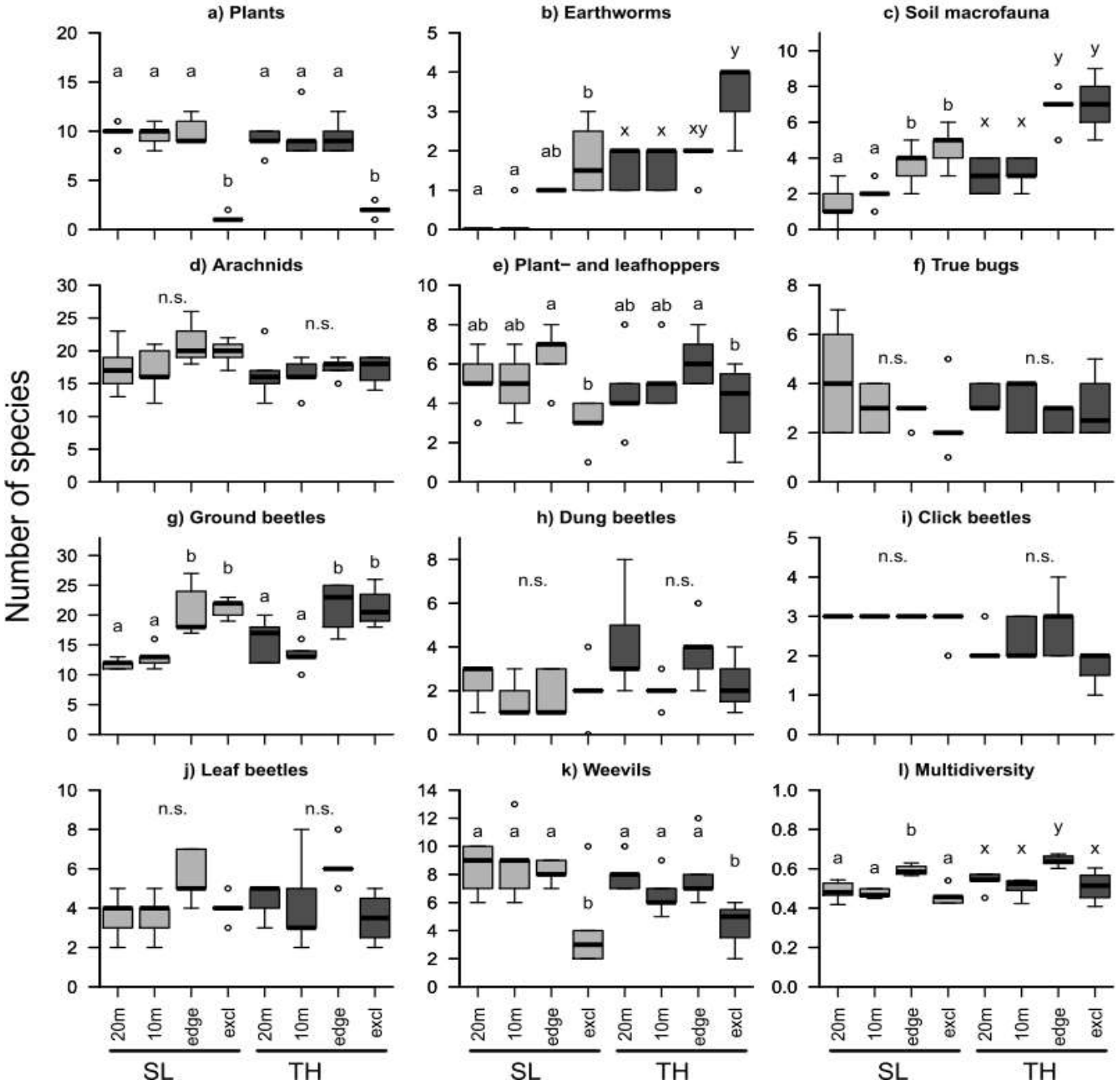
Smit et al, 2015 (Biol Cons)

Possibilities tree establishment

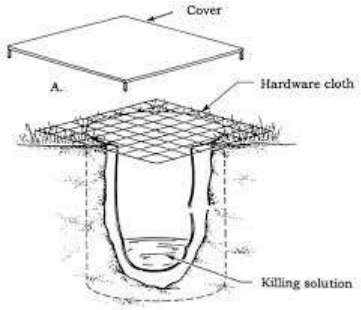
- *Grazing refugia*
  - Coarse woody debris
  - Water bodies / islands
- *Population crashes*
  - Strong winter / diseases
- *Lowering grazing pressure*
  - Ecological corridors
  - 'Ecology of fear'

Smit et al, 2015 (Biol Cons)

Response plant & invertebrate diversity?



Roel van Klink



van Klink et al, 2016 (AGEE)

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Response plant & invertebrate diversity

- Plant diversity higher outside exclosures
- Higher numbers of invertebrates outside exclosures
- Response invertebrates functional group dependent
  - Response herbivores is plant-species dependent
  - Response predators is (prey) species dependent
  - Diversity soil fauna higher inside exclosure

Exclosures / grazing refugia:

enhance (local) heterogeneity & structure, and thus diversity

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Extrapolation OVP to other rewilding sites?

- OVP: very productive site, specific land-use history & herbivore assemblage
- Much abandoned agricultural land available for rewilding
- Role of predators?

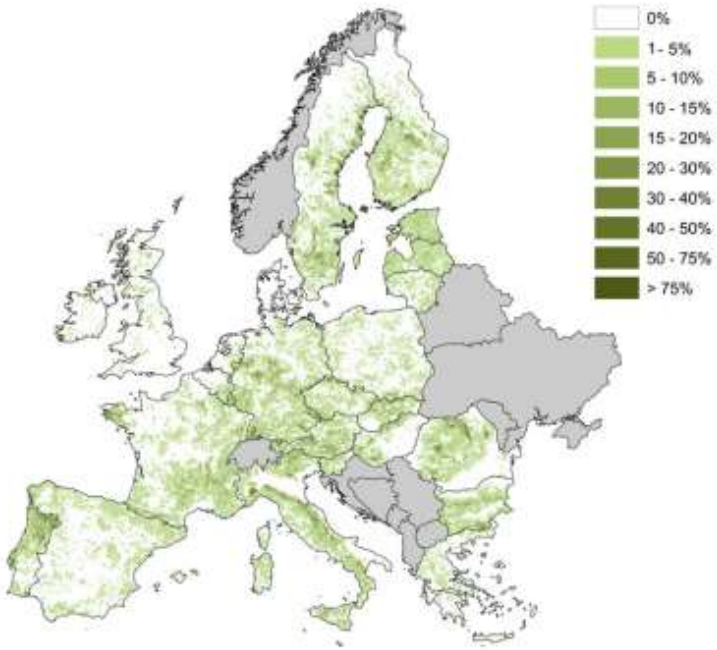
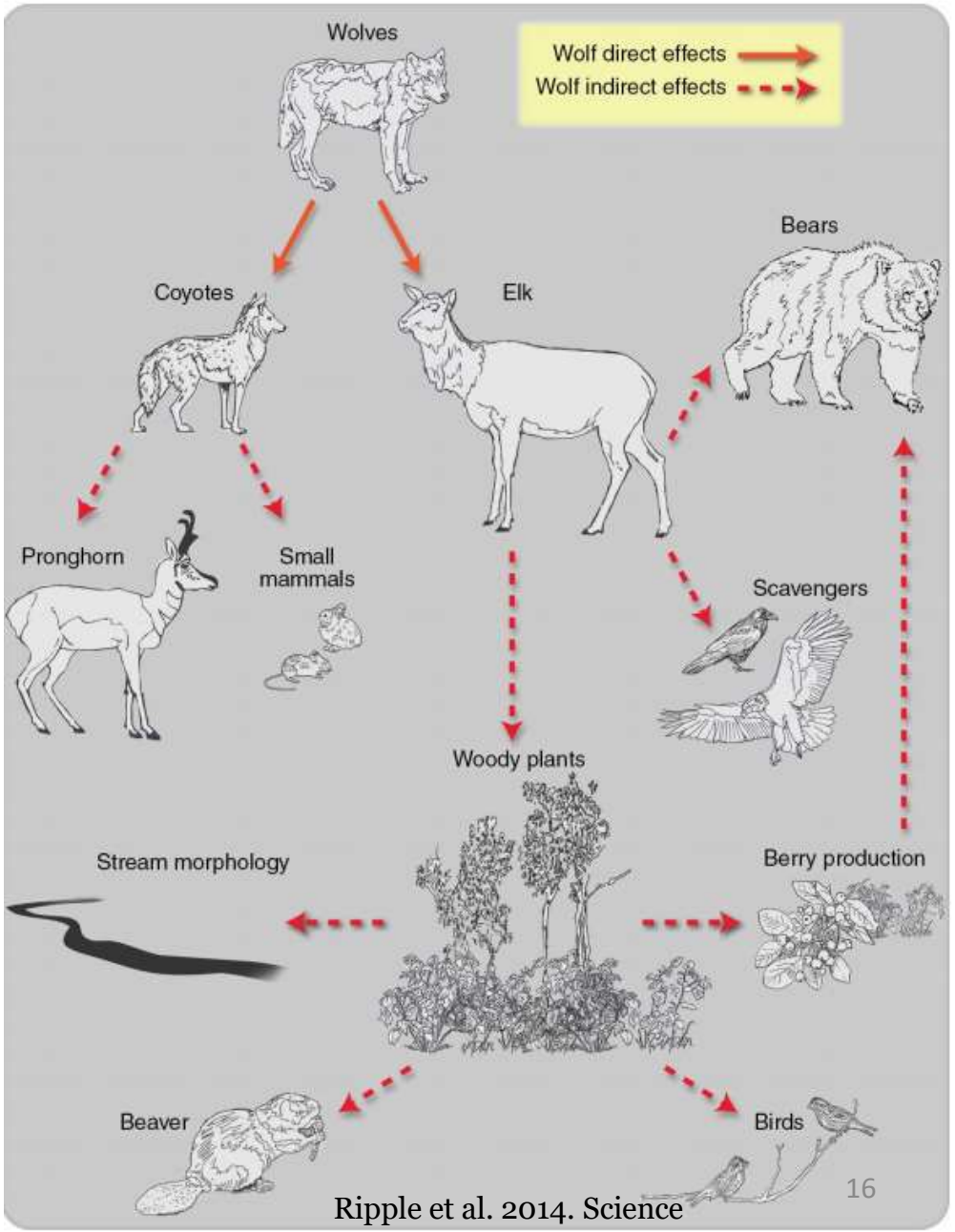


Figure 4. Localization of the hotspots of abandonment and rewilding in Europe. Those hotspots are areas categorized as "agriculture" in 2000 that are projected to become rewilded or afforested in 2030 and that are common to all four scenarios of the CLUE model (Verburg and Overmars 2009). Hotspots are expressed as a percentage of each 10-km^2 grid cell. Agricultural areas correspond to "arable land (non-irrigated)", "pasture", "irrigated arable land" and "permanent crops". Rewilded and afforested areas correspond to "(semi)-natural vegetation", "forest", "recently abandoned arable land" and "recently abandoned pasture land". Countries in *grey* have no data.

Navarro & Pereira 2012
(Ecosystems)

Trophic cascading effects of returning large carnivores

Ripple & Beschta 2011 Biol Cons



Ripple et al. 2014. Science

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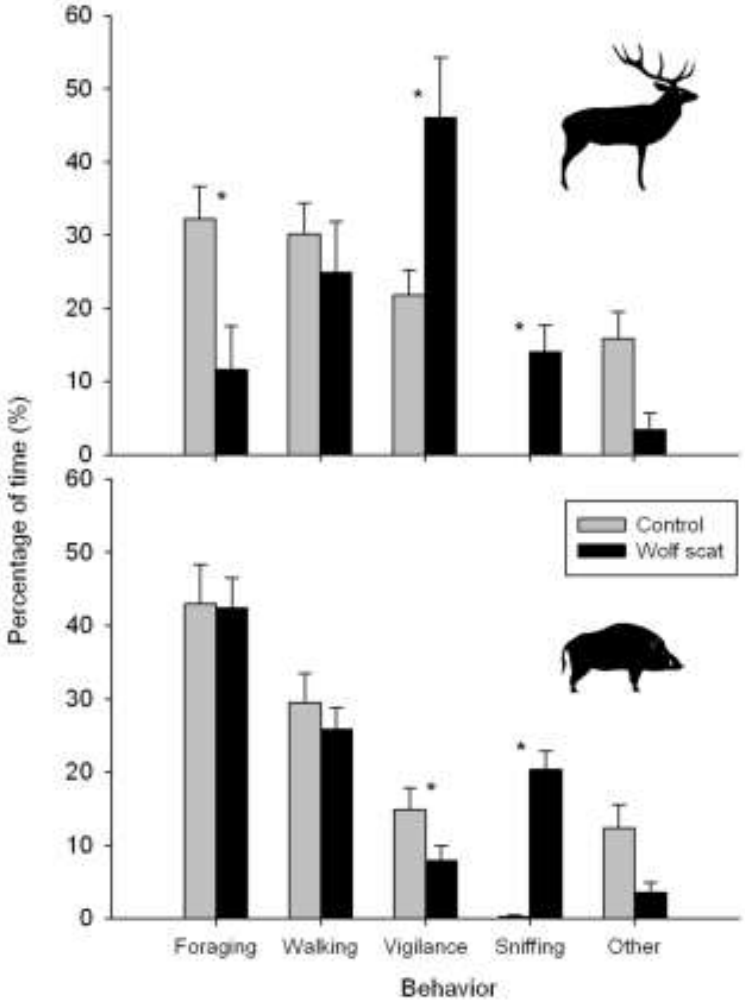
Ecology of fear in Bialowieza, Poland

PEN ACCESS Freely available online

PLOS ONE

What Cues Do Ungulates Use to Assess Predation Risk in Dense Temperate Forests?

Dries P. J. Kuijper[1*], Mart Verwijmeren[2], Marcin Churski[1], Adam Zbyryt[3], Krzysztof Schmidt[1], Bogumiła Jędrzejewska[1], Chris Smit[4]



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Effects landscape of fear (CWD & wolves) on vegetation by alteration of red deer behaviour?

PhD Annelies van Ginkel

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Mammal Research Institute Polish Academy of Sciences Białowieża

Landscape of fear in closed-canopy forests

Annelies van Ginkel, Chris Smit, Dries Kuijper

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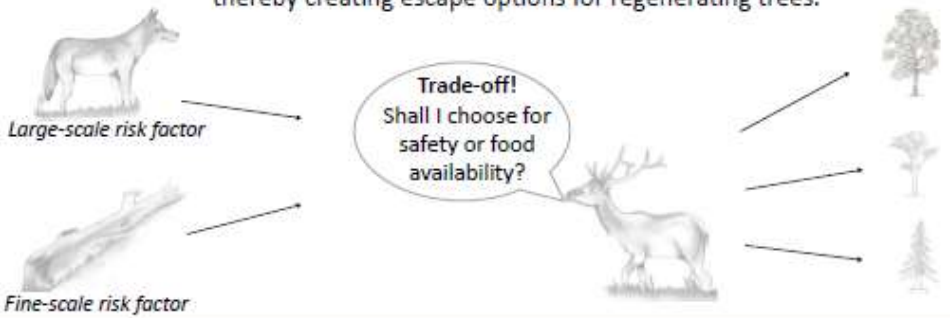
Landscape of fear:

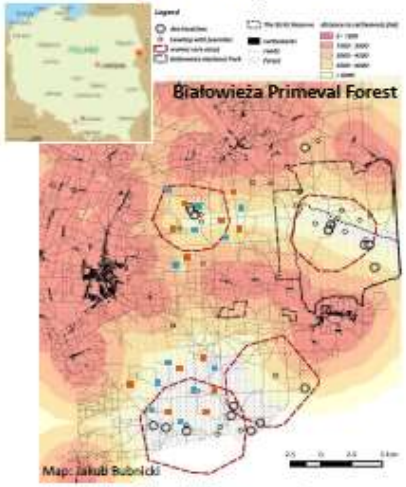
The perception of predation risk that differs within an animals home range over space and time.

Wolves and coarse woody debris create both a landscape of fear, but on different scales, and thereby creating escape options for regenerating trees.



Experimental design: Planting saplings with gradient of perceived risk by red deer

Large-scale risk gradient: distance from plot to wolf den.

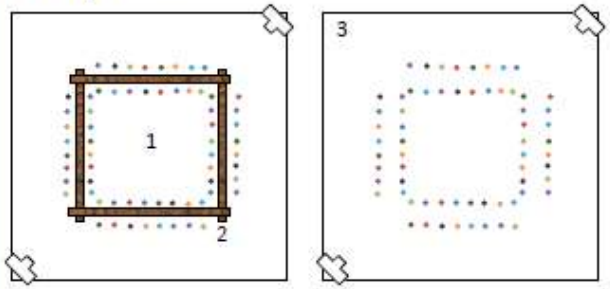


- Plot with added olfactory predator cue
- Plot without added olfactory predator cue

Fine-scale risk factor: protection by coarse woody debris or not.

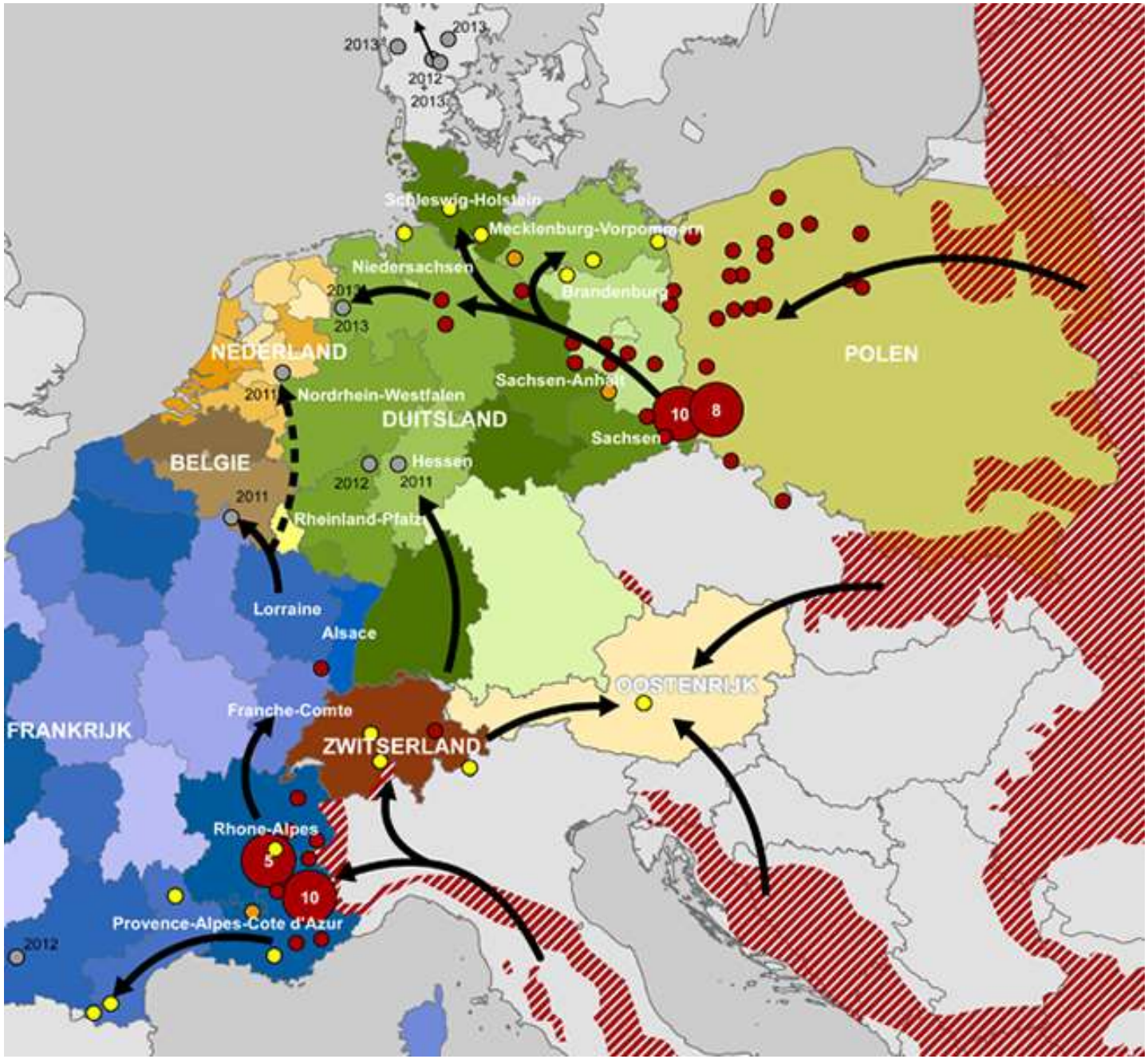
1 = Physical impediment
2 = Escape and visual impediment
3 = No impediment

Camera trap



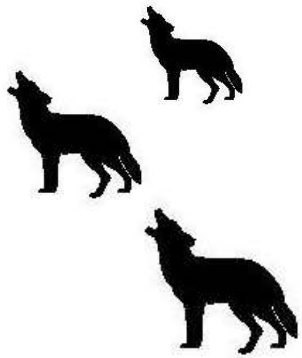
- *Quercus robur*
- *Carpinus betulus*
- *Tilia Cordata*
- *Acer platanoides*
- *Pinus sylvestris*
- *Alnus glutinosa*
- *Picea abies*
- *Prunus padus*

Measurements:
- Survival rate
- Browsing damage
- Sapling growth



Actuele wolvenstand

- zwerver gezien
- gevestigde eenling
- wolvenpaar
- roedel
- meerdere roedels
- wolvengebied verder weg
- Verspreiding
- Mogelijke verspreiding



www.natuurmonumenten.nl/dossier/de-wolf/verspreidingsgebied-europa

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Ecology of fear: Poland vs. the Netherlands (ongoing)

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Thank you for your attention
Questions?

Netherlands Organisation for Scientific Research
Earth and Life Sciences

KNAW

staatsbosbeheer

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SCHWEIZERISCHER NATIONALFONDS
FONDO NAZIONALE SVIZZERO
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PRINS BERNHARD CULTUURFONDS