

# The fluctuating world of a tundra predator guild in winter



**Bottom-up constraints can overrule top-down  
species interactions in winter**

## The threat of a warmer climate over northern latitudes

Switch from **bottom-up** to **top-down** regulation<sup>1</sup>

Expansion of **boreal** species<sup>2</sup>

A threat to **native tundra** species<sup>3</sup>



© Don Gutoski- Winner of the Wildlife Photographer of the Year 2015

⇒ **Top-down effects (predation + competition)  
would become a significant structuring force**

<sup>1</sup>Legagneux et al 2014 ; <sup>2</sup>Elmhagen et al 2015 ; <sup>3</sup>Angerbjörn et al 2013

## A highly dynamic ecosystem

Seasonality should not be **ignored**<sup>1</sup>

**Winter severity**

Effect of the **rodent cycle**<sup>2</sup>

**Pulsed resources**

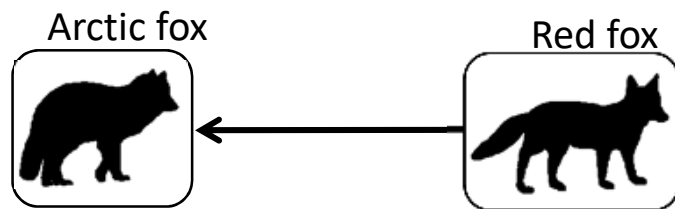


⇒ **Do top-down interactions still prevail over bottom-up effects**

- **in winter?**
- **when resources are low?**

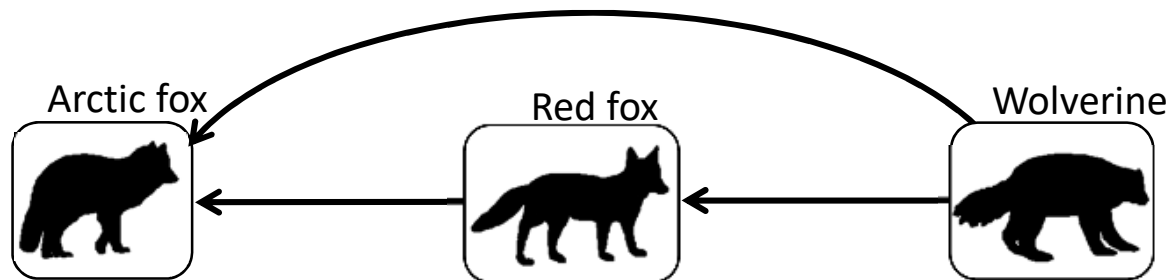
<sup>1</sup>Ims & Fuglei 2005 ; <sup>2</sup>Krebs 2011

## Fennoscandian mountain tundra community in winter



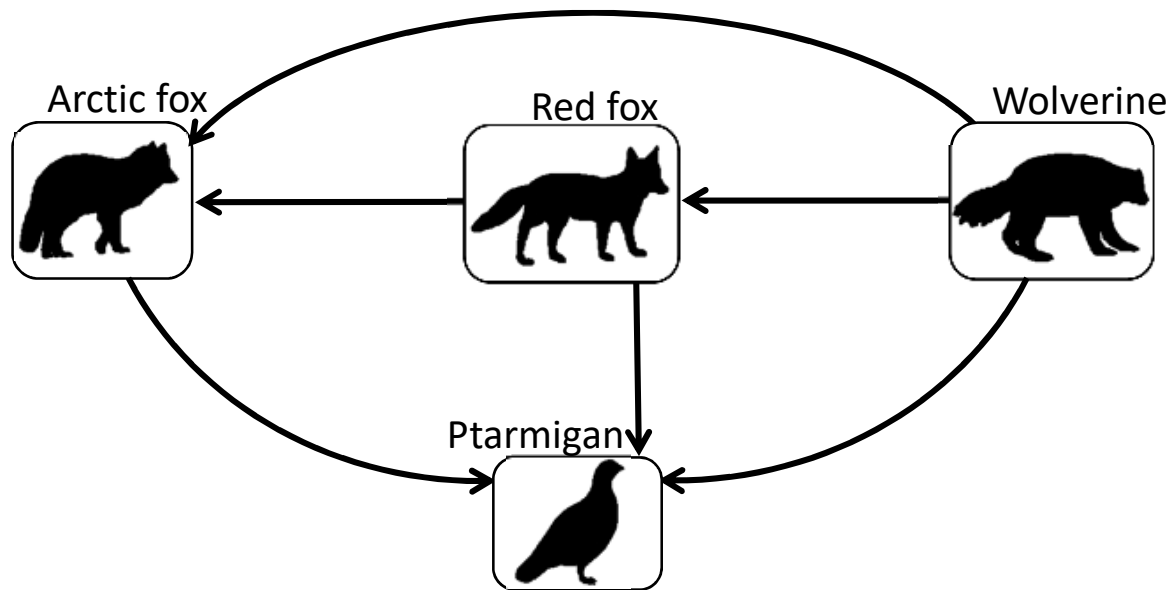
## Fennoscandian mountain tundra community in winter

**Largest predators detected were wolverine, red fox and arctic fox**



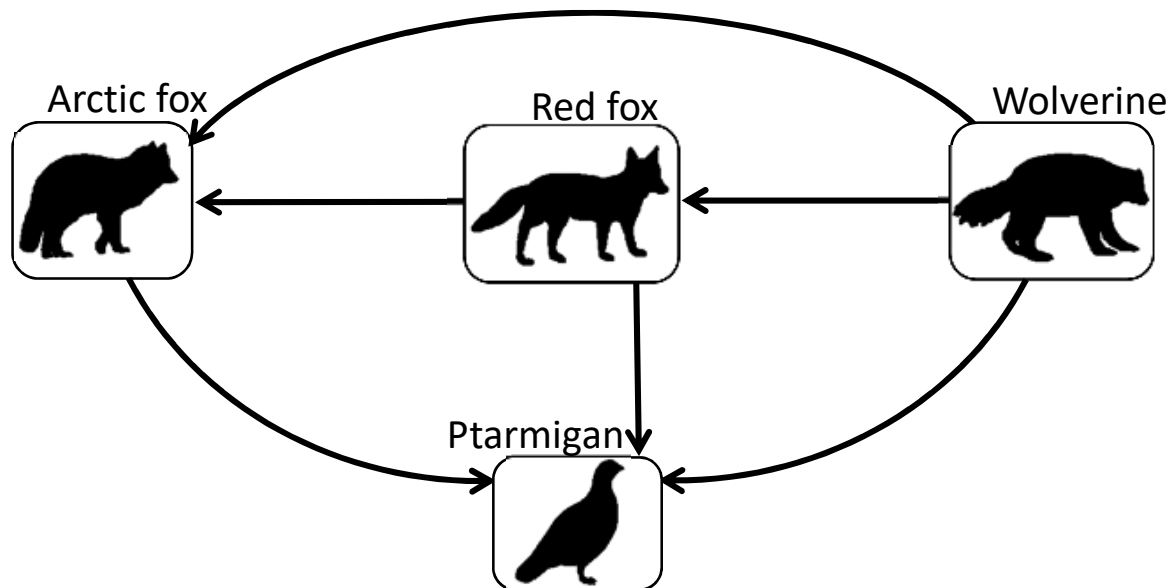
## Fennoscandian mountain tundra community in winter

**Largest predators detected were wolverine, red fox and arctic fox**



## Fennoscandian mountain tundra community in winter

Largest predators detected were wolverine, red fox and arctic fox



Rodent abundance  
as a treatment



Post-peak



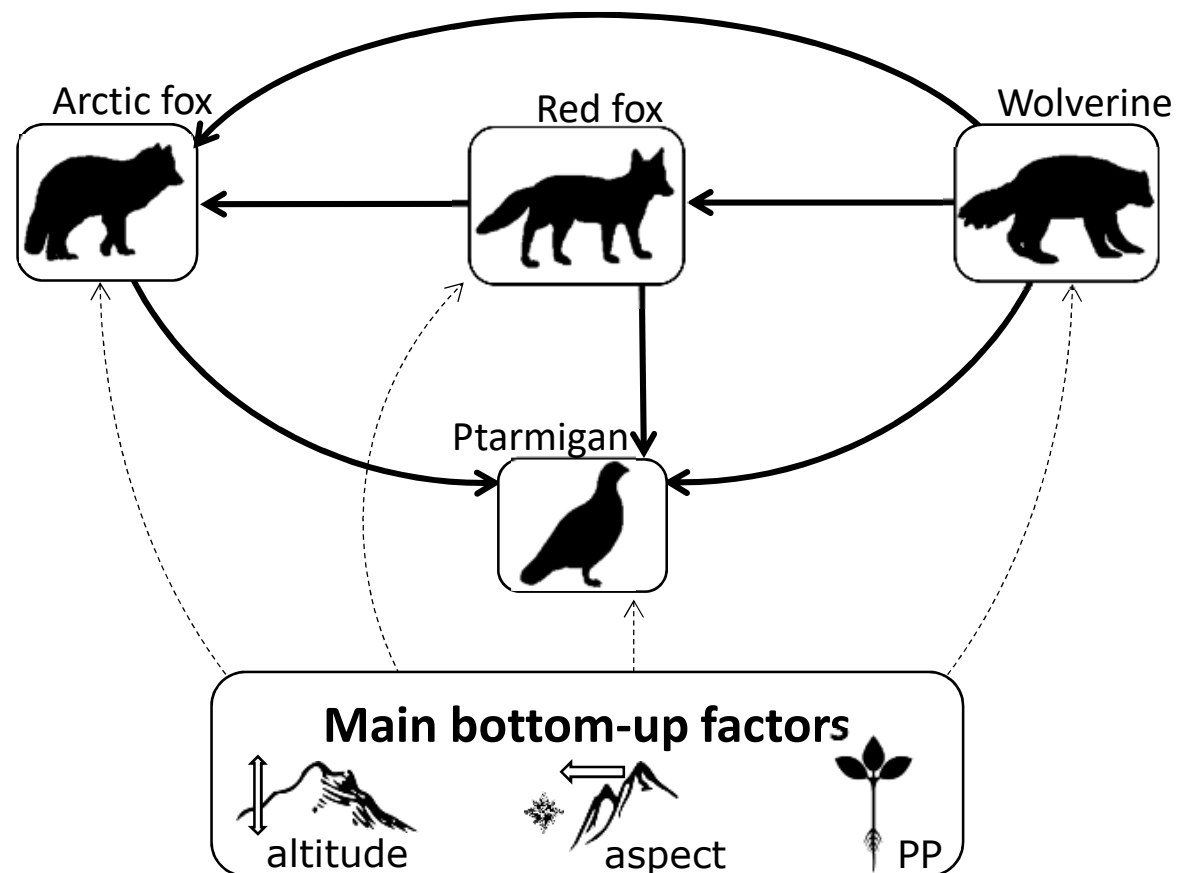
Pre-peak



Low

## Fennoscandian mountain tundra community in winter

Largest predators detected were wolverine, red fox and arctic fox



Rodent abundance  
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Post-peak



Pre-peak



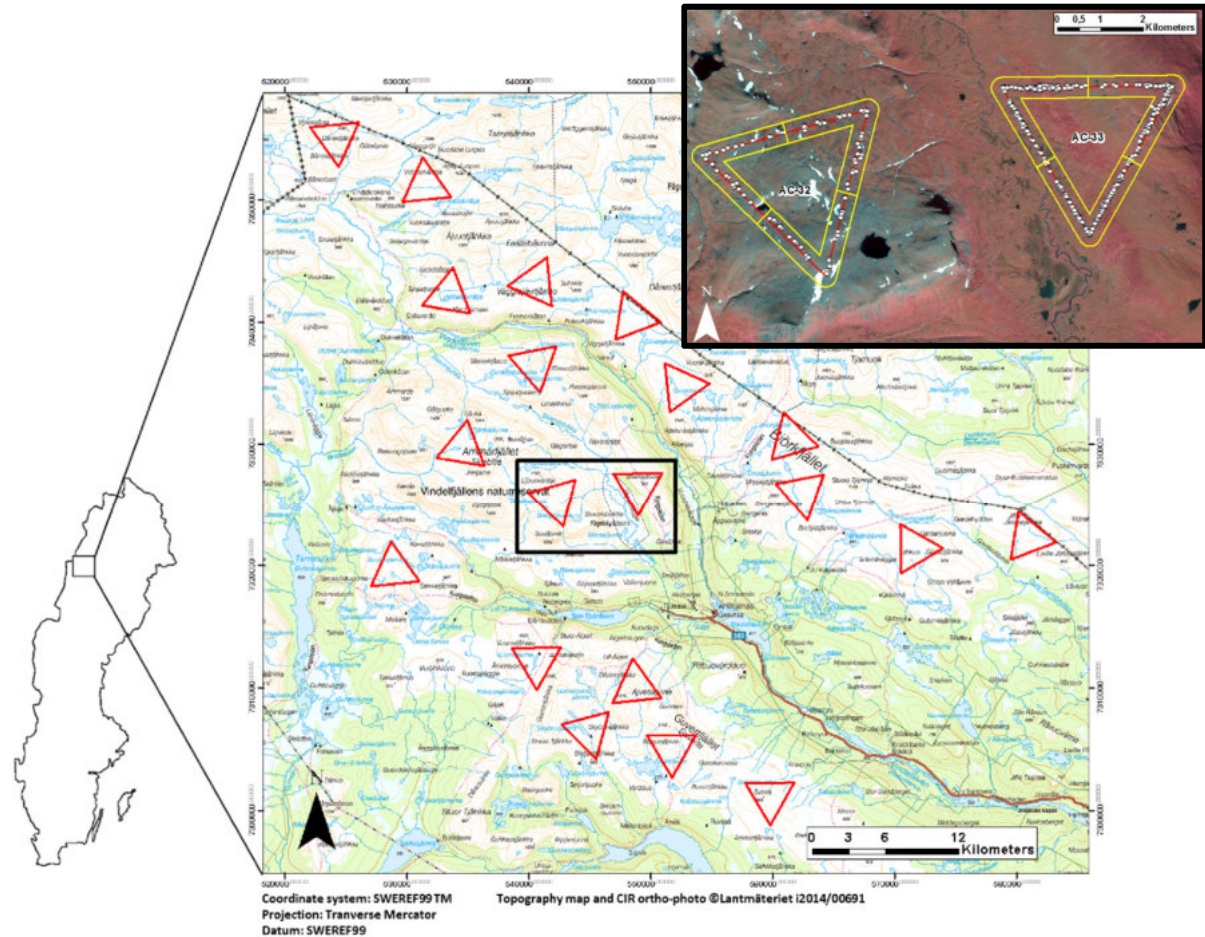
Low



## Methods:

12-year snowtracking  
survey (2004-2015)

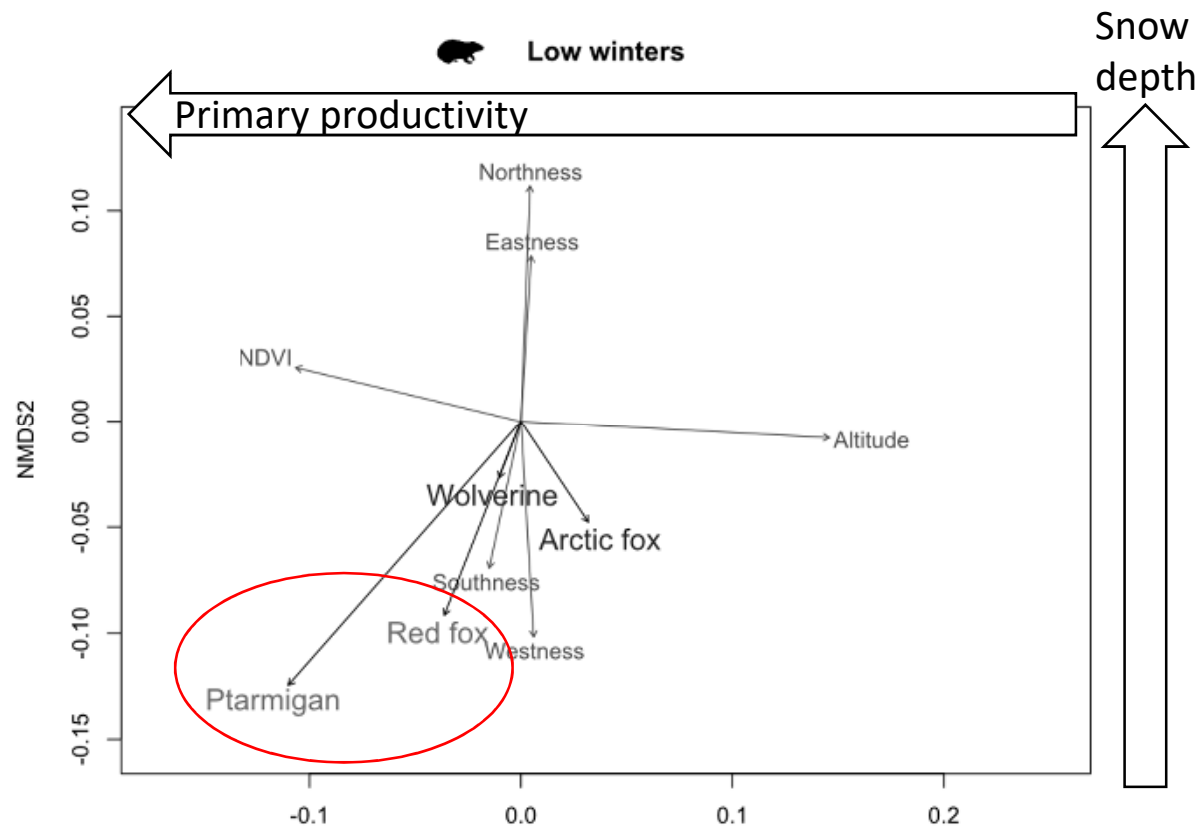
Wildlife Triangle Scheme<sup>1</sup>  
(12km triangle transects by  
snowmobile)



**Vindelfjällen nature reserve**

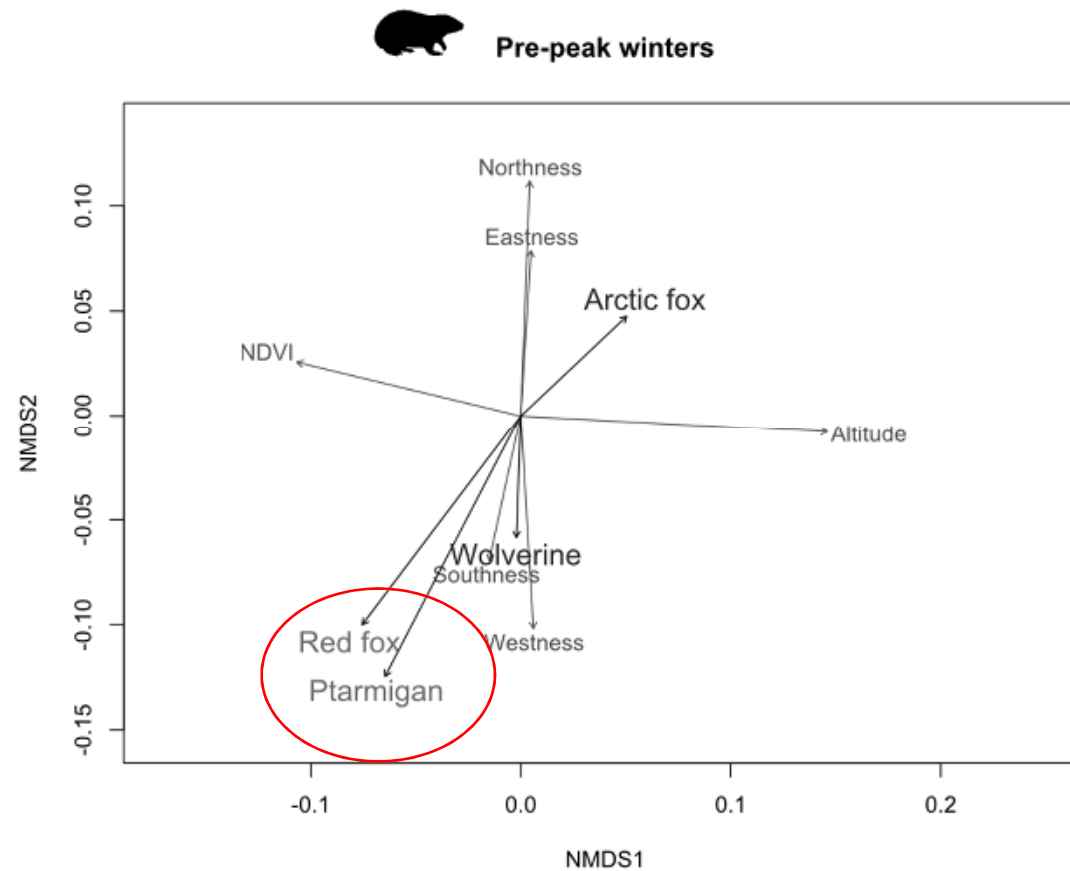
<sup>1</sup>Lindén et al. 1996

## Results: Analysis of the spatial patterns



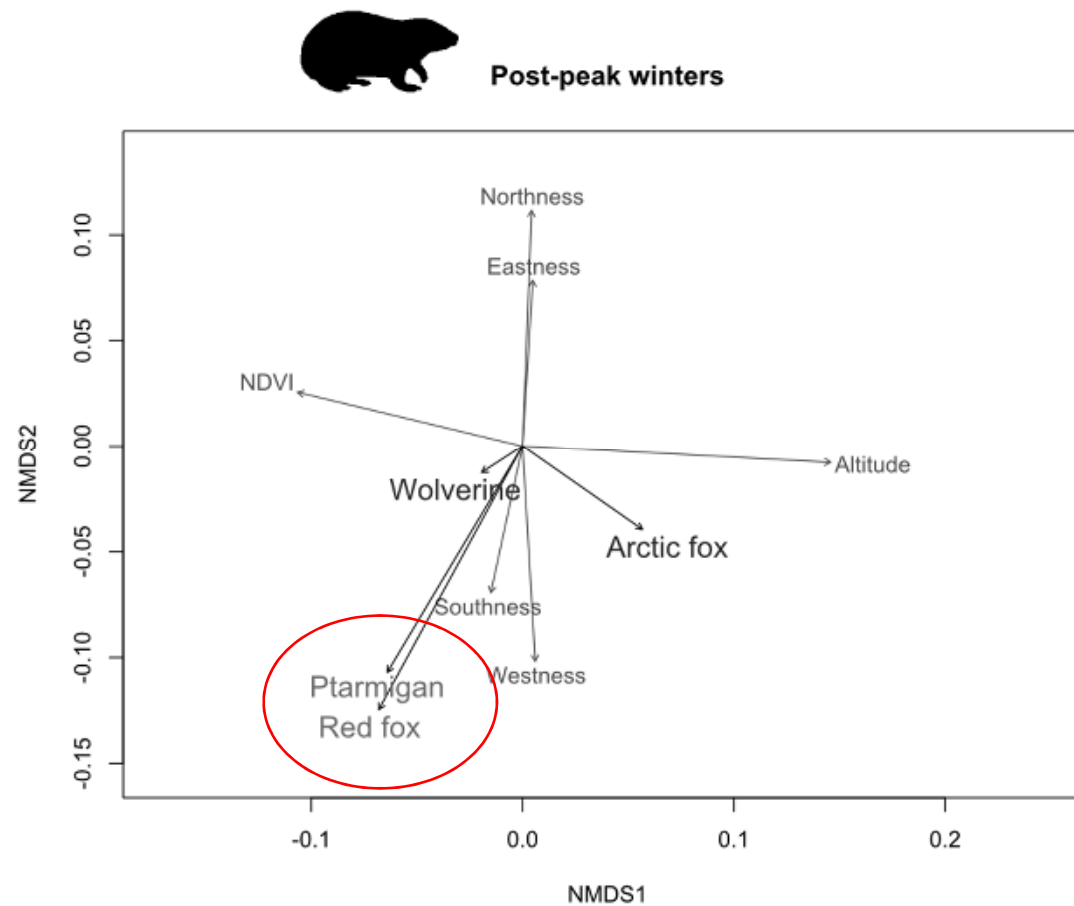
Non-metric dimensional scaling (NMDS) ordination

## Results: Analysis of the spatial patterns



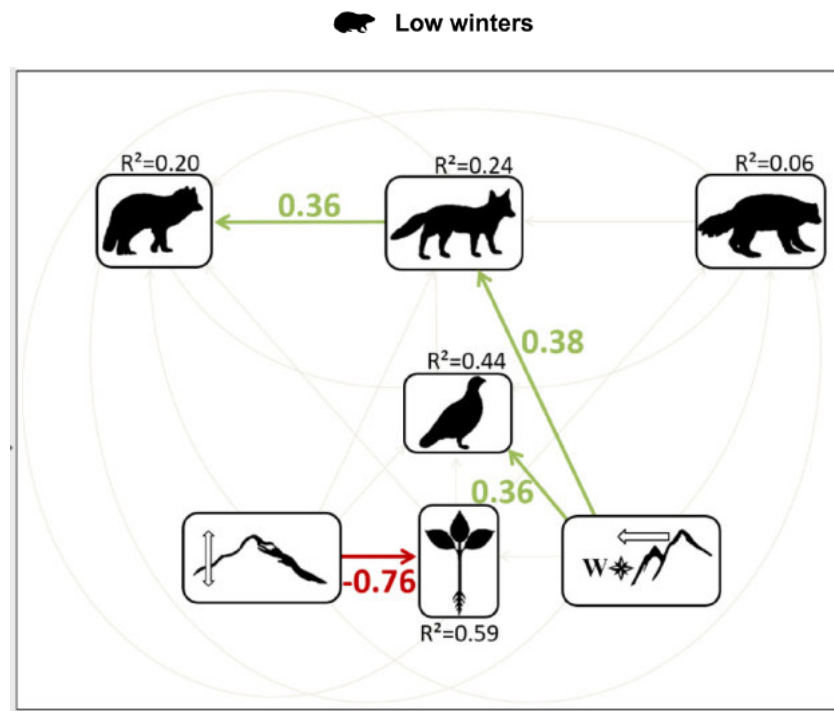
Non-metric dimensional scaling (NMDS) ordination

## Results: Analysis of the spatial patterns



Non-metric dimensional scaling (NMDS) ordination

## Results: Species interactions modelling



When rodent resource is low

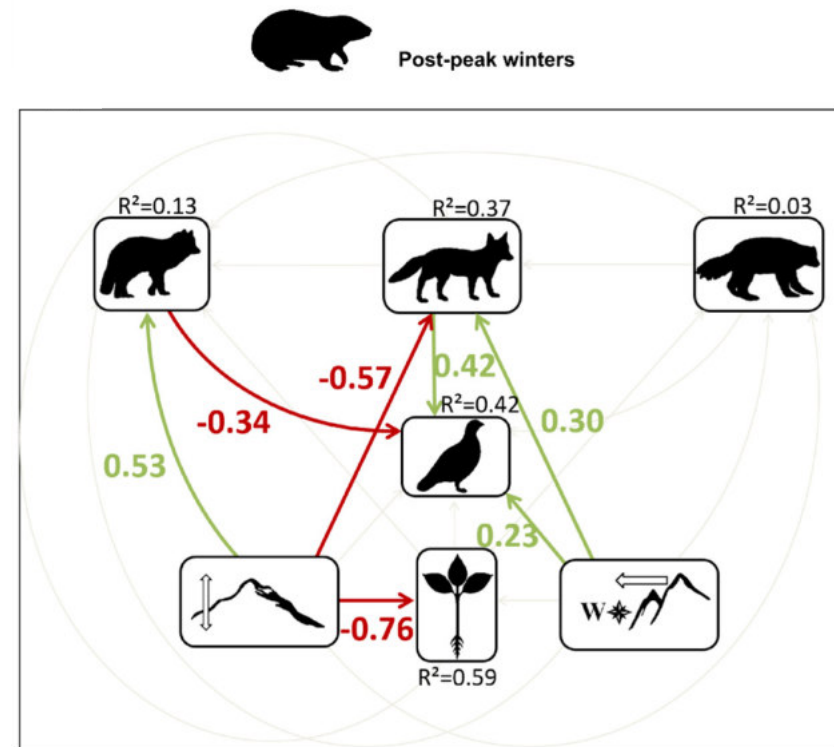
- No top-down effect observed
- Bottom-up effect from westness
- Surprising positive relationship between arctic fox and red fox

Final structural equation models

## Results: Species interactions modelling

When rodent resource is high

- Bottom-up effect on red fox (westness and ptarmigan)
- Top-down effect of arctic fox on ptarmigan
- Altitudinal segregation between fox sp



Final structural equation models

## Can bottom-up constraints overrule top-down interactions?

**Top-down effects** were weak  
and fewer than expected

**Bottom-up effects** appear dominant  
in winter

Red fox was **limited bottom-up**, rather than  
exerting a top-down effect

**Variable pattern** for arctic fox and wolverine



⇒ **cold-specialists: ecological strategy founded in flexibility?**

## Take-home message

**Seasonality and pulsed resources affects the structuring rules**

**Winter conditions + low food  
= dominant bottom-up control**

**The interplay between summer and winter**  
appears to determine the changing rate of  
northern ecosystems



© Angela Bohlke

**There is a need to include the winter perspective  
in community ecology**



Article accepted recently

<https://onlinelibrary.wiley.com/doi/10.1111/ecog.03984>

# ECOGRAPHY

## Research

### The fluctuating world of a tundra predator guild: bottom-up constraints overrule top-down species interactions in winter

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## Ecography

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Global warming is predicted to change ecosystem functioning and structure in Arctic ecosystems by strengthening top-down species interactions, i.e. predation pressure on small herbivores and interference between predators. Yet, previous research is biased towards the summer season. Due to greater abiotic constraints, Arctic ecosystem characteristics might be more pronounced in winter. Here we test the hypothesis that top-down species interactions prevail over bottom-up effects in Scandinavian mountain tundra (Northern Sweden) where effects of climate warming have been observed and top-down interactions are expected to strengthen. But

Thank you for your attention!

Questions?

## Acknowledgements

**The co-authors:**

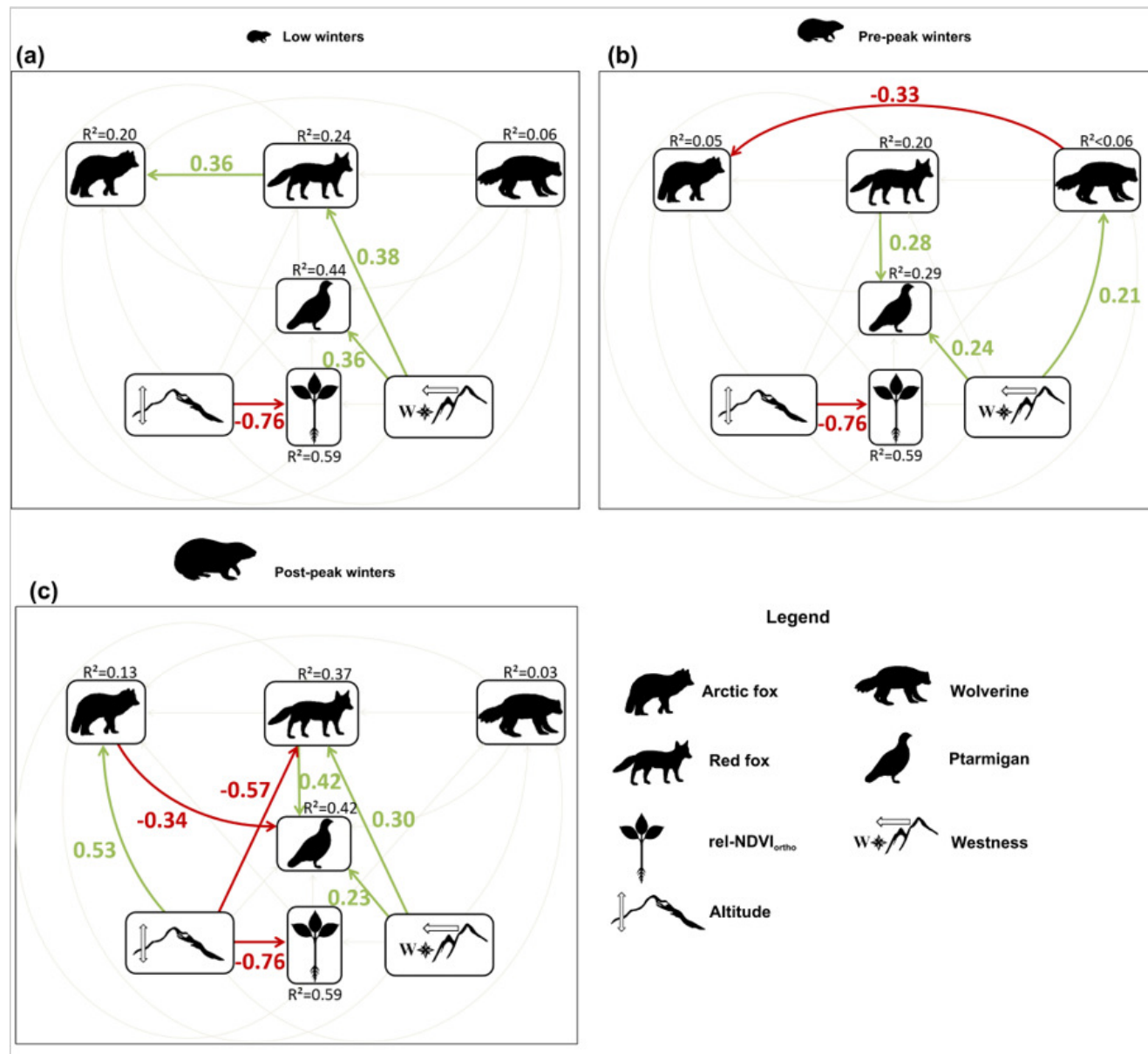
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## Community effect of rodents in winter

