Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Diseases, humans and animals in a biosphere region

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Collaborating Universities

Cary Institute of Ecosystem Studies

Funders

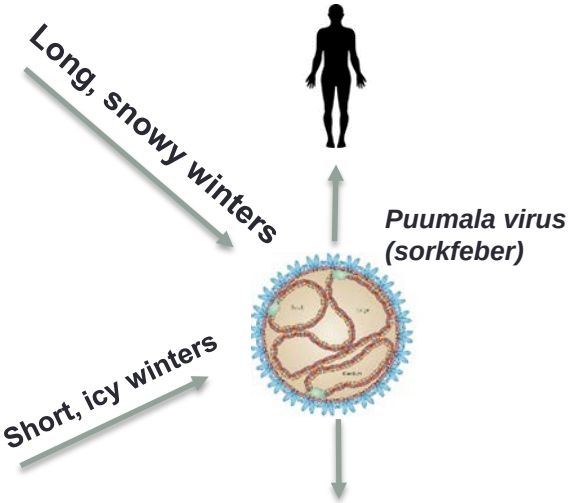
HELGE AX:SON JOHNSONS STIFTELSE

FORMAS

All along the Vindelriver

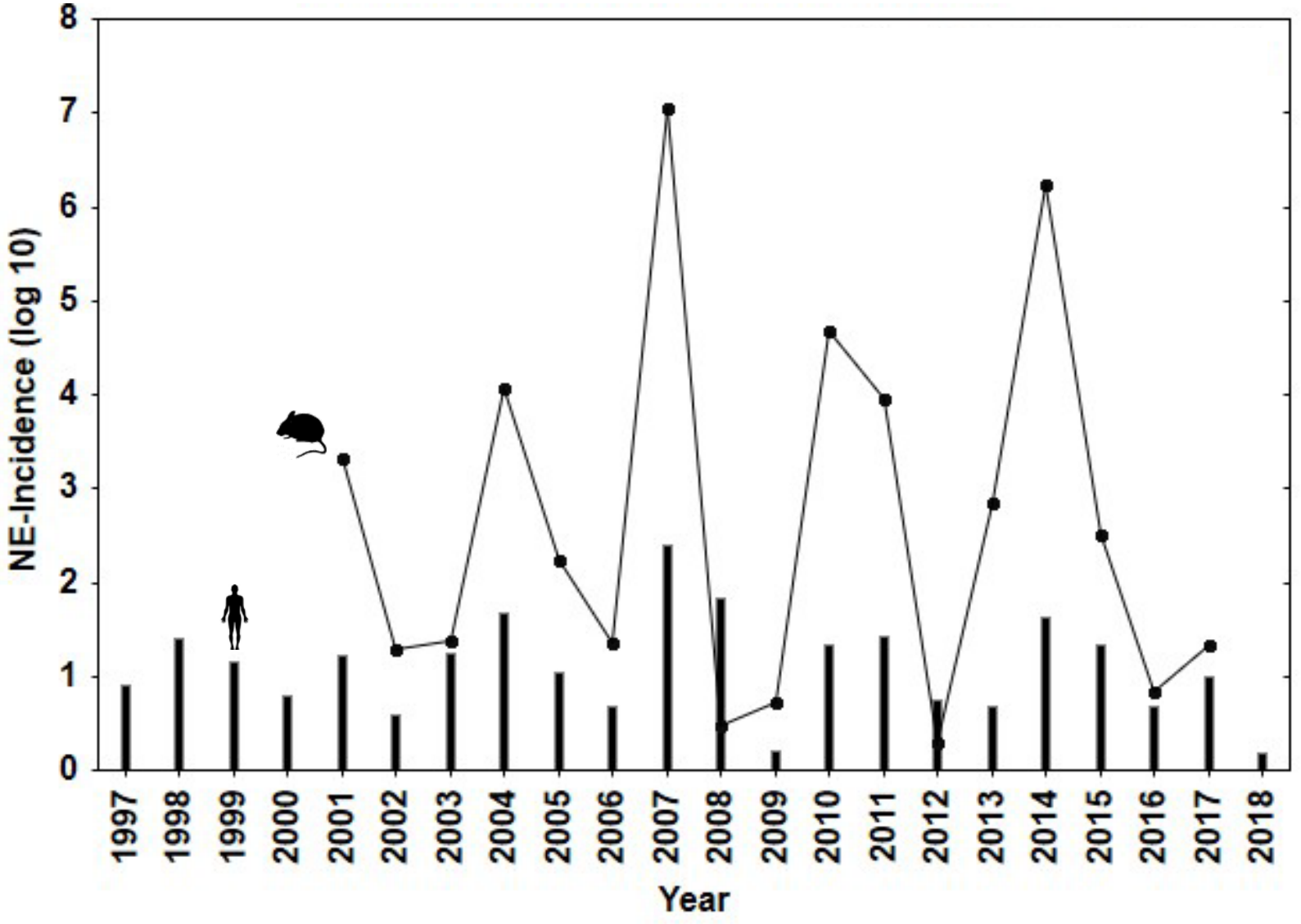
– humans interact with voles spreading disease

Climate gradient



Bank vole (skogssork)

Variation across years



Puumala hantavirus

Virus spreads through scats

Bank vole – only host species

Carrying wood from the woodshed is a risk

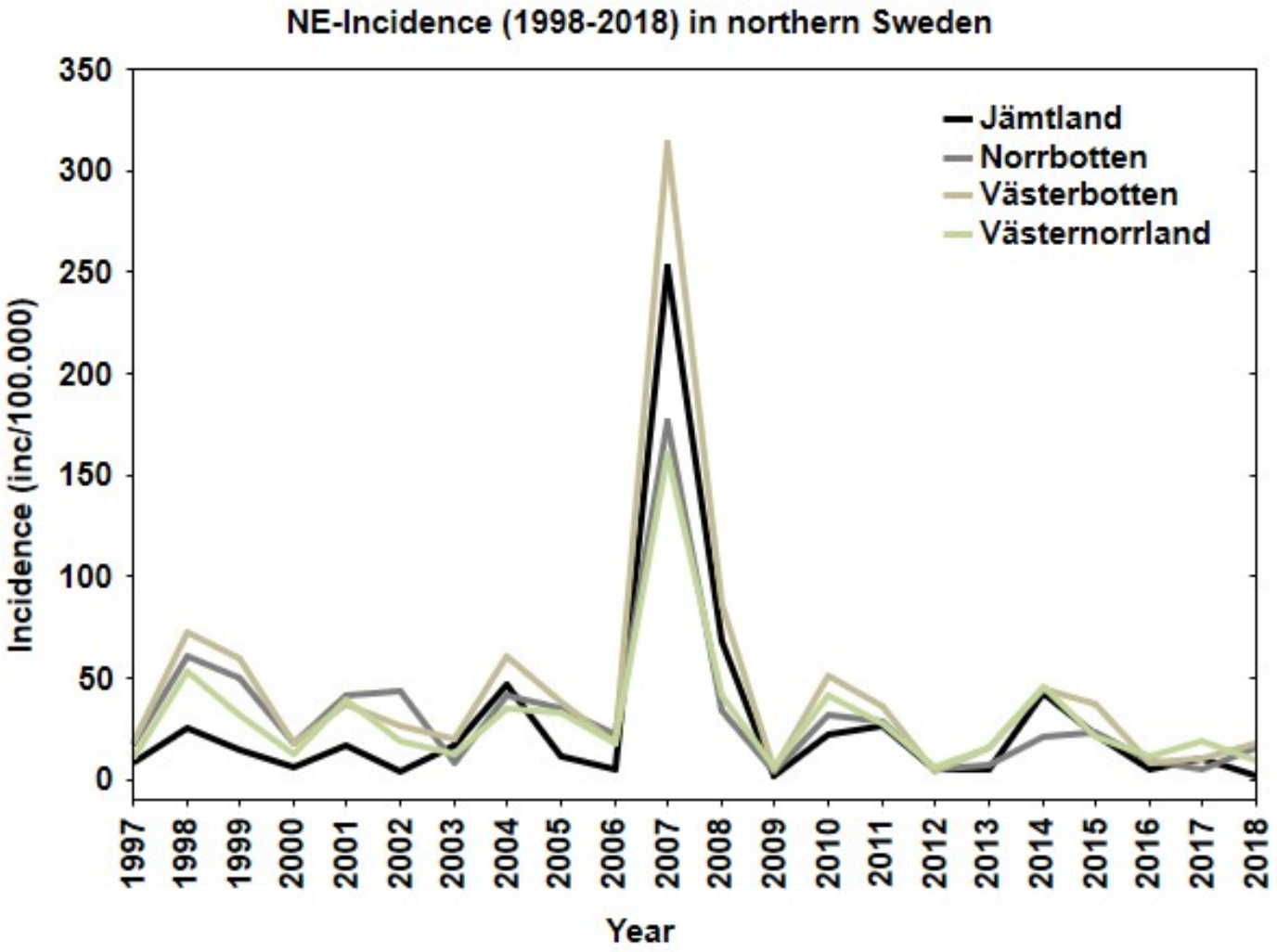
Puumalavirus cause vole fever (sorkfeber) in humans

Approx. 15 % of the human population in northern Sweden are antibody positive

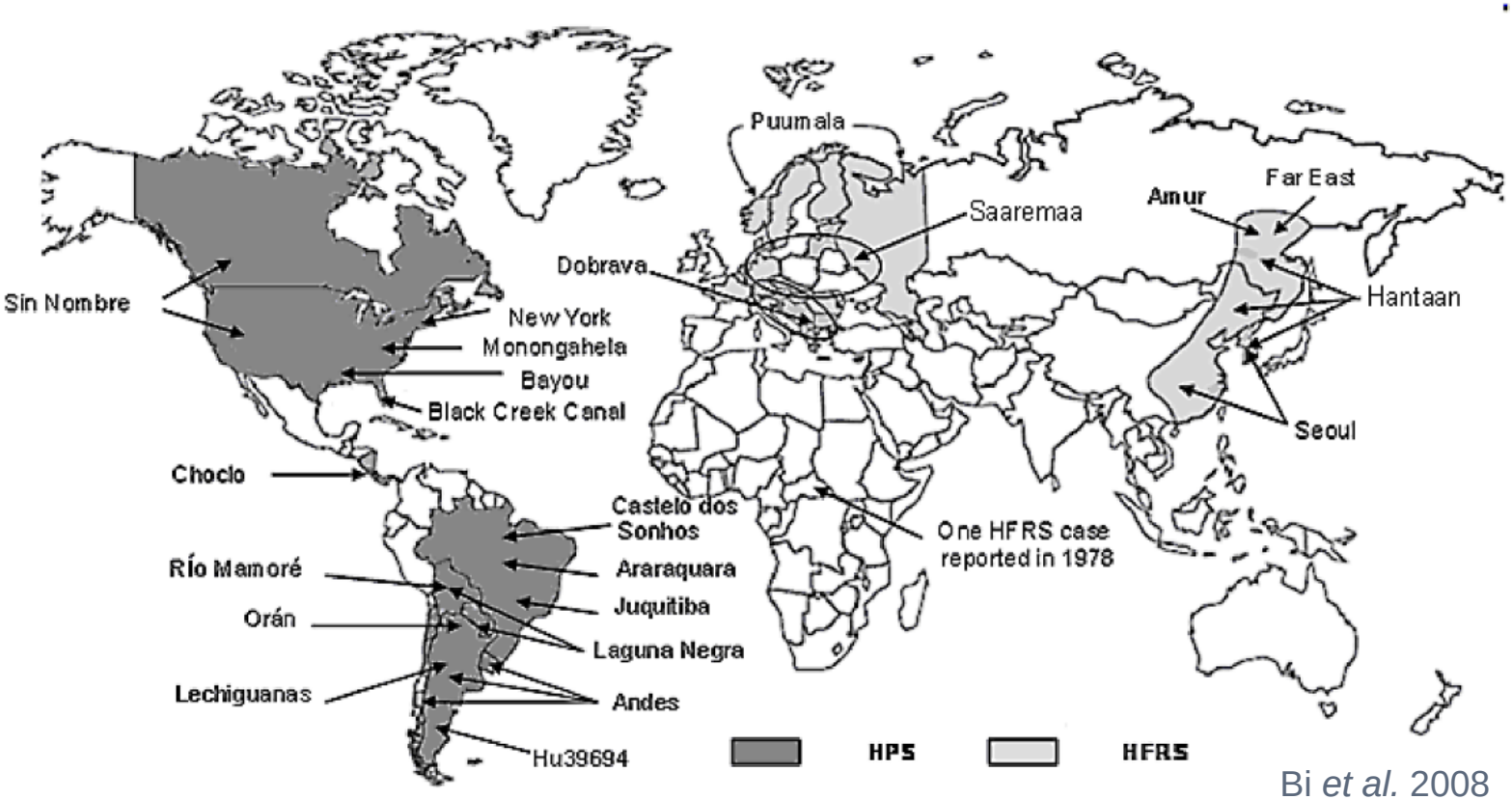
Winter survival of PUUV-infected bank voles hampered

Owners of forests and farmlands = increased risk (Oscarsson et al. 2016)

Puumala hantavirus outbreak 2007



Hantavirus world map



Bi *et al.* 2008

HFRS: Hemorrhagic Fever with Renal Syndrome
HPS: Hantavirus Pulmonary Syndrome

Forest gradient along the Vindelriver

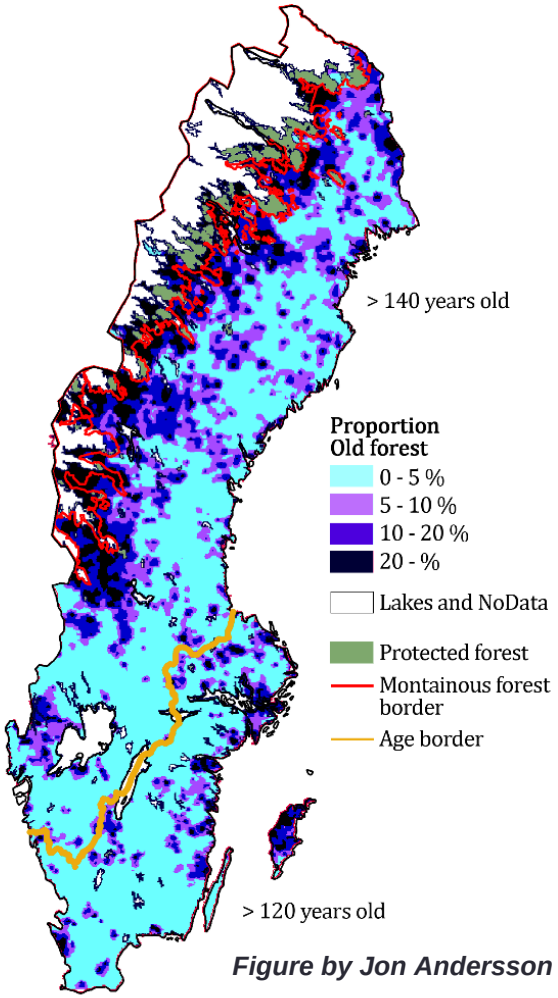
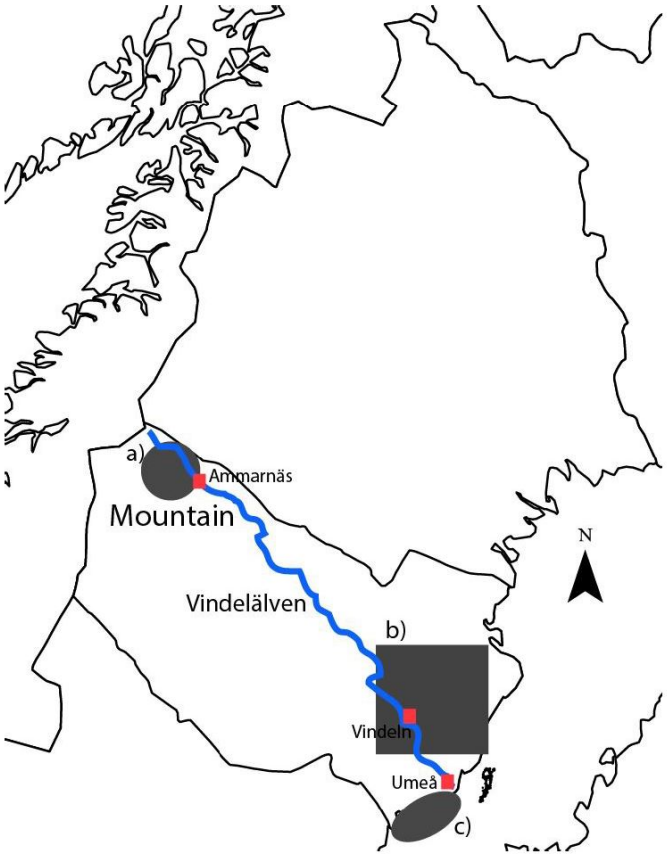


Figure by Jon Andersson



Forest landscape composition alters disease risk?

esa

ECOSPHERE

Spatial and temporal variation of hantavirus bank vole infection in managed forest landscapes

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Citation: Magnusson, M., F. Ecke, H. Khalil, G. Olsson, M. Evander, B. Niklasson, and B. Hörnfeldt. 2015. Spatial and temporal variation of hantavirus bank vole infection in managed forest landscapes. Ecosphere 6(9):163. http://dx.doi.org/10.1890/ES15-00039.1

Abstract. Zoonoses are major contributors to emerging infectious diseases globally. Hemorrhagic fever with renal syndrome (HFRS) is a zoonosis caused by rodent-borne hantaviruses. In Europe, *Puumala hantavirus* (PUUV) carried and shed by the bank vole (*Myodes glareolus*), is the most common cause of HFRS. We explore the relationship of PUUV infection in bank voles, as measured by PUUV antibody detection, with habitat and landscape scale properties during two successive vole cycles in boreal Sweden. Our analysis revealed that PUUV infection in the population was not uniform between cycles and across different landscapes. The mean density index of PUUV antibody positive and negative bank voles were highest in old forest, second highest in cut-over forest (approx. 0–30 years old) and lowest on mires. Most importantly, old forest was the core habitat, where PUUV antibody positive bank voles were found through the low density phase and the transition between successive vole cycles. In spring, occurrence of antibody positive voles was negatively related to the proportion of cut-over forest in the surrounding landscape, suggesting that large scale human induced land-use change altered the occurrence of PUUV infection in voles which has not been shown before. Dependence of PUUV infection on habitat and landscape structure, and the variation in infection load within and between cycles are of importance for human risk assessment.

Key words: bank vole; forest management; hantavirus; infection load; landscape change; land-use change; *Myodes glareolus*; Puumala virus; Sweden.

Received 22 January 2015; revised 28 April 2015; accepted 19 May 2015; **published** 29 September 2015. Corresponding Editor: R. R. Parmenter.

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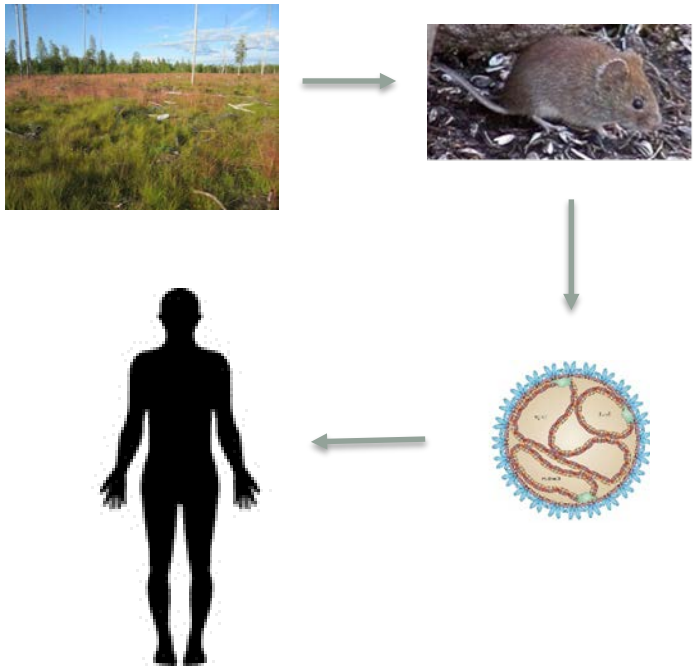
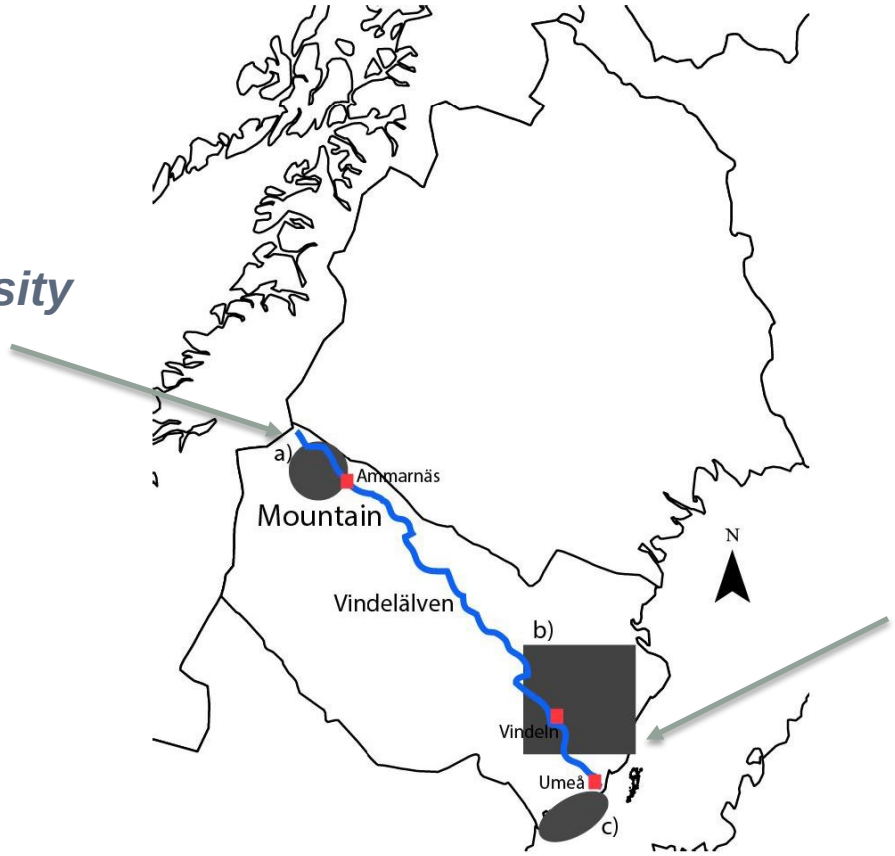


Intermediate disturbance
= highest risk?

Rodent diversity gradient along the Vindelriver

Higher diversity

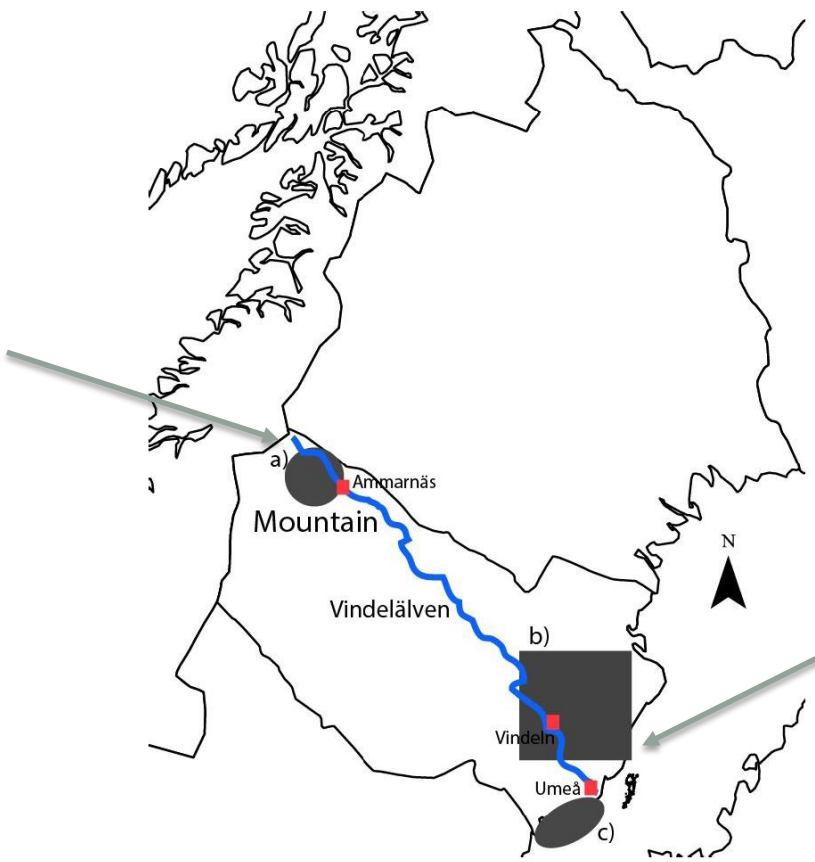


Lower diversity

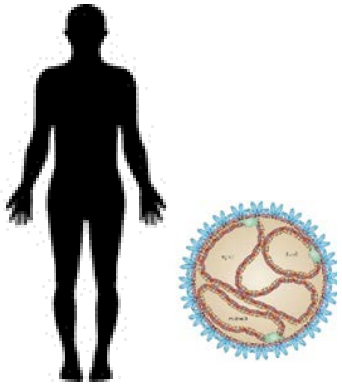
Dilution effect: High diversity predicts low disease prevalence

Human vole fever gradient along the Vindelriver?

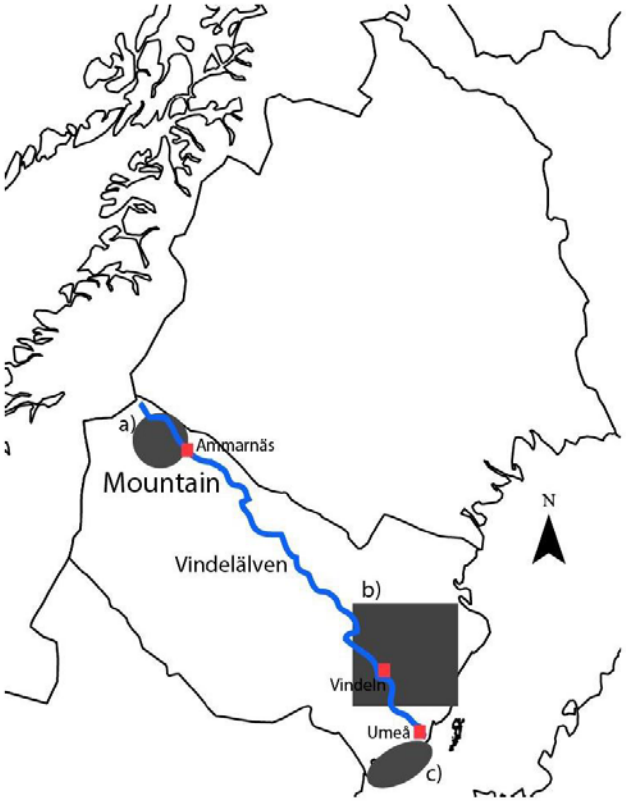
Lower risk?

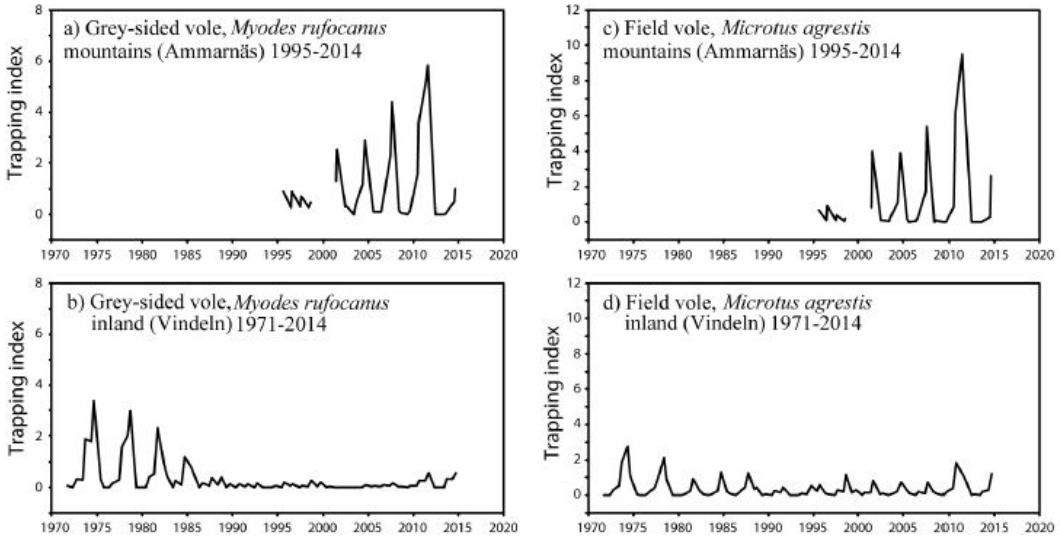


Higher risk?



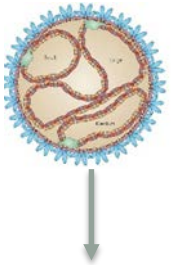
How does the bank vole and virus transmission cope with increased competition?



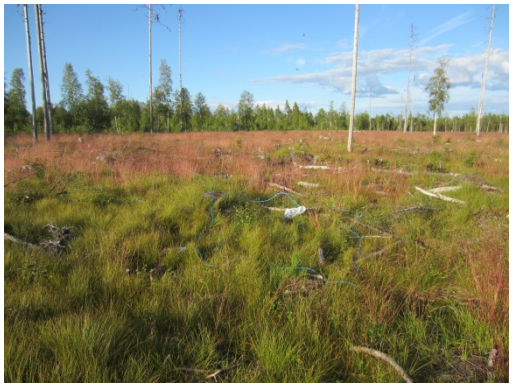


Bank vole populations = strong all along the gradient

Main forest habitats



Field vole (åkersork)
Microtus agrestis



Grassy clear-cuts

Grey-sided vole (gråsiding)
Myodes rufocanus

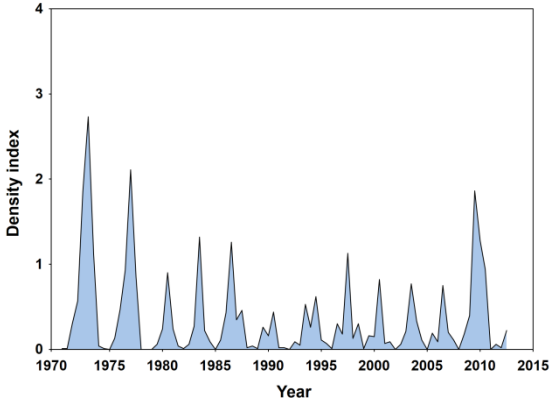
Stone fields in old pine forest

Bank vole (skogssork)
Myodes glareolus

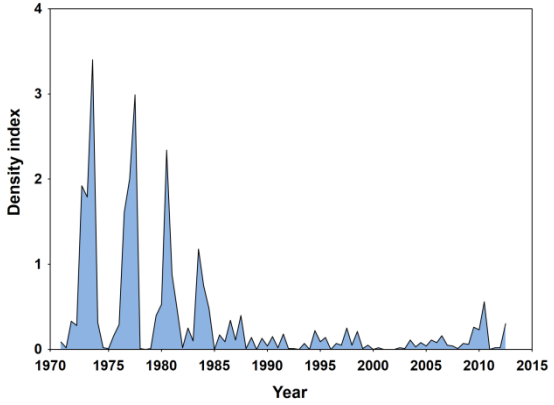
Old, moist spruce forest

Population dynamics

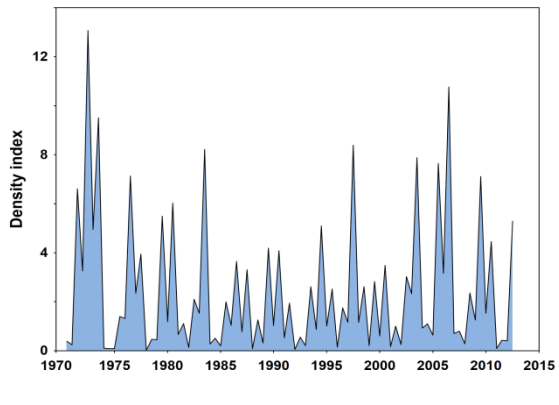
Field vole (åkersork)
Microtus agrestis



Grey-sided vole (gråsiding)
Myodes rufocanus



Bank vole (skogssork)
Myodes glareolus



Species community


Taiga shrew (taiganäbbmus)


Water shrew (vattennäbbmus)


Common shrew (vanlig näbbmus)


Yellow-necked mouse (större skogsmus)


Laxmann's shrew (lappnäbbmus)


House mouse (husmus)


Least shrew (mindre dvärgnäbbmus)


Wood lemming (skogslämmel)


Pygmy shrew (dvärgnäbbmus)


Tengmalm's owl (pärluggla)


Least weasel (vessla)


Red fox (rödräv)


Norwegian lemming (fjällämmel)


Red squirrel (ekorre)


Root vole (Mellansork)


Water vole (vattensork)


Northern red-backed vole (Rödsork)


Grey-sided vole (gråsiding)

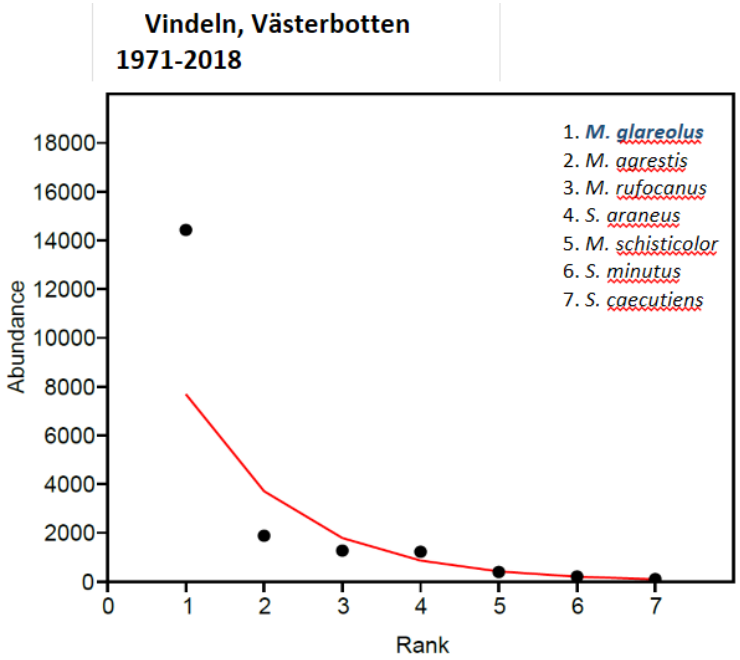

Field vole (åkersork)


Bank vole (skogssork)

Species abundance
Lowland forest

Laxmann's shrew (*S. caecutiens*)

Pygmy shrew (*S. minutus*)



Wood lemming (*M. schisticolor*)

Common shrew (*S. araneus*)

Grey-sided vole (*M. rufocanus*)

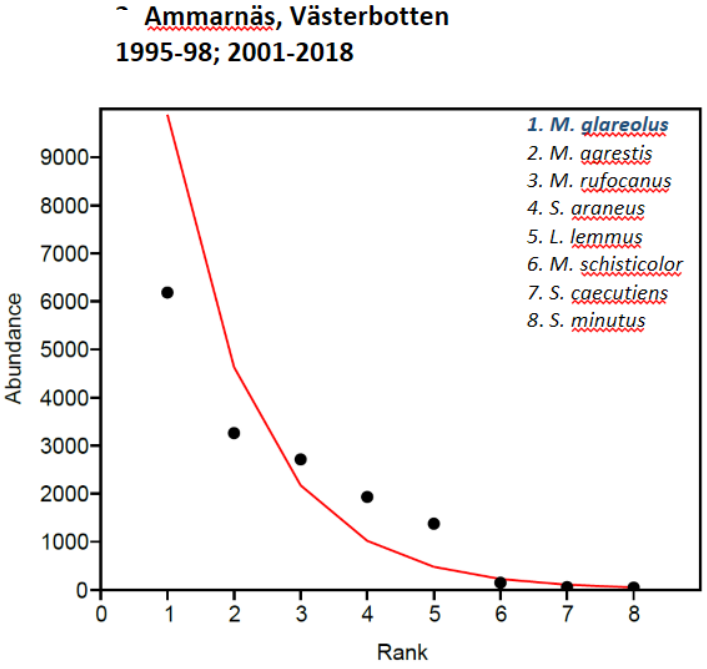
Field vole (*M. agrestis*)

Bank vole (*M. glareolus*)

Species abundance
Mountain forest and heaths

Laxmann's shrew (*S. caecutiens*)

Pygmy shrew (*S. minutus*)



Wood lemming (*M. schisticolor)*

Common shrew (*S. araneus)*

Grey-sided vole (*M. rufocanus*)

Field vole (*M. agrestis*)

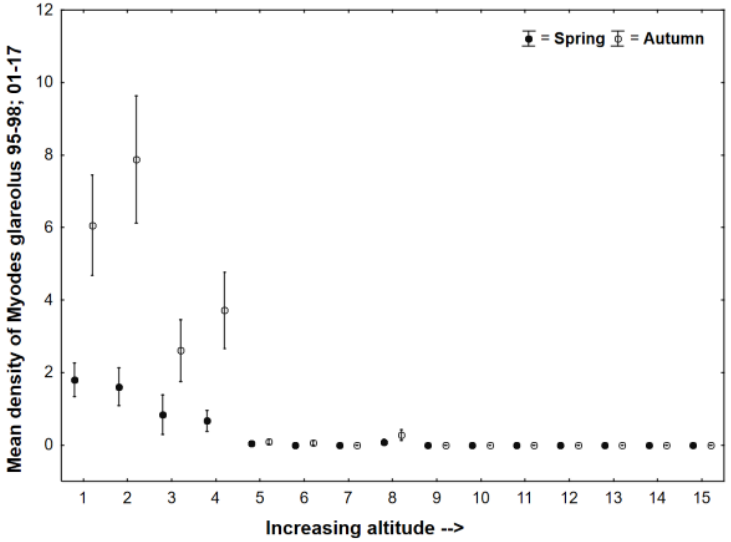
Bank vole (*M. glareolus*)

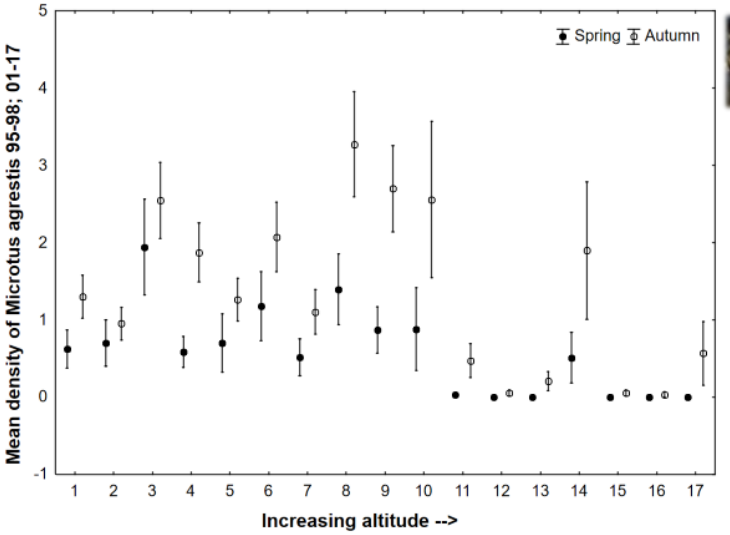
Norwegian lemming (*L. lemmus*)

Above treeline = Few bank voles and no virus?
Ammarnäs mountain altitude gradients

Bank vole
(*M. glareolus*)

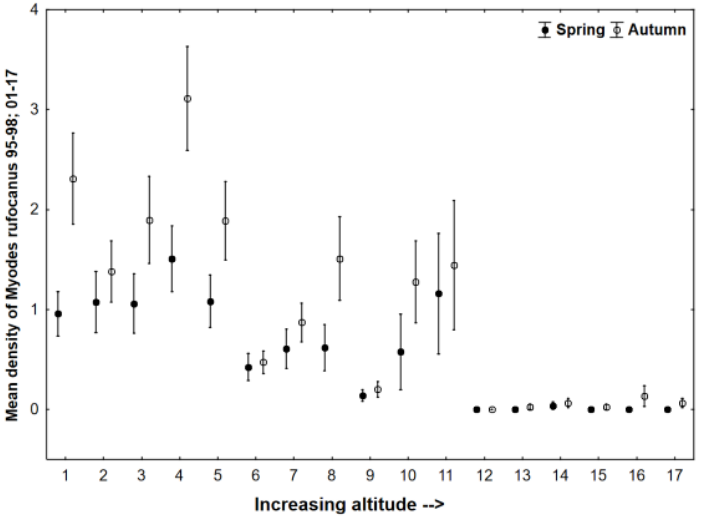
Hantavirus particle

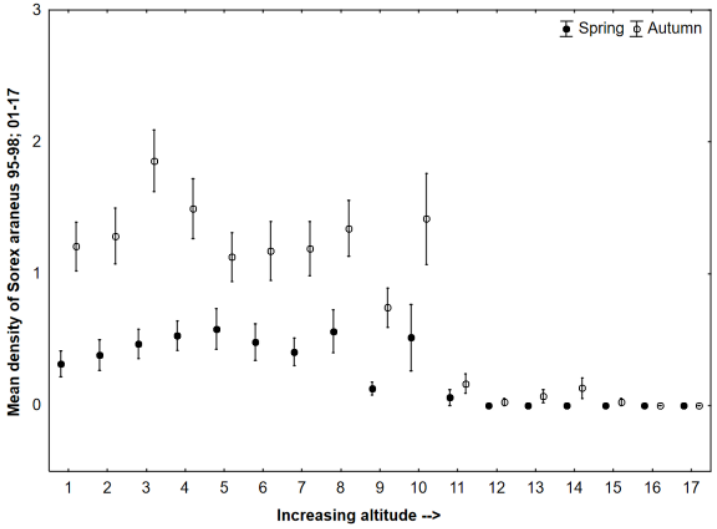




Field vole
(*M. agrestis*)

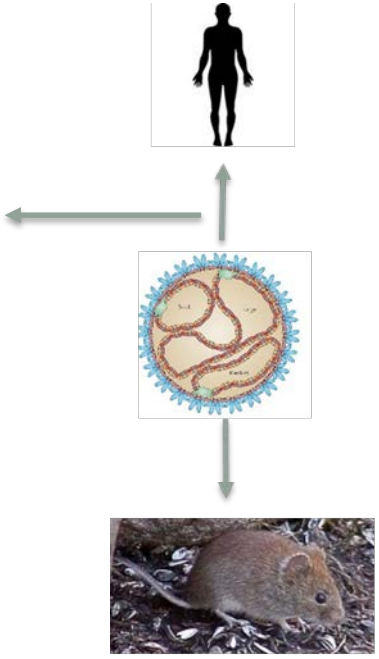
Grey-sided vole
(*M. rufocanus*)

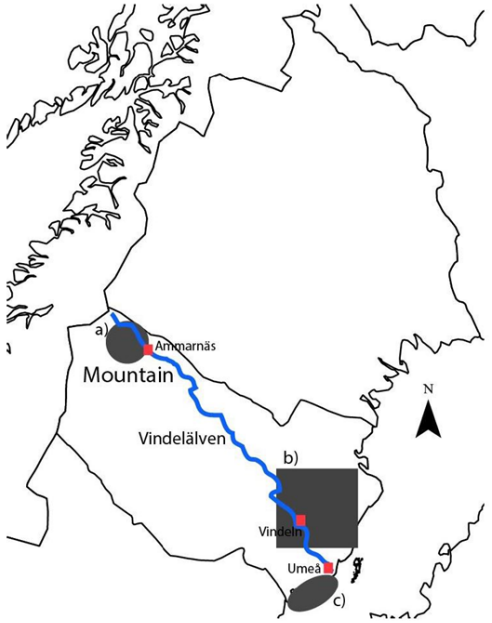




Common shrew
(S. araneus)

Questions





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