

Impact des propriétés physiques de la neige sur les lemmings en Arctique

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Gilles Gauthier, Florent Dominé



UNIVERSITÉ
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Sentinelle
Nord



TAKUVIK



Atelier transversal Neige – 30 septembre 2025
Observatoire des Sciences de l'Univers de Grenoble



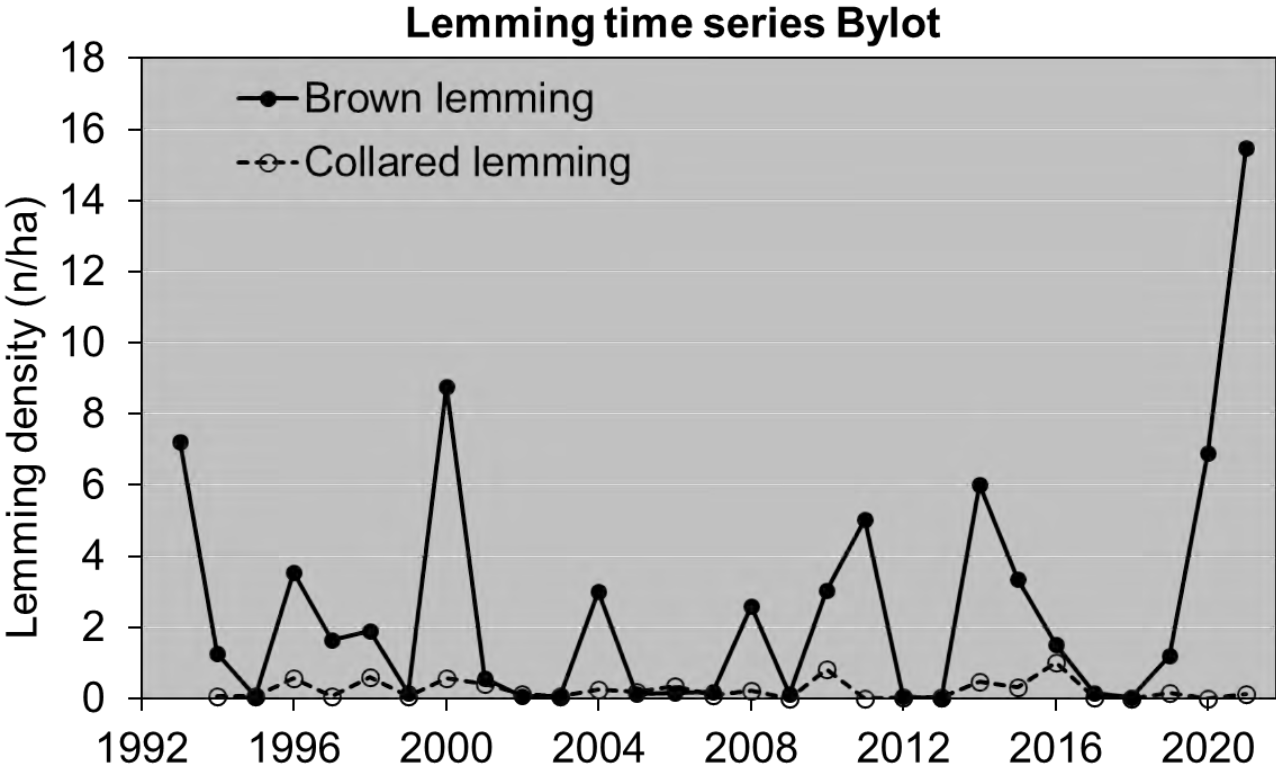
The snowpack can insulate animals from cold temperature



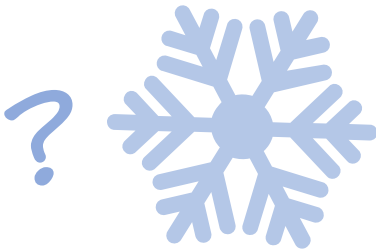
Lemmings play an essential role in the Arctic ecosystem



Lemmings have cyclic fluctuation of their population



© Clément Chevalier
Top-down (predators) Legagneux et al. 2012

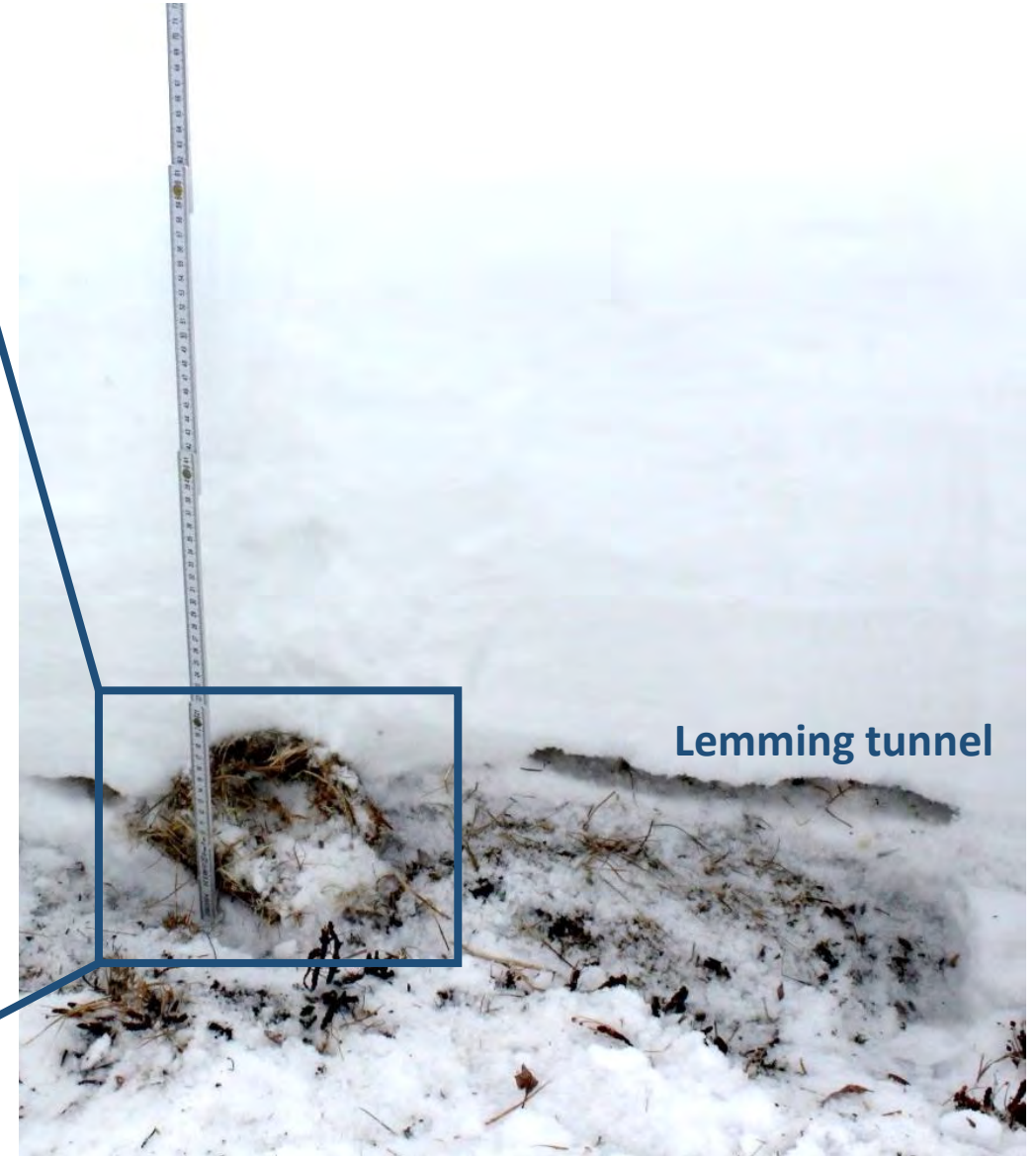


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Bottom-up (food) Oksanen 2000

Lemmings remain active throughout the winter



Lemming winter nest



A deep snowpack keeps lemming warm during the winter



Oecologia

<https://doi.org/10.1007/s00442-023-05385-y>

HIGHLIGHTED STUDENT RESEARCH



Lemming winter habitat: the quest for warm and soft snow

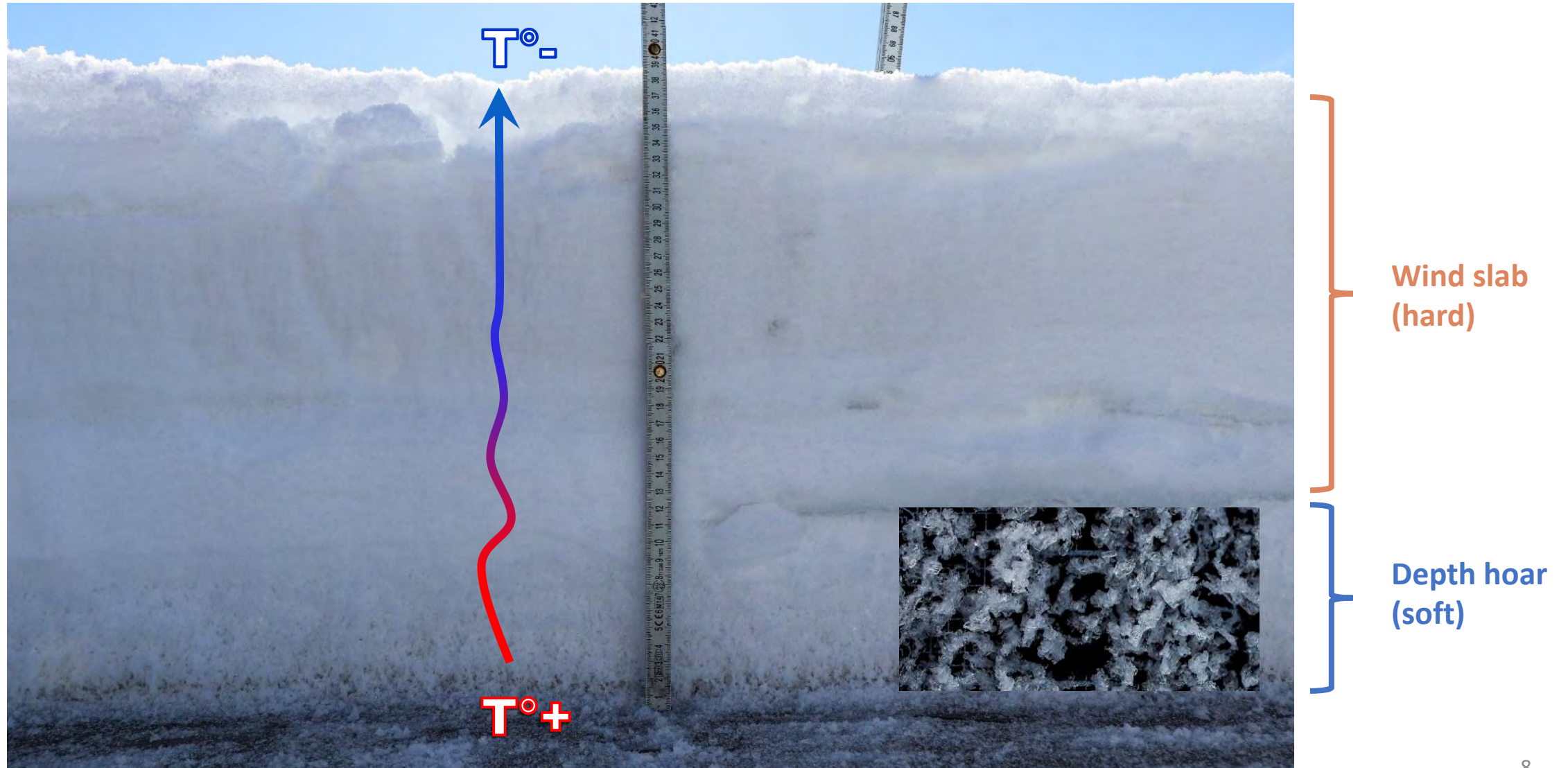
Mathilde Poirier^{1,2,3}  · Gilles Gauthier^{1,2}  · Florent Domine^{1,3,4}  · Dominique Fauteux^{1,5}

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The typical arctic snowpack



Rain-on-snow and melt-freeze events create hard melt-freeze crusts in the High Arctic snowpack

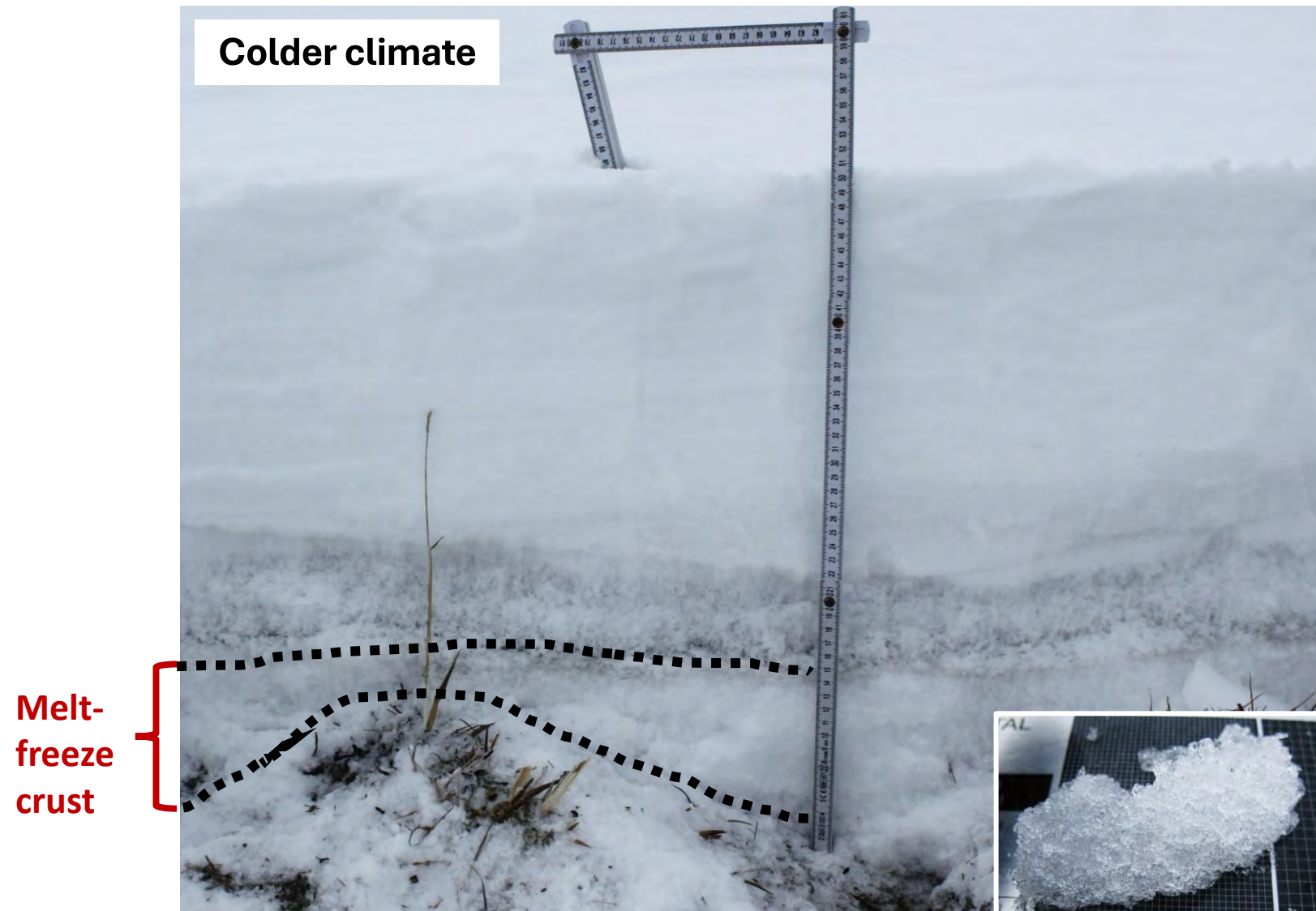


Figure from Peeters *et al.* 2012 (ERL) 9



Determining the impact of snow physical properties on lemming winter ecology



Study site

Bylot Island (73°N, 80°W)



Lemmings of Bylot Island



Collared lemming

- Less abundant
- More morphological adaptation to winter



Brown lemming

- More abundant
- Less morphological adaptation to winter

Determining the impact of snow physical properties on the use of the snowpack by lemmings.



Journal of Mammalogy, 100(5):1416–1426, 2019
DOI:10.1093/jmammal/gyz129

What guides lemmings movements through the snowpack?

MATHILDE POIRIER, GILLES GAUTHIER,^{*} AND FLORENT DOMINE[•]



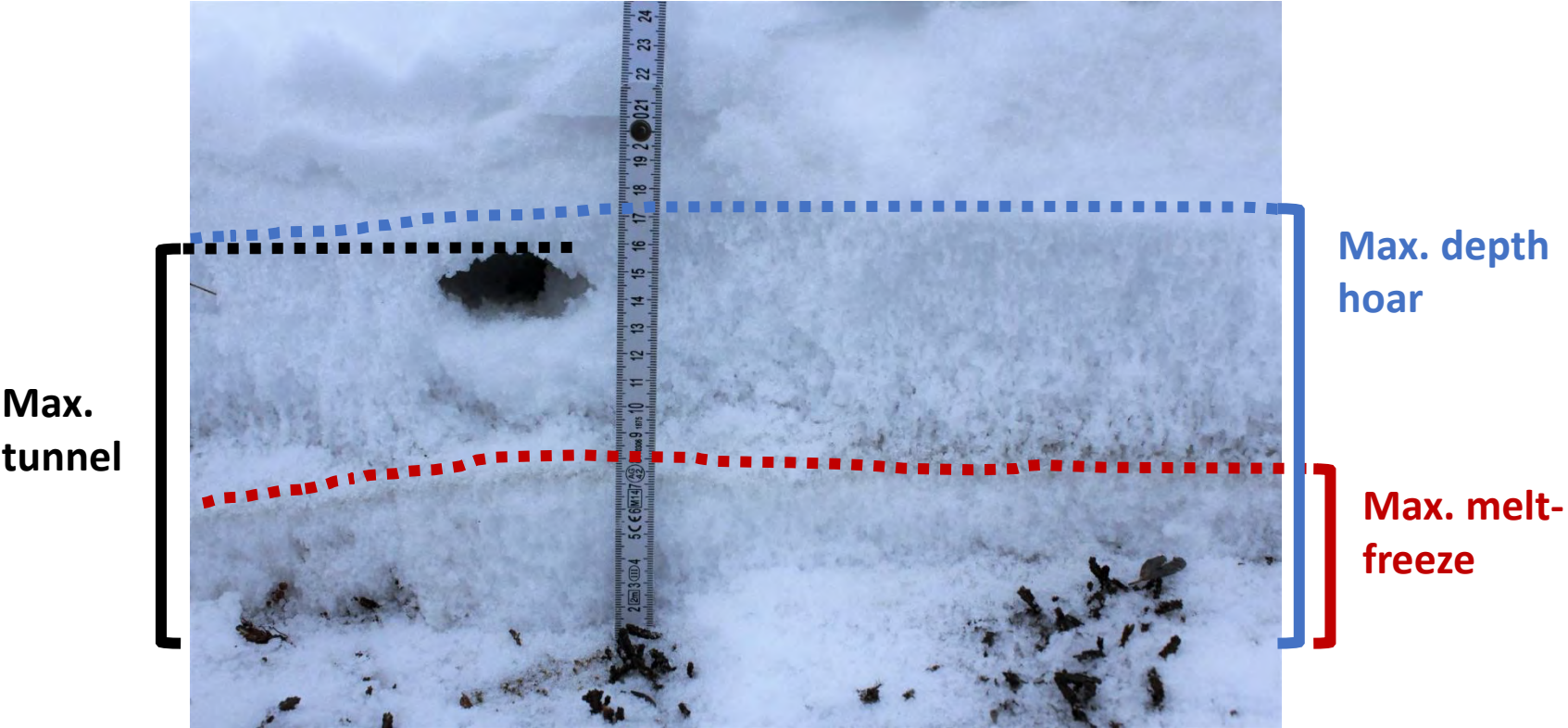
Digging into fox attack traces to find lemming tunnels



The crime scene!

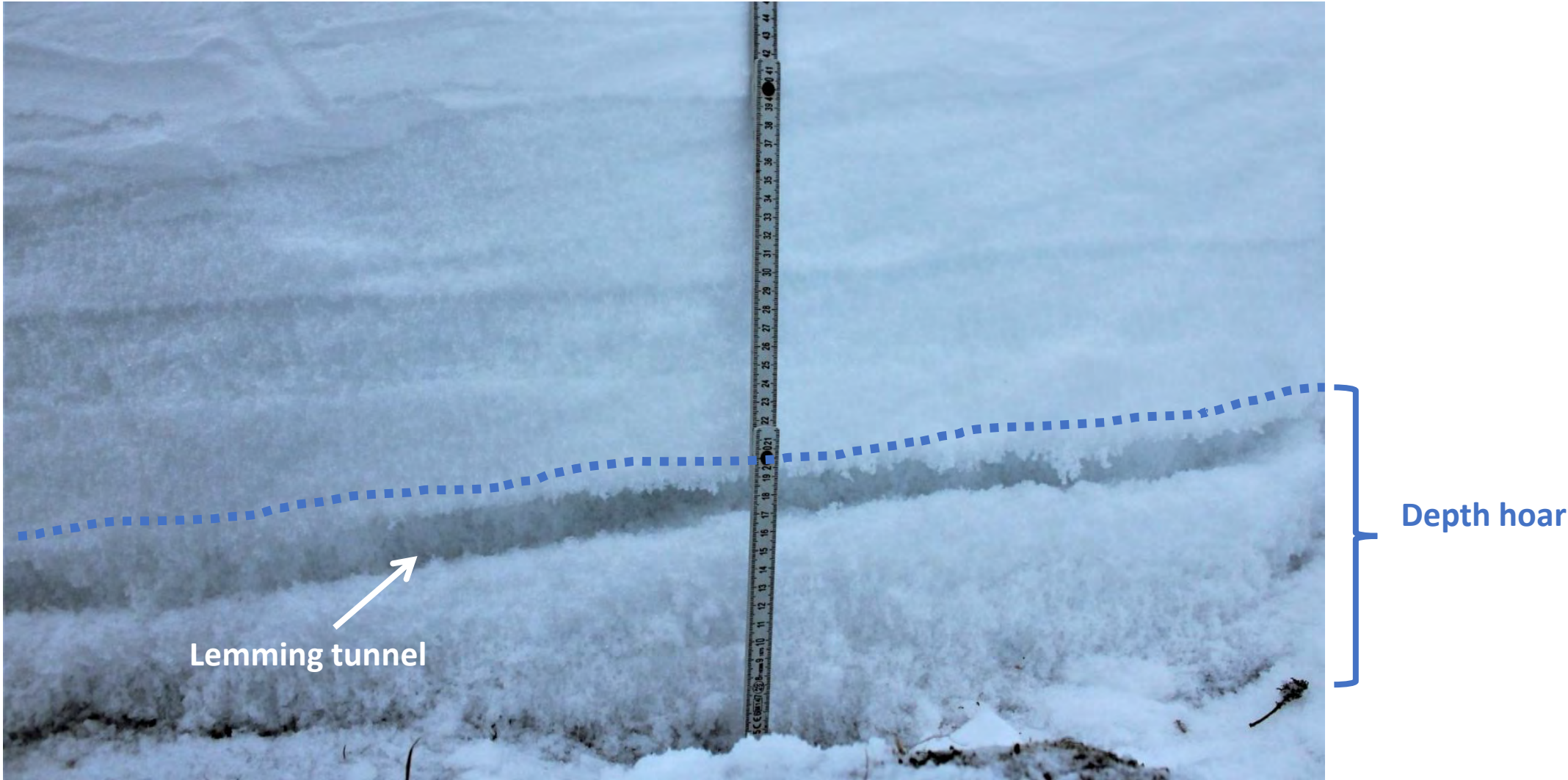


Characterization of lemming tunnels

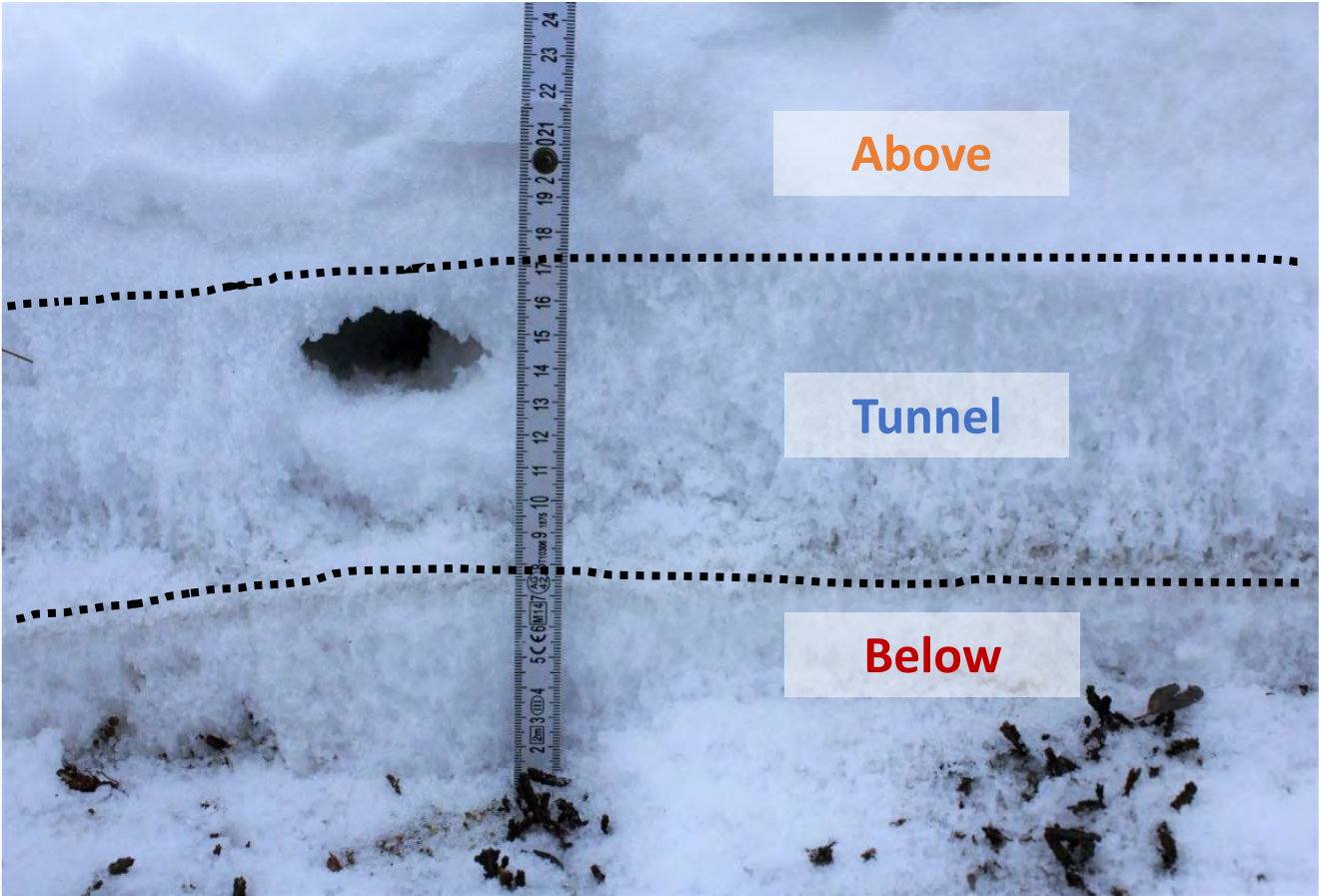
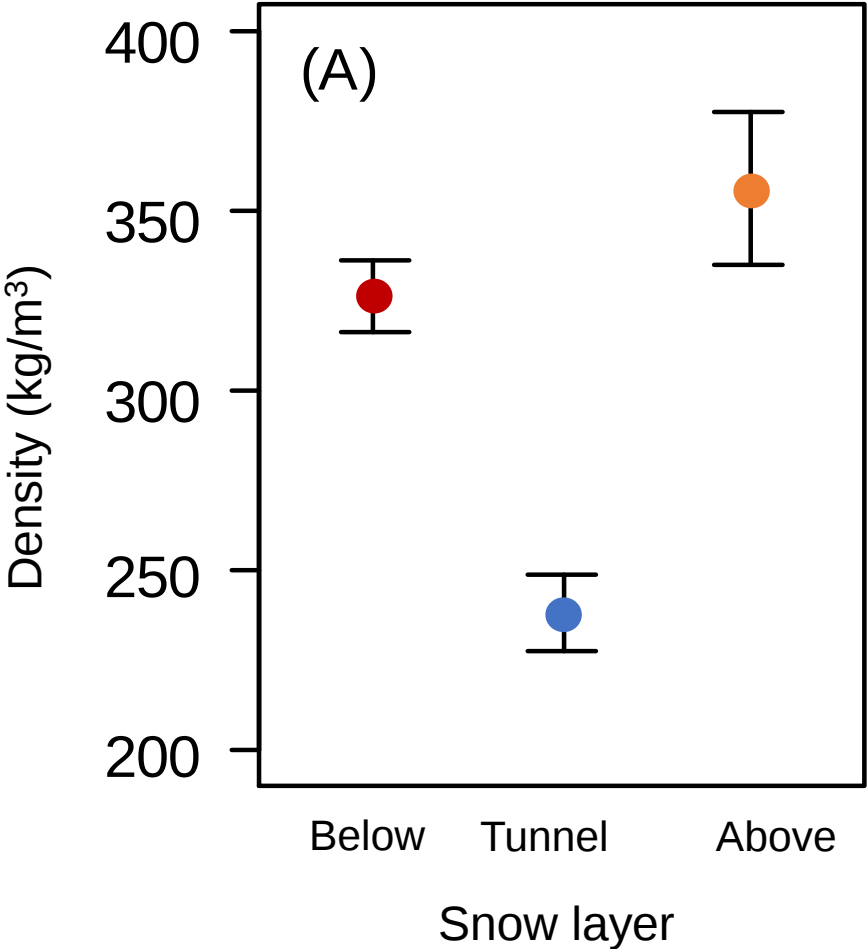


Density of snow
(mass/volume)

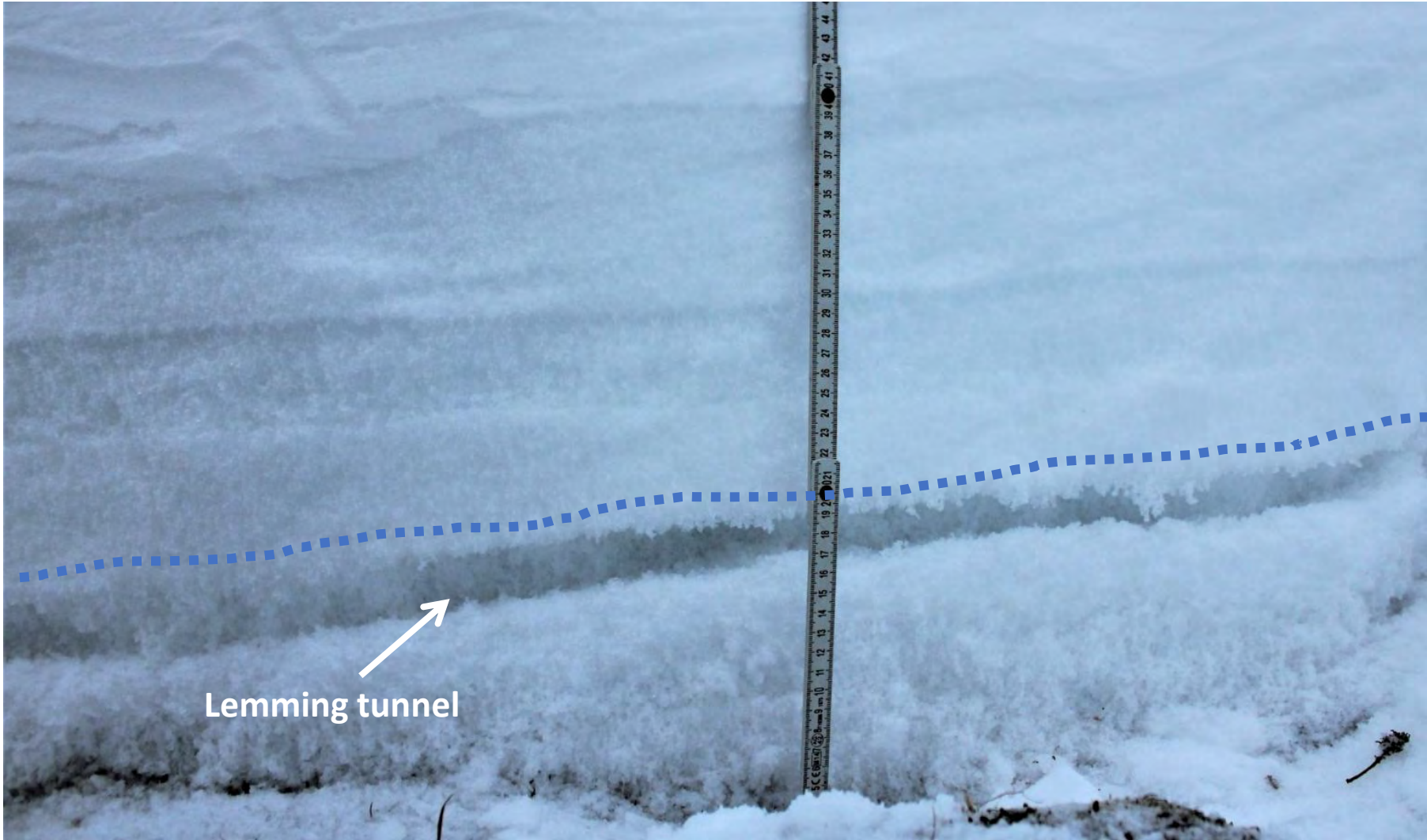
Lemmings systematically dig into the depth hoar layer



Lemmings systematically dig into the depth hoar layer

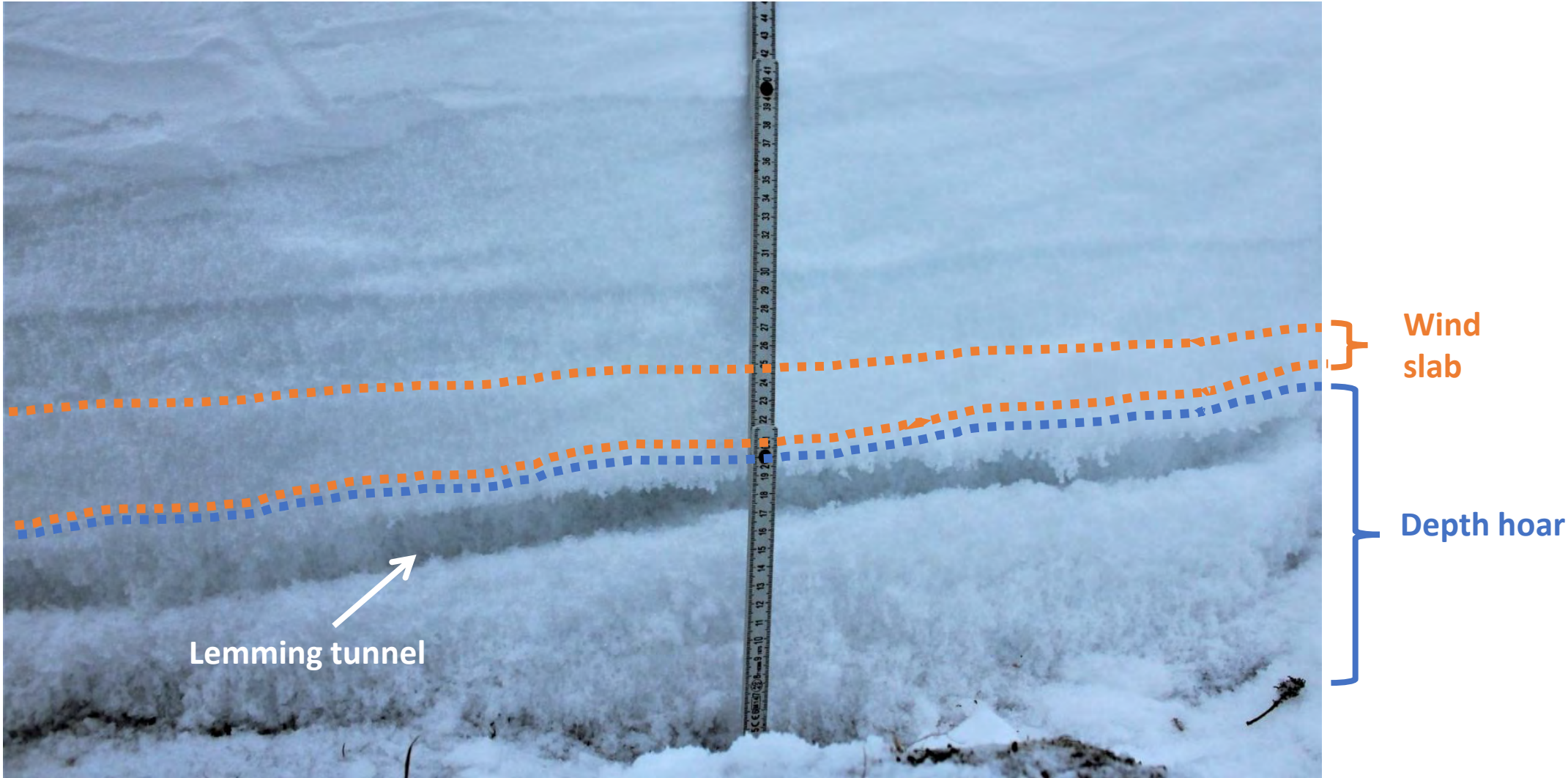


Lemmings dig higher than ground level



Depth hoar

Lemmings dig higher than ground level: strategy to avoid tunnels from collapsing



Determining the impact of snow physical properties on lemming digging behavior.

esa

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ECOSPHERE NATURALIST

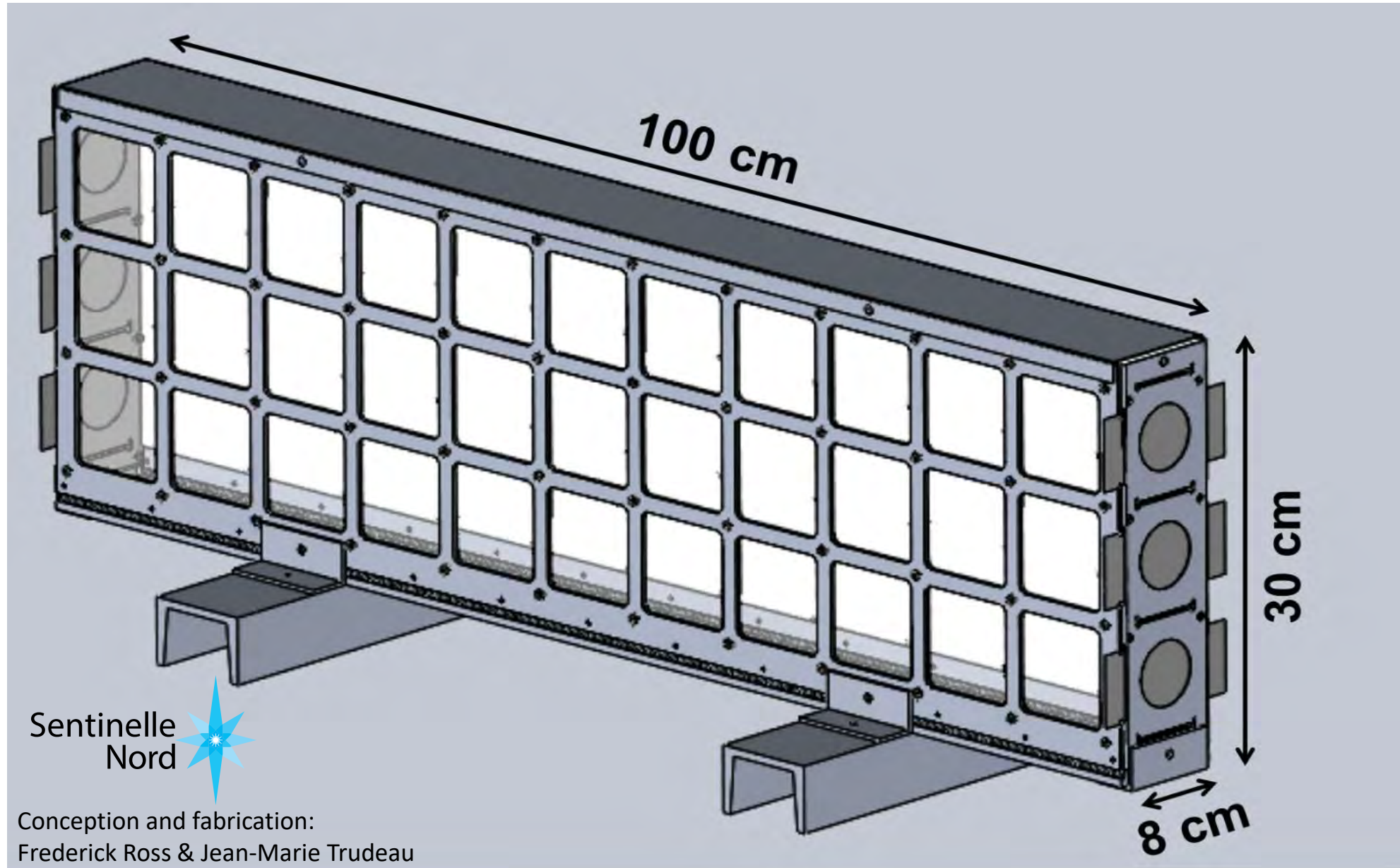
Snow hardness impacts intranivean locomotion of arctic small mammals

MATHILDE POIRIER ^{1,2,†} DOMINIQUE FAUTEUX ^{1,3} GILLES GAUTHIER ^{1,2}
FLORENT DOMINE ^{1,4,5} AND JEAN-FRANÇOIS LAMARRE ⁶

Citation: Poirier, M., D. Fauteux, G. Gauthier, F. Domine, and J.-F. Lamarre. 2021. Snow hardness impacts intranivean locomotion of arctic small mammals. *Ecosphere* 12(11):e03835. 10.1002/ecs2.3835

Study site: Ikaluktutiak (Cambridge Bay), Nunavut





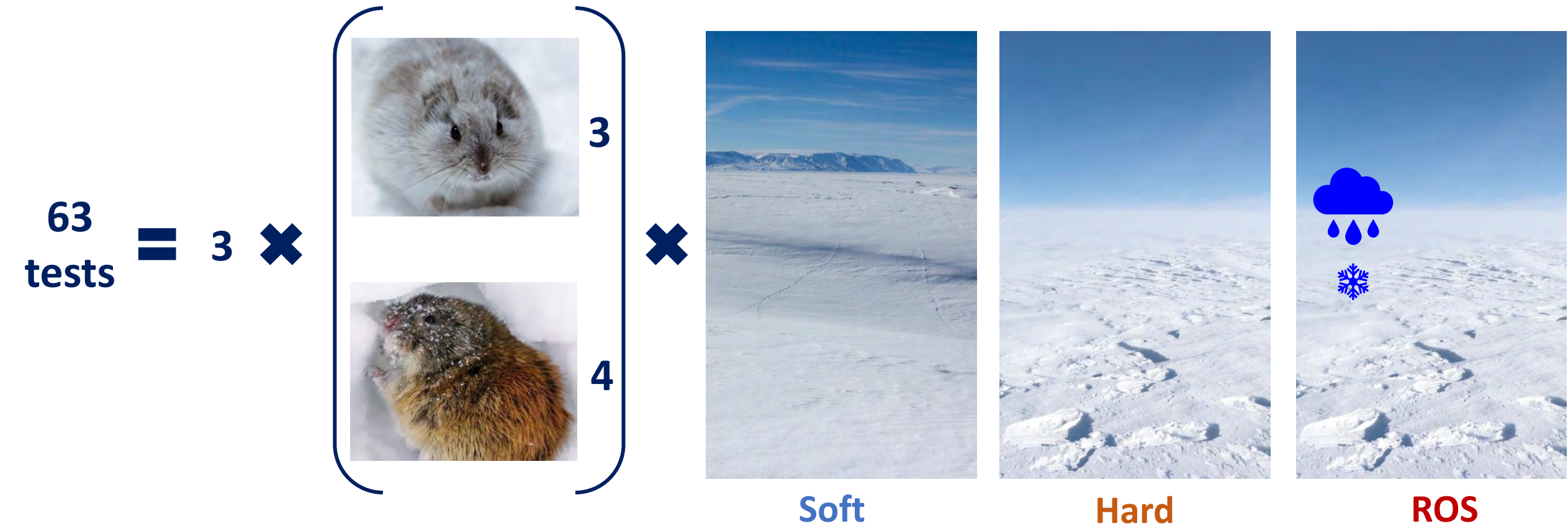
Sampling snow of different hardnesses



Soft



Rain-On-Snow (ROS)



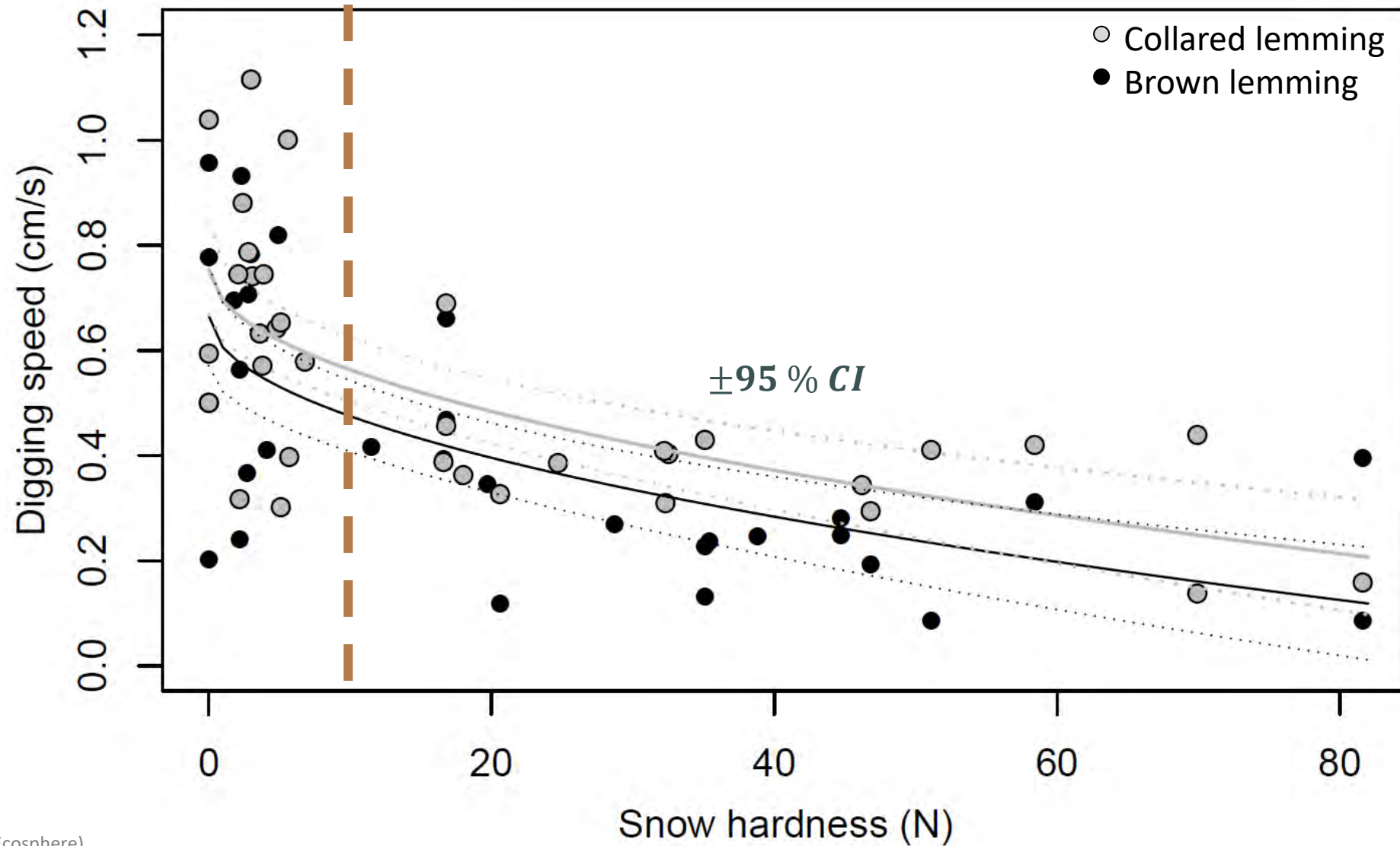


Digging speed

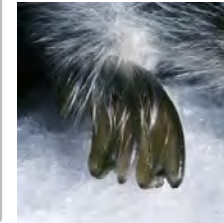
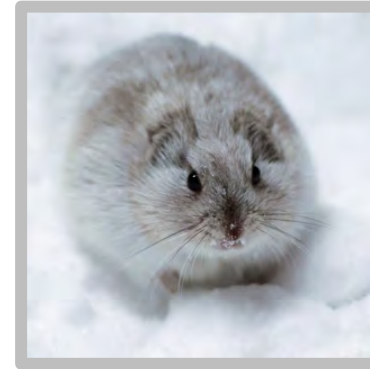
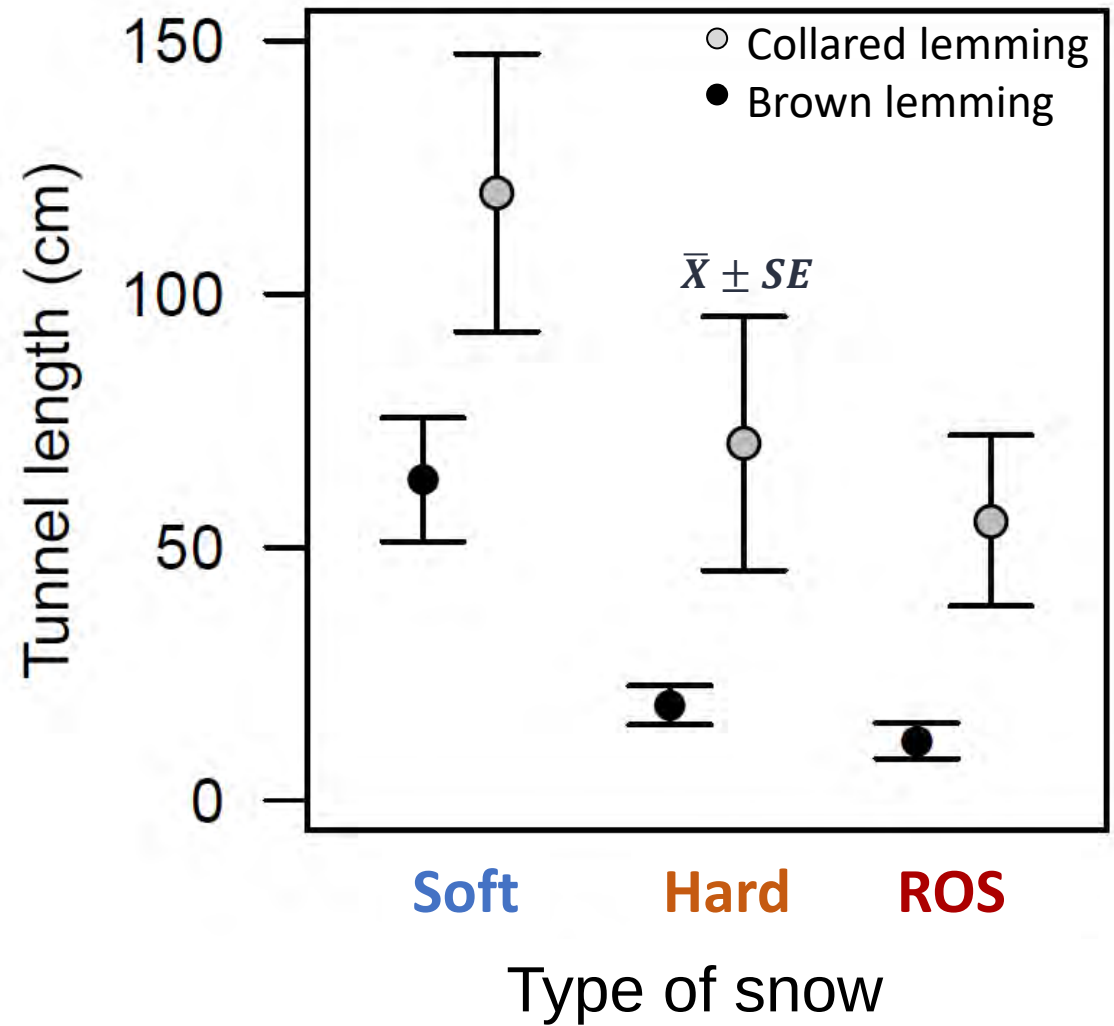
Tunnel length

Behavior

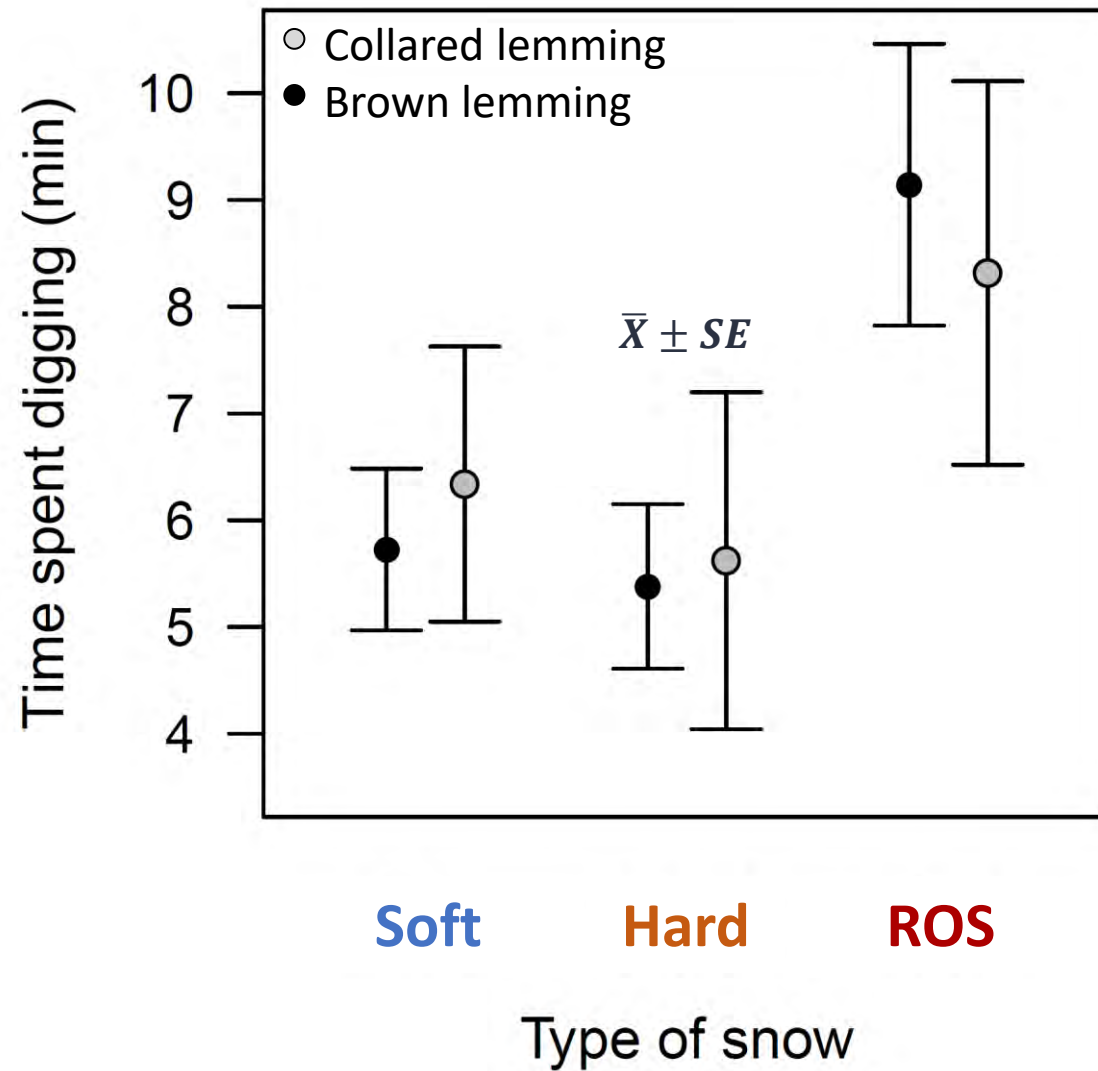
Snow hardness negatively impact lemming digging speed



Snow hardness negatively impact lemming tunnel length



Lemmings spend more time digging in snow indurated from rain-on-snow (ROS)



Determining the impact of snow physical properties on lemming demographic parameters

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DOI: 10.1002/ecs.70216

ARTICLE

ECOLOGY
ECOLOGICAL SOCIETY OF AMERICA

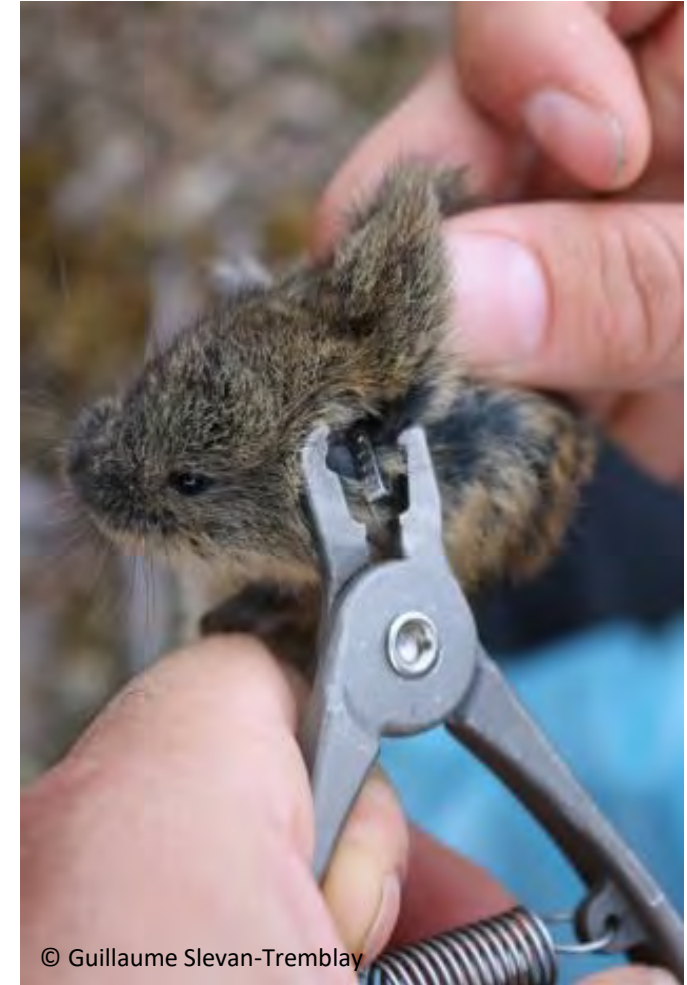
Demography of lemmings in response to changing snow conditions in the High Arctic

Mathilde Poirier^{1,2,3}  | Gilles Gauthier^{1,2}  | Florent Dominé^{1,3,4}  |
Dominique Fauteux^{1,5} 

Proportion of nests with reproduction

Winter growth

- Spring density / fall density (t-1)
- Capture-mark-recapture (CMR)



© Guillaume Slevan-Tremblay

© Don Reid

Estimation of meteorologic events in beginning of winter leading to hard snow basal layers

After snow onset:

Melt-freeze

$$\sum \text{Hours with } T > 0^{\circ} \text{ and humidity} < 95\%$$



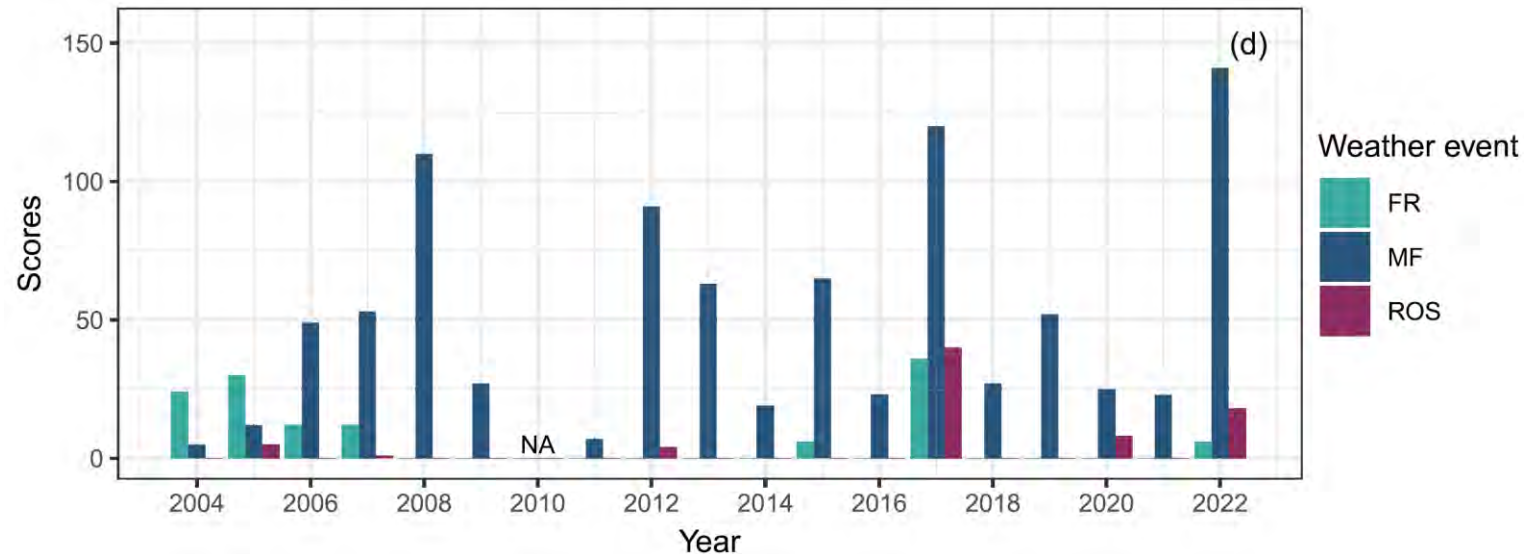
Rain-on-snow (ROS)

$$\sum \text{Hours with } T > 0^{\circ} \text{ and humidity} > 95\%$$

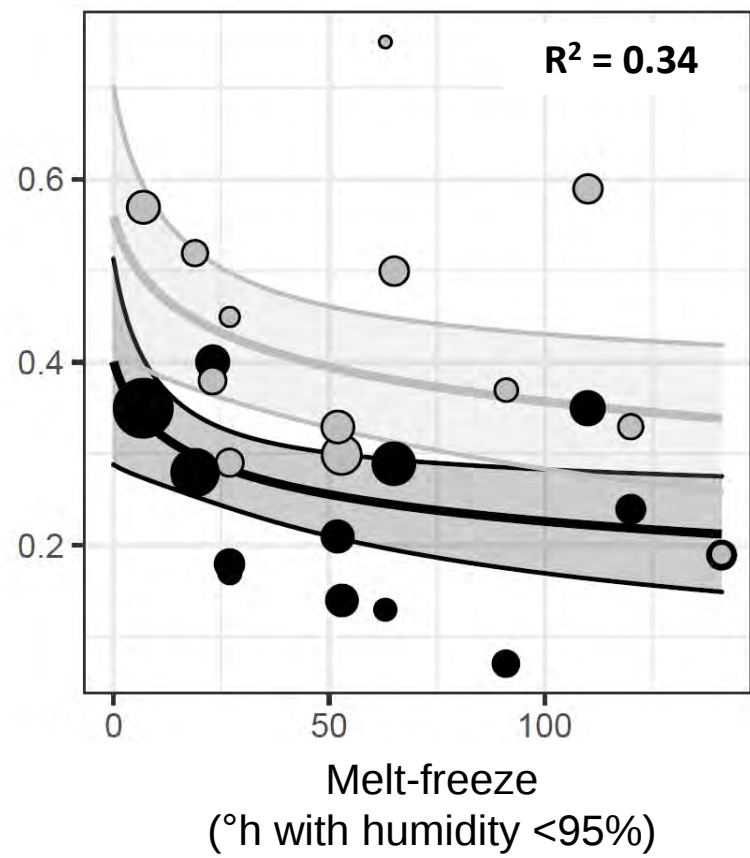
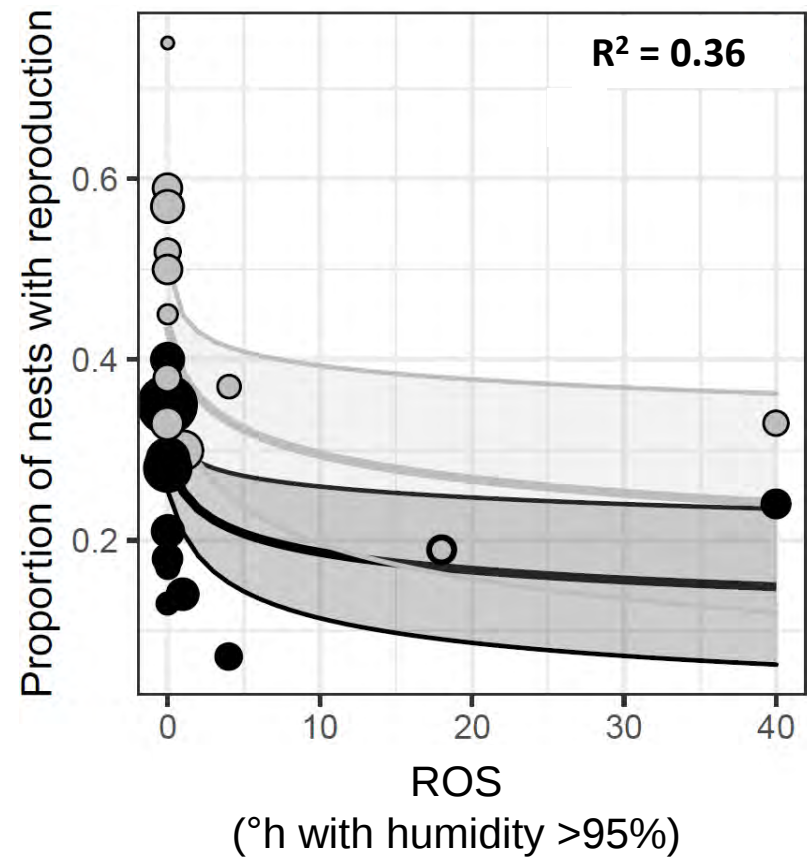


Freezing rain

$$\sum \text{Hours with freezing rain (reanalysis)}$$



Winter reproduction is negatively affected by rain-on-snow (ROS) and melt-freeze events

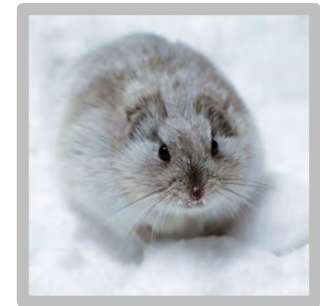
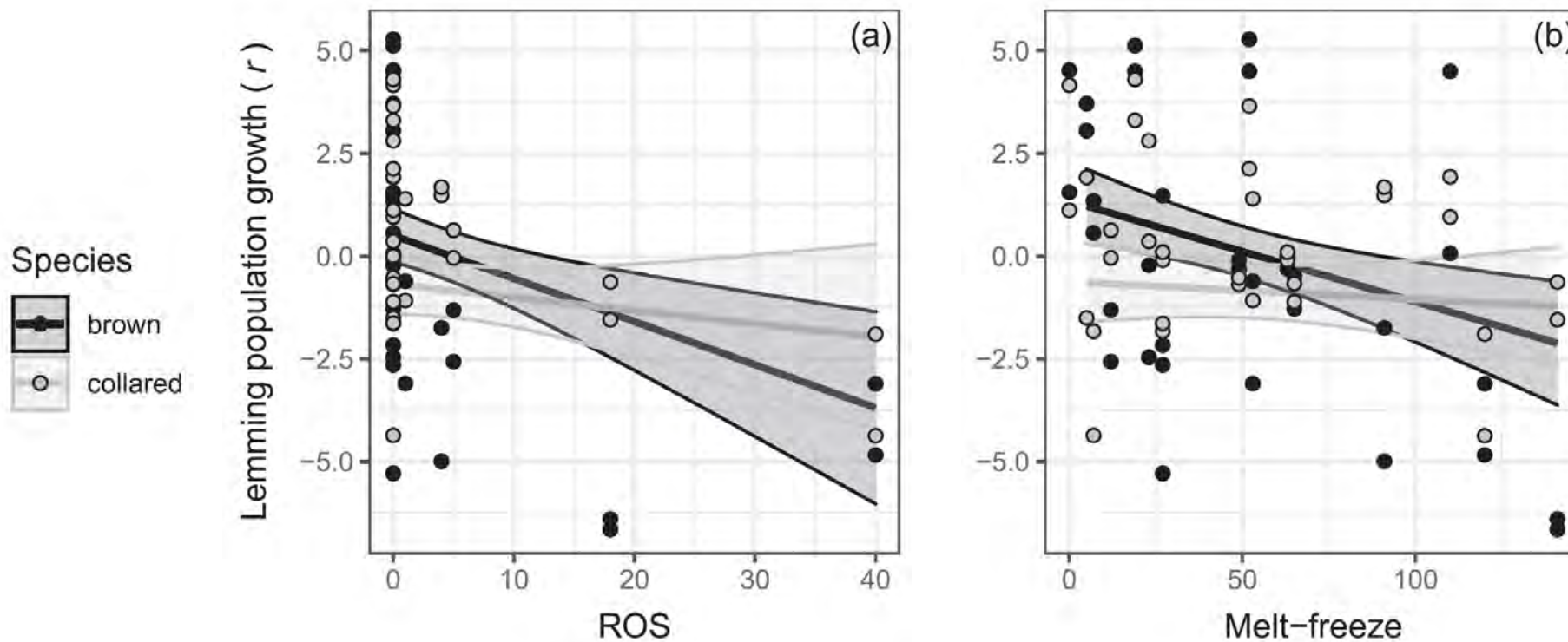


Species  brown  collared Number of nests ● 10 ● 100 ● 200



Brown lemming winter growth is relatively impacted by rain-on-snow (ROS) and melt-freeze events

Our findings support : collared lemming have better adaptation to cope with harder snow condition



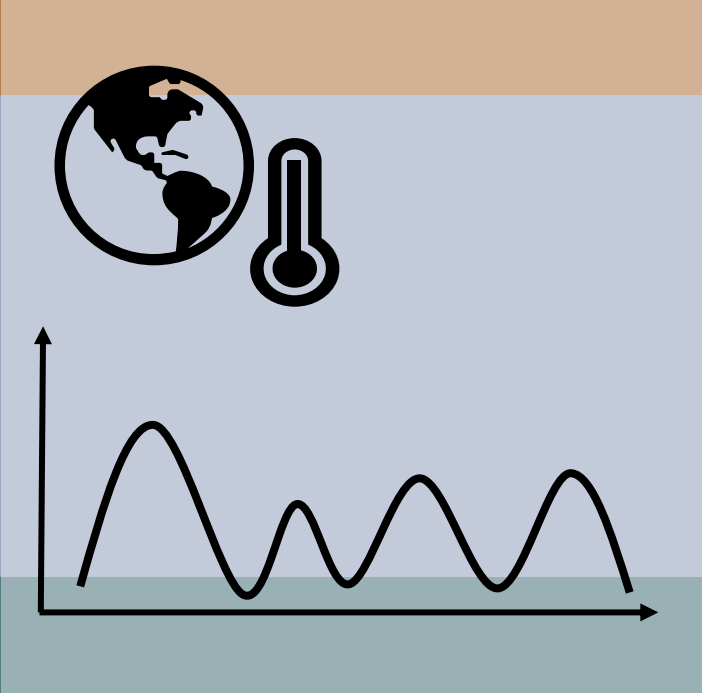
Lemmings used depth hoar to dig
their tunnels



Decrease in efficiency to dig in
harder snow layers



ROS and melt-freeze negatively impact winter
reproduction and growth



Gabriel Bergeron
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Camille Gaudreau-Rousseau
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