

Animal-plant-climate interactions near Kangerlussuaq over the past 20 years

Eric Post

Department of Wildlife, Fish, and Conservation Biology
University of California, Davis



Our work near Kangerlussuaq started in 1993 with a visit from Fairbanks, Alaska to study caribou



Mikael Eriksen with
Pernille Sporon Bøving
Cand. Scient. student Københavns Universitet

From field notes that summer:

“23 May 1993 – spoke with Peter Nielsen, Grønlands Hjemmestyre. They flew an aerial survey of caribou in March/April and found 50% less than Henning Thing reported in 1990.”

“1 June 1993 - Mikael Eriksen will drive us on a four-wheeler to the end of the trail going to the ice. We will camp at the east end of Aujuitsup Tasia, the east of the long lakes.”

Our work near Kangerlussuaq started in 1993 with a visit from Fairbanks, Alaska to study caribou



With Mikael Eriksen

After some years working on caribou in Alaska, with fond memories of Kangerlussuaq, we applied for a permit to return in 2002 to start a project on animal-plant-climate interactions



Cold Bay, Alaska

In spring 2002 we prepared to start the project...

Copenhagen, May 23th 2002

Permit
Scientific Expedition

From the Danish Ministry of Foreign Affairs the Danish Polar Center has received the US Application for conducting the scientific project no:

Ref.#2002-04/DPC ref. 512-168

Title of project: Experimental Ass. of the potential role of large herbivores in vegetation productivity response to global change	Activity area in Greenland: Kangerlussuaq
Name of project leader: Eric Post	Dates of arrival in and departure from Greenland: June 03 – July 05 2002



DANSK POLARCENTER

Strandgade 100 H
DK-1401 København K
Tel +45 32 86 01 00

Fax +45 32 86 01 01
www.dpc.dk

This is a permit of the operational and safety aspects of your scientific expedition. It does not represent nor does it imply an evaluation or recommendation of any activities included in your scientific expedition.

Based upon necessary hearing at relevant authorities, the Danish Polar Center hereby issues this permit on the following general conditions and exceptions and special requirements, viz.:

General conditions:

As in previous years, Danish/Greenlandic scientists shall be allowed to participate in the United States projects by direct agreement between the appropriate Danish and United States scientific institutions.

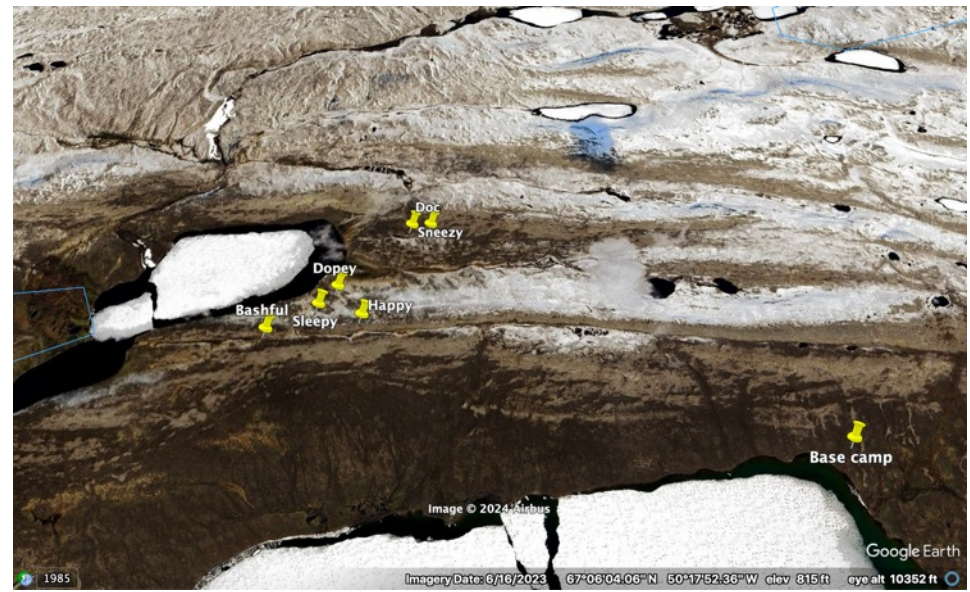
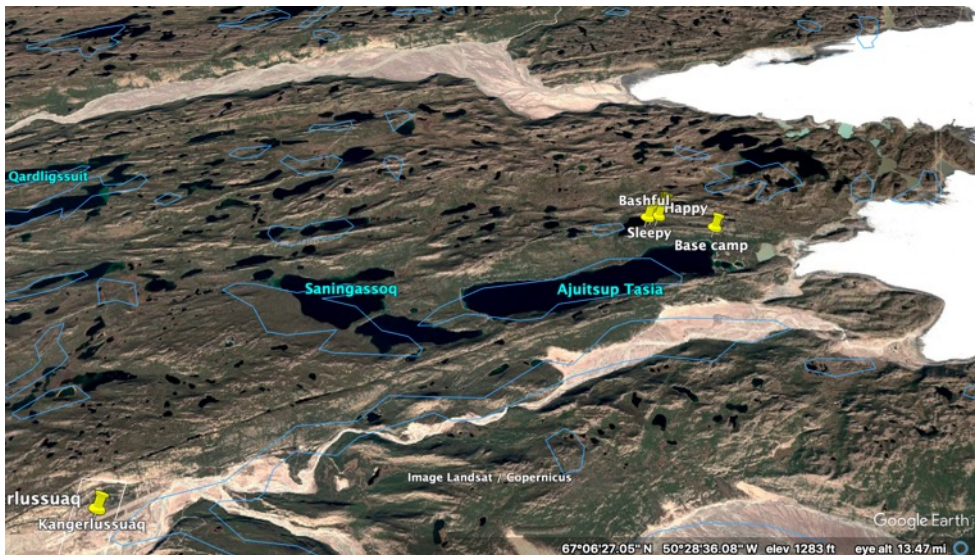
The Greenland Command shall be kept informed of the presence of the United States units in Greenlandic area in accordance with existing rules.

All research teams engaged in field activities in remote areas are strongly recommended to carry an approved (certified) type of emergency radio beacon.

We were excited to return in June 2002



We decided to locate the study site near what is now the east end of the UNESCO World Heritage Site Aasivissuit – Nipisat, where Henning Thing and Bjarne Clausen worked in late 1970s and we had worked in 1993



June 2002 – fencing material was flown in by helicopter



June 2002 – Six fences were installed (800 m²) to study how caribou and muskox might affect plant responses to warming



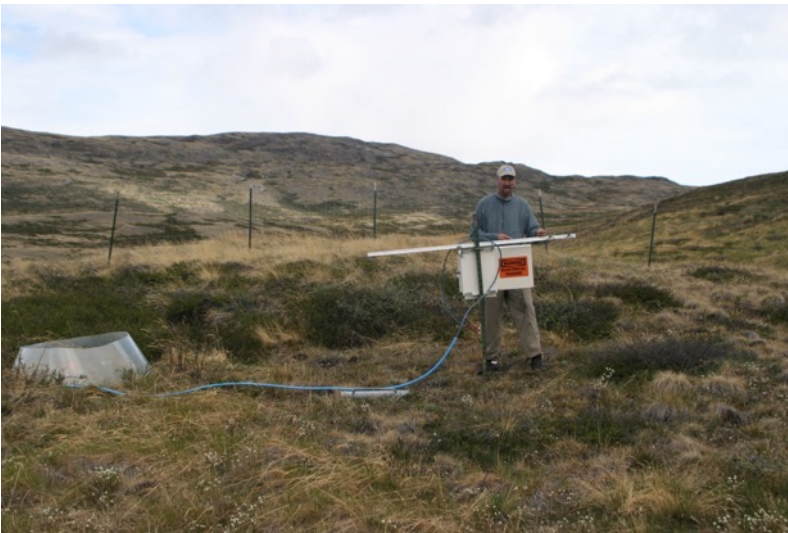
With Christian Pedersen (now at Norwegian Institute of Bioeconomy Research), Megan MacArthur (Penn State), Pernille Sporon Bøving (now UC Davis)



25 plots are warmed using Plexiglas chambers inside and outside the fences

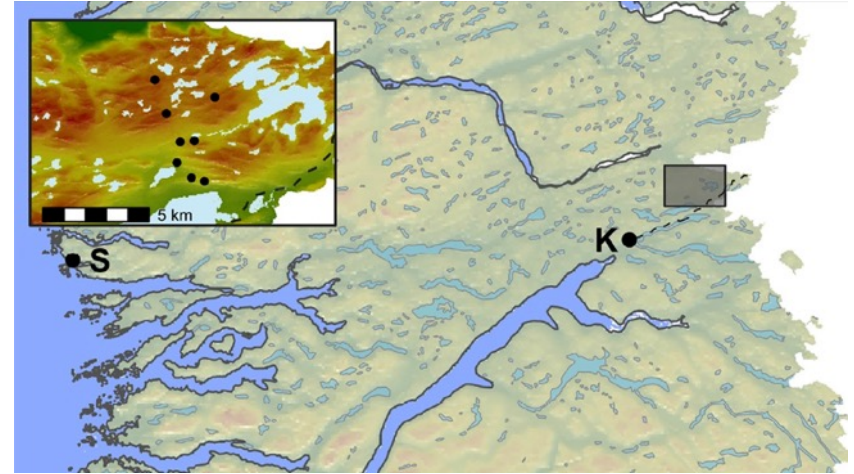
25 other plots left un-warmed also inside and outside the fences

We've sampled plant diversity and abundance non-destructively on these plots every year since 2002
(minus 2020)



A solar-powered weather station measures wind speed & direction, temperature, precipitation, solar radiation at the site

Caribou, muskox, and hares are counted daily from 8 lookout points from mid-May through June annually since 2002 to study changes in their abundance at the site



Main findings since 2002:

50% of the tundra plant species sampled are very rare at the Kangerlussuaq study site.

Compare this to: globally, 36% of plant species are very rare (Enquist et al. 2019 *Science Advances*)

Taxon	Functional group	Classification	Mean (\pm ISE) commonness	Minimum commonness	Maximum commonness
<i>Betula nana</i>	Deciduous shrub	Common	0.348 \pm 0.01	0.296	0.401
Graminoids	Grass, rush, sedge	Common	0.245 \pm 0.03	0.099	0.357
<i>Salix glauca</i>	Deciduous shrub	Common	0.095 \pm 0.007	0.066	0.135
<i>Equisetum arvense</i>	Forb	Rare	0.013 \pm 0.003	0.004	0.042
<i>Aulacomnium</i> sp.	Bryophyte	Rare	0.007 \pm 0.001	0.004	0.013
<i>Stellaria longipes</i>	Forb	Rare	0.002 \pm 0.008	4.0 $\times 10^{-4}$	8.44 $\times 10^{-3}$
<i>Cerastium alpinum</i>	Forb	Rare	0.001 \pm 0.0004	0.0002	0.004
<i>Bistorta vivipara</i>	Forb	Very rare	4.17 $\times 10^{-4}$ \pm 1.29 $\times 10^{-4}$	1.32 $\times 10^{-5}$	1.29 $\times 10^{-3}$
<i>Draba nivalis</i>	Forb	Very rare	2.05 $\times 10^{-4}$ \pm 5.5 $\times 10^{-5}$	0	6.25 $\times 10^{-4}$
<i>Campanula gieseckiana</i>	Forb	Very rare	1.92 $\times 10^{-4}$ \pm 7.58 $\times 10^{-5}$	0	9.13 $\times 10^{-4}$
<i>Viola canina</i>	Forb	Very rare	1.66 $\times 10^{-4}$ \pm 6.73 $\times 10^{-5}$	0	6.81 $\times 10^{-4}$
<i>Peltigera</i> sp.	Lichen	Very rare	6.56 $\times 10^{-5}$ \pm 4.77 $\times 10^{-5}$	0	5.83 $\times 10^{-4}$
<i>Pyrola grandiflora</i>	Forb	Very rare	2.54 $\times 10^{-6}$ \pm 1.36 $\times 10^{-6}$	0	1.53 $\times 10^{-5}$
<i>Calvatia cretacea</i>	Fungus	Very rare	1.66 $\times 10^{-6}$ \pm 1.22 $\times 10^{-6}$	0	1.32 $\times 10^{-5}$



Pyrola grandiflora
Storblomstret sommerkonval

Table 1. Classification of tundra taxa at the study site near Kangerlussuaq, Greenland as rare or common according to descriptive statistics calculated across 50 experimental plots annually for the period 2006–17.

Main findings since 2002:

Over the first 15 years, July temperature warmed $> 1^{\circ}\text{C}$
Plant diversity declined as shrubs increased with warming



2002 (credit: Christian Pedersen)

2024 (credit: Jeff Kerby)

Main findings since 2002:

Over the first 15 years, July temperature warmed $> 1^{\circ}\text{C}$
Plant diversity declined as shrubs increased with warming



2002 (credit: Megan MacArthur)



2024 (credit: Jeff Kerby)

Main findings since 2002:

Shrubs increased more, and plant diversity declined faster, inside fences and on warmed plots



2002 (credit: Megan MacArthur)



2024 (credit: Jeff Kerby)

Main findings since 2002:

Grazing by caribou and muskoxen slows the increase of shrubs and helps maintain rare plants, providing a buffer against climate warming



www.nature.com/scientificreports

scientific reports

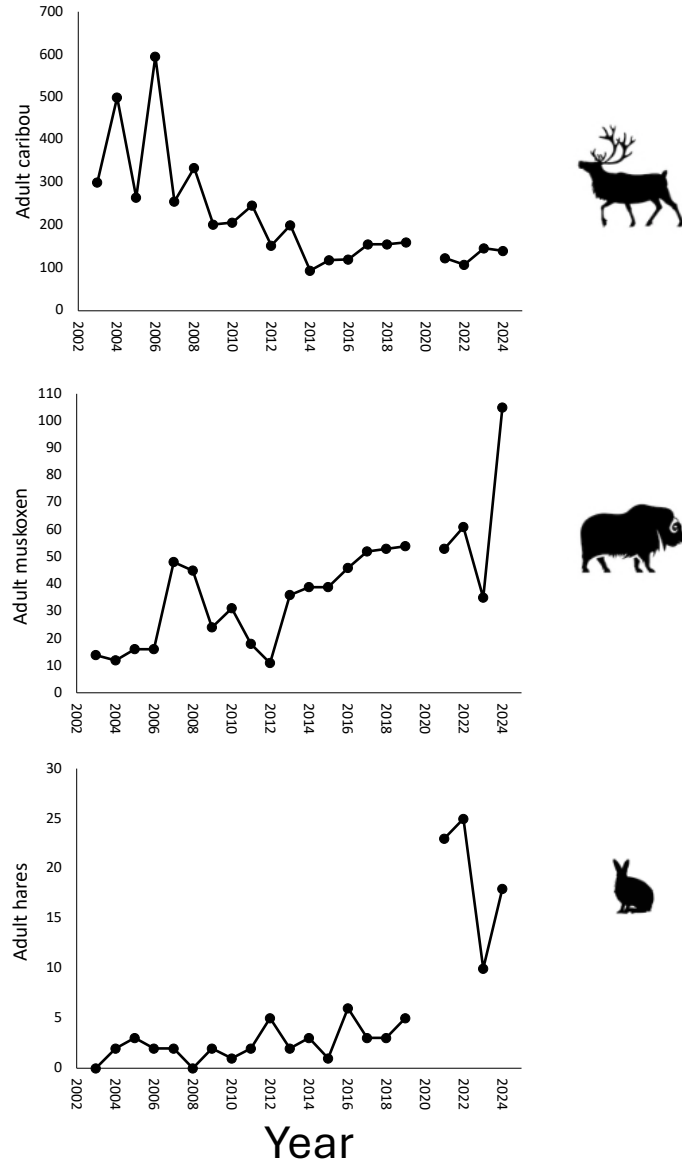
 Check for updates

OPEN Large herbivores facilitate
the persistence of rare taxa
under tundra warming

Eric Post^{1,2,3}, Christian Pedersen² & David A. Watts³

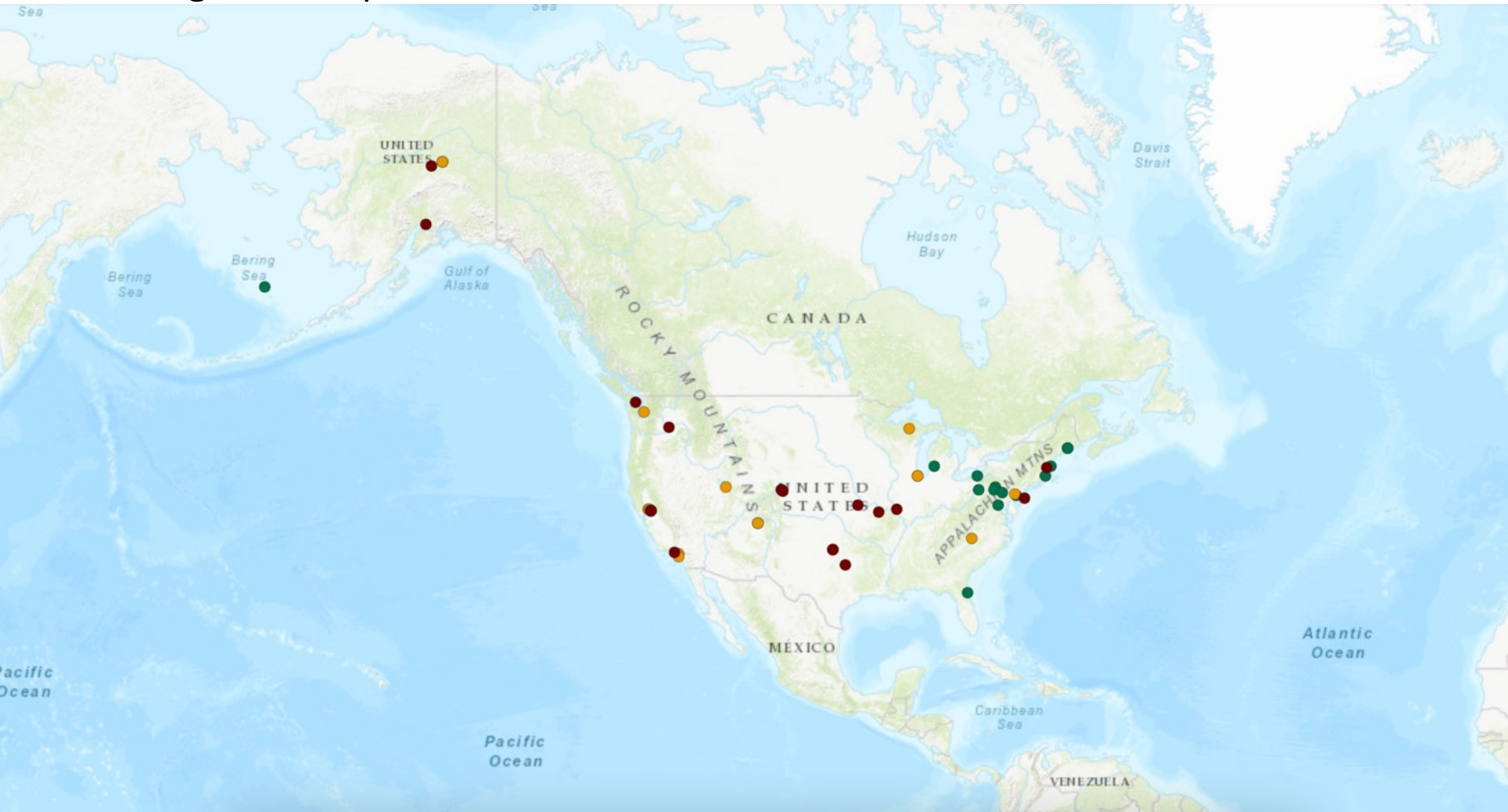
Main findings since 2002:

Caribou have declined at the site but muskoxen and hares have increased



Outreach: the APPLES Project (Arctic Plant Phenology – Learning through Engaged Science)

Kangerlussuaq science has trained 50 teachers in 19 U.S. states since 2016

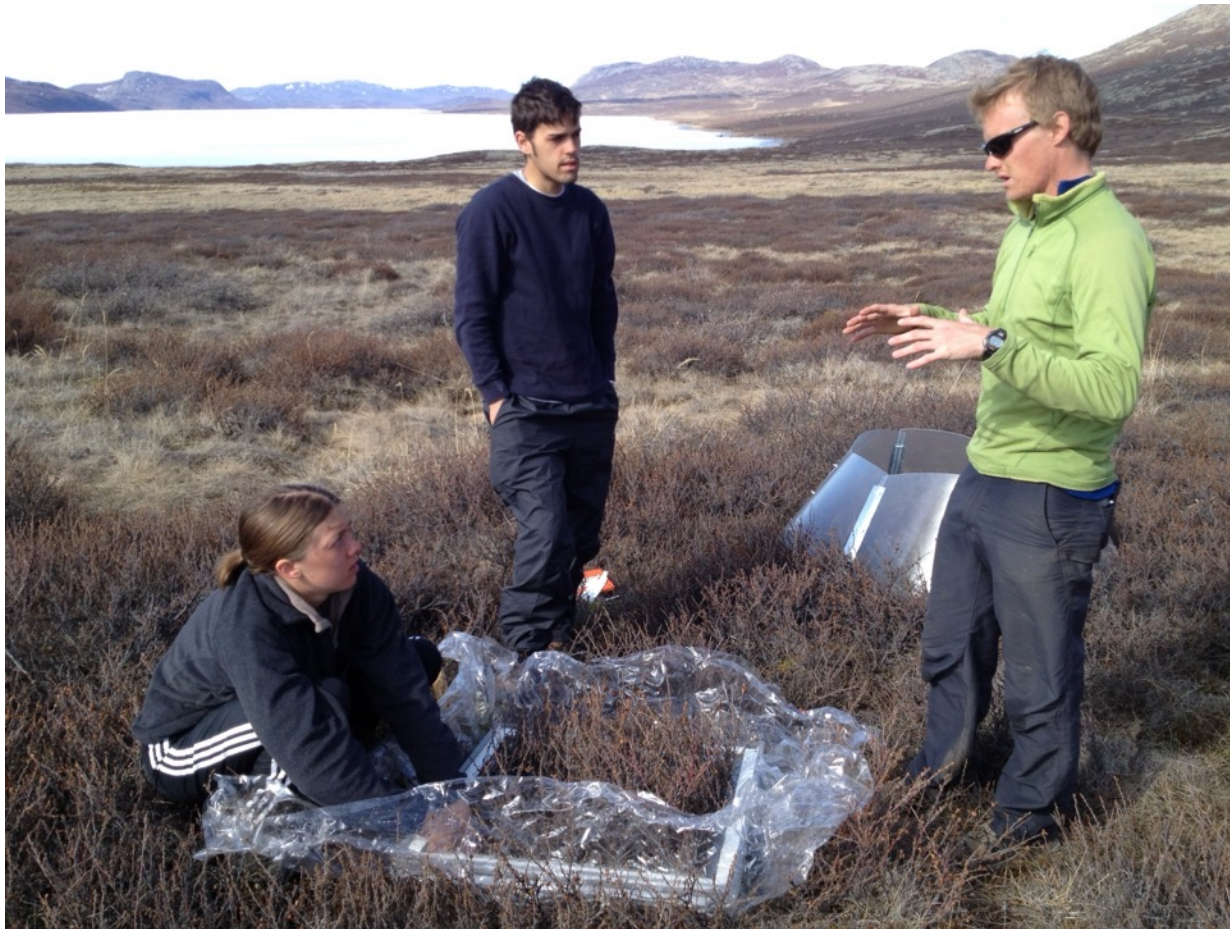


Outreach: the APPLES Project

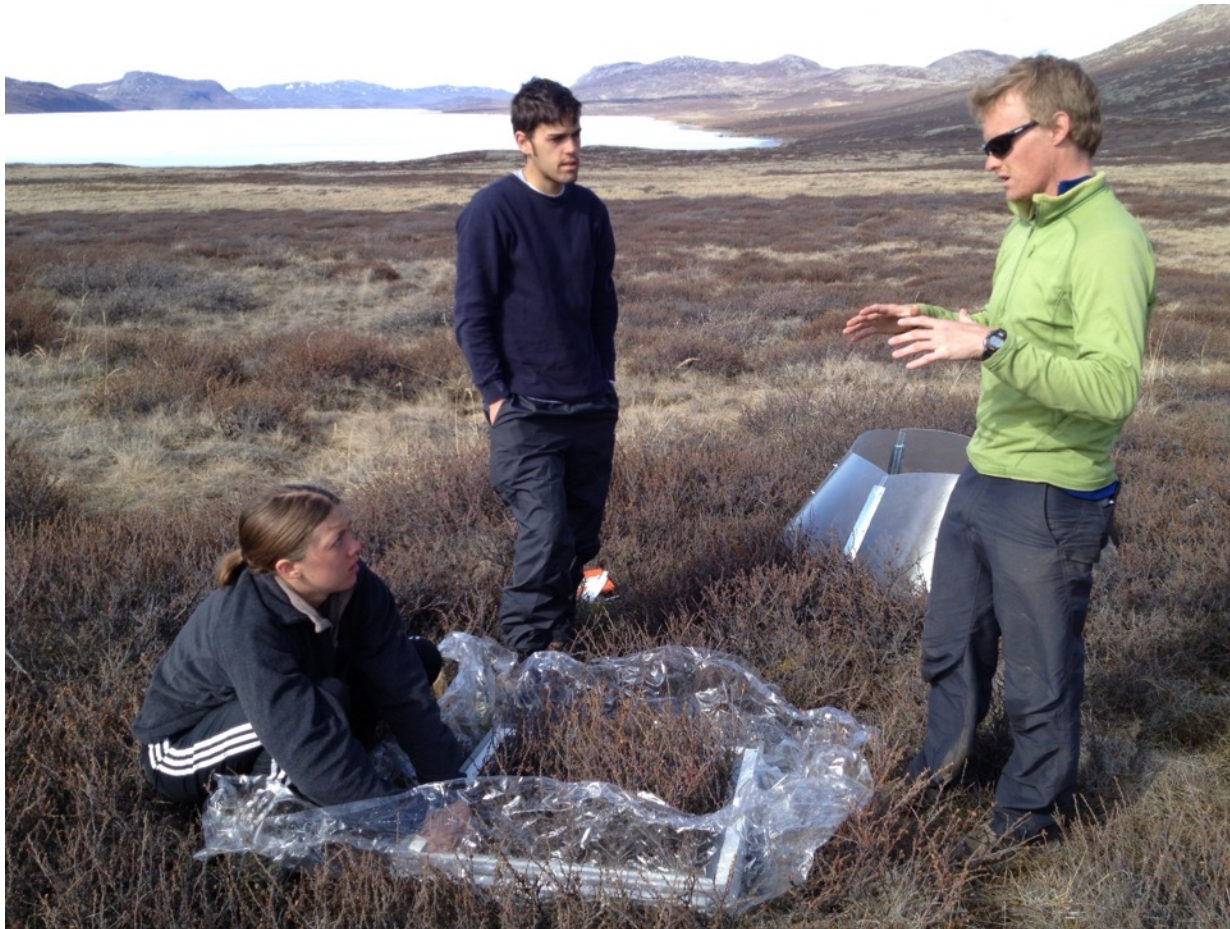
Primarily through workshops in the U.S. but also through visits to the site by teachers



The Kangerlussuaq study site has contributed to educational experiences for Greenlandic, Danish, and American high school students through JSEP; and field experience and training for 55 undergraduate students, graduate students, and post-docs from Denmark, Finland, Sweden, and the U.S.



Courses at Penn State Univ. and UC Davis using Kangerlussuaq data and have reached approx. 50-100 students every year since 2002



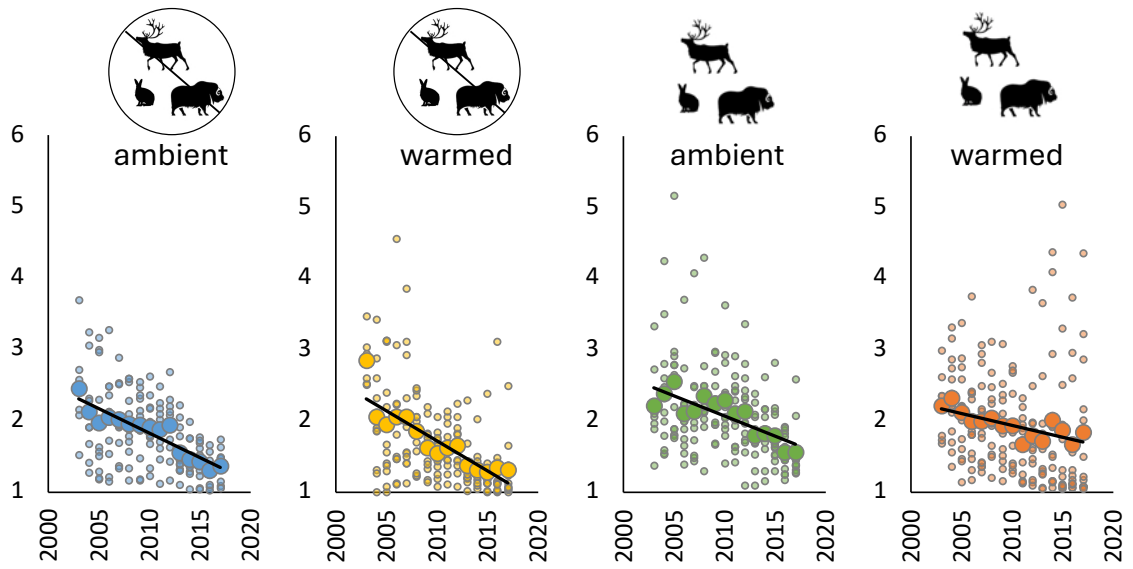
Future plans – the next 10 years?



We removed 3 of the fences in 2017



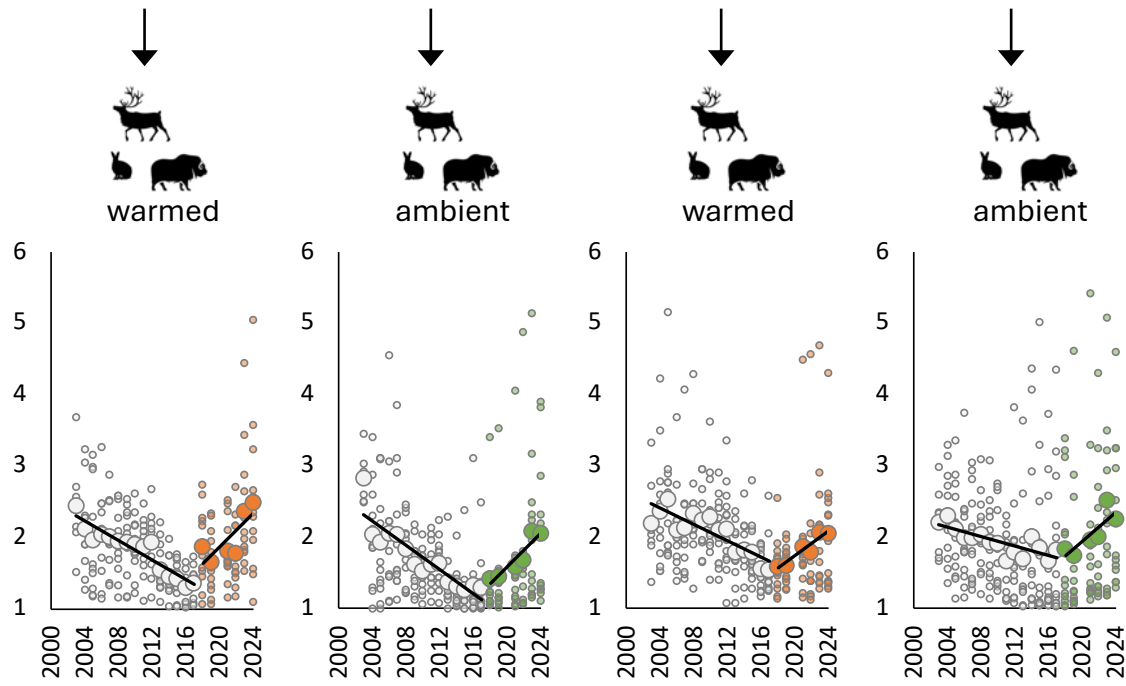
Tundra plant diversity



First 15 years
(diversity loss)

Post et al. *Science* 2023

removal of fences



2018-24
(diversity recovery)

Year

Many, many thanks to...

Jesper Schrøder & Laust Løgstrup for the kind invitation
Community of Kangerlussuaq

Government of Greenland

Air Greenland

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