



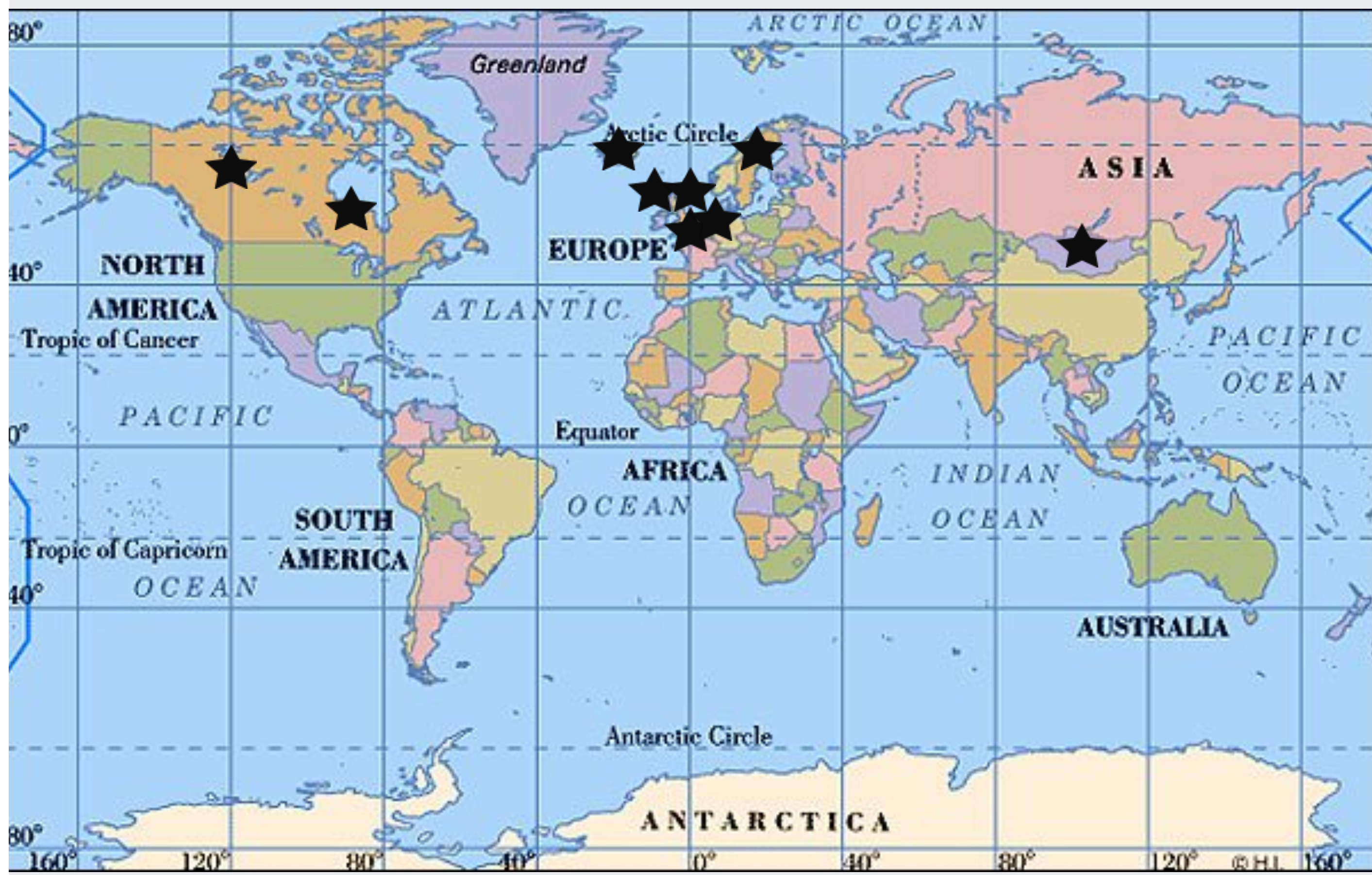
# MY LIFE WITH GRASS: FROM LA PÉROUSE BAY TO MONGOLIA

Dawn Bazely

@ Biology Department, YorkU, Toronto



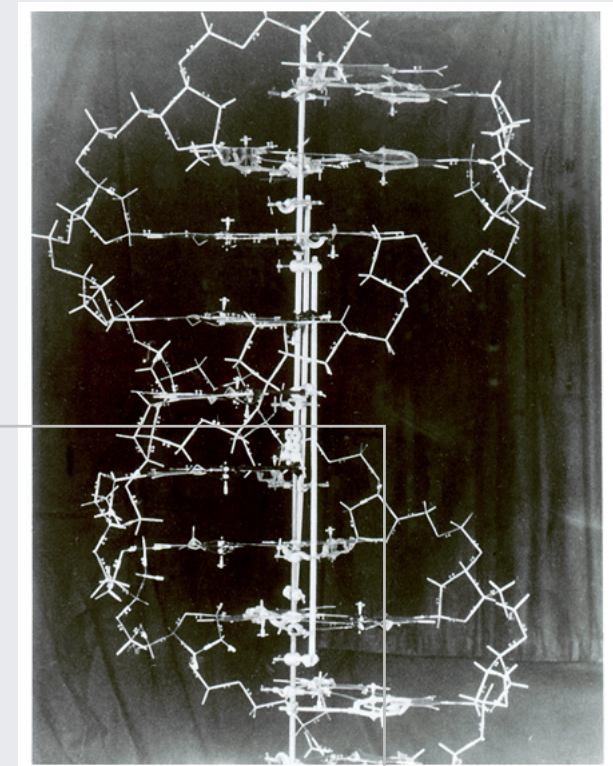






# ECOLOGY

- Surveys show that DNA is a more accessible concept than ecology!
- Ecology - is the area of biology that looks at how organisms interact with their environment.
- **It is complex.**



Courtesy of Cold Spring Harbor Archives. Noncommercial, educational use only.



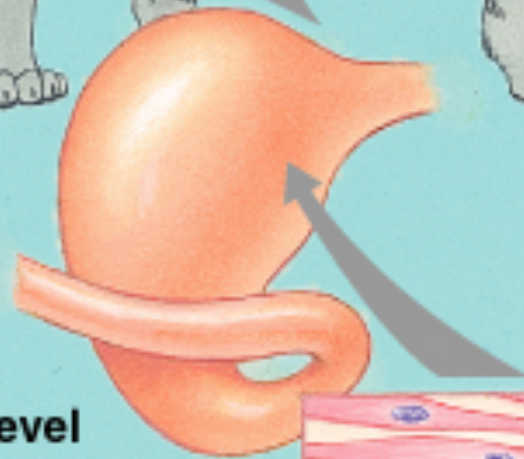
**Organism level**  
(consisting of many organ systems)

**Higher levels**  
(populations, communities, and ecosystems)

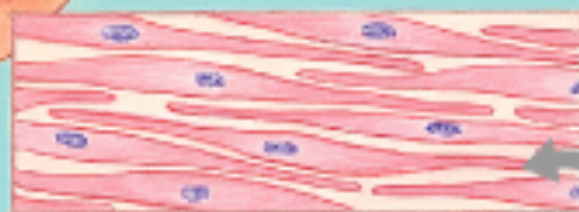
**Organ system level**  
(digestive system)



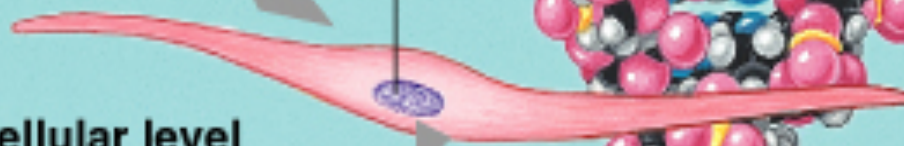
**Organ level**  
(stomach)



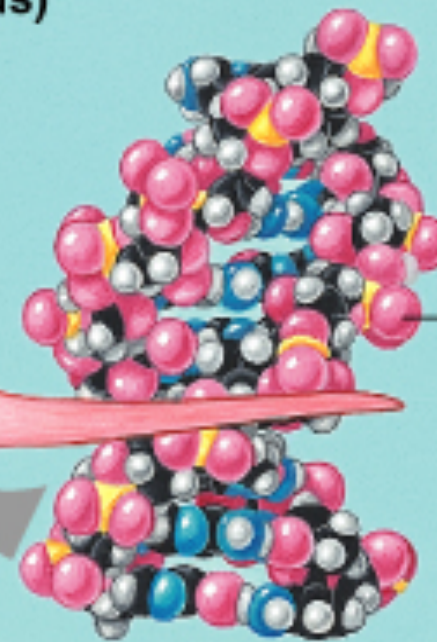
**Tissue level**  
(smooth muscle tissue)



**Cellular level**  
(smooth muscle cell)



**Organelle level**  
(cell nucleus)

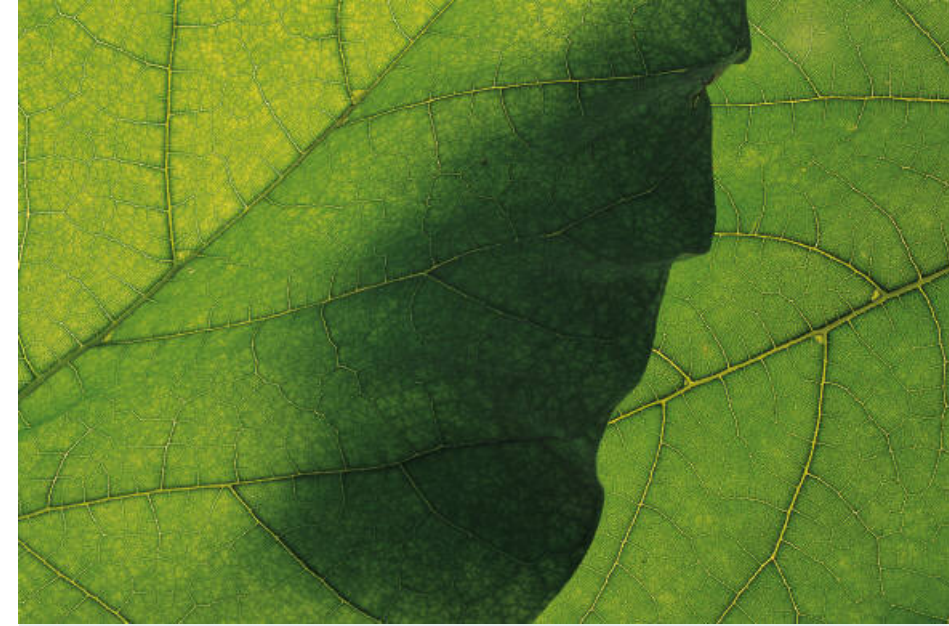


**Molecular level**  
(DNA)

**Atomic level**  
(oxygen)







- “The scientific study of the interactions between organisms and their environment”
- “Ecology is the study of the abundance and distribution of organisms”
- A KEY QUESTION -
- Why are there so many of a species and why are they living in a particular place?



# WHICH IS TO SAY THAT ECOLOGY...

- is fundamentally concerned with why population numbers change over time

- $N=B-D+I-E$

- **Number** of organisms in a population equals **Births** minus **Deaths** plus **Immigrants** minus **Emigrants**

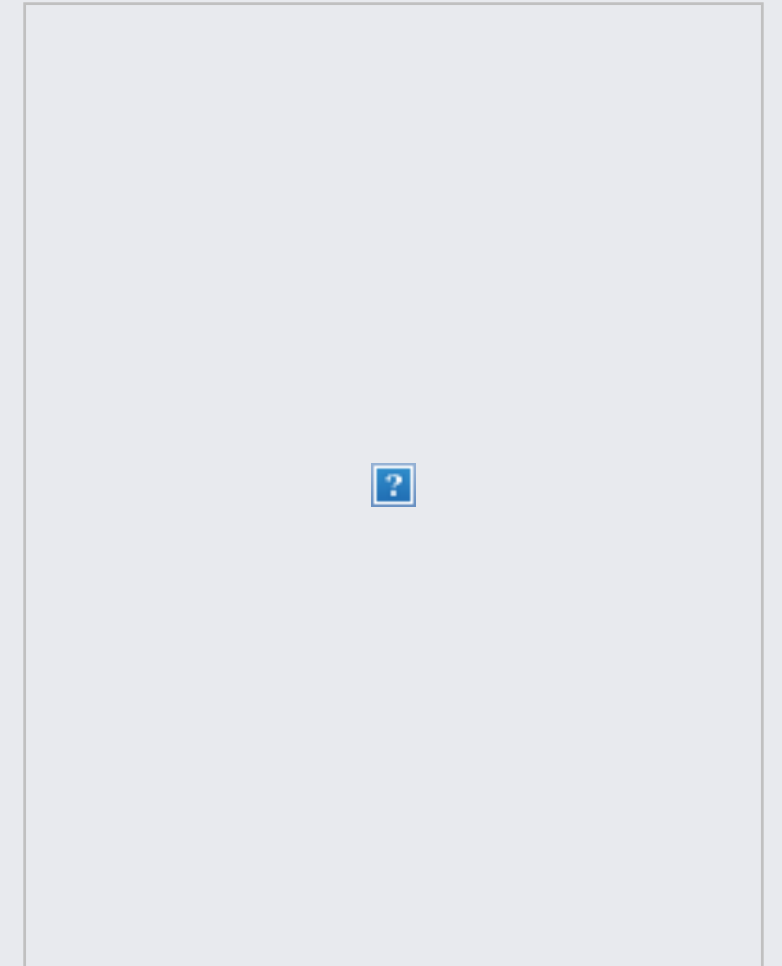
- Ecology asks if the numbers are going up, down, staying the same, and why?





# ECOLOGY IS CONFUSING

- It operates simultaneously on different levels or scales
- In space and time
- Involves many kinds of interactions
- e.g. HERBIVORY







# PREDATION

has a negative effect on prey that may be subtle and difficult to detect



# “TRUE” PREDATORS

- Most of the time they kill their victims shortly after attack
- Consume many prey items in a lifetime





# HERBIVORES

- Attack many different prey items in a lifetime
- Eat plants: leaves, twigs, roots, seeds
- Consume a bit of the victim at a time
- Do not usually kill prey in the short term (but may do so in the long term)





# WHAT I LEARNED FROM BOB

- how to count
- how to lie still and count leaves for hours and get other people to do it, too
- all about feedbacks
- patience





DAWN  
1982  
FaberCaster

JOB.....  
DATE..... PAGE.....

What we lost in the fire:  
\$15,000 worth of U of T equipment  
200 mm yashica lens  
FX-3 yashica camera body  
50 mm yashica lens  
3 close up lenses (1, 2, 4 diopter)  
Nikon 9x25 binoculars  
2 ms contact lenses

JOB.....  
DATE June 8 1982..... PAGE..... 4.....

Fire yesterday morning:  
Today sampled:  
X1 - 1 turf      C1 - 1 turf  
X2 - " "      C2 - " "  
X3 - " "      C3 - " "  
moved some of the reargrowth cages  
took samples from droppings  
exclosure - 2 turfs from hamline;  
ced droppings for FW/DWT  
took 2 Pucc. samples from  
green pond edges in Sawille  
ed droppings to DX  
it did not have enough  
or full treatments.  
so we ran out of  
cow wire to put up  
(Droppings exclosure).  
we will come back  
now to add the test of  
treatments and to  
wish of the the exclosure  
weather is still very  
but it has started

JOB.....  
DATE July 13/82..... PAGE.....

Saw Chrysanthemum arcticum  
flowering today. Also, I saw the  
first horseflies of the season  
and quite a few blackflies.

Found the yellow water buttercup  
Ranunculus Gmelini flowering  
in a pond across the river.  
The Pyrophyllum exalbescens is  
getting very green with new  
growth.  
Lots more Senecio open.

JOB.....  
DATE July 14/82..... PAGE..... 38.....

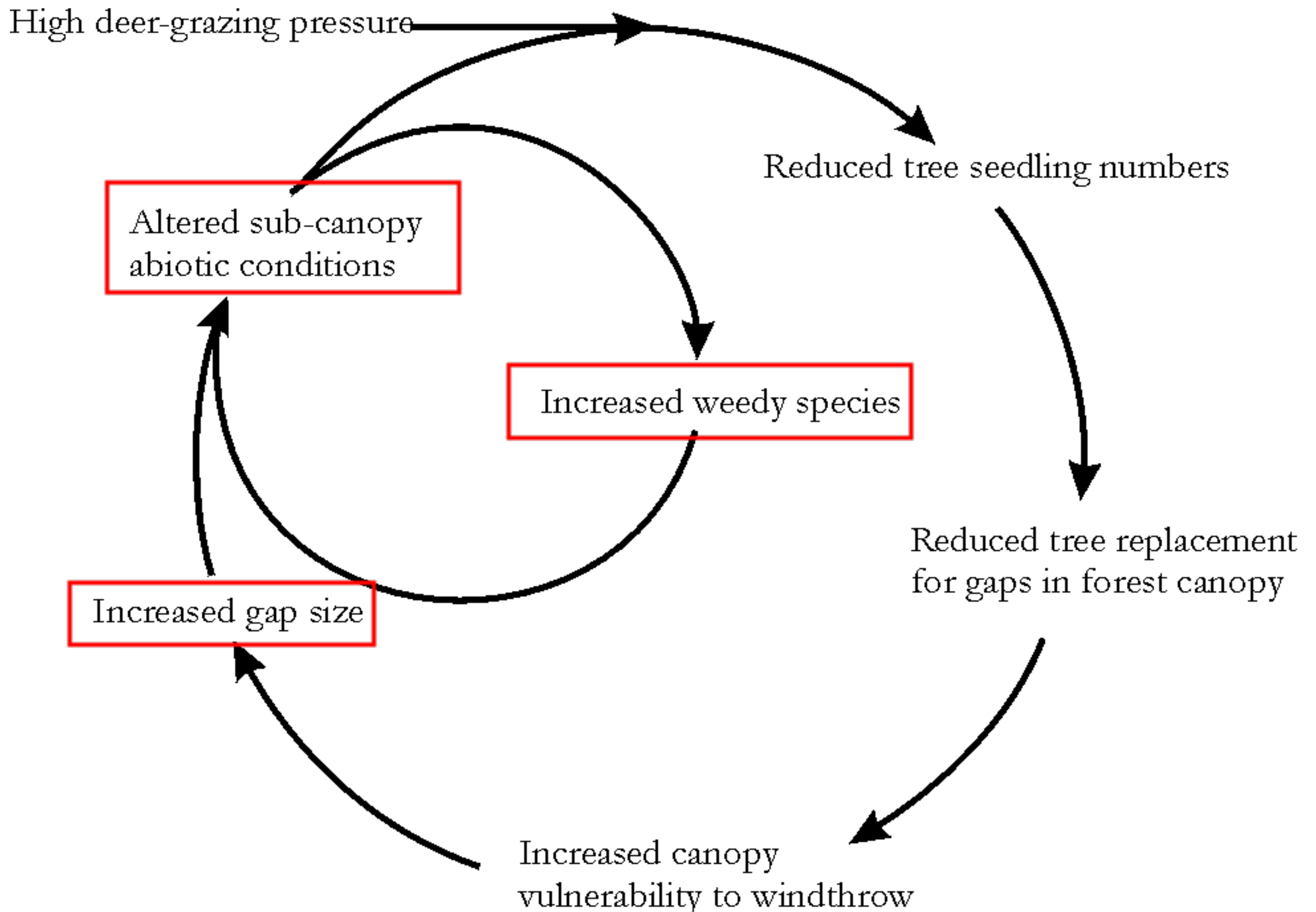
Presence Absence of species in exclosures

SPX 1980	Q123	P <sub>0</sub> , P <sub>1</sub> , Cx
Control Area	Q124	C <sub>m</sub> , M <sub>5</sub> , P <sub>1</sub> , Cx, C <sub>5</sub> , P <sub>5</sub>
Q101 Pucc, Carex	Q125	P <sub>0</sub> , Cx
Q102 Pucc, Carex	126	P <sub>0</sub> , Cx
Q103 Ranunc, Pot, Pucc, Car, Plant, Moss 27		Cx, P <sub>0</sub>
104 Pucc, Car, Ran.	128	P <sub>0</sub>
105 Pucc, car, Potent	129	P <sub>0</sub> , Cx
106 Pucc, car, Potent	130	P <sub>0</sub> , Cx
107 Car, Pucc	131	P <sub>0</sub> , Cx
108 Pucc, Car, Potent	132	P <sub>0</sub> , Cx, Rn
109 Pucc, Car, Potent	133	Cx, P <sub>0</sub>
110 Pucc, Car,	134	Rn, P <sub>0</sub> , Cx
111 Pucc, Car	135	Cx, P <sub>0</sub>
112 Pucc, Car	136	Cx, P <sub>0</sub>
113 Pucc, Car	137	P <sub>0</sub> , Cx
114 Pucc, Car	138	P <sub>0</sub>
115 Car, Pucc, Pot, Chrys	139	Cx, P <sub>0</sub>
116 Plant, Pot, Cx, P <sub>0</sub>	140	P <sub>0</sub>
117 Cx, P <sub>0</sub>	141	P <sub>0</sub> , Cx
118 P <sub>0</sub> , Cx	142	Cx
119 P <sub>0</sub> , Cx	143	P <sub>0</sub> , Cx
120 Cx	144	Cx
121 P <sub>0</sub> , Cx	145	P <sub>0</sub> , Cx
122 Cx, P <sub>0</sub>	146	Cx, P <sub>0</sub>

C<sub>m</sub>  
PARTY CHIEF Atkinson Cx, P<sub>0</sub>, P<sub>1</sub>, P<sub>2</sub>, Cx, M<sub>5</sub>, S<sub>5</sub>, S<sub>10</sub>  
WEATHER carex Pucc potent Plant chrys moss

PARTY CHIEF.....  
WEATHER.....





Firanski model: Have too many deer triggered a positive feedback cycle?



# AFTER LA PEROUSE - PLANTS CAN'T RUN AWAY

They have evolved various avoidance and anti-herbivore defences (Myers & Bazely 1991)

1. Spines and thorns
2. Toxin synthesis
3. Relationships with symbionts such as fungi

OR - they have adapted to herbivory and rapidly take up nutrients and replace lost tissue

e.g. graminoids (Vicari & Bazely 1993)





# GRASS-FUNGUS SYMBIOSES CONFIRMED IN 1980S

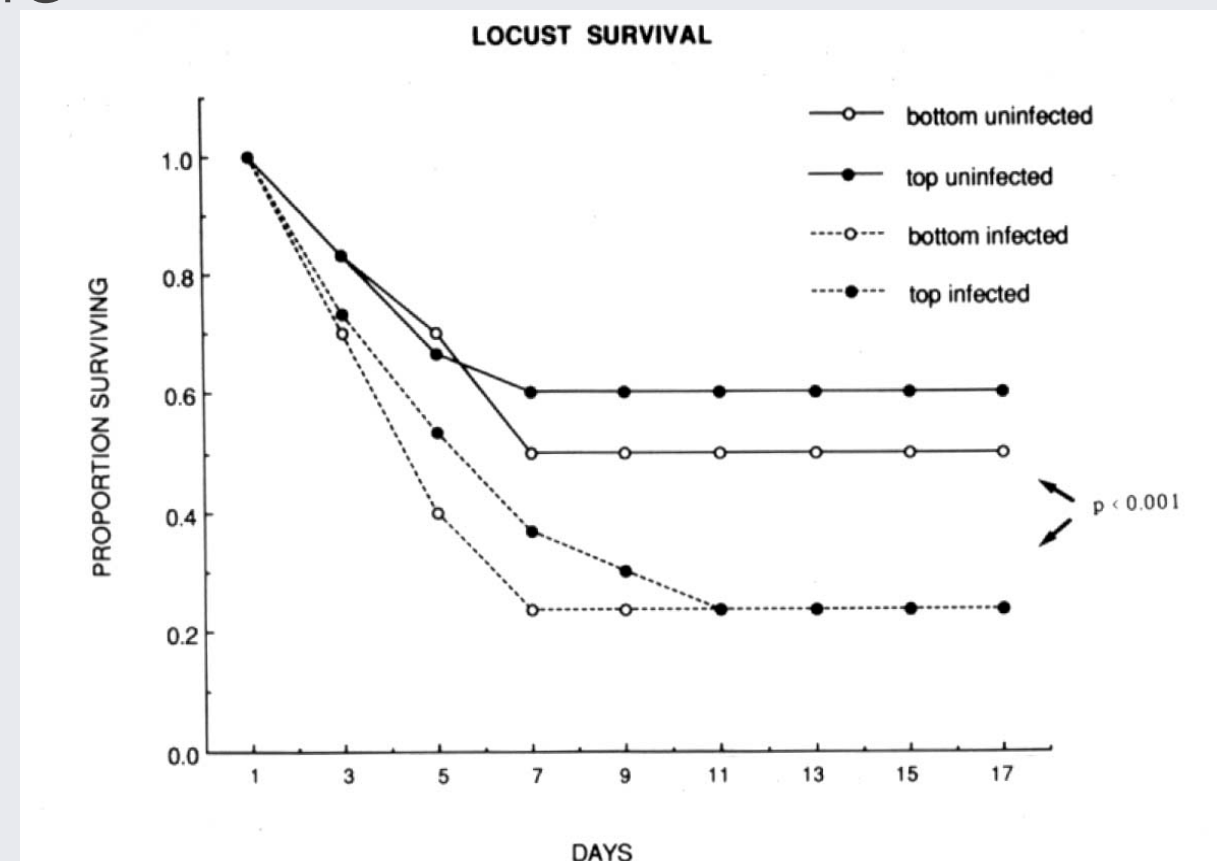
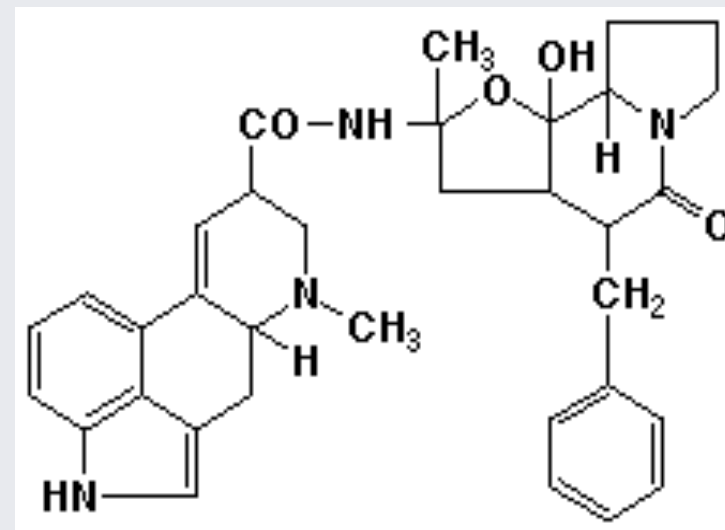
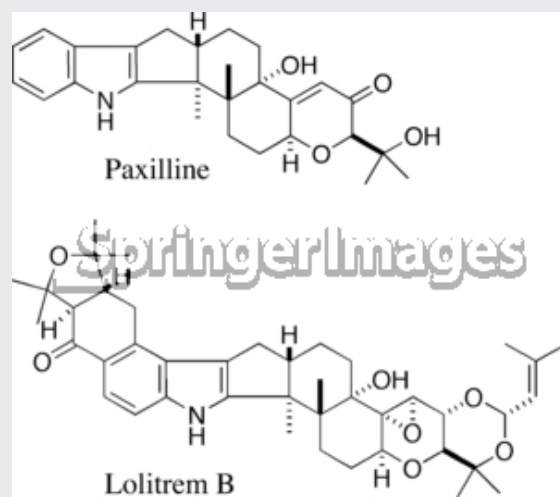
- As a cause of periodic “mystery” illnesses & deaths of livestock
- Clinical and sub-clinical effects - reduced forage intake, hypothermia, reduced milk production, ryegrass staggers, reduced growth rates
- Annual losses to US agriculture estimated at \$600 million (Hoveland 1993)





# TOXIC GRASSES

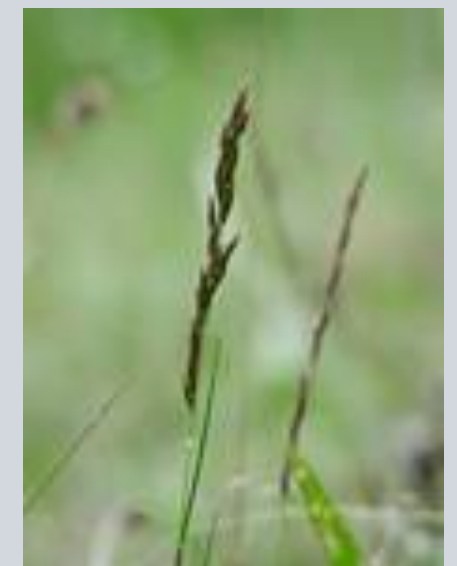
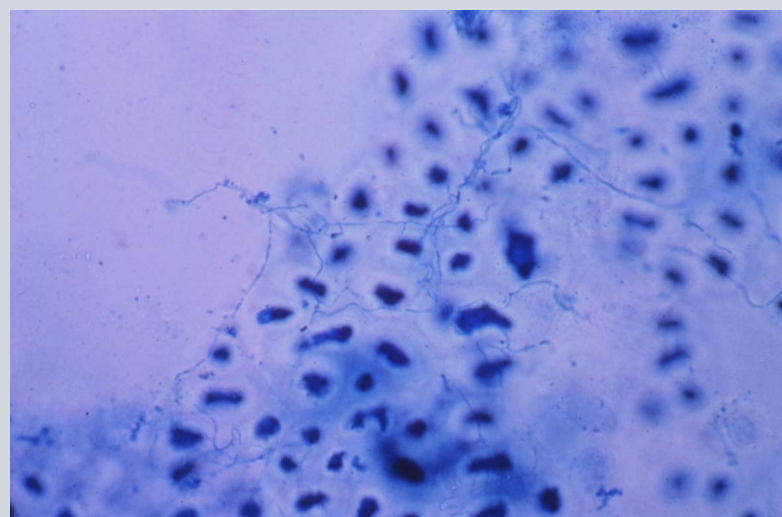
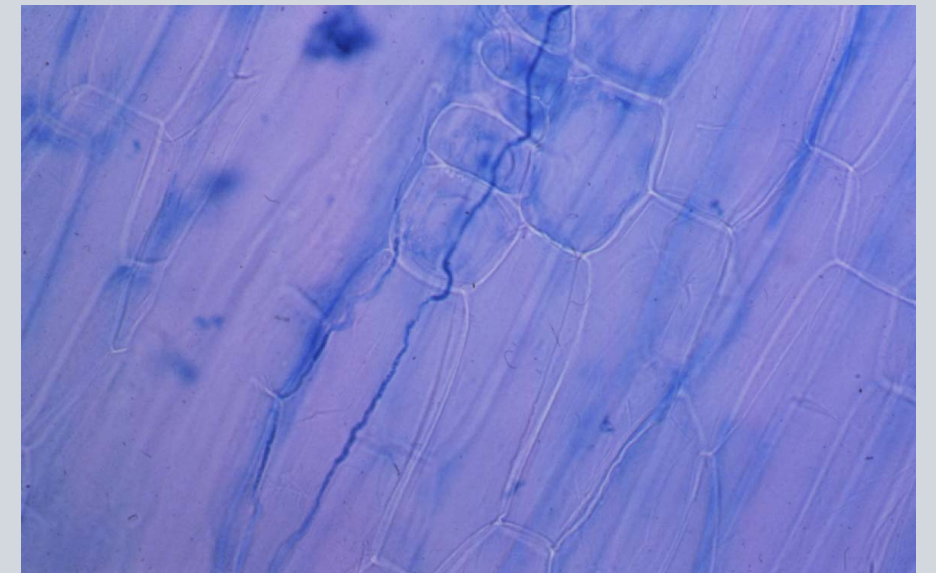
- Forage grasses infected include important agricultural grasses - *perennial ryegrass* and *tall fescue*
- They synthesize lethal or sub-lethal alkaloids e.g. lolitrems, and ergot alkaloids such as ergotamine





# SYMPTOMLESS ENDOPHYTES

The life cycle has vertical transmission





# RESEARCH GAPS

- Endophytes in grasses are important in agriculture for bad effects on domestic animals that eat them
- Their importance in natural ecosystems is MUCH less well understood
- Fungal endophytes are common in grasses (Clay 1997)
- Potential benefits to host grass from endophytic fungus
  - ↑ increased growth capacity
  - ↑ increased seed germination
  - ↑ higher resistance against herbivory and plant pathogens
  - ↑ higher tolerance to drought and flood induced stress



# NOW... LEARN ABOUT FUNGUS

pparently has  
fences against  
trees often die  
er being  
invariably suc-  
four years. "If  
g a hemlock as  
l, then you can  
adelgid with  
aps or oil  
McClure. "But  
are not  
e forest." Nor  
old deter the  
feed through-  
; even in tem-  
w zero [F], so  
s actually  
heir spread  
e says.  
s found nat-  
f the adelgid  
working to  
in North  
ntil an  
tor is settled  
es nothing  
delgid on its  
da: "It's mov-  
een 30 and 50  
hich is fast for  
Clure attrib-  
bread to its

## Rambo Grass

SHEEP MAY SEEM harmless to humans, but to grass plants, they are voracious predators. And, although conventional wisdom holds that grass benefits from being grazed by herbivores, that attitude is now being challenged by plant ecologists such as Dawn Bazely of York Uni-



scopic, toxin-pro-  
fungus that lives  
plant tissues. Fur-  
more, she reports  
fescue plants that  
grazed contain more  
the fungus than plants  
have not. On a field  
with no sheep, the  
of fescue grass remains  
uninfected.

The fungal endo-  
(literally, "fungus  
inside") is related

a grain fungus  
killed tens  
sands of people  
Middle Ages  
like ergot,  
the fescue fungus  
not harmful to  
but protected  
by suffusing  
toxic alkaloids  
to the hallucinatory  
drug LSD. In fact,  
the grass produces  
the fungus, which is  
asexual, with  
of reproduction  
because the  
infected plants

iversity in Toronto. "Nothing contains the fungus"

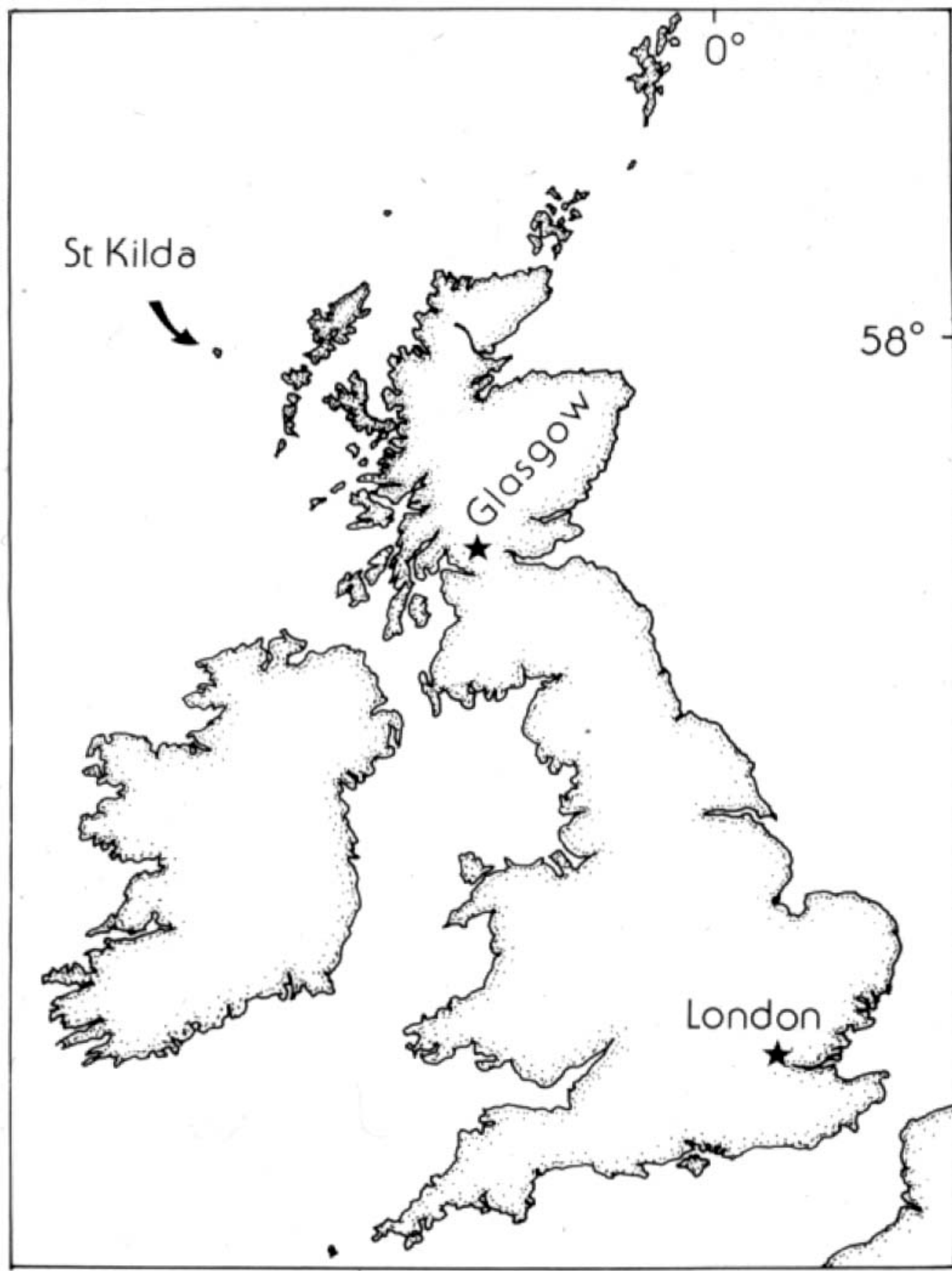


# QUESTION ARISING FROM NORTHERN GRASS-GRAZER SYSTEMS...

1. Are graminoids (grasses) always grazing-tolerant?
2. OR are anti-herbivore defences present and playing a role in plant-herbivore interactions?
  - What are fungal endophytes doing in temperate and arctic grasslands



# ST. KILDA ARCHIPELAGO



0 MILES 2

Stac an Armin

Stac Lee

BORERAY

SOAY

HIRTA

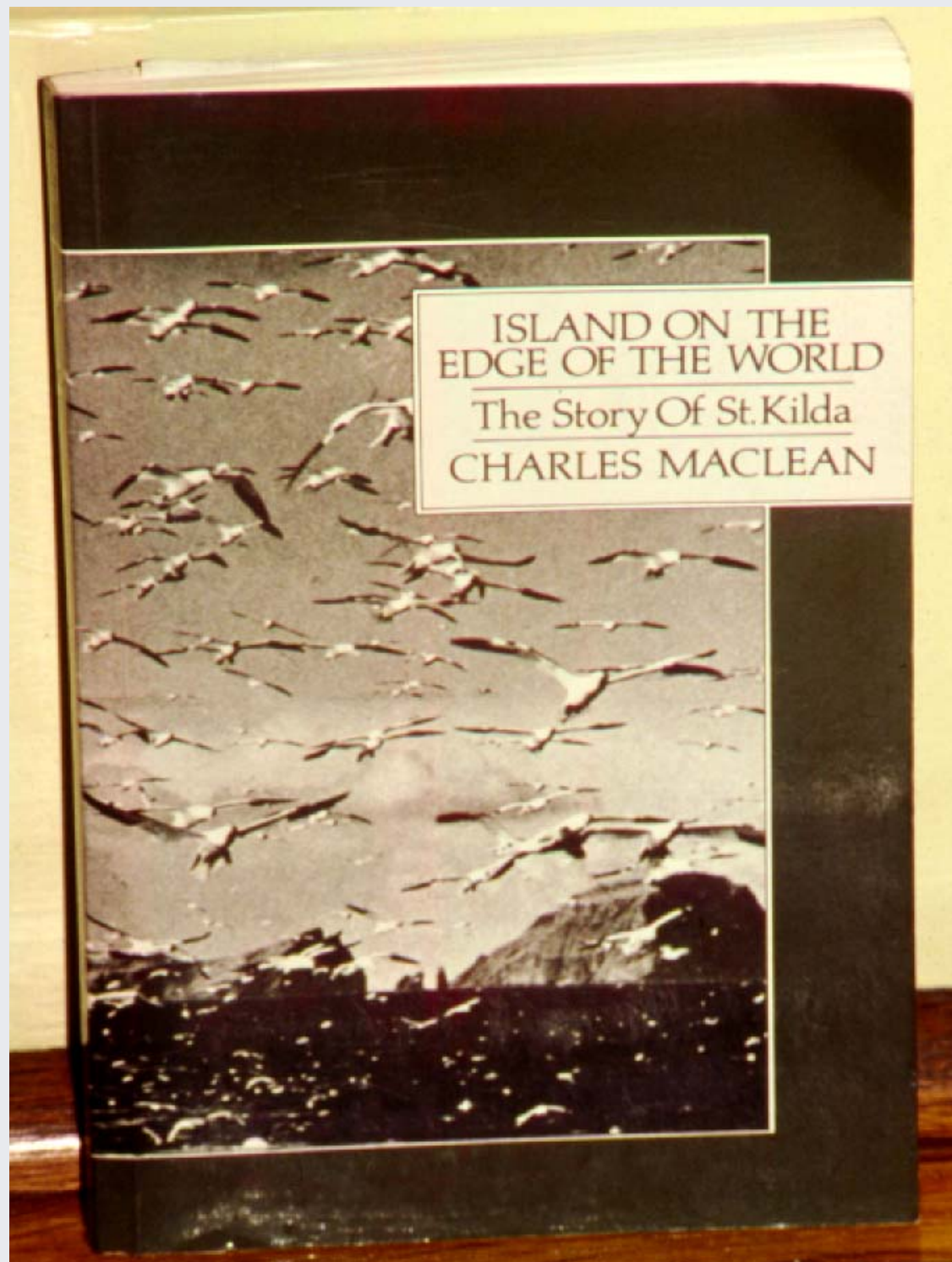
DUN

LEVENISH





# “ISLAND ON THE EDGE OF THE WORLD”





EVACUATED IN 1930 DUE TO THE ISOLATION AND  
SQUALID LIVING CONDITIONS OF THE SMALL (AND  
HIGHLY INBRED!) POPULATION



<http://www.kilda.org.uk/cultural-traditions.htm>



# A UNITED NATIONS WORLD HERITAGE SITE: GEOLOGY, ARCHAEOLOGY AND SEABIRDS

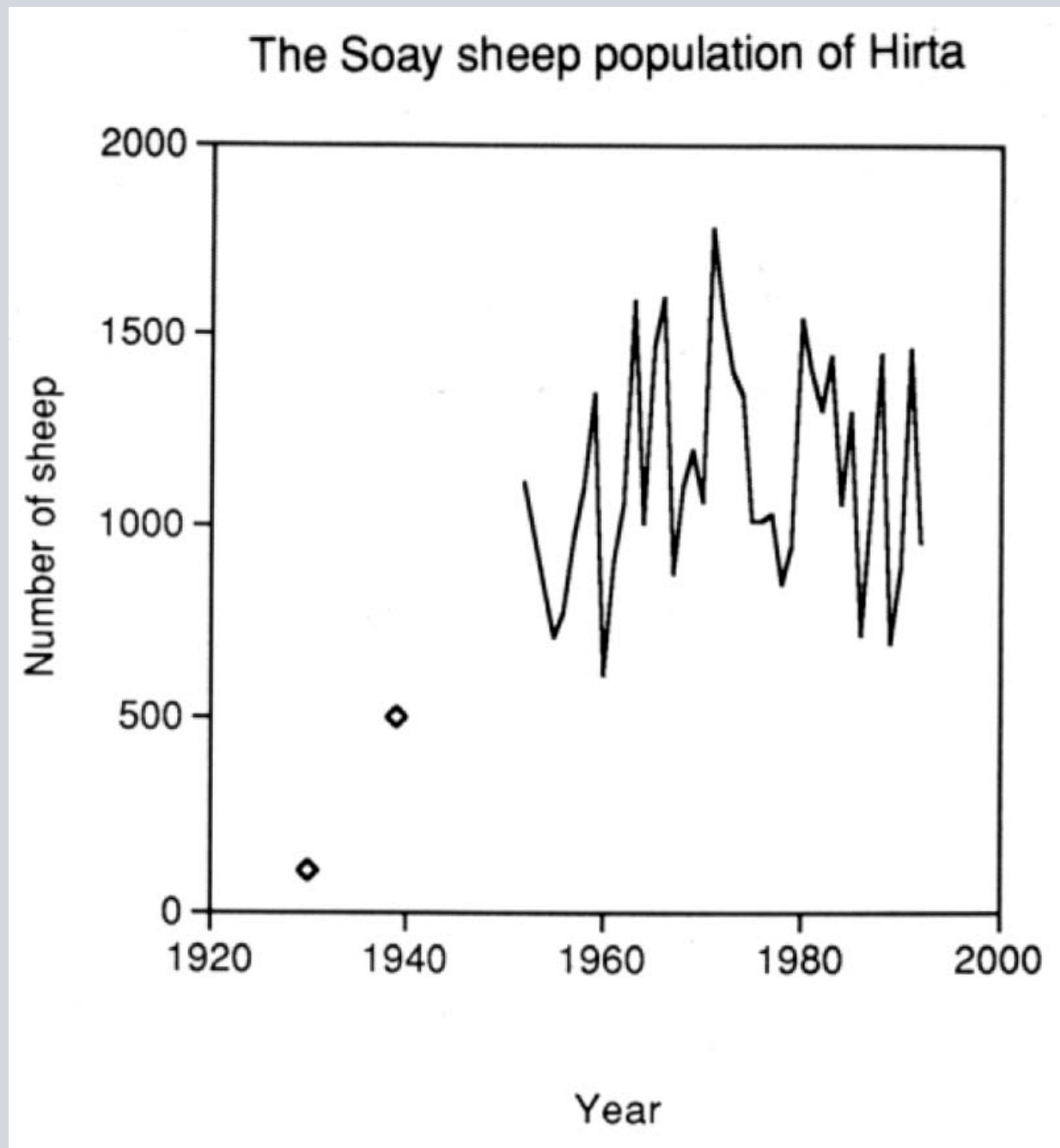








# Soay sheep - a feral, unmanaged crashing population (always) - no predators





# THE ST. KILDA FUNGAL ENDOPHYTE STORY IN BRIEF

- *red fescue* (grass) is common and preferred by sheep
- Primary production before a sheep “crash” in 1991-1992 was lower than after the crash, but there was still abundant forage...
- Prediction: endophytes should be present, and if they are part of a herbivore-defensive mutualism, then infection rates should be higher on the grazed island of Hirta compared with next door, always ungrazed, Dun



Hirta (left)  
Dun (right)





# YES - VISUAL INSPECTION FOUND

		Staining and microscopic examination	
Screening method	Infection (%)		<i>n</i>
Grazed			
St. Brianan	83·9		56
Ungrazed			
Dun	24·0		50
Fisher's exact (2-tail)		$P < 0·001$	



Bazely et al. 1997





# CLIMATE CHANGE AND INVASIVE SPECIES

Endophyte-infected grasses in Sweden

Dawn Bazely and John Ball



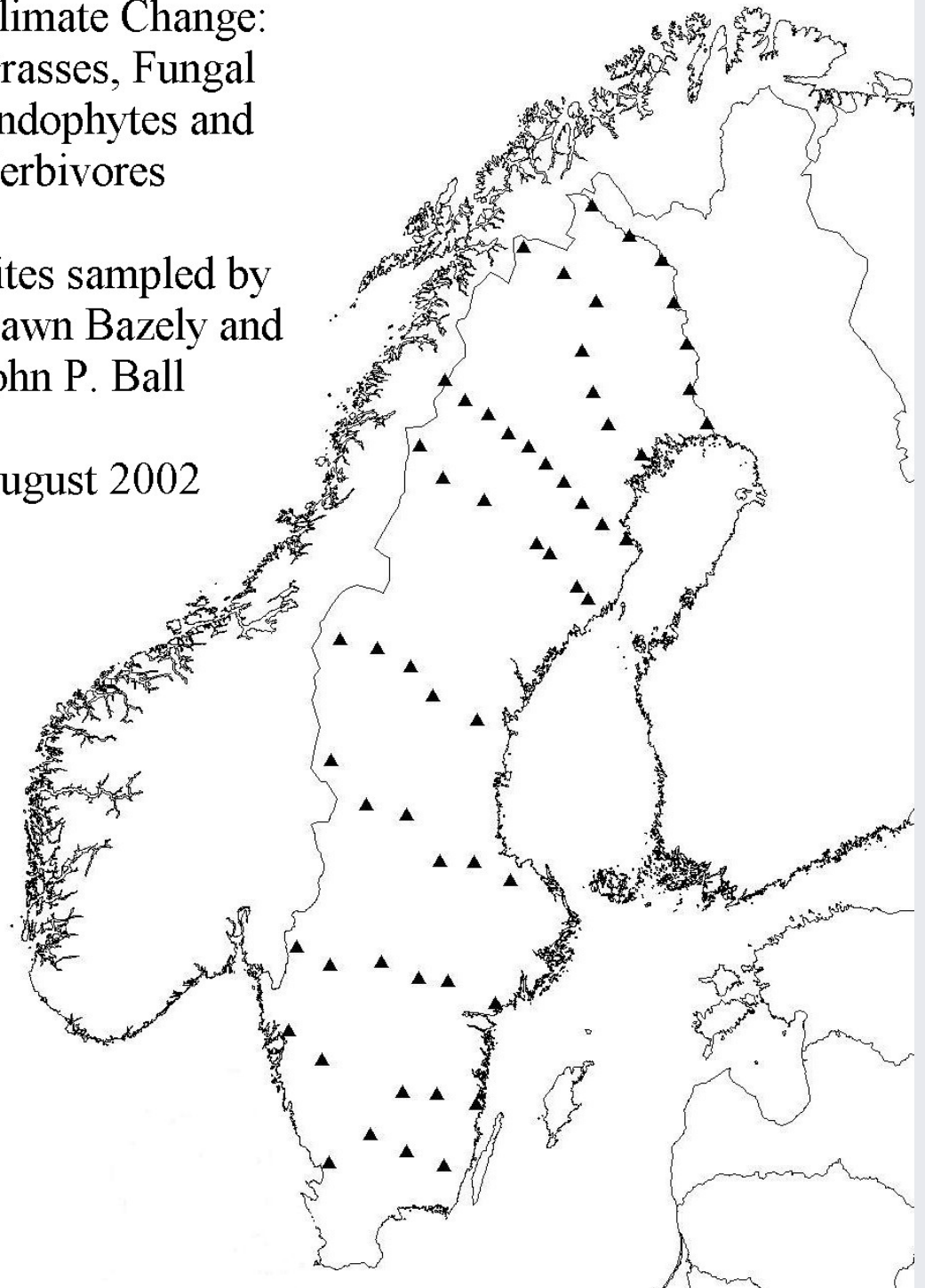
# SAMPLING AT THE COUNTRY LEVEL



Climate Change:  
Grasses, Fungal  
Endophytes and  
Herbivores

Sites sampled by  
Dawn Bazely and  
John P. Ball

August 2002



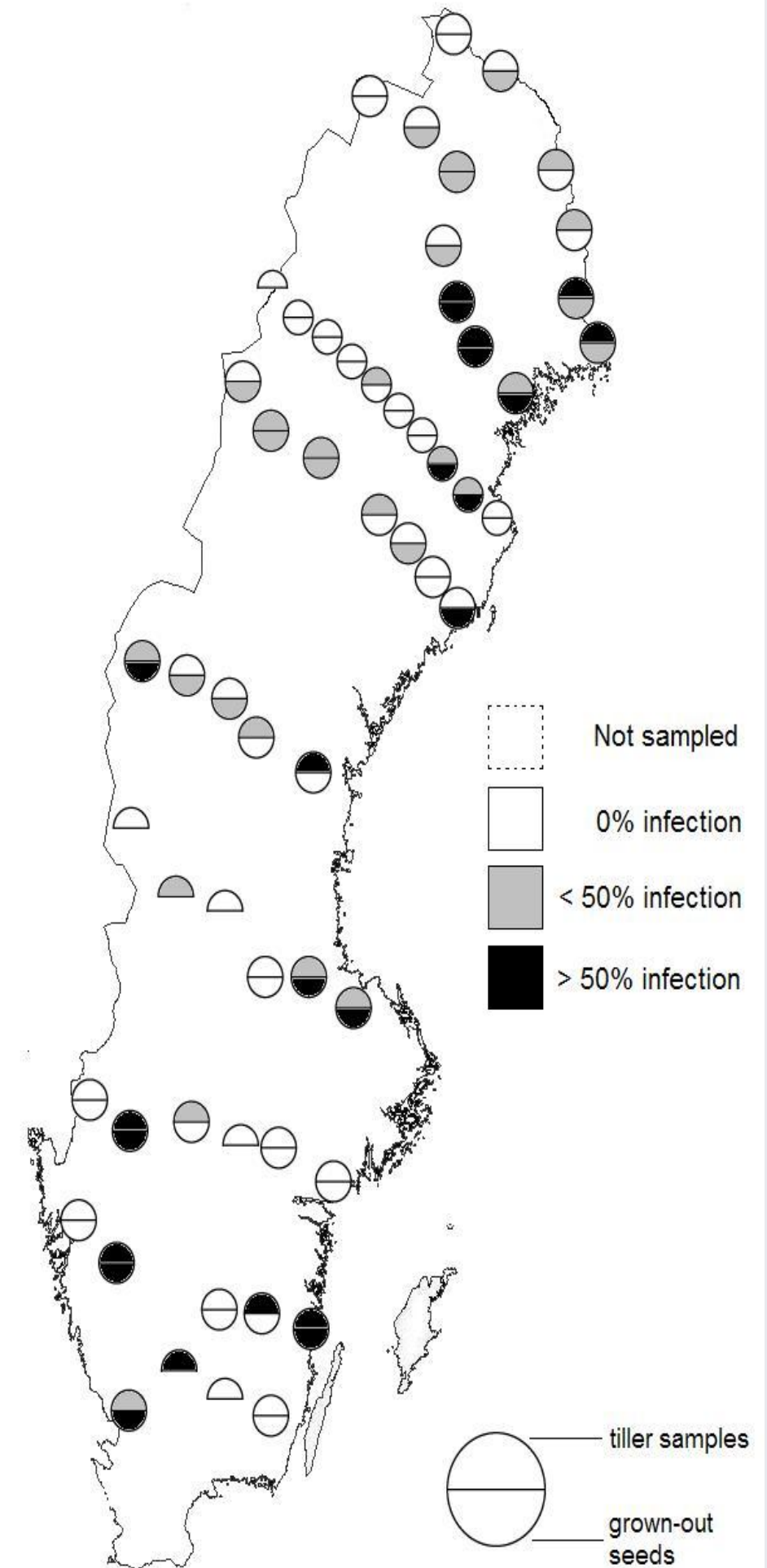




*Festuca rubra* - percentage of fungal infected plants was significantly greater at lower altitudes.

Plant tissue & seeds showed same results

$F_{1,55} = 11.4, p < 0.01, n = 250$



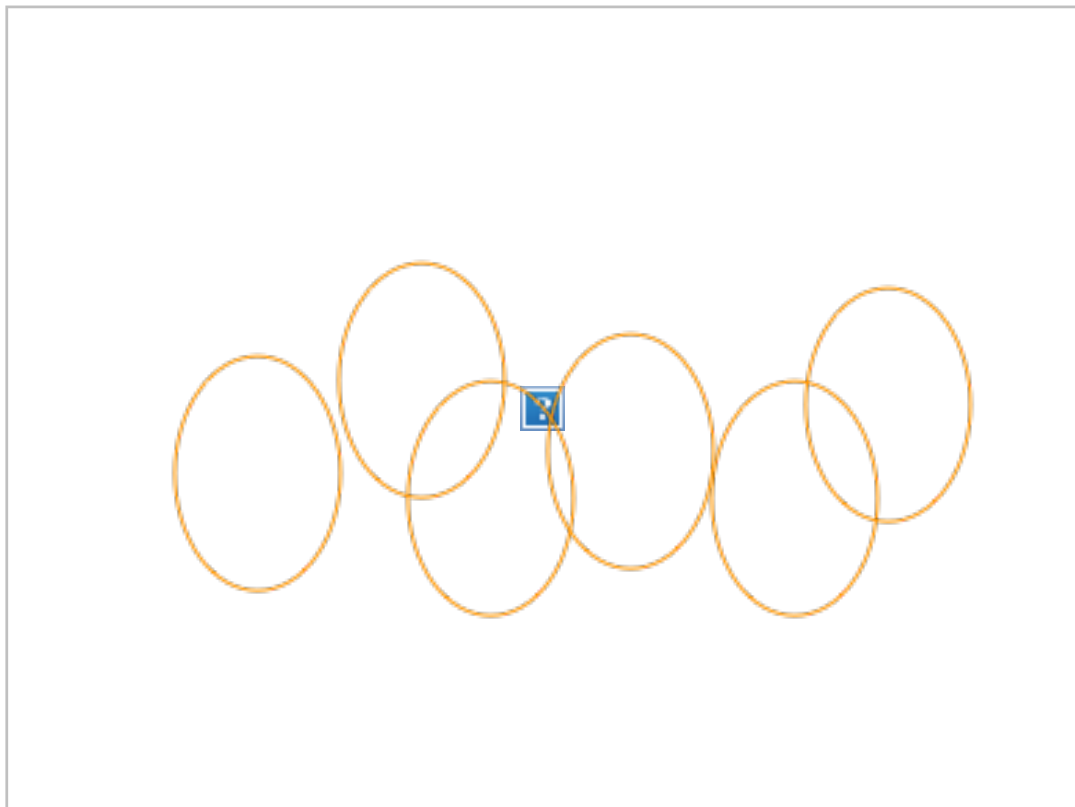


# Where to look at grasses next?



## • In Mongolia as part of an interdisciplinary team

- Dean Joni Seager - gender and women
- Prof. Gail Fraser - ornithologist
- Prof. Dawn Bazely - ecologist, grazing expert
- Korice Moir - economics of water - has lived in Arctic Canada for 2 years working for Inuit organizations
- Roberta Hawkins - gender and water - field experience in Bolivia and Mexico
- Paul Marmer - grazing and desertification - field experience in India







Dalandzadgad



Little Gobi Strictly Protected Areas A & B







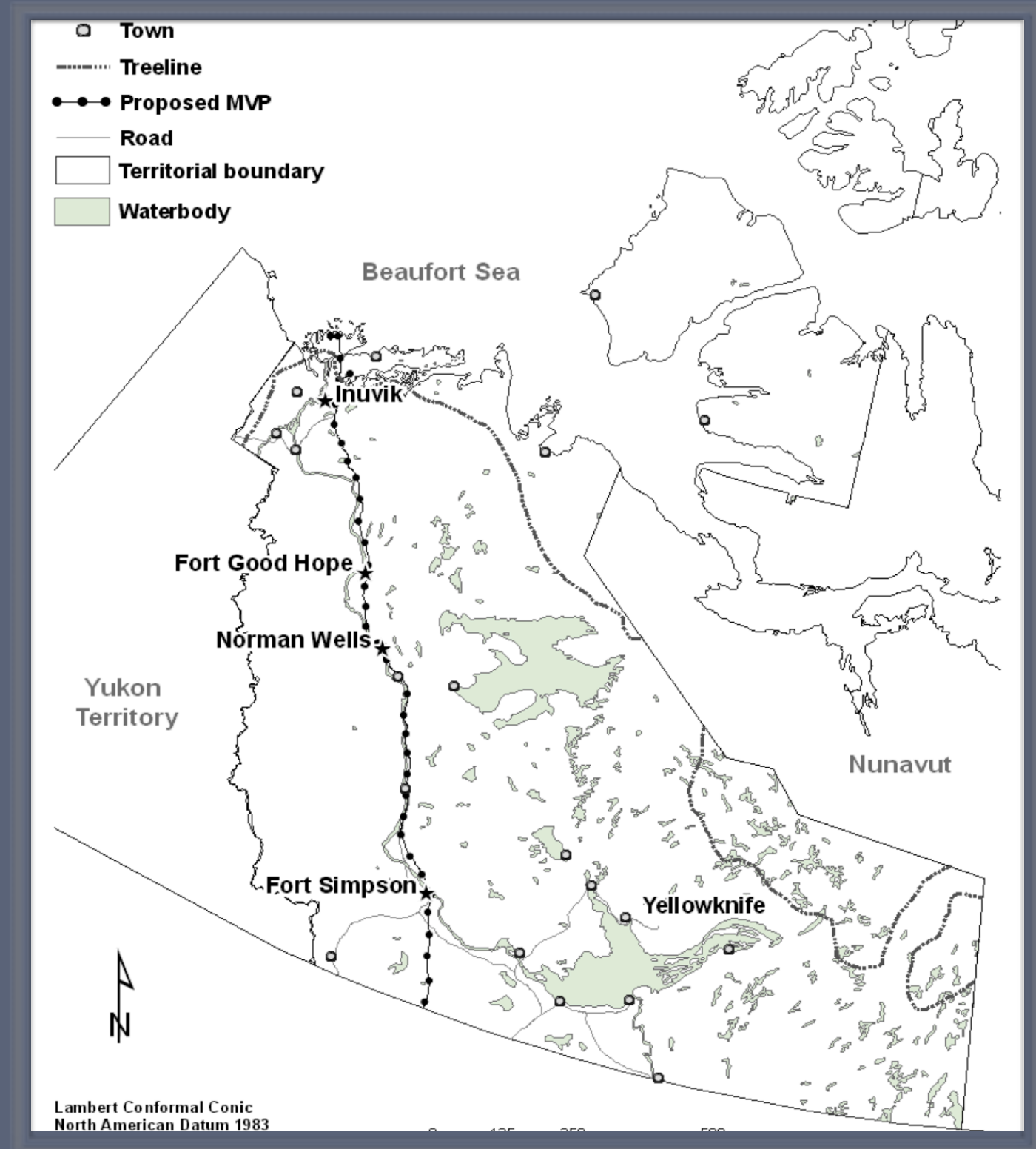






# Where next in the North?

- NWT as part of an International Polar Year project...









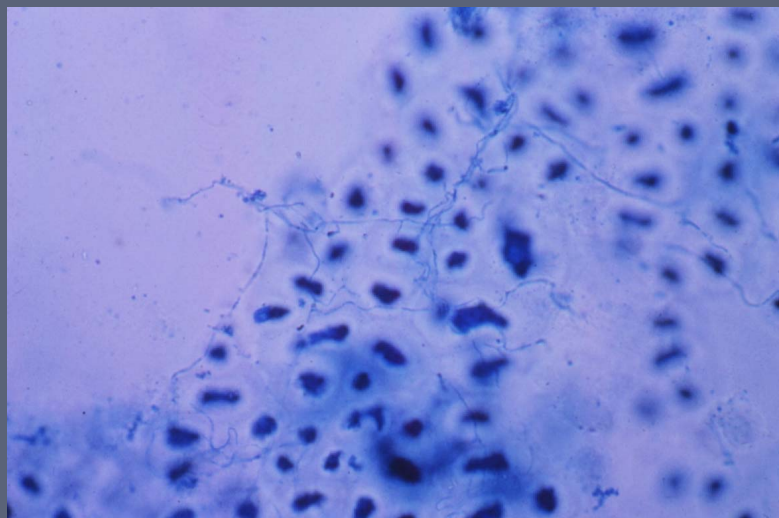
# 338 plots long roadsides in NWT



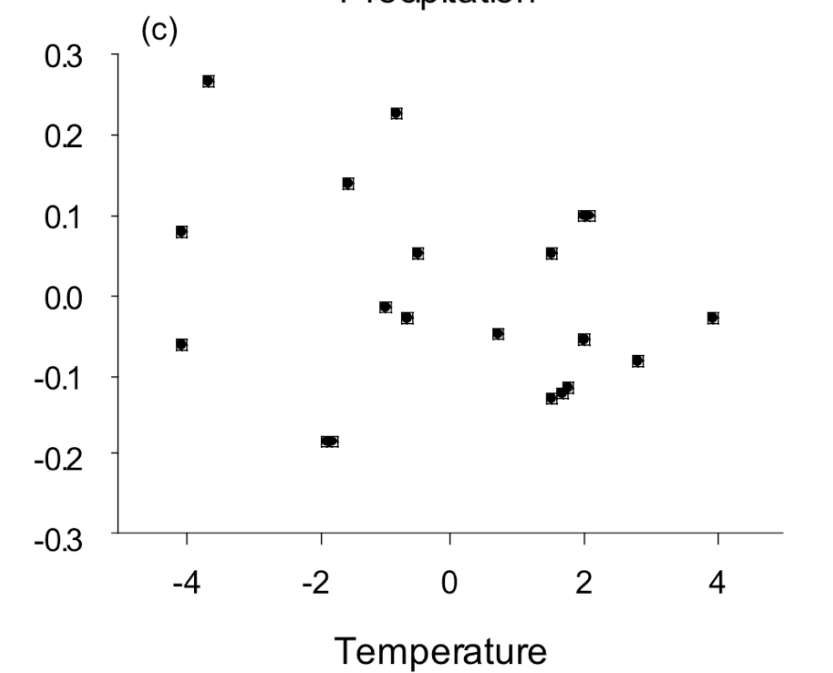
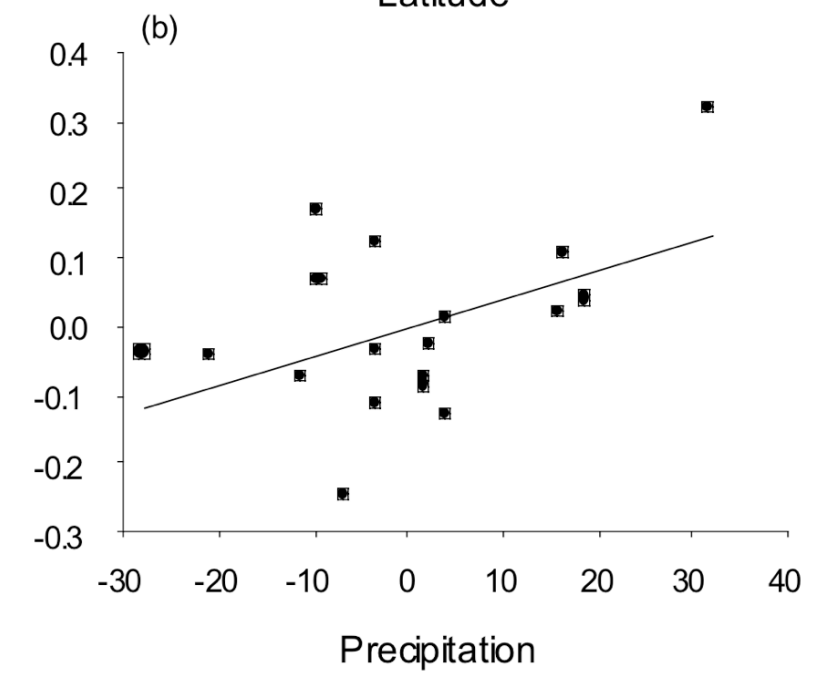
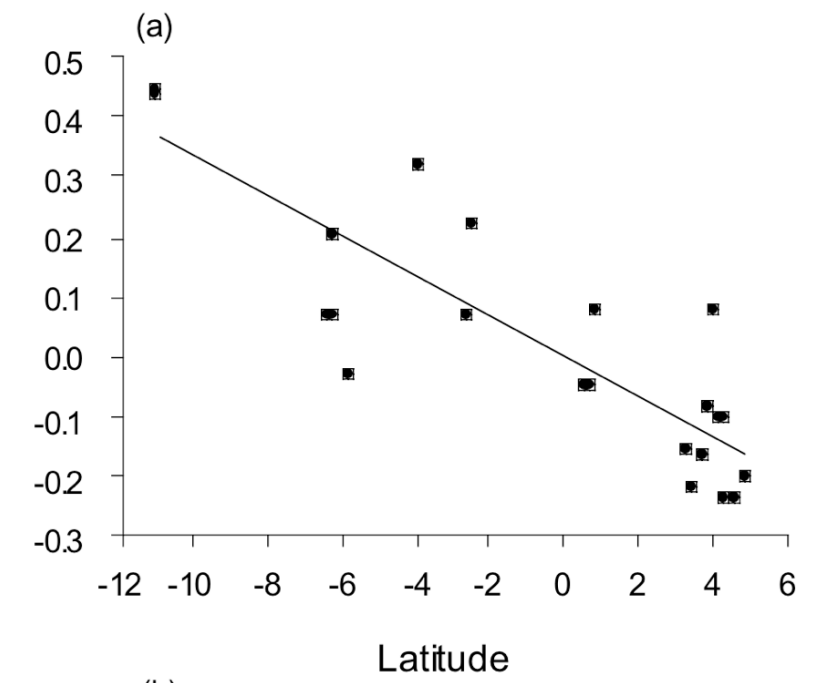


Microscopic fungal endophytes of *fescue* grasses are in NWT (apparently through introduced varieties)

The fungus is never seen outside the grass









# JEFFERIES' COLLECTION IN THE CHURCHILL COMMUNITY OF KNOWLEDGE - DIGITAL ARCHIVE

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http://pi.library.yorku.ca/dspace/

RSS

Yorkspace

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Canadian Soldiers



Introduction to "Political ecologies of urban waterfront transformations"



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