

Compensatory responses and multiple states of being: how La Perouse Bay influenced my understanding of ecological interactions in extreme environments



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Bob Jefferies Conference, CNSC, August 2011

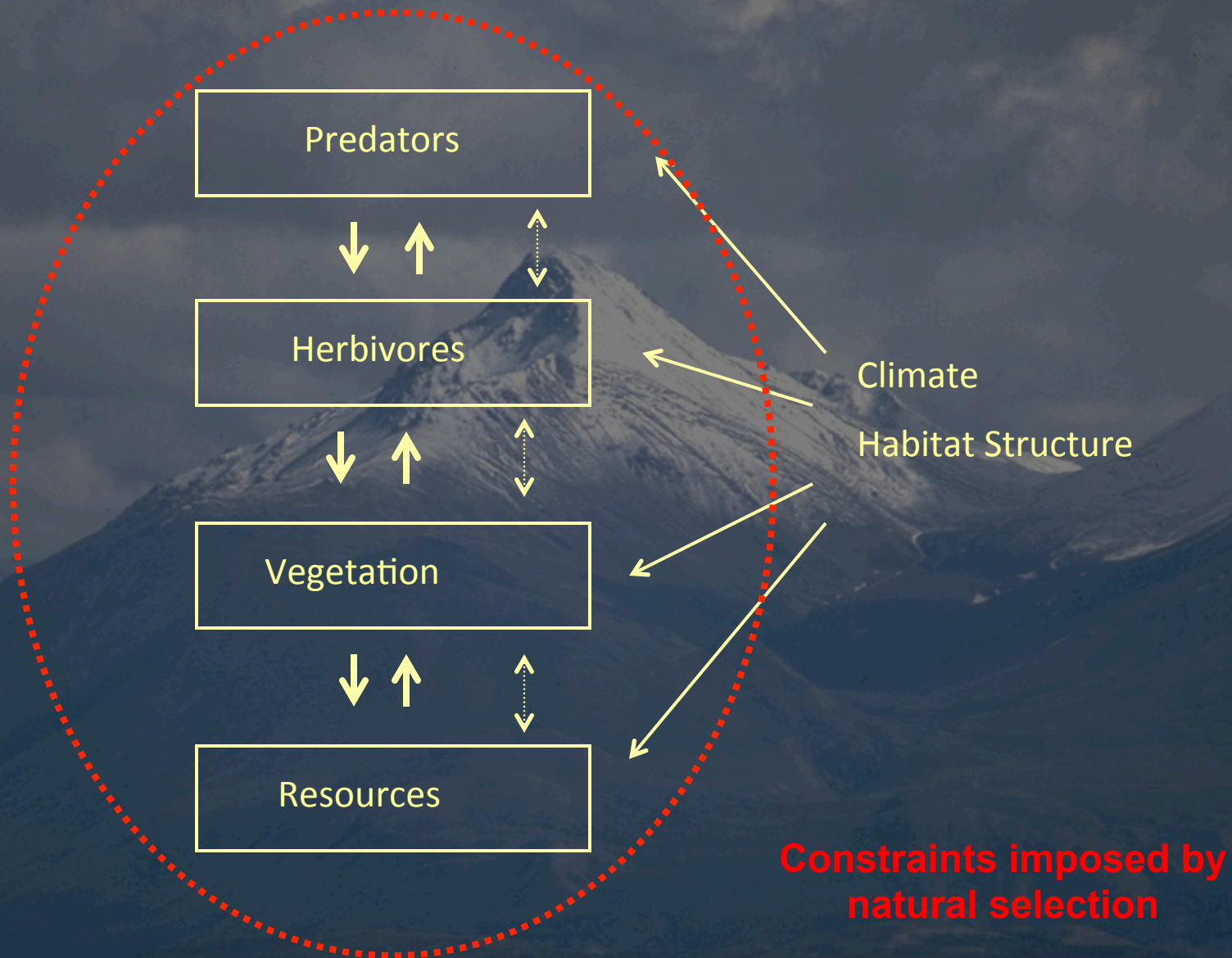
“mechanisms that sustain and drive feedback processes and sudden shifts that occur in ecological systems”







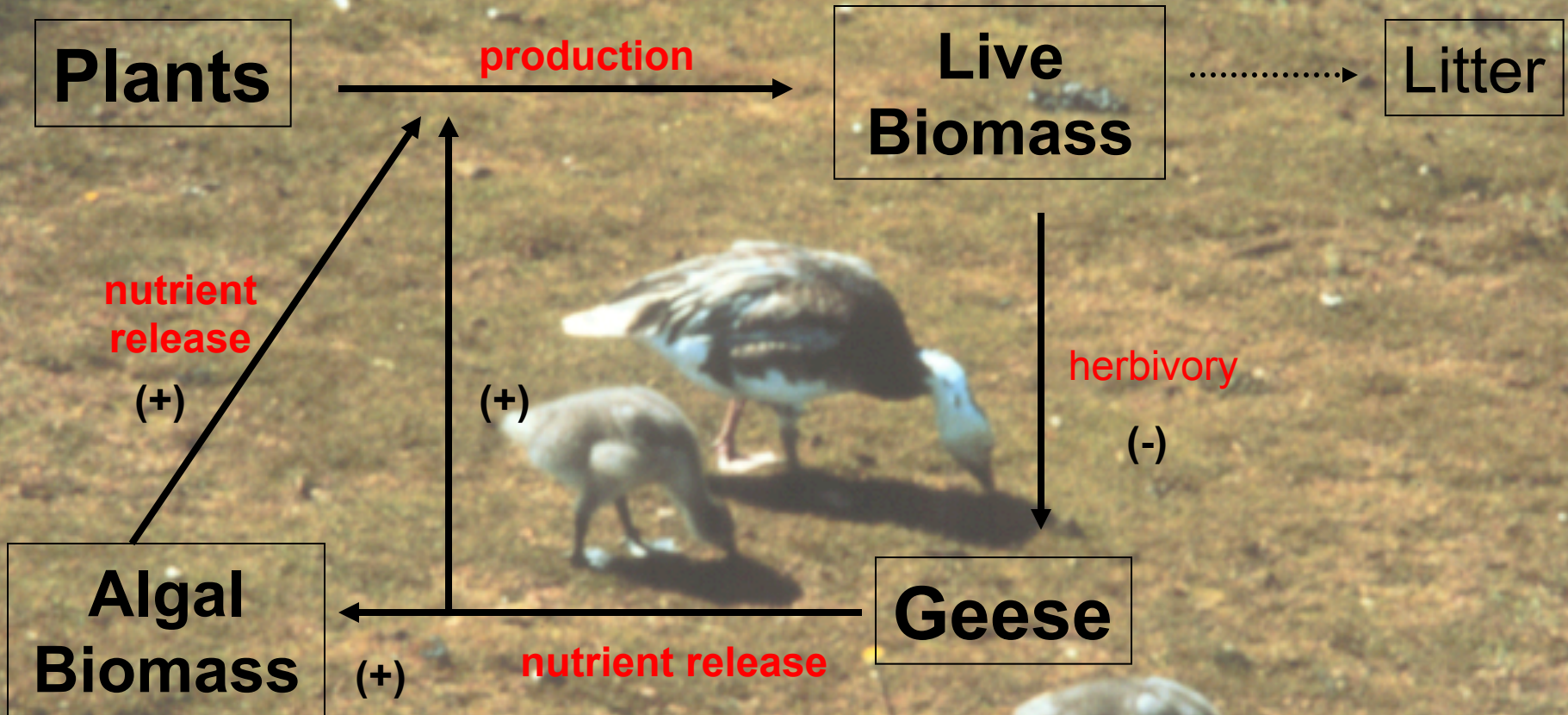




La Perouse Bay



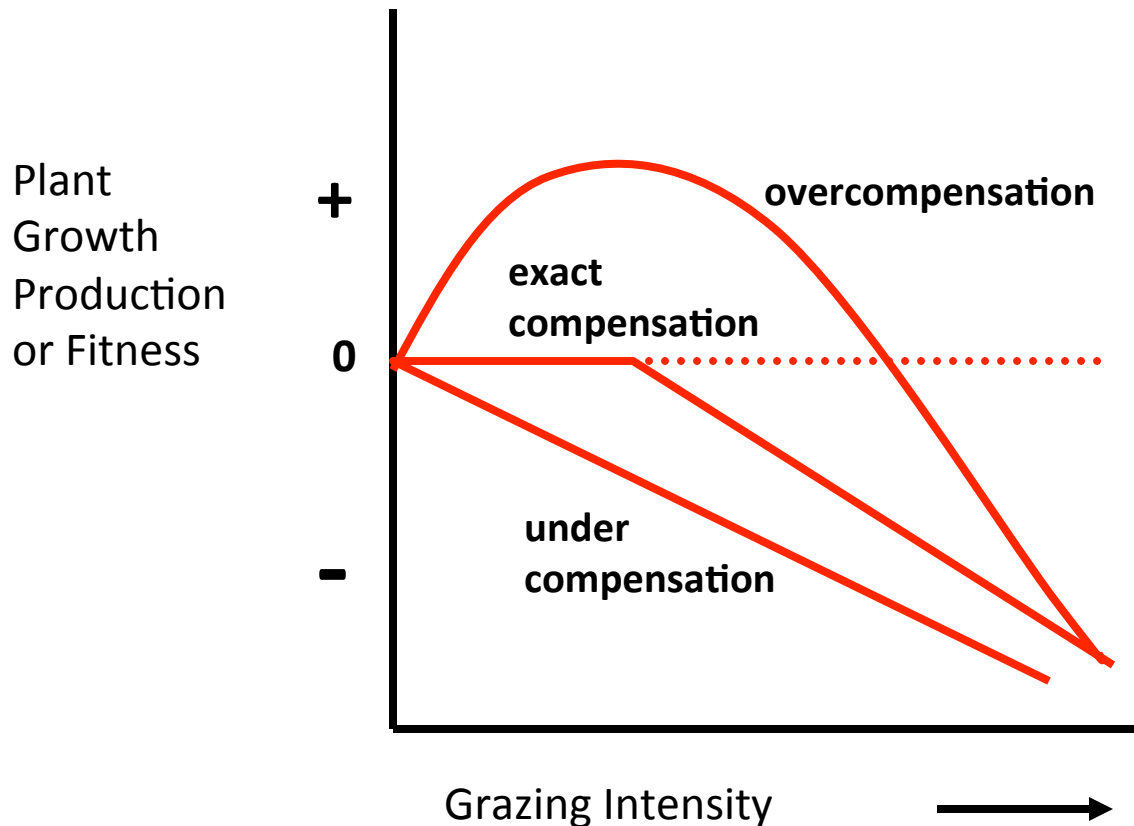
Positive Feedback Model

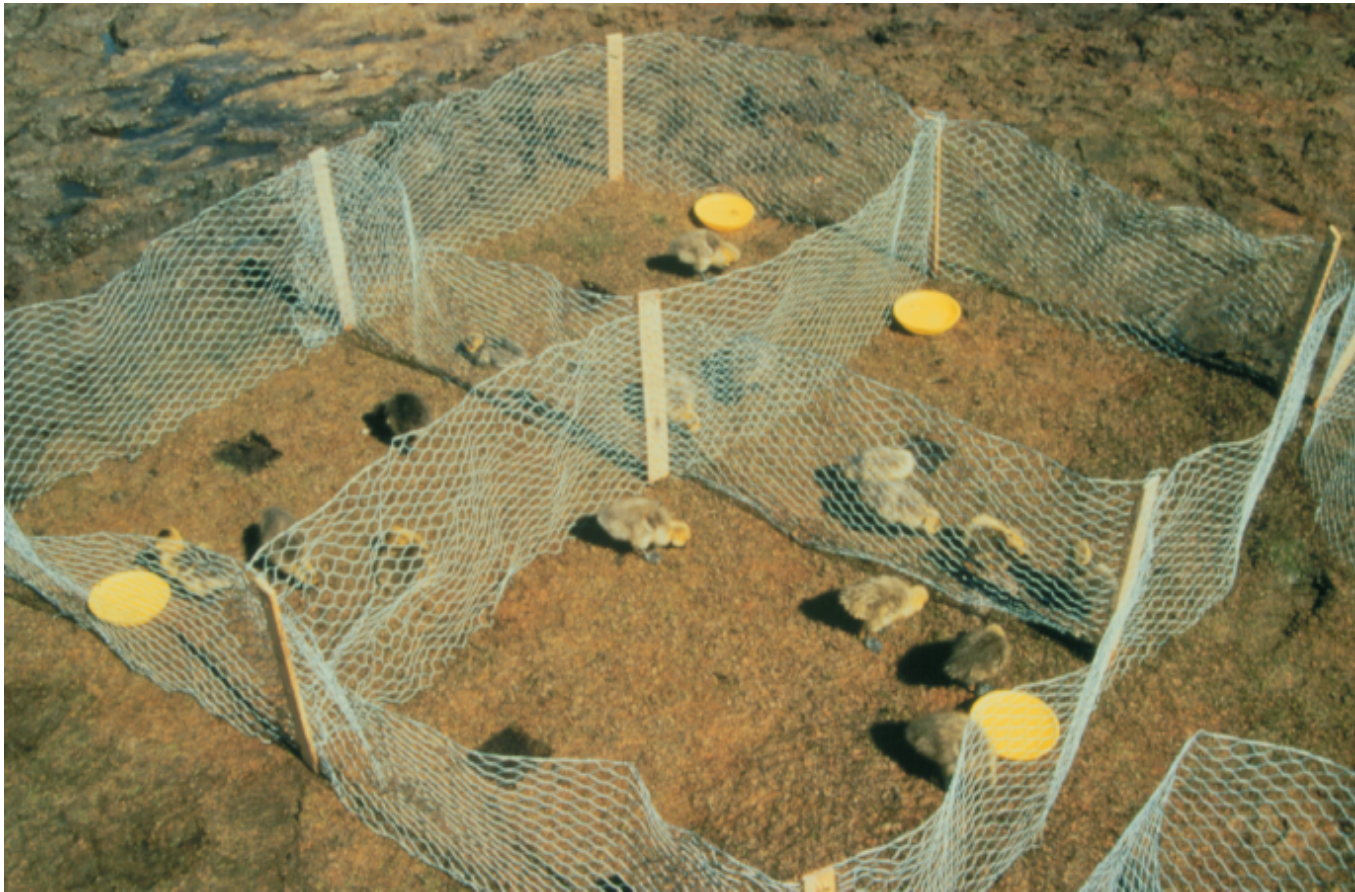




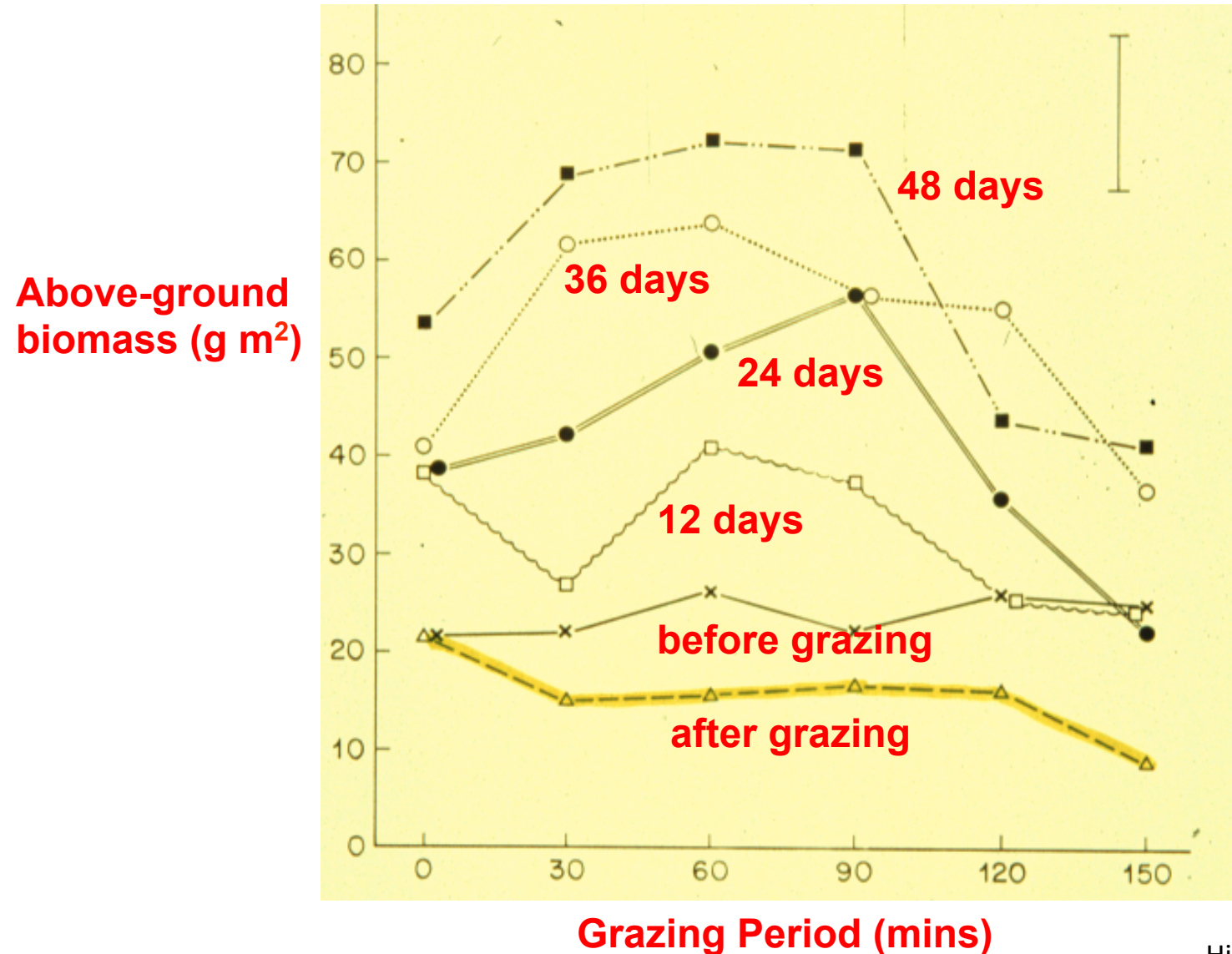
Positive Feedback Model

(Herbivore Optimization Hypothesis)

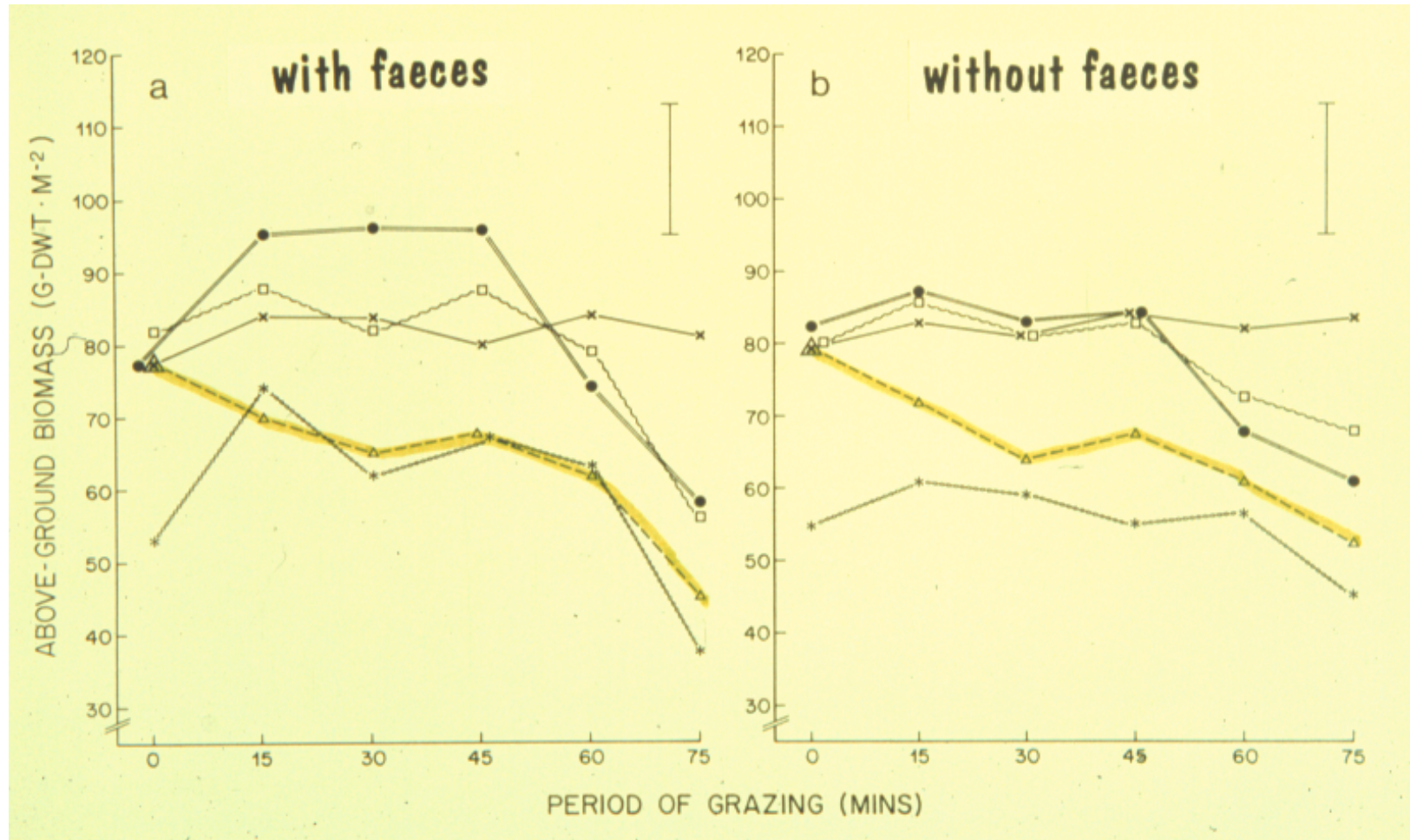




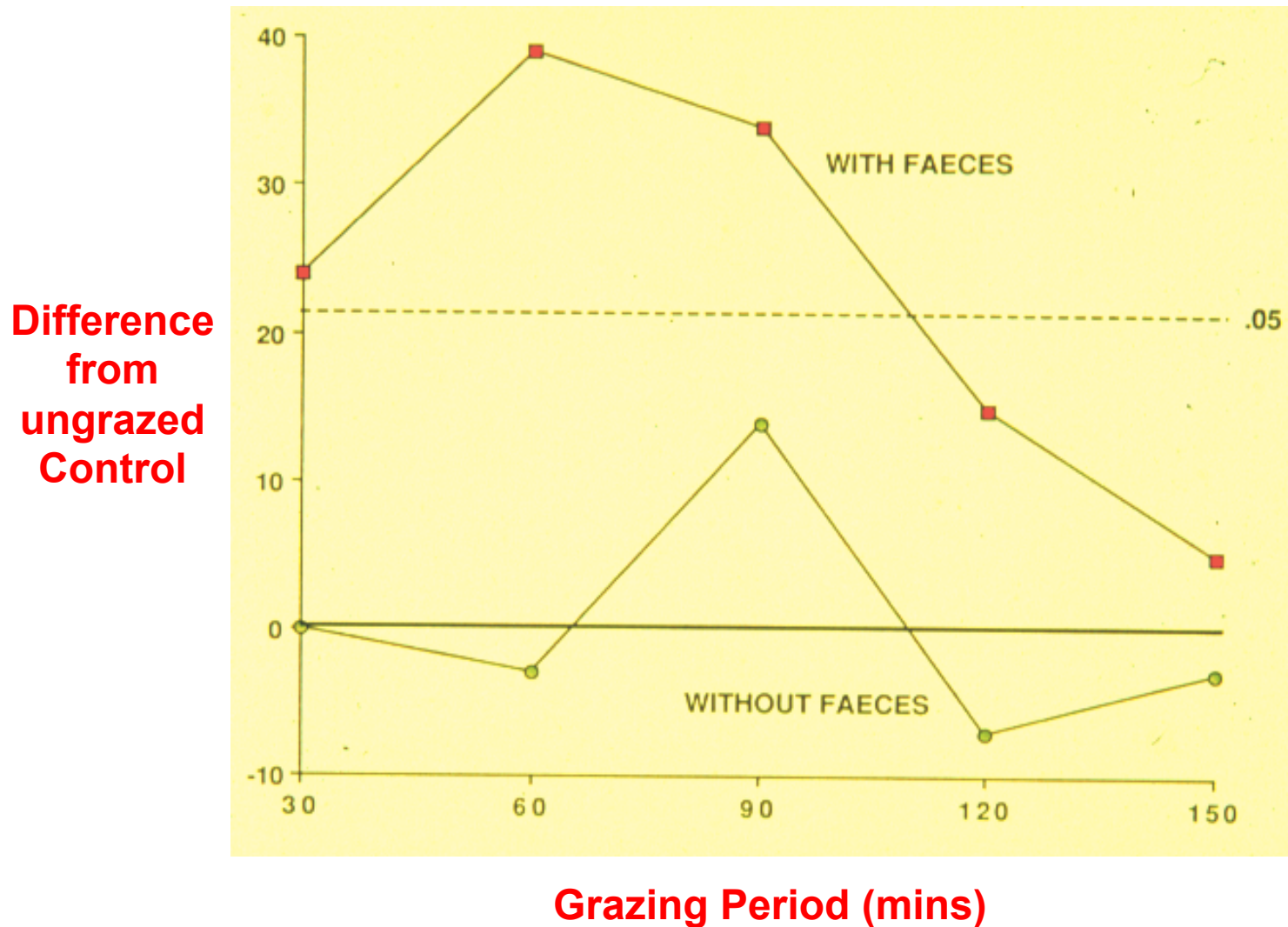
Response of *Puccinellia* to Grazing Intensity



BUT, this response is critically dependent on rapid nutrient recycling



'Faeces effect' as a difference from ungrazed control



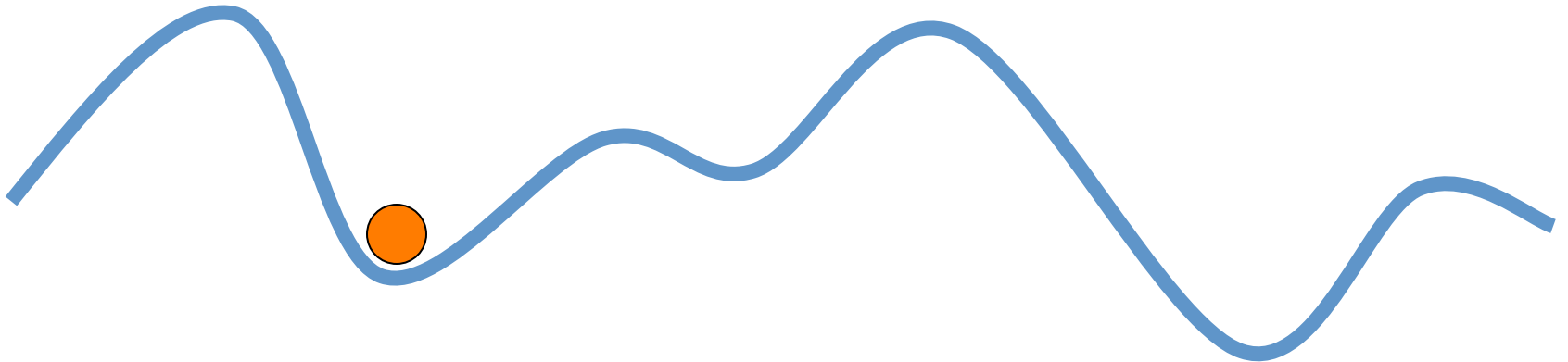




Continuum or Multi-state?



Continuum



Multiple States

Continuum

Continuous variation along disturbance gradient

Changes in composition are reversible

Current grazing pressure maintains vegetation composition

Multiple States

States +/- discrete; changes often event driven and rapid

Changes not always reversible by removing cause of change

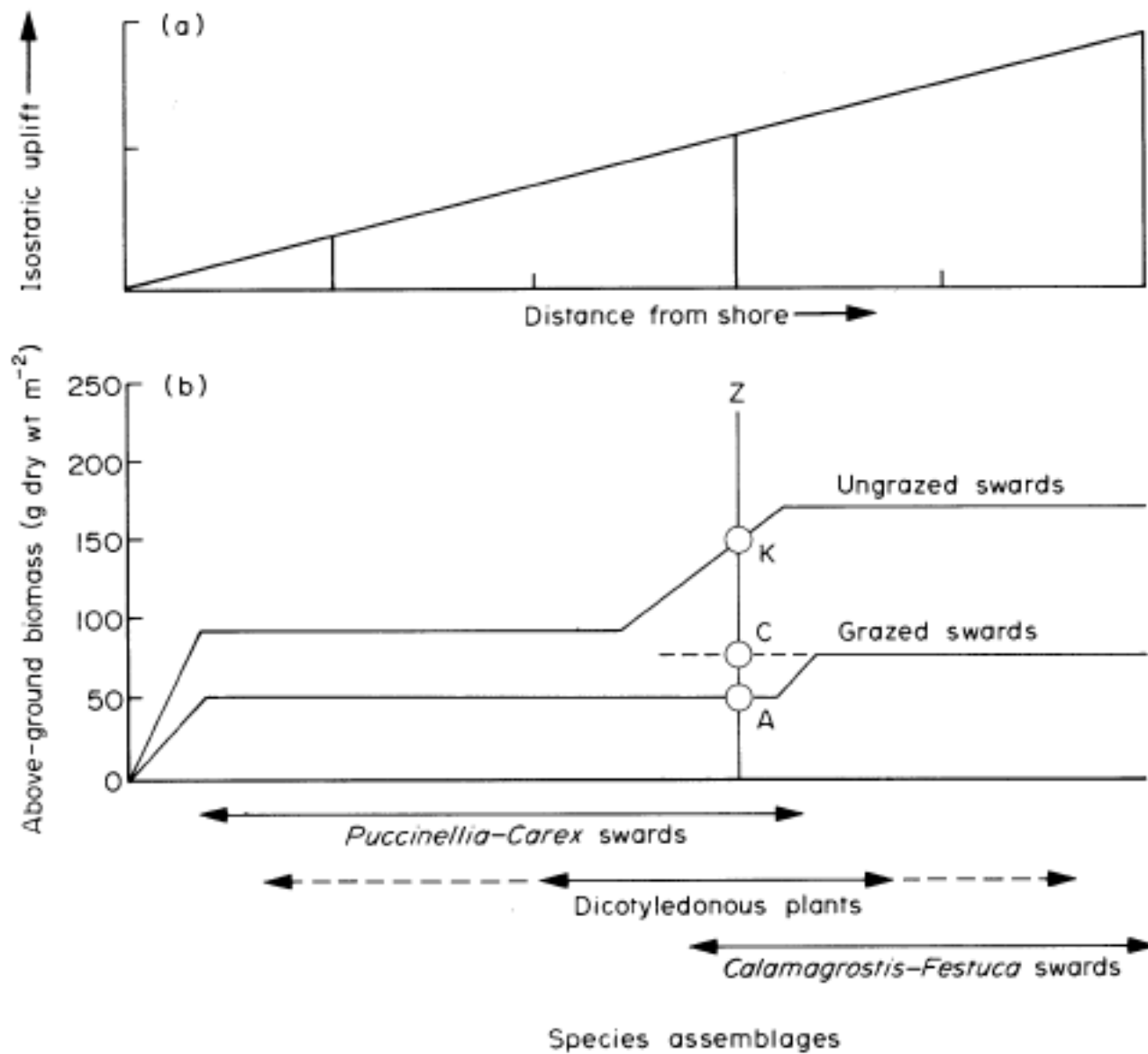
Historic effects can limit potential future changes

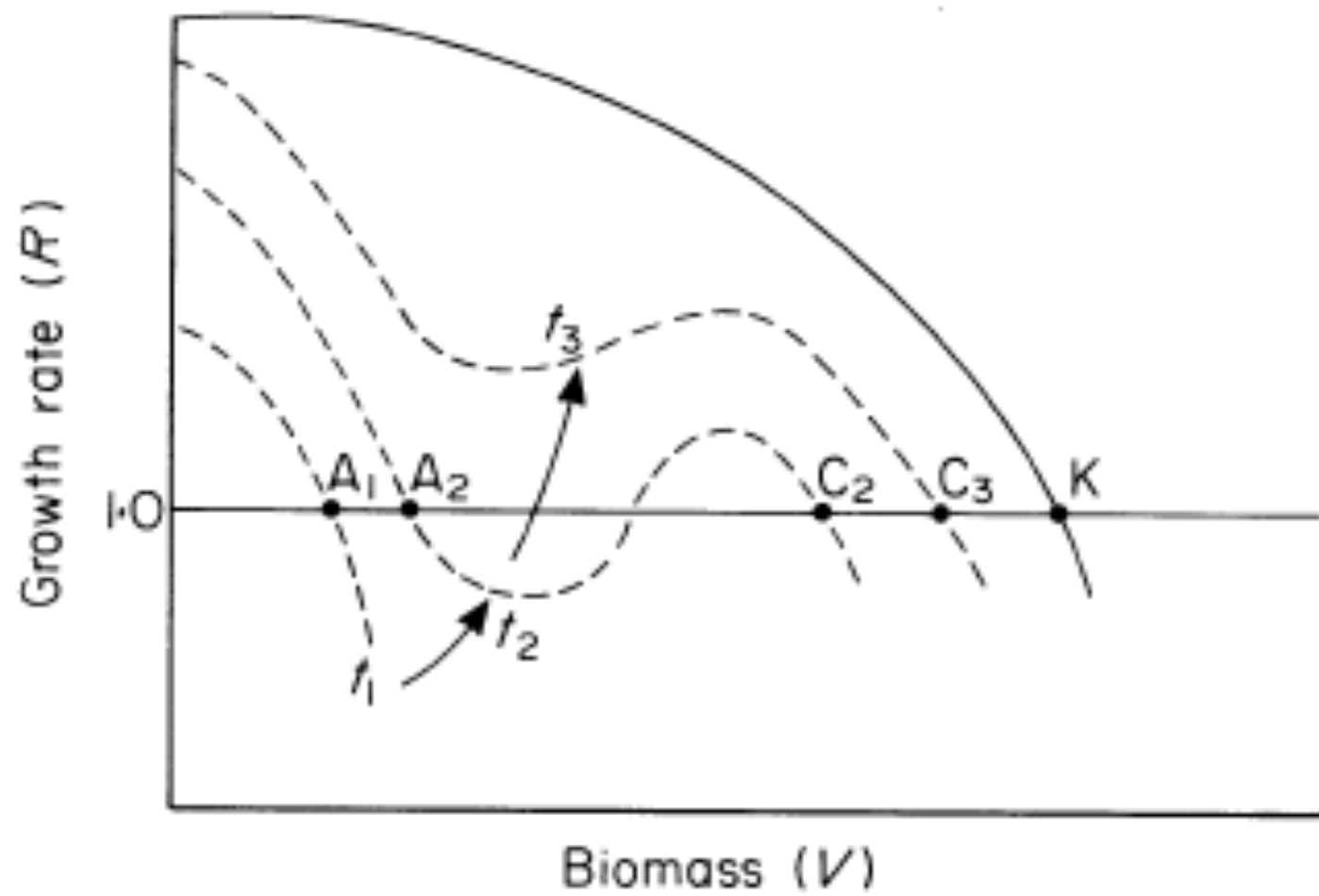
Two states in East Africa – with and without elephants

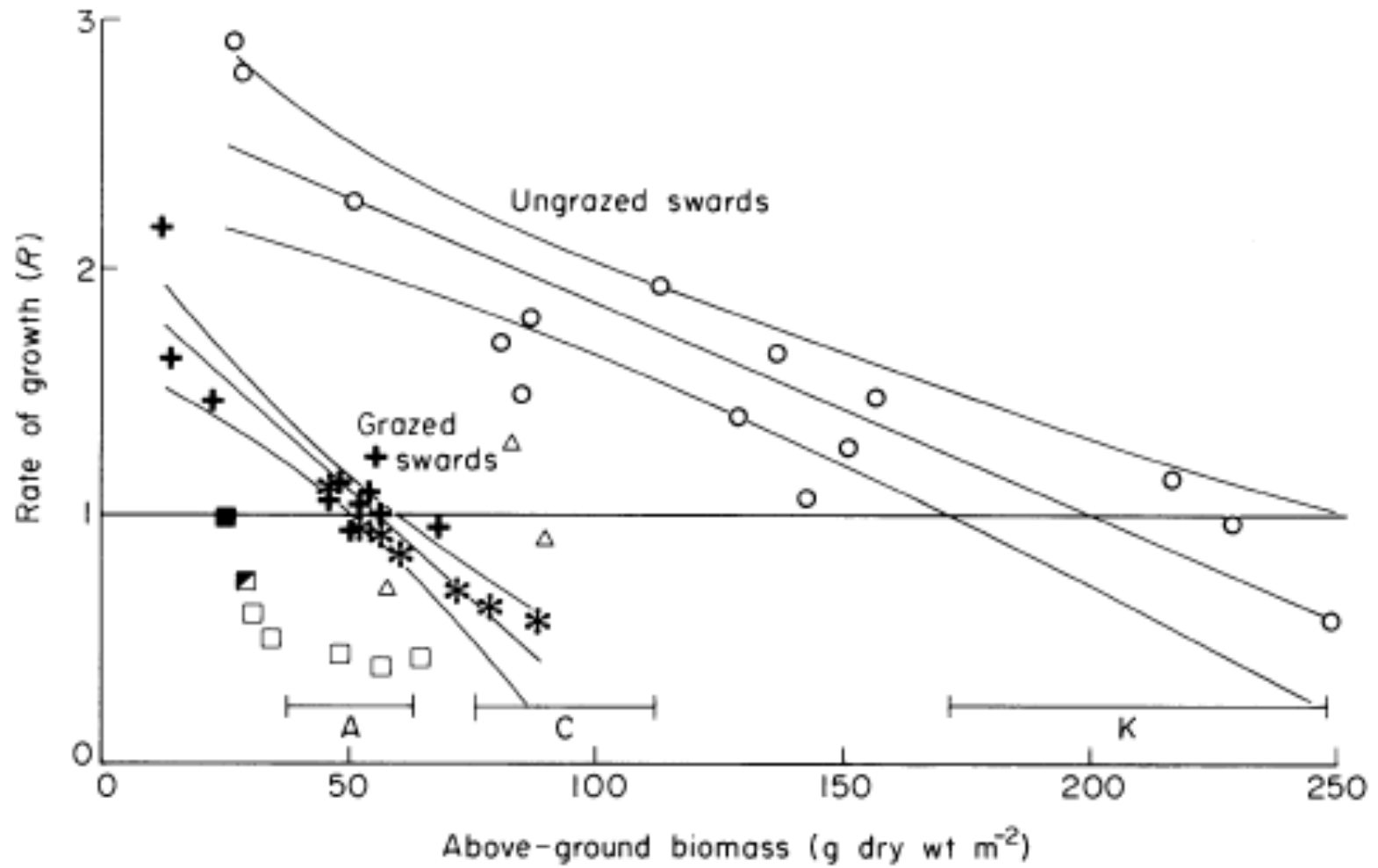


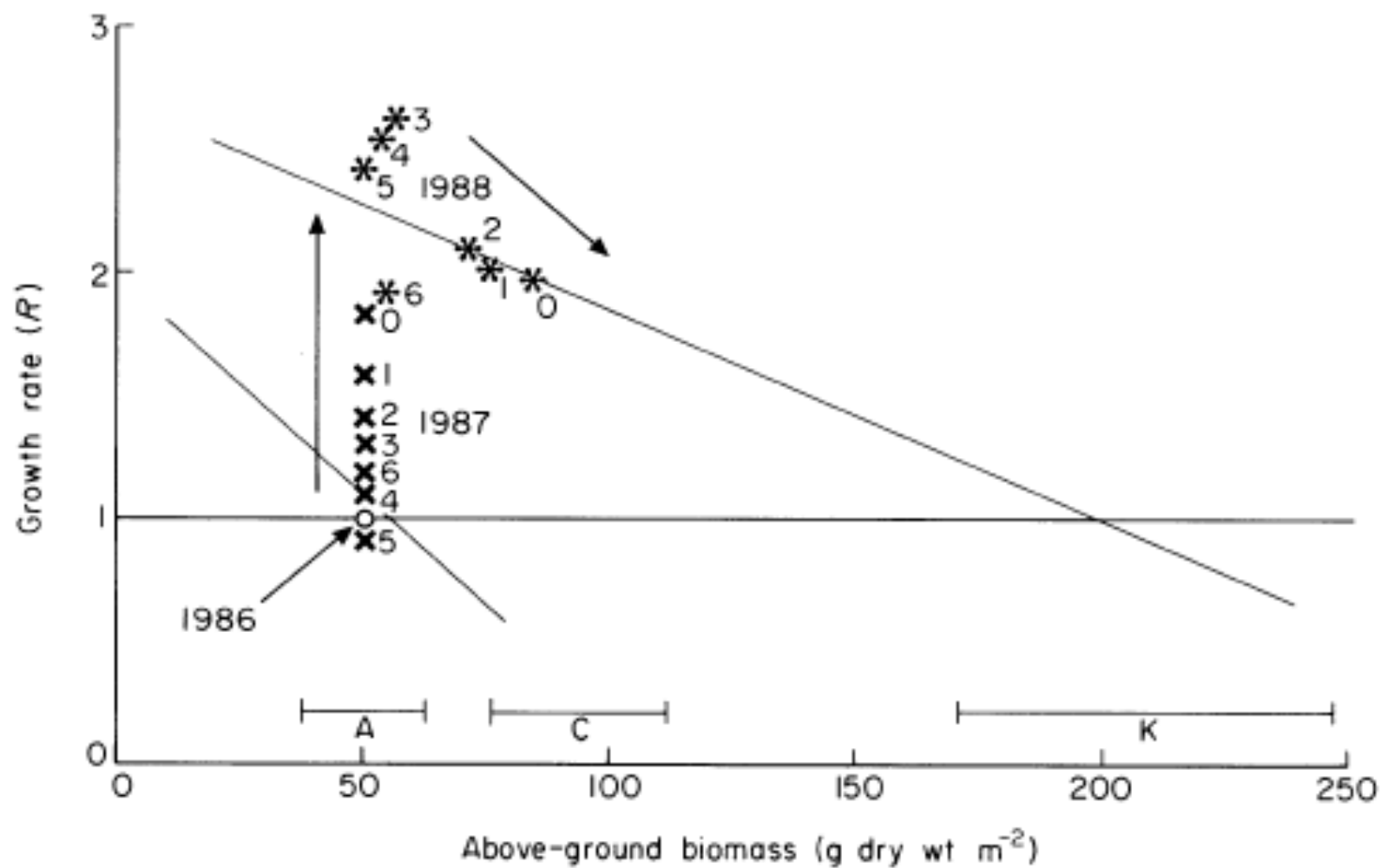
Snow Geese?



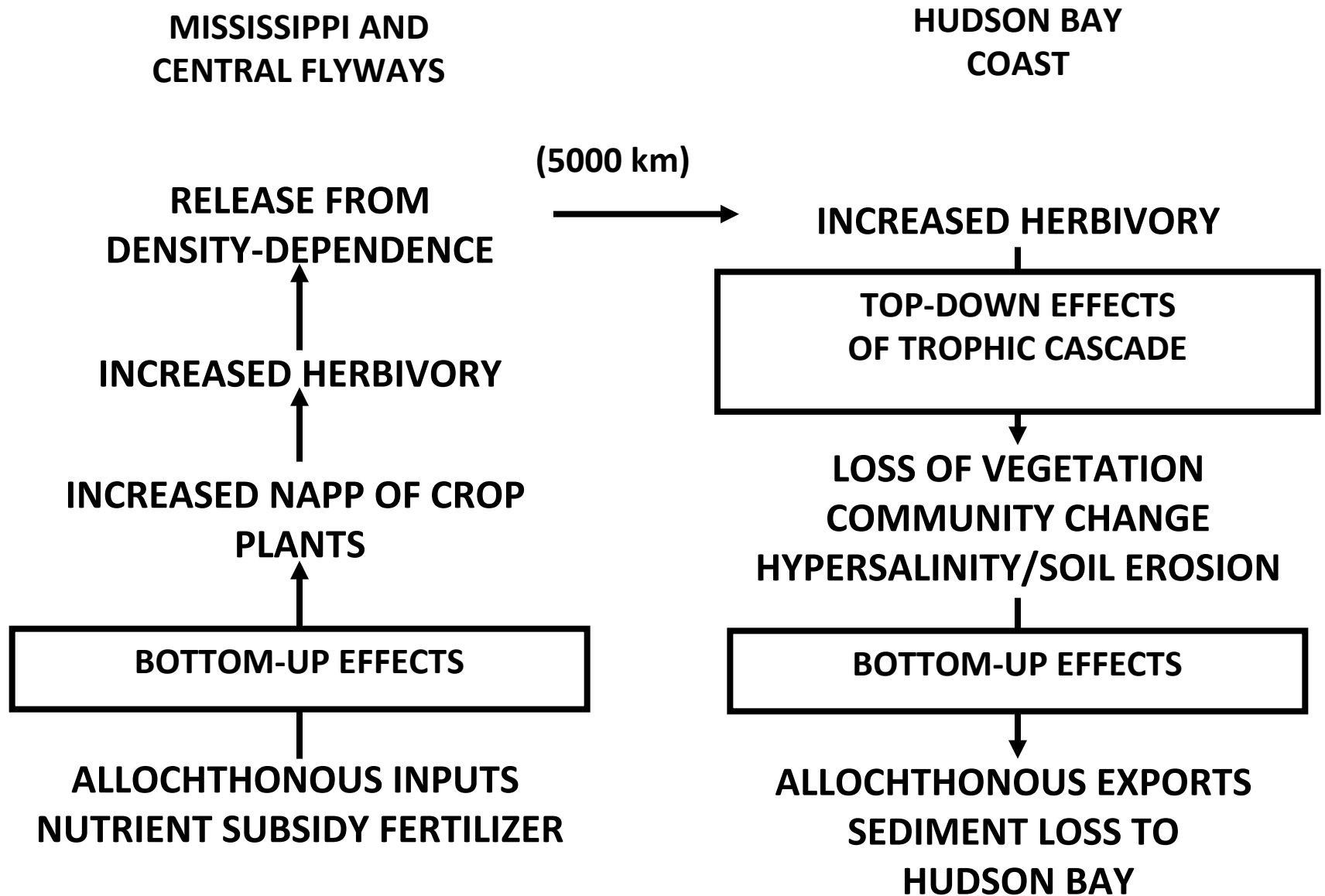








Summary

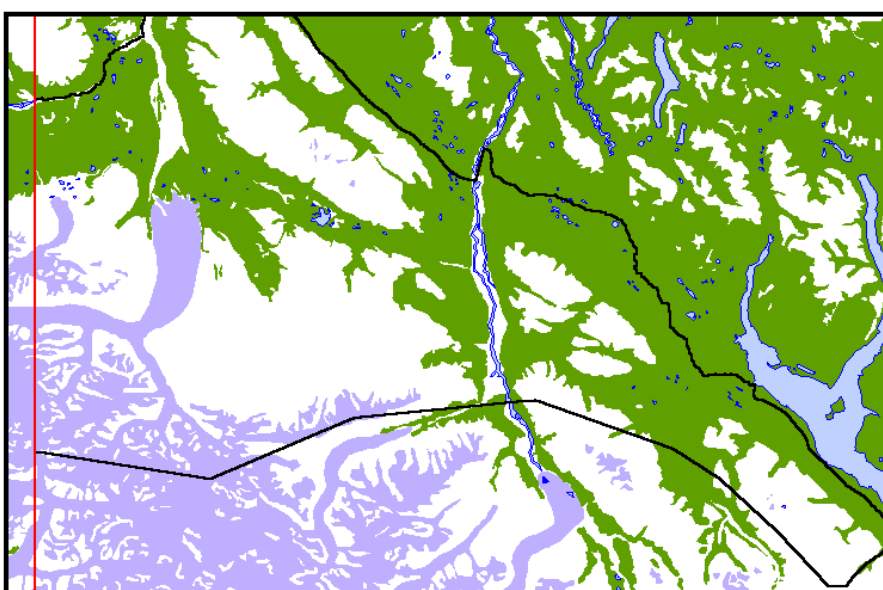




1961-2011

Kluane Lake Research Station



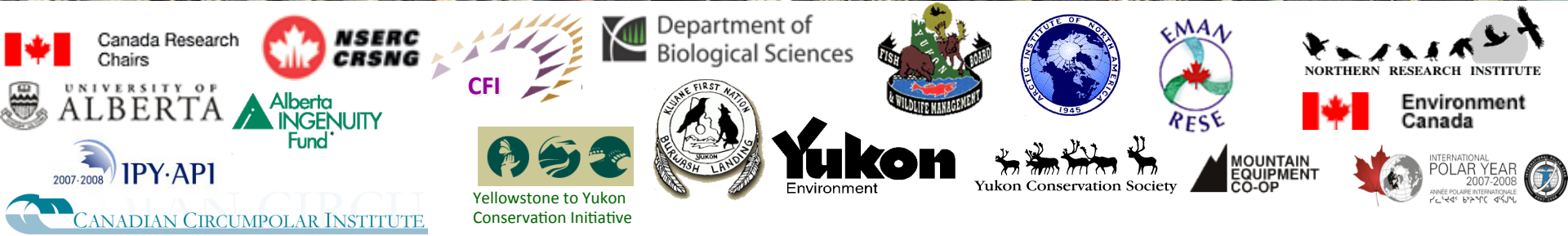


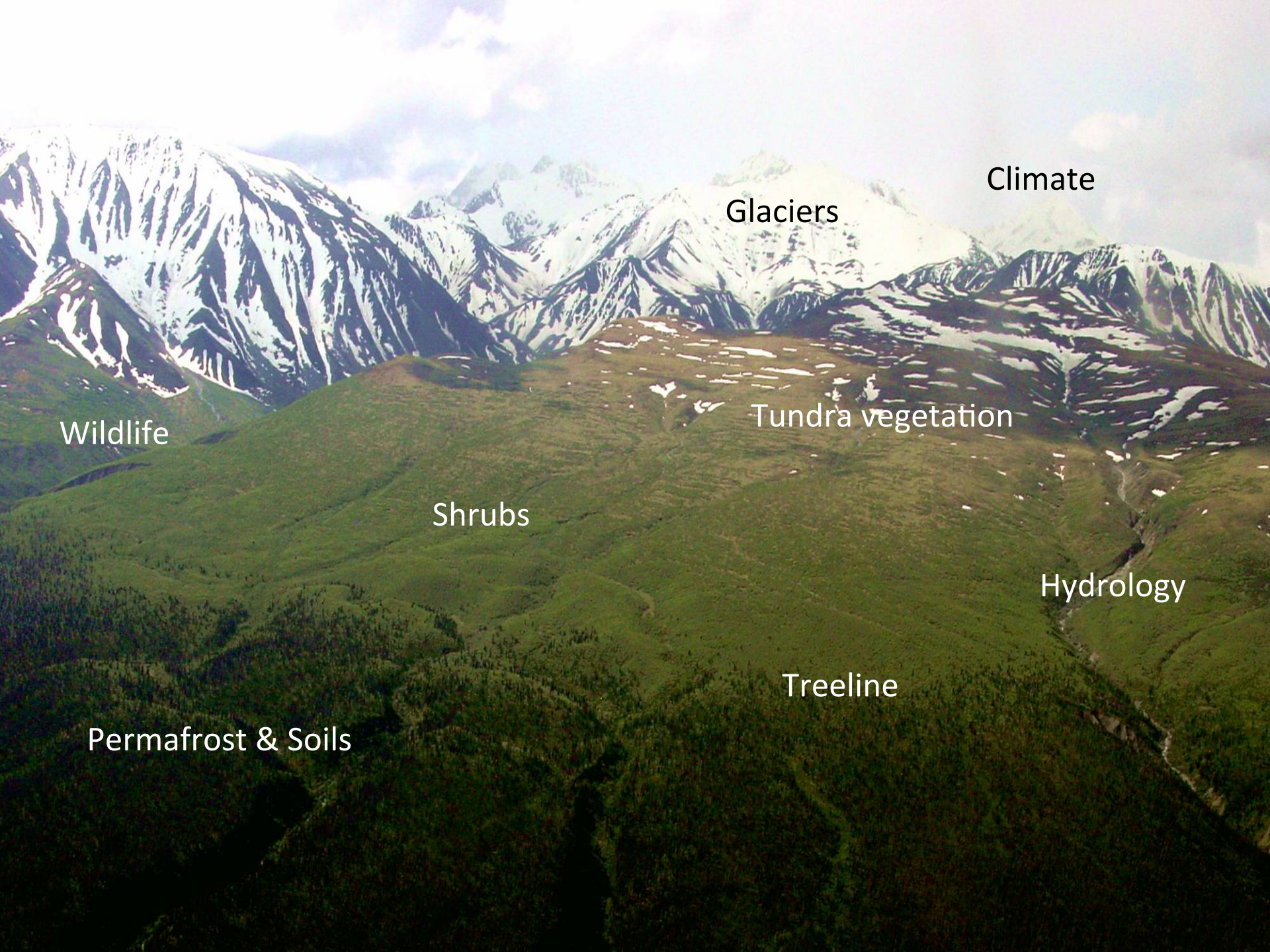












Climate

Glaciers

Wildlife

Tundra vegetation

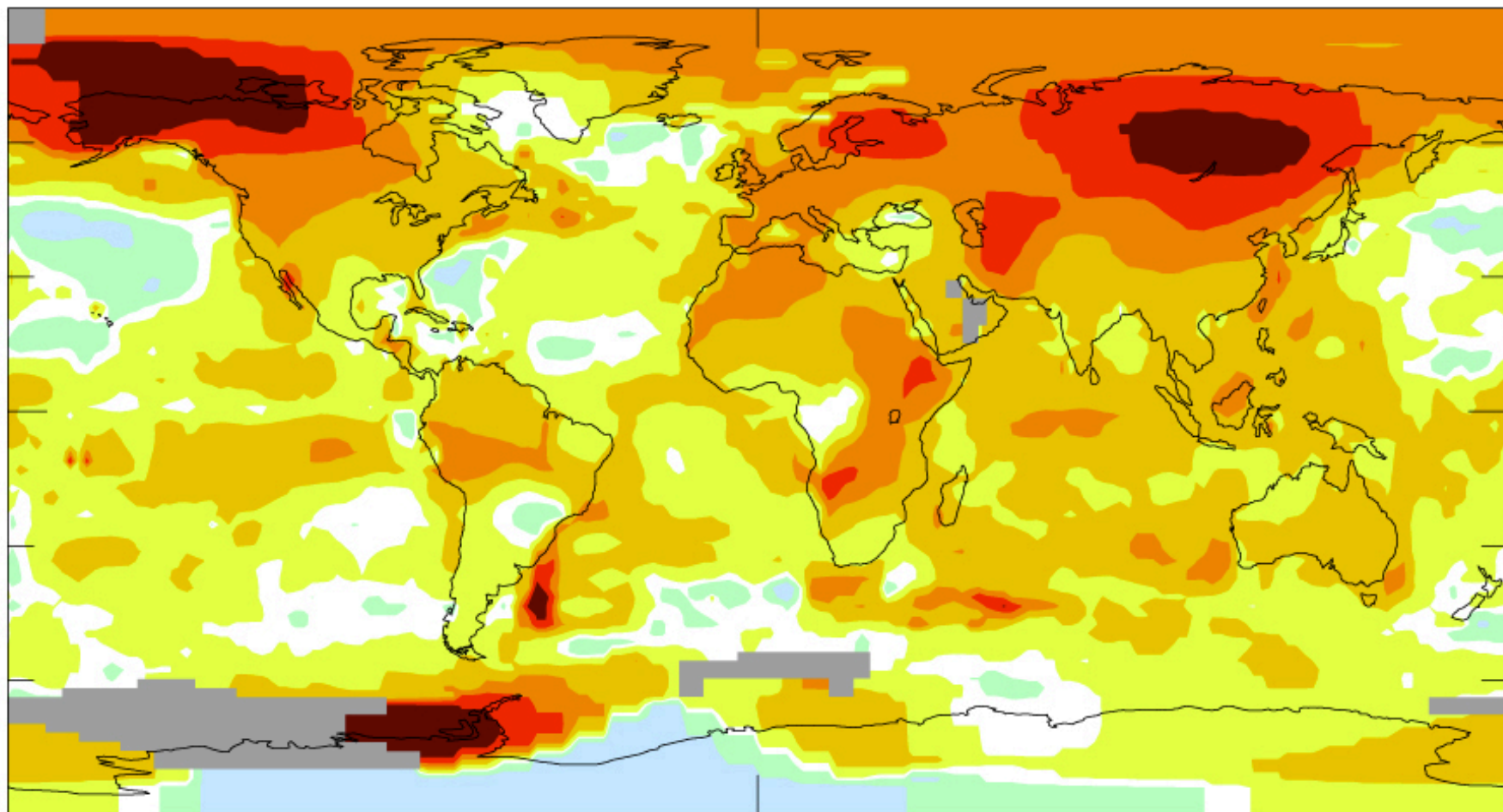
Shrubs

Hydrology

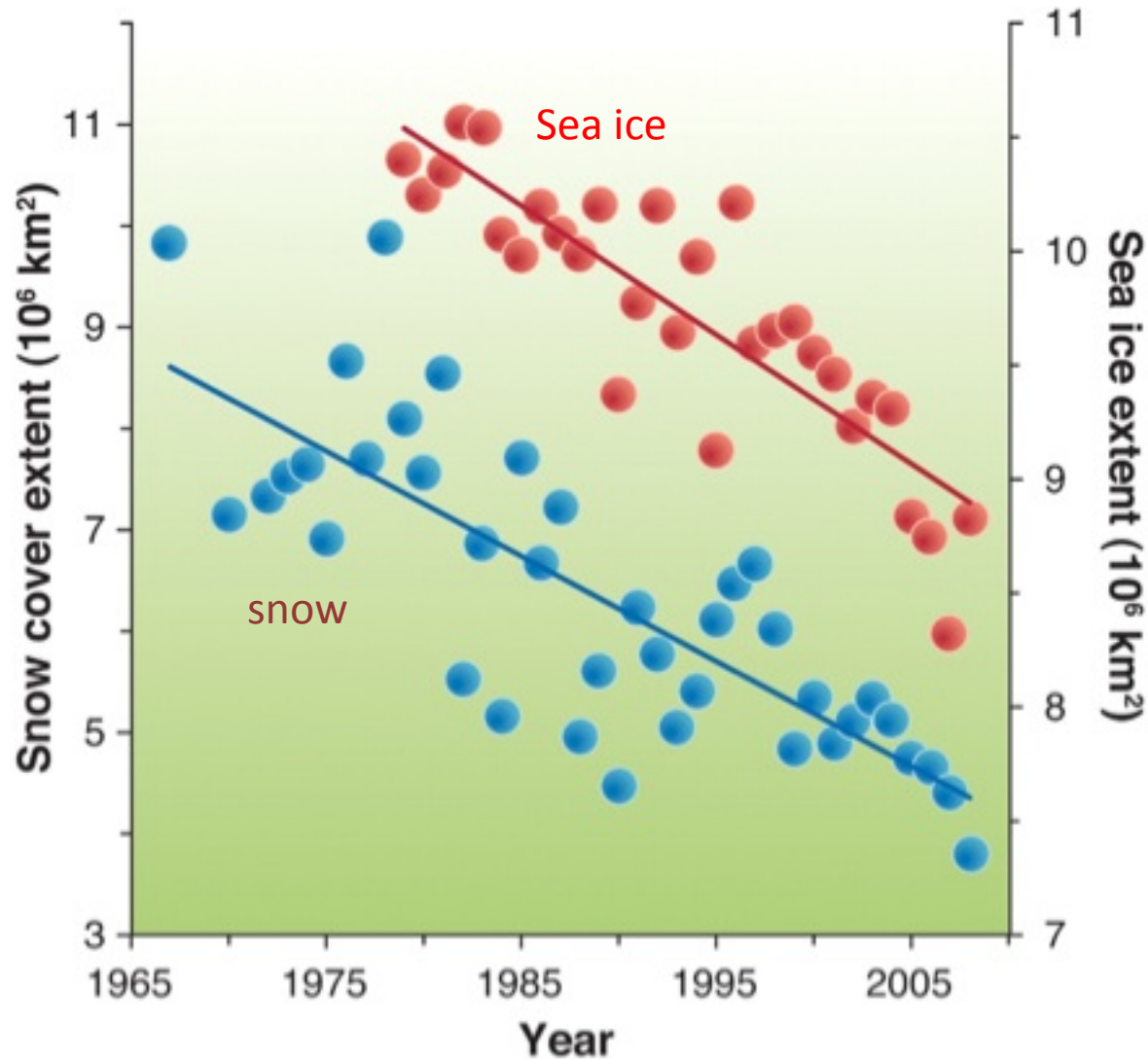
Treeline

Permafrost & Soils

Observed warming 1950-2000



The extent of Arctic Ocean sea ice and terrestrial snow cover are declining



Effects of climate change

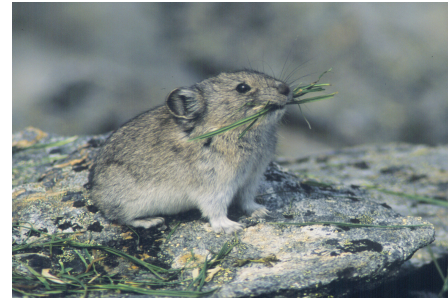
temperature, precipitation, phenology



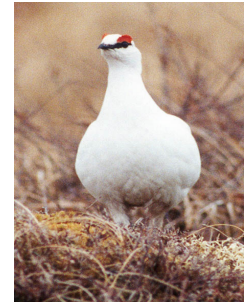
Composition and
production of
vegetation



Ecotones
("tree-line" &
"shrub-line")



Survival,
reproduction,
behaviour



Distribution



??

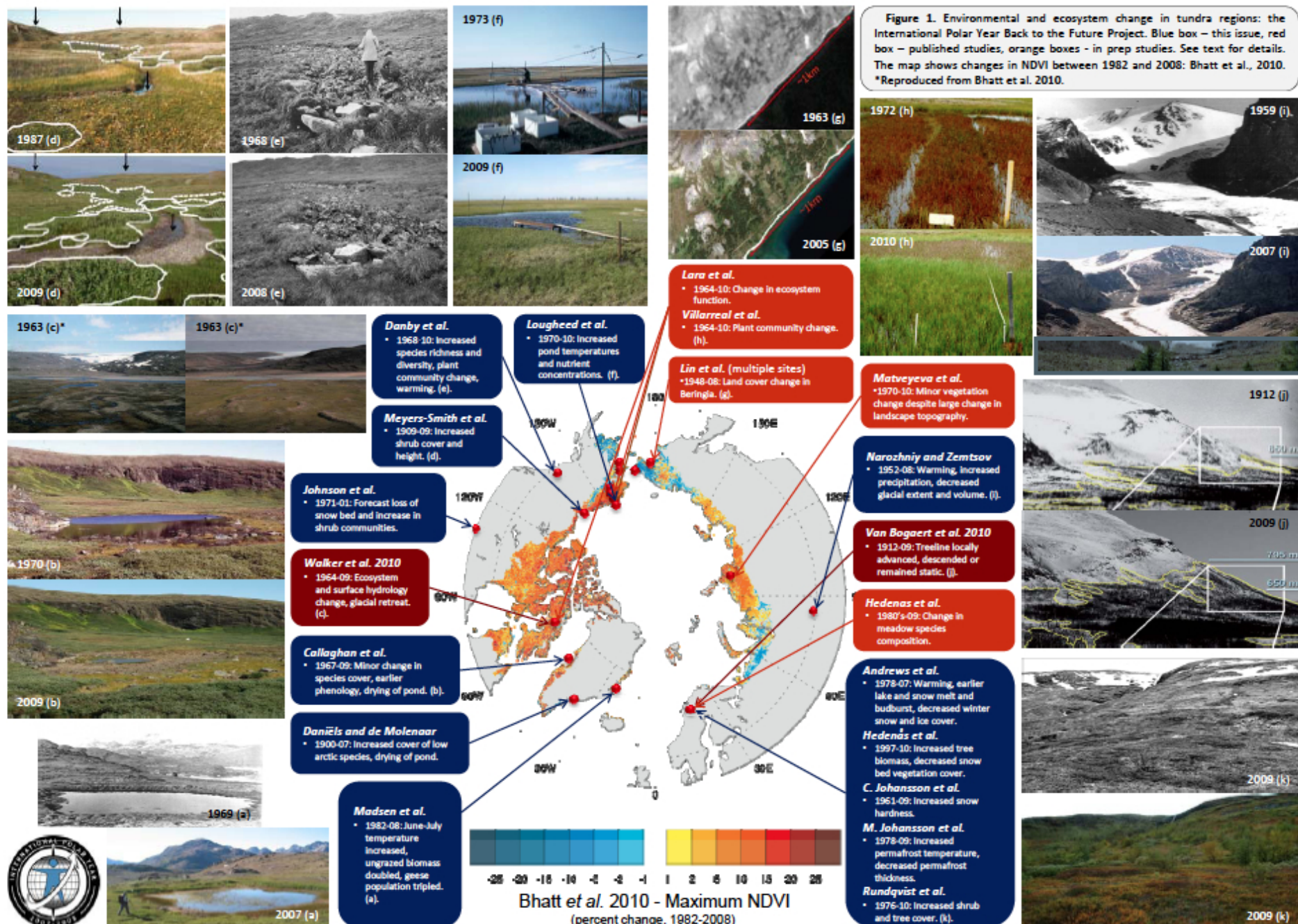
More trees



More shrubs

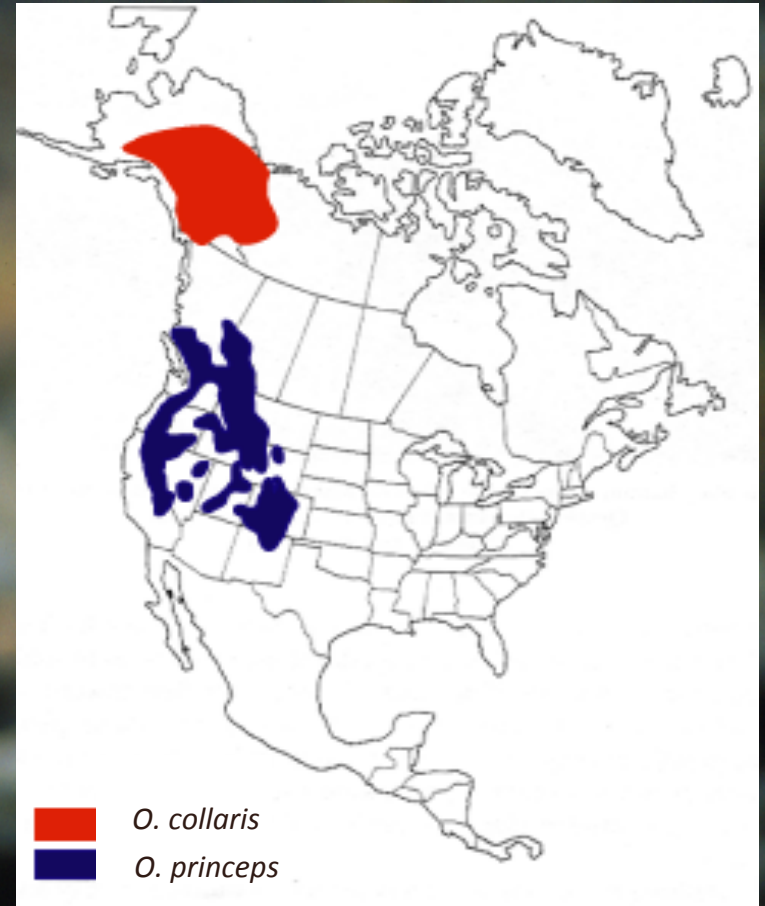


Arctic Vegetation Change (IPY 'Back to the Future') Ambio, 2011





Ochotona collaris (Collared pika)

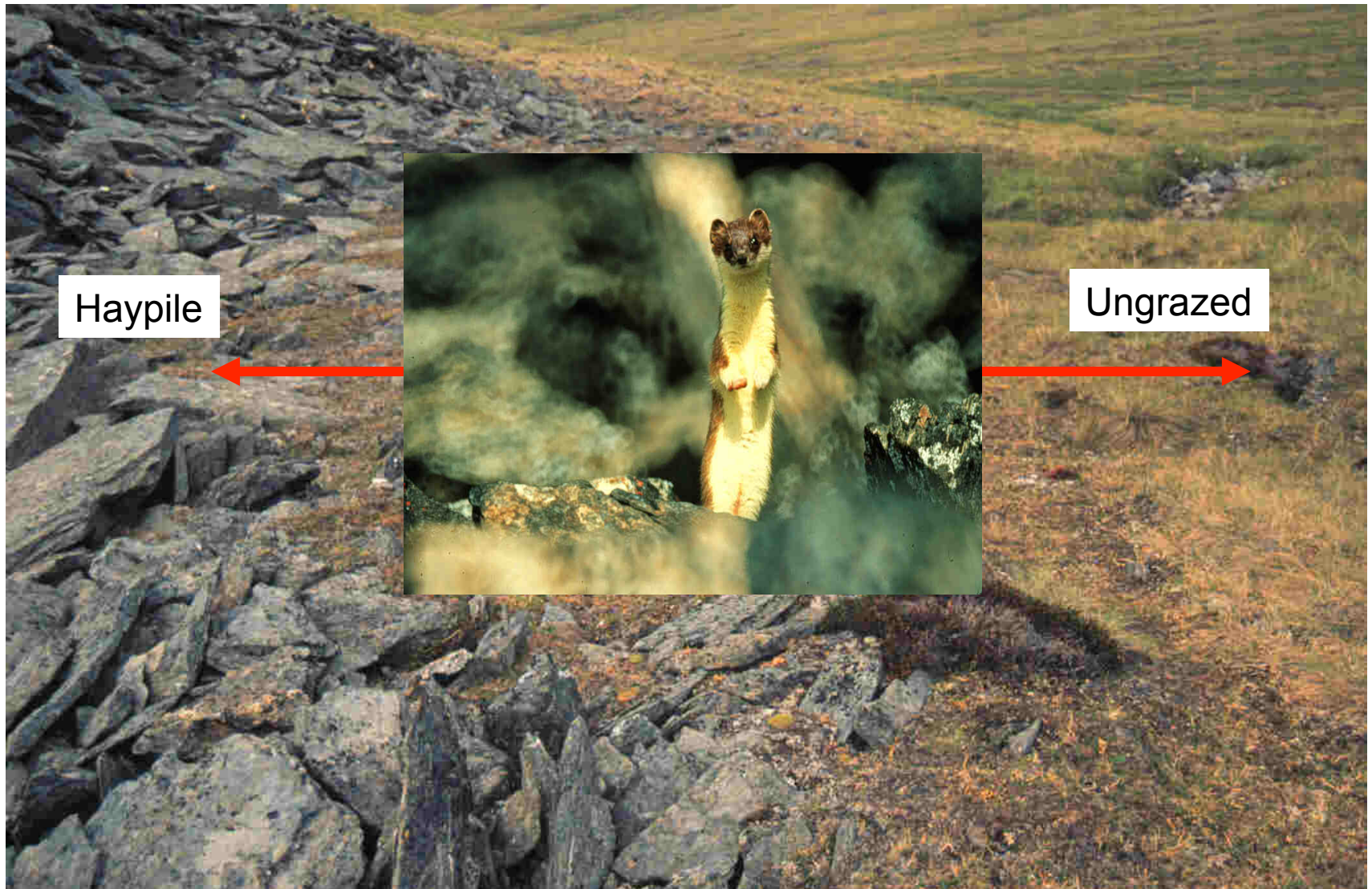








Pika Herbivory

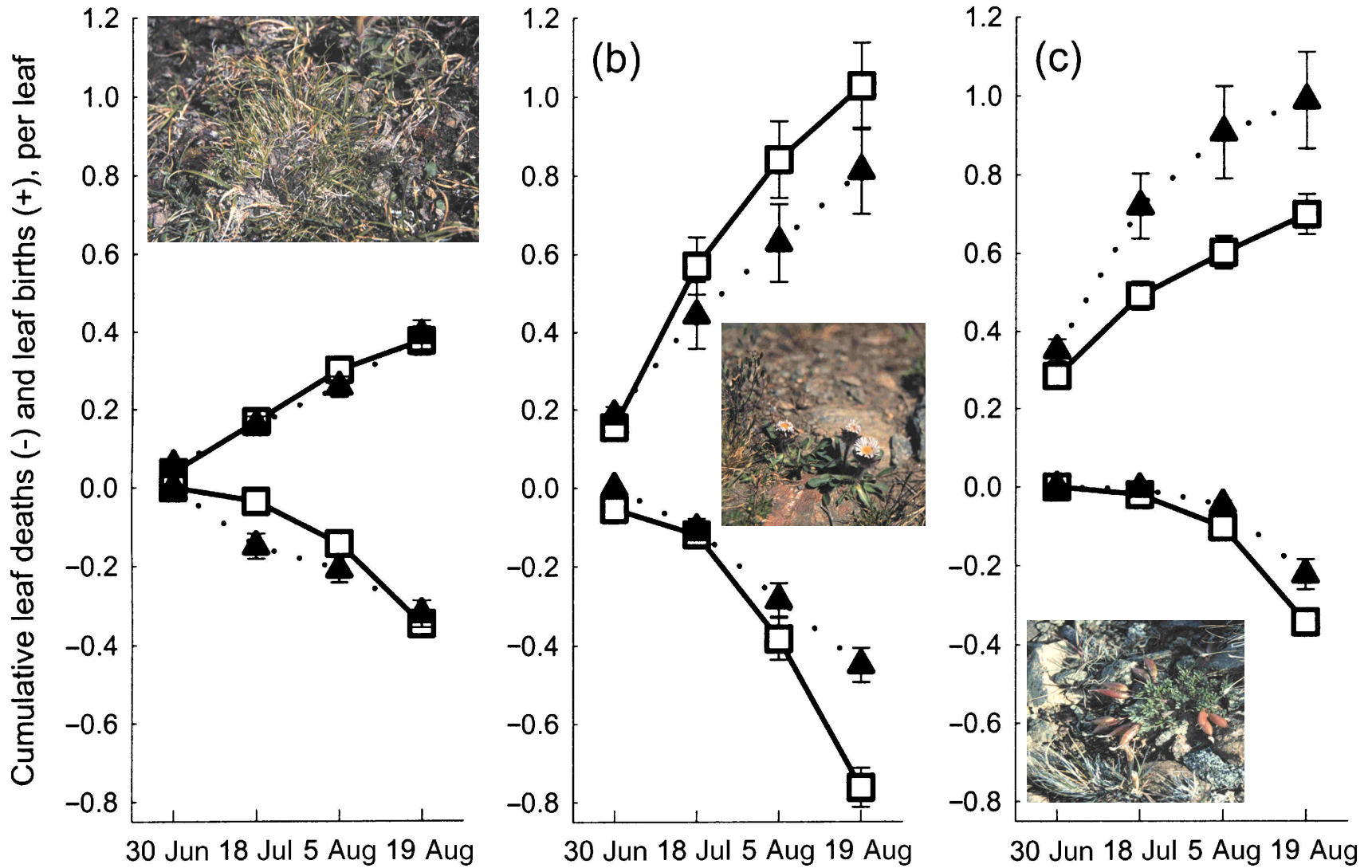




Grazing has a significant influence on composition and productivity

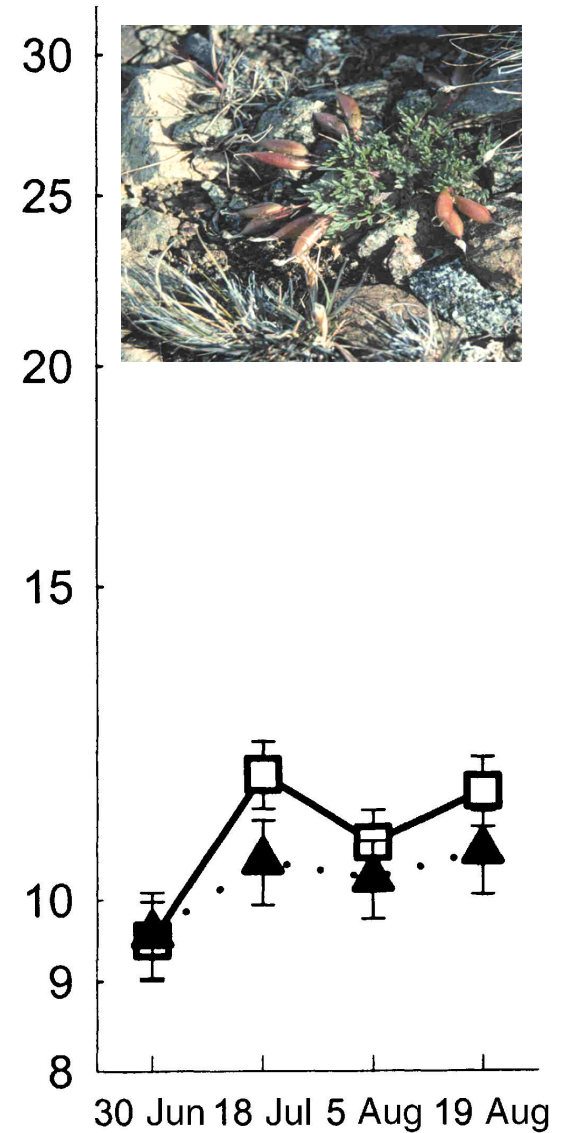
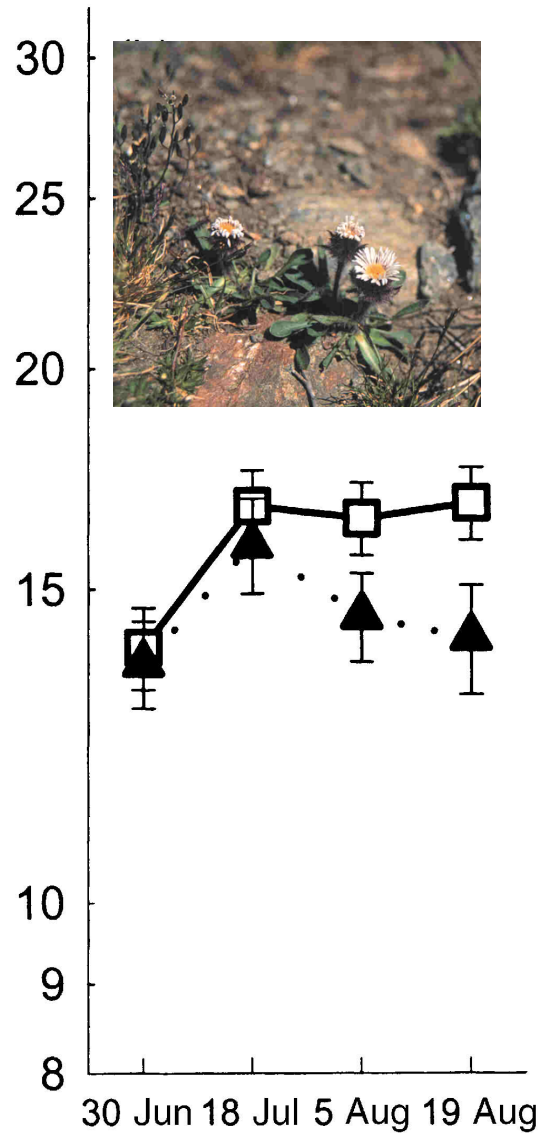
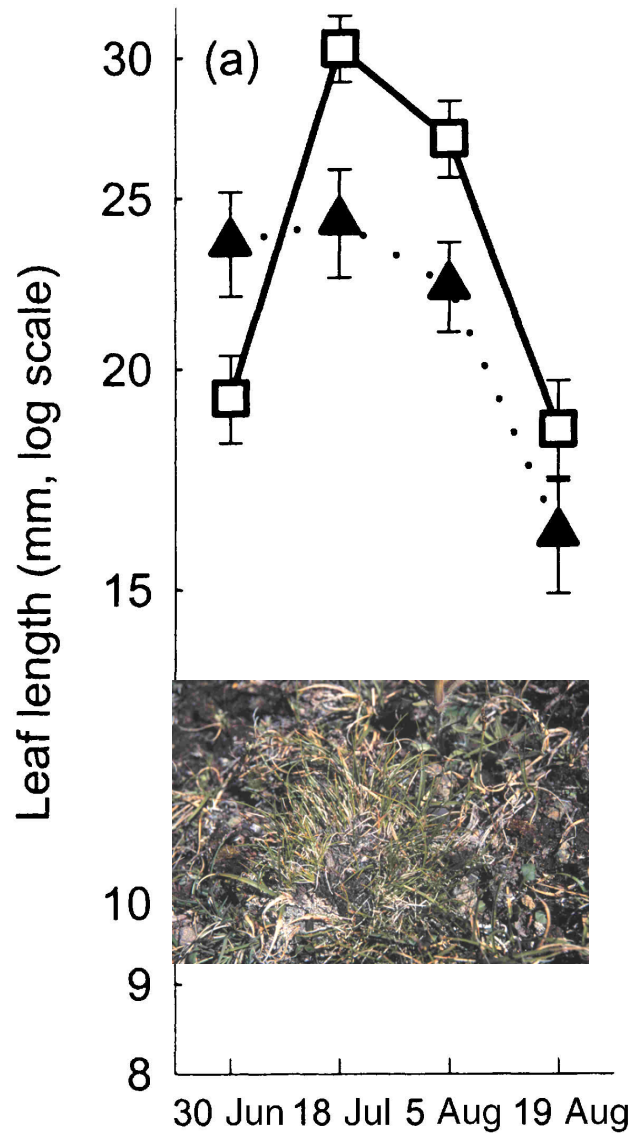


Leaf turnover



(McIntire & Hik, 2002, *J Ecol*)

Leaf growth



(McIntire & Hik, 2002, *J Ecol*)



Carex consimilis



Dryas octapetala



Salix reticulata



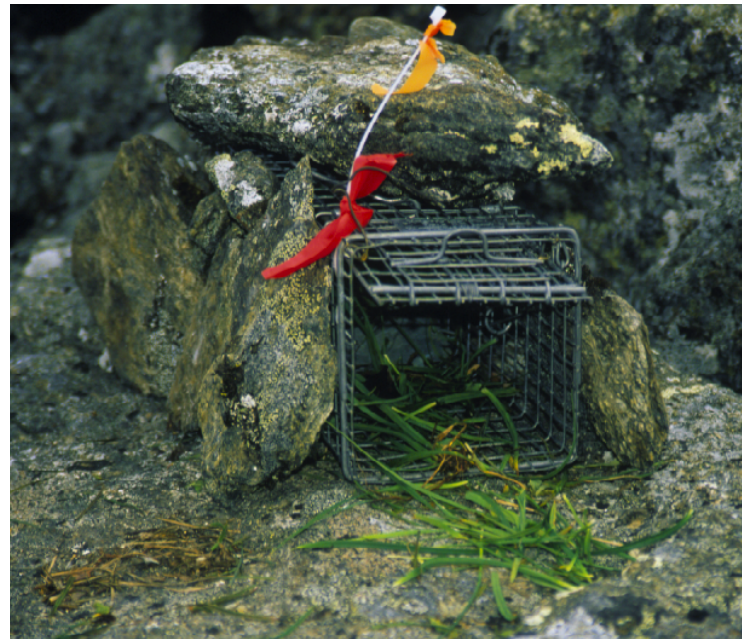
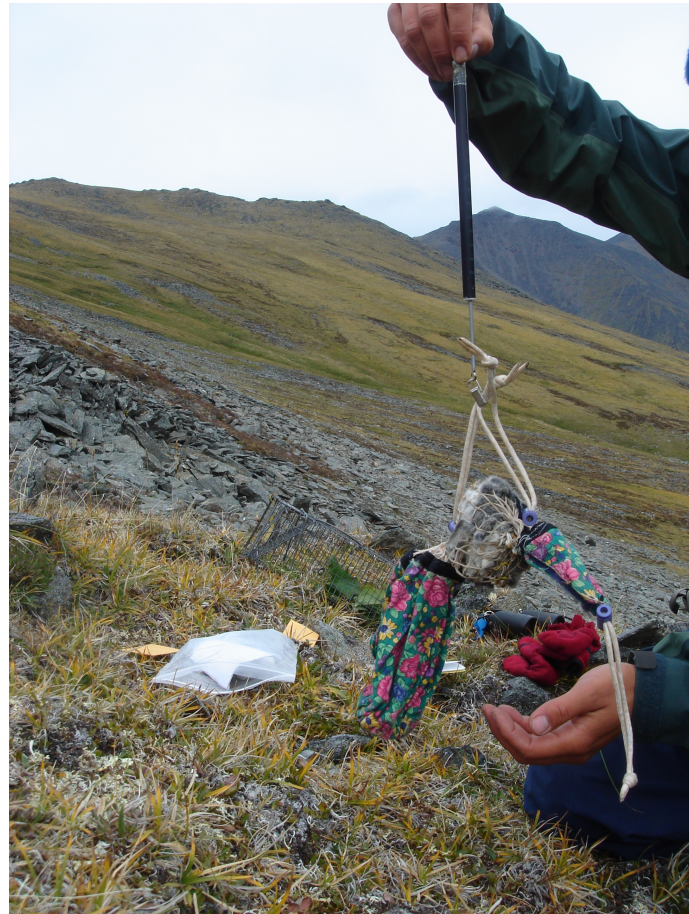
Polygonum bistorta

Clipping alone produces a 'grazing lawn'



Since 1995

Mark-recapture study
of all animals in $\sim 4 \text{ km}^2$



Winter conditions are a best predictor for population change in pikas

Poor Survival

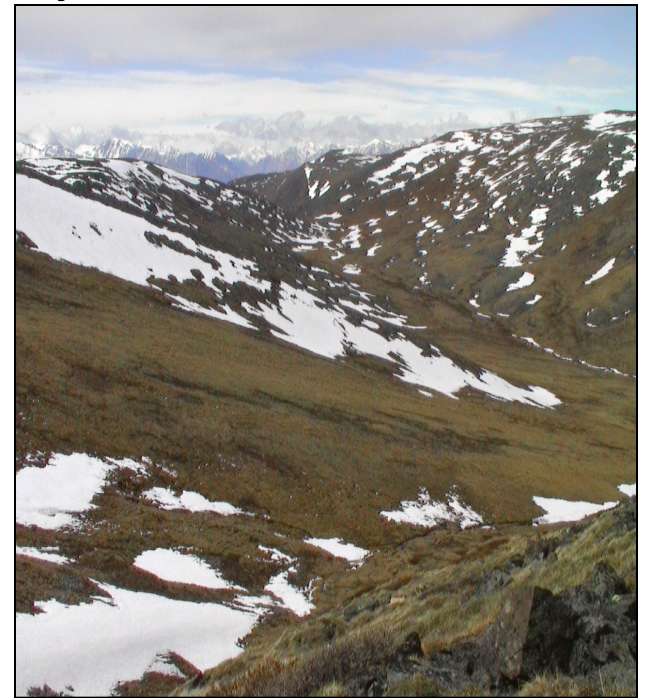
Late snowmelt



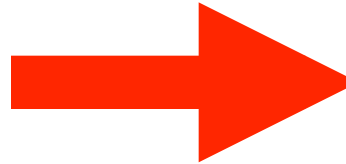
Deep snowpack

Good Survival

Early snowmelt

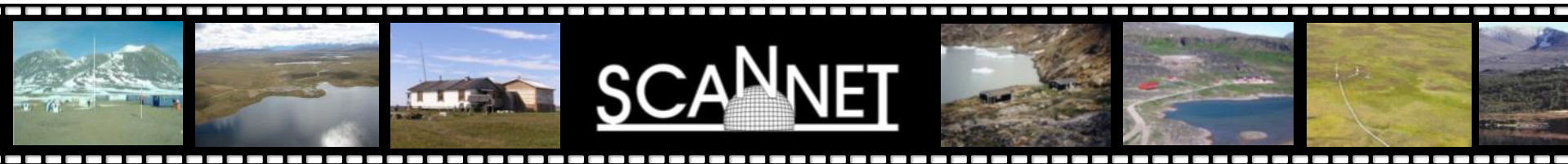


Shallow snowpack









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A Circumarctic Network of Terrestrial Field Bases



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