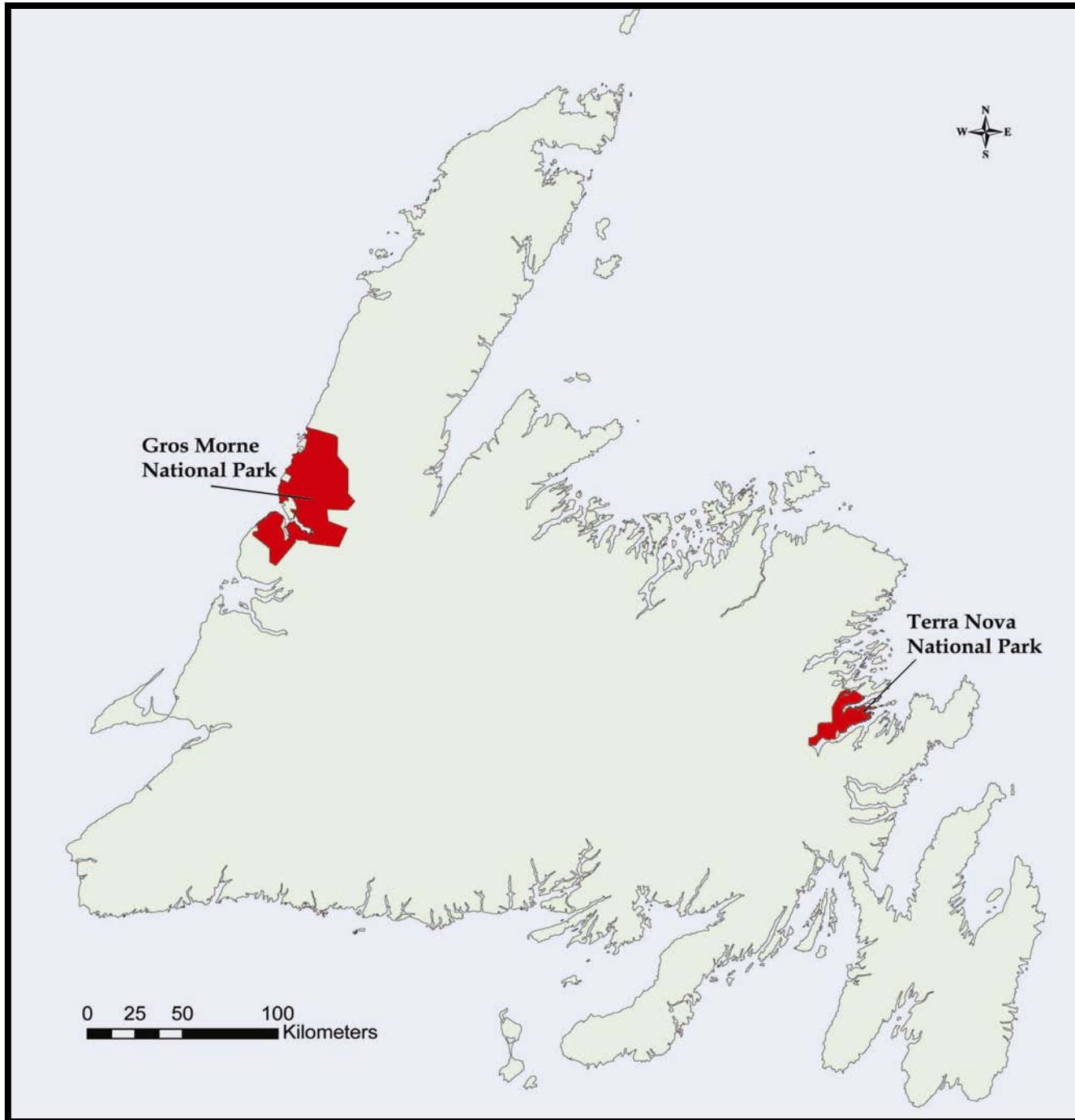




Impacts of hyperabundant moose on forest
regeneration in Terra Nova and Gros Morne
National Park

**John Gosse, Luise Hermanutz
Brian McLaren, Peter Deering**



The ecological context:

- Boreal forest dominated by spruce and fir.
- Moose were introduced to NF and are hyperabundant.
- Wolves were extirpated; natural predation is negligible.
- Abundant supply of preferred forage species.
- Other introduced herbivores include snowshoe hare, red squirrels, and slugs. Non-native plants: coltsfoot and Canada thistle. ***Moose are not acting alone!***

When is a species invasive?

- Moose are non-native in that they occur on the island from direct, human intervention and not as a natural range expansion.
- Because of a lack of predators and abundance of high quality forage, moose have persisted.
- They are *INVASIVE*; ecological impacts include habitat alteration and a disruption of natural processes.

The management issue:

- Inhibiting forest regeneration through intensive browsing following insect disturbance – leading to 'alternate stable states.'
- Reducing the abundance and distribution of native species (i.e. balsam fir, Canada yew, and mountain ash)
- Facilitating the establishment of exotic plants by modifying the forest floor and functioning as a vector of seed dispersal (Rose and Hermanutz 2004).



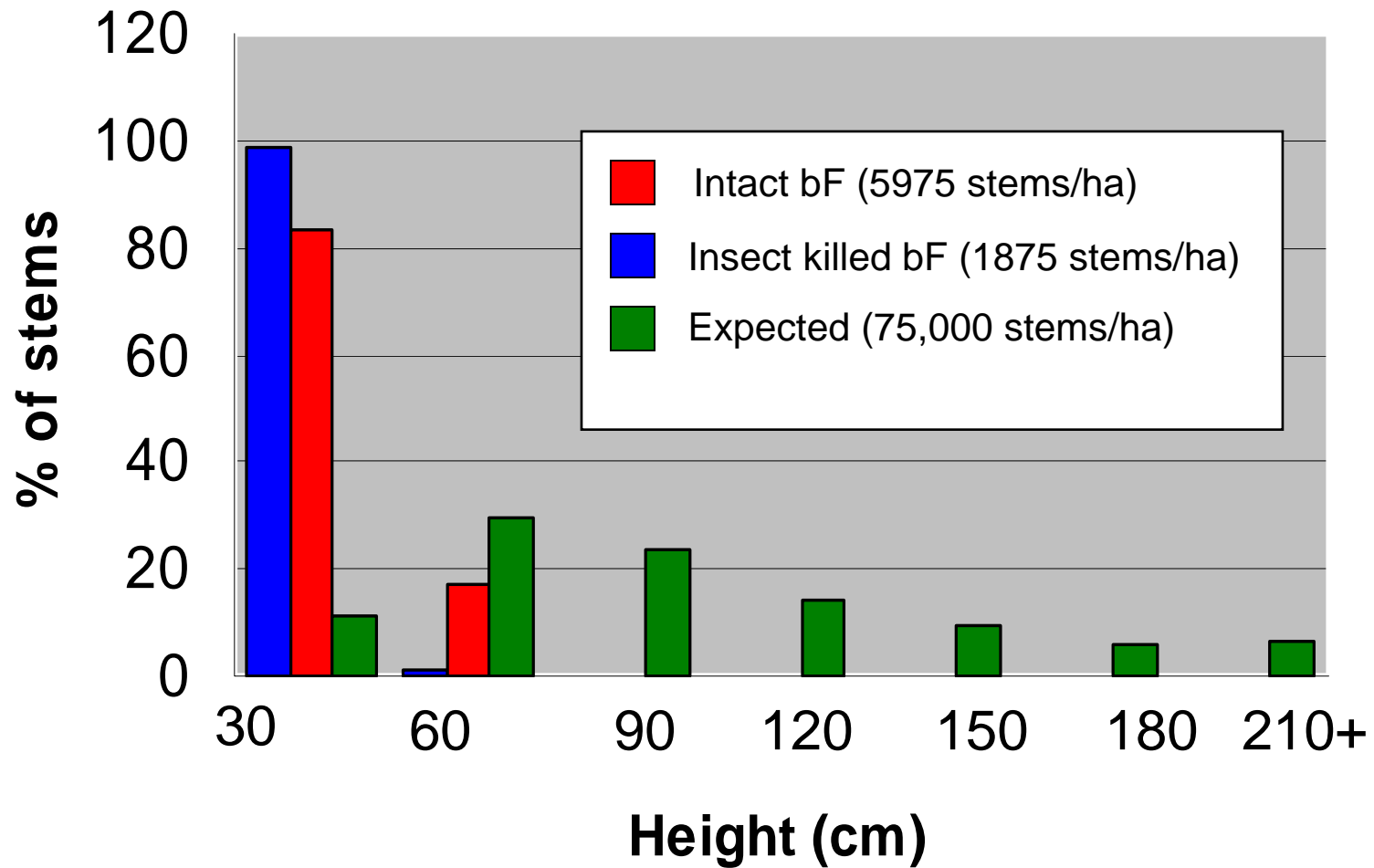
***Forest composition, structure, and function are changing!
Our mandate is being compromised***



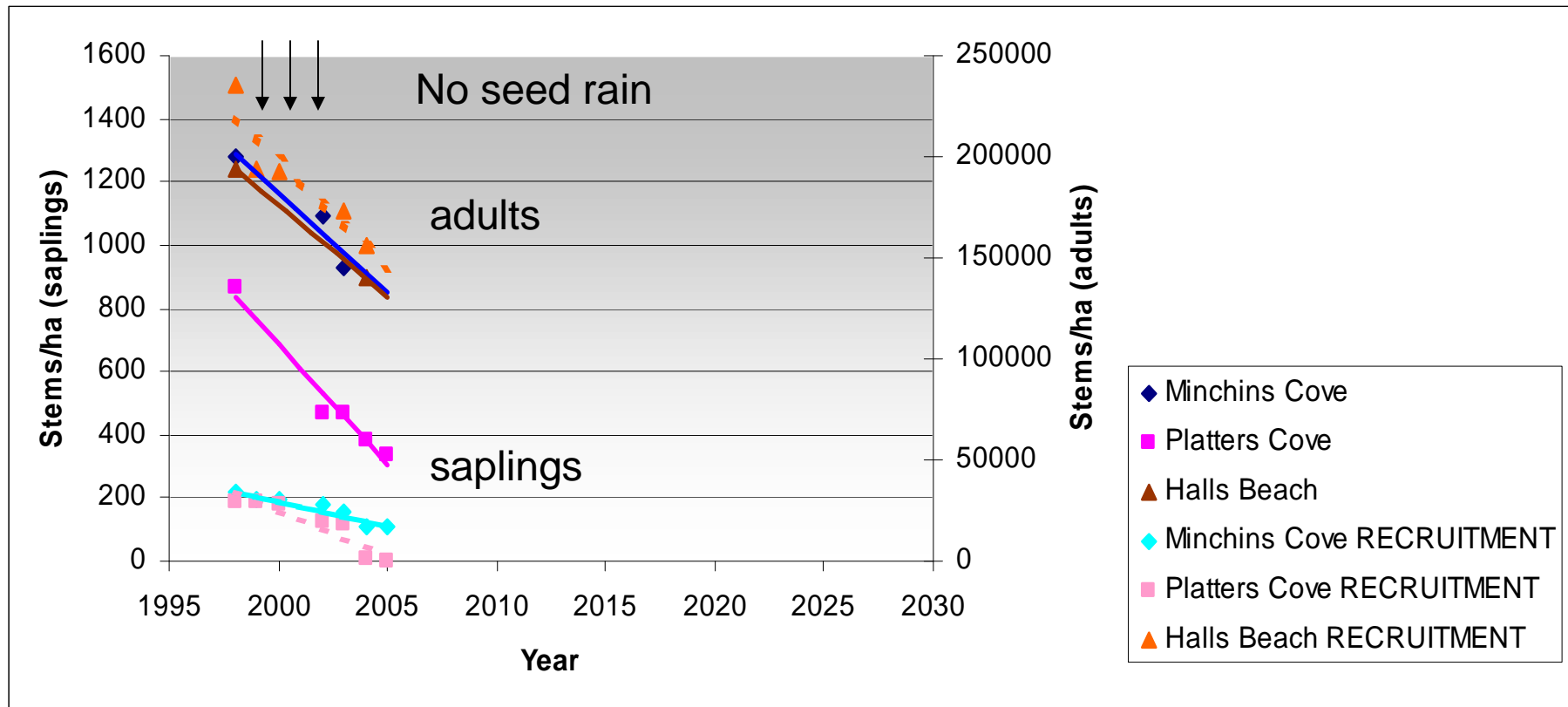
Defining hyperabundance:

- 1) An exotic species resident in the park that is resulting in the loss or reduction of native species or natural ecological processes;
 - 2) The natural population regulation mechanisms have been altered;
 - 3) There is clear evidence that the ecosystem is experiencing impacts outside the historical range of variation.
- Moose density (animals/km²) ranges from 3-20 times the density found in other boreal forest systems.
 - Moose have exceeded ecological carrying capacity

Expected vs. actual height growth of balsam fir saplings in TNNP

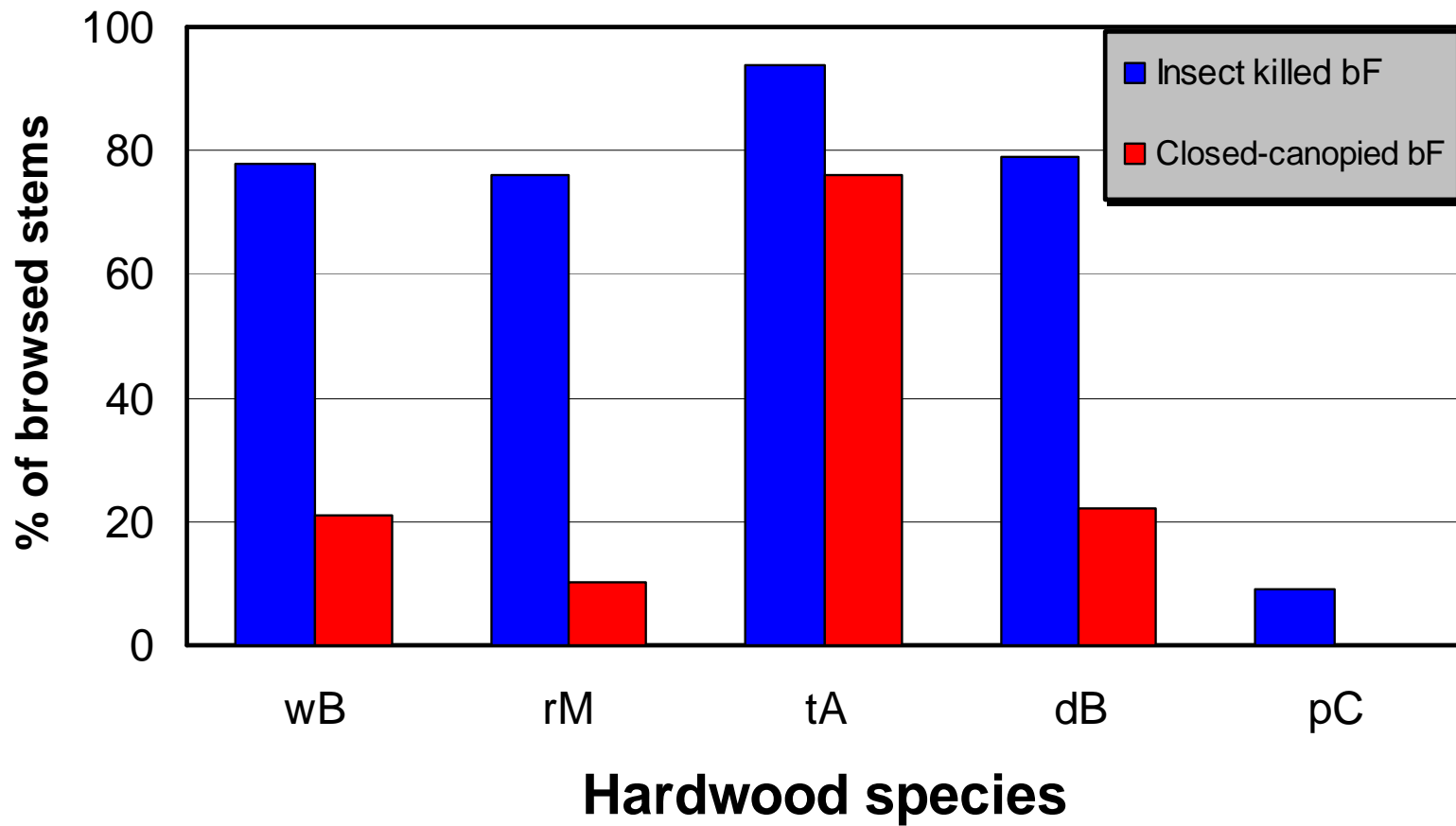


The 'not so bright' future for fir....



- **Adult trees are dying at rate of up to 50% over ~5 years.**
- **Saplings have high mortality rate due to repeated moose browsing.**
- **Very little seed rain since 1998; therefore limited recruitment.**

Proportion of hardwood stems browsed by moose in closed canopied and insect killed balsam fir stands, TNNP.



Severely browsed....



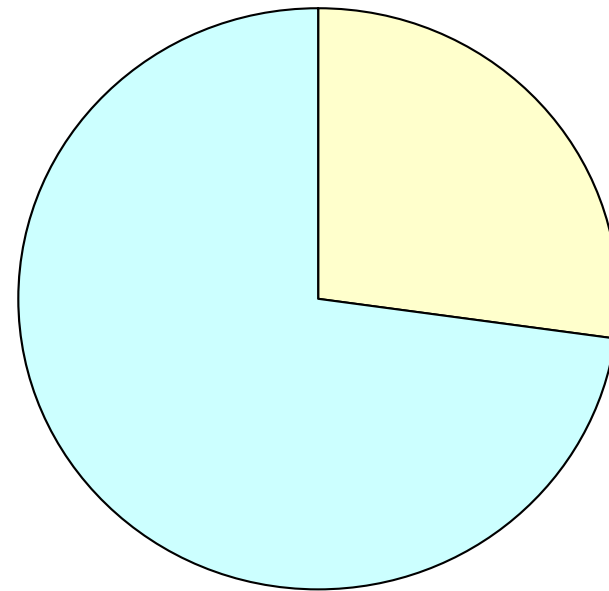
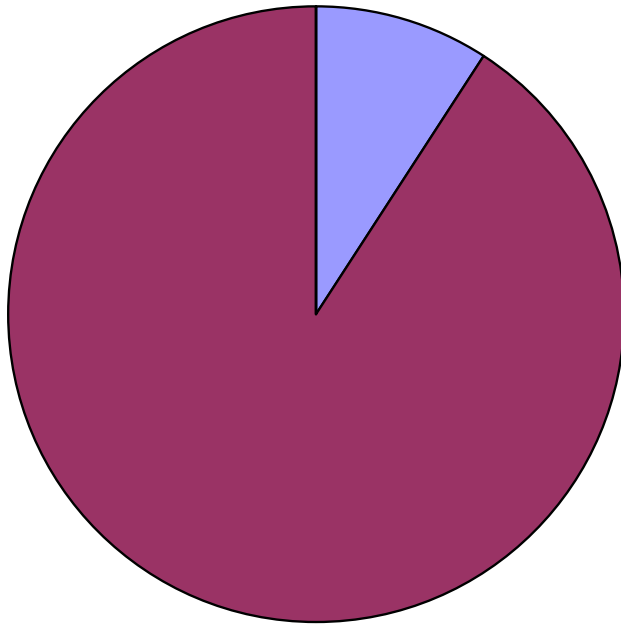
Natural condition...





Ground vegetation

- Insect disturbed sites are dominated by sun-loving grasses and *Kalmia*
- Fir seedlings can not establish due to root competition



■ kalmia ■ grass ■ herb ■ moss

INSECT KILLED FOREST

CLOSED CANOPY FIR FOREST

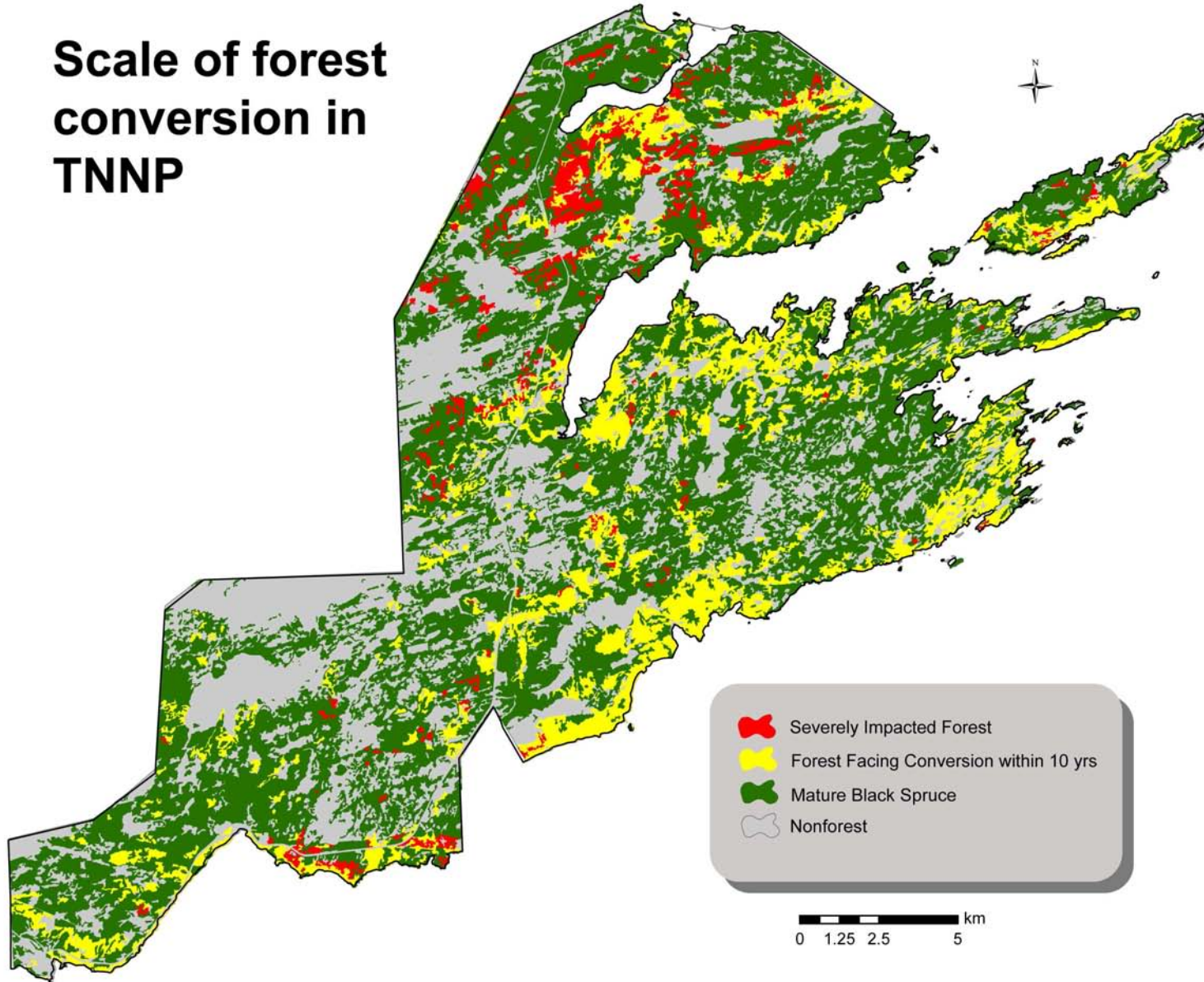
Gros Morne





Non-native coltsfoot (A), Canada thistle (B)

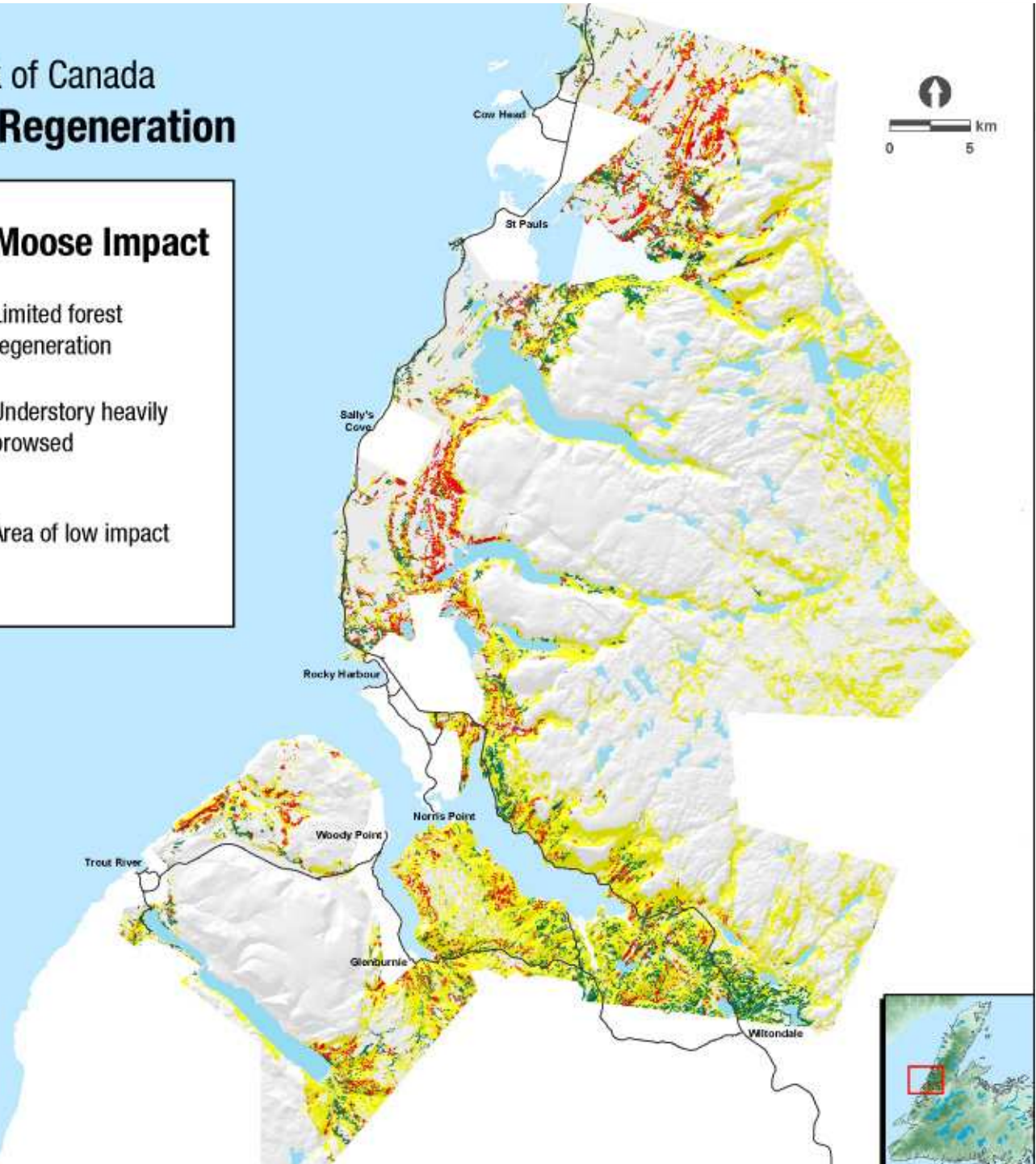
Scale of forest conversion in TNNP



Gros Morne National Park of Canada

Moose Impact on Forest Regeneration

Forest Stage	% of Forest	Moose Impact
Regenerating - age class 0-20 years - disturbed areas	13%	Limited forest regeneration
Immature - Over Mature - age class 20+ years - canopy <75%	74%	Understory heavily browsed
Immature - Over Mature - age class 20+ years - canopy >75% - understory not yet developed	13%	Area of low impact



Ecosystem impacts; examples from other studies....

Songbirds – Removal of understory vegetation by black-tailed deer increased nest predation and led to declines in bird density on the Queen Charlotte Islands, B.C. (Mcshea and Rappole 1992).

Soil chemistry – Sustained removal of deciduous leaf litter by moose reduces the amount of nitrogen that returns to the soil and decreases soil quality (McInnes et al. 1992).

Beavers – In Yellowstone NP, the reintroduction of wolves resulted in a decrease in elk. This in turn allowed trembling aspen to recover which reduced soil erosion along waterways and provided abundant forage for beavers.

Arboreal lichens – *Erioderma* in Newfoundland



What happens when browsing pressure is removed?

Outside fenced exclosures...



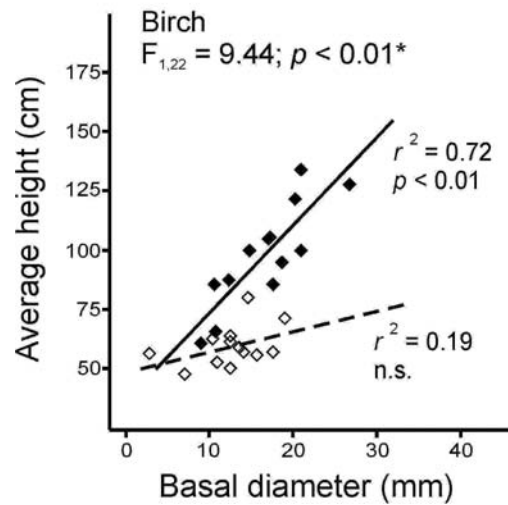
Inside exclosures...



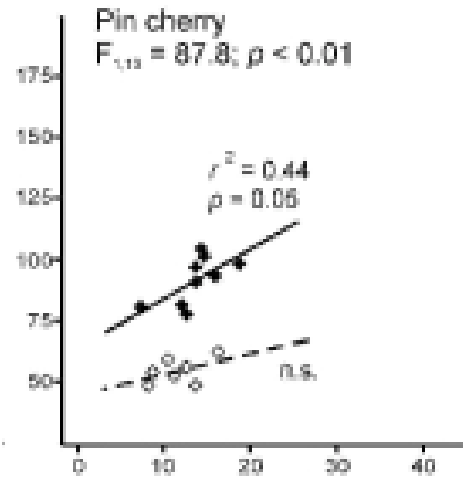
Experimental moose exclosures demonstrated that trees can recover following release from browsing pressure, *however*; balsam fir actually did better *outside* of the exclosures because of reduced competition with faster growing hardwoods.

Tree response following release from moose browsing

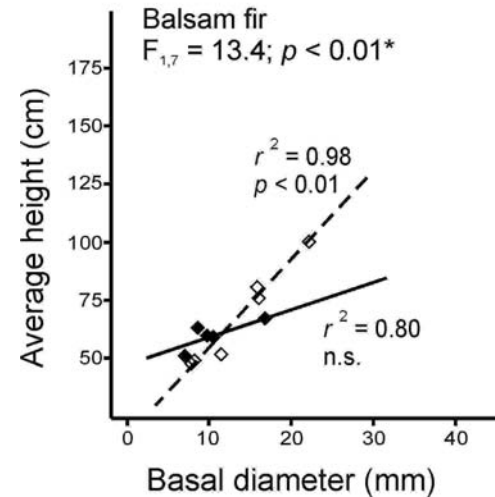
White birch



Pin cherry



Balsam Fir



 Fenced

- - -
 Control

Forest regeneration:

Current condition



Expected...short term



Earlier research from the island....

Bergerud and Manuel, 1968

“Moose damage had halted the growth of birch and killed some regeneration. Damage to BF was extremely severe resulting in the suppression of terminal growth and the uprooting of seedlings.”

Thompson and Curran, 1993

Two predictions of Bergerud and Manuel observed 27 years later; 1) forest composition was altered on 60 % of sites by a reduction in BF in favour of white and black spruce, and 2) white birch was eliminated from the canopy. “Ungulate-induced ecotype”

Connor et al. 2000

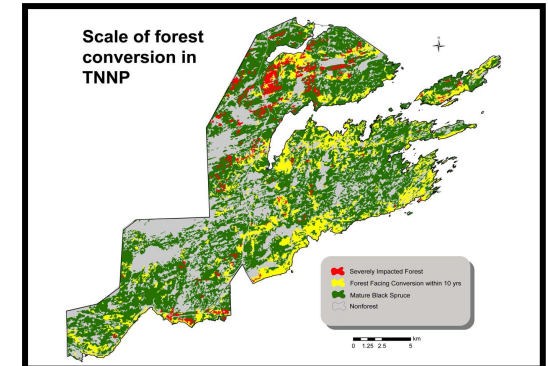
Recorded an increase in moose density from 1977-96 and a concurrent decrease in the abundance of shrub species including Canada yew and willows.

Forest monitoring:

- Fir and hardwood density & biomass (pre and post treatment)
- Moose demographics
- Long-term remote sensing to detect landscape scale change.

Other ecosystem components....

- Understory vegetation
- Aquatic productivity
- Lichen/fungal communities

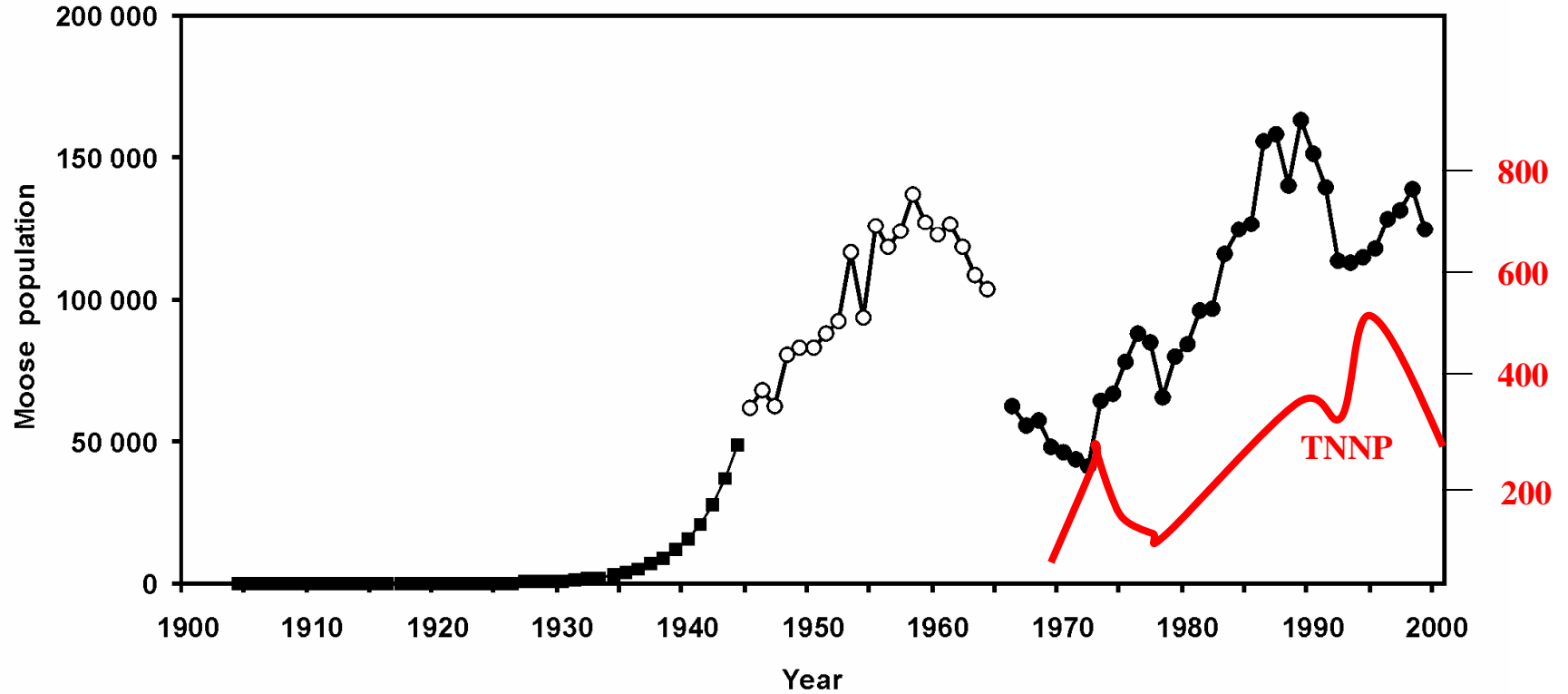




Questions ?

Comments ?

Moose trends in Newfoundland/TNNP



Productivity = 15 calves/100 cows



Social carrying capacity;

- The number of animals that can occur in an area to maximize hunting opportunities, viewing opportunities etc. ('the more the better').
- SCC is a value judgement
- Newfoundlanders have extremely high cultural/social ties with 'everything moose'

Ecological carrying capacity....

The number of healthy animals that an area can support without damage to the vegetation.



1) Below carrying capacity



 Typical situation when natural predators are present

3) “Beyond carrying capacity...”

followed by a decline in habitat quality and a die-off of moose....

