Southern snowshoe hares: updates, questions, forecasts

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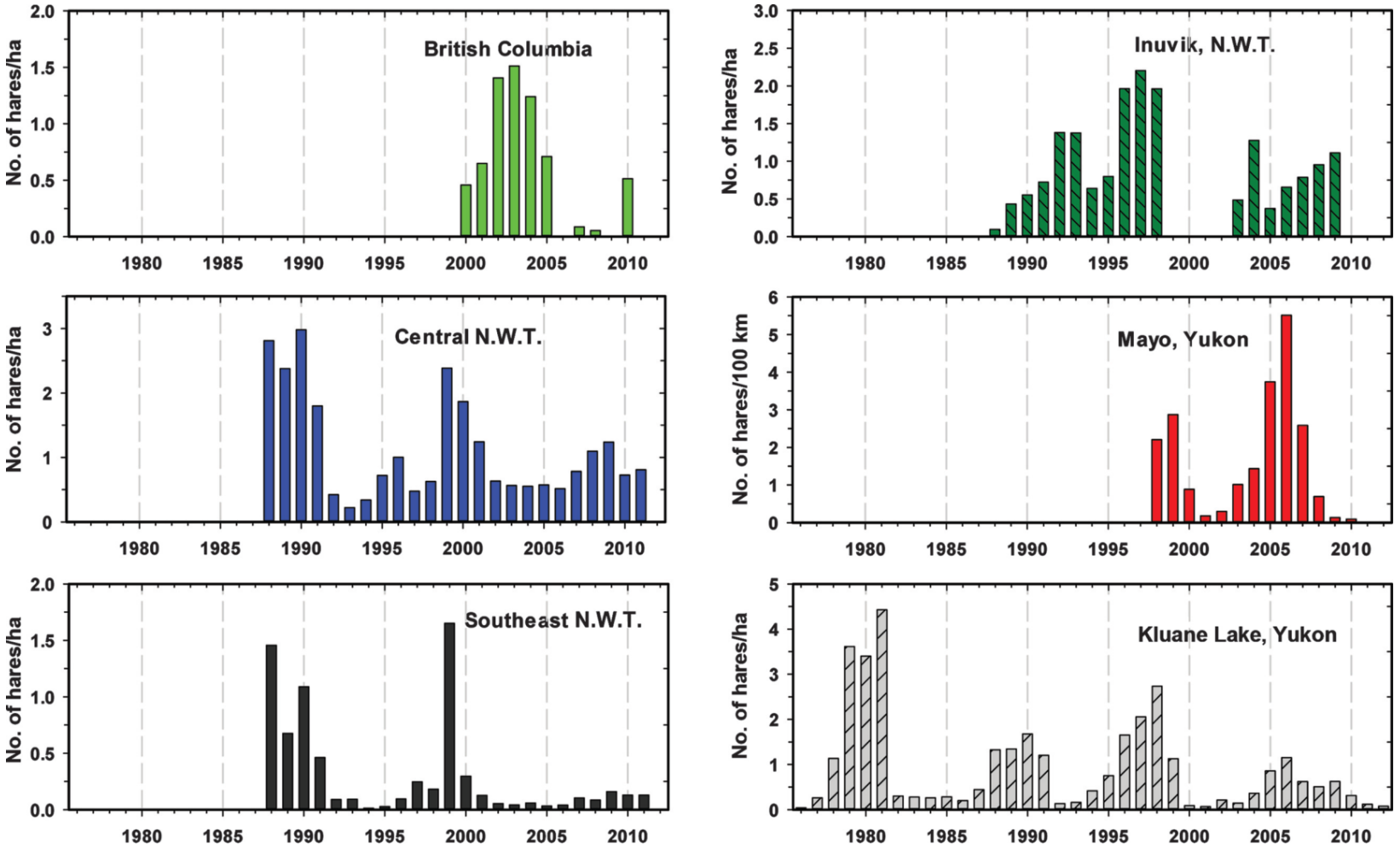
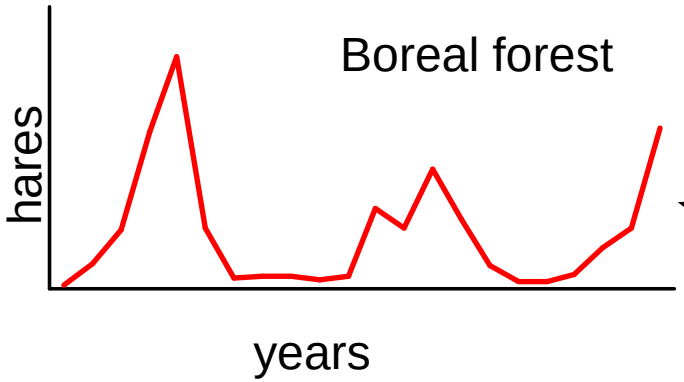
MAJOR POINT #1. Northern hare cycles are highly variable.

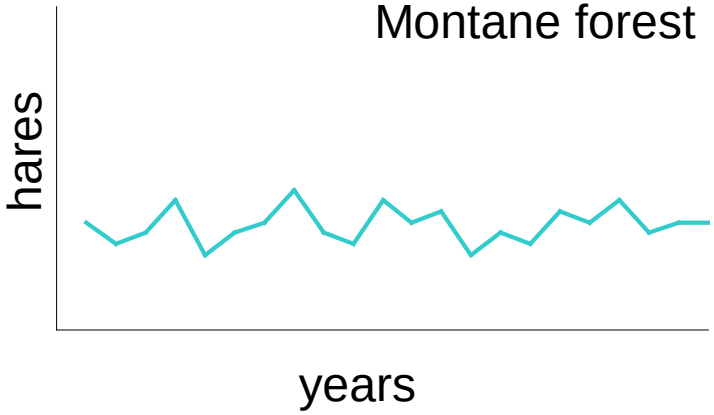
(iffy synchrony, variable peak heights and amplitudes)

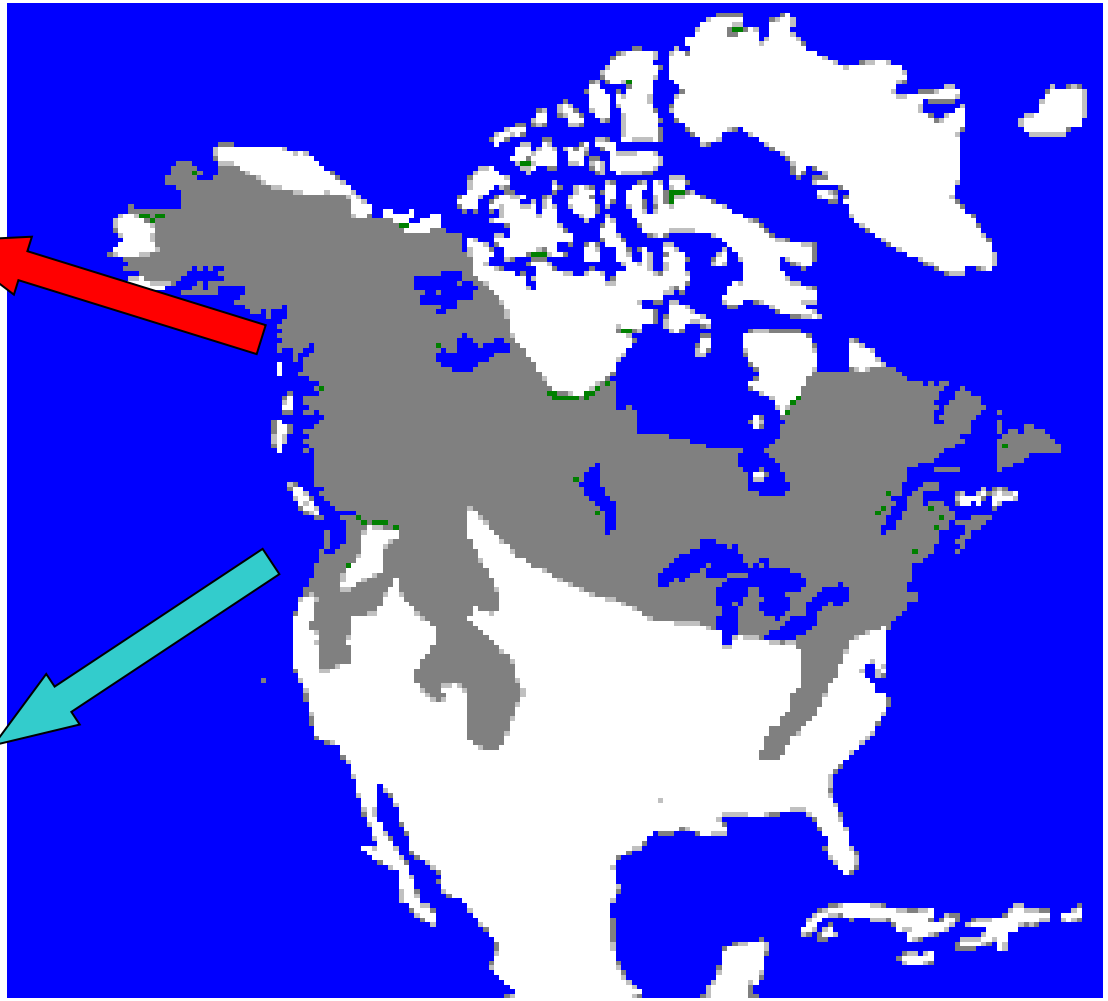


Krebs et al. 2013. Canadian Journal of Zoology 91:562-572

Is the cycle gradient, as told by textbooks, true?







Major stand types in NW Montana

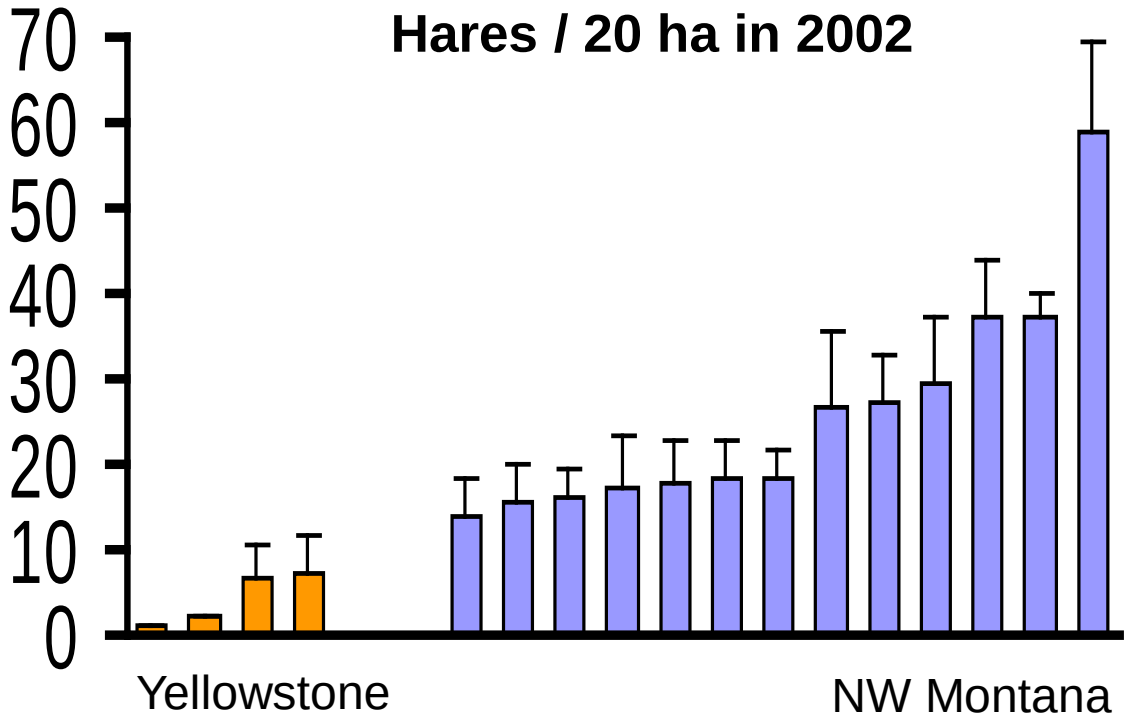
“thinned”

“mature”

“unthinned”

MAJOR POINT #3A.

Region matters enormously to hare abundances.



we trapped 13 sites:
only 4 sites had hares.

Western hare densities differ substantially across landscapes (mostly live-trapping data)

NW Montana (2001-12): 0.72 ± 0.12 hares/ha
Mills & Hodges unpublished

Oregon (2001-2): 0.25-0.42
Abele et al. 2013

Washington (2003-4) 0.82 ± 0.07
Lewis et al. 2009

Wyoming (YNP) (2002-7): 0.20
Hodges et al. 2009

Wyoming (2006-8): 0.48-1.69
Berg et al. 2012 (pellets)

Idaho (1998-2000): 0.09
Wirsing et al. 2002

Colorado (2002-3): 0.154
Zahratka & Shenk 2008

Hare densities vary with landscapes further east, too (mostly pellet data)

Maine 1.00-1.85
Homyack et al. 2007

Maine (summary of others): 0-1.8
Simons-Legaard et al. 2013

Voyageurs NP, Minnesota (2006-9): ~0.35 hares/ha
Moen et al. 2012

northeast Minnesota (2003-6): ~0.64 hares/ha
McCann and Moen 2011

Landscape attributes matter to stand quality for hares

In North Cascades, WA:

hare density increased with:
--stand saplings
--stand medium trees
--“moist forest” within 300 m

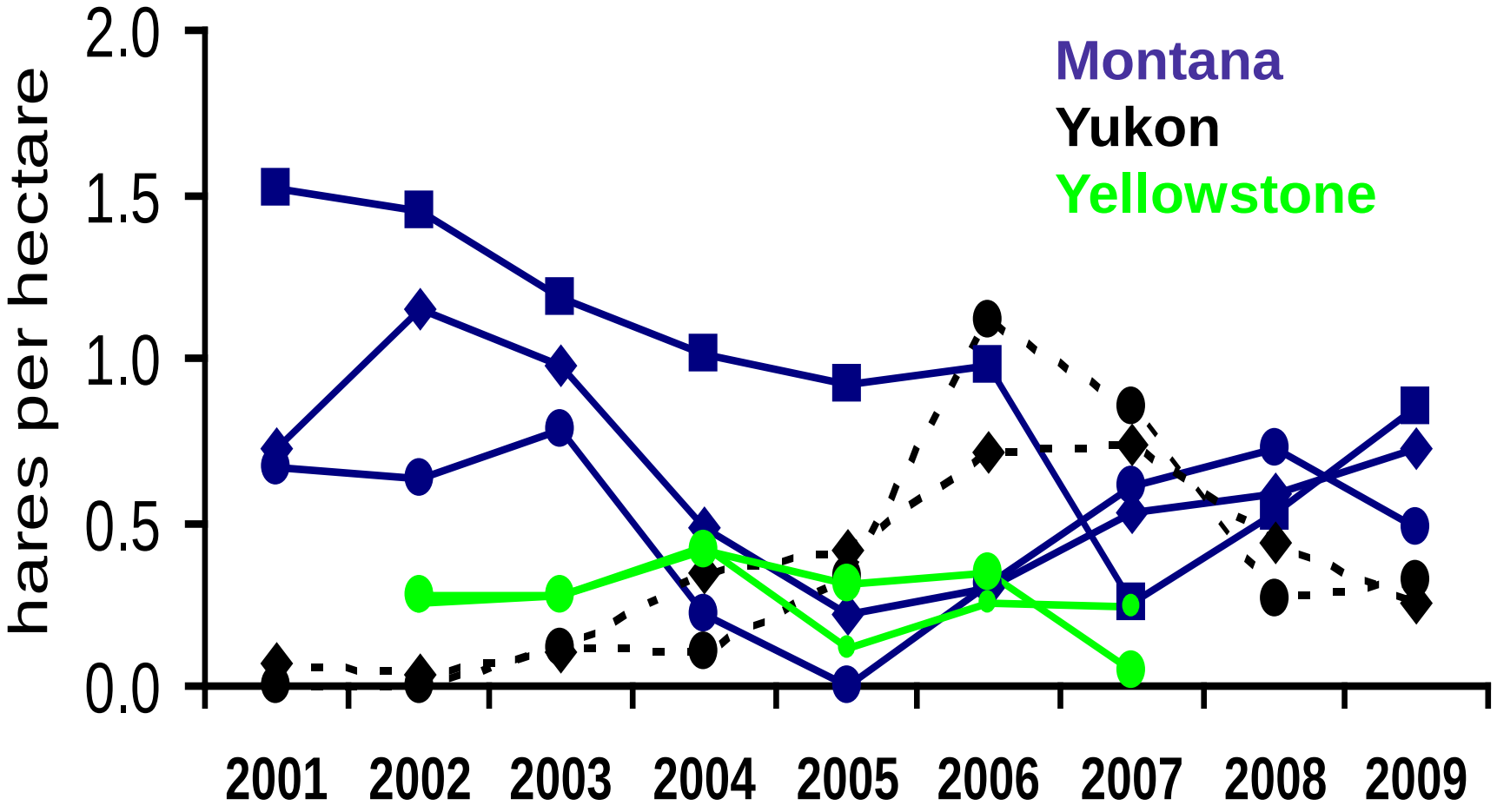
and decreased with
--“open” forest within 300 m.

Variables within 300 m more explanatory than variables within 600 m

Lewis et al. 2009. Journal of Mammalogy 92:561-567.

MAJOR POINT #3B.

Hare population dynamics also differ with region (cyclicity, synchrony, amplitude, and peak densities vary!)

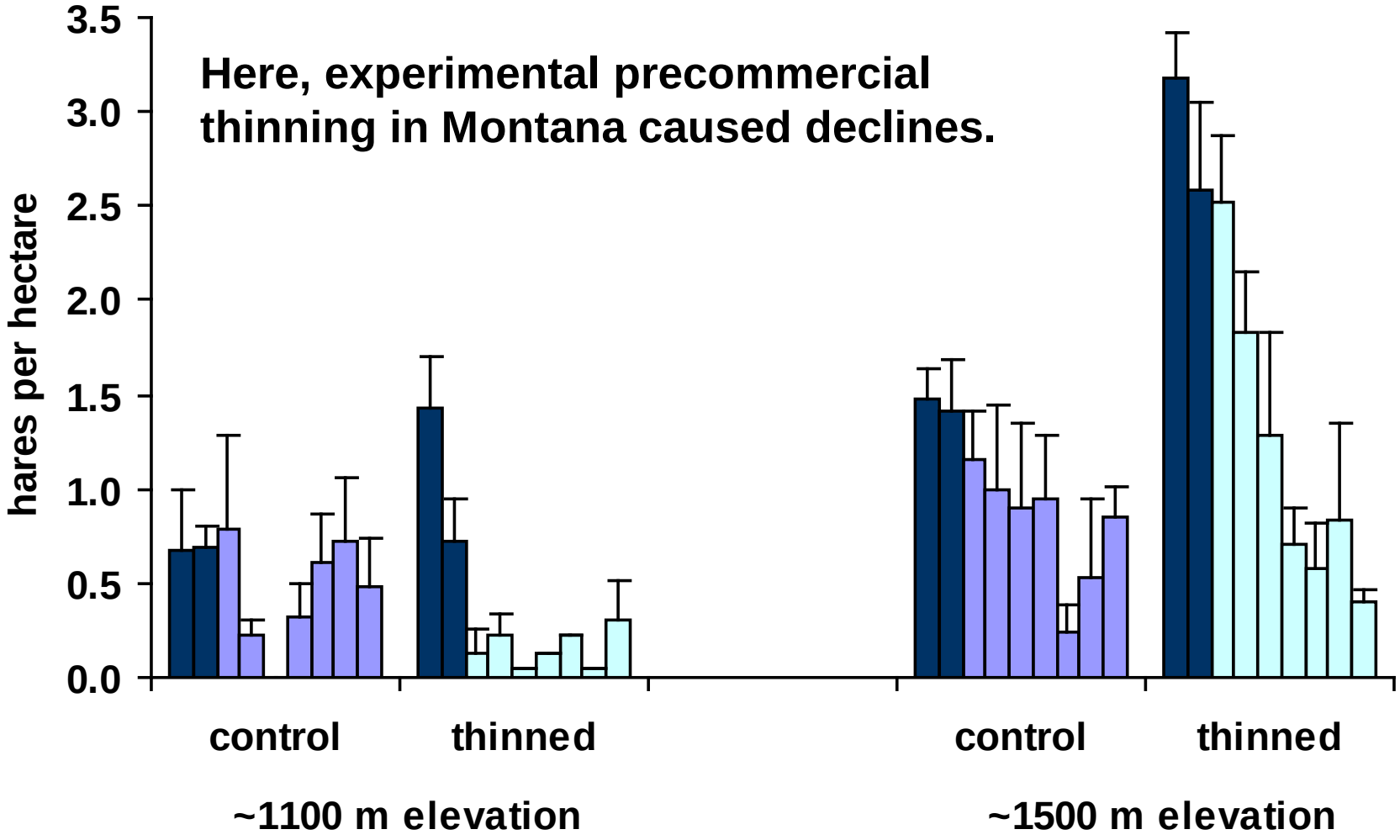


What happens to hares when habitats are disturbed?

MAJOR POINT #4A.

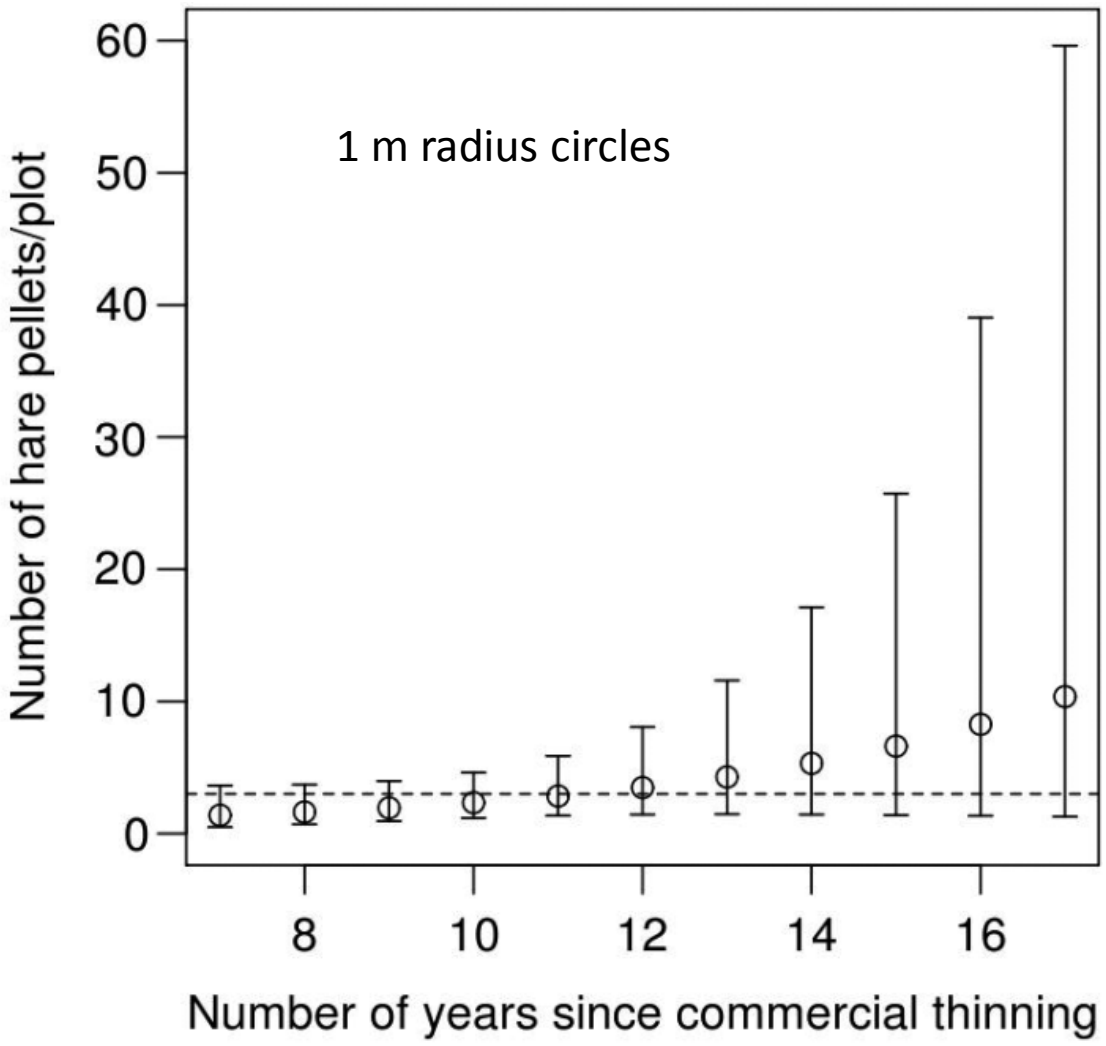
Forestry actions that reduce stand structure reduce hare abundances.

Here, experimental precommercial thinning in Montana caused declines.



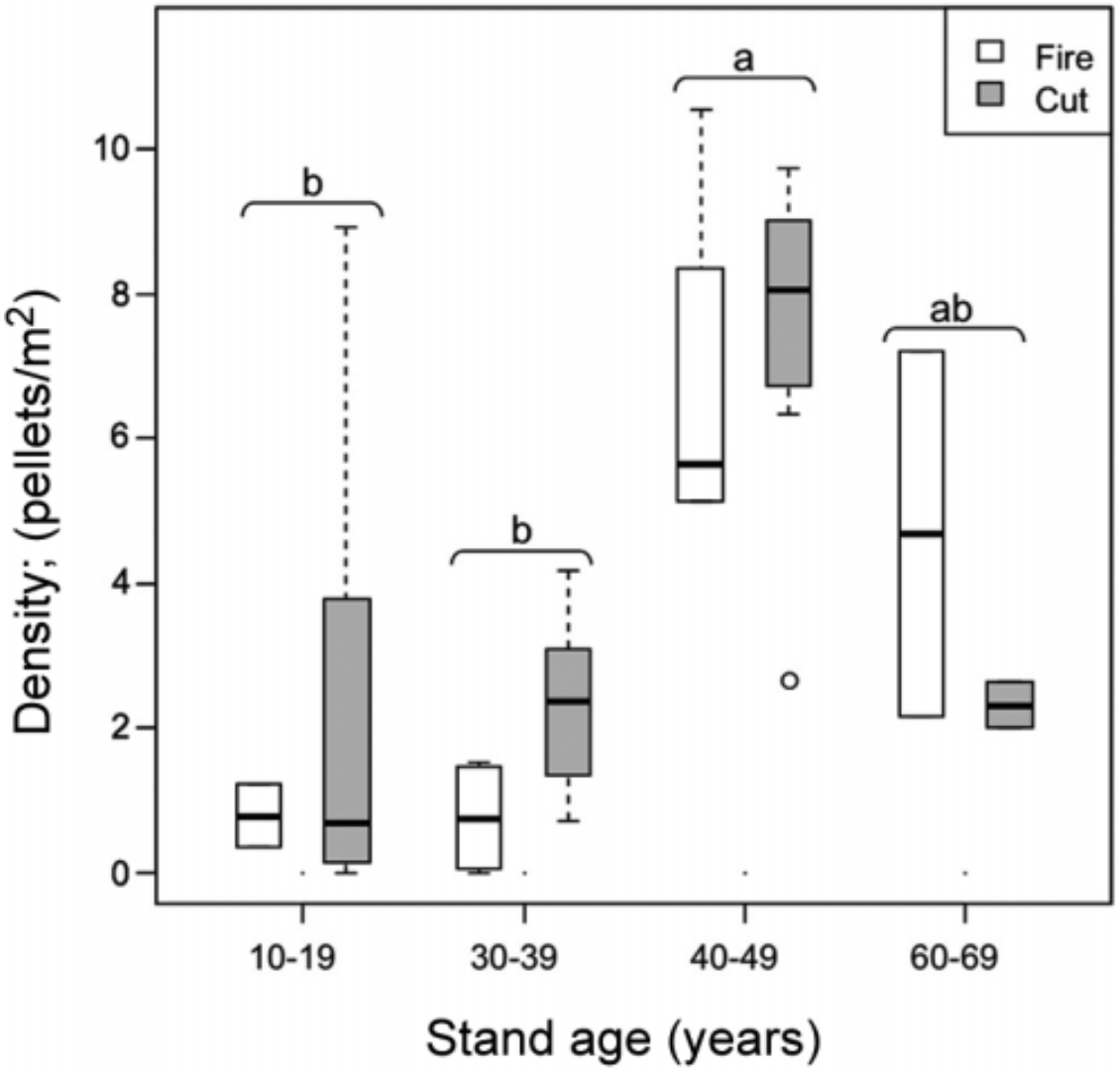
Hodges and Mills, unpublished

In Quebec, hare densities increase with years since commercial thinning



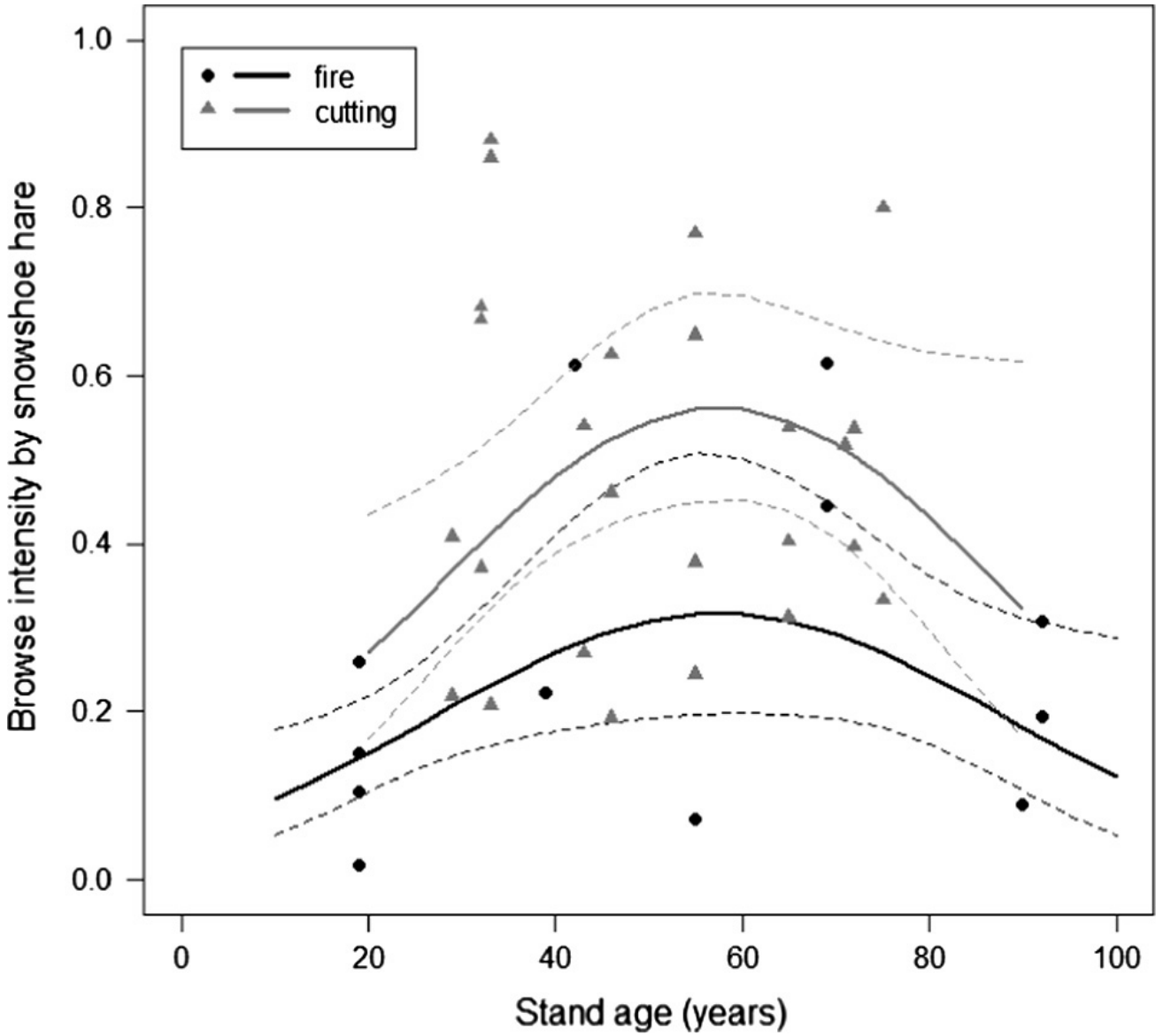
Bois et al. 2012 . Canadian Journal of Forest Research 42:123-133

And with years post-fire or post-harvest



Quebec, Hodson et al. 2011. Canadian Journal of Zoology 89: 908-920

In Quebec, forest age & history matter to snowshoe hares



Allard-Duchene et al 2014. Forest Ecology and Management 313:17-25

MAJOR POINT #4B. Fires destroy habitats short-term.

has hares
in 2002-2003

2003 ‘East’ fire

has no hares
in 2004-2007

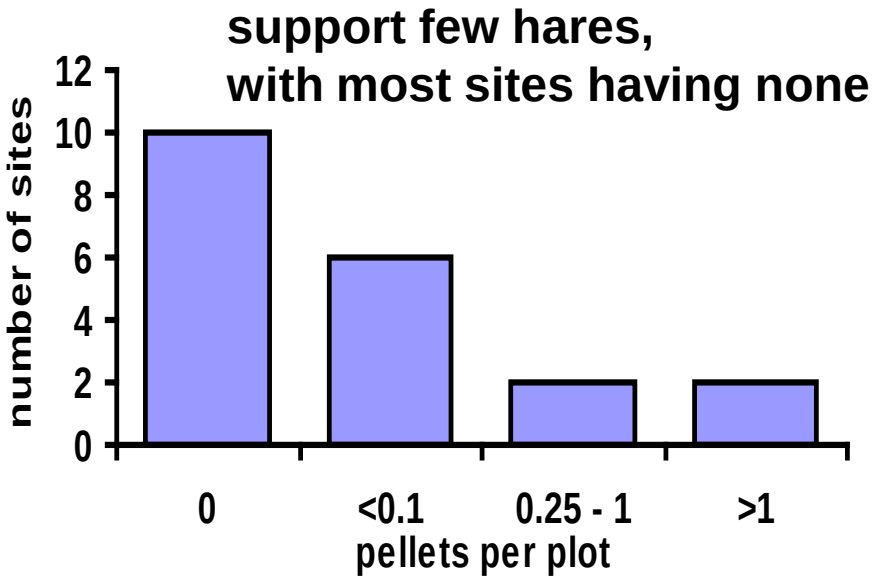
not good hare
habitat in 2011

YELLOWSTONE

MAJOR POINT #4C.
Hares re-use burned sites as soon as habitat enables them to do so.

We sampled 1988 burns in Yellowstone from 2002-2007

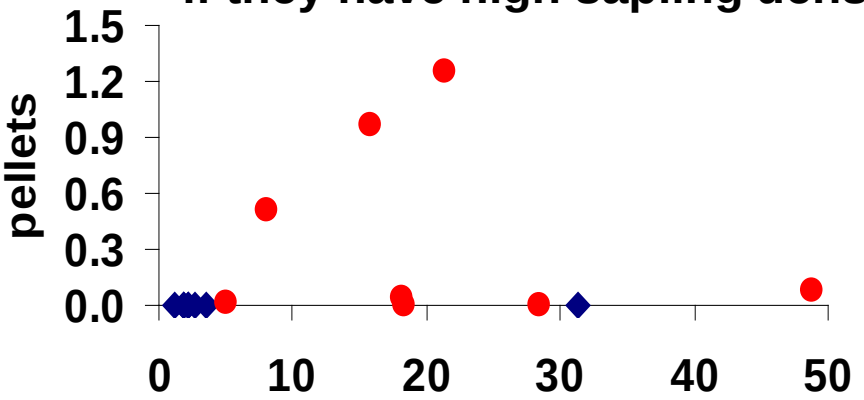
Yellowstone stands regenerating after the 1988 fires. . .



has hares

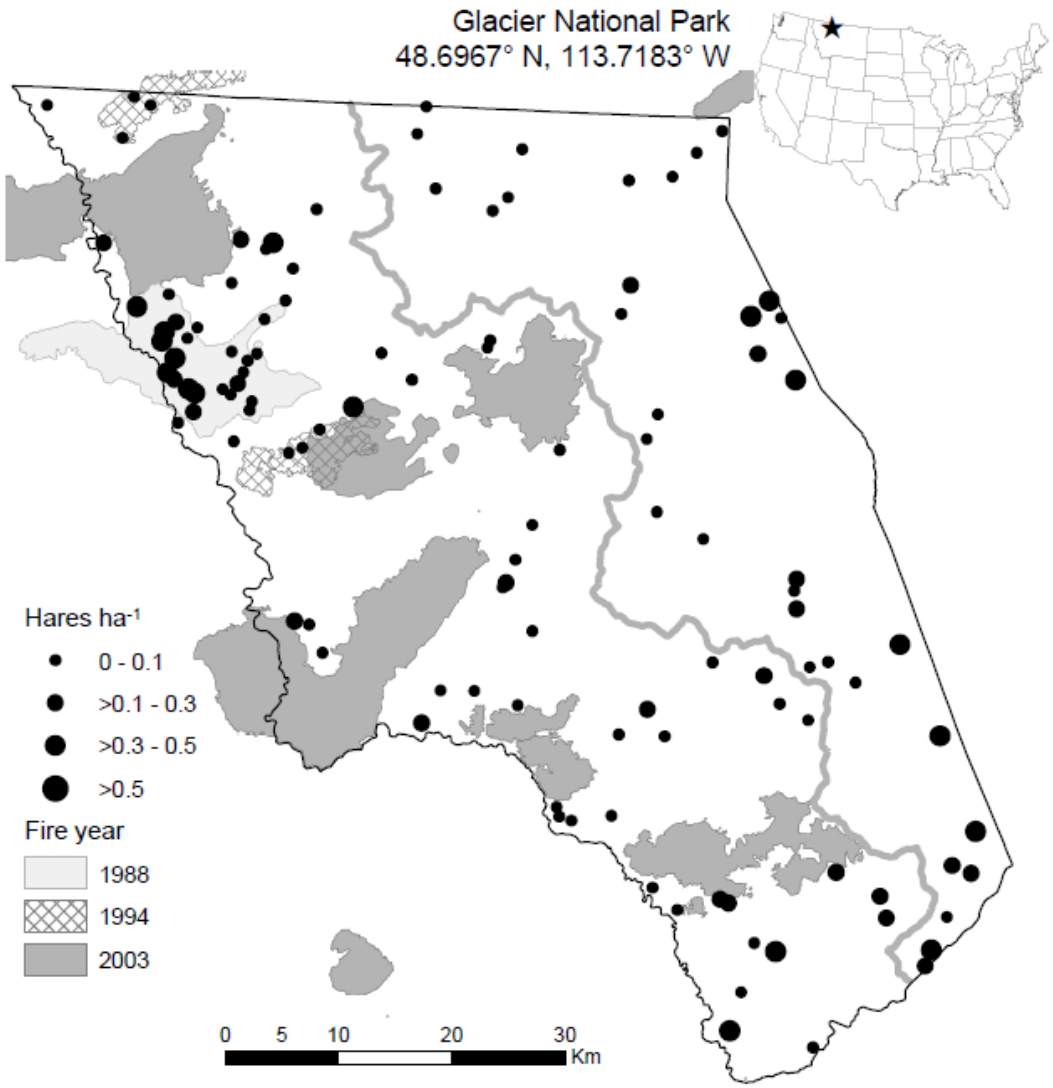
has no hares

are most likely to have hares
if they have high sapling densities



Hodges, Mills, and Murphy. 2009. J. Mammalogy 90:870-878

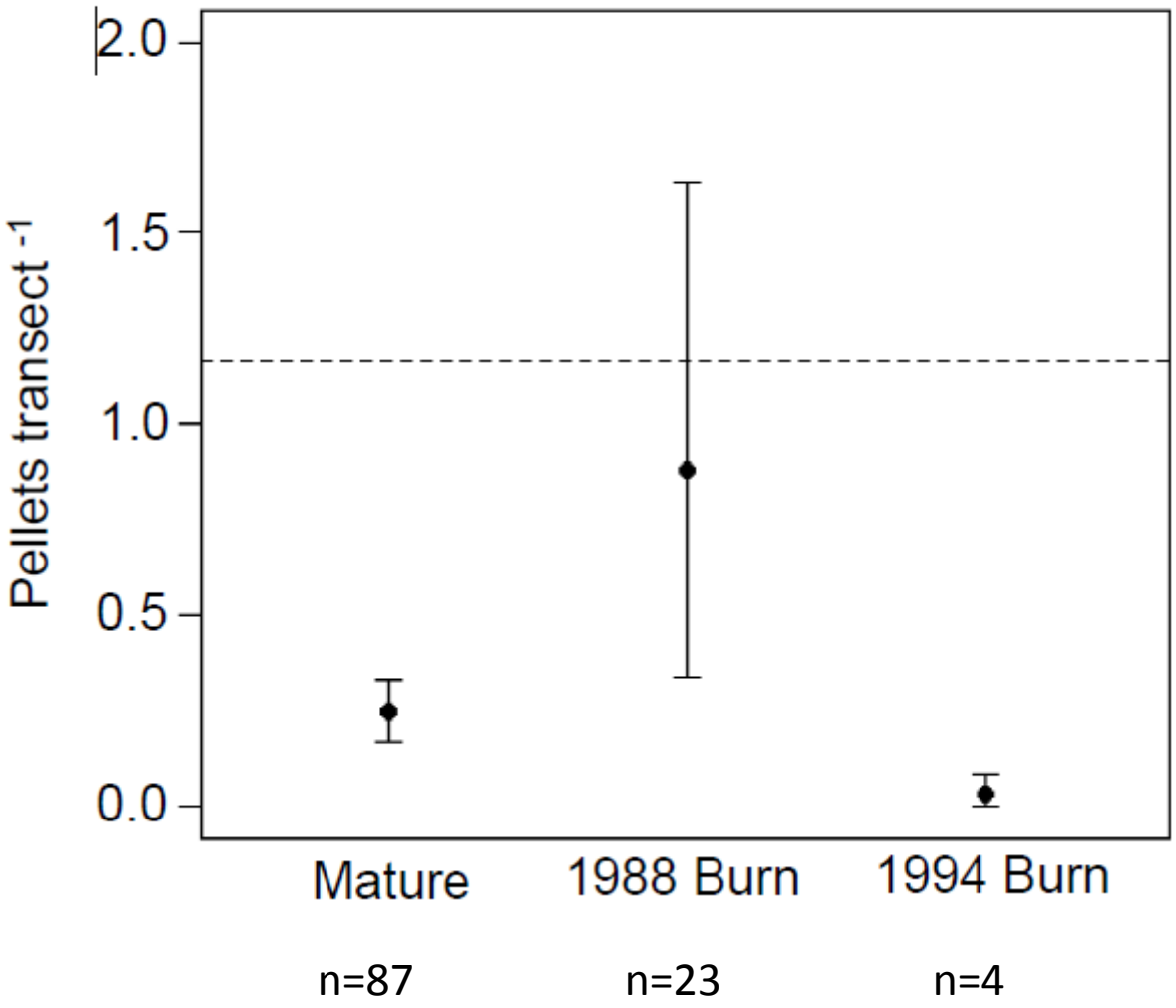
In Glacier National Park, we found similar patterns



data 2005-2007

Cheng, Hodges & Mills 2015. Fire Ecology 11:119-136.

High mean—and high variance—
in hare density in 1988 burns (17-19 yr post-fire)



Cheng, Hodges & Mills. 2015. Fire Ecology 11:119-136

Stands regenerating after 1988 fires: Glacier beats Yellowstone

	Yellowstone (2002-2007)	Glacier (2005-2007)
sites with hare pellets	47%	80%
maximum density (hares/ha)	1.3	2.4
average density	0.14	0.39
average density for sites with hares	0.27	0.49

Cheng, Hodges & Mills 2015, Hodges et al. 2009

Speculation #1:
How many hares do we need to keep lynx around?

Problem 1: Tally Lake sites in western MT: regionally high hares, but full of bobcats instead of lynx

Problem 2: Yellowstone has very low hare abundances, but has lynx

Problem 3: Spatial scales for "regional density" poorly articulated (lynx home range sizes vary, presumably partly in response to hare densities)

Problem 4: Lynx diets vary; we know less about red squirrel abundances than hare abundances

Speculation #2:
Future distribution and abundance of snowshoe hares

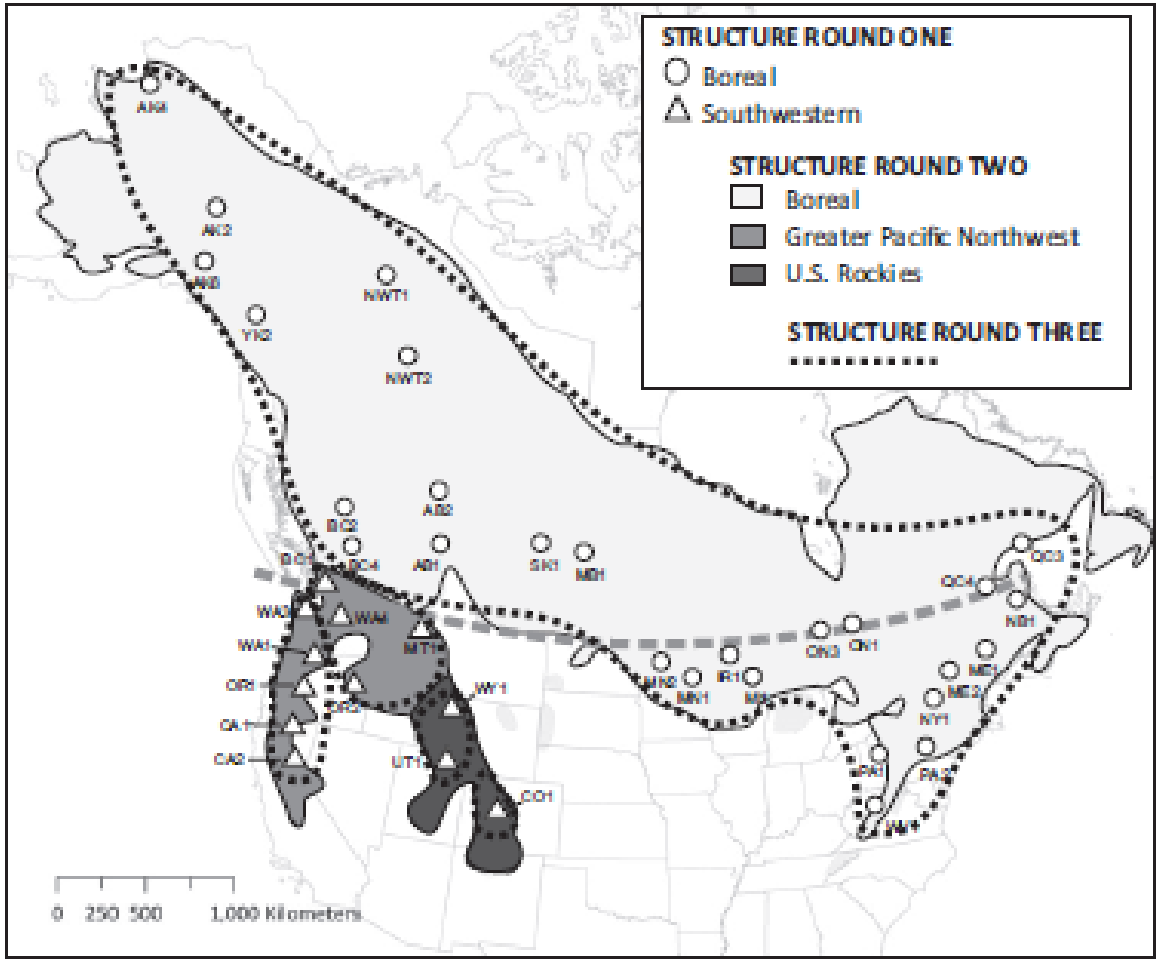
With very high confidence:
if we completely lose southern boreal / montane forest, hare numbers will decline in those areas.

1. **Forest loss (harvest, thinning, fire), will mean fewer hares at least for a few years.**
   Unknown impacts of salvage logging post-fire.

2. **We know more about hares and trees than about hares and shrubs. But understory cover and browse are very important to hares.**

3. **We don't know much about hares and winter snows (a few regional models, not much local or specific)**

Speculation #3:
Some hare lineages may be at risk themselves (or may respond differently to upcoming challenges)



High gene flow across boreal range

High genetic structure in southern range

Cheng et al. 2014. Molecular Ecology 23:2929-2942.

Speculation #4:
Impacts of climate change on snowshoe hares?

1. **Fires, insect outbreaks, changed forest regeneration**
   --habitat structure matters to hares, so changed habitats means changed distribution / abundance

2. **Coat colour issues?**
   --mismatch coat / forest floor may increase mortality
   --molt cue is daylength

2. **Changing forest community?**
   --Unclear impacts on hares of different predator communities
   --impacts of predation by bobcats, fisher, etc. are poorly known compared to raptors, lynx, coyote

Frontiers in snowshoe hare research

1. **Explaining regional variation in dynamics, peak abundance**

2. **Predicting post-fire re-colonization and density**

3. **Predicting responses to climate change (fires, winter snow pack, forest conditions: molt timing, physiology, demography)**

4. **Physiology – demography links (predation stress and reproduction)**