Evaluating wildfire-mediated vegetation change and climate-change refugia potential across Alberta boreal forests

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Alberta's climate is becoming warmer, drier and more variable. Our goal is to develop essential knowledge and tools to support the management of Alberta's biodiversity, our species and ecosystems, in a changing climate. Identifying the potential impacts of climate change on Alberta's species, ecosystems and human communities and incorporating that knowledge into today's decisions about land use, natural resource and species management can help avoid the need for ineffective, and potentially costly, actions in the future.

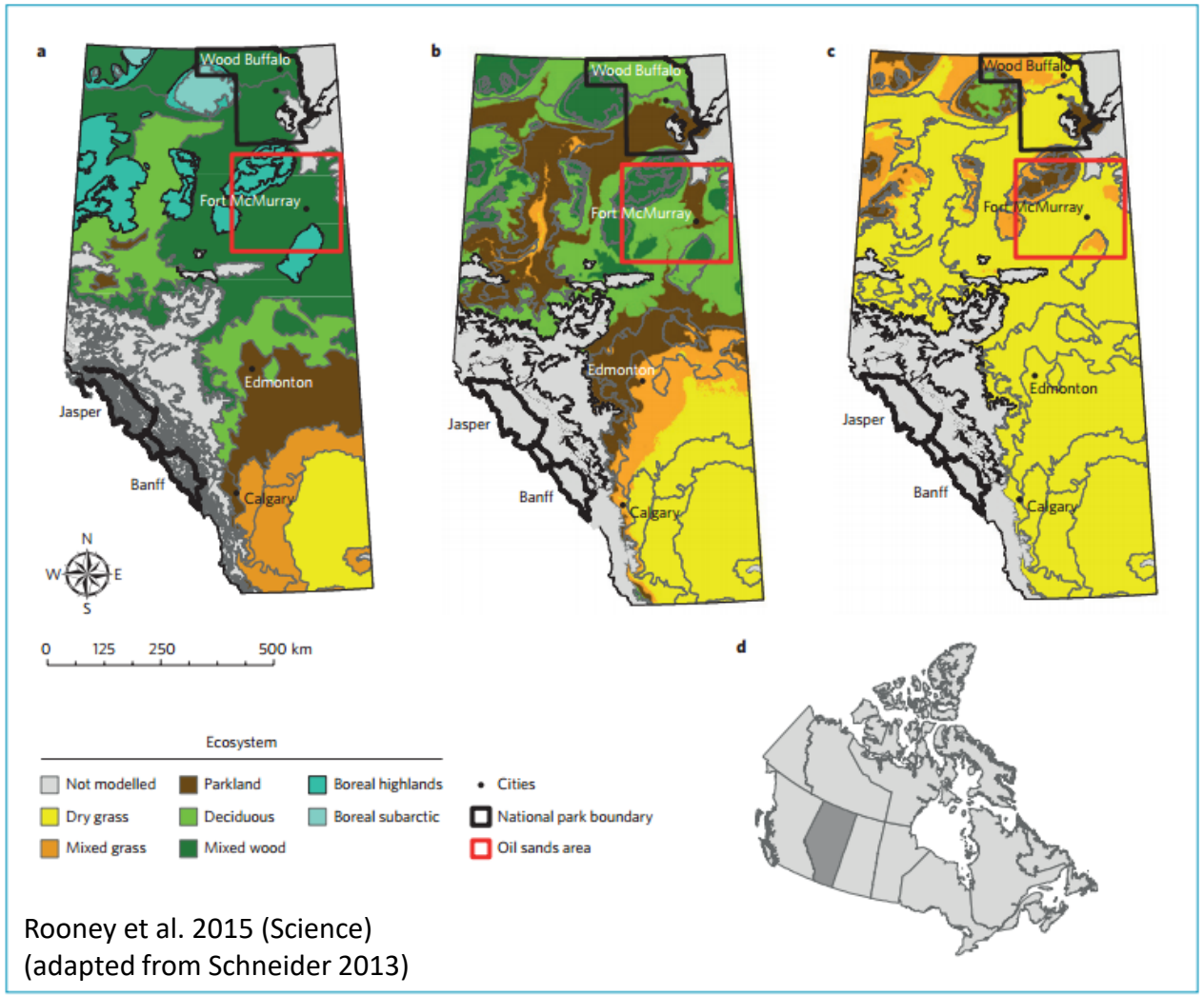
Climate Change Impacts

We're identifying the potential impacts of climate change on Alberta's species and ecosystems through a variety of mapping and analysis methods. We're predicting the consequences of climate change on our biodiversity is the first step towards integrating climate change into planning and decision-making in the province.

Field Projects

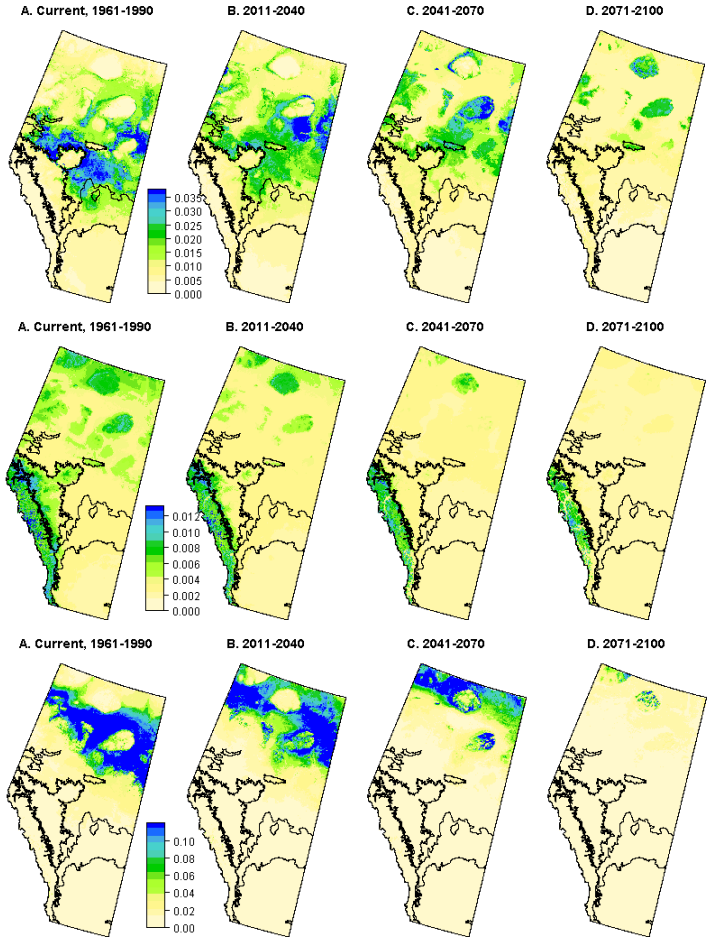
Our field projects are directed towards developing a better understanding of the relationships between today's climate and Alberta's biodiversity, including the ongoing survival of sensitive species like Burrowing Owls, Ferruginous Hawks and rare plants. Field experiments are also examining potential conservation actions that could support these species as climate change progresses.

Envelope models suggest near disappearance of climates suitable for Alberta's boreal forests



Rooney et al. 2015 (Science)
(adapted from Schneider 2013)

Figure 1 | Current and future distribution of ecoregions. **a–c**, Distribution of Albertan ecoregions in 2005 (**a**), and the range of predictions for 2080 based on relatively cool (**b**; HADCM3 B1) and hot (**c**; HADGEM A2) projections. **d**, The location of Alberta within Canada. Adapted from ref. 15, ABMI.



Stralberg et al. 2015 (Ecol. Appl.)

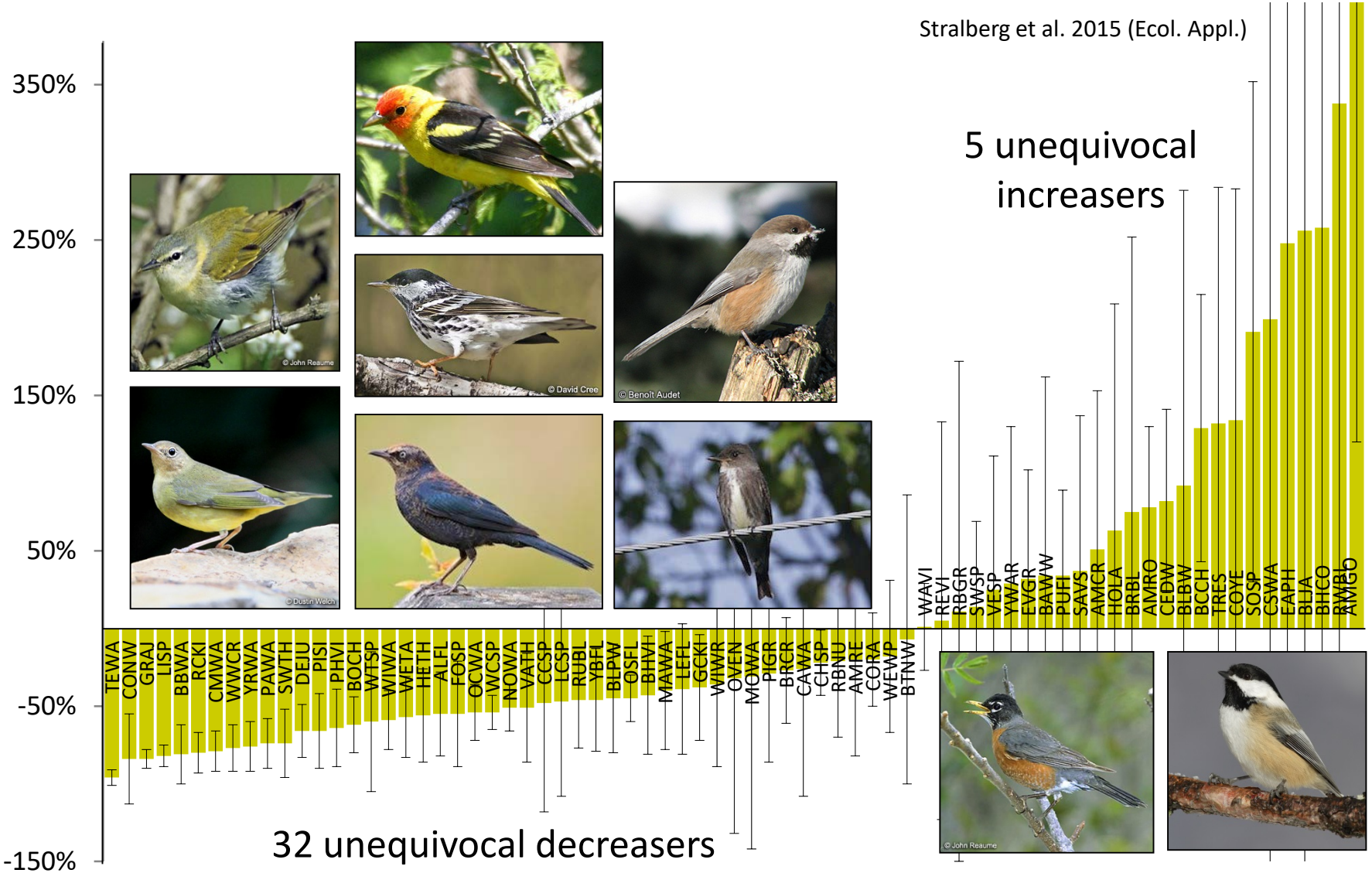
Canada Warbler

Olive-sided Flycatcher

Cape May Warbler

Suitable habitat for majority of Alberta boreal bird species projected to decline by 2100

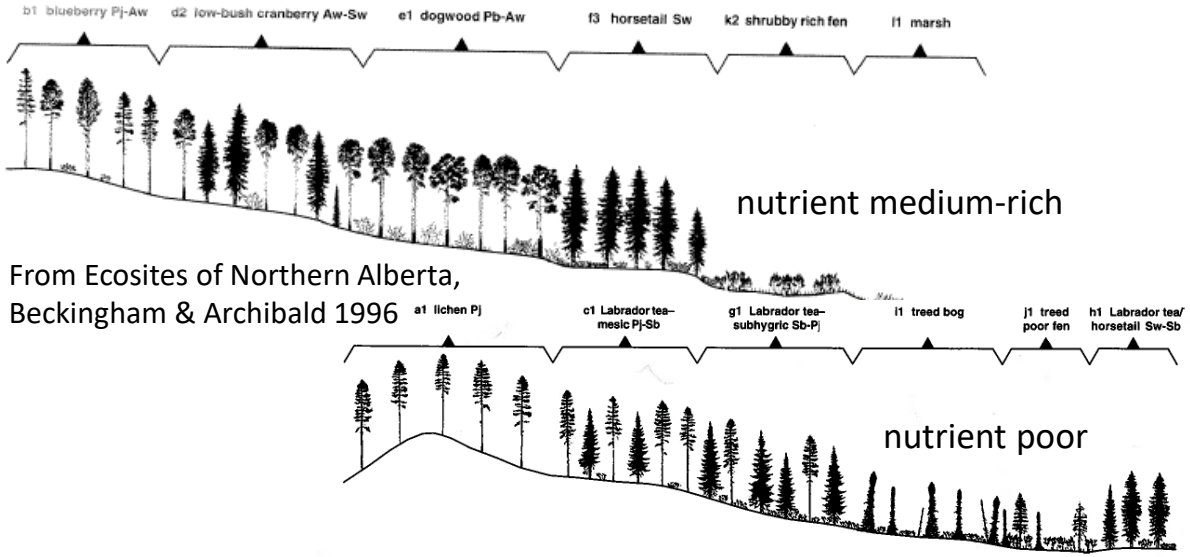
Stralberg et al. 2015 (Ecol. Appl.)



Forest transitions may not occur without disturbance

© B. de Groot, Coffee fire, Saskatchewan, 1980

Topography, geology, and soils will constrain change

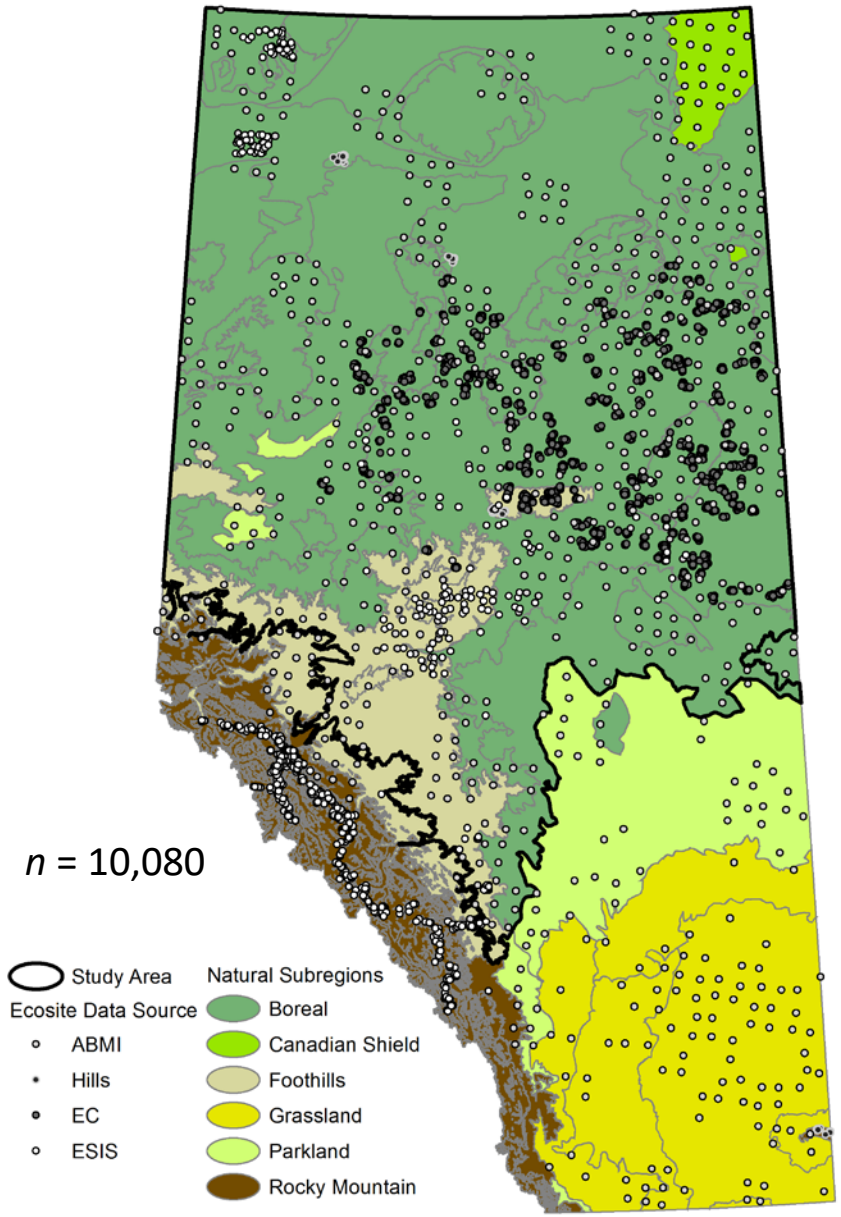


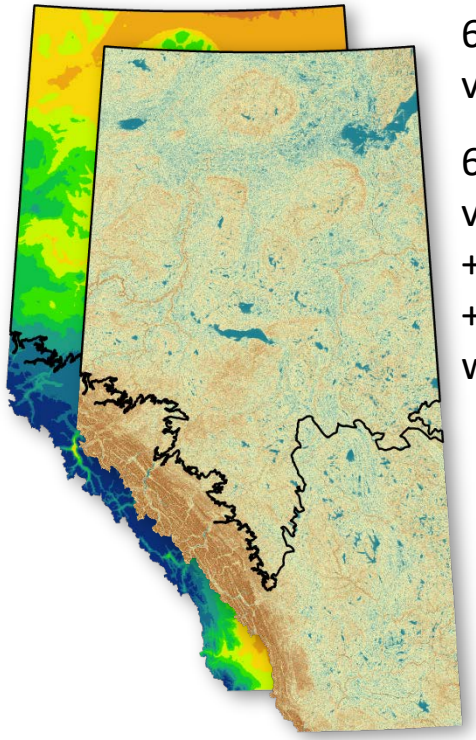
From Ecosites of Northern Alberta, Beckingham & Archibald 1996

Research questions

- What are realistic rates and spatial patterns of future vegetation change in northern Alberta, considering disturbance and physical constraints?
- What is the difference between climate-driven and “fire-mediated” vegetation change potential

ABMI monitoring data used to develop vegetation models

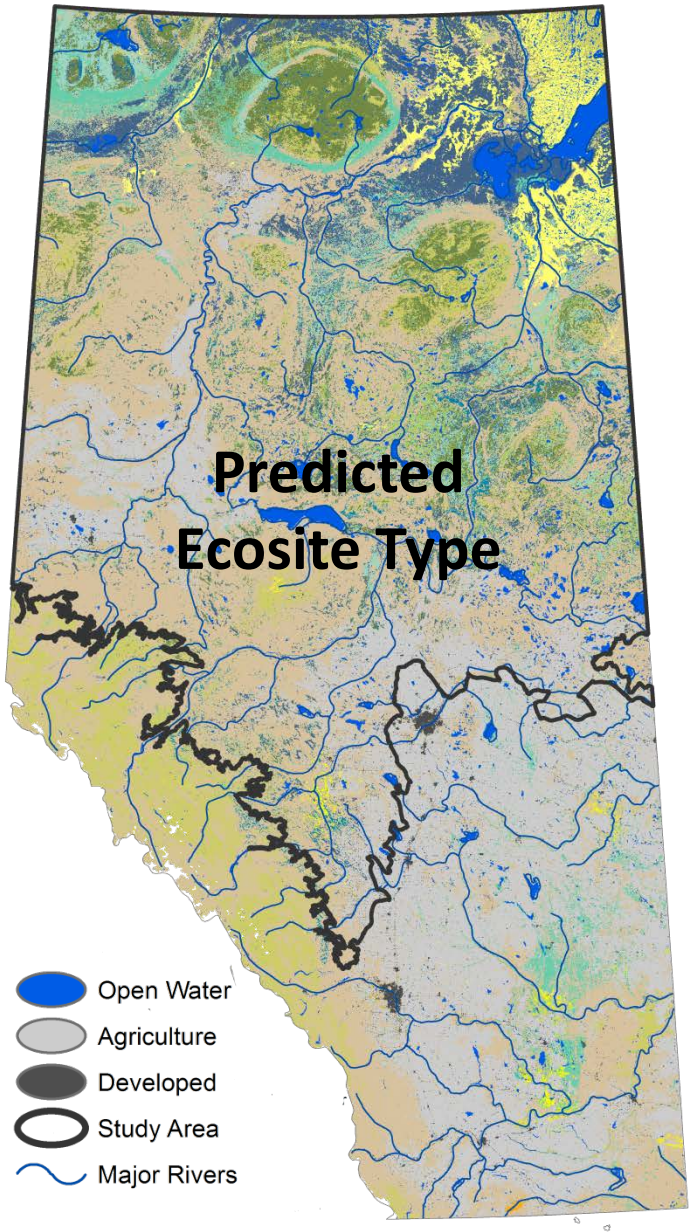


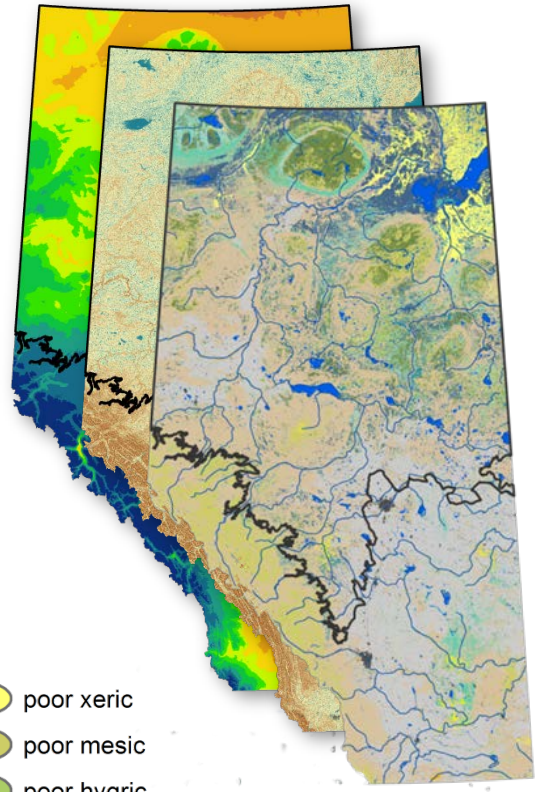


6 climate variables

6 terrain variables + geology + mapped wetlands

ABMI monitoring data used to develop vegetation models

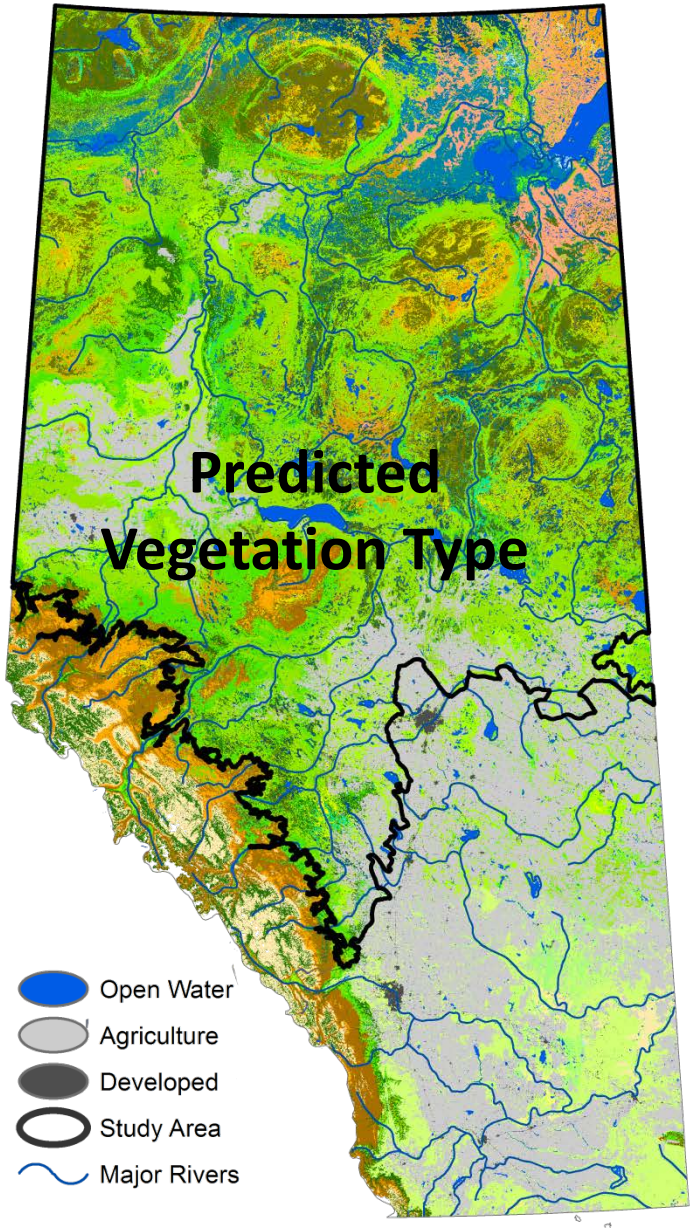




poor xeric
poor mesic
poor hygric
poor hydric (bog)
medium xeric
medium mesic
medium hygric
medium hydric (poor fen)
rich-mesic
rich hygric
rich hydric (rich fen)

Random forest model
62% cross-validation accuracy
(89% for medium-mesic)

ABMI monitoring data used to develop vegetation models



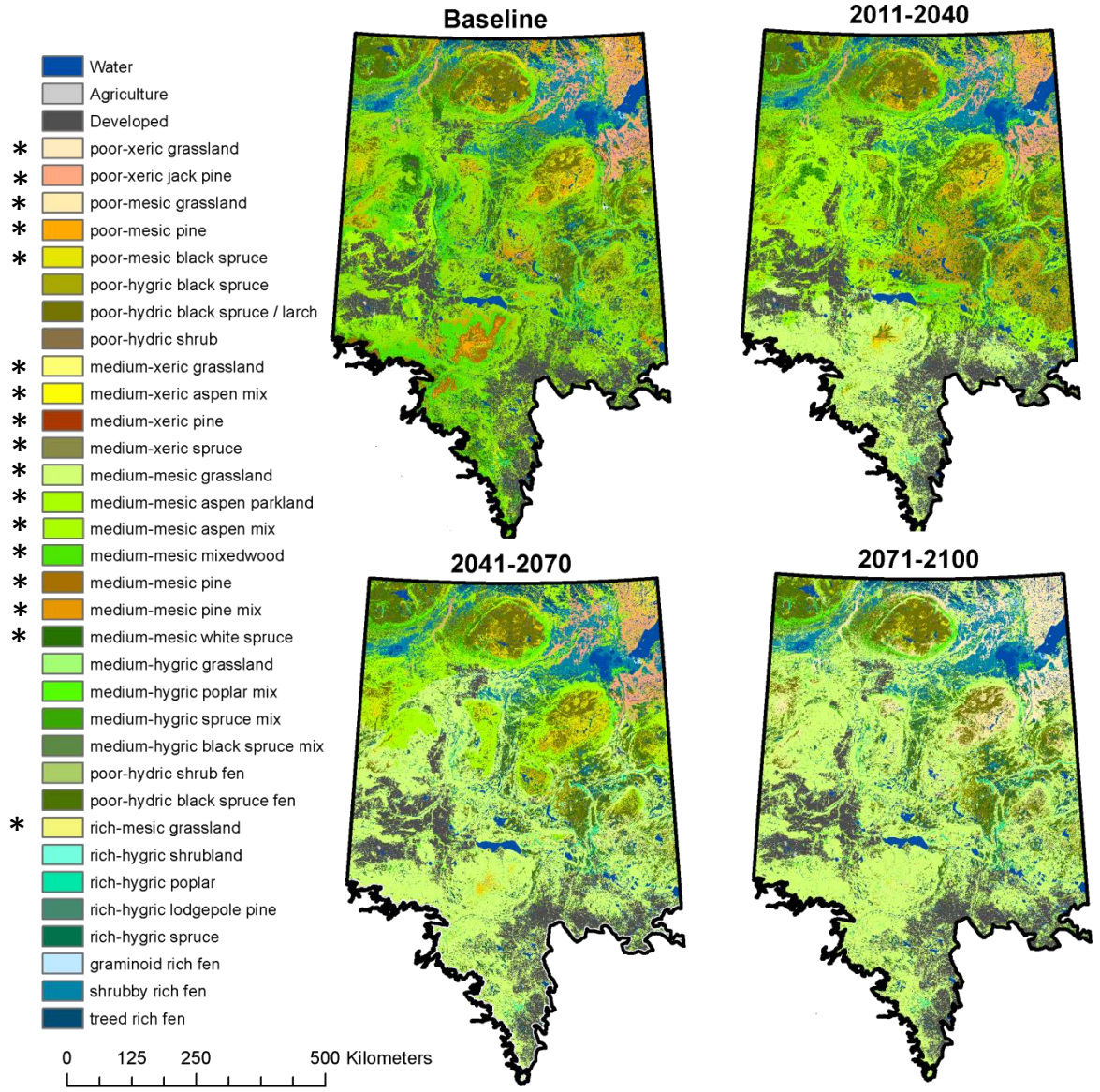
- Water
- Agriculture
- Developed
- * poor-xeric grassland
- * poor-xeric jack pine
- * poor-mesic grassland
- * poor-mesic pine
- * poor-mesic black spruce
- poor-hygric black spruce
- poor-hydric black spruce / larch
- poor-hydric shrub
- * medium-xeric grassland
- * medium-xeric aspen mix
- * medium-xeric pine
- * medium-xeric spruce
- * medium-mesic grassland
- * medium-mesic aspen parkland
- * medium-mesic aspen mix
- * medium-mesic mixedwood
- * medium-mesic pine
- * medium-mesic pine mix
- * medium-mesic white spruce
- medium-hygric grassland
- medium-hygric poplar mix
- medium-hygric spruce mix
- medium-hygric black spruce mix
- poor-hydric shrub fen
- poor-hydric black spruce fen
- * rich-mesic grassland
- rich-hygric shrubland
- rich-hygric poplar
- rich-hygric lodgepole pine
- rich-hygric spruce
- graminoid rich fen
- shrubby rich fen
- treed rich fen

* upland

Random forest model
81% cross-validation accuracy

500-m pixel resolution

Climate-driven vegetation change, constrained by physical site conditions

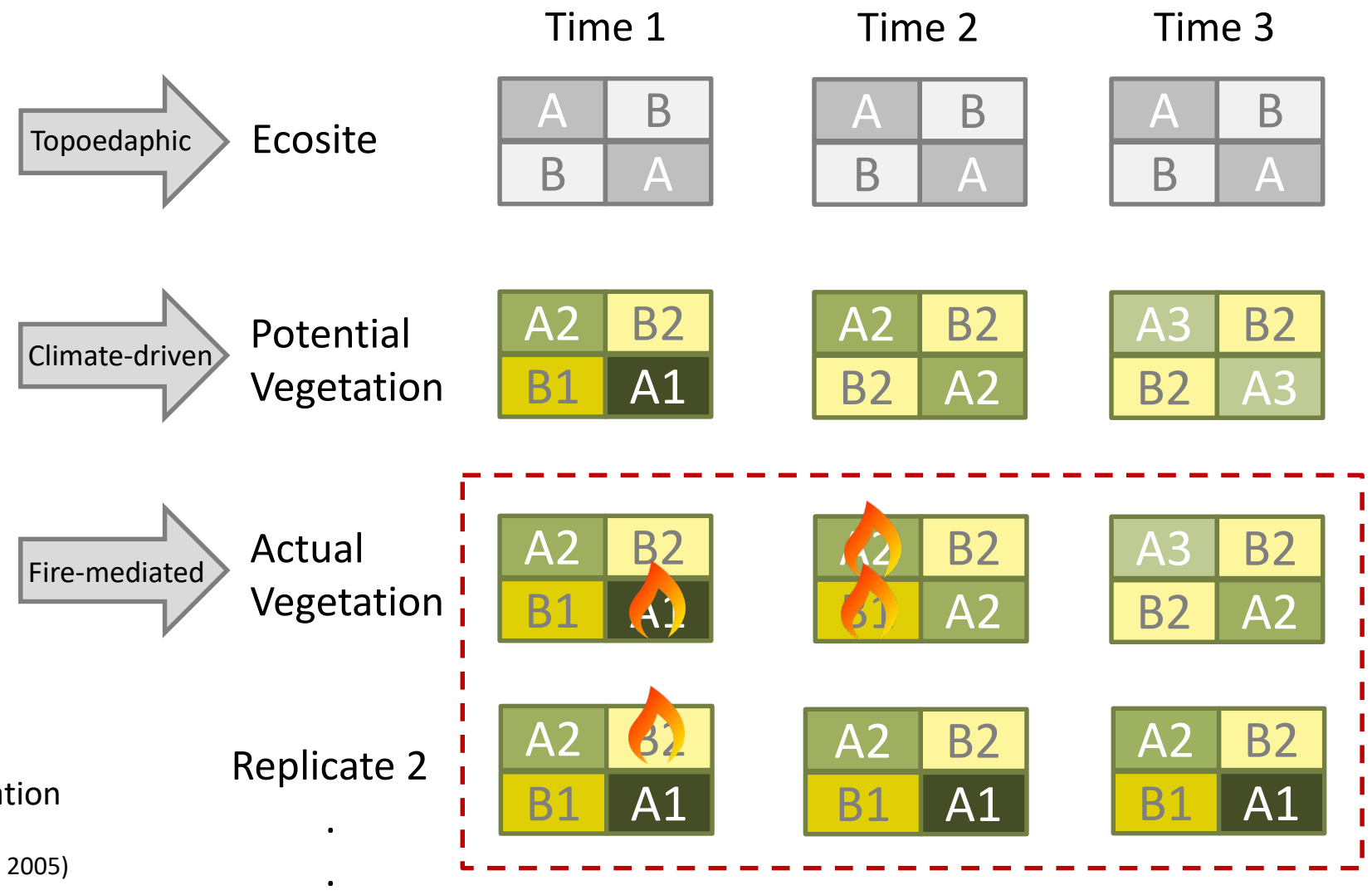


* Upland vegetation projected

Lowland vegetation held constant

CSIRO
Global Climate Model
RCP 8.5 (high emissions)

Fire-mediated vegetation change



Natural Resources Canada | Ressources naturelles Canada

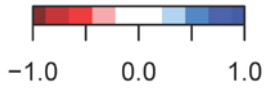
Canada

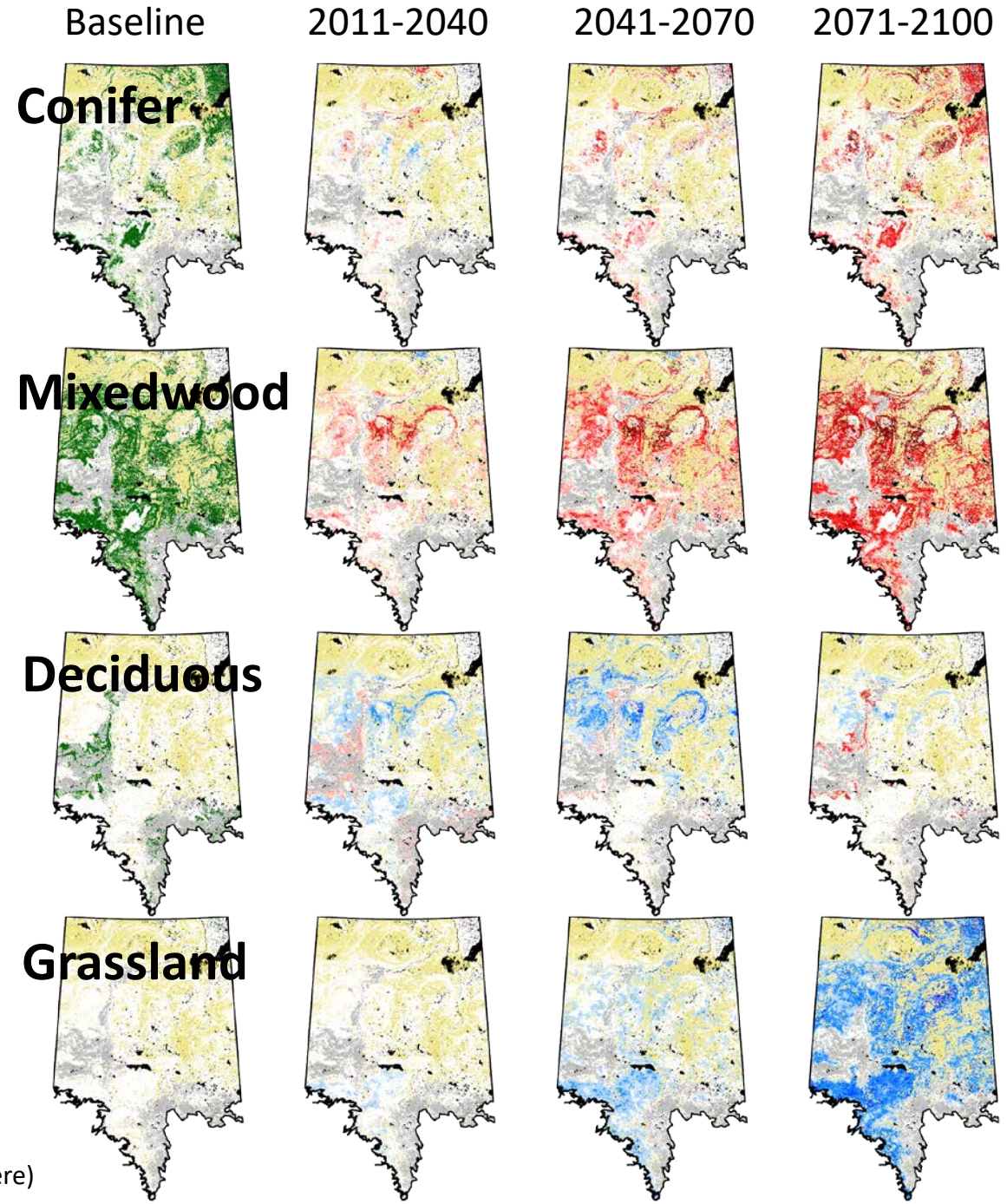
fire growth model .ca

Burn-P3
Fire simulation model
(Parisien et al. 2005)

Fire-mediated vegetation (constrained fire regime)

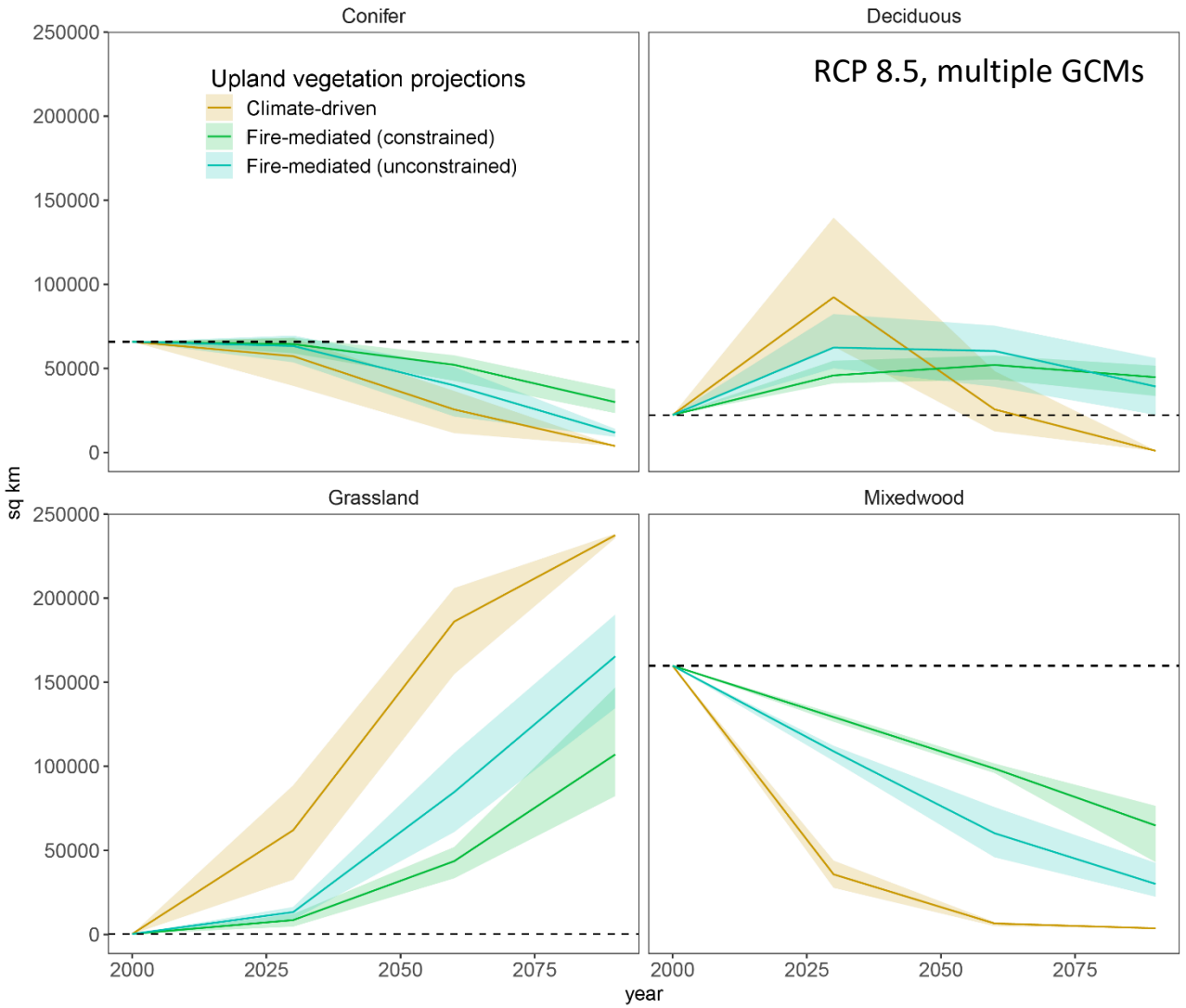
Proportional Change in cover type over multiple fuel iterations, Burn-P3 runs and GCMs (RCP 8.5)





Stralberg et al. 2018 (Ecosphere)

Climate-driven vs. fire-mediated vegetation scenarios



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Half of Alberta's boreal forest could disappear due to fires and climate change, study warns

COLETTE DERWORIZ, THE CANADIAN PRESS Updated: March 26, 2018

Canada's northern boreal forests are the largest storehouse of terrestrial carbon in the world. JEFF WELLS, BOREAL SONGBIRD INITIATIVE

SHARE

A study shows half of Alberta's boreal forest could disappear in just over 80 years due to wildfires and climate change.

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Wildfire-mediated vegetation change in boreal forests of Alberta, Canada

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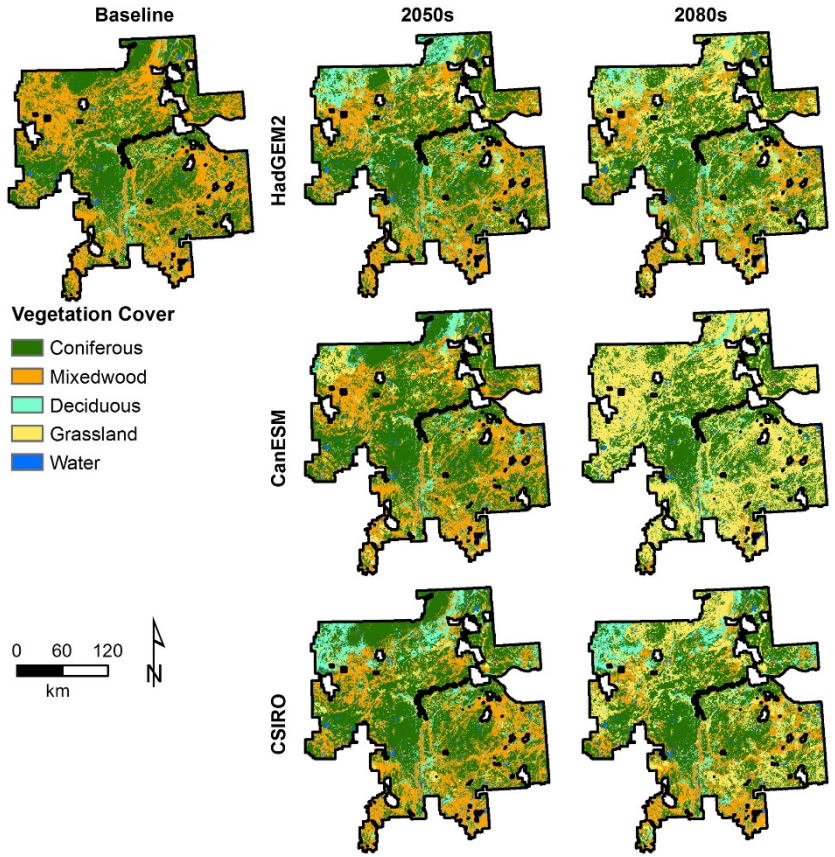
Conservation and Management Applications



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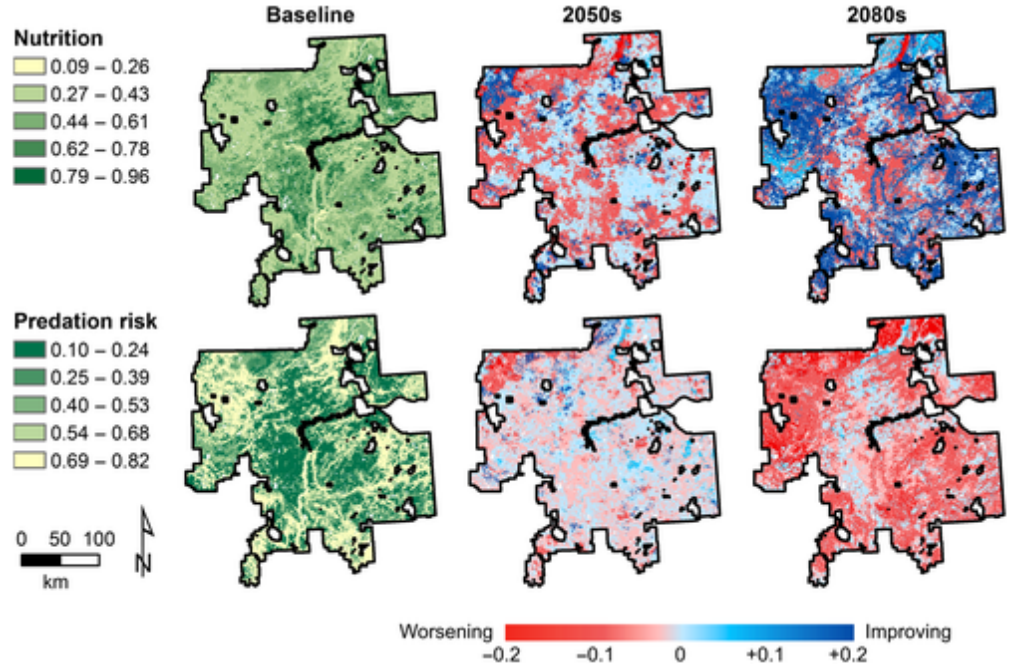
Potential impacts of climate change on the habitat of boreal woodland caribou

Quinn E. Barber, Marc-André Parisien, Ellen Whitman, Diana Stralberg, Chris J. Johnson, Martin-Hugues St-Laurent, Evan R. DeLancey, David T. Price, Dominique Arseneault, Xianli Wang, Mike D. Flannigan ... See fewer authors

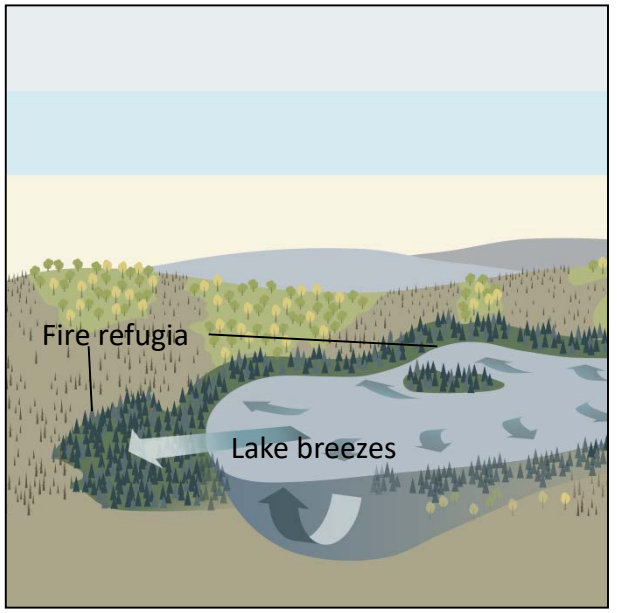
First published: 17 October 2018 | https://doi.org/10.1002/ecs2.2472



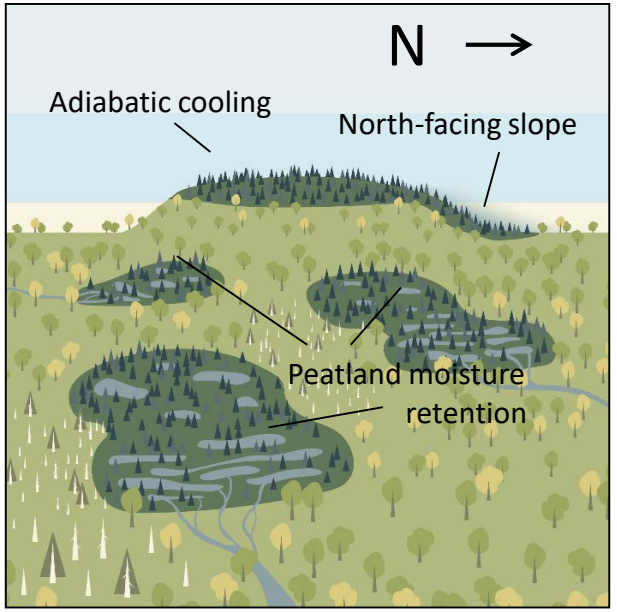
Summary and next steps

- Even under the current fire regime, fire is likely to catalyze rapid vegetation change
- Potential for much more dramatic vegetation change with more frequent and larger fires (knowledge gap)
- Next step is finer-scale identification of:
  - Fire refugia (e.g., lakeshores and islands) (Parisien et al. 2003, Fisichelli et al. 2012, Nielsen et al. 2016)
  - Topographic refugia (e.g. north slopes and valley bottoms) (Ashcroft et al. 2009, Dobrowski 2010)
  - Vegetation resilience (e.g., peatlands)

(Thompson et al. 2013, Waddington et al. 2015, Schneider et al. 2016)



Stralberg et al. in prep.



Thank you!

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