Using Simulation Models to Assess Impacts to Species at Risk and of Importance in Northern Ontario

A presentation to the working group for the Regional Assessment in the Ring of Fire Area

Matt Carlson, Integral Ecology Group

IEG
Integral Ecology Group

June 16, 2026

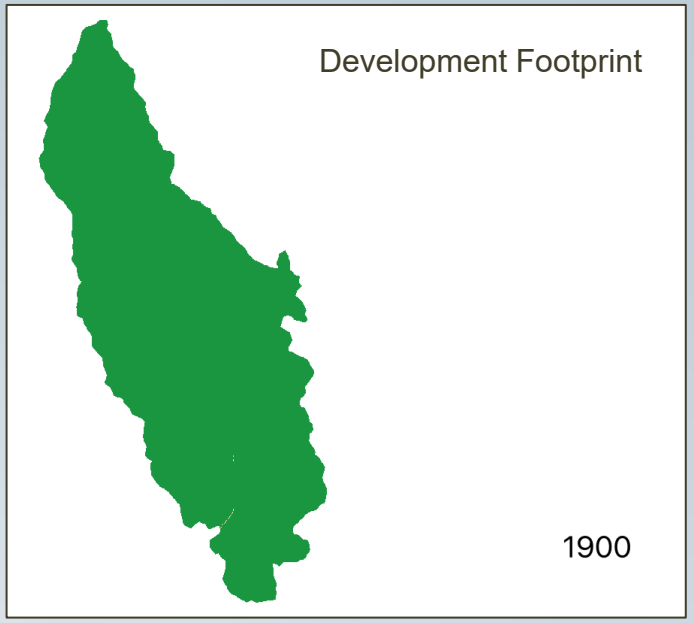
Background

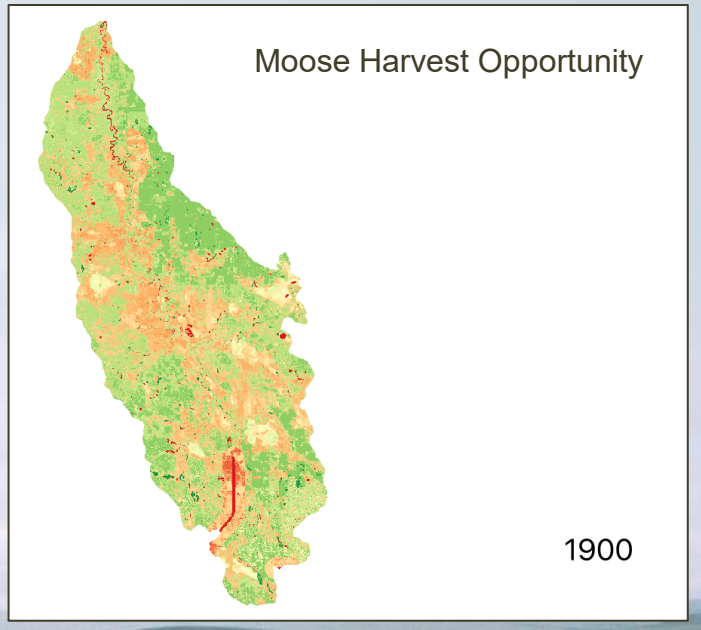
- IEG – support the maintenance and restoration of ecological and cultural integrity
- Cumulative effects assessment approach – Indigenous Knowledge and modeling
- Used by Nations in multiple Canadian jurisdictions including Ontario

IEG
Integral Ecology Group

The ALCES Simulation Platform

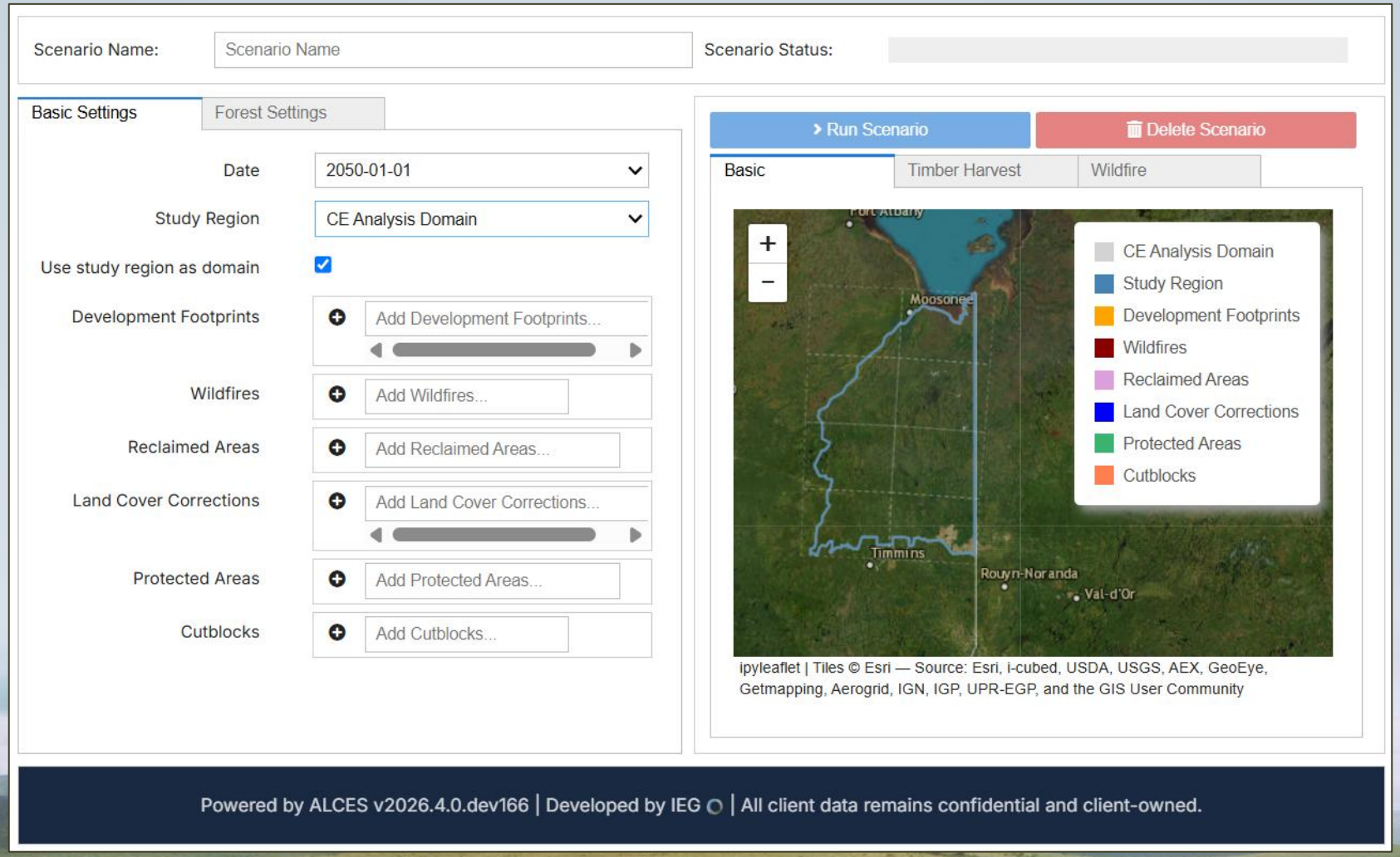
- Maps cumulative impacts to wildlife and Indigenous land use
- Simulates impacts over long time periods and large regions
- Builds capacity through custom tools that can be used by other organizations





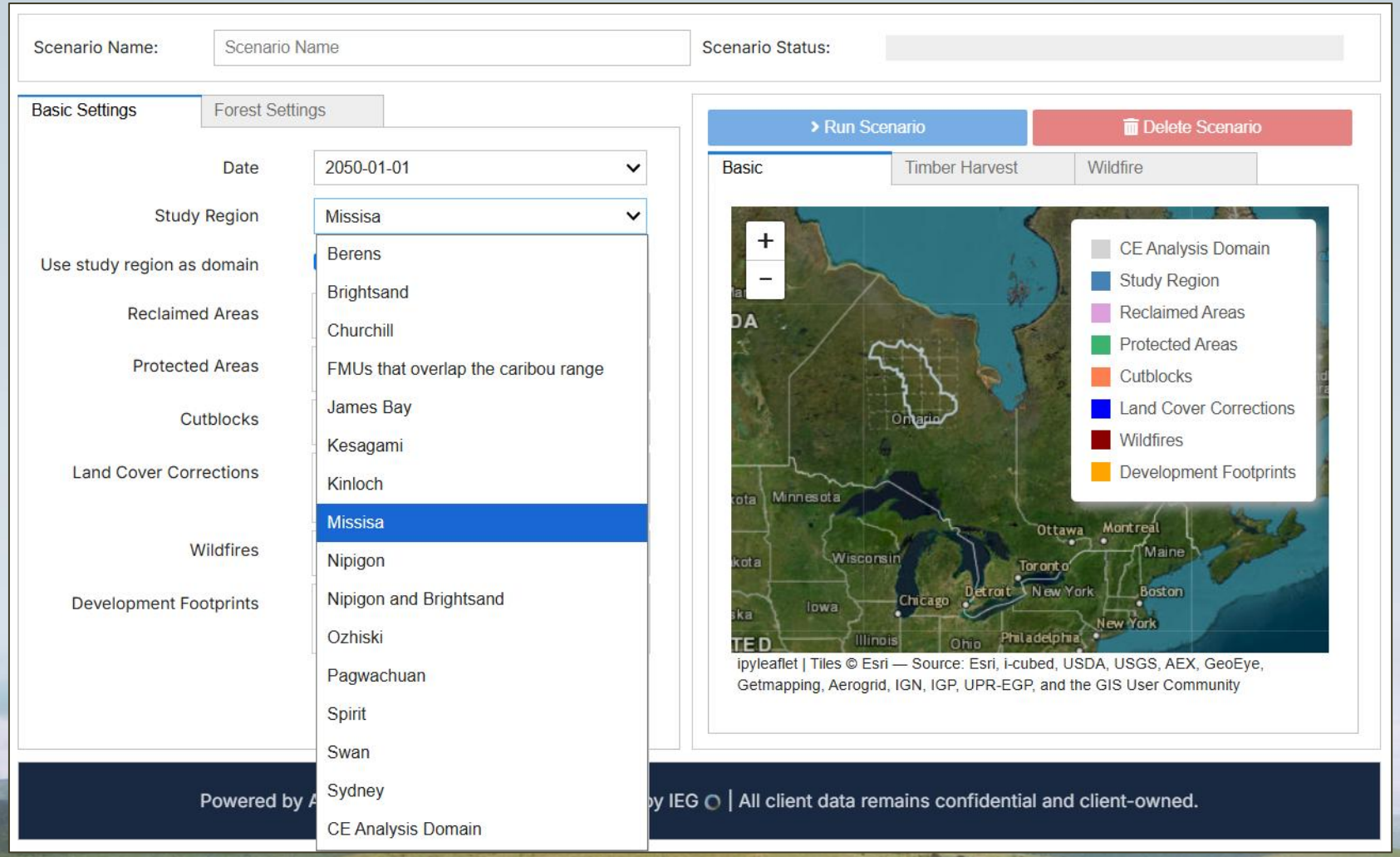
IEG
Integral Ecology Group

Use of ALCES in Northern Ontario
Moose Cree First Nation



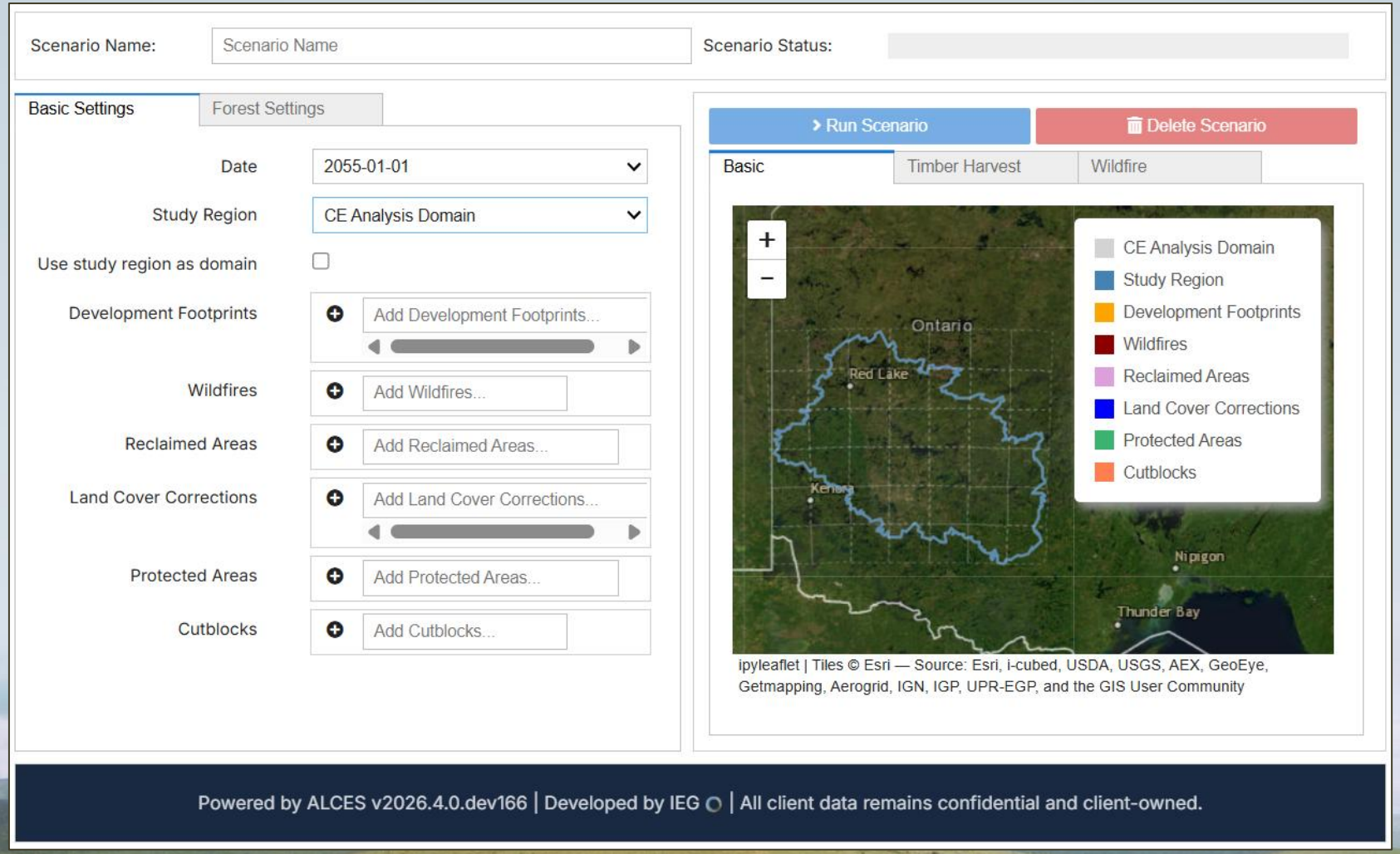
IEG Integral Ecology Group

Use of ALCES in Northern Ontario Government of Ontario



IEG Integral Ecology Group

Use of ALCES in Northern Ontario Wabauskang and Lac Seul First Nations



IEG Integral Ecology Group

Use of ALCES in Northern Ontario Natural Resources Canada

frontiers in Forests and Global Change

TYPE Original Research
PUBLISHED 04 June 2026
DOI 10.3389/ffgc.2026.1774480

Check for updates

OPEN ACCESS

EDITED BY
Cole Burton,
University of British Columbia, Canada

REVIEWED BY
Steven F. Wilson,
Consultant, Nanaimo, BC, Canada
Karine Pigeon,
Government of British Columbia, Canada

*CORRESPONDENCE
Effah Kwabena Antwi
effah.antwi@nrcan-rncan.gc.ca

RECEIVED 23 December 2025
REVISED 21 April 2026
ACCEPTED 28 April 2026
PUBLISHED 04 June 2026

CITATION
Antwi EK, Rempel RS, Carlson M, Darko AN and Yohuno (Apronti) PT (2026) An assessment of mitigation strategies for maintaining a balanced moose-wolf-caribou system in Ontario's ring of fire region.
Front. For. Glob. Change 9:1774480.
doi: 10.3389/ffgc.2026.1774480

An assessment of mitigation strategies for maintaining a balanced moose-wolf-caribou system in Ontario's ring of fire region

Effah Kwabena Antwi[1]*, Robert S. Rempel[2], Matthew Carlson[3], Akua Nyamekye Darko[1] and Priscilla Toloo Yohuno (Apronti)[1]

[1]Department of Natural Resources, Ottawa, ON, Canada, [2]FERIT Environmental Consulting, Thunder Bay, ON, Canada, [3]Integral Ecology Group, Ottawa, ON, Canada

Effective resource management is crucial for preserving global biodiversity. This paper employs scenario-based analysis of different mitigation strategies to assess their effectiveness and feasibility in addressing the cumulative impacts of resource development in Northern Ontario's Ring of Fire, a region that represents one of the largest remaining intact forest landscapes in North America, capable of supporting natural levels of biodiversity and traditional Indigenous land use practices. The scenario analysis was conducted to explore the consequences of resource development, fire, climate change, harvest, and proposed management strategies on the moose-wolf-caribou system in the Ring of Fire region. Specifically, the simulations assess the potential effectiveness of wolf control, maternal caribou penning, and moose harvest in maintaining a balanced predator–prey system. This modelling project was completed in the Mississa and Ozhizki caribou ranges, covering 108,000 km^2 of northern Ontario. Through the scenario analysis, we combined integrated landscape and population simulators to compare different management strategies aimed at conserving caribou and maintaining opportunities for moose harvest. The models and results presented here help identify the range of plausible outcomes and relative effort required for mitigation. The study concludes that to foster an effective wildlife management and maintain ecological balance among caribou, wolves and moose amid development pressures in the Ring of Fire region, a holistic, integrated science-based and community-led mitigation strategy is required.

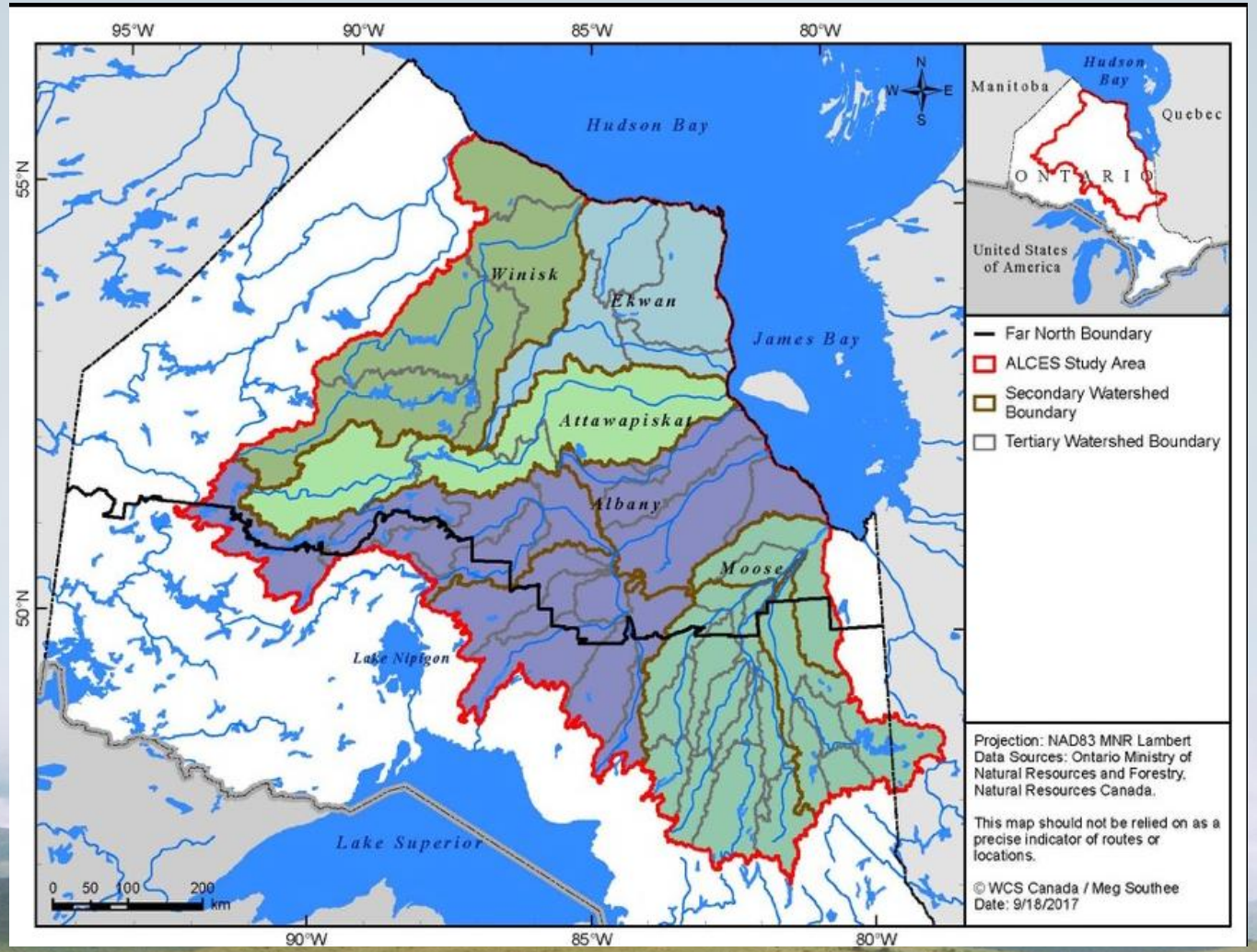
KEYWORDS
cumulative effect assessment, mitigation strategies, moose-wolf-caribou system, resource development, ring of fire, scenario analysis

1 Introduction

Ontario's Far North represents one of the largest remaining intact forest landscapes in North America, capable of supporting natural levels of biodiversity and traditional Indigenous land use practices. Maintaining these functions in the face of climate change and potential future development requires balanced predator–prey populations such as the moose-wolf-caribou system. The region's Ring of Fire mineral deposit has been selected for regional assessment under the new Canadian Impact Assessment Act (Impact Assessment Agency of

IEG Integral Ecology Group

Use of ALCES in Northern Ontario
WCS Canada



IEG
Integral Ecology Group

Use of ALCES in Northern Ontario

Case Studies

- Moose Cree First Nation
- Government of Ontario
- Natural Resources Canada
- Wabauskang and Lac Seul First Nations
- WCS Canada

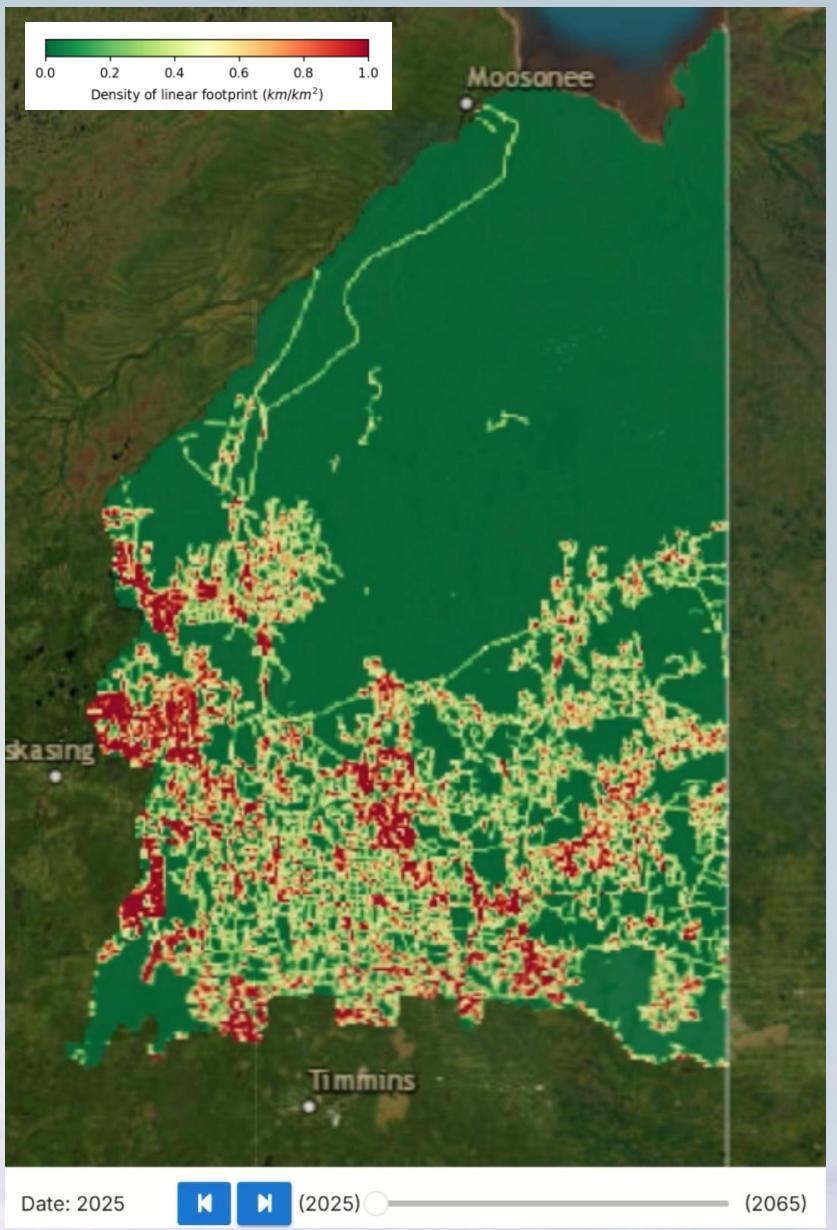
Impacts on wildlife

- Habitat fragmentation
- Climate change
- Migration
- Consequences to traditional ways of life

IEG
Integral Ecology Group

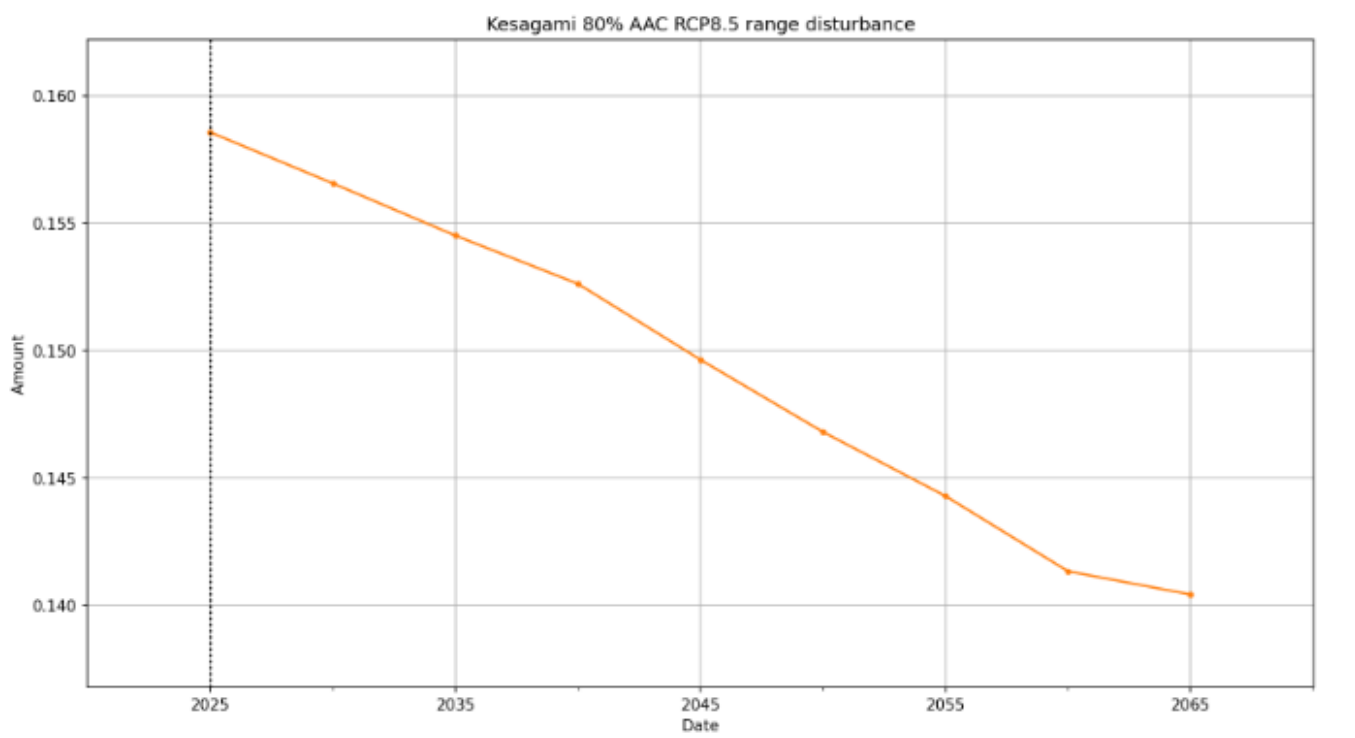
Impacts of Fragmentation and Climate Change

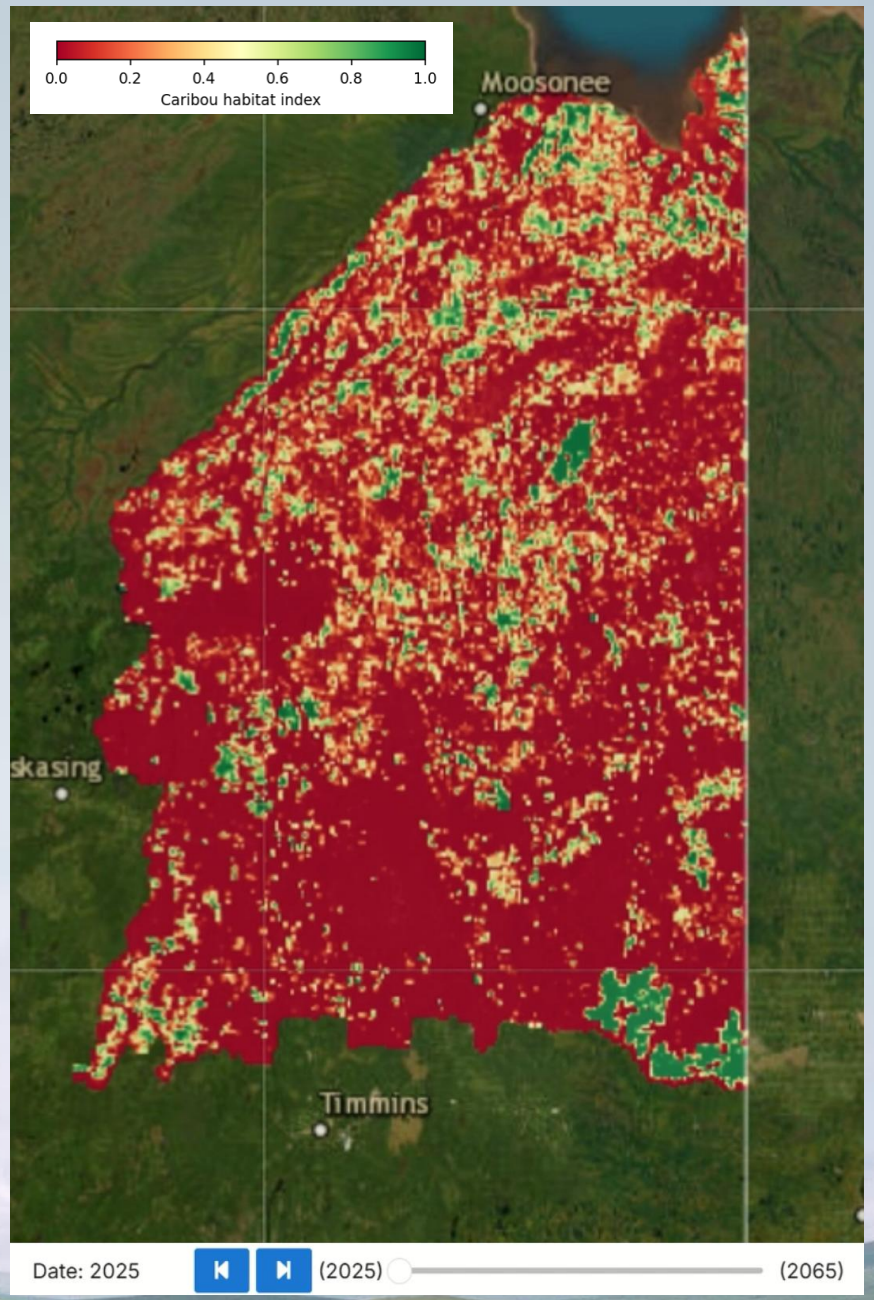
- Moose Cree First Nation with funding from the Caribou Conservation Stewardship Program
- Impacts and mitigation strategies
  - Kesagami caribou herd
  - Moose harvest



IEG Integral Ecology Group

Impacts of Fragmentation
Caribou Summer Habitat

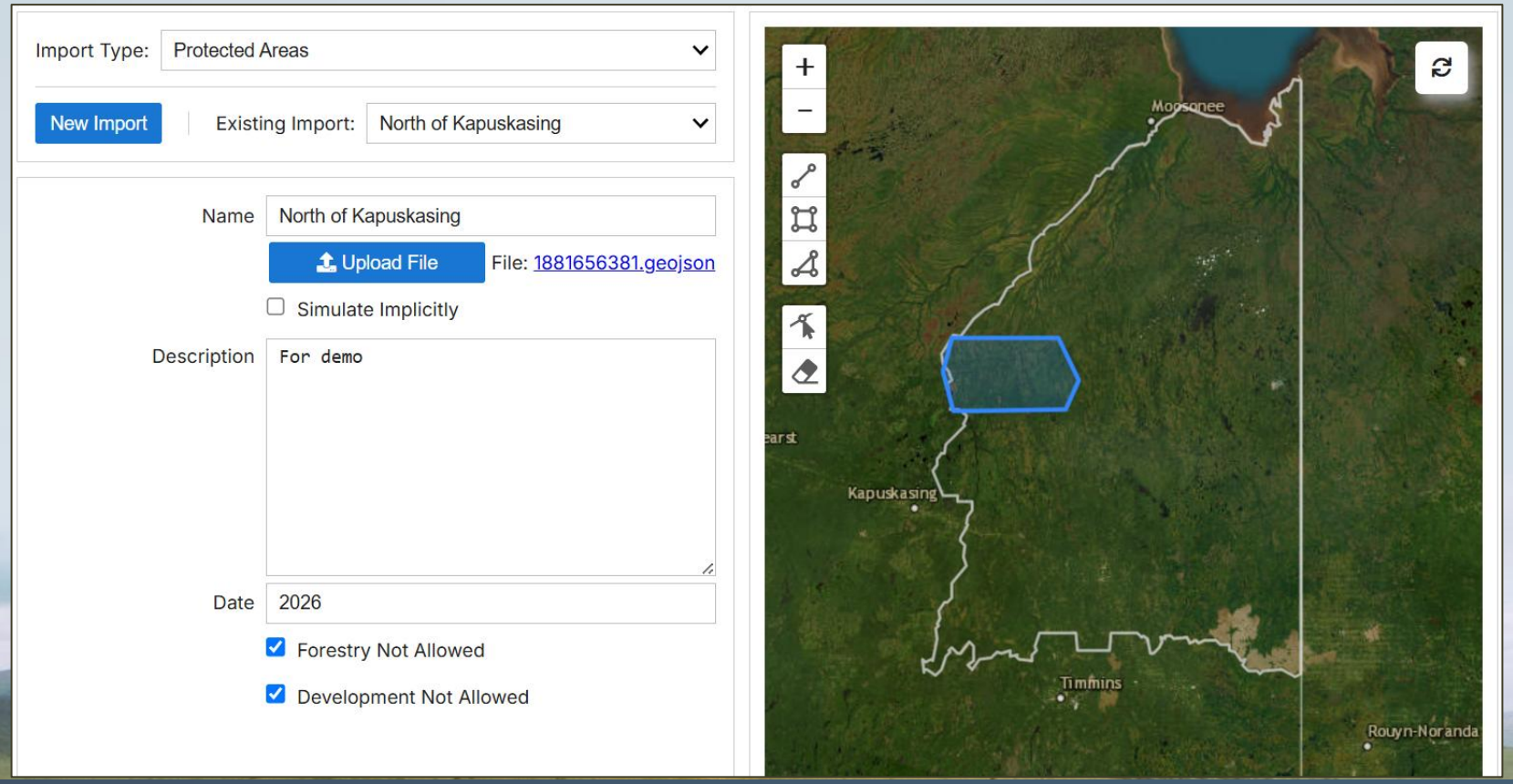




IEG
Integral Ecology Group

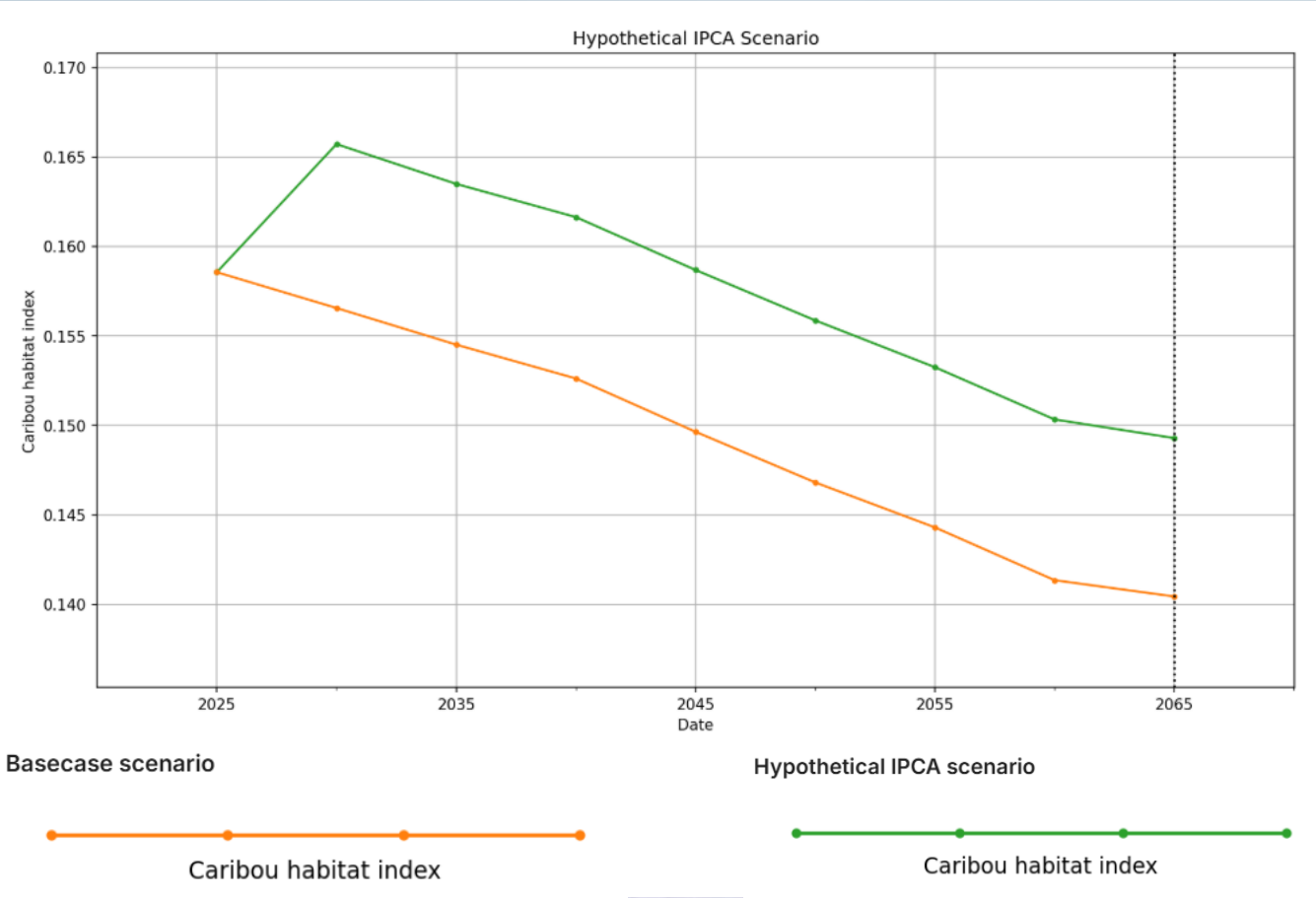
Conservation Planning

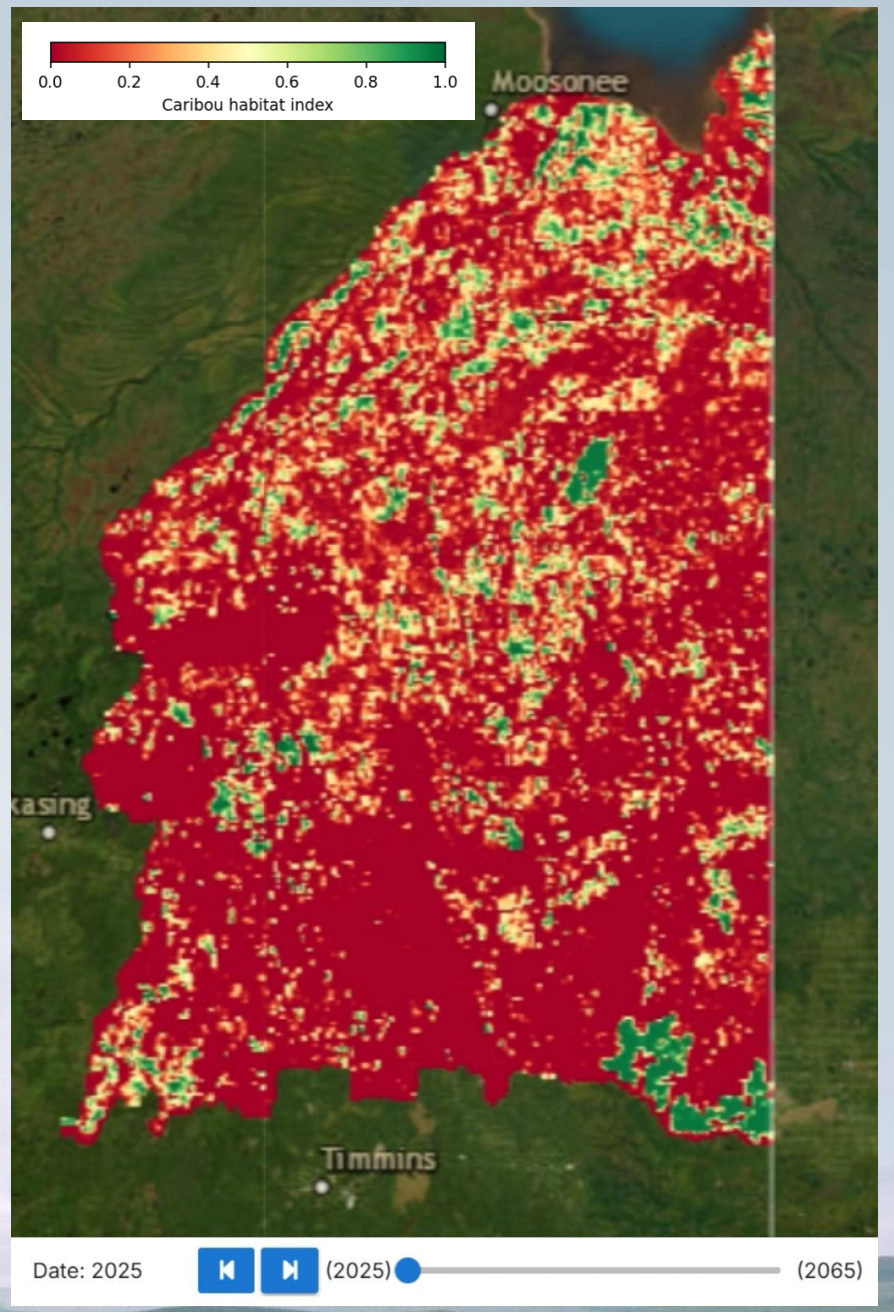
- Apply ALCES to explore conservation scenarios
- Hypothetical example



IEG
Integral Ecology Group

Conservation Planning

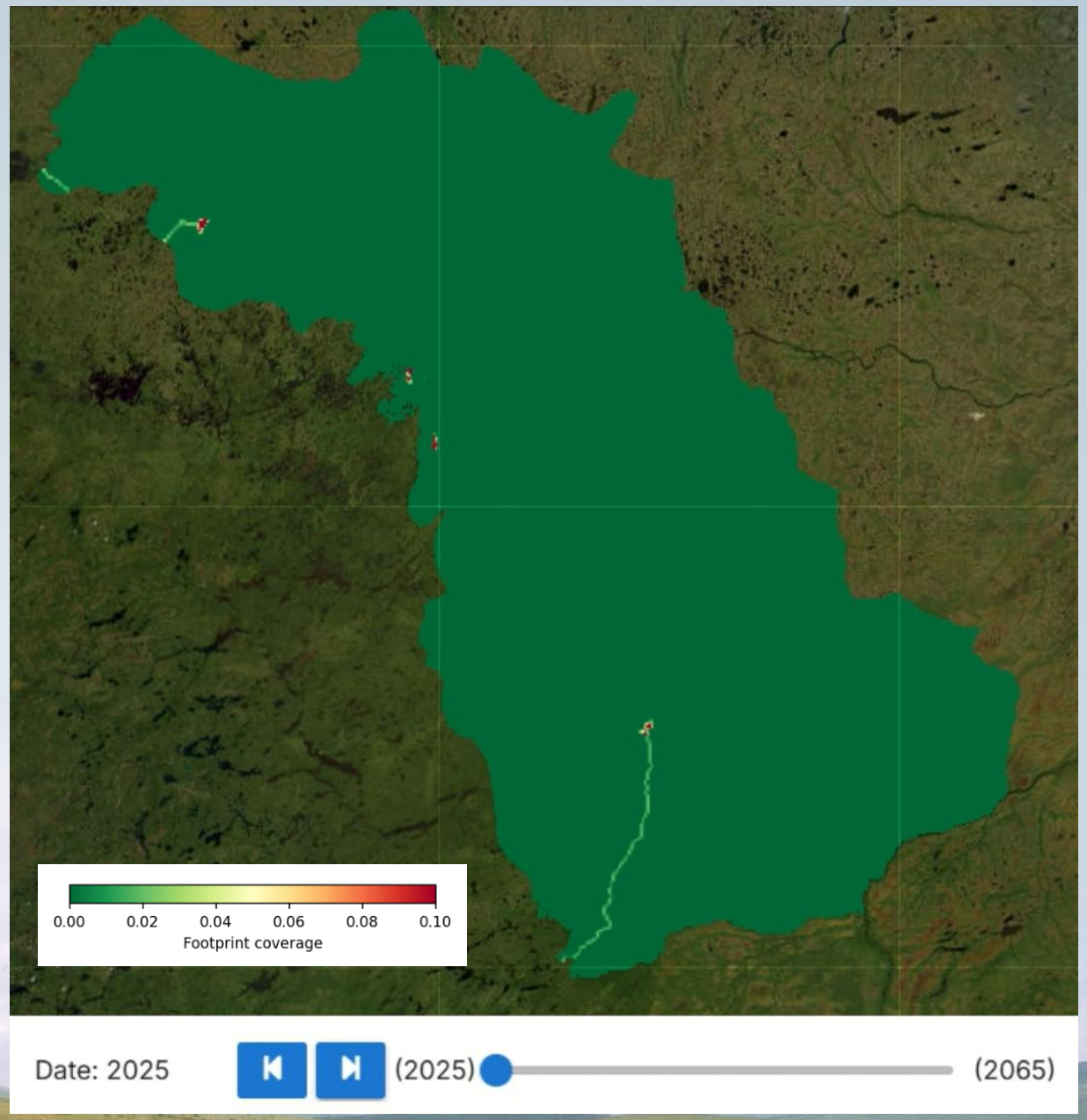




IEG
Integral Ecology Group

Impacts of Fragmentation and Climate Change

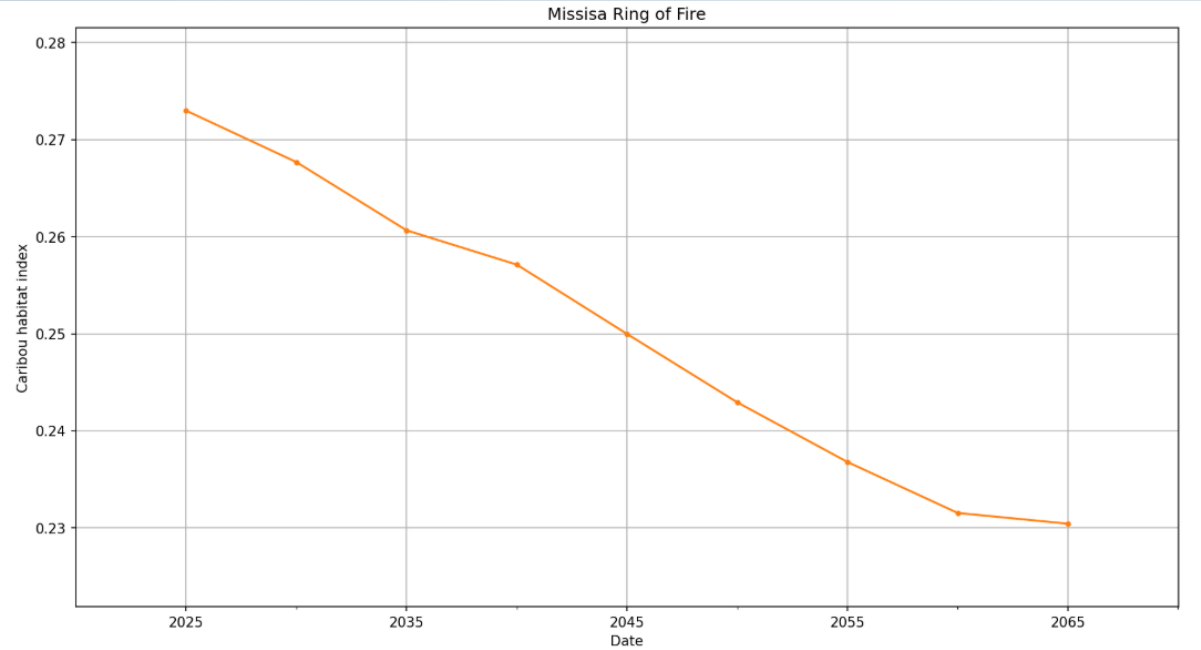
- Government of Ontario's Caribou Conservation Stewardship Program
- Parameterization of ALCES for all caribou ranges
- Ring of Fire – Missisa Range

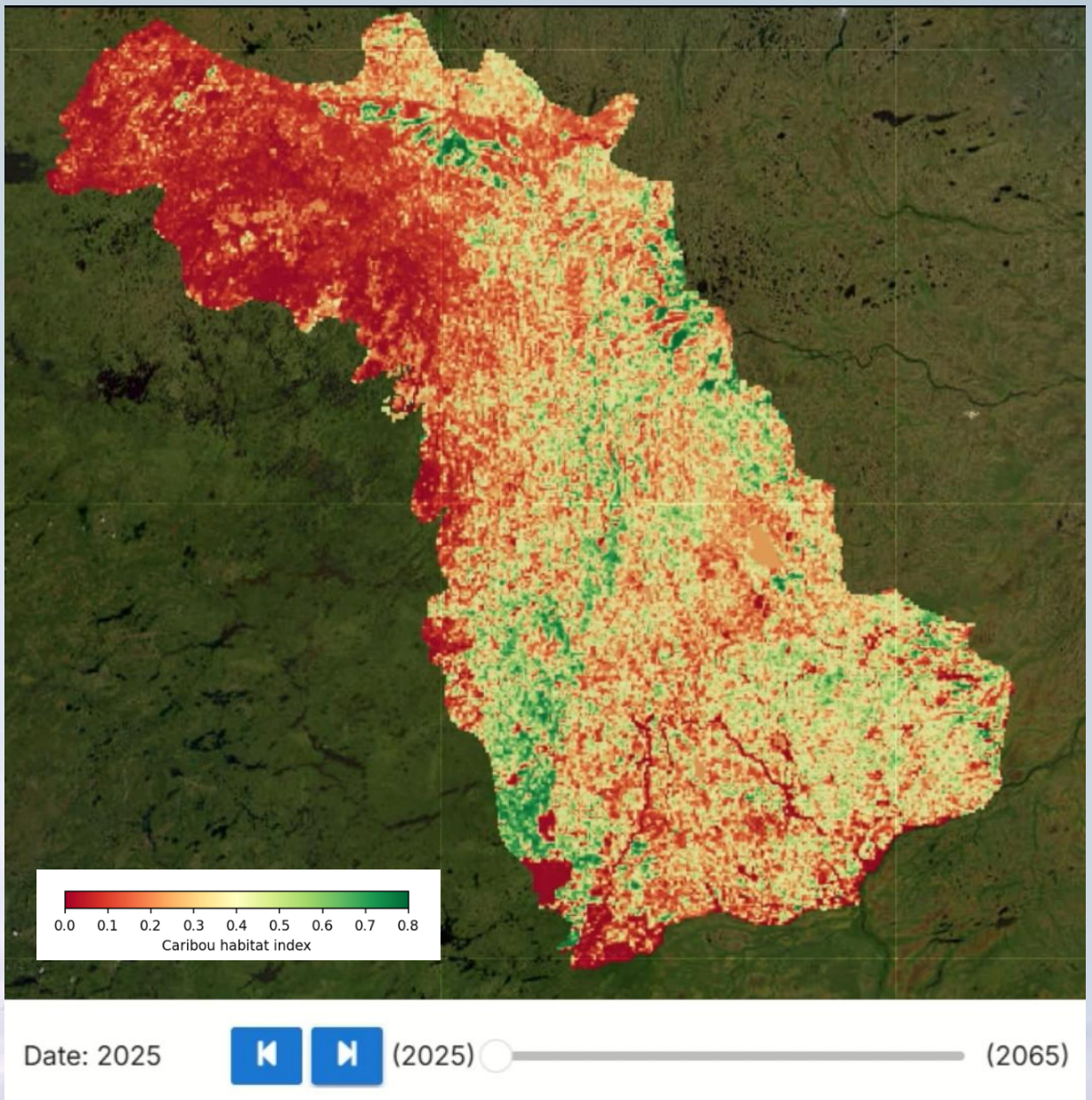


IEG
Integral Ecology Group

Impacts of Fragmentation and Climate Change

- Caribou habitat

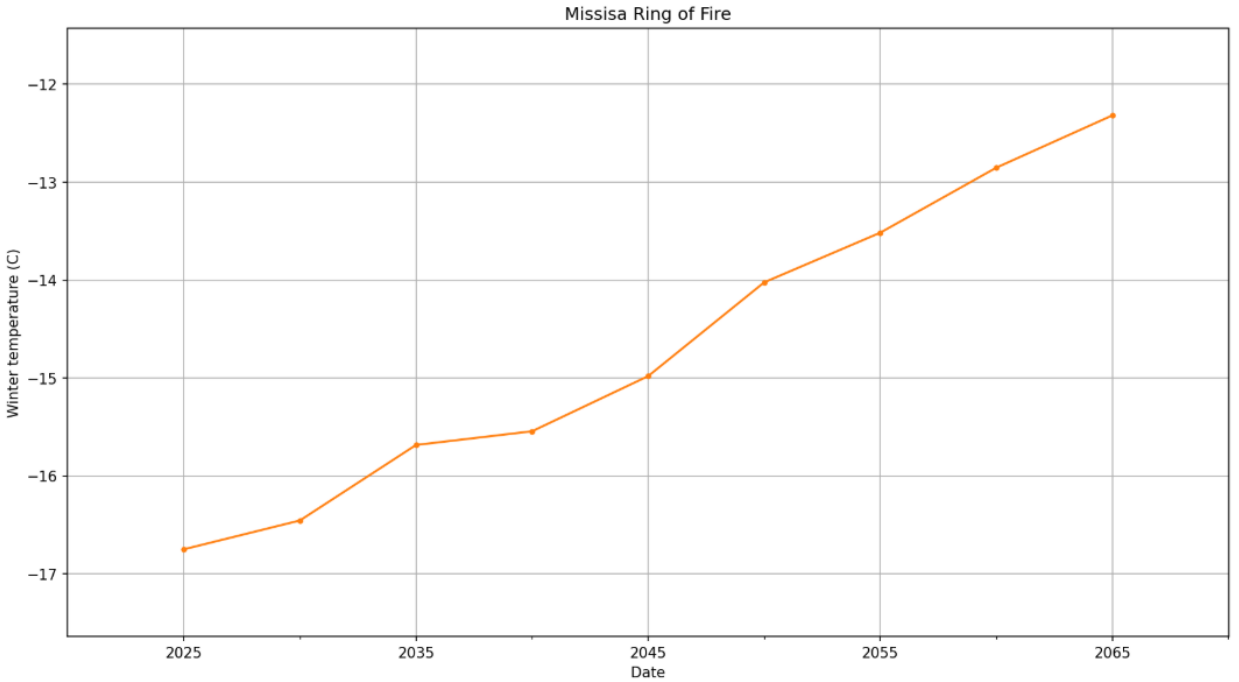


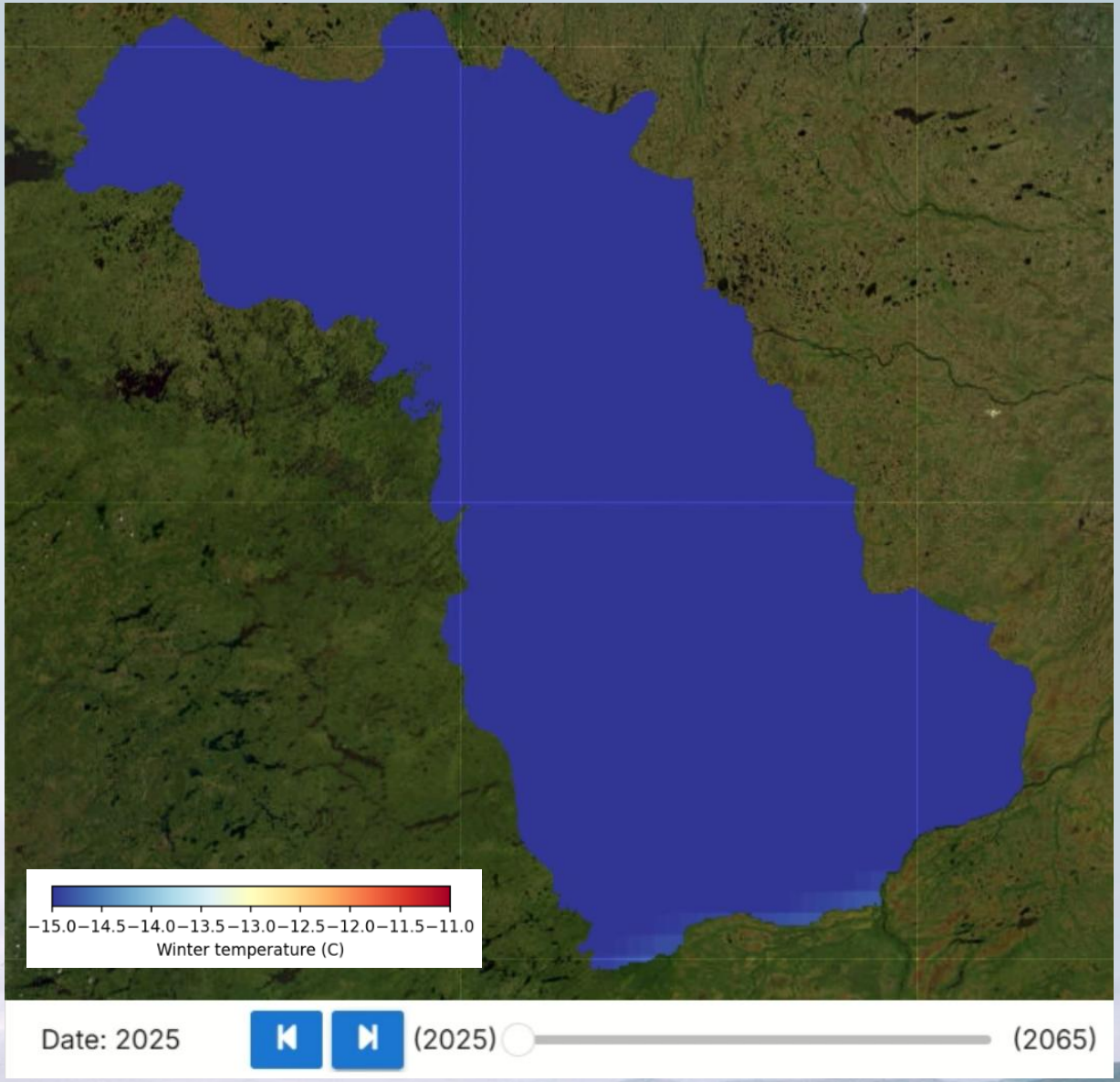


IEG Integral Ecology Group

Impacts of Fragmentation and Climate Change

- Winter temperature

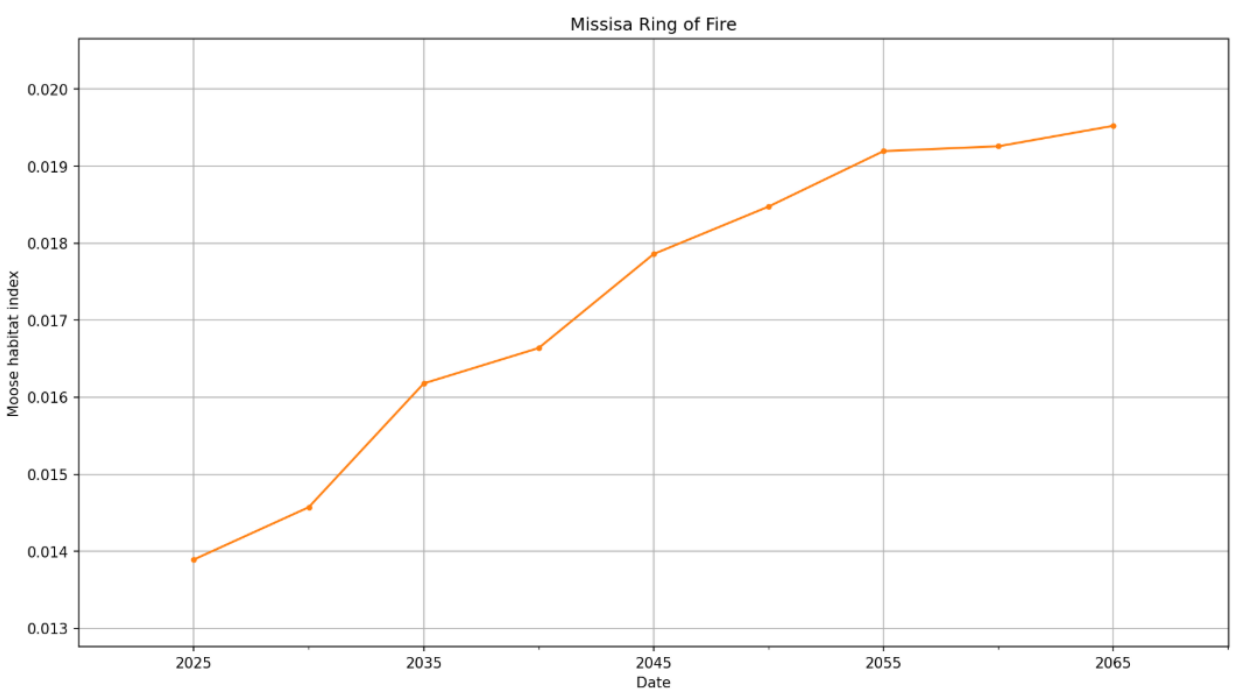


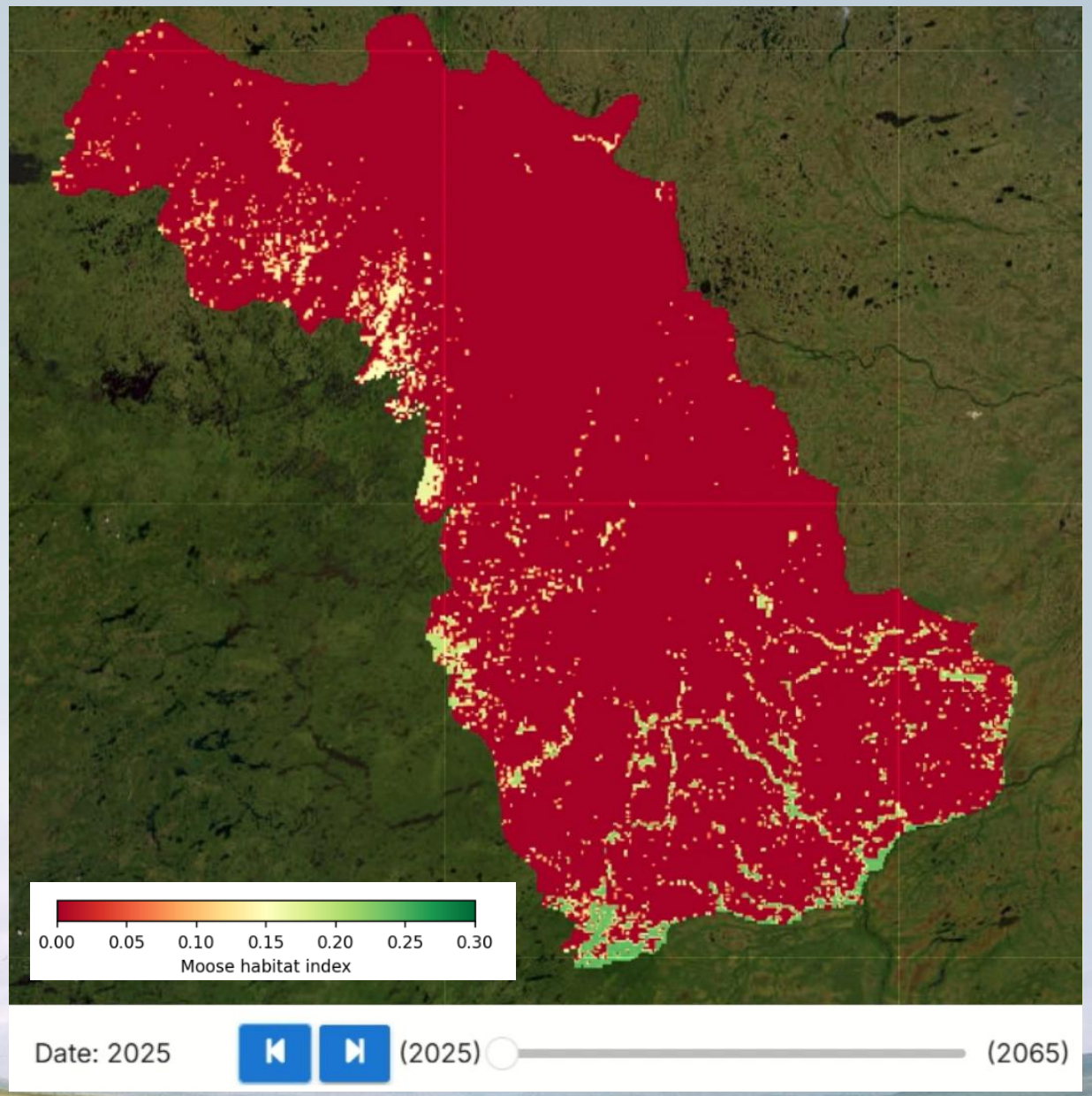


IEG
Integral Ecology Group

Impacts of Fragmentation and Climate Change

- Moose habitat



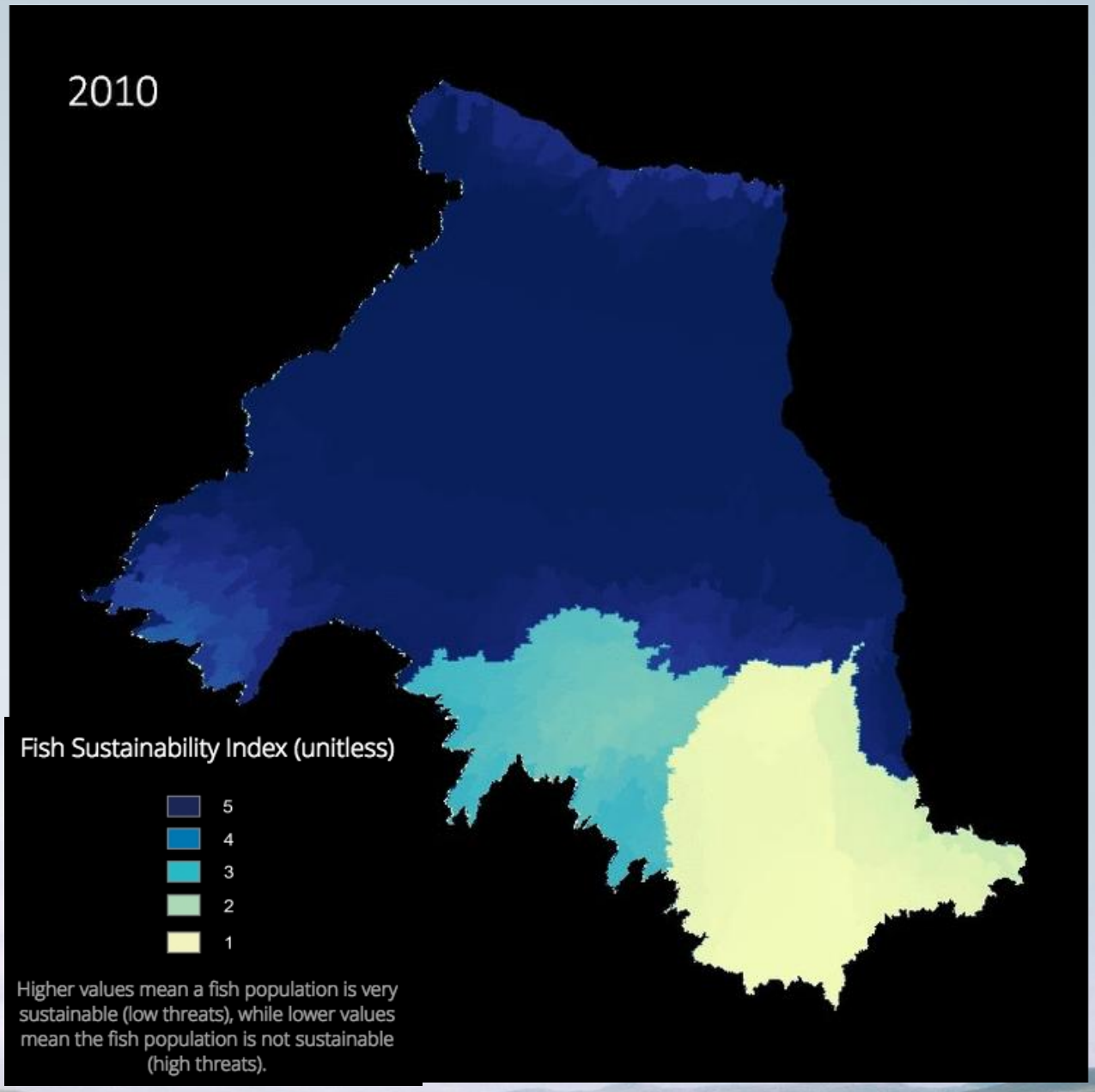


IEG
Integral Ecology Group

Impacts on Migration

- WCS Canada
- Dams as migration barriers

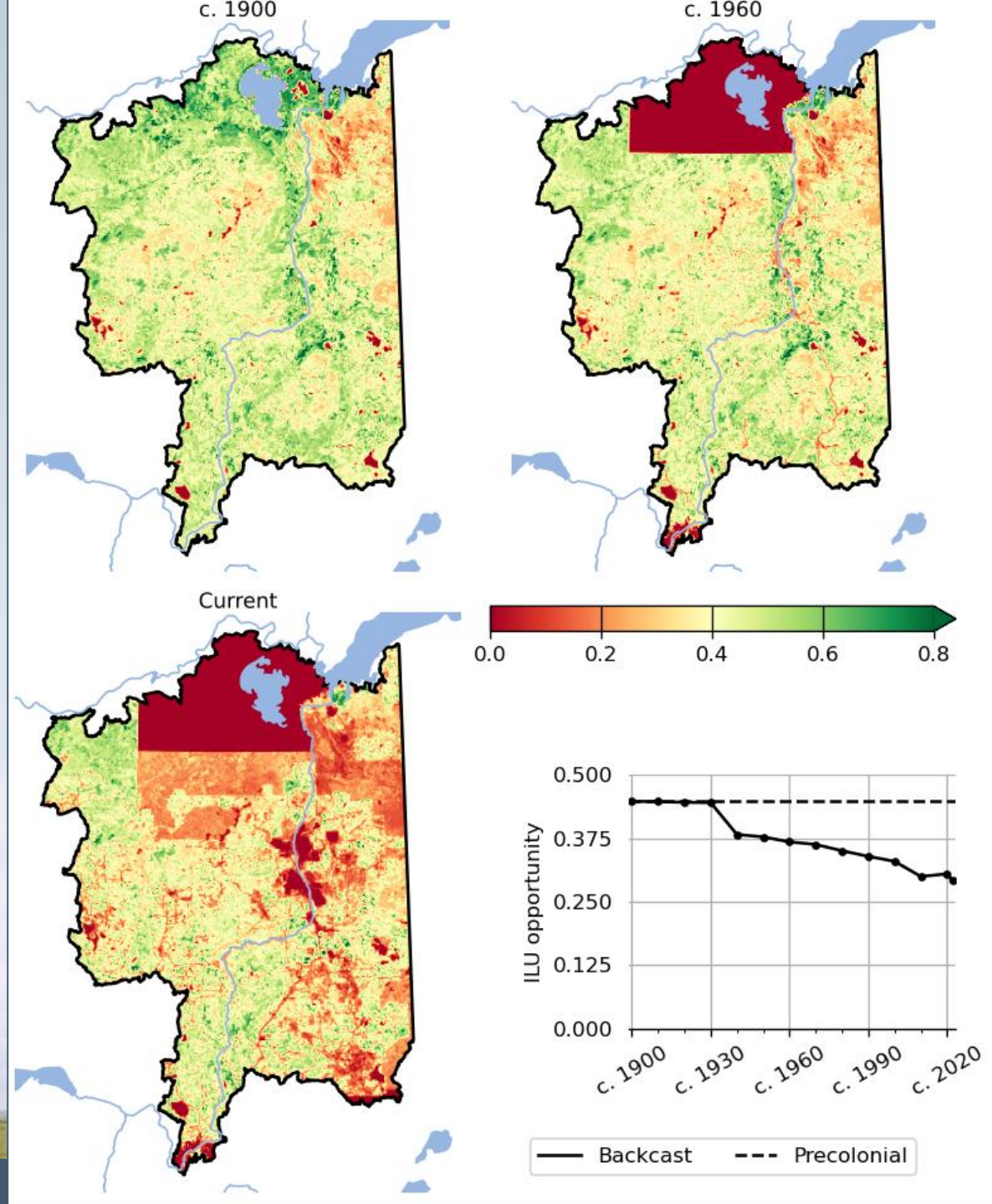
©Engbretson Underwater Photography



IEG
Integral Ecology Group

Impacts on wildlife important to traditional ways of life

- Fort McKay Métis Nation (Alberta) with funding from IAAC and ICCE
- Cumulative effect of habitat loss and degraded access to the land



Thank you

- mcarlson@iegconsulting.com

IEG
Integral Ecology Group