Mapping Biodiversity & Ecosystem Services in Alberta

Dan Farr
Natural Capital Symposium, Stanford CA
March 25, 2015

It's Our Nature *to Know*
Alberta Biodiversity Monitoring Institute

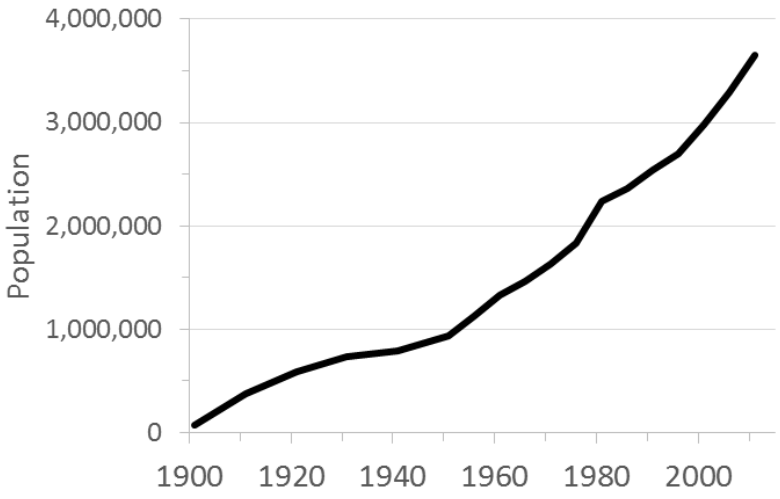
Alberta Canada

662 km²

1.4X California

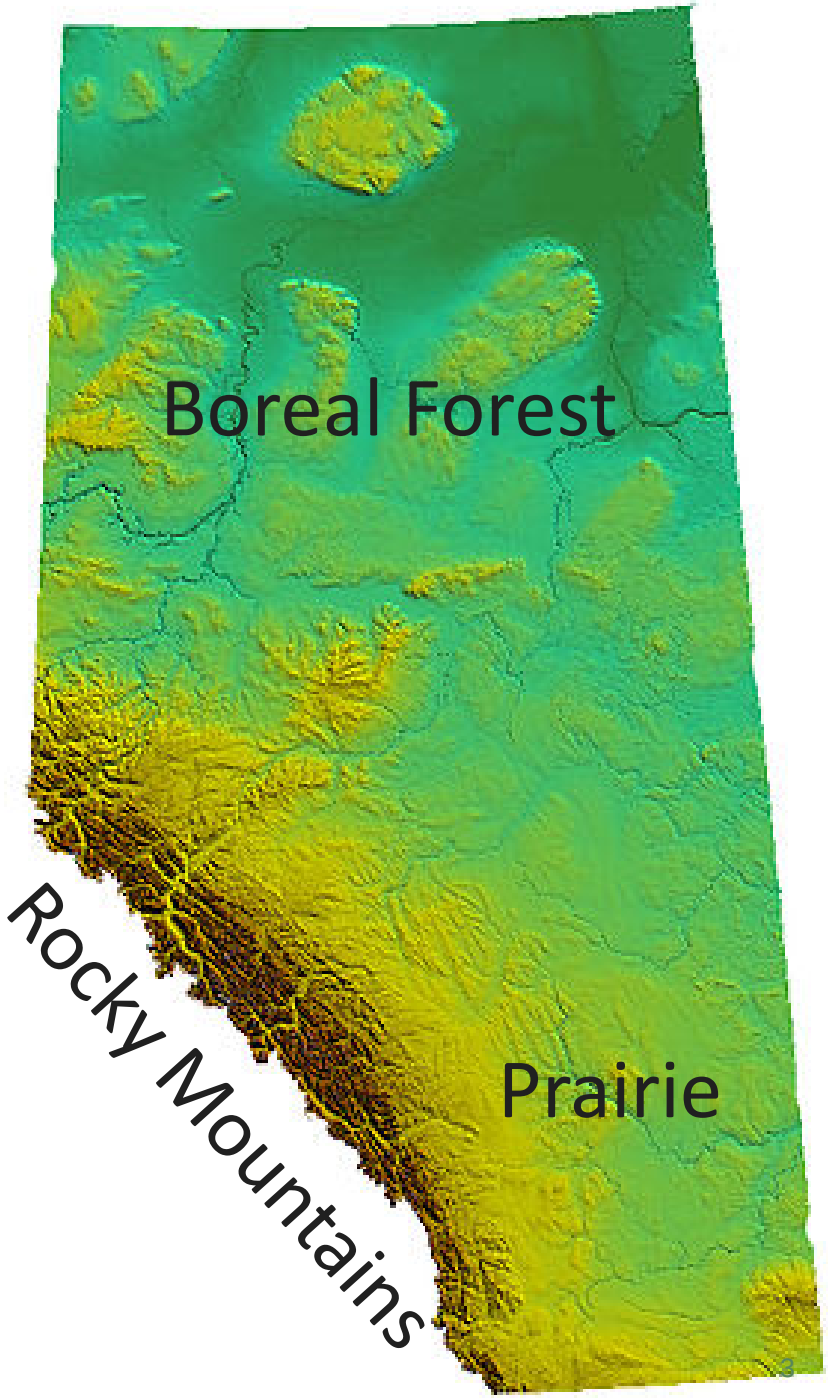
4 million people

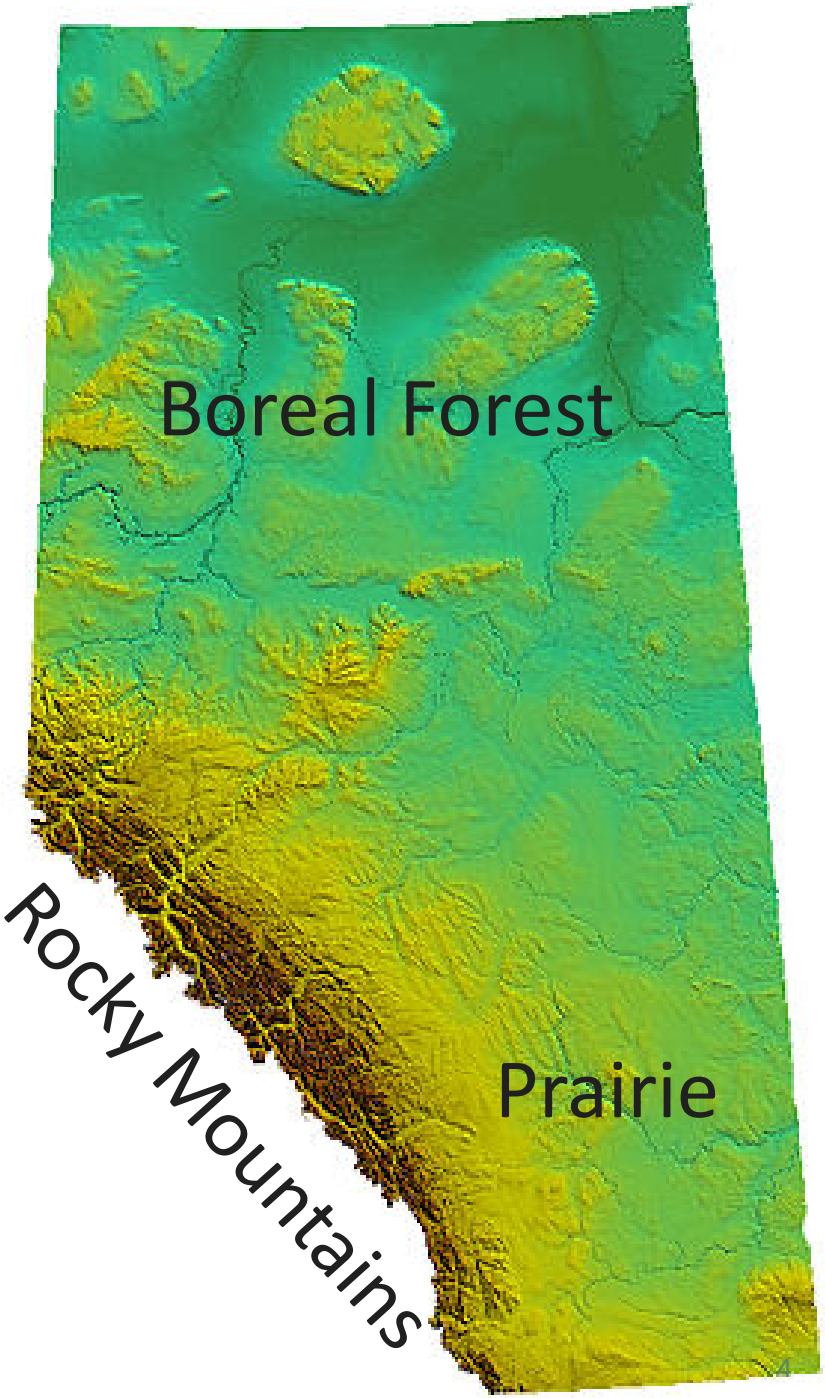
10% of California



Statistics Canada

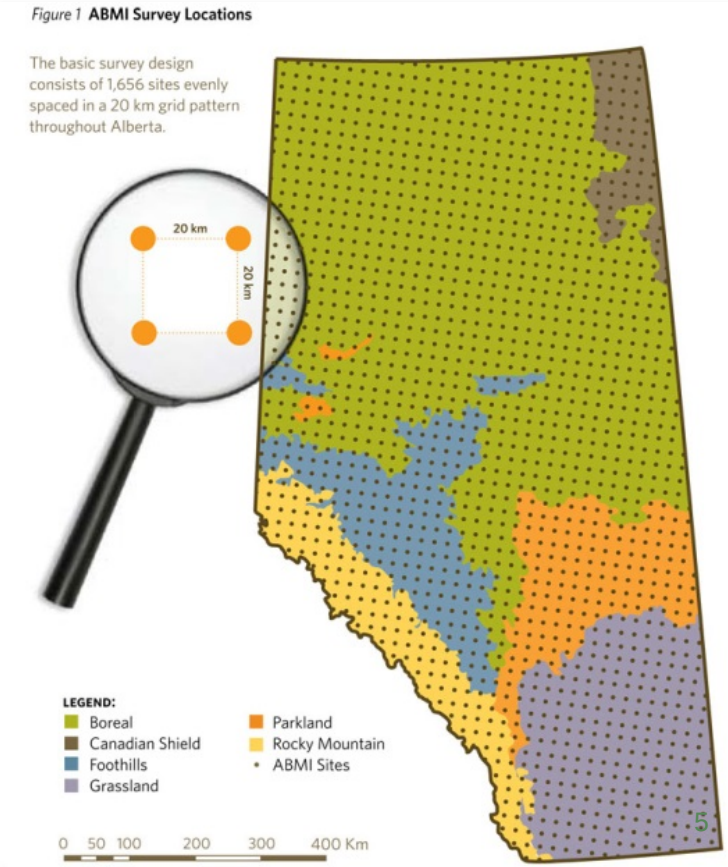
Alberta
Canada





Agriculture
Forestry
Conventional oil & gas
Oil sands mining & in situ
83% Urban

Long-term monitoring system
1,656 sites
1000 sampled since 2007
Upland & wetland
Vegetation, wildlife, soil, habitat



The project

1. Map ecosystem services & biodiversity
   - Biodiversity
   - Pollination
   - Water purification
   - Carbon storage
   - Timber production
   - Forage production
2. Demonstrate management applications
   - Sustainability reporting
   - Market-based instruments
   - Land use planning

esa

Ecosystem Services Assessment

Sustainability reporting

- Defining the Environmental Footprint of Canadian Beef Production
- Principles & Indicators for Biodiversity Assessment – International Guidelines
- Sustainability Assessment of the Canadian Beef Industry

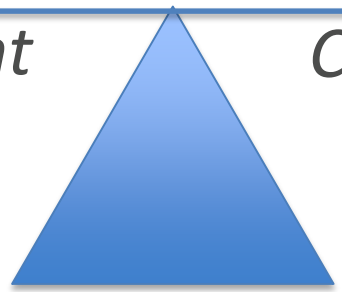
Market-based instruments

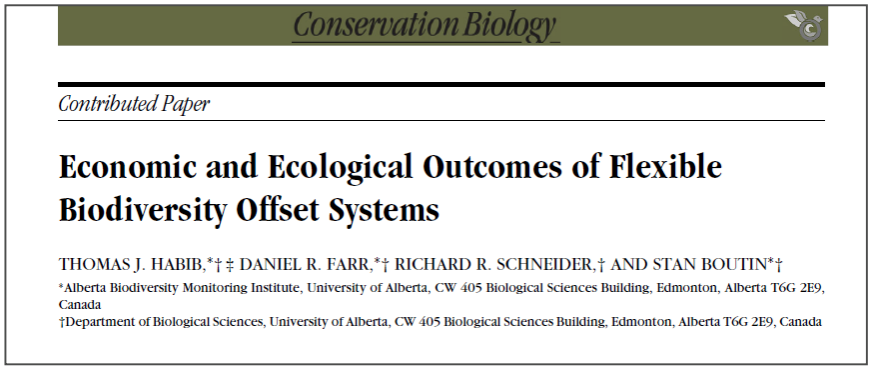
Biodiversity **loss**

Development

Biodiversity **gain**

Conservation





Conservation Biology

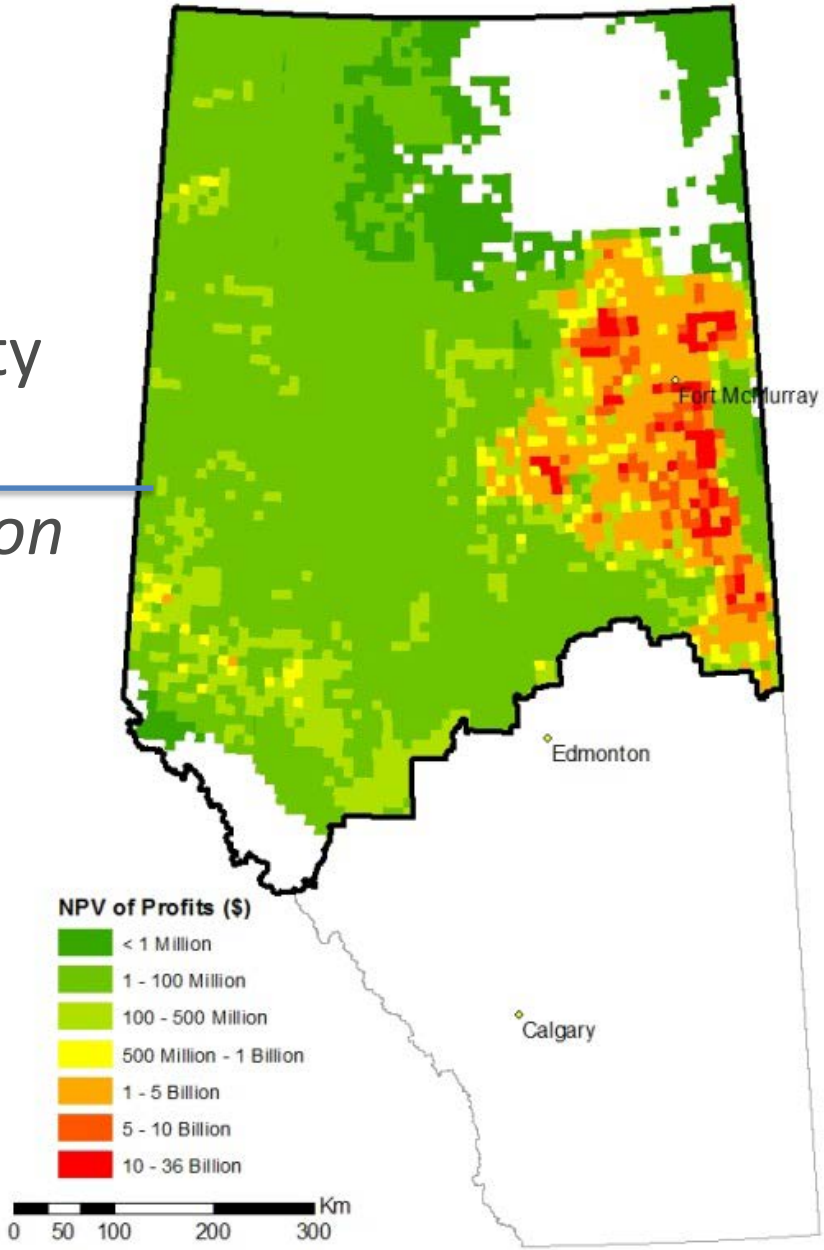
Contributed Paper

Economic and Ecological Outcomes of Flexible Biodiversity Offset Systems

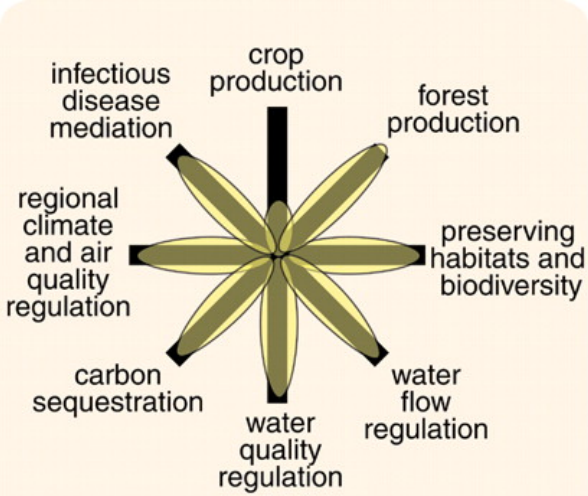
THOMAS J. HABIB,*† ‡ DANIEL R. FARR,*† RICHARD R. SCHNEIDER,† AND STAN BOUTIN*†

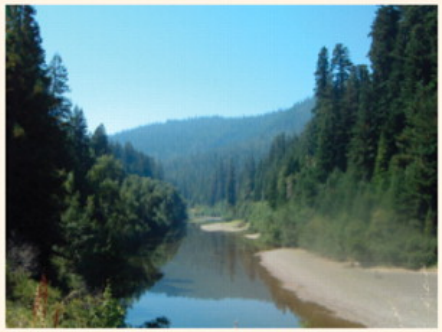
*Alberta Biodiversity Monitoring Institute, University of Alberta, CW 405 Biological Sciences Building, Edmonton, Alberta T6G 2E9, Canada

†Department of Biological Sciences, University of Alberta, CW 405 Biological Sciences Building, Edmonton, Alberta T6G 2E9, Canada

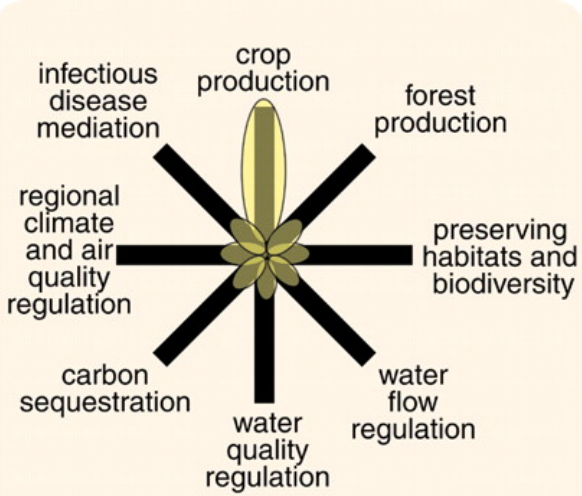


Land use planning

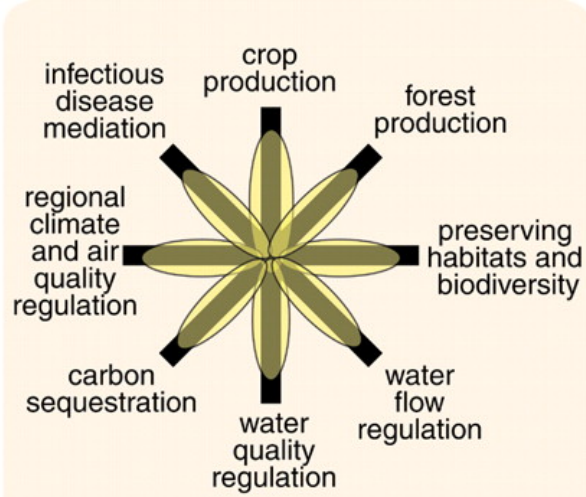




natural ecosystem



intensive cropland

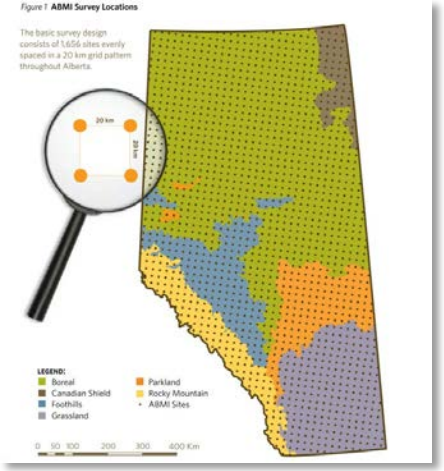


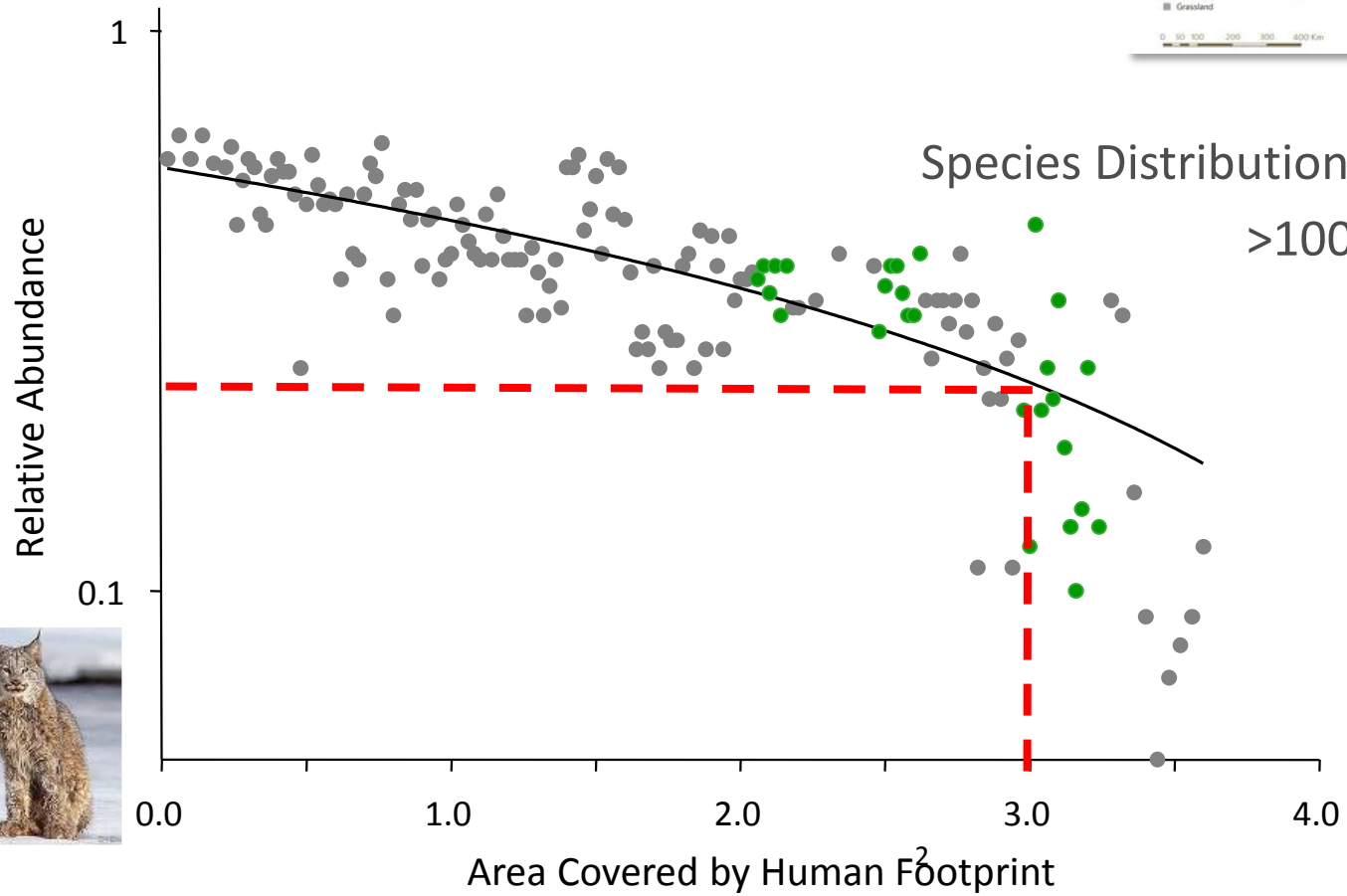
cropland with restored ecosystem services

Foley et al. 2005. *Science* 309:570

Biodiversity Model

How does human land-use impact biodiversity?





Biodiversity Model

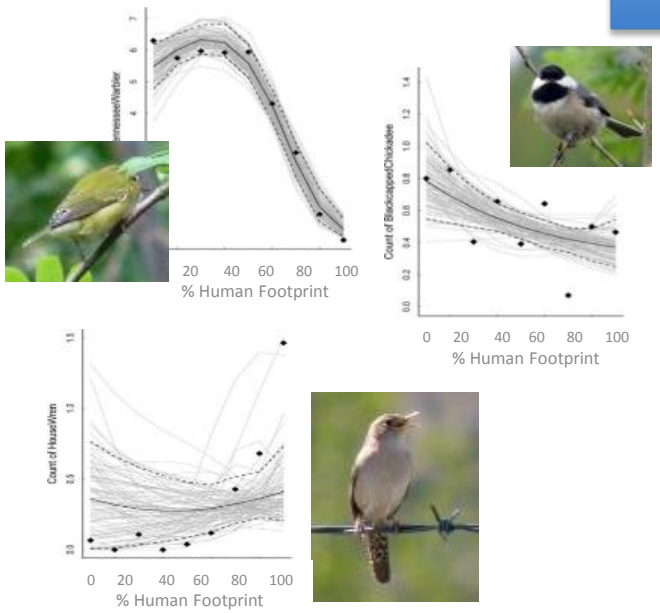
How does human land-use impact biodiversity?

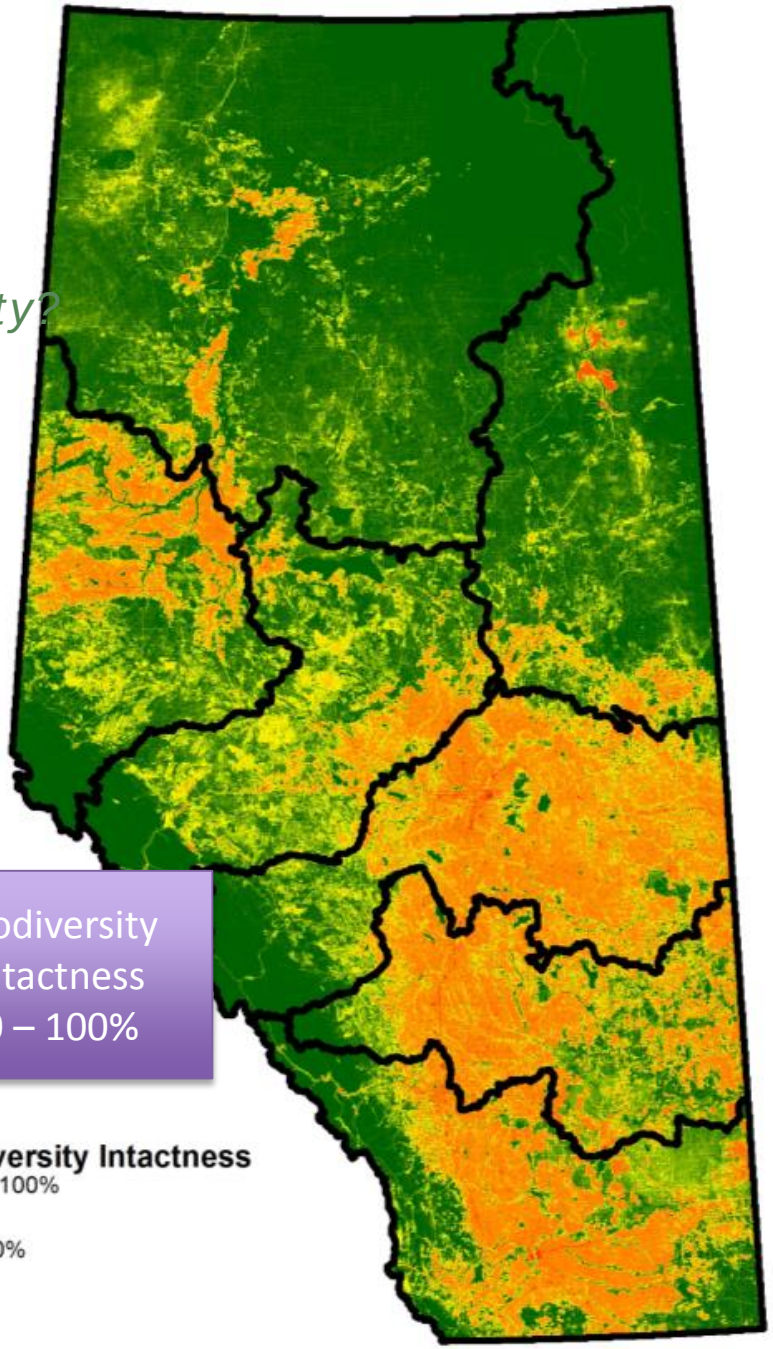
Landcover

Human Footprint

Biodiversity Intactness
- 0 – 100%

Species Distribution Models





Pollination Model

What is the value of wild pollinators to canola farmers?

Pollination Model

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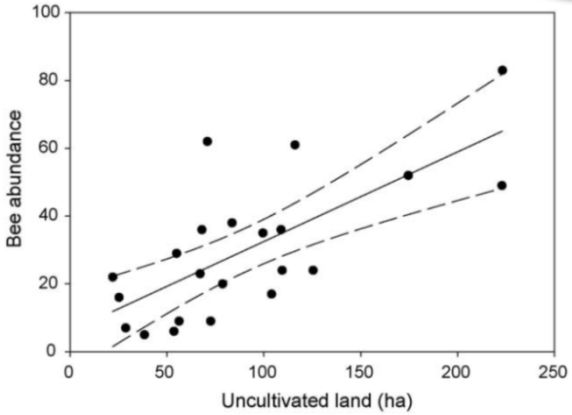
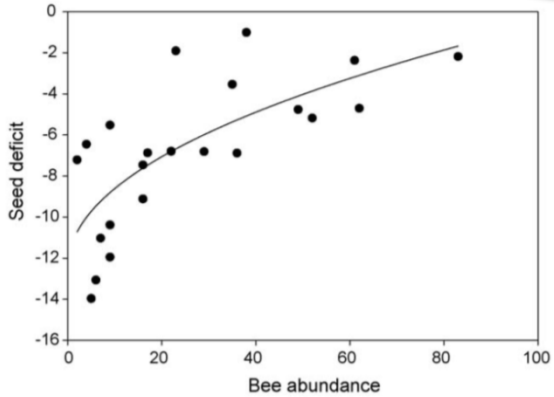
Land Cover
- Canola fields
- Nesting habitat

Bee Abundance

Canola Yield





Morandin & Winston 2006

Pollination Model

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Bee Abundance

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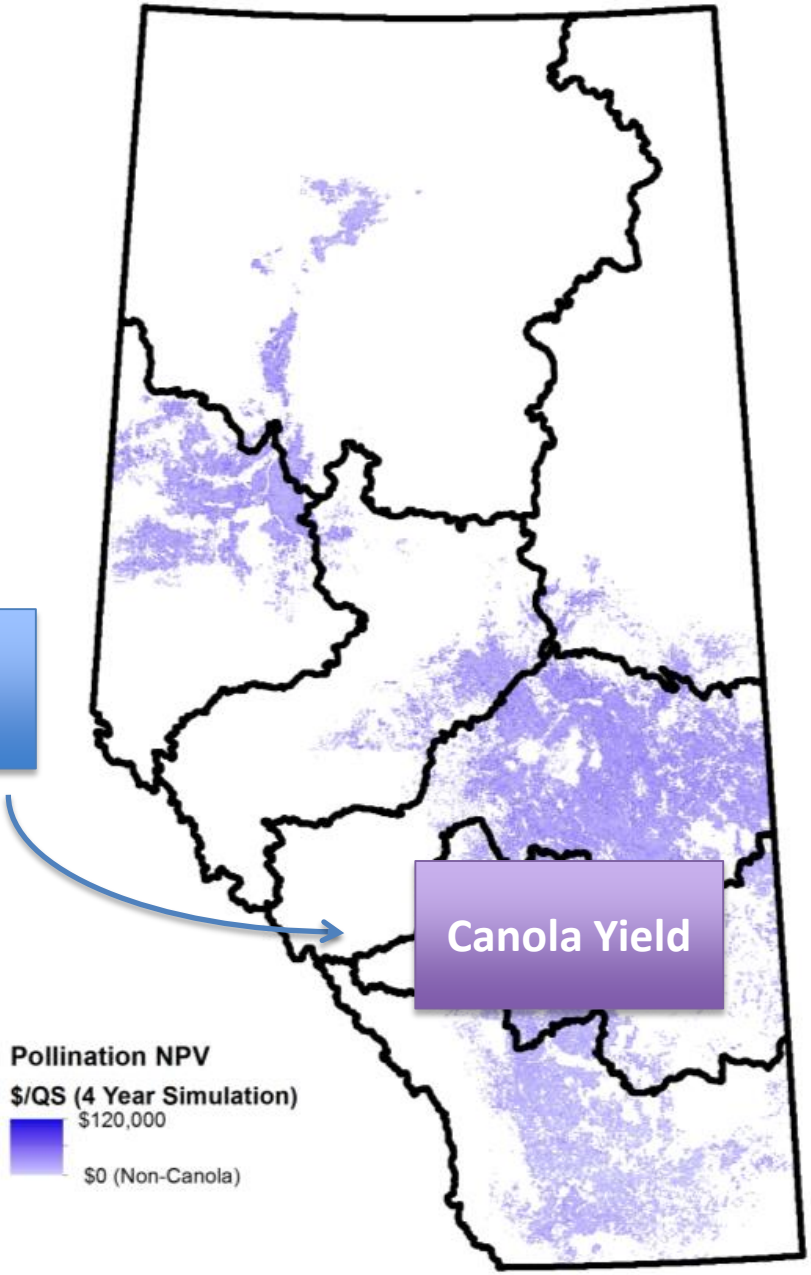
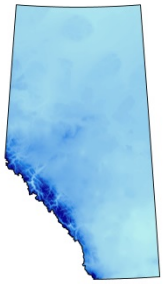
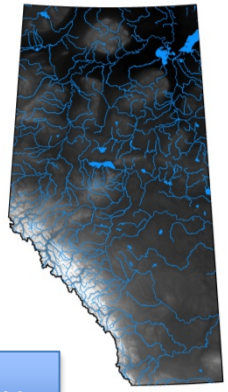


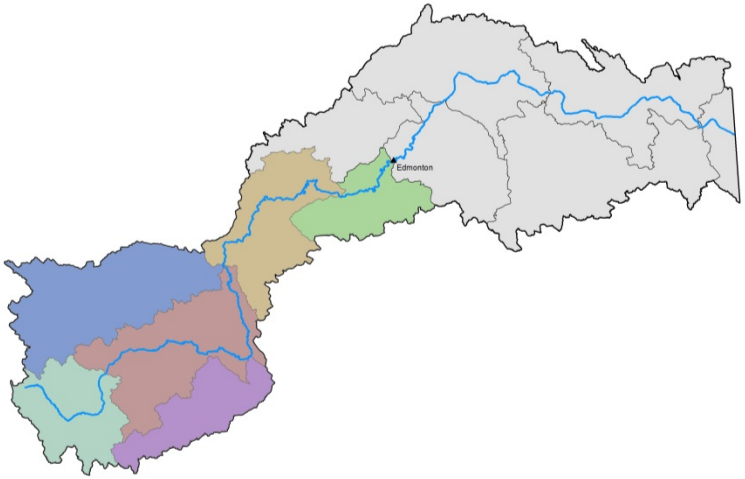
Water Purification Model

Where are the sources & sinks for water pollution?



Precipitation





Nutrient Loading

Overland Flow

Nutrient Supply Maps
- Nitrogen
- Phosphorus
- TSS

Nutrient Deposition

Cumulative River Loads

Nutrient Removal Maps

Sources/sinks for points along the river

Application: Lake Management

Winter Fish Kill in Isle Lake: "The Problem is Land Use, the Solution is Land Use"

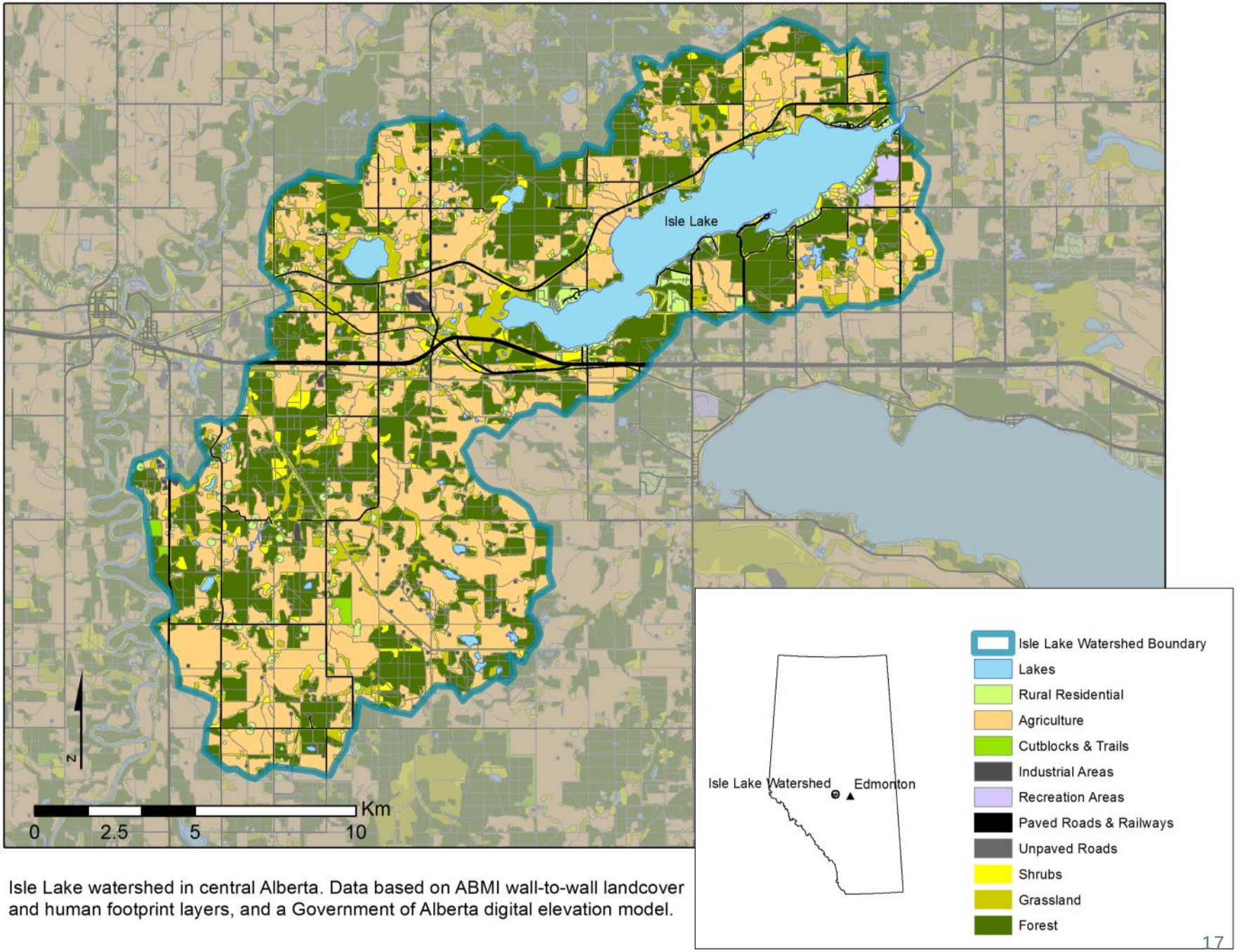
MARCH 19, 2014 / / CATEGORY: BIODIVERSITY

Posted by: Tom Habib

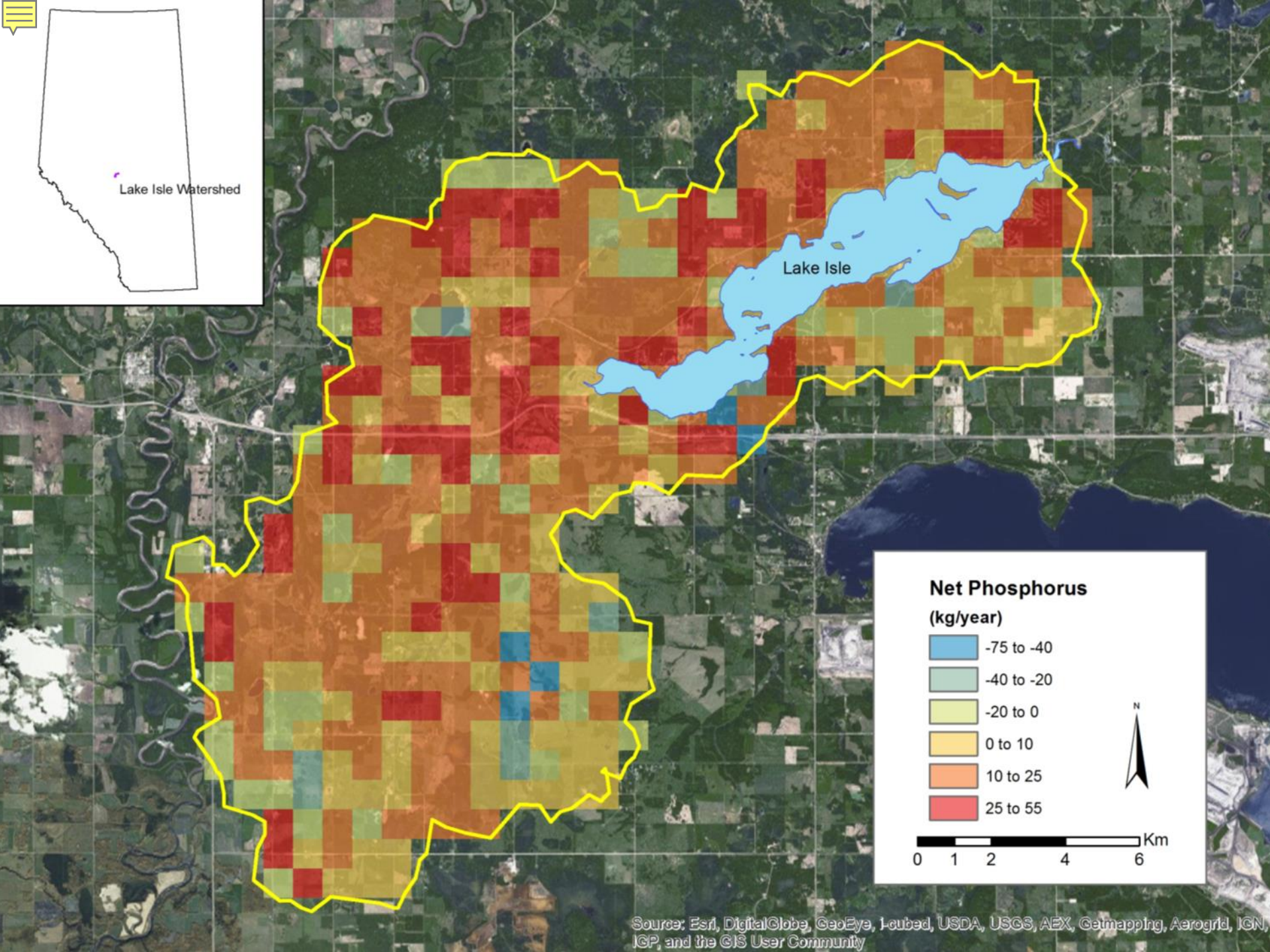
On March 16, the Edmonton Journal published an article focusing on the ongoing winter fish kill at Isle Lake, 80km west of Edmonton. The accompanying video shows hundreds of floating dead fish in ice breaks on the lake; thousands more can be seen gasping for air due

Isle Lake Fish Kill

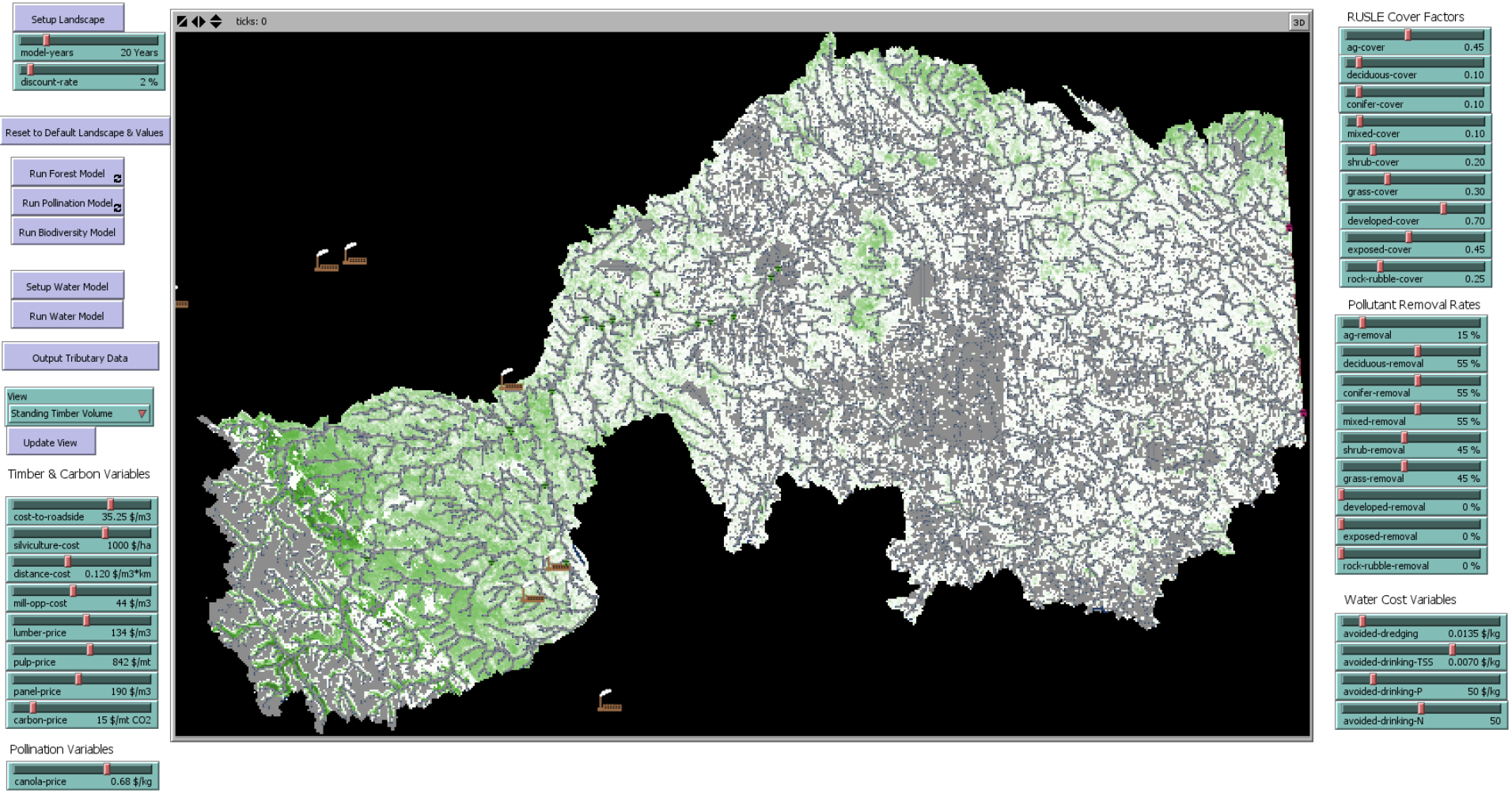
- What/where are the sources of pollutants?
- What areas are filtering pollutants?
- Where should future management focus?



Isle Lake watershed in central Alberta. Data based on ABMI wall-to-wall landcover and human footprint layers, and a Government of Alberta digital elevation model.


Lake Isle Watershed
Lake Isle
Net Phosphorus
(kg/year)
-75 to -40
-40 to -20
-20 to 0
0 to 10
10 to 25
25 to 55
N
Km
0 1 2 4 6
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Netlogo Platform



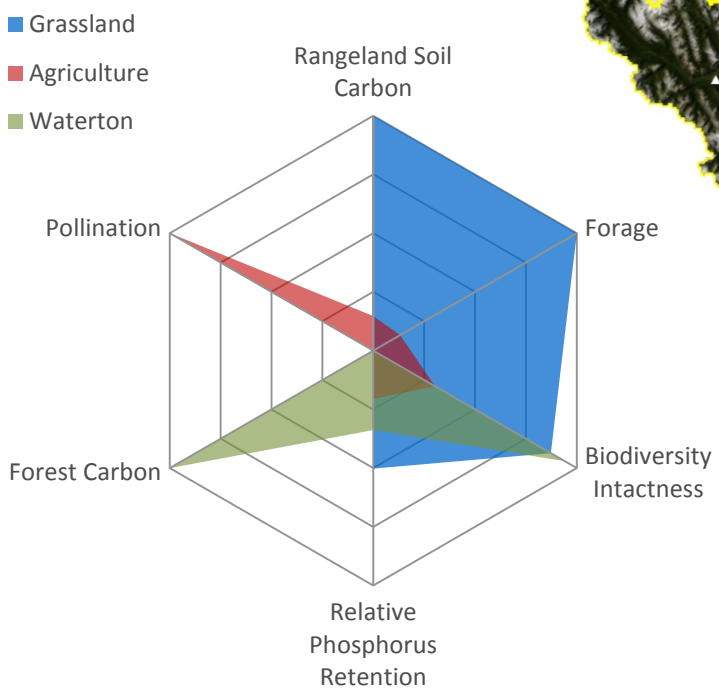
Integration… work in progress

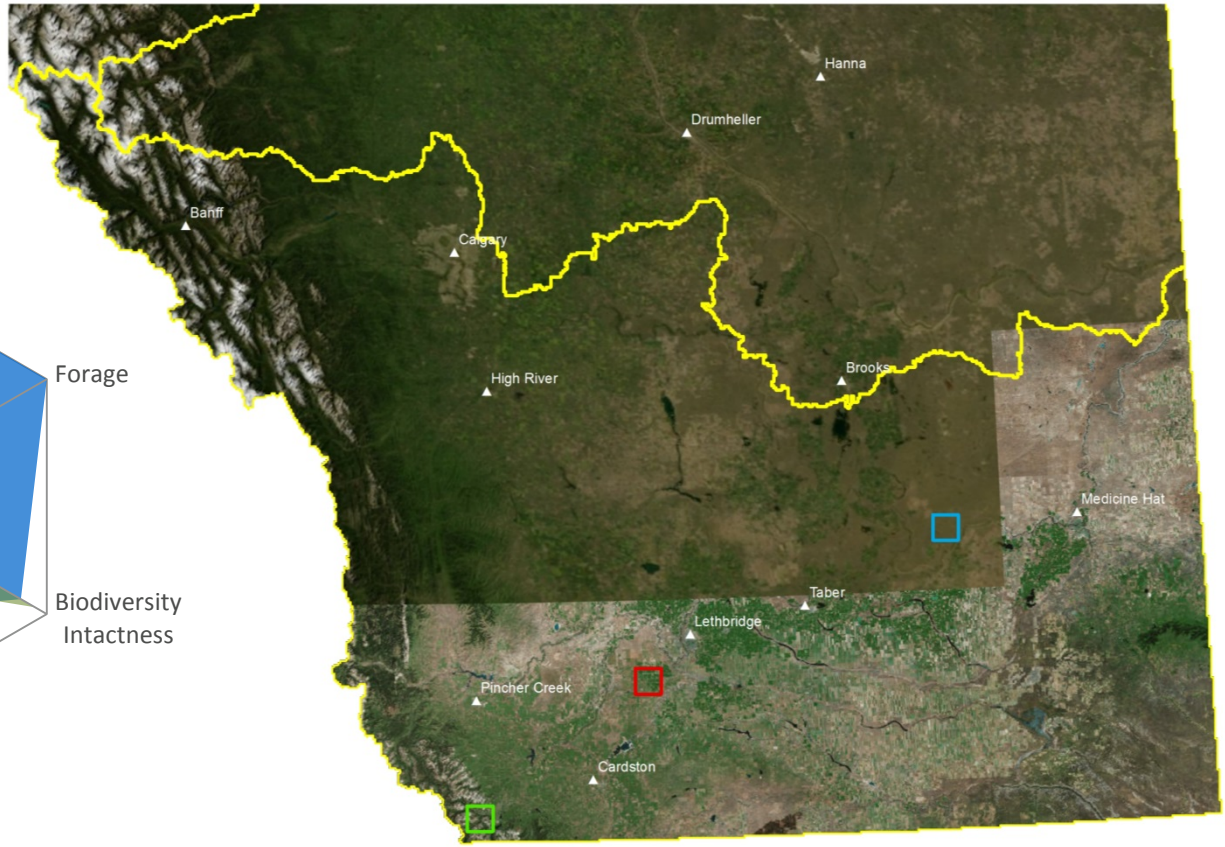
Three sample areas

10 x 10km plots

- Waterton NP
- Annual cropland
- Native grassland

South Saskatchewan Watershed





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