Fire, Floods, and Phosphorus: Impacts to Recreational ES

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December 6, 2018

ACES – Washington, DC

Roadmap

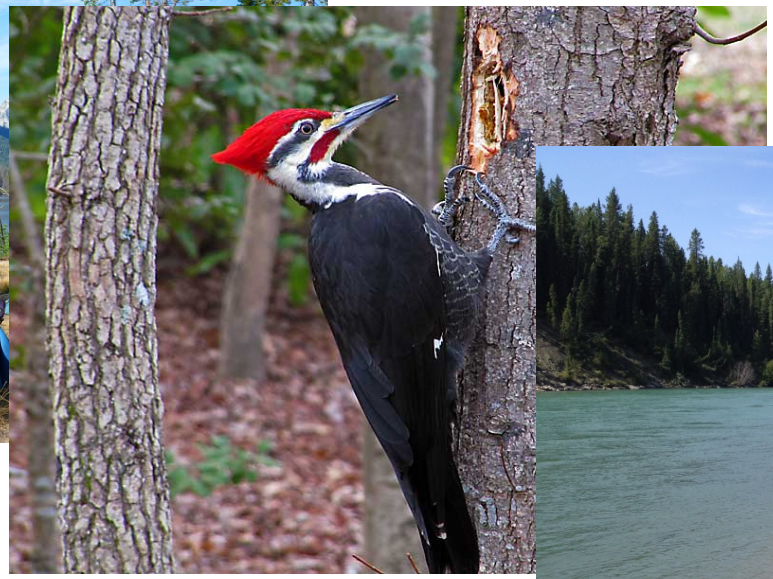
1. Recreation as an ES

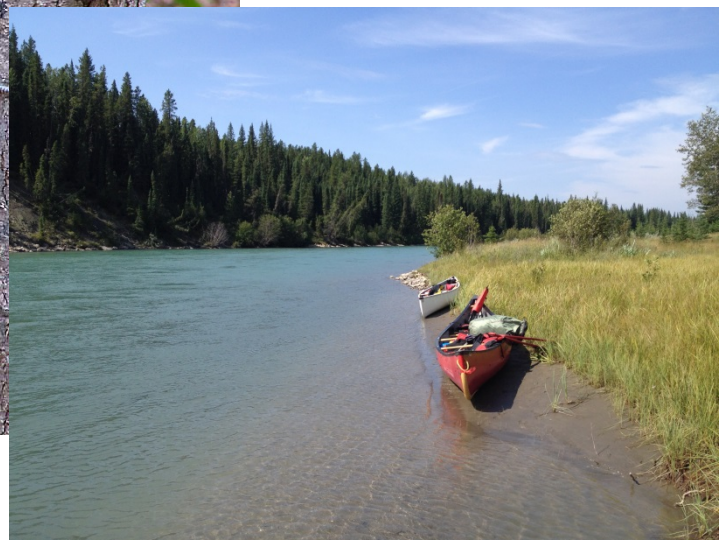
2. Fires and Floods
   - Welfare losses of site closures
   - Nonmarket impacts of natural disasters

3. Phosphorus
   - Downstream benefits
   - Behavioural linkages to environmental quality

1.1 Recreation as an ES

By providing the natural features that attract recreationists, ecosystems provide a ***recreation service***





1.1 Recreation as an ES

By providing the natural features that attract recreationists, ecosystems provide a ***recreation service***

What is this service worth?

How much are we willing to pay to access an area for recreation? How much do we need to be compensated if we lose one?

How does environmental quality impact our site choice?

2.1 Floods and Fires

Seasonal Recreation Demand Modeling and Impacts of Natural Disasters: An Application of the Kuhn-Tucker Model to Camping in Canada

Patrick Lloyd-Smith* Marcus Becker†

December 10, 2018

Abstract

This paper implements a seasonal Kuhn-Tucker travel cost model to estimate the welfare impacts of camping in Alberta, Canada. We use administrative data from the online camping reservation system on over 70,000 individuals taking approximately 145,000 trips. Using a bounding approach in our calculation of travel costs, we find substantial heterogeneity in the welfare impacts of park closures. We also provide an application of how these models can be used to estimate the non-market impacts of natural disaster.

Keywords: Recreation demand, Kuhn-Tucker model, Camping, Flooding

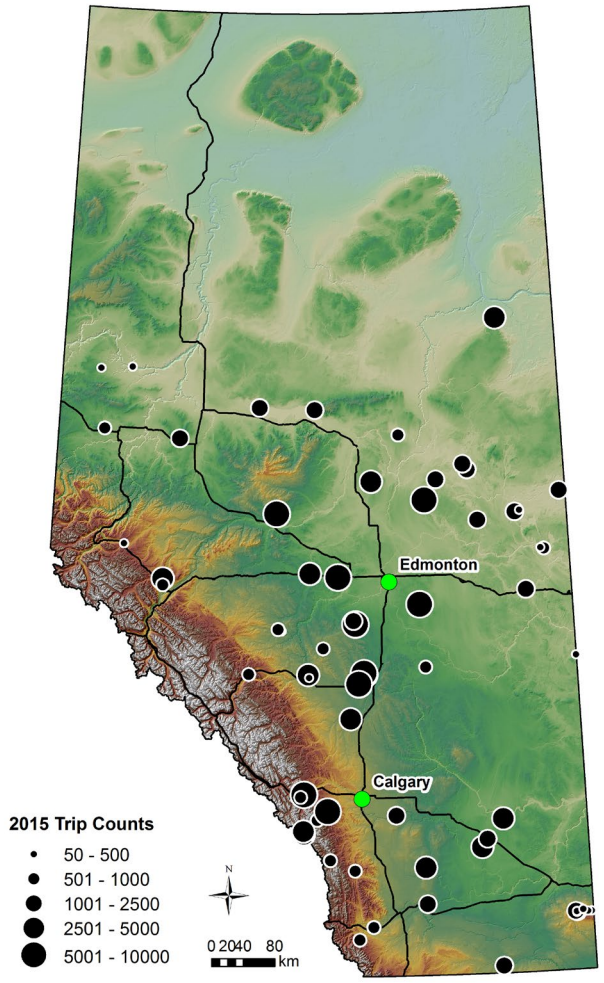
2.1 Floods and Fires

Loss of Recreational Assets

Alberta Environment and Parks

Network of provincial parks and recreation areas

Broadly representative of outdoor recreation choice in AB



2.1 Floods and Fires

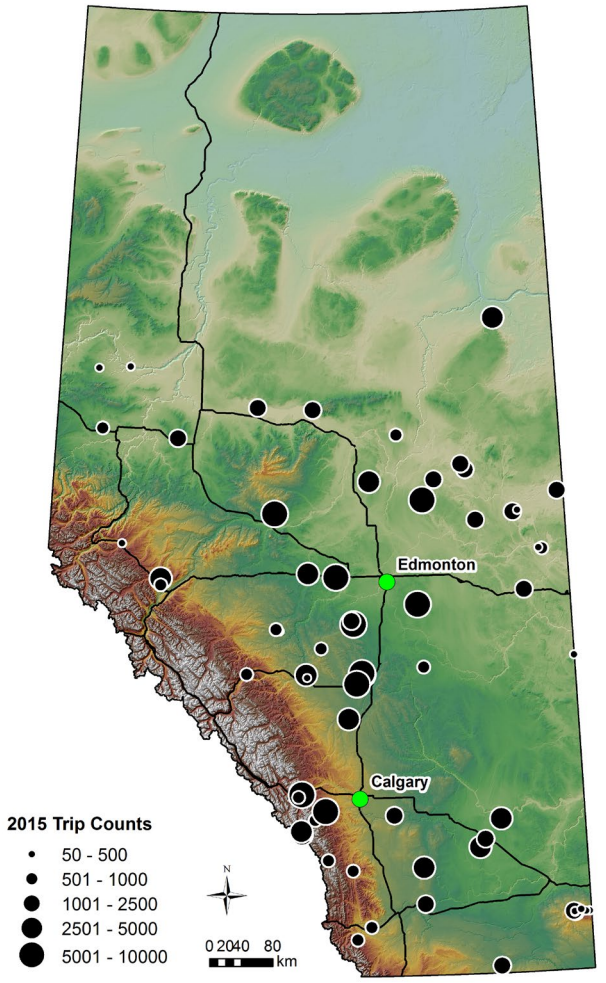
Loss of Recreational Assets

Alberta Environment and Parks

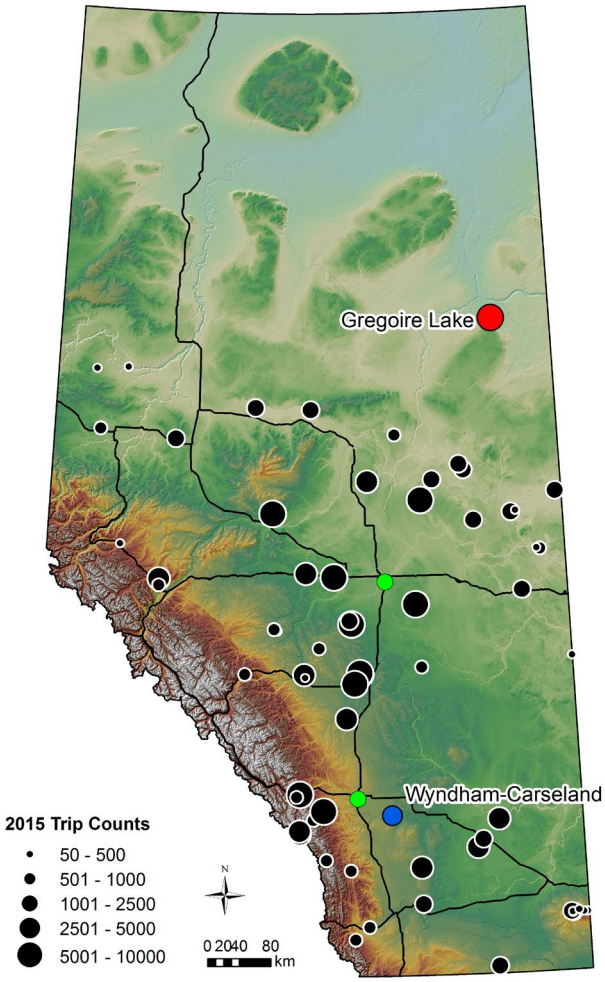
Administrative dataset of campsite reservations

~145,000 recorded trips in 2015, taken by 71,000 individuals

Postal codes – can calculate travel distances and link to Census data



2.1 Floods and Fires



2.1 Floods and Fires

Loss of Recreational Assets

Method:

Travel Cost Recreation Demand Model

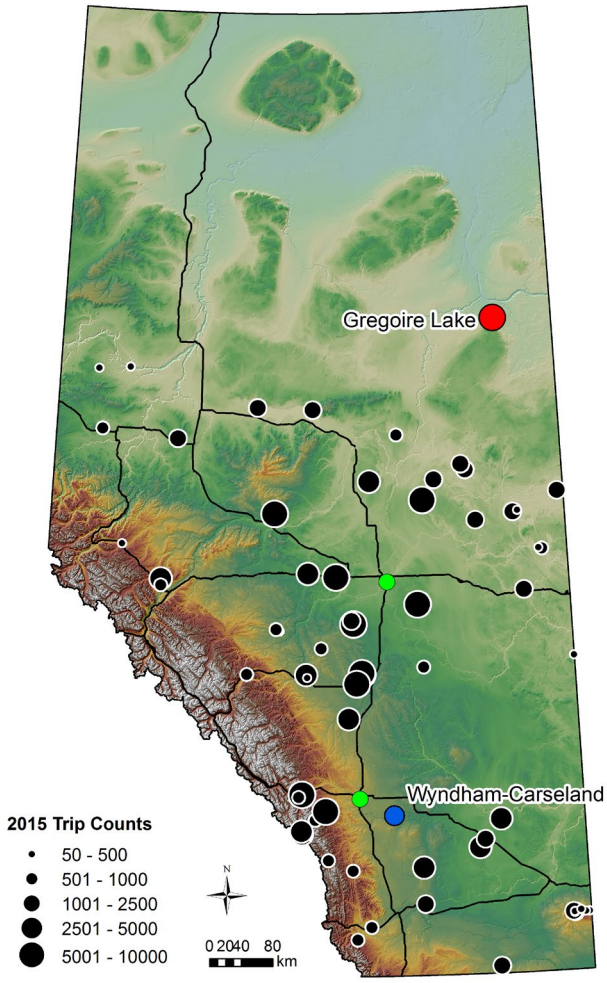
$Max(U_{Xk}) \sim Cost_k + Q_k$

U – Utility

Cost – Travel cost of reaching site

Xk – Number of trips to taken to site *k*

Q – Vector of site characteristics



2.2 Welfare Losses

Gregoire Lake Provincial Park

CS per person: **$2.10 – $3.98**

Number of people: ~**71,000**

Total Value: **~$150,000 - $285,000 (per year)**

Wyndham-Carseland Provincial Park

CS per person: **$0.48 - $0.93**

Number of people: ~**71,000**

Total Value: **~$34,000 - $67,000 (per year)**

Source: Lloyd-Smith and Becker (2018) *in review*

2.2 Welfare Losses

Gregoire Lake PP

Total number of trips: **2,652**

WTP per Trip: **$57 - $108**

Wyndham-Carseland PP

Total number of trips: **1,525**

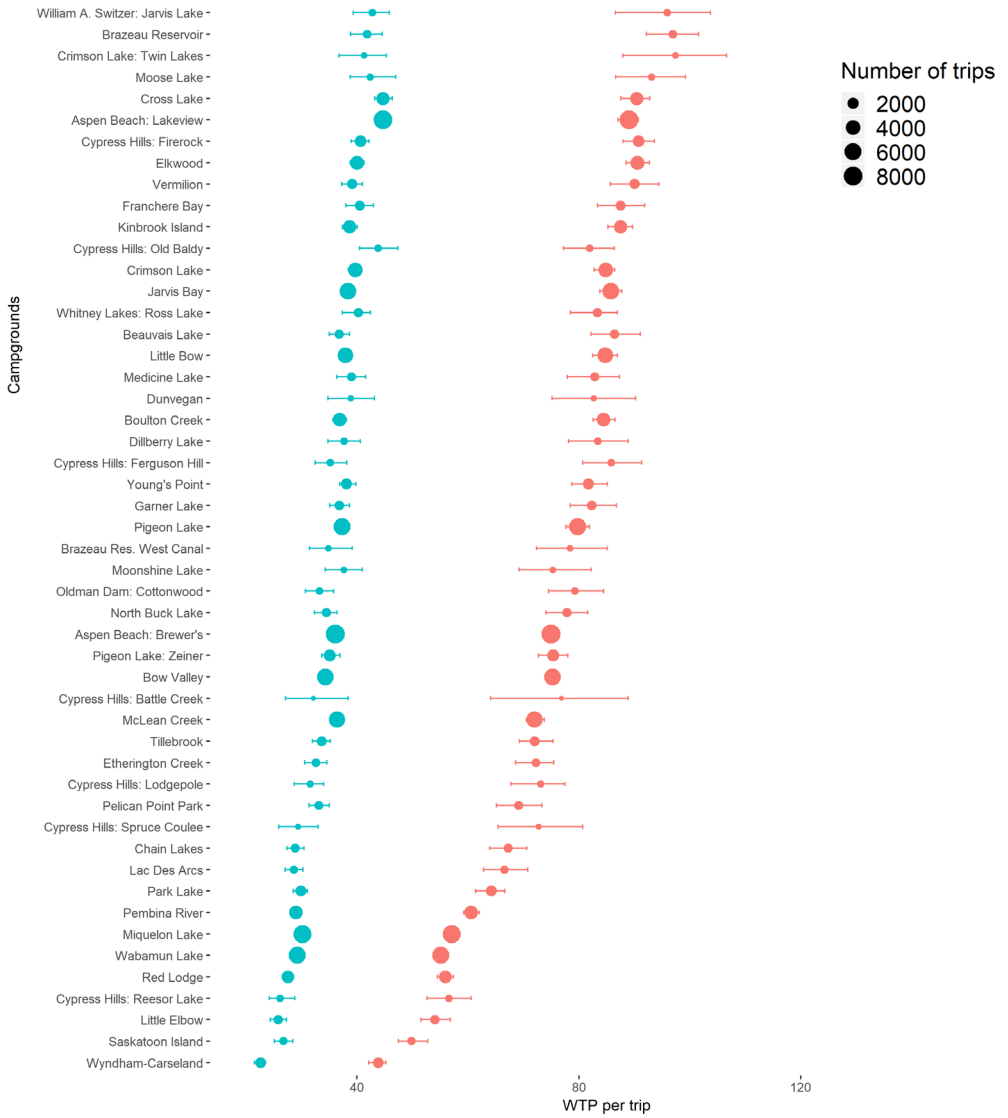
WTP per Trip: **$23 - $44**

Source: Lloyd-Smith and Becker (2018)

2.2 Welfare Losses

Implications for Benefit-Transfer

Benefits of investing in natural infrastructure (avoided costs)



Source: Lloyd-Smith and Becker (2018)

Roadmap

1. Recreation as an ES

2. Fires and Floods
   - Welfare losses of site closures
   - Nonmarket impacts of natural disasters

3. **Phosphorus**
   - **Downstream benefits**
   - **Behavioural linkages to environmental quality**

3. Phosphorus

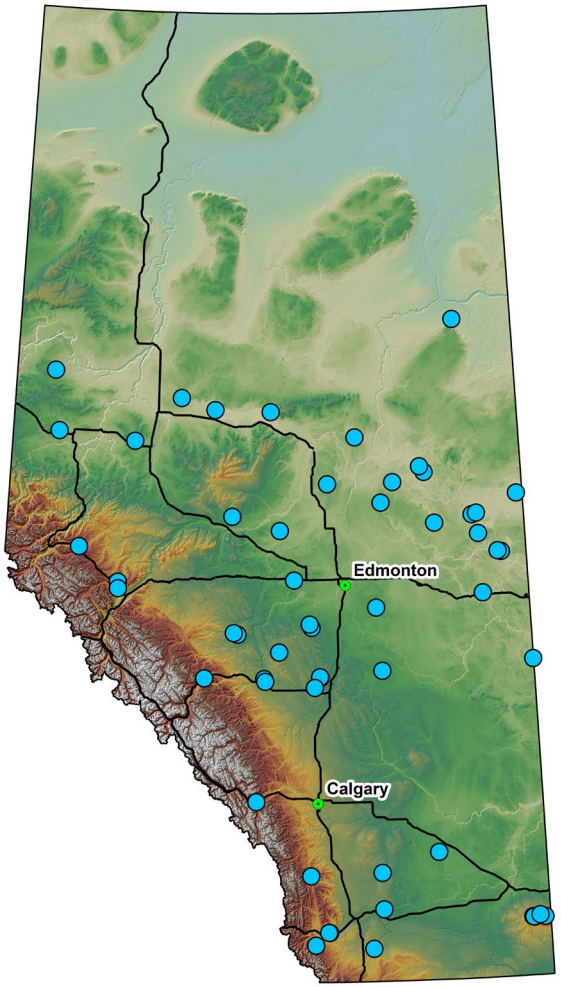
Linkages to Environmental Quality

$Max(U_{Xk}) \sim Cost_k + \mathbf{Q_k}$

U – Utility

Xk – Trip choice

***Q* – Vector of site characteristics**



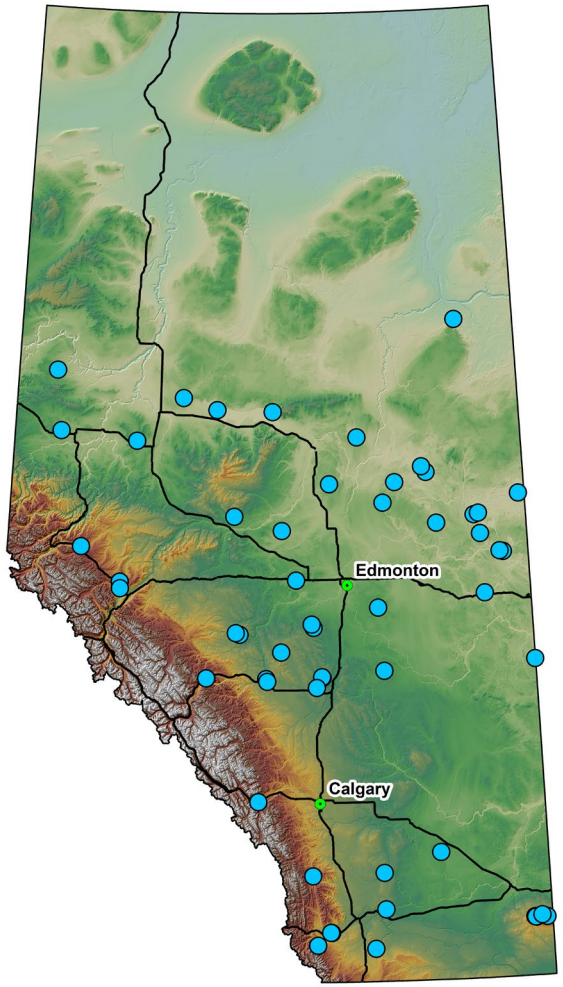
3. Phosphorus

But how to parameterize the water quality variable / indicator in the model?

1. Blue-Green Algae Advisories

2. Beach Water Quality Data

3. Satellite Imagery / Remote Sensing

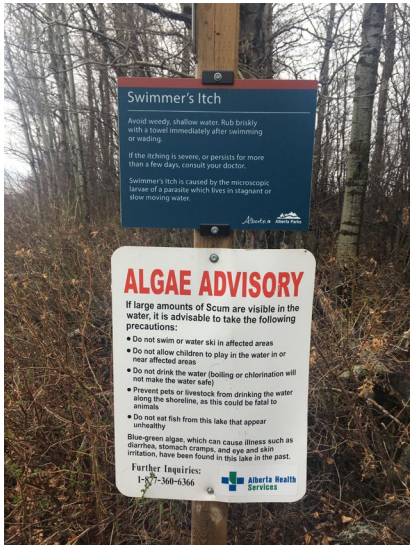


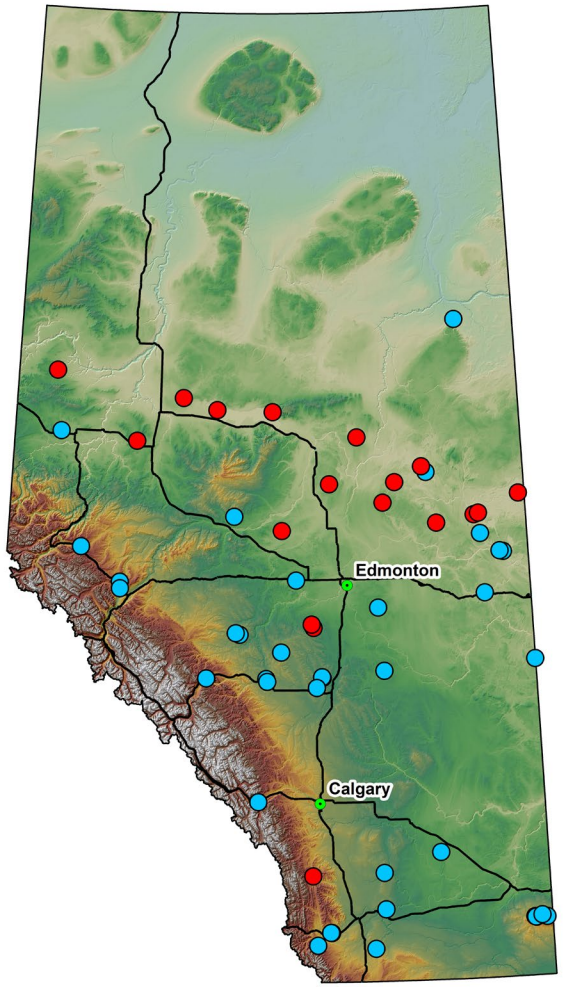
3.1 Advisories

But how to parameterize the water quality variable / indicator in the model?

1. **Blue-Green Algae Advisories**

Alberta Health Services





3.1 Advisories

CBC

Blue-green algae warning issued for Alberta's Pigeon Lake

Alberta Health Services is warning that toxic blooms have been identified in Pigeon Lake, south of Edmonton

But Oborowsky said as soon as the first notice is posted, tourism dips.

"There's 10 villages around the lake, we're only one of them. We count on a lot of people using our lakes for fishing, for boating, for recreation, even for our beaches," he said

"As soon as we get this negative advisory, people stay home."

3.1 Advisories

Testing the Influence of Advisories

Predict **daily campground occupancy** as a function of:

- Campground
- Year
- Month
- Day of the week
- Holidays
- Presence/absence of a water quality advisory

Isolate the effect of a water quality advisory on campground occupancy, controlling for everything else.

3.1 Advisories

Testing the Influence of Advisories

Predict **daily campground occupancy** as a function of:

Variable	Effect Size	Significance
June	+ 5%	***
July	+ 19%	***
August	+ 16%	***
September	+ 2%	n.s.
2015	0%	n.s.
2016	- 1%	n.s.
Weekend	+ 38%	***
AFTER ADVISORY	- 8%	***

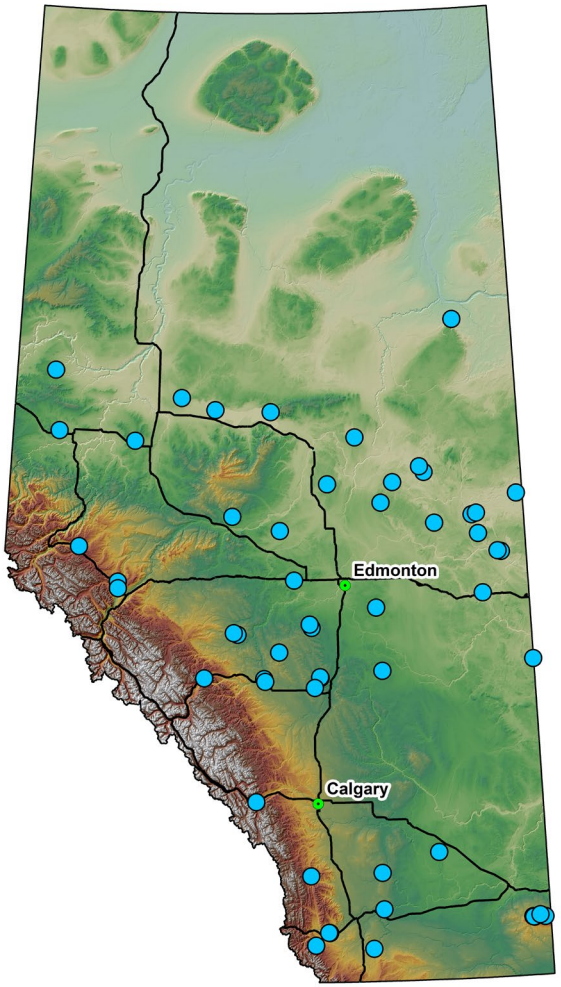
*** Significant at the 1% level

3.2 Beach Data

But how to parameterize the water quality variable / indicator in the model?

2. Beach Water Quality Data

Alberta Health Services



3.2 Beach Data

But how to parameterize the water quality variable / indicator in the model?

	day	LAKE_NAME	BEACH_NAME	ADVISORY	CB_CELL	MICRO
1	2014-06-03	PIGEON LAKE	Grandview Beach	0	4329	0.130
2	2014-06-10	PIGEON LAKE	Grandview Beach	0	9116	0.160
3	2014-06-17	PIGEON LAKE	Grandview Beach	0	12274	0.150
4	2014-06-24	PIGEON LAKE	Grandview Beach	0	34632	0.080
5	2014-07-03	PIGEON LAKE	Grandview Beach	0	163484	0.070
6	2014-07-08	PIGEON LAKE	Grandview Beach	0	495289	0.060
7	2014-07-15	PIGEON LAKE	Grandview Beach	1	995671	0.230
8	2014-07-22	PIGEON LAKE	Grandview Beach	1	338477	0.070
9	2014-07-29	PIGEON LAKE	Grandview Beach	1	41609	0.060
10	2014-08-05	PIGEON LAKE	Grandview Beach	1	103901	0.110
11	2014-08-12	PIGEON LAKE	Grandview Beach	1	147698	1.920
12	2014-08-19	PIGEON LAKE	Grandview Beach	1	288647	0.080
13	2014-08-26	PIGEON LAKE	Grandview Beach	1	82327	NA

3.2 Beach Data

But how to parameterize the water quality variable / indicator in the model?

Problems:

- **We don’t have this level of data detail for each lake;**

- **Spatial / temporal complexity of algal blooms**

3.3 Satellite Imagery

3. Satellite Imagery / Remote Sensing

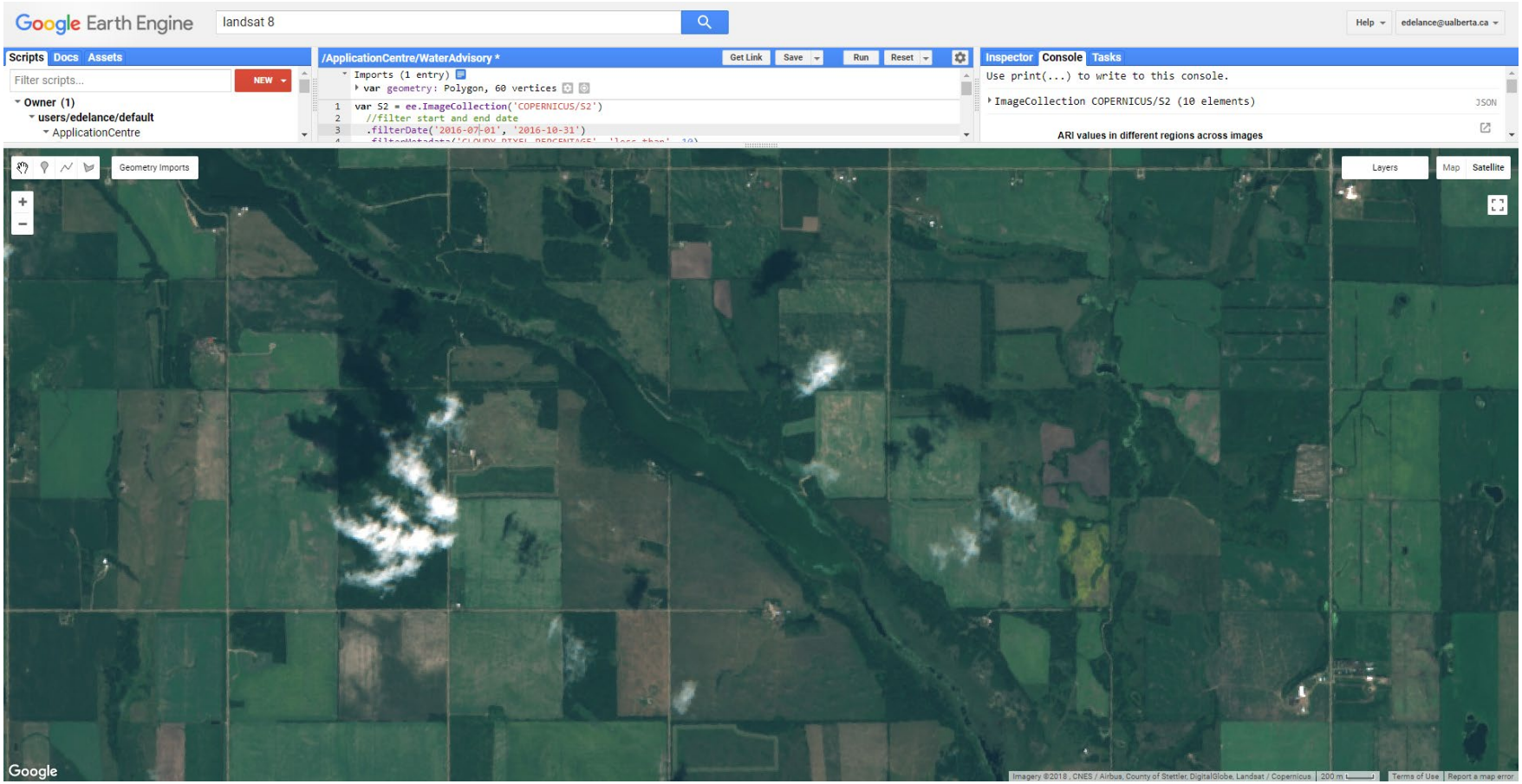
Near real-time monitoring of water quality conditions in Alberta lakes

Spatial and temporal specificity – assess lake conditions in 10m pixels

Goal: Construct a water quality variable(s) linking location and timing of bloom event to recreation visitation.

3.3 Satellite Imagery

3. Satellite Imagery / Remote Sensing



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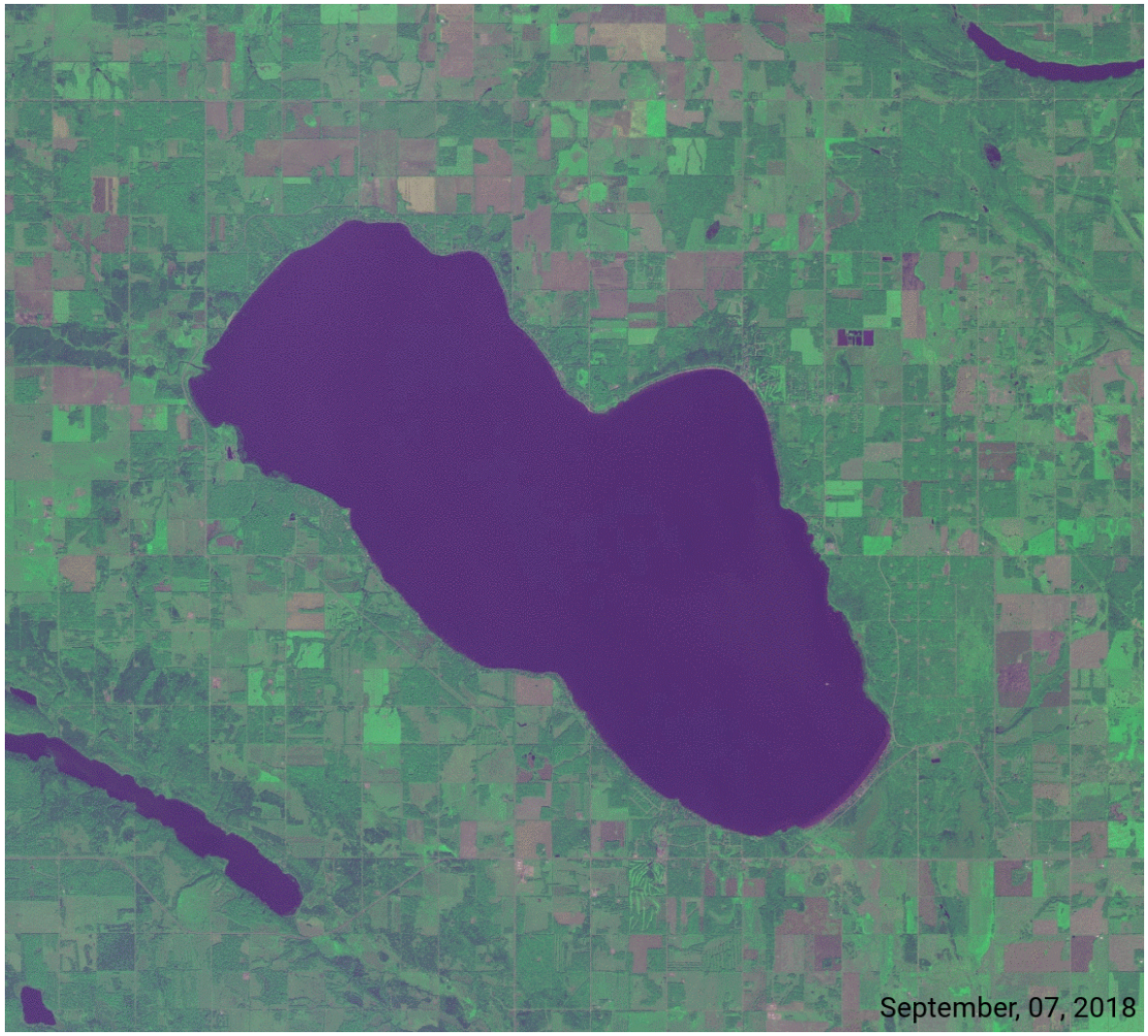

Final Thoughts

- Recreation is a downstream benefit of ecosystem service management
- Impacts to recreation services are difficult to measure
- Improved data collection and technology will enable us to more effectively capture these values