Integrated Monitoring of Biodiversity – Sharing in the world of Big Data

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Main types of environmental monitoring

Compliance Monitoring

Company measures X to assess compliance with regulations

Local spatial extent.
Time period finite

Designed to answer specific ? for life of project.

Example:
Environmental Protection & Enhancement Act Approvals

Trend Monitoring

Volunteers/ staff measure X in same sites to see how X changes over time

Large spatial extent
Time period infinite

NOT designed to answer any specific question

Example:
ABMI

Applied Research

Researchers compare in time/ space using control/ treatments how X varies

Spatial scales often local
Time period often short

Designed to answer specific question once & then move on

Example:
Erin Bayne's career

How most environmental monitoring data is used

Narrative Review

Systematic Review

Quantitative meta-analysis

Limitations of meta-analysis

File drawer problem

Only show graphical results

Can't double-check raw data

Variation in spatial scale

Is habitat defined the same way?

Forgot to report variance estimate

Variation in statistical methods

Variation in field methods

Did not report sample size

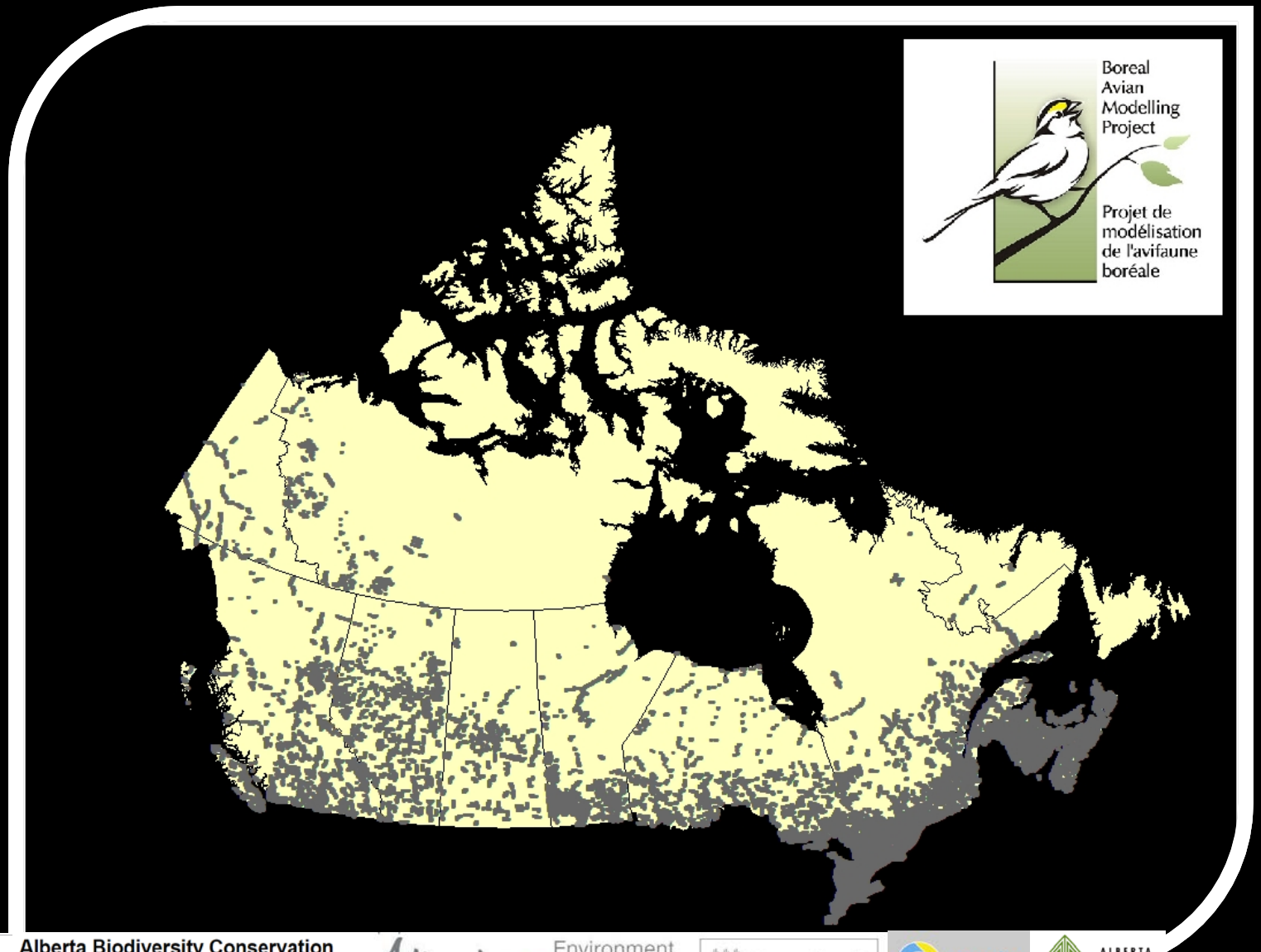
Violation of statistical assumptions

Did not report measure of central tendency

Ill-defined statistical population

Limits you to original questions

But what if we had the raw data?

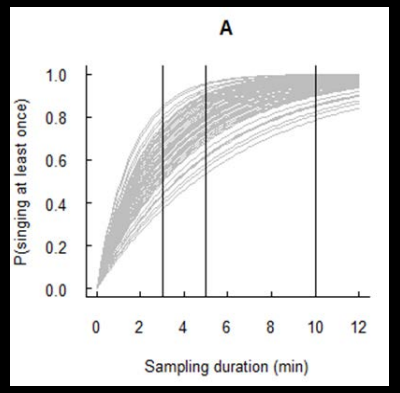


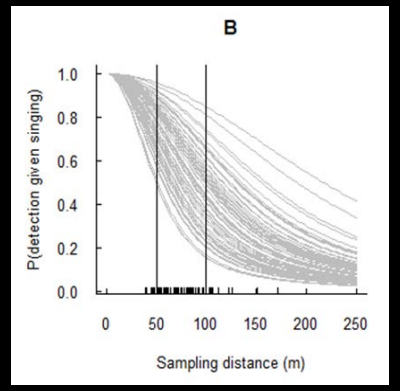
The messy part of big data

$E[Y_{j\cdot}] = D\,A\,[p(t_j) - p(t_{j-1})]\,q(r_K)$

$\hat{C}_i = \hat{A}_i \hat{p}(t_J)_i$

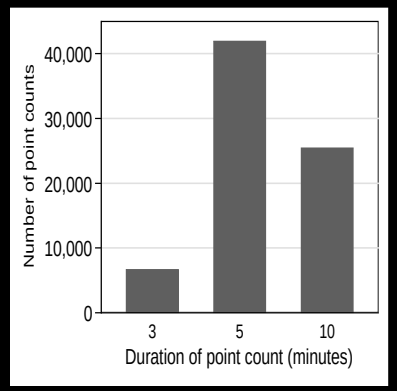
$p(t_J) = \int_0^{t_J} \phi \exp(-t\phi)\,dt = 1 - \exp(-t\phi)$

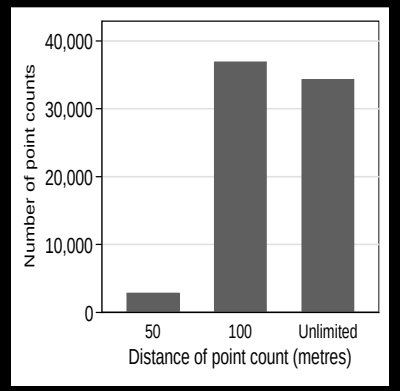




$\lambda_i = D_i A_i \hat{p}(t_J)_i \hat{q}(r_K)_i$

$g(r) = \exp(-r^2 / \tau^2)$



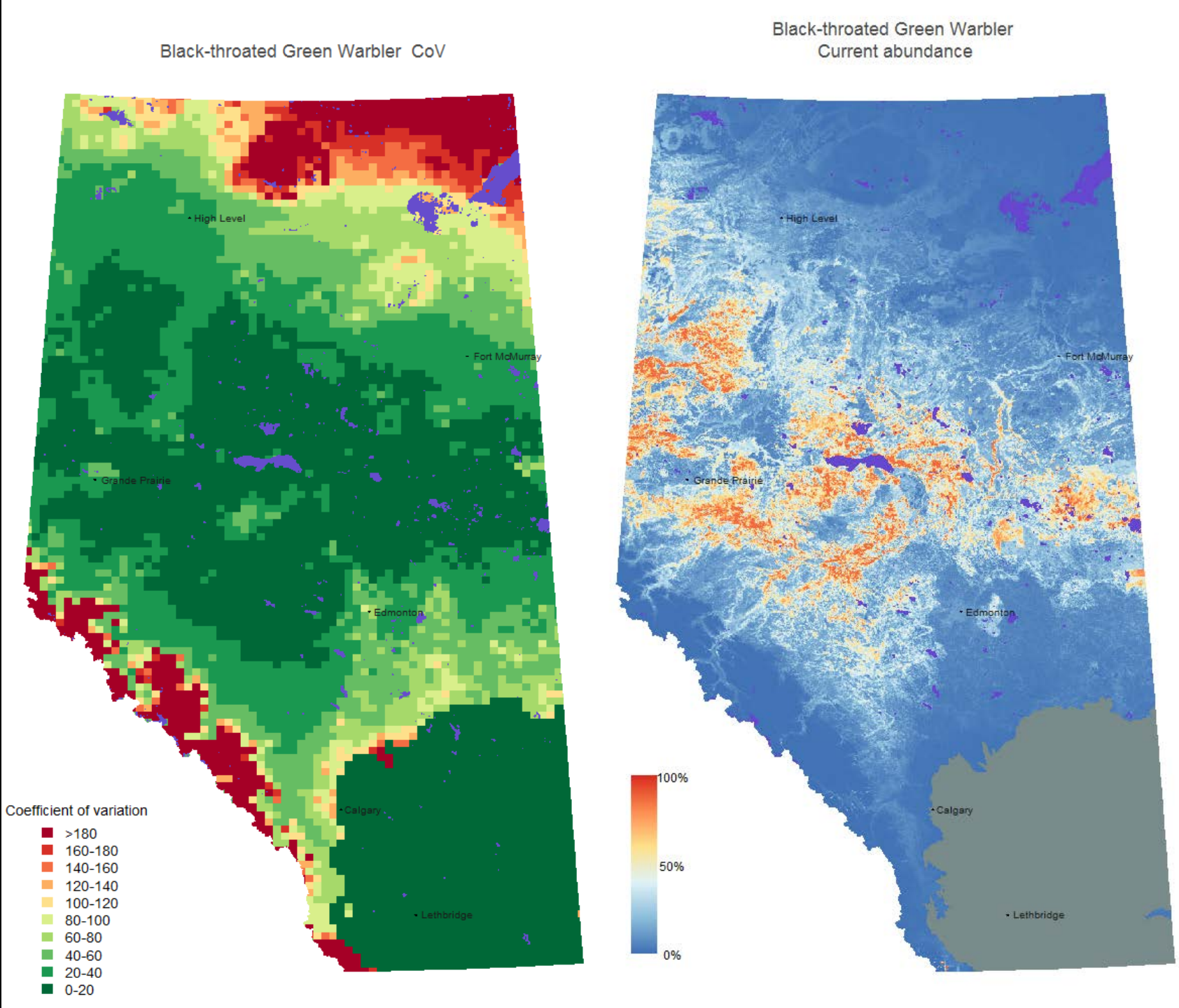


$\hat{q}(r_K)_i = \frac{\hat{\tau}_i^2}{r_K^2}\{1 - \exp(-r_K^2/\hat{\tau}_i^2)\}$

$E[Y_{\cdot\cdot}] = N\,p(t_j)\,q(r_K) = D\,A\,p(t_j)\,q(r_K)$

$$q(r_K) = \int_0^{r_K} c(r)g(r)dr = \frac{\int_0^{r_K} \pi 2r \exp(-r^2/\tau^2)\,dr}{\pi r_K^2} = \frac{\pi\tau^2 u(r_K)}{\pi r_K^2} = \frac{s(r_K)}{\pi r_K^2}$$

What we can do now!



Distribution maps

We can now make predictions at meaningful scales
Also can assess uncertainty & know where we really need more data

Gaps in habitat and space

Data sources:

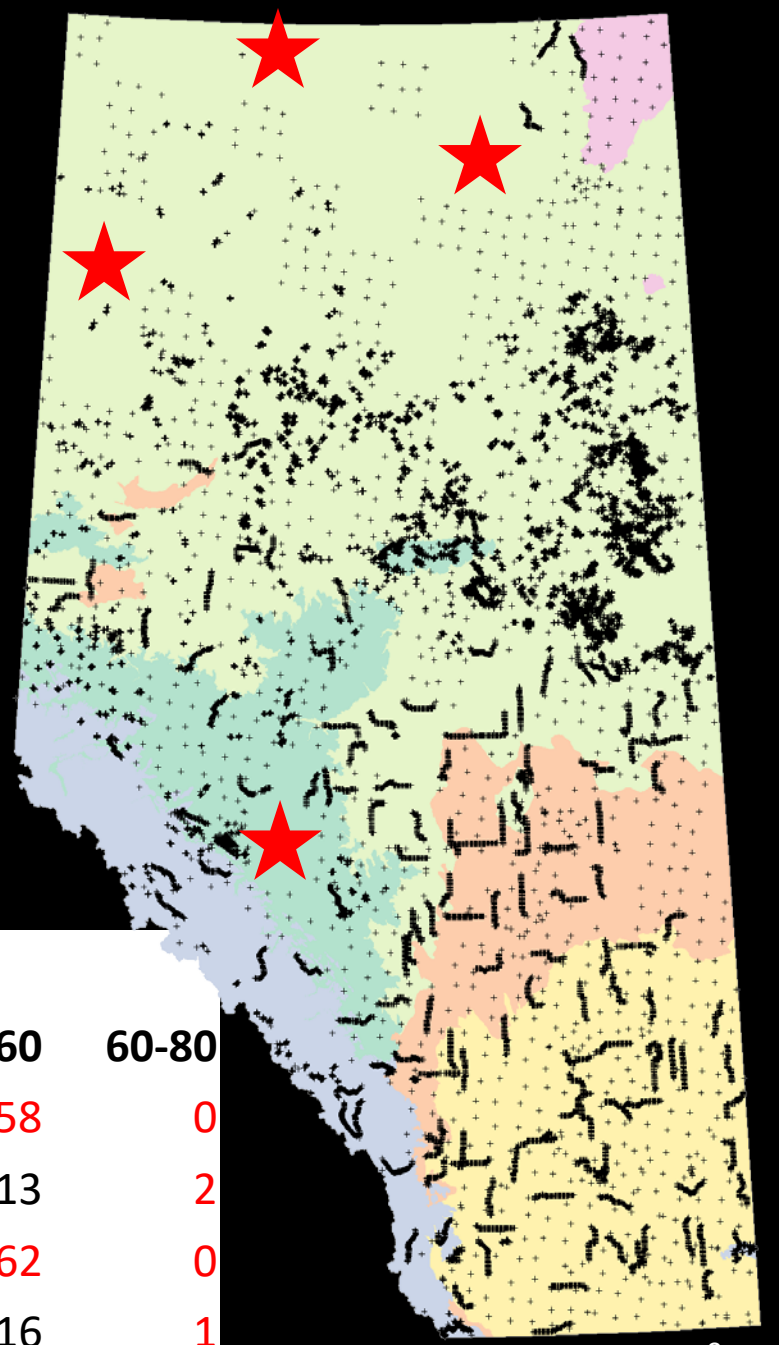
ABMI (33K)

BAM (53K)

BBS (78K) ← 1-10 min counts

ECCC (9K)

BU (63K)

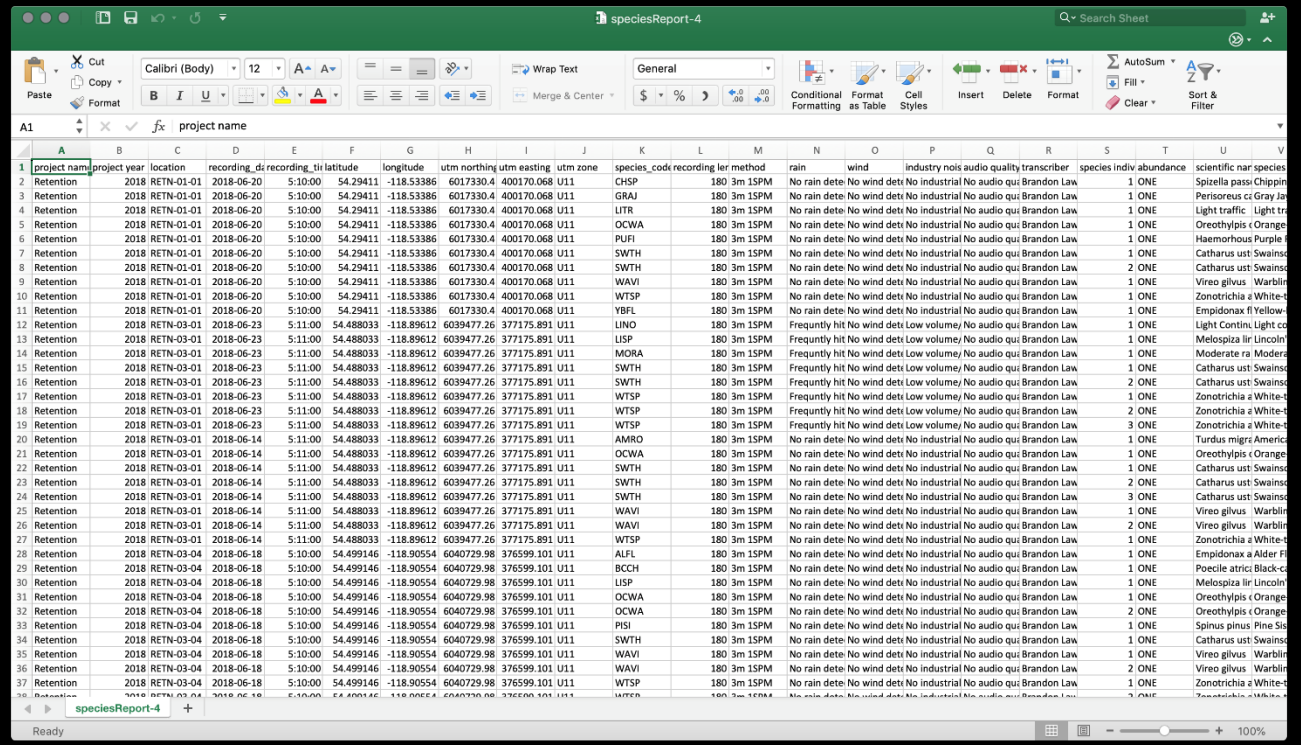


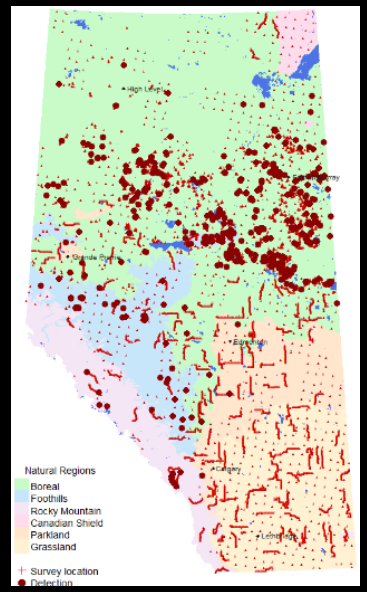
	Fire					Harvest				
	0-10	**10-20**	**20-40**	**40-60**	**60-80**	**0-10**	**10-20**	**20-40**	**40-60**	**60-80**
Deciduous	180	163	731	1862	10208	4093	3140	1788	58	0
Mixedwood	86	129	151	387	1305	669	429	508	113	2
Pine	1083	360	715	1141	2256	631	368	261	62	0
Spruce	147	201	67	42	409	828	616	1038	116	1

Reducing the messiness

Data Download

☐	2018	Sambaa K'e Winter Road CWS Northern Region 2018	675	560	WR
☐	2018	Post-disturbance Temporal Gradient	123	23	PDTG
✓	2018	Wetlands 2018	1963	1274	Y
✓	2017	Big Grids 2017	0	0	BG
☐	2017	Mackenzie Valley Winter Road CWS Northern Region 2017	319	297	WR
☐	2018	Natural Disturbance Long-term Monitoring Program CWS Northern Region 2018	57	57	FR
✓	2018	Big Grids 2018	1142	552	BG
☐	2013	Wetlands 2013	0	0	Y





We have made big strides on integrating old school bird point counts & ARUs

- ABMI and BAM are leading on an open data initative for birds across Canada in conjunction with ECCC

- Next steps are to do this for non-vocal species
  - initiative underway in Lower Athabasca to integrate mammal data
  - Coordinating all camera data into WildTrax
  - Developing data systems to store and share other mammal data:
    - Aerial surveys
    - Snow tracking
    - Track plates
    - Trapping
    - Hair snares
- Other taxa?

Our ultimate goal should be

- To create a system where all environmental monitoring information gets used effectively to make good decisions in a spirit of transparency and openness
- To do so in timely fashion so that research/ monitoring gets in the hands of everyone as quickly as possible and in as many formats as possible (peer-reviewed papers, maps, raw data, decision support tools)
- Our issues are big enough we can’t wait around & need to make environmental monitoring nimble enough to make good decisions