

Introduction

Peter Solymos

Point count data analysis workshop, BIOS2 2021, March 16-25

Housekeeping

- Camera on optional
- Go for a break as needed (2 breaks/session)
- Stretch

Housekeeping

Questions:

- Live
- In the chat
- Or <https://hackmd.io/@psolymos/qpad-2021>

Juan Andres (TA) will organize these, thanks!

About the instructor

- **Peter Solymos**
- Stat ecologist,
- R programmer (vegan, detect, ResourceSelection, pbapply),
- Sometimes I teach
- @psolymos

Acknowledgement

I am situated on Indigenous land in Treaty 6 territory; land occupied, traveled, and cared for by Indigenous Peoples since time immemorial to the present day.

What you will learn

1. How to analyze your point count data when it combines different methodologies/protocols/technologies
2. How to violate assumptions and get away with it

Outline

Day 1

- Introduction
- We need to talk about data
- A primer in regression techniques

Day 2

- Behavioral complexities

Day 3

- The detection process
- Dealing with recordings

Day 4

- Putting it all together
- Understanding roadside surveys

Install packages

```
source(  
  paste0("https://raw.githubusercontent.com/",  
    "psolymos/qpad-workshop/main/src/install.R")  
)
```


Get course materials

1. Visit <https://github.com/psolymos/qpad-workshop/releases>
2. Download the latest release into a folder
3. Extract the zip/tar.gz archive
4. Open the `workshop.Rproj` file in RStudio (or open any other R GUI/console and `setwd()` to the directory where you downloaded the file)
5. (You can delete the archive)

Apples and oranges

"A comparison of apples and oranges occurs when two items or groups of items are compared that cannot be practically compared."
[Wikipedia]

How we measure things can have big impact on our results.

- You might say: I saw 5 magpies (walking down the street),
- I might say: I only saw one (sitting on my deck)

Apples to apples

Effort:

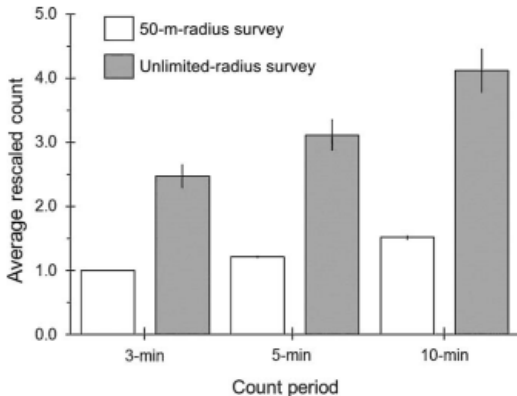
- *area* of the physical space searched
- amount of *time* spent
- number of *individuals* identified

Experience, skill etc.:

- number of years in field work
- eye sight, hearing ability
- microphone sensitivity, damage

The goal is to make our measurements **comparable**.

Effects can be significant



10-min unlimited count ~300% increase over 3-min 50-m count.
Average across 54 species of boreal songbirds¹.

¹Matsuoka et al. 2014, [Condor 116:599–608](#).

What is a point count?

- A trained observer
- records all the birds
- seen and heard
- from a point count station
- for a set period of time
- within a defined distance radius.

Questions we want to answer using point counts

- How many? (Abundance, density, population size)
- Is this location part of the range? (0/1)
- How is abundance changing in space? (Distribution)
- How is abundance changing in time? (Trend)
- What is the effect of a treatment on (relative) abundance?

Design based standardization

Have a set of standards/recommendations that people will follow to

- Maximize efficiency in the numbers of birds and species counted
- Minimize extraneous variability in the counts²

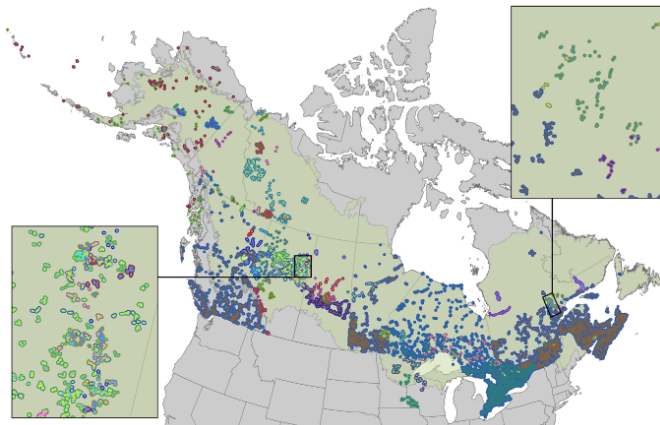
But programs started to deviate from standards:

“For example, only 3% of 196,000 point counts conducted during the period 1992–2011 across Alaska and Canada followed the standards recommended for the count period and count radius.”³

²Ralph et al. 1993, [Handbook of field methods for monitoring landbirds](#).

³Matsuoka et al. 2014, [Condor 116:599–608](#).

My protocol, your protocol



Survey methodology variation (colors) among contributed projects in the Boreal Avian Modelling (BAM) data base as of 2014⁴.

⁴Barker et al. 2015, [WSB 39\(3\):480–487](#).

Pop quiz

- In what regard can protocols differ?
- What drives protocol variation among projects?
- Why have we abandoned following protocols?

Moving away from standards

- Detection probabilities might vary even with fixed effort (we'll cover this later in depth)
- Programs might have their own goals and constraints (access, training, etc.)

Model based approaches

Less labor intensive methods for *unmarked populations* have come to the forefront:

- double observer ([Nichols et al. 2000](#)),
- distance sampling ([Buckland et al. 2001](#)),
- removal sampling ([Farnsworth et al. 2002](#)),
- multiple visit occupancy ([MacKenzie et al. 2002](#)),
- multiple visit abundance ([Royle 2004](#)).

Models come with assumptions

- Population is closed during multiple visits
- Observers are independent
- All individuals emit cues with identical rates
- Spatial distribution of individuals is random
- Etc.

Assumptions are everywhere

Although assumptions are everywhere, we are really good at ignoring them:

- Relativistic time dilation is negligible (as long as we are not on a space station)
- Samples are independent

Pop quiz

- Can you mention some other common assumptions?
- Can you explain why we neglect/violate assumptions?

The hard truth

Assumptions are violated in many ways, because we seek simplicity

The main question we have to ask: **does it matter in practice?**

Our approach

1. Introduce a concept
2. Understand how we can infer it from data
3. Recreate the situation *in silico*
4. See how the outcomes change as we make different assumptions

How to get away

It is guaranteed that we violate **every** assumption we make.

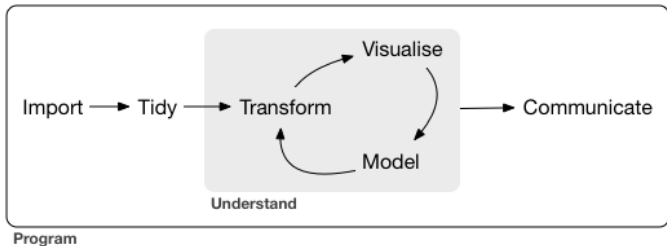
To get away with it, we need to understand **how much is too much**.

“All assumptions are violated, but some are more than others.”—Me



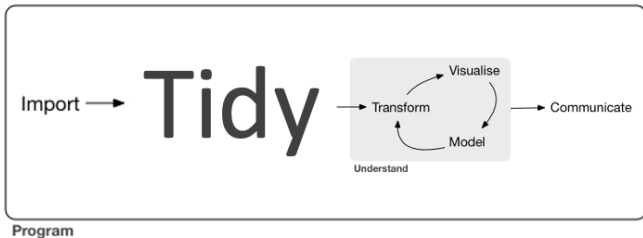
Source: [@pegleraj](#)

Tidy workflow



Source: [r4ds](#)

Tidy time tracking



Letters proportional to time spent

Data ...

It is often called:

- processing,
- munging,
- wrangling,
- cleaning.

None of these expressions capture the dread associated with the actual activity.

"All data are messy, but some are missing."

First mover disadvantage

If you are the first person to ever look at the data, hope for the best, expect the worst.

If no one looked, no one found the problems yet.

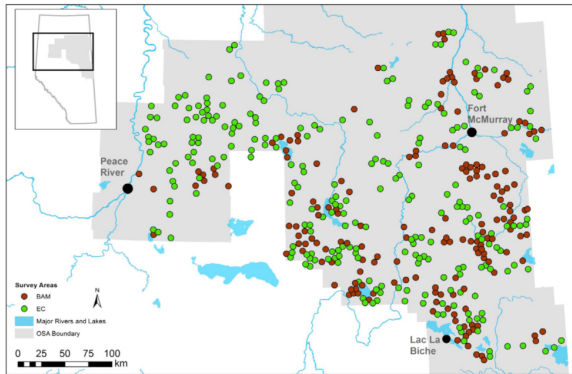
The four horsemen

Luckily, there are only 4 things that can get messed up:

1. space (e.g. wrong UTM zones),
2. time (ISO format please),
3. taxonomy (UNK, mis-ID),
4. something else (→ check again).

Check out source code if you are interested in data processing, we skip that for now to concentrate on the fun part.

JOSM (Joint Oil Sands Monitoring) data

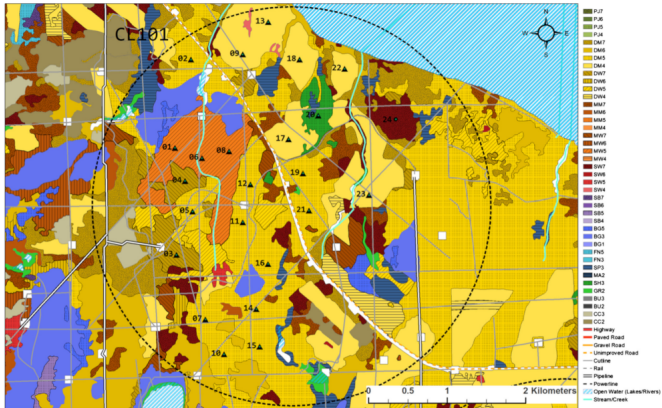


Cause-Effect Monitoring Migratory Landbirds at Regional Scales⁵⁶:
understand how boreal songbirds are affected by human activity in
the oil sands area.

⁵Mahon et al. 2016, [For. Ecol. Man.](#)

⁶Mahon et al. 2019, [Ecol. Appl.](#)

Survey design



Survey area boundary ($r=2.5$ km circle), habitat type and human footprint mapping, and clustered point count site locations.

Sampling, replication

- We want to make inferences about a population,
- full census is out of reach,
- thus we take a sample of the population
- that is representative and random.
- Ideally, sample size should be as large as possible,
- it reduces variability and
- increases statistical power.

How do we pick survey locations

- Stratification,
- gradients,
- random location (control for unmeasured effects),
- take into account historical surveys (avoid, or revisit),
- access, cost (clusters).

Dive into the data

After the break

```
load("data/josm-data.rda")  
names(josm)  
#> [1] "surveys" "species" "counts"
```