Nevada Bighorn Modeling Project

Aim 1

Build a mechanistic / transportable model of how bighorn move across NV (to get at risk of contact with DS)

Aim 2

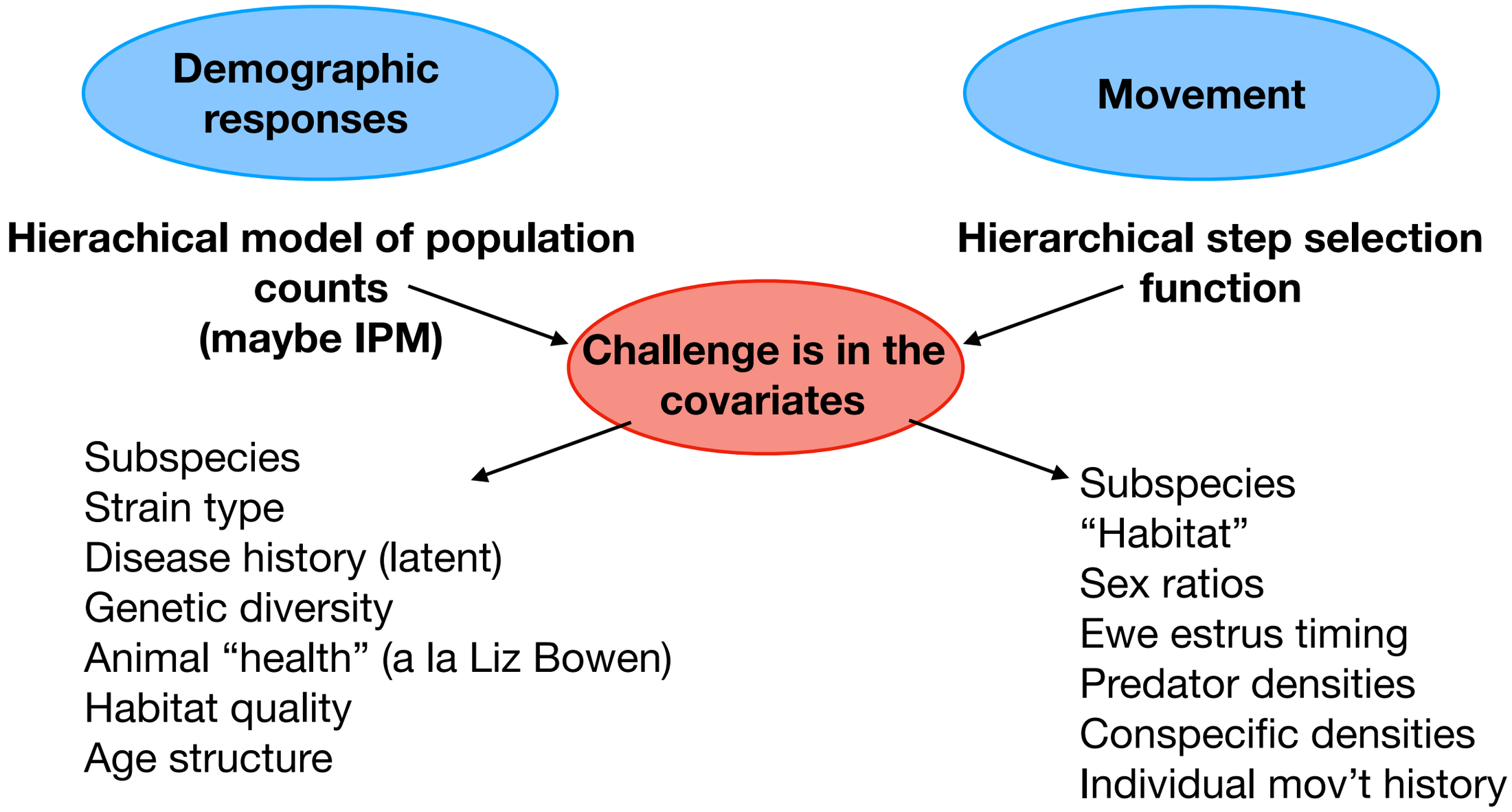
Build a mechanistic/transportable model of why demographic responses vary after die-off events

Aim 3

Forecast aggregate disease risk (contract *M.ovi* AND suffer long-term demographic consequences) across all NV herds

Tactic

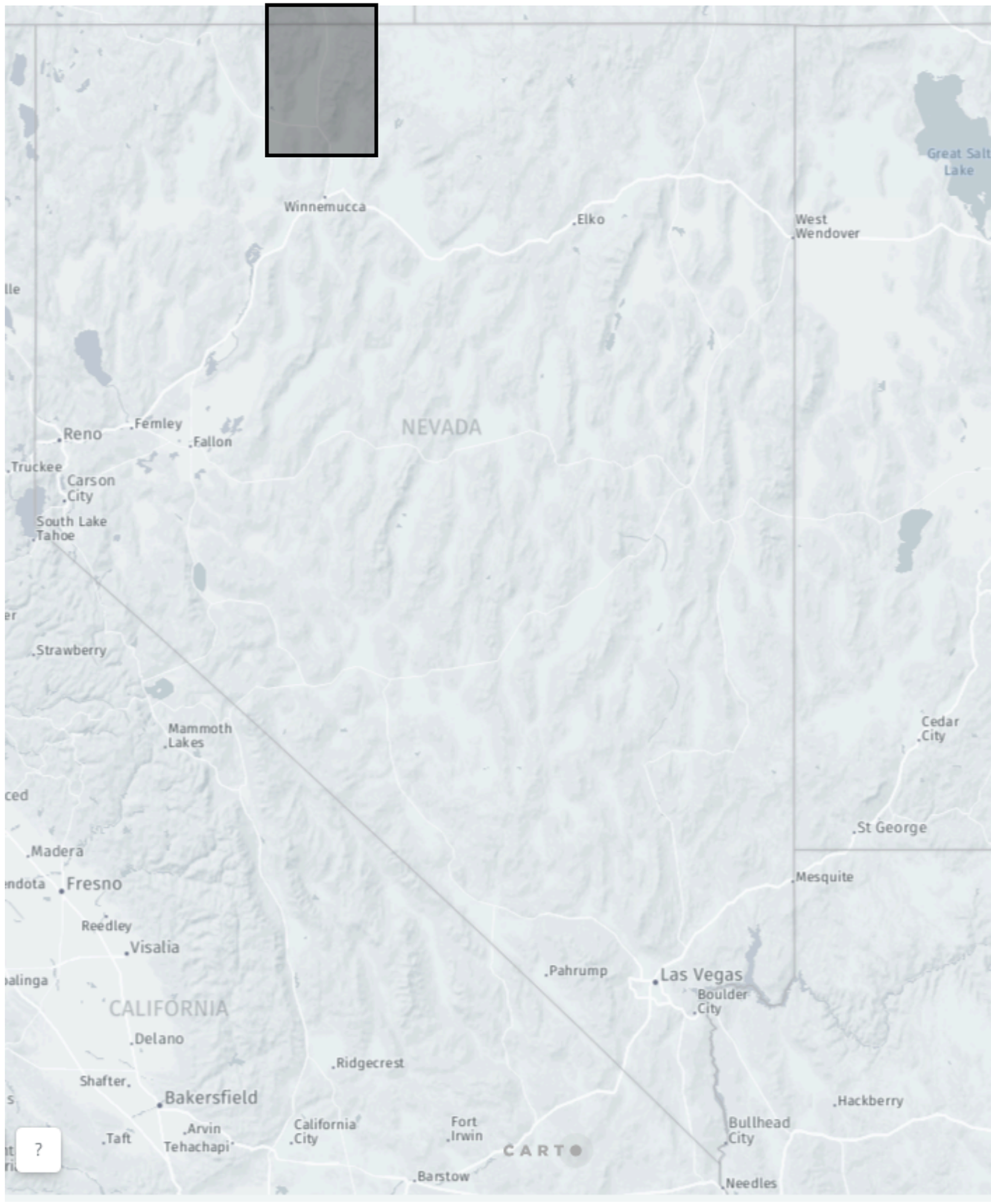
- Assess patterns across the whole statewide dataset



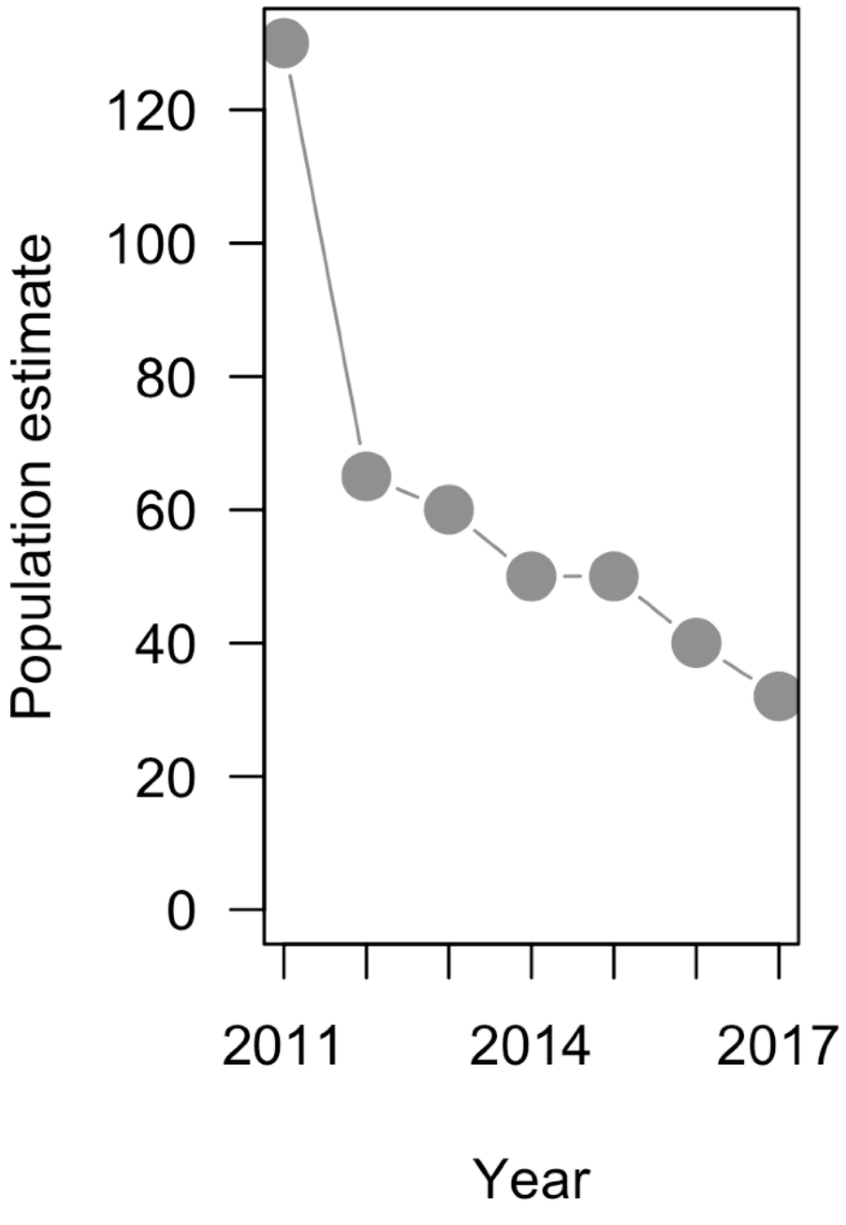
- Learn mechanisms from sites with the strongest data

Strong data example: Snowtorms

Thanks to Matt Jeffress



Snowstorms



Die-off in summer, 2011

Two rounds of removals

- 2014-15 (non-selective)
- 2016-17 (test-cull)

How well did the removals succeed at

1) **eliminating *M. ovi*?**
2) **generating population growth?**

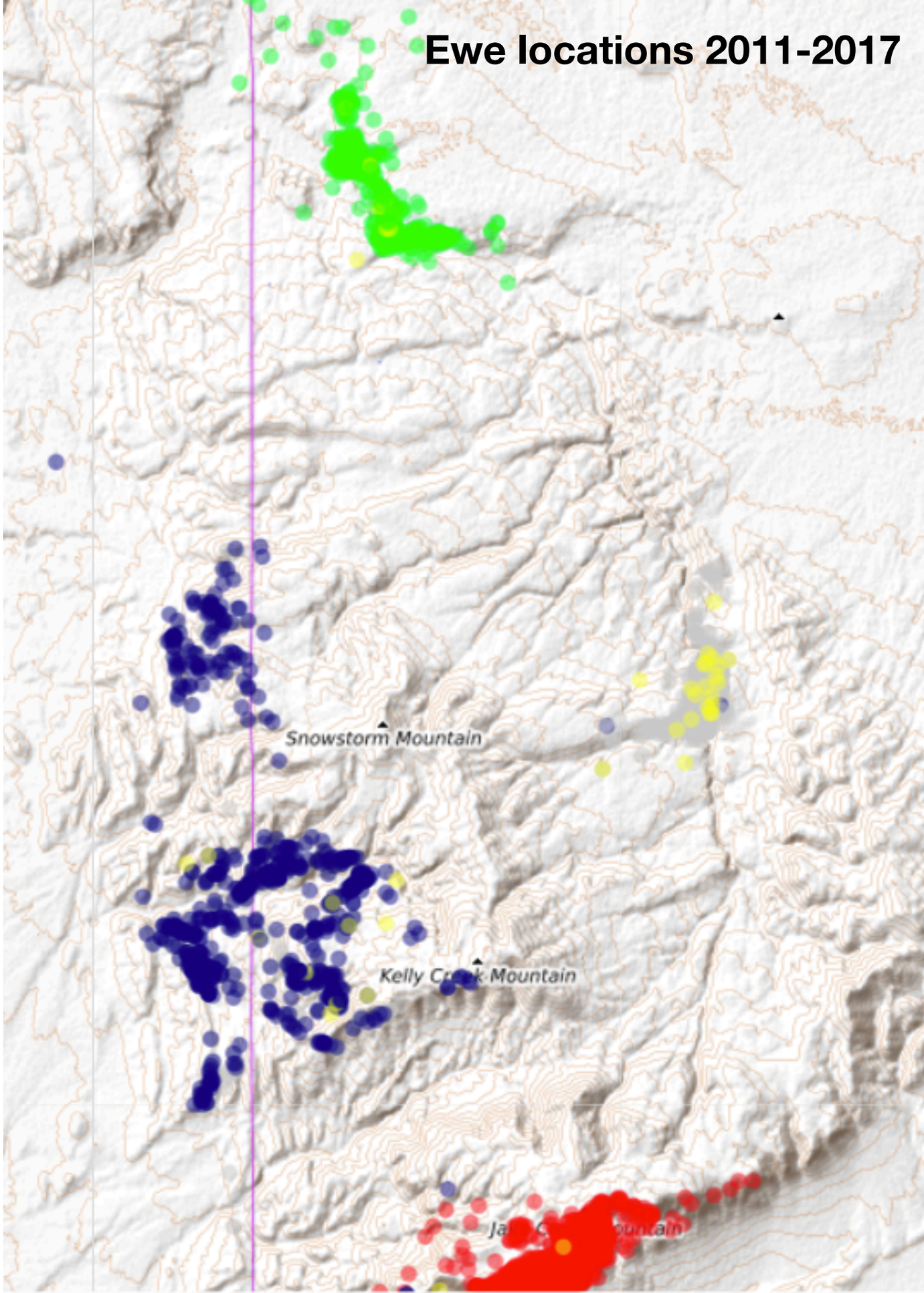
Snowstorms

Spatially segregated herd with 4 distinct subunits

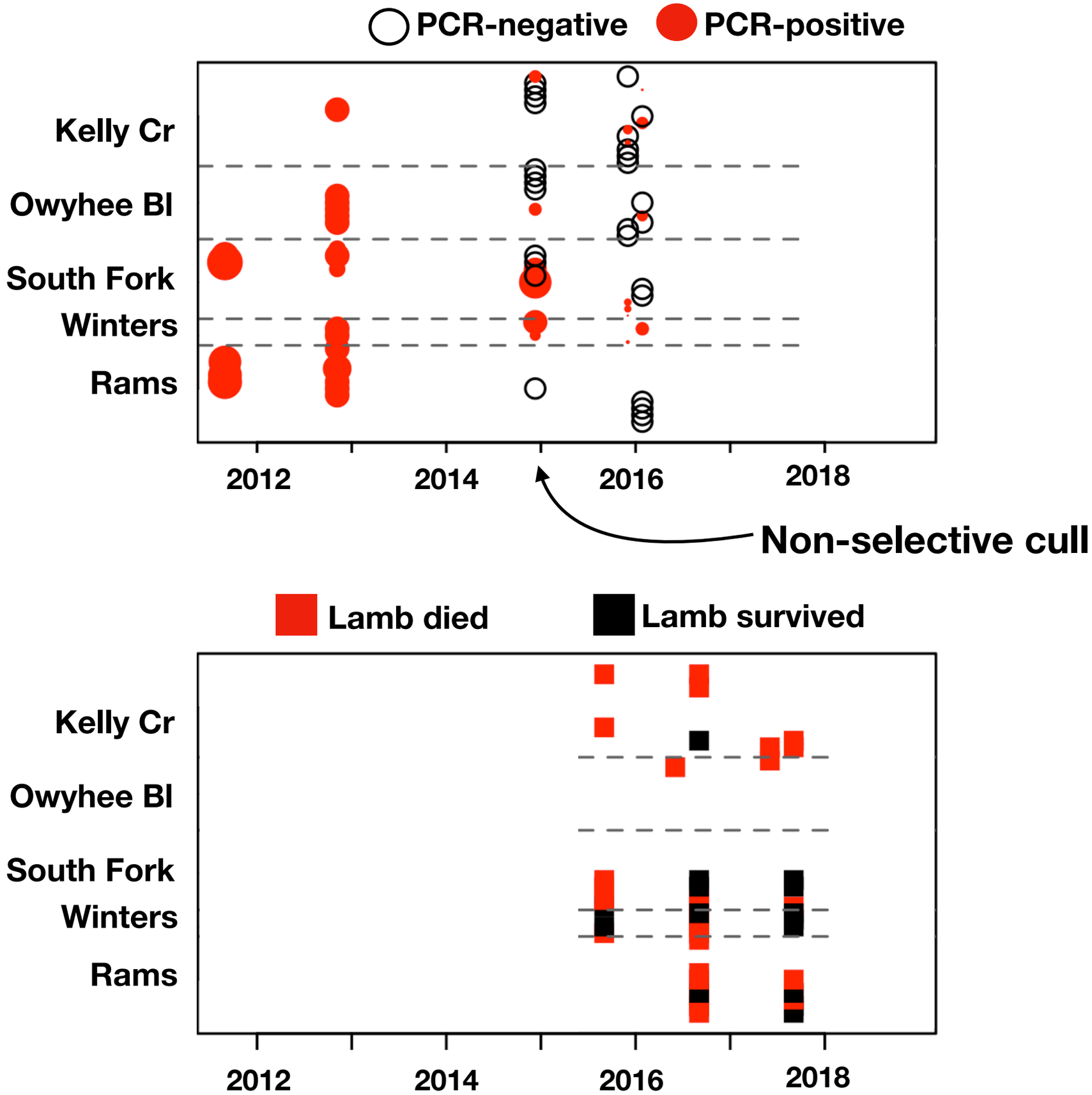
- Kelly Creek
- Owyhee Bluffs
- S. Fork of the Little Humboldt River
- Winters

Removals in all

Lamb survival measured at subunit level



Individual testing histories



Take-home messages

Summer lamb survival improved substantially from 1st to 2nd round of removals

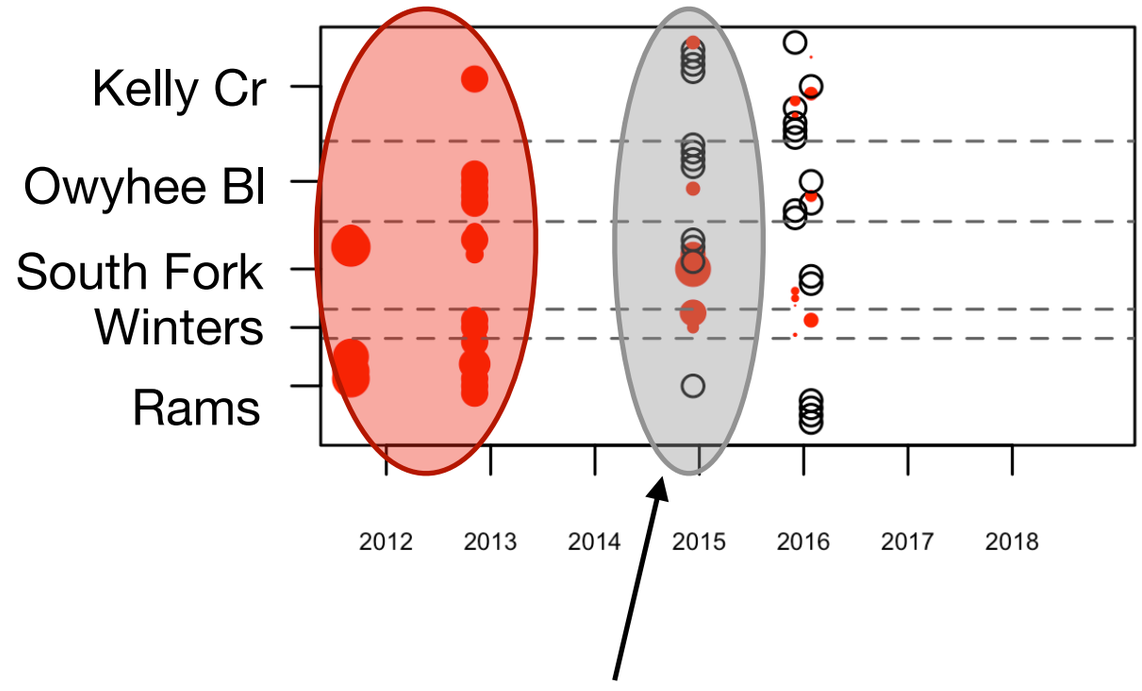
- **One round may not be enough, especially if non-selective**
- **Density reduction alone didn't help much**

Lamb survival improved significantly as *M. ovi* prevalence declined in local ewes

- **Only visible if we look at subherds individually**
- **Measuring responses at scale of ewe-mixing during summer may be important!**

Other things learned from the Snowstorms

1. In the sampling event a year after the die-off, nearly everyone was still positive

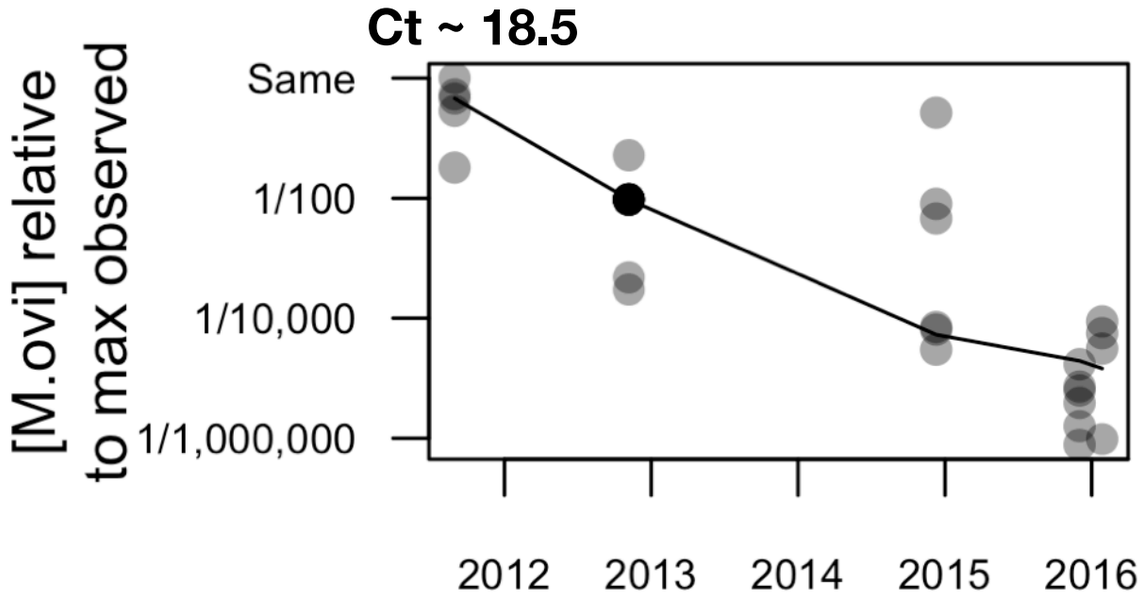


Wait a couple years to test-and-remove!

Other things learned from the Snowstorms

2. ‘Quality’ of infection and immune response changed through time

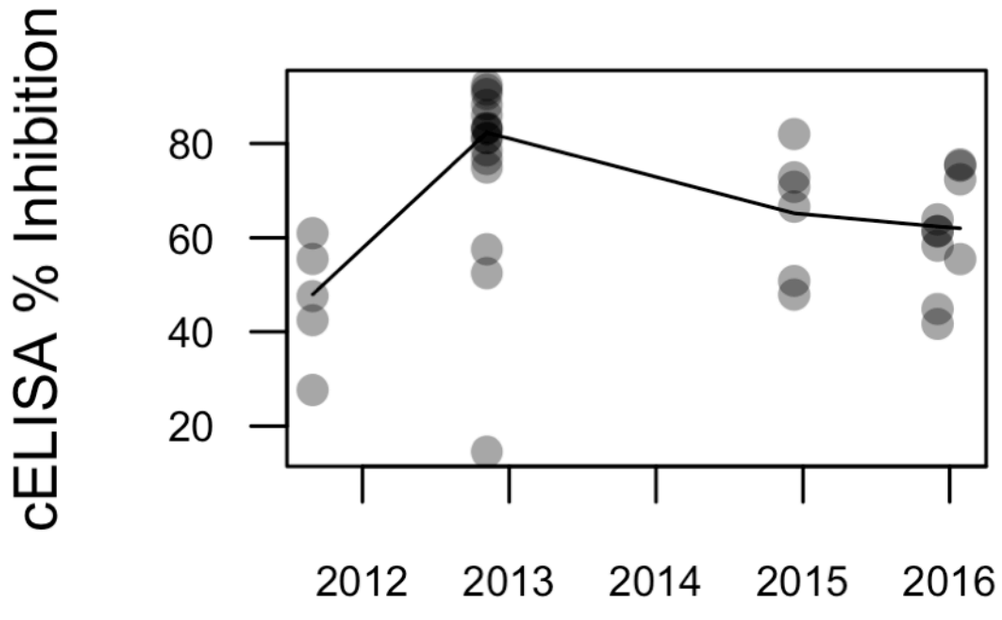
Current Infection status



How do these declines interact with the test-cull?

Median Ct ~ 35.5

Exposure status



What will happen with immunity going forward?

Take-home messages

- **Summer lamb survival improved substantially from 1st to 2nd round of removal**
    - **One round may not be enough, especially if non-selective**
    - **Density reduction alone didn't help much**

- **Lamb survival improved significantly as *M. ovi* prevalence declined in <u>local</u> ewes**
    - **Only visible if we look at subherds individually**
    - **Measuring responses at scale of ewe-mixing may be important!**

- **We can learn a lot (or confirm captive results) through intensive monitoring**

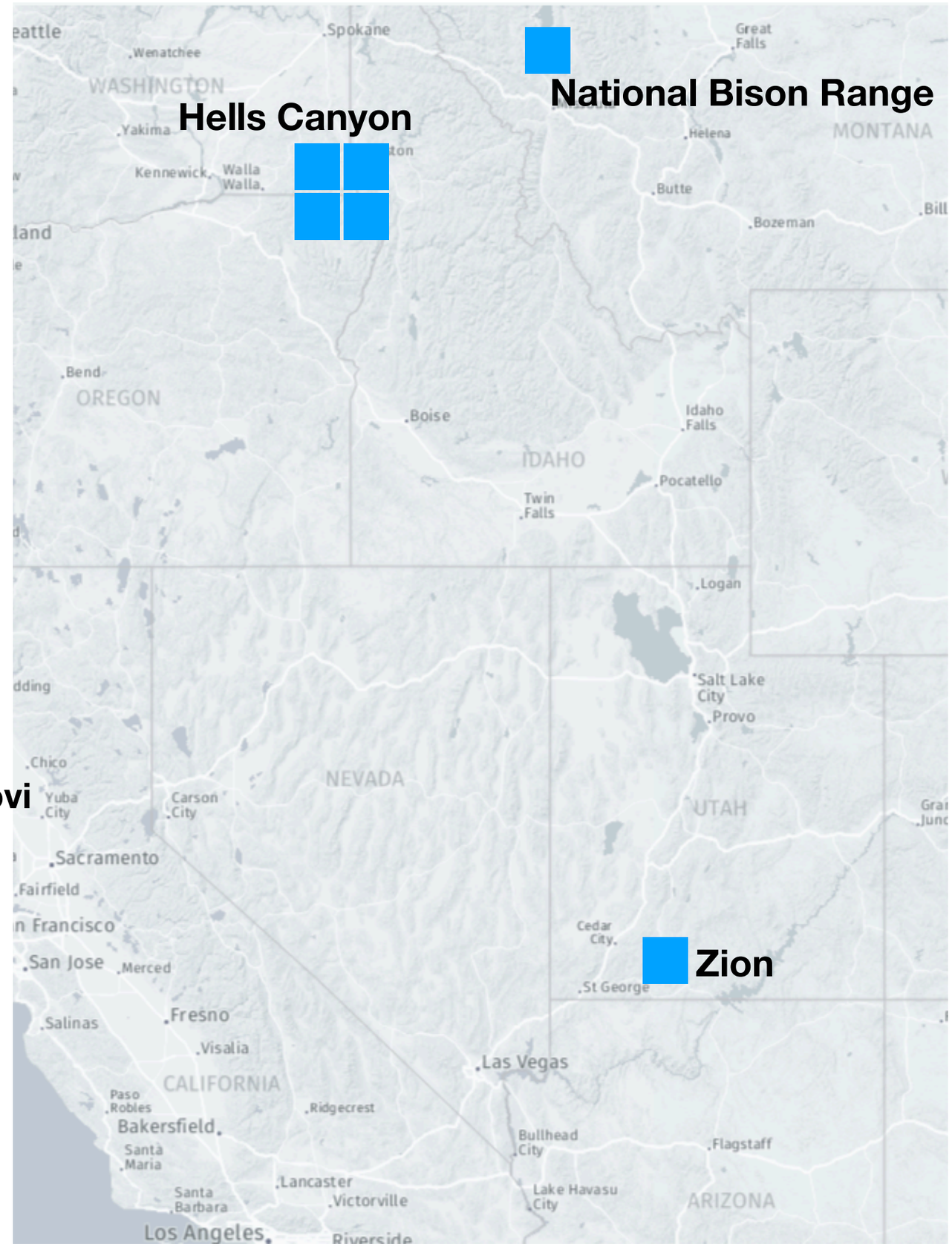
Intensively monitored sites

Known individuals

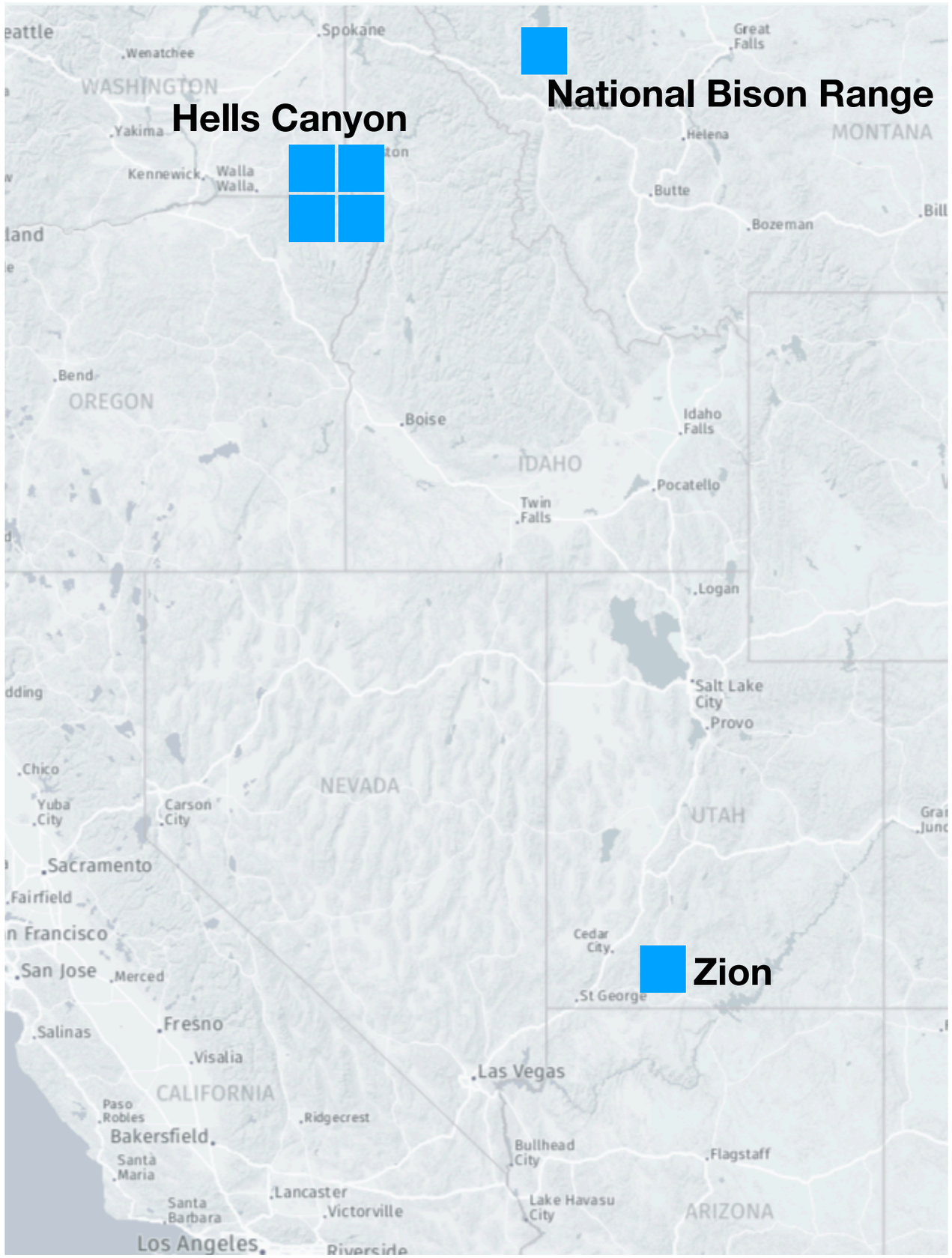
- Age
- Pedigree
- Individual disease history

Goal: Figure out mechanisms!

- What are the long-term consequences of pneumonia on individual health
  - Birth pulse timing, horn growth
- What drives ram mov't during rut?
  - Relative rank + # estrus ewes
- Why do we see so much heterogeneity in post-translocation movements?
  - "Decisive" animals
- How hard is it for a herd to recover after M.ovi is gone?
  - Predation — changes in vigilance
  - Inbreeding — changes (?) in dispersal
- How does desert vs. Rocky ecology shape transmission — should we expect different dynamics?
  - Group size
  - Birth pulse synchrony



Intensively monitored sites



<u>Useful features</u>

- **Presence on the ground**
- **Methodological consistency x sites**

Happy to share methods;
Happy to incorporate other ideas

Intensively monitored sites

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Mechanisms

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Broadscale predictions

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Test using statewide monitoring data

Thank you!

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