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

Demographic responses

Hierarchical model of population counts (maybe IPM)

Movement

Hierarchical step selection function

Challenge is in the covariates

- Subspecies
- Strain type
- Disease history (latent)
- Genetic diversity
- Animal “health” (a la Liz Bowen)
- Habitat quality
- Age structure

- Subspecies
- “Habitat”
- Sex ratios
- Ewe estrus timing
- Predator densities
- Conspecific densities
- Individual mov’t history

- 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

Non-selective cull

Lamb died
Lamb survived

Kelly Cr
Owyhee Bl
South Fork
Winters
Rams

PCR-negative
PCR-positive
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
  
  - Median Ct ~ 35.5
  
- Exposure status
  
  - Median Ct ~ 35.5
  
  - How do these declines interact with the test-cull?
  
  - 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 local 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

Useful features

• 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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