Problems with Idaho's Wolf Population Estimates

Michel Liao

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Contents

1 Introduction

This entire document is **not my work** and is based on a professor of ecology's informal paper who remains anonymous for the sake of privacy.

- Population numbers can never be ascertained but only estimated. Good estimates follow three properties:
  1. Rely on methods that provide independent info about the number of individuals detected (C) and the probability an individual is detected ($\hat{p}$)
     - Knowing $\hat{p}$ is important to see if changes in animal counts reflect a change in real population size (N)... could be a change in survey methods or effort, change in animal behavior or location, changes in counting conditions
  2. Based on enough data to provide precise information (i.e. margin of error is small)
     - w/o cannot detect changes in population size until they become severe
  3. Data is collected in a manner that matches assumptions of statistical models used to estimate population sizes

2 Sampling Methods

- **Distance sampling** records the distance from a point where animals are detected to find $\hat{p}$
  - Population size is estimated with $\hat{N} = \frac{C}{\hat{p}}$
  - Often used for species that are not individually identifiable
  - Bad for large carnivoers because you can't obtain enough sightings to produce a precise estimate
- **Capture-mark-recapture** methods rely on individual identification to estimate $\hat{p}$ by examining patterns in re-sighting of individuals
  - Typically provide accurate estimates but sampling design can lead to substantial uncertainty
  - Difficult to apply to elusive and wide-ranging species
  - For large carnivores, several years of intensive field study are needed to obtain $\hat{p}$
    - Hard to identify individual wolves. **False positives** (same wolf is recorded as two different ones) and **false negatives** (two different wolves are recorded as the same) are common
- **Acoustic surveys** use howl boxes to play wolf howls and record responses
- **Genetic capture-recapture** uses genotypes from fecal samples to apply capture-recapture
  - Wolves are hard to identify by sight but not by genotype
- **Integrated population models** use data on survival and pack counts to estimate population size
- A method that combines predictions about area occupied, territory size, and pack size into predicted $\hat{N}$ (call it 'unknown method')
- Space-to-event models using camera traps

3 Problems with Used Methods

- Unknown method and space-to-event method has been used in Idaho after liberalization of wolf hunting regulations
  - These methods show that wolf populations haven't been substantially affected by major changes in hunting regulations, which counters prior studies
- Assumption that wolf populations have been stable with liberalized regulations fails to explain why wolf harvests have decreased with longer seasons, increased limits, and wider range of methods of hunting and trapping

4 Idaho's Space-to-Event (STE) Model fit to Camera Trap Data

- Idaho's Statewide Wildlife Research Report for 2021 states that the Idaho wolf population was highly stable with 1556 wolves in 2020, unchanged from the 1566 estimate from 2019
- Space-to-event model can work if its assumptions are met, but they typically aren't met, leading to inaccurate $\hat{p}$ (1,2, 4-6)
  - Many developers of this model have admitted that reliable inference is only possible with unrealistic assumptions that are in better data than we typically see

4.1 STE's Assumptions

- Premise: the area examined before the first individual is seen should go down as population size goes up

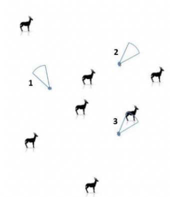

Figure 1: The 'space-to-event' model. A set of cameras (dots) is placed randomly, and each records a photograph of a known area (arcs) at fixed times. At any given time, summing the area for each camera in a random sequence until the first animal is detected (here by camera 3) allows an estimate of population density. As the number of animals increases, the area that must be sampled to detect one animal should decrease.

1. Assumption: The times and places that cameras sample an area must be independent of the location of animals.
   - STE is designed for cameras at fixed times, not cameras triggered by animal motion
2. Assumption: Random placement of cameras is required.
3. Limitation: The need to use time-lapse cameras at random locations makes it unlikely to provide accurate estimates for species that are sparse (wolf or other apex carnivores)
4. Assumption: Detections of species must be independent in space (adjacent cameras don't produce correlated data) and time (detections at one time are uncorrelated with the next)

5. Assumption: The area sampled by photographs must be accurately measured

6. Probability of detection is 1 for any animal within the viewshed of a camera which isn't likely with motion sensitive cameras

7. Individuals have a Poisson distribution, i.e. features of a landscape don't affect the animals' distribution and animals move independently

4.1.1 Violations of STE's Assumptions in Idaho

- Violation of Assumption 1: Idaho's wolf assessment is based entirely on motion-triggered cameras (3)

- Violation of Assumption 2: "Cameras were deployed along roads or trails within 500 m of either historical wolf pack rendezvous sites (i.e., pup-rearing sites used in summer) or highly suitable predicted rendezvous site habitat" (3)

  - Assumptions 1 & 2 are integral to the STE model.

- Heavily Censored Data for Limitation 3: Huge holes in data. No wolves were detected at 142 of 206 locations for a two-year study. One can expect 0.005 to 0.04 wolves in an area of 1 km^2.

- Violation of Assumption 4: Idaho wolf assessment placed cameras in areas known or strongly suspected to be rendezvous sites for pups (3).

- Violation of Assumption 5: Idaho wolf assessment estimated that each camera samples 106 m^2 at all times, even though some cameras angles were changed, affecting their areas covered.

- Coordinated movement by pack members make it unlikley for wolves to be a good fit. This problem can be solved through "zero-inflated Poisson" or a negative binomial distribution, but Idaho wolf analysis didn't make these modifications.

- Idaho analysis used STE model to estimate to estimate wolf density from cameras deployed in a grid within $10,438$ km^2, which was used to predict rendezvous sites. These density estimates were extrapolated to a larger x10 area using a resource selection function based purely on the landscape. But many species are known to alter their habitat use when they're faced with increased predation risk (7-10).

5 References

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