Estimating Abundance by Combining GPS and Counts

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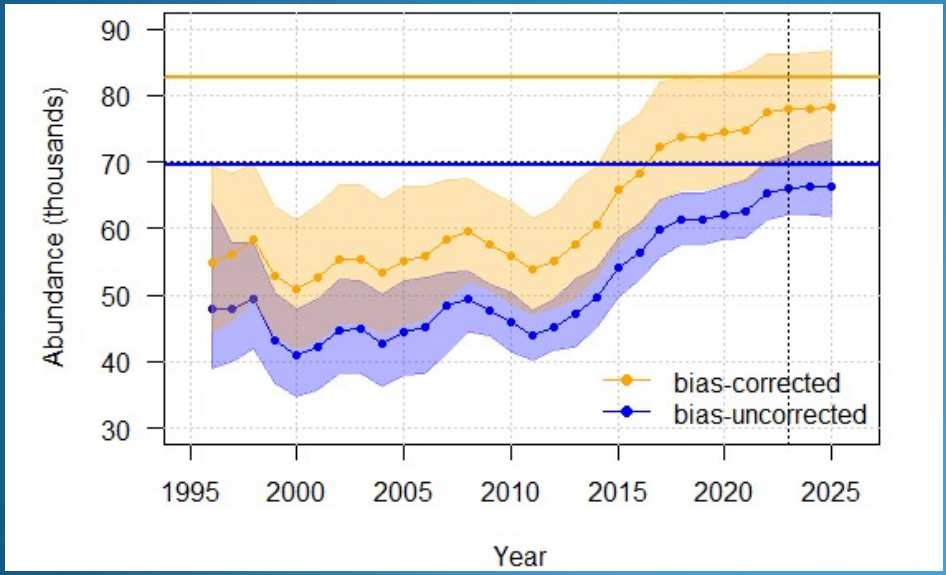
Two sample estimator (Lincoln-Petersen)

- Two sample occasions: one to GPS tag individuals and one to count the population
- p_1, p_2, p_3 are the proportion of GPS tags located at 1, 2, and 0 count sites, respectively
- $\widehat{N} = \frac{c(1-p_2)}{(1-p_3)}$
- Confidence intervals for N-hat can be derived in a number of ways
  - based on an assumption of normality in N
  - likelihood profile
  - boot-strapping - drawing a large number of samples from a Dirichlet distribution parameterized by the number of tags located at 1, 2, and 0 locations and estimating N for each

Taiga bean geese

- Imbedded the GPS tag data in the existing IPM

- Net bias averaged -17% in the spring count and -22% in the autumn count



- Increased estimated carrying capacity from 70,000 to 83,000

Practical considerations

- Locations of GPS-tagged individuals are representative of the spatial and temporal distribution of the population

- Depends on simultaneous measurements of marked & unmarked birds
  - Count data must be of sufficient temporal and spatial resolution
  - GPS locations must occur when the count is made
  - Both have proved challenging in practice

- Small sample sizes of GPS locations imply considerable sampling error, which is reflected in wide confidence intervals for population size