Monitoring Piping Plovers in the Great Plains

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Preview

- International PIPL Census
- Important monitoring issues
- A specific proposal

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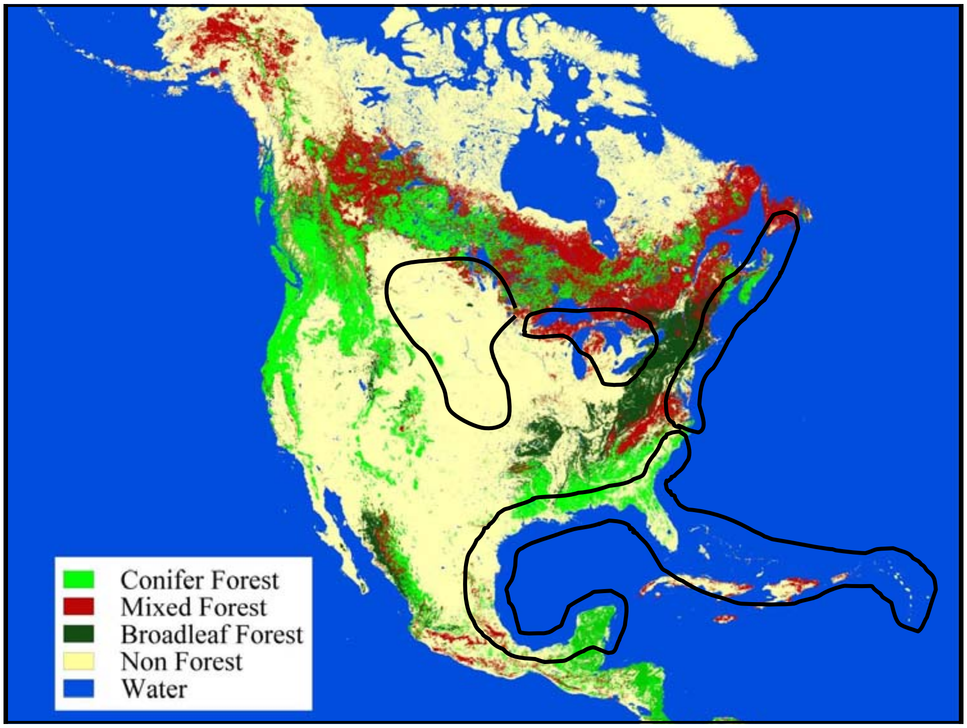

International Census

Census methods

- 1991, 1996, 2001
- 2 weeks in June
- All sites known to be occupied or contain habitat in last 5 years
- Count all adults exactly once

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Census results

Year	Obser-vers	Sites visited	Sites occupied	Count
1991		1121	0.38	3,469
1996	351	837	0.39	3,286
2001	414	958	0.41	2,953

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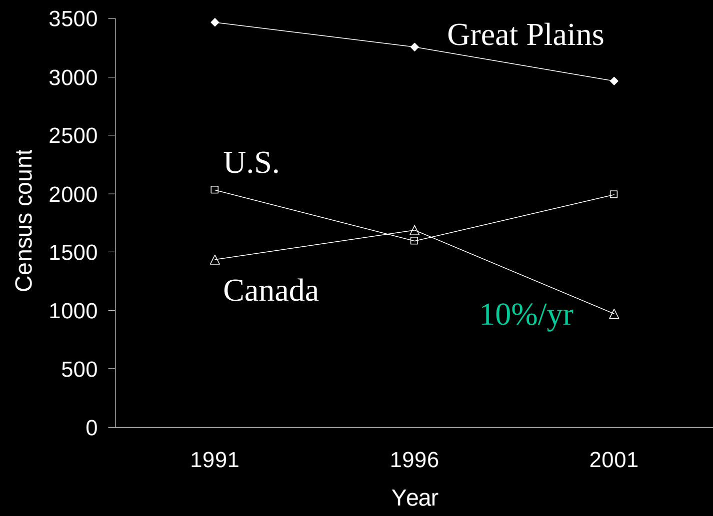
Census results



Benefits of the census

- Coverage of many ‘small’ sites
- Document distribution changes
- Habitat assessment
- Generating interest/participation

An identified need…

- to provide scientifically defensible estimates of PIPL abundance in the Great Plains

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Important monitoring issues

Monitoring issues

- Why monitor?
  - What is the larger context?
- What to monitor?
  - Objectives
- How to monitor?
  - Methods

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Why?

- Is documentation enough?
- Is there a greater scientific or management framework?
  - Science: *a priori* hypotheses
  - Mgt.: state-dependent decisions

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Objectives

- Define the population
- Select a state variable
  - Abundance, Site occupancy (good)
  - Status, Trend (not good)

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Methods

- Detectability
  - counts are usually incomplete
- Spatial sampling design
  - inability to sample everywhere
  - geographic variation

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Detectability, *p*

- $N = C / p$
  - N = abundance, C = count
- Census, $N = C$
  - assumes $p = 1$
- Index, $N_2 / N_1 = C_2 / C_1$
  - assumes $E(p_1) = E(p_2)$

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Dealing with variation in *p*

- Standardize
  - Identify & control sources of variation
- Model covariates
  - Identify & measure sources
- Estimate *p*

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Estimating detectability

- Marking birds

  - Individually
    - Good analysis methods available
    - Very difficult logistically
  - Generically
    - Lincoln-Petersen estimator
    - Banding required before each survey

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Estimating detectability

- Multiple-observers approaches
  - Good balance between effectiveness and feasibility
- Distance sampling
- Removal modeling

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Spatial sampling design

- Lots of options
  - stratified, systematic, cluster, dual-frame, adaptive
- Random selection
- Sampling where birds are not

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A proposal for piping plovers in the Plains and Prairies

Objectives

- Population: entire population of adult piping plovers in the Great Plains and Prairie Canada
- To estimate abundance every 5 years in geographic units identified in the Recovery Plan

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Methods

Detectability

Double-observer method

- Primary observer sees birds and tells secondary observer
- Secondary observer records birds seen by primary observer and additional birds (s)he sees

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Double-observer method

- Visit several sites, switching primary, secondary roles
- x_{i1} = count by observer i in primary role
- x_{i2} = count by observer i in secondary role

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Double-observer method

$E(x_{11}) = Np_1$　　$E(x_{21}) = Np_2$

$E(x_{12}) = N(1\text{-}p_2)p_1$　　$E(x_{22}) = N(1\text{-}p_1)p_2$

$$\hat{p} = 1 - \frac{x_{12}x_{21}}{x_{22}x_{11}}$$

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Methods

Spatial sampling design

Sampling design

- Where to count plovers?
  - at all sites
- Where to estimate *p*?
  - at all sites
  - at a subset of sites

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Stratified random sample

Prop. of:	Sites	Plovers
Small lakes	0.60	0.60
Large lakes	0.05	0.05
Rivers	0.30	0.15
Reservoirs	0.05	0.20

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Estimation methods

- Count plovers at all sites
- Estimate *p* at a subset of sites
  - and mean *p* by strata
- Estimate *N* at all sites
- Calculate *N* for the population

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Sample sizes

- Estimate *p* at 10-20% of sites
  - 100-200 sites
  - 2-6 estimates per stratum
- If mean *p* within strata…
  - >0.8 with SE < 0.1…

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Hypothetical results

	Count	*N*	var(*N*)	SD(*N*)
Site	8	10	4	2
Population	3000	3750	1775	42

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Hypothetical results

- N_{2001} = 3,750
  - 95% CI: [3,672-3,837]
- 1% annual decline for 5 years… N_{2006} = 3,566
  - 95% CI: [3,491-3,649]
  - observed decline: -1.6%/year

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Assumptions

- Inference method requiring the ***most*** assumptions that are ***least*** likely to be valid: naïve reliance on counts

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Sampling for detectability

- Stratify for consistent *p*
  - habitat
    - small lakes, large lakes, rivers
  - ???

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Double-observer method

- 2 people visit a series of sites
- They alternate being primary and secondary observers
- Allows flexible modeling of detection probabilities

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Preview

- Define objective(s)
- Sampling issues
  - Why not census?
- Analysis issues
  - Power analysis

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Monitoring objectives

- Estimate parameters for a demographic model
- Evaluate the effectiveness of management activities

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Monitoring objectives

- Determine the status of a population
- Detect trends in abundance
  - provides insight into status

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Define the population

- Spatial scale
  - Piping plovers in the US Great Plains and Prairie Canada
  - Where do movements occur?
- Temporal scale
  - When do movements occur?

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Census results

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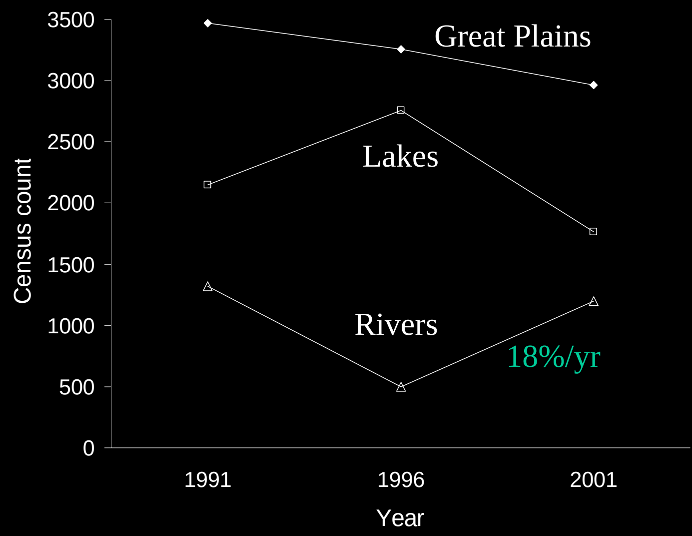
Piping plover census



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Why census is inadequate

- Census assumes every bird is counted (detection prob. = 1)
- Detection problems at 2 scales
  - Not all sites visited
  - Imperfect counting at each site
  - What if detection differs? by 0.15?
- Other methods are better

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Spatiotemporal scales

- Evolutionary time: full mixing
- Annual: major redistributions
- Within a breeding season:
  - stable during core time
  - some inter-basin movement

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