Estimating shorebird abundance on Alaska's North Slope using passive acoustic monitoring

Morgan A. Ziegenhorn, Alison Johnston, Sarah T. Saalfeld, Paul A. Smith, Shiloh A. Schulte, C. Latty, Stephen C. Brown, Richard B. Lanctot, and Nicolas Lecomte

Program for Regional and International Shorebird Monitoring (PRISM)

- Active in the Arctic since 2001
- Focused on documenting population distributions and trends, habitat use
- Observation-based surveys use a double-sampling method
  - Intensive surveys at several plots
  - Rapid surveys (90 minutes) at wide range of randomly selected plots

Program for Regional and International Shorebird Monitoring (PRISM)

Observational surveys

- Active in the Arctic since 2001
- Double-sampling method
- 90 minutes per plot

Acoustic surveys

- Active since 2022
- Passively record sound on autonomous recording units **(ARUs)** at center of each PRISM plot
- **Detect and classify** sounds from this data using machine learning tools

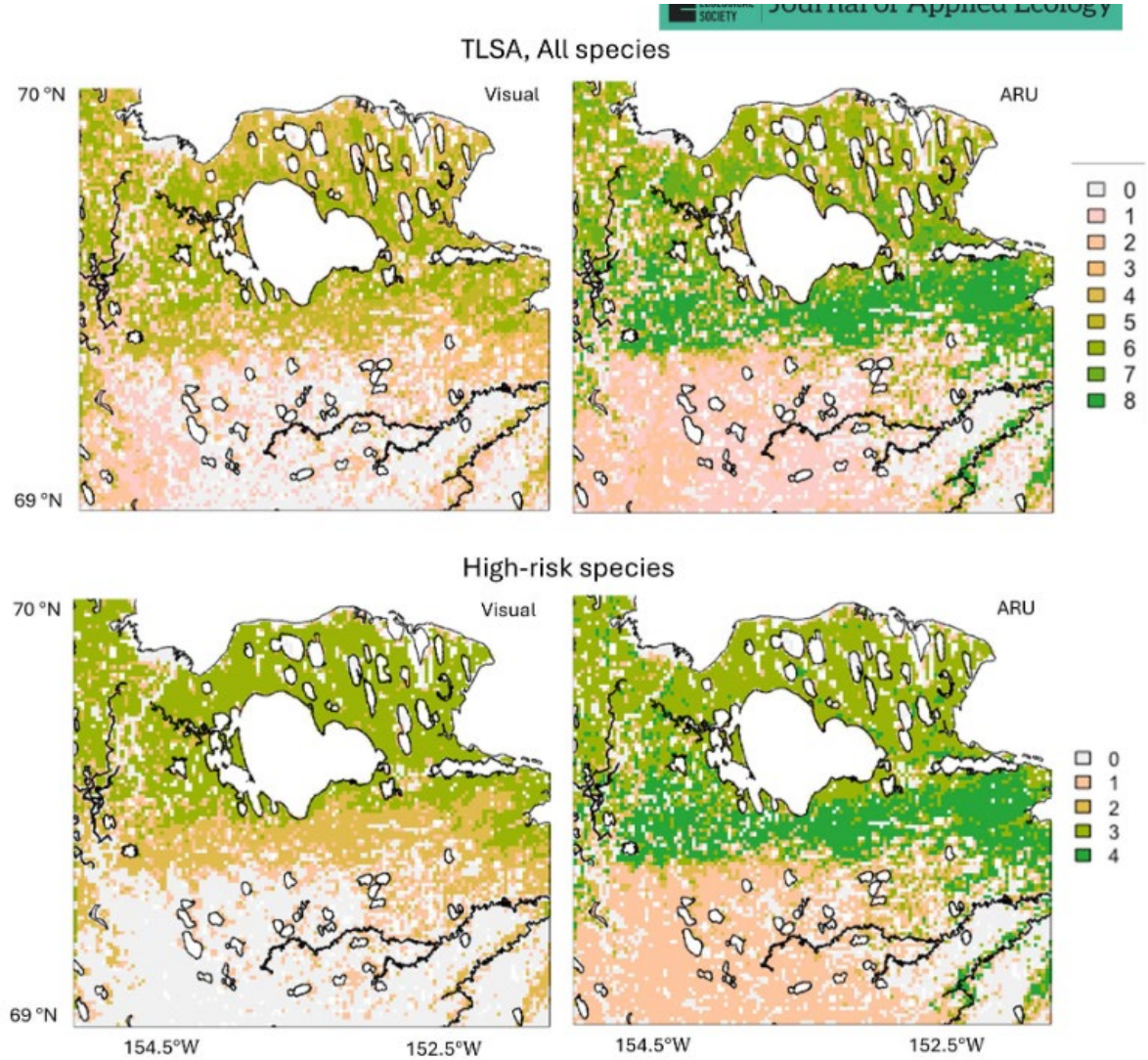
DOI: 10.1111/1365-2664.70300

Journal of Applied Ecology

RESEARCH ARTICLE

Comparing acoustic and visual monitoring methods for assessing biodiversity and distributions of Arctic-breeding shorebirds

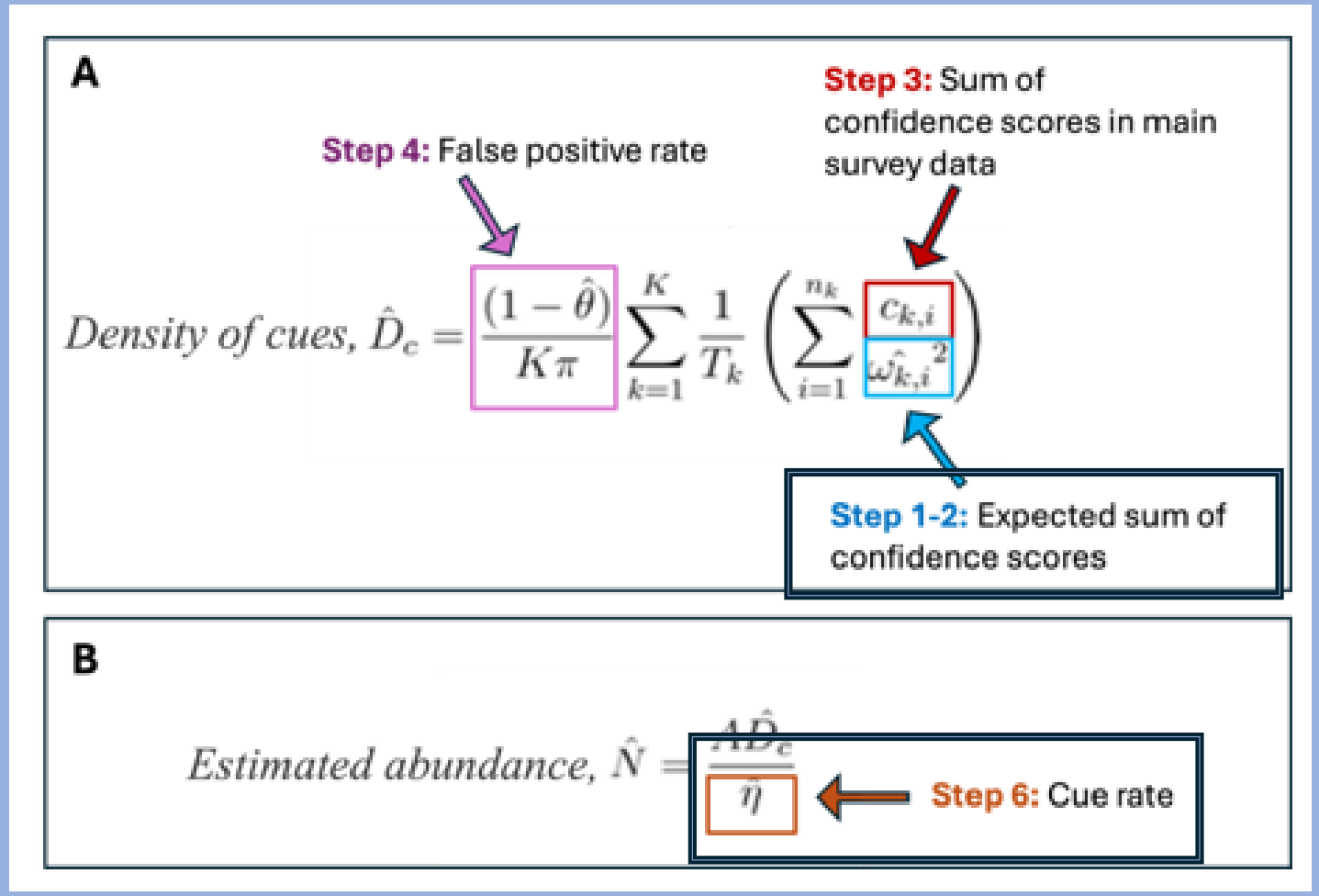
Morgan A. Ziegenhorn[1] | Richard B. Lanctot[2] | Stephen C. Brown[3] | Shiloh Schulte[3,†] | Sarah T. Saalfeld[2] | Christopher J. Latty[4] | Paul A. Smith[5] | Nicolas Lecomte[1]



Objective

Transform acoustic species detections into reliable estimates of shorebird abundance

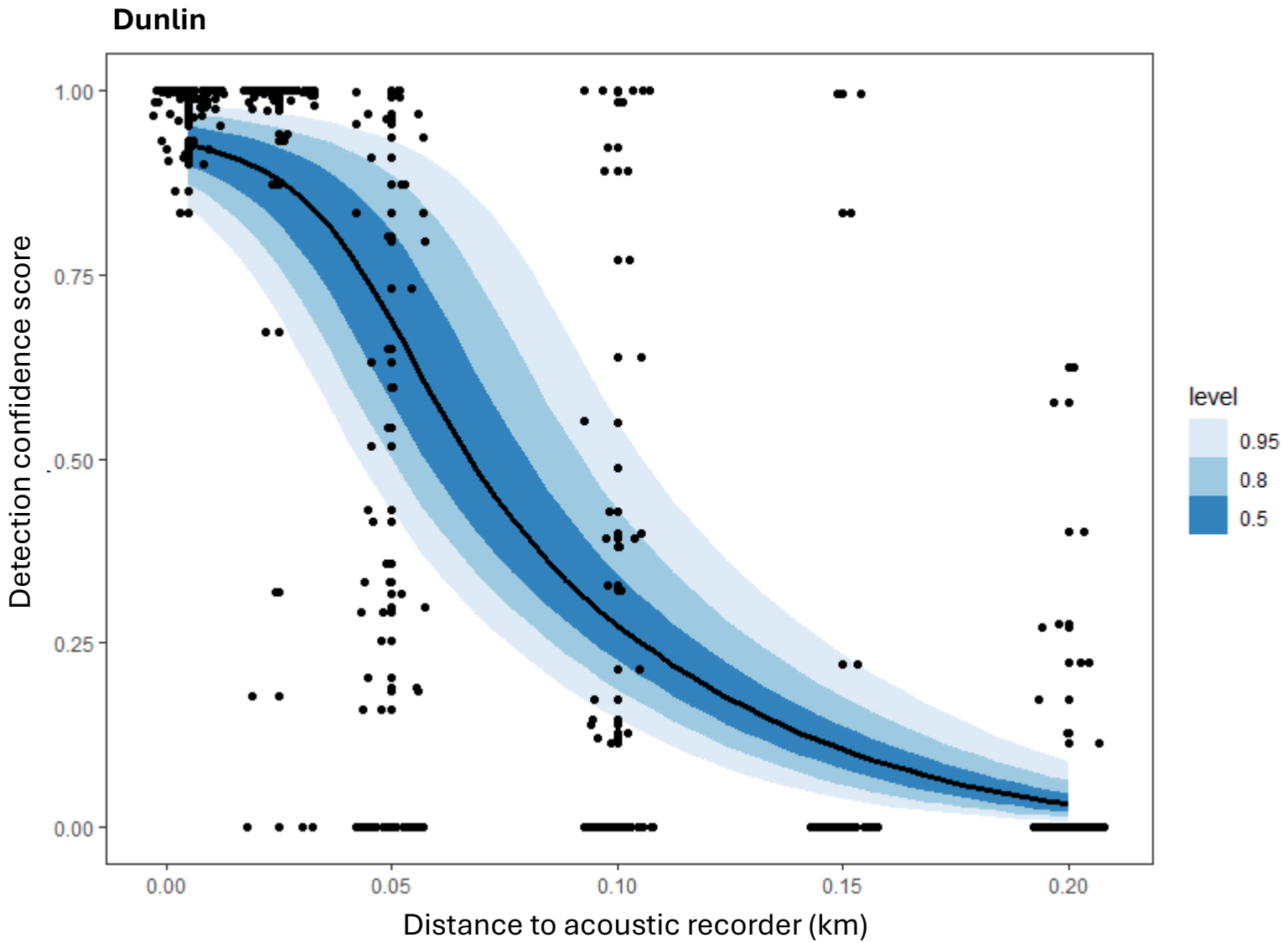
Estimating abundance with acoustic data



Dr. Alison Johnston, University of St. Andrews

Step 1: Detectability

→ How does the model's confidence that a Dunlin is a Dunlin scale with distance?



Step 6: Cue rate

B

$$\text{Estimated abundance, } \hat{N} = \frac{A\hat{D}_c}{\eta}$$

← **Step 6:** Cue rate

$$\text{Cue rate} = \frac{Number\ of\ 10\ second\ periods\ with\ calls}{Total\ number\ of\ 10\ second\ periods}$$

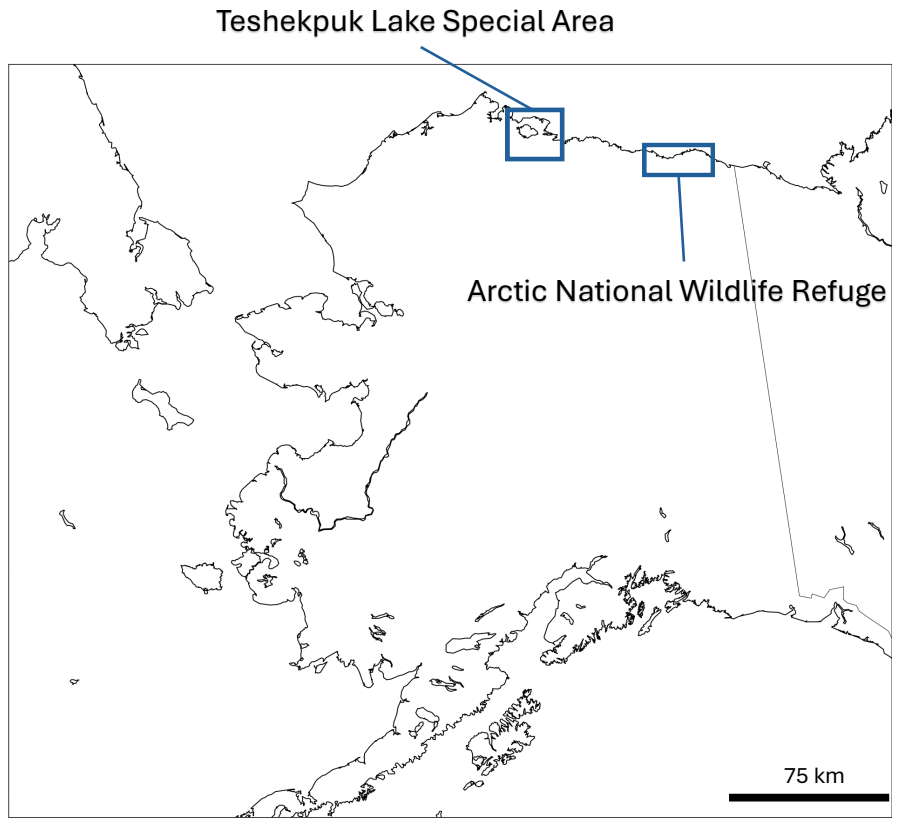
-both in a 5-minute window (e.g., denominator value is always 5*6 = 30)

Step 6: Cue rate (how often an individual vocalizes) is calculated **from behavioral surveys**

Comparing results to existing estimates

Acoustic estimates of number of individuals are **similar to existing estimates**

	Individuals per km2			
	Dunlin	**Long-billed Dowitcher**	**Semipalmated Sandpiper**	**Pectoral Sandpiper**
Teshekpuk Lake Special Area				
Andres et al. 2012	20.93	7.18	32.94	15.1
TLSA 2023-2024	21.52	12.94	38.89	27.01
Acoustic data, 2023	14.9	10.3	14.6	27.0
Acoustic data, 2024	14.3	9.99	22.0	89.3
Arctic National Wildlife Refuge				
Brown et al. 2007	1.2	0.8	5.7	6.1
Brown et al. 2026	0.17	0.14	4.88	9.05
Acoustic data, 2022	3.001	4.52	3.56	21.2



Andres, Brad A., et al. "Shorebirds breed in unusually high densities in the Teshekpuk Lake Special Area, Alaska." *Arctic* (2012): 411-420.
Brown, Stephen, et al. "Shorebird abundance and distribution on the coastal plain of the Arctic National Wildlife Refuge." *The Condor* 109.1 (2007): 1-14.
Brown, Stephen, et al. "Breeding shorebird surveys in the Arctic National Wildlife Refuge, Alaska, suggest population declines over two decades for most species." *Ornithological Applications* (2026, in press)

Comparing results to existing estimates

Acoustic estimates of number of individuals are **similar to existing estimates**

	Individuals per km2			
	Dunlin	**Long-billed Dowitcher**	**Semipalmated Sandpiper**	**Pectoral Sandpiper**
	Teshekpuk Lake Special Area			
Andres et al. 2012	20.93	7.18	32.94	15.1
TLSA 2023-2024	21.52	12.94	38.89	27.01
Acoustic data, 2023	14.9	10.3	14.6	27.0
Acoustic data, 2024	14.3	9.99	22.0	89.3
	Arctic National Wildlife Refuge			
Brown et al. 2007	1.2	0.8	5.7	6.1
Brown et al. 2026	0.17	0.14	4.88	9.05
Acoustic data, 2022	3.001	4.52	3.56	21.2

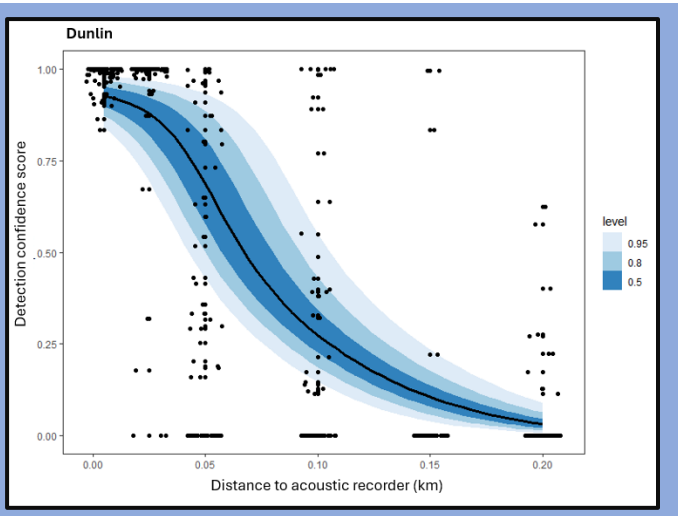
Andres, Brad A., et al. "Shorebirds breed in unusually high densities in the Teshekpuk Lake Special Area, Alaska." *Arctic* (2012): 411-420.
Brown, Stephen, et al. "Shorebird abundance and distribution on the coastal plain of the Arctic National Wildlife Refuge." *The Condor* 109.1 (2007): 1-14.
Brown, Stephen, et al. "Breeding shorebird surveys in the Arctic National Wildlife Refuge, Alaska, suggest population declines over two decades for most species." *Ornithological Applications* (2026, in press)

Email: maziegenhorn36@gmail.com
mziegenhorn@manomet.org

Next Steps

Collect additional data on species' cue rates

Continue to improve detectability models



Expand estimates to additional shorebird species

Email: maziegenhorn36@gmail.com
mziegenhorn@manomet.org

Questions?

	Individuals per km2			
	Dunlin	**Long-billed Dowitcher**	**Semipalmated Sandpiper**	**Pectoral Sandpiper**
Teshekpuk Lake Special Area				
Andres et al. 2012	20.93	7.18	32.94	15.1
TLSA 2023-2024	21.52	12.94	38.89	27.01
Acoustic data, 2023	14.9	10.3	14.6	27.0
Acoustic data, 2024	14.3	9.99	22.0	89.3
Arctic National Wildlife Refuge				
Brown et al. 2007	1.2	0.8	5.7	6.1
Brown et al. 2026	0.17	0.14	4.88	9.05
Acoustic data, 2022	3.001	4.52	3.56	21.2

Andres, Brad A., et al. "Shorebirds breed in unusually high densities in the Teshekpuk Lake Special Area, Alaska." *Arctic* (2012): 411-420.
Brown, Stephen, et al. "Shorebird abundance and distribution on the coastal plain of the Arctic National Wildlife Refuge." *The Condor* 109.1 (2007): 1-14.
Brown, Stephen, et al. “Breeding shorebird surveys in the Arctic National Wildlife Refuge, Alaska, suggest population declines over two decades for most species." *Ornithological Applications* (2026, in press)