Foraging opportunity: a method of monitoring shorebird migration and overwintering sites in a changing environment

James Rourke  
*Hemmera, Canada, jrouke@hemmera.com*

Wendell Challenger  
*LGL, Canada, wchallenger@lgl.com*

Ron Ydenberg  
*Simon Fraser Univ., Canada, ydenberg@sfu.ca*

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Foraging Opportunity
A Method of Monitoring Shorebird Migration and Overwintering Sites in a Changing Environment

By:
James Rourke, Hemmera
Wendell Challenger, LGL
Ron Ydenberg, Simon Fraser University

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Western Sandpiper (WESA) & Biofilm

- WESA = Small Calidrid shorebird
  - Winters: California-Peru
  - Breeds: Alaska

- Migration
  - Northward: Late April-May
  - ~5-6 Major Stopover sites
  - Fraser River Estuary – Roberts Bank

- Predation Danger
  - Peregrine Falcons
Dominant Theme in Migration

- Tight time and energy budgets drive migratory strategy

- Migratory Agenda:
  - Obtaining energy and nutrient reserves to fuel flights between successive stopover sites

- Models predict similar masses for migrant population at a given stage of their journey
  (Piersma & Jukema 1993)

- Landscape of Fear (LOF)
  - Perception of risk from predation alters animal behavior
  (Bleicher 2017)
Shorebird’s Response to LOF

- Food highest closest to shore
- Areas close to shore are closer to cover = riskier
- Shorebirds select for safer areas with less food
Foraging Opportunity

- Foraging opportunity considers both safety and abundance
- Quantifies prey relative to predation risk
- Safety = distance from cover (e.g., shoreline)

- A – High prey abundance, low safety
- B – Lower prey abundance, higher safety
Collected and analysed data over the entire FRE for:
  • Meiofauna, macrofauna, biofilm, shorebird usage
Presentation focus:
  • Roberts Bank
  • Biofilm and shorebirds

Fraser River Estuary (FRE)
Biofilm (Prey) Abundance

Biofilm

- Comprises 35-65% of WESA diet
- Collected/analyzed sediment samples
- Chlorophyll $a$ abundance (mg/m$^2$)

Biofilm Modeling

- Elevation
- Geomorphology model output:
  - Water column salinity
  - Wave height
- Distance to cover (e.g., marsh, causeway)
- Northward migration (April-May, 2012)
Western Sandpiper Usage

Dropping Densities
• WESA “poop” frequently
• Poop transects
• ~1,500, 15-m² plots sampled

Modeling Assumptions
• Chlorophyll a (mg/m²) = biofilm abundance
• Dropping density = foraging intensity
• Distance to cover is a good metric of safety
Biofilm and Sandpiper Distributions

Biofilm Abundance

Northward Migration

Chlorophyll a (mg/m²)

Shorebird Usage
(Dropping Density)
Visualizing Foraging Opportunity

- Study area was overlaid with a 1 ha grid
- Biofilm and shorebird usage were calculated for each cell
Visualizing Foraging Opportunity

- Opportunity can be represented in 3D by summing Food x Safety

- 2 peaks in opportunity surface
Visualizing Foraging Opportunity

3D Foraging Opportunity

2D Foraging Opportunity

- Lines represent contour lines similar to a topographic map.
Study Area

Canoe Passage

Intertidal
Foraging Opportunity and Usage

Safety Index (m)

Chlorophyll $a$ Abundance (mg/m²)

- Peak abundance $\sim 75$ mg/m²
- 1,200 - 1,500 m from shore

- Peak abundance $\sim 100$ mg/m²
- < 500 m from shore
- Possessed $\sim 35\% >$ available prey biomass
Foraging Opportunity and Usage

Shorebird Usage (Green)
Usage largely followed opportunity

Canoe Passage
- Usage aligned with foraging opportunity
Foraging Opportunity and Usage

Usage largely followed opportunity

**Canoe Passage**
- Usage aligned with foraging opportunity

**Intertidal Zone**
- Peak usage shifted to > 500 m from shore

> Usage in Canoe Passage

Shorebirds select for safer areas with < food
Shorebird Monitoring

Understanding foraging opportunity of sites can help explain changes in shorebird distribution

- Scale
  - Local scale
  - Flyway

- Causes
  - Anthropogenic
  - Natural
    (e.g., climate change)
Climate Change

- Coastal Squeeze
  - Loss of intertidal habitat due to a fixed high water mark (dyke) as low the watermark migrates landward due to sea level rise (SLR).
  - SLR = +0.8 to 1.2 m by 2100
- SLR likely to affect:
  - Foraging opportunity of sites
  - How shorebirds use sites
Thank you

Contact Us

James Rourke, jrourke@hemmera.com

Hemmera, an Ausenco Company
18th Floor, 4730 Kingsway
Burnaby, BC
T: 250.889.2071