Apr 4th, 3:45 PM - 4:00 PM

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

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Foraging Opportunity

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

By:
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HEMMERA

Date: April 4, 2018

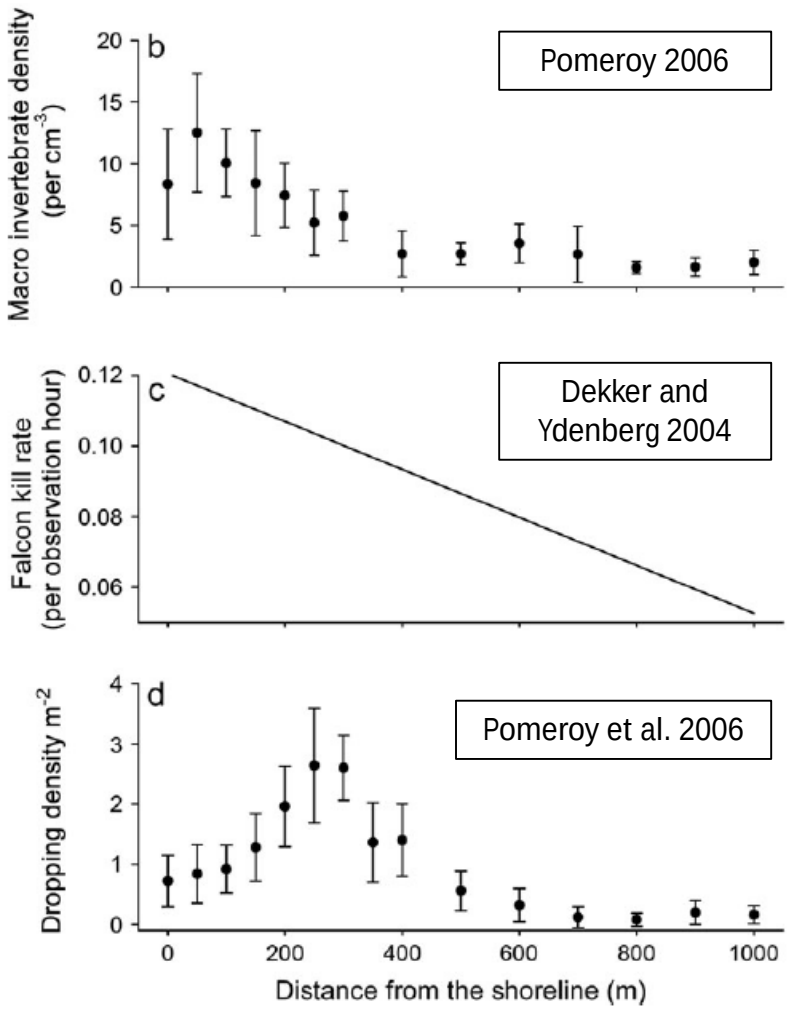
Western Sandpiper (WESA) & Biofilm

- 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

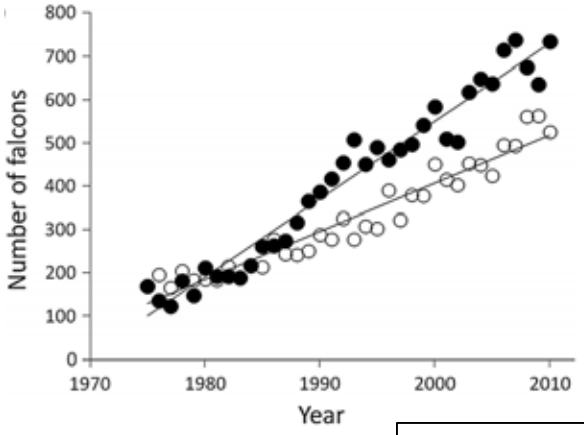
- Tight time and energy budgets drive migratory strategy
- Migratory Agenda:
  - Obtaining energy and nutrient reserves to fuel flights between successive stopover sites
- Models predict similar masses for migrant population at a given stage of their journey (Piersma & Jukema 1993)
- Landscape of Fear (LOF)
  - Perception of risk from predation alters animal behavior (Bleicher 2017)

Shorebird's Response to LOF



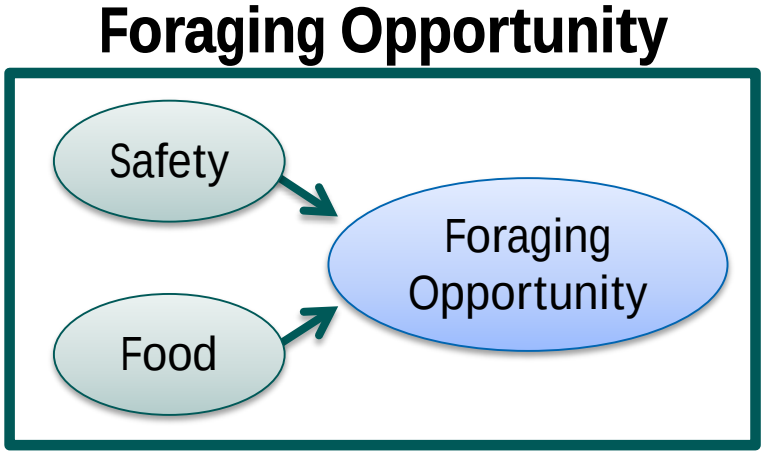
- Food highest closest to shore
- Areas close to shore are closer to cover = riskier
- Shorebirds select for safer areas with less food

Peregrine Falcons

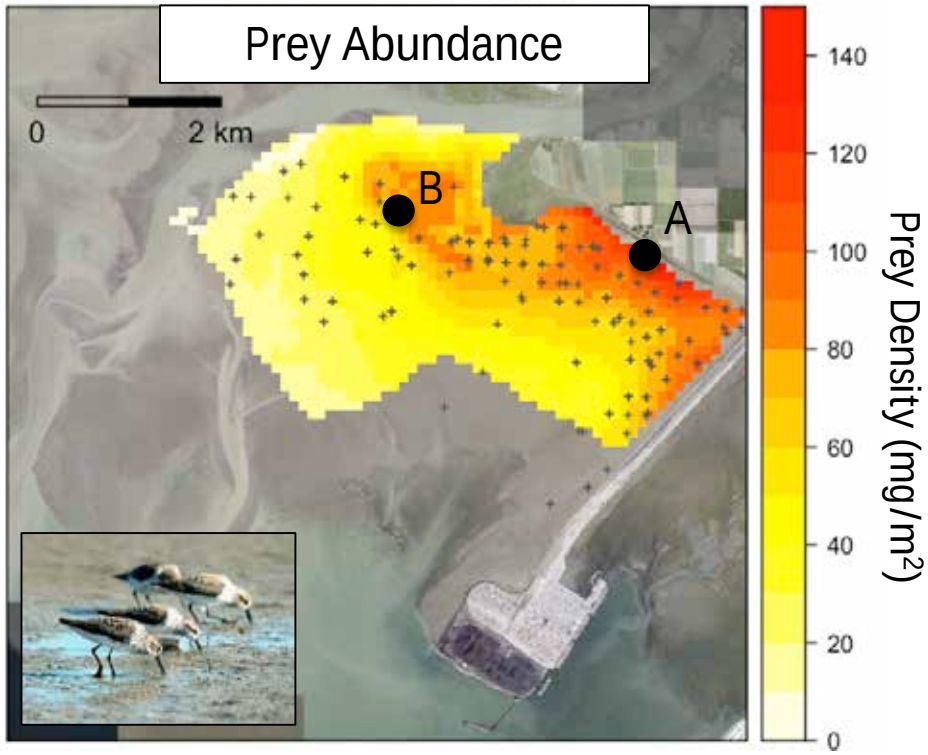


Ydenberg et al. 2017

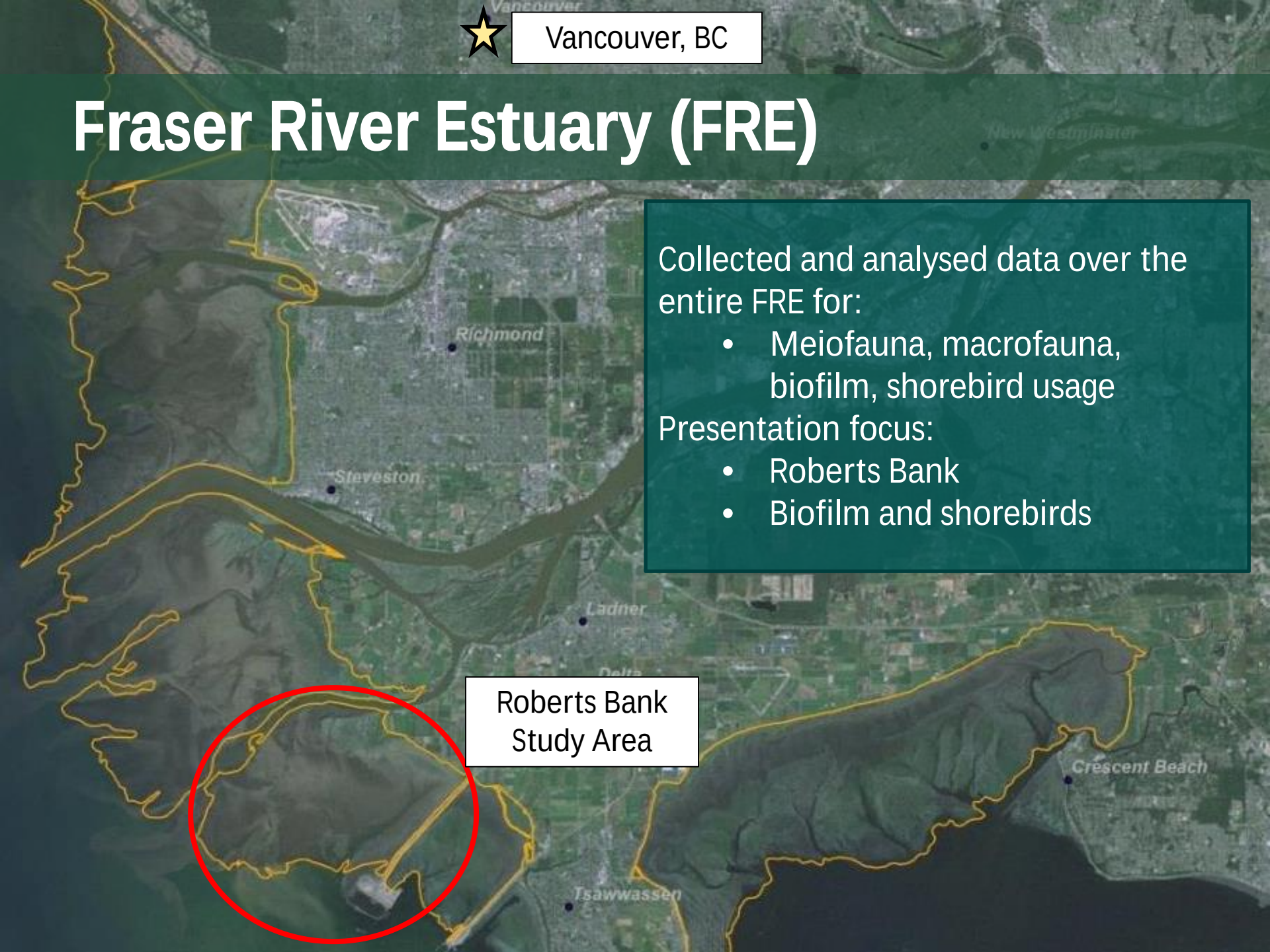
Foraging Opportunity



- 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



Fraser River Estuary (FRE)

Collected and analysed data over the entire FRE for:

- Meiofauna, macrofauna, biofilm, shorebird usage

Presentation focus:

- Roberts Bank
- Biofilm and shorebirds

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

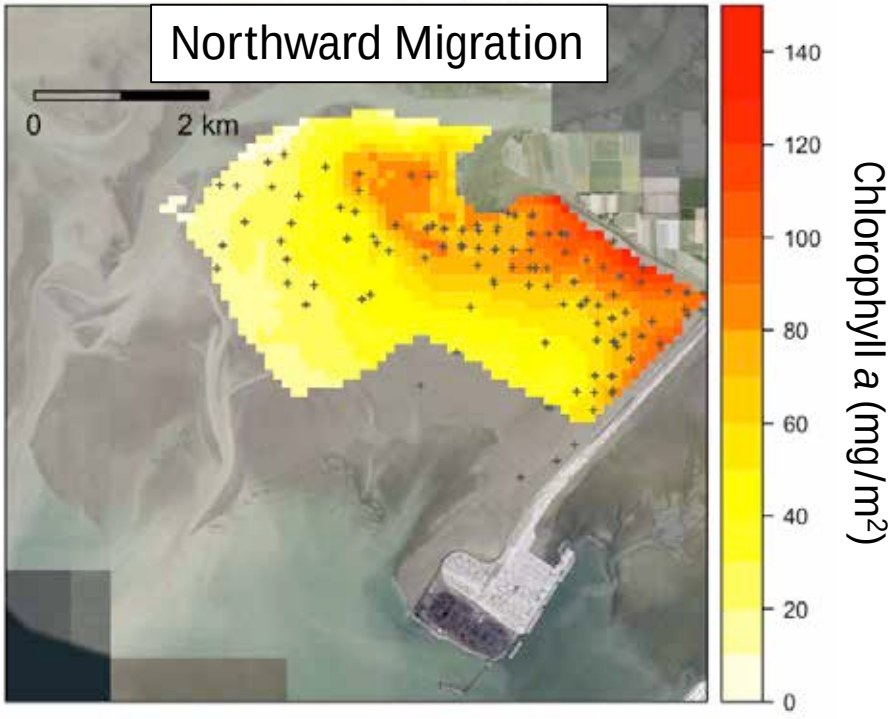
- WESA “poop” frequently
- Poop transects
- ~1,500, 15-m^2 plots sampled

Modeling Assumptions

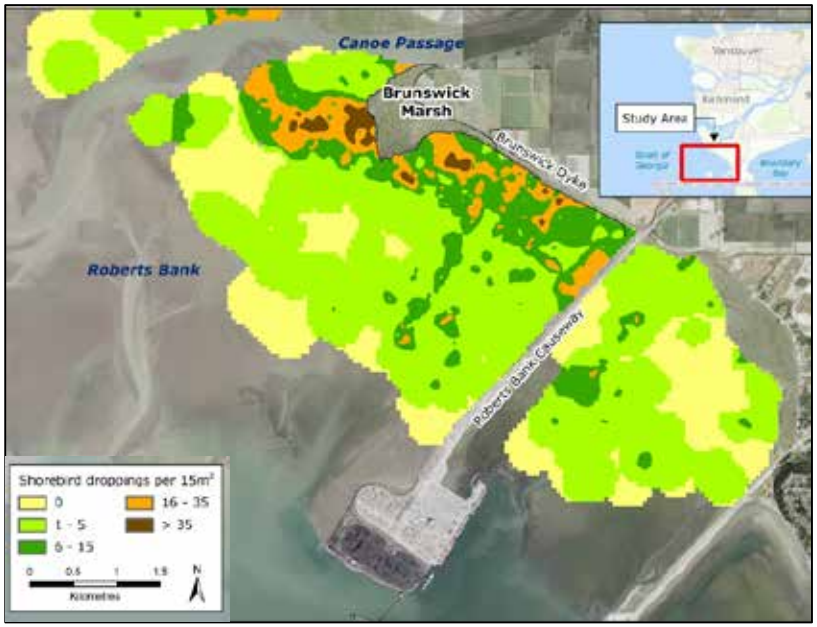
- Chlorophyll a (mg/m^2) = biofilm abundance
- Dropping density = foraging intensity
- Distance to cover is a good metric of safety

Biofilm and Sandpiper Distributions

Biofilm Abundance

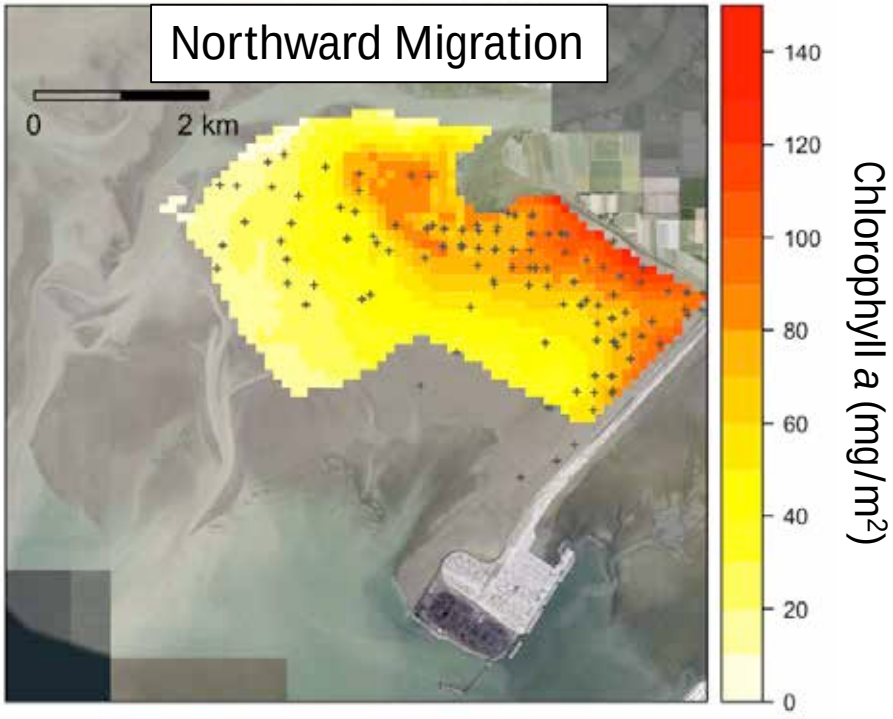


Shorebird Usage
(Dropping Density)



Visualizing Foraging Opportunity

Biofilm Abundance

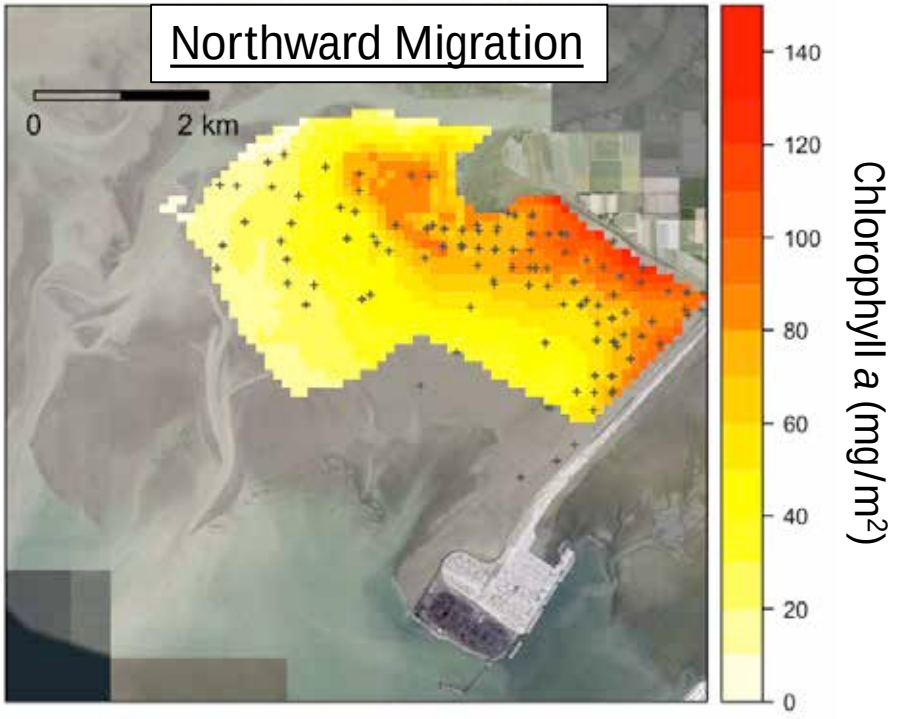


Modelling Grid

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

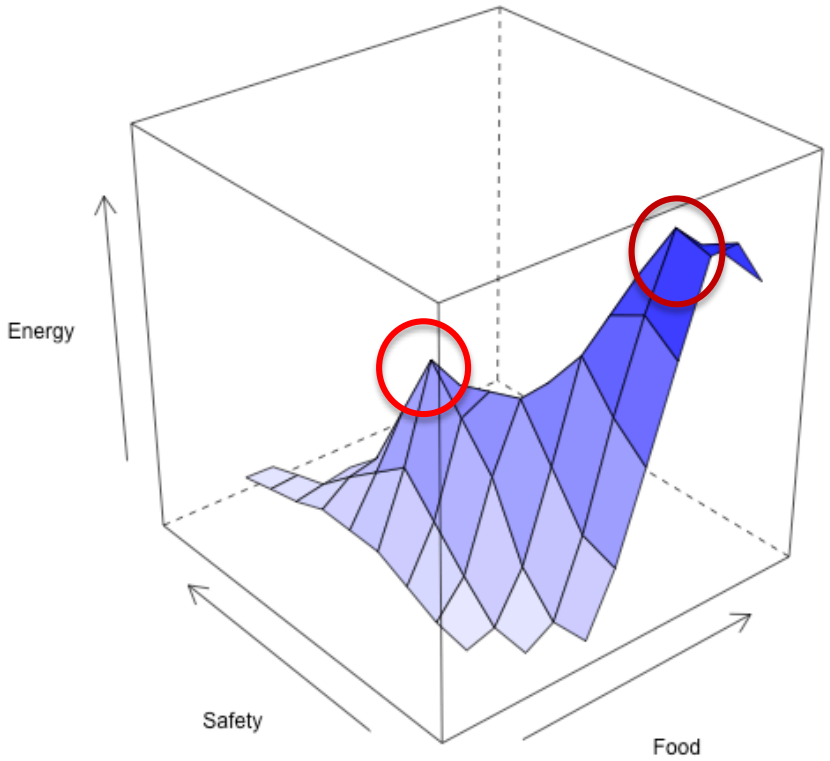
Visualizing Foraging Opportunity

Biofilm Abundance



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

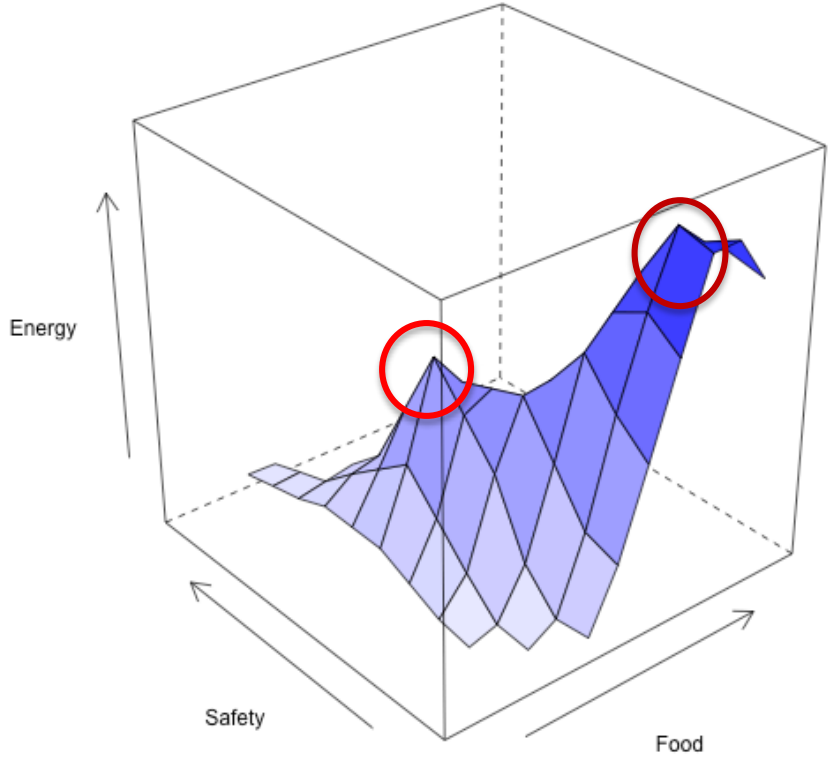
3D Foraging Opportunity



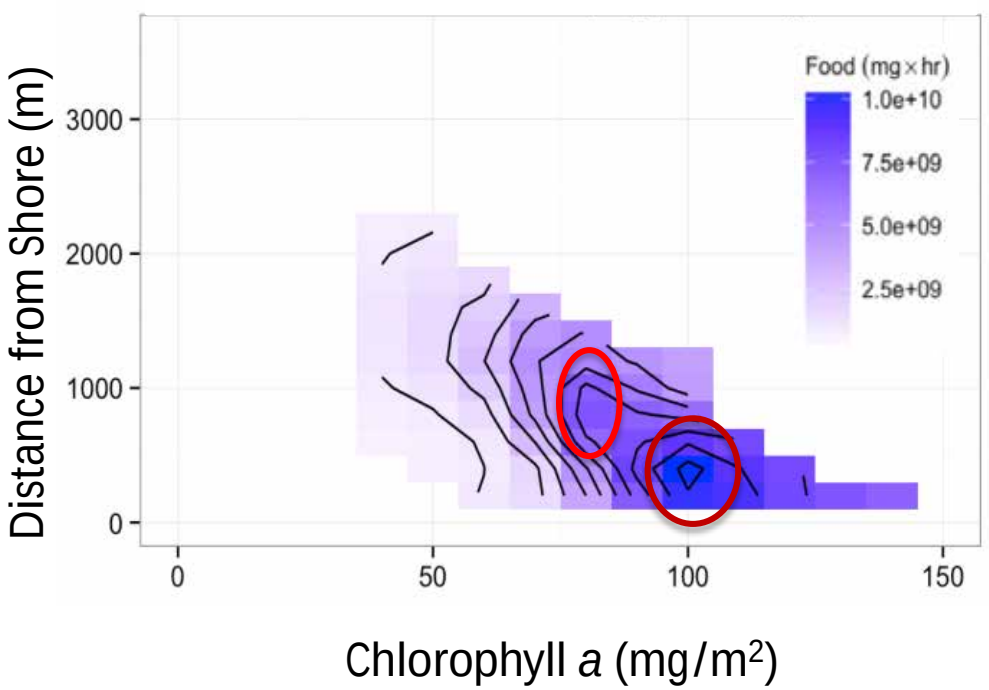
- 2 peaks in opportunity surface

Visualizing Foraging Opportunity

3D Foraging Opportunity

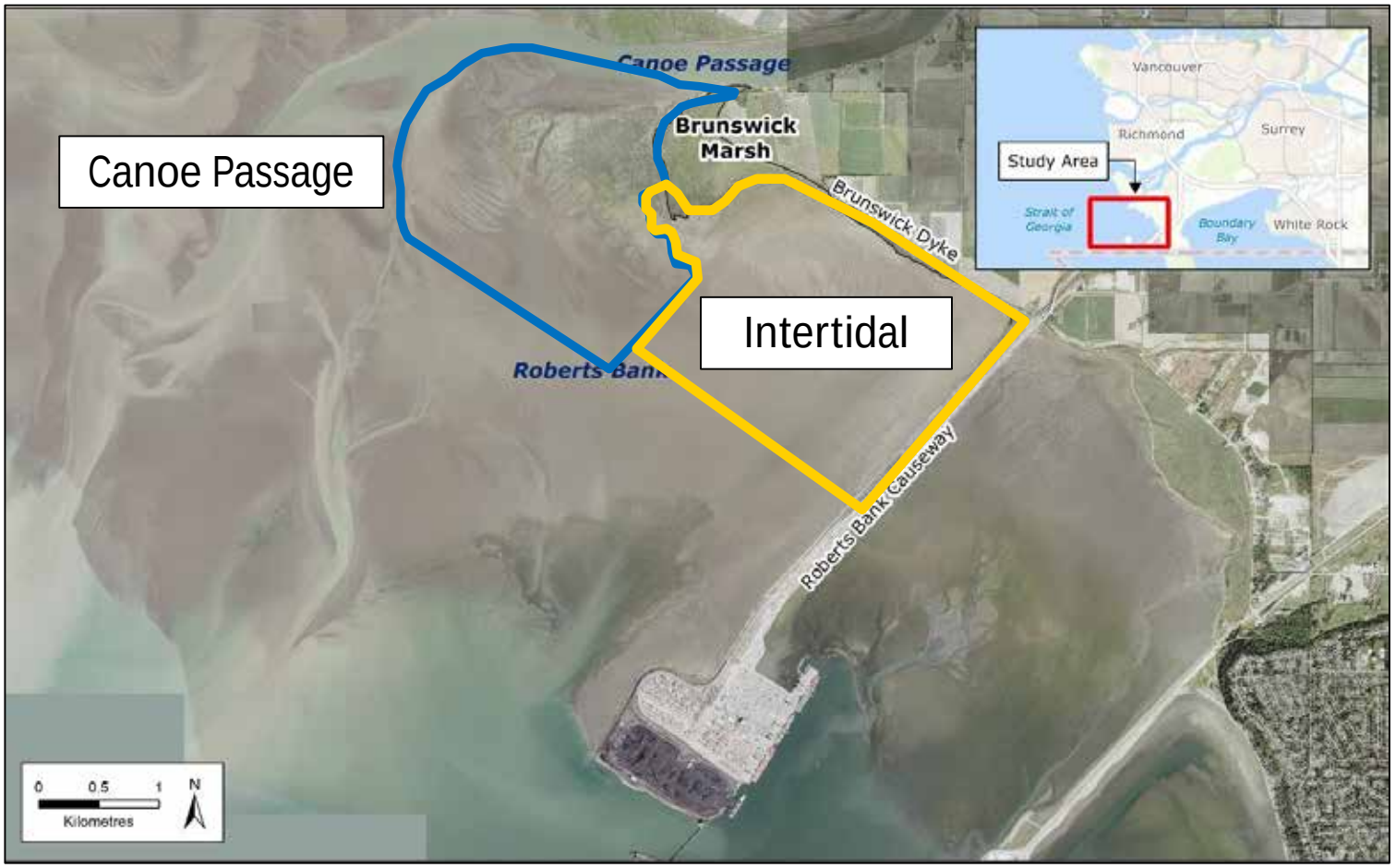


2D Foraging Opportunity

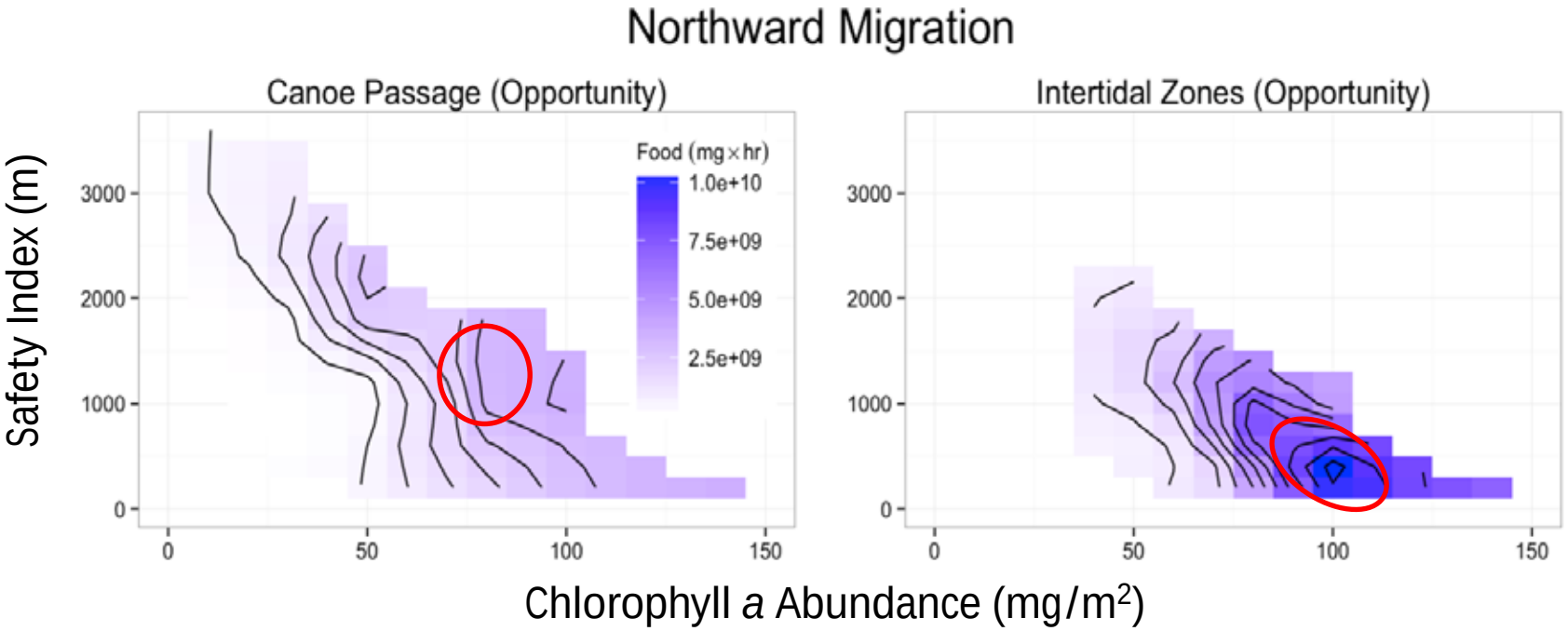


- Lines represent contour lines similar to a topographic map

Study Area


Canoe Passage
Brunswick Marsh
Brunswick Dyke
Roberts Bank
Roberts Bank Causeway
Canoe Passage
Intertidal
Vancouver
Richmond
Surrey
Study Area
Strait of Georgia
Boundary Bay
White Rock
0 0.5 1
Kilometres
N

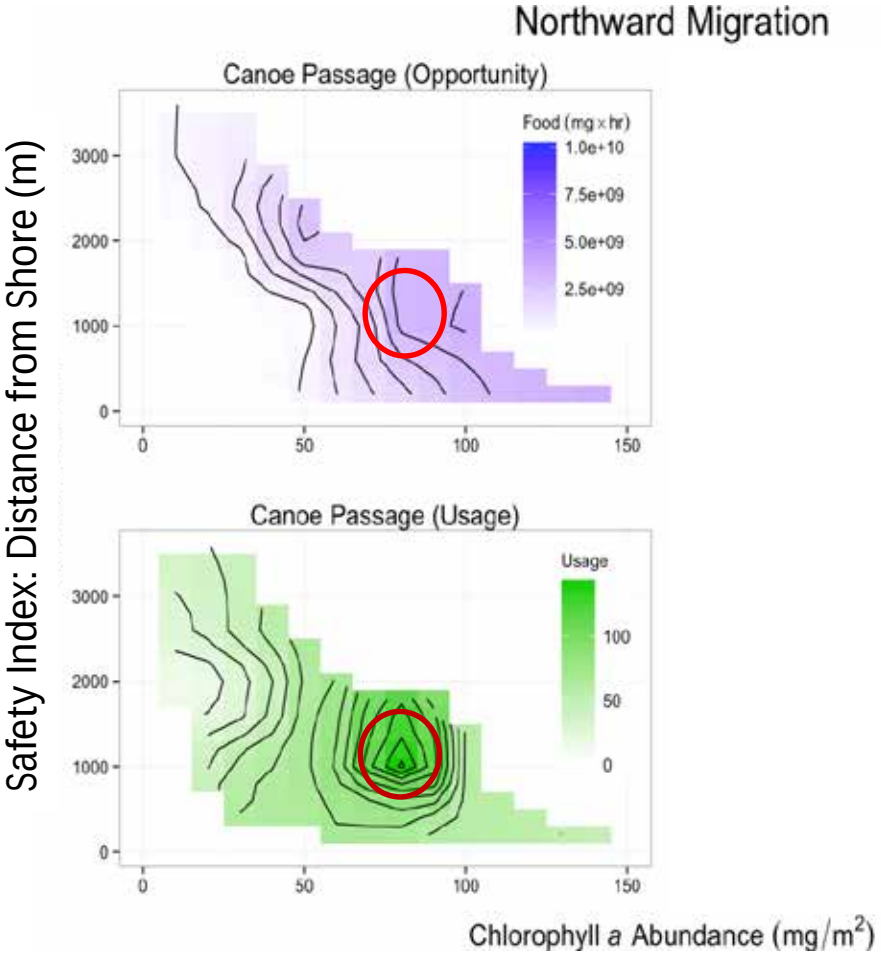
Foraging Opportunity and Usage



- Peak abundance ~ 75 mg/m^2
- 1,200 - 1,500 m from shore

- Peak abundance ~ 100 mg/ m^2
- < 500 m from shore
- Possessed ~ 35% > available prey biomass

Foraging Opportunity and Usage



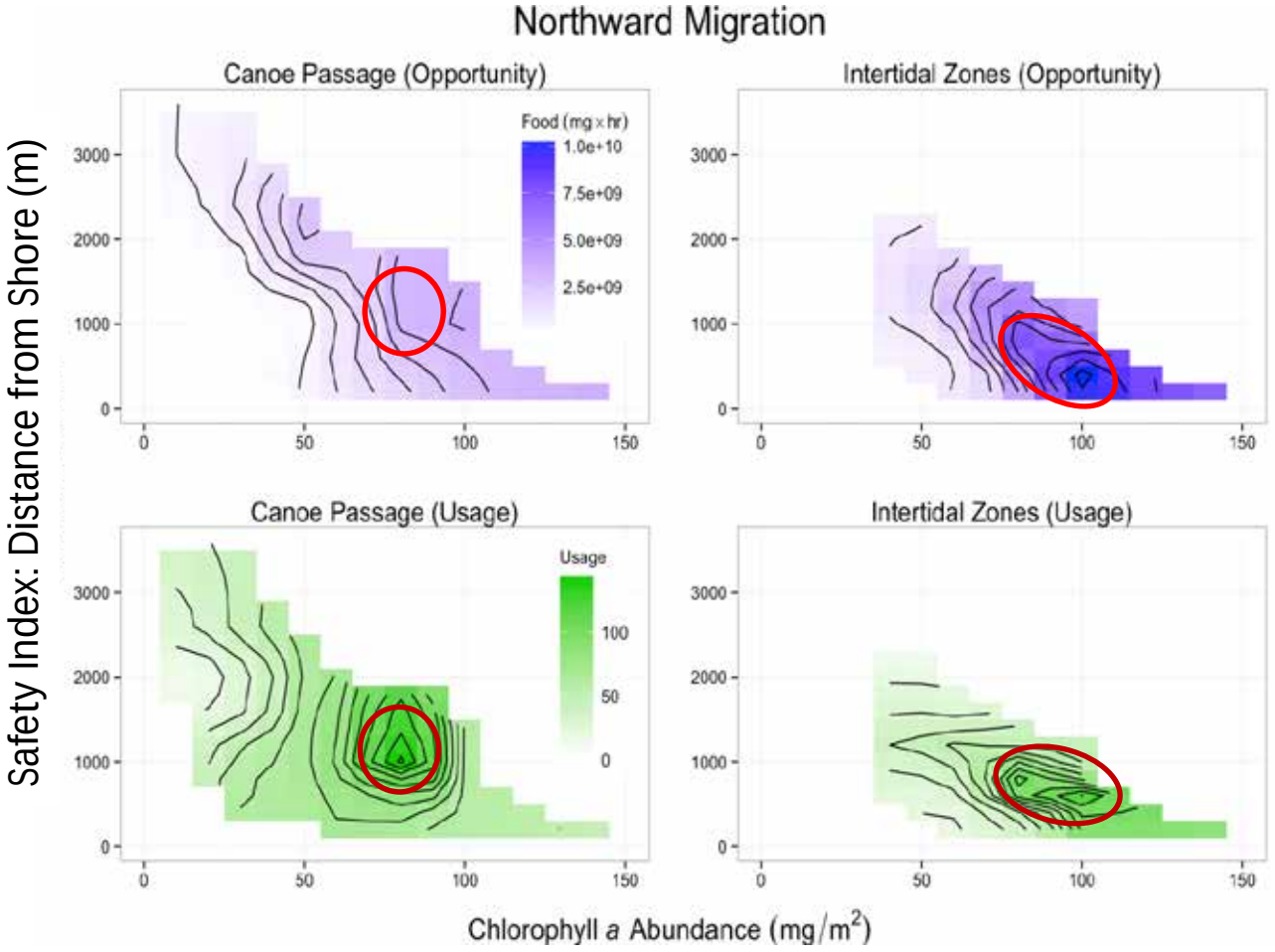
Shorebird Usage (Green)

Usage largely followed opportunity

Canoe Passage

- Usage aligned with foraging opportunity

Foraging Opportunity and Usage



Shorebird Usage (Green)

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

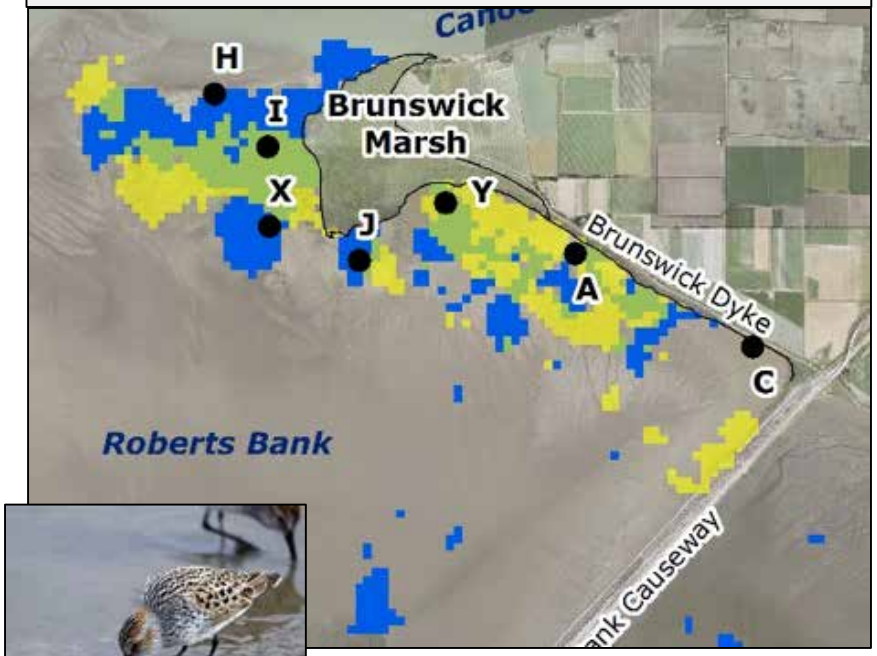
Shorebirds select for safer areas with < food

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)

WESA Usage (2012 / 2013)

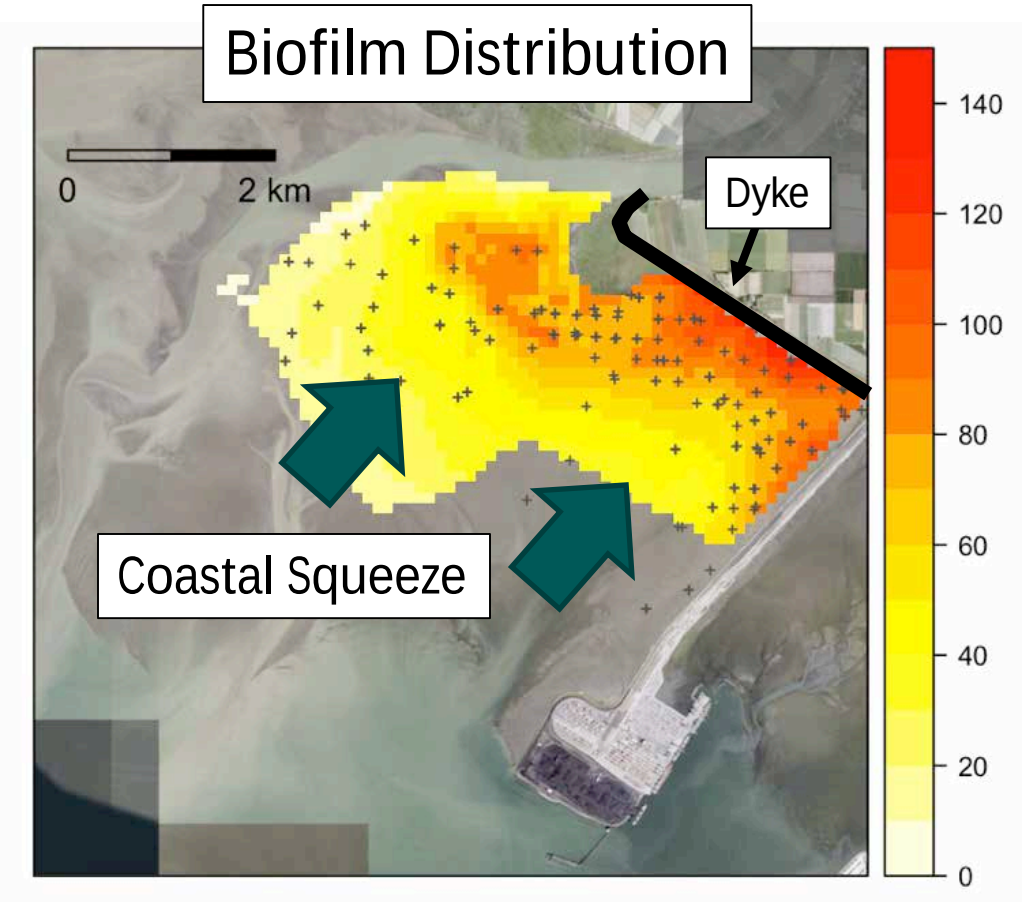


Blue = 2012, Yellow = 2013
Green= 2012 & 2013

Shorebird Monitoring

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

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