# Arctic Shorebird Demographics Network

## Overview and Preliminary Report

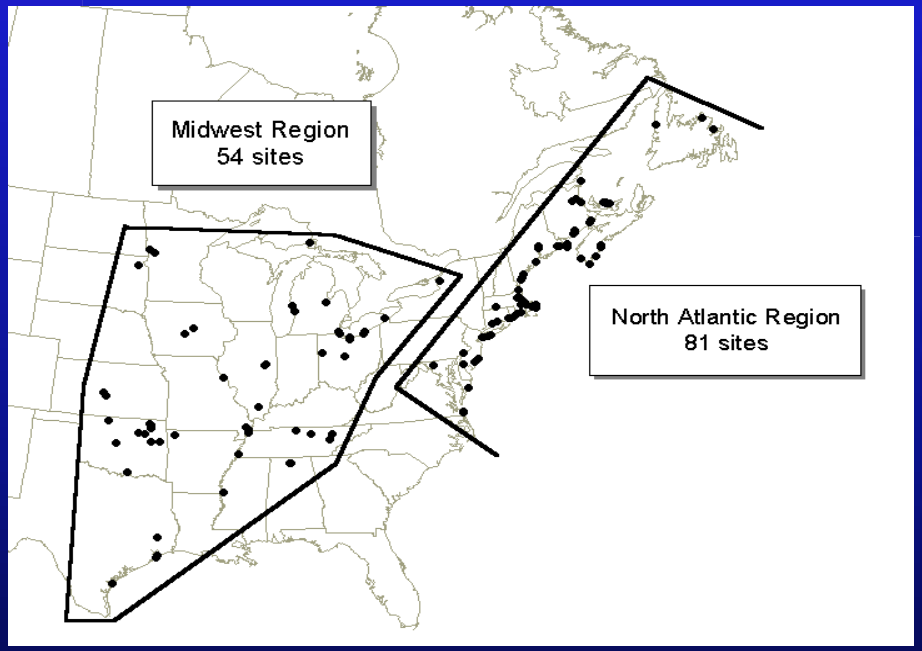
Steering Committee:
Stephen Brown, Network Coordinator
Rick Lanctot, Science Coordinator
Brett K. Sandercock, Demographics Coordinator
River Gates, Field Coordinator

MANOMET
Center for Conservation Sciences

U.S. FISH & WILDLIFE SERVICE

K-STATE
Kansas State University

# North American Shorebirds Are Declining




International and Maritimes Shorebird Survey Data

North Atlantic: 22 of 30 species declining

Midwest: 11 of 29 species declining

Bart et al. 2007

# Why Are Shorebirds Declining?

Shorebird Research Group of the Americas hypotheses:

- Habitat loss or change
- Human disturbance
- Increasing predator populations
- Climate change
- Toxic chemicals and pollutants
- Interactions of these
- Declines are only apparent

The Problem: Shorebirds use vast areas, as these WHSRN sites illustrate.

# We need a new approach to the science of shorebird declines.

Collecting demographic data provides an indirect approach for determining what factors are most likely limiting population growth:

- Adult survival (annual, seasonal)
- Nest survival
- Brood survival

ASDN allows targeted research and conservation at appropriate life history stages. (breeding, migration, wintering)

# Why conduct demographic work in the Arctic?

Arctic has:

- 20% of the world's shorebird species
- 30 million of the 100 million shorebirds in the world
- Some species show site fidelity, necessary to measure adult survival

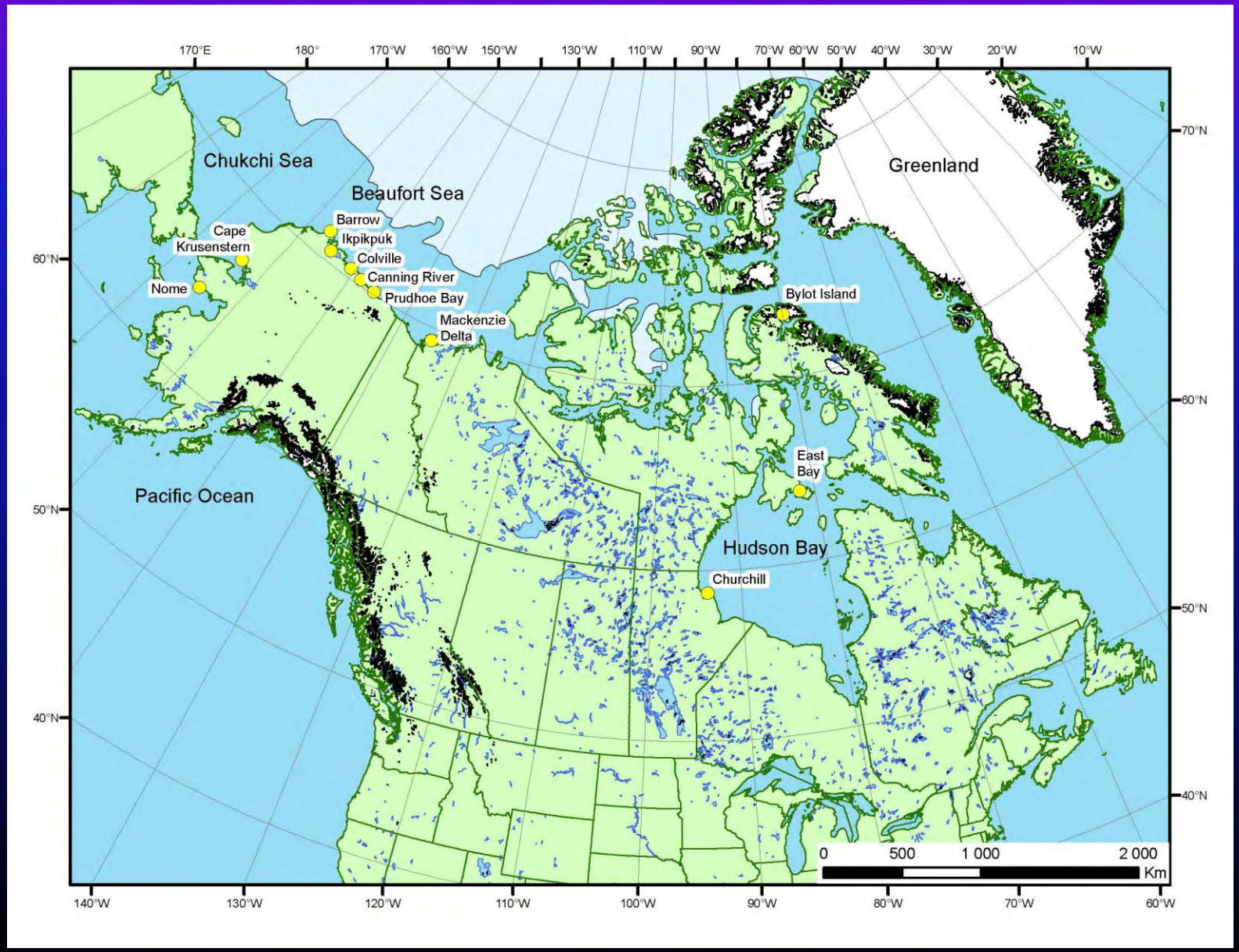
# Why a Network?

- The Arctic is HUGE! Requires a collaborative approach to address large scale questions.
- Ability to study same species at multiple sites adds power to demographic analyses.
- Builds significant opportunities for “network projects”, that rely on data collected over a large geographic area

# The Network Enhances Existing Efforts

- Compliments existing large scale monitoring efforts under Arctic PRISM
- PRISM addresses population size and trend, but does not provide information on the demographic mechanisms behind declines

# ASDN Sites Active in 2011



# Partner Organizations

- Nome - Simon Fraser University & Kansas State University, Dov Lank & Brett Sandercock
- Cape Krusenstern - USFWS, River Gates & Rick Lanctot
- Barrow - USFWS, Brooke Hill & Rick Lanctot
- Ikpikpuk River and Prudhoe Bay - Wildlife Conservation Society, Joe Liebezeit & Steve Zack
- Colville River - USGS, David Ward & David Pavlik

# Partner Organizations

- Canning River - USFWS & Manomet, David Payer & Stephen Brown
- Mackenzie Delta - Environment Canada, Jennie Rausch & Lisa Pirie
- East Bay - Environment Canada & Paul Smith Consulting, Grant Gilchrist & Paul Smith,
- Churchill - Trent University & Cornell Lab of Ornithology, Erica Nol & Nathan Senner
- Bylot Island - University of Quebec at Rimouski, Joel Bety & Jean-Francois Lamarre

# Memorandum of Understanding

- Signed by 15 Organizational Partners
- Establishes Steering Committee
- Outlines cooperative approaches on:
  - Development of protocols
  - Support of field research sites
  - Sharing of data for project-wide analysis and co-authorship
  - Participation in additional Network Projects

# A Note on Collective Impact

Stanford Social Innovation Review

Key Components of Collective Impact Projects:

- Common agenda
- Shared measurement system
- Mutually reinforcing activities
- Continuous communication
- Backbone support organization

www.ssireview.org/articles/entry/collective_impact

# Status of the Network

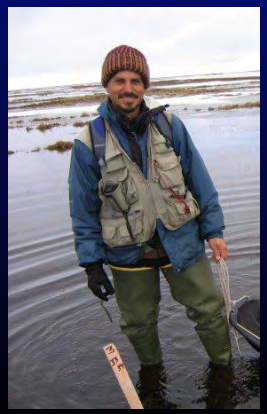
- 9 Field sites active in 2010, and 10 Sites in 2011
- Two field seasons completed, three more planned
- Network-wide funding from USFWS Arctic LCC, USFWS Neotropical Migratory Birds Conservation Act, National Fish and Wildlife Foundation, Manomet Inc.
- Major funding for each site being provided by sponsoring partner organizations

# Protocol Committee

- Developed protocols, dataforms and databases for 2010 field season
- 2010 protocols revised for 2011 field season

Committee

- River Gates, USFWS & Manomet
- Joe Liebezeit, Wildlife Conservation Society
- Paul Smith, Paul Smith Consulting
- Rick Lanctot, USFWS
- Brooke Hill, USFWS & UAF



# Built on Existing Protocols

- Intensive nest searching techniques:
  - Barrow shorebird studies – USFWS
  - Tundra bird study – WCS
- Capture and banding techniques:
  - North American Bander's Guide to Shorebirds – CWS
- Ecological correlates:
  - Arctic WOLVES – multiple institutions

# Selection of Focal Species

Selection based on species' site fidelity and the likelihood of sites to meet target numbers of nests & individuals (*n* = < 30)

# Network Databases

## Metadata

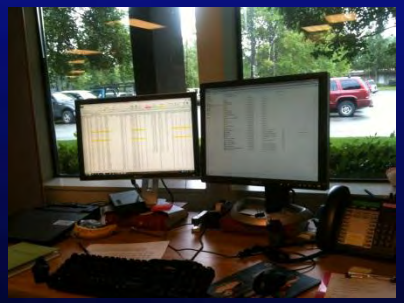
- Plot & sampling locations
- Daily species list
- Personnel effort

## Demographics

- Adult banding
- Resights
- Nest survival

## Ecological Correlates

- Snow & surface water cover
- Daily weather
- Lemmings counts
- Predator counts
- Terrestrial and aquatic inverts



# Demographic Variables/ Variables Demográficas

- Nest survival
- Brood survival (Barrow)
- Adult summer survival
- Adult over-winter survival
- Age of first breeding
- Site and mate fidelity
- Natal philopatry

# Environmental Variables

- Predator activity
- Food availability
- Lemmings and small mammals as alternative prey for predator-switching
- Climatic variables
- Timing of snow melt / water levels

# Preliminary Results

- Results compiled for 2010 season
- Preliminary results from field camps that completed 2011 seasons

# Total Nests Found 2011

| Site | SESA | DUNL | PESA | RNPH | REPH | WESA | WHIM | Others | Total |
|---|---|---|---|---|---|---|---|---|---|
| Nome | 64 | | | 52 | | 88 | | 0 | 204 |
| Cape Krusenstern | 36 | 13 | | 12 | | 10 | | 0 | 71 |
| Barrow | 41 | 70 | 111 | 12 | 160 | 10 | | 51 | 455 |
| Ikpikpuk | 52 | 18 | 0 | 9 | 8 | | | 0 | 87 |
| Colville | 77 | 14 | 5 | 19 | 13 | | | 15 | 143 |
| Canning | 80 | 15 | 78 | 34 | 27 | | | 0 | 234 |
| Mackenzie | 16 | | 10 | 22 | 0 | | 10 | 15 | 73 |
| Bylot | | | 1 | | | | | 26 | 27 |
| East Bay | | 2 | | | | | | 59 | 61 |
| Churchill | | 35 | | | 11 | | 19 | 0 | 65 |
| Total | 366 | 167 | 205 | 160 | 219 | 108 | 29 | 166 | 1420 |

# Total Birds Banded 2011

| Site | SESA | DUNL | PESA | RNPH | REPH | WESA | WHIM | Others | Total |
|---|---|---|---|---|---|---|---|---|---|
| Nome | 104 | | | 53 | | 184 | | 0 | 341 |
| Cape Krusenstern | 58 | 26 | | 11 | | 19 | | 0 | 114 |
| Barrow | 58 | 123 | 50 | 8 | 44 | 10 | | 67 | 360 |
| Ikpikpuk | 68 | 31 | | 10 | 9 | | | 0 | 118 |
| Colville | 31 | 6 | 3 | 2 | 4 | | | 8 | 54 |
| Canning | 51 | 19 | 38 | 10 | 7 | | | 0 | 125 |
| Mackenzie | 15 | | 8 | 11 | | | 4 | 16 | 54 |
| Bylot | | | | | | | | 48 | 48 |
| East Bay | | | | | | | | 22 | 22 |
| Churchill | | 32 | | 3 | | | 18 | 0 | 53 |
| Total | 385 | 237 | 99 | 108 | 64 | 213 | 22 | 161 | 1289 |

# Number of Resights 2011

| Site | SESA | DUNL | PESA | RNPH | REPH | WESA | WHIM | Others | Total |
|---|---|---|---|---|---|---|---|---|---|
| Nome | 43 | | | 3 | | 52 | | 0 | 98 |
| Cape Krusenstern | 1 | 13 | | 1 | | 2 | | 0 | 17 |
| Barrow | 26 | 28 | | 1 | 3 | 2 | | 6 | 66 |
| Ikpikpuk | 30 | 15 | | 1 | 2 | | | 0 | 48 |
| Colville | NA | | | | | | | 0 | 0 |
| Canning | 37 | 7 | 1 | 5 | 0 | | | 0 | 50 |
| Mackenzie | 3 | | | | | | 3 | 5 | 11 |
| Bylot | | | | | | | | 9 | 9 |
| East Bay | | 2 | | | | | | 15 | 17 |
| Churchill | | 21 | | 1 | | | 12 | 0 | 34 |
| Total | 141 | 108 | 1 | 12 | 5 | 57 | 15 | 35 | 350 |

# Demographic Analyses

**Nest survival**

- Known fate models control for losses prior to nest discovery
- Allows nest checks at different schedules
- Input: date of discovery, dates bracketing nest completion, nest fate
- Nest covariates: age at discovery, habitat, latitude

# Demographic Analyses

## Adult Survival

- Cormack Jolly Seber models for live encounter data
- Estimate apparent survival
- Control for encounter rates < 1, transients, and variation in site fidelity
- Environmental and individual covariates

# Additional Network Projects

- Avian Influenza detection – Kim Trust
- Avian disease sampling – Samantha Wisely, Debbie Buehler, Jorge Santo Domingo
- Migratory connectivity of DUNL using geolocators – Steve Yezerinac
- SESA stable isotope project – David Mizrahi
- NDVI and nest initiation – David Ward
- Invertebrate phenology and pond characteristics – Mac Butler and Daniel Rinella
- Feather and blood collection for stable isotope and genetic investigations

# Total Network Project Samples 2011

| Site | Feathers | Fecal | Genetic Blood | RNA Blood | Malaria Blood |
|---|---|---|---|---|---|
| Nome | 261 | 58 | 172 | 59 | 81 |
| Cape Krusenstern | 113 | 61 | 104 | 93 | 66 |
| Barrow | 365 | 211 | 350 | 297 | 181 |
| Ikpikpuk | 115 | 99 | 59 | 55 | 56 |
| Colville | 53 | 34 | 36 | 14 | 16 |
| Canning | 122 | 54 | 75 | 55 | 32 |
| Mackenzie | 40 | 21 | 36 | | |
| Bylot | 41 | 21 | 5 | 2 | 36 |
| East Bay | 22 | | | | |
| Churchill | 12 | 21 | 31 | 10 | 13 |
| Total | 1144 | 580 | 868 | 585 | 481 |

# Acknowledgments


- Network Site Partners Listed Previously
- Network Funders
  - USFWS Arctic LCC, USFWS Neotropical Migratory Bird Conservation Act, National Fish and Wildlife Foundation, Manomet Inc., and Network site partners

# Acknowledgments

***Thanks to many other project participants who helped design the study or carry out the work in the field!***

# Arctic Shorebird Demographics Network

## For Further Information:

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# Demographic Analyses/ Los Análisis Demográficos

Return rate

| $t_1$ | | $t_2$ or $t_{2+}$ |
|---|---|---|
| mark sample | $\xrightarrow{\text{RR}}$ | % recaptured, % resighted or both |

Index of adult survival but a product of four rates

| Probability ($\theta$) | Complement ($1-\theta$) |
|---|---|
| • True survival ($S$) | • Mortality |
| • Site fidelity ($F$) | • Permanent emigration |
| • Site propensity ($\gamma*$) | • Temporary emigration |
| • True detection rate ($p*$) | • Missed by observer |

$$\text{RR} = S \times F \times \gamma* \times p*$$

# Mark-Recapture Models (CJS)

Encounter histories

1 = detection, 0 = no detection

| $t_1$ | | $t_2$ | | $t_3$ | | $t_4$ |
|---|---|---|---|---|---|---|
| 1 | $\phi_1$ | 0 | $\phi_2$ | 1 | $\phi_3$ | 1 |
| | $p_2$ | | $p_3$ | | $p_4$ | |

CJS models estimate 2 probabilities:

- Apparent survival ($\phi$) = $S \times F$
- Encounter rates ($p$) = $\gamma* \times p*$

Frequently $p < 1$

Limitations

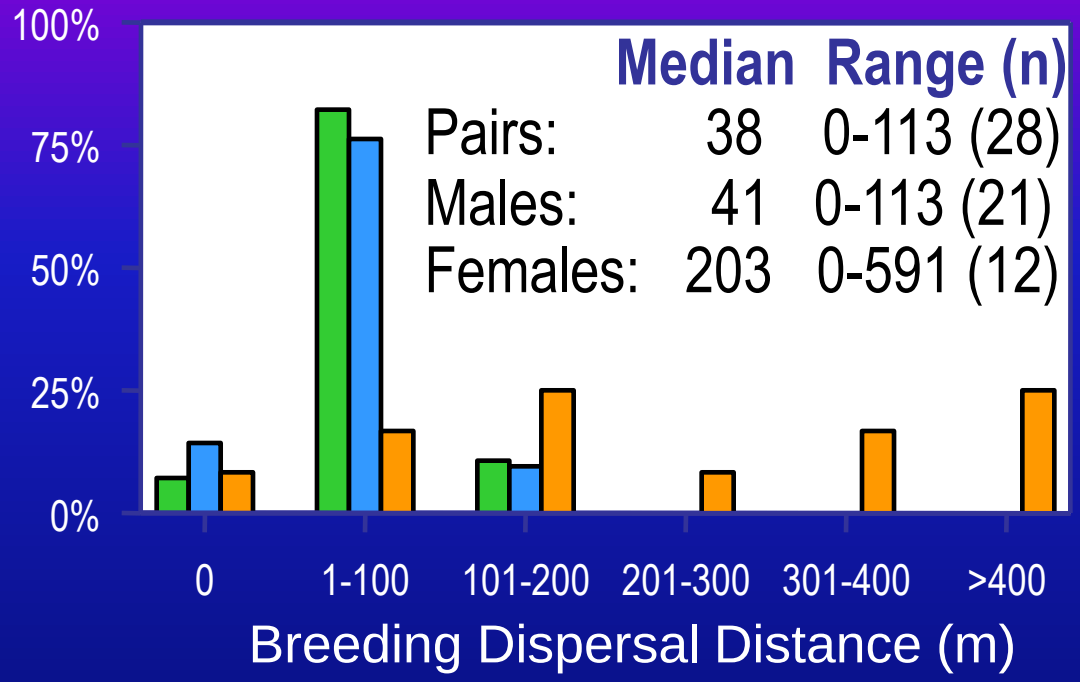
- Require 3-4 years
- $\phi \neq S$, models based solely on live encounter data cannot disentangle $S$ and $F$
- $\phi$ of less value if $F$ is low: juveniles, phalaropes, species using unstable habitats

# To Interpret $\phi$, *F* Is Needed

**Semipalmated Sandpiper**

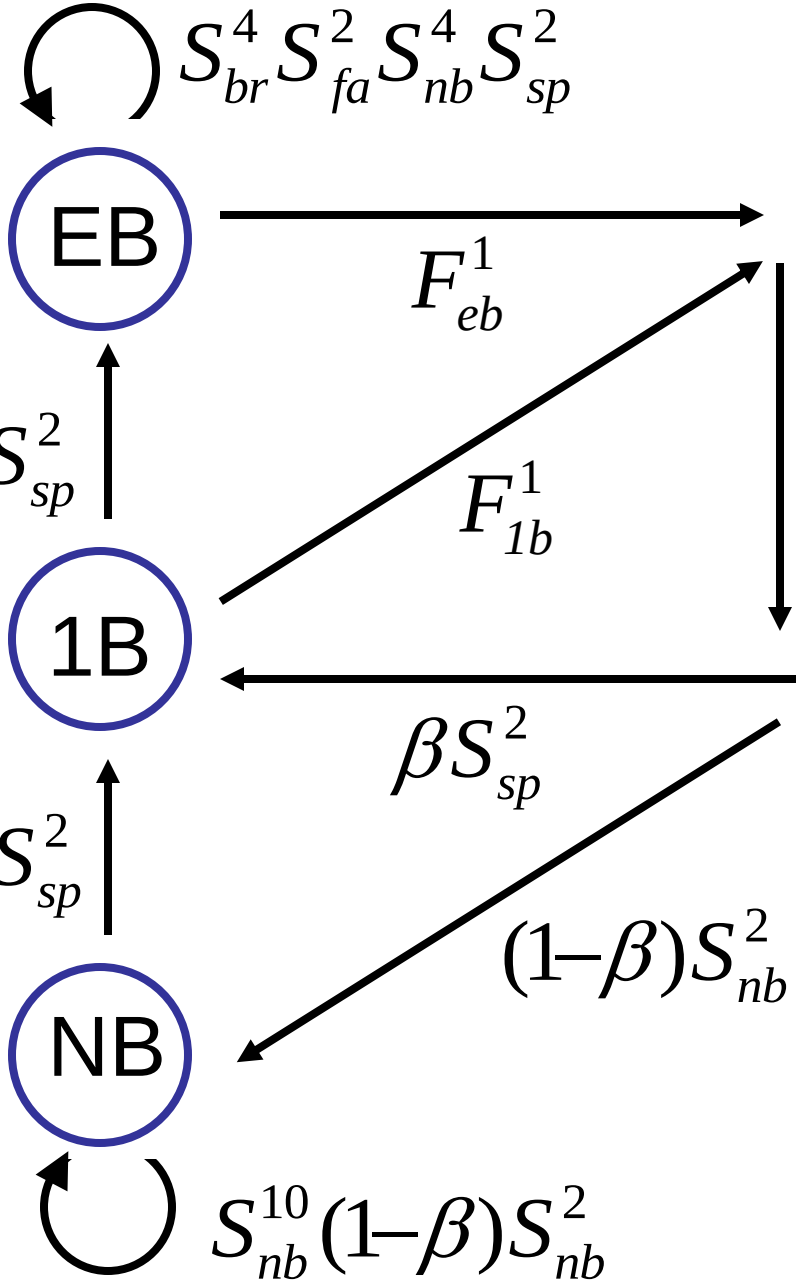
$\phi_{mal} = 0.61$

$\phi_{fem} = 0.56$




Limitation

- Estimates of dispersal distance are biased if calculated from small study plots




Demographic Model/Modelo Demográfico