Population Structure (Delineation)

Definition: geographic scale at which populations are demographically independent (dynamics are driven by intrinsic attributes [survival and productivity])

Two key information needs:

1) Connectivity

2) Site-fidelity

=> Basic requirements to conserve and/or manage (e.g., harvest)

Simple theoretical examples: Dynamic Bubble Figures
Theoretical Pop’n Structure #1

LOW WINTER SITE FIDELITY

BREEDING

MIGRATION

WINTERING
Theoretical Pop’n Structure #1

LOW WINTER SITE FIDELITY

BREEDING

MIGRATION

WINTERING
Theoretical Pop’n Structure #2

**HIGH WINTER SITE FIDELITY**

- BREEDING
- MIGRATION
- WINTERING
Theoretical Pop’n Structure #2

**HIGH WINTER SITE FIDELITY**

- BREEDING
- MIGRATION
- WINTERING
Theoretical Pop’n Structure #2

**HIGH WINTER SITE FIDELITY**

- **BREEDING**
- **MIGRATION**
- **WINTERING**
Theoretical Pop’n Structure #2

HIGH WINTER SITE FIDELITY

BREEDING

MIGRATION

WINTERING
Pacific Barrow’s Goldeneyes
Captures & Marking

300+ PTTs

Vancouver, BC
2007 & 2011, Adult M & F

Pr William Snd, AK
Wintering
2009, Adult M & F

Wintering
2009, Adult M & F

Cardinal Lk, AB
Molting
2009 & 2010, Adult M

Kitimat, BC
Wintering
2009, Adult M & F

BAGO, N > 350 PTTs

Juneau, AK
Wintering
2012, Adult M & F

Riske Ck, BC
Breeding
2006 - 2011, HY, Adult M & F

Vancouver, BC
Wintering
2007, 2011, & 2015 Adult M & F

Kachemak Bay, AK
Wintering
2013, Adult M & F

Kitimat, BC
Wintering
2014, Adult M & F

Juneau, AK
Wintering
2012, Adult M & F

Cardinal Lk, AB
Molting
2009 & 2010, Adult M

Riske Ck, BC
Breeding
2006 - 2011, HY, Adult M & F

Vancouver, BC
Wintering
2007, 2011, & 2015 Adult M & F

Kachemak Bay, AK
Wintering
2013, Adult M & F

Kitimat, BC
Wintering
2014, Adult M & F

Juneau, AK
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2006 - 2011, HY, Adult M & F

Vancouver, BC
Wintering
2007, 2011, & 2015 Adult M & F

Kachemak Bay, AK
Wintering
2013, Adult M & F

Kitimat, BC
Wintering
2014, Adult M & F

Juneau, AK
Wintering
2012, Adult M & F

Cardinal Lk, AB
Molting
2009 & 2010, Adult M

Riske Ck, BC
Breeding
2006 - 2011, HY, Adult M & F

Vancouver, BC
Wintering
2007, 2011, & 2015 Adult M & F
Kernel “Home Ranges”

• For each season, computed the mean center of distribution for each bird using best ARGOS fixes

• For each cohort, used the mean center as sampling unit and calculated kernel “home range” (= kernel breeding area, etc)

• Used ArcGis to plot contour maps @ 10% intervals
Kernel Wintering Range
BAGO Adult Males & Females
Captured at: Riske Creek, BC
Capture years: 2006-2008
Probability contours are shown in 10% intervals.

Kernel Wintering Range
BAGO Hatch-Year Males & Females
Captured at: Riske Creek, BC
Capture years: 2008 & 2009
Probability contours are shown in 10% intervals.
Return rates of (a) female and (b) male Barrow’s goldeneyes banded as ducklings and resighted in subsequent years at Riske Creek, British Columbia, 1995–2002
Age at which female Barrow’s goldeneyes were first observed (a) pairing and (b) breeding, as well as the cumulative proportion that were either (c) paired or (d) showed evidence of breeding according to age.
Kernel Wintering Range
BAGO Hatch-Year Males & Females
Captured at: Riske Creek, BC
Capture years: 2008 & 2009

Probability contours are shown in 10% intervals.
Molting males
Cardinal Lake, AB
2009, 2010
Wintering Males & Females

Vancouver, BC
Juneau, AK
PWS, AK
Kernel Breeding Ranges
BAGO Adult Males and Females
Captured at:
Prince William Sound, AK, 2009 (F:5, M:10)
Juneau, AK, 2012 (F:9, M:11)
Indian Arm, BC, 2007 & 2011 (F:27, M:15)

Probability contours are shown in 10% intervals.
Site Fidelity

Breed → Breed
Winter → Winter
Summary

• BAGOs are highly site faithful, especially adult females to their wintering and breeding areas

• At the larger NA scale, BAGOs in south BC are largely independent from BAGOs in AK, demographically and genetically (?)

• However, at smaller regional scales dispersal between “adjacent or overlapping” subpopulations must exist…eg., PWS & Kachemak
Management at the Regional Scale

GEOGRAPHICALLY DISCRETE SUB-POPULATIONS

BREEDING
- PWS AK + Kachemak AK
- Juneau AK
- Vancouver BC

MIGRATION

WINTERING
- PWS AK + Kachemak AK
- Juneau AK
- Kitimat BC
- Vancouver BC
Management at the Flyway Scale

BREEDING

MIGRATION

WINTERING

Pacific BAGO

Pacific Barrow’s goldeneye
Western High Arctic (Grey-belly) Brant
Izembek Lagoon

Neumann Island

MB-Point

Moffet Bay

Blaine Point

Strawberry Point

OP-2

Joshua Green R.

KL-Kinzarof Lagoon

OP-1

Cold Bay

Trout Creek
Wintering
Breeding
Snow Geese
Snow Geese
Fraser/Skagit Deltas: 1991/92
Airphoto Counts

- Total
- Fraser
- Skagit

Number (x1000) vs. Day

Oct Nov Dec Jan Feb Mar Apr
30 60 90 120 150 180 210 240
Flexible/Responsive Harvest Strategy

Harvest Rate Year t+1 vs Mid-winter Pop’n Year t

Target pop’n range