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Science
Center

Northern fur seal foraging – linking biophysical processes and fur seal behavior to demography

Alaska Ecosystems
Program
Plan Team
September 14, 2016

Management status

- Listed as depleted under the Marine Mammal Protection Act
 1. Eastern Stock population is ~ 622,908 seals (~ 1/3 of its historical peak)
 2. Well below OSP (optimum sustainable population)
 3. To be delisted, population needs to double to achieve 60% of historical K
 4. 2016 St. Paul declined ~12% and St. George Island increased ~7%
 5. Eastern Stock will likely show a ~ 5% decline (preliminary results)
- Determine factors influencing demography as outlined in the Northern Fur Seal Conservation Action Narrative in the 2007 Conservation Plan
 1. Compile and evaluate available habitat-use data
 2. Compile and evaluate existing physical environmental data
 3. Select appropriate environmental indices
 4. Quantify environmental effect on behavior and productivity
 5. Ecosystem modeling
 6. Conduct oceanographic and fishery surveys based on pelagic fur seal habitat use

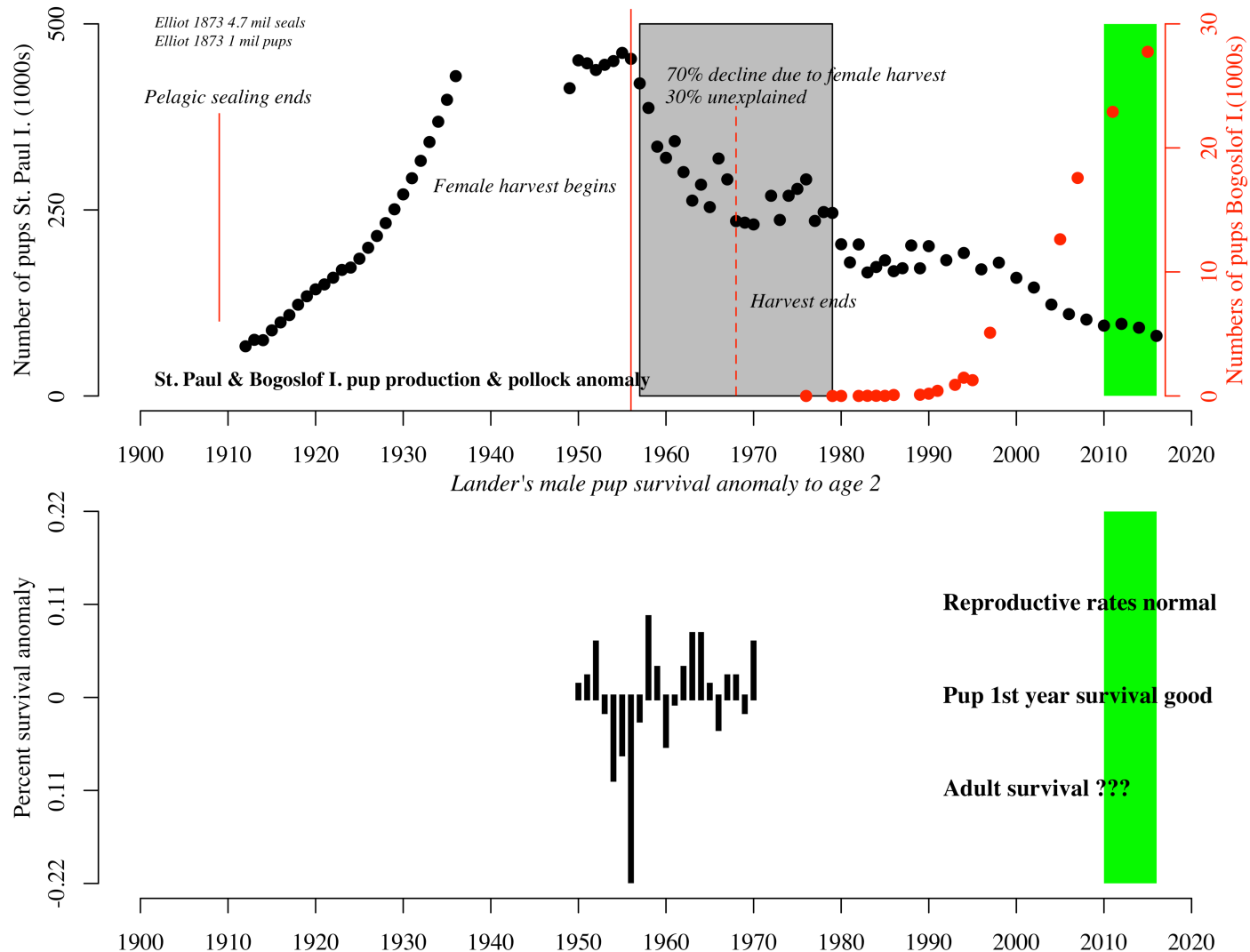
Alaska Ecosystems Program Strategy

- Looking back to inform future study design and hypotheses (1870-2016)
 1. Data rescue
 - Roger Gentry's behavioral observation archive (1973-1992)
 - Mike Goebel's PhD thesis (1995-1996)
 - Jason Baker's Pup migration study (1996/97-1997/98)
 2. Telemetry – Alaska Ecosystem Program has satellite tagged 847 northern fur seals (1991-2016)
 - Adult males and females, juveniles, pups
 - At all Eastern Stock locations
 - Half in the winter, half in the summer
 3. Saildrone survey of fur seal foraging hotspots in the Bering Sea
 - Autonomous oceanographic and acoustic sampling of fur seal prey fields
 - Bottom trawl, mid-water survey, and BASIS survey

Objective

- Identify factors influencing northern fur seal demography (Eastern Stock)
 1. Pup production (~1950-2016)
 2. Lander's estimates of male pup survival to age 2 (1950-1980)
 3. Current AEP northern fur seal demography (2010-2016)
- Our hypotheses focus on bottom up processes in both summer and winter
 1. Summer foraging and pup provisioning
 2. Winter migration

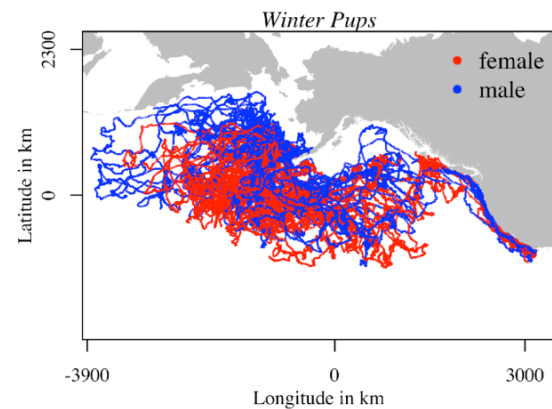
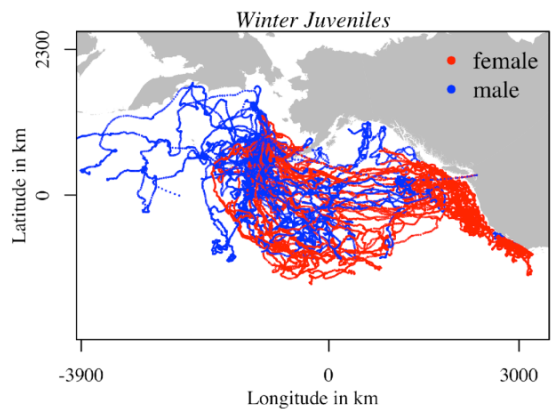
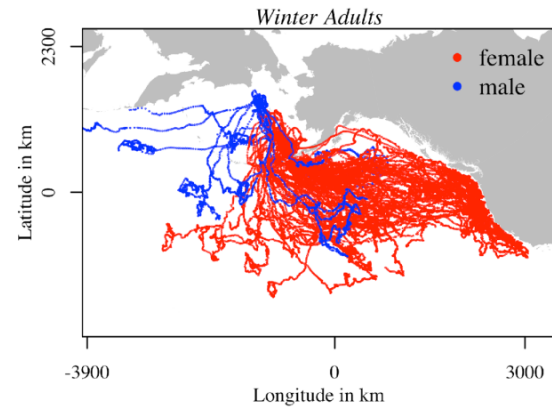
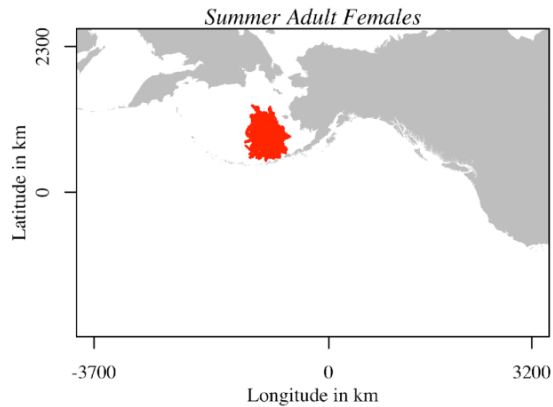
Northern fur seal demography



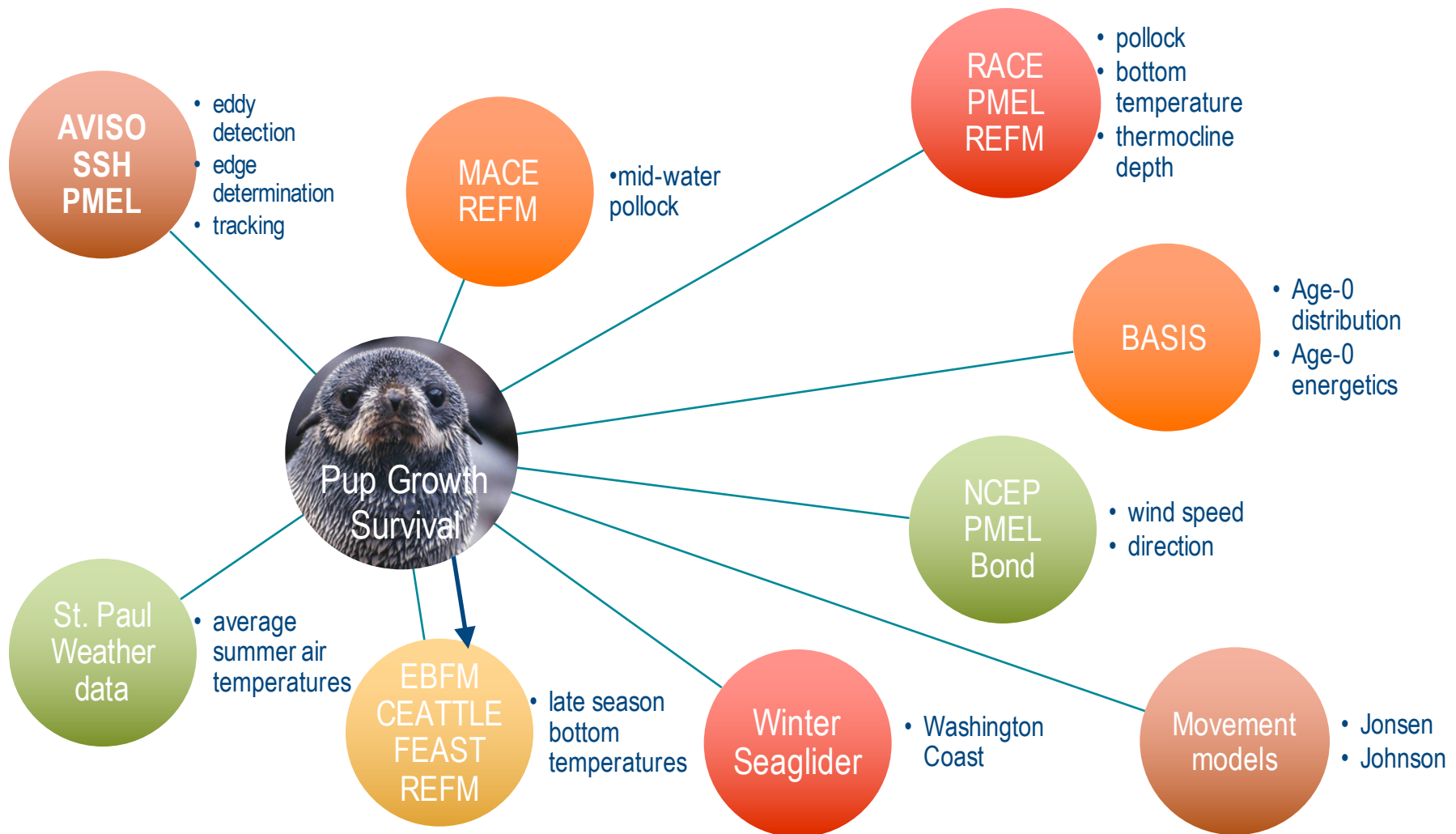
Objective

- Identify factors influencing northern fur seal demography
 1. Pup production (~1950-2014)
 2. Lander's estimates of male pup survival to age 2 (1950-1970)
 3. Current AEP northern fur seal demography (2010-2015)
- Our hypotheses focus on bottom up processes in both summer and winter
 1. Summer foraging and pup provisioning
 2. Winter migration

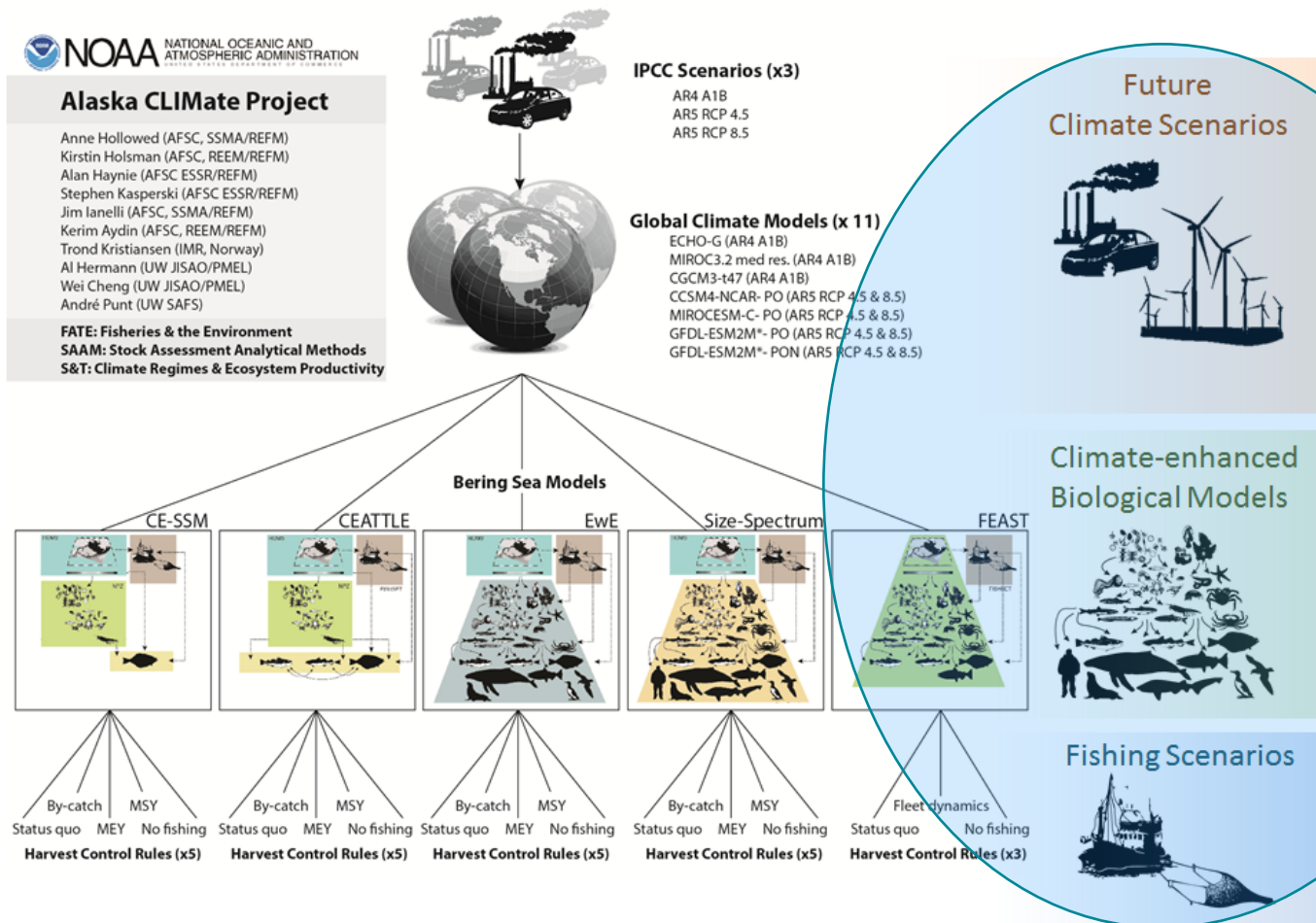
Annual Cycle



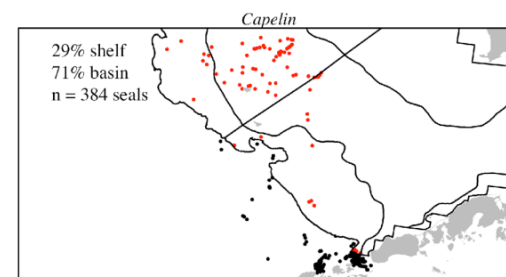
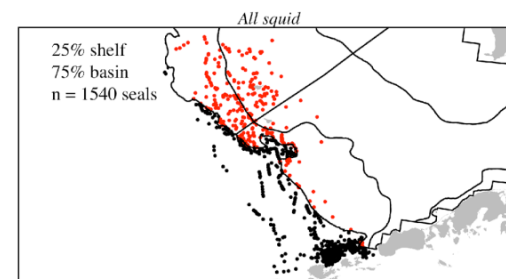
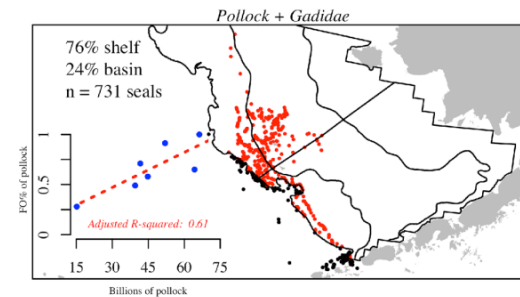
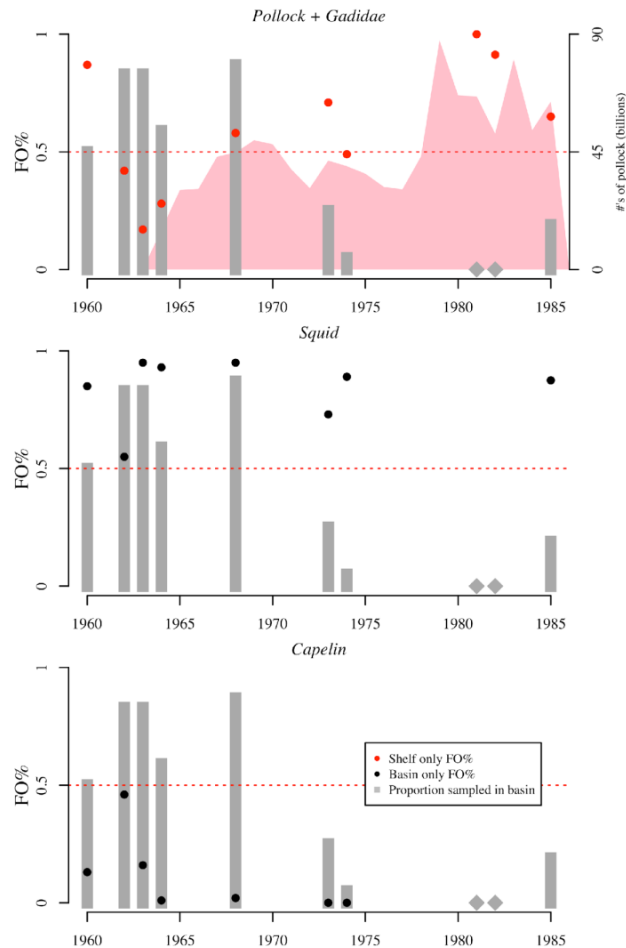
Ecosystem Data



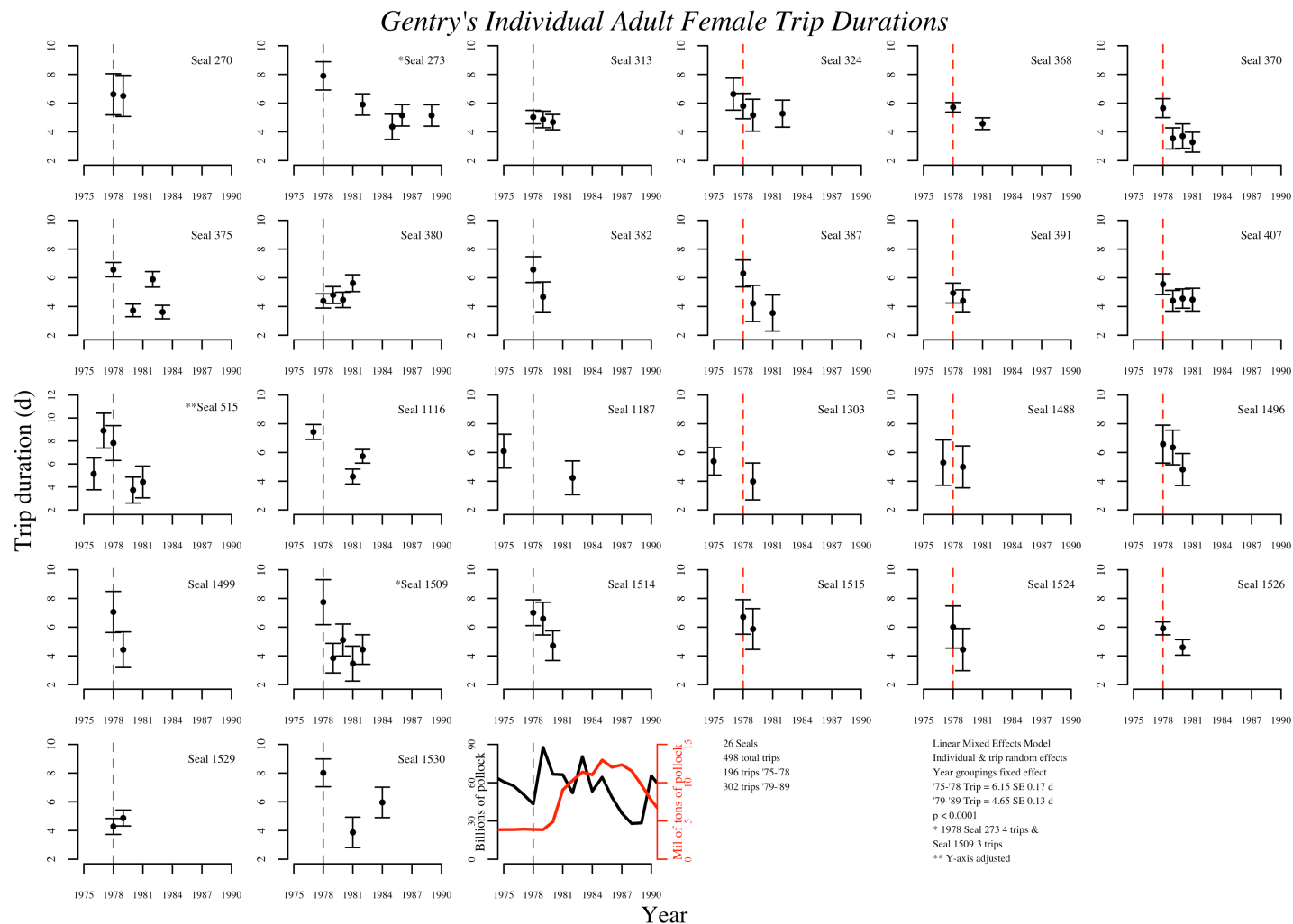
Objective – Align with Ecosystem Models



Diet – spatial

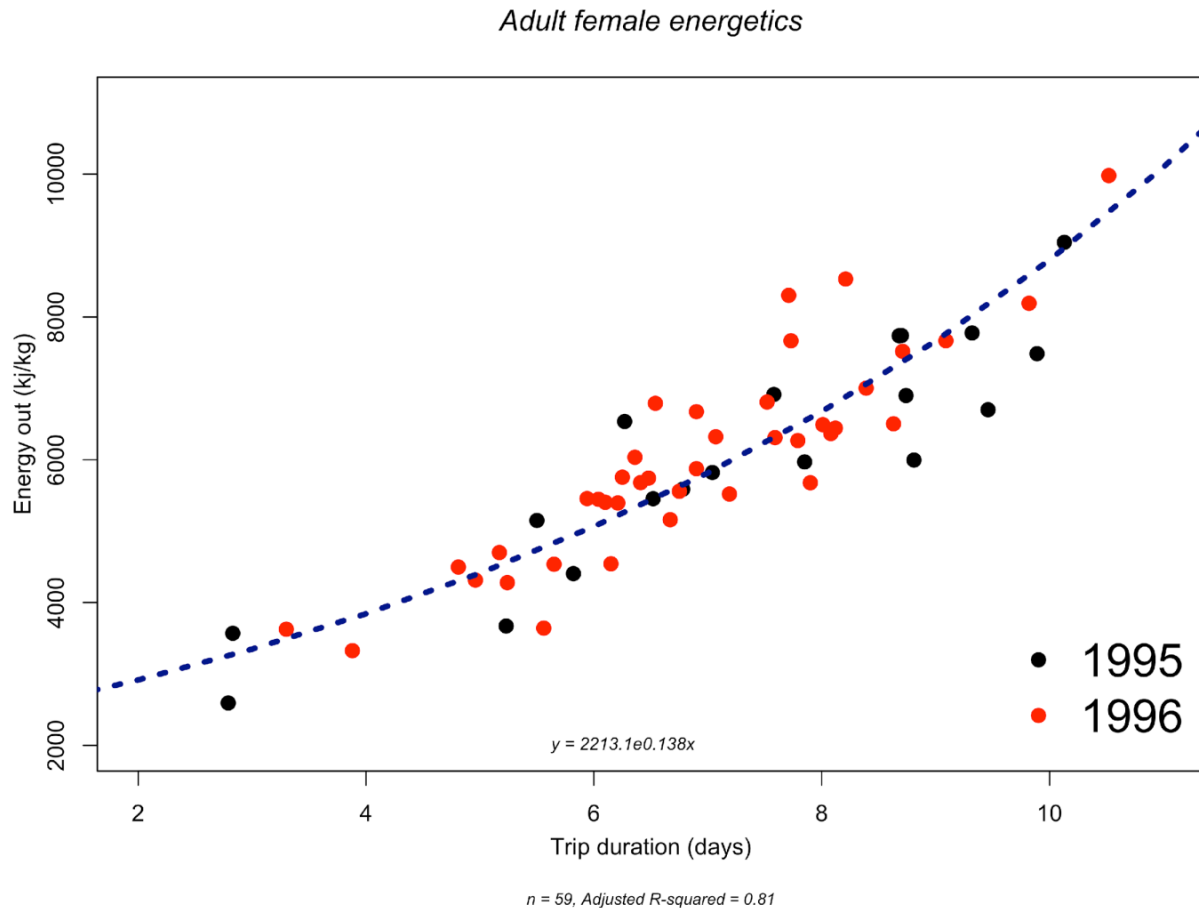


Gentry's Trip Durations



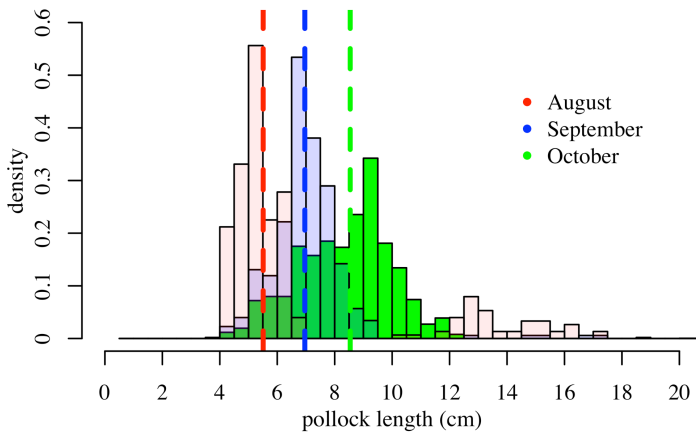
Seal selection: With pup, multiple years, > 4 trips per year, before/equal to 1978 and after 1978

FEAST – unpublished fur seal energetics data

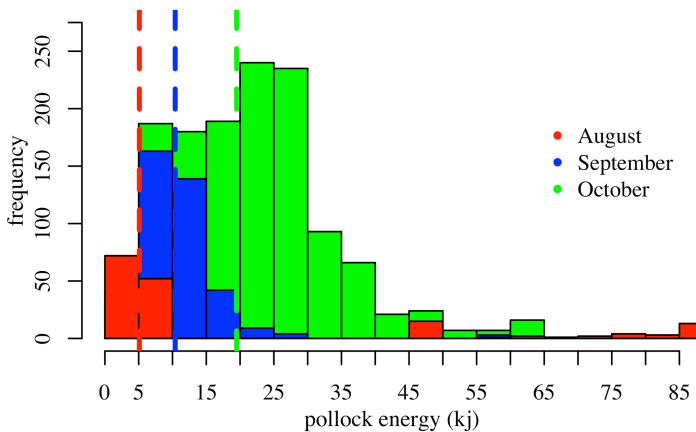


Fur Seal Diet – Energetics

August, September, October pollock length frequencies



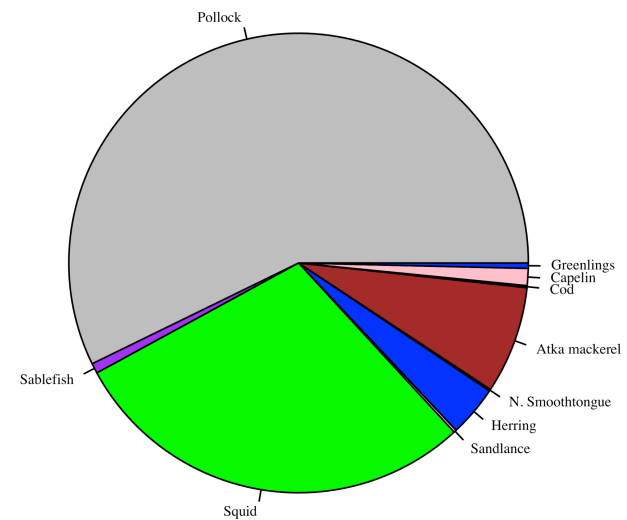
August, September, October pollock energy in kilojoules



1996 Enema Results

n = 65 seals and 1,986 fish & 313 squid

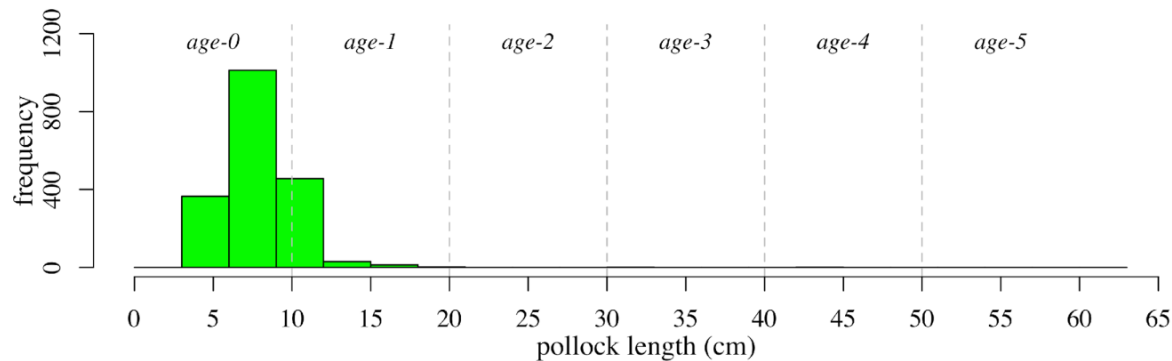
Enema prey energy content - Total = 70,689 kj



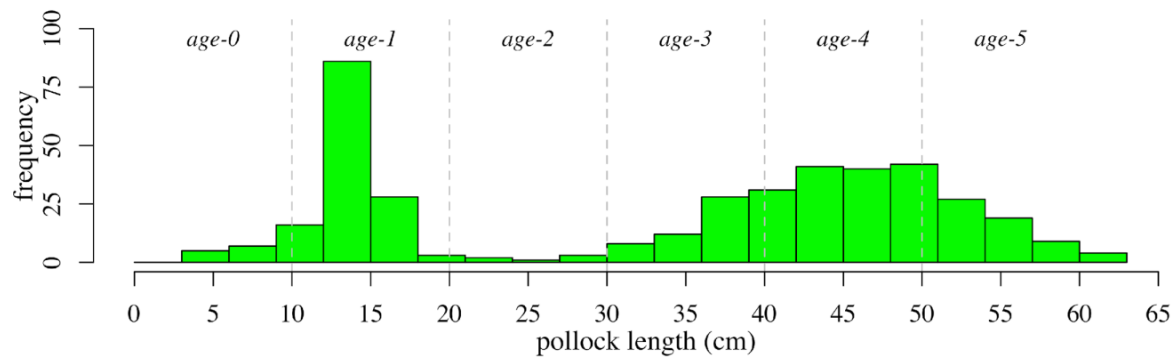
Diet – pollock age structure by sample type

All spew samples vs 1995 & 1996 enema samples

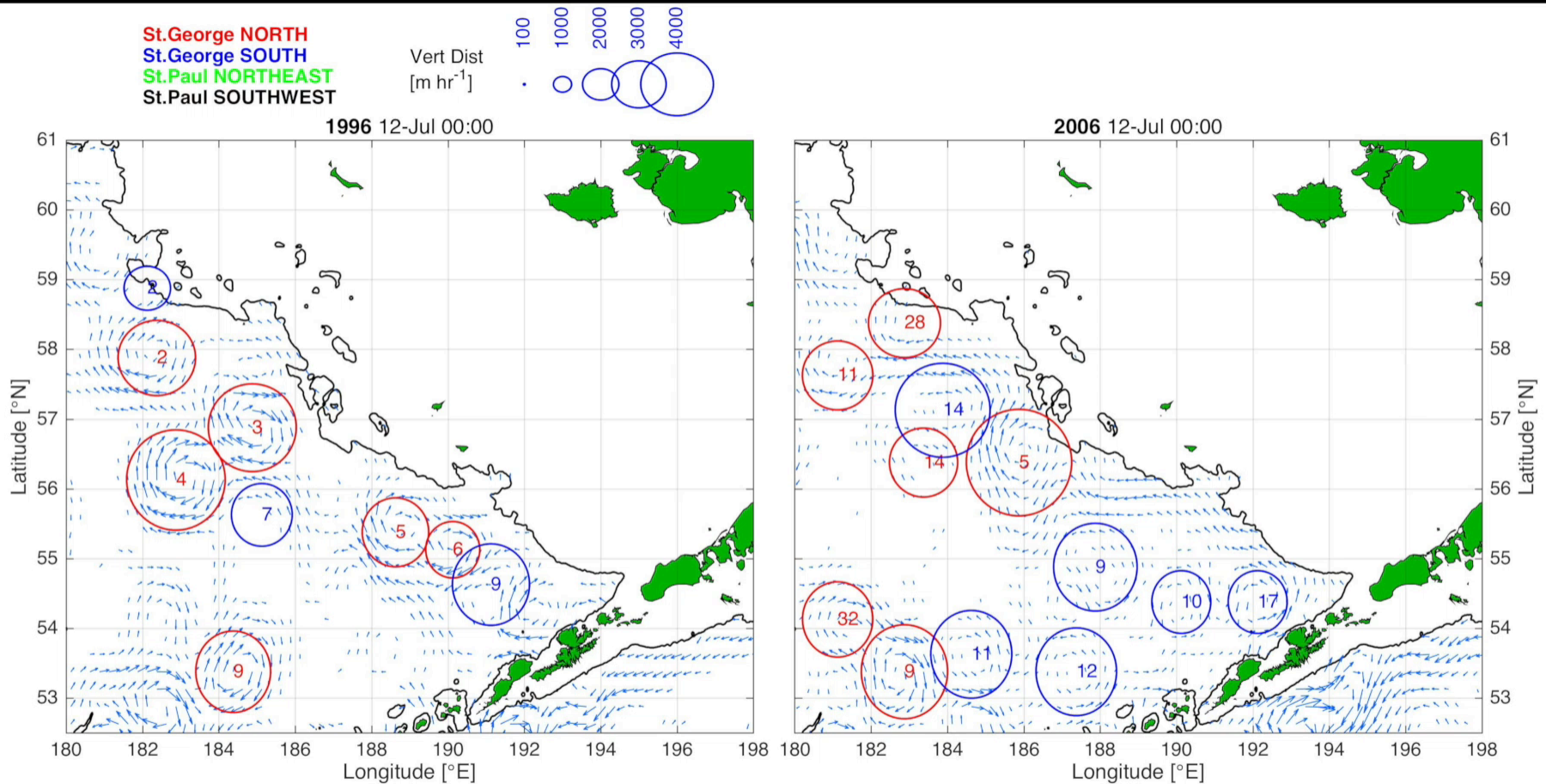
Enema pollock length frequency



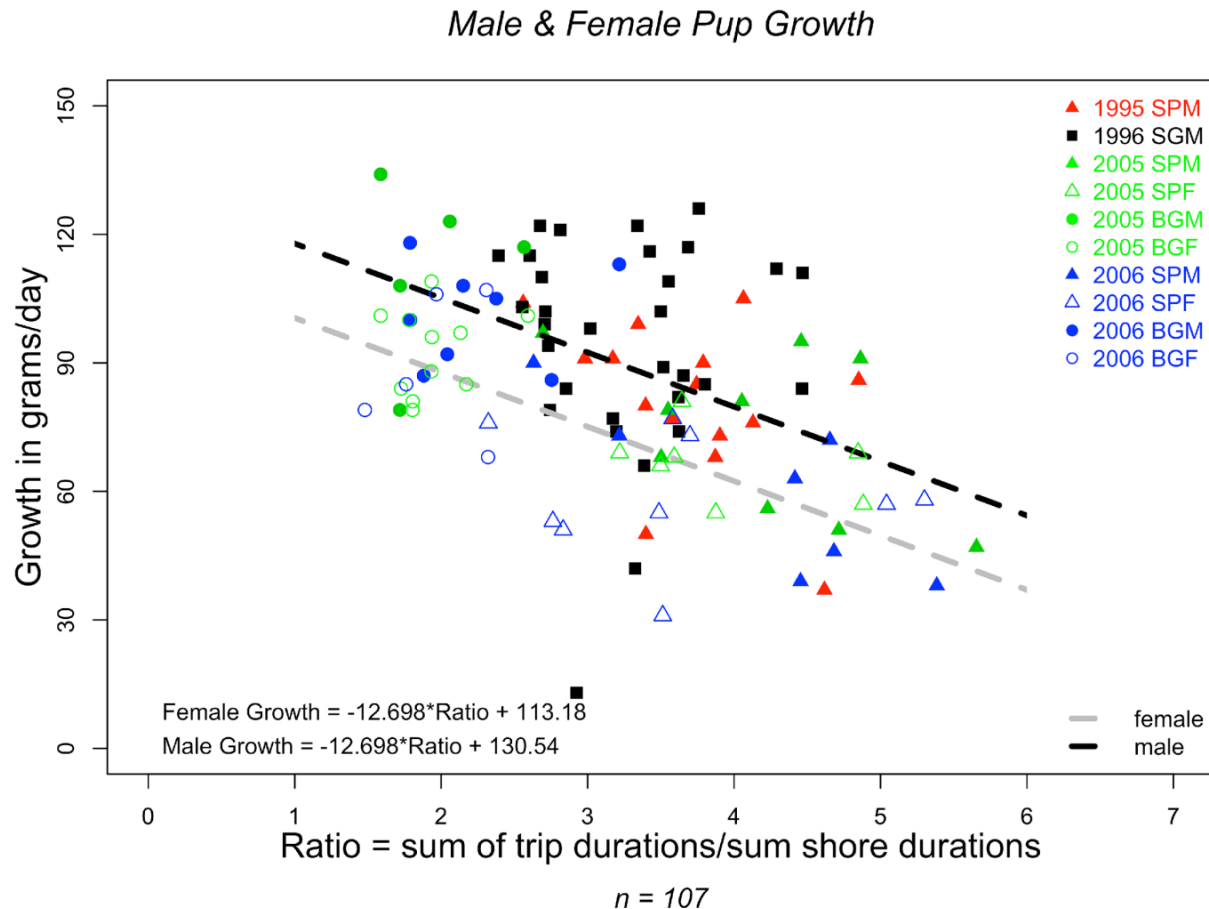
Spew pollock length frequency



Pup provisioning – 2 Studies (Goebel & COFFS)



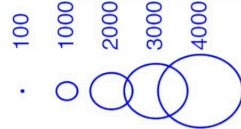
Mom behavior and pup growth



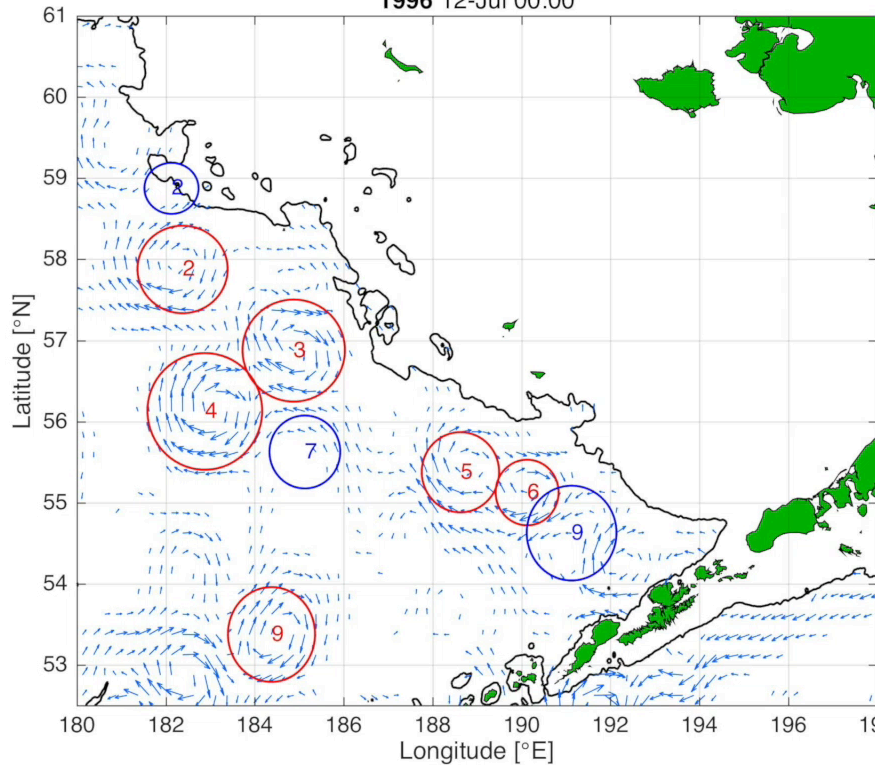
Eddy variability

St. George NORTH
St. George SOUTH
St. Paul NORTHEAST
St. Paul SOUTHWEST

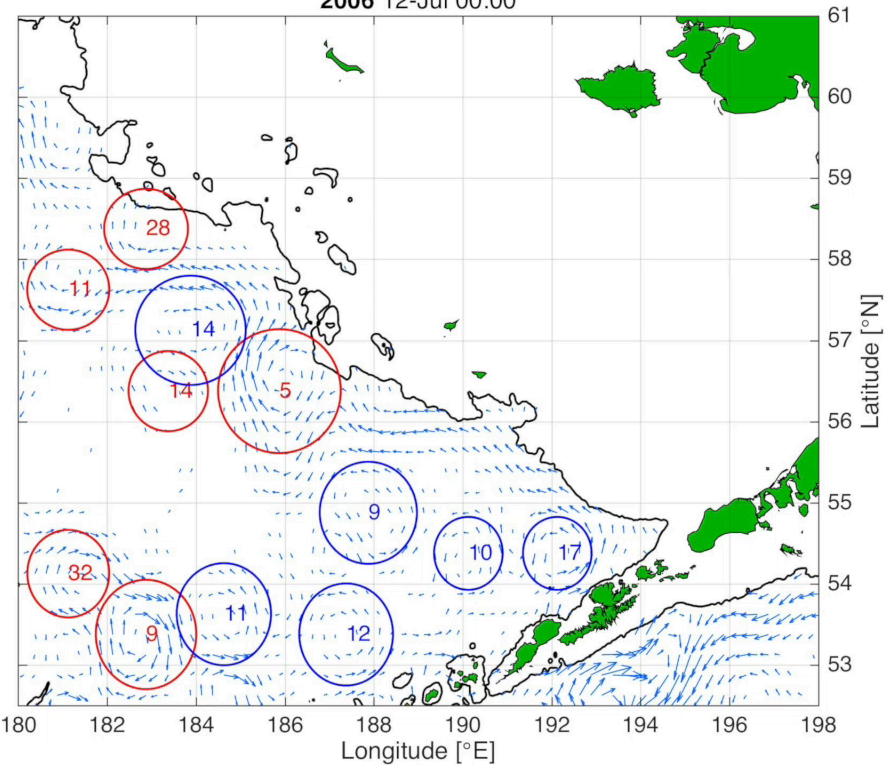
Vert Dist
[m hr⁻¹]



1996 12-Jul 00:00

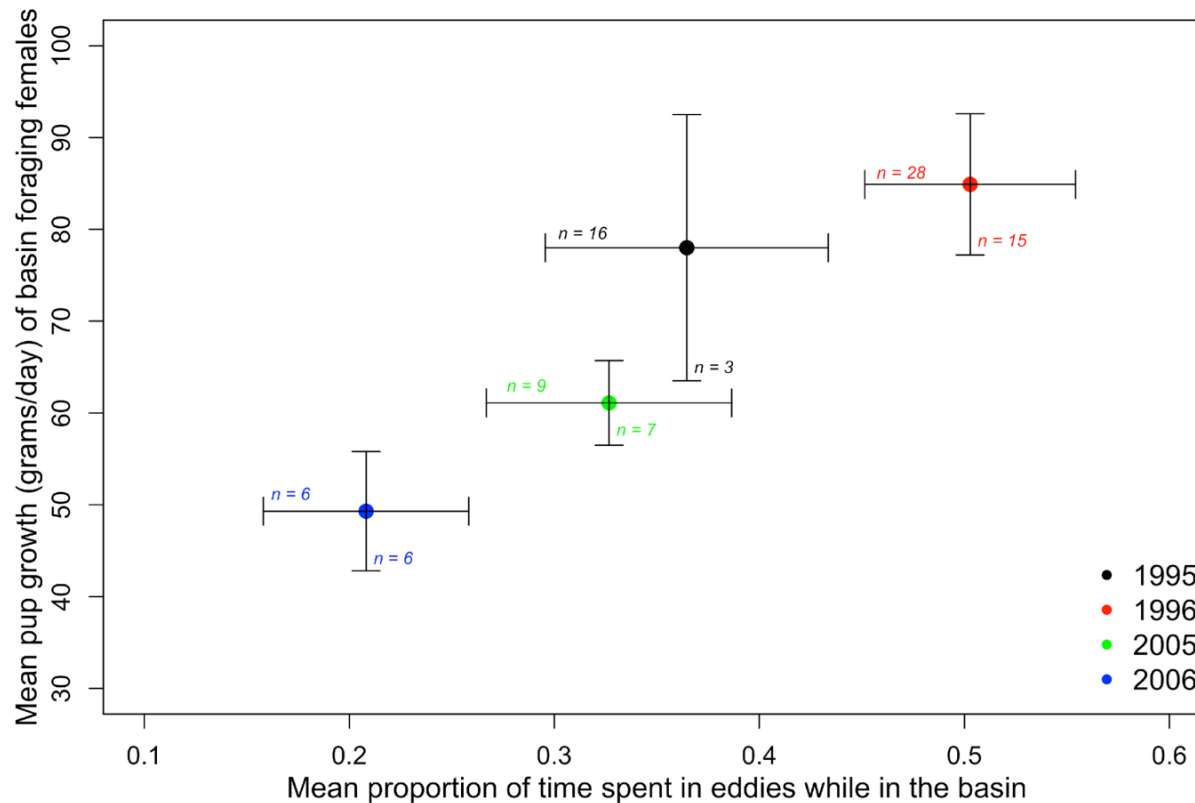


2006 12-Jul 00:00



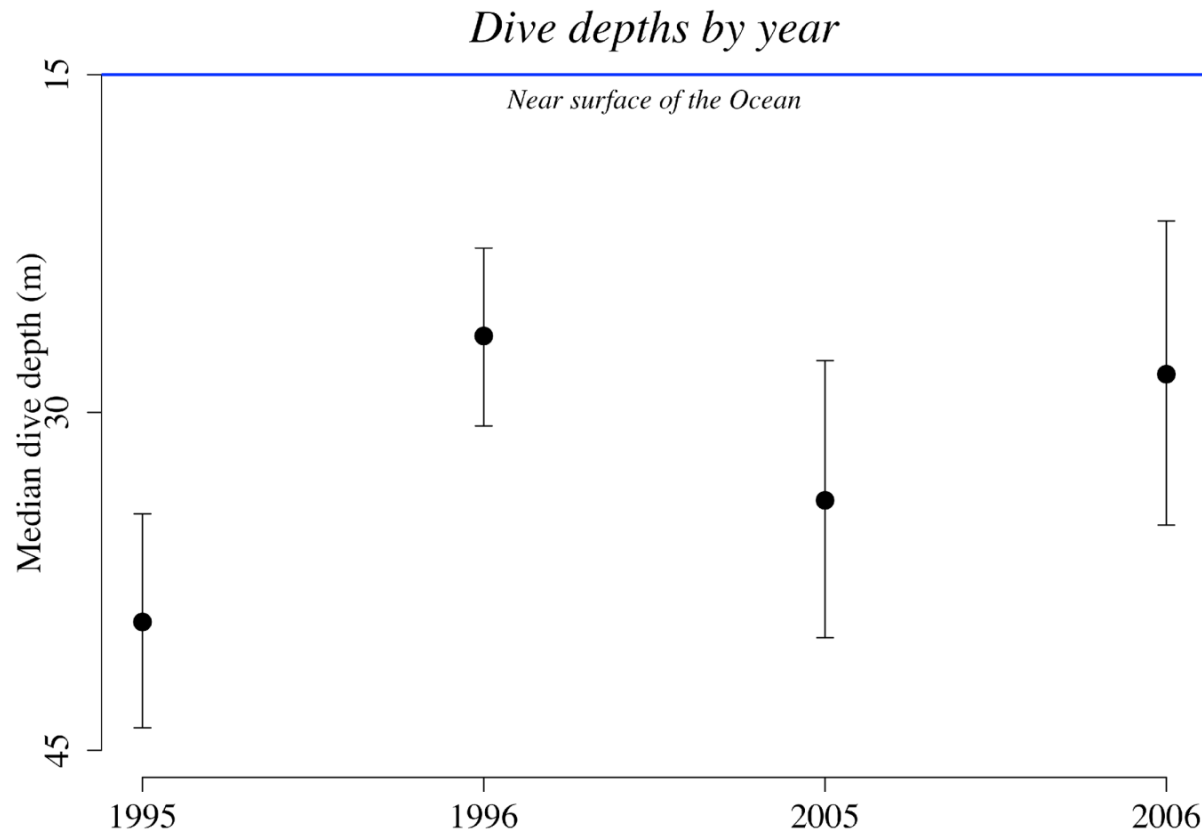
Pup growth and time in eddies

Proportion of basin time in eddies and pup growth

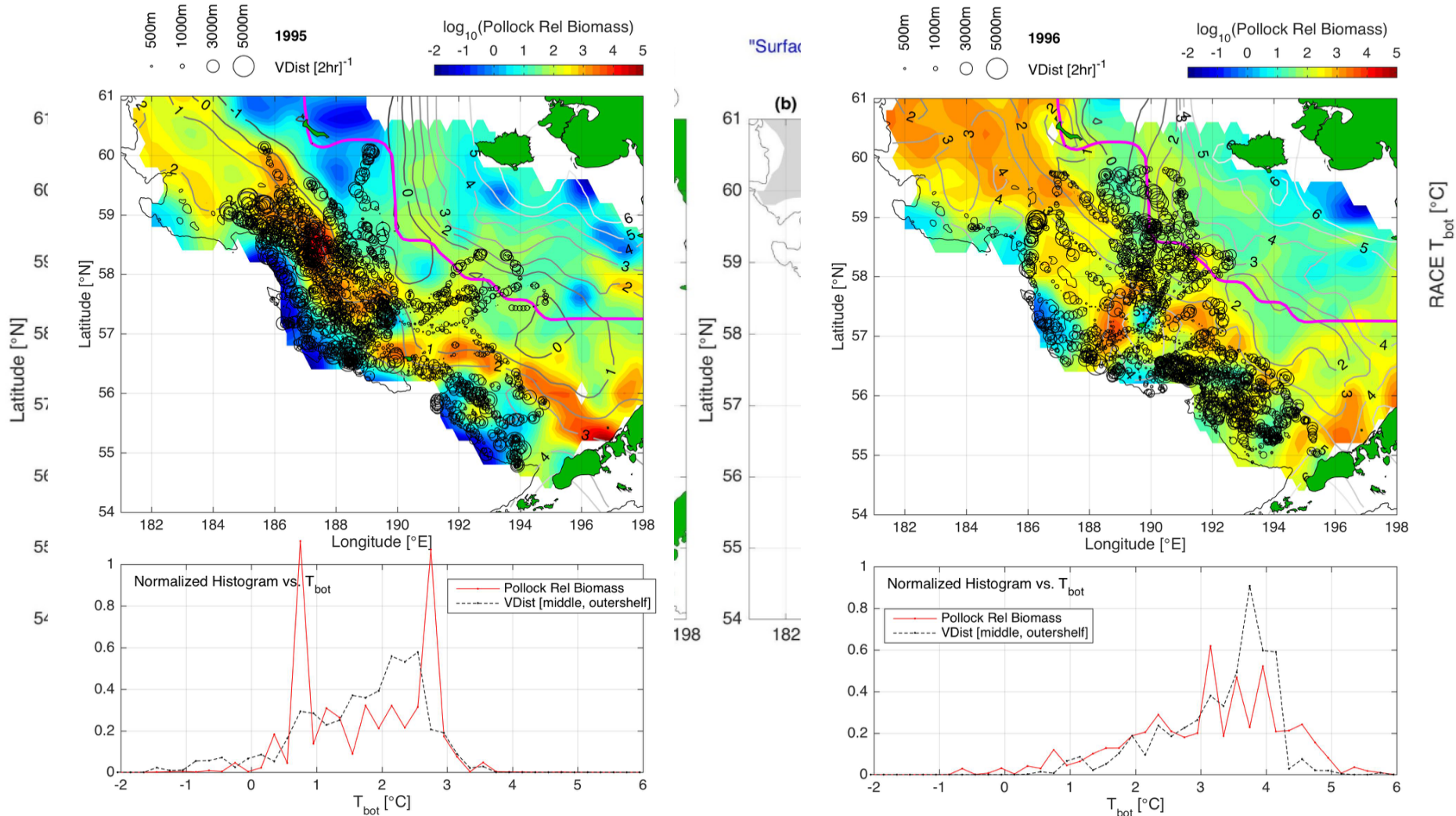


Female pups included in 2005 & 2006 - no difference in basin M/F pup growth

Shelf foraging – diving

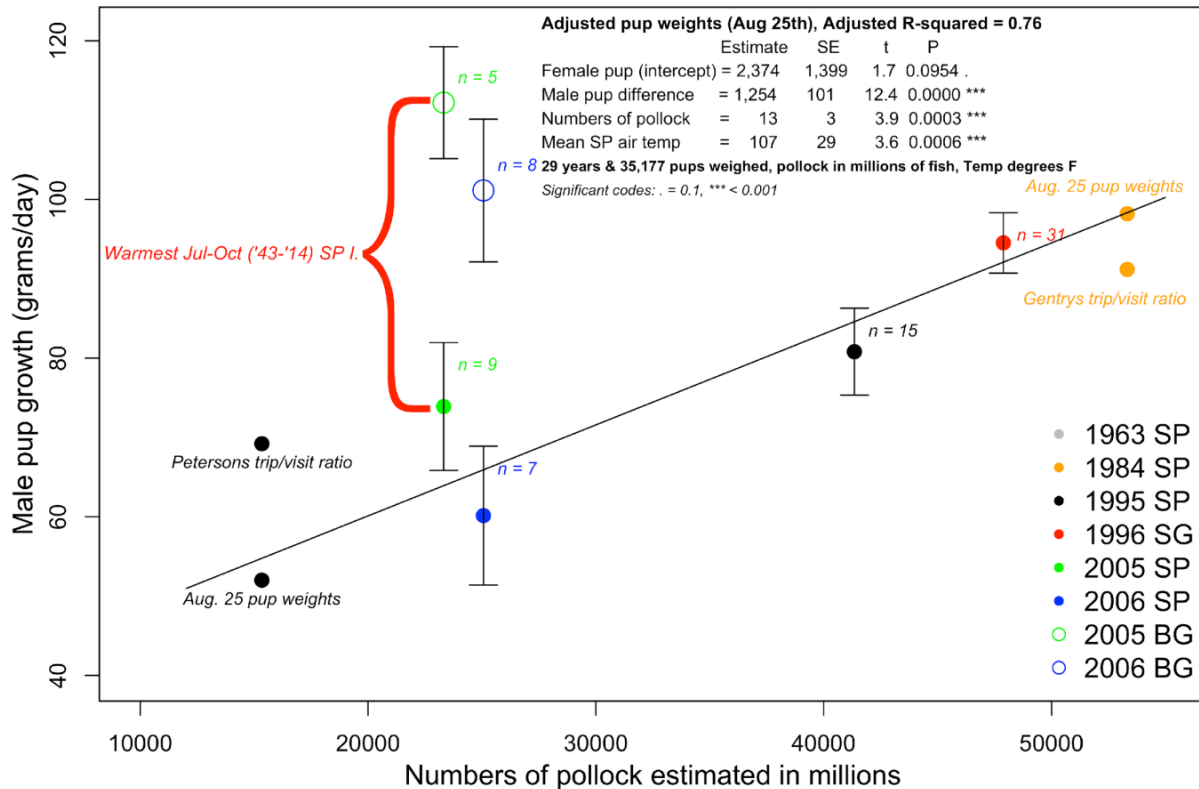


Shelf foraging – cold vs. warm



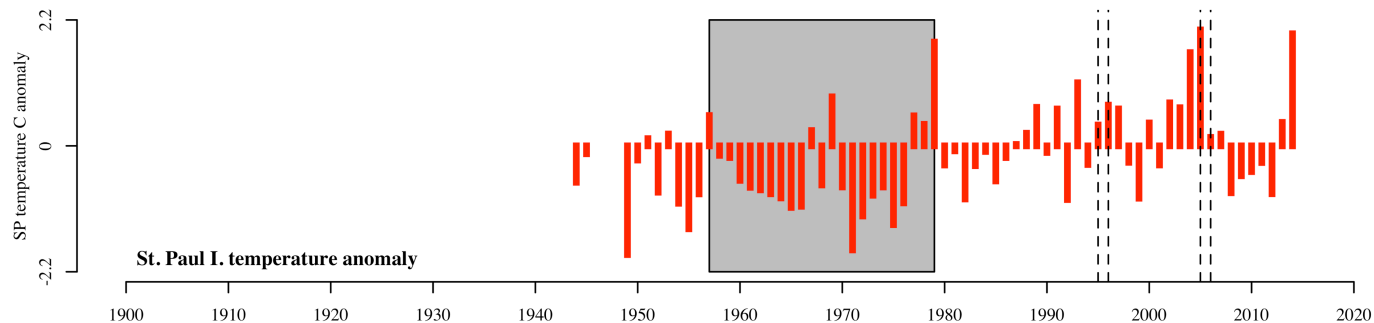
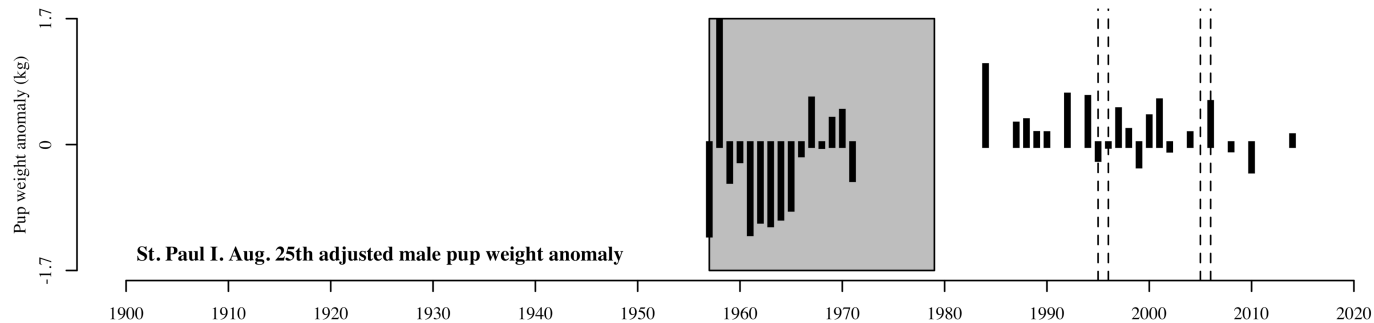
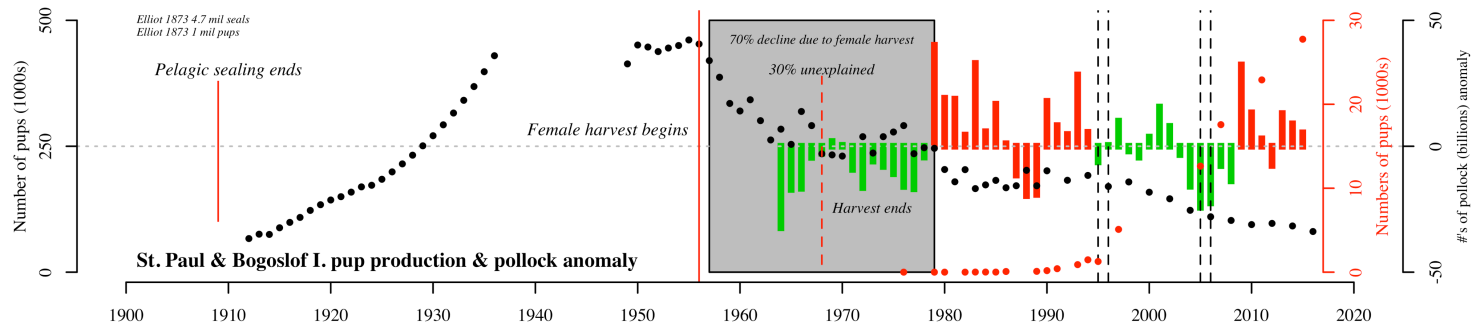
Pup growth and linkages to pollock

Male pup growth & M/F pup weights



Linear model fitted to '63 & '84 est. growth from pup weights & '95,'96,'05,'06 Pribilof pup growth from study animals

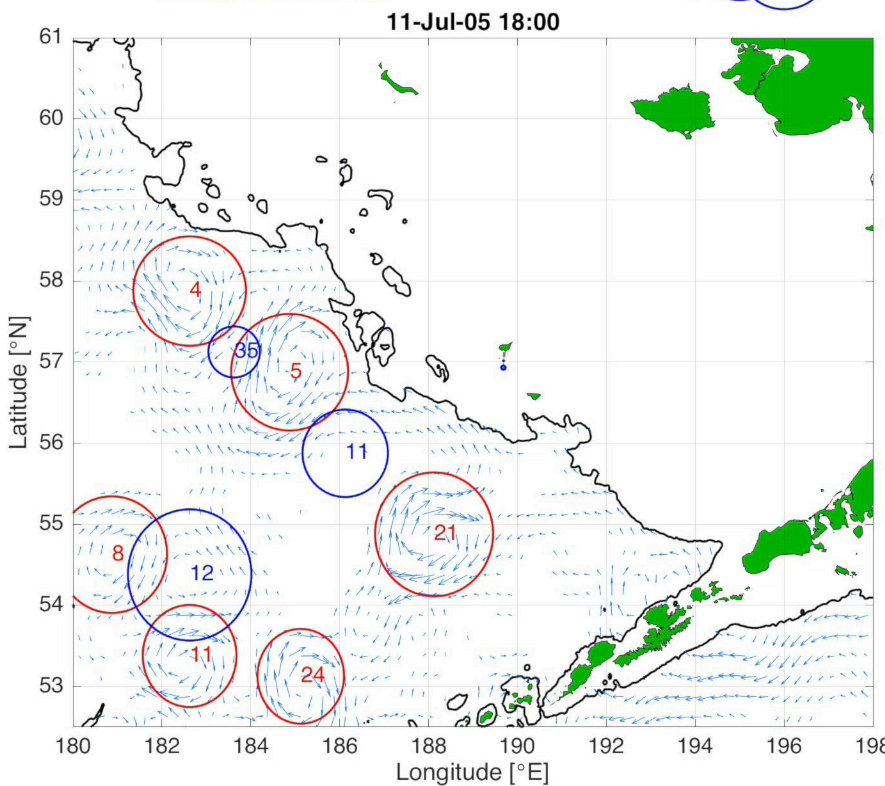
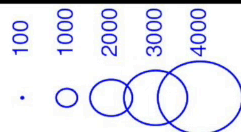
Potential links to productivity



Storms

St.George NORTH
St.George SOUTH
St.Paul NORTHEAST
St.Paul SOUTHWEST

Vert Dist
[m hr⁻¹]



Wind Speed [m s⁻¹]
0 10 20

