



Mammal-eating killer whales of the Aleutian Islands and Bering Sea

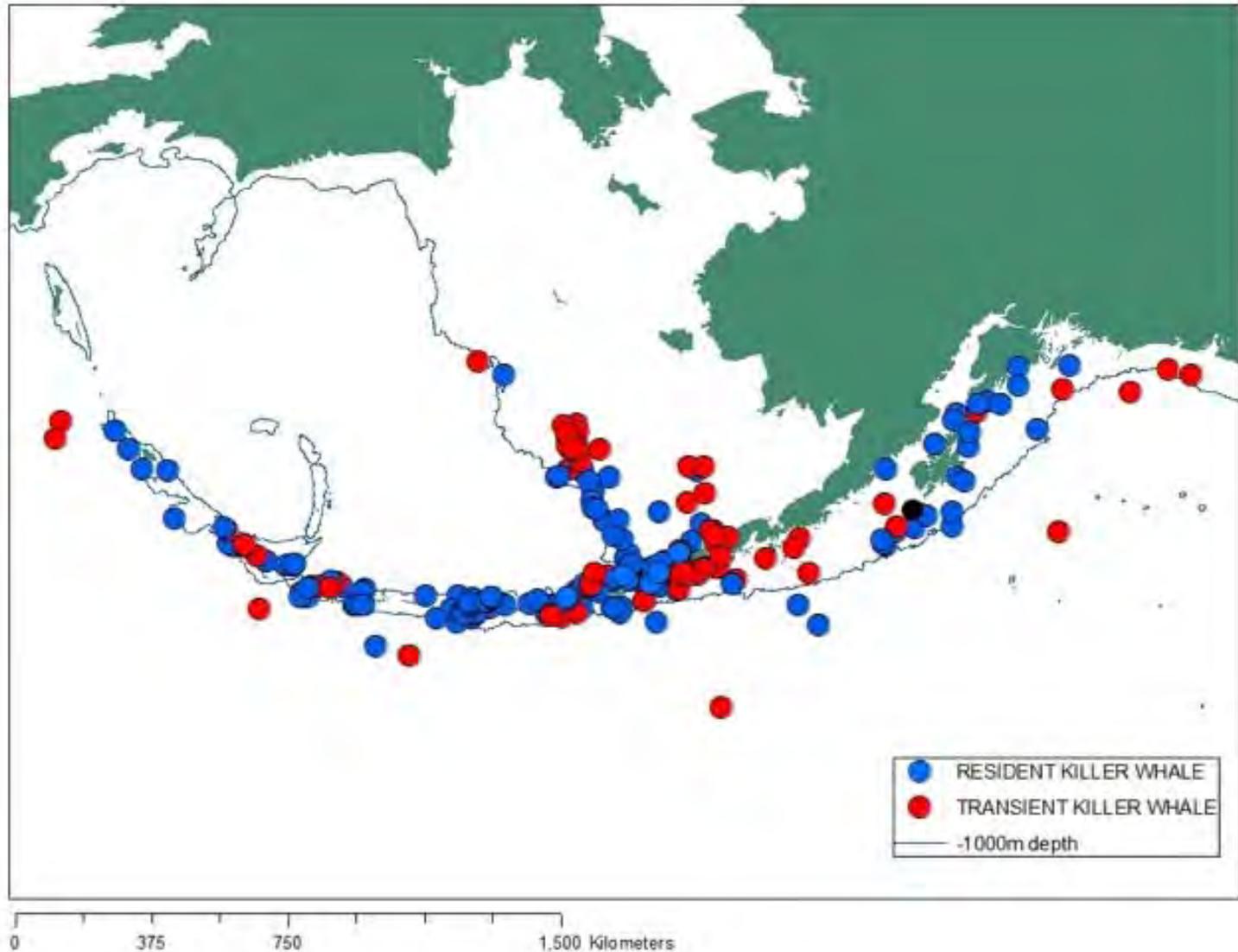


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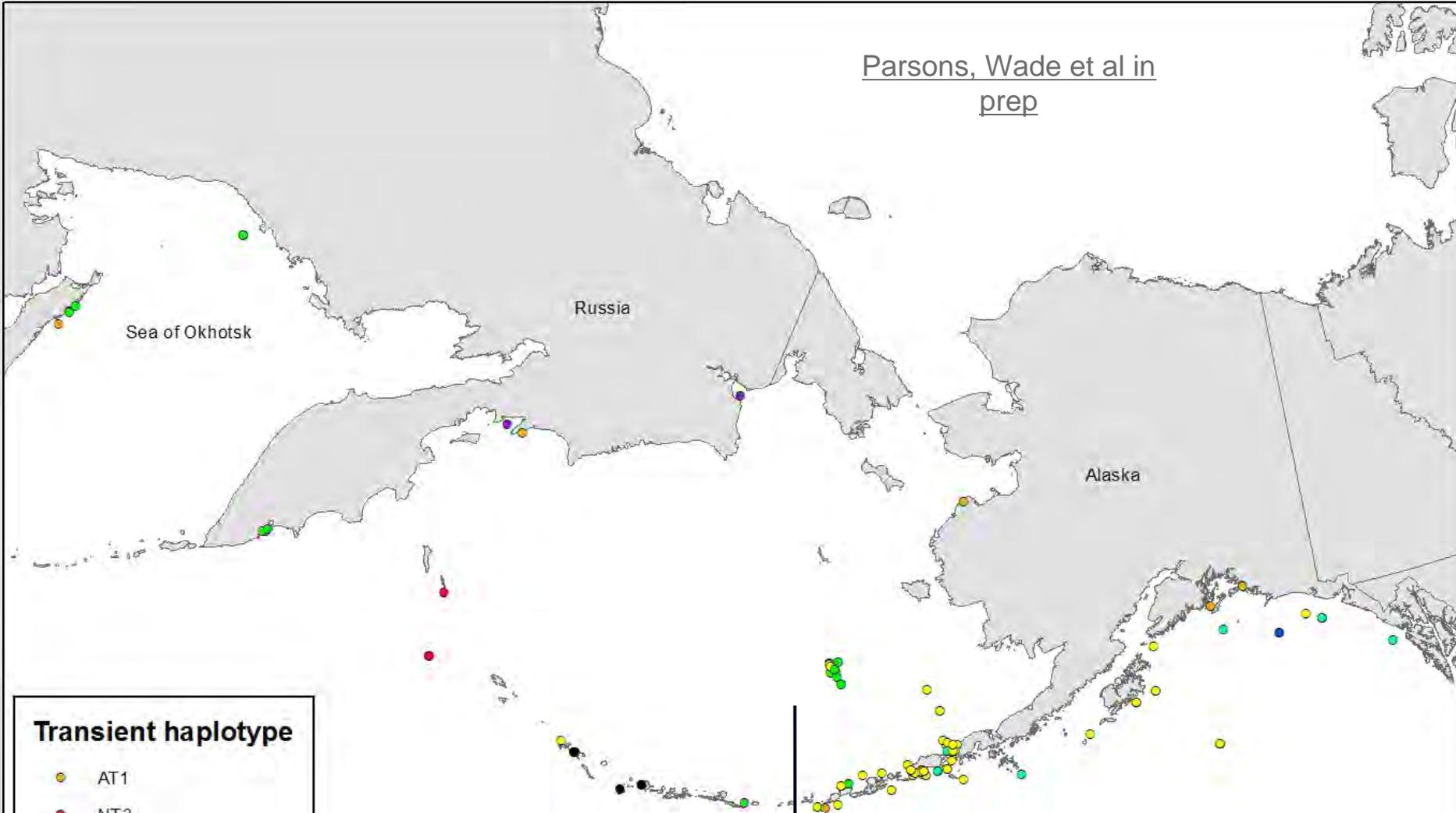
Killer whale studies by the National Marine Mammal Laboratory 2001-09

- 2001-03
 - Systematic line transect surveys
- 2004-05
 - Focused surveys for transient photo-ID and biopsy for chemical studies
- 2006-07
 - Added satellite tagging
 - First survey in central and western Aleutian Islands
- 2008-09
 - Added acoustic monitoring at Steller sea lion rookeries
- 2009
 - Adding acoustic and land-based monitoring at Reef Pt. on St. Paul

>250 Encounters with killer whales



Parsons, Wade et al in prep



Transient haplotype

- AT1
- NT3
- GAT2
- NT2
- GAT3
- NT4
- GAT
- GMex
- NT1

Unique haplotypes

- NT2
- NT3
- NT4
- GMex

?

Shared haplotypes

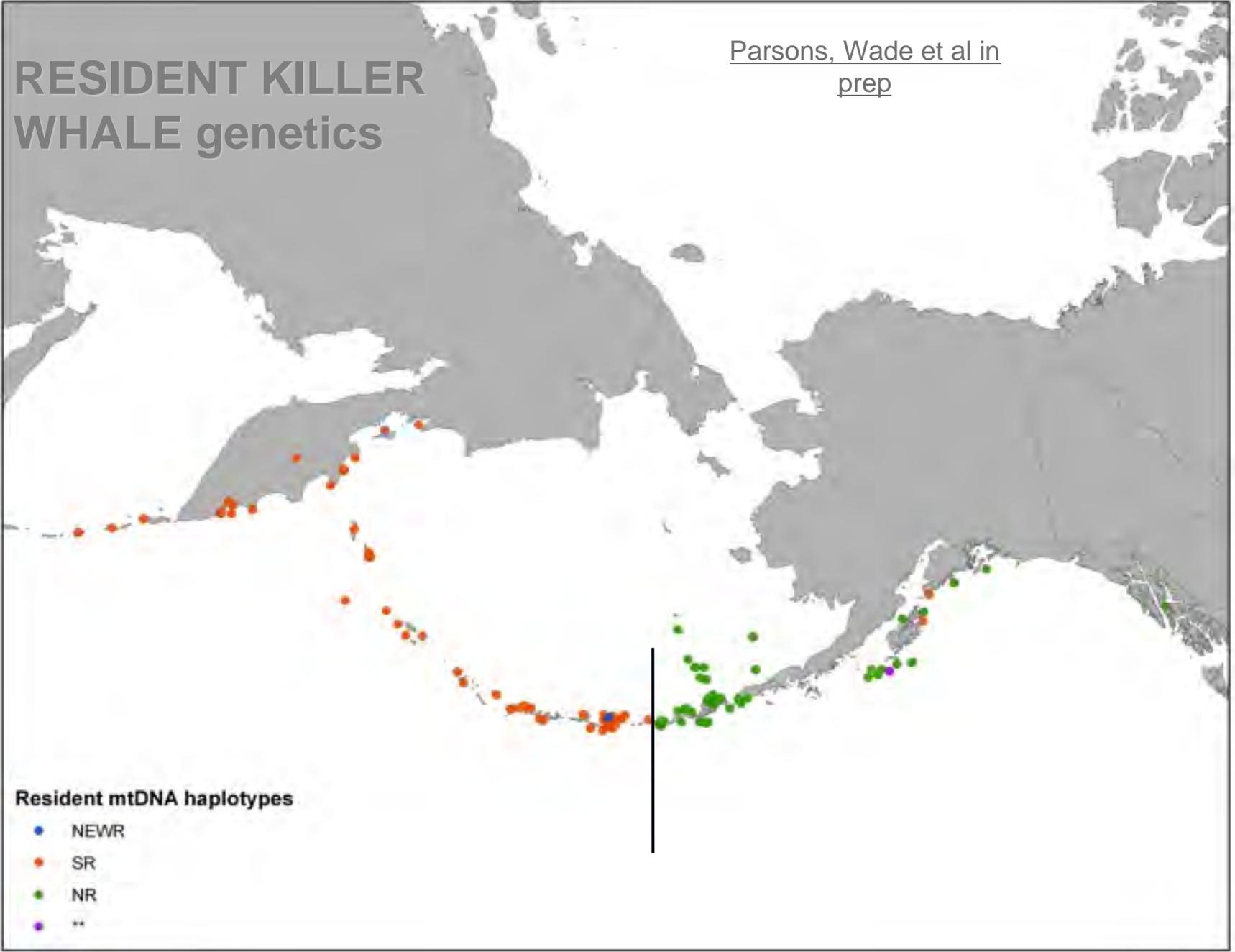
- GAT
- NT1
- AT1

Unique haplotypes

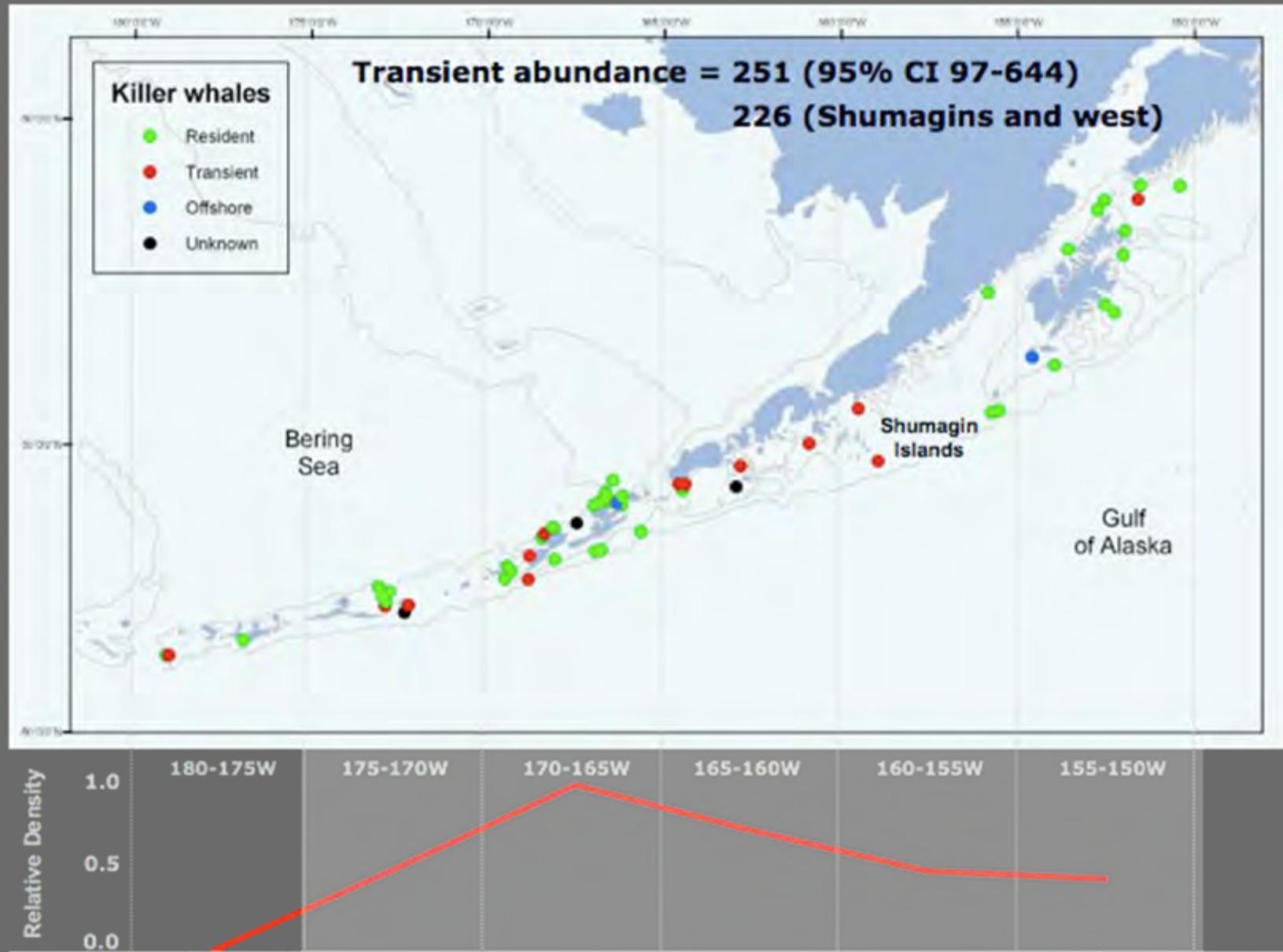
- GAT2
- GAT3

RESIDENT KILLER WHALE genetics

Parsons, Wade et al in prep



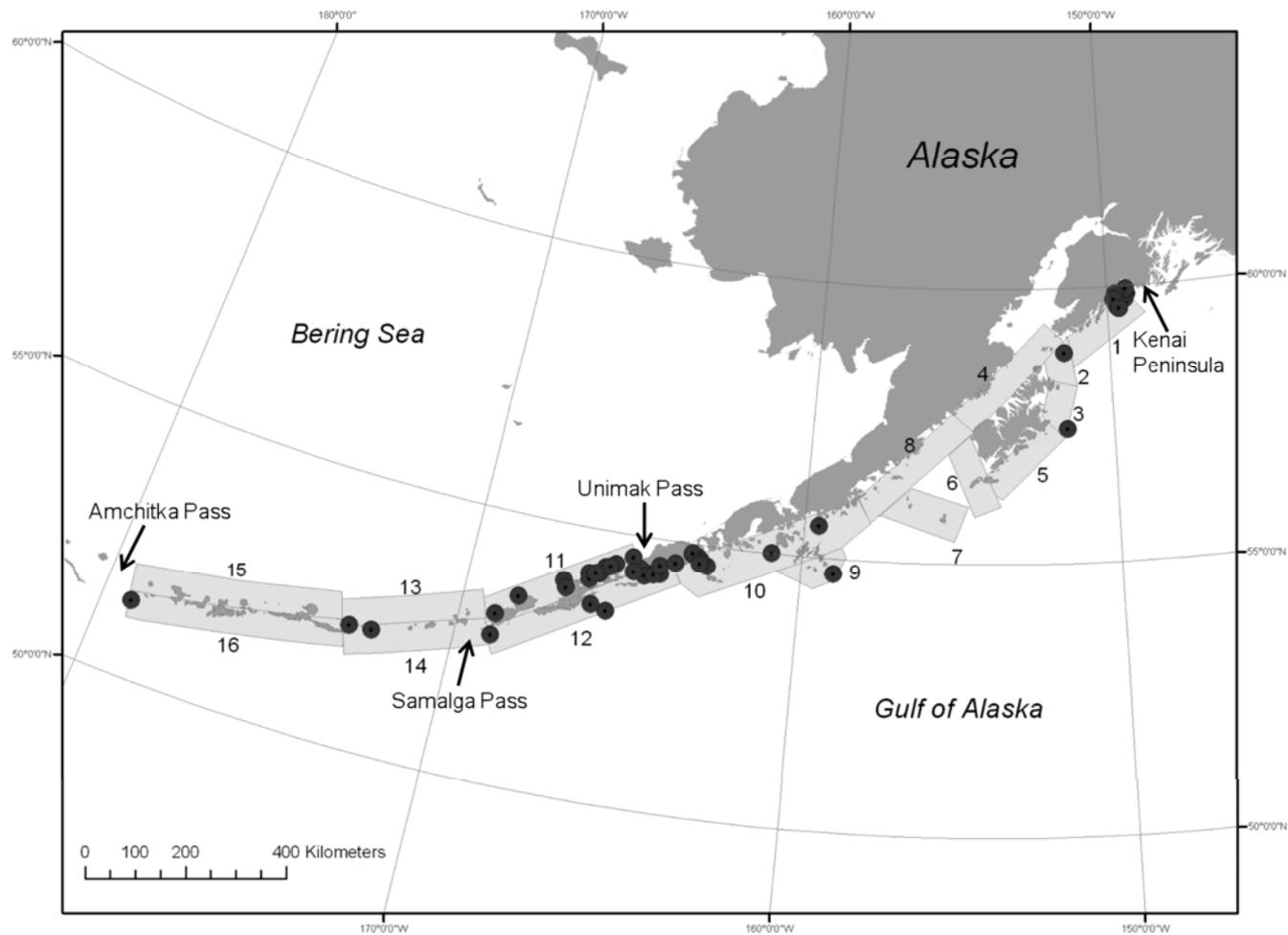
Zerbini et al. 2006. Estimating abundance of killer whales (*Orcinus orca*) in the nearshore waters of the Gulf of Alaska and the Aleutian Islands using line transect sampling





Notches in the dorsal fin (a) were considered primary markings that could be used to uniquely identify individuals. Secondary markings such as oval scars (a and b), saddle patch pigmentation patterns (c), linear scars on the saddle patch (c), and variation in dorsal fin shape (a,b,c) were used in combination to identify individuals. Some individuals were not deemed to be sufficiently distinctive for long-term matches (d), but subtle secondary markings allowed them to be distinguished within the group.

Model with clustered recaptures



Transient abundance using same area, 2001 to 2003 ~ 370 (283-515)

Mark-recapture abundance estimate of transient killer whales (Durban et al. accepted Marine Biology)

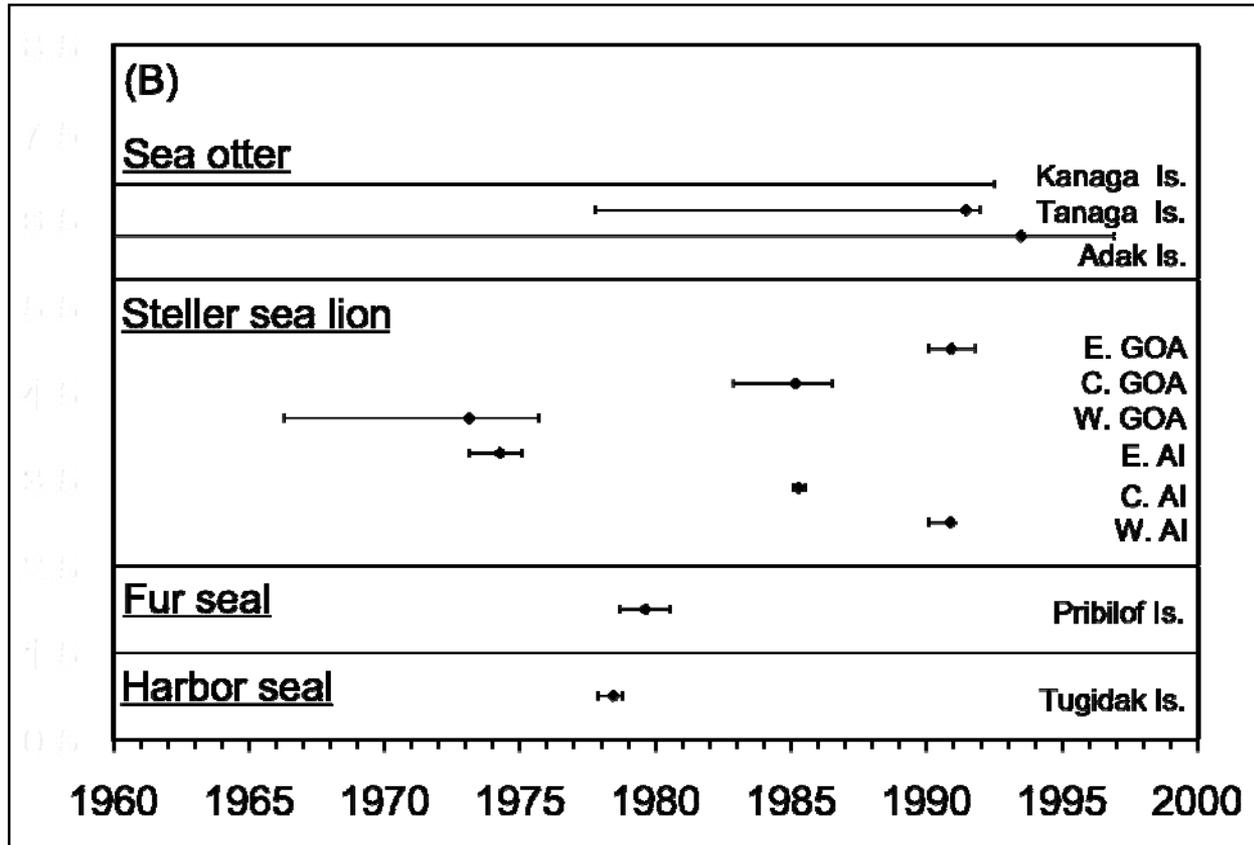
- Mark-recapture estimate: 370 (283-515)
- Line-transect estimate: 251 (97-644)
- Different interpretation
 - M-R is an estimate of all whales using the area rather than just the number of whales in the area during the survey
 - Also, M-R includes 59 individuals only seen on the spring False Pass survey (52 of which were not seen on any other survey)
- Abundance of fish-eating killer whales much higher (joint catalogue between NMML and NGOS > 2000 whales)

Impact on Steller sea lions?

- From abundance estimates, observed % prey, and energetic calculations, killer whale predation is estimated to account for 40-80% of the natural mortality of Steller sea lions
- Killer whales would not cause a decline of Steller sea lions under these assumptions
- We get very similar numbers for Southeast Alaska, where Steller sea lions have been increasing for decades
- Much more work to be done to get a better understanding of the impact of killer whale predation

Wade, Ver Hoef and DeMaster 2009. Mammal-eating killer whales and their prey – trend data for pinnipeds and sea otters in the North Pacific Ocean do not support the sequential megafaunal collapse hypothesis

Marine Mammal Science 25: 737–747



Steller sea lions
Ugamak Island, Unimak Pass



Photo by M. Whisman/P. Adams (NMML)



Photo by M. Whisman/P. Adams (NMML)

Predation on northern fur seals



Photo by J. Waite (NMML)



Photo by D. Ellifrit (NGOS)



Minke whale
west of Kodiak Island,
GOA

Photos by D. Ellifrit (NMML)

Minke whale, south side of Unimak Island



Photos by D. Ellifrit (NMML)



Photos by D. Ellifrit (NMML)

NOAA/NMML photo (D. Ellifrit)

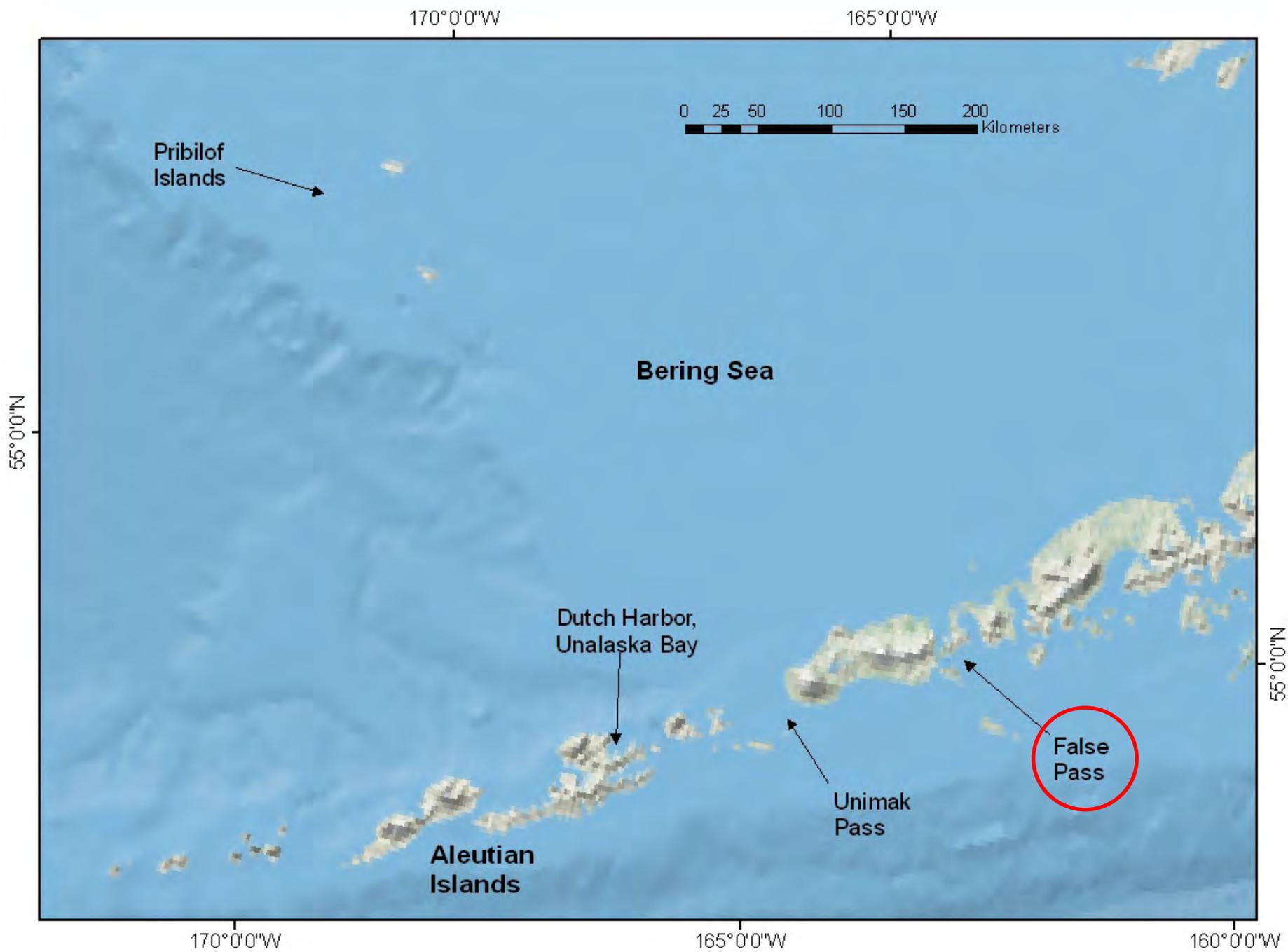


Photos by D. Ellifrit (NMML)

Dall's porpoise



R. Baird photo



Gray whale



Photos by D. Ellifrit (NGOS)

Matkin, Barrett-Lennard, Yurk, Ellifrit, Trites 2007 Ecotypic variation and predatory behavior among killer whales (*Orcinus orca*) off the eastern Aleutian Islands, Alaska. Fish. Bull. 105:74–87 2007

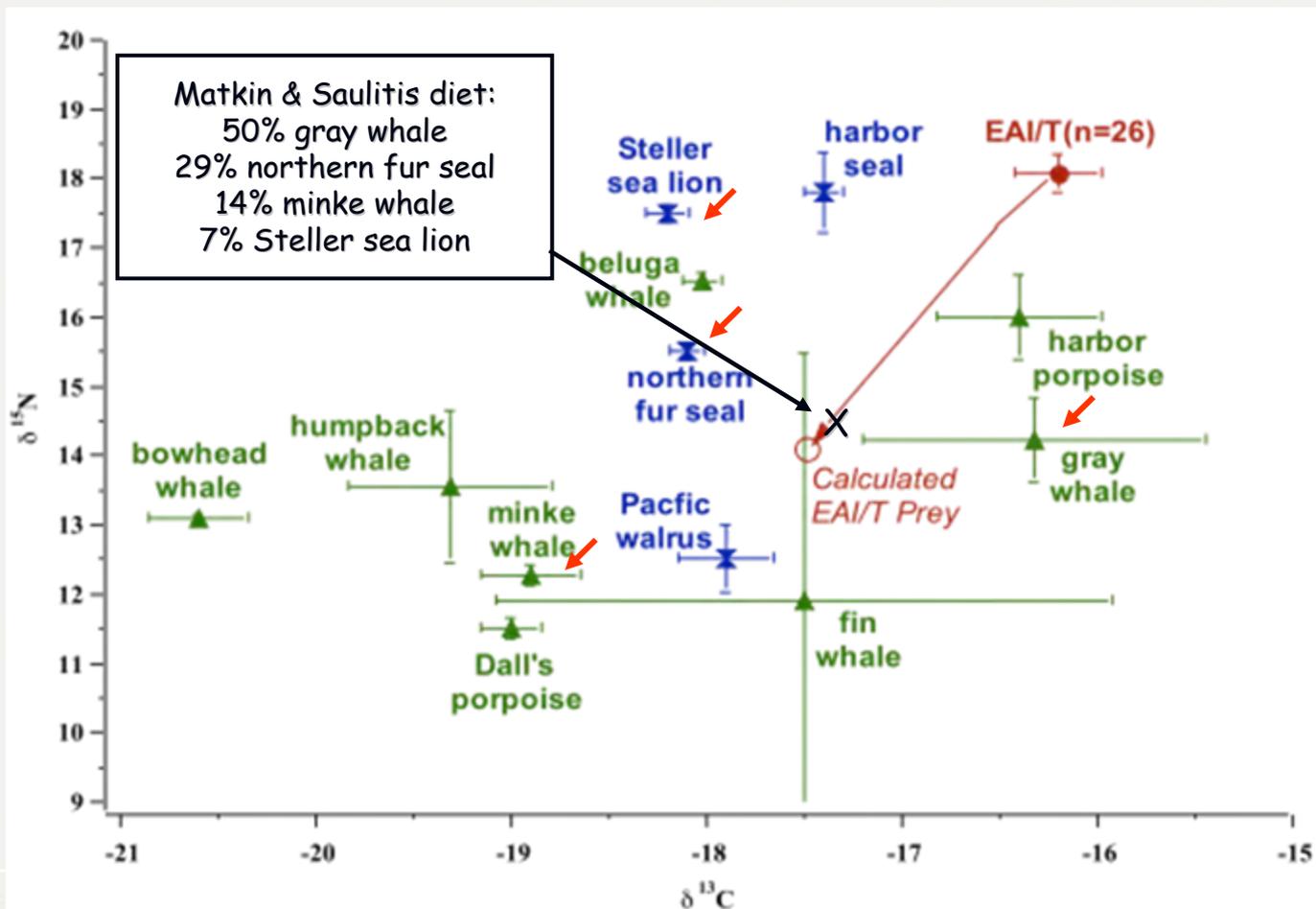
- Identified 114 transient killer whales in False Pass in spring (2001-2004)
 - Preying exclusively on calf/juvenile gray whales on migration
 - Great majority of these whales are not seen in this area in summer

- Identified 51 transient killer whales in the eastern Aleutians in summer (with only 6 whales also seen in False Pass)
 - Preying on:
 - 57% N. fur seals
 - 29% minke whale
 - 14% Steller sea lion
 - Attacks on Dall's porpoise also seen

NMML/NMFS prey observations June-August

Species	% predation observations	% predation (w/ gray whale carcass)
Northern fur seal	57%	50%
Minke whale	14%	13%
Dall's porpoise	14%	13%
Gray whales	7%	19%
Steller sea lion	7%	6%

Comparison of stable isotope values of eastern Aleutian Islands transient killer whales with predicted value from visual observations of predation

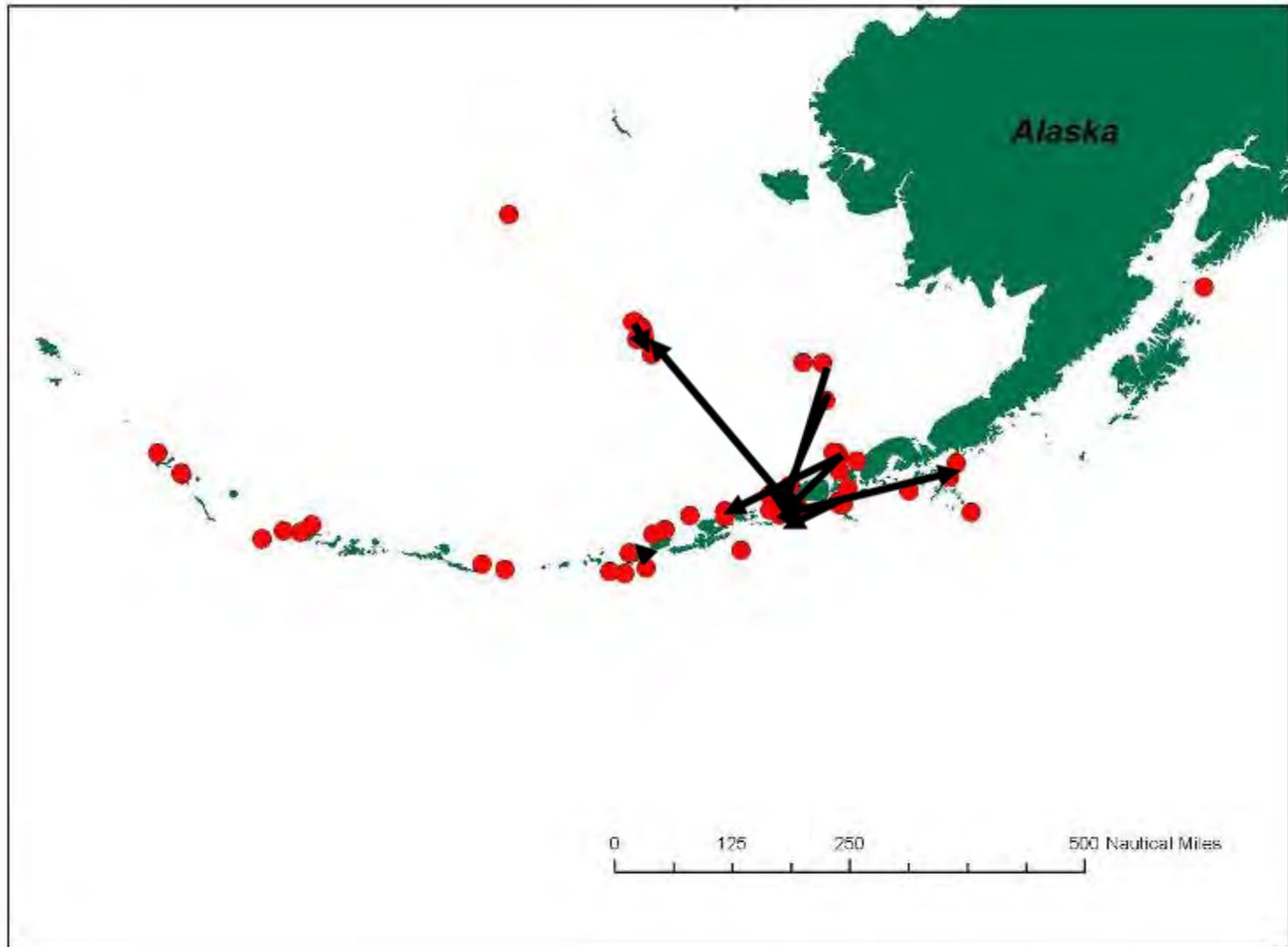


Krahn et al. 2007. Use of chemical profiles in assessing the feeding ecology of eastern North Pacific killer whales. *Marine Environmental Research*. 63:91–114.

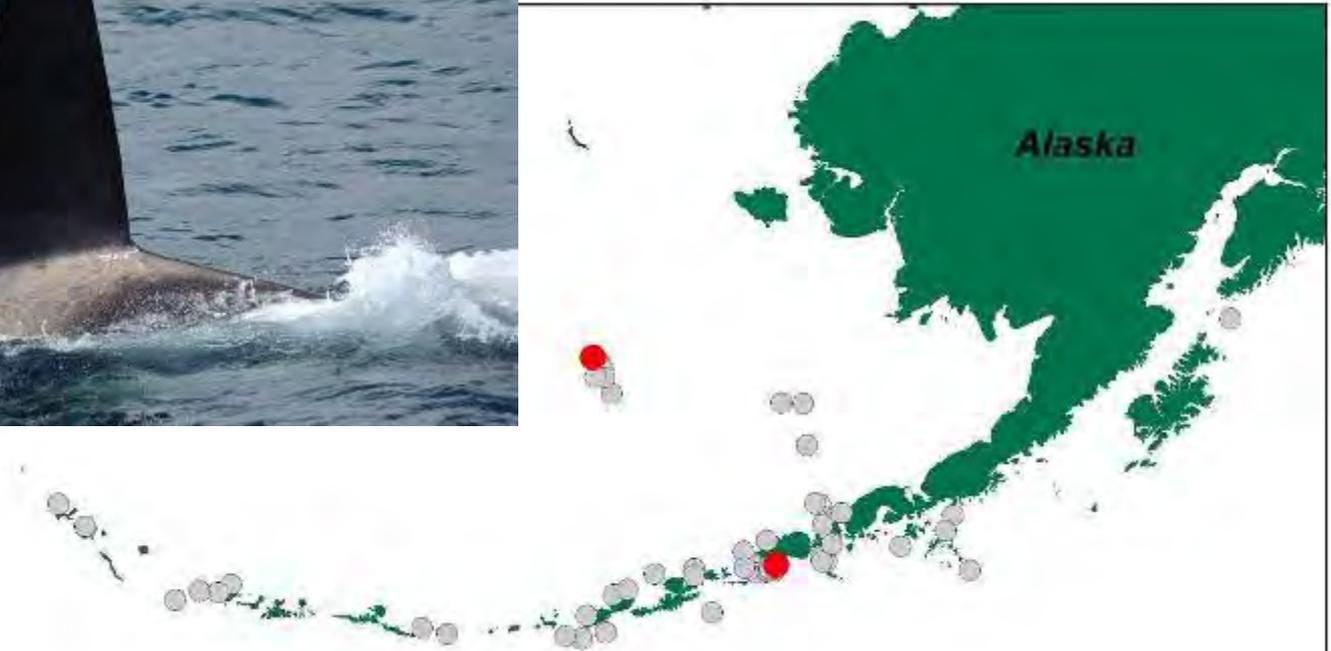


- Overall, Steller sea lions are not a dominant component of transient killer whale diet (consistent with observations that SSLs are ~7% of diet)

Movements of transients from photo-identification matches



Match from Unimak Island area to Pribilofs



- Seen in Unimak Island region in multiple years, including False Pass
- Seen July 2003 in Pribilof Islands killing a fur seal

Joint results from NMML and Ngos photo-identification studies

- Total of 67 individual transients have been seen around the Pribilofs
- 15 of these individuals have been seen in the Aleutians
 - 2 at Bogoslov Island (another fur seal rookery with sea lions as well)
 - 5 in the same group in Samalga Pass
 - 8 (in two groups) have been seen in the False Pass area

Killer Whale Satellite Tagging



2006 Satellite tagging from NMML Survey

Aleutian transient transitions!

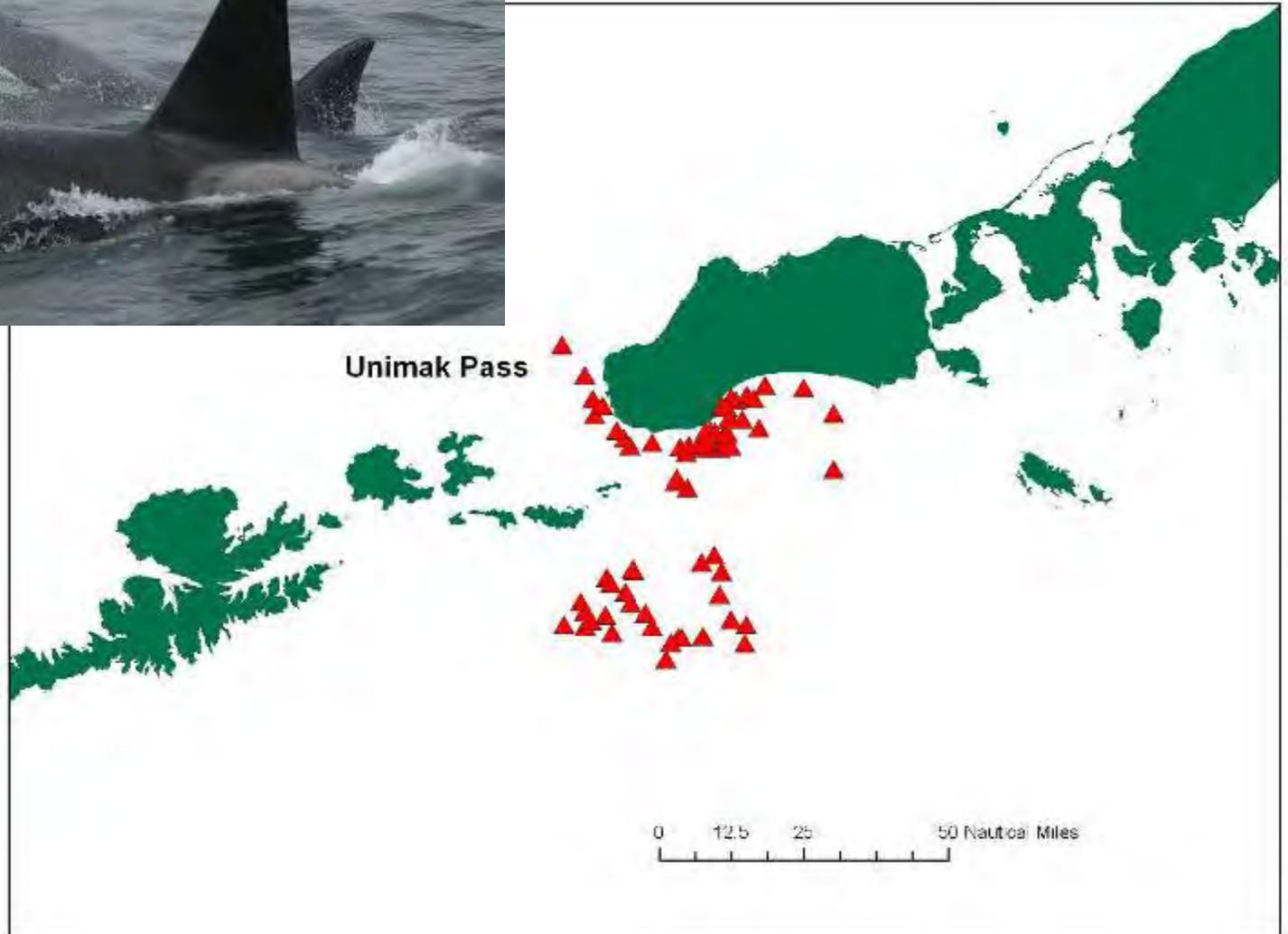


Durban (NMML), Andrews (ASLC) and Matkin (NGOS). Unpublished Data.

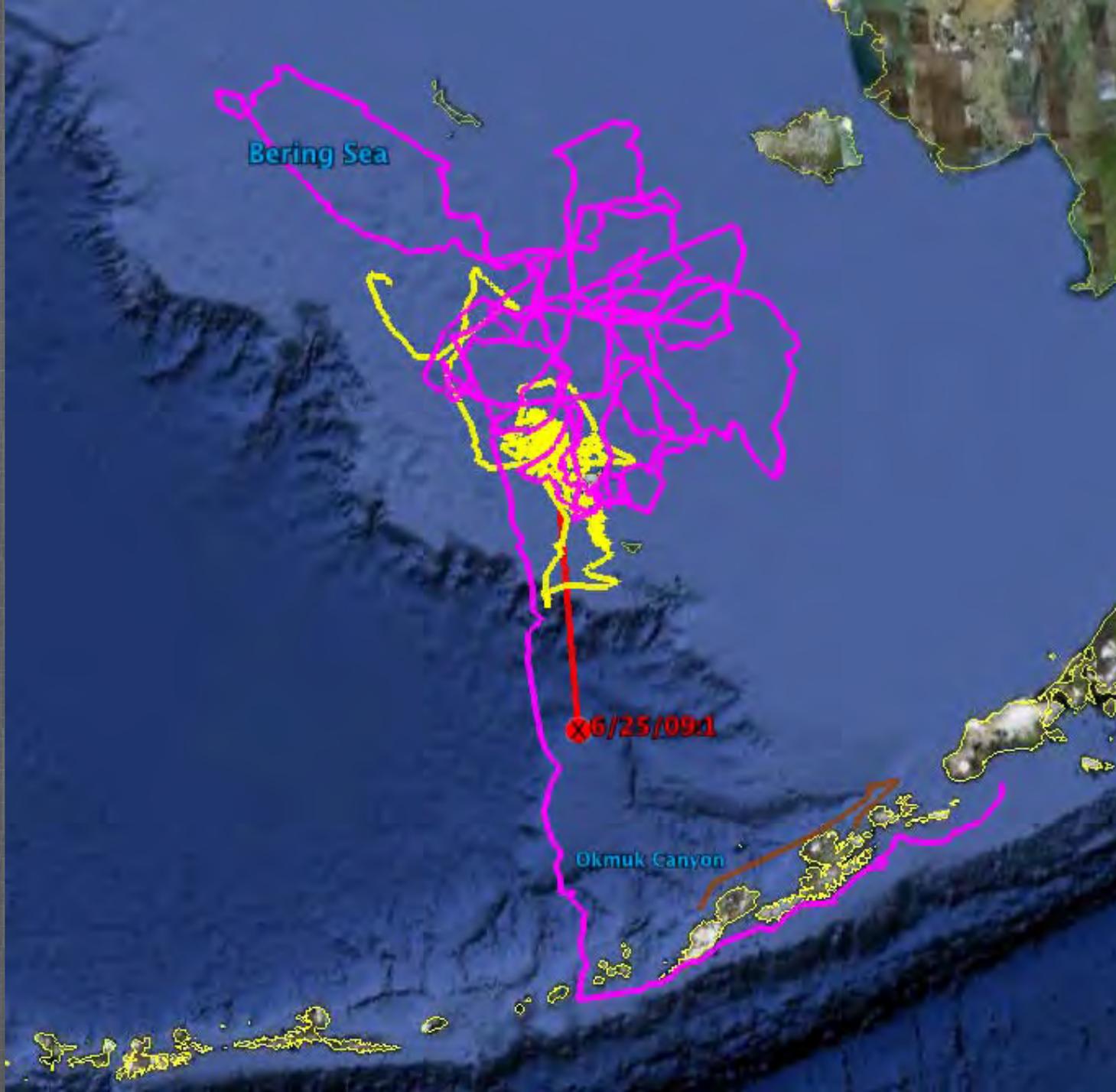
2007 Satellite tagging from NMML Survey (red)



*2006 from NMML Survey
Mid-June to Mid-August*



Durban (NMML), Andrews (ASLC) and Matkin (NGOS). Unpublished Data.



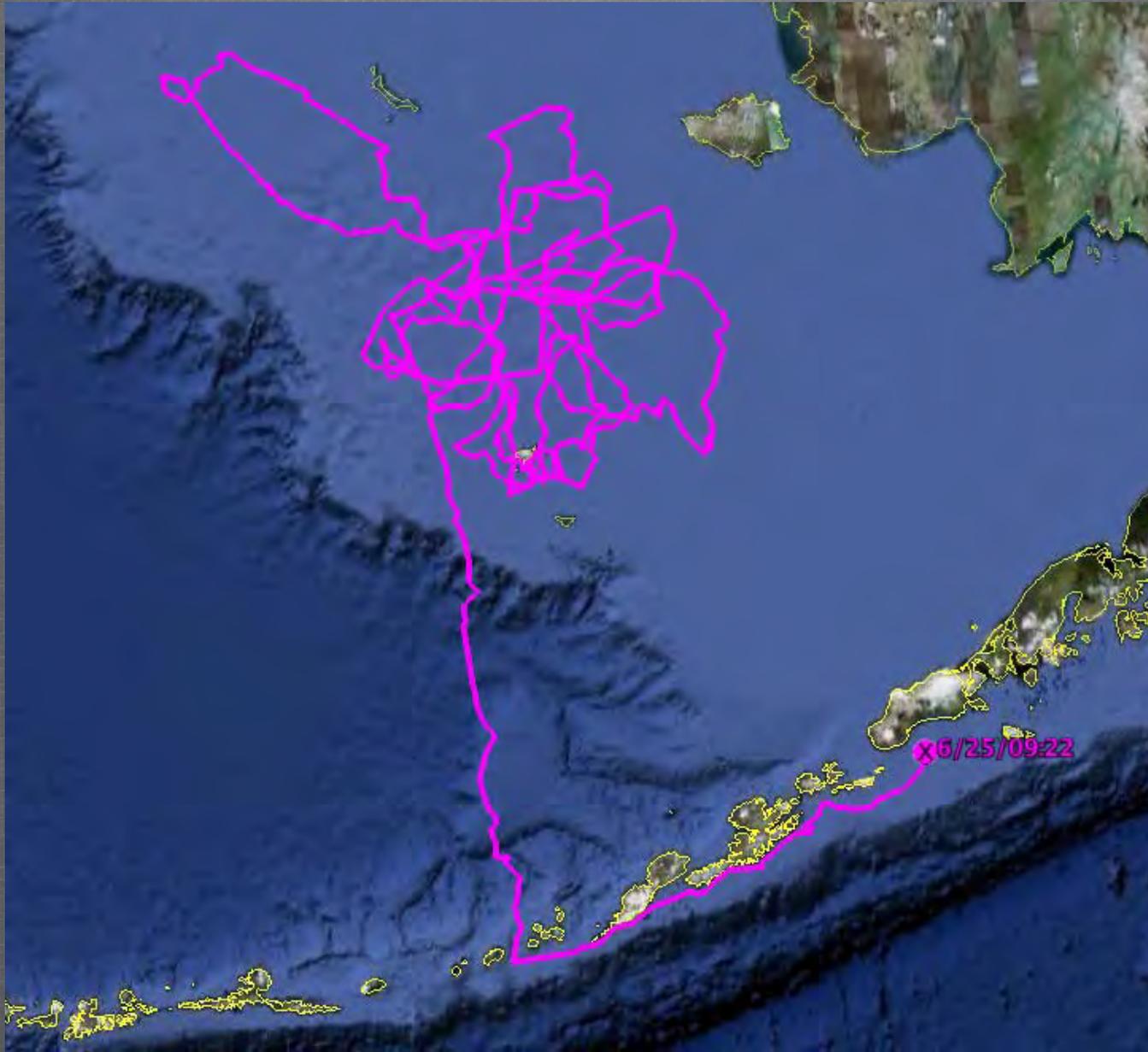
Bering Sea

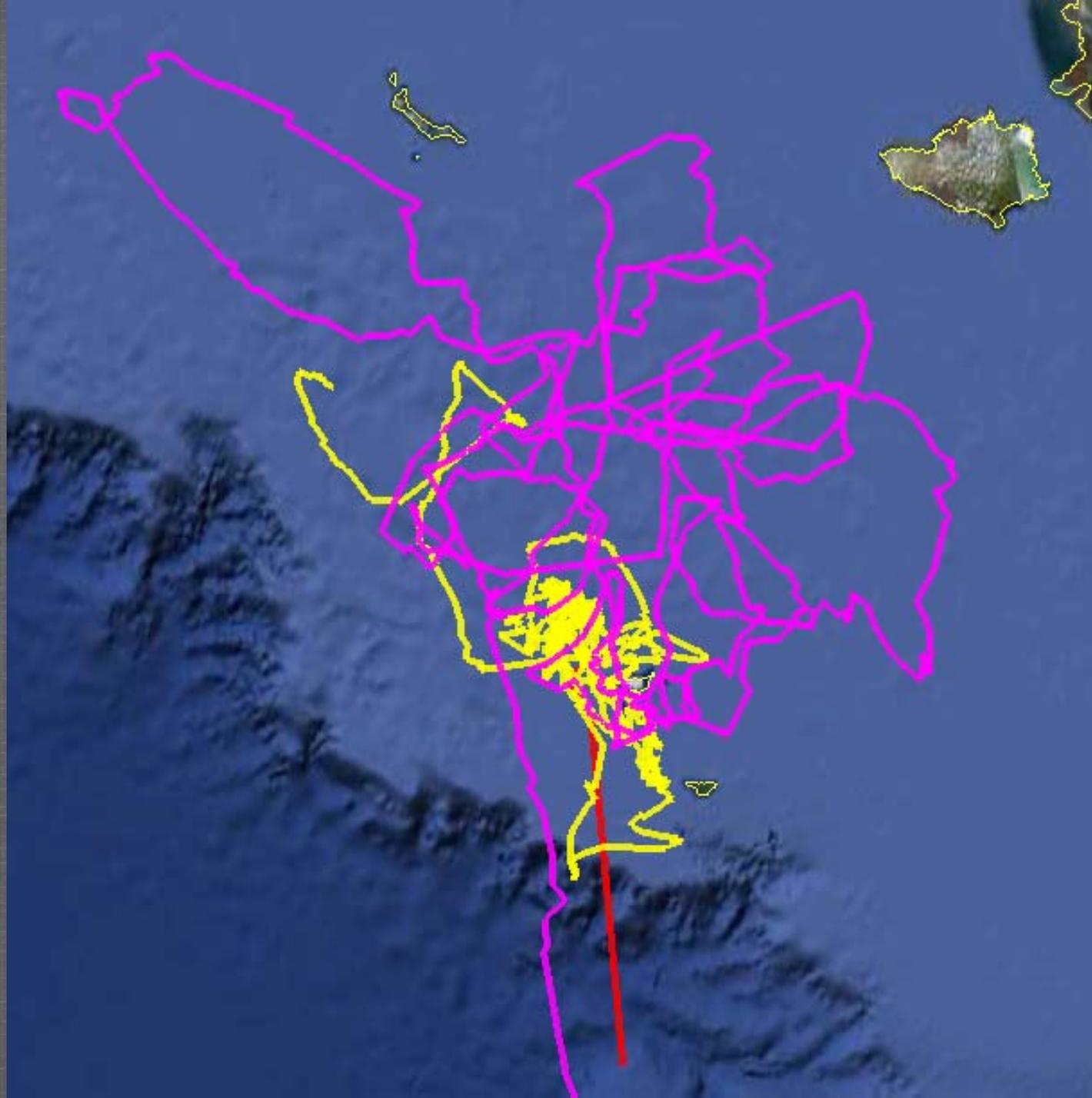
6/25/091

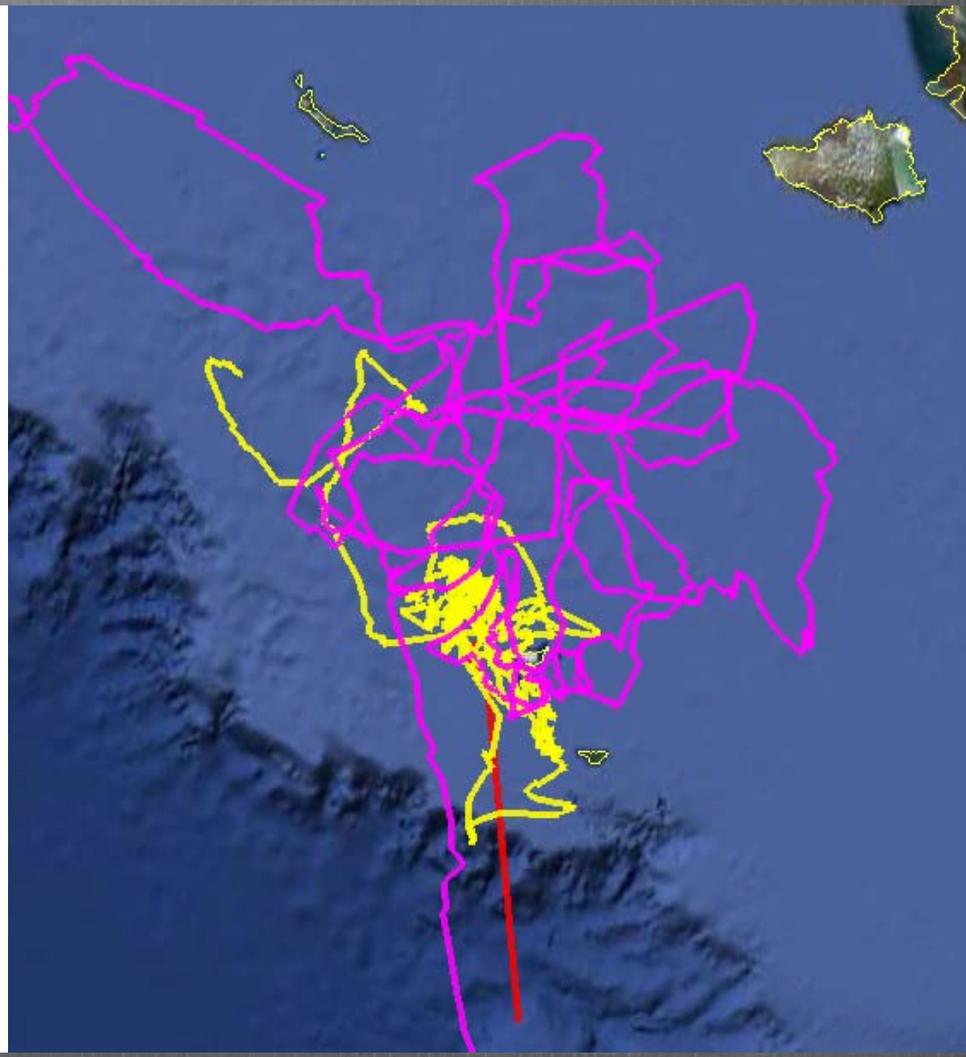
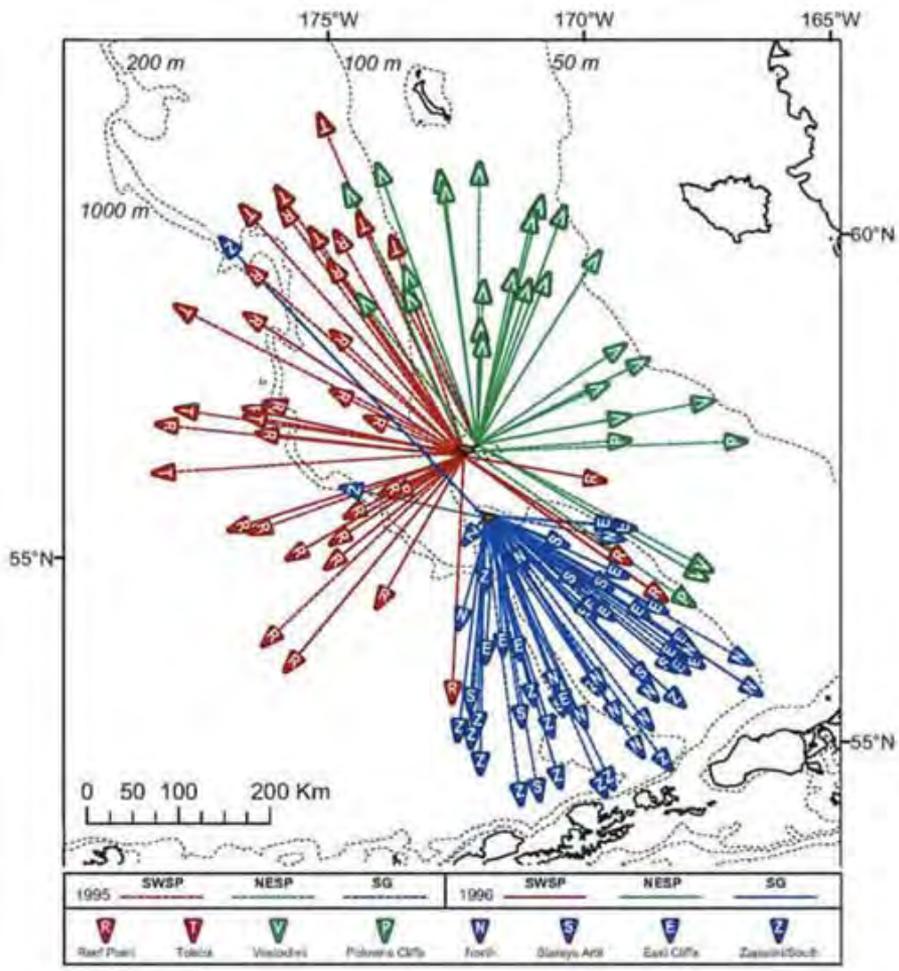
Okmuk Canyon



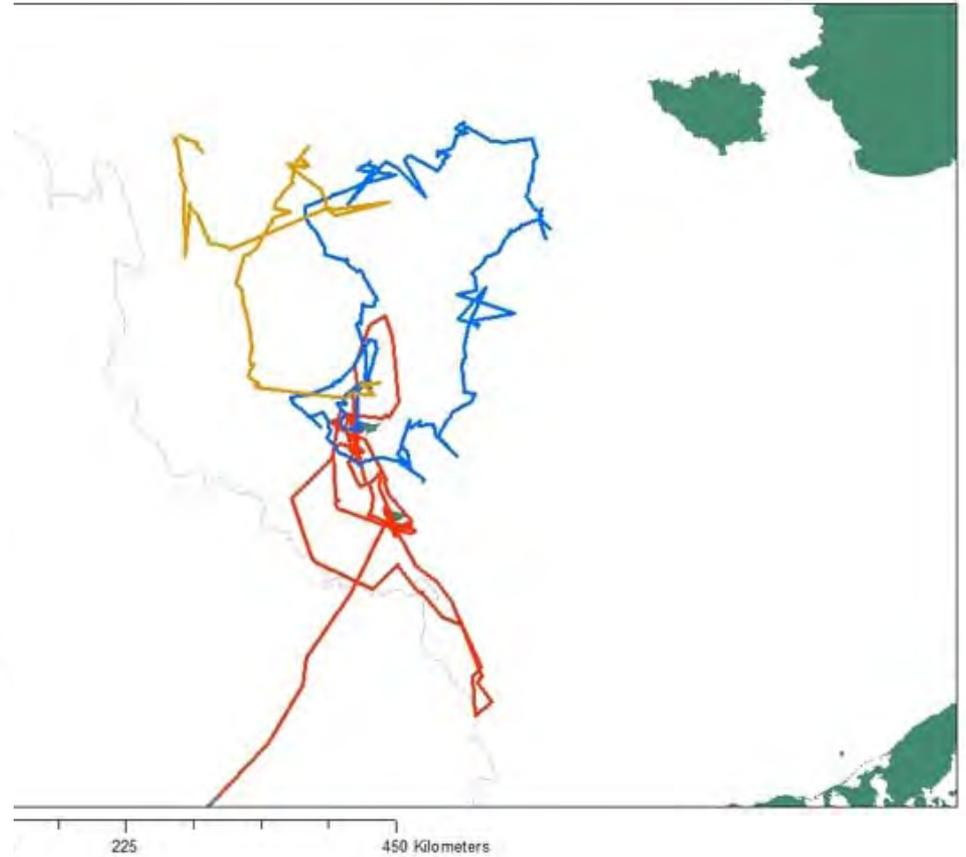
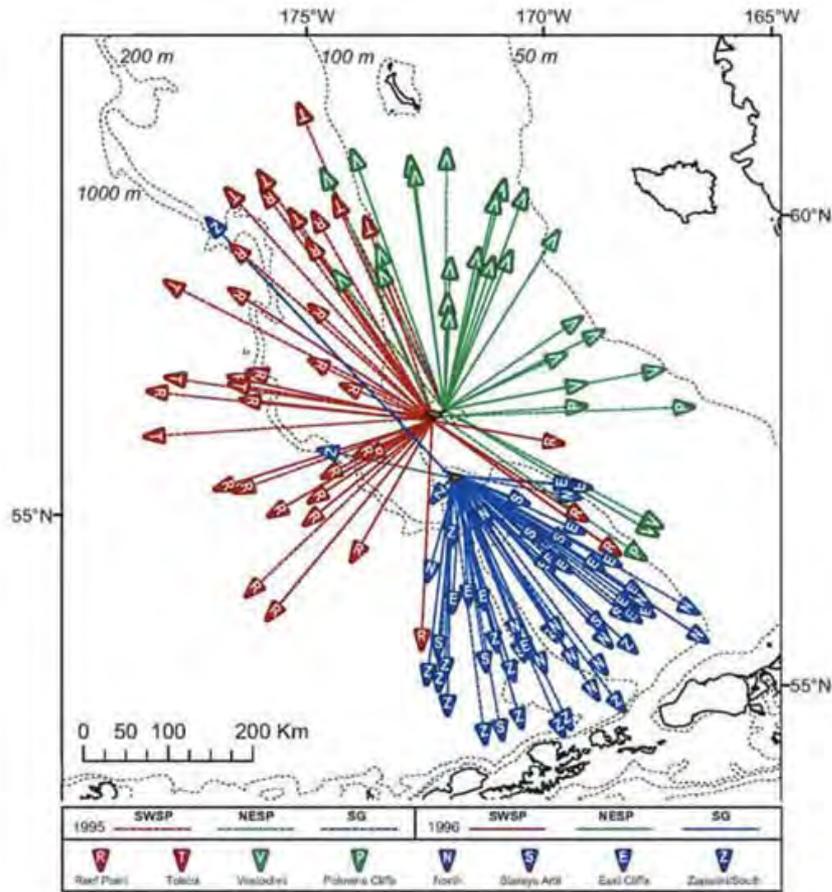
Adult female tagged 6/29/08 on a gray whale carcass south of Unimak Island







Satellite tag tracks of transient killer whales



Is predation on fur seals a new thing?

Birds and mammals of the pribilof Islands (Preble and McAtee 1923)

- “Killer whales are often seen around the Pribilof Islands and prey on seals and sea lions, both young and old”
- “A large school of killers was seen near East Landing on October 21, 1875, and 5 near the same place on Sept. 21, 1891; 1 seen of Reef Rookery on Dec. 2 1902, was playing havoc with a band of seals.”
- These records indicate that killer whales are by no means uncommon about the Pribilofs. The stomachs of two killers examined by Captain Bryant [in 1899] contained, respectively, 18 and 24 seal pups”
- “The fall visit of the animals coincides with the period when the young seal pups are learning how to swim, and it is upon them that the greatest damage is wrought. At times, however, they have been seen to capture older animals. In the spring of 1917 a school of them maintained a stand between St. Paul Island and SeaLion Rock, and for more than a week succeeded in capturing or driving away practically every seal....”

Considered a threat to the commercial harvest

Killers around the Pribilofs

“..find a means by which the pup seals may be protected from these monsters..”

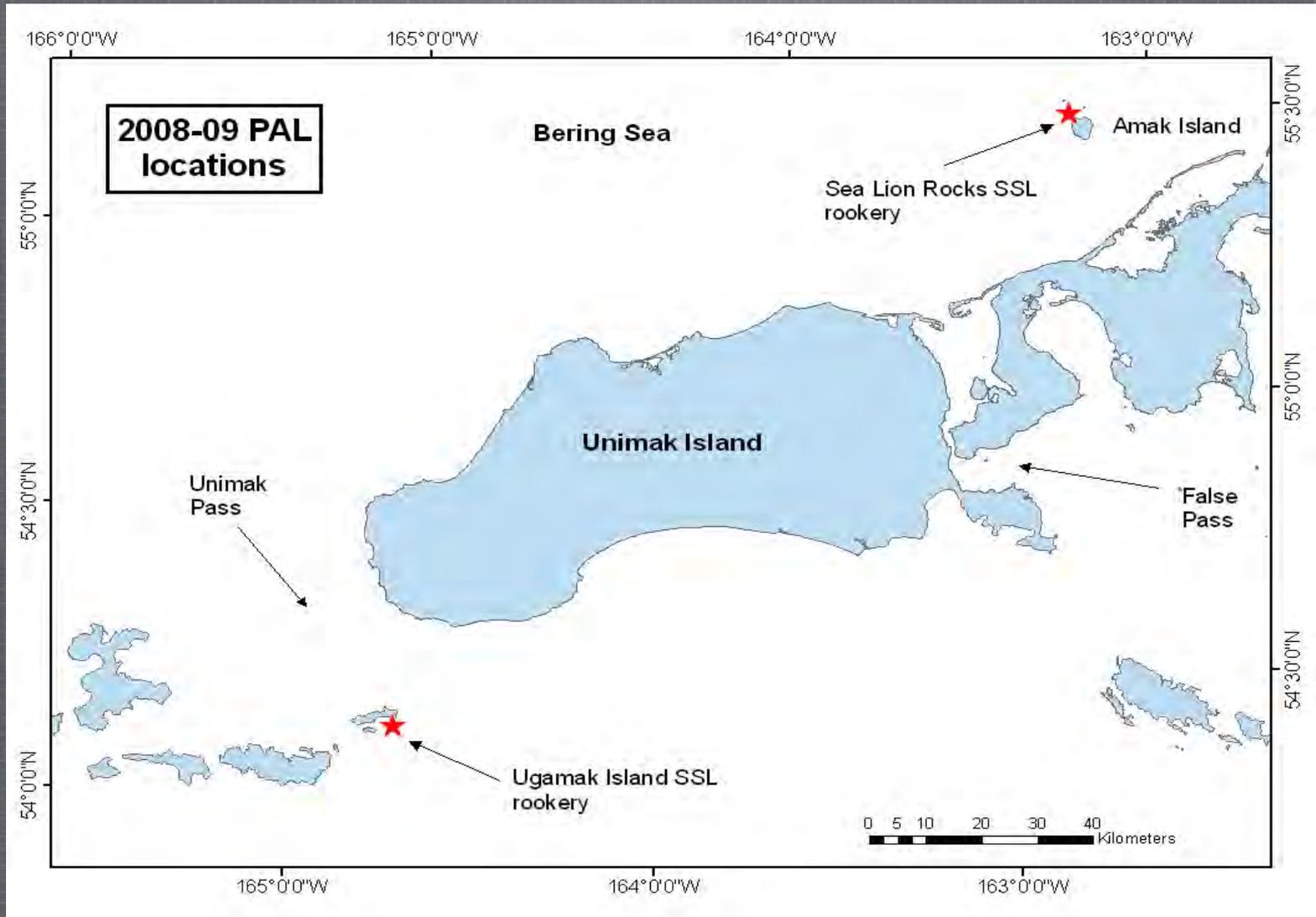
“..bombs, guns, or the Gatling gun would prove very effective”

William Gossitt, 1888

U.S. Treasury agent, Pribilof Islands



Passive Acoustic Recorder (PAL) project collaboration with Dr. Jeff Nystuen Applied Physics Laboratory, University of Washington





PAL recordings

Volker Deeke termed KRaCS: Killing, Ramming and Crushing Sounds

Ugamak
call and
crunch



Ugamak
crunches

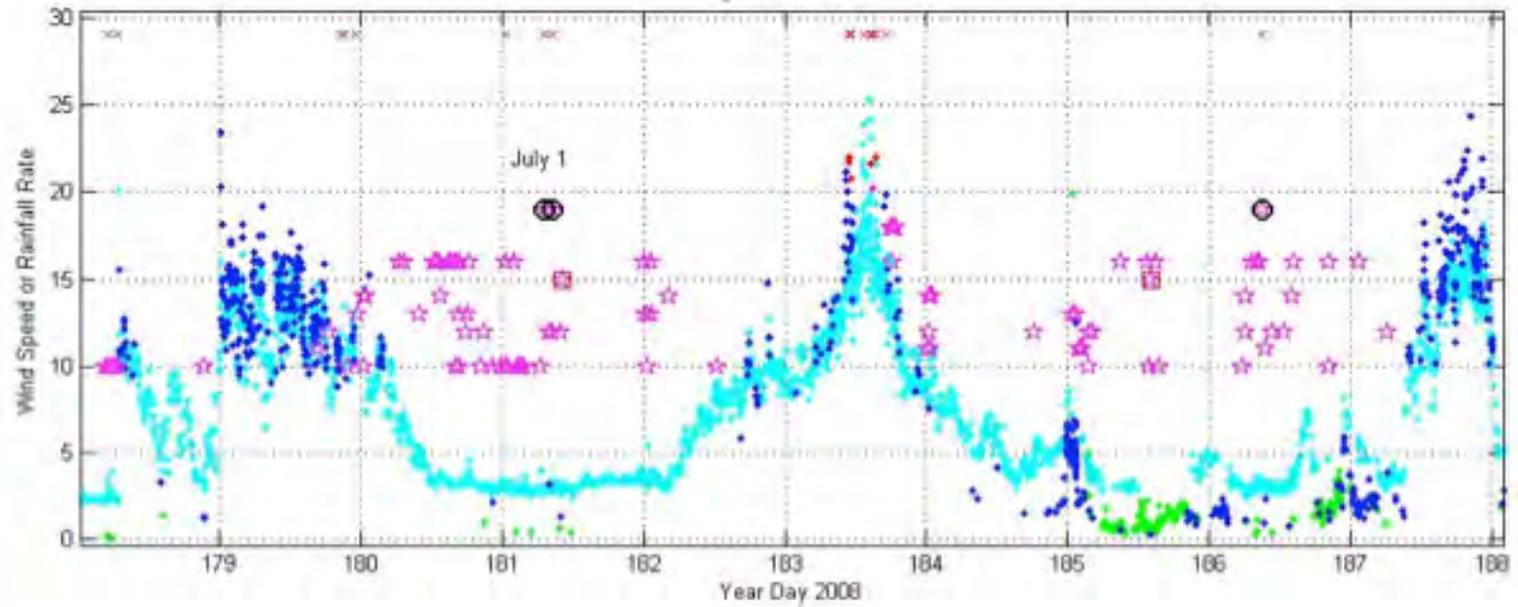


Ugamak
crunches
2

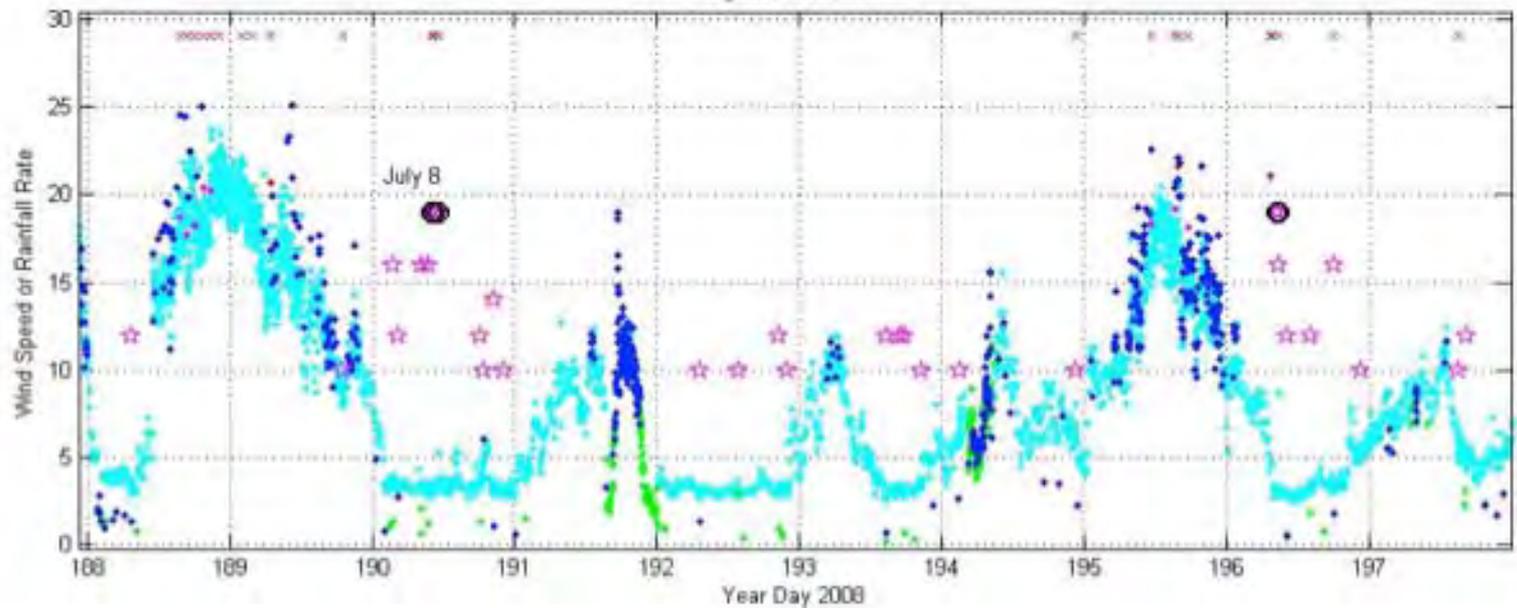


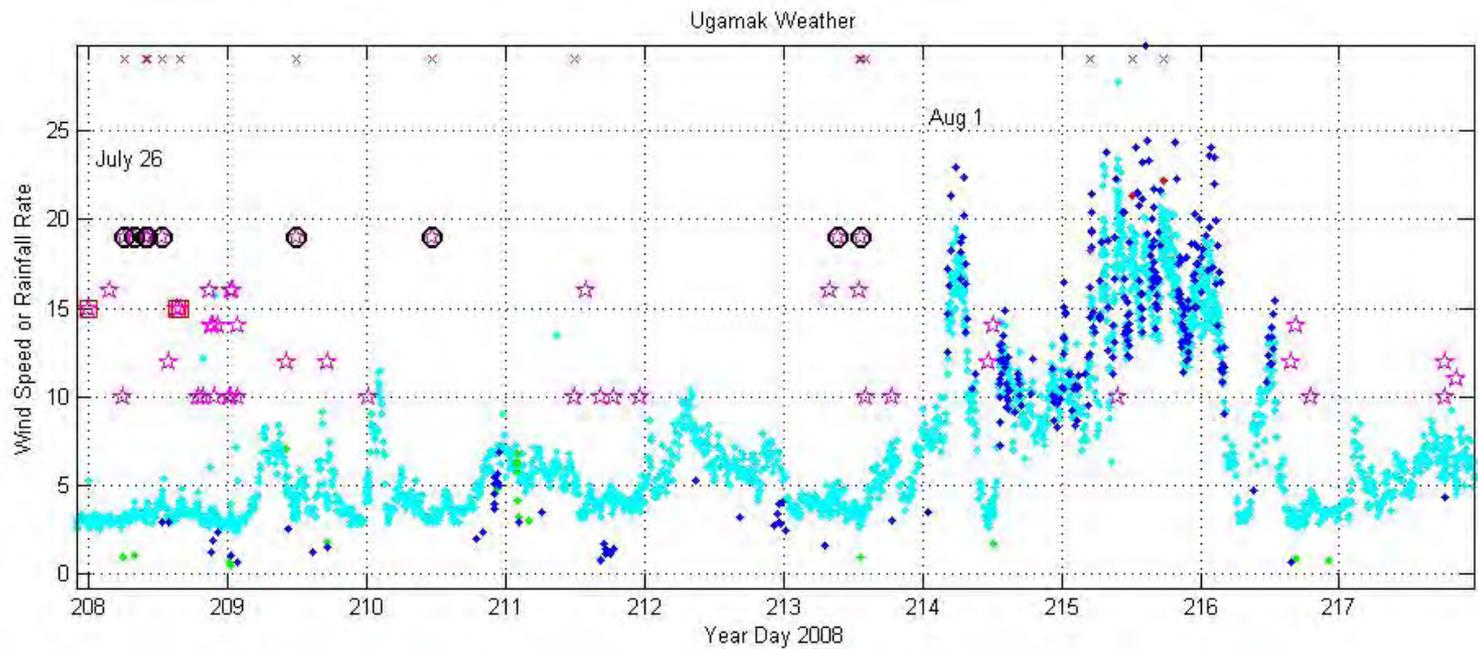
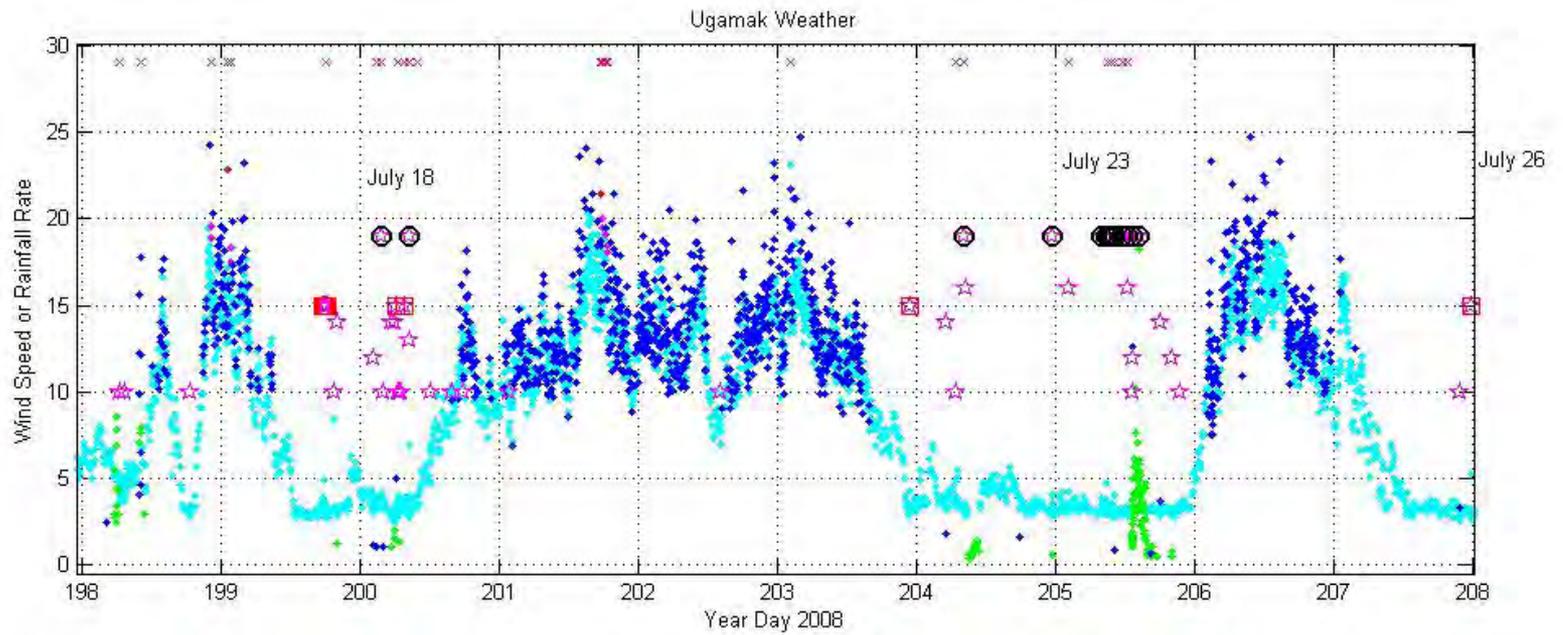
Photo by M. Whisman/P.
Adams (NMML)

Ugamak Weather



Ugamak Weather





PAL deployments to date

- **Ugamak Island**
 - Heard KRACS on 21 days between 6/25/08 and 9/01/08. ~67 days
 - PAL not recovered in 2009 (has data from 9/2008 to ~8/2009)
- **Amak Island**
 - Much fewer KRACS, not fully analyzed
 - June 2008 to June 2009
- **Sugarloaf Rookery in Barren Islands, GOA**
 - July 2008 to August 2009
- **New deployments in summer 2009**
 - Adugak Rookery on the north side of Umnak Island
 - Reef Pt on St. Paul (for fur seal studies)
- **Planned deployments in summer 2010**
 - 2 at Central and Western Aleutian rookeries