Steller sea lion tracking using satellite telemetry in the western/central Aleutian Islands after the 2010 Biological Opinion

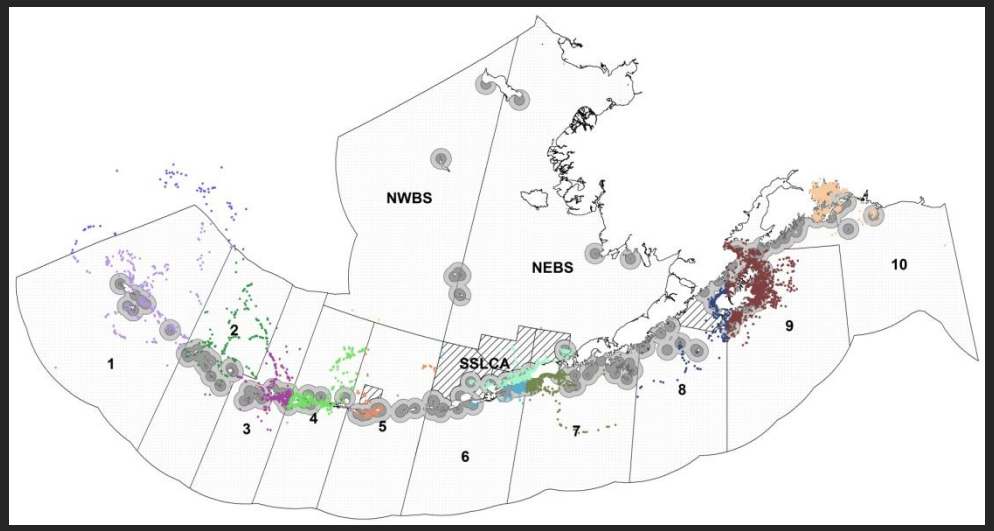
Alaska Ecosystems Program

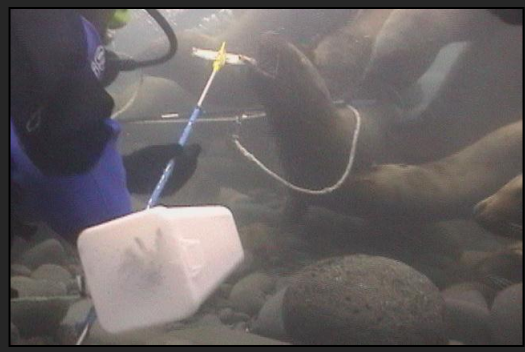
National Marine Mammal Laboratory

NOAA Alaska Fisheries Science Center

Background

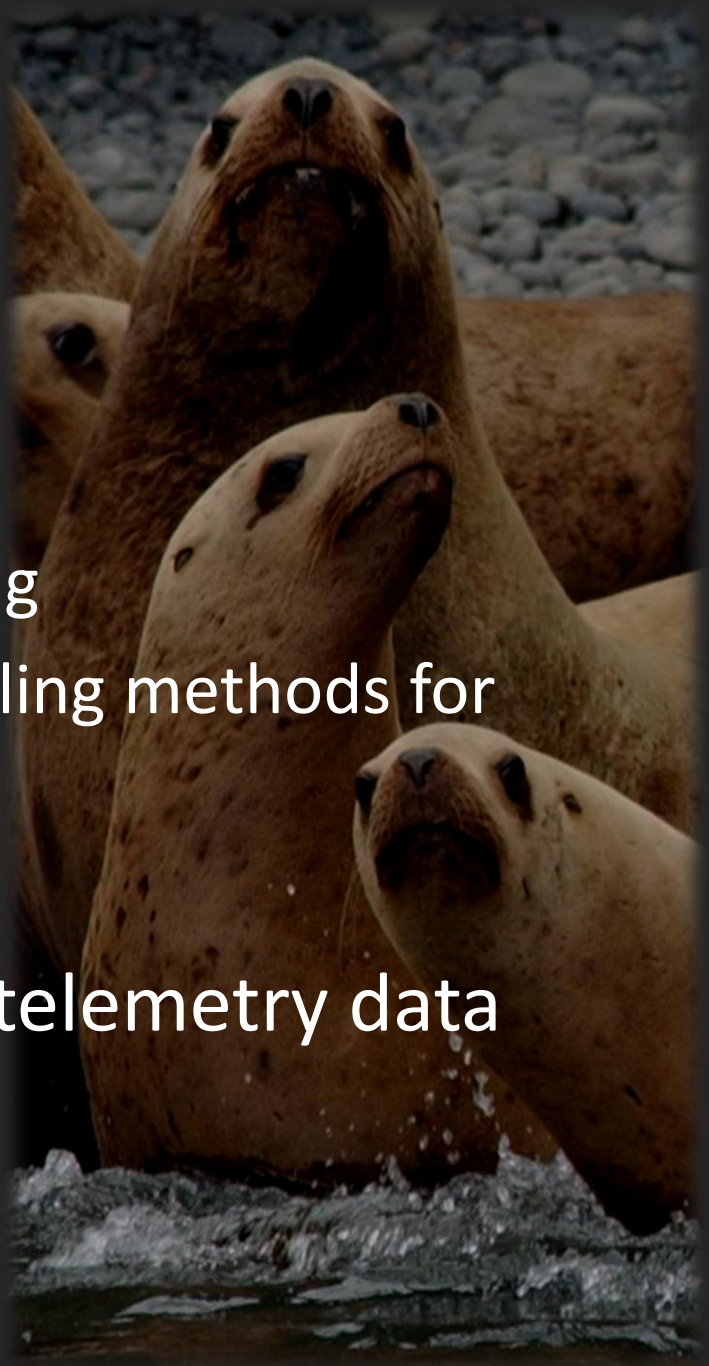
- 2010 BiOp summarized telemetry from 116 juvenile (3-28 months old) sea lions tracked during 2000-2005 throughout the wDPS in Alaska by NMML/ADFG.
- 37 were tracked in the western/central Aleutian Islands (RCAs 1-4).



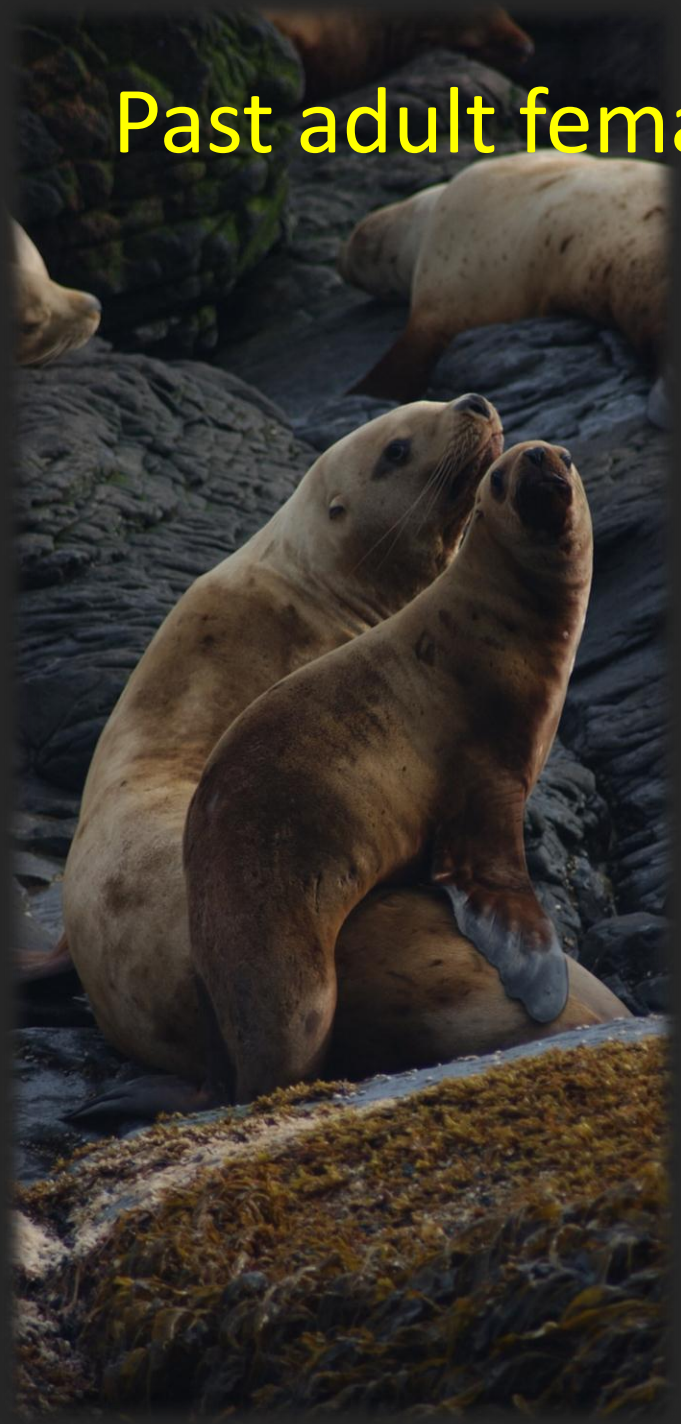


Objectives

- Track adult females
  - population trends and modeling
  - develop safe capture and handling methods for adult females
- Continue analysis of juvenile telemetry data



Past adult female captures - Alaska



Limited options for capture

Drug issues

Permits unobtainable

Adult female captures

Permit issued in mid-2009 allowed some captures; supported by recent work in Russia

Planned pilot project Southeast November 2010

September 2010 - California sea lion study

Medetomidine-midazolam-butorphanol

Low volume! Reversible!

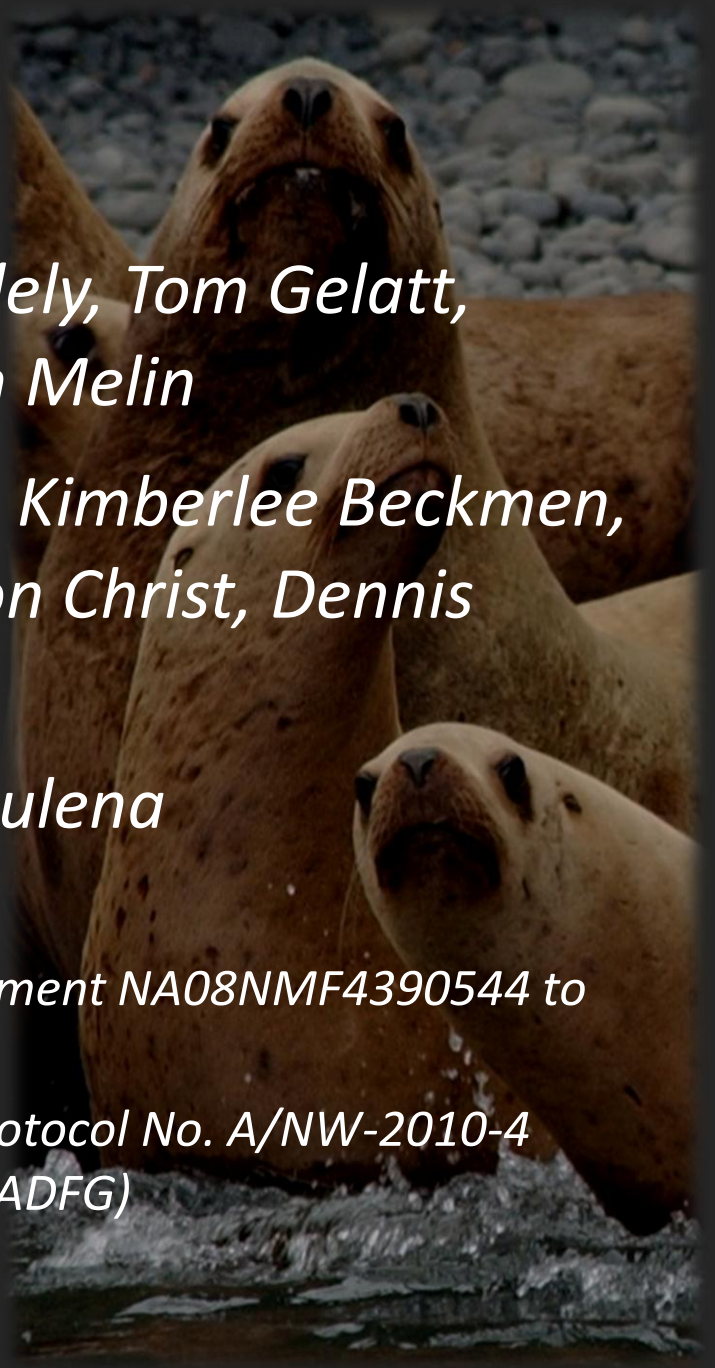
-- quick, amend the permit!!

Adult female captures

- **NMML**: *Michelle Lander, Brian Fadely, Tom Gelatt, Carey Kuhn, Jeremy Sterling, Sharon Melin*
- **ADF&G**: *Lorrie Rea, Mike Rehberg, Kimberlee Beckmen, Greg Snegden, Justin Jenniges, Aaron Christ, Dennis McAllister*
- **Vancouver Aquarium**: *Marty Haulena*

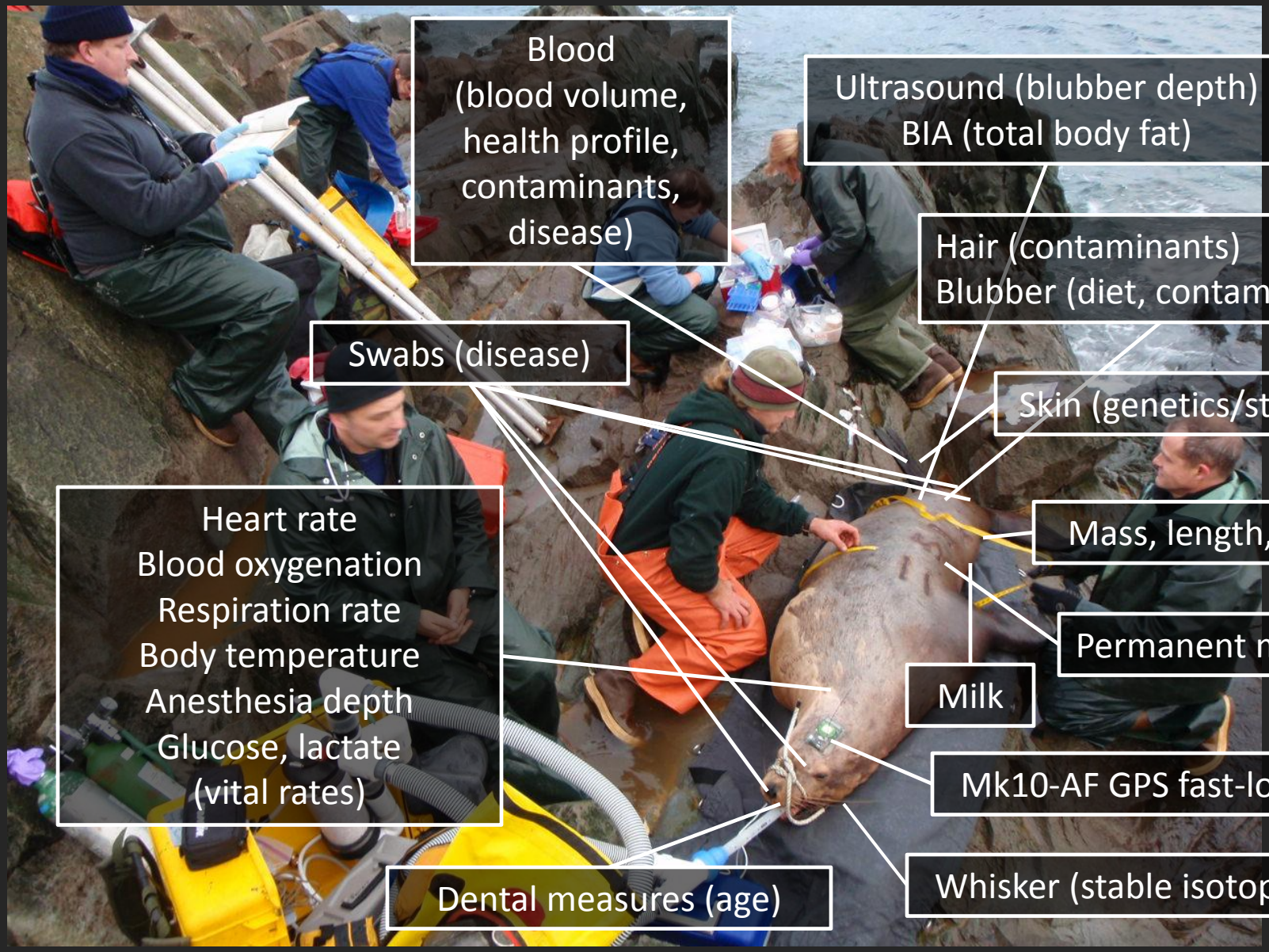
Funding: *NOAA/NMFS, and NOAA Cooperative Agreement NA08NMF4390544 to ADFG SSL Project*

Permits: *14325 (ADFG) and 14326 (NMML), IACUC Protocol No. A/NW-2010-4 (NMML) and ACUC Protocol No. 2010-14R 09-28 (ADFG)*



Adult female captures

Methods - sampling



Adult female captures

- Challenges
  - Weather/access
  - Sea lion distribution
  - Drug: dosage/sedation

Adult female captures-results

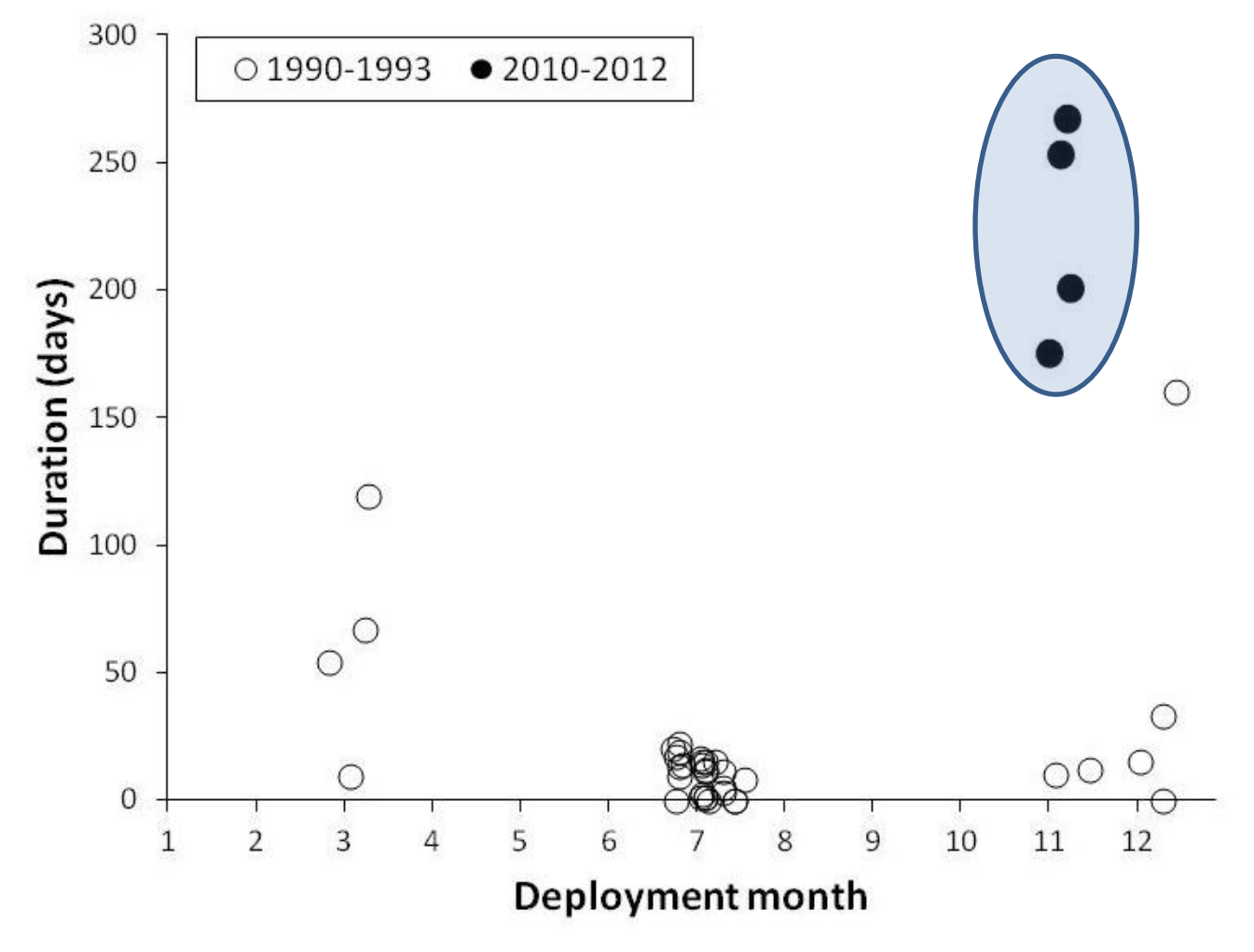
- Southeast Alaska, November 2010
  - 6 darted
  - 3 handled
- Central Aleutian Islands, November 2011
  - 4 darted
  - 1 handled

Results – the ones that got away

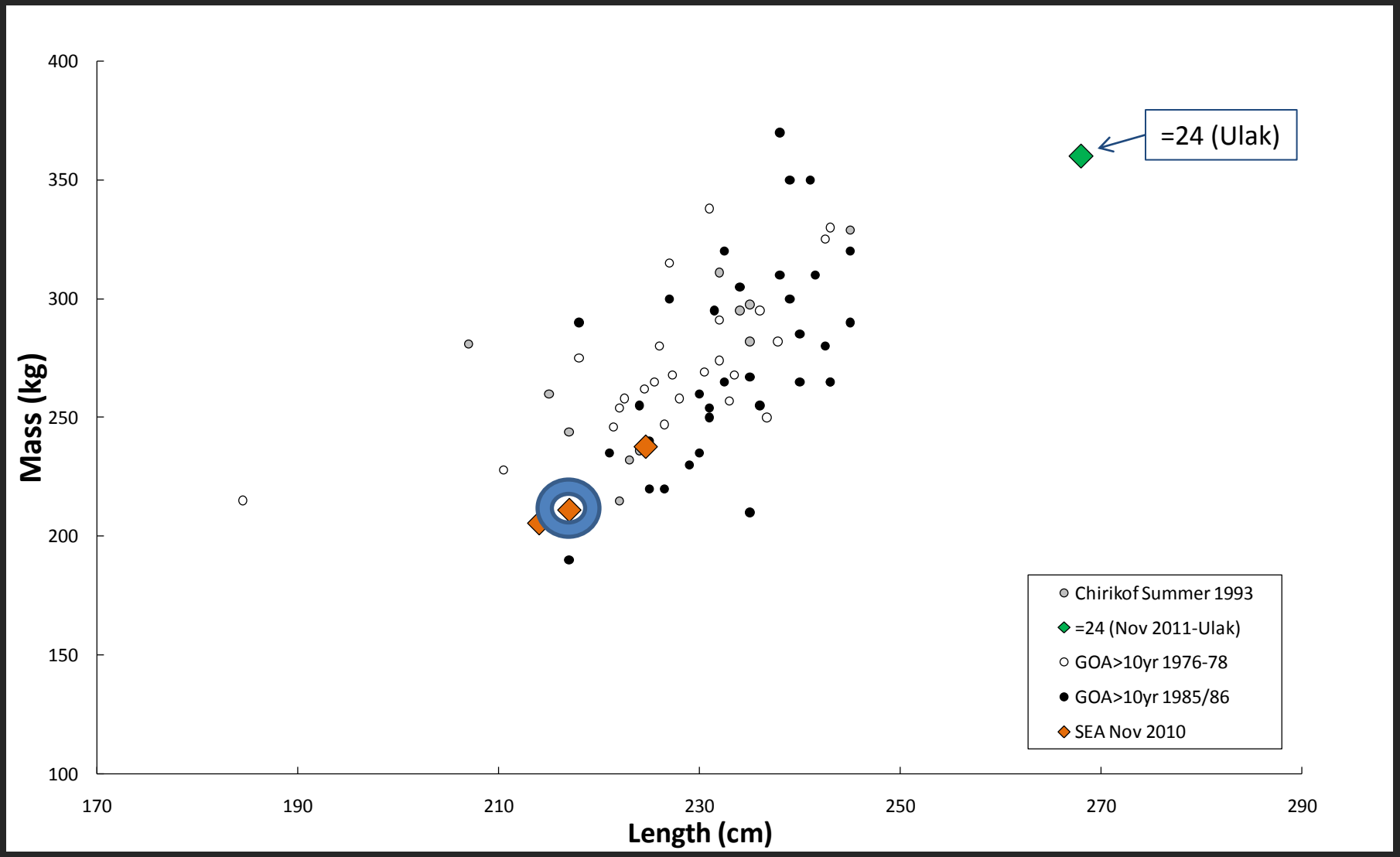
Dated with reversal drugs, observed hauling out

ID	Age	Loc	Mass (kg)	Handling time (hrs)	Tracking time (days)
=22	Adult	SEAK	205.5	1:57	253
=23	Adult	SEAK	211.0	2:33	202
=511	6 yrs	SEAK	237.5	2:27	267
=24	Adult	AI	360.0	1:36	176

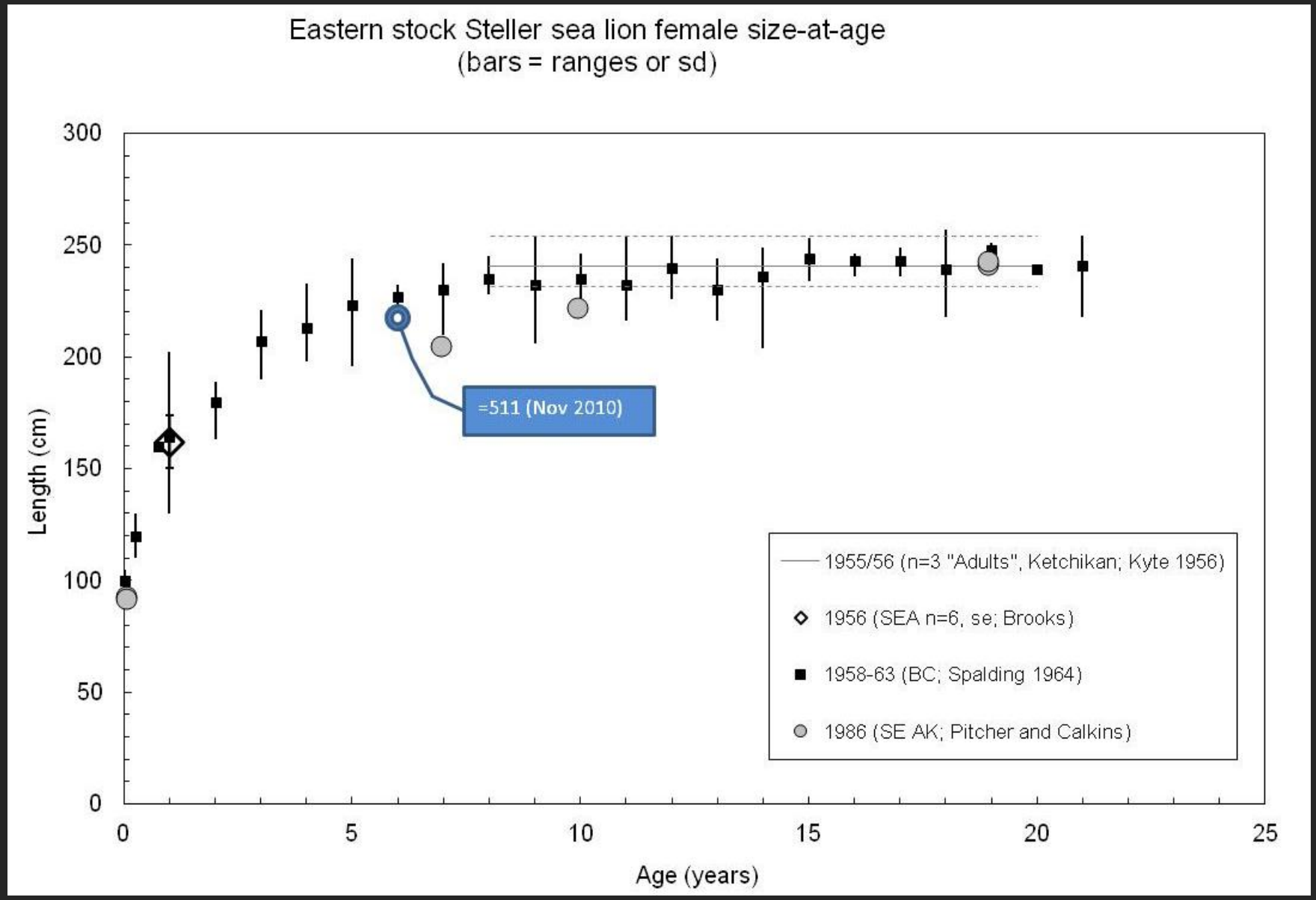
Transmission durations for adult female deployments in Alaska by NMFS/NMML and ADFG



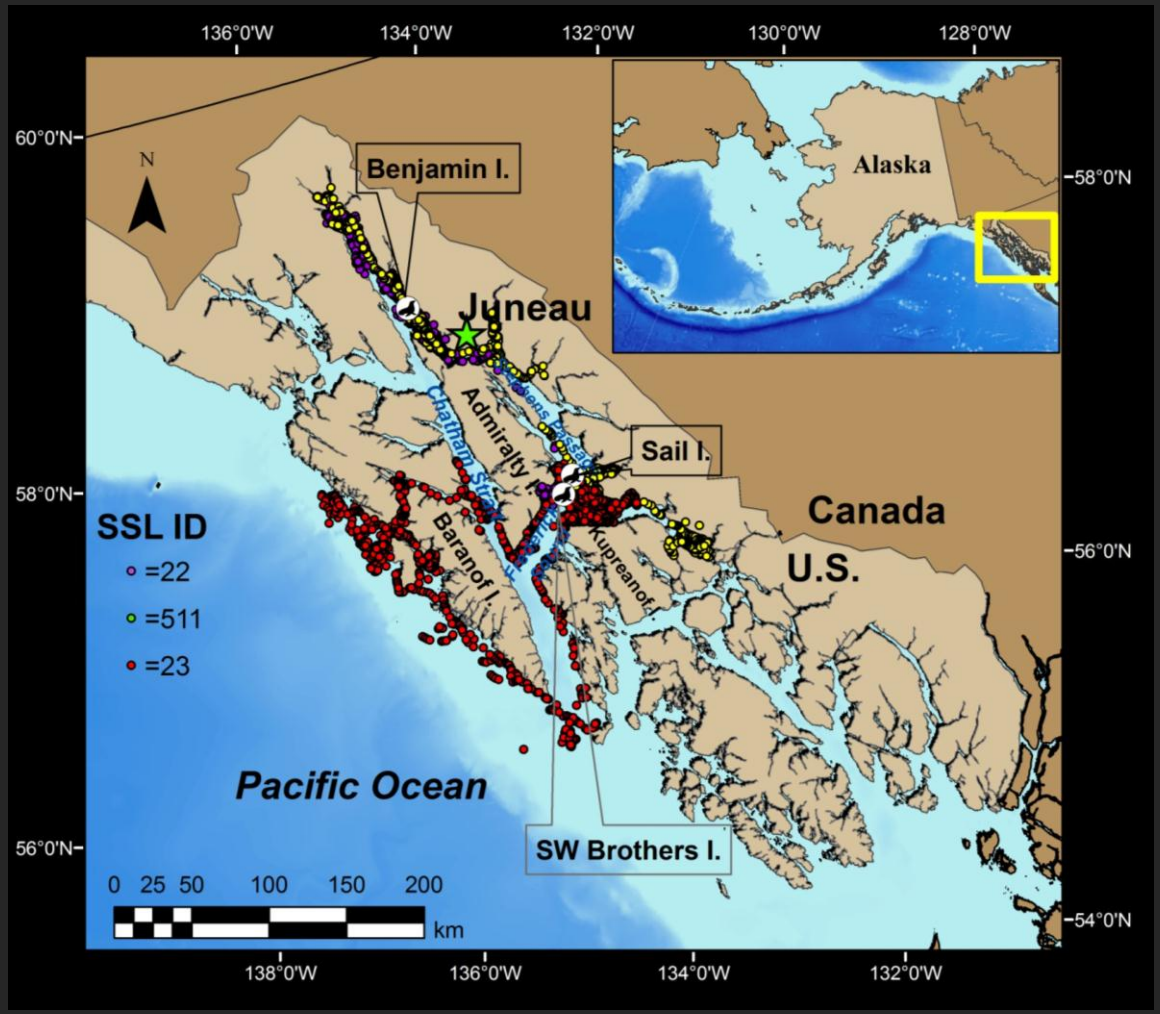
Adult female sizes



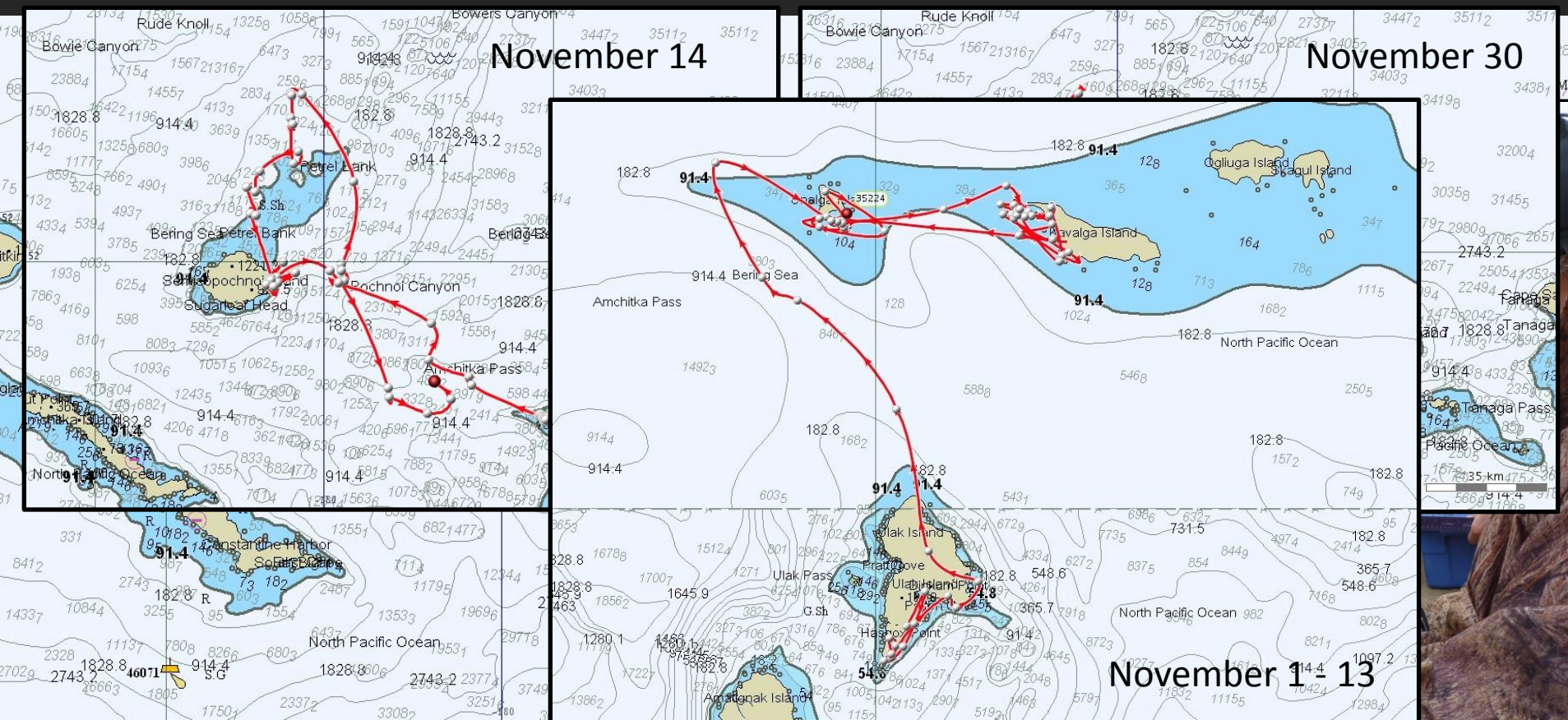
Adult female sizes – Southeast Alaska

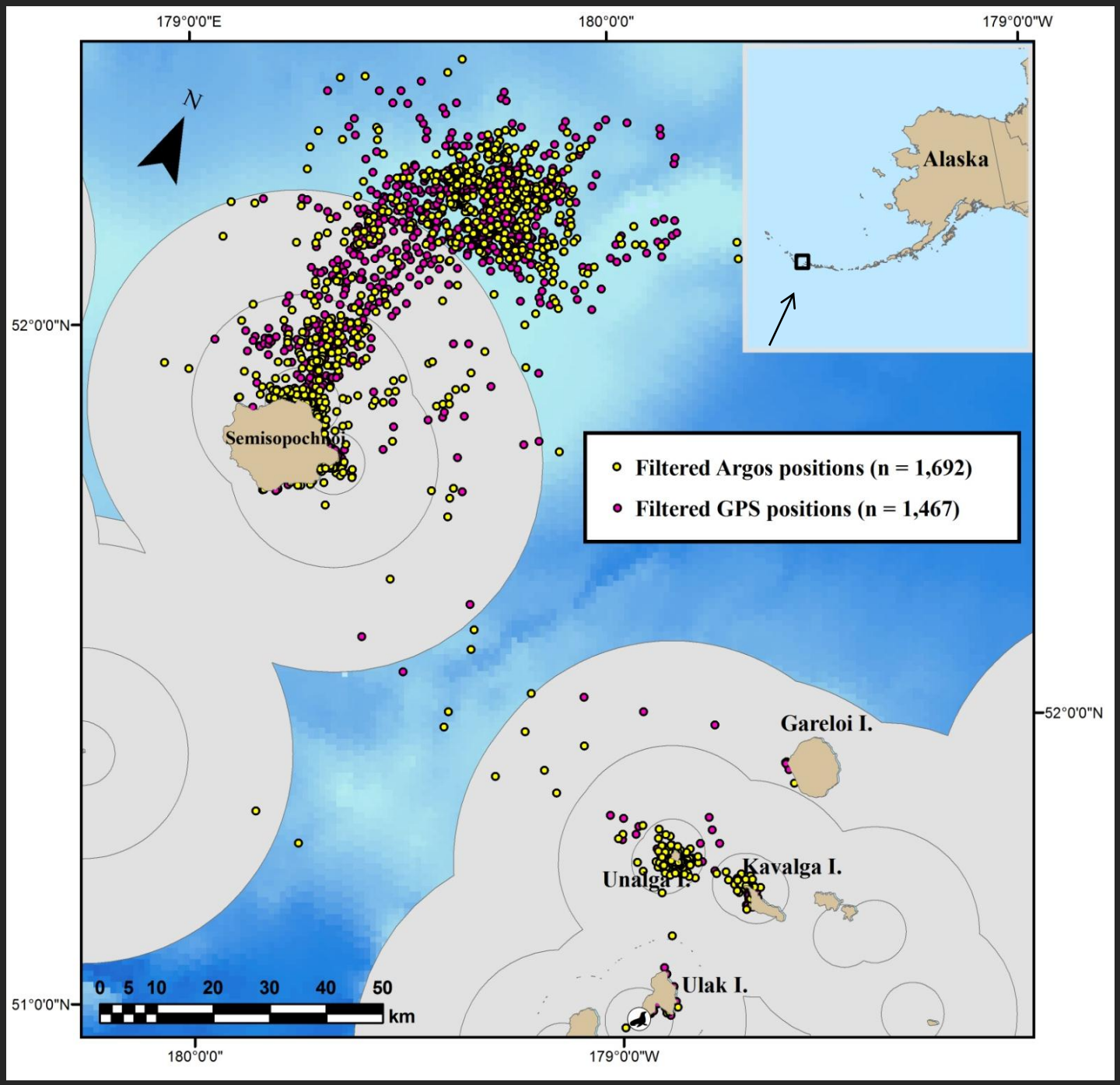


Adult female Steller sea lions Southeast Alaska GPS positions November 2010 – July 2011

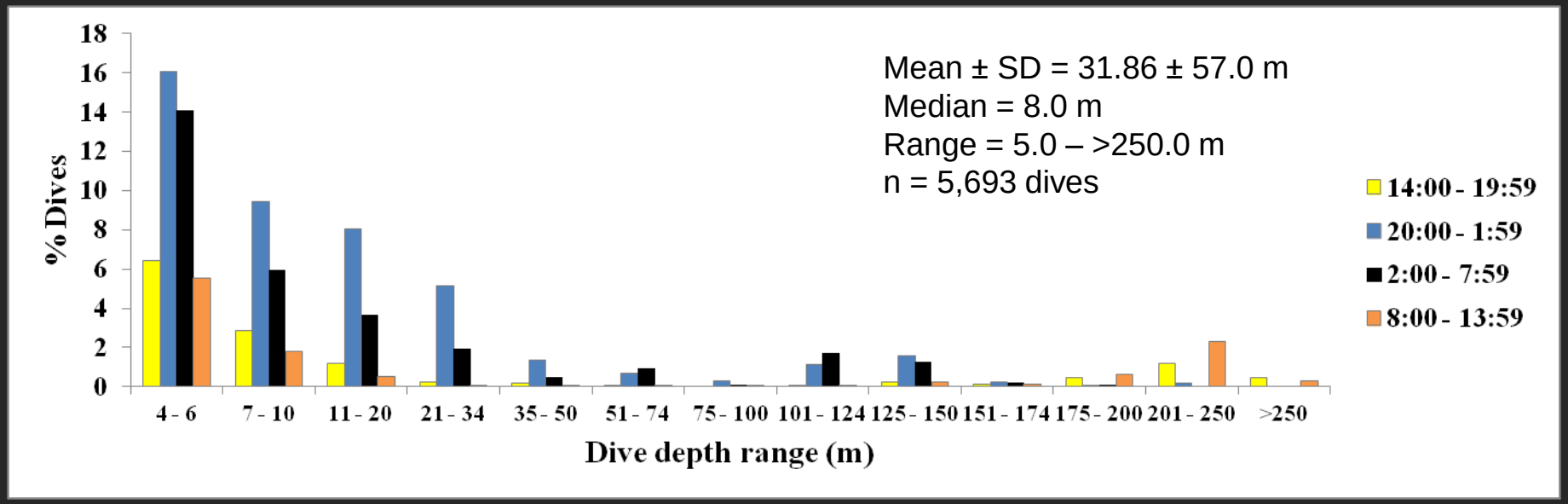


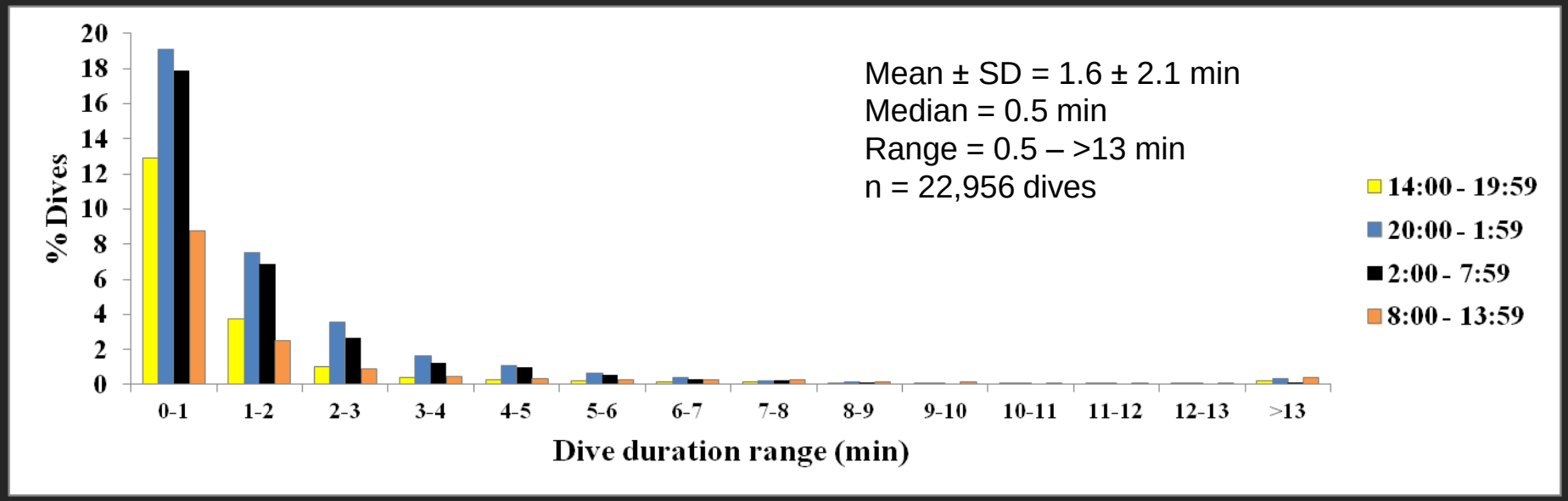
Steller sea lion adult female (=24)
November 1, 2011 – 24 April, 2012 (175 days)



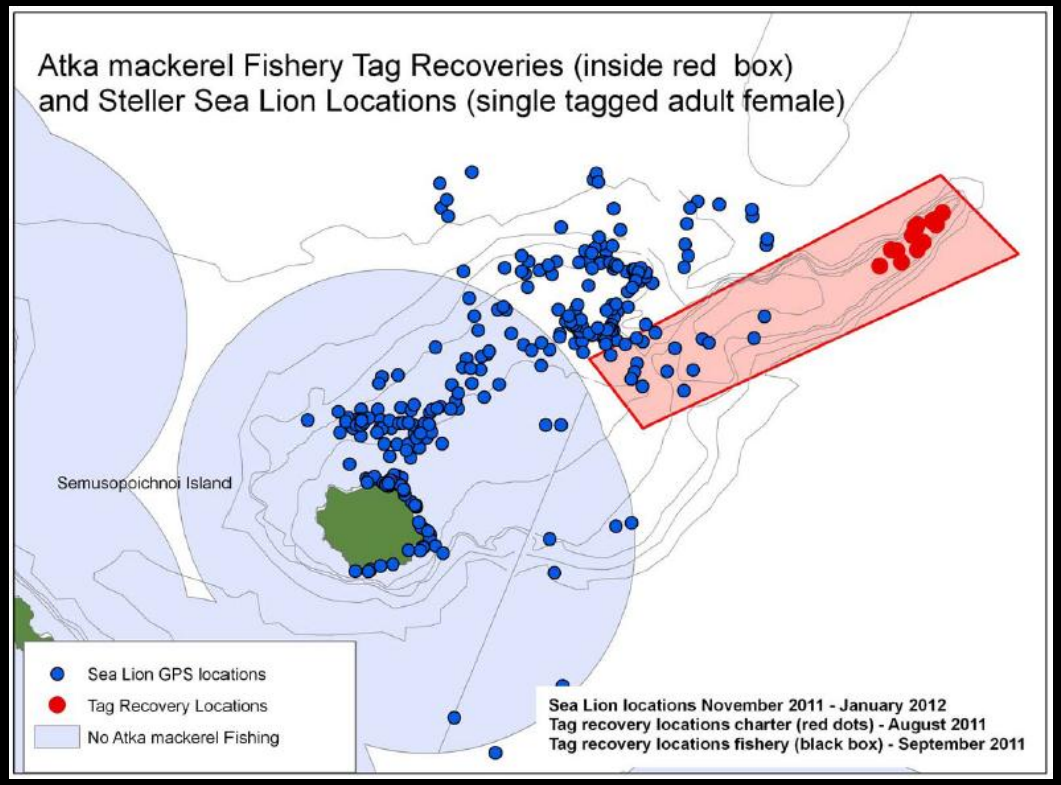

179°0'0"E
180°0'0"
179°0'0"W
52°0'0"N
51°0'0"N
N
Alaska
Semisopochnoi
Filtered Argos positions (n = 1,692)
Filtered GPS positions (n = 1,467)
Gareloi I.
Kavalga I.
Unalga I.
Ulak I.
0 5 10 20 30 40 50
km

Dive profile of adult female “=24”



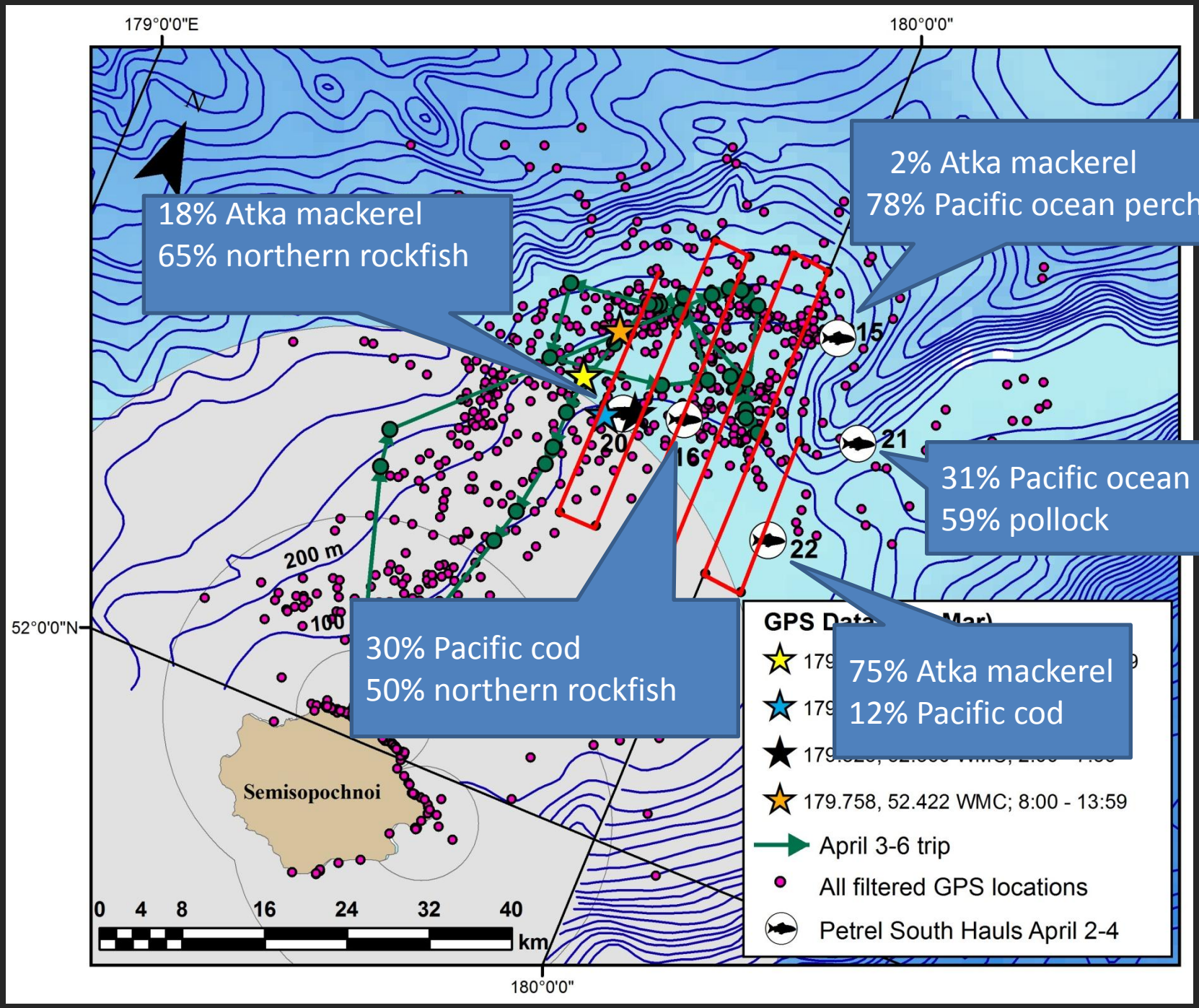


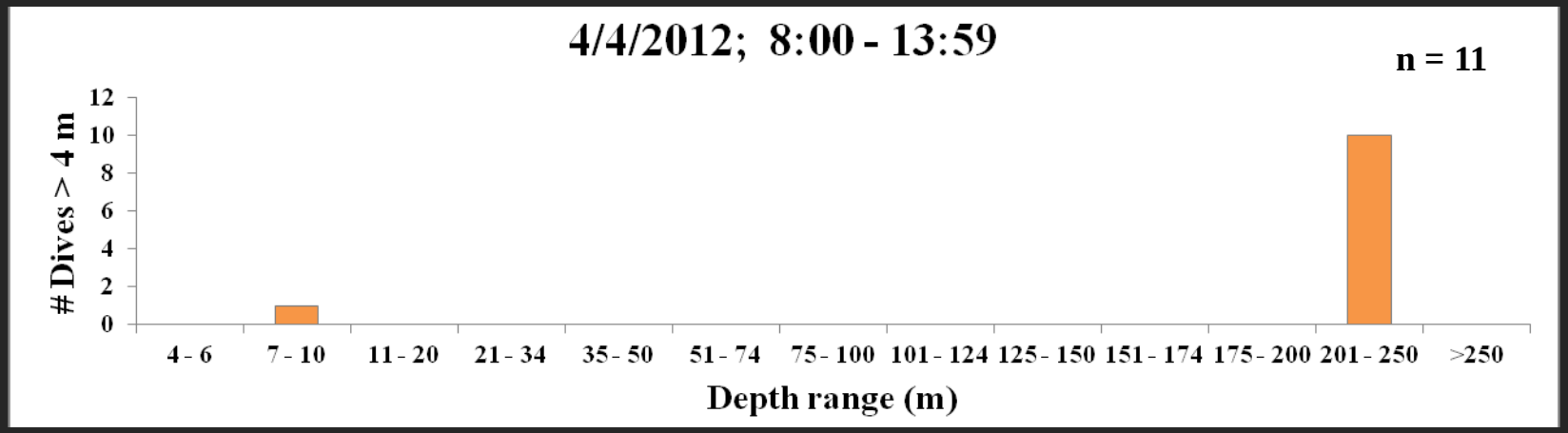
Overlap of sea lion tracks with fishery studies – Central Aleutian Islands

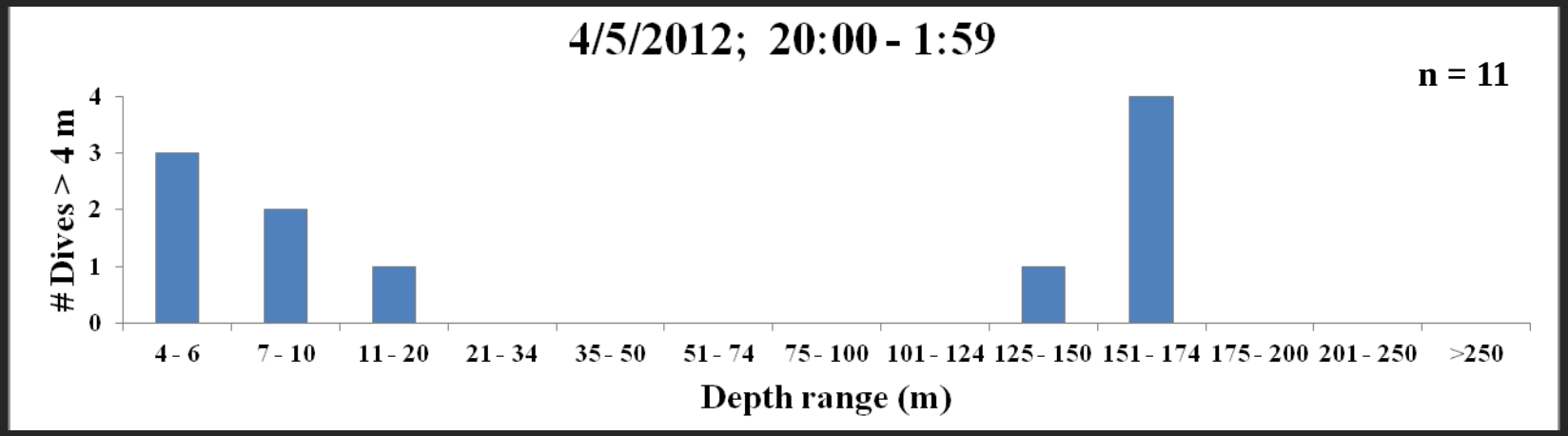


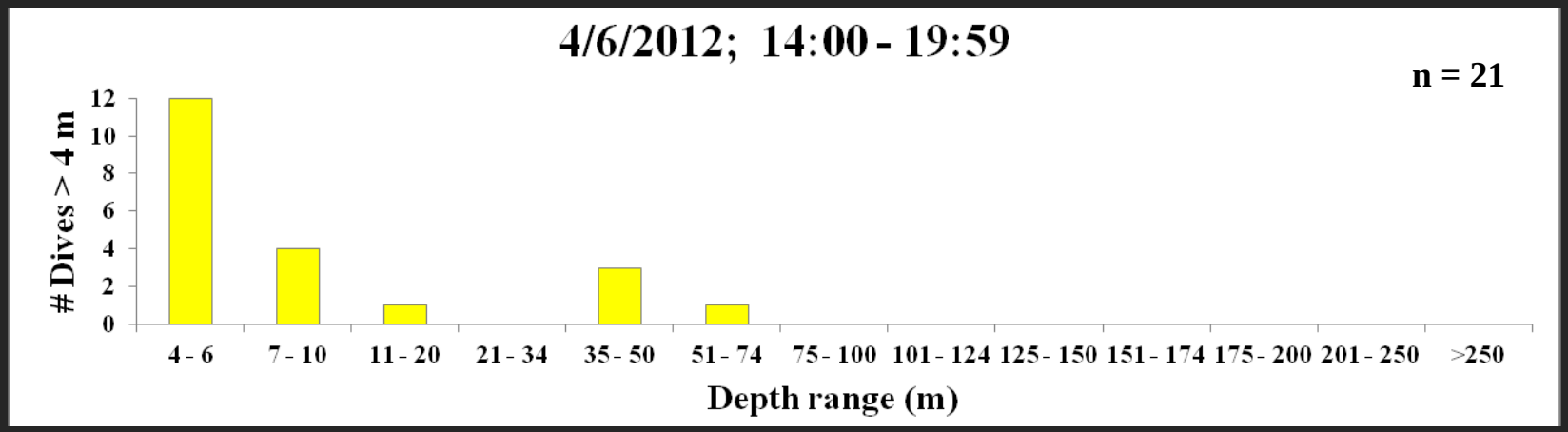
Atka mackerel tagging studies

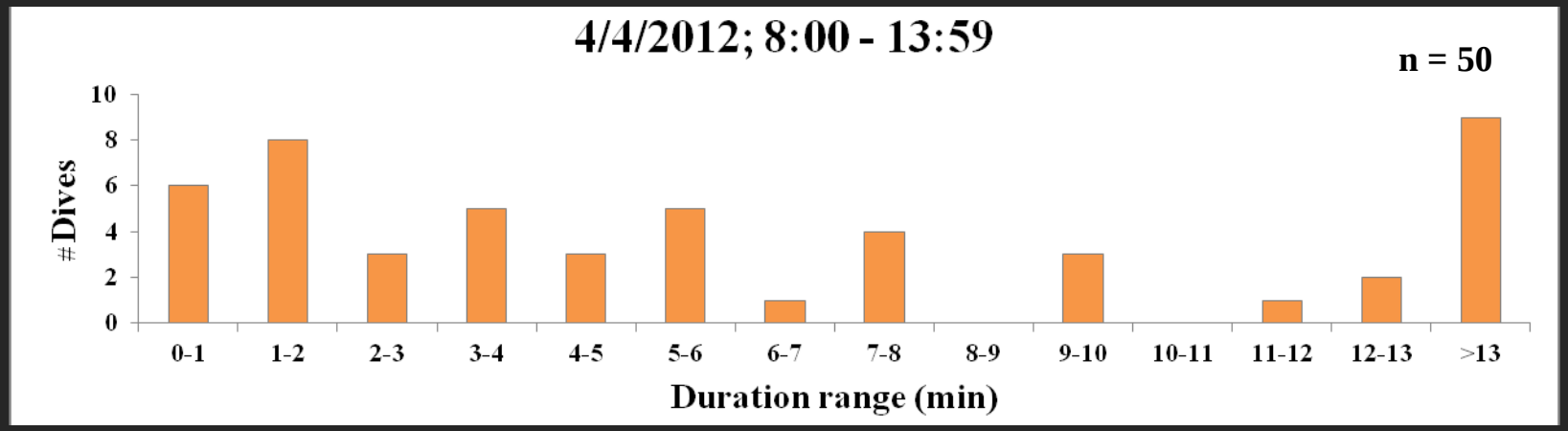
Susanne McDermott and others of the Fisheries Interaction Team, AFSC

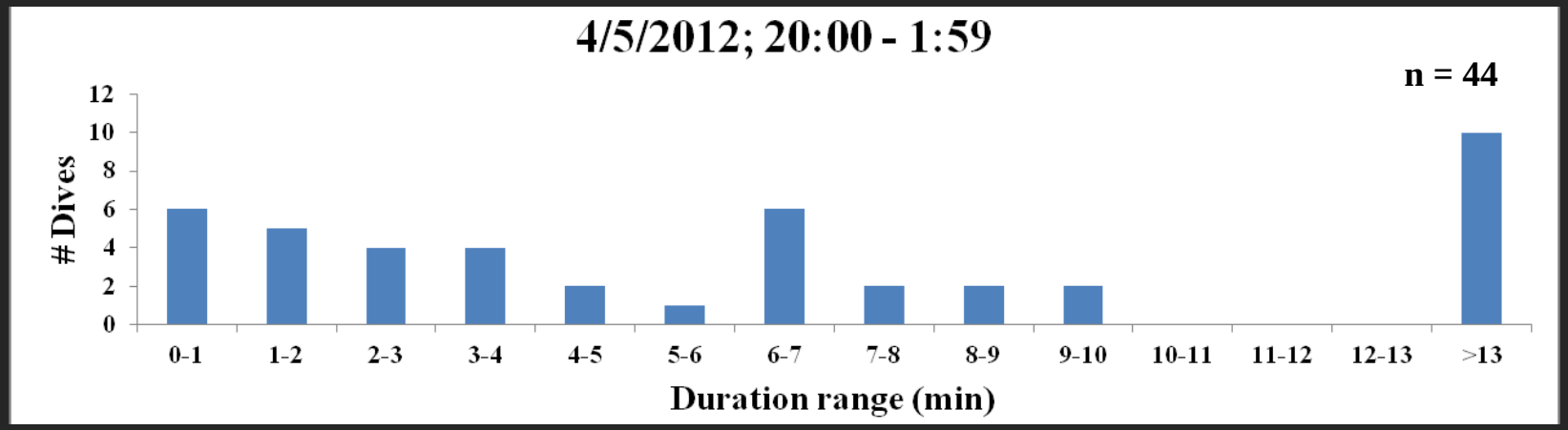

179°0'0"E
180°0'0"
52°0'0"N
N
18% Atka mackerel
65% northern rockfish
2% Atka mackerel
78% Pacific ocean perch
31% Pacific ocean perch
59% pollock
30% Pacific cod
50% northern rockfish
75% Atka mackerel
12% Pacific cod
15
20
16
21
22
200 m
100
Semisopochnoi
0 4 8 16 24 32 40
km
179.758, 52.422 WMC; 8:00 - 13:59
April 3-6 trip
All filtered GPS locations
Petrel South Hauls April 2-4

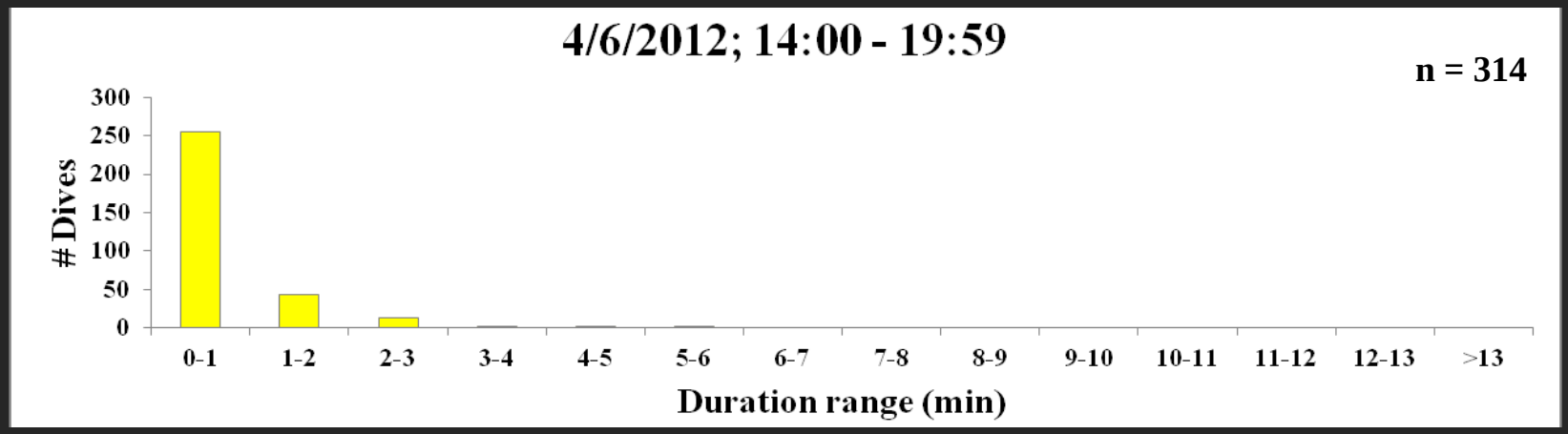

4/4/2012; 8:00 - 13:59
n = 11
# Dives > 4 m
0
2
4
6
8
10
12
4 - 6
7 - 10
11 - 20
21 - 34
35 - 50
51 - 74
75 - 100
101 - 124
125 - 150
151 - 174
175 - 200
201 - 250
>250
Depth range (m)


4/5/2012; 20:00 - 1:59
n = 11
# Dives > 4 m
0
1
2
3
4
4 - 6
7 - 10
11 - 20
21 - 34
35 - 50
51 - 74
75 - 100
101 - 124
125 - 150
151 - 174
175 - 200
201 - 250
>250
Depth range (m)

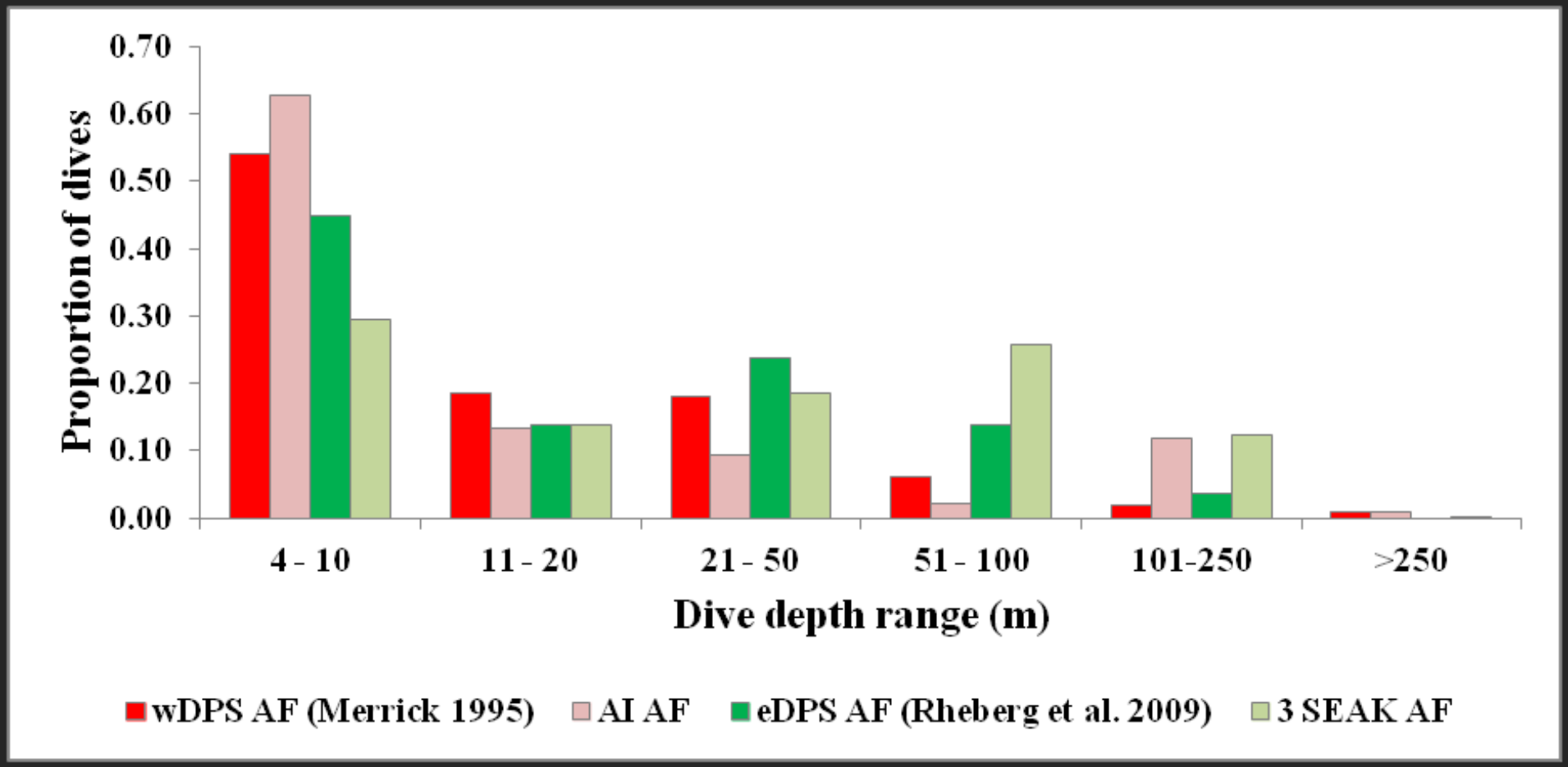

4/6/2012; 14:00 - 19:59
n = 21
# Dives > 4 m
0
2
4
6
8
10
12
4 - 6
7 - 10
11 - 20
21 - 34
35 - 50
51 - 74
75 - 100
101 - 124
125 - 150
151 - 174
175 - 200
201 - 250
>250
Depth range (m)


4/4/2012; 8:00 - 13:59
n = 50
# Dives
0
2
4
6
8
10
0-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
>13
Duration range (min)

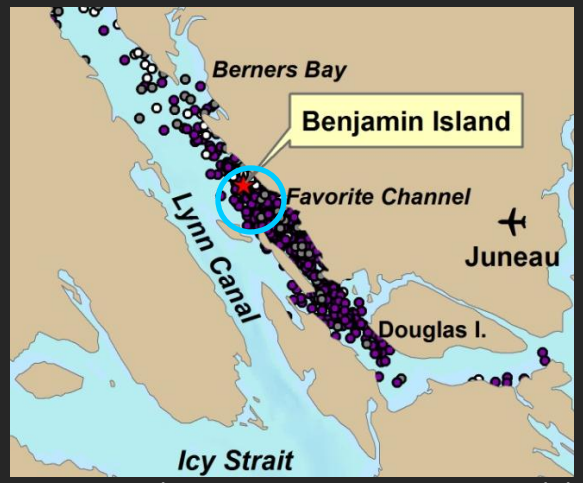

4/5/2012; 20:00 - 1:59
n = 44
# Dives
0
2
4
6
8
10
12
0-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
>13
Duration range (min)


4/6/2012; 14:00 - 19:59
n = 314
# Dives
0
50
100
150
200
250
300
0-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
>13
Duration range (min)

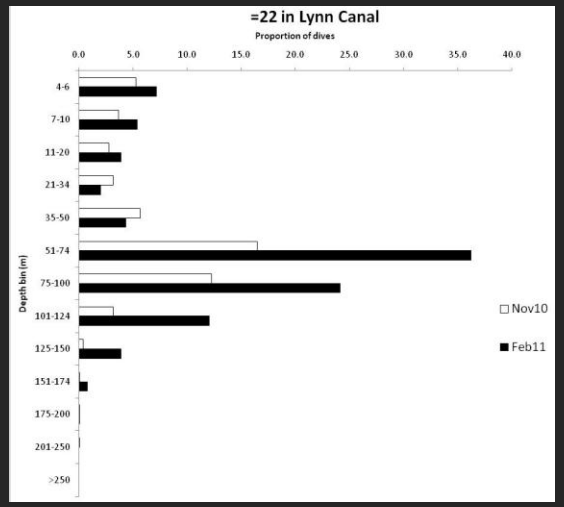
Alaska adult female Steller sea lion dive profiles



Overlap of sea lion tracks with fishery studies – Southeast Alaska

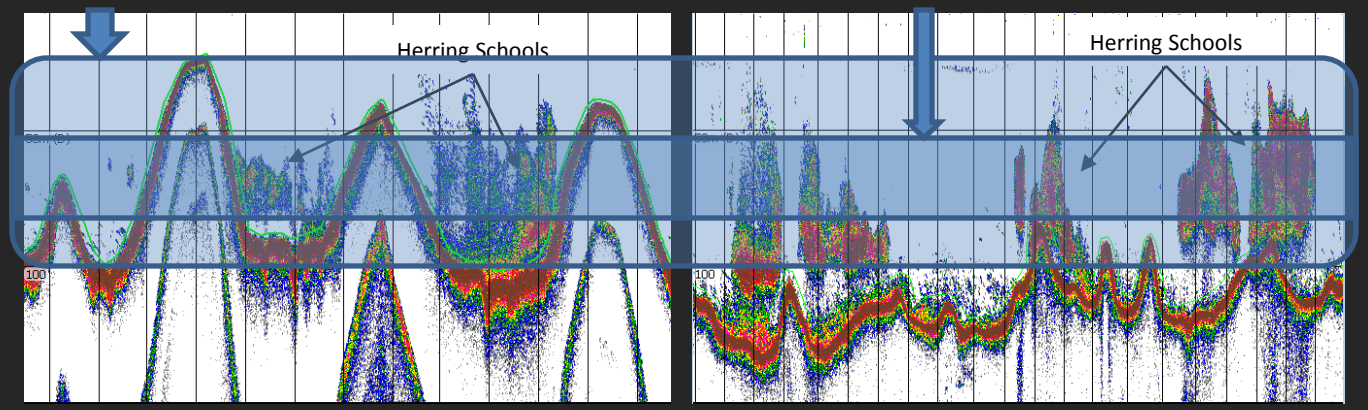


Jonsen et al. 2007 MEPS state-space model



69% of dives by depth for =22, Nov 2010

Modal dive bin (28% of dives)



Echogram data from JJ Vollenweider, AFSC-TSMRI

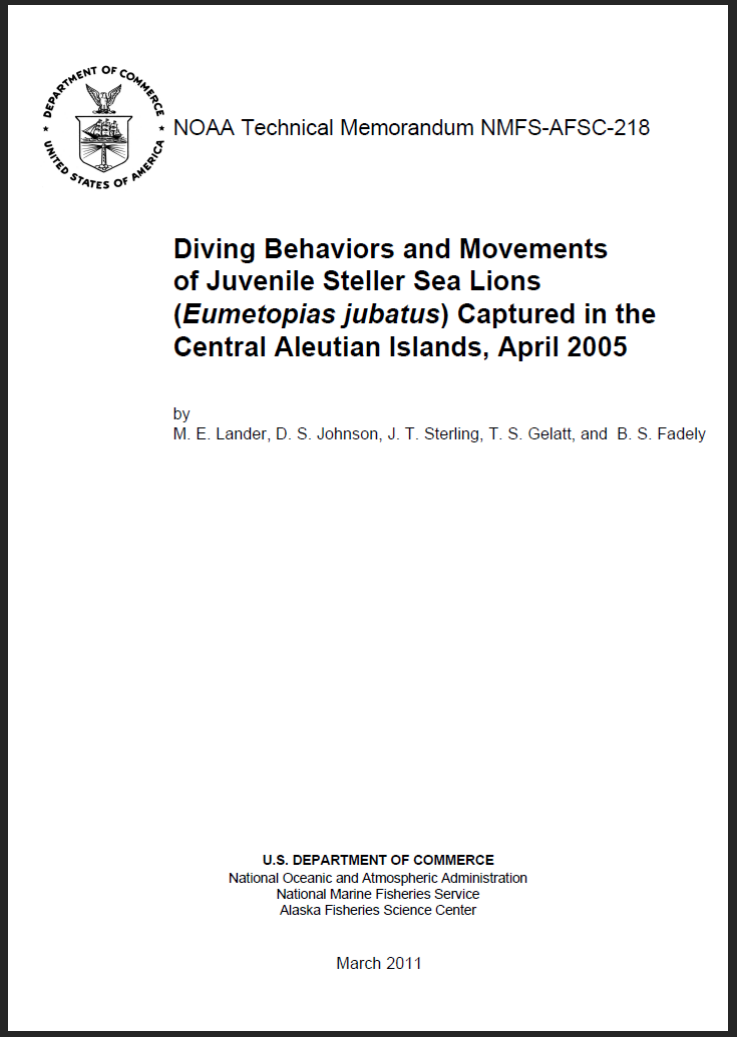
Adult female captures - summary

- It is possible to safely capture and handle adult female Steller sea lions
- Transmission durations are excellent
- Adult females exhibit a broad range of dive behavior likely related to targeted prey and bathymetry (or habitat) features
- Habitat patchiness creates a challenge for investigating relationship between foraging behavior and prey abundance/distribution

Adult female captures – next steps

- October 2012 capture trip to western/central Aleutian Islands
- Continued data analysis
- Analysis of remote camera data to improve understanding of sea lion distribution

Juvenile sea lion movement analysis



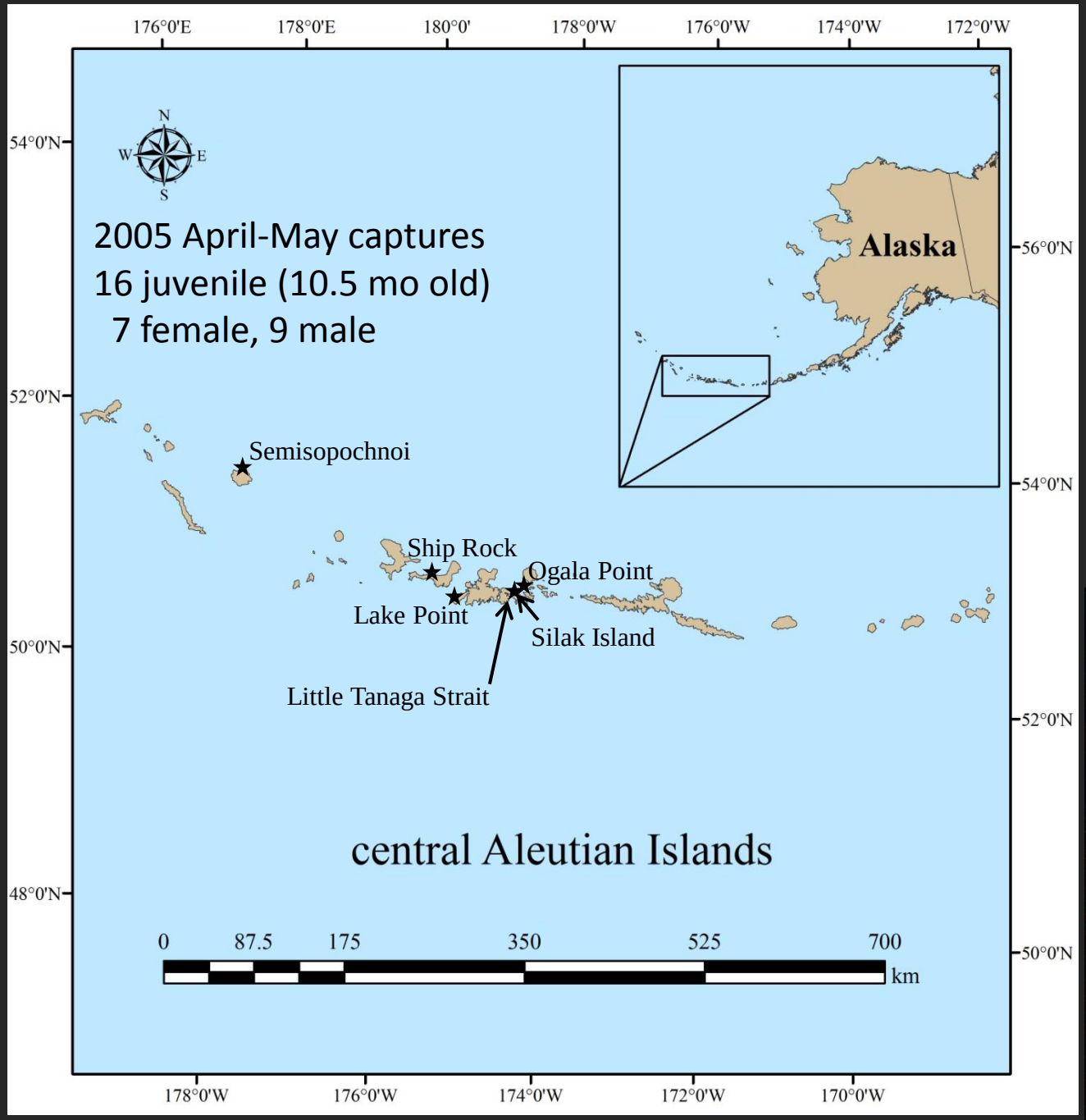
NOAA Technical Memorandum NMFS-AFSC-218

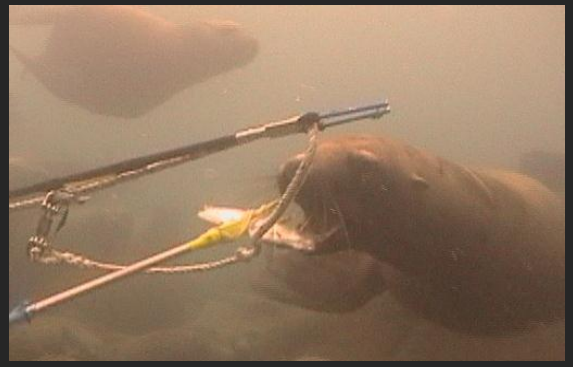
Diving Behaviors and Movements of Juvenile Steller Sea Lions (*Eumetopias jubatus*) Captured in the Central Aleutian Islands, April 2005

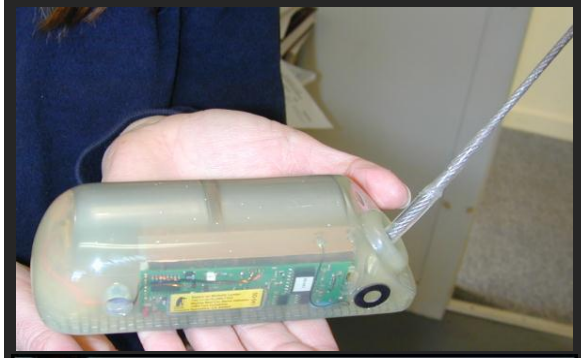
by
M. E. Lander, D. S. Johnson, J. T. Sterling, T. S. Gelatt, and B. S. Fadely

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center

March 2011


2005 April-May captures
16 juvenile (10.5 mo old)
7 female, 9 male
Alaska
Semisopochnoi
Ship Rock
Ogala Point
Lake Point
Silak Island
Little Tanaga Strait
central Aleutian Islands
176°0'E
178°0'E
180°0'
178°0'W
176°0'W
174°0'W
172°0'W
170°0'W
54°0'N
52°0'N
50°0'N
48°0'N
56°0'N
0
87.5
175
350
525
700
km
N
S
E
W



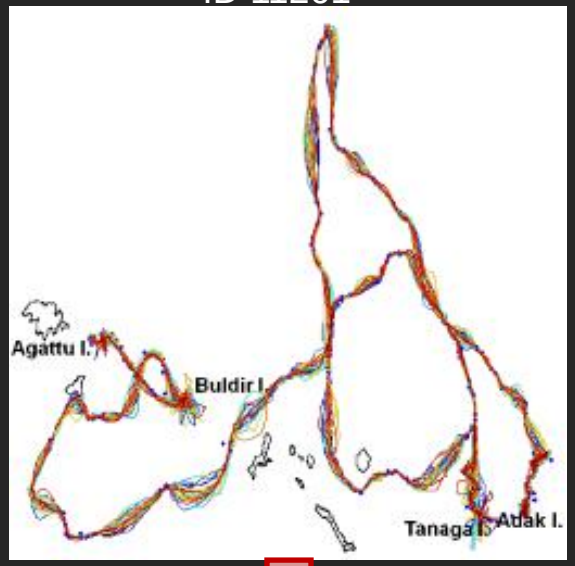


Applied a continuous-time correlated random walk model

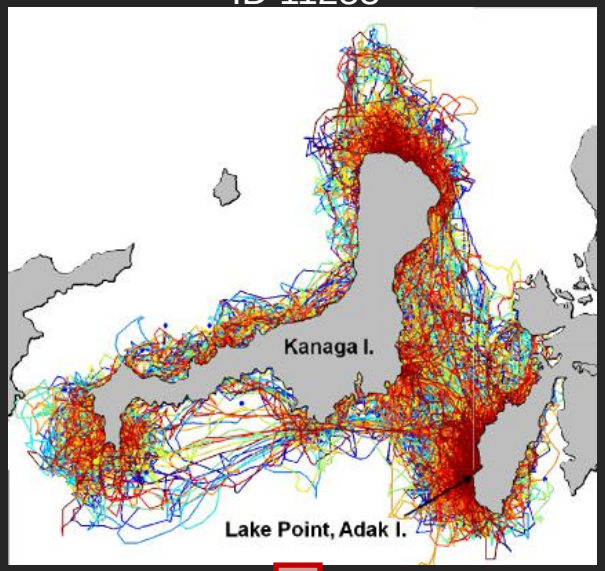
(Johnson et al. 2008, Ecology 89:1208-1215

20 tracks sampled from posterior distribution to show variance of predicted tracks

ID 11261

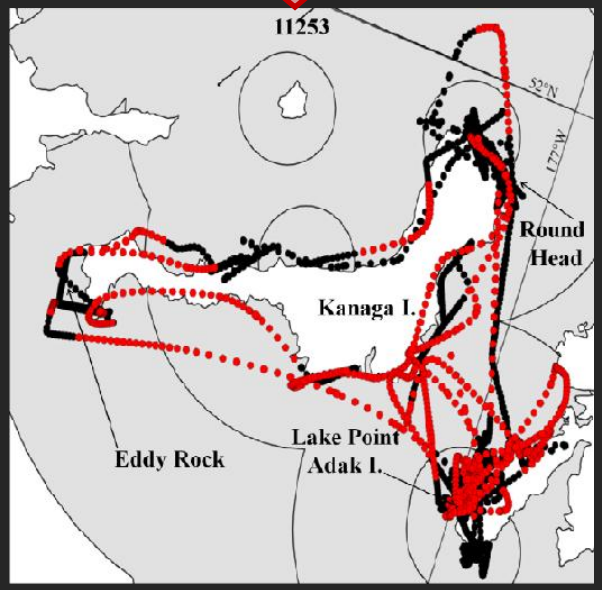


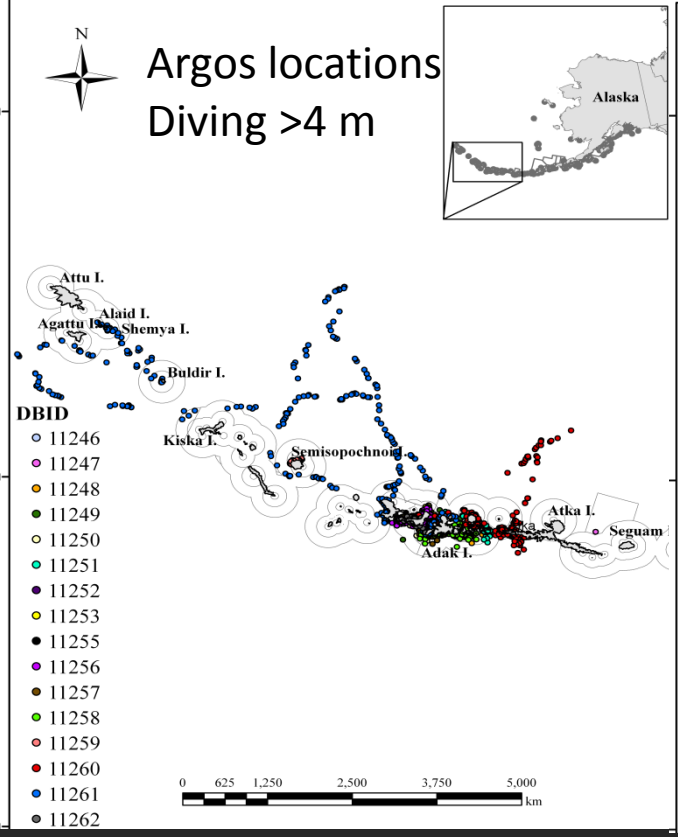
ID 11253

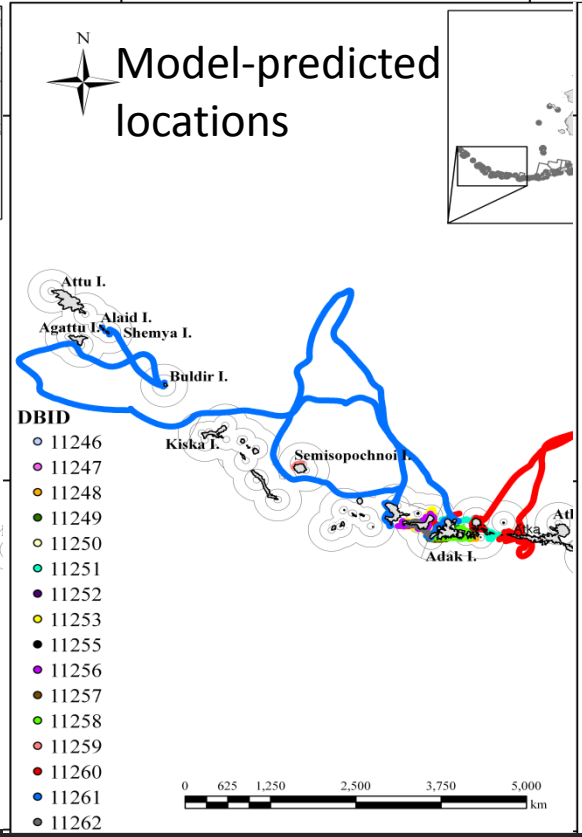


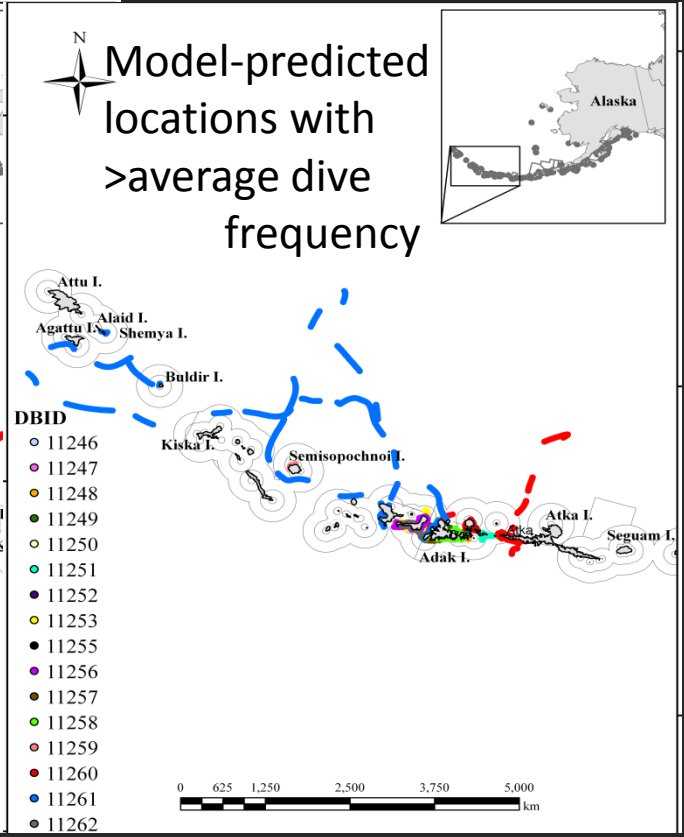
predicted locations associated with:

- diving to >4 m
- diving > mean frequency

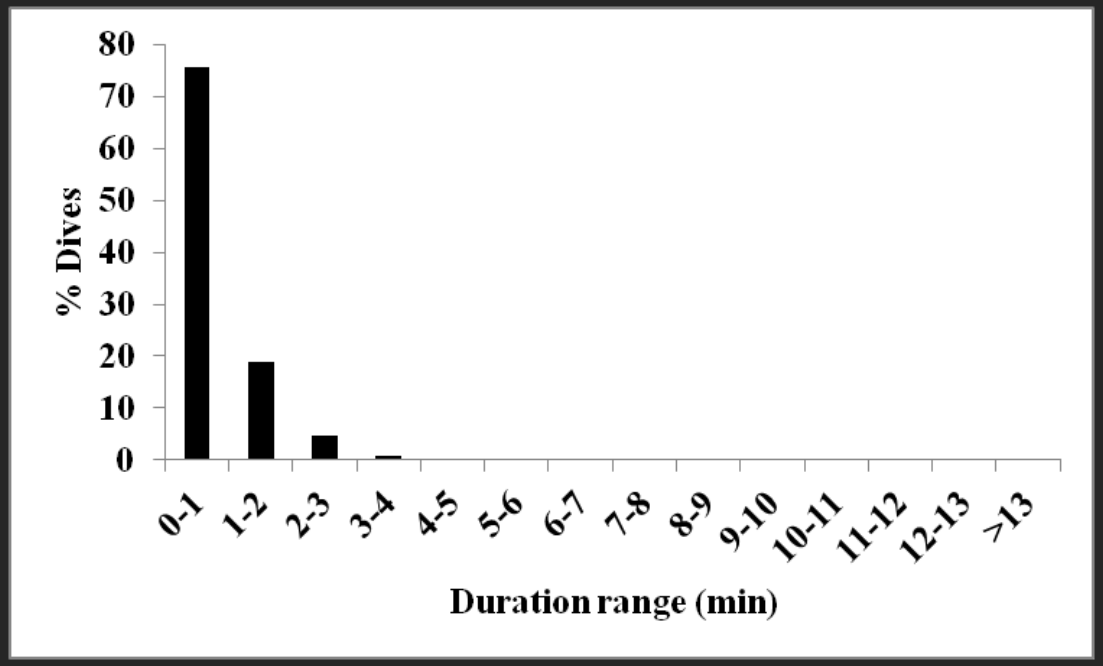




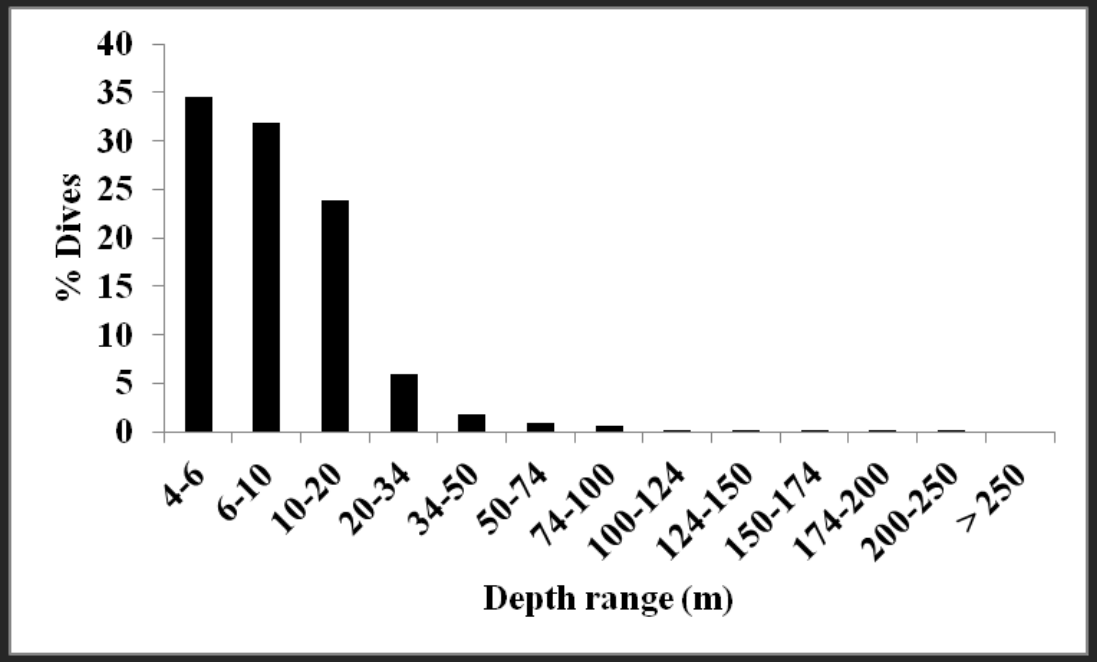




Critical Habitat Zone	Argos Locations Diving > 4 m (n = 16)	Predicted Locations Diving > 4 m (n = 16)	Predicted Locations > ave. dive frequency (n = 16)
0 – 10 nmi	68.30	69.49	65.37
10 – 20 nmi	23.71	23.69	26.21
Foraging Areas (> 20 nmi)	0.04	0.00	0.00
> 20 nmi	7.96	6.82	8.42



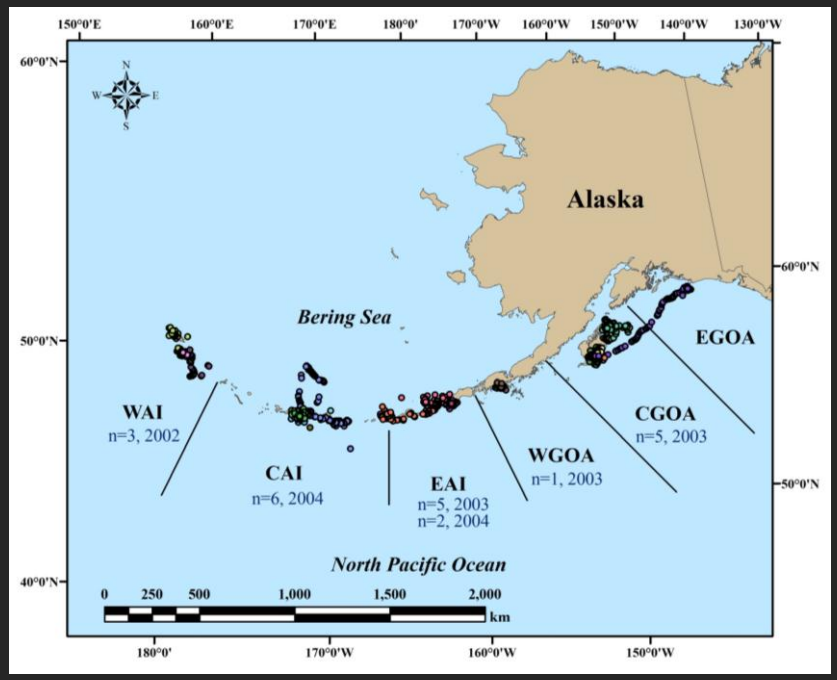
Mean ± SD = 0.8 ± 0.6 min
Median = 0.5 min
Range = 0.5 – > 13 min
n = 155,620 dives



Mean ± SD = 11.8 ± 12.6 m
Median = 8.0 m
Range = 5.0 – 255.0 m
n = 89,993 dives

Additional juvenile sea lion data

22 SMRU satelite relayed-data loggers



Lander *et al* 2011. Spatial patterns and scaling behaviors of Steller sea lion (*Eumetopias jubatus*) distributions and their environment. Journal of Theoretical Biology 274:744-83

Lander *et al* 2010. Foraging effort of juvenile Steller sea lions *Eumetopias jubatus* with respect to heterogeneity of sea surface temperature. Endangered Species Research 10:145-158.

Lander *et al* 2009. Regional differences in the spatial and temporal heterogeneity of oceanographic habitat used by Steller sea lions. Ecological Applications 19(6):1645-1659.