



Image credit: Josh London

# Steller sea lions - Alaska

AFSC/Marine Mammal Laboratory/Alaska Ecosystems Program

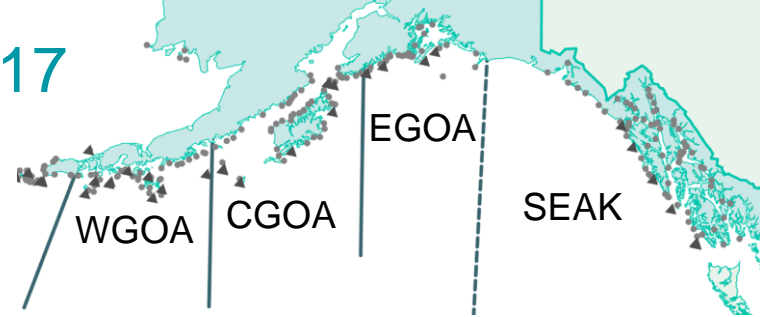
*Presenter: Brian Fadely*

# Abundance Surveys – Steller sea lions

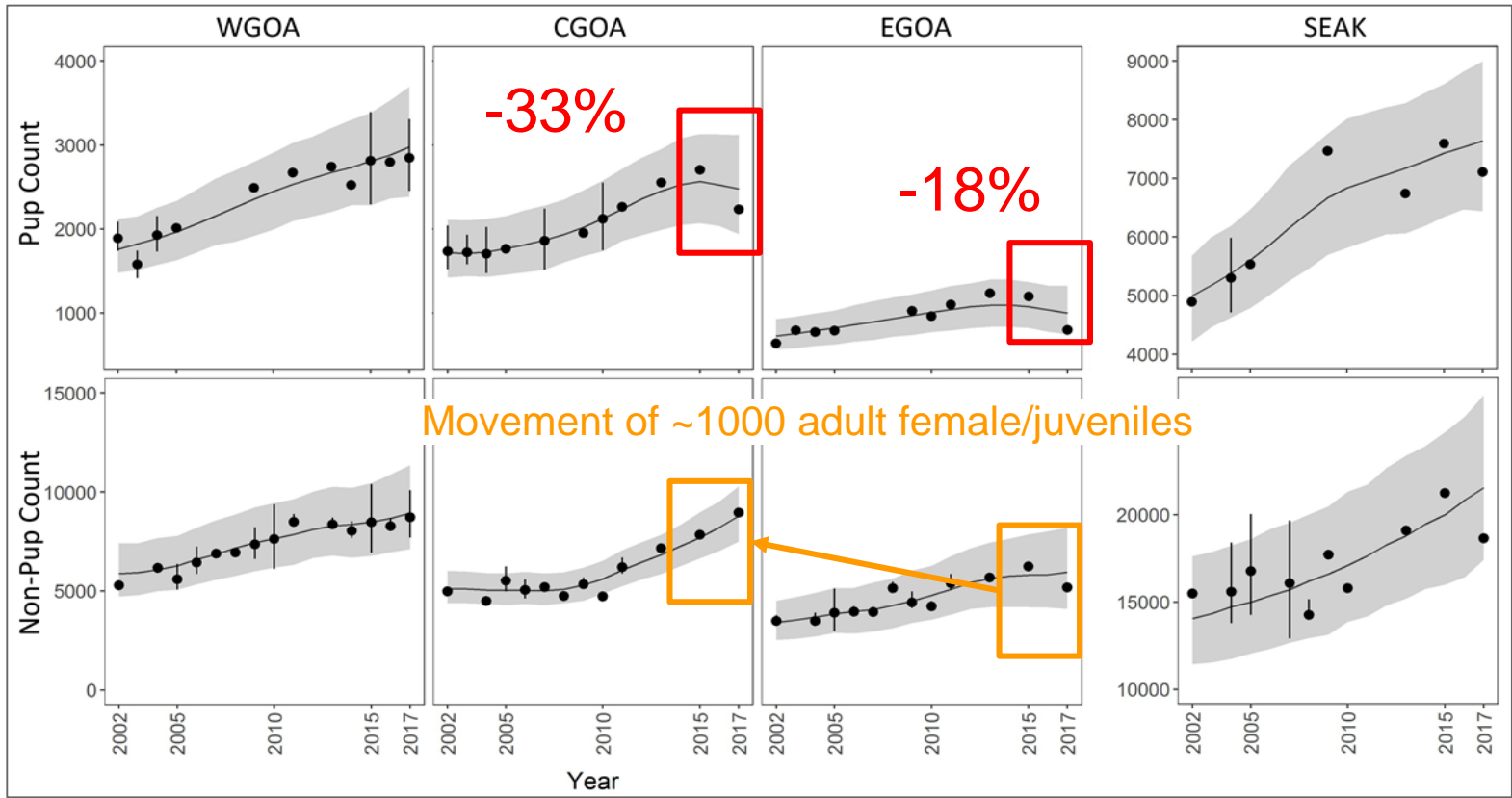
- Annual Surveys
- NOAA Twin Otter: east of Delarof Islands
  - Even years: Aleutian Islands
  - Odd years: Gulf of Alaska
- Ship/Drone effort: west of Delarof Islands
  - Aerial image & visual counts



# Abundance Surveys – Gulf of Alaska 2017

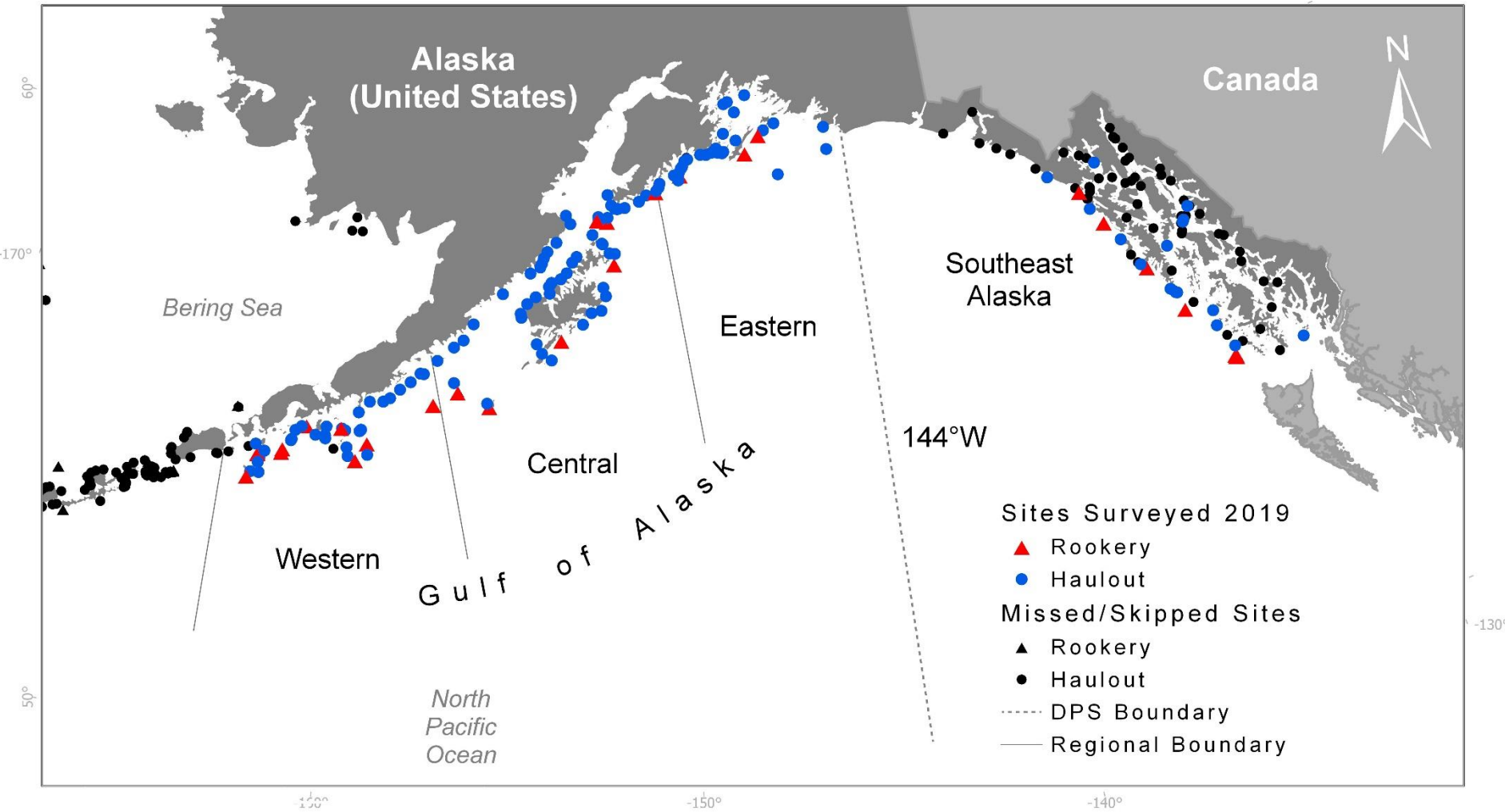


Sweeney et al. 2017. <https://repository.library.noaa.gov/view/noaa/18790>



- Pup declines at three northernmost rookeries and in Southeast Alaska (eDPS)
- WGOA seemingly unaffected
- Decline in pup production, stability of non-pups, notable since area was increasing since early 2000s. Potentially showing response to environmental variability associated with 71% reduction in Pacific cod as result of “Blob” (cod is 46% of winter diet).

# Abundance Surveys – Gulf of Alaska 2019

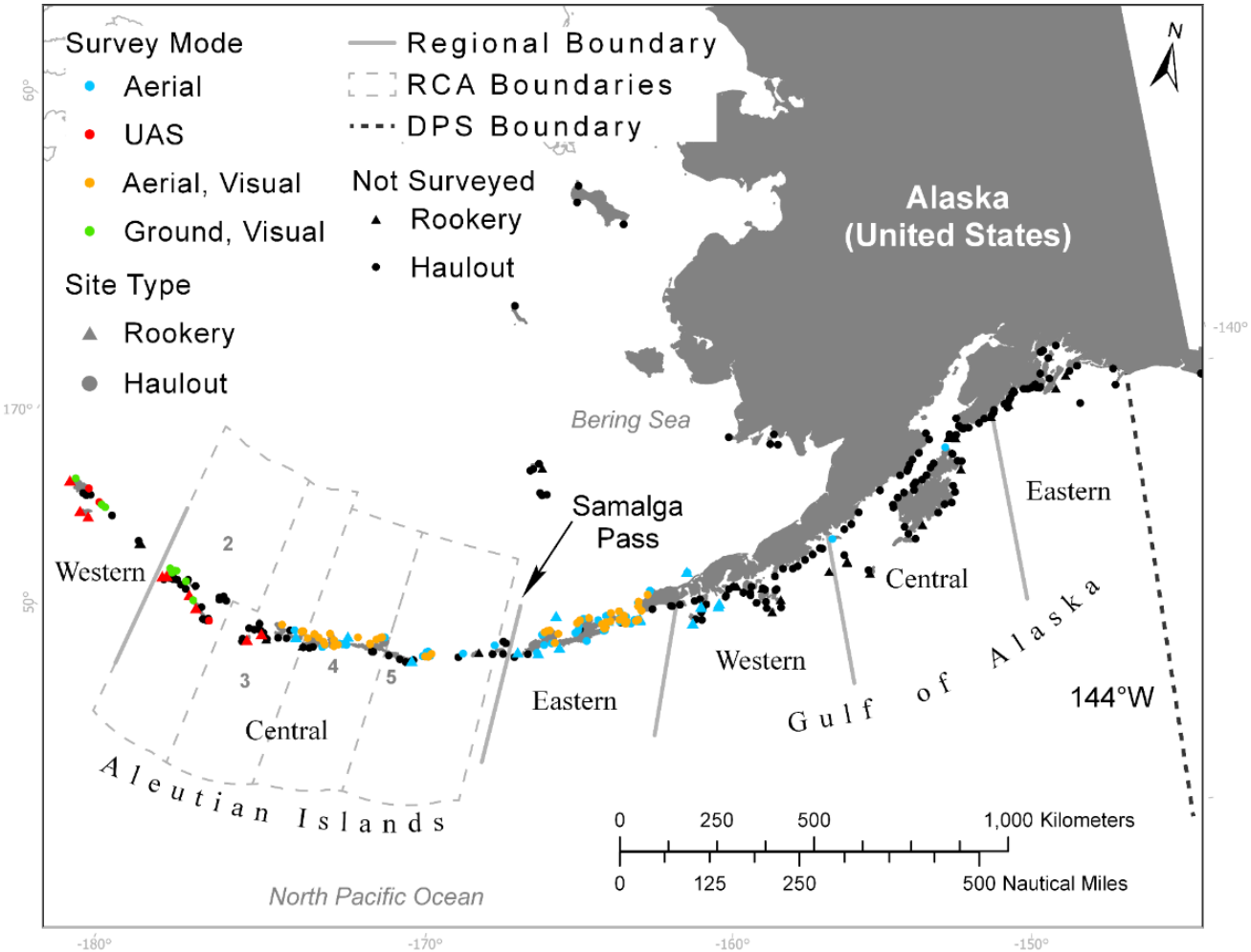


- Unprecedented coverage of Gulf of Alaska sites.
- Covered all rookeries and major haulouts in Southeast Alaska
- Data currently being analyzed.



# Abundance Surveys – Aleutian Islands 2018

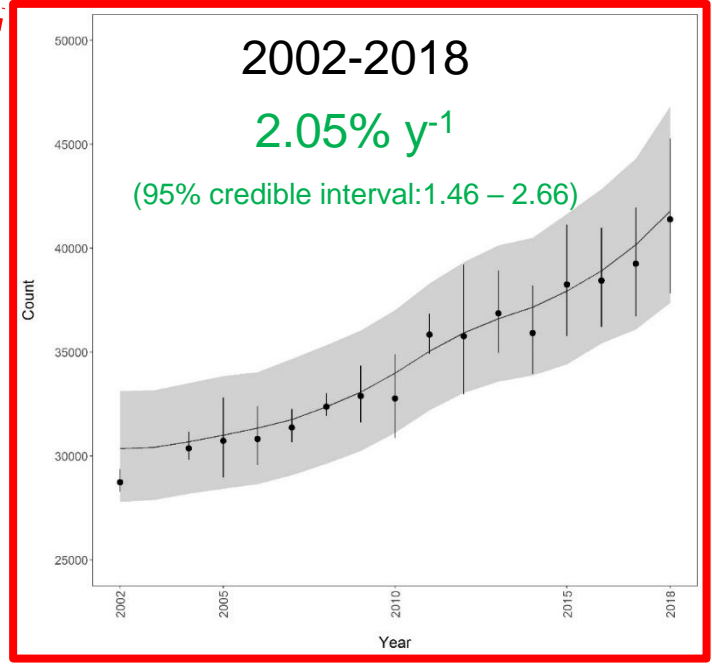
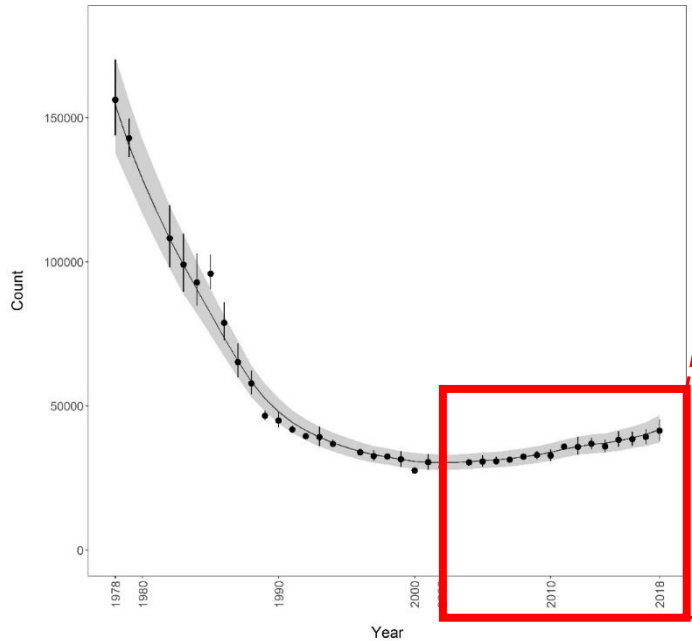
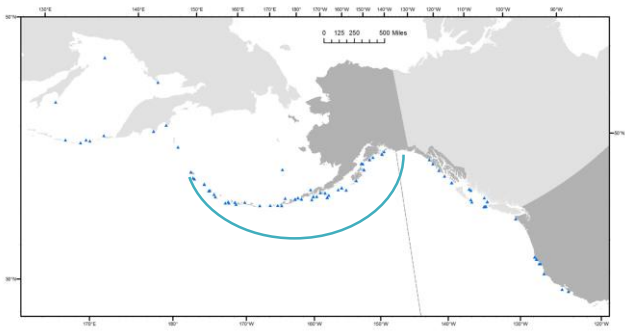
Sweeney et al. 2018, Results of Steller sea lion surveys in Alaska, June-July 2018



- 114 sites surveyed by aircraft, ship/drone surveyed 21 sites

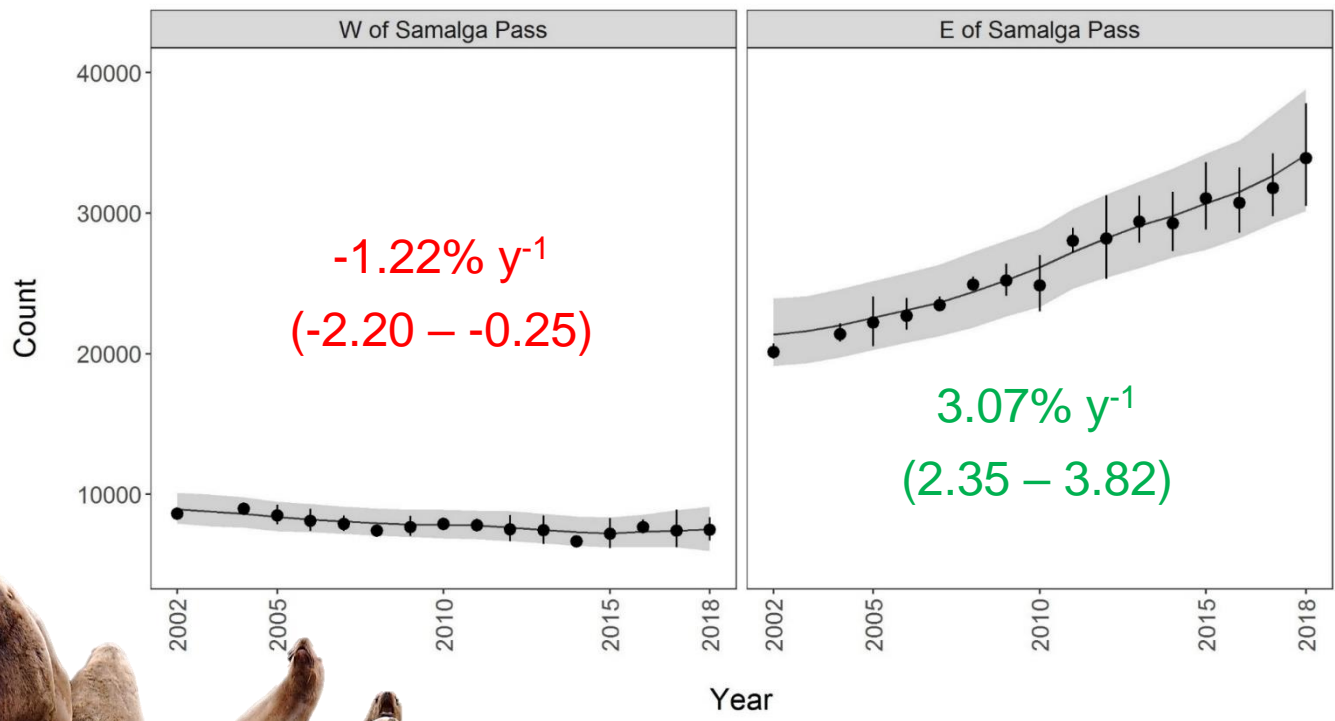
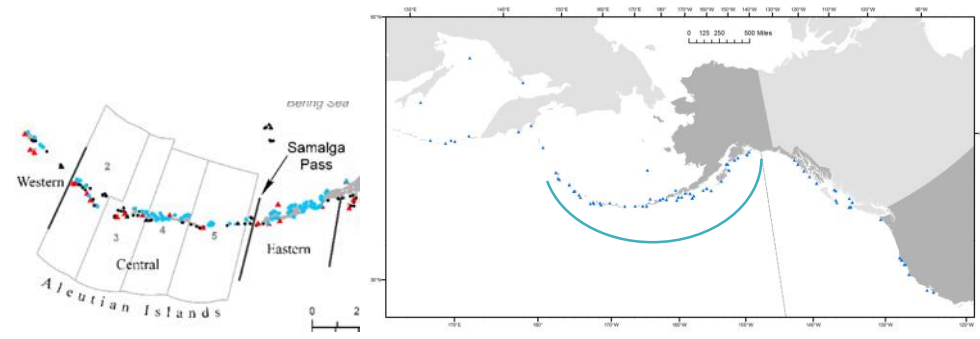


# Abundance Surveys – wDPS Alaska non-pups



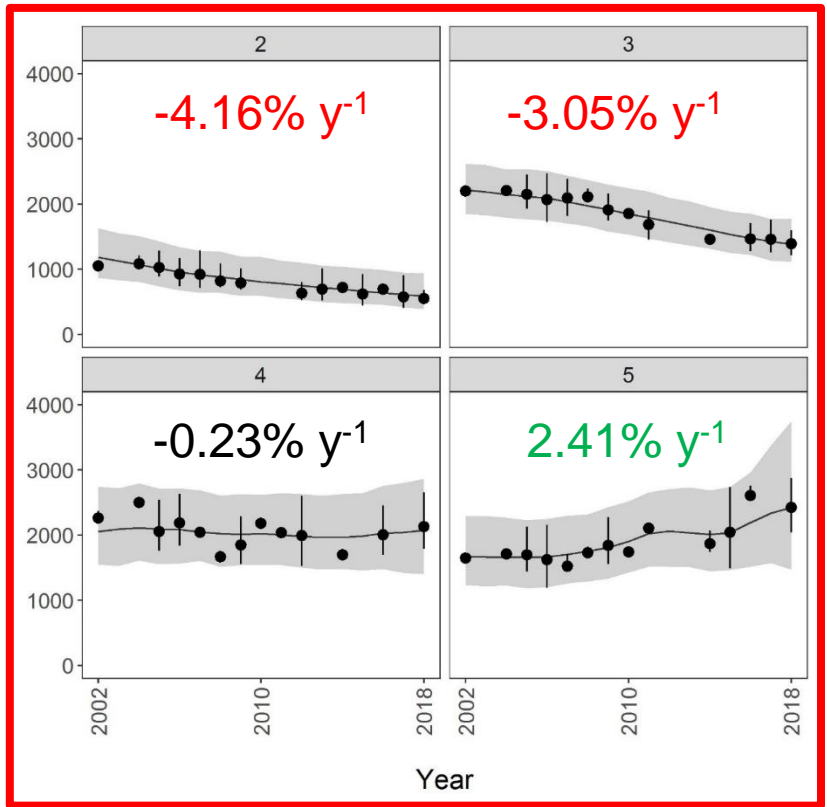
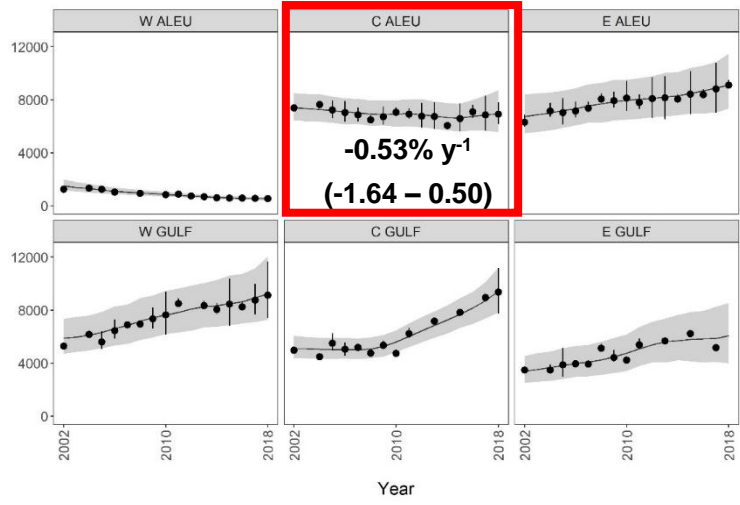
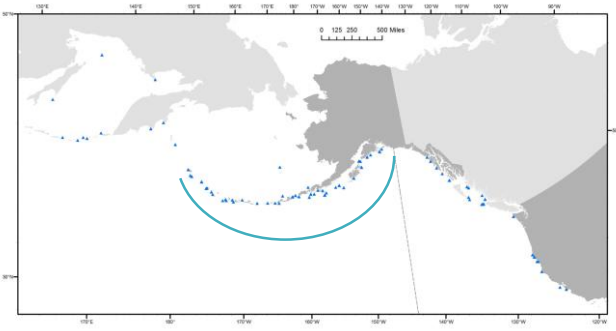
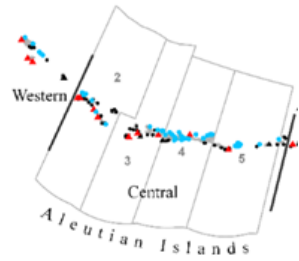
Sweeney et al. 2018, Results of Steller sea lion surveys in Alaska, June-July 2018

# Abundance Surveys – wDPS Alaska non-pups



Sweeney et al. 2018, Results of Steller sea lion surveys in Alaska, June-July 2018

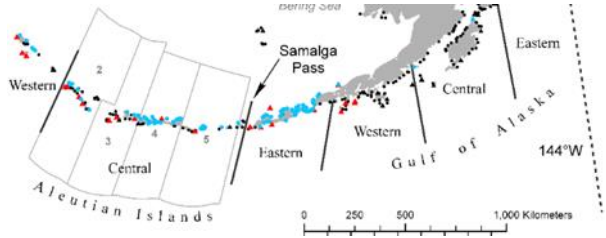
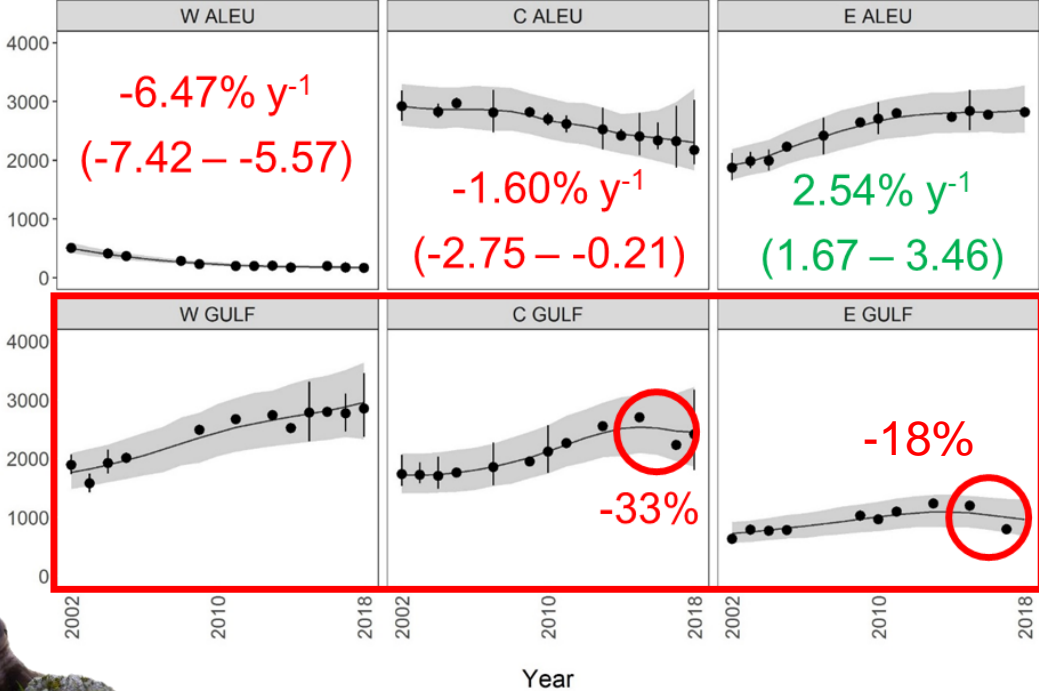
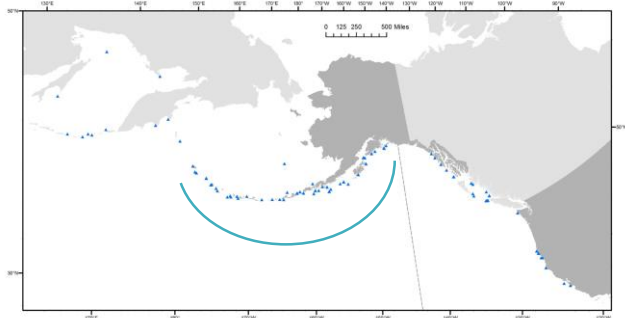
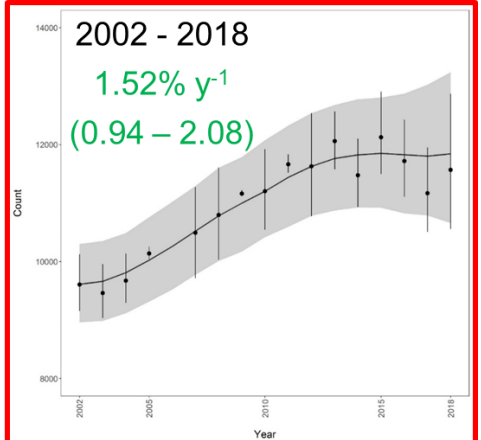
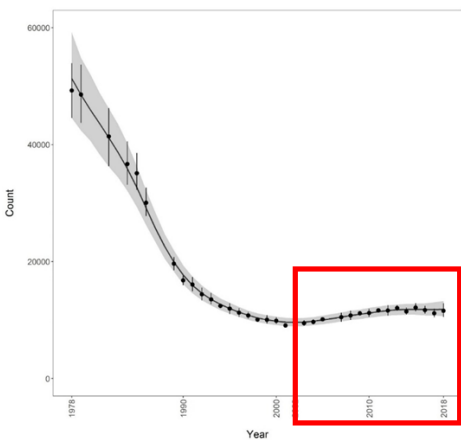
# Abundance Surveys – wDPS Alaska non-pups



Sweeney et al. 2018, Results of Steller sea lion surveys in Alaska, June-July 2018



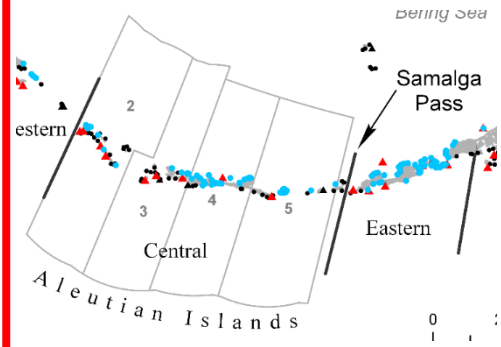
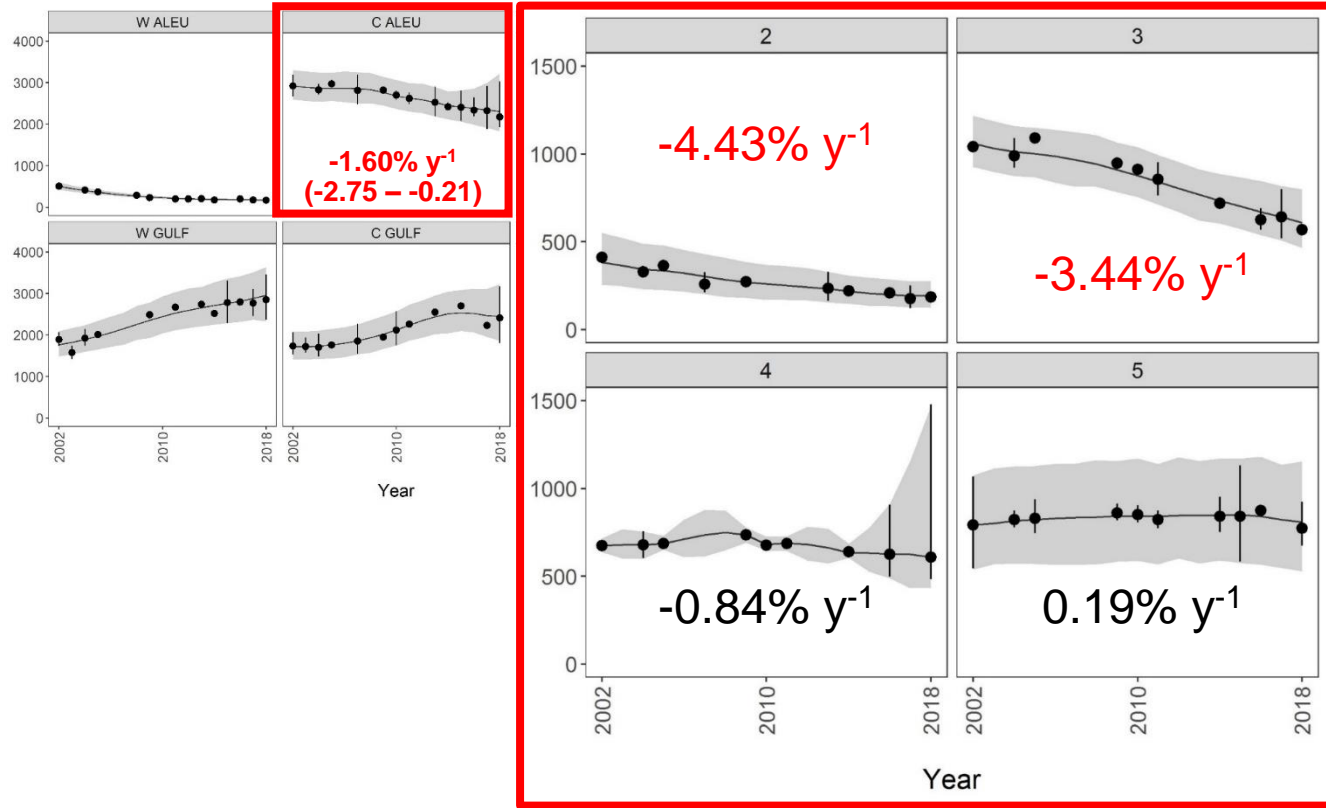
# Abundance Surveys – wDPS Alaska pups



Sweeney et al. 2018, Results of Steller sea lion surveys in Alaska, June-July 2018



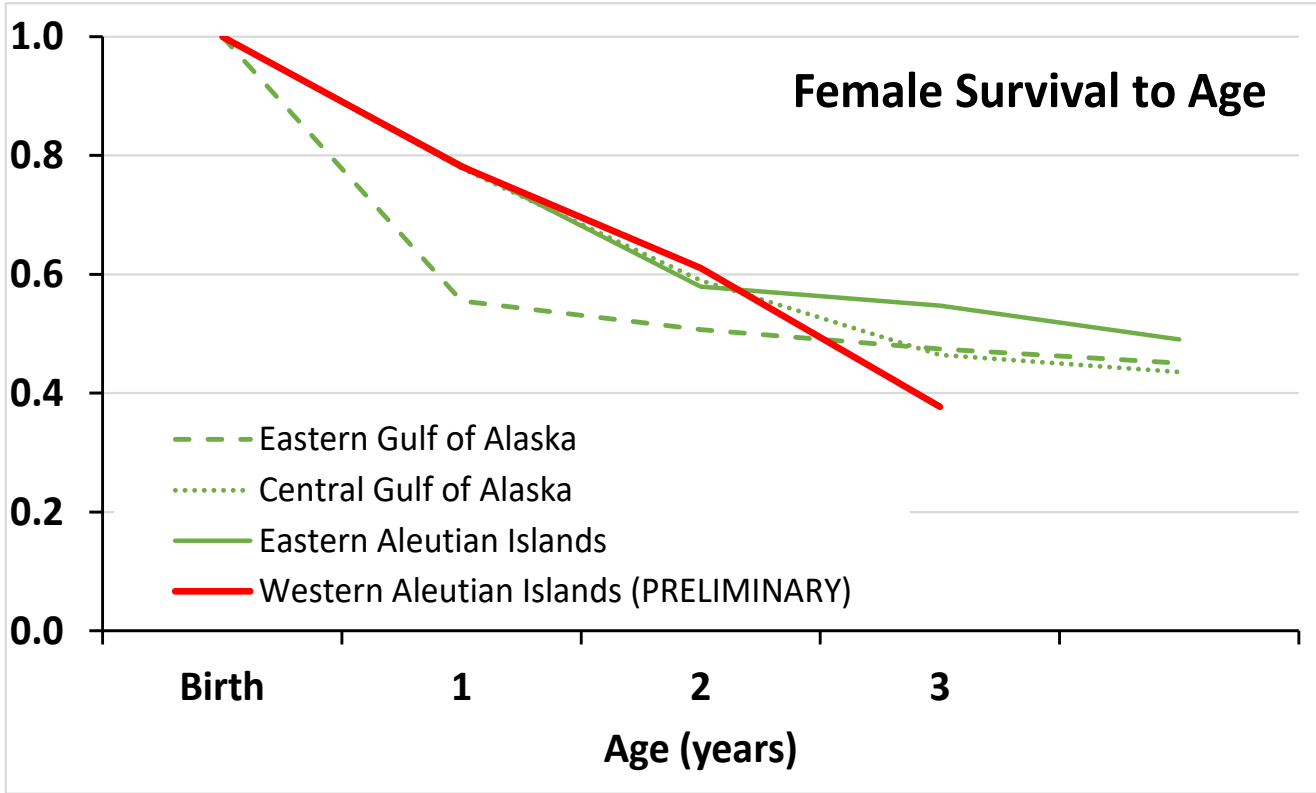
# Abundance Surveys – wDPS Alaska pups



Sweeney et al. 2018, Results of Steller sea lion surveys in Alaska, June-July 2018



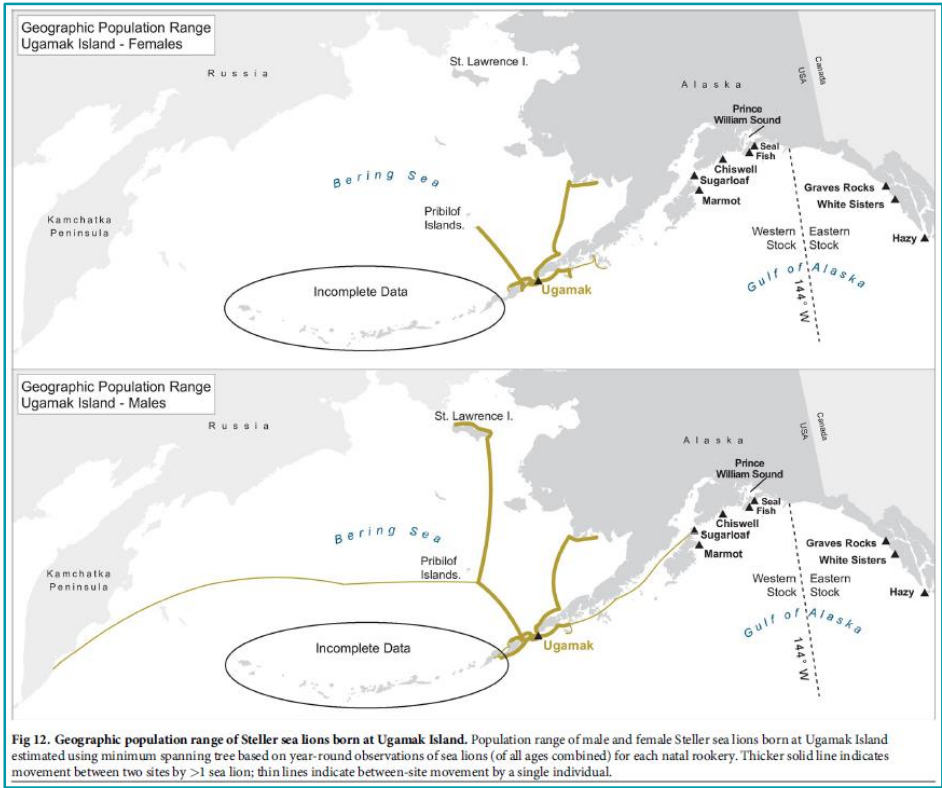
# Mark-resight studies – Steller sea lion



Fritz et al. 2014;  
MML unpublished

- Survival to ages 1 & 2 years is similar across the range of the Western Stock in Alaska
- Survival to age 3 years MAY be lower in Western Aleutian Islands

# Mark-resight studies – Steller sea lions



**PLOS** ONE

RESEARCH ARTICLE

Spatial distribution, movements, and geographic range of Steller sea lions (*Eumetopias jubatus*) in Alaska

Lauri A. Jemison<sup>1\*</sup>, Grey W. Pendleton<sup>1</sup>, Kelly K. Hastings<sup>1</sup>, John M. Maniscalco<sup>2</sup>, Lowell W. Fritz<sup>2</sup>

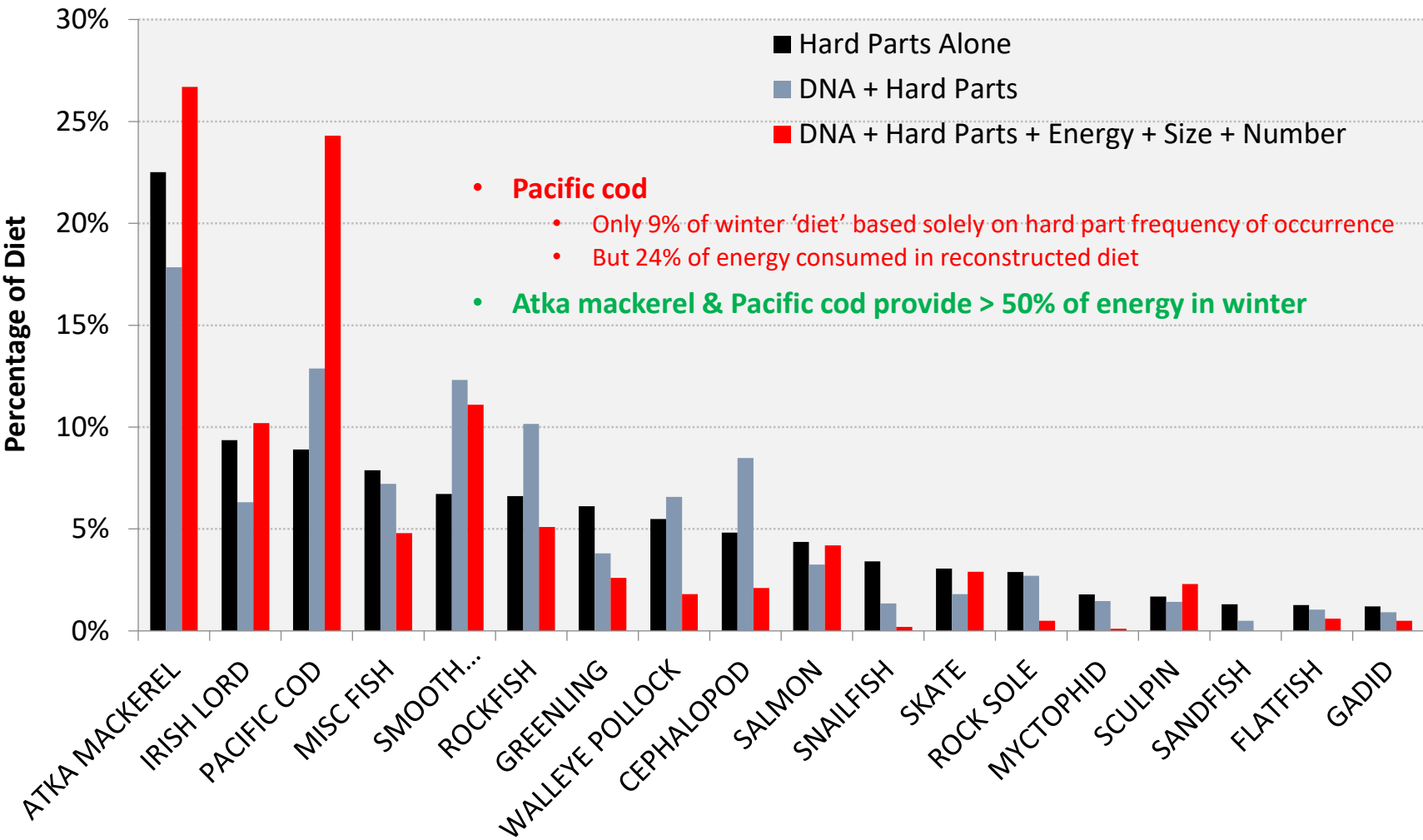
Analyzed >30,000 sightings collected from 2000–2014 of 2,385 sea lions

Density dependent movement patterns:  
animals from larger rookeries, and rookeries with slower population growth and lower survival, had wider dispersion than animals from smaller rookeries, or rookeries with high growth and survival.

animals born in the eastern Aleutian Islands had the most distinct movements and had little overlap with other western sea lions.

northern Southeast Alaska, within the eastern stock, is the area of greatest overlap between stocks, and is important to western animals, especially those born in Prince William Sound.

# Steller Sea Lion winter diet, Aleutian Islands 2008-2012

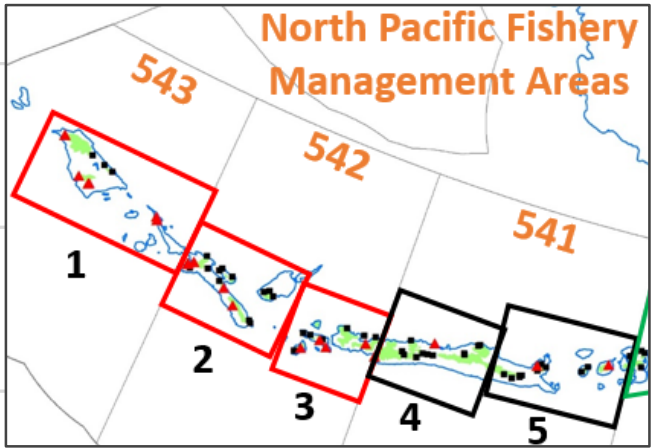


Tollit et al. 2017. Diet of endangered Steller sea lions in the Aleutian Islands: new insights from DNA detections and bio-energetic reconstructions. Can. J. Zool. 95(11).

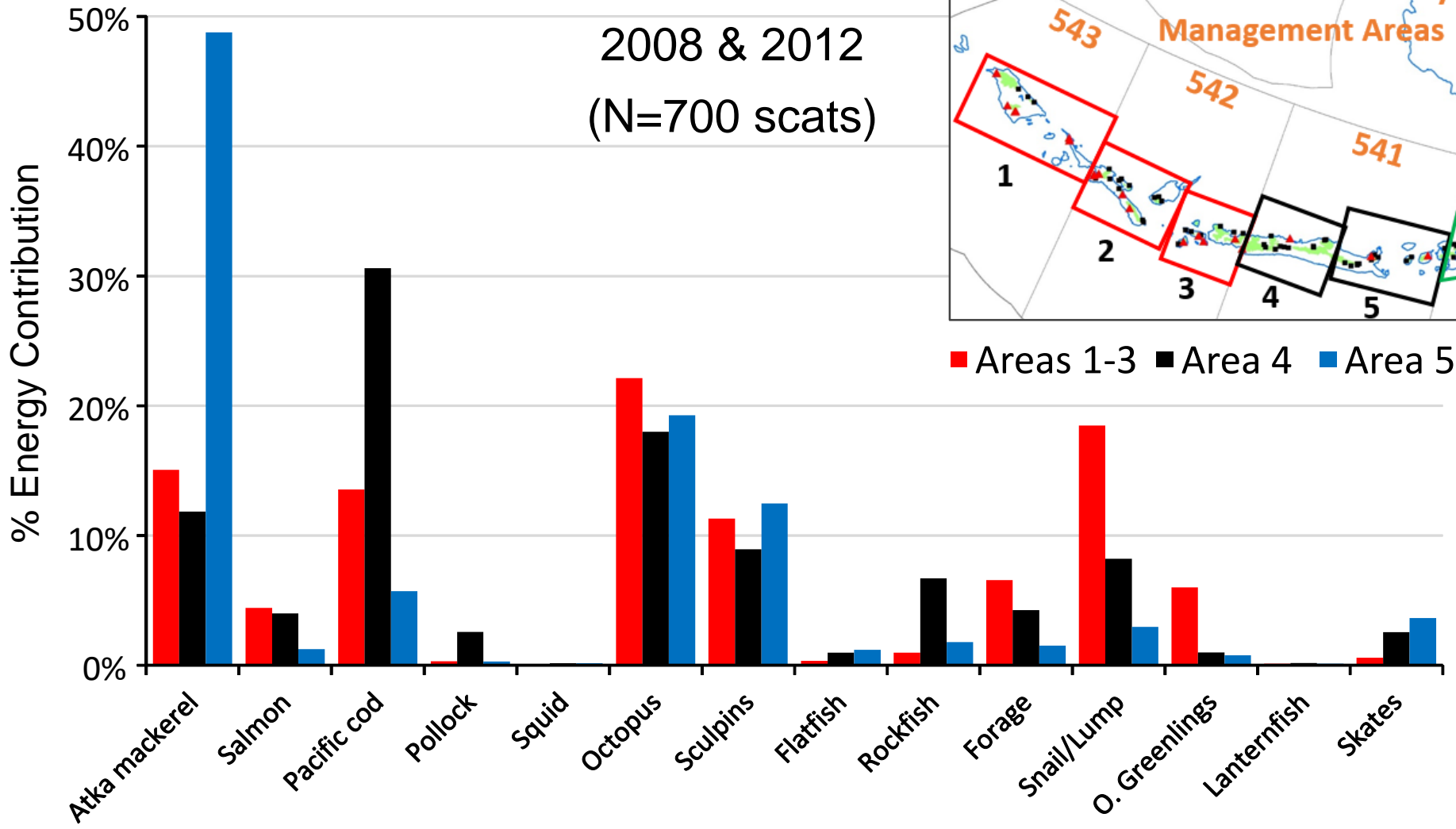
# Steller sea lion Aleutian Islands winter diet biomass reconstruction

Based on: Tollit, et al. 2017.

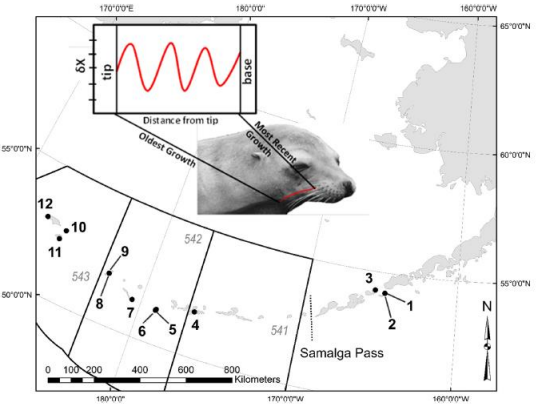
2008 & 2012  
(N=700 scats)



■ Areas 1-3 ■ Area 4 ■ Area 5



# Steller sea lion individual adult female diet diversity



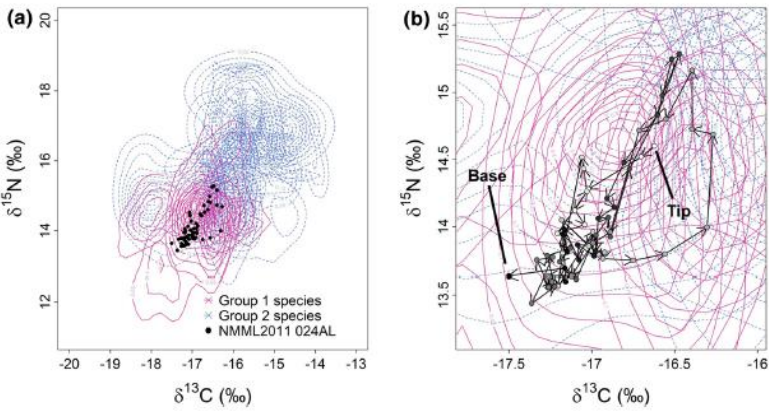
Oecologia (2018) 188:263–275  
<https://doi.org/10.1007/s00442-018-4173-8>

COMMUNITY ECOLOGY – ORIGINAL RESEARCH

Temporal records of diet diversity dynamics in individual adult female Steller sea lion (*Eumetopias jubatus*) vibrissae

A. C. Doll<sup>1</sup> · B. D. Taras<sup>2</sup> · C. A. Stricker<sup>3</sup> · L. D. Rea<sup>2,4</sup> · T. M. O'Hara<sup>5</sup> · A. P. Cyr<sup>6</sup> · S. McDermott<sup>7</sup> · T. M. Loomis<sup>8</sup> · B. S. Fadely<sup>9</sup> · M. B. Wunder<sup>1</sup>

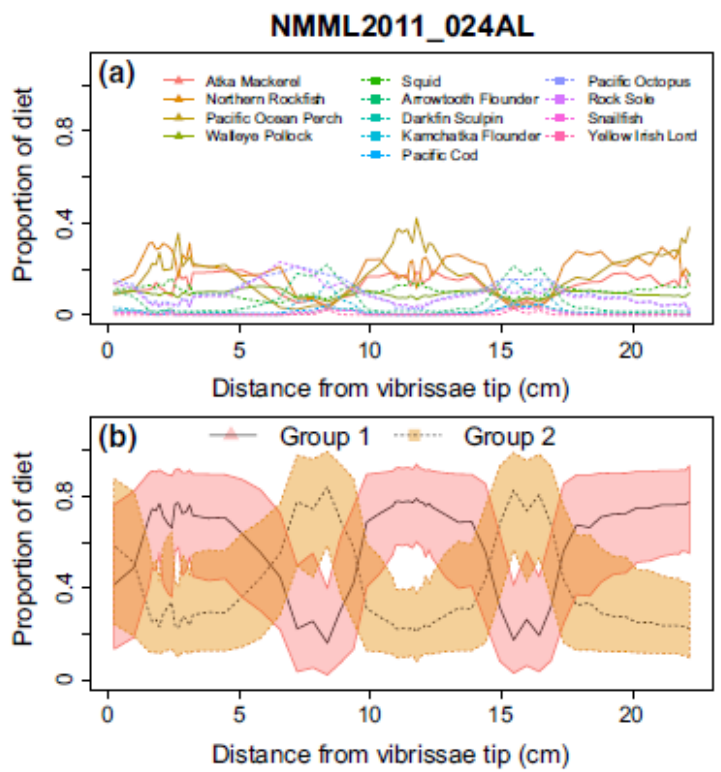
Received: 13 April 2017 / Accepted: 21 May 2018 / Published online: 13 June 2018  
 © Springer-Verlag GmbH Germany, part of Springer Nature 2018



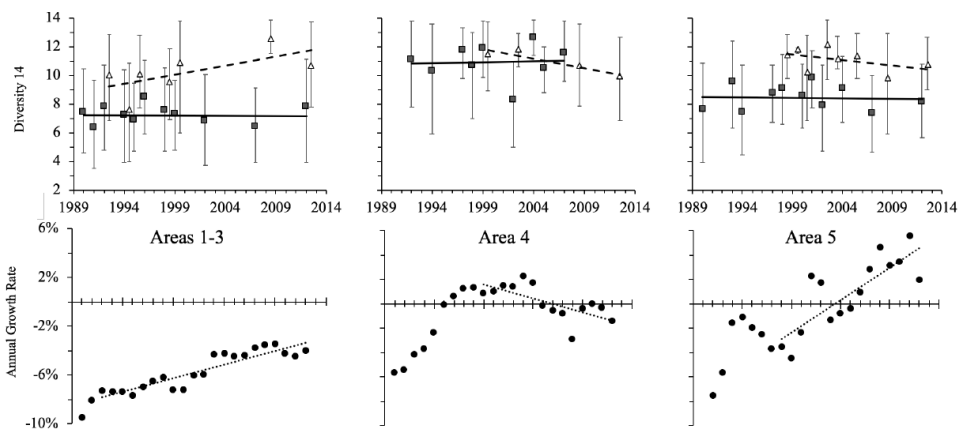
**Significant seasonal shifts in diet**

Summer: higher proportion of lower trophic level species (Pacific Ocean Perch; northern rockfish, Atka mackerel, pollock)

Winter: more diverse diet with more higher trophic level species (arrowtooth flounder, Pacific cod, octopus, rock sole, snailfish)



# Steller sea lion population diet diversity



Modeled Steller sea lion (*Eumetopias jubatus*) diet diversity.

Top three panels show breeding (filled squares and solid simple linear trend line) and non-breeding season (open triangles and dashed simple linear trend line) diversity.

Bottom three panels show estimated annual rate of change in counts of adult and juvenile Steller sea lions; dotted lines are simple linear trends over the same time period as non-breeding season diversity in each area.

The screenshot shows the journal's homepage with a navigation bar (Home, About Us, Journals, Books, Compilations, Open Access, Authors, Librarians, Society) and a breadcrumb trail: Home > Journals > Canadian Journal of Zoology > List of Issues > Volume 0, Number 1a > A re-examination of the relationship between Steller sea lion diet and population trend using data from the Aleutian Islands. The article title is prominently displayed, along with authors (Lowell William Fritz Fritz, Brian Brost, Edward Laman, Katie Luxa, Kathryn Sweeney, James Thomason, Dominic John Tollit, PhD, William Walker, Tonya Zeppelin), publication date (10 September 2019), and a DOI link.

No significant change in diet diversity over the 23-y study period, nor any significant differences across the Aleutian Islands.

Results consistent with prey abundance data from nine groundfish bottom trawl surveys.

Relationship between Steller sea lion diet metrics and population trends in the Aleutian Islands over a 22-y period (1990-2012) is inconsistent/non-existent.

While diet studies detail *what* Steller sea lions eat and provide an estimate of their energy intake, they provide only limited information on the energy expended to obtain their food or the consequences of their diet and foraging ecology on individual or population fitness.





# Habitat Use – Steller sea lions



**Lander et al. *in review*. Mixing it up in Alaska: habitat use of adult female Steller sea lions reveals a variety of foraging strategies.**

- Pronounced individual variation
- Primarily nocturnal foragers
- Deep Water: Shallow dives at night and deep during day. Possibly feeding on vertically migrating prey (e.g. Salmonidae, Myctophidae, and Gonatidae)
- Continental shelf: opposite with on bottom at night and shallow during day. Consistent with foraging on benthic species (e.g. Atka mackerel)
- Summer: 92% of time within critical habitat, and mostly within 200 m isobath
- Winter: 26% of locations beyond 200 m isobath, 80% within critical habitat

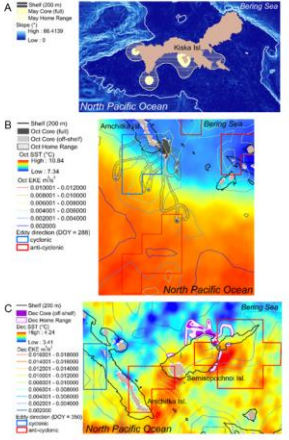


Fig. 5. Examples of monthly core (50% isopleths) and home range (95% isopleths) polygons plotted with respect to select environmental covariates to illustrate significant cases provided in

Received: 1 March 2019 | Accepted: 9 July 2019  
 DOI: 10.1111/2041-210X.13275

RESEARCH ARTICLE

Methods in Ecology and Evolution

### The Langevin diffusion as a continuous-time model of animal movement and habitat selection

Théo Michelot<sup>1,2</sup> | Pierre Gloaguen<sup>3</sup> | Paul G. Blackwell<sup>1</sup> | Marie-Pierre Étienne<sup>4</sup>

FIGURE 8 Estimated utilization distribution for the sea lion analysis (left), and its logarithm, for comparison with Wilson et al. (2018) (right). This figure shows the results of the model fitted jointly to the three individuals. The black dots are the filtered sea lion locations

Received: 7 September 2017 | Accepted: 19 December 2017  
 DOI: 10.1111/2041-210X.12967

APPLICATION

Methods in Ecology and Evolution

### Estimating animal utilization densities using continuous-time Markov chain models

Kenady Wilson<sup>1</sup> | Ephraim Hanks<sup>2</sup> | Devin Johnson<sup>1</sup>

FIGURE 5 Combined UD for all three Steller sea lions in the central Aleutian Islands, Alaska