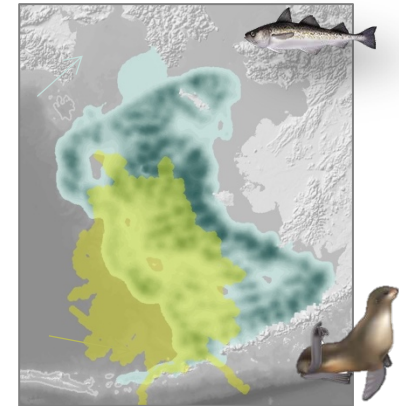
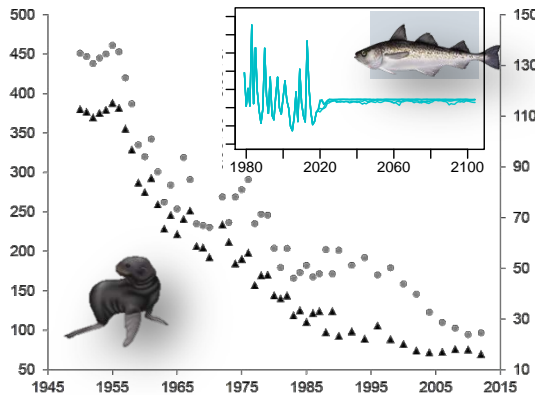


# Northern fur seal research



1. Pup production estimates of the eastern Pacific stock
2. Some noteworthy differences in feeding behavior
3. What do the Pribilof Island seals eat and how much?
4. How do St. Paul seals respond to the availability of pollock?
5. It's not all about summer, winter pup dispersal research results



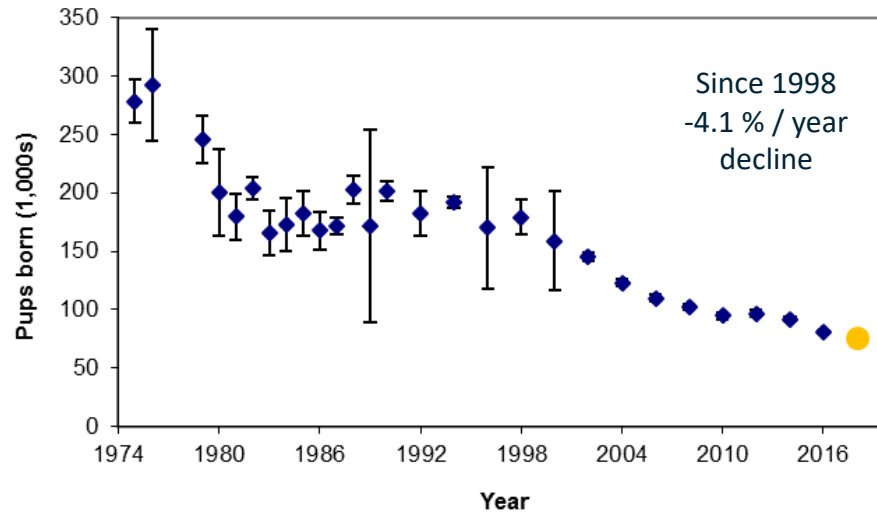
Plan Team 18 September 2019



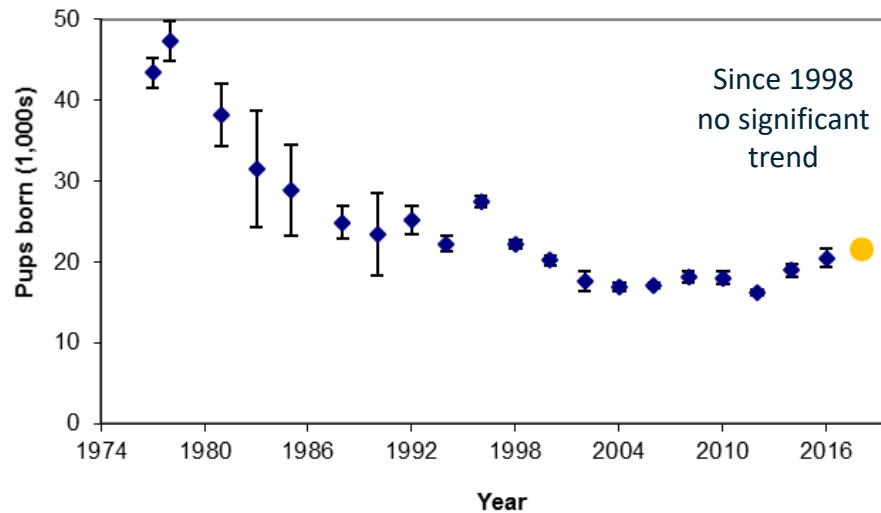
# How many Pribilof Islands seals?



### St. Paul



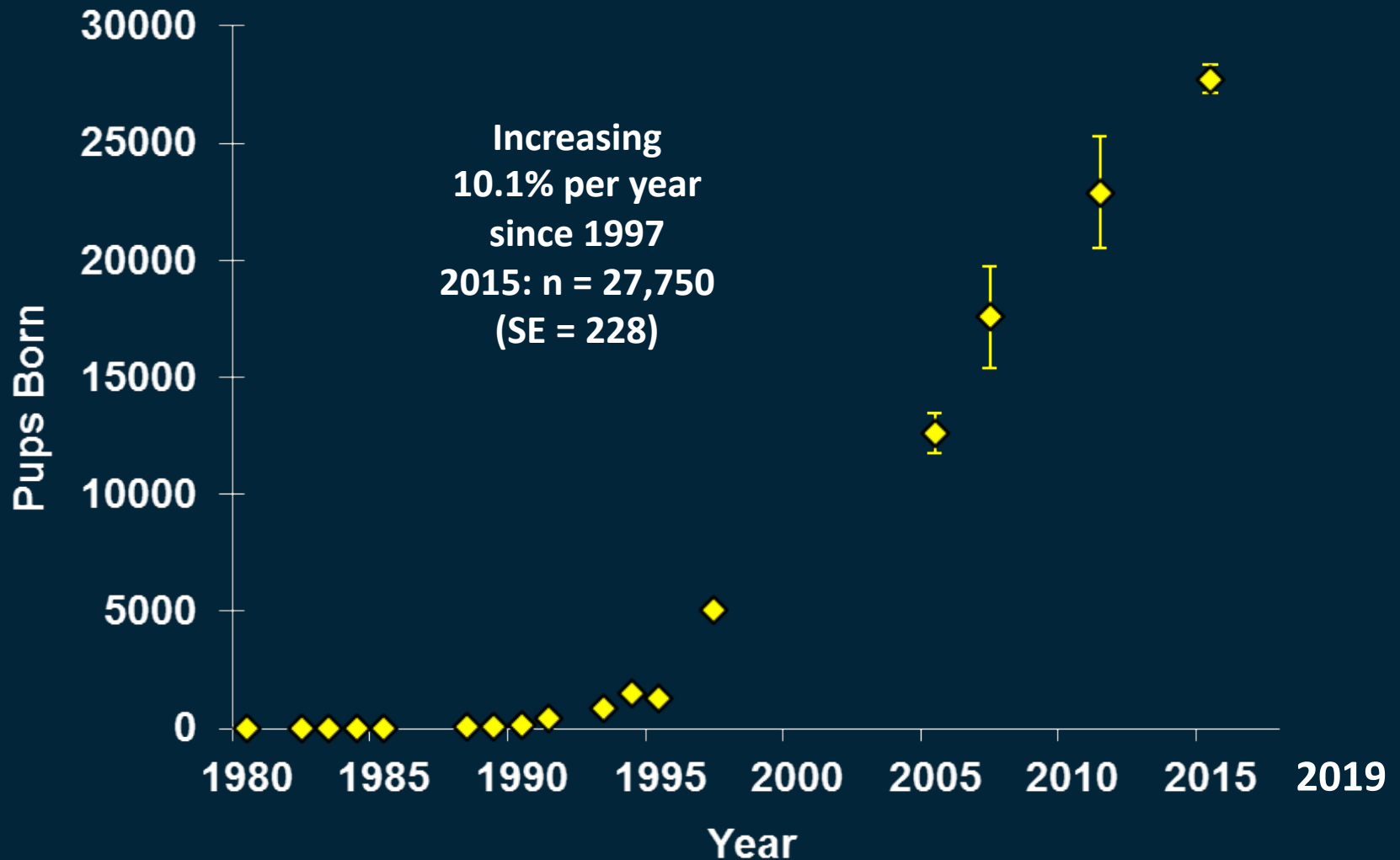
### St. George



# How many Bogoslof seals?



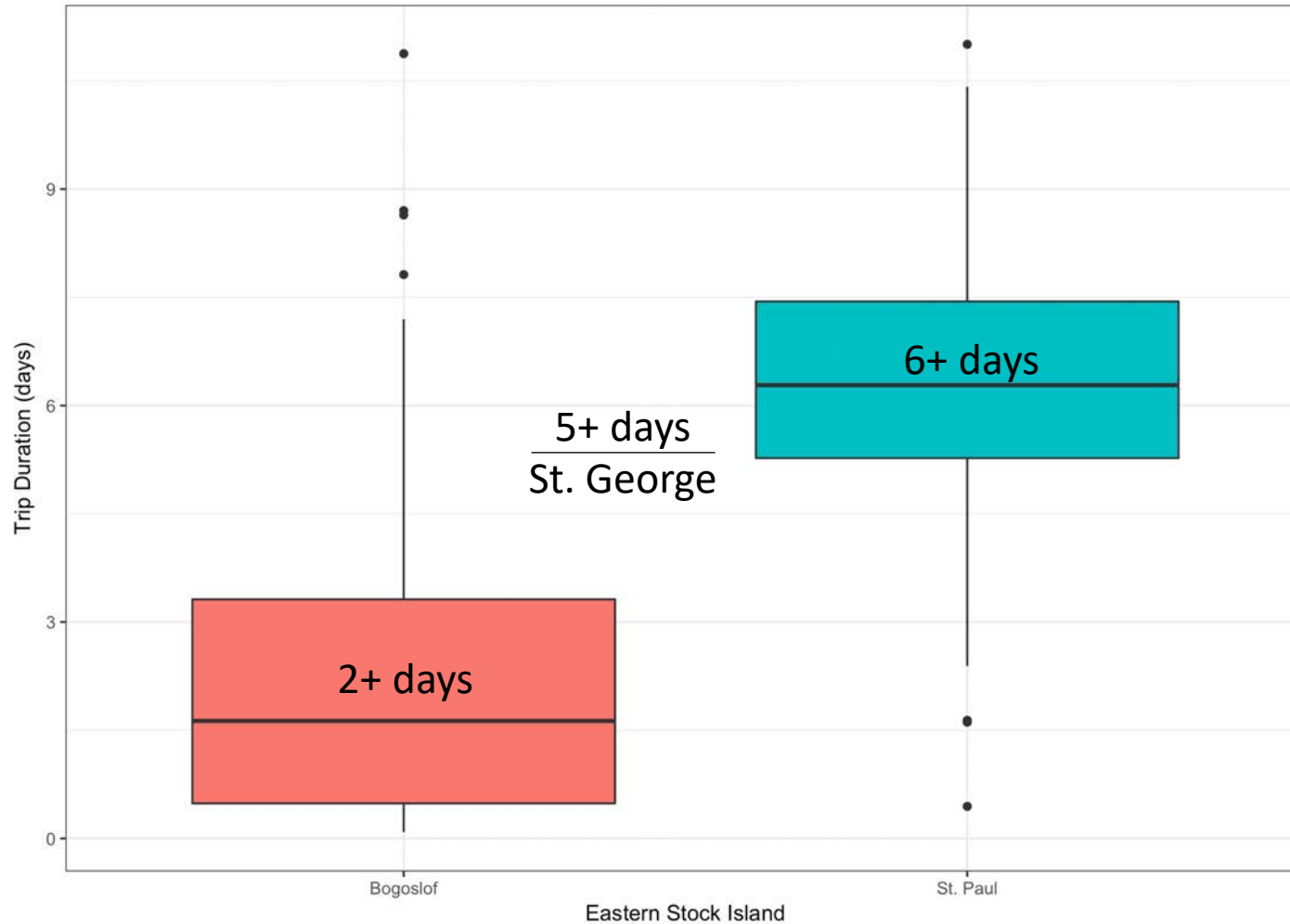
Preliminary results



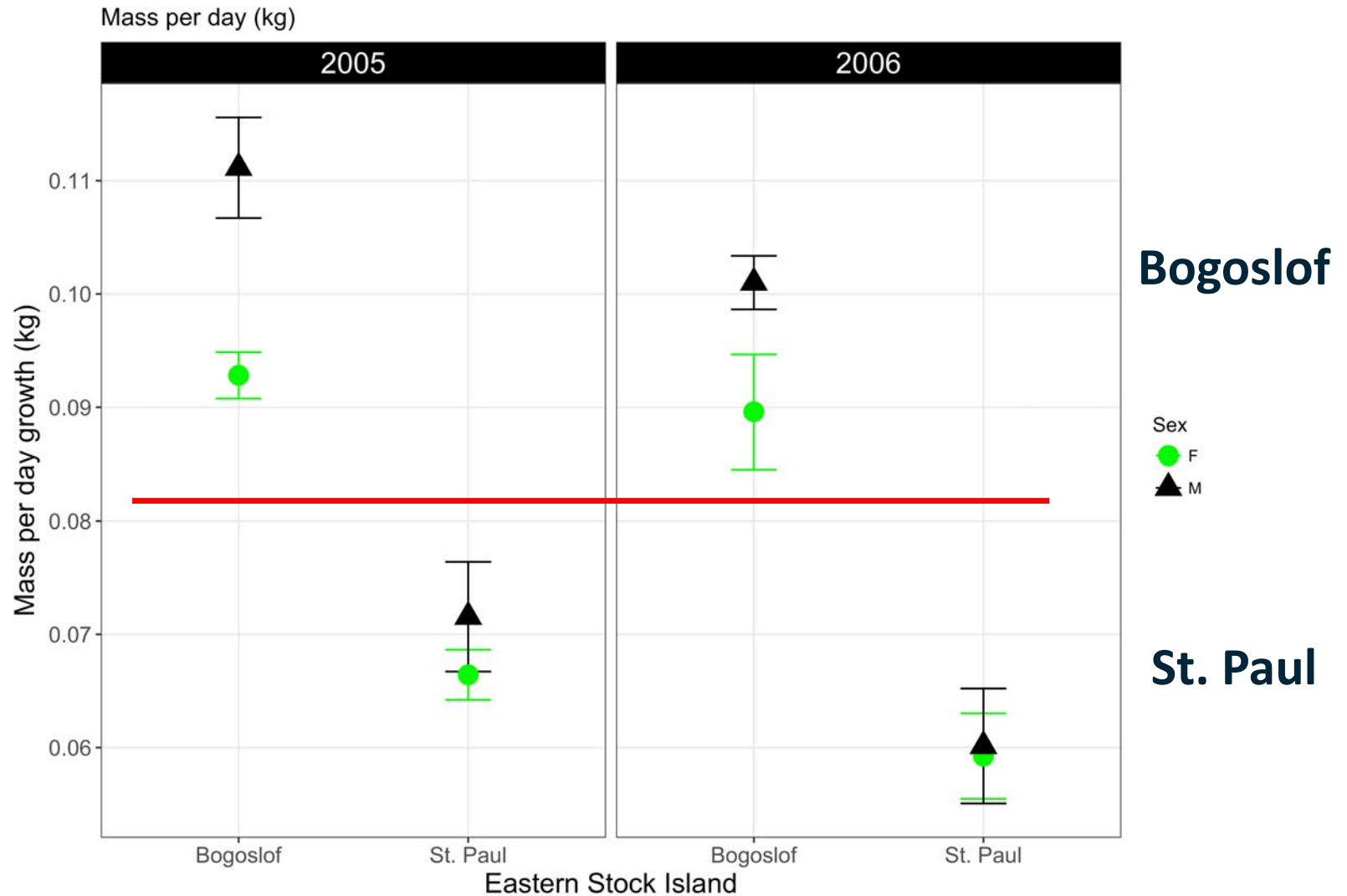
# Noteworthy differences: Length of moms feeding trips



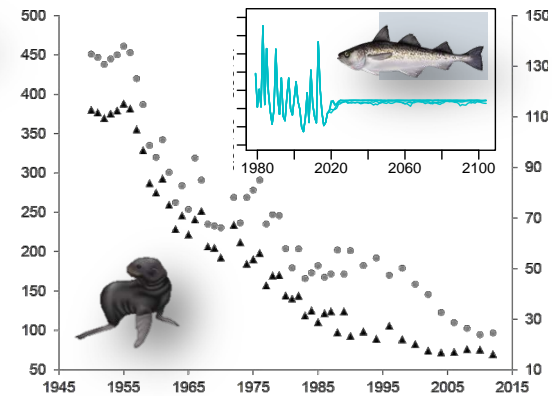
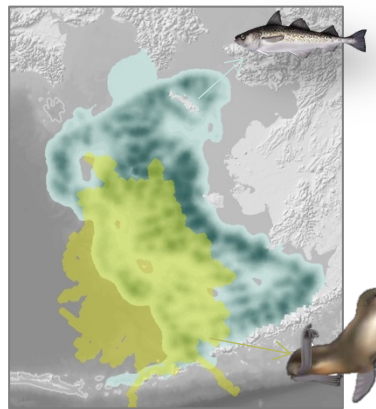
Bogoslof vs. St. Paul Trip Durations



# Noteworthy differences: Consequence of longer feeding trips



# What do the Pribilof Island fur seals eat and how much?



A collaboration between the **JOINT INSTITUTE FOR THE STUDY OF ATMOSPHERE AND OCEAN AT THE UNIVERSITY OF WASHINGTON** and the **RESOURCE ECOLOGY AND FISHERIES MANAGEMENT AND MARINE MAMMAL LABORATORY AT THE ALASKA FISHERIES SCIENCE CENTER** with support from **THE LENFEST OCEAN PROGRAM**



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# Project Goal



*By combining a spatially explicit fur seal bioenergetics model with **ecosystem** and **stock assessment models** we can provide feedbacks between pollock and fur seal stock assessments and contribute to **conservation** goals*

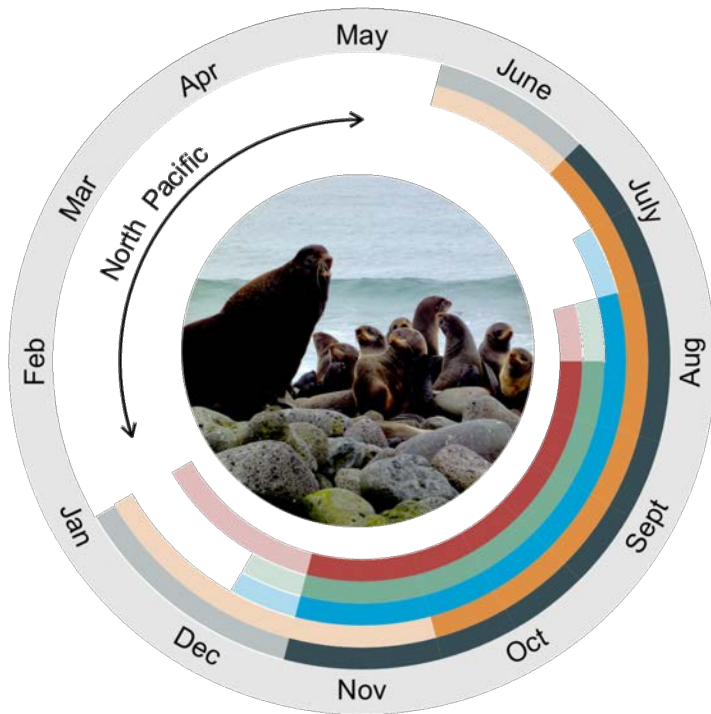
# Bioenergetic model



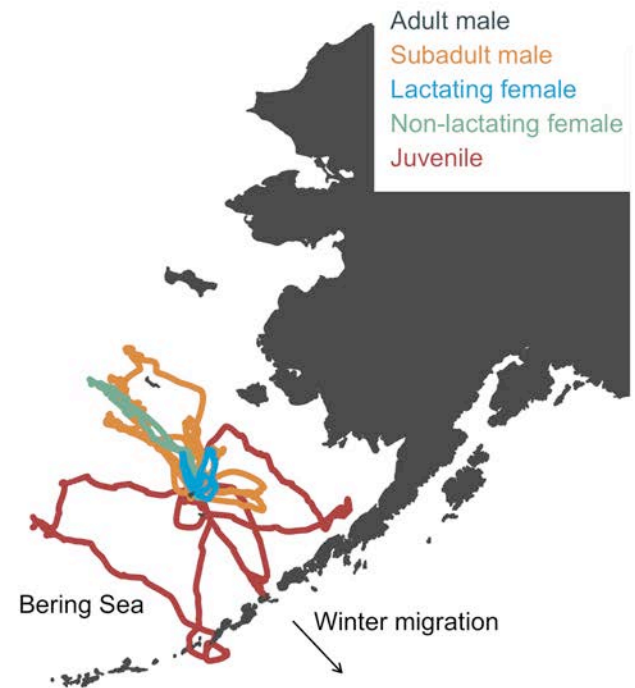
## Adding up the costs an animal experiences

- 6 years (1995 – 1996, 2004 – 2006, 2010)

Adult male   Subadult male   Lactating female   Non-lactating female   Juvenile



Variation in timing of arrival and departure



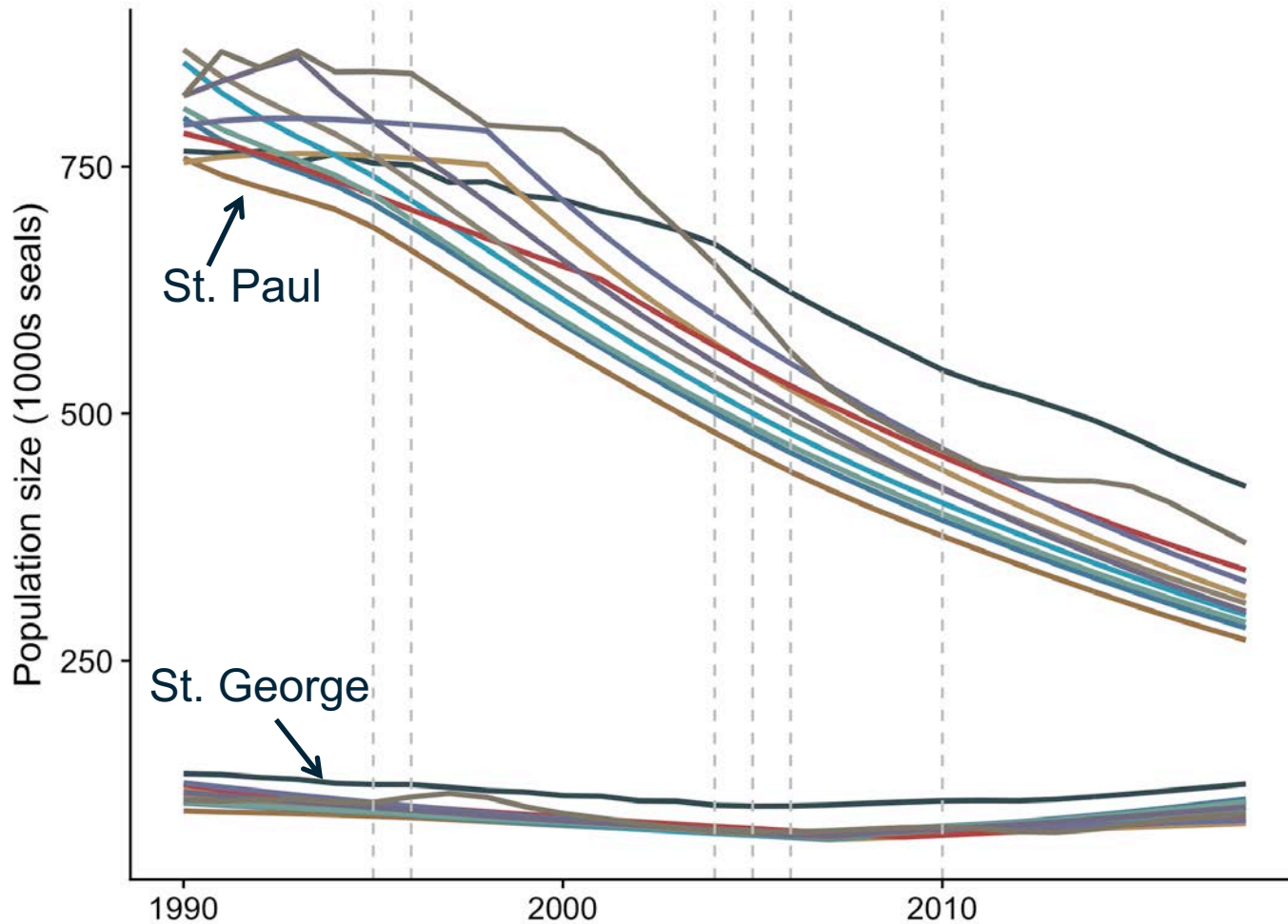
Variation in duration of foraging trips



# Bioenergetic model



11 different population models



Breakdown



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# Fur seal current energy intake



Juvenile



Adult ♂



6,000 kcal day sea<sup>-1</sup>  
438,000 kcal

26,500 kcal day sea<sup>-1</sup>  
3,301,000 kcal

30 day sea<sup>-1</sup>  
2,190 season

132 day sea<sup>-1</sup>  
16,500 season



Donut equivalents

2010    1995



370 – 620 billion kcal (too many donuts to count)



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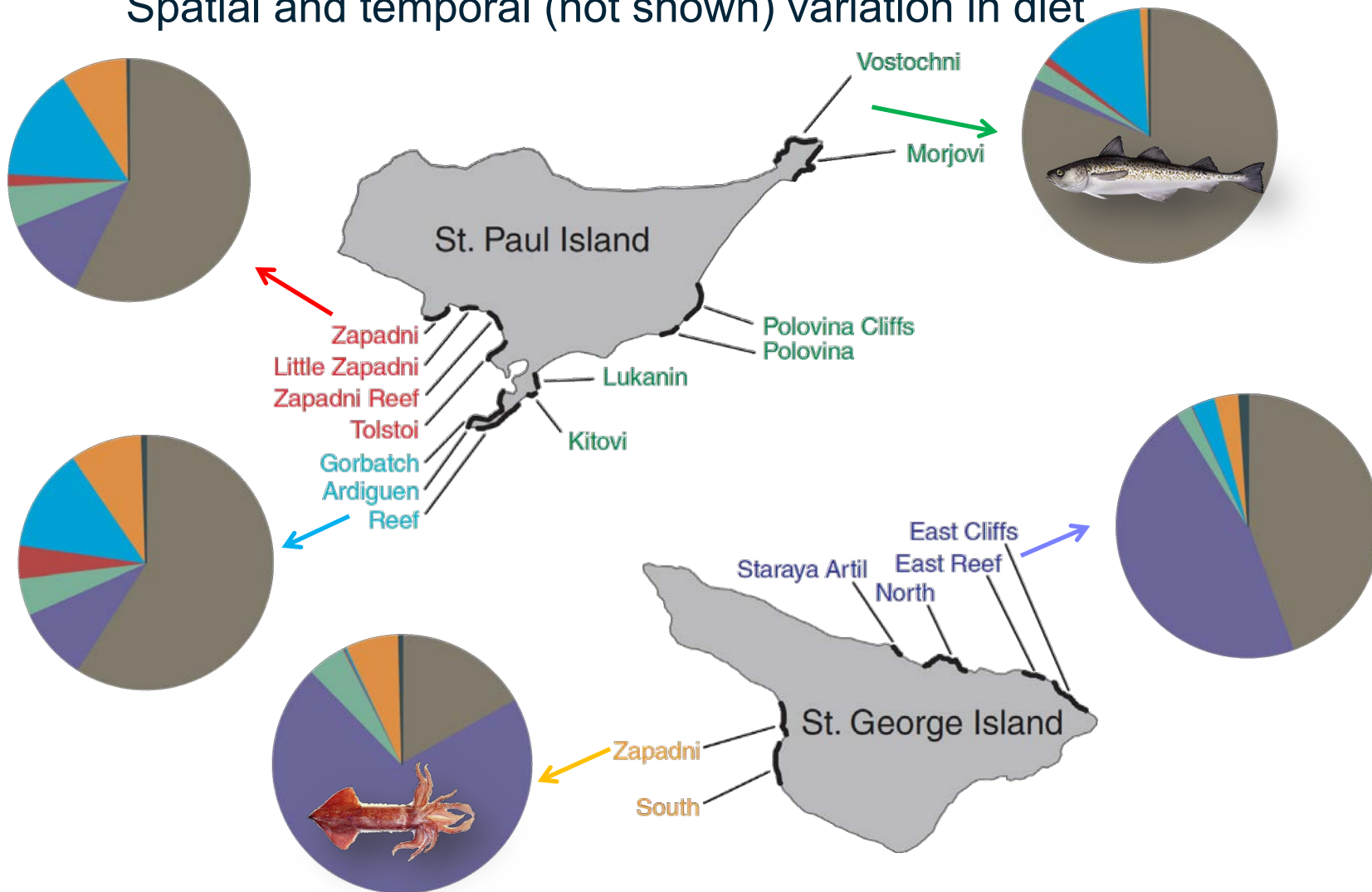
AFSC Contact: Jeremy Sterling  
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# Diet reconstruction to estimate consumption



Spatial and temporal (not shown) variation in diet



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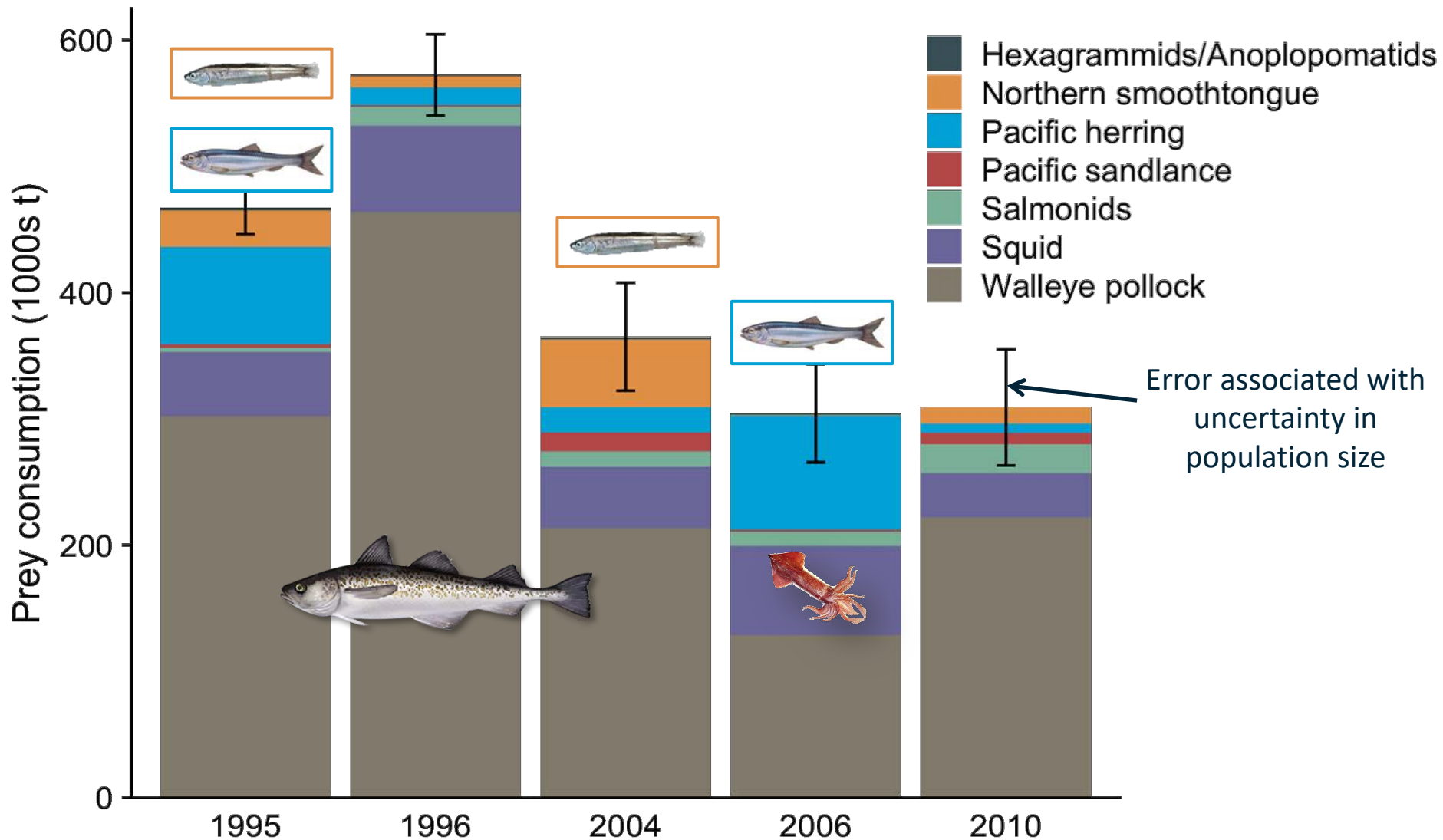


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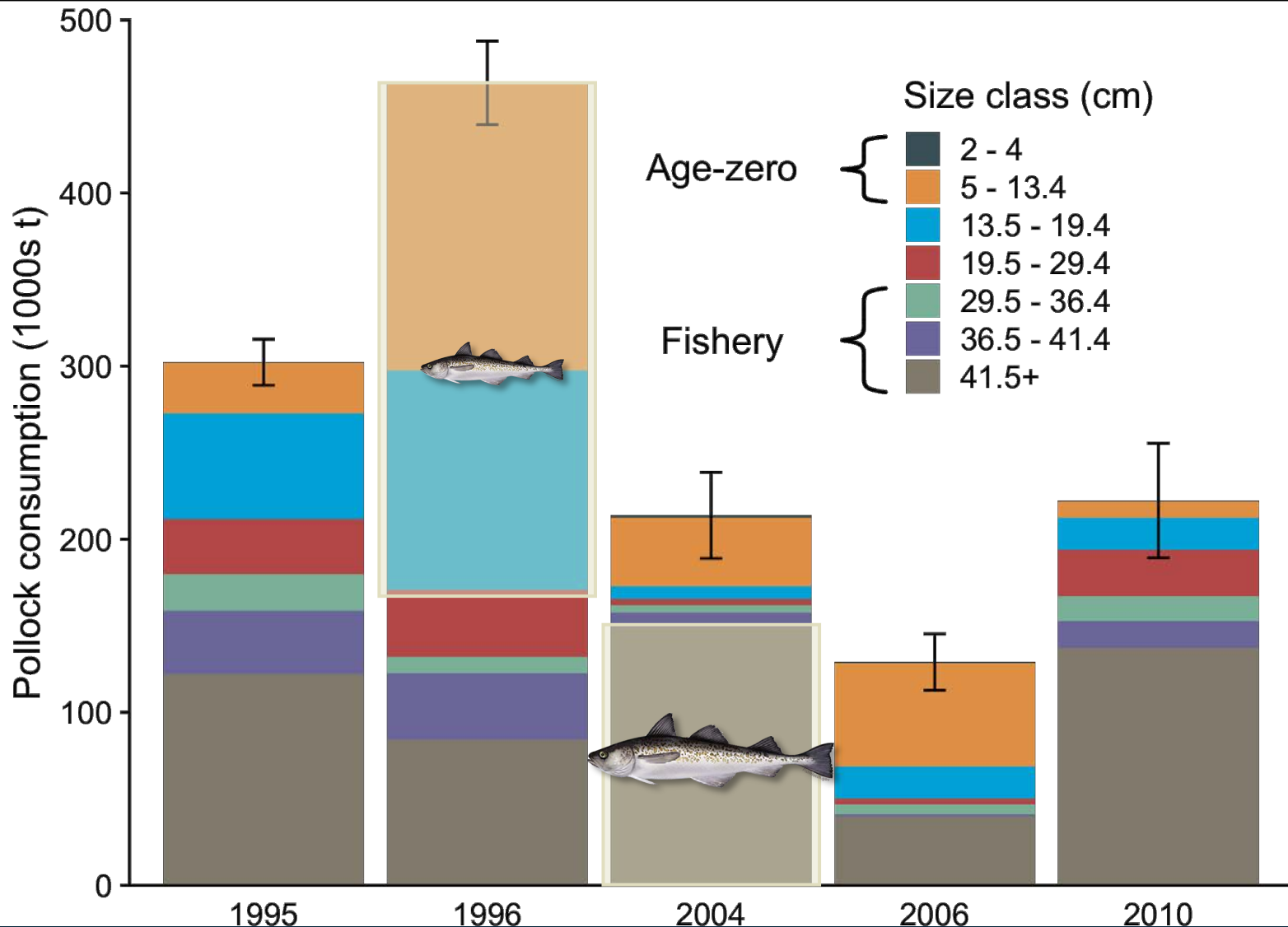
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# Prey consumption



# Size-specific pollock consumption



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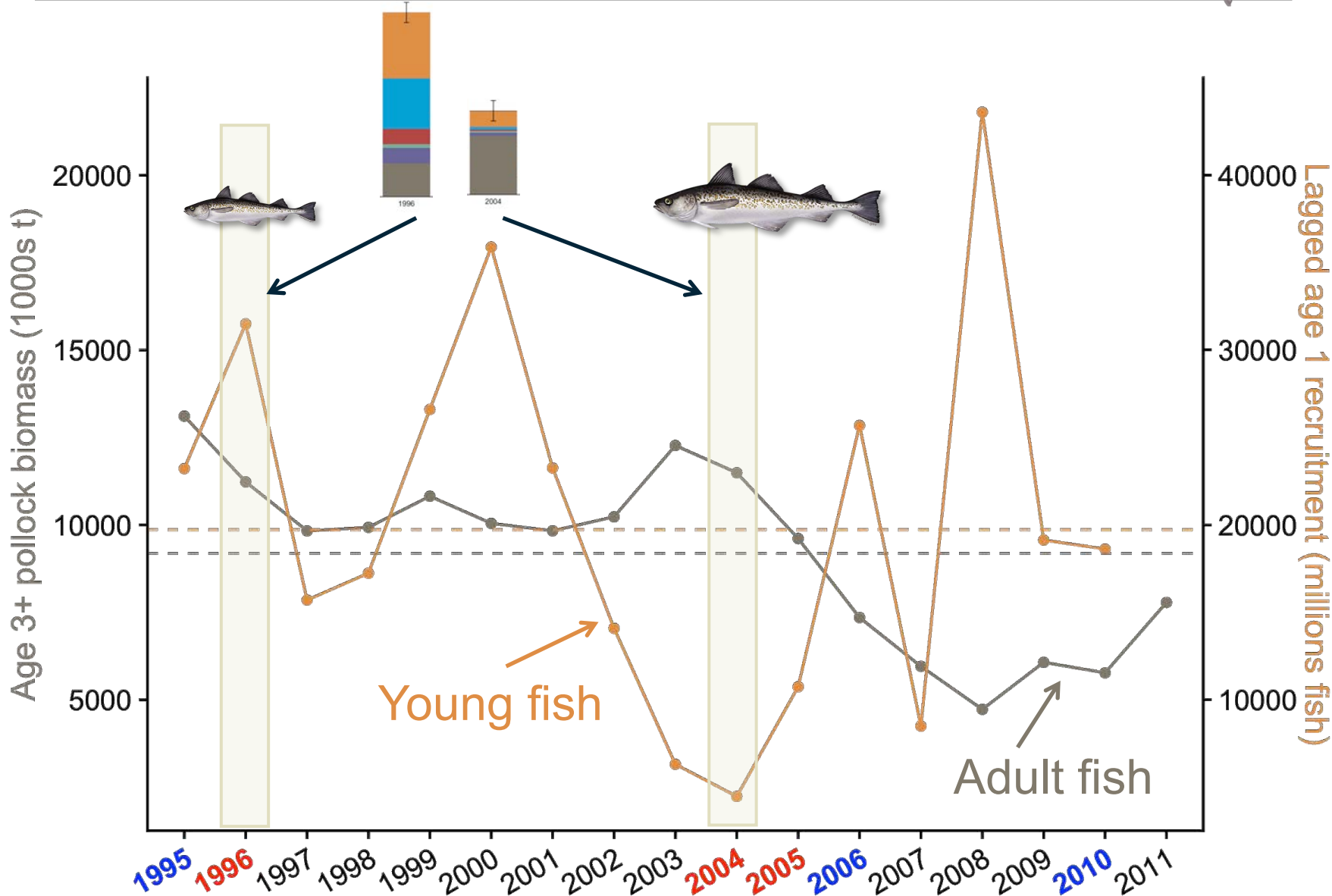


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# Pollock consumption vs. stock assessment



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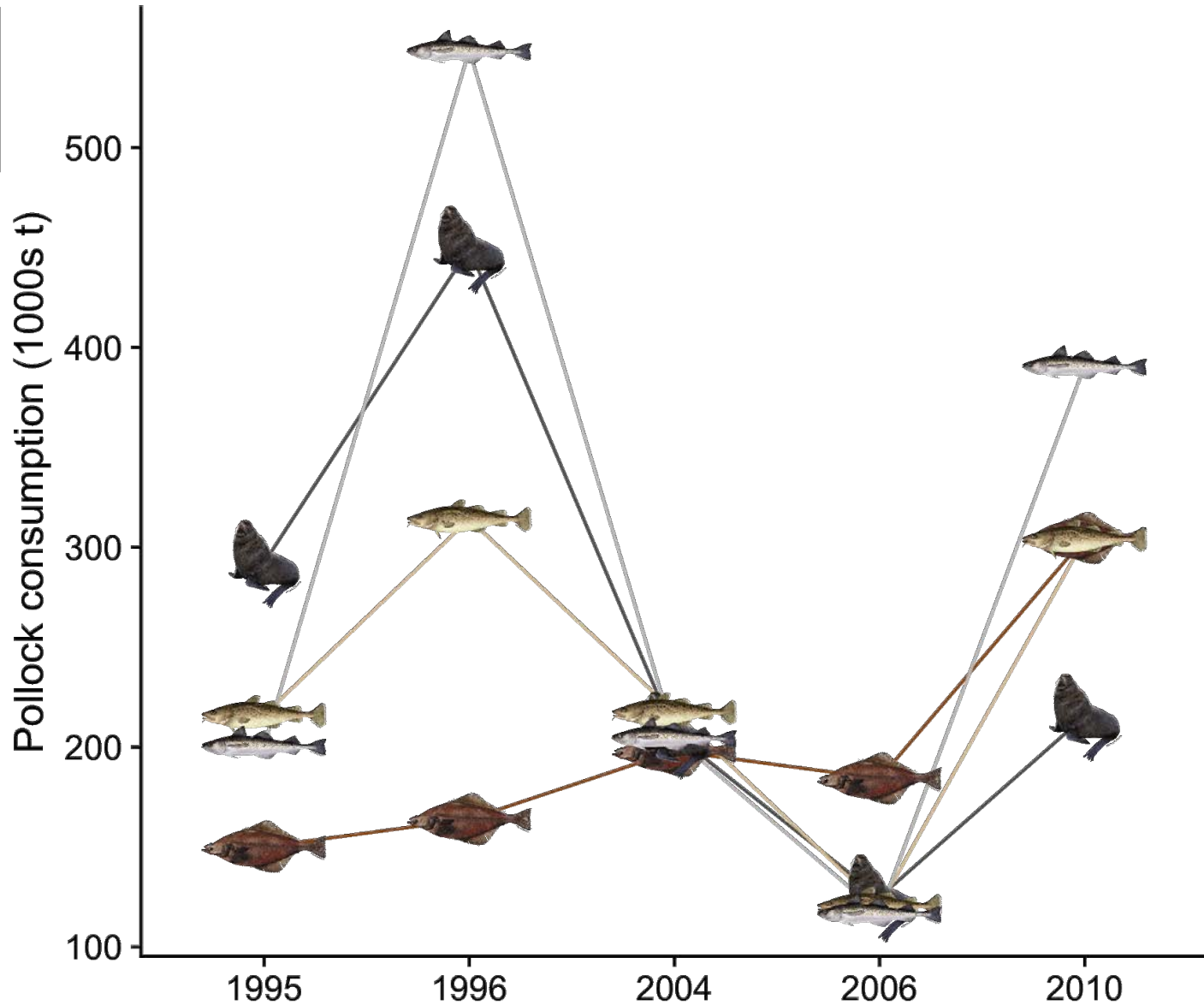
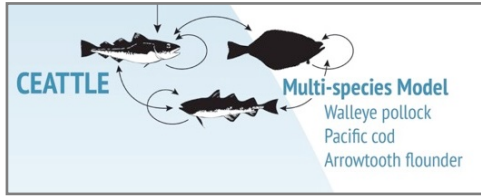


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# Pollock consumption compared to CEATTLE predators



Arrowtooth flounder



Pacific cod



Walleye pollock



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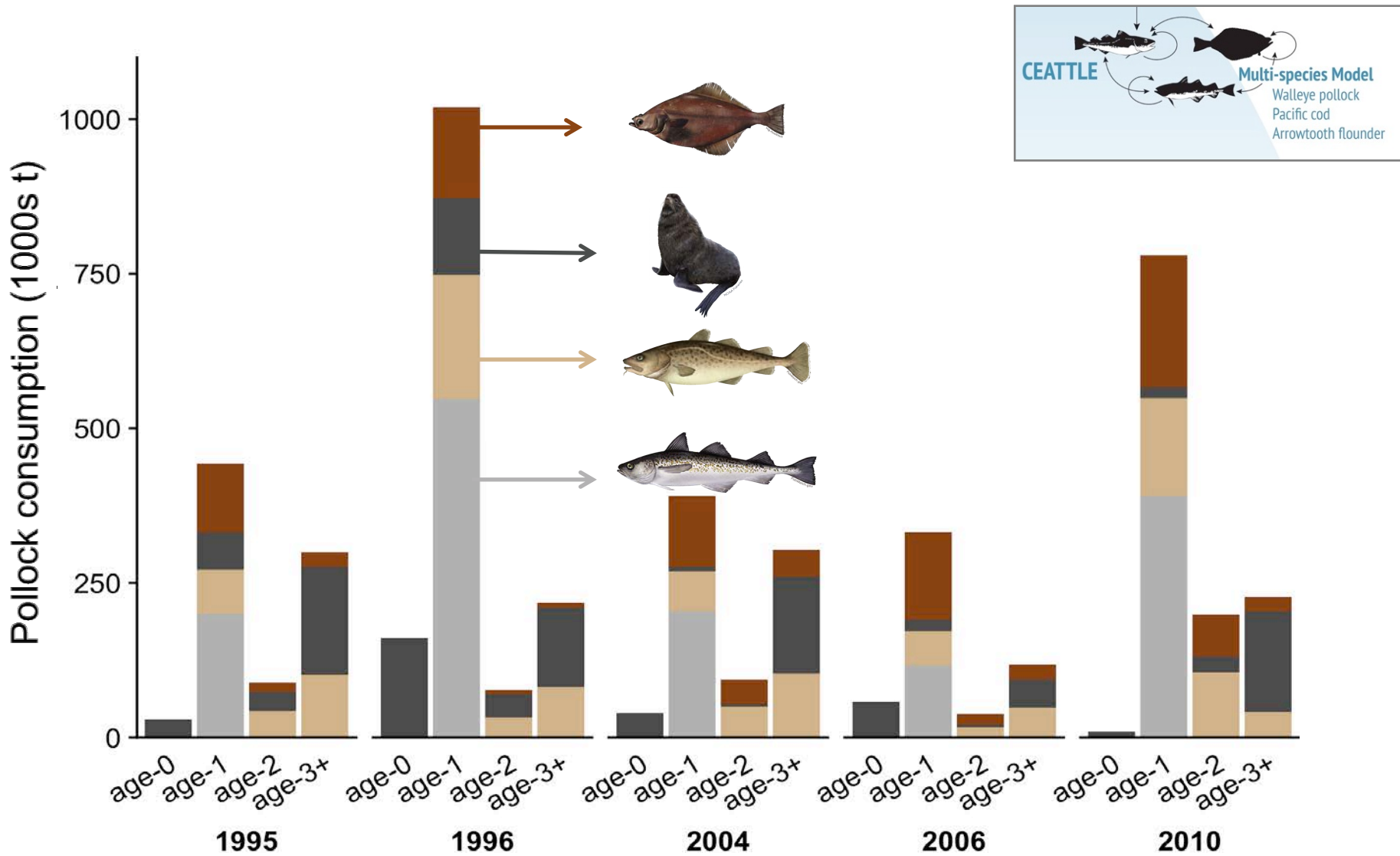


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# Pollock consumption compared to CEATTLE predators



**NOAA FISHERIES**



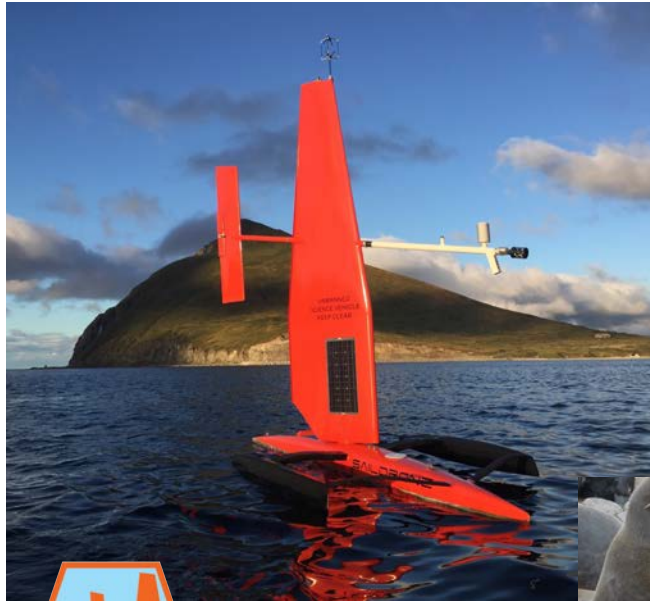
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# How do St. Paul seals respond to the availability of pollock?

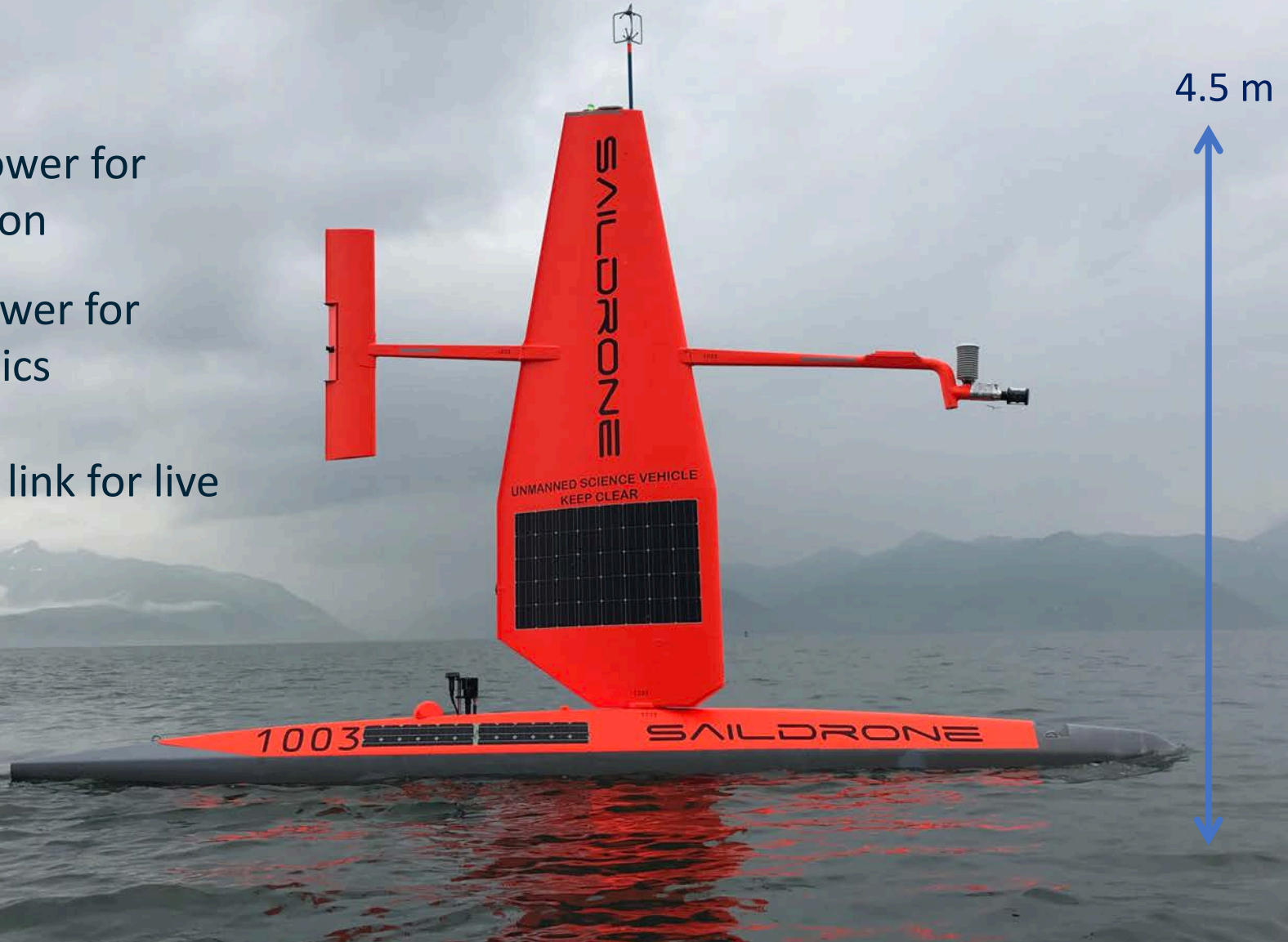


Carey Kuhn (Carey.Kuhn@noaa.gov)  
J. Sterling, A. De Robertis,  
M. Levine, C. Mordy, H. Tabisola,  
N. Lawrence-Slavas, C. Meinig,  
R. Jenkins

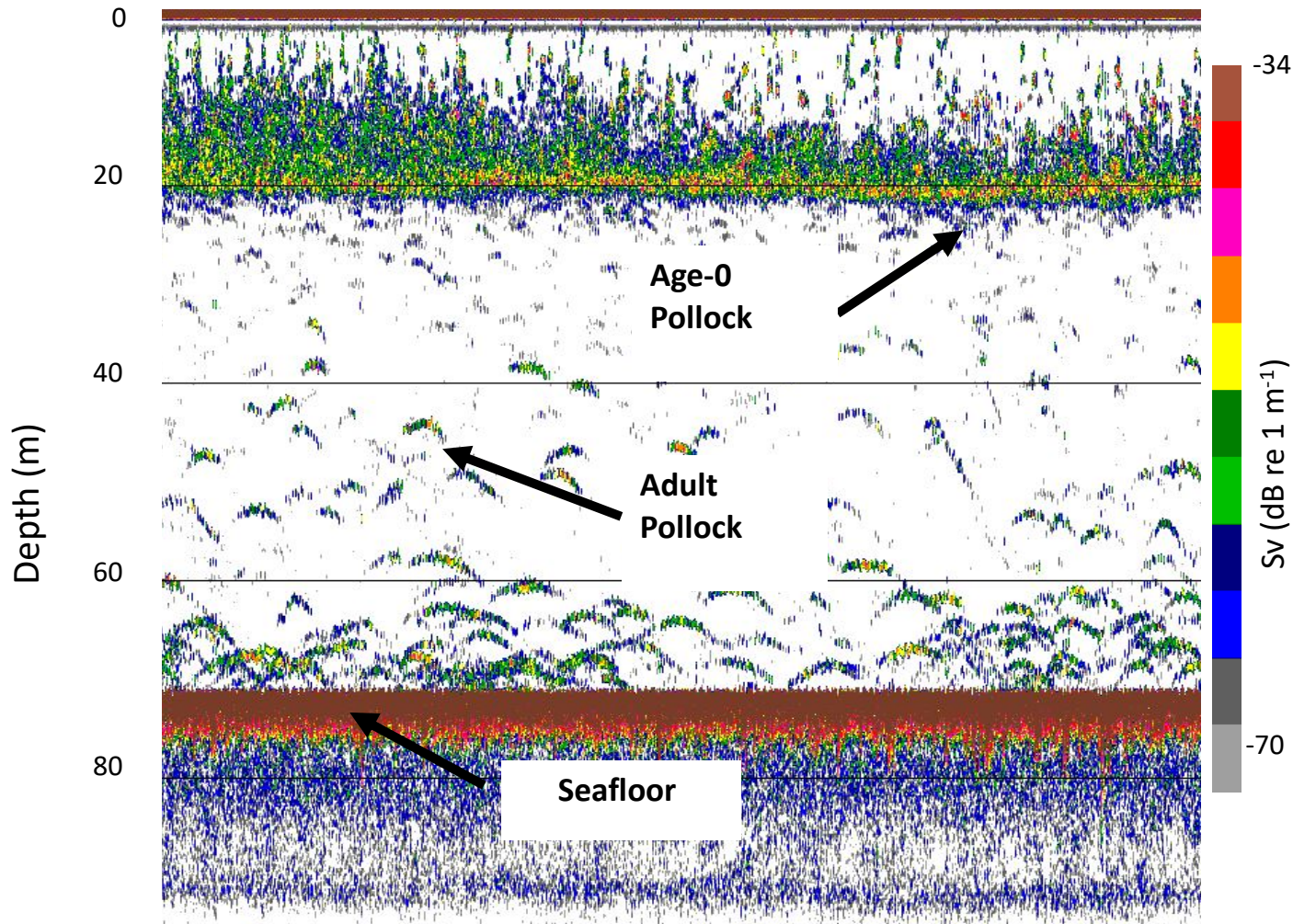


# Saildrone: unmanned, wind- and solar-powered surface vehicle

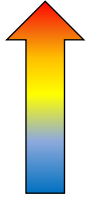
- Wind power for propulsion
- Solar power for electronics
- Satellite link for live data



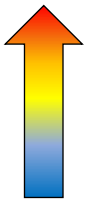
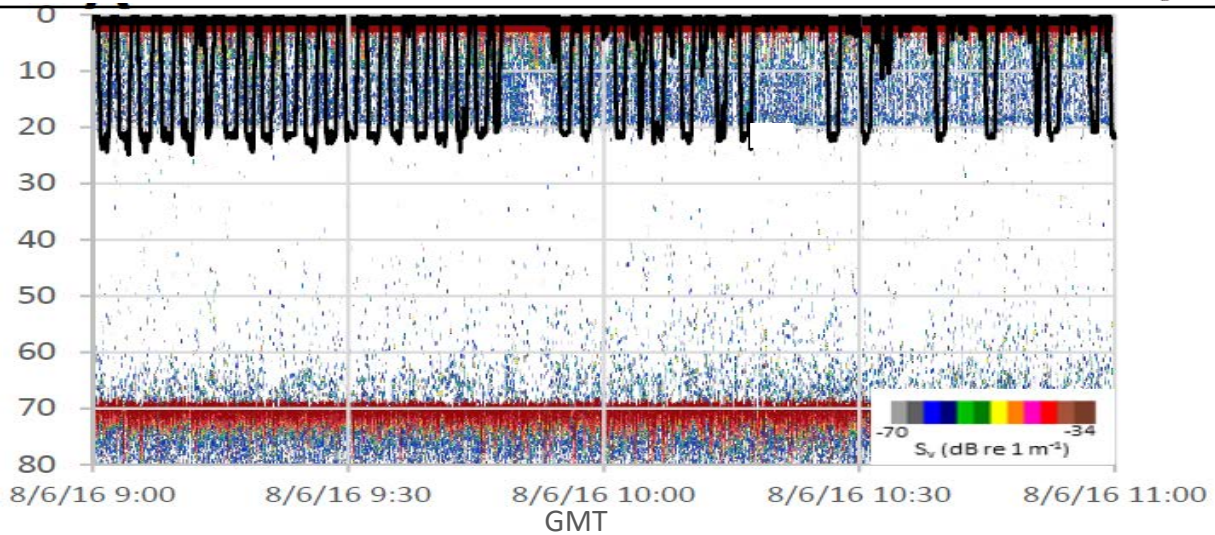
# Fisheries echosounder



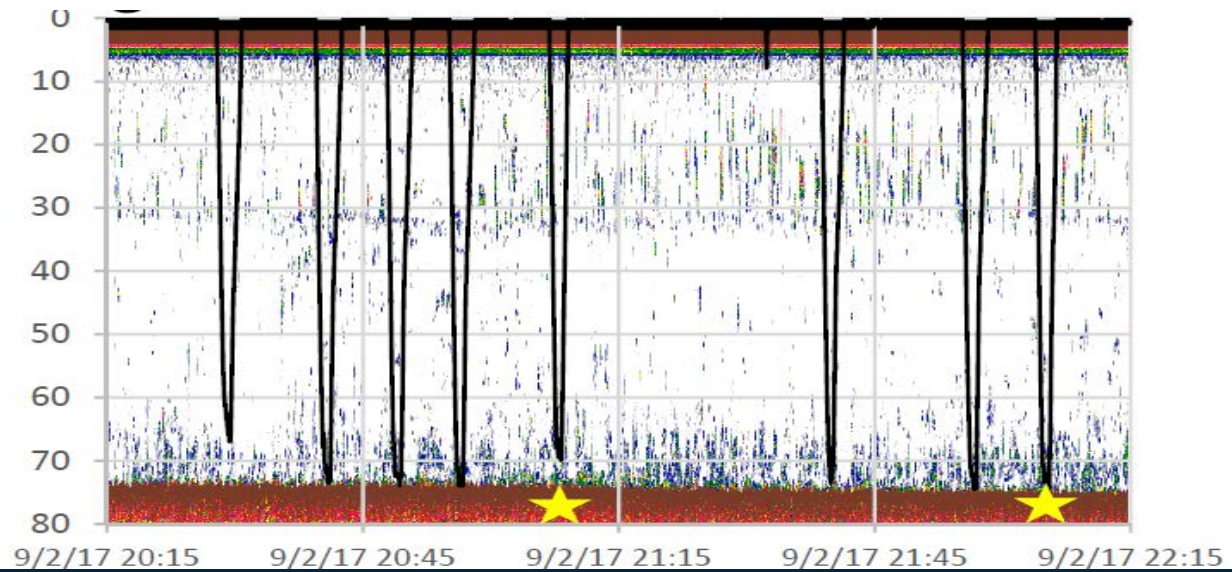
# Differences in fur seal dive behavior



Depth (m)

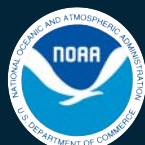
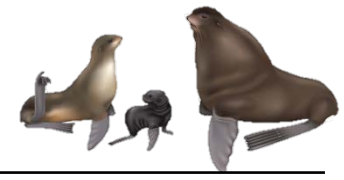


Depth (m)



# Small pollock foraging

---

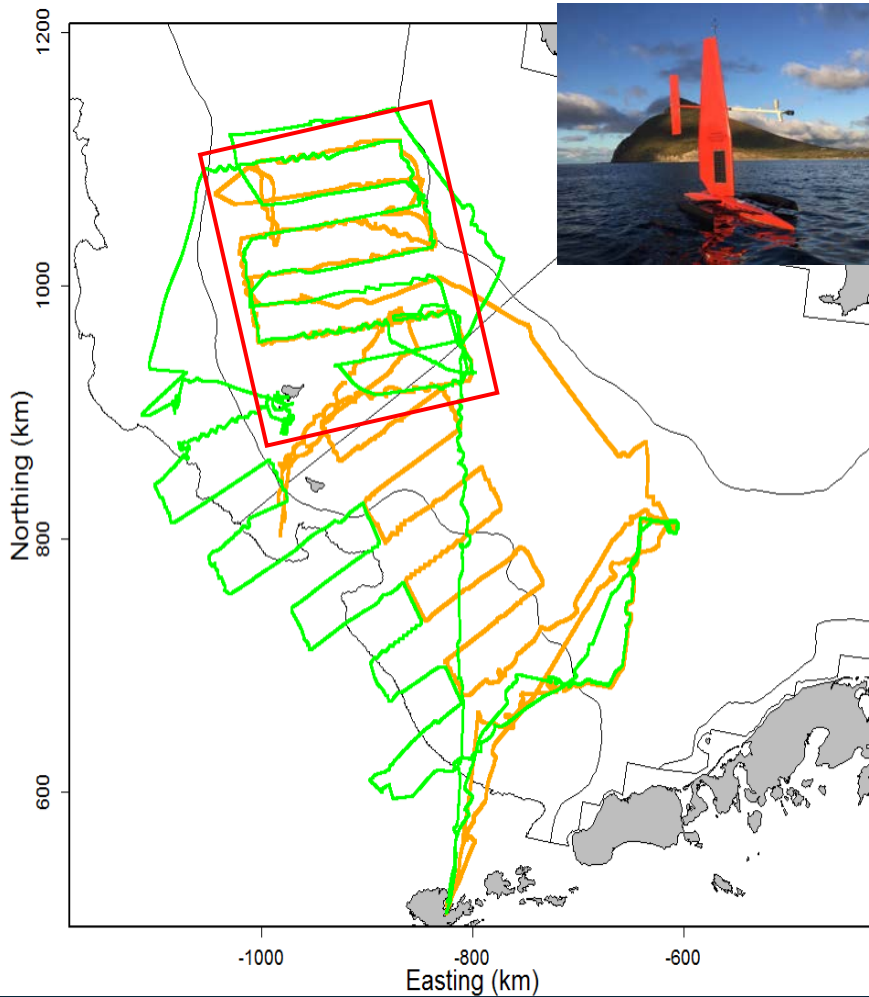


# Large pollock foraging



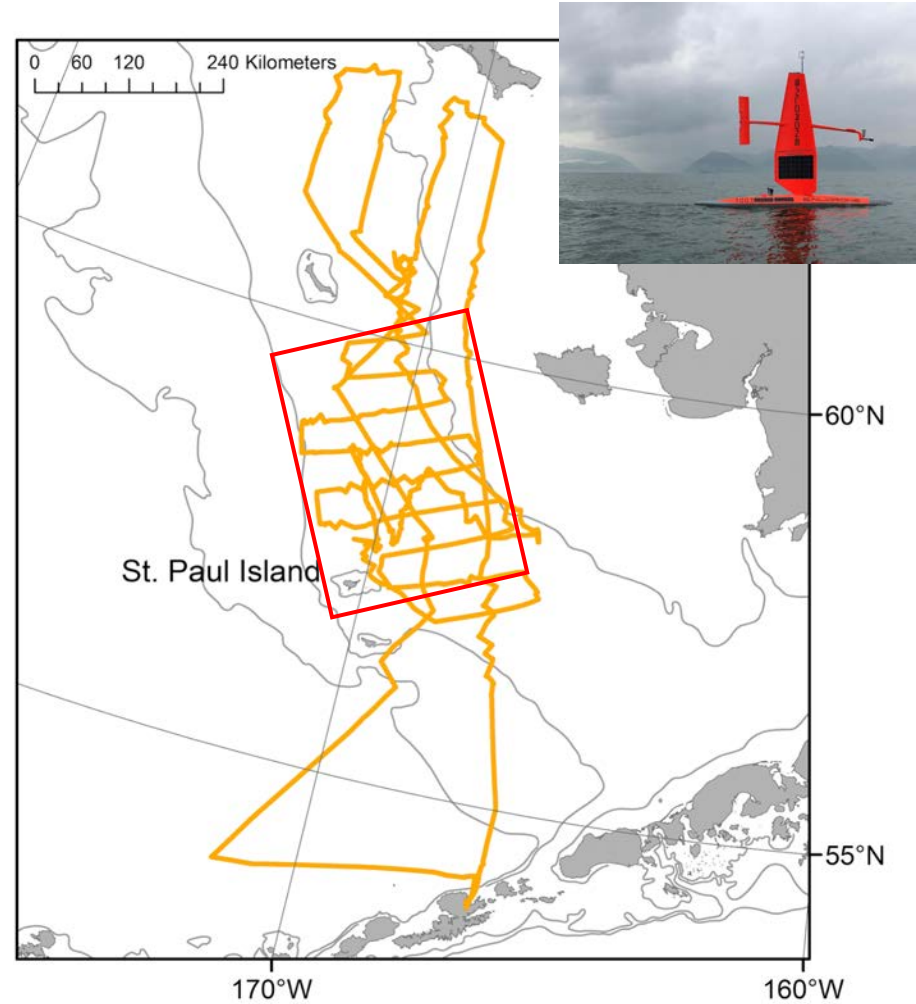
# 2016 Research

- 2 Sairdrones Bering Sea
- 65 sampling days in core fur seal area



# 2017 Research

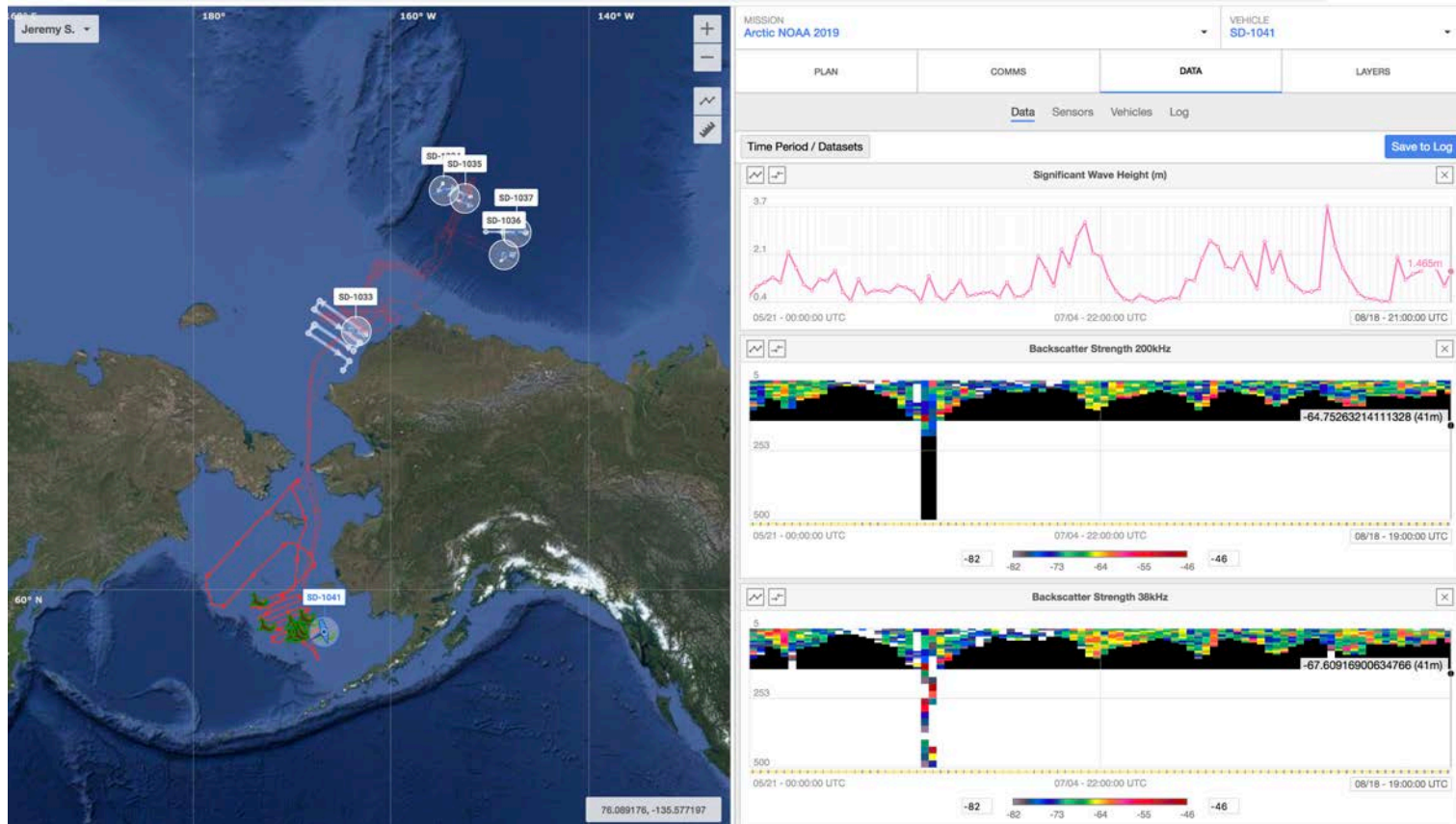
- 1 Sairdrone Bering Sea, 2 Arctic
- 36 sampling days in core fur seal area



# 2019 Saildrone fur seal study

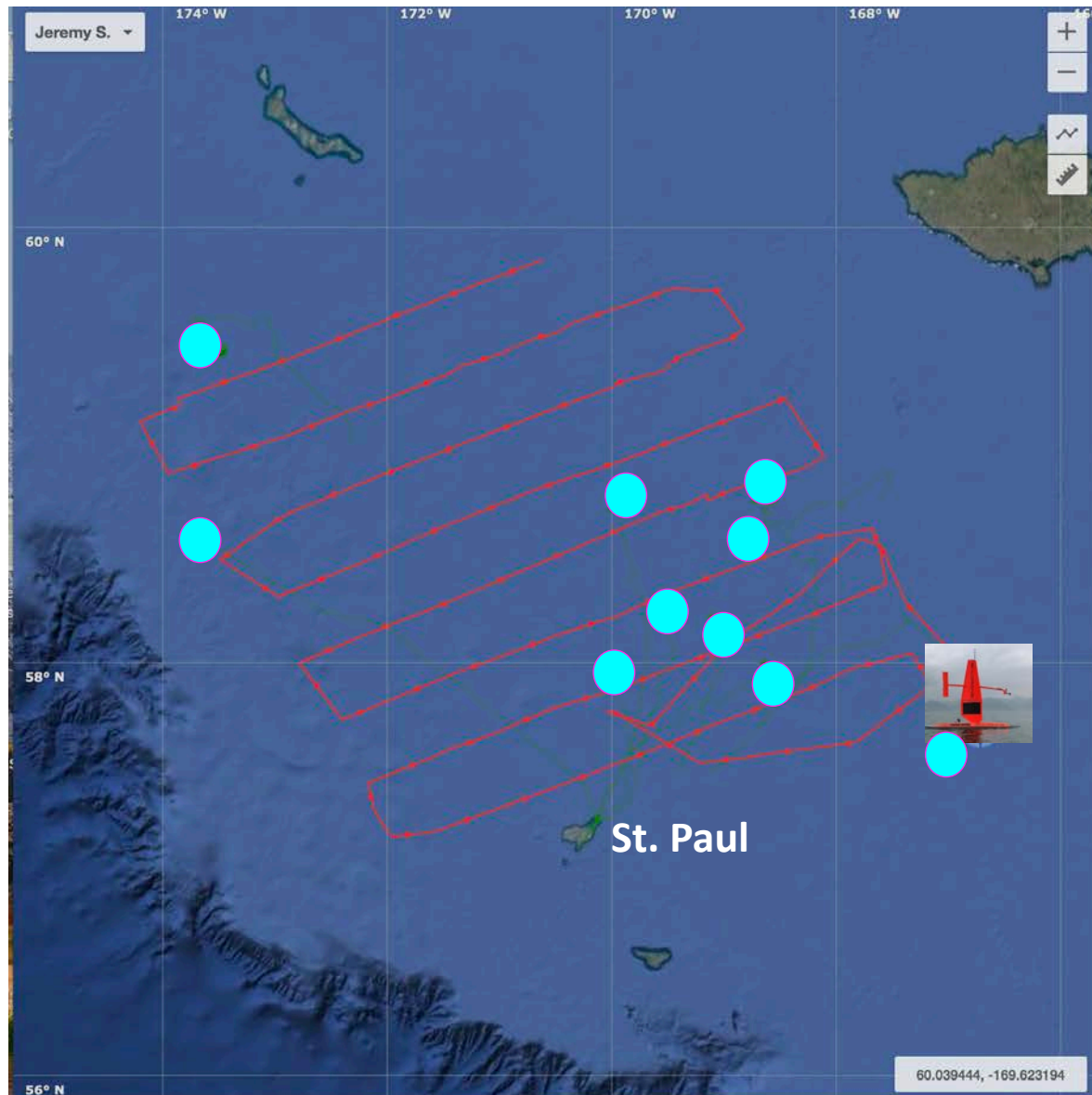


- 1 Saildrone Bering Sea, 5 Arctic
- Tracking 10 female seals
- June-October mission
- Bering Sea, US/Russia border and fur seal foraging area survey
- Focal follows underway





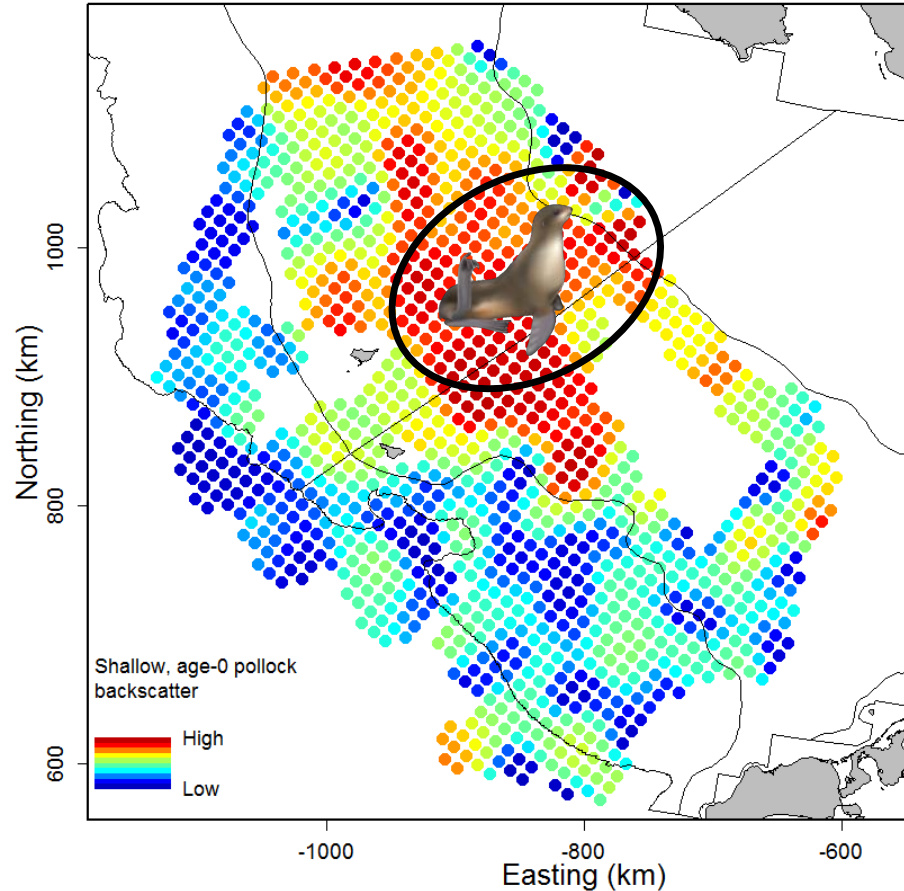
# 2019 Satellite tracking



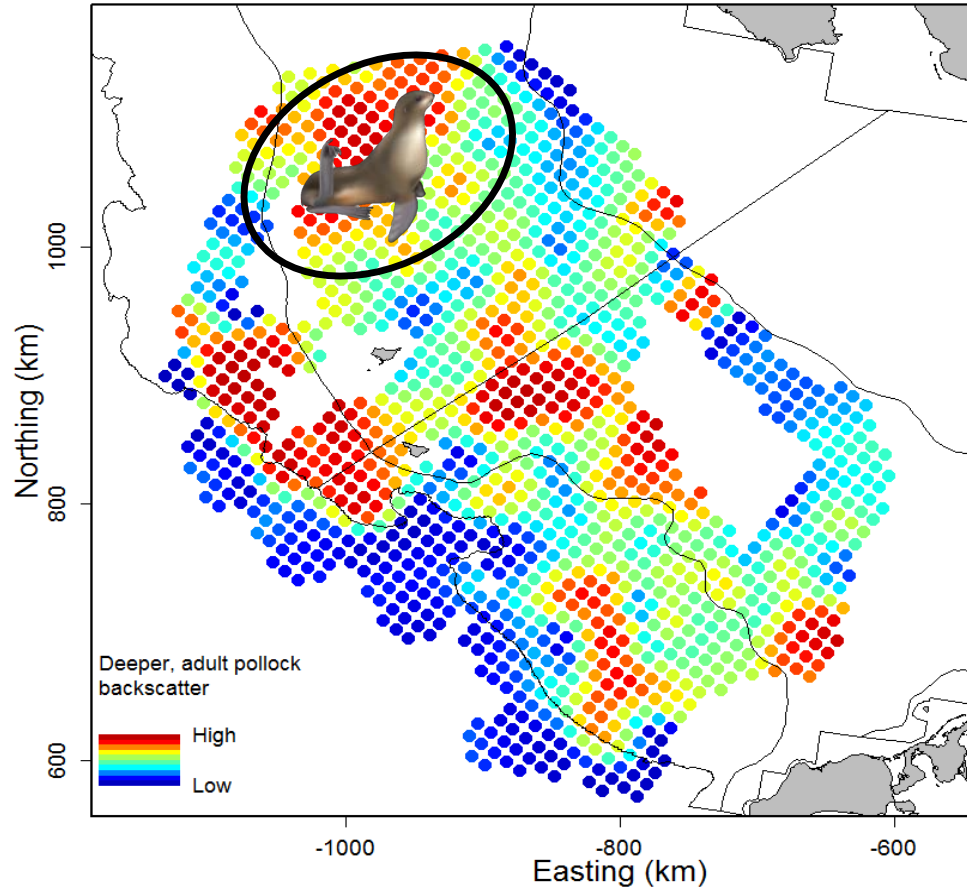
# 2016 results – more pollock backscatter more time spent foraging



## Small pollock



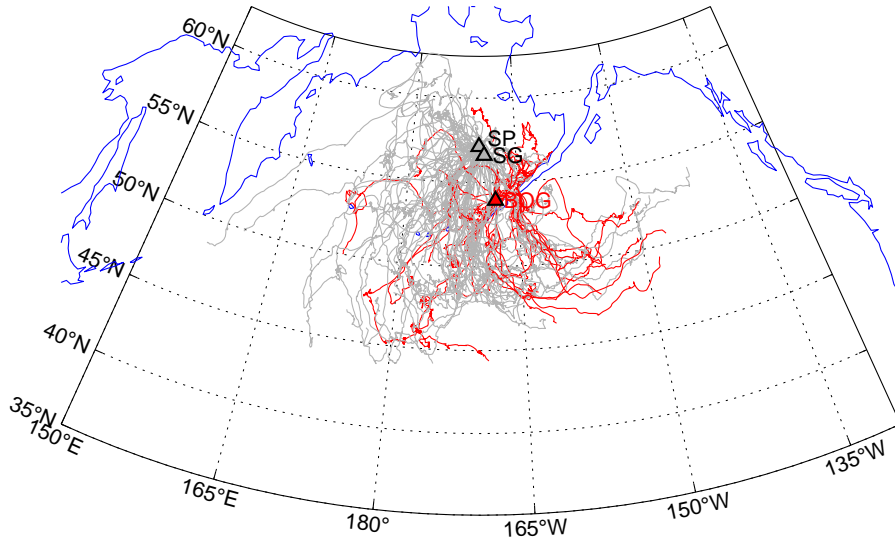
## Big pollock



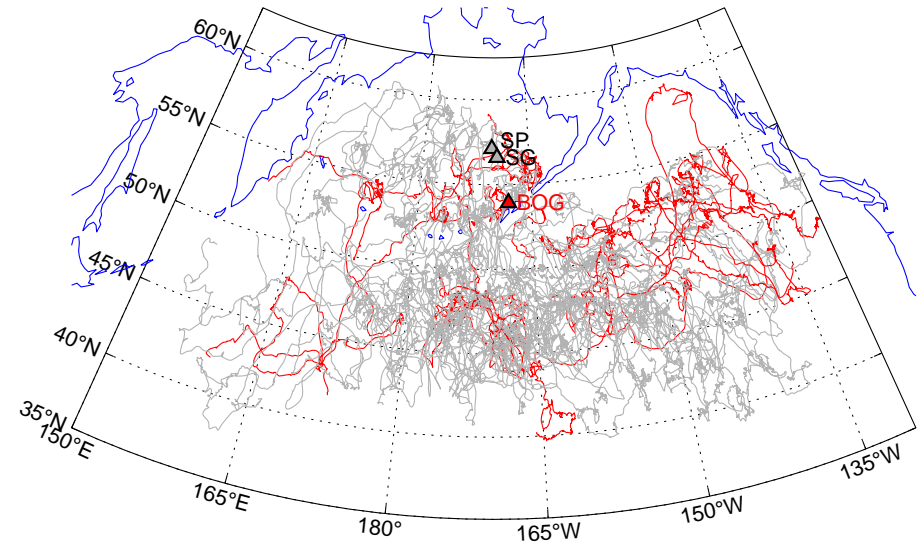
# Winter pup dispersal similar between the islands



2005, 2006 Deployments, Pribilofs/Bogoslof Pups  
Departure to 1 Jan



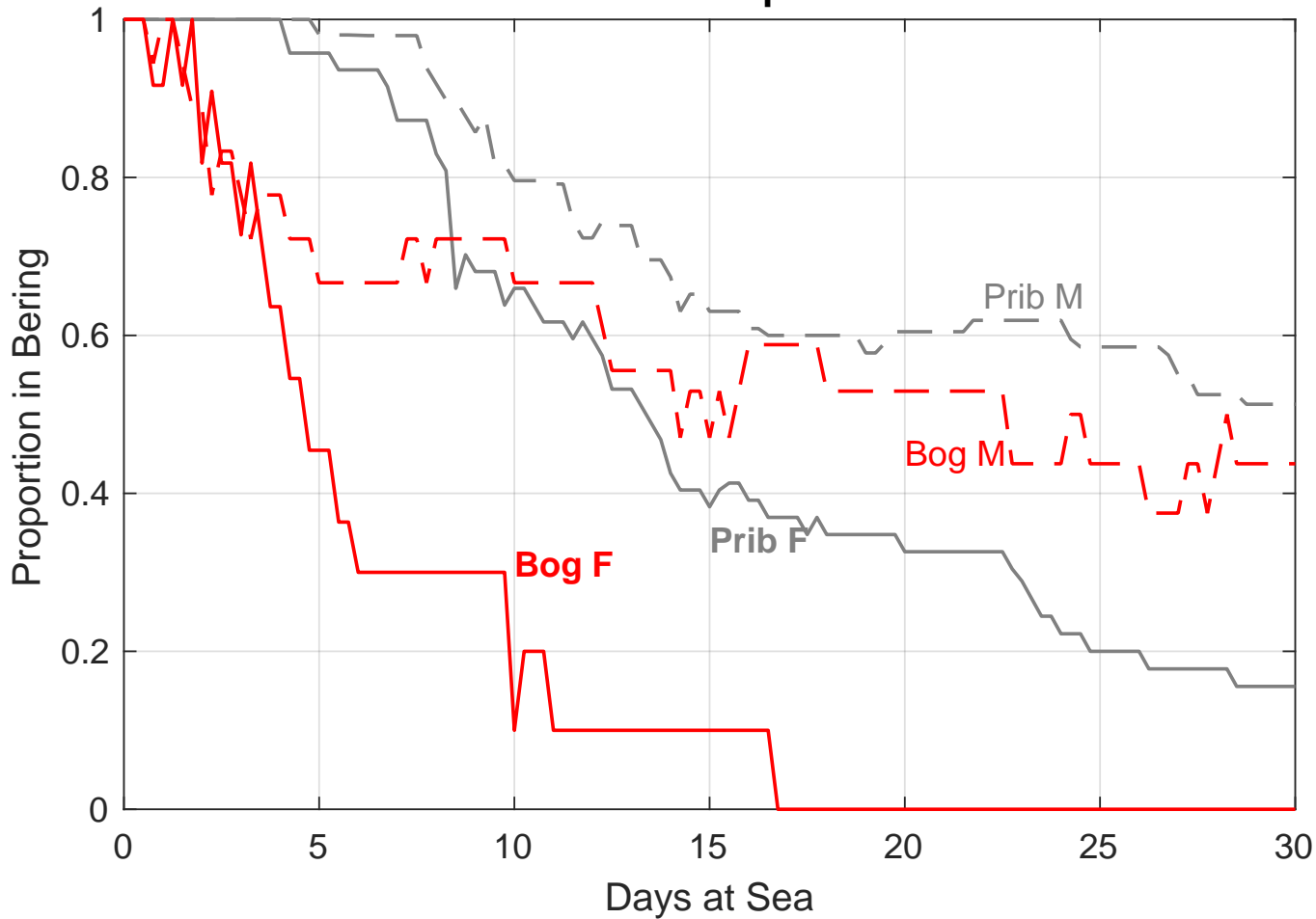
2005, 2006 Deployments, Pribilofs/Bogoslof Pups  
1 Jan - onward



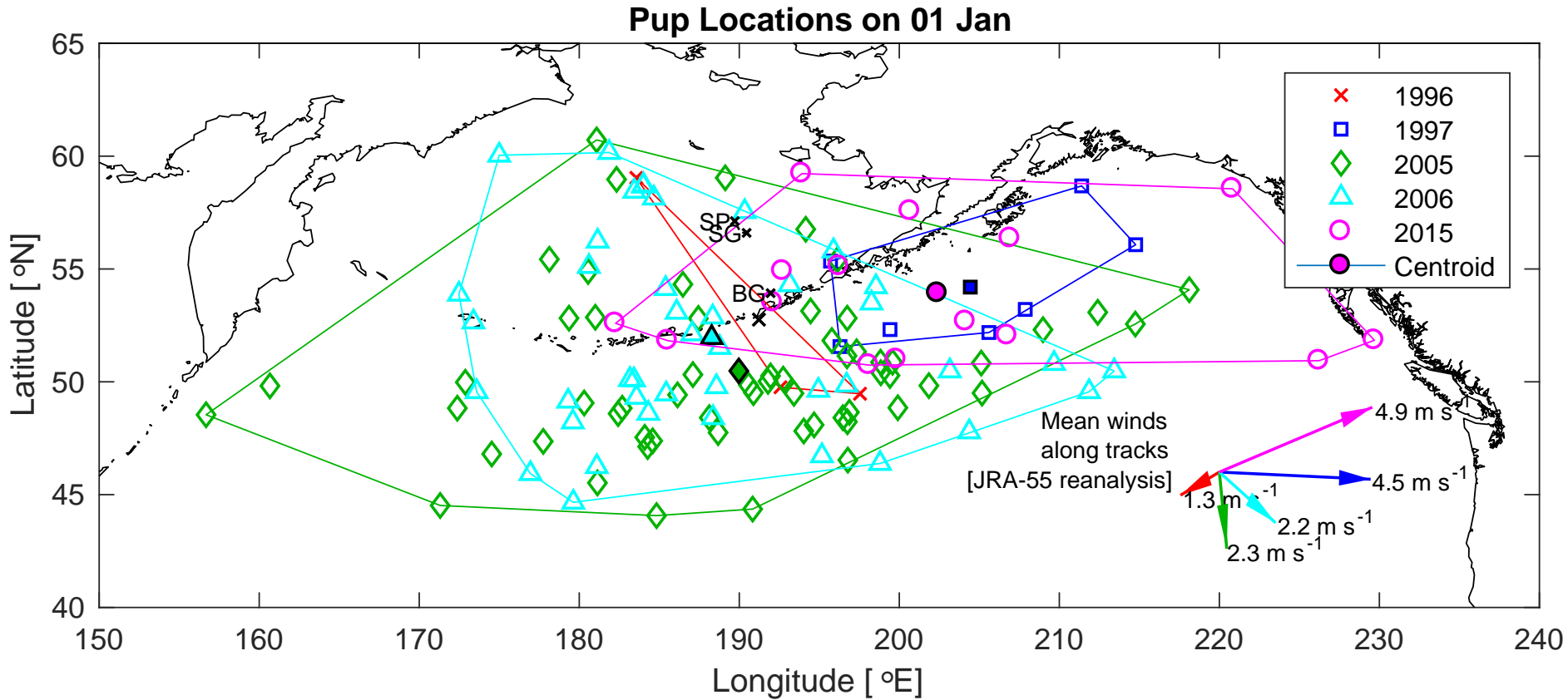
# Bogoslof pups exit the Bering Sea more rapidly



Proportion in Bering by group, first 30d at sea  
05/06 Pups



# Interannual differences potentially relevant to pup survival



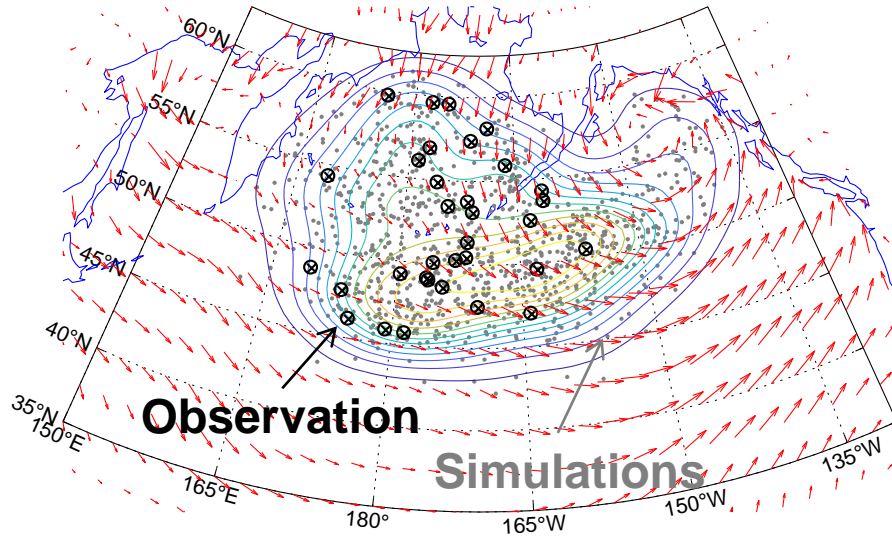
What is driving these differences?



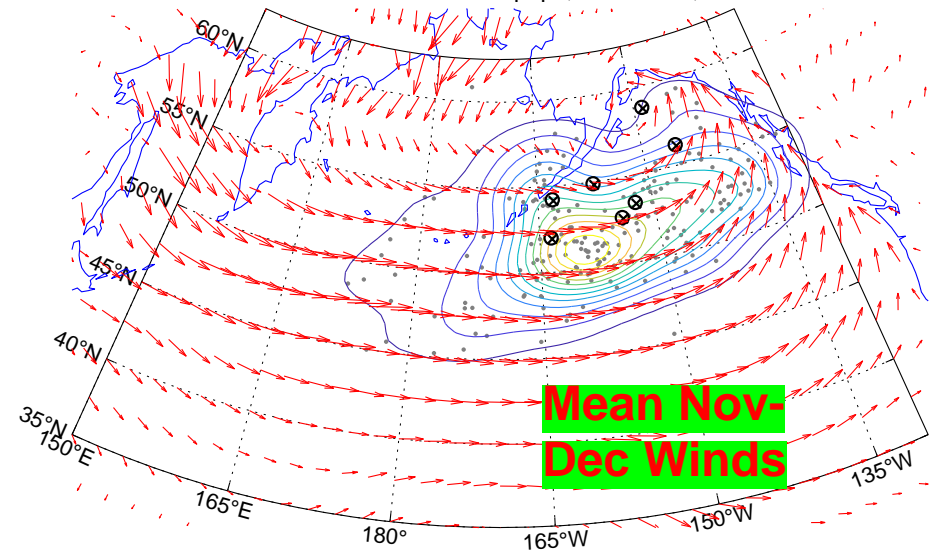
# Background movement to the south combined with wind speed and direction



Simulated/Observed PRB pups, 50d at sea, 2006



Simulated/Observed PRB pups, 50d at sea, 1997

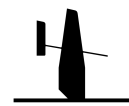
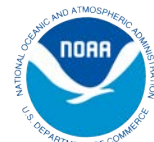


## Next steps

1. Simulate pup dispersal in years without telemetry
2. Compare to pup survival estimates and other observations



# Questions



SAILDRONE



UC SANTA CRUZ  
**WILDLIFE**  
COMPUTERS

