

New Discoveries from Passive Acoustic Monitoring and Future Applications and Directions for its Use



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ALASKA FISHERIES SCIENCE CENTER

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Introduction



Passive Acoustics

Hydrophone



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Platforms - Fixed

Dipping
Hydrophone



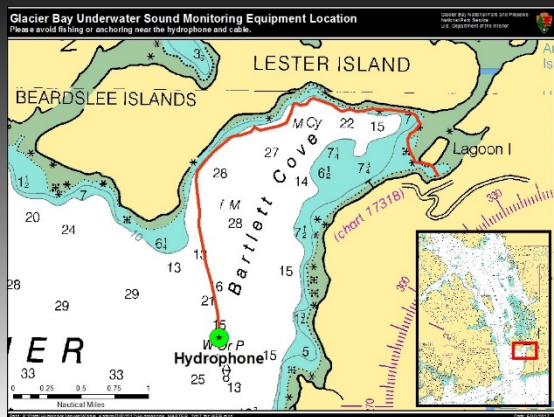
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Platforms - Fixed

Dipping
Hydrophone



Cabled
Hydrophone/Observatory



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Platforms - Fixed

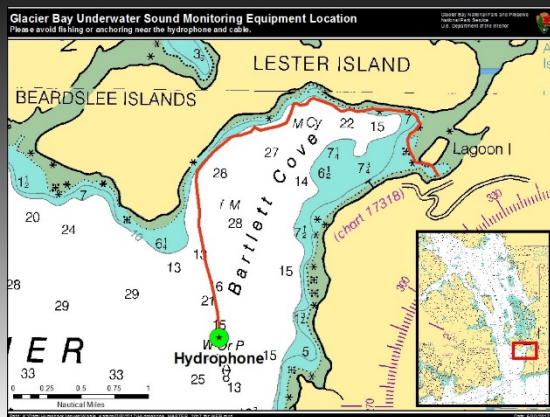
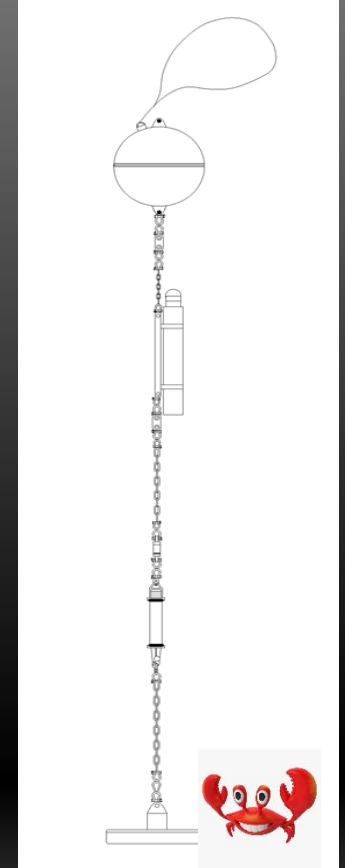
Dipping
Hydrophone



Mooring

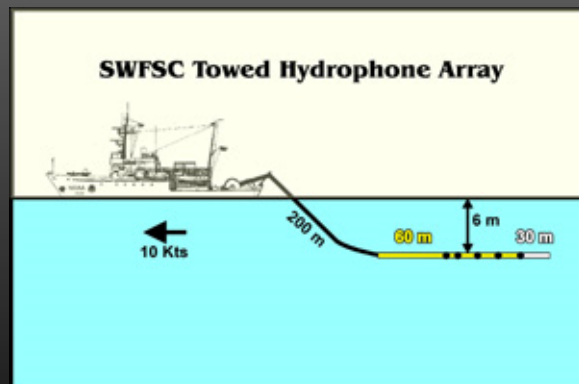


Cabled
Hydrophone/Observatory



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Platforms - Mobile

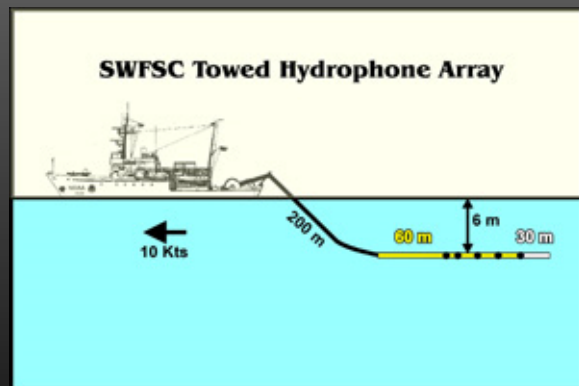


Towed

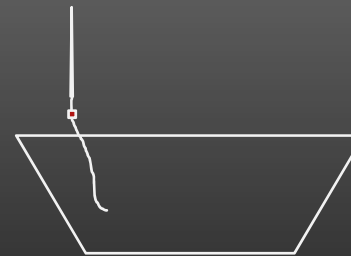


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Platforms - Mobile



Towed

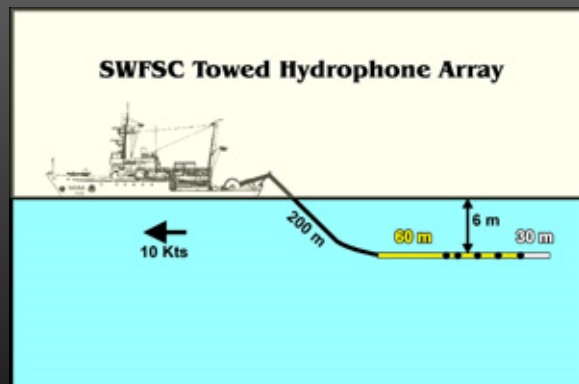


Sonobuoys/
drifting sensors

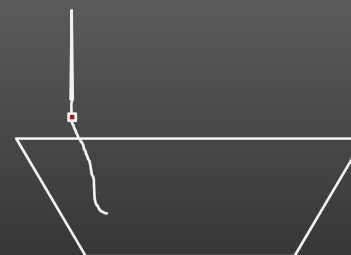


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Platforms - Mobile



Towed



Sonobuoys/
drifting sensors

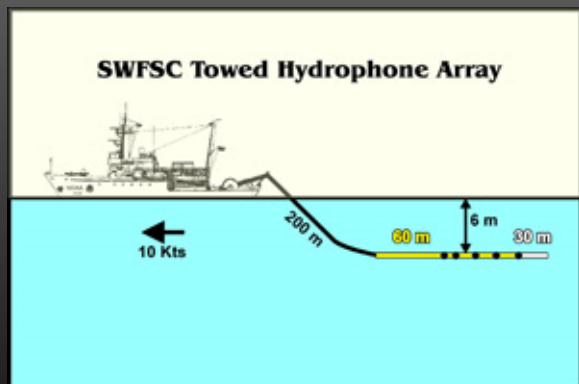


Tags

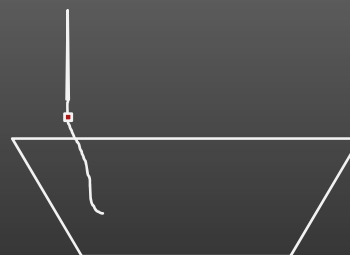


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Platforms - Mobile



Towed



Sonobuoys/
drifting sensors



Tags

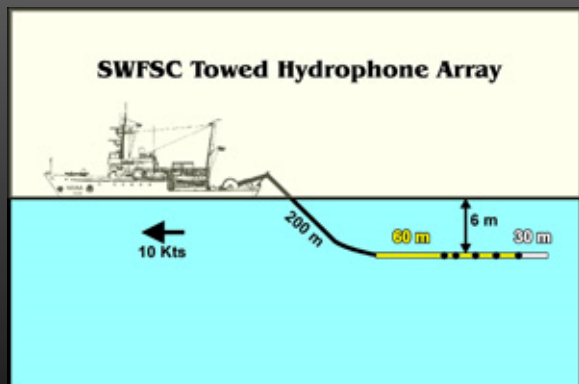


AUVs

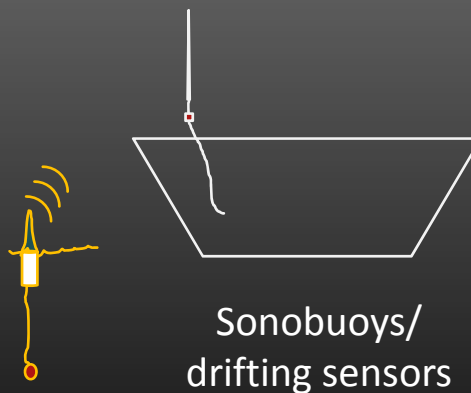


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Platforms - Mobile



Towed



Tags



AUVs



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Benefits

Multiple species



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Benefits

Multiple species



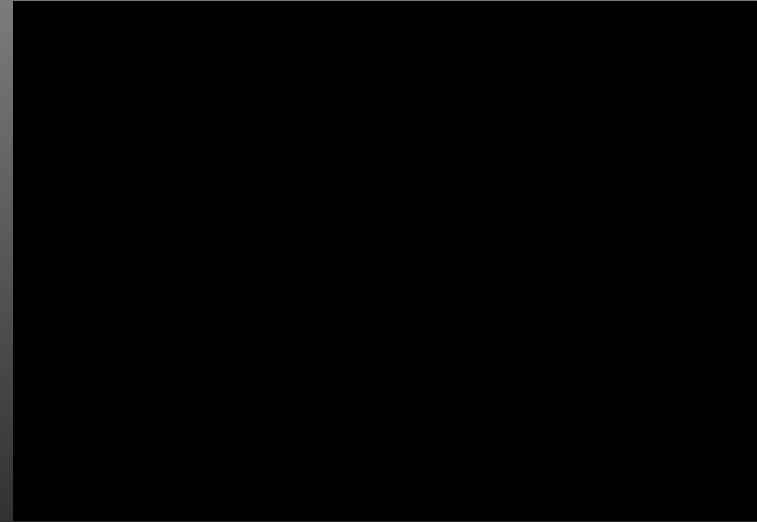
And sound sources



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Benefits

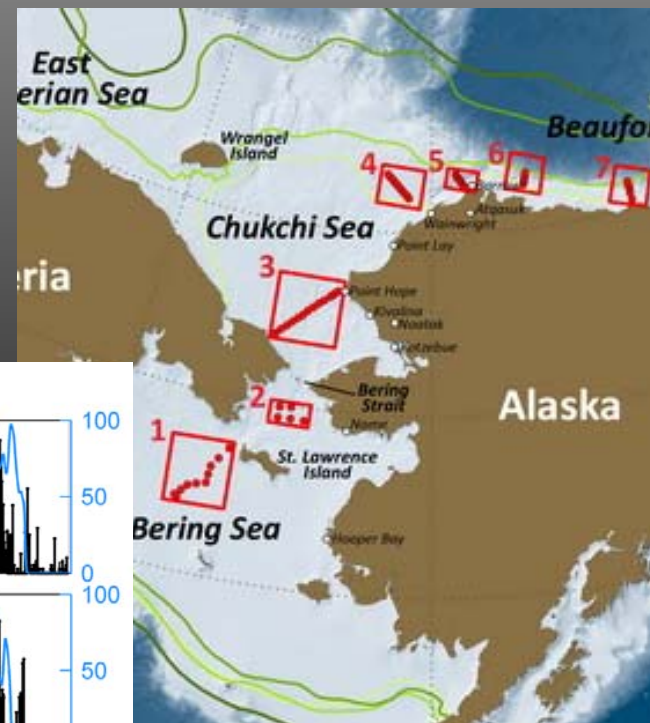
All the time



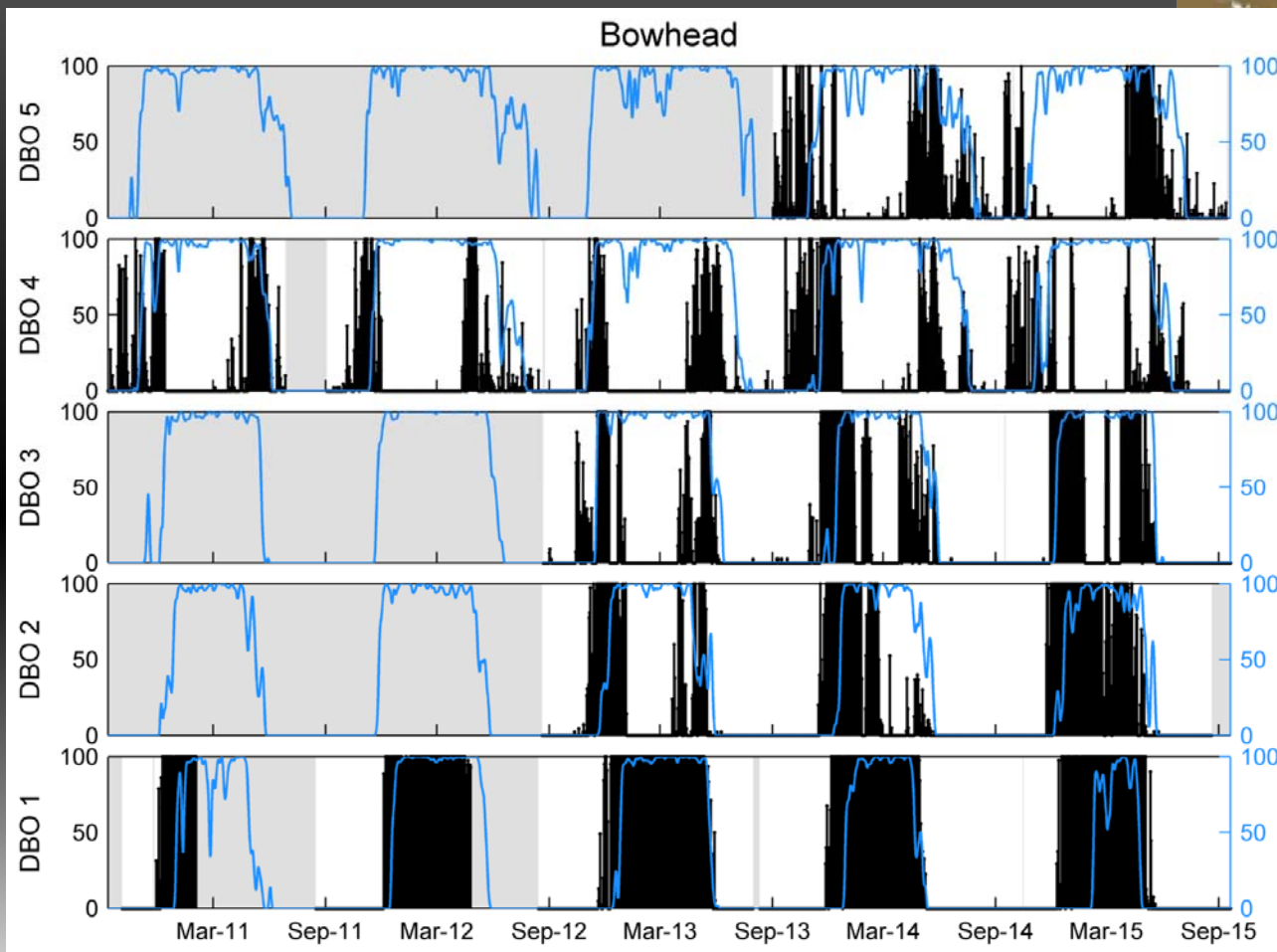
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Highlights

Long-term Seasonal Distribution



<https://www.pmel.noaa.gov/dbo/>

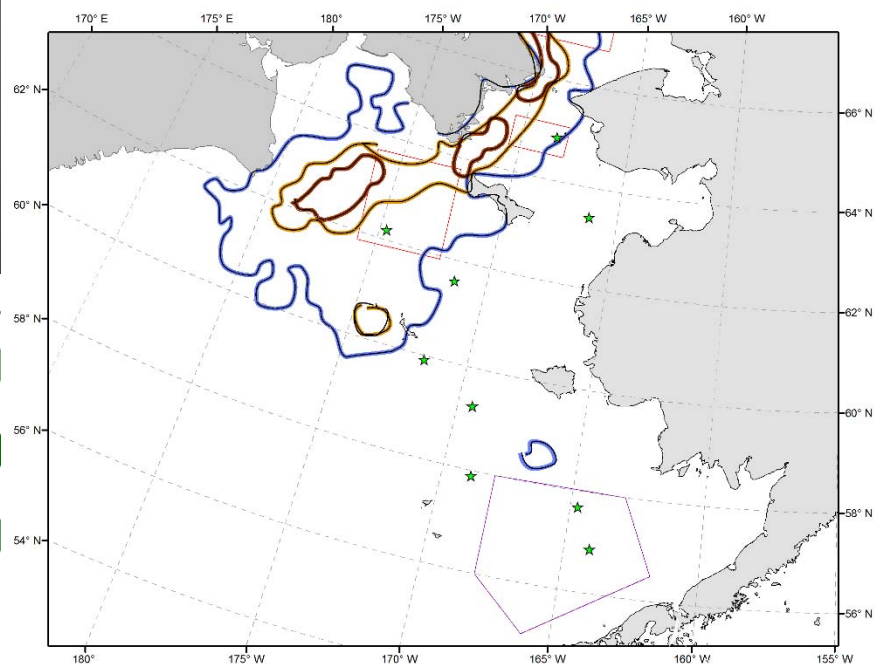
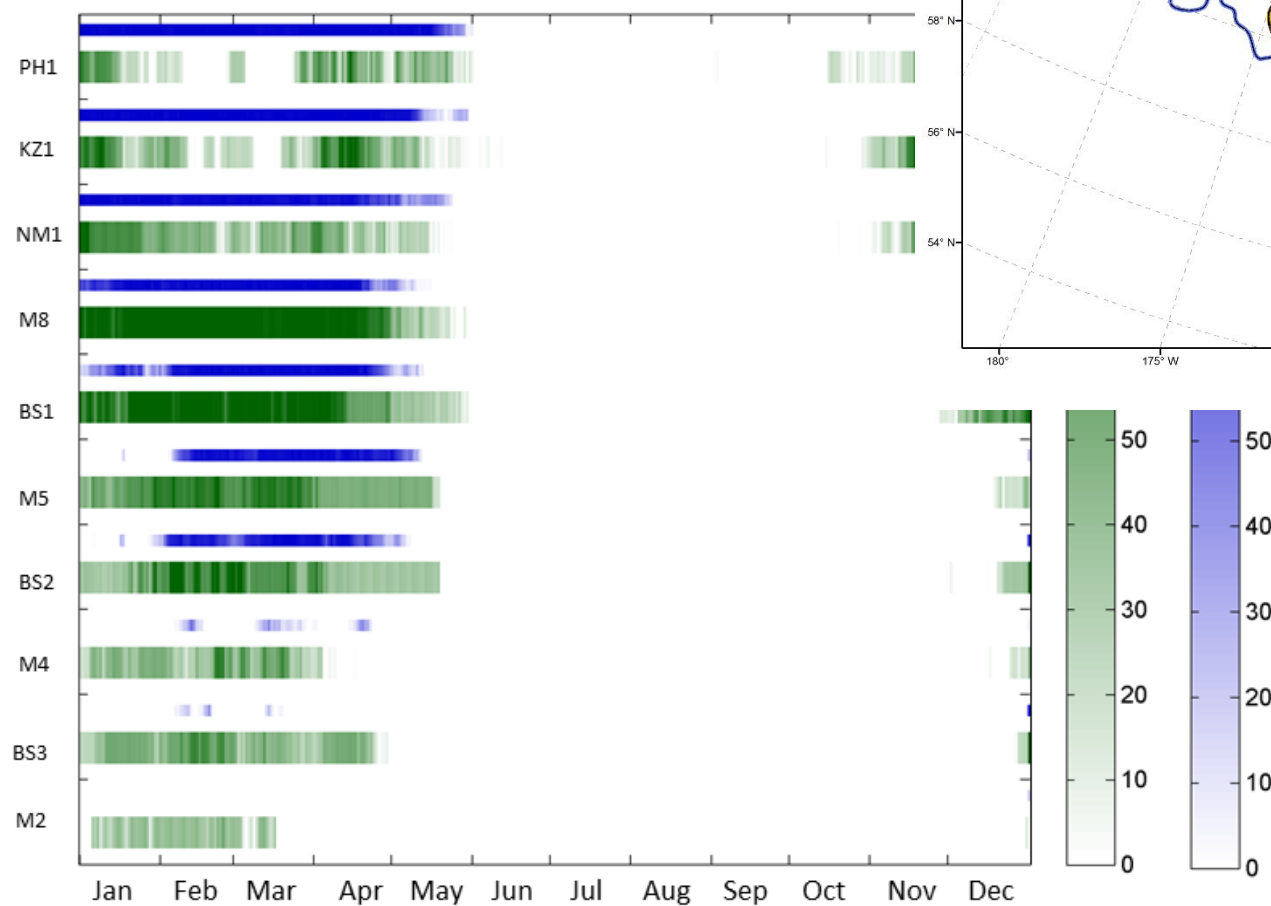


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Highlights

Better understanding of
seasonal ranges

Bowhead



*Adapted from Citta et al.
2015, Progress in
Oceanography: Bowhead
location densities from
satellite tagging May 2006-
Dec 2012*

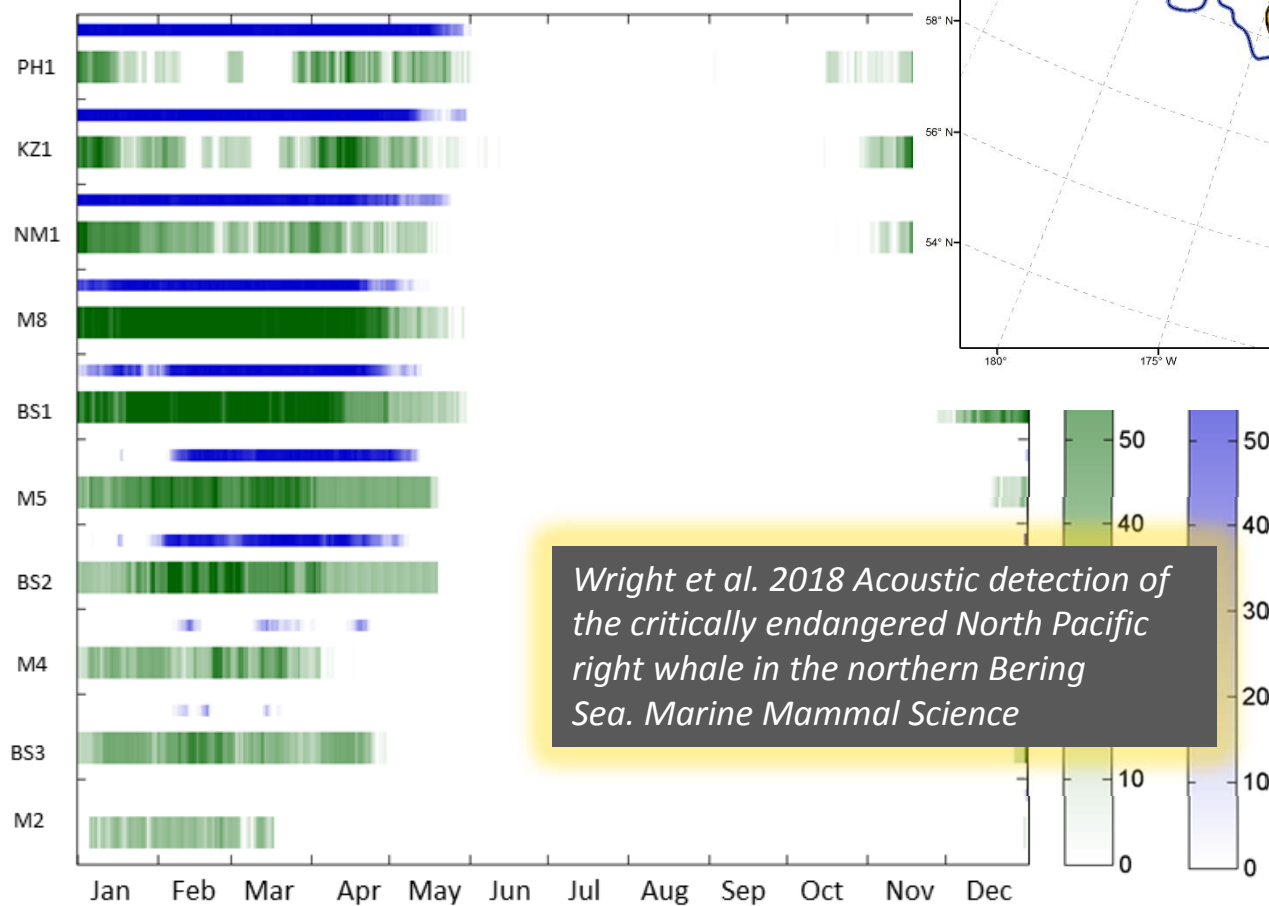


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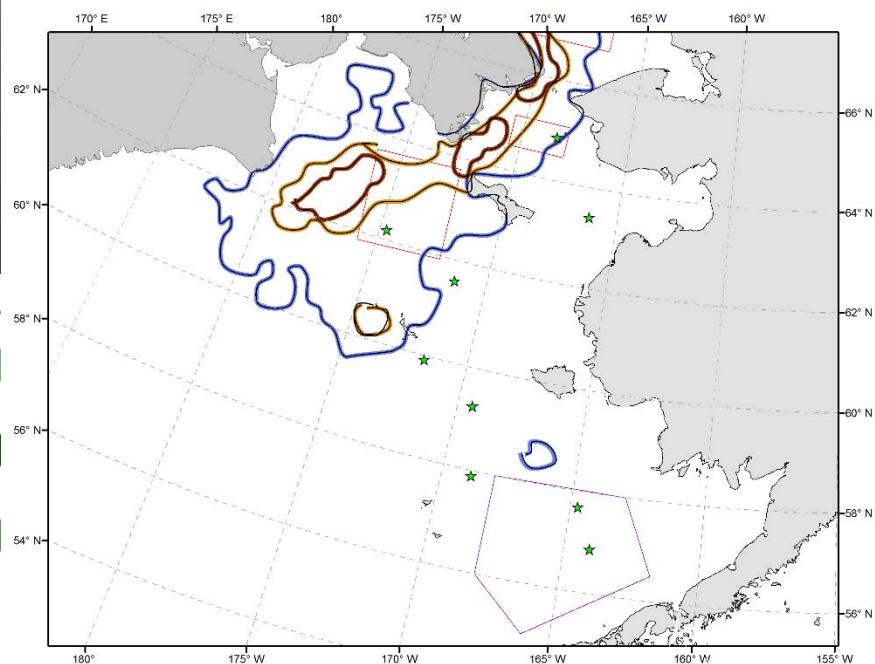
Highlights

Better understanding of seasonal ranges

Bowhead



Wright et al. 2018 Acoustic detection of the critically endangered North Pacific right whale in the northern Bering Sea. *Marine Mammal Science*



From Citta et al. 2015, *Progress in Oceanography: Bowhead location densities from satellite tagging May 2006-Dec 2012*

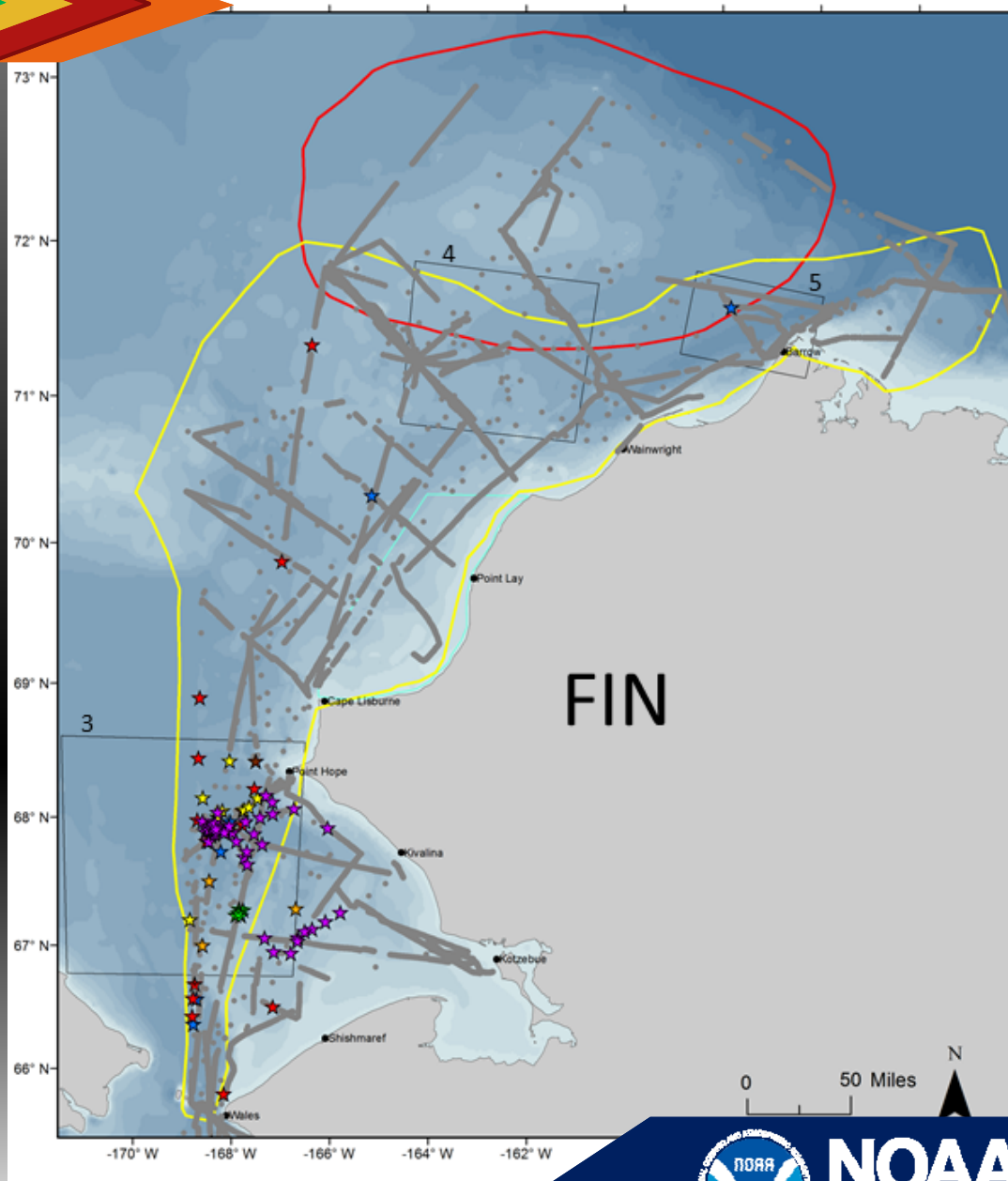


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Highlights

Better understanding of seasonal ranges

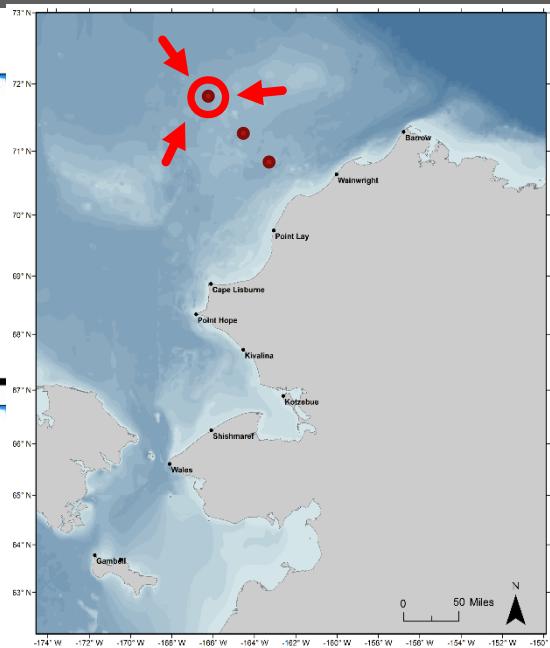
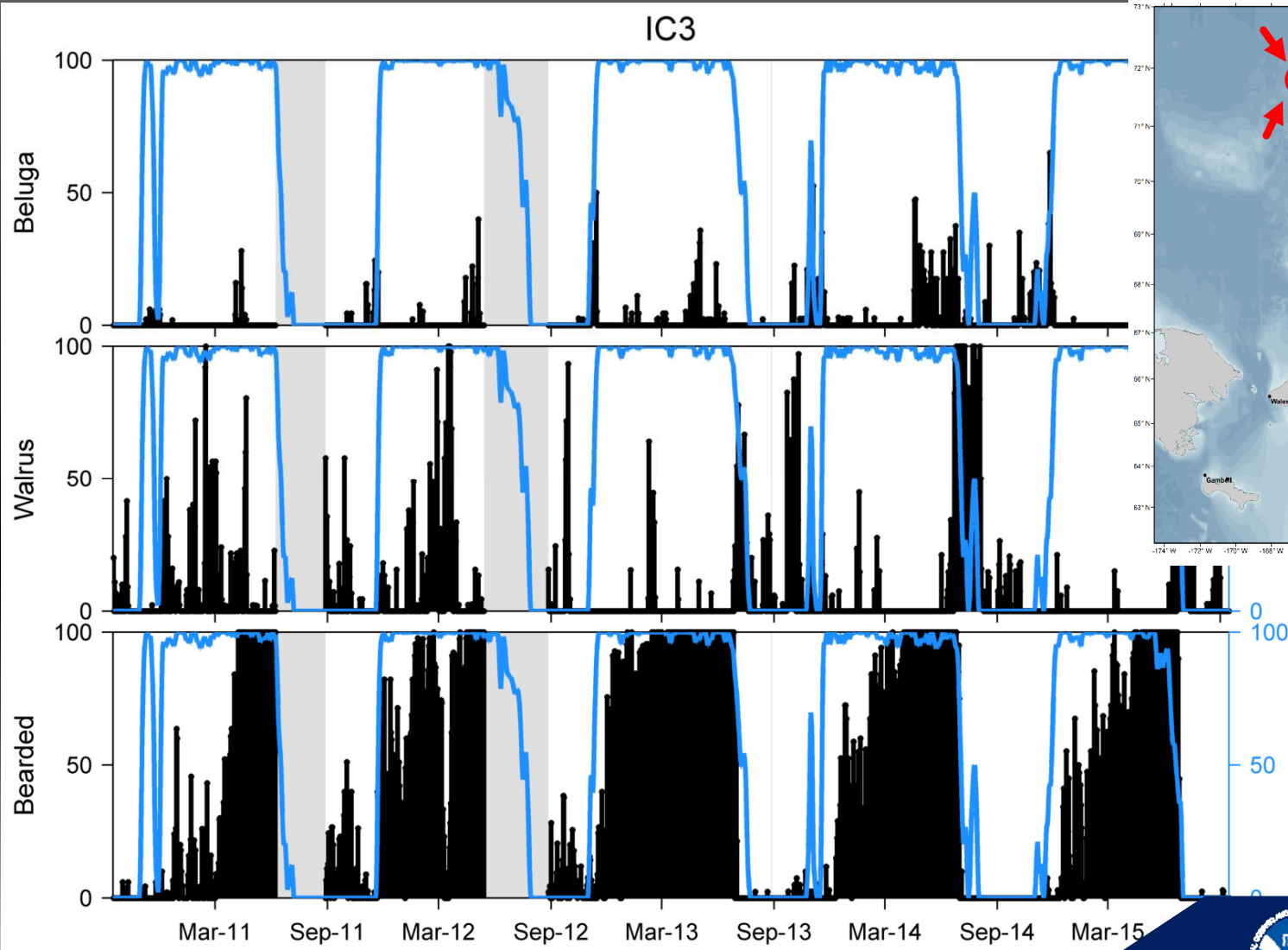
- Crance et al. 2015 Northeasternmost record of a North Pacific fin whale (*Balaenoptera physalus*) in the Alaskan Chukchi Sea. *Polar Biology*



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Highlights

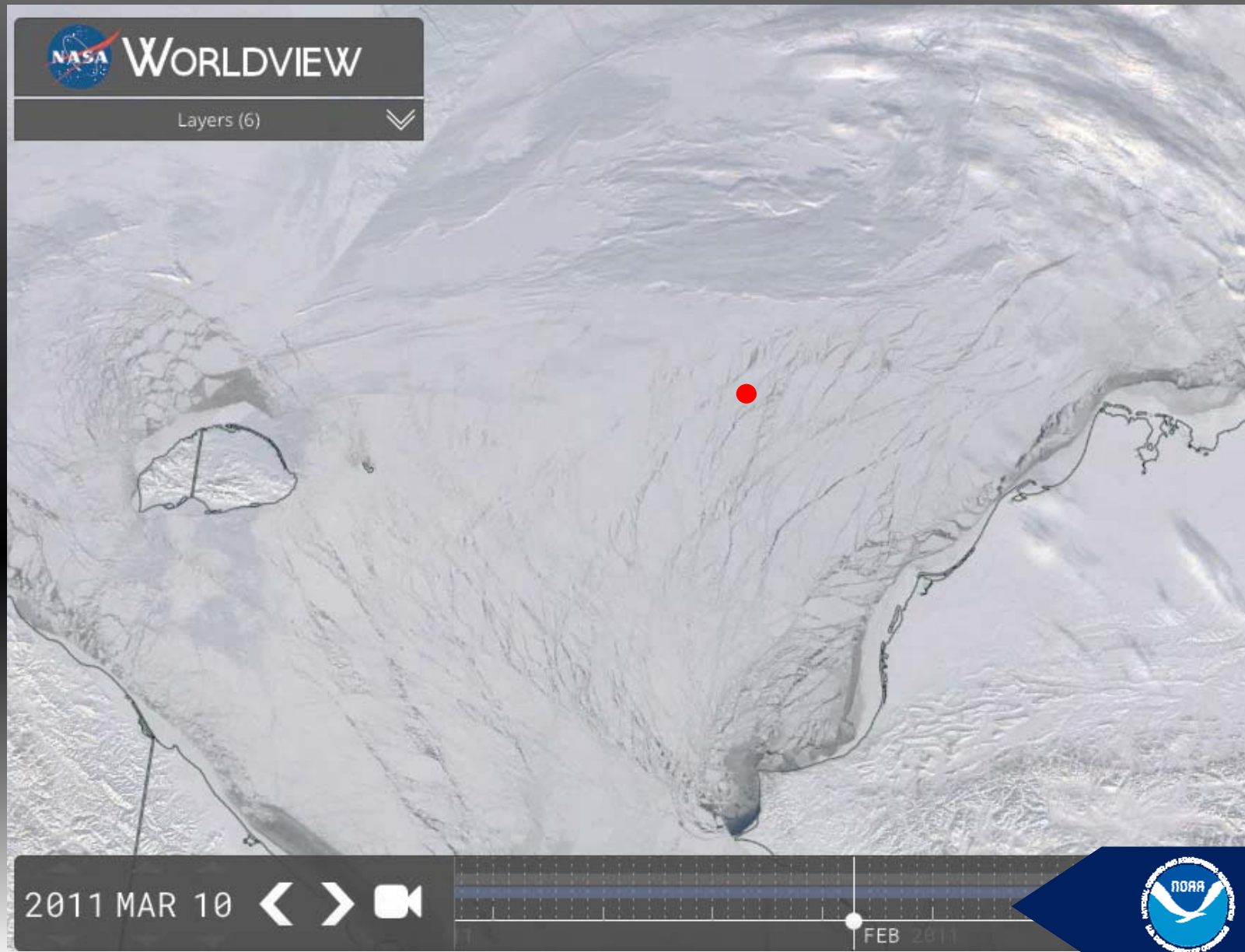
Better understanding of seasonal ranges



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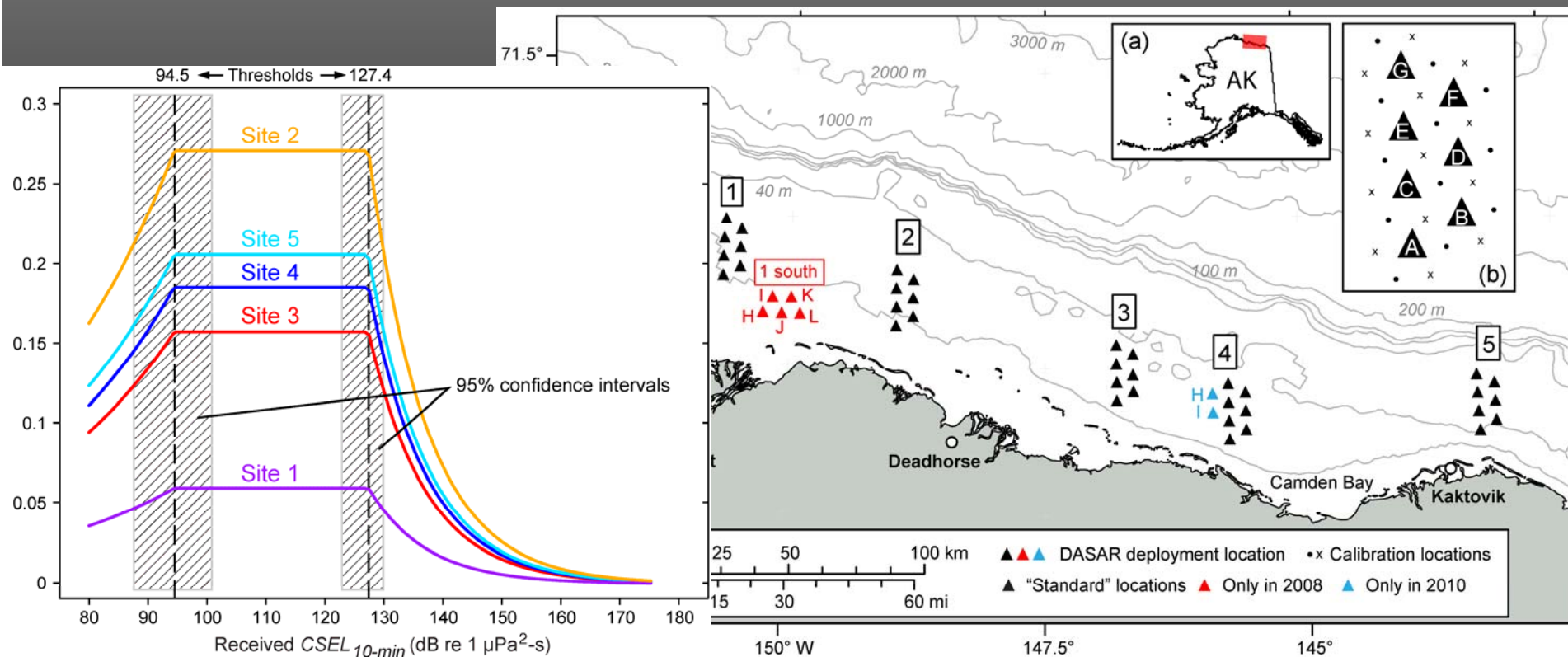
Highlights

Proxies for ice condition?



Highlights

Multi-threshold noise effects



Bowhead

Blackwell et al. (2015) Effects of Airgun Sounds on Bowhead Whale Calling Rates: Evidence for Two Behavioral Thresholds. PLoS ONE

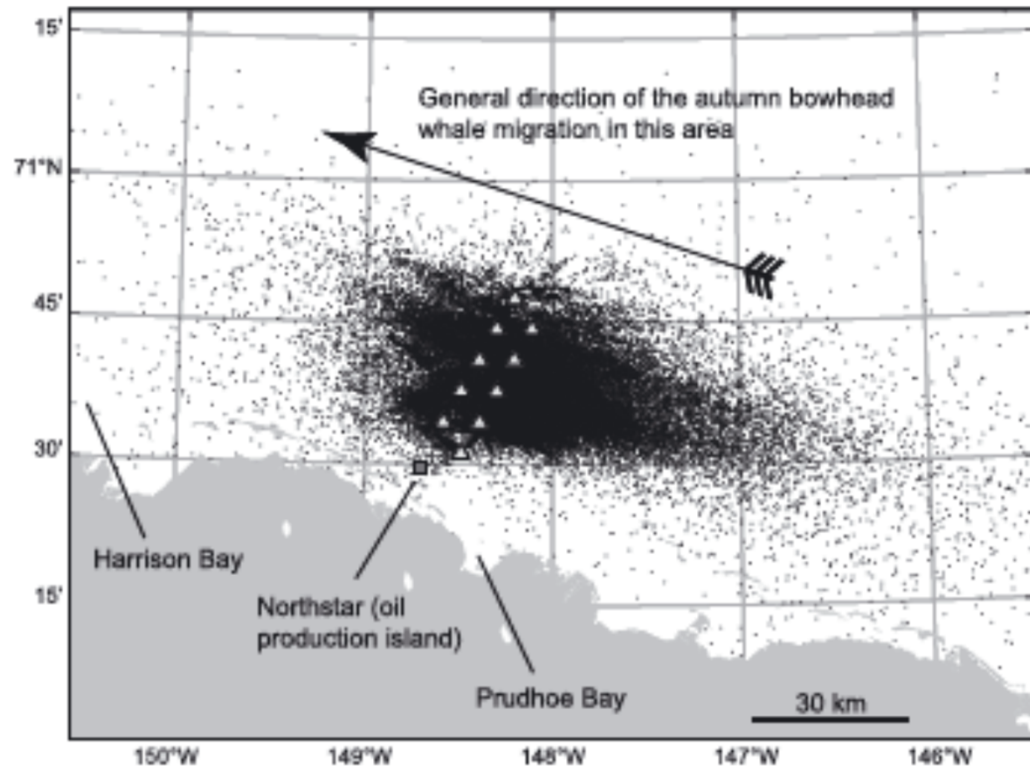
Blackwell et al. (2017) Effects of tones associated with drilling activities on bowhead whale calling rates. PLoS ONE



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Highlights

Directional calling



Bowhead

Blackwell et al. (2012) Marine Mammal Science

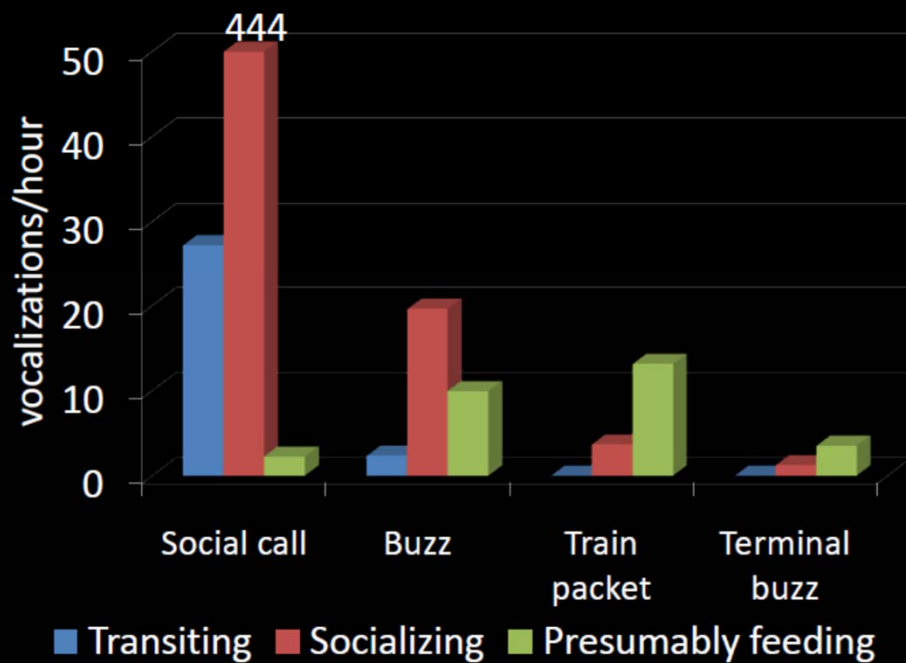


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Highlights

Determining behavioral state

Acoustic comparison



*Castellote et al.,
(2011) Alaska Marine
Science Symposium*

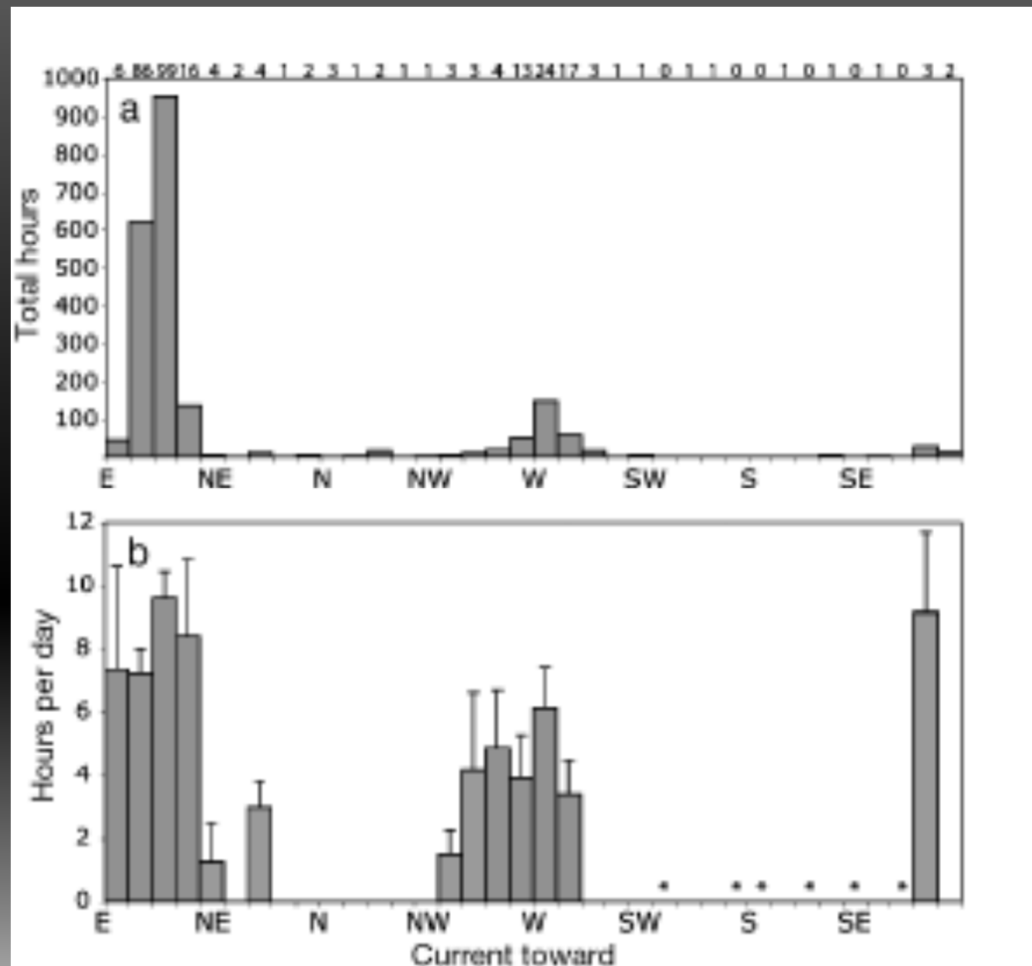
Beluga



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Highlights

Correlations with oceanographic parameters



Stafford et al. (2013)
MEPS

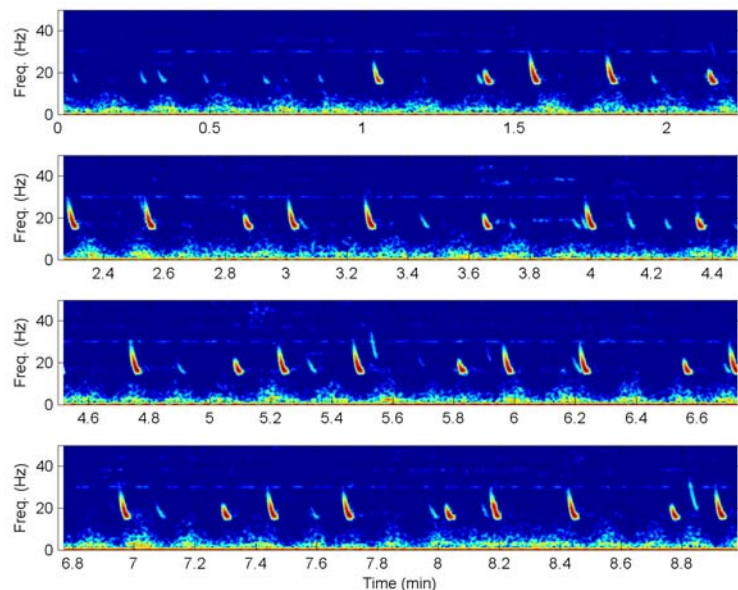
*Strong Alaska Coastal
Current may bring better
feeding opportunities for
Beluga in Barrow Canyon*



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Highlights

Differentiate populations

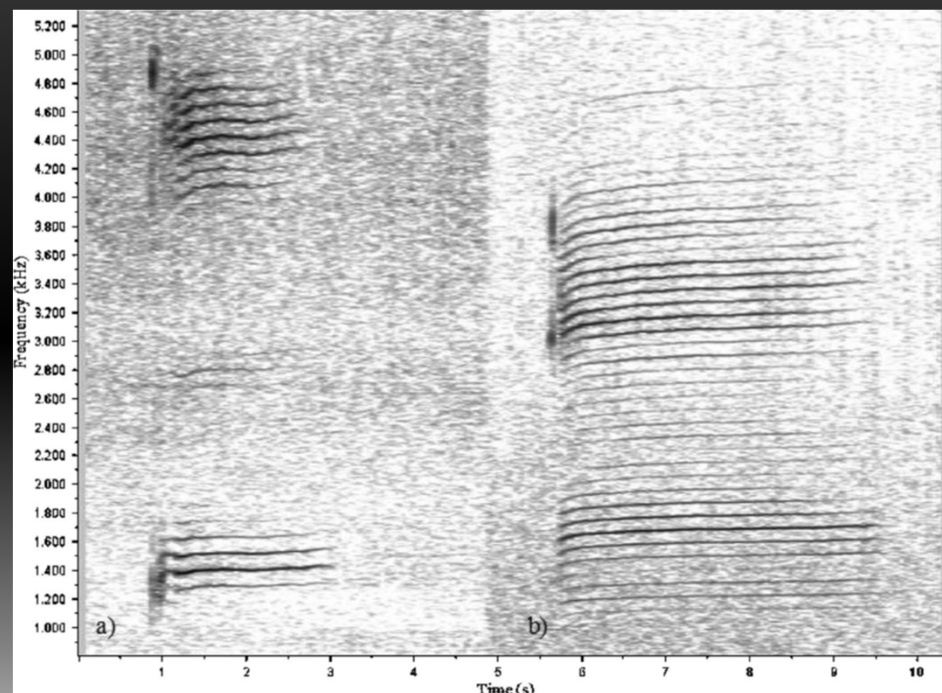


Fin

Delarue et al (2013), Arctic

Minke

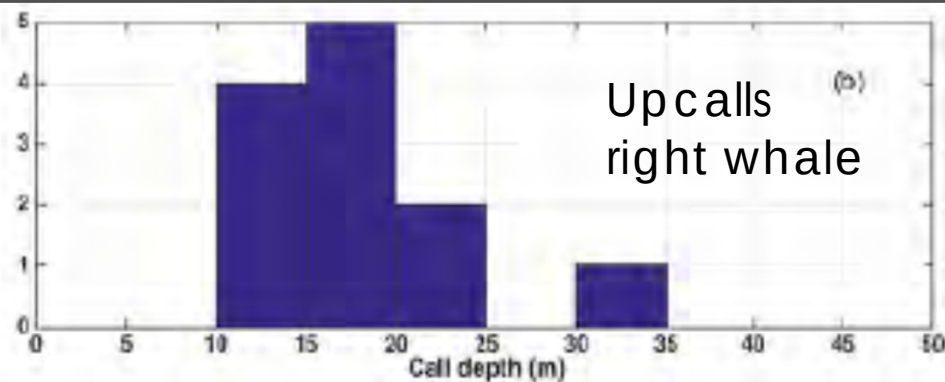
Delarue et al (2013), MMS
From Rankin & Barlow (2005) JASA



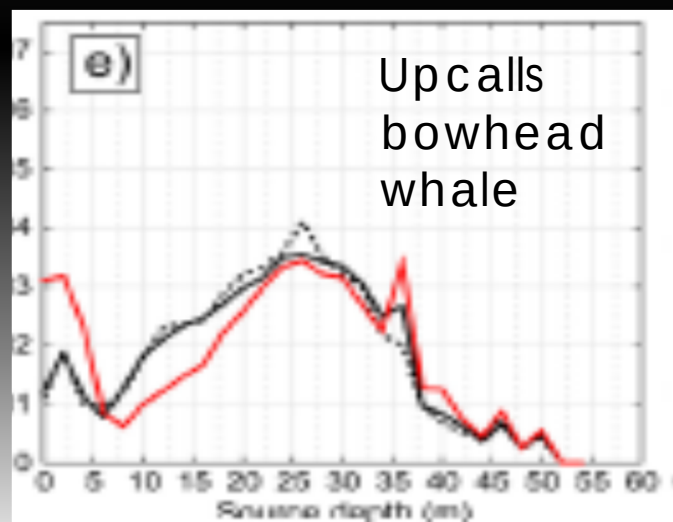
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Highlights

Differentiate species



From Thode et al (2017) JASA



From Thode et al (2016) JASA

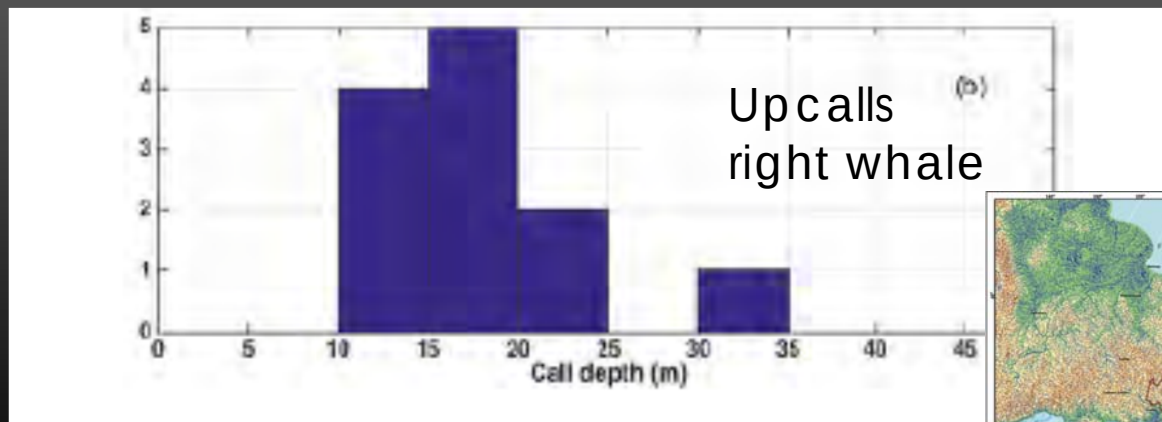


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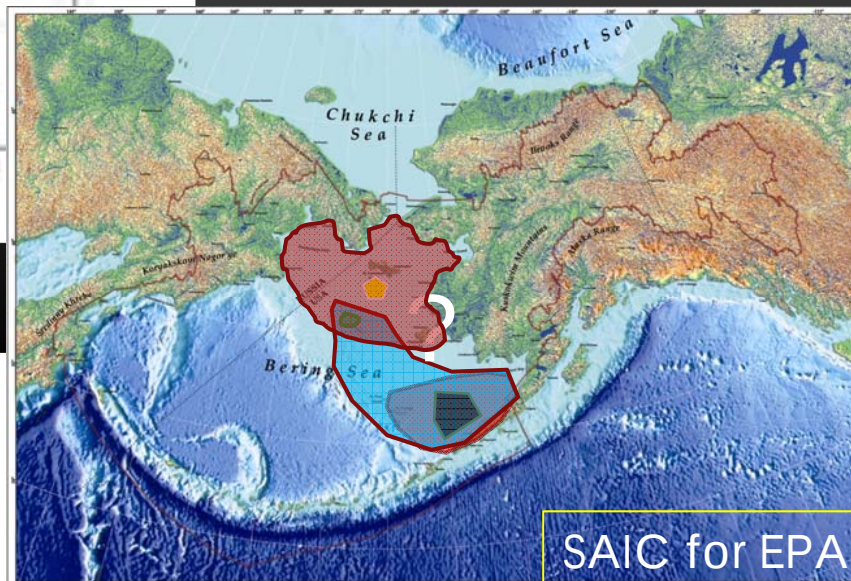
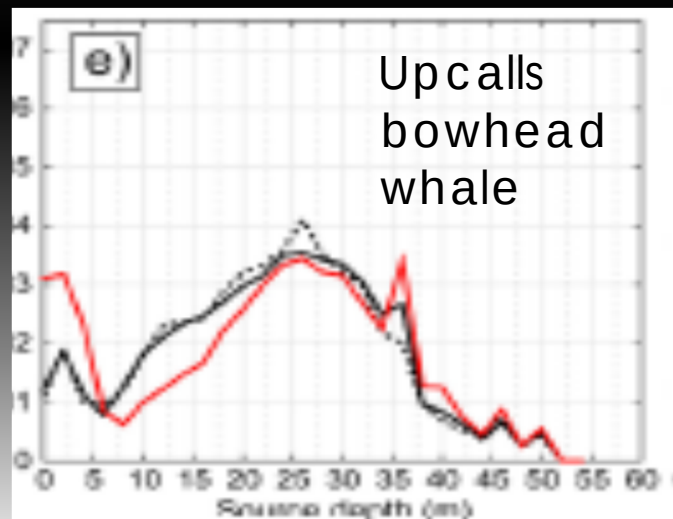
Highlights

Differentiate populations

From Thode et al (2017) JASA



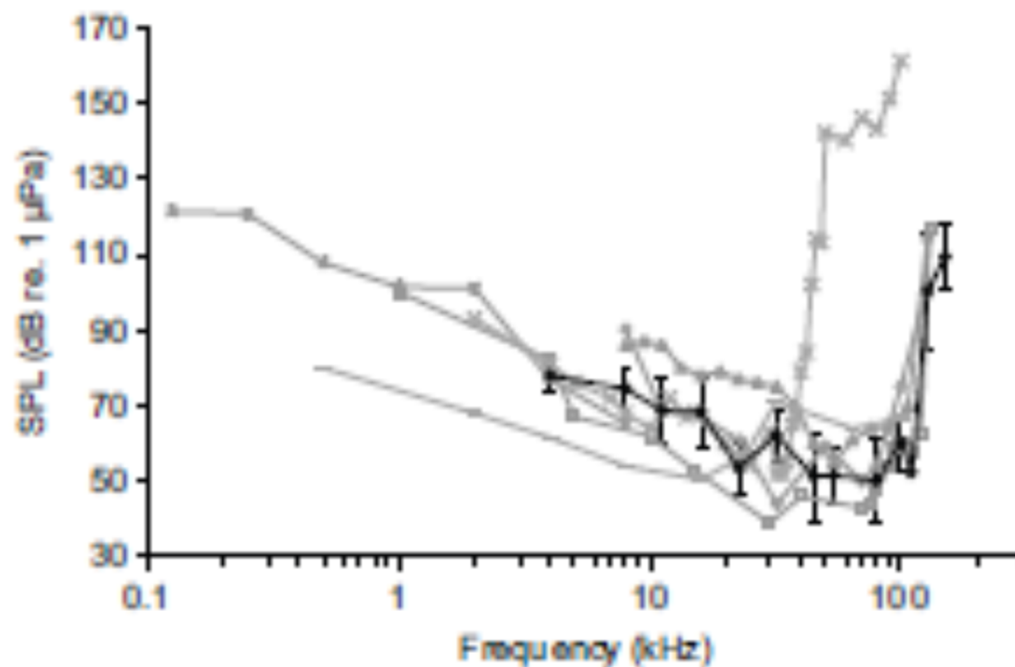
From Thode et al (2016) JASA



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Highlights

Hearing sensitivity of wild animals (auditory evoked potentials)



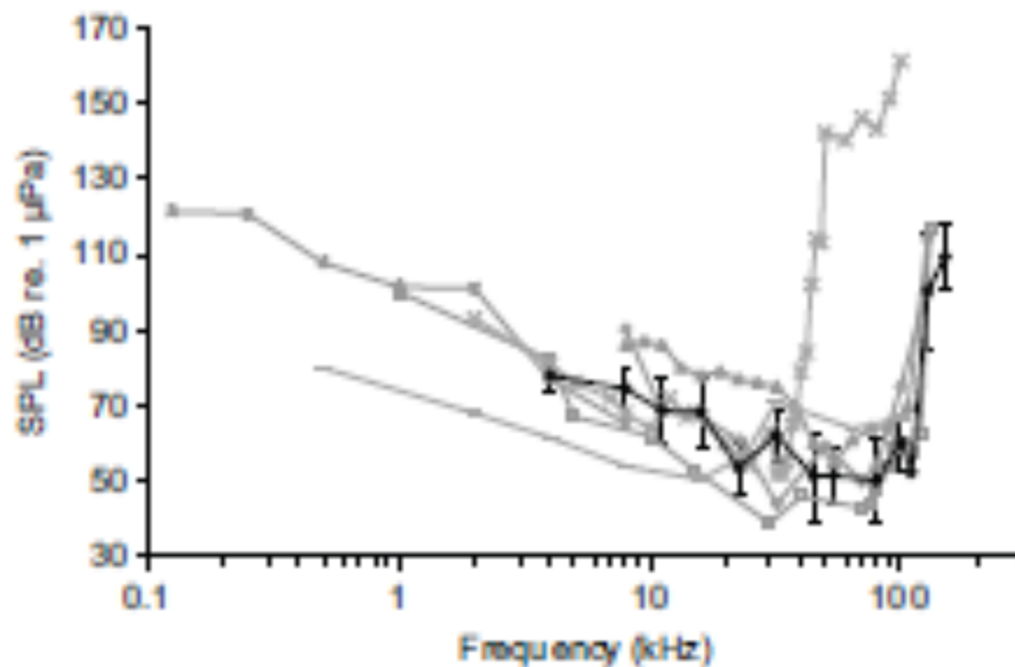
Castellote et al. (2014) *Journal of Experimental Biology*



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Highlights

Hearing sensitivity of wild animals (auditory evoked potentials)



Castellote et al. (2014) *Journal of Experimental Biology*



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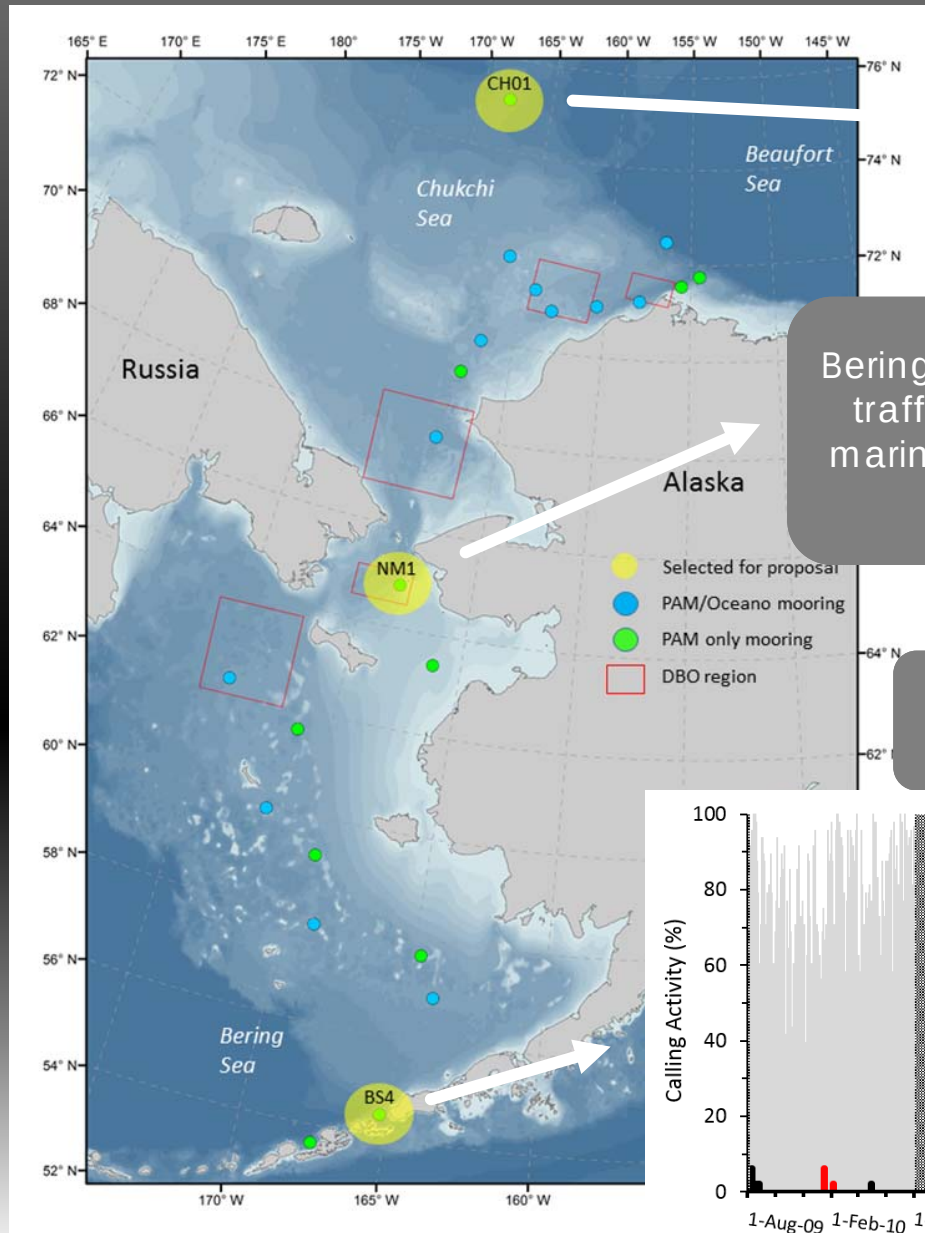
Future Directions

- Continuing to collect long-term time series
 - Archived data can be reprocessed!!!!
- More work on
 - Population differentiation
 - Behavioral context
 - Noise effects



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Future Directions

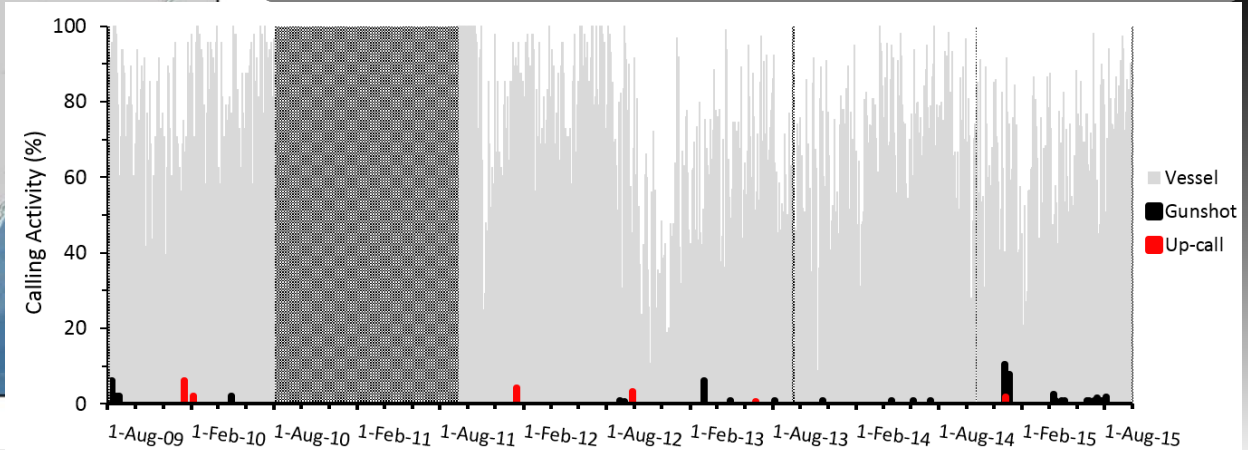


Chukchi Plateau
(~ pristine)

Collaboration
with Alaskan
Audubon &
Cornell Univ.

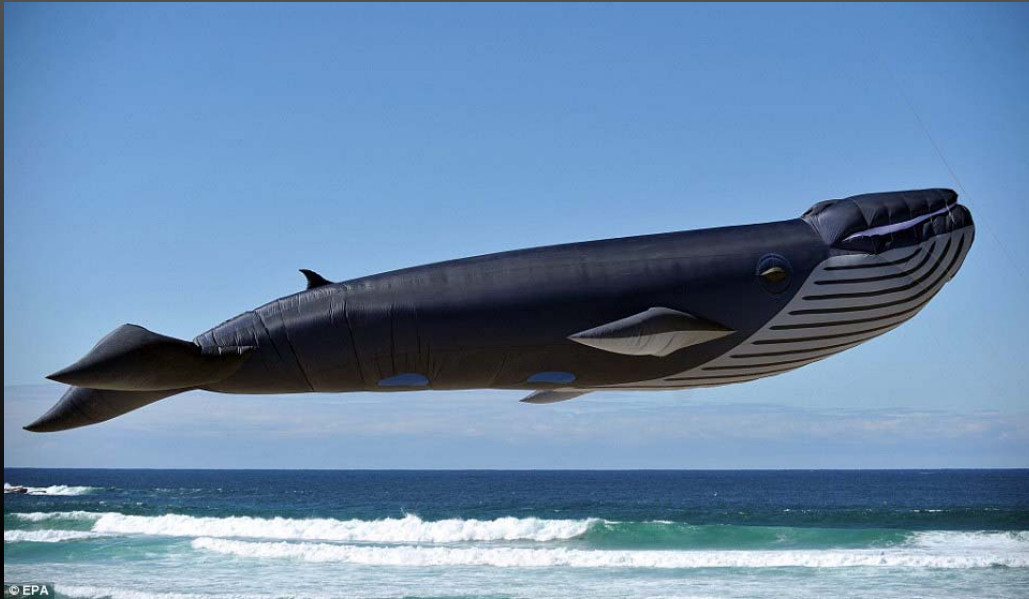
Bering Strait High
traffic + many
marine mammal
spp.

Unimak Pass – very high traffic (lt. gray) + Critically
Endangered North Pacific Right Whale (red &
black) (Wright et al. (in review) End. Spp. Research)



Future Directions

Abundance estimates



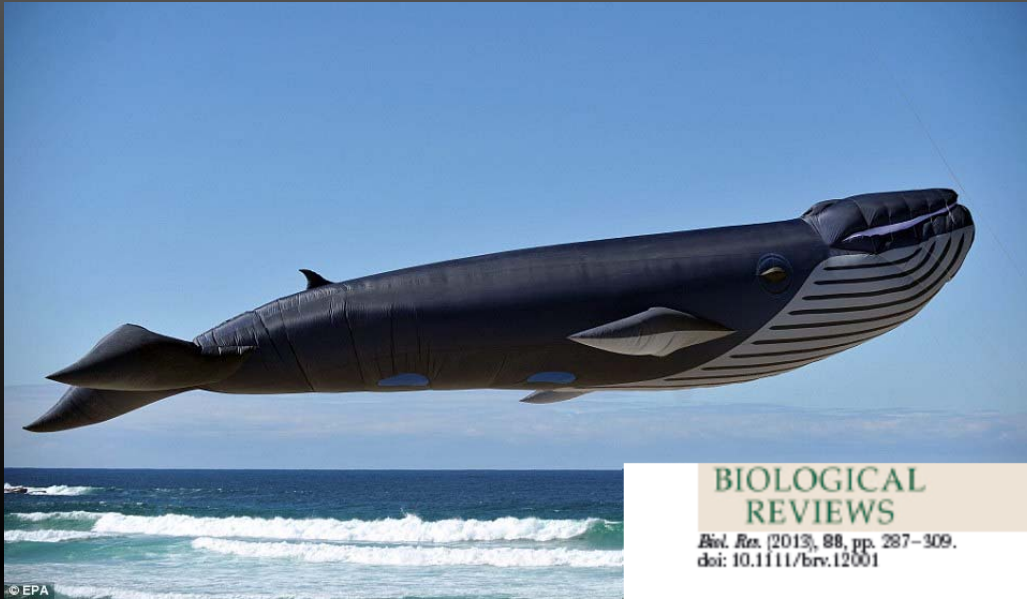
Can't count non-vocalizing animals; don't know how many are calling



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Future Directions

Abundance estimates



Can't count non-vocalizing animals; don't know how many are calling

BIOLOGICAL REVIEWS

Biol. Rev. (2013), 88, pp. 287–309.
doi: 10.1111/brev.12001

Cambridge
Philosophical Society

287

Estimating animal population density using passive acoustics

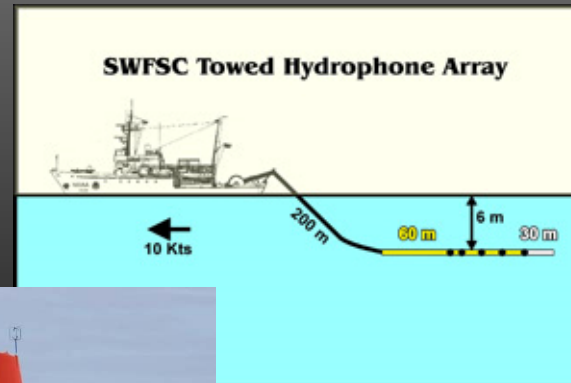
Tiago A. Marques^{1,2,*}, Len Thomas¹, Stephen W. Martin³, David K. Mellinger⁴, Jessica A. Ward⁵, David J. Moretti⁵, Danielle Harris¹ and Peter L. Tyack⁶



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Future Directions

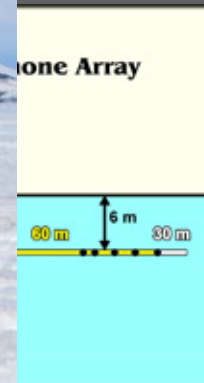
New
technological
advances



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Future Directions

New
technological
advances



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