ping Forward Into the Past, a Predator's Perspe
On Climate and Change in the Western Antarcti
Peninsula Region

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Connecting people, places, animals and spaces

The Western Antarctic Peninsula Region, Long-Term Climate Trends in Space and Time

Palmer Station

Anvers Is.

Avian Is.

Charcot Is.

Climate Migration

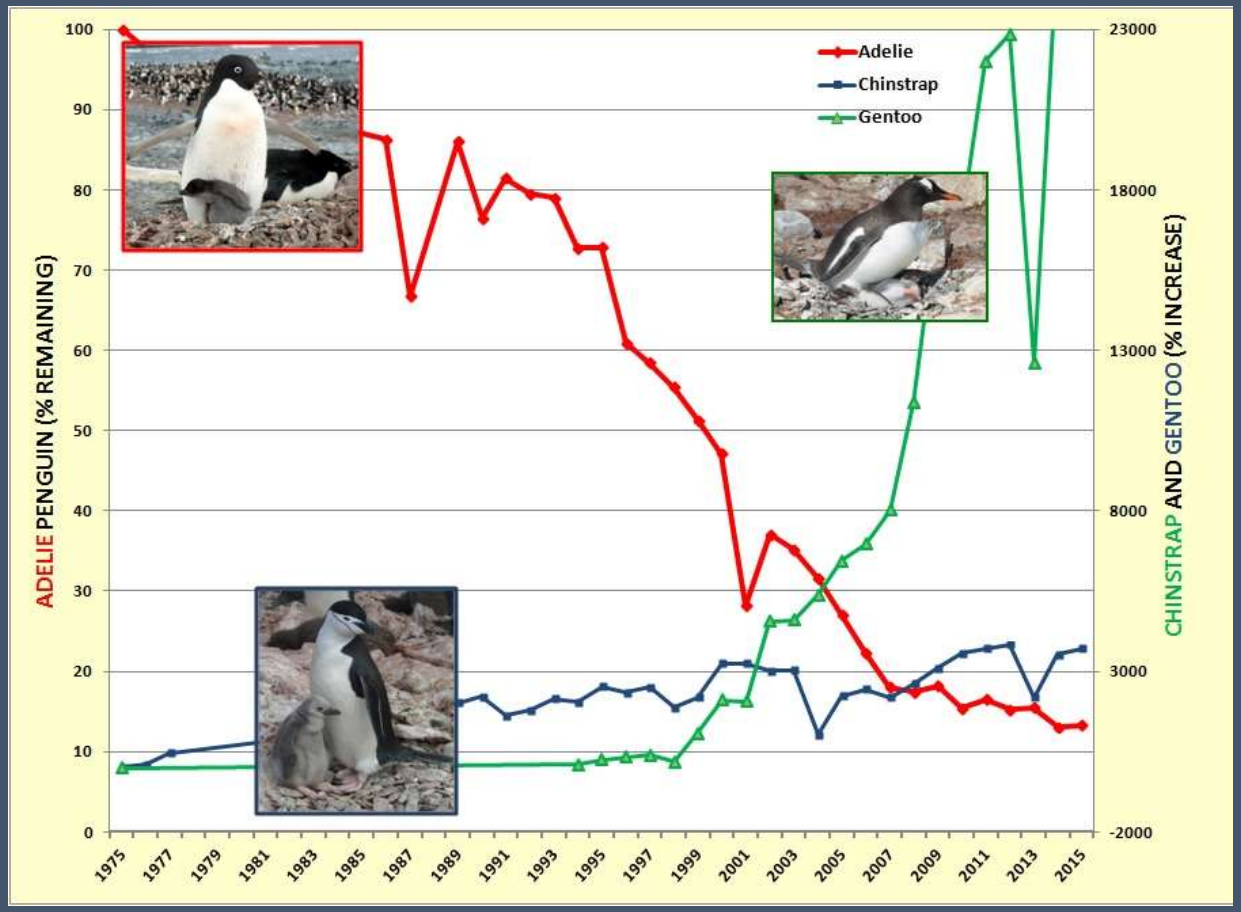
Sub-Antarctic Climate Warm-Moist

Antarctic Climate Cold-Dry

Pristine Antarctica?

Consequences to the Marine Ecosystem: Penguins, Krill, Sea Ice and Hypotheses.

Penguin Population Trends

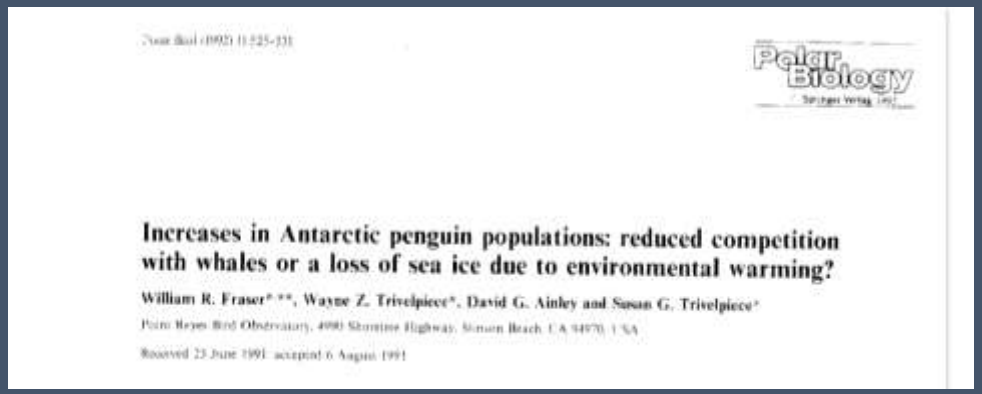


Hypotheses

The krill surplus hypothesis (Laws et al., 1972)

The sea ice reduction hypothesis (Fraser et

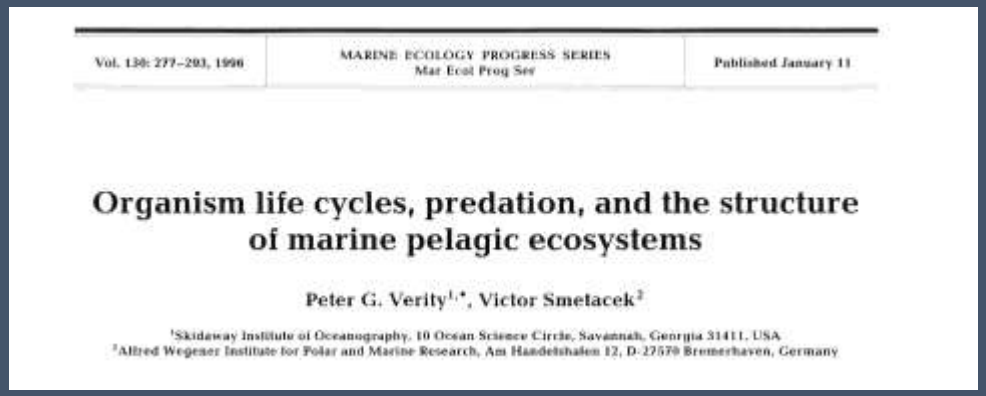
Publications and Controversy… and the clear need to test hypotheses.



Polar Biology

Increases in Antarctic penguin populations: reduced competition with whales or a loss of sea ice due to environmental warming?

William R. Fraser*, Wayne Z. Trivelpiece*, David G. Ainley and Susan G. Trivelpiece*



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Organism life cycles, predation, and the structure of marine pelagic ecosystems

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[2]Alfred Wegener Institute for Polar and Marine Research, Am Handelshafen 12, D-27570 Bremerhaven, Germany

"…the day **bird people** have something to tell us about climate warming is perhaps the day logic in climate science is abandoned…"

Anonymous Reviewer, Nature

"…a paper that creates this kind of controversy should be positive for science and the journal…"

G. Hempel, Editor, Pol. Biol.

"…marine ecosystems select the life histories of the species that populate them…" -- or, **life history strategies**, once known and understood, can be used to test hypotheses that address how ecosystems are structured

Hypothesis Testing, how do we link penguin life history strategies to marine ecosystem change?

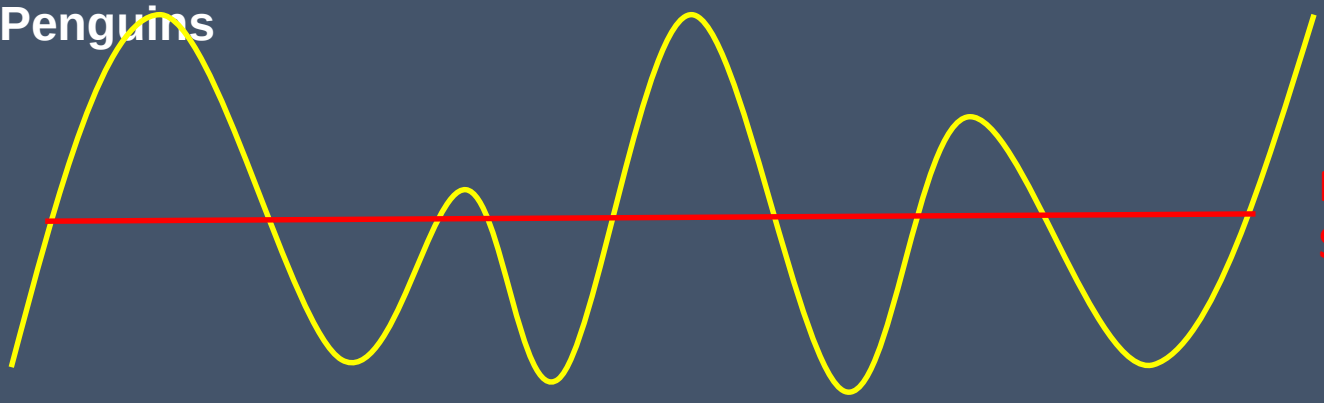
Key Indicator Species:

Ice-Dependent - Krill-Dependent

Adélie Penguin

Ice-Intolerant - Krill Dependent

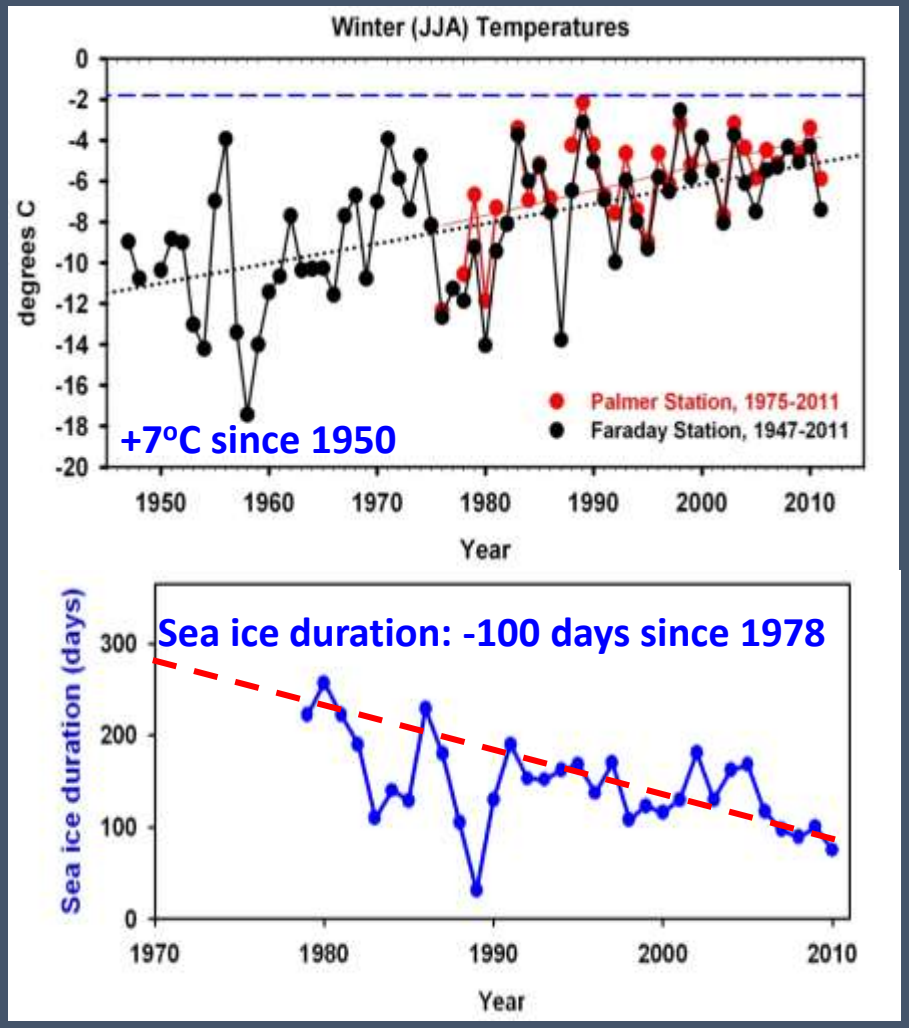
Gentoo and Chinstrap Penguins

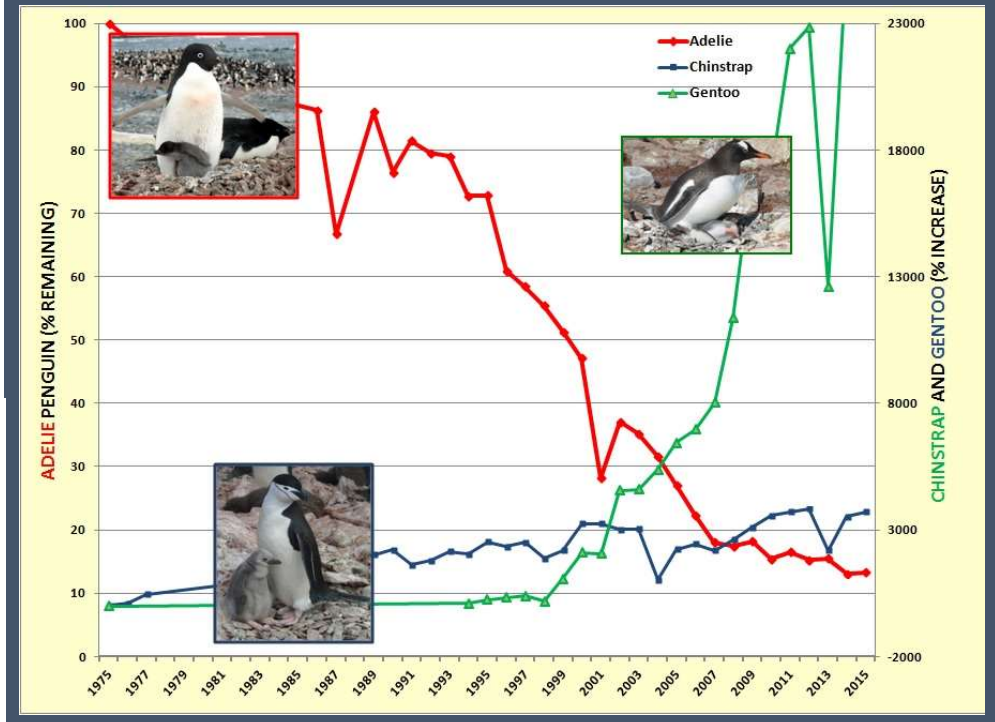


Marine Variability

Methods and Sampling Effort

Hypothesis Testing, decadal trends and marine ecosystem baselines.





What is the signature linking changes in sea ice to changes in

Hypothesis Testing, the beginning of a natural experiment during an unnatural summer

Summer 2016.

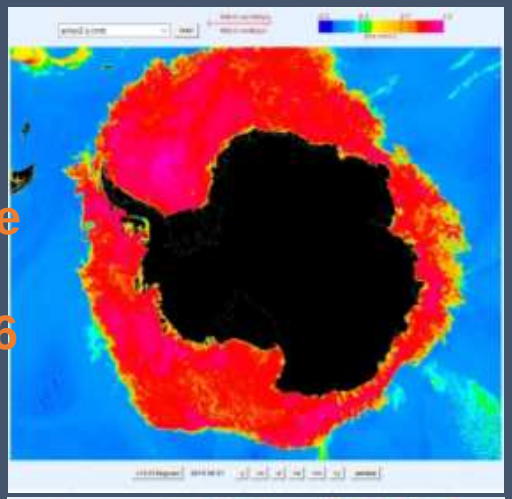
The unusually extensive sea ice winter of 2015 is followed by an equally extensive sea ice summer in 2016

Whales, both Minke and Humpback, are virtually absent from the Palmer region

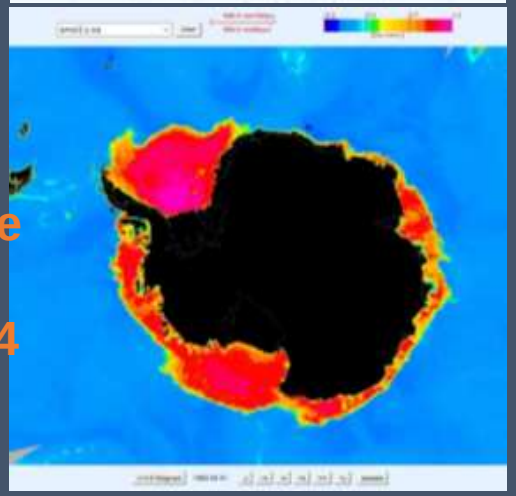
There is no evidence of any unusual change in krill abundance and/or distribution

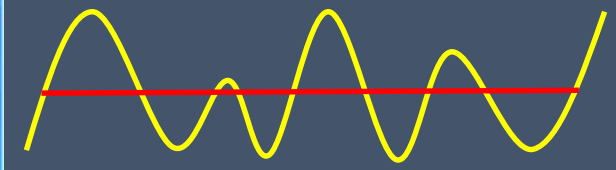
Satellite tags are deployed on Adélie and Gentoo penguins

September 2015/2016



September 1993/1994





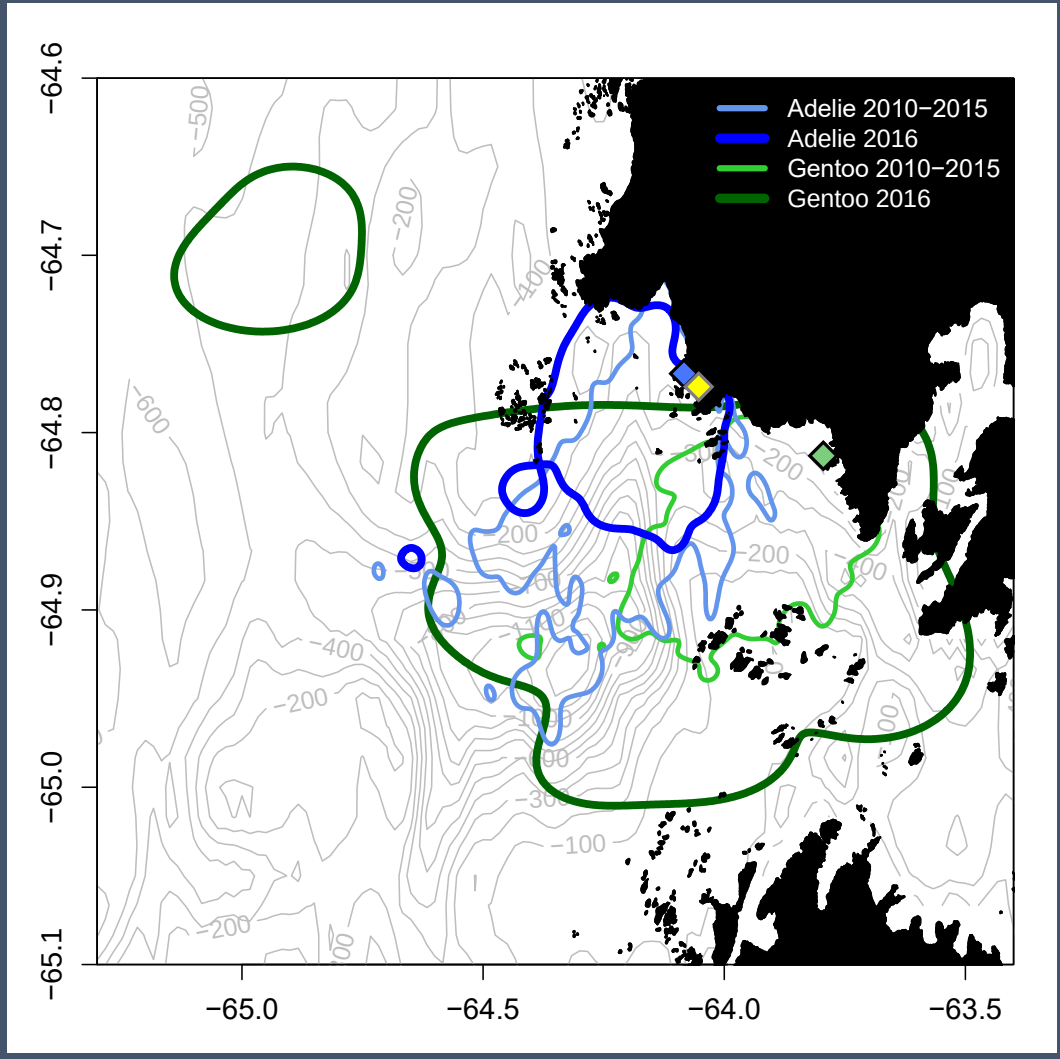
Hypothesis Testing, using decadal trends in baseline data to predict how Foraging Behavior may respond to different life history affinities to sea ice.

Adélies, sea ice dependent, enhanced foraging efficiencies

Gentoos, sea ice intolerant, deteriorating foraging efficiencies

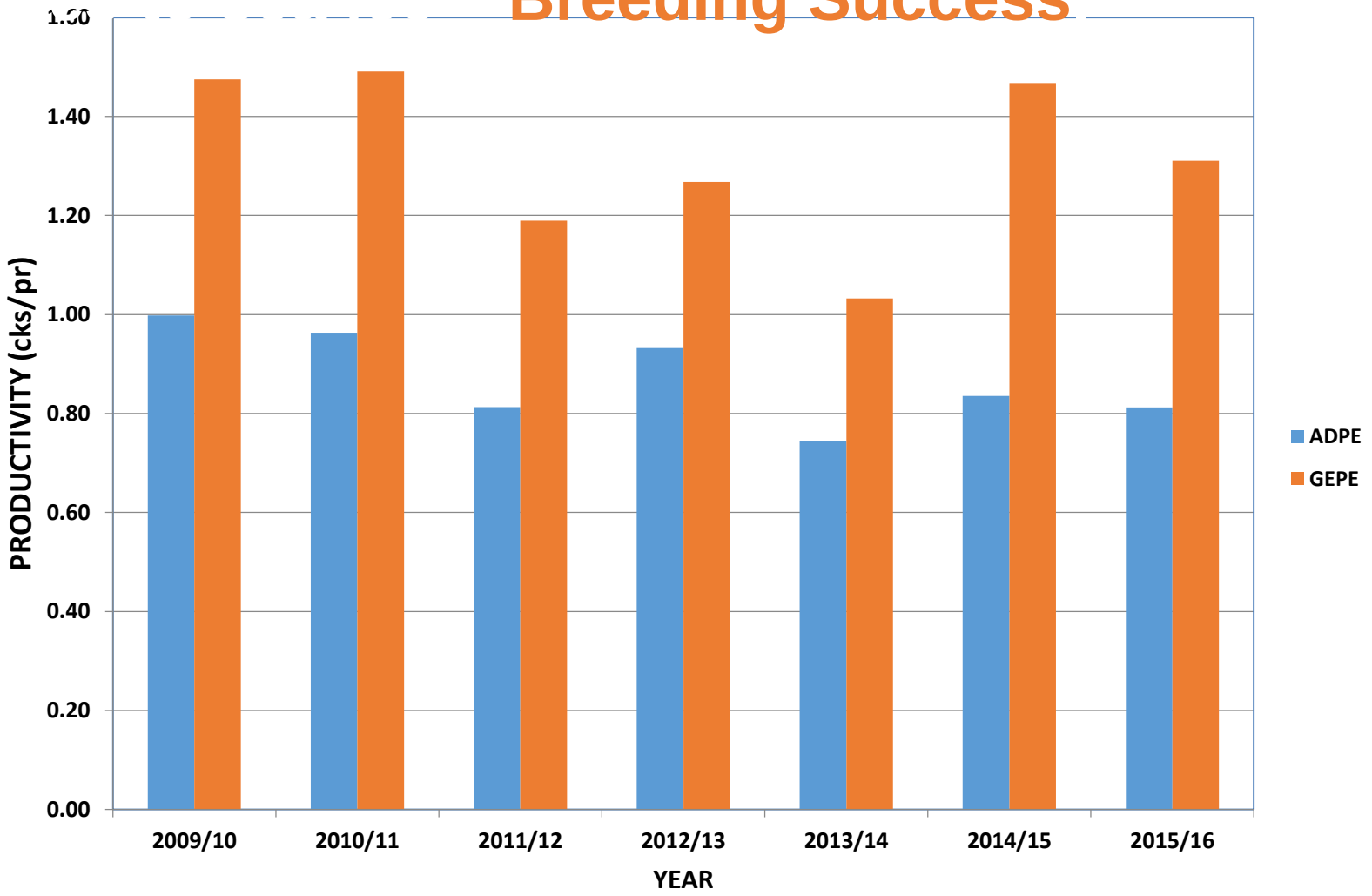
Adélies, foraging area contracts (more efficient) by 36.05% (336 vs 215 km^2)

Gentoos, foraging area expands (less efficient) by 350% (383 vs 1375 km^2)

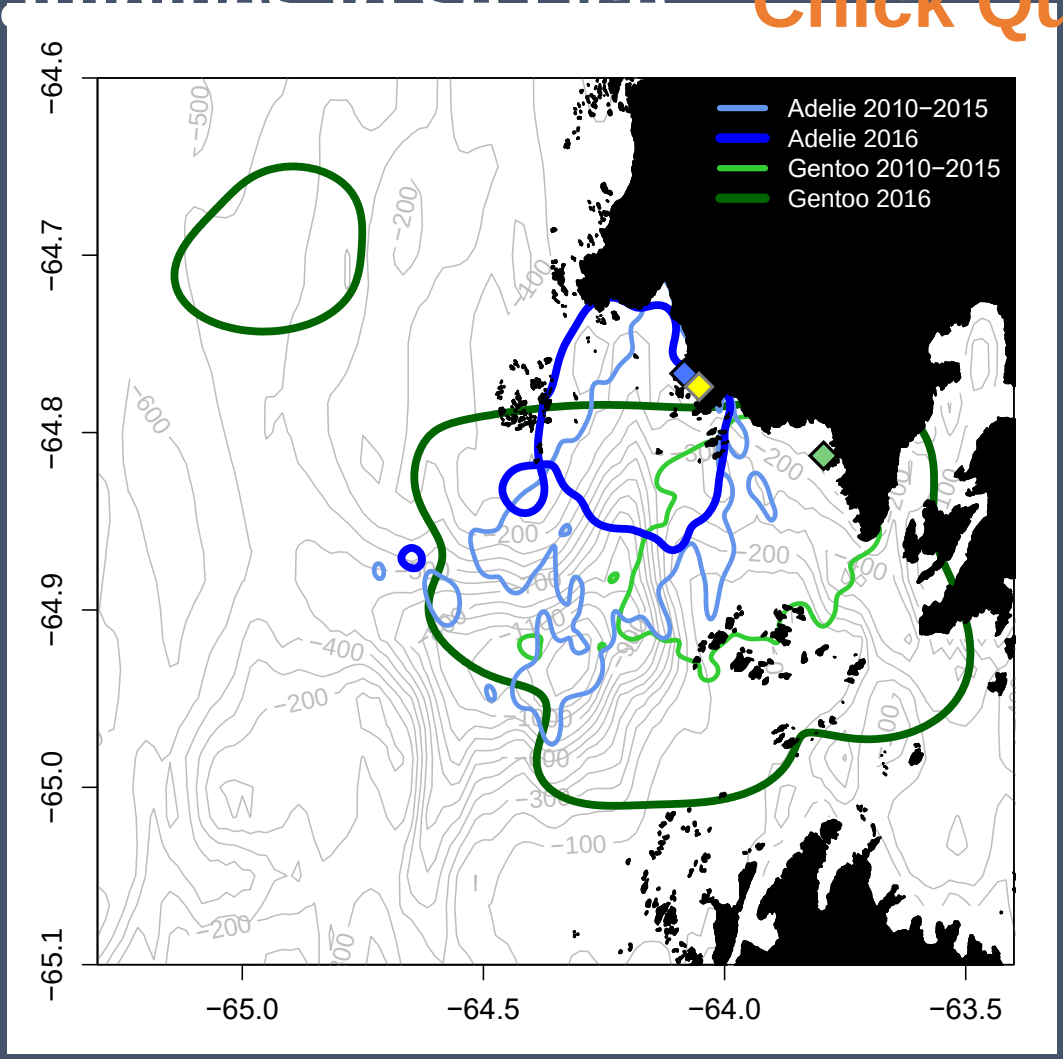


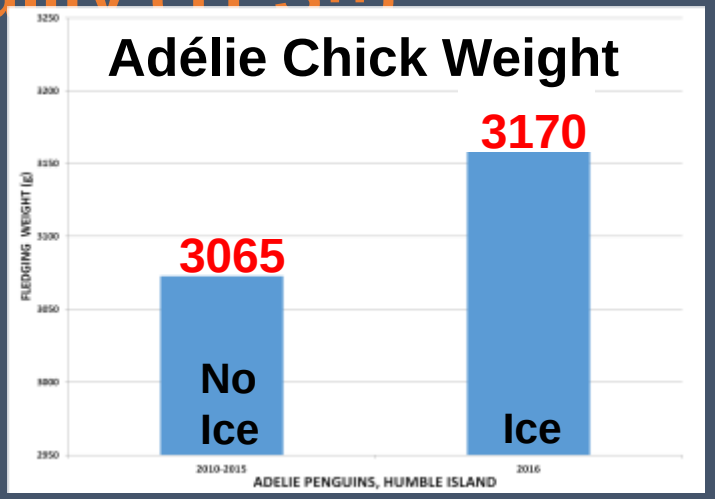
Hypothesis Testing, searching for the mechanism that translates Foraging Efficiency into species-specific population changes based on life history affinities to sea ice

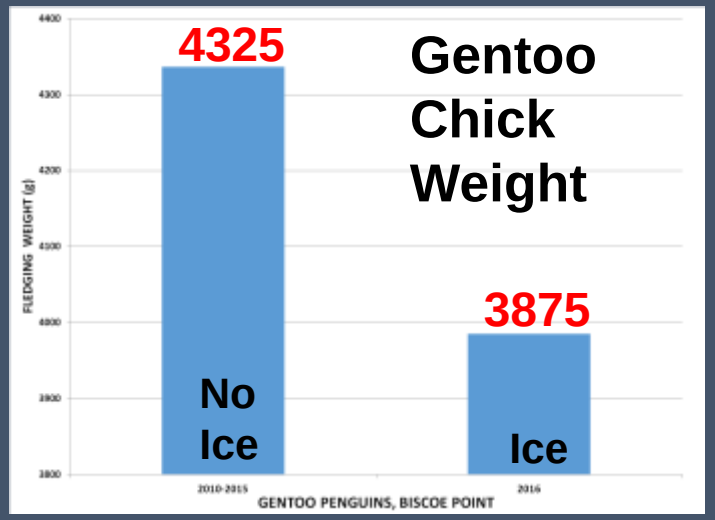
Breeding Success



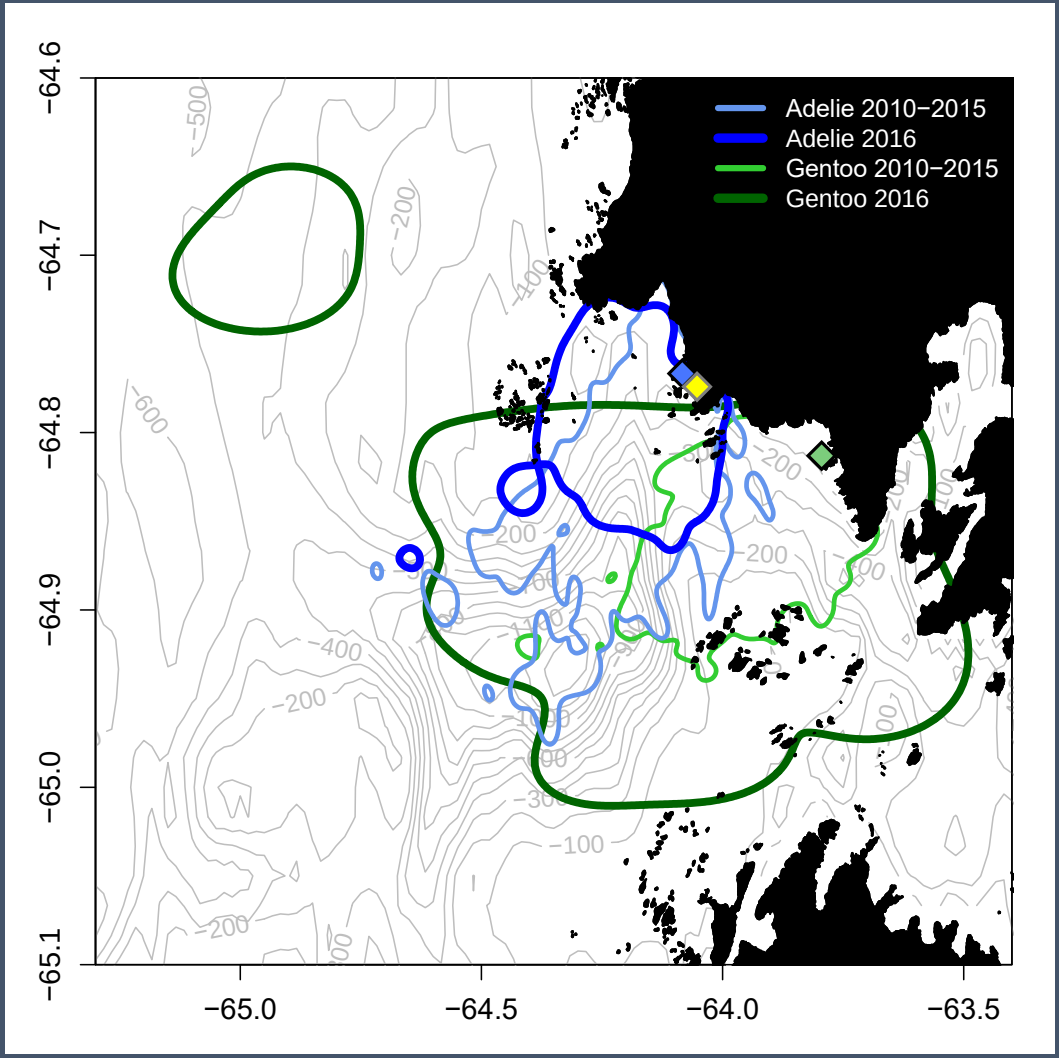
Hypothesis Testing, searching for the mechanism that translates Foraging Efficiency into species-specific population changes based on life history affinities to sea ice Chick Quality (YES!!)

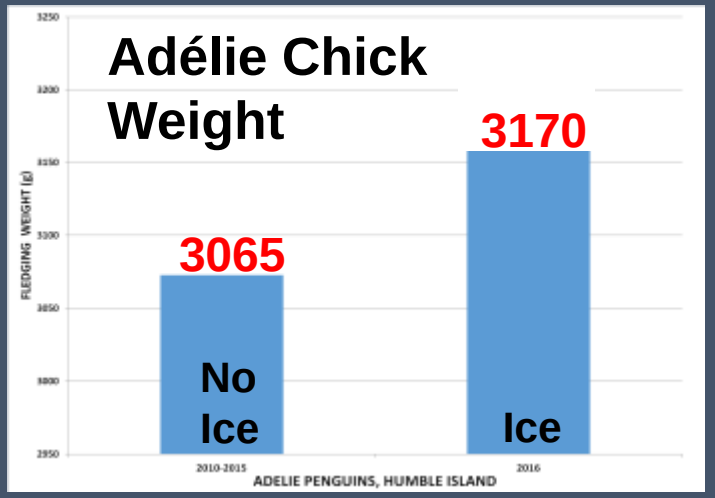


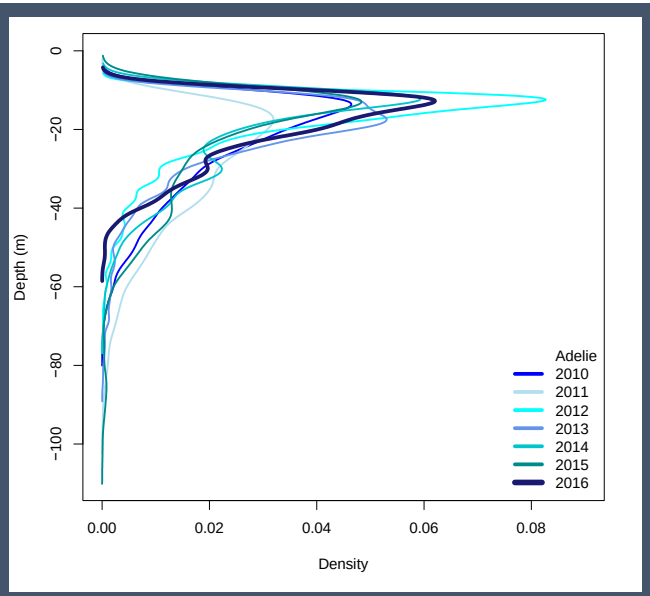




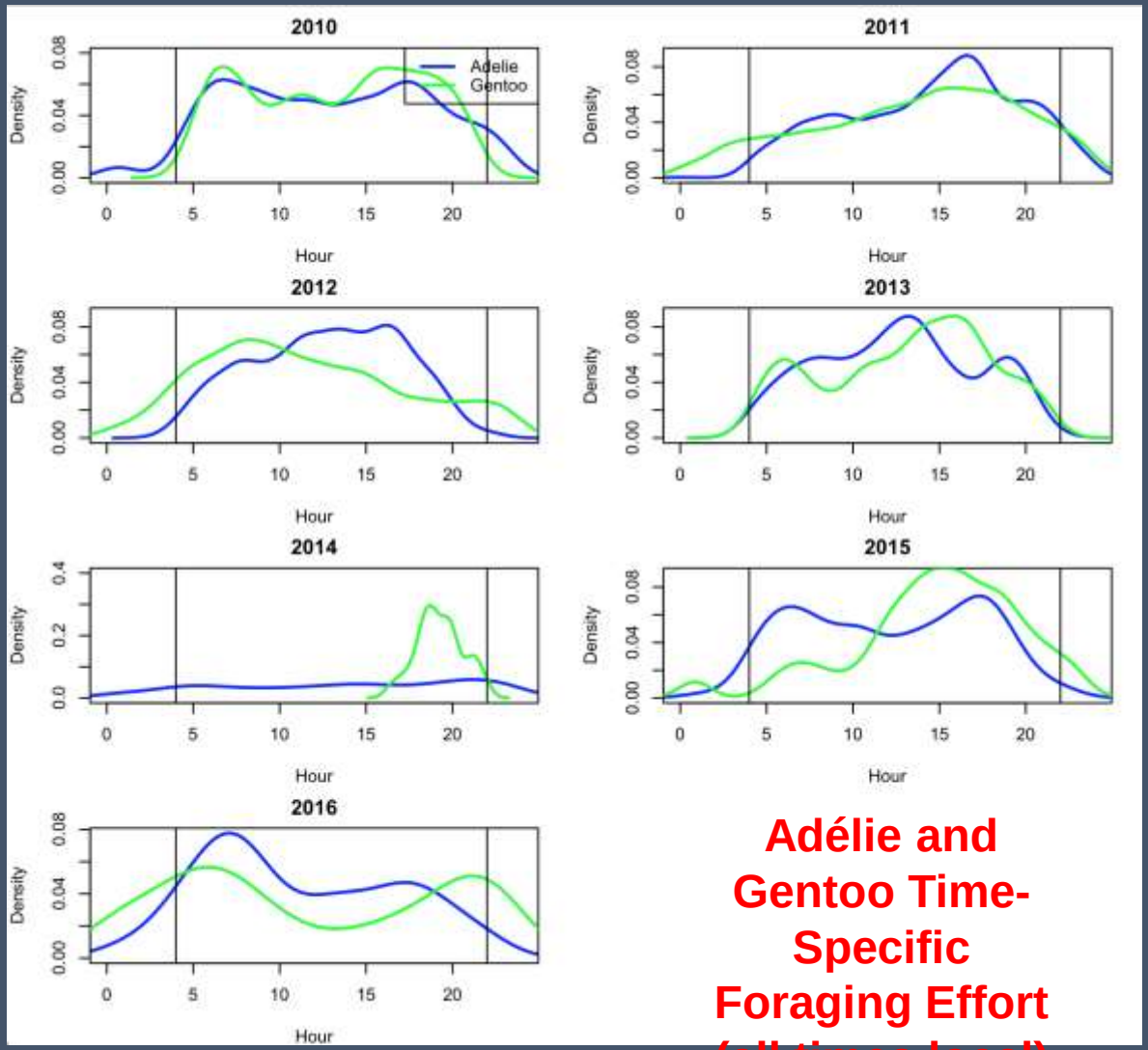
Adélie penguin chick quality, related processes with positive effects…







Gentoo penguin chick quality, related processes with negative effects…

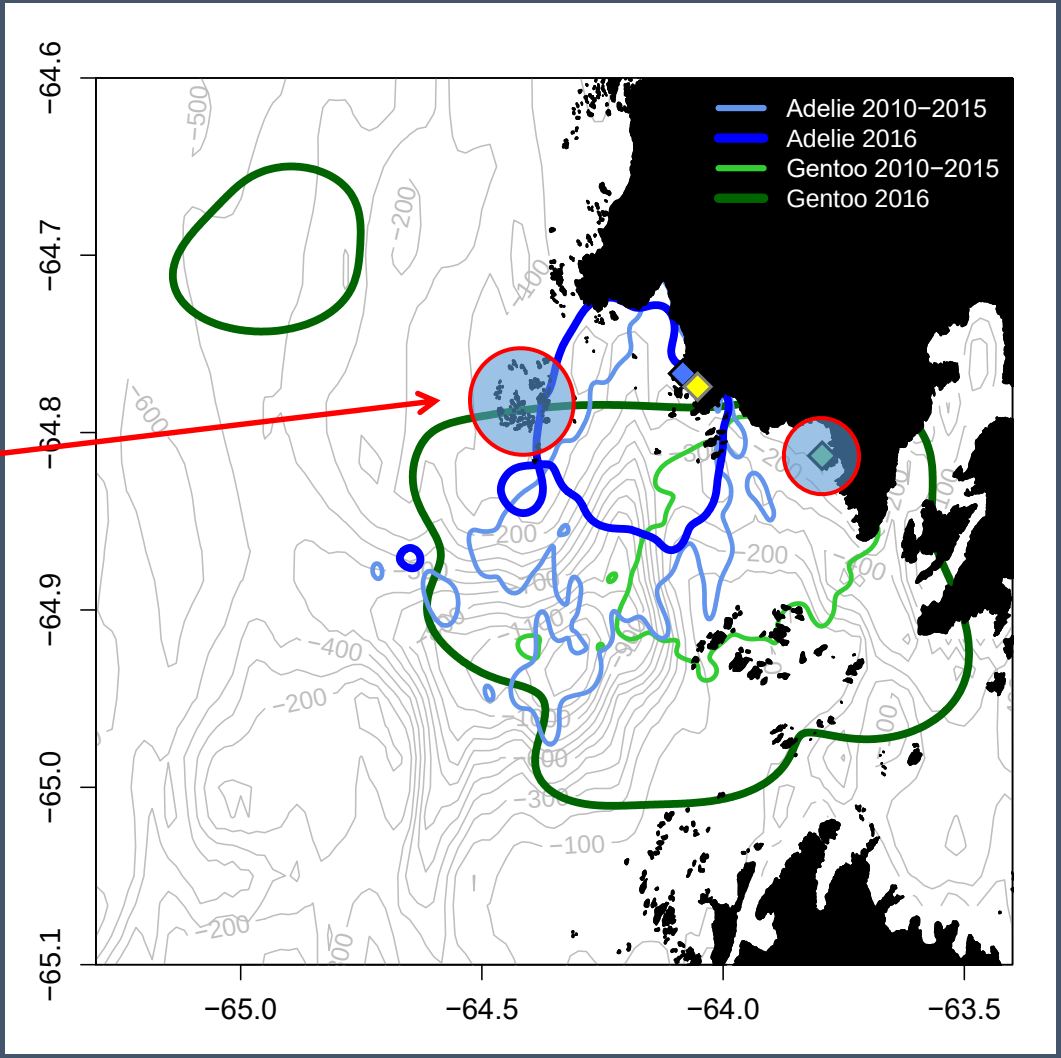


Adélie and Gentoo Time-Specific Foraging Effort (all times local)

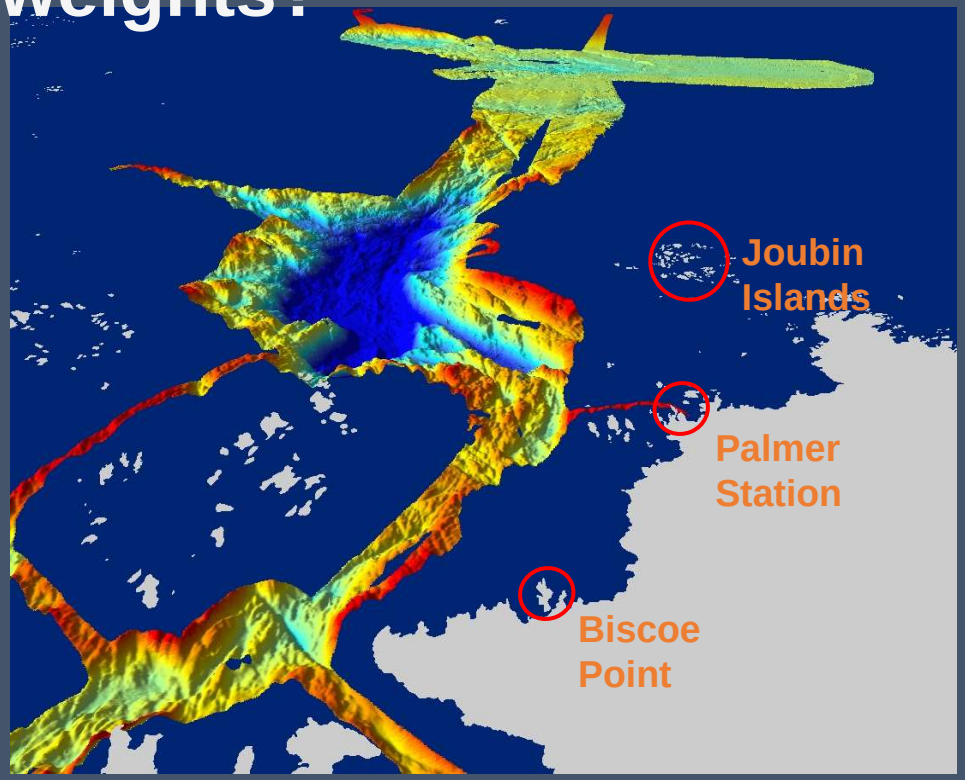
Hypothesis Testing and the Importance of Experimental Controls, how confident can we really be of this “ice effect” on penguin chick weights?

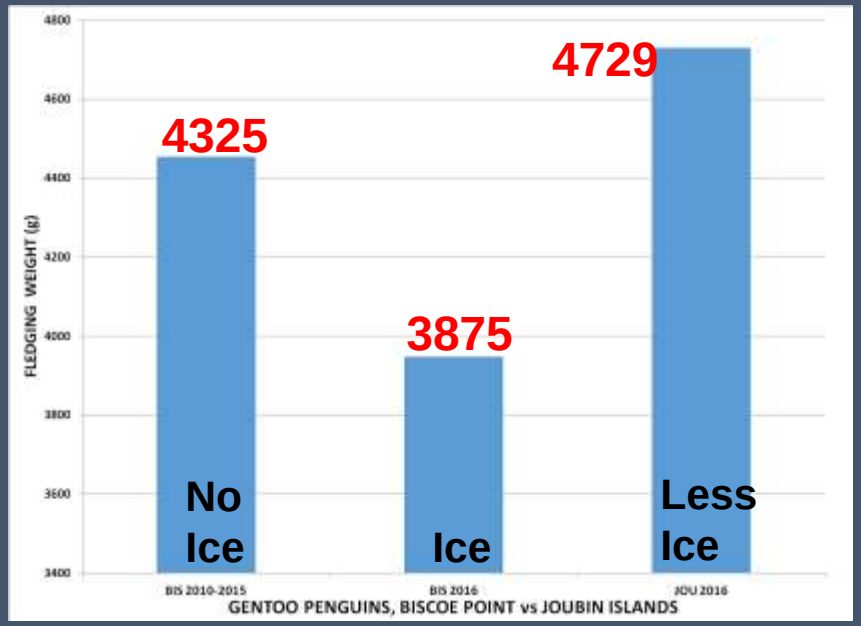
Adélies, all coastal colonies, no ice-free control sites

Gentoos, one offshore colony on the Joubin Islands close to the historical Palmer Deep polynya



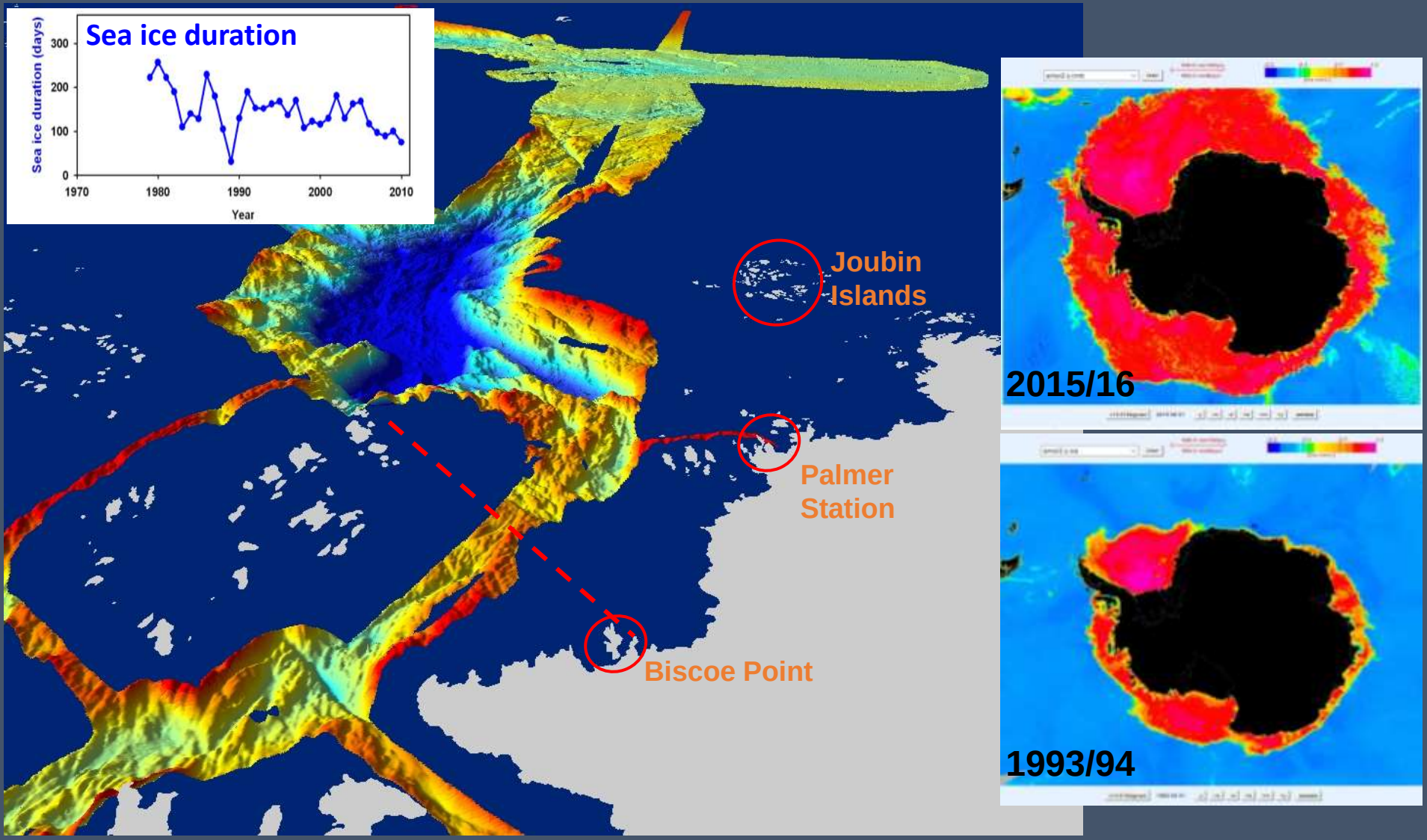
Hypothesis Testing and the Importance of Experimental Controls, how confident can we really be of this “ice effect” on Gentoo penguin chick weights?





Difficult to conclude that krill abundance would change over these spatial scales, much more reasonable (?) to deduce that to an ice-intolerant predator krill availability must surely be causally linked to a sea ice concentration

Slipping Forward Into the Past, a Predator's Perspective On Climate and Change in the Western Antarctic Peninsula Region



Conclusions and Closing Thoughts.

Connecting people, places, animals and spaces…
but what about connecting to time?

Global Use of Our Data in 2016
http://pal.lternet.edu/

Acknowledgements

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- Holmes & Narver
- ITT Antarctic Services
- Antarctic Support Associates
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- Antarctic Support Associates
- RV Hero, Rieber Shipping and Edison Chouest

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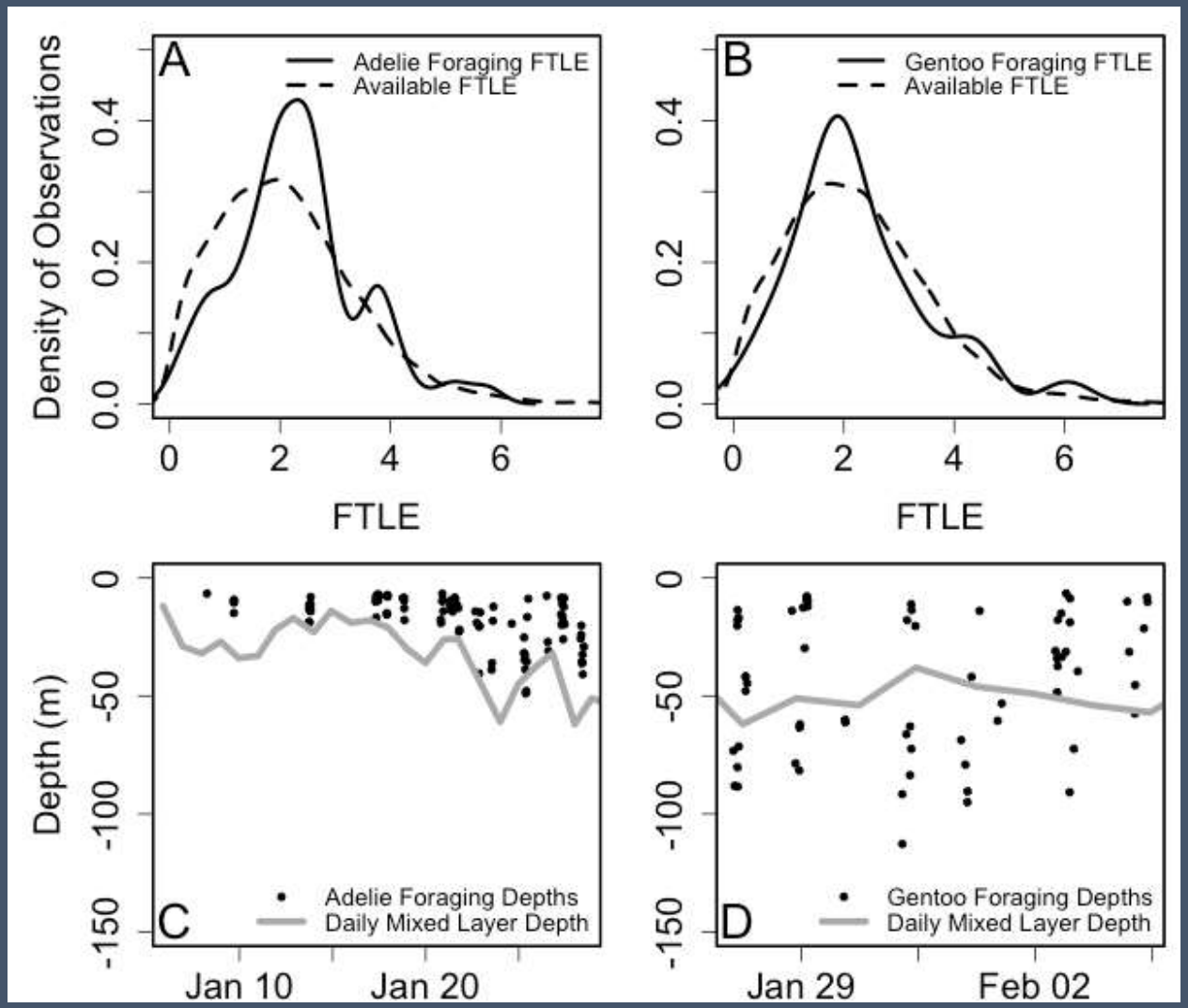
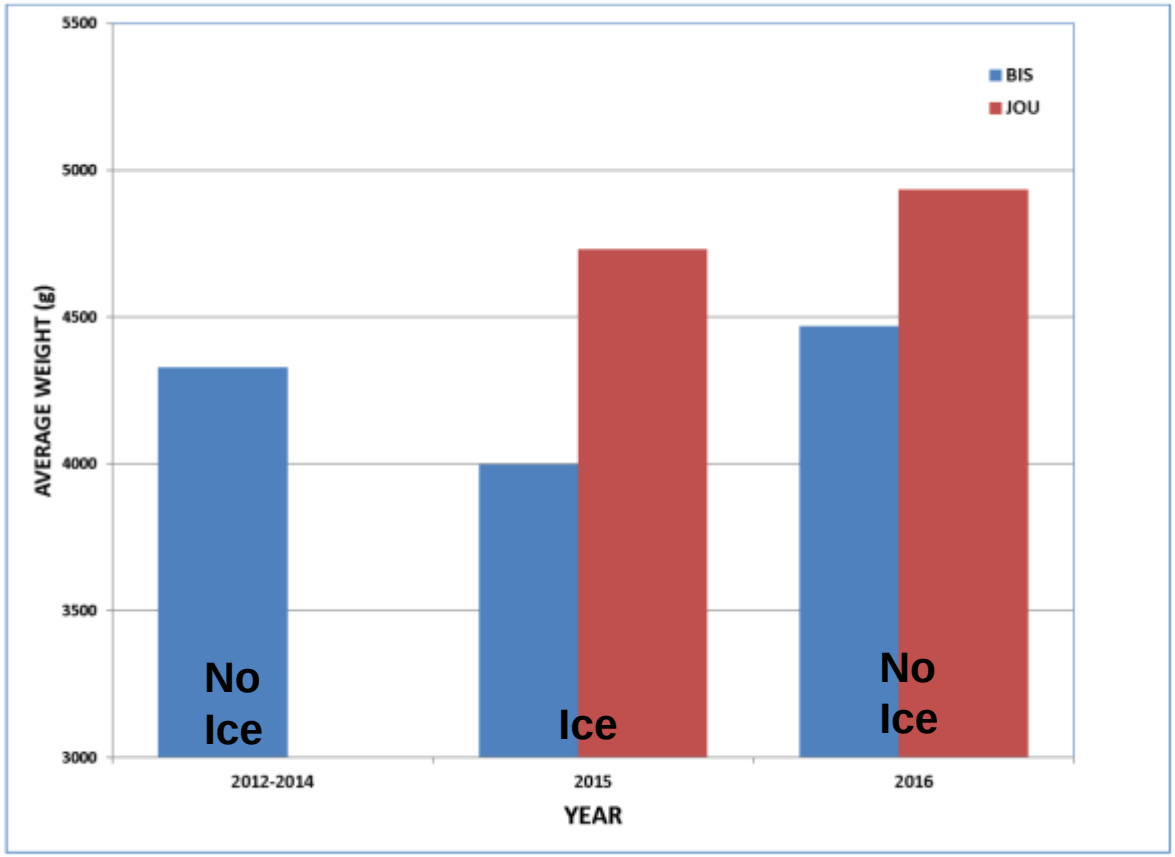
Data Management and Analyses, Megan Cimino, Donna Fraser, Erin Pickett, Christine Ribic

Mixed Layer Depth and Adélie vs Gentoo Foraging Depths.



FTLE = Finite Time Lyapunov Exponent (Kohut/Fraser et al. In Prep., 2017)

New Data, Gentoo Fledging Weights 2016-2017.

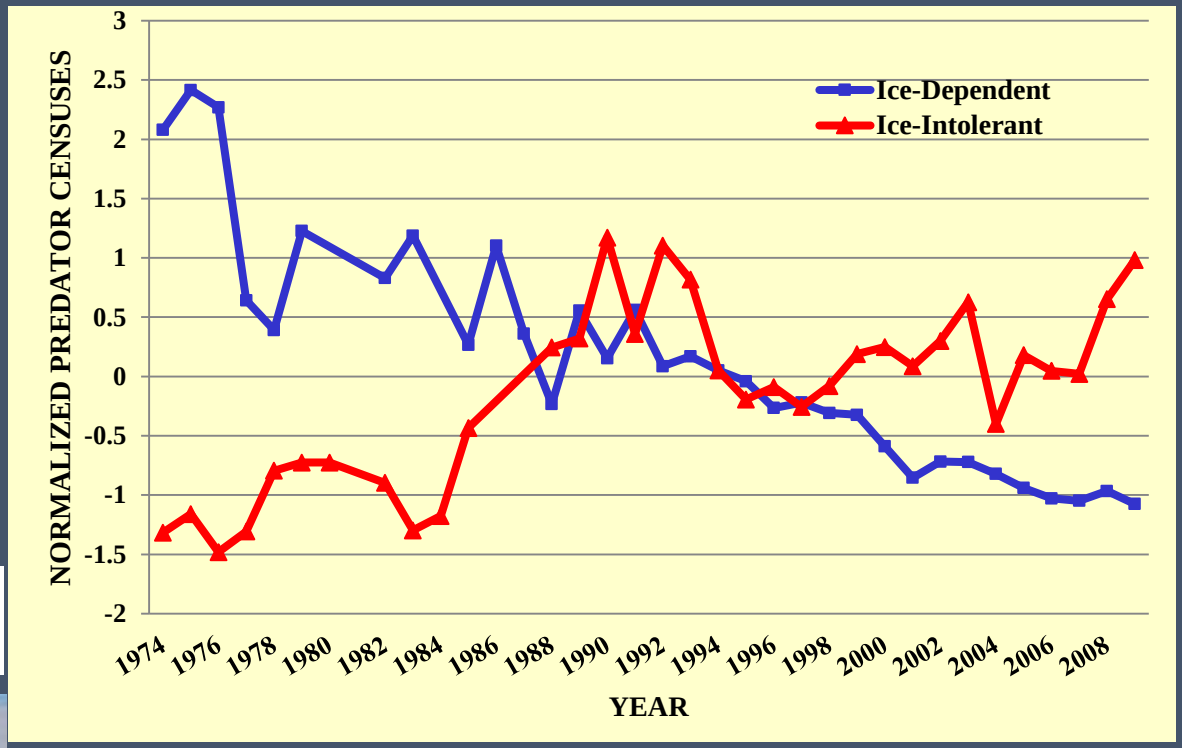


Population trends of ice-dependent versus ice-intolerant species, Anvers Island, 1974-2010.

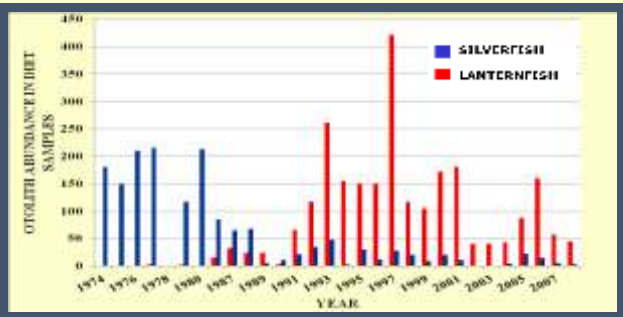
Ice-dependent

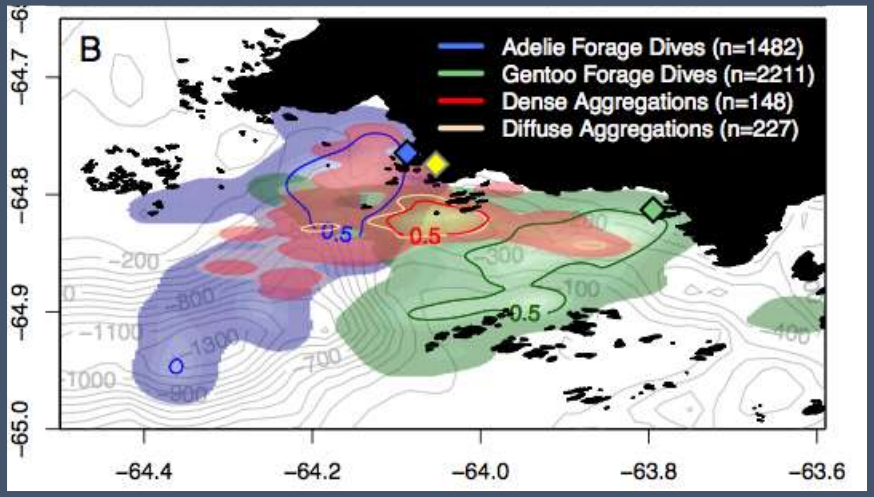
A 7-year "transition" between dominant life history types, 1988-1995.

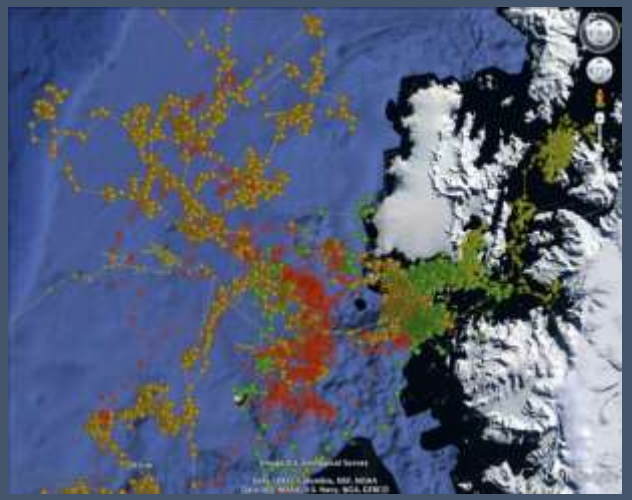
Ice-intolerant



FUNCTIONALLY EXTINCT







Small Scale Processes? ?