Presentation notes: Pinniped project

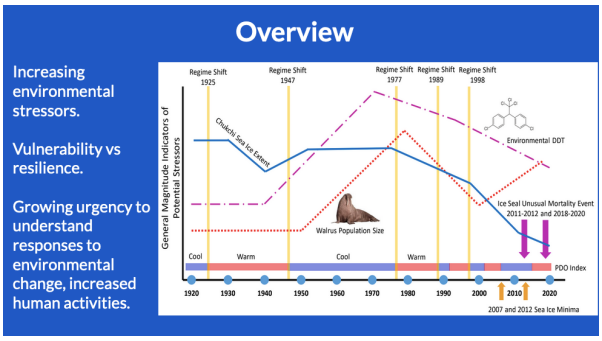
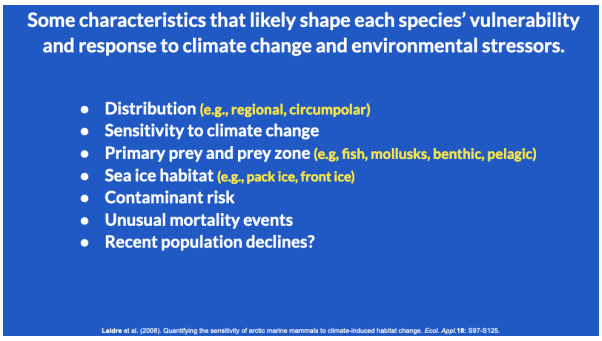
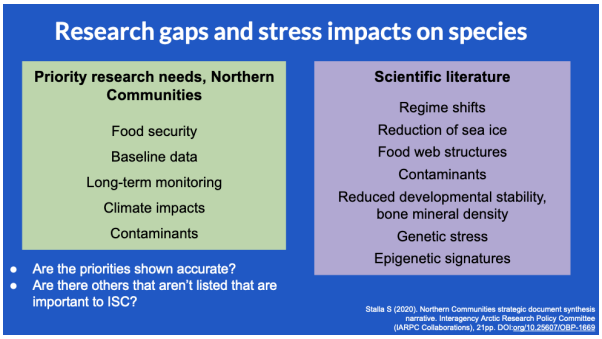
Introductions

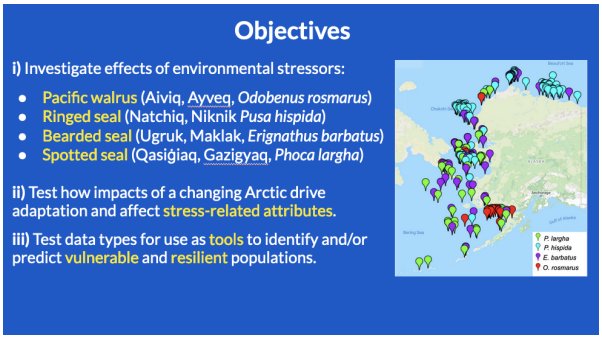
SB: Res. Assoc. at NM Museum of Natural History and Science, with a focus on morphometrics. Before moving to NM, lived in Alaska for 10 years, working at University of Alaska Museum of the North, first as collection manager, then as Res. Assoc. where I worked mainly on marine mammal stranding and specimen salvage projects.

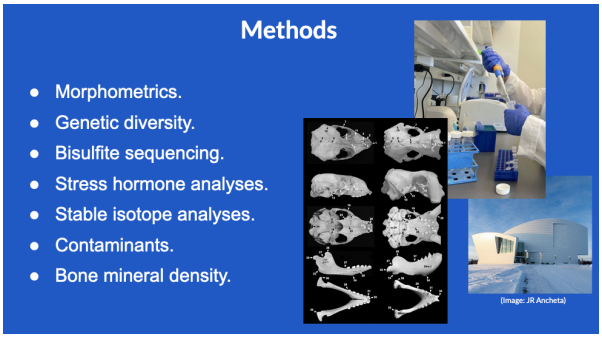
AH: Professor of Oceanography and director of the Charismatic Megafauna and Oceanography Laboratory at Nova Southeastern University in Fort Lauderdale, FL. PhD in Oceanography at UAF and continue to conduct research in and around AK on the role of trophic dynamics and contaminants in organisms as diverse as sea otters, beluga whales, pelagic fishes, and coastal gray wolves.

LH: Associate Professor of Marine Biology at CFOS-UAF and Chair of the Marine Biology Department. Have been in Alaska for almost 25 years and worked on a variety of Arctic marine mammals, e.g., ice seals, walruses, bowheads, polar bears, on a wide range of issues, including, feeding ecology, digestive physiology, contaminants, steroid hormones.

GOCC: Completed B.Sc., Ph.D. at University College Dublin, Ireland. Ran a research group at NOAA's Southwest Fisheries Science Center in La Jolla, California, for 14 years studying molecular and behavioral ecology of several marine mammal species.

	Current research includes field and lab studies on beluga whales, Steller sea lions, ice seals, bottlenose dolphins and polar bears.
	Marine mammals subjected to increasing array of environmental stressors, especially at higher latitudes. Increasing awareness of risks facing Arctic fauna should be examined in terms of **vulnerability vs resilience** to potential cascading impacts of multiple stressors. **Growing urgency** to understand how marine mammal populations will deal with loss of sea-ice, snow cover, ecological disruptions to food webs and breeding areas, increased human activities.
	Differing ecologies, habitat specificity, ranges and abundances may predispose some to greater risk than others. Laidre et al. (2008) developed a quantitative-sensitivity-to-climate-change index based on species biology and reliance on sea ice; yet, how these species are **responding** at and below the **organismal level** and how molecular, physiological, and morphological capacity confers resilience is **largely unknown**.
	**Priority research needs summarized in Northern Communities Strategic Document Synthesis, outlined by Sorina Stalla (Stalla 2020):** • Challenges to food security • Baseline data, support studies, and impact assessments on subsistence species • Long-term monitoring and observation systems of subsistence species to support food security • Climate impacts such as changes in

	sea ice and ocean temperatures on subsistence resources ● Increased understanding of contaminants in subsistence species **Scientific literature describing impacts on species of importance to Northern communities:** ● Climatic and oceanic regime shifts ● Unprecedented reduction of sea ice ● Changes in Arctic food web structure and prey quality ● Exposure to contaminants ● Changes in developmental stability and bone mineral density in species under environmental stress ● Genetic stress such as chromosome balance alterations ● Epigenetic signatures showing adaptive responses of some marine species to climate change
	i) Investigate effects of environmental stressors and the biological systems involved in responding to them, for: Pacific walrus (Aiviq, Ayveq, *Odobenus rosmarus*) Ringed seal (Natchiq, Niknik *Pusa hispida*) Bearded seal (Ugruk, Maklak, *Erignathus barbatus*) Spotted seal (Qasiġiaq, Gazigyaq, *Phoca largha*) ii) Test predictions about how the impacts of a changing Arctic drive adaptation and affect stress-related attributes of ecologically diverse species. iii) Test whether data types from this study can be used as tools to identify and/or predict vulnerable and resilient populations living with long-term environmental change and stochastic extreme stress events.



1,000 specimens held at UAMN and collected over a 70 year period will be scanned and subsampled. All museum/lab-based work, so we **won't be disturbing** any seals or **subsistence hunts**.

Using 7 different methods on each specimen:

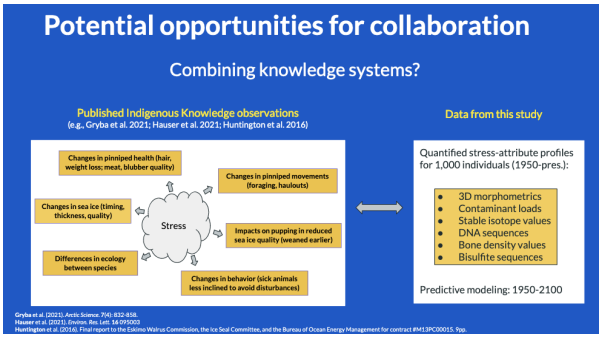
i) Morphometrics, incl. FA, indicative of early life stressors and proxy for developmental stability.
ii) Genetic diversity, including genes involved in the stress response, indicative of adaptive potential.
iii) Bisulfite sequencing, tests for adaptive controls of gene expression and potential signs of maladaptive marks relating to chronic stress.
iv) Bone cortisol, revealing lifetime chronic stress.
v) Stable isotope analyses of bone collagen revealing differences/shifts in trophic ecology.
vi) Absorption of organic and inorganic contaminants, based on those accumulated in bones and teeth.
vii) Bone mineral density, impacted by contaminants, and nutritional, physiological, and/or genetic stress.

Of interest to the ISC:

Develop quantified stress-attribute profiles for 1,000 specimens archived at University of Alaska Museum of the North, that were collected over a period of 70 years.

Provide scenarios of vulnerability and/or resilience of subsistence species over time.

Potentially provide tools to identify species/populations that may be more at risk of decline, and which might require tailored co-management approaches.



Combining knowledge systems will provide a much finer-detailed, **more complete picture** for understanding the effects of stress on subsistence species, particularly at regional levels where some populations may be affected by stressors more than others. This approach may also provide a **better** understanding of ecosystem health as a whole.

- People living in the coastal Arctic have been **observing changes** to the environment in **real-time** (both subtle and large scale) **daily**, for thousands of years.
- This **level** and **depth of knowledge** can only be achieved by Traditional Knowledge holders, and may be all-important in correctly interpreting the results we get from analyzing samples.

- From a co-management perspective, **our data may fill gaps** in the different knowledge bases: e.g., two groups of seals have been exposed to the same stressor event but one group is observed to be more affected than another. Why?
- We could look at the history of **stress-attribute profiles** for both groups, **alongside** the **IK observations** for a particular time period. Maybe one group has higher contaminant loads than the other? Maybe there's a particular combination of stress-attributes that, when **occurring together**, makes one group less able to withstand the stressor event than one with fewer - **or different** - stress signatures?

Should we be funded, we invite collaboration with the ISC and other co-managers who may find our research useful to their own. If there is interest in collaborating, we would apply for **supplemental funding** that would cover costs for collaborative efforts. For example:

- While relying on museum specimens, we would much appreciate **working with hunters** to include some modern samples as well.
- **Collaboration with ISC researchers** on analyses and joint publication of results for co-management priority areas following the **3-year** project period.
- **Addition of analyses** identified by co-managers that would **benefit co-management efforts** during the project period, particularly at regional/population levels, and in the face of new stressor events.
- **Sharing** project progress/findings and new co-management observations at the **end of each project year**, either virtual or in person at the **Alaska Marine Science Symposium.**

Thank you for your time and consideration.

Although this is project is still working its way through NSF and **has not yet been funded**, we wanted to share our ideas with you.

Please reach out to any of us if you'd like to know more about our project, or would like to share some ideas.