

Shifting bearded seal breeding behavior associated with changing ice conditions in Utqiagvik, AK

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Using data collected as part of the bowhead whale census in 2010 and 2011, we are investigating changes in the onset (timing) of the bearded seal breeding season associated with sea ice conditions. Additionally, in anticipation of increased vessel traffic in the region and in acknowledgment of elevated vessel noise throughout the bearded seal range, we are investigating if bearded seals are adjusting their calling behavior in response to natural sounds (other seals), and if strategies to contend with natural sounds are transferable to anthropogenic noise (vessel noise).

Specific research questions:

1. Does the period of peak bearded seal calling vary based on sea ice extent?
2. Do bearded seals adjust their frequency (pitch) in noise conditions?
3. Are high ice years louder overall than low ice years?
 - a. If so, is this associated with biological sounds or geological (ice, wind, etc.) sounds?

In the spring of 2010 and 2011 multi element hydrophone arrays (underwater listening devices) were deployed off of Point Barrow in order to census migrating bowhead whales. In addition to bowhead whales, these hydrophones also captured the vocalizations of breeding bearded seals (*ugruk*). These two years were selected out of a larger historic dataset due to (a) their early deployment times (April of both years) and (b) their contrasting ice conditions.

Soundscape conditions varied widely between 2010 (a period of early ice breakup) and 2011 (a period of later ice break up). Long term spectral averages (LTSA's) were generated to visualize ambient noise conditions during the spring of each year (Figure 1). Although calling seals were documented throughout the month of April, in 2010 early May was characterized by long periods absent of both calling animals and environmental sounds, while May 2011 was characterized by the sounds of chorusing bearded seals at all hours of the day.

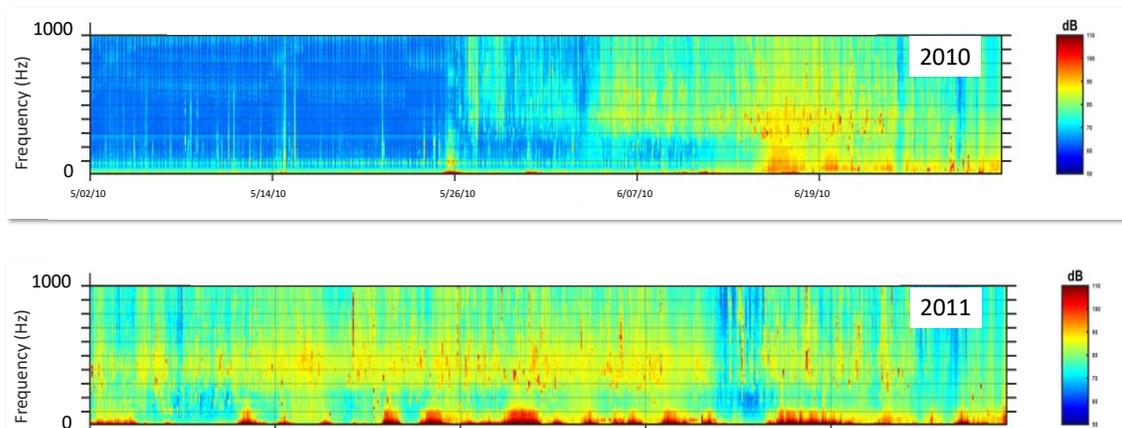


Figure 1- Long term spectral average (LTSA) demonstrating noise and pitch values from May-June in both 2010 and 2011.

Differences in calling behavior are reflected in the ambient noise trends of each year. As would be expected in the absence of calling seals, the months of April and May were significantly quieter in 2010 compared to 2011. Median ambient noise levels in April 2010 were 79 dB re 1 μ Pa, while median noise levels for the same time period in 2011 were 88 dB re 1 μ Pa. Noting that dB are logarithmic, this indicates that sound intensity was approximately 10 times louder in 2011 with the primary driver of ambient sound being chorusing seals.

Similarly, the periods of peak onset calling – which corresponds to bearded seal breeding activity – varied based on ice conditions. Onset calling (the period of highest number of bearded seal vocalizations at the start of the breeding season) occurred on April 7th in 2010 (lower ice year), but not until April 28th in 2011 (higher ice year). Notably, once chorusing began in 2011 it persisted throughout the spring breeding season, while in 2010, calling peaked in April, and then calling stopped almost in its entirety until June. Notably, the number of daily calls documented during peak calling periods in 2011 was approximately double the number of calls from 2010. Given the consistent and predictable calling behavior of bearded seals, this increase likely reflects a true increase in the number of individuals in the region in 2011 rather than an increase in calling effort.

As a follow up to an earlier study that found bearded seals can only moderately adjust their call volume (source levels) in response to changing ambient noise conditions, this study looked at shifts in the pitch (frequency) of bearded seal calls in response to noise from other seals. Adjusting call pitch is a common mammalian strategy adopted in order to be detected above elevated noise levels. Applying this strategy may indicate increased resilience to changing ocean soundscapes for this species.

We measured the peak frequency of 870 bearded seal calls in 2010 and 2011 and compared this to ambient noise conditions that predominantly contained the sounds of calling seals and bowhead whales. Overall, there was a negative relationship between pitch and noise, however the relationship was bimodal rather than linear. At higher ambient noise levels, call types appeared to change from shorter high-frequency calls to longer low-frequency call types. In most phocids, lower and longer calls are preferred by females. This strategy of call type switching may be an effort on the part of male callers to distinguish themselves as higher quality mates when conspecific competition increases, or may be a feature of larger more dominant males increasing their calling effort in noisy conditions.

In spring of 2023 and 2024, as part of a NPR-A grant, multiple hydrophones will be again deployed off of Point Barrow. In 2023, hydrophones will be deployed earlier in an effort to capture the beginning of the breeding season. Contemporary hydrophone recordings are essential for continuing the time series, so that current conditions can be compared to historic (1980's and 90's) baselines. The broader goal is to assess the cumulative impacts of both climate change and associated noise on bearded seals in the Arctic and sub-Arctic, and to further apply these datasets and methodologies to other relevant ice seal species.