

Analysis of knock sequences produced by walrus in the northeastern Chukchi Sea

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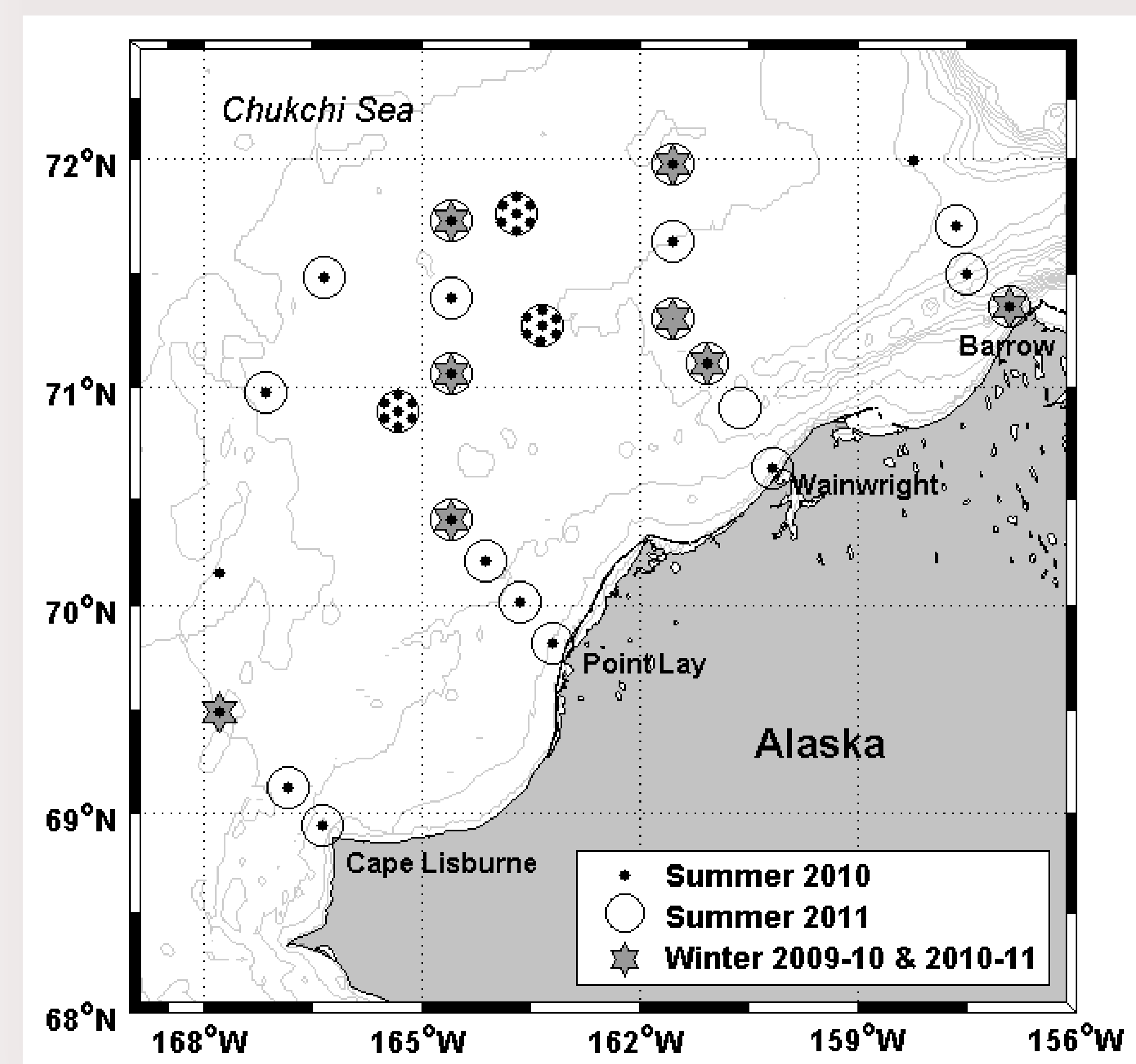
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Introduction

Walrus produce a variety of underwater sounds including bell sounds, grunts, and low frequency pulses called knocks. Knocks are usually produced in trains consisting of a sequence of pulses produced in rapid succession and often finished with a bell sound. In the High Canadian Arctic, knock sequences from Atlantic walrus have been shown to be highly stereotyped and repeated over long periods of time by mature males as mating display (also referred to as knock songs). Stirling et al. (1987) observed that different male Atlantic walrus produced different knock songs and that individual knock song patterns persisted over several years. Pacific walrus summering in the eastern Chukchi Sea also produce knock sequences; however, their function is unclear. The Chukchi Sea is not a breeding ground for walrus and it is mostly frequented by females with pups and juveniles. The objective of this ongoing study is to determine the purpose of the knock sequences produced by walrus in the eastern Chukchi Sea.

Data collection



- Up to 40 acoustic recorders deployed during the summer in the northeastern Chukchi Sea
- Data from 2007 to 2014
- Recorders configured to capture sound continuously from 10 Hz to 8 kHz
- Recorders deployed in walrus habitat

Methods

Semi-automatic detection of walrus knocks

- Ran kurtosis-based walrus knock detector on the entire dataset to identify recordings with walrus knocks (Mouy et al., 2012)
- Analyst manually verified that all knocks were correctly detected by the detector.
- Analyst added or deleted knock detections as required

Definition of knock-trains

- Knocks separated by less than 0.5 s were grouped as *knock-trains*
- Each knock-train was represented by its number of knocks and its duration
- The density-based clustering algorithm dbSCAN (Ester et al, 1996) was used to defined the different types of knock train in the dataset.

Definition of the most frequent knock-train sequences (songs)

- Used the Prefix-Span sequential pattern mining method (Pei et al, 2001) to define knock songs based on the most frequent succession of knock-trains found in the data
- Method used for discovering DNA sequences
- Can discover patterns even in the presence of several individuals knocking in the same recording.

Results and Discussion

Knock recordings analyzed

Year	Number of knock recordings	Locations
2007	3	B10, W20, PL5
2009	6	B50, W35, W50,
2010	5	B50, W5, WN40,
2011	6	CL5, PL5, W5, W20, W50, WN40
2012	6	W5, W20, W50, B50

Most frequent song

- 1 walrus knock song found over several years

SPECTROGRAM HERE

- Maybe be produced by one male singing the same songs every year (not likely)
- May suggest that some knock songs in the eastern Chukchi Sea are shared at the population level.

Acknowledgements

- We acknowledge Olgoonik-Fairweather LLC and the sponsors of the CESP Program: Shell E&P Co., ConocoPhillips Co., and Statoil USA E&P. Thanks to the crew of the Norseman 2 and Fairweather Science for logistical support.