Spatio-temporal distribution of male bearded seals in the Chukchi Sea using underwater vocalizations

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ABSTRACT

The Chukchi Sea Environmental Studies Program (CSESP; www.chukchiscience.com), sponsored by Statoil, ConocoPhillips, and Shell, includes passive acoustic monitoring that has operated almost continuously since summer 2006. Bearded seal (*Erignathus barbatus*) is a highly vocal ice seal that is widely distributed in the high north. Due to the implementation of the CSESP, and monitoring during seismic acquisition in 2007, scientific knowledge regarding their movements and behavior has increased. By using autonomous long-term acoustic recordings, researchers have been able to investigate the acoustic behavior and seasonal occurrence of marine mammals in areas, and in periods where ship-based or on ice studies were not previously possible. In this study, underwater vocalizations of male bearded seals that occurred between July 2007 and October 2011 were analyzed. Bearded seals were identified by their trills, ascents and moans. To determine the seasonal variation in the occurrence of male bearded seal vocalizations in a year, call counts were determined by analyzing 20 minute recordings between 2:00 and 6:00 a.m., from every third day. Bearded seal vocalizations increased progressively from August to March, peaked between April and June, but were essentially absent in July. Outside of and during the mating period (April–June), the occurrences of vocalizations varied on a daily cycle.

INTRODUCTION

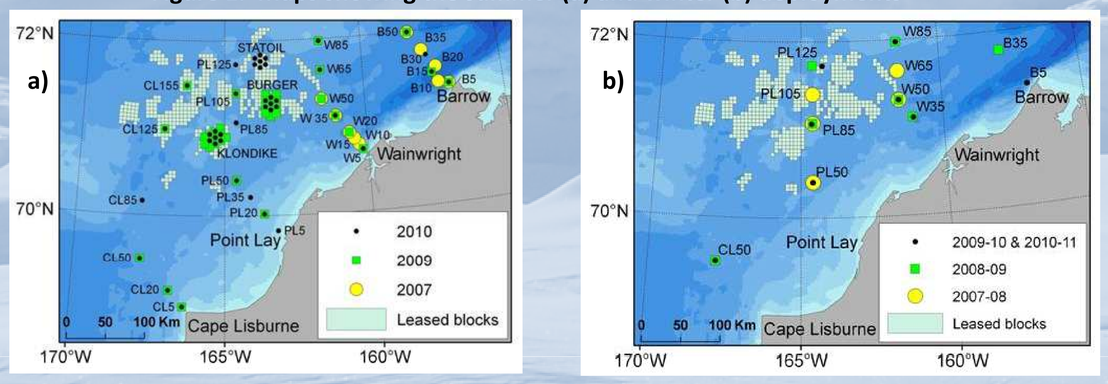
Bearded seals (*Erignathus barbatus*), the largest of the northern phocids, are distributed throughout the Arctic. Females give birth in mid-April to mid-May (Burns, 1981). Mating takes place towards the end of lactation and males are in breeding condition from April to early July (Burns, 1981; Cleator, 1996; Van Parijs et al., 2001). Male bearded seals either hold small aquatic territories or roam over larger areas while displaying (Van Parijs et al., 2003). Males advertise their breeding condition by producing long underwater trills (e.g. Cleator et al., 1989) and use vocal and dive displays throughout the breeding season (Van Parijs et al., 2001).

MATERIAL AND METHODS

▪ Data collection

Deployment in the northeastern Chukchi Sea each year from 2007 to 2012

Figure 1. Maps showing the summer (a) and winter (b) deployments



- 2007 summer deployment – 10 AURALs
- 2009 to 2011 summer deployments – up to 44 AMARs
- Data were recorded continuously
- Winter deployments - 5-8 AURALs
- 20% duty cycle in 2007–2008
- 17% duty cycle in the other years

▪ Data analysis

Bearded seal vocalizations were detected and classified manually by one trained analyst following two methods:

- 20-min recordings between 2:00 am and 6:00 am every 3 days (to examine call counts vs ice; 3% of all data)
- 10-min recordings on a 17-20% duty cycle every 10 days (to examine daily cycle, duration of vocalizations and the proportion of each vocal type; 2.5% of all data)

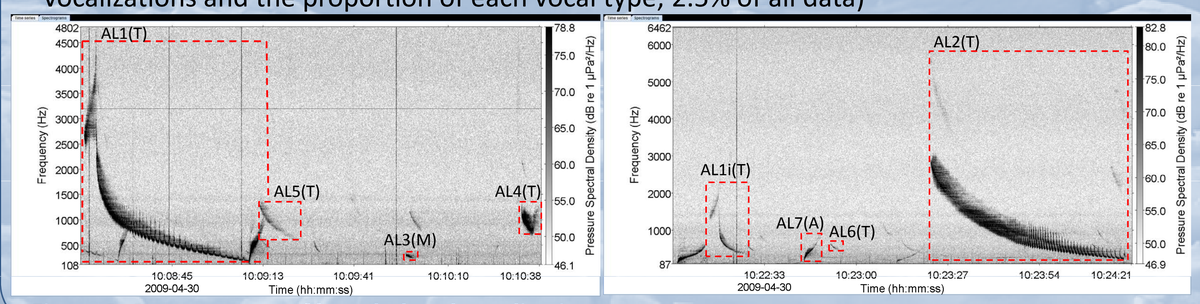


Figure 2. Spectrograms of bearded seal vocalizations

RESULTS

- Bearded seal detections increased progressively from December to March, peaked between April and June (mating period) and were essentially absent in July.
- Decreased ice cover in May-June resulted in more males displaying.

Figure 3. Seasonal variation in the total number of vocalizations and ice cover in a) 2007-2008 and b) 2008-2009;

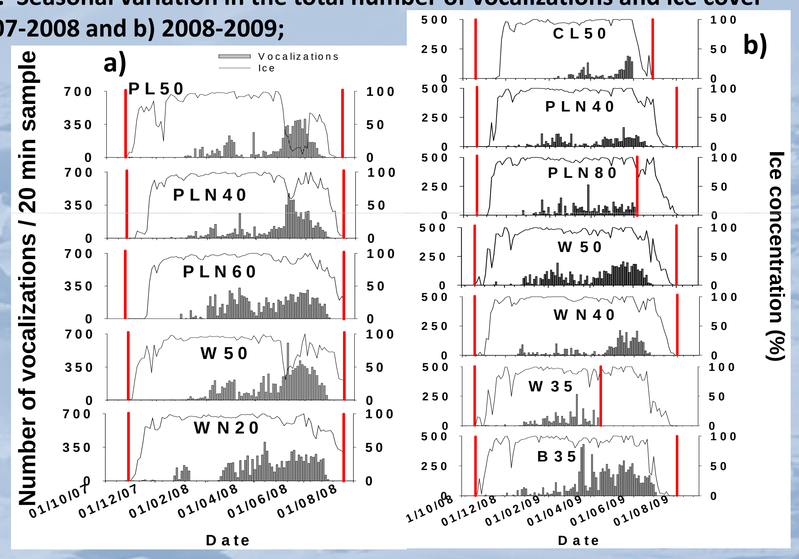


Figure 4. Daily cycle during the summer 2011; grey area represents darkness period

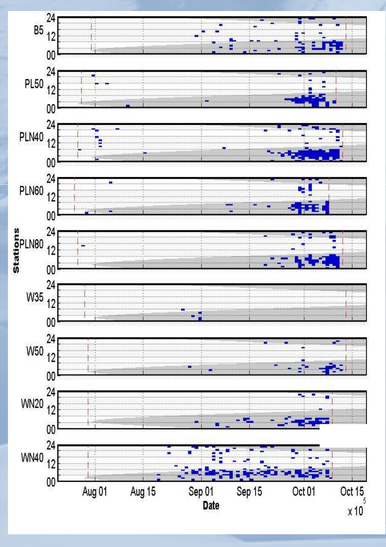
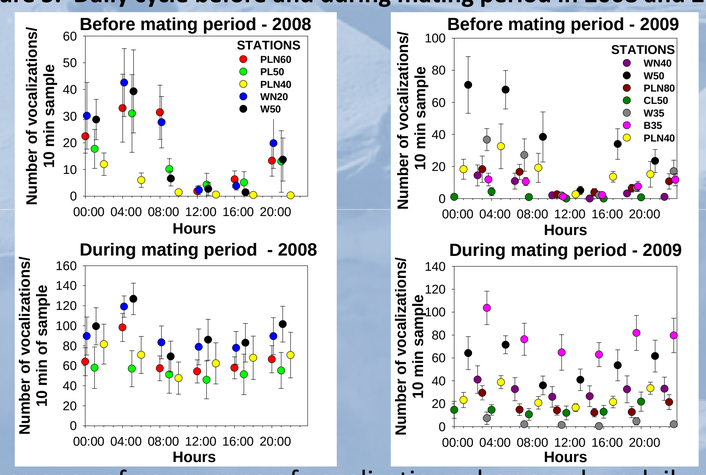
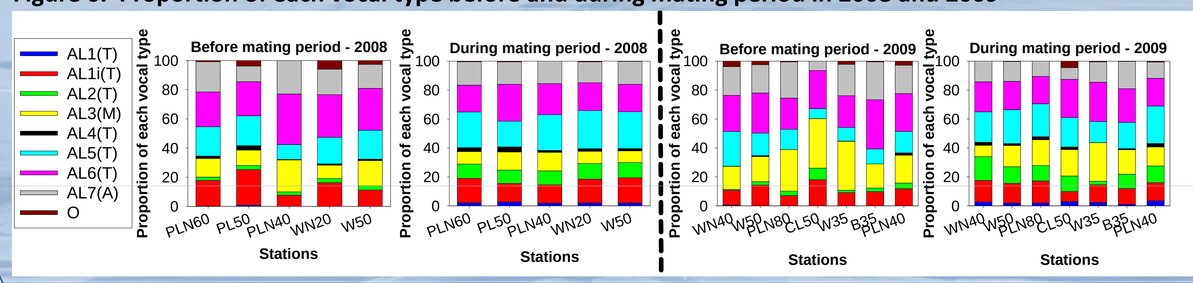


Figure 5. Daily cycle before and during mating period in 2008 and 2009



Frequency of occurrence of vocalizations shows a clear daily cycle outside the mating period (Fig. 4) as well as before and during mating period (Fig.5) and was higher during "periods of darkness"

Figure 6. Proportion of each vocal type before and during mating period in 2008 and 2009



During mating period, proportion of AL1(T) and AL2(T) increased

DISCUSSION

Bearded seals were present at all sampled stations. Peak in calling occurred in the spring, coinciding with mating period. Fewest vocalizations were detected in summer and vocalizations increased with the formation of pack ice in the winter. A similar seasonal pattern was observed for both years, but call counts were lower in 2008-2009. Frequency of occurrence of vocalizations varied following a daily cycle (diurnal pattern continued throughout winter even though there no real night-day cycle). Males advertise their breeding condition by producing longer underwater trills (notably [AL2(T)] and trills with ascent/plume [AL1(T)])

LITTERATURE CITED

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