Different habitat use strategies by subadult and adult ringed seals (*Pusa hispida*) in the Bering and Chukchi Seas

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ABSTRACT: Movement patterns of 14 subadult and 11 adult ringed seals (*Pusa hispida*) were monitored in the Bering and Chukchi Seas using satellite-linked telemetry. Seals were captured in Kotzebue Sound, Alaska during October 2007 and 2008 and tracked for 17-297 days. Subadult seals dispersed south from the Chukchi to the Bering Sea as sea ice coverage increased during November-December, traveling a mean distance of 36 km/day. In contrast, adults stayed north of St. Lawrence Island, their locations were more clustered, and movements covered a mean distance of 22 km/day. Distance to the ice edge differed significantly (P<0.01) by age class, month, and by an age class by month interaction, indicating that only subadult ringed seals moved south during fall as seasonal ice formed in the Bering Sea and returned north in the spring with the receding ice edge. Subadult seals were 322 km closer to the ice edge and 48 km farther from land and shorefast ice than adults. During winter, adult female ringed seals construct and maintain breathing holes and subnivean pupping lairs mostly in shorefast ice and adult males defend breeding territories around those lairs. Our results show a different strategy by subadults during winter. Unconstrained by the need for a stable breeding/pupping platform, they move south to the Bering Sea ice front, and by doing so they can use areas where they may have better feeding opportunities, avoid having to maintain breathing holes, and are less exposed to predation.

METHODS:

- Ringed seals were captured in Kotzebue Sound during October of 2007 and 2008 using entanglement nets. Satellite transmitters were glued to the hair on the mid-dorsum.
- Age classifications (adult or subadult) were based on weight at age data from ringed seals harvested for subsistence in the fall since 2000 (n=249).
- ARGOS locations (Harris et al. 1990) were filtered using a Speed-Distance-Angle-filter (Freitas 2008) with a velocity threshold of 2.5 m/s.
- To establish locations used for habitat analysis, for every seventh day of each seal's tracking period we selected and used the first highest quality location received on that date.
- We used ArcMap to quantify four habitat parameters: 1) Distance between seal locations and the southern edge of the sea ice (10% coverage, Fig. 1); 2) distance to land; 3) ice concentration; and 4) depth at that location. For sea ice concentration data we used Advanced Microwave Scanning Radiometer – Earth Observing System (12.5 km) imagery available through the National Snow and Ice Data Center.
- We tested for effects of age class, sex, and month on habitat parameters using a repeated-measures mixed model. Models were ranked with Aikaike's Information Criterion adjusted for sample size. We used a first-order autoregressive structure to account for covariance.

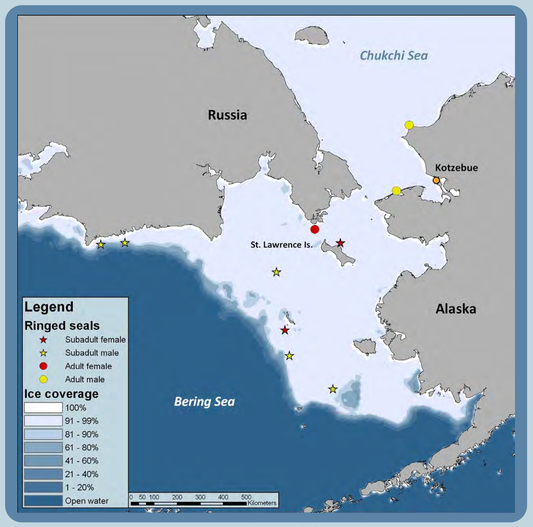

Figure 1. Ice image and seal locations on 19 February 2009

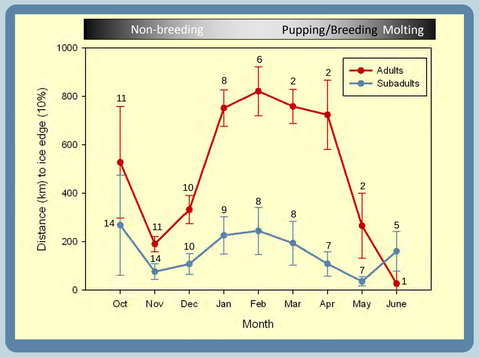

Figure 2. Monthly distances (km) to ice edge for satellite tagged adult and subadult ringed seals, 2007-2009.

RESULTS:

- Subadult seals traveled 36 km/day, while adult seals traveled 22 km/day.
- During November and December, subadults moved south into the middle of the Bering Sea and remained near the ice edge (within 165 km) as sea ice coverage increased (Figs. 2 and 3) while adults mostly remained in the northern Bering and southern Chukchi Seas far from the ice edge (487 km).
- Subadults returned to the Chukchi Sea in early June as sea ice receded north. Adults followed the receding sea ice north as the ice edge entered the Chukchi Sea in June.
- Distance to the ice edge differed significantly (P<0.01) by age class, month, and an age class by month interaction.

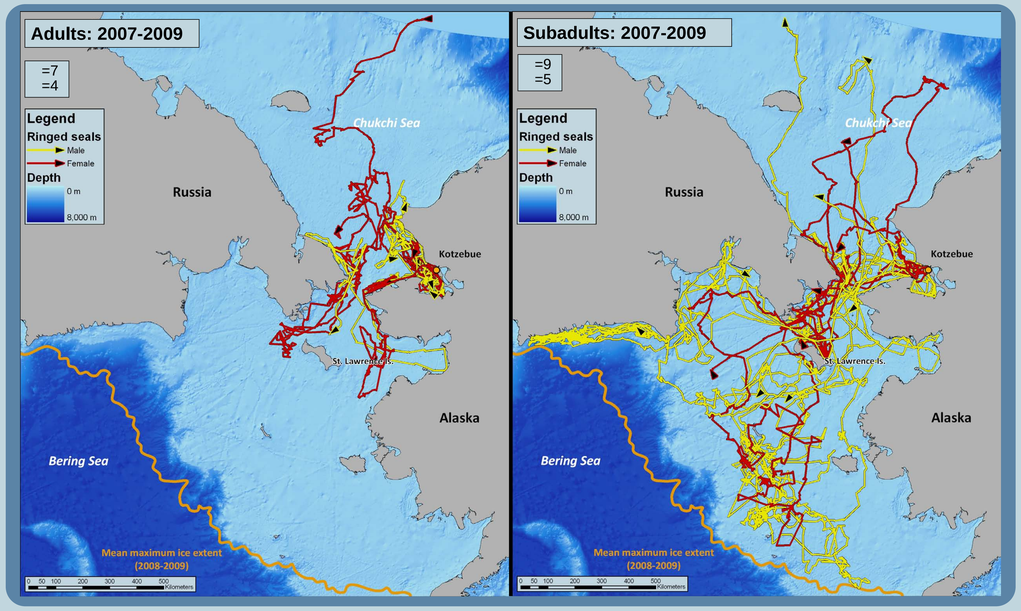

Figure 3. Movements of satellite tagged adult and subadult ringed seals, 2007-2009. Tags transmitted for 17–297 days ($\bar{X}$=139 days).

❖ Other maps and information about this project can be viewed at: http://kotzebueira.org/current_projects2.html

Table 1. Habitat parameters for satellite tagged adult and subadult ringed seals. Differences between age classes were all significant, P<0.05.

Age class	Distance to ice edge in km (SE)	Ice Concentration (SE)	Depth in m (SE)	Distance to land in km (SE)
Adults (n=11)	486.7 (61.9)	82.0% (5.4)	36.5 (6.5)	75.6 (21.0)
Subadults (n=14)	164.8 (48.1)	53.6% (4.5)	60.8 (5.2)	123.5 (16.2)

CONCLUSIONS:

- Subadults wintered in the floating pack ice near the ice edge in the middle of the Bering Sea.
- Adults wintered in fast ice far from the ice edge in the northern Bering and southern Chukchi Seas.
- Advantages to this strategy for subadults may include better feeding opportunities in the productive Bering Sea ice edge, avoiding the energetic expense of maintaining breathing holes, and being less exposed to polar bear predation.

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