Spotted seal (*Phoca largha*) spatial use, dives, and haul-out behavior in the Beaufort, Chukchi, and Bering Seas (2012-2016)

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Objectives

Collect baseline data on spotted seal spatial movements, characterize their seasonal and annual habitat use, and identify patterns in their diving and haul-out behavior.

Background

- Spotted seals (*Phoca largha*) are ecologically important as both predators and prey. They also are an important subsistence resource for Native Alaskans. Though less ice-associated than other ice-seal species, spotted seals do rely on sea ice for such key life history events as reproduction and molting (Boveng et al. 2009).
- There have been significant changes over time to sea ice cover and concentration within spotted seal range (Frey et al. 2015, Wood et al. 2015). Direct and indirect effects from this habitat change, including increases to shipping and industrial development, is likely to affect spotted seals.
- Generally limited information on spotted seal spatial ecology in the Alaskan Arctic (see: Lowry et al. 1998, Lowry et al. 2000) makes it difficult to assess the potential impact of climate and habitat disruption, anthropogenic disturbance, and/or pollution.
- An updated understanding of spotted seal biology will be useful for mitigating the potentially negative effects of future climate and/or anthropogenic disturbances. This information will better inform decision-makers tasked with planning future economic development in the Arctic, and will help to protect Native Alaskan subsistence resources.

Methods

Spotted seals (n = 35) were captured in the late summer (2012-2016) near Utqiaġvik, AK with drift-nets deployed by boat near known haul-outs. Captured seals were instrumented with Wildlife Computers Argos satellite transmitters (Fig. 1). Data collected included: daily movements, dive characteristics (e.g. depth, duration), and haul-out periods.

Figure 1. (Top) seal crew physically restraining a spotted seal and attaching an Argos transmitter. (Bottom-L) SPLASH tag mounted to the seal's back. (Bottom-R) SPOT6 tag mounted to a rear flipper.

Results: Spatial Use

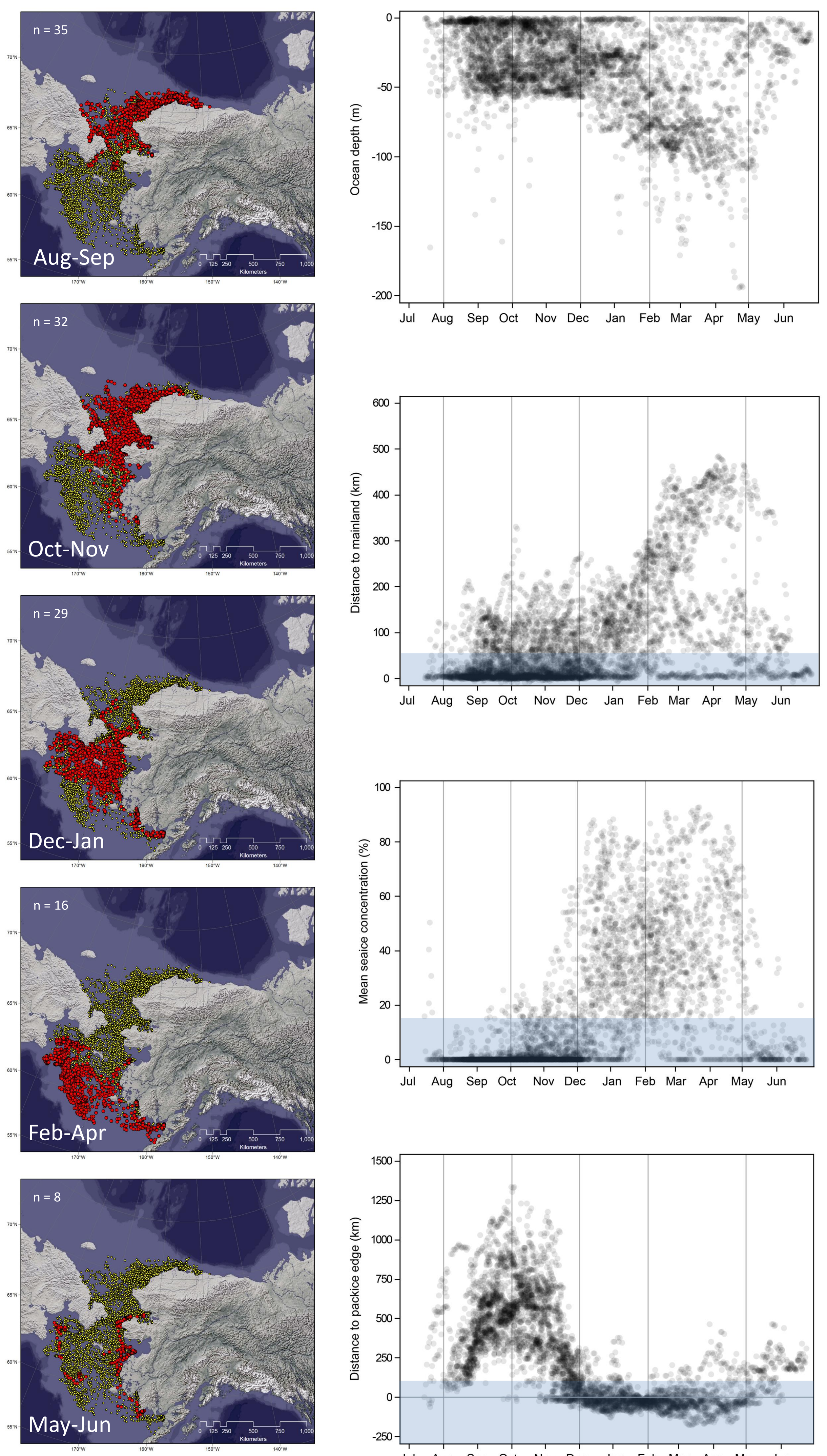

Figure 2 – Seasonal spatial movements and habitat associations. Dots on maps are daily locations estimated by a movement model (CRAWL, Johnson et al. 2008) derived from the Argos tracking data. Red dots are locations during respective monthly periods. Habitat attributes at each daily seal location are shown in the scatter plots. Ocean depth is shown in the upper scatter plot. Distance to the mainland coast (islands excluded) is shown in the second scatter plot with a 50 km demarcation for near-shore vs. pelagic. Mean sea ice concentration within a 100km radius is shown in the third plot with a demarcation (15%) between open water and ice. Distance to the edge of the ice pack is shown in the bottom scatter plot with +100km demarcation; negative values represent seal locations that were within the ice pack. Results indicate that spotted seals ranged widely from the Beaufort Sea to Bristol Bay. Though some seals were associated with coastal regions in the winter, most were pelagic. Continental shelf (<100m) occupancy ranged from a summer low of ~50% to a winter high of >81%. Coastal occupancy dropped from summer (48%) to winter (12%), increasing in the spring (20%). Seals never ventured beyond the 300m isobath. Ice-free habitat use in the summer (>99%) dropped to 16% in the winter. Pack-ice (>50% concentration) and marginal-ice (15-50% concentration) occupancy increased from fall (30%, 13%) to winter (68%, 16%), but fell in the spring (27%, 11%).

Results: Dives

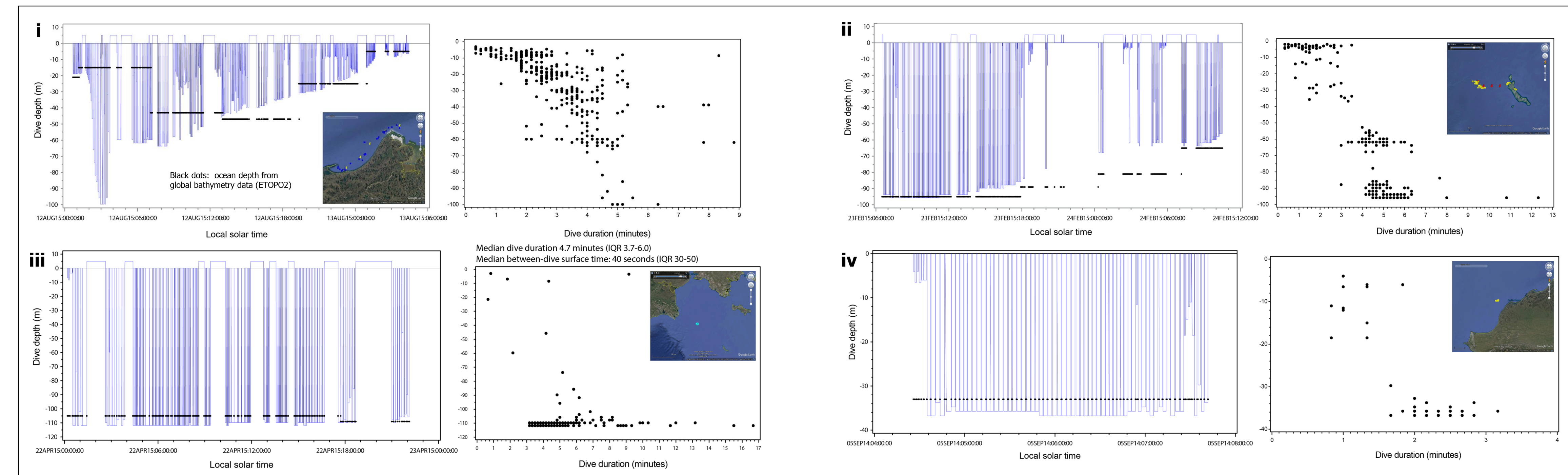

Figure 3A – Selected spotted seal dive profiles. Each line plot (i–iv) shows individual dive data during a short time period accompanied by a scatter-plot of dive depth vs. dive duration. Inset maps show where the dives occurred. While dive depths were variable, comparisons with low spatial resolution bathymetry data suggest that most dives were benthic. Deeper dives were typically longer in duration. All dives occurred over shelf waters. Deeper dives were typically longer in duration; however, dives >12 minutes long may be artifacts of data collection methods. These four examples (i-iv) represent a small sample of the >280,000 dive records that have been collected to date.

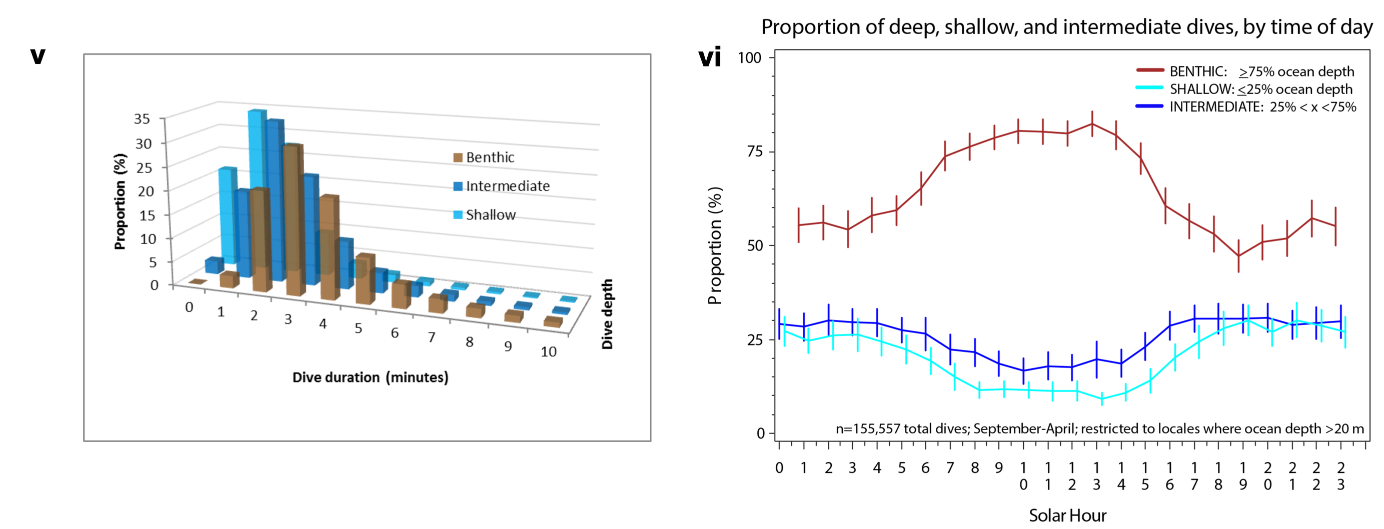

Figure 3B – Spotted seal dive summaries. Partitioning dives into 3 relative depth categories (benthic, shallow, and intermediate) shows that benthic dives were longer in duration (v), they were the most frequent type of dive (vi), and they were most frequent during daytime hours (vi). All dives in this analysis occurred during the autumn. Dives >12 minutes long may be artifacts of data collection methods. This analysis excluded dives where the water depth was <20m deep.

Results: Haul-out Behavior

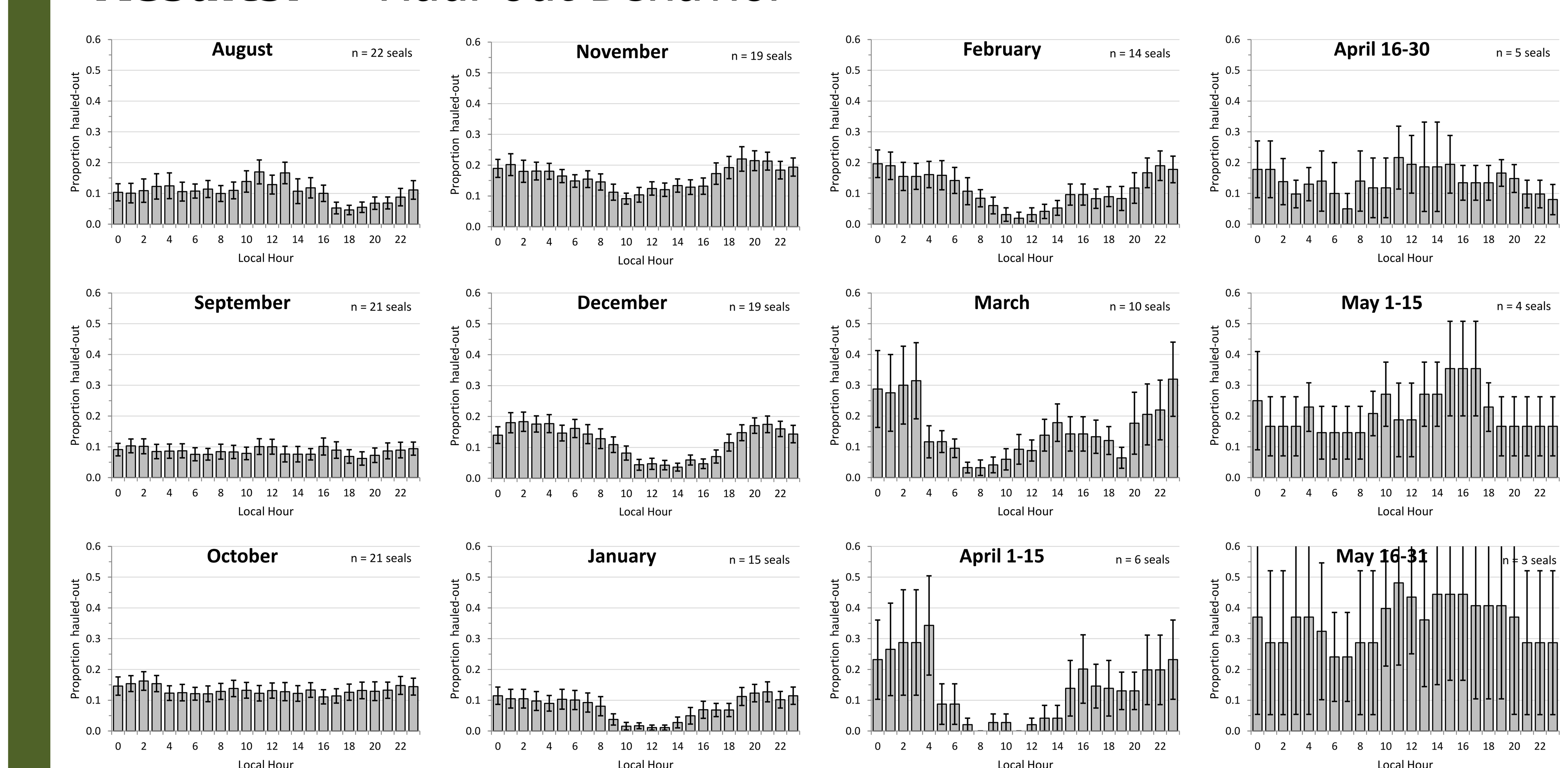

Figure 4 - Inter-seasonal variation of haul-out behavior. Wet/dry sensors recorded when a seal was out of the water. A "haul-out" hour was defined as an hour during which the sensor recorded ≥80% dry. Sample size was highest in late summer when spotted seals were initially tagged, then progressively dropped as tags fell off or stopped transmitting. Histograms and error bars (+/-SE) represent the mean proportion of seals hauled out during each local hour (GMT-9h) and month. Haul-out times varied, but peaked in May and were lowest during the fall and winter daytime hours. In winter, spotted seals were least likely to be hauled out during daytime hours (consistent with diel diving behavior, above), but were somewhat more likely to be hauled out during the daytime in spring – the molting season.

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