The Relationship Between Seasonal Distribution of Steller Sea Lions (Eumetopias jubatus) and Weather During the Non-breeding Season in the Western Aleutian Islands, AK
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Introduction
Steller sea lion populations in the U.S. are separated into two distinct population segments at 144°W, the Eastern and Western Stock. The Western Stock is listed as endangered and the Eastern Stock as threatened under the Endangered Species Act. This analysis focused on the Western Stock, which is broken down into six sub-areas. While most sub-areas tend to show stable or erratic population trends, those in the western Aleutians continue to decline at ~10% per year, despite the shutdown of commercial fisheries and other conservation measures stated in the species’ Recovery Plan. A variety of factors likely contribute to population declines, but data about seasonal distribution during the non-breeding season and the effects of weather patterns on distributions are limited.

Severe weather may act as a disturbance at terrestrial sites, limiting use during the winter months when weather is most extreme. This study analyzed how seasonal distribution was correlated with weather at three haul-out or rookeries in the western Aleutians and one in the central Aleutians during the non-breeding season using wind gusts and average wind speed as proxies for severe or mild weather. Understanding how weather patterns affect sea lion distribution and habitat use will likely be important in coming years, since some predictions claim that climate change will cause an increase in the frequency and intensity of storms and cyclonic events in the North Pacific.

Research question
Using wind gust and average wind speed as a proxies for mild or severe weather, what is the relationship between seasonal distribution of Steller sea lions and weather patterns in the Western Aleutian Islands?

Methods
Data Collection:
One or more remote cameras were set up at each site: Gillon Point on Agattu, Cape Sabak on Agattu, Alaid, Cape Wrangell on Atu, and Hagox Point on Ulak. Photographs were taken at 30-minute intervals between sunrise and sunset. After the data collection period, I generated weekly counts for each site from a single photograph beginning after the first sea lion attendance at the site. Brand re-sights were also recorded, as well as various observations including first animal attendance, first breeding female attendance, first pup birth, dead/dying entangled animals, as well as any other significant observations or fluctuations in sea lion attendance. Sites were mapped using Google Earth. Weather data were obtained through OGMET website for Adak (latitude 51-52-40N, longitude 174-26-45S) and Shemya (latitude 52-43-00N, longitude 174-07-06E) at 3:00 UTC. Adak is the closest weather station to Ulak and Shemya is the closest weather station to the Near Island haulout: Agattu, Alaid, and Atu. All sites were removed to account for fluctuations in attendance due to breeding activity.

Analysis
Cape Sabak data was left out of analysis due to inaccessibility during the non-breeding season. All data after 15 June 2013, the date of first breeding female attendance, were removed to account for fluctuations in attendance due to breeding activity. Any counts missing data for average wind speed were removed from wind speed analysis and counts missing wind gust were removed from wind gust analysis. Overall trends in sea lion weekly counts, average wind speed, and average wind gust were analyzed. These were used to set parameters for mild and severe weather. Wind gusts > 50km/hour were designated as high and average wind speed > 31 km/hour were considered severe. Effects of mild versus severe based on average wind speed or wind gust velocity on sea lion counts were analyzed using generalized linear models with site as an additional factor and a Poisson error distribution (SPSS).

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Conclusion
Average speed and wind gust velocity did not have a consistent effect on Steller sea lion counts. However, the effect of the interaction between average wind speed and site was significant. In other words, counts were higher when wind speeds were greater on some islands, but the reverse was true on others. This interaction could be due to microclimatic differences between sites, where one site may have more cover or protection against weather.

Further research should examine differences in geography of sites and other microclimatic features that could influence the use of haul-out sites in severe weather. Also, I believe that with more data points more significance could be shown at more sites, as some had very few counts when broken down into mild/severe weather and high/low wind gusts.

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Fig. 1. Maps show weather stations in red and study sites in yellow both zoomed out (left) and zoomed in (right). Shemya weather station was used for weather for Near Islands: Agattu, Alaid and Atu. Adak weather station was used for weather for Ulak.

Fig. 2. Examples of haul-out sites/rookeries at Ulak (right) and Agattu (left).

Fig. 3. Average Sea Lions Counts in Mild and Severe Average Wind Speeds at All Sites Combined

Fig. 4. Average Sea Lions Counts in Low and High Wind Gusts at All Sites Combined

Fig. 5. Average Sea Lions Counts in Mild and Severe Average Wind Speeds at Each Site

Fig. 6. Average Sea Lions Counts in Low and High Wind Gusts at Each Site

References