Habitat Use by Steller Sea Lions (*Eumetopias jubatus*), Harlequin Ducks (*Histrionicus histrionicus*), and Black Oystercatchers (*Haematopus bachmani*) at Cattle Pass, Washington

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Abstract:

Two studies were conducted at Cattle Pass, Washington between 13-18 August 2014. The first study was conducted to determine the relationship between tidal height and the haul-out abundance of Steller Sea Lions (*Eumetopias jubatus*) at the Whale Rocks of the San Juan Channel. There was a clear diurnal pattern of abundance during both of the days used for data analysis. The abundance was very low in the morning which may be a result of the nighttime/early morning foraging behavior characteristic of Steller Sea Lions. It was determined that this variation in haul-out abundance of Steller Sea Lions did not occur in response to changes in tidal height. The data also suggest that air temperature may play a role in determining the total abundance of Steller Sea Lions. The second study was done to understand how two unrelated bird species, Harlequin Ducks (*Histrionicus histrionicus*) and Black Oystercatchers (*Haematopus bachmani*), compare and contrast in their use of the Cattle Pass rocky intertidal habitat post-breeding season. It was found that Black Oystercatchers spend most of their time loafing in the region while Harlequin Ducks spend most of their time swimming and foraging. These data suggest that Black Oystercatchers use the habitat primarily as a resting area between flock feedings while Harlequin Ducks use it primarily as a feeding ground during molting periods that cause them to be temporarily flightless.

Key Words: Cattle Pass, San Juan Channel, Steller Sea Lion, *Eumetopias jubatus*, Harlequin Duck, *Histrionicus histrionicus*, Black Oystercatcher, *Haematopus bachmani*, Whale Rocks, haul-out behavior, Pinnipeds, Otariids, abundance, behavior, habitat use

Introduction:

I conducted two distinct studies at Cattle Pass, Washington (Approximately 48.45° N, 122.96° W) throughout the 13-18 August 2014. These studies addressed the use of habitat by three different species in the area. The first study considered the abundance of Steller Sea Lions (*Eumetopias jubatus*) that haul-out at the Whale Rocks of the San Juan Channel within viewing distance of my survey station at Cattle Pass. The second study on Harlequin Ducks (*Histrionicus histrionicus*) and Black Oystercatchers (*Haematopus bachmani*) documented how these two very different species compare in regard to their use of the rocky intertidal habitat of Cattle Pass during the post-breeding season.

The second study began as a result of poor weather conditions including heavy rain and fog that made it impossible for me to record Steller Sea Lion abundance at the Whale Rocks. I decided to study the behavior of Harlequin Ducks and Black Oystercatchers because they could be observed in the low visibility conditions of the area and because I was curious as to how these species, which are taxonomically and morphologically distinct, use a common habitat. When the weather cleared I was able to resume the Steller Sea Lion abundance surveys but decided to continue the bird behavior study because I considered the question to be interesting and worth further investigation.

Cattle pass is known for its rocky intertidal geography, fast current speeds, high productivity, and its status as a biodiversity hotspot. Steller Sea Lions are one species that dwell in the area around Cattle Pass and represent one of the many living strategies found in the habitat.

Steller Sea Lions spend extended periods of time hauling out in the San Juan Channel near Cattle Pass after their breeding season comes to a close at the end of July (Pitcher and Calkins 1981).There have not been any recent studies documenting the abundance of Steller Sea Lions in the Cattle Pass region. Unlike Harbor Seals (*Phoca vitulina*) whom reside on haul-out sites that become completely submerged under water during high tides, the Steller Sea Lions of the Whale Rocks always have a place to haul-out because the islands never become completely submerged. Also, unlike harbor seals, Steller Sea Lions are known to be nocturnal feeders (Fiscus and Baines 1966). These habitat and lifestyle differences caused me to question whether or not the abundance of resident Steller Sea Lions of the Whale Rocks is as dependent upon tidal height as the abundance of Harbor Seals in the Salish Sea has been documented to be (Blythe 2012, Pauli and Terhune 1987).

It is important to question how different species of birds spend their time in this habitat if Cattle Pass and the San Juan Channel are to be fully understood as an ecological system. During this study, neither Black Oystercatchers nor Harlequin Ducks were breeding since they breed earlier in the year. The Harlequin Ducks were in their dull non breeding plumage and the Black Oystercatchers were in large flocks as opposed to pairs which also showed that they had finished breeding.

While Harlequin Ducks spend most of their lives in the water, Black Oystercatchers spend most of their time on the shoreline. This is a lifestyle difference that causes these birds to adopt very different survival strategies even when they occupy the same space. Another lifestyle difference that affects habitat use is the molting period that Harlequin Ducks undergo which renders them unable to fly for an extended period of

time (Cook et al. 1997). This makes the ducks vulnerable to predation and causes them to aggregate in areas with an abundance of food (Robertson et al. 1997).

While Harlequin Ducks tend to feed whenever they are in the water, Black Oystercatchers feed at very particular times of day in large flocks (Hartwick et al. 1976). Because huge flocks are not seen feeding at Cattle Pass, I hypothesized that Black Oystercatchers use the Cattle Pass intertidal habitat as a resting ground between feedings. I was interested as whether or not behavioral data would support this idea.

This research on resident Steller Sea Lions, Harlequin Ducks and Black Oystercatchers will lay the groundwork for further studies and inform local conservation projects in the Salish Sea. Poor weather conditions limited the amount of data that could be collected. Further research is necessary to confirm the results of the study. Rain and fog limited the visibility of the islands for four out of the six research days which made only two days of data usable for analysis.

In this paper I present Steller Sea Lion abundance at the Whale Rocks as it changes throughout the daylight hours of two days that have very different tides. I discuss the relationship between abundance and tidal height as well as the relationship between abundance and air temperature. I also present behavioral data that provides clues as to how the Cattle Pass habitat is used differently by Harlequin Ducks and Black Oystercatchers during the post-breeding season.

Methods:

Study Area

Both studies were conducted from the lighthouse at Cattle Pass, Washington. A 48x scope was placed within thirty feet of the lighthouse at a location that offered optimal viewing ability of the Whale Rock Islands in the San Juan Channel and the rocky intertidal area below the lighthouse.

Steller Sea Lion Abundance Surveys

Sea lions were observed through a 48x scope every twenty minutes for a minimum of six daylight hours on six consecutive days (13-18 August 2014). Sea lions were present on three distinct visible islands (Whale Rocks). At the beginning of each interval, scan sampling abundance counts were performed in the same order (northern island, middle island, then southern island) to control for the amount of time required to complete the survey of each island. Abundance of Steller Sea Lions on each island was recorded independently to determine abundance differences between the islands.

Steller Sea Lion Data Analyses

Only two days of the six days included complete data because the poor weather made data collection for four of the six days insufficient. The Analyses presented in this paper addressed total sea lion abundance and the different time intervals but did not explore the differences between the islands. Steller Sea Lion abundance over time for two non-consecutive days and was presented alongside both tidal height and air temperature attained from NOAA to determine whether or not either factor influenced haul-out abundance. All analyses were done using Microsoft Excel 2010.

Harlequin Duck and Black Oystercatcher Behavior

The Behavior of the Harlequin Duck and Black Oystercatcher was gathered by using land based focal sampling. One to five birds were observed at once for a period of three minutes. Every twenty seconds the instantaneous behavior of the individual(s) was recorded, thus each bird had ten recorded behavior data entries for every three minute session. Observations were done with the naked eye and with a 48x scope. The behaviors were broken into 7 categories: foraging, preening, loafing, swimming, flying, vocalizing, and left sight. "Foraging" was recorded when a bird was seen "dunking", "diving", or "pecking". "Preening" was recorded when a bird was seen tending to her/his feathers. "Loafing" was recorded when a bird appeared to be resting. "Swimming" and "flying" were recorded when the bird was in the water or in the air respectively. "Vocalizing" was recorded when the production of a sound could be positively associated with an individual bird. "Left sight" was recorded when a bird left my field of vision.

Harlequin Duck and Black Oystercatcher Data Analysis

All ten of the twenty second interval data entries that spanned the three minute observation session were inputted into Microsoft Excel 2010. The behaviors of each individual from both species were converted to percentages and the average percentage of each possible behavior was recorded along with standard deviation values. The percent averages of time allocated to each behavior for each species were graphed by putting "behavior type" on the X-axis and "mean proportion of time allocated to different behaviors" on the Y-axis. This was done to provide a clear comparison between Harlequin Ducks and Black Oystercatchers in regard to how they spend their time at Cattle Pass.

Results:

Steller Sea Lion Abundance

Despite the small sample size, my results suggest that Steller Sea Lion abundance on the whale rocks of Cattle Pass follows a diurnal pattern. This pattern does not appear to be influenced by tidal patterns (Figs. 2, 3). There may be an interaction between Steller Sea Lion abundance and air temperature, however (Figs. 4, 5). The data show that more sea lions were present when the air temperature was lower (Fig. 4) and fewer total Steller Sea Lions were hauled-out when the air temperature was higher (Fig.5). It is possible that this abundance difference is due to one or more factors unrelated to air temperature. More daily abundance data must be collected and analyzed in relation to air temperature to determine the nature and degree of this interaction.

Harlequin Duck and Black Oystercatcher Behavior

The sample size for Harlequin ducks was slightly lower than the sample size for Black Oystercatchers (n=32 and n=46 respectively). Harlequin ducks spent the majority of their time foraging and swimming while Black Oystercatchers spent most of their time loafing (Fig. 6). Harlequin ducks were never observed flying or vocalizing while Black Oystercatchers were observed performing these behaviors a relatively small percentage of the time (1% ± 6% and 2% ± 8 % respectively). Black Oystercatchers spent slightly less time foraging than Harlequin ducks (33% ± 39% and 34% ± 39% respectively). Harlequin ducks, despite spending less time on land, preened more often than Black Oystercatchers (13% ± 23% and 7% ± 15% respectively). Harlequin Ducks spent 61% of their time foraging and swimming and only spent 34% of their time on land. Only 21% ±

30% of their time on land was dedicated to loafing while the remaining 13%± 23% was dedicated to preening. Black Oystercatchers Spent more than half their time (54% ± 36%) loafing at Cattle Pass. There were only a handful of instances that I could not observe the Harlequin ducks or Black Oystercatchers (Left Sight values of 2% ± 6%and 3% ± 11% respectively). High standard deviation values were a symptom of small sample size.

Discussion:

Steller Sea Lion Abundance Survey

The data collected for the two days shows that there is a clear diurnal abundance pattern. On both days, the morning abundance was very low then steadily increased into the afternoon until it peaked. The numbers then declined and became relatively stable in the late afternoon. Longer periods of data analysis and a larger sample size could help illuminate the more long term diurnal trends.

I was somewhat surprised that tidal height did not appear to have an effect on haul-out abundance of Steller Sea Lions. I assumed when I began the study that the Steller Sea Lions would be influenced by tidal height to a similar degree as Harbor Seals, although in light of the difference in eating behaviors between the two species these results make sense. The low haul-out abundance in the morning may reflect nighttime/early morning foraging by the Steller Sea Lions. This also makes sense of high haul-out abundance at midday because this may be the time that Steller Sea Lions recover from their nighttime foraging and prepare for the following night's search for food.

Based on the data collected, it would appear that temperature plays a role in Steller Sea Lion haul-out abundance. There did not, however, appear to be a strong trend

between the change in Steller Sea Lion haul-out abundance and temperature directly. Temperature seems to more generally affect the total abundance of Steller Sea Lions on the Whale Rocks. Because hauling-out is a way to thermo-regulate and heat is lost much more quickly through water than through air, it would make sense for Steller Sea Lions to haul-out more often on colder days when heat loss needs to be minimized and to haul-out less often on extremely warm days when avoiding excess heat is more of an issue. More data is necessary to determine exactly what role temperature plays in the abundance of Steller Sea Lions at the Whale Rocks. There may be much more to the story than meets the eye when it comes to Steller Sea Lion haul-out abundance. Future data analyses should compare water temperature, current speed, tidal phase, prey abundance, and boating traffic with the abundance patterns of Steller Sea Lions in order to find other trends that I may have overlooked or did not have the time to consider.

Harlequin Duck and Black Oystercatcher behavior study

My results show that Black Oystercatchers and Harlequin Ducks use the Cattle Pass habitat in very different ways. Because Black Oystercatchers spend more than half of their time loafing, it seems likely that Cattle Pass serves as a resting area for this species. The surprisingly high foraging behavior shown in my data may be a result of a bias on my part. I defined "pecking" at the ground as "foraging", but I have never observed Black Oystercatcher flock feeding so I am unsure whether they "forage" in the same fashion during those feeding events. For this reason, the "pecking" that I observed may be better classified as a form of "loafing." Also, Harlequin Ducks forage almost constantly when they are in the water. If they are not feeding, they are swimming to a place to feed, thus "swimming" may better be classified as a "foraging" behavior since

they only rest on land. Oftentimes when I was recording the Harlequin Duck behavior, the instantaneous behavior of "swimming" was recorded even though the duck had just returned to the surface from a foraging dive a moment before the recording interval. For this reason, "swimming" and "foraging" are difficult to separate which challenges my mode of data collection because it may misrepresent how the ducks are spending their time in the water. If I had more time and was not alone in the field, I may have been able to perform a more in depth behavioral study that could have controlled for these issues of concern.

Harlequin Ducks, despite spending significantly less time on land, spent more time preening than Black Oystercatchers. This is to be expected because preening serves a thermoregulatory function that is especially important for species of birds that spend extended periods in water. Because Black Oystercatchers do not get wet as often, they do not have to preen as frequently.

I never heard a Harlequin Duck vocalize but that does not mean that they were not vocalizing. They have much softer calls than Black Oystercatchers so the data in this regard may be biased toward the more audible call of the oystercatchers.

It is difficult to compare these two species because Harlequin Ducks spend most of their time in the water while Black Oystercatchers live on the shore. Since Black Oystercatchers do not swim intentionally and are not diving birds, many aspects of these birds lives must be evaluated on their own terms and not strictly in relation to one another.

According to the collected data, it seems likely that Harlequin Ducks use Cattle Pass as a feeding ground that allowed them to safely acquire energy while they were rendered flightless after molting. After considering the possible sources of error in regard to "foraging" I stand by my original hypothesis that Black Oystercatchers use the Cattle Pass habitat as a resting point between mass flock feedings. I am eager to see further data shed more light on these ideas.

Acknowledgements:

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Figures:

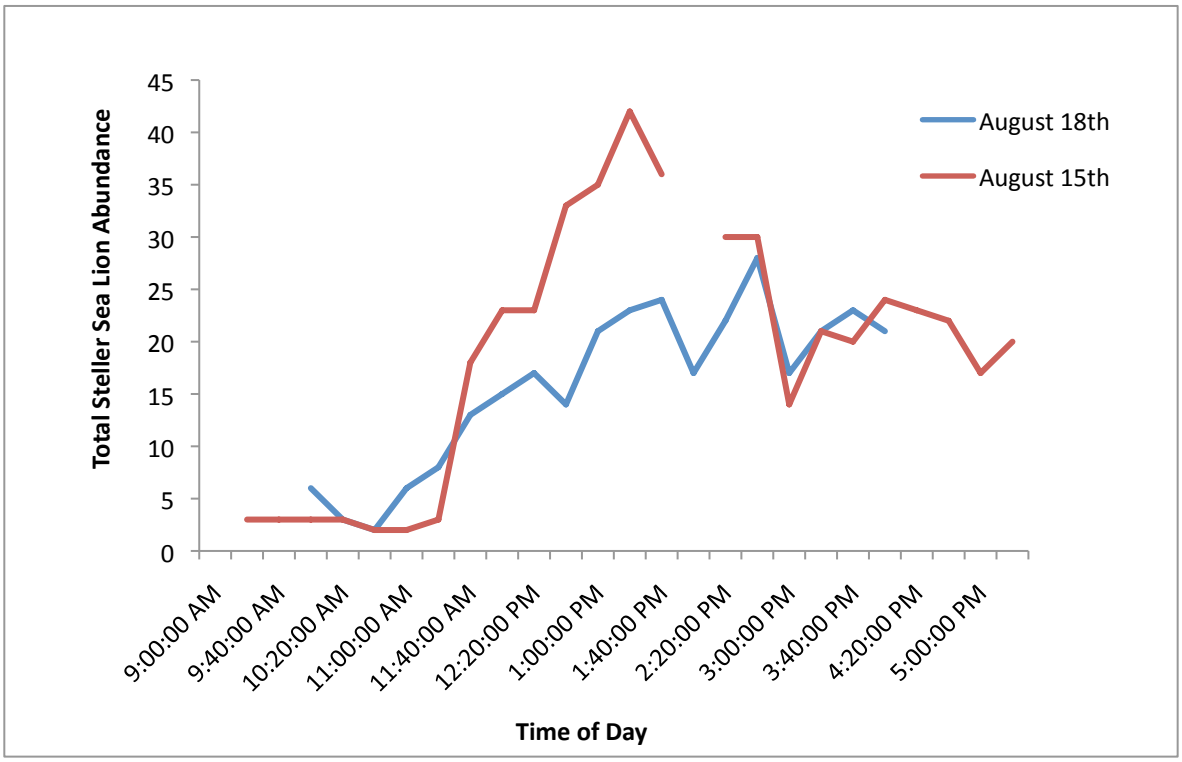

Figure 1: Total Steller Sea Lion Abundance (All three Whale Rocks combined) during daylight hours for the 15, 18 August 2014. The gap in the abundance data reflects a missing data entry.

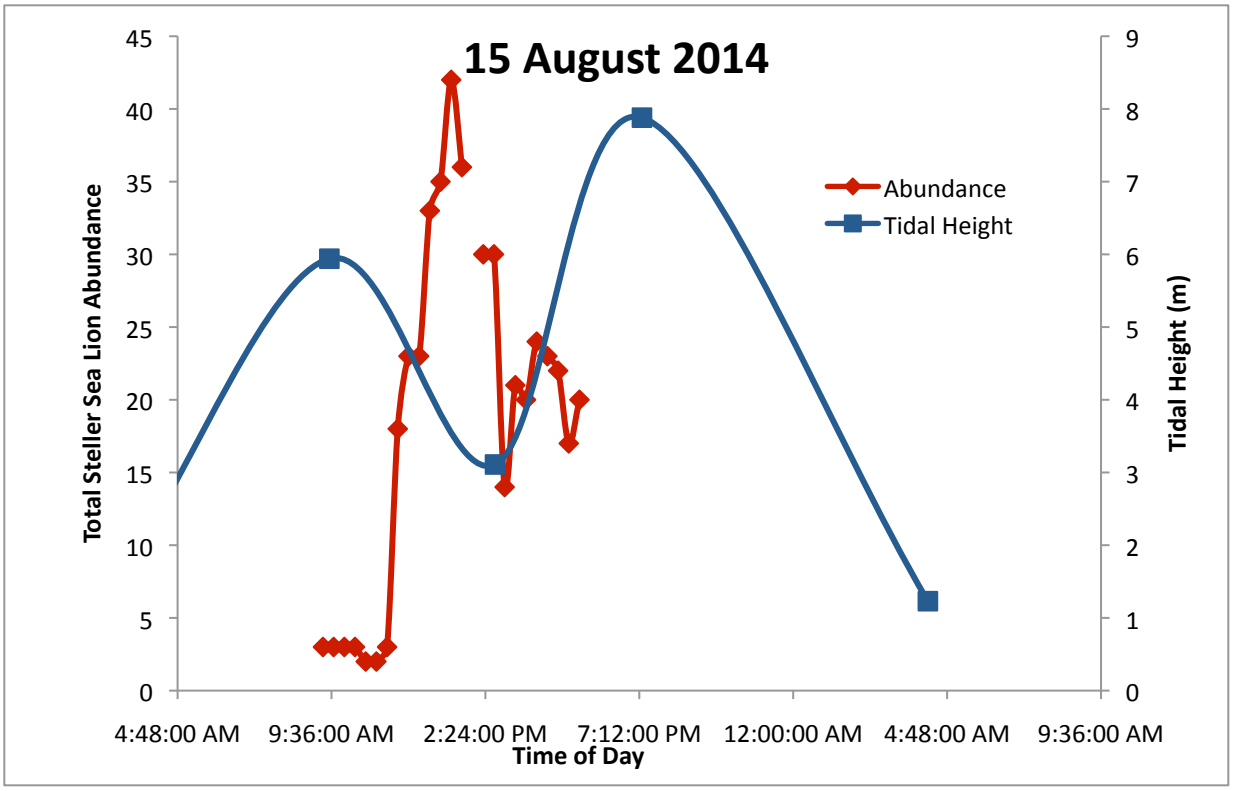

Figure 2: Total Steller Sea Lion abundance on 15 August 2014 (left y-axis) and Tidal Height in meters (right y-axis) over time. The gap in the abundance data reflects a

missing data entry.

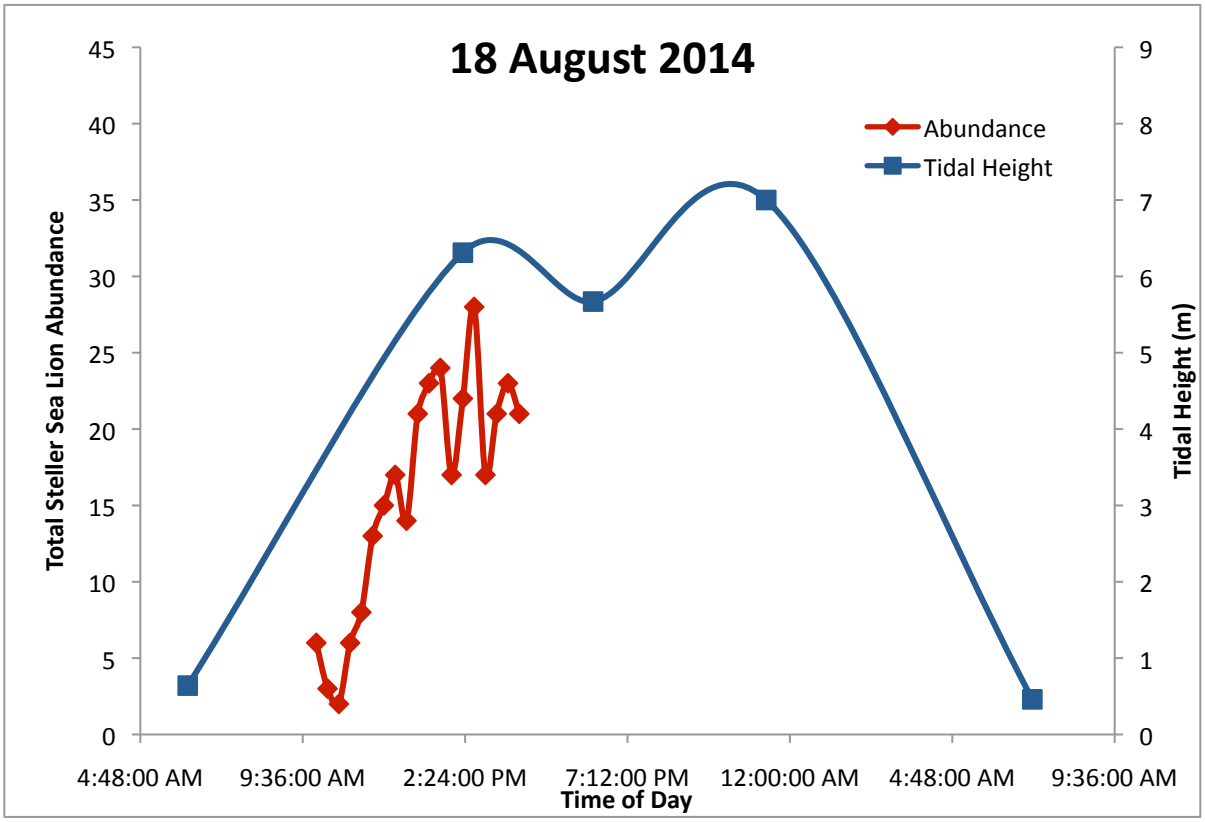

Figure 3: Total Steller Sea Lion abundance on 18 August 2014 (left y-axis) and Tidal Height in meters (right y-axis) over time.

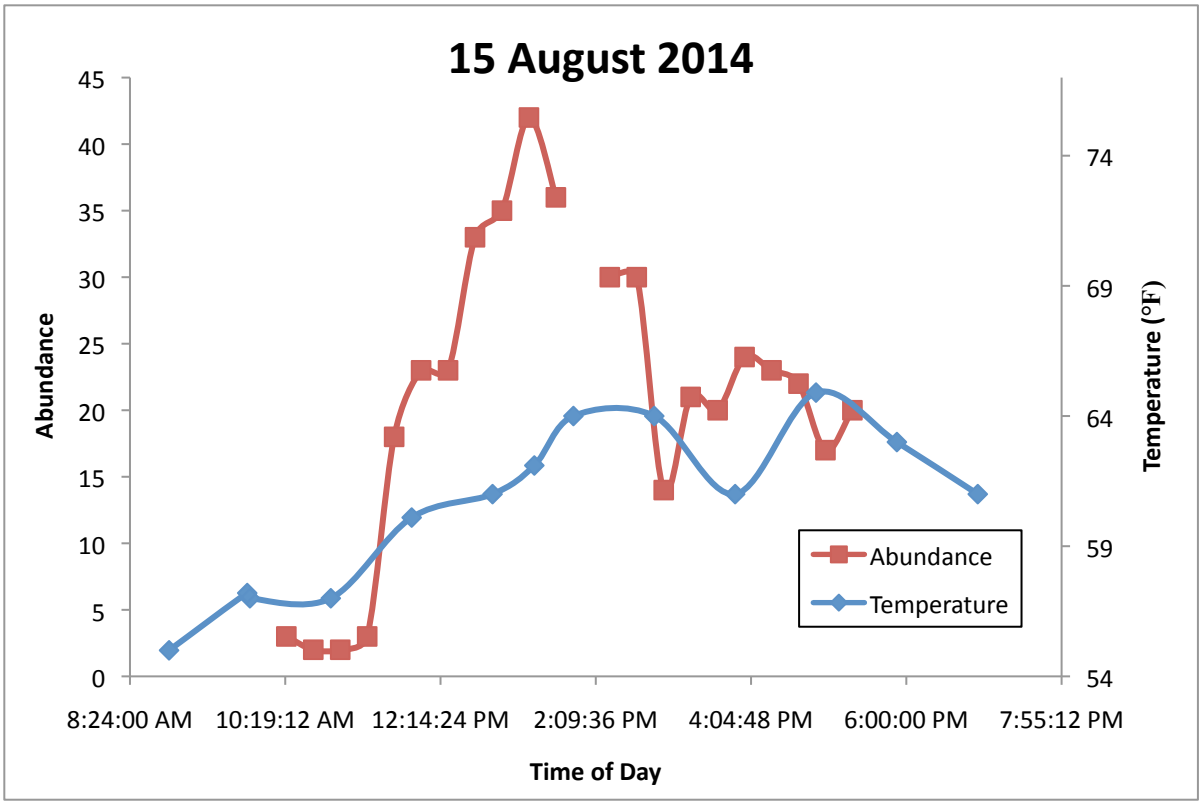

Figure 4: Abundance of Steller Sea Lions on 15 August 2014 (left Y-axis) and air temperature in degrees Fahrenheit (right Y-axis) over time. The gap in the abundance data reflects a missing data entry.

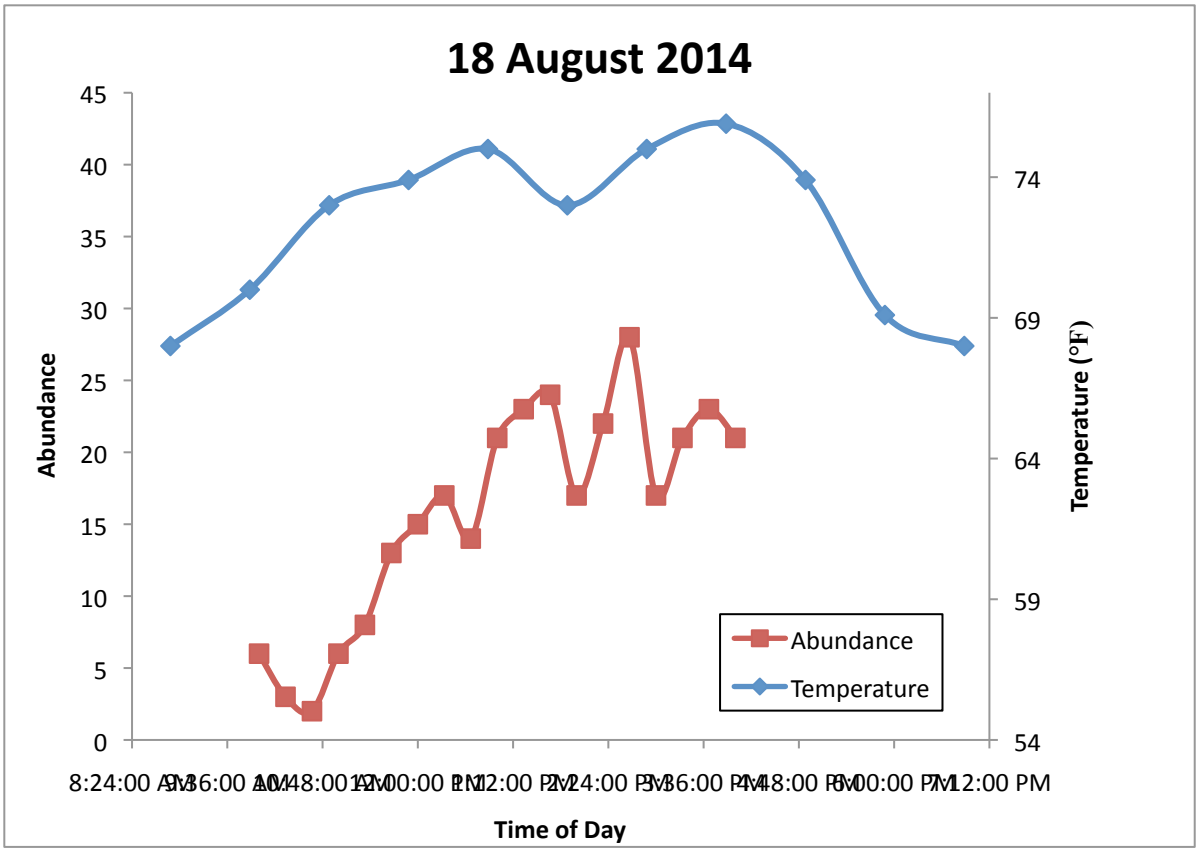

Figure 5: Abundance of Steller Sea Lions on 18 August 2014 (left Y-axis) and air temperature in degrees Fahrenheit (right Y-axis) over time.

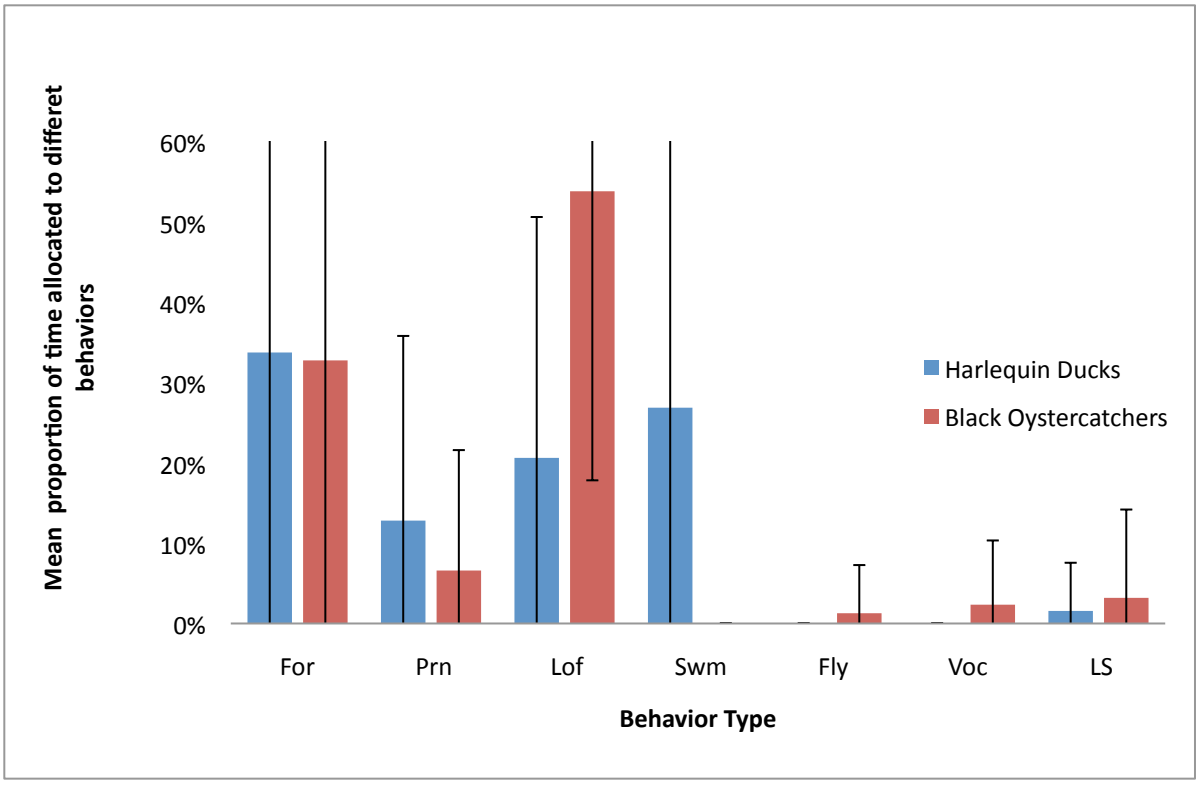

Figure 6: Mean proportion of time allocated to different behaviors by each species between 13-18 August 2014. Error bars represent standard deviation.

Key: Foraging (For), Preening (Prn), Loafing (Lof), Swimming (Swm), Flying (Fly), Vocalizing (Voc), Left Sight (LS).