

Behavior and distribution of *Phoca vitulina* and *Eumatopias jubatus* in the San Juan
Archipelago in summer 2011

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ABSTRACT

Changes in tidal patterns affect the prey composition of the two most common pinnipeds in the San Juan Channel, the harbor seal (*Phoca vitulina*) and Steller sea lion (*Eumatopias jubatus*). Tidal influences are therefore likely to affect the distribution, abundance and behavior of these pinnipeds. This study sought to determine the relationship between the frequency, distribution and behavior of harbor seals and sea lions with tidal phase and discuss the differences between the two species. While harbor seals showed greater variations in all three categories and distribution trends in sea lions were harder to distinguish, results support the idea that both species are affected by changes in tidal currents.

Keywords: harbor seal (*Phoca vitulina*), Steller sea lion (*Eumatopia jubatas*), tidal currents, San Juan Islands,

INTRODUCTION

The harbor seal (*Phoca vitulina*) and Steller sea lion (*Eumatopias jubatus*) are the most common pinnipeds in Washington waters (Zamon 2001). They feed on a wide variety of fish, with Pacific herring and adult salmonoids making up the majority of their diet during the summer (Lance and Jefferies 2007, Trites et al. 2007). Changes in tidal patterns are known to affect the distribution of schooling fish in the San Juan Channel (Zamon 2001). Tides are therefore likely to affect the distribution, abundance and behavior of these pinnipeds.

The San Juan Channel is located between San Juan and Lopez islands. It is a region of ample marine life, complex bathymetry and strong tidal currents (Zamon 2003). Average currents through the channel range from stagnant to more than 3.2 knots during maximum ebb flow (Queisser 2004). Water flows from south to north during flooding currents and north to south during ebbing currents (Zamon 2001). This makes the San Juan Channel an ideal location to study the relationship between pinnipeds and tides.

Overall, my interest was to study the behavior of pinnipeds in the San Juan Channel. The goals of this study were to characterize the frequency, distribution and behavior of harbor seals and sea lions in the study area, to compare the differences in the two species, and to assess the relationship of these patterns with tidal phase.

METHODS

Study Area

I conducted this study in the waters of the southern end of San Juan Channel (Fig. 1A).

Observations were made from Hunt Point, on the south eastern coast of San Juan Island

(48°27'54"N 122°57'36"W) (Fig. 1B). The study area was approximately 24,500m². The southern and western boundaries of the study area were the shoreline; the northern and eastern boundaries were the eastern edge of the far kelp patch (shown in green).

Survey Methods

I conducted observations during the period of August 12- 20, 2011. A total of 12.3 hours were done over eight days during various tides and in fair weather, between 8:45AM and 5:20PM. Surveys were done using binoculars (8 X 42 power).

On each survey I recorded the location, number and behavior of each pinniped observed within the study area and sightings were recorded on an aerial map (Google Maps). To determine distribution, I divided the study area into a grid with 24 sections. Open water sections were ~33m², but some sections along the coastline had a smaller submerged area. Sections D1 and D4-6 were either not visible from my survey point (marked with an X), or not submerged and were omitted from observations, leaving twenty sections in the survey.

Individuals surfacing simultaneously that were within half of a section of each other were counted as a single observation. I periodically scanned the far kelp patch for harbor seals that may have been bobbing among the bulbs. I made no attempt to identify individuals and did not count a sighting as a new observation if I saw the individual travel to a new location. Furthermore, for each sighting, I used only their location when first spotted. Behaviors were divided into five categories: traveling, stationary, socializing, feeding and play behavior (Table 1).

I divided the tide cycle into eight phases ~90 minutes in length using predicted current velocities (Braune and Gaskin, 1982). Specific current speeds on different days were measured in ten minute intervals by averaging the start and end speeds of each. Any observations during an interval were recorded as the average speed. During the study, current speeds with observed sightings for both species ranged from 0- 3.9 knots. No observations were done during slow ebb 1 or slow ebb 2 due to logistical constraints. Predicted currents were based on harmonic data for the south entrance of San Juan Channel which is the closest station to Hunt Point (Mr. Tides Software).

Analysis

I compared total sightings, behavior and distribution per section of both species to tidal phase, as well as sightings in the study area to specific current speeds. Data were averaged as number of events (sightings, behaviors, distribution) per hour to account for unequal times of observation during the different phases. Sightings during different phases were plotted on maps of the study area to show distribution and were based on total sightings from the study period.

RESULTS

Distribution

I observed a total of 476 sightings in the study area during 12.3 hours of surveys. Of the total sightings 391 (82%) were harbor seals and 85 were Steller sea lions. Average seal sightings per hour were ~33 (range 12-61); average sea lion sightings per hour were ~7 (range 0-18). Sightings of both species showed both spatial and temporal variation. The total distribution of both species among the 20 sections showed use of the majority of the

study area (Fig. 2). This shows distribution in the study area regardless of current. Seals had higher instances of sightings that were clustered around the shore and were infrequently spotted further out in the more open water. Sea lions on the other hand, had a more even distribution between the different sections.

Distribution vs. tidal phase

The distribution of both species varied with current direction but not with tidal phase. During both groups of flooding and ebbing phases, distribution for both species remained relatively constant regardless of current speed. However, there was a clear difference in harbor seal distribution during flooding and ebbing tides as a whole (Figs 3A & 3B). For example, during fast ebb, seals were observed strictly close to the shore or within the cove, while during fast flood they were more evenly distributed throughout the study area. Sea lions tended to maintain a more even distribution among the different tidal phases, but they exhibited the highest frequency of feeding events during the two slow flooding phases. Furthermore, when the current was visible, sea lions were often spotted swimming along the edge of it; it was here that all feeding events were located.

In contrast, the frequency of sightings of both pinnipeds did vary among the different tidal phases (Fig. 4). The highest number of harbor seals sightings occurred during both slow flood phases, and overall seal sightings were more frequent during flooding tides than during slack or ebbing tides. For sea lions the trend was less clear. The highest average sightings occurred during slow flood 2 and slack high and the lowest number of sightings were during slack low and fast ebb.

Current speed

Frequency of sightings also varied with current speed (Figs 5A & 5B). The highest rates of sightings for both harbor seals and Steller sea lions were at 1.3 knots (84/hr, 42/hr respectively). Relatively high (>40) numbers of sightings of seals were seen at least one time during the full range of current speeds. Relatively low numbers were generally seen during slower currents of 0.1 to 1.0 knots. The relationship of sightings of sea lions with current speed was less clear but the highest numbers of sightings (>20/hr) occurred during slower current speeds (≤ 1.3 knots).

Behavior

Frequency of the five behaviors varied greatly between the two pinniped species (Figs. 6A & 6B). Harbor seals showed much more variety in their behavior than did Steller sea lions. The two behaviors exhibited by seals with the greatest frequency were being stationary (44%), and traveling (39%). Also, seals frequently engaged in social and play behaviors, at least twice as often as sea lions. In contrast, sea lions spent the most time travelling (79%) and relatively little time doing the other four behaviors. Although feeding comprised a lower percent of seal behavior (2% vs. 7%), the total number of surface feeding events (10 vs. 6) observed was higher in seals than in sea lions. Seal behavior did not vary significantly among the different tidal phases. Sea lions also showed little variation in behavior among tide phases. Finally, the majority of sea lion social and play behaviors were during the final few days of the study when four sea lions had been present as opposed to one or two during the first few days.

DISCUSSION

Distribution

The distribution trends stated above show a difference in habitat utilization between the two species of pinnipeds. Harbor seals clearly prefer the calmer waters closer to shore and further within the cove, while Steller sea lions were found throughout the area. Seals spend a lot of time in the channel foraging (Zamon 2001) and have haul out sites north and south of the study area (Hardee 2008). It is then likely that while foraging in the channel, instead of travelling back to a haul out site to rest, the seals would seek the shelter and calm water of the study area. Studies on sea lions need to be done in the area to determine if these same patterns exist. Although the difference in distribution suggests that sea lions are using the location as more than just a resting area.

Distribution vs. tidal phase and current

The findings that harbor seals exhibit a greater variation in distribution among tidal phases, while Steller sea lions do not, support the idea that both species are using the area somewhat differently. The large number and varied distribution of seals during flooding tides is consistent with the findings of Zamon (2001). An increase of schooling fish abundance and distribution in the channel during flooding tides, as described by the tidal-coupling hypothesis (Zamon 2003), explains this trend in seal distribution. Seals are present in fewer numbers and within sections of the area more suitable for resting when prey is less available, becoming more abundant and spread out during flooding tides in response to changes in prey behavior.

Steller sea lions showed no clear trends in distribution vs. tidal phase or current. At first, this does not appear to support the tidal-coupling hypothesis. Although, low sea lion numbers most likely made it difficult to see a trend and therefore these data may not be an accurate representation of the situation. Since sea lions were often spotted farther out in the channel, especially in areas of visible current, it is likely they use this area more for foraging than resting. Areas along the edge of the current provide regions where prey is concentrated and is therefore a profitable foraging location (Tyler, pers. comm). This supports my observations of all feeding events by sea lions being located along this border. Furthermore, these feeding events all took place during slow flood phases, which does support the tidal-coupling hypothesis even if other trends were unclear.

Behavior

Both species exhibited quite different behaviors over the study period. The fact that harbor seals spent so much of their time being stationary also supports the idea that they are using this area as more of a resting spot. The larger proportion of seals involved in social behaviors compared to sea lions is most likely due to the simple fact that there were more seals, which were often in larger groups. Sea lions, except for the last two days of observation, were generally solitary. There is only one notable sea lion haul out location in the area, which is the probable explanation for the low number of sea lions observed (Vermeire 2010). These last two days, when a sea lions were regularly seen in a group, were when the majority of social and play behaviors were observed. Sea lions would have to be observed more often in groups to get a better sense of their different behaviors.

The feeding frequency in this study was much higher than previously found for harbor seals in the southern San Juan Channel by Zamon (2001). Over the 12.3 hours of observations, I observed harbor seals and sea lions feeding on salmon above the surface ten and six times respectively. This frequency is 43% higher than that recorded for harbor seals in 2001. I found no data on sea lion feeding frequency in the area to compare these data to so it is unclear if they exhibited an increase as well. Changes in feeding behavior of seals have a few possible explanations: the study area, located closer to shore and more sheltered than the open channel, may provide a location preferred by both fish and pinnipeds, which would increase feeding rates, or the general increase in harbor seal population since the previous survey in 1995-97 (Jeffries et al. 2003) could mean there are just more seals in the area catching large fish.

Critique – future suggestions

During the course of this study I observed a few possible ways for future studies to improve on my study methods. First, the sometimes poor visibility in the far kelp patch made it difficult to spot stationary harbor seals. This potentially could have lowered observation rates for that area, although periodic scans generally revealed no new sightings. Steller sea lions were easier to find in the kelp because of their larger size and loud exhalations. Choosing a similar region with a more open area would reduce this concern. Second, observations need to be made during slow ebb phases, as well as more done during the other six phases to get a clearer picture of trends in distribution and behavior. Finally, because the current speed on the outer edge of the study area was visibly faster than that near the shore within the cove, it is obvious that a generalized current speed is not representative of the entire study area. It is likely that this is the

reason why there were no clear trends for sightings vs. current speed for either species. A more specific current reading for different sections within the study area would create a more detailed picture than that provided here.

ACKNOWLEDGEMENTS

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FIGURES AND TABLES

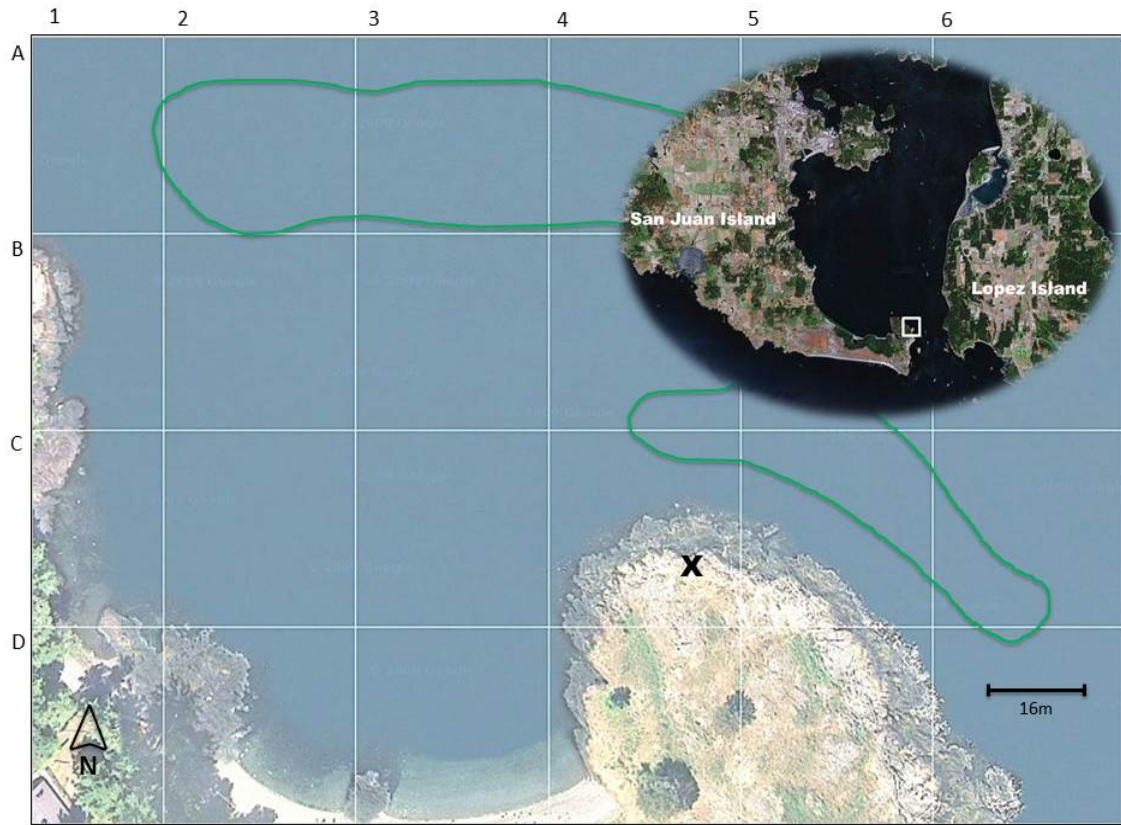


Figure 1. Map of study site. (A- Inset) Pinniped observations were made near the southern tip of San Juan Island, WA. (B) Close up of study area and labeled sections. Sections D1 and D4-6 were not included in the survey because of lack of visibility or water. Kelp patches are shown outlined in green.

Table 1. Characteristics of the five behavioral categories.

Behavior	Characteristics
Traveling	Swimming, riding current
Stationary	Bobbing, floating
Socializing	Touching, mother and pup
Feeding	Feeding, hunting
Play	Splashing, diving around kelp

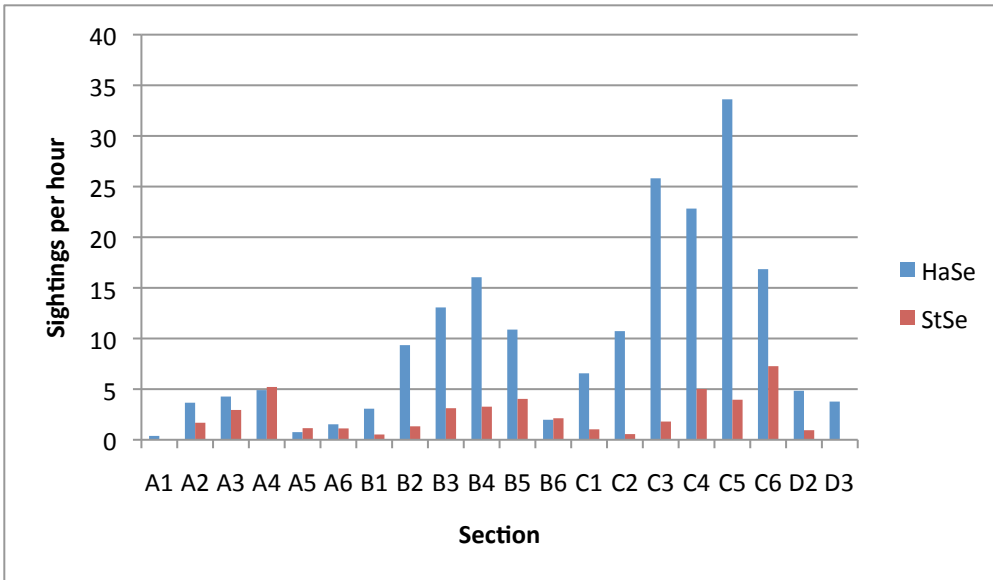


Figure 2. Average sightings of harbor seals (HaSe) and Steller sea lions (StSe) in the 20 sections of the survey area.

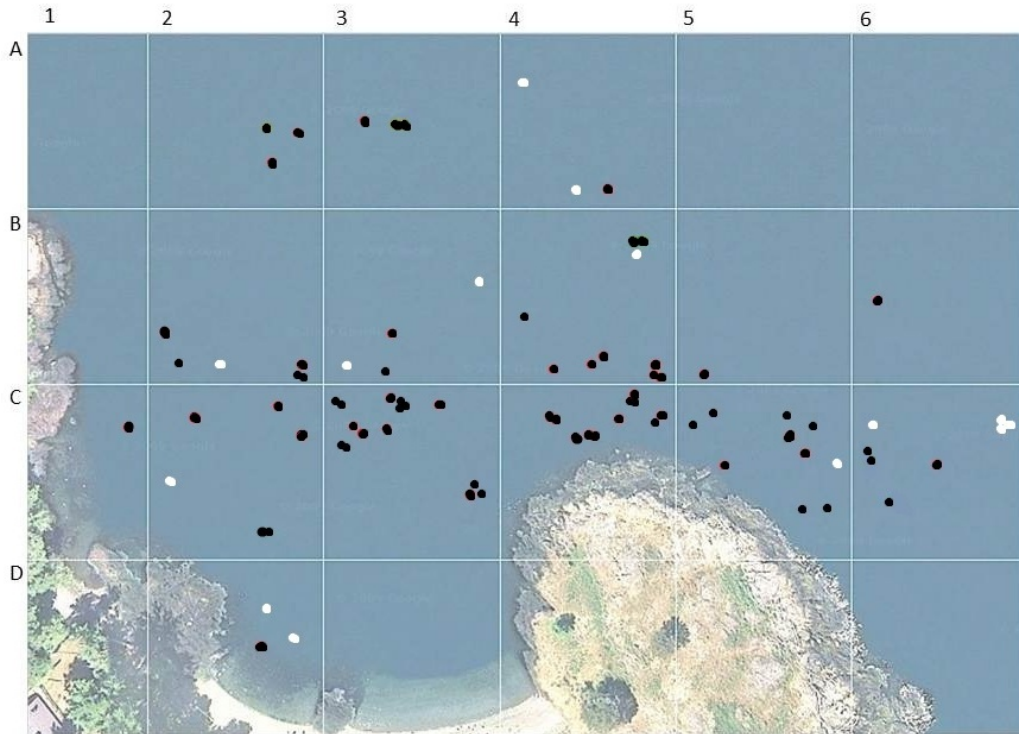


Figure 3A. Distribution of harbor seals and Steller sea lions during fast flood. Harbor seals are black dots and sea lions are white dots.

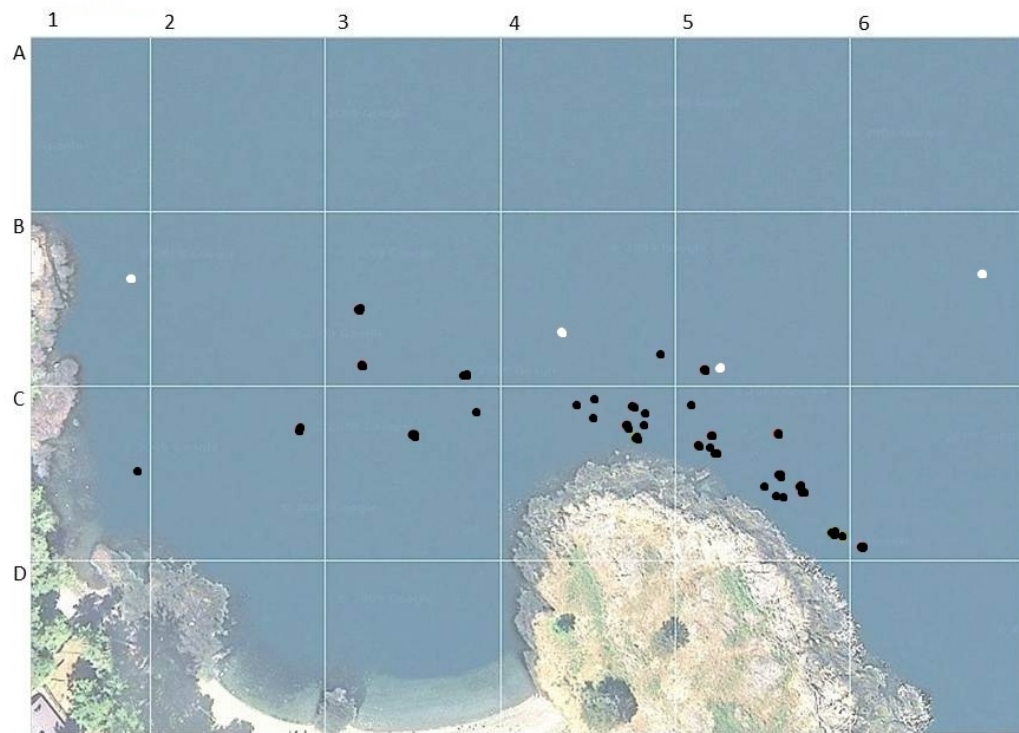


Figure 3B. Distribution of harbor seals and Steller sea lions during fast ebb. Harbor seals are black dots and sea lions are white dots.

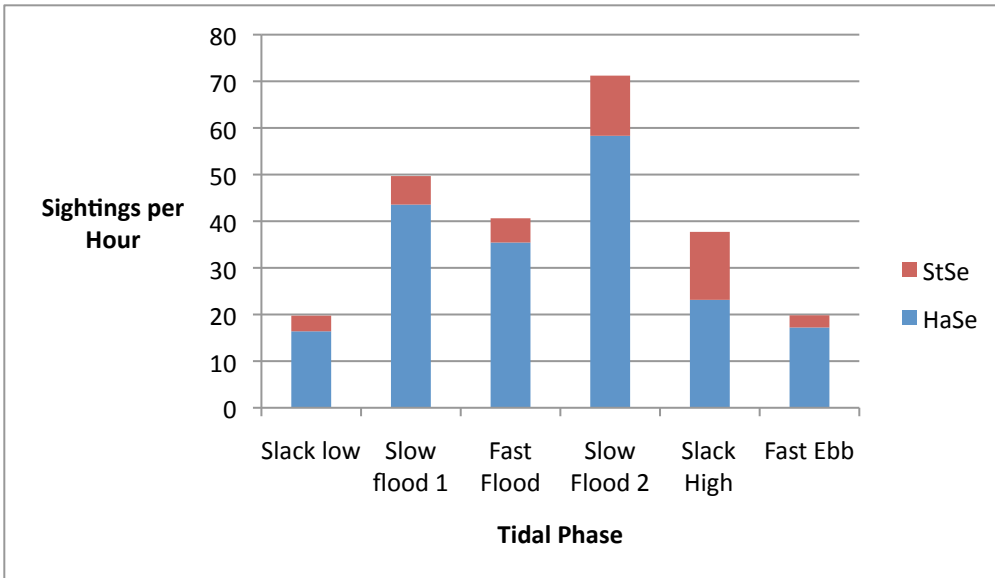


Figure 4. Average sightings of each species within study area during each tidal phase observed.

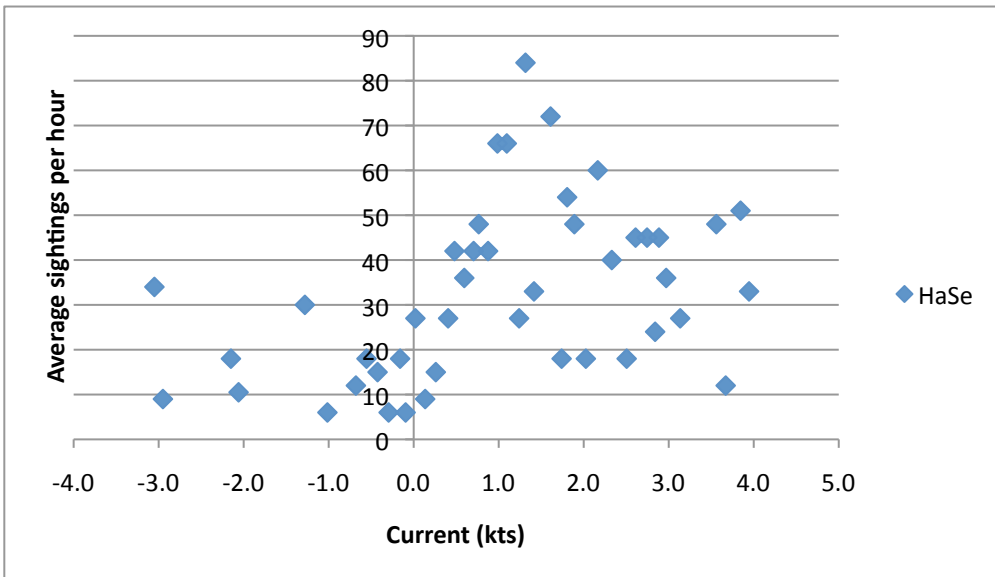


Figure 5A. Distribution of average sightings of harbor seals (HaSe) vs. current speed.

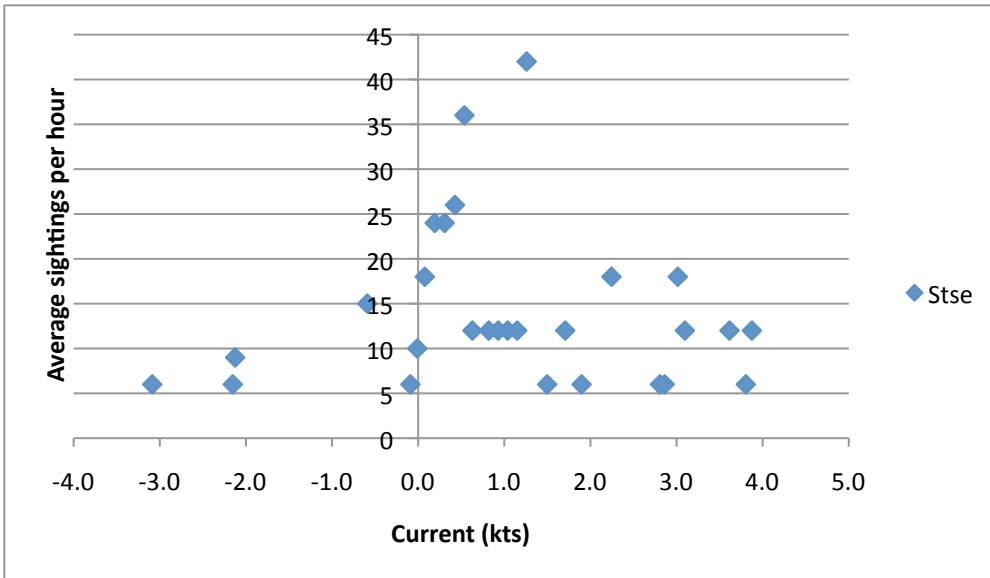


Figure 5B. Distribution of average sightings of Steller sea lions (StSe) vs. current speed.

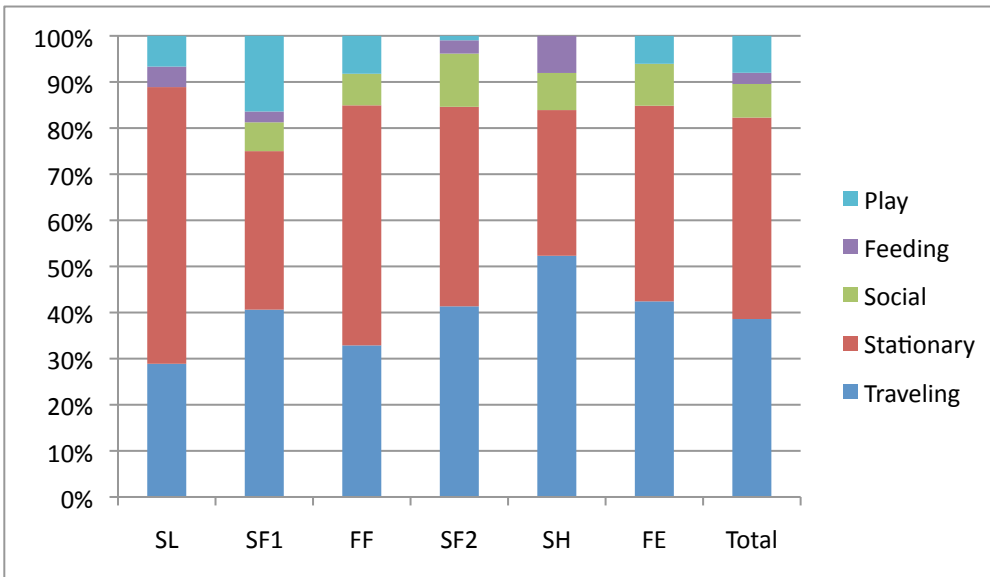


Figure 6A. Differences in observed behavior rates of harbor seals during different tidal phases and overall behavior rate during study.

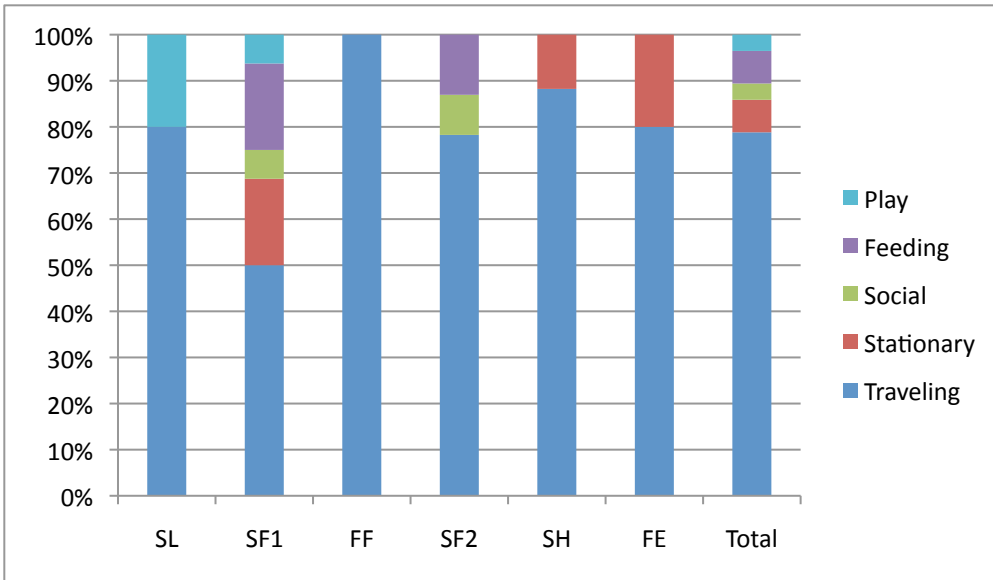


Figure 6B. Differences in observed behavior rates of Steller sea lions during different tidal phases and overall behavior rate during study.