Harbor Seal (*Phoca vitulina*) Haul-Out Patterns Relative to Air Temperature during Summer in the San Juan Islands, Washington

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Abstract

I present data taken during observations of harbor seal haul-outs and evaluate what effect temperature has on the number of seals hauled out on rocks. I propose some possibilities as to what might be influencing harbor seal behavior and haul-out preferences. Data is presented to lend evidence to the hypothesis that temperature is negatively correlated to seal numbers. Difficulty in separating temperature from other key variables, such as time of day, is addressed. Other studies are reviewed to examine congruity or lack thereof in findings and interpretations of harbor-seal haul-out patterns.
KEY WORDS: harbor seal haul-out hauling out temperature yellow island basking

Introduction

Many studies have shown proximate factors to impact harbor seal haul-out numbers, such as wind chill and wave intensity. The effects of tide have been studied extensively, due to their easily observable effects on haul-out space. It is a commonly held viewpoint that many factors determine haul-out patterns, with no single pre-eminent factor (Schneider and Payne 1983).

Harbor seals (*Phoca vitulina*) are commonly found hauled out on the beaches of the San Juan Islands to warm up after repetitive diving. This information may be useful in order to help determine the energy economics of seals. One possibility is that the harbor seals capitalize on warm conditions and spend longer basking in order to maximize their heat gain. Another is that they spend less time basking under warmer conditions because they do not need as much time to reach the body temperature required

for diving. This would maximize the time available for hunting. These data may also show if there is a temperature cutoff on either end of the spectrum.

I examine the data collected of seal numbers at a particular time and location in order to evaluate if abundance is related to the air temperature at corresponding times. In addition to counts and temperature readings, I made record of the time and anticipated tidal height in order to better review the potential factors of influence behind harbor seal haul-out patterns. I discuss the possibility of a low point within the observed temperature values at which hauling becomes uncommon, or a high point where the temperature can be high enough as to prevent seals from hauling out.

Methods

The climate of the San Juan Islands is moderate. Temperatures rarely fall below freezing, or exceed 27ºC Average annual rainfall is 29 inches. Reder et al. (2003) indicated that haul-out numbers are highest from mid-summer to early fall. This time frame encompasses the period of my study, which took place during 8-17 August 11.

I conducted this study from Yellow Island, which is located in the San Juan Channel 6.6 kilometers north of Friday Harbor and the same distance west of Orcas. The island is owned by the Nature Conservancy and maintained by two conservancy employees. The site may be sold to another agency with similar standards, but is protected from development by law. The 10.5-acre island has two haul-out sites, but only the west side was considered for this study (appendix 1). In addition to the area visible on appendix 1, the site has three distinct haul-out locations.

Because several factors may influence to the number of seals at haul-out sites, haul-out patterns are believed to be site-specific (Patterson and Acevedo-Gutierrez 2008). Thus, focused my I selected to focus on a single haul-out site to increase my ability to assess the role of temperature in affecting haul-out patterns. The haul-out sites in Puget Sound region have an unusually large proportion of areas that are available at all tide levels (Patterson and Acevedo-Gutierrez 2008). It is debatable whether Yellow Island should be included in this category or not, since most of the distinct haul-out locations are submerged at high tides. Thus, in order to isolate the effect of temperature on haul out numbers, I excluded all observations above tidal heights that appeared to restrict the size of haul out sites and thus numbers of seals hauling out. Predicted values of tidal heights were obtained using the software Mr. Tides 3.

I used a tripod-mounted 20-60x scope to count the number of seals at 15-minute intervals. I obtained temperature data from Friday Harbor Weather Station, which is similarly available at 15-minute intervals. I counted all seals that had most of their body out of the water. Counts were performed from a trail circumnavigating the island, at an estimated 150 m. The observation distance maintained was sufficient enough that none of my movements had any apparent effect on the behavior of the Harbor Seals.

Results

Seven of the 41total observations were not included in the calculations of regression lines. These data points are marked in red. Their omission is due to the fact that tide height appeared to be great enough to be limiting numbers hauled out. These cases are outliers inhibiting an accurate analysis of the effects of variable temperatures.

It is worthy of note that all of these data are included in the nine taken above a five-foot tidal height (Fig. 1).

The temperature correlation plot displays an arguably significant line of regression (R^2= .27) without the anomalous data points considered (Fig. 2).

Haul-out numbers may be truly more dependent on time of day, given that temperature is highly correlated with time of day. Temperature does show a strong correspondence with time of day during the hours in which I made observations (R^2 = 0.84, Fig. 3). Time of day operating as the independent variable is also apparently more convincing than temperature is (Fig. 4).

Though there is undoubtedly a connection between the two variable in the first figure, time of day shows an even stronger correlation with tides (Figure 5). Hence, time of day is not possible to isolate time of day as a competing variable in this study because it is linked with tidal height.

Discussion

In order to assess the affects of temperature on haul out numbers of harbor seals, it is important to understand how tide height affects numbers hauled out. No harbor seals were observed to be basking on the sandy portion of the beach, perhaps due to a preference of substrate the seals may have. In spite of what appeared to be unused haul-out space at every tide level, numbers of basking seals were more closely correlated to tidal height, though this is most likely due to spatial limitations. Although space was available in some amount at the time of every observation, it was reduced at higher tide levels and has a seemingly direct negative relation to number of seals hauled-out. I have

no data of the surface area of the locations at different tidal heights, so cannot present any ideas regarding the specifics of this. Many studies, however, indicate that seal haul-out numbers are restricted by the spatial limitations that tides impose. Schneider and Payne (1983) stated highest numbers of harbor seals to be hauled-out during low tide. One study on seal haul-out behavior that has been conducted examined harbor seals hauling out on floating water breakers (Patterson and Acevedo-Gutierrez 2008). The study is unique in that the surface area of the haul-out locations were in no way affected by tides, effectively isolating the variable. There was a positive correlation between tidal height and haul-out numbers, a finding contrary to studies where haul-out space is reduced at high tides. I consider this as evidence that where the haul-out space availability is limited, the negative relationship between haul-out numbers and tidal height is predominantly a cause of spatial restriction.

Other factors have been shown to influence harbor seal haul-out behavior also. In addition to tides, Patterson and Acevedo-Gutierrez (2008) observed wind speed, humidity, and cloud cover to have an effect on harbor seal haul-out patterns. This is understandable, being that these conditions are all related to temperature and thermoregulation of harbor seals. Time of day, however, was also assessed to have an association with haul-out numbers (regardless of its disjunction with the spatial restrictions tidal height usually imposes). Whether or not this is simply due to its correlation with temperature is unclear. A study conducted by Grellier et al. (1996) presented results showing a complete lack of correlation between temperature and haul-out numbers. The researchers suggest that this may because of the foraging patterns of the harbor seals that were studied. They found that these harbor seals were feeding up to eighty km from the haul-out site, for a

maximum of twelve days at a time. The researchers described that it was likely that this activity took precedence, and that the harbor seals only chose to haul-out when their foraging schedule allowed for it. Stewart (1984) cited that diurnal cycles may have a larger influence than tides in places where land above the high water level is used for haul-outs (Wilson, 1978).

There are multiple ways in which temperature has the potential to alter haul-out behavior. If time of day has an effect on harbor seal haul-out behavior independent of its connection to temperature, I find it a plausible explanation that time of day may somehow be affecting prey availability. This assumes that the harbor seals in question would be prioritizing feeding over basking. Studies to determine the energy expense and gain of foraging for various types of prey, the heat gain achieved from hauling-out, and the cost of blubber production relative to its efficiency would assist in understanding the haul-out patterns of harbor seals. If temperature is the predominant cause in determining haul-out behavior in this study, the results may indicate that warming time for harbor seals declines with increases in temperature. Another possibility to explain the negative relationship between temperature and haul-out numbers is that seals may start to become over-heated at high temperatures.

Some shortcomings in the diversity in the data prohibit me from making more general statements in the interpretation of my data. Perhaps most apparent deficiency in this study is the fact that I could not conduct counts at all times of day due to logistical constraints. Observation times spanned 08:45 to 16:15, so the data may not reflect behavior in the evening or early morning. In contrast to seals hauled out, I could not accurately count the number of seals in the water. As a result, I can make no conjecture

about when or if the temperatures might become low enough to negatively affect the number of seals hauling out. In contrast to my study, Reder et al. (2003) found low temperatures to have adverse effects on haul-out numbers of harbor seals. Their study, however, spanned temperatures of -0.5 and 9.0°C. This may be interpreted as support for the idea that at both sufficiently low and high temperatures, basking is no longer an energetically profitable activity for harbor seals. Greater knowledge about intricacies of haul-out behavior among pinnipeds has the potential to be useful for future conservation issues.

Acknowledgements

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Figures

Figure 1: Relationship between tidal height and numbers of harbor seals hauled out on Yellow Island, Washington during August 2011. Data points in red were eliminated from analyses as they occurred at tide heights that appeared to restrict the numbers of seals hauling out.

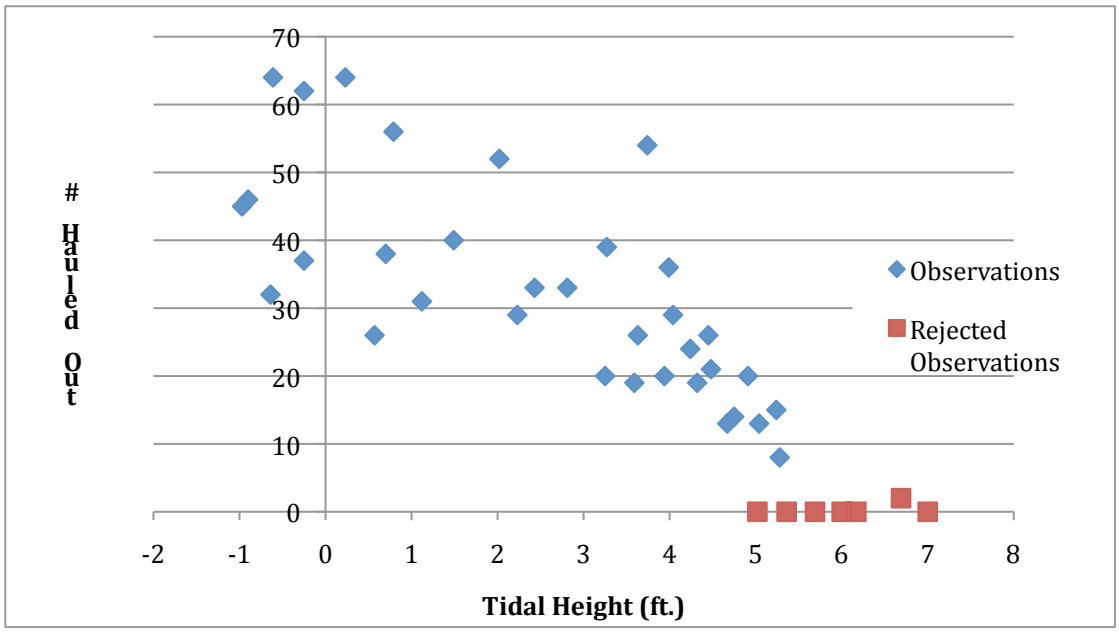


Figure 2: Relationship between temperature and numbers of harbor seals hauled out on Yellow Island, Washington during August 2011. Data points in red were exempted from the regression calculation.

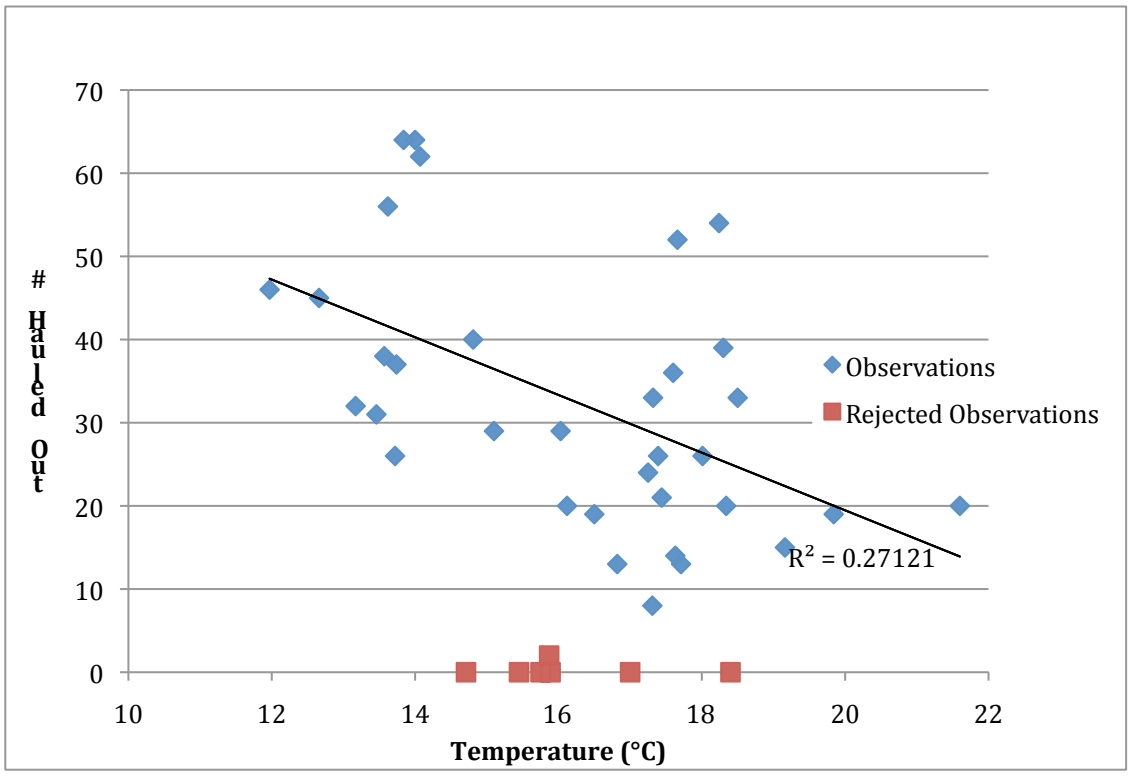


Figure 3: Relationship between time of day and temperature at Friday Harbor, Washington during August 2011. Rejected Observations are not displayed.

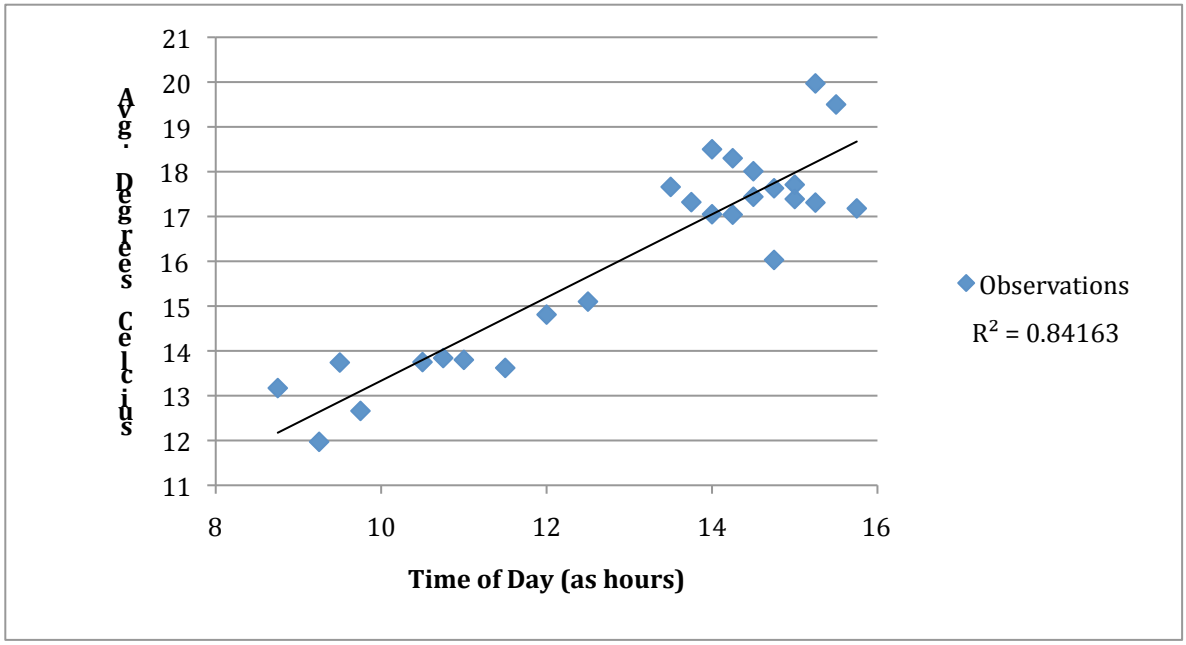


Figure 4: Relationship between time of day and average haul-out numbers. Rejected Observations are not displayed.

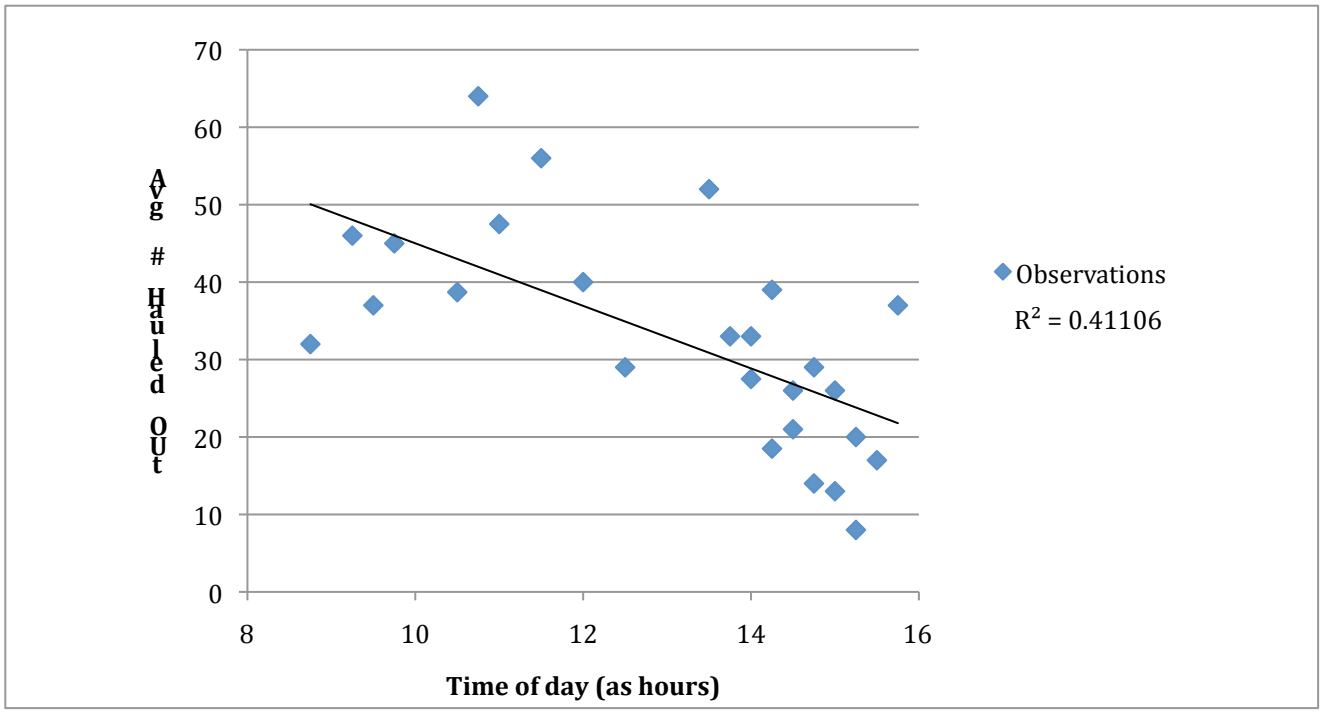
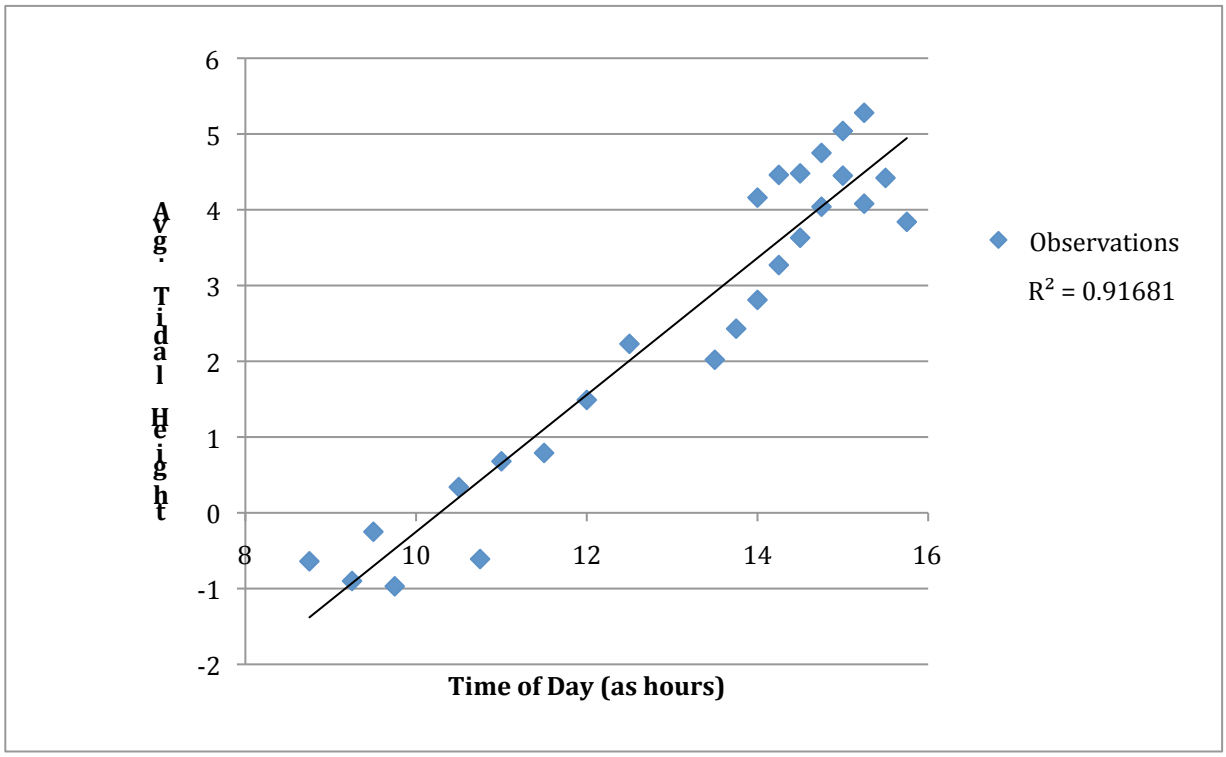


Figure 5: Relationship between time of day and tidal height. Rejected observations are not displayed.



Appendix 1

Three haul-out locations are submerged within frame.