

Surface behaviors of Southern Resident Killer Whales, *Orcinus orca*, along the West Side Scenic Preserve of San Juan Island

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ABSTRACT

Southern Resident Killer Whales have been studied since their population was harmed by live captures for aquariums and has not recovered since that time. Further understanding of their behavior could assist conservation efforts. Killer whales spend the majority of their time underwater, so surface behaviors are one of the few accessible forms of study. Observations were made from the West Side Scenic Preserve to assess the frequency of surface behaviors between periods when the whales were milling versus traveling. Surface behaviors occurred more frequently during milling, especially pectoral slaps. Only breaching behavior occurred equally while milling and traveling. An opportunistic observation allowed me to assess changes in the frequency of SRKW surface behaviors when they were in the vicinity of transient killer whales. Surface behavior activity increased substantially in the presence of transient killer whales; especially tail slaps and other percussive behaviors. Further study needs to be done to investigate the frequency of surface behaviors for better insight of the SRKW population.

KEYWORDS

Behavior, *Orcinus orca*, Southern Resident Killer Whales, transient killer whales

INTRODUCTION

Killer whales (*Orcinus orca*) have been studied for over 25 years and continue to fascinate scientists and the public. These whales can be found worldwide and are divided into offshore, transient, and resident populations. The populations show morphological differences in their dorsal fins, and have distinct calls, social structures, and diets

(Felleman et al. 1991). Transient whales hunt marine mammals, while offshore whales are thought to eat mainly fish and possibly sharks (NOAA 2011). Resident whales eat mainly fish and are the most observed of the populations.

I focused my study on the Southern Resident Killer Whale (SRKW) population that inhabits the Salish Sea (Puget Sound, the Strait of Juan de Fuca, and the southern Strait of Georgia). The whales live in three family groups called pods, each consisting of maternal subgroups (Felleman et al. 1991). Salmon comprise 95% of SRKW prey, including a strong preference for Chinook salmon specifically (Ford et al. 1998). San Juan Island shorelines are steep and rocky, making perfect habitat for salmon. Killer whales can often be found close to shorelines where the salmon are present and can easily be corralled and captured (Ford et al. 1998).

The majority of killer whale activities take place underwater, accounting for 95% of their time (Jacobsen 1986). Determining important aspects of killer whale behavior from just 5% of their activity is a challenge, but is important since we have few alternative methods to comprehend killer whales. Insight into the behavior of this species can further assist in conservation efforts. In the 1960s and 1970s, studies of the SRKW were initiated in response to extensive aquarium captures (Felleman et al. 1991). While the original population was estimated to be about 200 whales, 47 were removed from the waters at that time. Since then, the population of the SRKW has been struggling, including a 20% decline from 1996–2001 (Noren et al. 2009). The current population is just 88 individuals and in 2005 the SRKW were listed as endangered under the Endangered Species Act (NOAA 2011).

Although conservation of the SRKW relies heavily on behavioral studies, the ecological context of much of their behavior remains poorly understood. Behavior has been used to study the effects whale watching has on the whales. Surface behaviors have been associated with close vessel approaches (Noren et al. 2009) indicating reaction from the whales, which we can relate to. Many whale species display breaching behavior and there is no definite explanation for this behavior. Breaching, a sideways jump from the water where majority of its body is exposed, requires a significant expenditure of energy. A single breach is thought to require 1% of the minimum daily energy requirement for humpback whales (Waters and Whitehead 1989). Other surface behaviors require less energy expenditure and are also not fully understood.

For this study, I conducted behavioral observations of killer whales off the west side of San Juan Island. In this paper, I present my findings on surface behaviors of the SRKW in relation to acts of milling versus traveling. I elected to focus on this relationship in order to gain further insight into the behavioral interactions of this population. I also discuss my methods and make suggestions for future work.

METHODS

My study area was on the west side of San Juan Island along the shoreline of the West Side Scenic Preserve in Haro Strait. The West Side Scenic Preserve occurs on high bluffs allowing a clear view of the waterway. The shoreline is steep and rocky and includes tidal pools and kelp beds. Observations took place along an approximately 1.6 km long segment of shoreline, from the northern end of Deadman's Bay (48.51N, 123.15W) to the southern end of the preserve (48.50N, 123.13W). Observations

extended about 0.80 km into Haro Strait. My study site was restricted to areas in which I could clearly see the whales as they passed and did not require binoculars. Observations without the aid of magnification were the only method I used to ensure that I had a wide perspective of the study area as well as to increase the likelihood of observations. Afternoons were used since I found the whales to be present in my study area more often at this time.

When a southern resident killer whale was spotted within the study area, I recorded a time and began the observation. When the last whale(s) exited the study area, the time was also recorded. The direction the whale(s) were headed was noted, along with any directional changes. Periodic notes on the direction of the whale(s) were also listed. Surface behaviors of breaches, pectoral slaps, tail slaps, and spyhops were recorded along with the time they happened and the number of times this behavior occurred per incident.

Behaviors were defined similar to Martinez and Klinghammer (1978) with some terms generalized in order to group activity together, such as types of tail slaps. I defined a breach as any jump from the water where at least two thirds of the whale's body was exposed. A pectoral slap entails an orca floating or swimming on its side and slamming its pectoral fin on the water with force. My definition of a tail slap is simply the rising of the fluke to hit the water with force. A spyhop is a vertical rising of an orca from the water where at least the eyes are exposed, although this can also include raising above the water so the pectoral fins are exposed.

I also noted traveling or milling behavior. Traveling is defined as any consistent forward movement. This is often associated with either basic travel or foraging for food.

Milling is defined as slower, non-directional movement and is often associated with active feeding. At times the distinction between traveling and milling could not be determined until after watching the orcas for a period of time. Notes concerning the interactions between transient whales and SRKW were also included.

I analyzed surface behaviors by comparing the average number of each behavior per hr between milling and traveling categories. Frequency of surface behaviors in milling and traveling were then compared using Excel bar graphs. Error bars were included to determine any significance. Surface behaviors of SRKW were also compared between periods when transient killer whales were present and absent using Excel bar graphs.

RESULTS

Results of my surface behavior study were based on 267 min. of observations from four days, with a total of 101 surface behaviors recorded. The majority of observations were during time of travel, which constituted 62% of their time, while milling was seen 38% of the time.

The study recorded all four expected common surface behaviors. Tail slaps occurred most frequently, with 15/hr. All other surface behaviors occurred less than 8/hr. The frequency of these behaviors differed depending on whether the whales were milling or traveling. All types of surface behaviors were more frequent (number/hr) during times of milling than traveling except breaching (Fig. 1). The mean frequency of pectoral slaps was 9/hr while milling, but this behavior was not observed during times of travel. Tail slaps and spyhops also showed more activity while milling versus traveling. Breach

behavior showed little difference with an average frequency of 5/hr while traveling and 6/hr while milling. Overall, the percentage of time surface behaviors seen was greater while milling than traveling (Fig. 2).

My observations included a small pod of four transient whales heading south along my study area one of the days in my study. No surface behaviors were seen from the transients when they were clearly present. SRKW appeared in my study area from the south and performed four breaches right away. This was followed by a lot of tail slaps by various members of the pod along with pectoral slaps, more breaches, a few spyhops, and even a cartwheel. This behavior lasted an hour in the area the transients were first seen, until the residents continued to head north. The transients were not seen once the residents appeared.

Surface behavior patterns of the SRKW were different when transient killer whales were present than when there were no transients in the water (Fig. 3). The frequency of most surface behaviors was greater in the presence of the transient killer whales, especially tail slaps and pectoral slaps. Tail slaps showing the greatest increase, 28/hr, almost four times higher when transients were present. Pectoral slaps increase to twice the amount as well. Only the frequency of spyhopping was similar in times when transients were present and absent.

DISCUSSION

Variation in surface behavior while milling and traveling in SRKW

I observed an increase in some surface behaviors while the SRKW were milling compared to travelling, especially percussive behaviors such as pectoral slaps and tail

slaps. Pectoral slaps showed the most difference, with none observed during times of travel. This is understandable considering that this behavior is often associated with feeding and could be used to facilitate fish herding (Felleman et al. 1991). Tails slaps would have a similar effect, similarly explaining why this behavior was more frequent during milling. Spyhopping is not percussive or associated with fishing, so it makes sense that milling and traveling times yielded similar frequencies of this behavior.

A relationship between percussive surface behaviors and directional changes has also been suggested (Hoelzel 1993), and such behaviors may entail a form of non-verbal communication (Noren et al. 2009). Humpbacks may increase their rates of tail slaps and breaching in groups about to undergo a split (Dunlop et al. 2008). In my study, I did not see any trends suggesting that surface behaviors were used to communicate directional changes, but my study time was too brief for any definitive conclusions in this regard.

Breaching behavior occurred almost equally during traveling and milling. Whales have been observed breaching when disturbed by external stimuli, extreme annoyance, general arousal, play, and feeding (Pryor 1986). Play is especially common in younger members of a population (Jacobsen 1986). Supporting this notion, I observed young members of a pod perform five out of the nine total breaches while traveling one day. Since breaching takes more energy to perform than other surface behaviors, I expected this behavior to be seen least frequently, and more so during travel. Traveling would also provide more speed and energy needed for a breach. My results demonstrate that the frequency of breaching is similar to other surface behaviors.

Observations of surface behaviors of SRKW while transients were present.

There have not been many observations of interactions between resident and transient killer whales, but these populations do not socially mix (Jacobsen 1986). Most literature suggests that these populations tend to pass with no change in their behavior, or that transients change course to avoid contact with residents when in close proximity (Ford et al. 1998). In one observation, members of the J pod from SRKW chased away transient whales (Ford and Ellis 1999).

I observed increased frequency of surface behaviors of milling SRKW in the presence of transients, although the distance between these two groups was not clear. This increased rate of surface behaviors might be explained as non-verbal communication signifying a warning or threat. Breaching is thought to signal location, threats, or warning (Martinez, Klinghammer 1978). The considerably higher frequency of tail slaps while the transients were present suggests that this behavior is used as a warning sign (Marsh 2008). Loud percussive behavioral displays were used extensively, starting with four energy-depleting breaches as SRKW entered the area in which transients were present. I believe my findings support the idea that increased rates of surface behaviors of SRKW entailed aggression towards transient whales. Interactions with transient killer whales are infrequent, making the observation unusual and difficult to study further.

Future Work

I compared methods for surveying the surface behaviors of orcas to determine the most efficient technique, including both land- and water-based observations. One day I rode along with the Soundwatch vessel, which surveys waters that SRKW reside for the protection of the population. Soundwatch concentrates on the boaters, so visual contact

with the killer whales was limited. There was also no control over the location of the boat, making studying SRKW difficult. A whale watch trip on a local whale watch vessel was also tested for gathering data. I found perspective of the population as a whole would be lost following just a few individuals, when the waters have many other orcas present. Land-based studies were challenging since there is no way of knowing when or where the killer whales are located. Attempts were made to track down the whales from shore, looking for commercial whale watch boats to signal the presence of killer whales. Land on the west side is limited south of West Side Scenic Preserve and north of San Juan County Park. I found that Lime Kiln limited observations due to geographic formation of the shoreline and being low to the water. San Juan County Park has a limited viewing area and killer whales tend to stay farther offshore making observations more of a challenge.

I decided on West Side Scenic Preserve for my land-based observations since it provided a consistent viewing area, but my study only tells a story about that specific location. Prevalence of fish in the area differs from other locations, which could yield varying behavioral observations, including time spent traveling versus milling. The study time frame was also just one week long, severely limiting data collection and diversity of the data by time of season and day. All observations occurred mid-afternoon when the SRKW happened to pass by. The research could be assisted not only by a longer study time, but also observations done throughout the entire day and occurring at two or more locations along the west side of San Juan Island for some comparison. The ability to tap into a network of up to the minute orca sightings could also assist in maximizing viewing

times while the SRKW pass land observation points. If land around False Bay or Eagle Point could be secured, this could help tremendously as a secondary observation spot.

Further work could be done looking at various surface behaviors by SRKW in regards to not only traveling and milling, but directional change, age groups or opportunities of study such as the encounter with the transient pod. A longer study would need to be performed in order to collect more data to find any statistical significance. A research team of more than one individual could help get better data since it allows more eyes on the water at any given time. More than one observation point would also be ideal to give comparisons of results and give a large picture into the behavior of SRKW. The study of surface behaviors of SRKW is a good start into understanding the population and there is a lot of potential for further research in this area.

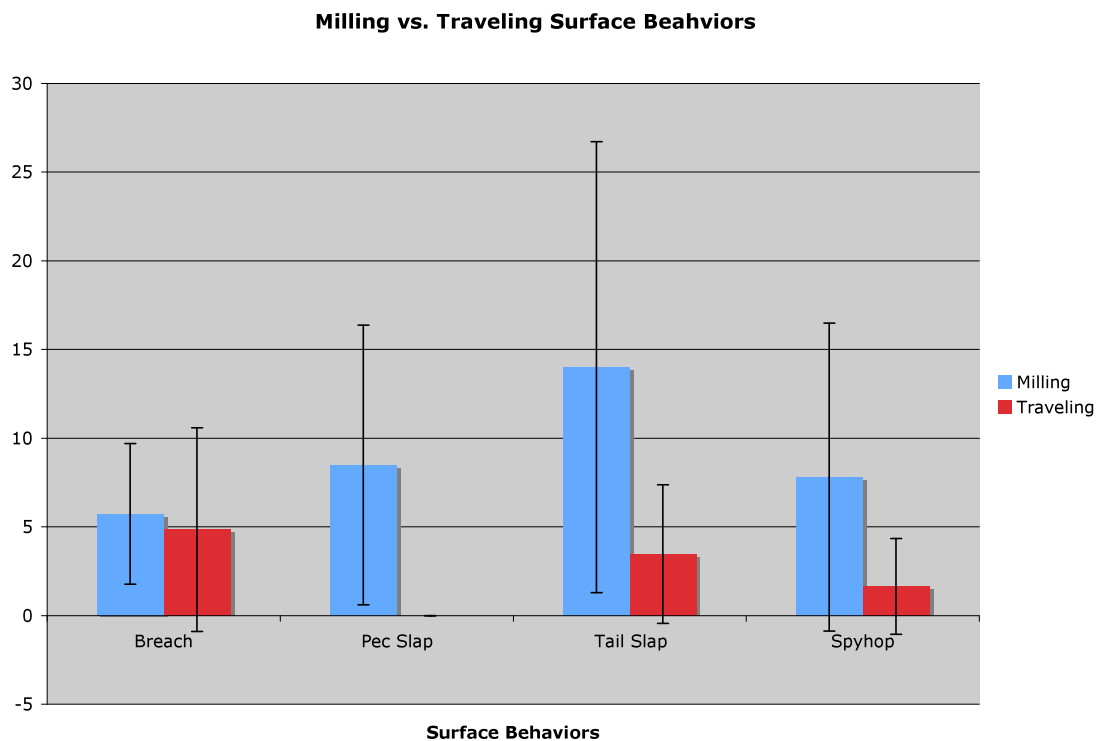


Figure 1. Mean frequency (number/hr) of four surface behaviors observed in SRKW during periods of milling versus traveling. Observations were made in August 2011 from the West Side Scenic Preserve on San Juan Island, Washington.

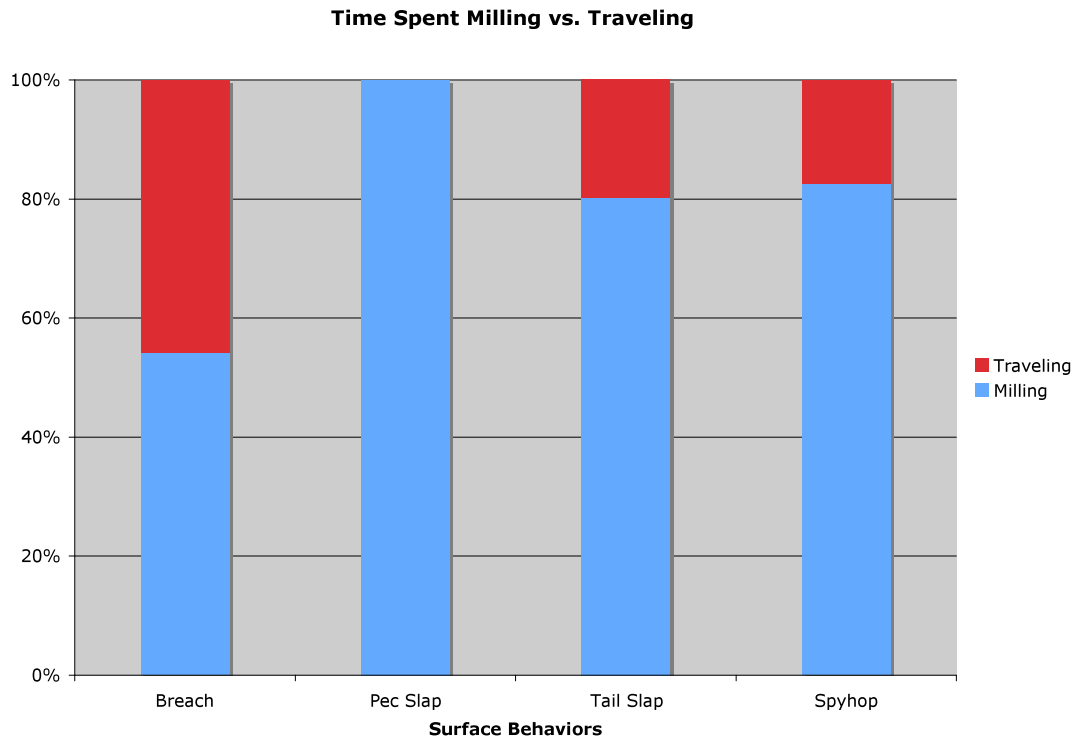


Figure 2. Percentage of time four surface behaviors were observed in SRKW during periods of milling versus traveling. Observations were made in August 2011 from the West Side Scenic Preserve on San Juan Island, Washington.

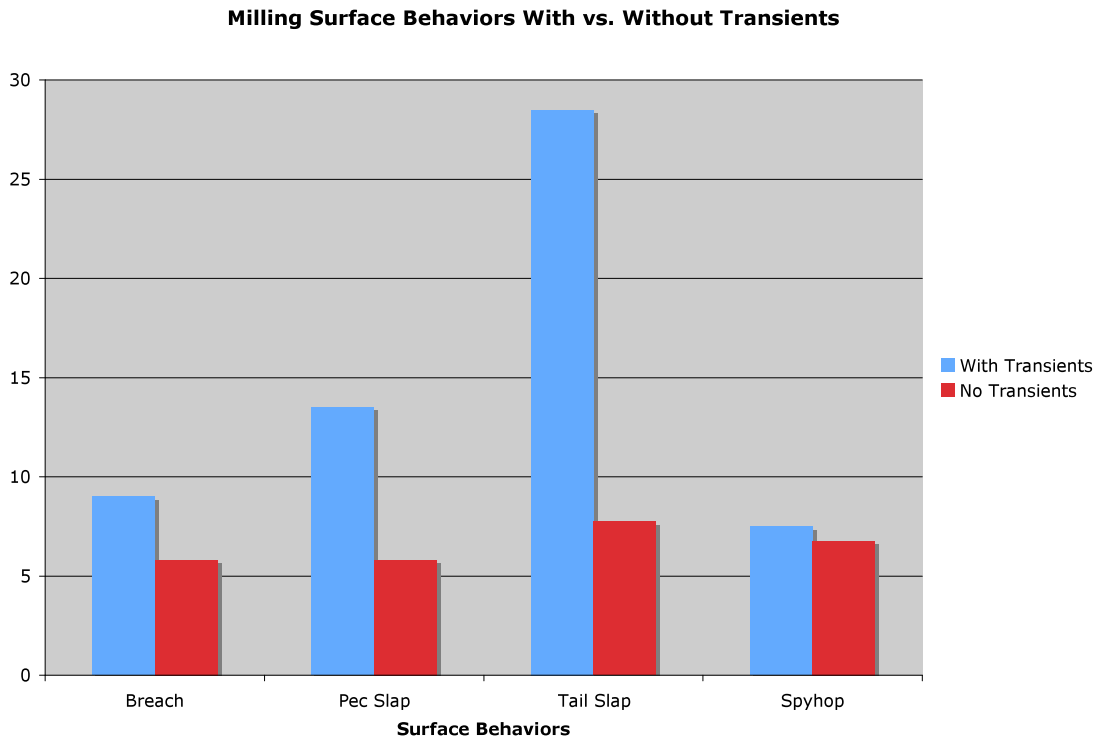


Figure 3. Mean frequency (number/hr) of four surface behaviors observed in SRKW with killer whale transients present versus no transients. Observations were made in August 2011 from the West Side Scenic Preserve on San Juan Island, Washington.

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