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Research Proposal: Surface behaviors in relation to specific phonations in southern resident killer whales

Understanding and classifying animals' behavioral responses is important for further comprehension of social systems within their species. Benefits to living in such complex social groupings include mutualistic foraging techniques, increased group care for infants, and protection from predators (Parsons et al., 2009). Different animal reactions will trigger depending on situation. In past research with various animals, it has been shown that through communication, animals behave in a type of structural sense. The Gunnison's prairie dog, honeybee, and several species of birds perform alarm calls. For example, they signal a warning to other individuals of impeding danger. Based on spontaneous situations, animals can change their vocalizations and call signals (Forrester, 2008). Having firm grip of categorization of behavior is extremely important, for a certain behavior can be defined in various ways. After definition, documenting behavior is extremely important as well, because it allows scientists to uncover the group-living benefit patterns of animals (in this paper, killer whales). With discoveries such as this, conservation is possible (Marsh, 2008).

In the past, a large amount of behavioral research was done, apart from acoustic research. Previous studies on the connection between killer whale surface behaviors with the sounds they emitted have shown some results, but they were never conclusive. Questions were left unanswered, including whether or not there would be specific behavioral responses to certain sounds that were emitted. In one study, done on two killer whales by the names of Corky and Orky at Marineland in Palos Verdes, CA, phonations were made monthly with several breaks

during performances. Results showed that when an F1 call was made in captivity, it was recognized as tranquility. But in the wild, F1 calls were frequently used during behaviors such as directional course change, spyhopping, or blowing in unison (Morton et. al, 1986). It is very difficult to determine if one particular sound coincided with a specific behavior. Comparing wild versus captive killer whales makes the study of behavior more challenging. Because captive killer whales have totally different environments as wild killer whales, will general behavior be different? Is there always a unique call that will be made in preparation of a spyhop or a breach? The main objective of this study is to continue to search for a correlation between particular surface behaviors and phonations created by the southern resident killer whales. My second objective of the study is to record, if any, influence that ambient noise made by boat vessels will affect the killer whale's behavior, in contrast to having no boat vessel noise.

The southern resident killer whales consist of three main pods: the J, K, and L pods. The southern resident killer whales are characterized by their specific diet of fish and social subgroups composed with several matrilineal lines (Marsh, 2008). The southern resident killer whale population consists of about 85 individuals, residing in the waters around British Colombia and Washington State. During the summer, the southern residents will frequently swim towards inshore waters. The killer whales are identified distinctively by their whitish-grey marking behind the dorsal fin, the saddle-patch. Identification of individuals allow for saved records of population change (Parsons et. al, 2009). Offspring stay in their own individual groups amongst the pod, with the parental ties enveloped in matrilineal lines (Holt, 2008).

To be able to answer my various questions and objectives towards the study, I will test the following hypothesis: Specific calls and phonations from the southern resident killer whale J pod will occur during a certain time interval of predefined surface behaviors. Phonations that are

made will more likely occur before or after the active surface behavior. A second hypothesis regarding interference from the noise of other boat vessels is that J pod's behavior will demonstrate irritation, with more frequent occurrences of spyhopping, tail slaps, and change of direction. Noise level of the killer whales' calls will increase in presence of the boats.

In order to conduct this study for behavior, classification of the surface behaviors is absolutely necessary. Before collecting any field data at all, a chart describing wild killer whale behavior will be formulated, referencing Table 1 of Noren's (2009) previous study on surface behavior based on vessel approach and Morton's behavior classifications from Table 13.1 of his 1986 study on behavior and sound correlations (Morton et. al, 1986). I plan to use a palm PDA, handwriting material with a pen, a pair of binoculars, and a camera to document surface behaviors. One hour watch increments with a few minutes of break will be conducted. For precision, time of the behavior occurrence, duration of the behavior, and the rough range from the boat to the whales will be recorded as well. To document the sound, the hydrophone will be trailing or dangling off the boat, at a certain recorded distance that meets the Be Whale Wise expectations. Distance will be measured using an electronic range finder, and generally whales within hydrophone vicinity will be observed. Headphones will remain used throughout the whole time of observation and data collection of behavior. During this time, recordings will be made immediately preceding the behavior performed for later reference and analysis. Group size of the killer whales will be initially recorded as well, because if there is boat traffic, group behaviors can vary based on group size in southern resident killer whales (Williams et. al, 2002).

From all these methods, I expect to come up with a notebook filled with a tally-marked chart listing all the earlier, specifically defined behaviors. By using a PDA, after each recording session, the data will be transferred via handwriting into a notebook. All camera and hydrophone

data will be saved and be viewed on my Windows XP Vostro 1500 laptop after the initial data collection process. What is most likely not going to come out of this experiment are categorized sounds for individual surface behaviors. Killer whales spend roughly 5% of their time per day performing surface behaviors (Nash, 2006). It is highly unlikely that I will obtain a huge amount of data taking into account the number of killer whales in J pod and the limited amount of sailing time.

Analysis of the data will be broken up into several steps as follows: all behavioral tallies will be counted and graphed in both a pie and bar graph. Relative sounds that were recorded alongside the documentation of the behaviors will be analyzed using MatLab in the Friday Harbor Lab computer room. Any sound collected with direct correlation to a surface behavior an orca performed will be more concentrated in during analysis. I shall end up with spectrograms for analysis of the frequency of calls versus the call duration. To analyze any data with the most ambient boat vessel noise, separate graphs will be made for comparison of recorded killer whale behavior without the ambient noise.

The results and analysis of this study will further deepen understanding and clear confusion regarding the social complexity of southern resident killer whales in terms of acoustics and surface behavior relations. Before, in one research study done by a previous Beam Reach student Juliette Nash, S10 calls were mainly heard when the southern resident killer whales were active in foraging behavior. Results showed no direct correlation between actual foraging and the S10 phonations to demonstrate the act of “foraging”. Other calls, such as S42, occurred too randomly to be categorized with a behavior (Nash, 2006). What I want from this experiment is to distinguish specific calls to certain behaviors. Humans use a variety of verbal and nonverbal methods of communication, but sometimes use visual communication signals alongside as well,

such as body language (Forrester, 2008). The southern resident killer whales display a wide variety of complex behaviors in their daily lives: foraging, traveling, resting, and socializing. Because we can only catch a glimpse of the killer whales' activities above water, technology such as hydrophones and underwater cameras are used to help interpret their behavior; the rest is up to our imagination (Ford et. al, 2000).

By completing this research study, it will be able to better close the information gap about killer whale behavior in better relation to sound. This study is important towards further conducted research as it will provide more recorded data of killer whale behavior along with the sounds made. Understanding behavior allows humans to understand implications necessary for conservation of species. By investigating acoustics in connection to behavior, others can better comprehend what the killer whales need in terms of conservation. Being a small community compared to transients and offshores, the southern resident killer whales have a tighter social structure. Thus, by utilizing these populations as study material to how they act around the shifting environment, the framework for future conservation can be possible (Parsons et. al, 2009).

Literature Cited

Ford, J. K. B., G. M. Ellis, and K. C. Balcomb. 2000. Killer whales: the natural history and genealogy of Orcinus orca in British Columbia and Washington State. 2nd edition. UBC Press, Vancouver, British Columbia.

Forrester, G.S. 2008. A multidimensional approach to investigations of behaviour: revealing structure in animal communication signals. Science Direct, Animal Behaviour, 2008, 76, 1749-1760.

Holt, M.M. 2008. Sound exposure and southern resident killer whales *(Orcinus orca):* A review of current knowledge and data gaps. NOAA Technical Memorandum NMFS-NWFSC-89. Washington.

Marsh, J.A. 2008. Social behavior and ecology of "southern resident" killer whales (*Orcinus orca*). Ecology.

Morton, A. B., J. C. Gale, R. C. Prince. 1986. Sound and behavior correlations in captive *Orcinus orca*. In: *Behavioral Biology of Killer Whales* (ed. By B.C. Kirkevold & J. S. Lockard), pp303-333. New York: A. R. Liss.

Nash, J. Behavioral and acoustic relationships: The significance of shared calls in the southern resident killer whales. Beam Reach, FHL. (as cited from **Osborne, R. W.** 1986. A behavioral budget of Puget Sound killer whales. In: *Behavioral Biology of Killer Whales* (ed. By B.C. Kirkevold & J. S. Lockard), pp211-249. New York: A. R. Liss.)

Noren, D.P., Johnson, A.H., Rehder, D., Larson, A. 2009. Close approaches by vessels elicit surface active behaviors by southern resident killer whales. Endangered Species Research. Vol. 8: 179–192

Parsons, K.M., K.C. Balcomb, J.K.B. Ford, and J.W. Durban. 2009. The social dynamics of southern resident killer whales and conservation implications for this endangered population. Animal Behaviour. 77:963-971.

William, R., Trites, A.W., Bain, D.E. 2002. Behavioural responses of killer whales (Orcinus orca) to whale-watching boats: opportunistic observations and experimental approaches. The Zoological Society of London. J. Zool., Lond. (2002) 256, 255-270.