Because light doesn’t travel very far in water but sound does it is theorized that marine animals must rely on sound to keep in communication with each other (Myberg 1980 in miller et al. 2004). Vocalizations are very important when studying marine mammal behavior because observing their behavior can be extremely difficult. As one of the only ways we are able to research free-ranging orca, decoding the information in sounds is very important to understanding their both their communication and behavior.

Ford (1987) first theorized that there were specific dialects among the different pods and later between matrilineal lines.

Morton (1986) concluded that when the frequency of calls were measured during different behavior states, there were correlations between behaviors and the certain of certain calls. She also suggests that there is a high degree of order in ‘sound sequencing’ and found that in many cases a sound that she dubbed ‘F1’ correlated to the start and stop of ‘conversations’.

Thomsen et al. (2002) discovered that whistle frequency and use was predominant during social behavtios among northern residents. He also

Thomson et al. (2001) and Reisch et al. (2005) found that orca whistles are much more complex thatn previously suspected and are most commonly occur during socializing behavior leading them ot theorize that it important to communication.

Miller (2004) found that when one whale called with a specific call a significant amount of the time another would respond with the same or very similar call. He also found that a significant amount of time the one or two most frequently used calls were produced in series.

Weiland found that there were patterns in calls, where a significant amont of the time one call was voiced and a certnian call then followed.69 she also showed that calls, though they were more repetitive than human language, were not random occurances of noise. 74

While Morton found these patterns in captive orca the question of the same behavior existing in wild orca still remains. A study of similar phenomenon occurring during other times, such as playing or foraging has also not been looked too carefully into. Based on the lack of this type of data my objective is to find patterns in sound sequencing as it occurs in different situations. To do this I will test the following \_ hypothesis.

Where do patterns exist in orca vocalizations over time?

I hypothesize that there will be distinguishable patterns over time in both frequency of certain calls and repetition of sequences during different behaviors. I also hypothesize that there will be patterns of certain vocalizations that occur before or after certain behavioral changes. (Morton)

Are there ‘signals’ at the beginning and end of behaviors and conversations? Are there other ‘signals’ that come at the beginning or end of group behavioral shifts?

Like human conversations

Greeting, new action instigated by suggestion and agreement of suggestion, leaving.

Due to scarcity of Off-shores sightings they are the least well studied. What is known is that they tend to be smaller than either transients or residents; they eat mostly fish and have the largest geographic range. As is true with all of the ecotypes, Off-shores do not intermingle with either of the other types.

Transients have the smallest group size, usually containing fewer than 10 individuals. They eat primarily marine mammals, have straighter dorsal fin tips, and a significant genetic difference means that they do not bread with whales from other types.

*Orcinus orca* are the largest whale in the *Delphinidae* family. They are classified into three distinct ecotypes in the northeastern Pacific Ocean: transients, offshore and residents. Each ecotype is distinct in their behavior, morphology, ecology, and vocalization repertoire. (NMFS 2008, Ford 1991)

Residents can be identified from others by their slightly more curved dorsal fin, occurrence in stable groups, fish focused diet and their unique vocalization repertoire. Residents have a very complex social structure consisting of four levels. The smallest are matrilineal groups, a female and her offspring for up to four generations. Next are pods, closely related matrilines who spend the majority of their time together. This grouping is the most common one (NMFS 2008, Ford 1991). After that come clans, one or more pods who share similar dialects and ancestry. The largest are communities, clans and pods that regularly associate with each other regardless of matrilineal relatedness. (NMFS 2008, Ford 1987, Ford 1991)

On the west cost of the US and Canada there are 4 different communities, southern residents, northern residents, southern Alaska residents and western Alaska residents (NMFS 2008, Ford 1991, 1987). The southern residents will be the focus of this study.

Orca have a complex social structure which allows for their advanced communication. There are three categories of calls: clicks, whistles, and pulsed calls (Ford 1991, 1987).

Clicks are very short bursts of sound that most often are produced in a series called a click train. These click trains are used mostly for navigation and foraging, but since they occur during social interaction it is thought that they may also have a communicative function. (Barrett-Lennard et al. 1996 in NMFS 2008)

Whistles are continual tonal calls with harmonics that last from a range of about .06-18.3 seconds. They have a high average dominant frequency of 8.3kHz and are most commonly used both during foraging and socializing among the southern residents. (NMFS 2008, Ford 1987)

Pulsed calls are signals that are made by a string of pulses so close together that it creates what sounds like a tone. They last from 50 milliseconds - 10 seconds long and have an average frequency ranging from 1-6kHz (Ford 1987, NMFS 2008). These calls are broken into three categories discrete, variable and aberrant.

Discrete calls are categorized by being highly structured and having repeated occurrences. It is thought that they’re function is to help maintain group identity and contact. Variable calls are categorized as random unrepeated discrete calls. Aberrant calls are as they sound, calls differ from other pulsed calls (Ford 1987, 1991).

Orca’s complex social structure is mirrored in the existence of dialects on three levels. Dialect differences exist between clans, pods and matrilines. Dialects are categorized as differences in vocal repertoires and acoustics (Ford 1991).

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