Can clicks tell us anything about the foraging behavior of the southern resident *Orcinus orca*?

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Abstract:
Foraging is of great importance in understanding the biology of killer whales. One of the three major threats to the southern resident killer whales (SRKW's) is limited prey availability. It is particularly hard to decipher when killer whales are engaged in foraging because this activity mainly takes place below the water's surface. It is believed that killer whales use pulsed calls and whistles to communicate, while echolocation clicks are thought to be associated more with foraging than communicating. The SRKW's are thought to be particularly vocal during foraging due to their preference in prey. To determine whether click rate (number of clicks per minute) may be a proxy for observing foraging behavior, acoustic data was collected from September thru October in 2011. A linear 4 hydrophone array was used to record clicks made by the SRKW's while observational data was collected. Behavior data and recordings from the 4 hydrophone array were synchronized in time. Click rate for foraging behavior was compared to click rate during other known behaviors. This data was then analyzed and compared to data collected from similar experiments using the same experimental set up.

Methods

Mobile Hydrophone Array

A linear array of 4 Labcore hydrophones were pulled behind a 42 foot catamaran, named the Gato Verde (Figure 1). These hydrophones were spaced 10 m apart. The speed of 2 knots was enforced to minimize noise produced by water flowing over the hydrophones. The hydrophone array was connected to sound devices solid state recorders which were used to make recordings (Figure 2).

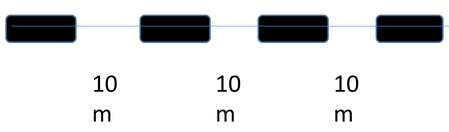


Figure 2 Figure 1

Behavior

Approximately 30 minutes of recordings corresponding to observed foraging behaviors, and 30 minutes of recordings corresponding to observed non-foraging behaviors (Figure 3) were analyzed for each day, and listened to in Audacity.

Figure 3 Shows photos of behaviors cataloged as foraging and non foraging

Foraging Behavior

Non-foraging Behavior

Click Rate

The click rate (# of clicks/ minute) was obtained by hand counting the total number of clicks in one minute sound files corresponding to both foraging and non-foraging behaviors using Audacity. The average number of clicks for each hour of a given day was then calculated. Clicks were only counted if they were twice the size of the background noise, if they were audible, and if they were t any echoes

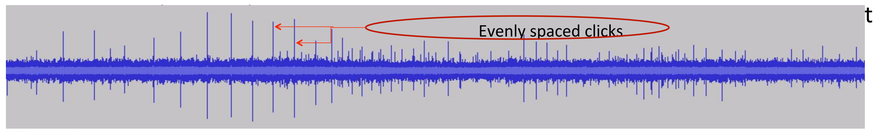


Figure 4

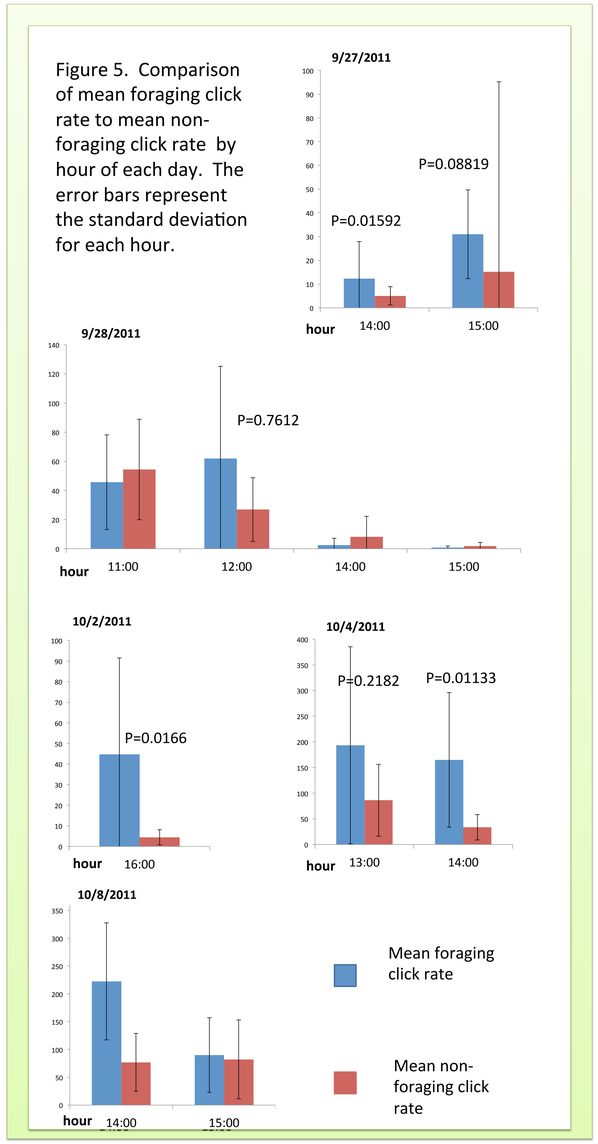


Figure 5. Comparison of mean foraging click rate to mean non-foraging click rate by hour of each day. The error bars represent the standard deviation for each hour.

Figure 6 Comparison of all non-foraging mean click rates (1) and all foraging mean click rates (2).

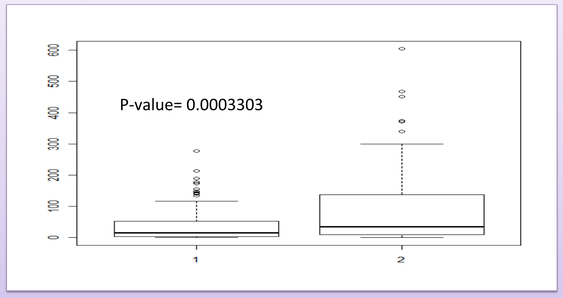
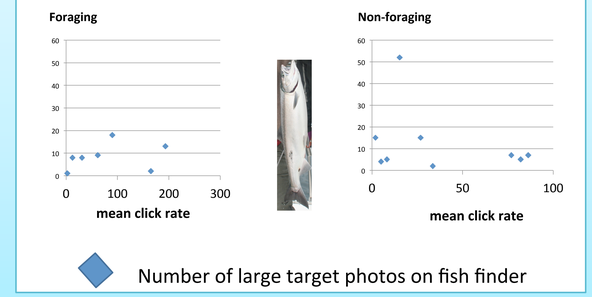


Figure 7
Compares the number of large targets seen on the fish finder to the mean click rates during foraging and non-foraging events. Fish finder data was provided by Charla Basran.



Results

The resulting P-values (Figures 5 and 6) were determined by running a Wilcox test in R. These P-values indicate statistical significance in difference in mean click rates during foraging and non-foraging behaviors (Figures 5 and 6), no direct correlation between mean click rates and behavioral states were observed. The mean click rates for foraging and non foraging behaviors were also compared to the number of large targets seen on a fish finder (Figure 7). There was very weak correlation in this data.

Conclusion

This data suggests that there is no difference in average click rate during observed foraging and non-foraging behaviors. It is possible that some behaviors were misinterpreted as foraging. It is difficult to determine foraging because it usually takes place under water where visibility is limited. Bathometry is another element that may impact distance and clarity of clicks. Further research examining click rate during foraging and non-foraging behavior is suggested. The small sample size of analyzed recordings may account for these results.

Acknowledgments

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Citations

2011, Audacity 1.3 beta unicode. http://audacity.sourceforge.net