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Beam Reach Spring 2012

Marine Science and Sustainability School

Preliminary Data Set

5/11/2012

The goal of this study is to determine if southern resident killer whale echolocation click rates change with variation of the number of ships and range of ships near the whales and what the potential masking effect is. I am specifically interested in how underwater noise pollution from shipping traffic impacts Southern Resident killer whale echolocation when their surface behaviors are indicative of foraging.

To provide insight into my curiosities I have come up with two data sets that I plan to analyze and use in a model of potential masking effects. I plan to collect recordings with a calibrated hydrophone at approximately 6 various waypoints in Haro Strait. These recordings will be used to determine an average noise budget for shipping traffic during the day in these locations. AIS screenshots will be taken with every calibrated hydrophone recording, including information for ships within a 26 nautical mile range. These shots, along with the recordings, will be used to determine the received level (RL) of various types of ships at various distances at the specified waypoints.

I will also be collecting acoustic recordings from a towed hydrophone array while the whales are present. These recordings will be analyzed with PAMguard to determine click rate per minute. AIS screen shots will be taken every 30 minutes while whales are present and recording is occurring. These shots will again provide ship information within a 26 nm range and be compared to the determined click rates.

Given the data I am collecting, I expect to have the following variables in my data analysis:

Calibrated Hydrophone Recordings and AIS Ship Data

* Received Level (RL)
  + determined from the calibrated hydrophone recordings
* Range of ships
  + during the recording that was used to determine RL
* Number of ships
  + during the recording that was used to determine RL
* Average, Minimum, and Maximum Range of ships for that RL
* Average, Minimum, and Maximum number of ships for that RL
* Waypoint will also be another variable that I plan to plot against RL, number of ships, and range of ships.
  + This will help determine if specific waypoints experience more underwater noise pollution from shipping traffic than other locations.

Hydrophone Array Recordings and AIS Ship Data

* Click rate per minute
  + Calculated using PAMguard click detector
* # Of ships during recording
* Range of Ships during Recording

Inferred Data:

I will use the calculated RL and distances from the calibrated hydrophone recordings to infer what the RL would be during the hydrophone array recordings by examining the number of ships and range of ships in the area. All of this data will be collectively used to model the potential masking effect that killer whales experience when echolocating off of salmon in the presence of shipping traffic.

Preliminary Data Product:

All of these data sets are slightly smaller than expected because some data collected was unusable due to either error during the collection or analysis processes. It is expected that both of these data sets will increase two fold and there for the correlations demonstrated in this preliminary stage of analysis will be stronger after data collection is complete. These graphs are also fairly simple, however I plan to attempt to add the waypoint data and type of ship into the graphs as well (once I learn how).

The process of analyzing this data included organizing all data into a “raw data” sheet. Using the calibrated hydrophone recordings and Audacity I calculated the RL for each recording made (given the data was usable). The ship data was retrieved from AIS screen shots and analyzed by # of ships present for each recording, the average distance of these ships, the maximum and minimum distance of these ships as well.

This graph plots the number of ships in a 26 nm radius vs. the calculated received level (RL) in dB. From the shape of the line we can see that the number of ships doesn’t seem to be the determining factor in RL. However, this is a small data set and I expect to see a more significant correlation between RL and #of ships as I collect more data. I do believe that the range of ships will have a stronger correlation with RL than the # of ships.

This graph plots the average ship range during my calibrated hydrophone recordings (retrieved from the AIS screen shots) against the calculated received level. Although this data set is small, I expect to see this trend of the received level increasing as the average range decreases. This trend demonstrates that the received level grows later with closer ship proximity.

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