

# Utilizing passive acoustic monitoring to study baleen whale diversity, distribution, and seasonality off the coast of Chile



Megan Wood<sup>1</sup>

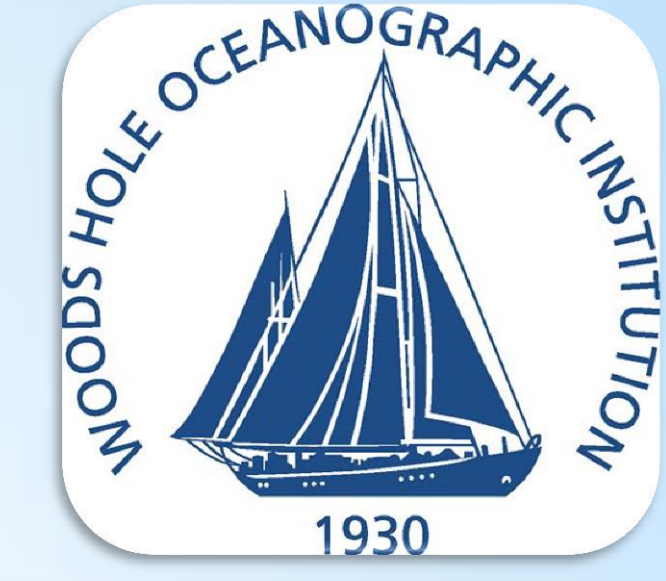
Rafaela Landea Briones<sup>2</sup>

Alexandra Carroll<sup>1</sup>

Laela Sayigh<sup>1</sup>

<sup>1</sup>Biology Department, Woods Hole Oceanographic Institution, Woods Hole MA 02543

<sup>2</sup>Centro MERI, 15.312.010-2 Av. Kennedy 5454, Vitacura, Santiago, Chile



## Results & Discussion

Mean sound production rates per hour across sites and months suggest that:

1. Southeastern Pacific blue whales
  - a. migrate into the area in summer, peak in fall, and begin to leave the area in winter;
  - b. may be migrating to the Eastern Tropical Pacific during the winter, since similar sounds were found there<sup>2</sup>;
  - c. are more prevalent offshore than in coastal locations, since sound rates were 10x greater offshore.
2. (Possible) Sei whales
  - a. are more prevalent in the summer, as evidenced by summer sound rates 69% higher than average;
  - b. are more prevalent offshore than in coastal locations, since sound rates were 3x greater offshore.
3. (Possible) Minke whales
  - a. are most prevalent offshore Chiloe in the summer, as this is where 72% of their calls occur in the summer;
  - b. are most prevalent inshore at Melimoyu in the fall, as this is where 76% of their calls occur in the fall;
  - c. leave the area in winter, as call rate drops by 50% in the winter.
4. Humpback whales
  - a. are most prevalent in Guafo North during the fall season, which is when and where 68% of their sounds occur.
5. Unidentified animals
  - a. Include Antarctic blue whales in Chiloe during the summer, and may include calls produced by fin whales, as well as a variety of other species;
  - b. Are 15x more common in offshore waters.

➤ **However, in all cases fewer calls may be due to lower call rates rather than absence of a particular species; visual groundtruthing is needed!**

## Future Work:

- Parameters from the possible sei and minke whale calls, as well as from any repeated and distinctive unidentified calls, will be measured and compared to values in the published literature for various species
- Visual data will be obtained to confirm species identifications of calls, and to establish whether seasonal and geographic variation is due to lack of animals or lower call rates
- Acoustic monitoring will continue to increase sample sizes from different locations and times of year
- Possible effects of noise from ship traffic on communication in blue whales will be evaluated (see poster by Colpaert et al.)

## Acknowledgments

This work was supported by the Melimoyu Ecosystem Research Institute. Thanks to our colleagues at the Woods Hole Oceanographic Institution for their input and support.

## Introduction

The Chiloe-Corcovado area is a unique coastal habitat that boasts an abundant and diverse assortment of marine life<sup>2,4</sup>. Survey efforts in the area have found numerous marine mammal species, including Cuvier's beaked whales, several species of dolphin, orcas, minke, humpback, and blue whales<sup>8</sup>. The Chilean or Southeast Pacific population of blue whales is acoustically and morphologically distinct from the Antarctic and pygmy blue whale populations<sup>1,2,5,6,7</sup>. They produce low-frequency, high-intensity calls that are composed of three parts and are sometimes punctuated with a higher-frequency pulse (Figure 1)<sup>1,2,3</sup>. There are two established variants of this call (SEP 1 & 2) and their communicative function remains undetermined. We documented the occurrence of both of these call variants on passive acoustic monitors that were moored at several locations from January 2012 to April 2013 (Fig 2). We also logged occurrences of calls of several other baleen whale species, including humpback, and possibly sei and minke whales (Figure 1). These data provide insights into potential seasonal and movement patterns of baleen whales in the Chiloe-Corcovado region.



## Methods

Six Marine Autonomous Recording Units (MARUs, Cornell University) were deployed within the Chiloe-Corcovado area, recording sounds continuously at a 2000 Hz sample rate for six-month periods between January 2012 to April 2013. The recordings were subsampled, resulting in the analysis of every sixth hour, for a total of 3,586 hours. Sound types were categorized visually using RavenPro software, resulting in 102,360 sound selections. Calls from four possible mysticete species were identified, and the rest were put into a broad 'unidentified' category. Seasonal trends were determined for each group by dividing the year into the four seasons. Geographic variation was analyzed by observing relative sound rates at the four locations.

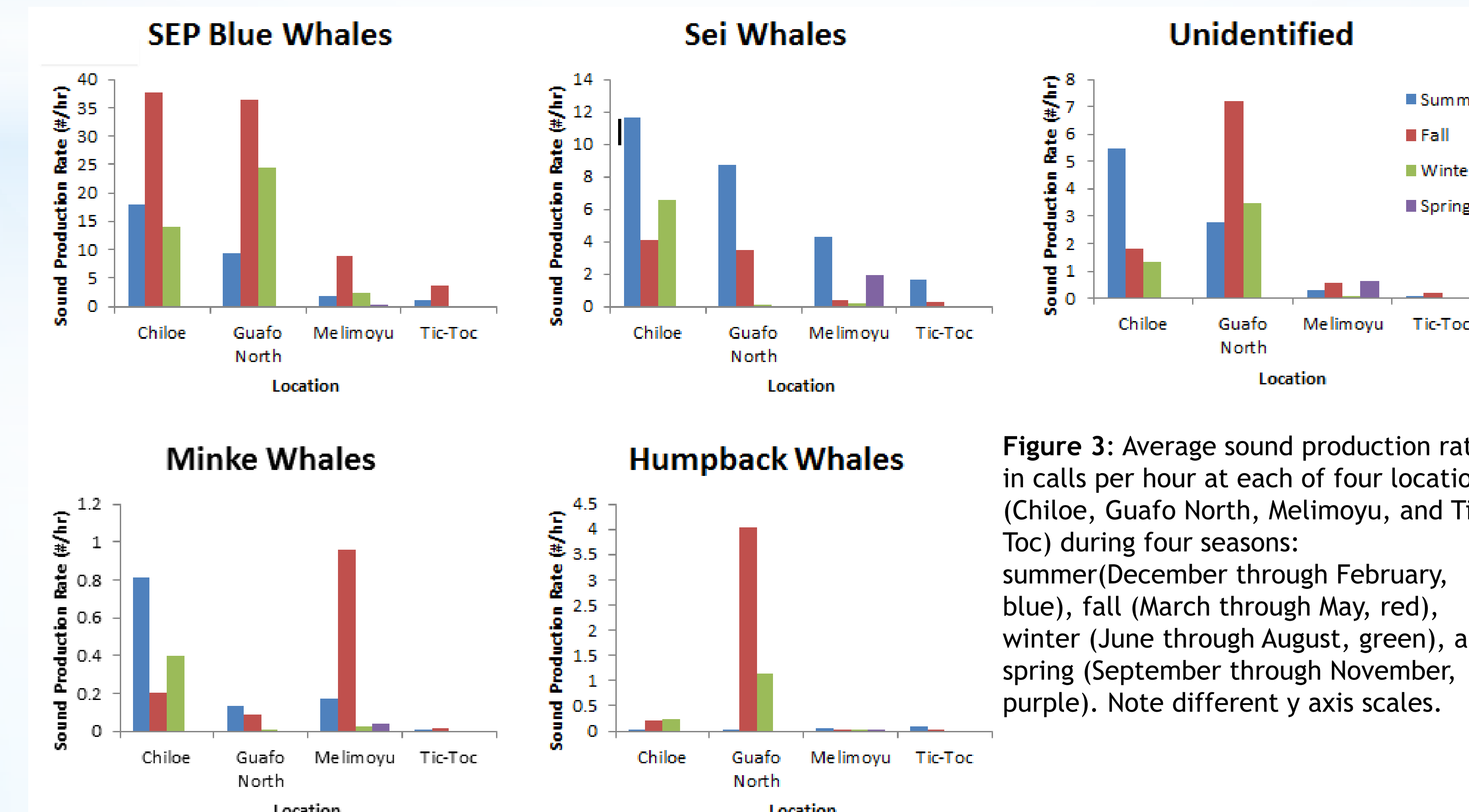


Figure 1 : Spectrograms of identified sounds. X-axes are all 1 minute in length. Y axes are as follows: blue whales (SEP1 & SEP2) - 400 Hz; possible minke and sei - 200 Hz; humpback - 650 Hz. Note that there are blue whale calls in the background of the sei whale spectrogram.

## References

1. Buchan, S.J., Rendell, L.E., Huccke-Gaete, R. 2010. Preliminary recordings of blue whale (*Balaenoptera musculus*) vocalizations in the Gulf of Corcovado, northern Patagonia, Chile. *Marine Mammal Science* 26(2):451-459.
2. Buchan, S.J., Huccke-Gaete, R., Rendell, L., Stafford, K.M. 2012. A new song recorded in the Corcovado Gulf, southern Chile, and an acoustic link to the Eastern Tropical Pacific. *Endangered Species Research* 23: 241-252.
3. Cummings, W.C., Thompson, P.O. 1971. Underwater sounds from the blue whale, *Balaenoptera musculus*. *The Journal of the Acoustical Society of America* 16: 1193-1198.
4. Huccke-Gaete, R., Buchan, S. 2012. Passive acoustic monitoring of blue whales throughout the Chiloe ecoregion, Chile. A progress report to the Melimoyu Ecosystem Research Institute: 1-15.
5. McDonald, M.A., Mesnick, S.L., Hildebrand, J.A. 2006. Biogeographic characterization of the blue whale song worldwide: Using song to identify populations. *Journal of Cetacean Management and Research* 8: 55-65.
6. Stafford, K.M., Bohnenstiehl, D.R., Tolstoy, M., Chapp, E., Mellinger, D.K., Moore, S.E. 2004. Antarctic-type blue whale calls recorded at low latitudes in the Indian and eastern Pacific Oceans. *Deep-Sea Research I* 51: 1337-1346.
7. Viddi, F.A., Huccke-Gaete, R., Torres-Florez, J.P., Ribeiro, S. 2010. Spatial and seasonal variability in cetacean distribution in the fjords of northern Patagonia, Chile. *Journal of Marine Science* 67: 959-970.