Introduction

The Chiloé-Corcovado area is a unique coastal habitat that boasts an abundant and diverse assortment of marine life. We used passive acoustic monitoring (PAM) to study the seasonal patterns of occurrence of vocalizations of several baleen whale species in this area. Our primary focus was the Chilean or Southeast Pacific (SEP) population of blue whales, which is acoustically and morphologically distinct from Antarctic and pygmy blue whale populations. SEP blue whales produce low-frequency, high-intensity calls that are composed of 3–4 parts and are sometimes punctuated with higher-frequency components (Fig 1a and b). There are two established variants of this call (SEP 1 and 2; Fig 1a and b), and we also found two new variants consisting of two (SEP 3; Fig 1c) or one (SEP 4; Fig 1d) low-frequency pulsed sound(s). In addition, we found a down sweep call that we believe is also produced by SEP blue whales, based on recent recordings made with DTAGs in this area (Fig 1e). Further, we logged occurrences of calls of Antarctic blue whales, humpback and possibly minke whales (Fig 1e, f, g), as well as several unidentified species. These data provide insights into potential seasonal and movement patterns of baleen whales in the Chiloé-Corcovado region.

Figure 1: Spectrograms of identified baleen whale sounds. X-axes are one minute in length. Y-axes are presented as follows: a) SEP 1 - 650 Hz, note high-frequency component (circled in red) and low frequency component (boxed in red); b) SEP 2 - 650 Hz, note high frequency component (circled in red); c) SEP 3 - 100 Hz; d) SEP 4 - 100 Hz; e) Antarctic blue whale call (boxed); f) humpback whale call (boxed); g) minke whale call (boxed).

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.

Methods

Six Marine Autonomous Recording Units (MARUs, Cornell University) were deployed at four sites within the Chiloé-Corcovado area, recording sounds continuously at a 2000 Hz sample rate for six-month periods between January 2012 to April 2013 (Fig 2). 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 three likely 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 four seasons. Spatial variation was analyzed by comparing call rates at the four locations (Figs 3 and 4). Blue whale sounds were further examined by comparing the mean sound production rate of four major SEP call types and Antarctic ‘z’ calls in different seasons at the Chiloé site (Fig 5).

Figure 2: Map of acoustic recorder locations within the Chiloé-Corcovado region (from Buchan et al. 2014).

Results & Discussion

Southeastern Pacific (SEP) blue whale sounds dominated at all sites and in all seasons with over 17 calls per hour on average (note different y axes in Figs 3 and 4). SEP call production rates suggest that these whales probably migrate into the area during the summer, peak in abundance in the fall (call rate 1.4x the mean), begin to leave in the winter, and are rare in the spring (only 0.14x the mean, although recordings were only made at Melimoyu in the spring). SEP whales appear to be more prevalent offshore, where call rates were 1.75x the mean. Of the four SEP call types, SEP2 and SEP3 were most frequent, occurring 2.4x and 2.3x more often than overall mean call rate, respectively.

Antarctic blue whale calls tended to occur most often in summer (call rate = 1.79 calls/hour) compared to fall (rate = 0.18 calls/hour) and winter (0.02 calls/hour). Since Antarctic blue whale sounds tend to feed in the summer in Antarctica, this is likely a product of whales passing through the area.

Humpback whale calls were much less abundant than blue whale calls, and although they occurred in all four seasons in Melimoyu, in 2-3 seasons at the other sites, most calls occurred at Guano North in fall, where call rate was 8x the mean. This trend may reflect southern hemisphere humpback whales beginning to migrate north to winter breeding grounds in the fall.

Calls tentatively attributed to minke whales also occurred in all four seasons in Melimoyu, and in 2-3 seasons at the other sites. In the summer, the majority of calls occurred offshore at Chiloé (3x summer average), whereas in the fall the majority occurred in coastal Melimoyu waters (3x fall average). Overall, winter call rates were 0.4x lower than the species average.

Unidentified animals called 2x more often in offshore waters than average and most calls occurred in the fall (1.7x the mean call rate).

It is important to note that all of these trends may be due to more or fewer animals being present and/or to more or less calling behavior in a given area or time of year. Visual groundtruthing is needed to tease apart these possibilities.

References