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Animal Bioacoustics

Session 4pAB: Animal Vocal Modification in Noise

4pAB6. Variation in the vocal behavior of southern right whales (*Eubalaena australis*) in coastal Brazilian waters

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Currently there are three recognized species of right whales. The largest population is the southern right whale (*Eubalaena australis*), with circumpolar distribution in the southern hemisphere. One calving area for this population is in Brazilian waters, where increasing numbers of right whales have been sighted over the past decade along with an increase in anthropogenic activities including shipping traffic and fishing. The goals of this study were to describe the vocal behavior of southern right whales in Brazilian waters, assess the difference in vocalizations between areas with low and high human activity, and compare these results to studies conducted with North Atlantic right whales (*Eubalaena glacialis*) in the Western North Atlantic. Bottom-mounted archival acoustic recorders were deployed in October and November 2011 in two coastal locations in central Santa Catarina State, southern Brazil. One recorder was placed off Gamboa (27°56'S and 48°39'W, low traffic) and a second off Ribanceira (28°11'S and 48°37'W, high traffic). Automated detectors and noise statistic analysis tools developed for North Atlantic right whale upcalls were utilized to analyze the dataset. Calls produced by Brazilian whales were significantly lower in fundamental frequency than North Atlantic right whale calls and the implications for these results will be discussed.

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INTRODUCTION

Currently there are three recognized species of right whales, the North Atlantic right whale (*Eubalaena glacialis*), the North Pacific right whale (*Eubalaena japonica*), and the Southern right whale (*Eubalaena australis*). Both northern hemisphere species are highly endangered with population estimates at 509 (*E. glacialis*) and 35 (*E. japonica*) (Pettis, 2012; Wade et al., 2011). The southern right whale has a significantly larger population, with a total estimated population in 2009 of 12,000 individuals (IWC, 2012). This population has a circumpolar distribution in the southern hemisphere with primary calving grounds located in Argentina, Brazil, South Africa, Australia and New Zealand (IWC, 2012).

One calving area for this population is in Brazilian waters, where increasing numbers of right whales have been sighted over the past decade along with an increase in anthropogenic activities such as shipping and fishing (Groch et al., 2005). The goals of this study were to describe the vocal behavior of southern right whales in shallow coastal Brazilian waters, assess the difference in background noise between areas with relatively low and high human activity, and compare these results to studies conducted with North Atlantic right whales in the Western North Atlantic (Parks et al., 2009).

METHODS

Bottom-mounted archival acoustic recorders, DSG-ocean (Loggerhead Instruments), were deployed in October and November 2011 in two coastal locations in central Santa Catarina State, southern Brazil. One recorder was placed off Gamboa Beach (27°56'S and 48°39'W, low human activity) and a second off Ribanceira Beach (28°11'S and 48°37'W, high human activity) (Fig. 1). The Ribanceira deployment location was approximately 3km from a commercial port with additional small boat and fishing traffic. The Gamboa location had lower levels of human activity with only small scale fishery and boat traffic, including small whale watching boats. Automated detectors and noise statistic analysis tools developed for North Atlantic right whale upcalls (described in Parks et al., 2009; Urazghildiiev and Clark, 2006; Urazghildiiev et al., 2009) were utilized to analyze the dataset.



FIGURE 1. Deployment locations (red balloons) for the acoustic data recorders used to investigate vocal behavior of southern right whales and assess the background noise in shallow coastal Brazilian waters.

RESULTS

The acoustic recorders were deployed for 14 days off Gamboa and for 22 days off Ribanceira. A comparison of the background noise levels between the two locations and with North Atlantic right whale habitat areas is presented in Fig 2. Recordings from coastal Georgia are comparable in terms of water depth to the Brazilian recording sites, though vessel traffic at all North Atlantic sites was relatively high.

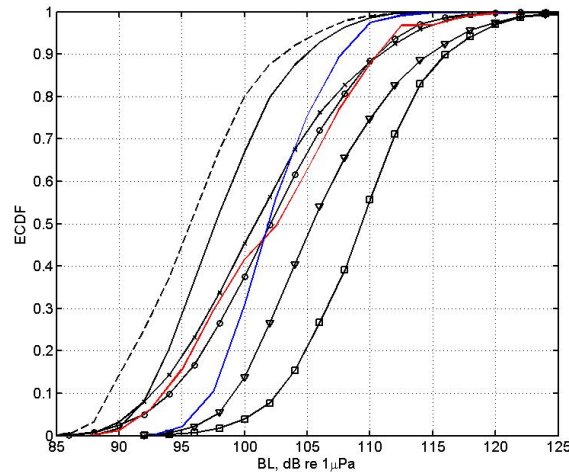


FIGURE 2. Empirical cumulative density function (ECDF) of the rms band level ambient noise (50–350Hz) from acoustic recordings from Brazil compared to previously published ECDF from the North Atlantic (Parks et al. 2009). The three North Atlantic sites are coastal Georgia (no symbol solid, no symbol dashed), Cape Cod Bay, Massachusetts (circle and x), and the Bay of Fundy, Canada (triangle and square). The two South Atlantic sites are off Gamboa beach, Brazil (red, low human activity) and off Ribanceira beach, Brazil (blue, high human activity).

Right whales were regularly sighted in both Brazilian locations. Over 10,000 right whale calls were automatically detected between the two locations. For this analysis we focused on a particular call type, the right whale upcall (Clark, 1982) with a signal to noise ratio > 10dB. This resulted in 1024 upcalls from Ribanceira and 1061 upcalls from Gamboa. The distributions of the minimum frequency of the upcalls at the two locations are shown in Fig 3. The mean minimum frequency from Gamboa was 68.2 ± 18.6 Hz and from Ribanceira was 70.1 ± 24.8 Hz. Note the bimodal distribution of call frequencies recorded in Ribanceira.

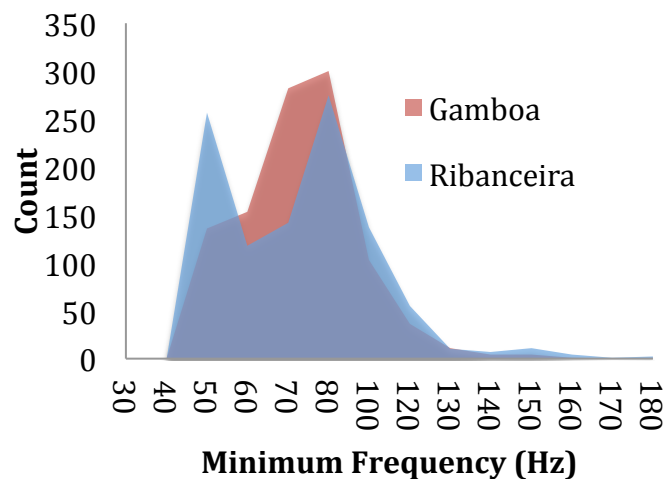


FIGURE 3. A histogram showing the distribution of minimum frequency from upcalls recorded off Gamboa beach, Brazil (red) and off Ribanceira beach, Brazil (blue).

DISCUSSION

The noise levels measured in the two Brazilian locations showed different ranges and different slopes in the ECDF when compared to sites in the North Atlantic. Identified background noise sources included small vessels and a significant biotic source of sound from chorusing fish. The minimum frequency of right whale upcalls recorded in Brazil was notably lower than minimum frequency recorded from the North Atlantic right whales in the Cape Cod Bay habitat in 2005 of 103 ± 18 (N= 2604) (Parks et al. 2009) and lower, but similar, to the frequency range of Southern right whales reported for Argentina in 2000 (78 ± 15) (Parks et al., 2007). The implications of these findings will be discussed.

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