

Calling Behavior of Blue Whales in the Southern California Bight

Erin Oleson^{1*}, John Calambokidis², William Burgess³, Mark McDonald⁴, Sean Wiggins¹, and John Hildebrand¹

¹ *Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA 92093-0205*

² *Casadia Research Collective, 218 1/2 West 4th Avenue, Olympia, WA 98501*

³ *Greeneridge Sciences, Inc. 4512 Via Huerto, Santa Barbara, CA 93110*

⁴ *www.whaleacoustics.com, 11430 Rist Canyon Road, Bellvue, CO 80512*

Northeast Pacific blue whales (*Balaenoptera musculus*) produce calls that are low frequency (17Hz) long duration (20 sec.), and high intensity. The majority of blue whale calls can be described as a pulsed (A) and tonal (B) call pair, whose character has remained consistent over the past 40 years. We have been conducting concurrent visual and acoustic observations of blue whales in the Southern California Bight to better understand the behavioral context of the calls. Thus far, we have found four calling blue whales with known genders to be male. If only males produce this call type this would suggest that this call type functions in finding, attracting, or guarding mates or territories. In addition, there are two modes of type A-B calling, repeated, long duration sequences (song) or irregularly occurring A and/or B calls. The number of song calls increases throughout the season, while irregular call rates remain fairly constant, suggesting that song production is intensified as the mating season approaches. Irregular B calls have a lower source level than do song calls, and are produced at 12 to 23m depth, in asynchronous surfacing patterns from other animals in the pair or group.

THE GENDER OF CALLING BLUE WHALES

Acoustically active blue whales were detected and located using DiFAR (Directional Fixing and Ranging) sonobuoys and then pursued for photo-identification and biopsy to determine their gender. In addition, tags were deployed on blue whales that had not been monitored acoustically prior to tag deployment. Each tag deployment provided skin samples for determination of gender. Through these efforts we have identified four calling blue whales to be male. Three lone, singing whales were male. In three cases where loud calls were recorded on acoustic tags, the tagged animal was male; however in only one case can we assign call production unambiguously to the male. No female blue whales have been observed producing A-B calls. That A-B calls may be produced by males only indicates this call type is likely related to breeding rather than navigating or prey locating. Breeding displays can take the form of mate attraction, stimulation, or guarding, as well as territory defense, or as an indicator of fitness. In southern California we can narrow the possible functions of the display because; 1. blue whales do not appear to maintain territories and 2. if the song were to stimulate or guard mates, it seems unlikely this would be taking place several months before the breeding season.

PATTERNS OF BLUE WHALE CALLING: SONG VERSUS IRREGULAR CALL INTERVALS

Previous studies of blue whale calling (1,2), along with our own observations from seafloor acoustic recording packages (ARPs) and sonobuoys have indicated that blue whale type A and B calls occur in extended sequences with consistent intercall intervals, also termed song. Our observations of singing blue whales indicate that these animals are solitary and are generally traveling at a consistent speed and direction for many hours. With the application of acoustic recording tags, we have discovered that blue whales also produce A and B calls in irregular patterns. Three blue whales, members of either pairs or a trio of whales, were all recorded producing an irregular sequence of A and B calls. The calls occurred at unpredictable intervals and did not always occur in an A-B sequence. Data from one tag deployment, where call and gender assignment are certain, show that the tagged whale was calling at depth while the lead animal was at the surface, suggesting that the calls were not intended for communication between paired animals and that irregular A-B calling must have a function different from song. All three identified irregular callers were paired or in a group, were fairly stationary over time, and made non-calling dives which included lunges, presumably for feeding.

Using the long term acoustic records from ARPs, the number of blue whale calls recorded per hour of the day can be compared throughout the season. Blue whale calling first appears on ARP records in late May, peaks in September, and is gone by early January. Throughout the season there is more calling on average at dawn and dusk than during daylight or the middle of the night; however, most of the diurnal pattern can be attributed to song calls rather than irregular calls. In addition, the proportion of song calls increases relative to the number of irregular calls as the season progresses. The diurnal patterns and fluctuations in the proportion of song calls to irregular calls throughout season may help determine the function of each of these call types. The three irregular callers that we have tracked have been observed in stationary pairs or groups, while all seven observed singers have been seen traveling alone. These patterns might indicate that song is used to attract mates; while the function of irregular calling remains unknown. Large changes in the number of whales producing irregular calls would not be as easily detectable as changes in the number of animals producing songs because of the unpredictable intercall interval.

CALL SOURCE LEVELS OF BLUE WHALES

Reported average source levels for blue whales are approximately 178 dB re μ Pa at 1m between 10 and 110 Hz for the type A call and 186 dB re μ Pa at 1m over 10-110Hz band for the type B call (2). These source levels are from blue whales producing regular call sequences, and while we do not have data on the underwater behavior of these animals, we have observed very regular surfacing behavior with little change in speed, direction, and surfacing rate. Our deployment of acoustic recording tags on blue whales has allowed us to discover that this is not the only mode of A-B calling for these whales. The source level of irregular calls is lower than that reported for A and B calls occurring as patterned sequences. Data from two individuals indicates that all A (N = 26) and B (N = 16) calls recorded on acoustic tags occurred at depths between 12 and 23m, with a mean depth change during the call of 1m upward for A calls, and 1.5m downward for B calls. The average source level of the irregularly produced A calls is 159 dB re μ Pa at 1m in 10-110 Hz band and 163 dB re μ Pa at 1m in 10-110Hz band for B calls. The received level at the tag is assumed to approximate the source level for these calls. The source location within the whale is unknown, as is the propagation path.

Type A and B call source levels are correlated while there is only a weak relationship between source level and max dive depth. There are no significant relationships between call amplitude and concurrent dive duration, surface interval, or number of breaths. Dives in which lunge feeding occurred did not typically include calls, and tended to have greater max dive depths and durations.

CONCLUSIONS

Our observations show four male blue whales producing type A-B calls, while no females have been found to produce this call type, suggesting that these signals may function in finding, attracting, or guarding mates or territories. Two independent modes of type A-B calling may indicate that the call type serves two or more different roles. The number of song calls increases throughout the season while irregular call rates remain fairly constant, suggesting that song production is intensified as the mating season approaches. Irregularly produced calls are heard from pairs of groups of animals engaging in milling or feeding behaviors, indicating that these calls may function to keep groups in contact or to guard mates or territories. Irregular B calls have a lower source level than do song calls, suggesting they are not intended for long distance communication.

REFERENCES

1. Stafford, K.M., Nieuwkirk, S.L., and Fox, C.G. (1999). "An Acoustic Link Between Blue Whales in the Eastern Tropical Pacific and the Northeast Pacific," *Marine Mammal Science* **15**, 1258-1268.
2. McDonald, M.A., Calambokidis, J., Teranishi, A.M., and Hildebrand, J.A. (2001). "The Acoustic Calls of Blue Whales off California with Gender Data," *Journal of the Acoustical Society of America* **109**, 1728-1735.