Vocalization behaviors of Minke Whales and potential new call type off the coast of Jacksonville, FL.

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Autonomous recorders are effective tools for investigating the distribution, occurrence, and acoustic behaviors of a variety of marine mammals especially in remote and deepwater locations. Nine Marine Autonomous Recording Units (MARU's) were deployed in a rectangular array at 9 sites approximately 60-150 kilometers offshore Jacksonville, FL in a location that coincides with the United States (U.S.) Navy's planned Undersea Warfare Training Range (USWTR). All 9 units were deployed during fall (13 September to 8 October) and again in winter (3 December to 8 January) 2009-2010 for a total of 63 days. The timing of the MARU deployment was intended to allow recordings of marine mammal vocal behaviors and sonar activity to be made before, during, and after the U.S. Navy training exercises. The goal of this study was to analyze the passive acoustic data recorded from MARU's in order to characterize marine mammal vocal activity in relation to U.S. Navy activities (with an emphasis on extended sonar events). Data were reviewed in detail using the MATLAB program Triton (Wiggins 2007). Event logs were created for each day at every site. Custom-written MATLAB scripts, based on the methods in Melcón et al. (2012), were used to calculate the probability of marine mammal vocalization events occurring in the presence and in the absence of sonar. Results indicated that minke whale vocalization events were completely absent in the fall deployment period, however, they occurred almost continuously during winter deployment period, indicating a strong seasonal occurrence pattern for this species in the study area. Speed-up' and 'slow-down' pulse trains were the predominant vocalizations detected. Also detected was a new call type, which we attributed to minke whales and that, to our knowledge, has not been described before. Results of the probability analysis indicated a strong negative correlation to sonar. Minke whale vocalization events were greatly reduced or completely ceased during most days with concurrent sonar events in an approximate 3 day period. Using these data, it was not possible to determine whether animals stopped vocalizing or moved away from the area (or some combination of these possibilities). To our knowledge, changes in acoustic behaviors of minke whales in relation to sonar have not been reported before. Additional research is needed to determine the effects and relationship of sonar on these whales.

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Seeing the species through the trees: using random forest analysis to classify delphinid whistles

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Whistles produced by delphinids are highly variable, making acoustic identification of these species challenging. It is possible that not all whistles contain species-specific information and that only some should be used for species identification. Random forest analysis was used to classify whistles (n=1,863) of eight species recorded in the tropical Pacific Ocean (*Delphinus delphis, Globicephala macrorhynchus, Pseudorca crassidens, Stenella attenuata, S. coeruleoalba, S. longirostris, Steno bredanensis, Tursiops truncatus*). In random forest analysis, a number of classification trees are created based on measured variables and whistles are classified as the species that the greatest number of trees "votes" for. In this analysis, the number of trees that voted for the predicted species was used as a measure of the classification strength. A whistle was considered strongly classified (or 'strong') if the predicted species received at least 35% of the votes, even if the prediction was incorrect. The percent of whistles that were strongly classified ranged from 56% (*Steno bredanensis*) to 90% (*G. macrorhynchus*). Overall, 47% of strong whistles were correctly classified, in contrast to a 33% correct classification score for weak whistles alone. Correct classification scores for strong whistles ranged from 18% (*S. longirostris*) to 71% (*P. crassidens*). An examination of strong and weak whistles showed that different variables are important for the classification of different species. For example, whistles strongly classified as *P. crassidens* were lower in frequency than whistles weakly classified as that species, while whistles strongly classified as *Stenella attenuata* were more upswept and had significantly fewer inflection points than whistles weakly classified as *S. attenuata*. Results suggest that some whistles may contain more species-specific information than others. The distinctiveness of these whistles and the frequency with which they are produced varies among species. The use of random forest votes as a measure of the strength of classification has been incorporated into ROCCA (Real-time Odontocete Call Classification Algorithm), a Java-based software package for the acoustic identification of tonal sounds that is available as a module in PAMGuard, an open source signal processing software suite. While ROCCA was developed using whistles recorded in the tropical Pacific Ocean, work is currently underway to create a classifier for delphinid species in the California Current.

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