Behavior, Group Characteristics, Density and Habitat-use Patterns of Marine Mammals off Southern California during 2008-2012 Aerial Surveys

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Marine mammal seasonal density, abundance, behavior and habitat-use patterns were monitored off southern California 2008-2012 during 15 aerial surveys for the U.S. Navy. Line-transect, scan sampling, and focal follows occurred using video/photography. During 65,238 km of effort (99% Beaufort ≤4), ~190,310 individuals were seen in 2,151 groups (19+ species). Behavior differed significantly by species, depth, slope, aspect, survey sub-region (east or west of San Clemente Island (SCI)), time of year/day, and calf presence. Group size and maximum nearest-neighbor distance (in body lengths) generally increased with body size. Group size was significantly larger with calf presence for Risso's, common, and bottlenose dolphins. Group size increased significantly across the year among Risso's but decreased for common dolphins. Risso's were 13x more likely to rest and significantly less likely to fast travel/be surface active than commons. Resource Selection Function analyses showed that fin whales were significantly more likely to be found west vs. east of SCI, and medium-fast travel predominated over basins vs. rest/mill/slow travel over steep slopes. Density was highest for short-beaked common dolphins followed by long-beaked commons, California sea lions, Risso's, gray whales, bottlenose dolphins, fin, humpback and blue whales and Pacific white-sided dolphins. Calves occurred in 5% of 331 mysticete sightings.

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The use of passive acoustic data to predict beaked whale habitat in the California Current Ecosystem

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Beaked whales spend the majority of their time at depth, typically occur in small groups, and behave inconspicuously at the surface. These factors make them extremely difficult to detect using standard visual survey methods. To date, beaked whale habitat models have been limited in their utility due primarily to the small samples of visual observations available to inform the models. However, recent advancements in acoustic detection capabilities for beaked whales have made passive acoustic monitoring (PAM) a viable alternative method to detect beaked whales. We used beaked whale acoustic encounters to inform Generalized Additive Models (GAMs) of encounter rates for beaked whales in the California Current Ecosystem (CCE) and compare these to visual based models. Acoustic and visual based models were independently developed for a small beaked whale species group and Baird's beaked whales (*Berardius bairdii*). Distributions were modeled using a combination of fixed spatial features and inconstant oceanographic variables. Two models were evaluated for visual and acoustic encounters, one using all of the predictor variables listed and one that additionally included Beaufort scale as a predictor. The visual models that included Beaufort scale as a predictor variable retained this variable in the best fit resulting models, whereas the acoustic models did not, confirming this variable's effect on visual detection probability. The visual and acoustic models differed markedly for both small beaked whales and Baird's beaked whales in the predictor variables retained in the best fit models and in the regions of high encounter rate prediction. The model results indicate that Baird's beaked whale habitat preferences may be distinctive from other beaked whale species. This work improves current understanding of beaked whale distribution and habitat use and can be used to better inform management and conservation efforts for beaked whales. This study demonstrates the effectiveness of using acoustic data to develop habitat models. Future work will benefit from further developing the use of acoustic based habitat models for beaked whales and other species that are difficult to survey visually.

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