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

Mari A. Smultea[1,2], Cathy E. Bacon[1,3,4], Thomas A. Jefferson[5], Bernd Würsig[2], Meggie Moore[1], and Vanessa James[1]

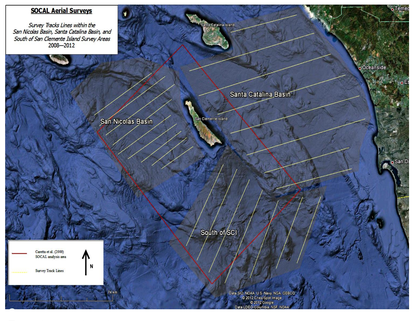
[1]Smultea Environmental Sciences (SES), P.O Box 256, Preston, WA 98050; [2]Department of Marine Biology, Texas A&M University at Galveston, 200 Sea Wolf Parkway, Bldg. 3029, Galveston, TX 77553; [3]HDR Inc., 9449 Balboa Avenue, Suite 210, San Diego, CA 92123; [4]Marine Science Department, Texas A&M University at Galveston, 200 Sea Wolf Parkway, Galveston, TX 77553, [5]Clymene Enterprises, 13037 Yerba Valley Way, Lakeside, CA 92040

ABSTRACT

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 72,467 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), 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 San Clemente Island (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.

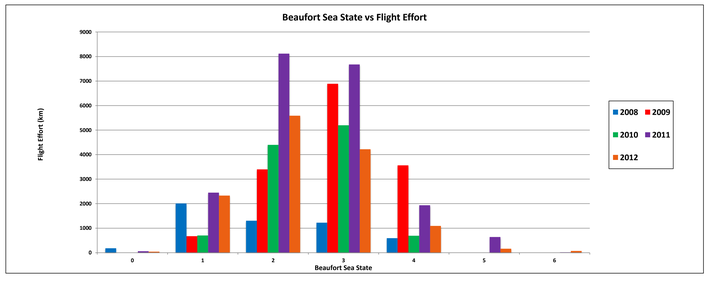
METHODS

- Personnel consisted of two observers, one recorder/photographer/videographer, and one or two pilots
- Each marine mammal sighting included verifying species, numbers and behavior with photographs
- When possible, sightings of target species included a focal follow to obtain detailed behavior information (min of 10 min.)



Pre-determined survey tracklines (yellow lines) were oriented WNW to ESE generally perpendicular to to bathymetric contours/coastline. Shaded polygons delineate subregions within the southern California study area. Red box indicates analysis study area used by Carretta et al. (2000) for 1998-99 aerial surveys of marine mammals.

Partenavia P68-C; twin-engine, fixed-wing aircraft used as primary platform for aerial surveys flown at 800-1000 ft. altitude & 100 kt. Focal follows at 1200-1500 ft. altitude & 0.5-1 km radial distance.



Beaufort sea state in relation to flight effort per year. 99% of total flight effort occurred at a Beaufort of 4 or less. These conditions were considered suitable for estimating density and abundance.

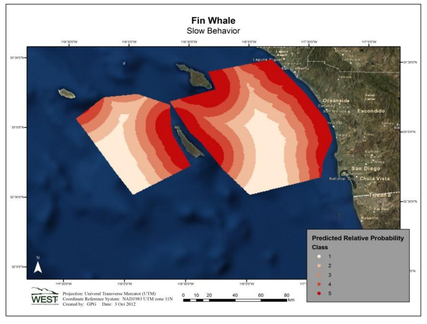
RESULTS***

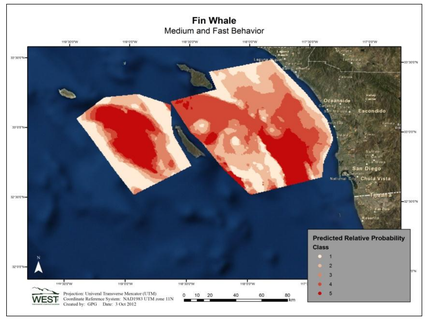
We believe gray whales swam unusually close together due to documented high predation pressure by killer whales during migration; their smaller body size vs. blue and fin whales likely makes them more vulnerable to attack. Photo by B. Würsig under NMFS permit 14451.

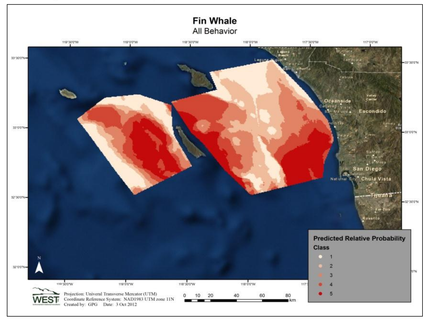
Risso's appear to rest during the day, and are believed to forage at night on squid associated with the Deep Scattering Layer that rises closer to the surface at night. Photo by B. Würsig under NMFS permit 14451.

Common dolphins swam very close together compared to other larger-bodied cetaceans. We believe this reflects higher predation pressure/increased vulnerability to predation. Swimming in large, closely-knit groups reduces predation risk through the "dilution" and "predator confusion" effects, similar to bird flocks and fish schools. Photo by B. Würsig under NMFS permit 14451.

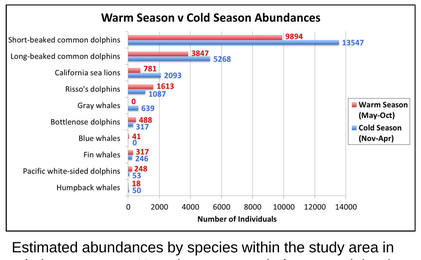
Fin and blue whales had the smallest mean group sizes (~1.7). We believe this is related to relatively low predation pressure related to their large body size and to the patchy, ephemeral distribution of invertebrate prey. Photo by M. Smultea under NMFS permit 14451.



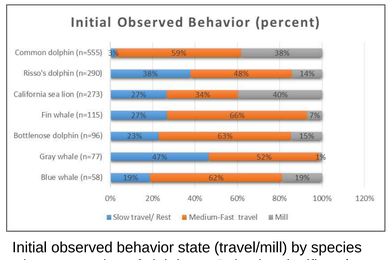




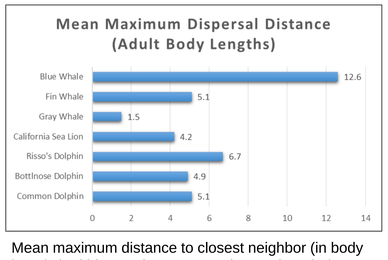
Predicted relative probability of selection for fin whale. Areas with highest probability of selection are represented by red; areas with lowest probability of selection are represented by white. Fin whales were most likely to occur W of San Clemente Island. Medium-fast travel was significantly more likely to occur over flat basins while slow travel occurred over steep slopes, likely in association with upwelling and foraging.



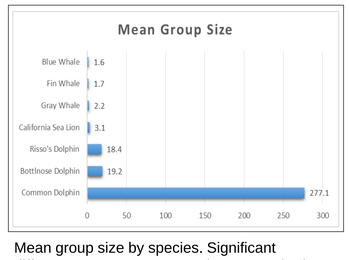
Estimated abundances by species within the study area in relation to season. Note that no gray whales were sighted during the warm-water season (May-Oct) and no blue whales were sighted during the cold-water season (Nov-Apr).



Initial observed behavior state (travel/mill) by species where n=number of sightings. Behavior significantly differed across species. Most notably Risso's and gray whales exhibited (proportionally) the most rest/slow travel, while commons and CA sea lions exhibited the most milling. Milling often appeared to involve foraging.



Mean maximum distance to closest neighbor (in body lengths) within species groups. Dispersal tended to increase with body size while group size generally decreased with body size. We hypothesize that maximum dispersal distance and group size reflect predation pressure and distribution of prey. Thus, small dolphins swim in the largest groups and have the tightest spacing between individuals due to increased vulnerability to predation.



Mean group size by species. Significant differences seen across species. Larger body size commonly correlates with smaller mean group size.

*****See Smultea and Bacon 2012 for full study results.**

CONCLUSIONS

- Our 5-year study provides the most up-to-date, comprehensive marine mammal abundance and behavior database for the southern California study area.
- The collected baseline behavioral observations are important for identifying and quantifying "normal" behavior to assess potential effects of anthropogenic activities.
- In summary, results indicate that a number of environmental and other variables significantly influence behavior, group size, abundance, and habitat-use patterns of marine mammal species in southern California.
- Other important results emerged from these surveys that merit additional research. These include social-sexual behavior among fin, blue and minke whales and "play" behavior documented on video, as well as significant associations between slope aspect and behavior/distribution.

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