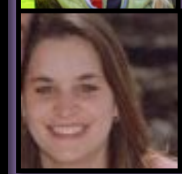

Photograph by L. Mazzuca under NMFS Permit 15369





Assessing 'Observer effect' from an aerial platform during marine mammal focal observations on Risso's dolphins, short-beaked common dolphins and killer whales in the Southern California Bight

K. Lomac-MacNair[1,2], M.A. Smultea[1,3], and C.E. Bacon[1,4]

[1]SES (Smultea Environmental Sciences), P.O. Box 256, Preston, WA 98050 USA; [2]Environmental Science Advanced Academic Program, Johns Hopkins University, Washington D.C. 20036, USA; [3]Marine Mammal Behavioral Ecology Group, Marine Biology Department, Texas A&M University at Galveston, Pelican Island, Galveston, TX 77553 USA; [4]Marine Science Department, Texas A&M University at Galveston, Pelican Island, Galveston, TX 77553 USA


Killer whales photographed by M. Deakos under NMFS Permit 15369

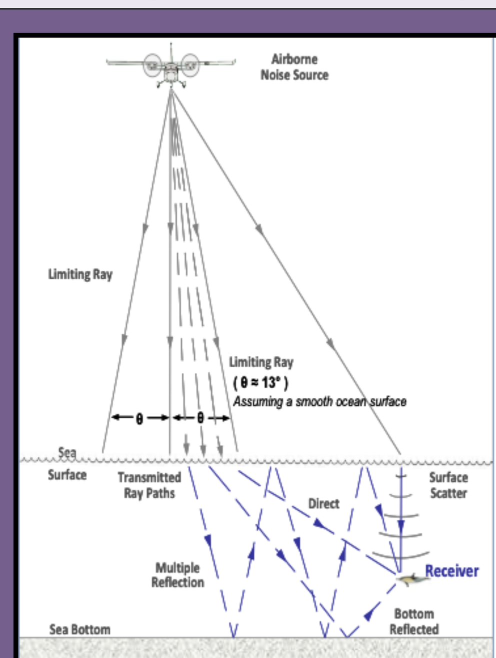

Risso's dolphins photographed by L. Mazzuca under NMFS Permit 15369

ABSTRACT

We systematically video-documented the behavior of a subsample of Risso's dolphins, short-beaked common dolphins (SBCD) and killer whales in the Southern California Bight (SCB) (2009-2011) to assess whether the observation aircraft (fixed-wing Partenavia) affected selected behavioral variables. Focal observations were conducted from the aircraft to examine potential changes in group cohesion (minimum and maximum distance between nearest neighbors in body lengths [BL]) and heading reorientation rate, to the plane circling at altitude ~213m (700ft), 305m (1000ft), (457m (1500ft) and 610m (2000ft) and radial distance ~0.5-1 km. Dependent parameters were selected based on previous studies showing that they are indicative of disturbance to anthropogenic or natural threatening stimuli. Ten focal sessions were analyzed: eight of Risso's dolphins, one SBCD, and one killer whale. A total of ~194 minutes (min) was spent observing Risso's dolphins, ~27 min of SBCD and ~29 min of killer whales. Data were divided into four plane altitude categories ~213m, 305 m, 457 m, 610 m and pooled into "low" (~213 m and 305 m) and "high" (457 m and 610 m). Paired t-tests were used to test the null hypothesis that mean maximum cohesion (C) and mean reorientation (R) of groups do not vary significantly based on plane altitude. For cohesion (C) no significant effects were found for the eight Risso's dolphin focal sessions ($p = 0.447$), one SBCD ($p = 0.602$) and one killer whale: $p = 0.197$). For reorientation (R) no significant effects were found for the eight Risso's dolphin focal sessions ($p = 0.591$) and one killer whale ($p = 0.936$); the sample size was too small to calculate reorientation for SBCD. Results suggest (1) that our small plane circling at radial distance >500m and altitude ~213 – 610 m did not cause measurable changes in cohesion and reorientation or other observable changes for the three species (based on small sample size), and (2) "undisturbed" baseline observations can be made on these species from our aircraft within the parameters examined. We believe this is due to the aircraft remaining 0.5-1 km radial distance from the animals and at altitudes well outside the theoretical 26-degree sound transmission cone ("Snell's Cone") below the aircraft for the air-through-water interface. This is important when using the aircraft to assess baseline marine mammal behavior and potential effects of anthropogenic activities relative to management and conservation needs.

INTRODUCTION

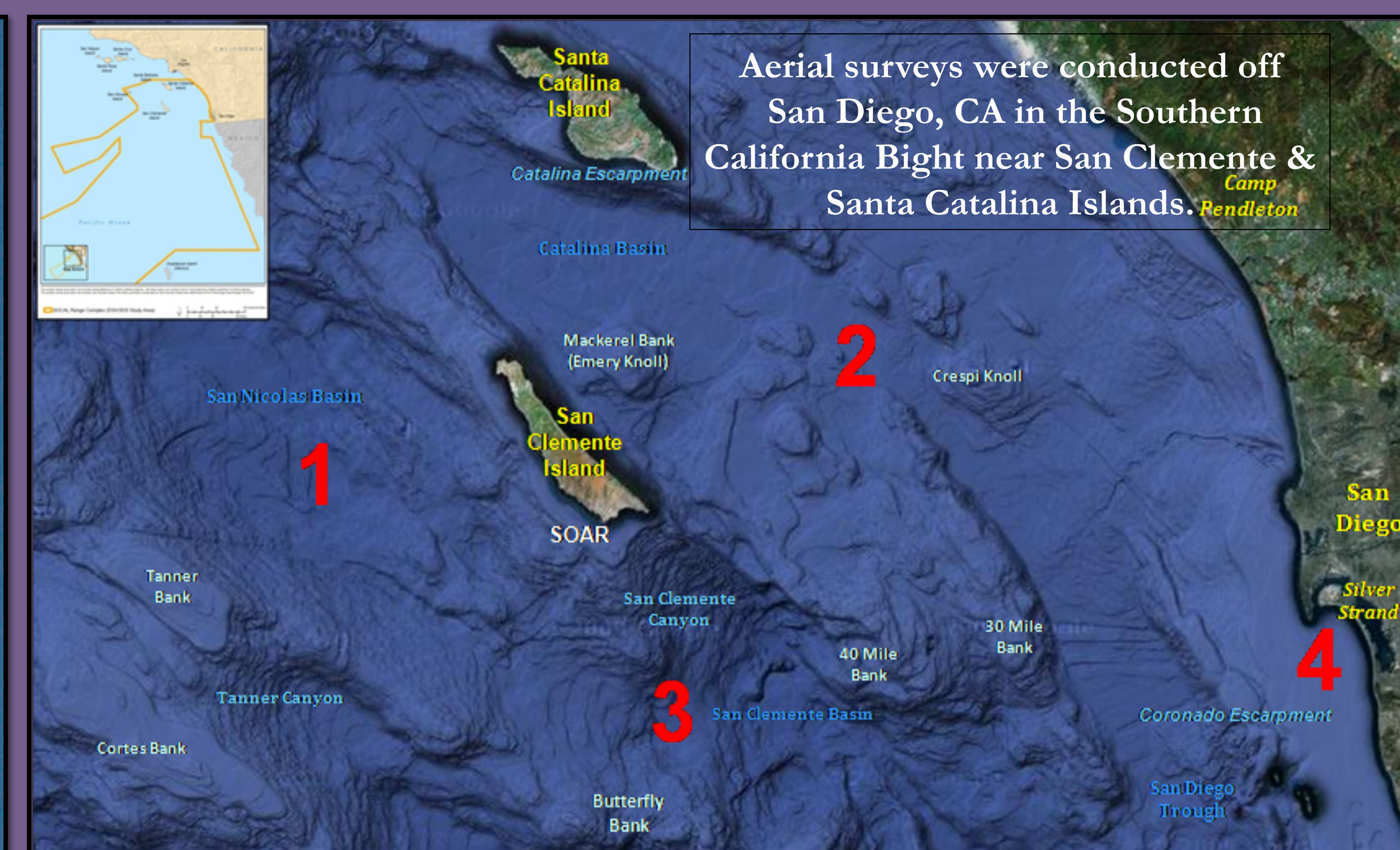
- Studies were conducted during aerial line-transect surveys off southern California, U.S. (2008-2013) to describe and quantify baseline occurrence, distribution, density and behavior of marine mammals.
- Behavioral observations included focal individual and group follows of whales and dolphins using video and computer-based collection of behavioral events with Mysticetus Observation and Analysis software (www.mysticetus.com).
- For reliable, baseline behavioral data it is important to ascertain weather observed behaviors are indeed representative of undisturbed, baseline behavior not impacted by plane presence.



Snell's Cone – the theoretical 26° inverted sound cone (radius 13°) within which the sound ray of an over-flying aircraft is limited at the sea surface under calm flat sea conditions (Beaufort 0-2). Also illustrated are ways in which the transmission of sound rays through the water surface can be influenced by water depth reflection. Increasing disturbance of surface waters (i.e., increasing Beaufort sea state) can increase the size of the radius beyond the theoretical 26-degree sound cone. (Modified from source: Richardson et al. 1995 per Urick 1972).

METHODS

Line-transects were flown from a Partenavia aircraft at ~305m altitude. For this plane-effects sub-study, upon locating a focal group, altitude was then increased to 457 or 610m. When possible the focal group was circled at descending altitudes for ~5 min at each of 610m (2000ft), 457m (1500ft), 305m (1000ft) and 213m (700ft). Group dispersion and reorientation rate were collected at 1-min sampling intervals via focal group scan sampling.




Short-beaked common dolphin photographed by M. Deakos under NMFS Permit 15369

OVERALL RESULTS

Species	Group Size	Lateral Distance (m)	Alt min/max (m)	Date	Focal Session (min)	# of 1-min intervals with dispersal: Low Alt. <213m	305m	High Alt. 457m	610m	Mean max dispersal (mean of the max dispersals at 1-min intervals): Low Alt. <213m	305m	High Alt. 457m	610m	# of 1-min intervals with reorientation: Low Alt. <213m	305m	High Alt. 457m	610m	Reorientation rate (total changes in heading in degrees/total min): Low Alt. <213m	305m	High Alt. 457m	610m	Behavior states observed at 1-min intervals: Low Alt. <213m	305m	High Alt. 457m	610m
Risso's dolphin	13	693m	213/610	7/21/09	0:24:09	5	7	5	5	6.4	5.7	5	4.2	4	6	4		2.5	11.7	2.5		RE = 2 TR = 5	RE = 1 TR = 7	TR = 5	RE = 1
	38	678m	305/457	11/19/09	0:43:14		14	8	7		3.6	3.5	2.9		13	9	5		17.7	13.3	14		RE = 15	RE = 9	RE = 6
	65	1076m	305/457	11/23/09	0:21:28		13	4			32.1	6.6			13	3			14.6	10			MI = 1 SM = 2 ST = 11 TR = 3	MI = 2 SM = 1 ST = 1 TR = 3	
	35	300m	305/457	5/17/10	0:20:37		3	13			6	8.9			2	14			45	22.9			TR = 3	TR = 15	
	6	297m	152/610	2/15/11	0:34:56	10	3	5	7	4.6	4.3	6.4	4.3	10	3	5	6	13.3	10	2	7.5	RE = 10	RE = 3	RE = 5	RE = 6 TR = 1
	20	549m	305/457	3/31/11	0:15:20		7	7			3	6.9			7	5			28.6	66			RE = 7	RE = 4 MI = 2 ST = 1	
	22	958m	305/457	3/31/11	0:14:47		5	9			2.6	1.8			5	8			8	22.5			RE = 6	RE = 9	
	12	736m	305/457	3/31/11	0:19:56		4	11			12.5	11.5			3	10			76.7	26.6			RE = 1 MI = 3 ST = 1	RE = 1 MI = 1 TR = 10	
Short-beaked common dolphin	135	861m	152/610	7/29/09	0:27:23	10	4	5	5	2.6	7.5	4.6	3	10	3	1		30.6	53.3	10		TR = 5 ST = 9	TR = 3	TR = 2 MI = 1	PF = 2 MI = 1 SM = 1
Killer whale	55	1624m	305/457	11/21/09	0:29:23		11	5	5		35.9	42	30		8	5	4		0	2	17.5		TR = 7 ST = 1	TR = 5	TR = 5

STATISTICAL RESULTS

Species	Paired T-Test "low" to "high" altitude for Cohesion (C)	Paired T-Test "low" to "high" altitudes for Reorientation (R)
Risso's Dolphin	p = 0.447	p = 0.591
Short-beaked common dolphin	p = 0.602	NA (small sample size)
Killer whale	p = 0.197	p = 0.936


Risso's dolphins photographed by L. Mazzuca under NMFS Permit 15369

DEFINITIONS OF VARIABLES STUDIED

Variable	Definition	Analysis Method
Aircraft Altitudes	~213, 305, 457, 610m Maintain lateral distance of ~0.5-1 km	"low" altitudes (<213 and 305 m) "high" altitudes (457 m and 610 m)
Maximum Dispersion in Group	Maximum distance (in estimated adult body lengths) between nearest neighbors	Average maximum dispersion calculated per group Paired T-Test of mean max dispersal at "low" (pooled ~213 m and 305 m) and "high" (pooled 457 m and 610 m) altitudes
Group Reorientation Rate (degrees per minute)	Orientation of the majority(>50%) of the group	Sum of the difference between successive travel orientations, divide by the total # of min of observation (deg/min) Paired T-Test of mean reorientation "low" (pooled ~213 m and 305 m) and "high" (pooled 457 m and 610 m) altitudes

Behavior States

- **Travel (TR)** = >50% of group swimming with an obvious consistent orientation (directional) and speed, no surface activity. Medium travel = 1-3 km/hr wake no white water; Fast travel = >3 km/hr with white water
- **Rest/Slow Travel (RE)** = >50% of group exhibiting little or no forward movement (<1 km/hr) remaining at the surface in the same location or drifting/ traveling slowly with no wake
- **Mill (MI)** = >50% of group swimming with no obvious consistent orientation (non-directional) characterized by asynchronous headings, circling, changes in speed, and no surface activity. Includes feeding.
- **Surface-active mill (SM)** = While milling, occurrence of aerial behavior that creates a conspicuous splash (includes all head, tail, pectoral fin, and leaping behavior events Includes feeding.
- **Surface-active travel (ST)** = While traveling, occurrence of aerial behavior that creates a conspicuous splash (include all head, tail, pectoral fin, and leaping behavior events
- **Probable Foraging (PF)** = Apparent searching for prey; the process of finding, catching, and eating food


Aerial photographs by K. Lomac-MacNair


Risso's dolphins photographed by L. Mazzuca under NMFS Permit 15369

CONCLUSIONS

- In summary, results suggest that our small plane circling at altitude ~213-610m and lateral distance ~500-1000m did not cause significant *measurable or observable* changes in the group dispersion distance, rate of re-orientation, or general behavior state of the Risso's dolphins, common dolphins, and killer whales we observed.
  - Sample size was too small for common dolphins and killer whales for statistical tests, but no obvious changes were observed at different altitudes.
  - Further, more extensive statistical tests are to needed better understand the potential "observer effect".
- Our results are consistent with similar studies on bowhead, beluga, humpback and sperm whales, and bottlenose dolphins indicating that a small airplane circling at ~366-457m altitude and radial distance 500-1000m does not result in measurable changes in selected behavioral parameters (e.g., respiration and dive rates, reorientation, dispersal, etc.) (Patenaude et al. 2002, Smultea et al. 2008, Smultea et al. 1995).

THE IMPORTANCE OF PROTOCOL

- When protocol is adequately followed ensuring that the observation aircraft is well outside the theoretical 26-degree sound radius of Snell's cone relative to observed animals, this observation platform is believed to provide a non-disturbing forum from which potential impacts of other activities are not confounded by the observation platform (based on results of this small sample size and previous similar studies).

References

- Patenaude, N. J., Richardson, W. J., Smultea, M. A., Koski, W. R., Miller, G. W., Würsig, B., & GReene, C. R. (2002). Aircraft sound and disturbance to bowhead and beluga whales during spring migration in the Alaskan Beaufort Sea. *Marine Mammal Science*, *18*(2), 309-335.
- Richardson, Greene, C.R., Malme, C.I.,Thomson, D.H., (1995) Marine Mammals and Noise, 1995. Academic Press.
- Smultea, M. A., Mobley Jr, J. R., Fertl, D., & Fulling, G. L. (2008). An unusual reaction and other observations of sperm whales near fixed-wing aircraft. *Gulf and Caribbean Research*, *20*, 75-80.
- Smultea, M. A., & Würsig, B. (1995). Behavioral reactions of bottlenose dolphins to the Mega Borg oil spill, Gulf of Mexico 1990. *Aquatic Mammals*,*21*(3), 171-181.
- Smultea, M. A., Kieckhefer, T. R., & Bowles, A. E. (1995). Response of humpback whales to an observation aircraft as observed from shore near Kauai, Hawaii, 1994. *Marine Mammal Research Program of the Acoustic Thermometry of Ocean Climates Project (ATOC).*

Acknowledgements

Many thanks to K. Ampela, J. Biondi, C. Boerger, R. Braaten, J. Bredvik, M. Cotter, M. Deakos, D. Engelhaupt, A. Fowler, G.L. Fulling, S. Garrett, C. Goertz, J.C. Grady, V. James, C. Johnson, C. Kyburg,, M. MacKay, L. Mazzuca, R. Merizan, M. Moore, J. Mobley, T. Norris, M. Richie, D. Steckler, B. Wuersig. Aspen Helicopters: R. Throckmorton C. Bartush, A. Blasingame, N. Carillo, M. Estomo, B. Hanson, D. Moody, I. Ufford, K. Veatch. Funding provided by U.S. Navy, Pacific Fleet, either to Smultea Environmental Sciences (SES), Scripps' Institute of Oceanography, or HDR|EOC. Data collected under NMFS permit numbers 14451, & 774-1714-09

SES SMULTEA ENVIRONMENTAL SCIENCES, LLC

NAVFAC Naval Facilities Engineering Command

HDR