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Changes in Abundance, Density and Diversity of Marine Mammals in the Southern California Bight 1998-1999 vs. 2008-2010

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ABSTRACT

Twelve line-transect aerial surveys occurred during summer/fall 2008-2011 to monitor the occurrence, abundance and behavior of marine mammals in the Southern California Bight. The study area overlapped where Carretta et al. (2000) flew surveys in 1998-1999, coinciding with their "warm-water period". Density and abundance were estimated using standard line transect methods and DISTANCE software. Analyses were limited to 12,206 km flown in Beaufort 0-4 conditions and 495 marine mammal sightings of the seven most common and observed species. Blue whale densities were all well below historical estimates. Fin whales continue to be the most common and abundant large whale. Risso's dolphins have apparently dramatically increased in numbers and/or distribution over the last several decades: calculated density east of San Clemente Island (SCI) was 19.99 animals/100 km². This is much higher than those for Carretta et al.'s warm season, but similar to those they estimated for the cold season. Our densities of common dolphins were lower than Carretta et al.'s warm-water season (318.99 animals/100 km² east of and 58.43 animals/100 km² west of SCI). However, short-beaked common dolphins were still by far the most abundant species (~29,044 individuals). Historically, Pacific white-sided dolphins were seen only in the cold-water season, but we had 26 sightings (density 19.7 individuals/100 km²) in the warm-water period. Pilot whales, though historically common, were never seen. Results indicate that recent patterns of cetacean relative abundance and presence are, in many cases, very different from historical records. This is likely related to previous exploitation and depletion of these species and long-term changes in oceanographic conditions, concomitant changes in prey distribution and densities, and anomalous El Niño and La Niña events. This study provides the only available recent estimates of abundance for marine mammal species east and west of San Clemente Island where the U.S. Navy conducts major training exercises.

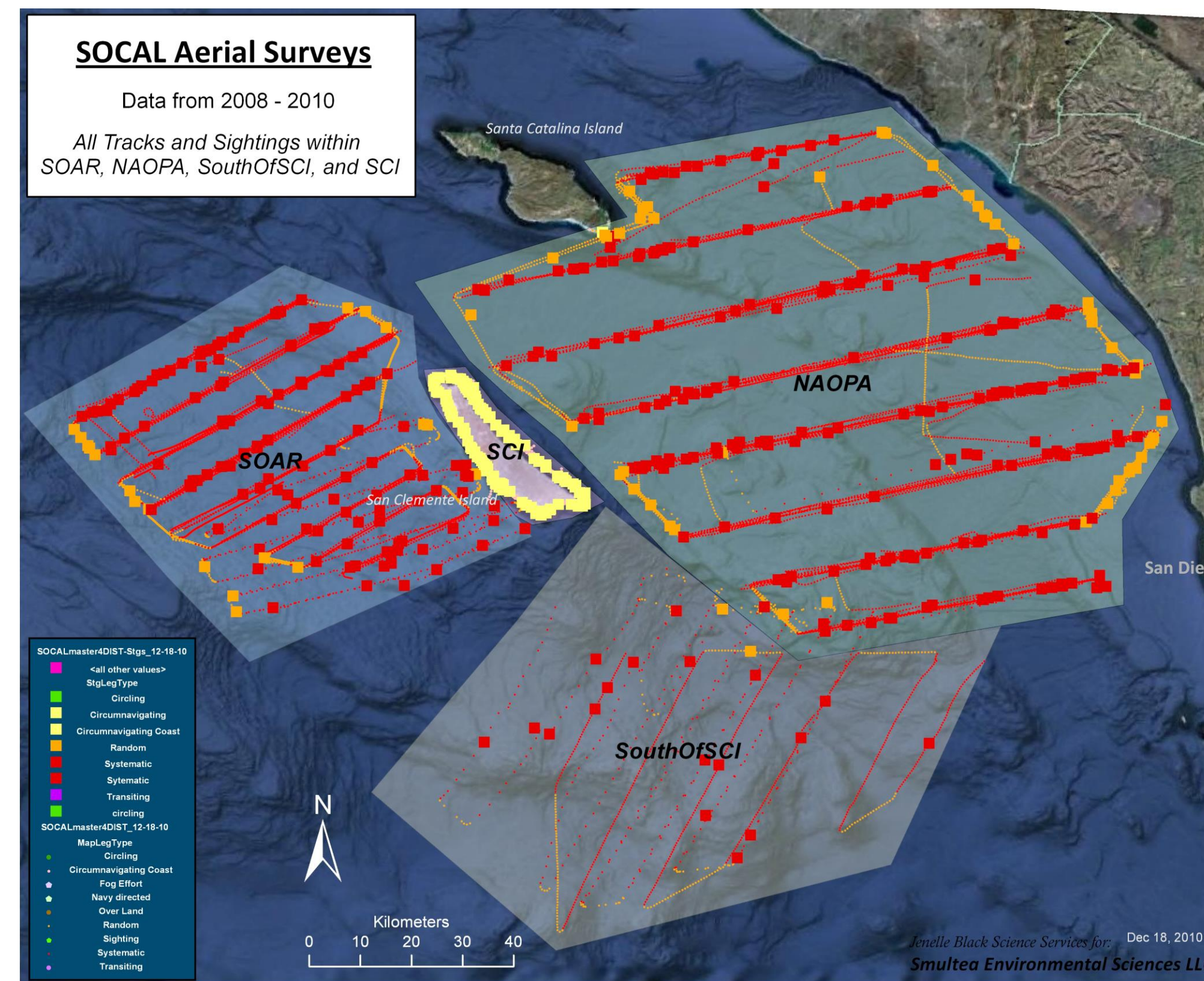
RESULTS



Common dolphins remain the most commonly seen marine mammal species in the S. California Bight, although their abundance was lower in 2008-10 than in 1998-99. Photo by Lori Mazzuca/Permit No. 14451.

Total marine mammal sightings (nT) seen during our surveys, number used in line transect estimation (nD), and months observed (1=Jan, etc.). (Surveys were flown in months 5-11 (May-Nov)).

SPECIES	Total Sightings	#Sightings Used for Density Estimates	Months Observed
Blue whale - <i>Balaenoptera musculus</i>	50	8	5, 6, 7, 8, 10, 11
Fin whale - <i>B. physalus</i>	51	26	5, 6, 7, 10, 11
Sei whale - <i>B. borealis</i>	1	0	9
Bryde's whale - <i>Balaenoptera brydei/edeni</i>	1	1	9
C. Minke whale - <i>B. acutorostrata</i>	5	3	5, 7, 9, 11
Humpback whale - <i>Megaptera novaeangliae</i>	5	5	6, 11
Cuvier's beaked whale - <i>Ziphius cavirostris</i>	4	2	7, 9, 11
Killer whale - <i>Orcinus orca</i>	2	2	11
Pacific white-sided dolphin - <i>Lagenorhynchus obliquidens</i>	21	11	5, 7, 11
Risso's dolphin - <i>Grampus griseus</i>	157	61	5, 6, 9, 10, 11
Common bottlenose dolphin - <i>Tursiops truncatus</i>	27	11	5, 6, 7, 9, 10
Short-beaked common dolphin - <i>Delphinus delphis</i>	19	19	10, 11
Long-beaked common dolphin - <i>D. capensis</i>	10	2	6, 9, 10, 11
Common dolphin - <i>Delphinus spp.</i>	299	120	5, 6, 7, 9, 10, 11
N. right whale dolphin - <i>Lissodelphis borealis</i>	3	2	6
California sea lion - <i>Zalophus californianus</i>	300	127	5, 6, 7, 9, 10, 11
Harbor seal - <i>Phoca vitulina</i>	13	1	7, 10, 11
N. elephant seal - <i>Mirounga angustirostris</i>	1	5	5, 9, 11
Unid. baleen whale	19	17	6, 7, 9, 11
Unid. dolphin	161	39	5, 6, 7, 9, 10, 11
Unid. pinniped	45	17	5, 6, 7, 10, 11
Unid. marine mammal	12	16	5, 6, 7, 11
TOTAL	1,215	495	



Risso's dolphins near San Clemente Island have increased since 1998-99 and were seen year-round. Photo by Lori Mazzuca/Permit No. 14451.

Estimated Density and Abundance (N) in Spring/Summer ("warm-water period") in 3 Areas of Southern California for the Most Commonly Seen Marine Mammal Species During 2008-2010 Aerial Surveys. Abundance Estimates for 1998-1999 (Carretta et al. 2000) Aerial Surveys in an Overlapping Area are also Shown.

SPECIES	2008-2010			1998-99 ^{1/}	
	Density (Di*) (# Indiv/100 km)	Abundance (N)	%CV	Combined S CA Abundance (N)	Carretta et al. (2000) S CA Abundance (N)
Common dolphins - <i>Delphinus spp.</i>				30,034 ^{2/}	38,851 ^{3/}
NAOPA (San Clemente Isld to San Diego)	3.18990	27,028	36.2		
SOAR (W of San Clemente Isld.)	0.58430	2,442	52.6		
South of San Clemente Isld (SCI)	0.11505	564	61.7		
Risso's dolphin - <i>Grampus griseus</i>				2,537	7
NAOPA	0.19985	1,693	31.7		
SOAR	0.01403	59	85.3		
South of SCI	0.16006	785	110.9		
California sea lion - <i>Zalophus californianus</i>				2,534	22 ^{3/}
NAOPA	0.11240	952	43.0		
SOAR	0.31082	1,300	63.7		
South of SCI	0.05743	282	108.8		
Common bottlenose dolphin - <i>Tursiops truncatus</i>				585 ^{4/}	6
NAOPA	0.06915	585	72.4		
SOAR	0	0			
South of SCI	0	0			
Pacific white-sided dolphin - <i>Lagenorhynchus obliquidens</i>				135	0
NAOPA	0.00530	45	100.7		
SOAR	0.02154	90	86.5		
South of SCI	0	0			
Fin whale - <i>Balaenoptera physalus</i>				66	15
NAOPA	0.00177	15	56.7		
SOAR	0.01219	51	33.9		
South of SCI	0	0			
Blue whale - <i>Balaenoptera musculus</i>				13	8
NAOPA	0.00124	11	40.7		
SOAR	0.00047	2	99.8		
South of SCI	0	0			

^{1/}The 2008-2010 study area overlapped where Carretta et al. (2000) flew surveys in 1998-1999, coinciding with their "warm-water period"; however, they were not the exact same areas. Methods and equipment were similar between the two studies. See map for 2008-2010 study areas.
^{2/}All *Delphinus* spp. were combined because not all sightings could be differentiated. A subsample of 348 confirmed sightings based on photographs revealed 7.2% *D. delphis* and 6.9% *D. capensis*.
^{3/}Carretta et al. (2000) reported only short-beaked common dolphin estimates; their California sea lion abundance estimate was much higher for hauled-out animals on San Clemente Island (SCI).
^{4/}Common bottlenose dolphins were not seen in the SOAR region during the 2008-2010 surveys.
^{5/}Pacific white-sided dolphins were only seen in the cold-water season during the 1998-1999 surveys.



Fin whales continue to be the most abundant large whale during warm-water period and numbers have increased since 1998-99. Fin mom/calf pair following ~1,000 northern right whale dolphins videotaped for ~1 hr as species interacted. Photo by Mark Deakos / Permit No. 14451



Confirmed Bryde's whale sightings have increased in the last decade (Smultea et al. 2011). Photo by Lori Mazzuca / SES Permit No. 15369

CONCLUSIONS

CHANGES from historical patterns (warm-water period only):

- More Risso's dolphins
- More blue, fin and Bryde's whales
- Lower common dolphin abundance may be at least partly related to cooler water temperatures in recent years (e.g., 2010 La Niña with unseasonably cool water temperatures).
- Pacific white-sided dolphin absent in 1998-99 warm-water period
- Pilot whale absent in recent years (2008-2010)

- We provide compelling evidence suggesting that the distribution and density of some marine mammal species has changed off southern California.
- Changes are likely related to previous exploitation / depletion of species, long-term changes in oceanographic conditions, and concomitant changes in prey distributions and densities.
- This study provides the only available recent estimates of abundance for marine mammal species in the majority of coastal and offshore waters of San Diego County.
- Such data are needed to effectively assess potential impacts of military and other activities to marine mammals, and to implement effective mitigation measures to reduce or eliminate those impacts.
- See Jefferson et al. (2011) for more details of study results.

Ongoing GOAL

Assess up-to-date year-round use and numbers on Navy's S California training range. Currently analyzing 4 cold-water aerial surveys in winter-spring 2011 by HDR, Inc.

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