

California Marine Life Protection Act Initiative

*Draft Methods Used to Evaluate
Marine Protected Area Proposals
in the
MLPA North Coast Study Region*

Chapter 9

Protection of Marine Birds and Mammals

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9. Protection of Marine Birds and Mammals

Status of this chapter: The ~~evaluation methods~~changes to~~in~~ this chapter are waiting SAT approval.

Marine protected areas (MPAs) may benefit marine birds and mammals by 1) potentially reducing human disturbance at roosting/haulout sites and breeding colonies/rookeries, 2) protecting their forage base and 3) reducing bycatch (e.g., gray whales interacting with fishing gear). To evaluate the protection afforded by proposed MPAs to birds and mammals the SAT does the following:

- identifies proposed MPAs or special closures¹ that contribute to protection of birds and mammals
- identifies species likely to benefit from MPAs and for which data are available
- identifies important breeding and foraging hot spots for marine birds and mammals
- estimates the proportion (of total numbers of individuals) of breeding birds at colonies and the number of rookeries potentially benefiting by proposed MPAs
- estimates the number and size of marine bird roost sites and proportion (of total numbers of individuals) of mammals at haulouts potentially benefiting by proposed MPAs
- estimates the proportion of available near-colony foraging areas protected by proposed MPAs, defined by evaluating protection of buffered areas around colonies
- estimates the proportion of available neritic foraging 'hot spots' protected by proposed MPAs, defined by at-sea densities of marine birds and mammals
- estimates the proportion of estuarine and coastal beach habitats protected and diversity and density of shorebirds and waterfowl protected by proposed MPAs ~~for shore birds and waterfowl~~

This evaluation focuses on birds, including seabirds, shorebirds and waterfowl, and on pinnipeds (seals and sea lions), and cetaceans (harbor porpoise and gray whales) ~~and birds, including seabirds, shorebirds and waterfowl~~². Population, as used in this evaluation, refers to the number of animals that use a site for breeding or resting. Evaluations are focused on the study region as a whole. Evaluations include numbers of species (species diversity), numbers of individual birds or mammals, number of roosts or haulouts and percentages of populations breeding within individual proposed MPAs and within all proposed MPAs that contribute to the protection of birds and mammals. Species evaluated are limited to those identified as likely to benefit from MPAs and special closures.

The SAT evaluation for marine birds and mammals focuses on:

¹ Special closures are not MPAs, but could restrict access to discrete areas to prevent human disturbance to colonies, rookeries, haul-outs and roosts. Special closures may be included in future rounds of the marine birds and mammals evaluations if included in MPA proposals; they would be evaluated with regard to marine birds and mammals using similar methods as used for MPAs.

² Cetaceans are included only in foraging analyses (i.e., 4 and 5 below), because there are limited data about fine-scale use patterns.

1. Protection of seabird breeding colonies and pinniped rookeries based on population size, location and species composition

This analysis examines whether MPAs and special closures proposals will benefit the species identified as likely to benefit. Evaluations are based on the numbers of animals in the MLPA North Coast Study Region, and the proportion of breeding colonies and number of rookeries within each proposed MPA or special closure area. For each colony within a proposed protection area, the SAT considers the likely effect of the specific protections or regulations identified (e.g. no-entry zones) that would reduce human disturbance, and whether the MPA or special closure area affects significant numbers of animals. Special closure areas will provide maximum benefit by minimizing disturbance caused by boats, irrespective of vessel type, but will not afford shore-based protection above the mean high tide line. MPAs that restrict fishing or other activities in waters surrounding colonies would provide less benefit than no-entry zones but likely would provide a benefit by reducing the numbers of boats approaching and lingering near colonies. Possible benefits of reduced disturbance include increased bird/mammal productivity, colony/population size, and species diversity (Carney & Sydeman 1999; ~~Rojek et al. 2007~~).

Data used for these assessments comes from the National Oceanic and Atmospheric Administration (NOAA)/U.S. Fish and Wildlife Service (USF&WS) bird colony database³, from pinniped data compiled from Mark Lowry (NOAA Fisheries), and other sources. Count data were gathered when the maximum numbers of animals were expected to be at the sites. The SAT evaluates total counts of seabirds and pinnipeds, and the proportion breeding by species, and for all species combined, within each proposed MPA or special closure. The sizes of special closures vary, but usually range between 300 and 1000 feet.

2. Marine bird and mammal population hot spots

This analysis evaluates whether proposed MPAs or special closures overlap important seabird and marine mammal population hot spots. For seabirds, SAT has identified a population hot spot as seabird islands with more than 10,000 nesting birds recorded. Population hot spots for seabirds in the north coast study region are:

- Castle Rock
- False Klamath Rock
- Green Rock
- Flatiron Rock
- False Cape Rocks
- Steamboat Rock
- Rockport Rocks
- Cape Viscaino

For marine mammals, the SAT has identified a population hot spot as rookeries with recorded Steller sea lions or other pinniped haulout/rookeries with 500 or more pinnipeds present at least one or two pinniped species totaling over 500 animals on average in one season. Population hot spots for marine mammals in the north coast study region are:

³ Original data is from Carter et al. 1992 and Sowles et al.1980. These data were then updated in 2004.

- Southwest Seal Rock
- Sugarloaf Island
- Vicinity of Castle Rock, Crescent City
- South Bay, Humboldt Bay
- Arcata Bay, Humboldt Bay
- Mouth of the Eel River

3. Marine bird and mammal resting (roost/haulout/raft) locations based on population size, location and species composition

In addition to reproduction, many marine birds and pinnipeds require areas close to foraging locations where they can safely come to shore to rest, sleep, dry (i.e., cormorants, pelicans), or molt (some pinnipeds). Frequent disturbance at resting sites results in high levels of energy expenditure that can lead to poor body condition and/or cause animals to abandon the area (Carney & Sydeman 1999; Rojek et al. 2007).

The methods the SAT uses to assess roosting areas and haulout sites are similar to those used for colonies/rookeries. For seabirds, the SAT uses data on major Brown Pelican roosts, which also serve as a surrogate for other species. For pelicans, ~~major~~ roosts have been categorized as ~~those typically containing~~ low, medium, or high importance based on maximum counts of: 1) never more than 100-500 birds; 2) 100-500-4,000 birds; and 3) > 4,0500 birds, respectively. For pinnipeds, total numbers and the proportion are calculated for each species and for all species combined, and sites used by each species are evaluated based on these proportions.

4. Marine bird and pinniped near-colony/rookery foraging concentrations based on population size, location, and species composition

As upper-trophic-level predators, marine birds and mammals require an abundance of resources for survival and reproduction. With long life expectancies (>20 years), low annual productivity, and high site fidelity, these animals are subject to population level impacts from reduced prey supplies or disturbance at foraging areas. High levels of disturbance at foraging areas may cause increased energy expenditure leading to poor body condition; this may be especially detrimental for species with long migration routes (e.g., Brown Pelican, waterfowl, shorebirds), which may not have sufficient energy reserves to complete migration. Thus, protection of important prey species and foraging areas could have benefits, especially to species with limited foraging distributions.

For breeding species, the SAT will focus on four seabird and two marine mammal species most likely to benefit based on limited foraging ranges. For birds, this analysis focuses on the Pelagic Cormorant, Brandt's Cormorant, Pigeon Guillemot, and Common Murre. For pinnipeds, this analysis focuses on the harbor seal and the Steller sea lion. These species mainly forage in nearshore waters within a few miles of colonies during the breeding season. However, other species are likely to benefit (e.g. Double-crested Cormorant, Black Oystercatcher, loons and grebes, waterfowl, California sea lion).

Evaluations of benefits to marine birds and mammals near colonies are based on whether or not proposed regulations may benefit forage species (Table 9-1) or foraging habitats, how much foraging area will be protected near breeding areas, and how many animals stand to benefit. Zones extending three miles alongshore and to three miles offshore (the main foraging range of these species when breeding) from breeding colonies/rookeries are used to examine the numbers of birds/mammals utilizing the area within the proposed MPA.

5. Marine bird and mammal neritic foraging based on location, density, and species composition

There are hydrographic features within the neritic zone of state waters that concentrate prey of many marine birds and mammals. Retention areas and thermal fronts adjacent to upwelling centers and river plumes are known to concentrate prey. These areas are often referred to as 'hot spots', or areas of high trophic transfer, as they provide essential foraging opportunities to upper trophic level predators. While the types of prey typically found at hot spots are highly mobile (e.g. anchovies, squid, and krill), they may benefit from MPAs protecting hot spots as they have a high probability of being concentrated in these areas. Any protection given to hot spots will likely ultimately translate into added marine bird and mammal benefits. A composite map of at-sea densities based on transect surveys will be plotted over proposed MPAs and special closures to determine the area of neritic foraging hot spots protected for seabirds and pinnipeds. Hot spots are identified as areas with the top 10% density for each of seven groups of species in the analysis. The seven groups of species are:

- Loons, Grebes, and Scoters
- Pigeon Guillemots and Pelagic Cormorants
- Marbled Murrelets
- All other seabirds
- All pinnipeds
- Harbor Porpoise
- Gray Whales

Gray whales typically migrate past the northern California coast in the late fall and early spring as they travel between their northern Arctic feeding grounds and their southern Mexican breeding and calving grounds. The north coast region is significant to gray whales because there is a small population (~200 whales) of gray whales that forgo their full northern migration and spend summers foraging south of the Bering and Chuckchi seas (Calambokidis et al. 2002). These animals are part of the Pacific Coast Feeding Aggregation and the southern terminus of their range is in the northern California waters. These gray whales depend on the nearshore habitat during this time to feed in order to procure enough resources to successfully overwinter while fasting in Mexico. In addition to the at-sea analysis, a map of near shore densities for gray whales surveyed from shore sites will be plotted over proposed MPAs and special closures to determine the area of near shore ~~A map of at-sea densities for gray whales will be plotted over proposed MPAs and special closures to determine the area of neritic~~ foraging hot spots protected.

6. Estuarine and coastal beach protection for resident and migrant shorebirds and waterfowl

~~The SAT evaluates whether proposed MPAs and special closures provide protection to the inhabitants of estuarine areas.~~ There are many human activities, including hunting, that take place within estuaries and have adverse effects on shorebird and waterfowl populations. Estuaries provide critical resting and foraging habitat for resident and migrant birds and seals. Protecting both estuarine and coastal beach habitat, even if limited to below mean high tide, will have direct benefit to these populations. The SAT evaluates whether proposed MPAs and special closures provide protection to the avian inhabitants of estuarine areas using three analyses. The first analysis evaluates the level of protection to the habitat by identifying ~~For this analysis, five habitat types have been identified:~~ estuarine waterways, tidal flat, coastal marsh, coastal beach and eelgrass in

Humboldt Bay. The analysis will investigate the amount of available habitat and number of estuaries protected within proposed MPAs and special closures.

The second analysis evaluates the protection provided to wintering waterfowl and shorebirds in north coast estuaries. This evaluation is based on maximum winter counts from aerial annual surveys conducted by the California Department of Fish and Game. Each estuary is rated high, medium or low based on the range of maximum winter counts for each species group among all estuaries. For waterfowl and shorebirds, the number of groups and estuary rating by group that are represented in proposed MPAs are evaluated. The analysis reports on six groups of species, as follows:

- Dabbling Ducks
- Diving Ducks
- Geese
- Sea Ducks
- Shorebirds
- Swans

The third analysis evaluates the protection specifically provided to shorebirds in Humboldt Bay. Humboldt Bay is a significant site for migratory and wintering shorebirds (Danufsky and Colwell 2003). Intertidal mud flat areas in Humboldt Bay provide important feeding habitat for a variety of species supporting consistently large populations of shorebirds. Nineteen mud flat sites throughout Humboldt Bay were systematically sampled and baseline data for species densities were recorded. For shorebirds, the species density and diversity for each proposed MPA containing one of the 19 survey sites are evaluated. The number of survey sites in proposed MPAs in Humboldt Bay are reported for each proposal. Proposed MPAs that capture the western shore of Arcata Bay and/or one of the three higher density Marbled Godwit areas are noted.

Consideration of MPAs in analyses 1 through 6

The bird and mammal analysis focuses only on benefits provided by proposed MPAs and special closures. The SAT recognizes that many other marine birds and mammals protections exist outside the MLPA, such as the Marine Mammal Protection Act and the Migratory Bird Treaty Act. Note that aAll current protections outside the MLPA affect all proposals equally, and therefore are not considered separately from or in addition to proposed MPAs and special closures in these analyses. The focus of all six analyses outlined above will be on special closures and state marine reserves (SMRs), with the recognition that special closures will provide greater protection than SMRs. However, the SAT recognizes some activities have greater impacts than others and state marine conservation areas (SMCAs) permitting certain activities should be considered independently during each analysis. Mills et al. (2005) provide summaries of fisheries activities with potential impacts to marine bird populations. Table 9.2 defines which activities an SMCA can allow and still be considered for a given analysis. For analyses of breeding and resting sites, the ultimate goal is to reduce all human activities around those areas. Table 9.2 is the criteria for level of protection specific to seabirds based on activities that put user groups in close proximity to the species breeding and resting areas. Specifically, activities which allow harvest close to or on islands will not be included in any analysis. For example, MPAs allowing recreational and/or commercial salmon fishing in depths greater than 50m are included in some evaluations, since virtually all islands occur

in shallower waters in this region, but only MPAs allowing commercial salmon trolling (and commercial trap crabbing) in waters less than 50m deep are included in some evaluations, since the large commercial boats generally stay clear from islands or rocks. Another example would be MPAs allowing hand harvest of algae and mussels limited to the mainland shoreline. These MPAs would be included in the breeding and foraging analyses, whereas no shore-based activities are included in the estuary/beach analysis, since these activities would likely affect birds and mammals on shore. Therefore, for analyses of breeding and resting sites, SMGAs allowing activities that take place near or from shore will not be analyzed. For the near-colony foraging analysis, SMGAs allowing activities that have potential for bycatch, compete for prey resources, or alter prey habitat will not be analyzed. For the neritic foraging 'hot spots' analysis, SMGAs allowing activities that have potential for bycatch will not be analyzed. And for the estuaries/coastal beach analysis, SMGAs allowing activities close to shore that have potential for bycatch, compete for prey resources, cause displacement of foraging activities, or significantly alter prey habitat will not be analyzed. Finally, fisheries interactions with marine mammals have been less studied in those areas than those with seabirds. Given this the lack of information on the impacts of specific activities, only special closures and SMRs will be included in the marine mammal analyses.

Table 9-1. Known important prey items of Brandt's Cormorant, Pelagic Cormorant, Common Murre, Pigeon Guillemot, harbor seal, Steller sea lion, harbor porpoise and gray whale

Note: Most fish taken by seabirds are in the juvenile stage.

Species	Prey	Preferred Foraging Habitat
Brandt's Cormorant	Fish Osmerid smelt Short-belly rockfish <i>Sebastes jordani</i> Yellowtail rockfish <i>Sebastes flavidus</i> Other rockfish <i>Sebastes</i> spp. Pacific sandlance <i>Ammodytes hexapterus</i> Speckled sanddab <i>Citharichthys stigmaeus</i> Northern anchovy <i>Engraulis mordax</i> Pacific herring <i>Clupea pallasii</i> Pacific staghorn sculpin <i>Leptocottus armatus</i> <i>Hemilepidotus</i> spp. (Cottidae) Other sculpins (Cottidae) Pacific tomcod <i>Microgadus proximus</i> Northern Pacific hake <i>Merluccius productus</i> Shiner perch <i>Cymatogaster aggregata</i> Pacific tomcod <i>Microgadus proximus</i> Spotted cusk-eel <i>Chilara taylori</i> Butter sole <i>Isopsetta isolepis</i> Rex sole <i>Glyptocephalus zachirus</i> English sole <i>Parophrys vetulus</i>	Soft bottom
	Invertebrates Market squid <i>Loligo opalescens</i>	

Species	Prey	Preferred Foraging Habitat
Common Murre	Fish	
	Osmerid smelt	
	Northern Anchovy <i>Engraulis mordax</i>	
	Pacific herring <i>Clupea pallasii</i>	
	Market squid <i>Loligo opalescens</i>	
	<u>Juvenile rockfish (esp. Short-belly <i>Sebastes jordani</i>)</u>	
	<u>Pacific sanddab <i>Citharichthys sordidus</i></u>	
	<u>Juvenile Salmonids</u>	
Pelagic Cormorant	Fish	Submerged reefs
	Short-belly rockfish <i>Sebastes jordani</i>	
	Yellowtail rockfish <i>Sebastes flavidus</i>	
	Other rockfish <i>Sebastes</i> spp.	
	Sculpins (Cottidae)	
	<i>Coryphopterus nicholsii</i>	
	<i>Chilara taylori</i>	
	Invertebrates	
Shrimp <i>Spirontocaris</i> spp.		
Pigeon Guillemot	Fish	Submerged reefs
	Rockfish <i>Sebastes</i> spp.	
	Pacific sanddab <i>Citharichthys sordidus</i>	
	Blennies (Clinidae)	
	Sculpins (Cottidae)	
	Gunnels (Pholidae)	
	Spotted cusk-eel <i>Chilara taylori</i>	
Invertebrates		
Red octopus <i>Octopus rufescens</i>		

Species	Prey	Preferred Foraging Habitat
Harbor seal	Fish Rockfish <i>Sebastes</i> spp. Pacific sandlance <i>Ammodytes hexapterus</i> Plainfin midshipman <i>Porichthys notatus</i> Speckled sanddab <i>Citharichthys stigmaeus</i> Northern anchovy <i>Engraulis mordax</i> Pacific herring <i>Clupea pallasii</i> Pacific staghorn sculpin <i>Leptocottus armatus Hemilepidotus</i> spp. (Cottidae) Other sculpins (Cottidae) Pacific tomcod <i>Microgadus proximus</i> Northern Pacific hake <i>Merluccius productus</i> Shiner perch <i>Cymatogaster aggregata</i> Spotted cusk-eel <i>Chilara taylori</i> Butter sole <i>Isopsetta isolepis</i> Rex sole <i>Glyptocephalus zachirus</i> English sole <i>Parophrys vetulus</i> Salmonid Lamprey <i>Lampetra tridentata</i> Hagfish <i>Eptatretus</i> spp Walleye <i>Pollock Theragra chalcogramma pollock</i> Starry flounder, <i>Platichthys stellatus</i> Pile perch, <i>Rhacochilus (Damalichthys) vacca</i> Invertebrates <i>S</i>hrimp <i>Spirontocaris</i> spp. Market squid <i>Loligo opalescens</i> <i>Octopoda</i> spp. Crustacea Bivalve mollusk	

Species	Prey	Preferred Foraging Habitat
Steller sea lion	Fish	
	<u>Pacific Hake <i>Merluccius productus</i></u>	
	<u>Pacific Lamprey <i>Lampetra tridentata</i></u>	
	Walleye pollock	
	Pacific herring <i>Clupea pallasii</i>	
	<u>Rockfish <i>Sebastes</i> spp.</u>	
	<u>Smelt (Osmeridae)</u>	
	<u>Sculpins (Cottidae)</u>	
	<u>Sandlance <i>Ammodytes hexapterus</i></u>	
	Capelin <i>Mallotus villosus</i>	
	Pacific cod <u><i>Gadus macrocephalus</i></u>	
	Salmon <u><i>Oncorhynchus</i> spp.</u>	
	<u>Sculpins (Cottidae)</u>	
	Flatfishes	
	Rockfish spp.	
	Invertebrates	
Market squid <i>Loligo opalescens</i>		
Octopus spp.		
Squid spp.		
Harbor porpoise	Fish	
	Northern anchovy <i>Engraulis mordax</i>	
	Spotted cusk eel <i>Chilara taylori</i>	
	Rockfish <u><i>Sebastes</i> spp.</u>	
	Pacific hake <i>Merluccius productus</i>	
	Pacific sardine <u><i>Sardinops sagax caeruleus</i></u>	
	Pacific herring <i>Clupea pallasii</i>	
	Plainfin midshipmen <i>Porichthys notatus</i>	
	Pacific sanddab <i>Citharichthys sordidus</i>	
	Pacific tomcod <i>Microgadus proximus</i>	
Invertebrates		
Market squid <i>Loligo opalescens</i>		
Gray whale	Invertebrates	Sandy bottom, rock bottom
	<i>Diastylopsis dawsoni</i>	
	Atylus tridens	
	Jassa spp.	
	Ischyrocerus spp	
	Gammaridean spp.	
	Thysanoessa spinifera	
	Crab larvae (zoea stage)	
<i>Neomysis rayii</i>		

Sources for Table 9-1: Data on seabird prey items from Ainley, D.G., C.S. Strong, T.M. Penniman, and R.J. Boekelheide. 1990. The feeding ecology of Farallon seabirds. Pp. 51-127 in (D.G. Ainley and R.J. Boekelheide, eds.), *Seabirds of the Farallon Islands: Ecology, Dynamics, and Structure of an Upwelling-system Community*. Stanford University Press, Stanford, California. Data on harbor seal prey items from Harvey JT, Helm R, Morejohn G. (1995) Food habits of harbor seals inhabiting Elkhorn Slough, California. *Calif. Fish and Game*. 81:1-9; Antonelis, G.A. and C.H. Fiscus. 1980. Steller Sea Lion Diet from Pitcher 1981, *Fish. Bull.*, Gray whale prey from Jenkinson 2002 MS thesis HSU.

Table 9-2. Proposed activities that will qualify (Yes) or disqualify (No) an SMCA for inclusion in each seabird analysis

Activity	Breeding Colony/Hot Spots Analysis	Roost Analysis	Near-colony Foraging Analysis	Neritic Foraging Analysis	Estuary / Beach Analysis
Coonstripe shrimp and spot prawn (trap)	No	No	No	No	Yes
Pacific halibut (H&L)	No	No	No	No	Yes
Surf and night smelts (dip net, a-frame net, cast net)	Yes	Yes	Yes	Yes	No
Salmon – <u>Recreational</u> (H&L or troll in waters >50m depth)	Yes	Yes	No	No	Yes
<u>Salmon – Commercial (H&L or troll in waters >50m depth)</u>	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>
Salmon – <u>Recreational</u> (troll in water <50m depth)	<u>YesNo</u>	<u>YesNo</u>	No	No	Yes
<u>Salmon – Commercial (troll in water <50m depth)</u>	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>
Salmon – <u>Recreational</u> (H&L in waters <50m depth)	No	No	No	No	Yes
<u>Salmon – Commercial (H&L in waters <50m depth)</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>Yes</u>
Coastal pelagic finfish (H&L, round-haul net, dip net)	Yes	Yes	No	No	No
Dungeness crab – <u>Recreational</u> (trap, hoop-net, diving)	No	No	No	No	Yes
<u>Dungeness crab – Commercial (trap, hoop-net, diving)</u>	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>
Smelt (H&L, dip net)	Yes	Yes	No	No	No
Redtail surfperch and other surfperch (H&L from shore)	Yes	Yes	Yes	Yes	No
Surfperch (H&L)	No	No	No	No	No
California halibut (H&L)	No	No	No	No	No
Clams (intertidal hand harvest)	Yes	Yes	Yes	Yes	No
Turf algae (intertidal hand harvest)	Yes	Yes	Yes	Yes	No
Lingcod, cabezon and rockfishes and greenlings (H&L, spearfishing, trap)	No	No	No	No	No
Red abalone (free-diving)	No	No	Yes	Yes	No
Urchin (diving)	No	No	No	No	?
Rock scallop (diving)	No	No	No	No	<u>?No</u>
Mussels (hand harvest)	Yes	Yes	Yes	Yes	No
Bull kelp (hand harvest)	No	No	No	No	No
Ghost shrimp (hand harvest)	Yes	Yes	Yes	Yes	No
Sea palm (intertidal hand harvest)	<u>YesNo</u>	<u>YesNo</u>	<u>YesNo</u>	Yes	No
Canopy-forming algae (intertidal hand harvest)	<u>YesNo</u>	<u>YesNo</u>	<u>YesNo</u>	Yes	No

Works Cited in Chapter 9

Calambokidis, J., J.D. Darling, V. Deecke, P. Gearin, M.I. Gosh, W. Megill, C.M. Tombach, D. Goley, C. Toropova and B. Gisborne. 2002. Abundance, Range and Movements of a Feeding Aggregation of Gray Whales from California to Southeastern Alaska in 1998. *Journal of Cetacean Research and Management* 4(3):267–276.

Carney, K.M. and W.J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. *Waterbirds* 22:68-79.

Danufsky, T. and M.A. Colwell. 2003. Winter shorebird communities and tidal flat characteristics at Humboldt Bay, California. *The Condor* 105:117-129.

Mills, K. L., Sydeman, W.J. and Hodum, P. J. (Eds.), 2005. The California Current Marine Bird Conservation Plan, v. 1, PRBO Conservation Science, Stinson Beach, CA.

Rojek, N.A., M.W. Parker, H.R. Carter, and G.J. McChesney. 2007. Aircraft and vessel disturbances to Common Murres *Uria aalge* at breeding colonies in central California, 1997–1999. *Marine Ornithology* 35: 67–75.