The California Current Marine Bird Conservation Plan

Chapter 11

Seabird Conservation Strategies and Needs

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CHAPTER 11. SEABIRD CONSERVATION STRATEGIES AND NEEDS

11.1 MITIGATION AND ELIMINATION OF BYCATCH

For the conservation of seabirds of the CCS, it is essential that injury and mortality from fishery bycatch is reduced and even eliminated. As long as fisheries exist, bycatch will be of concern. However, there are certain measures that fishers can take to reduce the risk of seabird entanglement.

It is of great importance to: (1) have observer programs that can identify the problem fisheries, (2) have knowledge of the seabird species affected and the areas where the problem exists, (3) have measures developed that can be taken to reduce or eliminate bycatch, and (4) work with fishers to accomplish this goal.

The appropriateness of measures that help decrease seabird bycatch and the effectiveness of these measures depend on several factors, including location where the fishery operates, season of operation, seabird species involved in the interactions, and environmental factors, among others.

Measures designed to mitigate seabird bycatch can target several different goals: decrease the attractiveness of the vessels to seabirds; prevent seabirds from becoming hooked; and if a seabird gets hooked, reduce the possibility of death (*1*).

Since 1991, mitigation measures to reduce incidental seabird bycatch have been developed and evaluated for effectiveness. In both pelagic and demersal longline fisheries, only five countries have active research programs designed to test the effectiveness of mitigation measures for addressing seabird bycatch: Australia, Japan, New Zealand, United Kingdom, and United States (*2*).

Several types of mitigation measures have been developed or are currently under development for reducing seabird bycatch in longlines. Table 11.1 summarizes these mitigation measures, their stage of development and testing, relative cost, and their effectiveness at reducing bycatch.

At an international level, a number of measures, both governmental and non-governmental, have been developed to address issues of seabird bycatch. In an effort to reduce seabird bycatch in longline fisheries in the high seas and in exclusive economic zones (EEZs), the Food and Agriculture Organization (FAO) of the United Nations created an International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries in 1999 (IPOA-Seabirds) (*3*).

As one of the recommendations of the IPOA-Seabirds, individual nations were encouraged to develop a National Plan of Action for reducing incidental catch of seabirds in longline fisheries (NPOA- Seabirds). Currently, NOAA Fisheries (formerly the National Marine Fisheries Service), the U.S. Fish and Wildlife Service, and the State Department are working together on an Interagency Seabird Working Group to implement the NPOA.

Seabirds, as highly migratory animals, do not necessarily remain within U.S. waters; many species frequent international waters as well as waters under the jurisdiction of other countries. This situation can add further levels of complexity to seabird conservation efforts. For example, longline fisheries operating outside of U.S. waters have high seabird bycatch rates, although there is little documentation and observer programs are rare, if present at all (*2*). Most vessels are required to submit catch data to fisheries agencies of their respective countries in addition to filling out logsheets, although logsheets do not provide data on bycatch of marine mammals, turtles, or seabirds.

Some longline fisheries do monitor bycatch. In the swordfish fisheries operated by Japan, Chile, and Australia, bycatch is monitored on Japanese and Australian vessels (*4*). However, observer coverage in these fisheries is not entirely random and logbook data may be incomplete or inaccurate.

The measures that appear to be most effective at reducing seabird bycatch in longlines are night line-setting, sinking hooks faster by adding weights, using bird-scaring lines, and enacting area and seasonal closures (*1, 5*) (Table 11.1). Additional strategies are being explored to develop new technologies, build awareness of seabird conservation among fishers, and encourage the use of mitigation measures (*1, 2*).

In response to growing recognition of the threats posed to seabirds by fisheries, several international efforts have been initiated to increase public awareness of the problem as well as cooperation and coordination between nations. A prominent example of such efforts is the "Save the Albatross" campaign begun by BirdLife International in 2000 (http://www.birdlife.net/seabirds/index.cfm). The first workshop to address seabird mortality in longline fisheries was held in Hobart, Australia in 1995, with a second workshop held in Honolulu, Hawaii in 2000. These workshops specifically addressed the mortality of albatrosses and petrels. In 1999, the Pacific Seabird Group held a symposium on seabird bycatch which resulted in production of the book, *Seabird Bycatch: Trends, Roadblocks, and Solutions* (*6*).

***Table 11.1** – Mitigation measures for decreasing seabird bycatch, the stage of their development and testing, their relative cost, and their effectiveness in reducing bycatch.*

MITIGATION MEASURE	DEVELOPMENT STAGE	TESTED	RELATIVE COST	CATCH REDUCTION EFFICIENCY
Reduce bait visibility	in use	in use	widely none, locally high initial	very high
Reduce attractiveness of vessel	fully	unknown	moderate initial	very high (line hauling)
Weighted line	partly	unknown low ongoing	high initial,	very high
Brickle curtain	fully	unknown	low	very high
Preferential licensing for vessels	concept only	no	unknown	high
Bird-scaring line	fully	yes, some	low ongoing	high but variable
Area and seasonal closures	not used	no	unknown	high potential
Artificial bait or lures	concept only	no low ongoing	high initial,	high potential
Below-the-water setting	partly	unknown	high initial	total
Release live birds	fully	unknown	no	moderate potential
Hook modifications	concept only	no	moderate initial	moderate potential
Thawed bait	partly	yes	low ongoing	moderate potential
Punctured swim bladder	partly	yes	low ongoing	moderate potential
Line-setting machine	fully	partly	moderate initial, low ongoing	moderate potential
Bait casting machine	fully	partly	high initial	moderate potential
Water cannon	fully	limited	moderate initial	unknown, low likelihood
Acoustic deterrent	fully	limited	low initial	unknown, low likelihood
Magnetic deterrent	fully	limited	moderate initial	very low likelihood

Observer Programs

Observer programs are crucial for documenting fisheries-induced seabird mortality and injury, although very little quantitative or qualitative information exists regarding seabird bycatch for most of the fisheries that operate in the North Pacific.

Categorization of fisheries under the Marine Mammal Protection Act's (MMPA) List of Fisheries (LOF) determines whether or not a specific fishery needs to comply with certain regulations imposed by the MMPA, such as mandatory observer coverage. However, the LOF only covers fisheries that operate within U.S. waters, notwithstanding the fact that several foreign fisheries also pose a significant threat to seabirds.

Although the majority of observer programs that document seabird bycatch were originally developed to monitor and minimize sea turtle and marine mammal bycatch, seabirds have indirectly benefited from this monitoring effort; much of the currently available information on seabird bycatch has been a result of this indirect monitoring. Currently, observer data are being collected for only 8 of the 17 fisheries that have documented seabird bycatch (see Table 6.1).

Rigorous scientific studies need to be conducted to develop gear and/or fishing techniques that have the primary goal of zero bycatch. These types of studies require an adaptive management approach, such that once the studies are completed and new regulations are implemented, the fishery will be monitored to document that the bycatch does decrease as expected. If it fails to do so, the regulations may need to be changed. Recent studies in Hawaii have provided promising results regarding the use of underwater setting chutes to eliminate the bycatch of albatrosses on pelagic longline gear.

Measures specifically targeted to help reduce seabird bycatch include the following:

1. High mortality of marine mammals, sea turtles, and seabirds caused a permanent closure of the set gillnet fishery in California (approved in September 2002), prohibiting the use of gill and trammel nets in the area from Point Reyes, Marin County to Point Arguello, Santa Barbara County, in waters 60 fathoms or less.
2. As one of the outcomes of California's Marine Life Management Act (MLMA), the development of Fisheries Management Plans (FMP) is required for all fisheries. These plans must address issues of bycatch. The MLMA requires a shift in fisheries management from a focus on individual populations to a focus on the sustainability and resiliency of the entire nearshore ecosystem, including seabirds.
3. The Washington Fish and Wildlife Commission adopted regulations in 1997 to reduce seabird bycatch (mostly Common Murre *Uria aalge* and Rhinoceros Auklet *Cerorhinca monocerata*) in the non-tribal Fraser River sockeye fishery in northern Puget Sound. These regulations included the elimination of dawn fishing and the use of modified nets that had 20-mesh visual alerts (*7*). These measures have only been partially effective because they do not apply to the tribal fisheries.
4. Mexican fisheries regulations set by the Ley de Pesca (D.O.F. 25-VI-1992) allow for fisheries closures to prevent overharvesting of target species. However, currently there are no closures based on reserving prey resources for seabird species of the Baja California islands (Q. García, pers. comm.).
5. In British Columbia, a 1998 workshop that focused on seabird bycatch issues led to the formation of a Pacific Seabird Bycatch Working Group in 2000. This group is active in determining levels of seabird bycatch in the different fisheries, training observers, and developing seabird salvage programs.

11.2 PROTECTING FOOD WEBS: MARINE RESERVES AND MINIMIZING FISHERIES PREY DEPLETION

The total area of the world's marine protected areas currently covers only about 0.5% of the world's oceans, while 0.01% of the sea is legally protected from fishing. Estimates show that more than 40% of the world's marine fishery populations are profoundly exploited, with an additional 25% overexploited, exhausted, or recovering. Prominent marine scientists are supporting a marine environment management program based on designating 20-30% with no-take and fully protected status (*9*).

Fully protected marine reserves are an emerging tool for marine conservation and management. Defined as "areas of the ocean completely protected from all extractive and destructive activities," fully protected marine reserves (hereafter, simply "marine reserves") have explicit prohibitions against fishing and the removal or disturbance of any living or nonliving marine resource, except as necessary for monitoring or research to evaluate reserve effectiveness.

Sometimes called "ecological reserves" or "no-take areas," marine reserves are a special class of "marine protected areas" (MPAs). MPAs are defined as "areas of the ocean designated to enhance conservation of marine resources." The actual level of protection within MPAs varies considerably; most allow some extractive activities such as fishing, while prohibiting others such as drilling for oil or gas. A "network of marine reserves" is "a set of marine reserves within a biogeographic region, connected by larval dispersal and juvenile or adult migration" (*10-12*).

By protecting geographical areas, including both resident species and their biophysical environments, marine reserves offer an ecosystem-based approach to conservation or fisheries management, which is distinct from the traditional focus on single-species conservation or management (*10, 13, 14*).

Halperin (*15*) quantitatively analyzed 69 studies of marine reserves of various sizes and found the diversity of communities and the mean size of the organisms within a reserve were between 20% and 30% higher relative to unprotected areas. The density of organisms was roughly double in reserves, while the biomass of organisms was nearly triple. The establishment of marine reserves increased catch and size of individuals caught in adjacent fisheries (*16*).

Marine reserves facilitate the recovery of degraded marine habitat (*17*), and it is believed that habitat protection in reserves underpins fish productivity and provides the link between reserves and augmented catches (*18*).

The few studies investigating fisheries effects of marine reserves have occurred in tropical and subtropical marine environments, where most reserves have been established; however, modeling of fisheries-marine reserve interactions has yielded promising results.

A wide range of models suggest reserves will be most effective for species that are relatively sedentary as adults, but produce offspring that disperse widely. Adult spawning stocks will be secure from capture in reserves, while their offspring disperse freely into fishing grounds. Such species include animals like reef fish, mollusks, and echinoderms, and models typically indicate that when they are over-fished, catches will be higher with reserves than without.

By contrast, the same models suggest that reserves will be ineffective for animals that are mobile as adults—species like cod, tuna, or sharks. These species remain vulnerable to fishing whenever they move outside reserves. Unfortunately, most models lack sufficient realism to effectively gauge reserve effects on migratory species. They usually assume that individuals are homogeneously distributed in a uniform sea and move randomly. They also assume that fishers hunt at random. Neither is true. For centuries, fishers have targeted places and times when their focal species are most vulnerable to capture. Protecting these sites and/or temporal windows could have disproportionately large effects on stocks.

Furthermore, models rarely take into account possible benefits from improvements in habitat within reserves. Such changes, like increased biomass and complexity of bottom-living organisms, could alter fish movement patterns and reduce natural mortality rates in ways that enhance reserve benefits. A simple model of reserve effects on a migratory fish species that incorporated spatial variation in vulnerability to capture showed that strategically placed reserves can offer benefits in the form of increased spawning stock and catch, especially when fishing intensities are high (*19*).

The Ecoseed MPA model considered both multiple fleets and ecosystem-scale dynamics for the North Sea. This realistic model suggested that policy goals that did not include ecological considerations negatively impacted rents obtained by the different fishing sectors.

Size of the MPA was another important variable; the conservation value of an MPA was negatively impacted unless the MPA was very large. The Ecoseed model also suggested that policy goals based solely on conservation negatively impacted most fisheries. Under policy options that included ecological considerations, maximum benefits were derived from an MPA that covered 25-40% of the North Sea, situated along the southern and eastern coasts.

Finally, the Ecoseed model suggested that small-to-substantial positive impacts to most species and fleets occurred by excluding only the trawl fishery from the MPA; this relative impact depended on the level of interaction between the trawl fleet and the target species of other fleets (e.g., through bycatch) (*20*).

Studies of effects of marine reserves on marine birds are slowly forthcoming. Satellite data from foraging penguins indicated that marine reserves near colonies may effectively protect gentoo penguins, but will be inadequate to protect other penguin species.

Many seabird species are wide ranging and, thus, would require marine reserves on immense spatial scales to protect their full foraging range. For such highly mobile species, marine zoning (regulating location and timing of human activities over large areas of the marine environment) will be required to minimize seabird-human use conflicts (*21*).

11.3 SEABIRD RESTORATION

Due to their proximity to highly populated areas, major shipping lanes, and commercially important fishing grounds, seabird communities in the CCS region have been subjected to numerous anthropogenic impacts. Oil spills, gillnet fisheries, habitat degradation, introduction of non-native plants and animals, and disturbance to breeding colonies and roost sites have all had detrimental effects on seabirds. These effects range from increased mortality and decreased reproductive success to large-scale population reductions and loss of breeding colonies. Restoration is becoming an increasingly popular and effective management tool to counteract these effects and aid in the conservation of seabirds (*22*).

Restoration has been defined by the Pacific Seabird Group as "any action taken directly or indirectly to manipulate a system for the repair or recovery of injured populations, colonies, or communities" (*23*). Unlike previous definitions by NOAA and the U.S. Department of the Interior (reviewed in Warheit et al., (*23*)), this does not consider natural recovery as restoration unless a specific management action is taken to facilitate the recovery.

Successful restoration plans aim to return populations, communities, or systems to the level and function that would have occurred had the disturbance not taken place.

Successful restoration of seabird communities requires a few key pieces of information: 1) reliable estimates of the population size and trends, productivity, and survival prior to perturbation, 2) reliable injury assessment; that is, information on the number of birds directly or indirectly affected, 3) knowledge of the factors (both natural and anthropogenic) that may limit population growth or recovery, and 4) regular monitoring as a follow-up to the restoration initiative in order to gauge its effectiveness.

Past seabird restoration efforts have focused on four main strategies:

1. Reintroduction or supplementation of populations:

Reintroduction of species or supplementation of existing populations is perhaps the most direct method for restoring a seabird community. Efforts have been made involving translocation of adults or chicks from existing colonies to those that had been reduced or extirpated (*24*). Social attraction is another effective method for drawing adults and first-time breeders into a new colony. This technique employs a variety of methods, including decoys, mirrors, and call playback, to entice birds from nearby colonies to settle and eventually reestablish breeding (*25-27*). Captive rearing and release is another option that has been employed in the restoration of species such as the California Condor (*Gymnogyps californianus*), but is not frequently used with seabirds due to relatively high costs and low returns for the investment (*23*).

2. Creation or enhancement of seabird habitat:

Habitat enhancement is most effective where suitable habitat is either limited or degraded due to perturbation. Installation of artificial nest boxes has been an effective means of restoration for cavity-nesting seabirds such as the Rhinoceros Auklet, Cassin's Auklet (*Ptychoramphus aleuticus*), and Pigeon Guillemot (*Cepphus columba*) (*28*). Artificial ledges or structures for cliff-nesting species such as Pelagic Cormorants (*Phalacrocorax pelagicus*) and Common Murres have also been successful (S. Hatch, pers. comm.). Enhancement of habitat may also be accomplished through the removal of introduced plant species and/or reestablishment of native vegetation. Efforts such as these may provide additional available habitat, slow erosion (particularly important for burrowing seabirds), and mitigate damages caused by human disturbance (*29*).

3. Management of human activities around colonies:

Managing human activities can have a positive restorative effect by removing or lessening impacts on the colony and allowing natural recovery. Creation of protected areas, enhanced regulation of fisheries that compete with seabirds for food or result in bycatch, reductions of disturbance through public education and closure of sensitive areas, and regulation of pollutants are all ways to reduce negative anthropogenic impacts on seabird communities.

4. Management of non-native species:

Seabirds are adapted to breed in remote locations and on islands that are free of mammalian predators. The accidental introductions of mice and rats and the intentional introduction of cats, foxes, and rabbits have had devastating impacts on seabird colonies (*30*). These species prey on eggs, chicks, and adults and in some cases compete for available resources such as nesting habitat (*28*). Eradication of these introduced predators and prevention of reintroduction allow colonies to recover from disturbance (*21, 31*). Non-native plants can also have detrimental effects on seabird communities by altering the habitat and making it unsuitable for use by seabirds (*21*).

Regardless of the methods employed, all restoration efforts require direct management action to preserve or enhance seabird resources and require substantial investment of time and money by managers and researchers to ensure their success. It is likely that restoration will become increasingly important in the future management of threatened or highly impacted seabirds.

11.4 SEABIRD CONSERVATION IN RELATION TO HABITAT THREATS

The Pacific coastlines of the United States, British Columbia, and Baja California and their offshore islands provide not only diverse breeding and roosting habitat but also rich feeding grounds for millions of seabirds, both migrants and residents. Nesting habitat and roosting sites, free of disturbance and predators, are critical to the survival of seabird species, yet habitat degradation and alteration continue to pose a serious threat to seabird populations in the CCS region.

Habitat usage by seabirds can be broadly lumped into three major categories: 1) nesting and roosting habitat, 2) foraging habitat, and 3) at-sea habitat (*21*).

Threats to nesting and roosting habitat may include direct damage caused to breeding and roosting sites through coastal development; introduction of non-native plant species which alter habitat, thereby making it unsuitable to use by seabirds; increased erosion due to loss of vegetation or overgrazing by introduced animals; and mining or guano harvesting operations. Indirect damage is also a concern. Increased disturbance caused by human encroachment around important seabird breeding and roosting areas and increased boat traffic and aircraft overflights can have serious detrimental impacts. Repeated disturbance may force seabirds to use less-preferred habitats, thereby increasing their energy expenditure and/or vulnerability to predation. Additionally, the amount of time spent traveling to and from food sources may increase (*32*), causing added stress.

Although they are most conspicuous when concentrated at breeding colonies, seabirds spend the majority of their life on the oceans. Effective conservation of seabirds must aim to protect not only the terrestrial habitats important for breeding and roosting, but also the marine habitat that is the source of their sustenance. Marine habitat protection is equally important for the many migrant species (such as the Sooty Shearwater *Puffinus griseus* and Black-footed Albatross *Phoebastria nigripes*) that rely on the marine resources of the CCS region, but do not breed within it.

Threats to marine habitat include, but are not limited to, oil spills, increased pollutant levels, destruction of benthic habitats through bottom trawling, overharvesting of prey species or direct competition with fisheries, alteration of coastal ocean communities through sediment runoff, and oil and natural gas exploration (*21*).

Protection of marine habitat for seabirds requires detailed baseline data on seabird abundance and distribution, foraging techniques and locations, and potential interactions with human interests such as fisheries. This information is critical to natural resources damage assessment when catastrophes such as oil spills occur, as well as to managers attempting to craft regulations to reduce harmful interactions with fisheries (both direct and indirect) and decrease human disturbance. Prey consumption models (see Chapter 5) are also important as baseline data that can yield information on where seabirds forage and how much food they require, which is essential information for responsible management of current and emerging fisheries.

National marine sanctuaries, marine protected areas, and marine reserves can indirectly provide protection to seabirds by limiting disturbance around roosting and breeding sites and by protecting important feeding areas and resources. Comprehensive seabird conservation programs require the inclusion of both nesting habitat and important roost sites within their management scheme to protect sites from disturbance and habitat degradation. In addition, it is essential to understand habitat usage patterns by seabirds, especially concentrations and seasonal distributions of seabirds near major colonies, at sea, and in nearshore waters, where anthropogenic threats are numerous and effects are potentially substantial.

11.5 SEABIRD CONSERVATION IN RELATION TO CLIMATE VARIABILITY

An increased understanding of fundamental processes affecting marine environments and ecosystems of seabirds is fundamental to effective management and sound conservation decisions for marine birds. Indications are that "bottom-up" oceanographic processes create suitable oceanic seabird habitat and affect seabird population dynamics in both tropical and temperate regions of the Pacific Ocean. The manner in which year-to-year and, possibly more importantly, decade-to-decade changes in ocean characteristics affect ocean habitats, foraging ecology, and demographic processes of Pacific Ocean marine birds will require renewed attention in the next decade.

Climate variability can result in periods of depressed reproductive success, decreased survival of adults and juveniles, reduced colony recruitment, and overall population declines (*33-35*). The coupling of multiple climatological events, such as Pacific Decadal Oscillation (PDO), El Niño, and global warming, may have devastating effects on seabirds. Furthermore, the understanding of natural climate variability is crucial to the ability of managers to accurately assess the impacts of perturbations and the probability of recovery (*23*). A catastrophic event such as an oil spill would be more devastating to seabird communities during periods of low productivity and survival related to climate variability, than at other times.

A coordinated study of the effects of the next few El Niño/La Niña events will provide novel information concerning ecosystem response after a shift in the state of the PDO (*36*). For the first time in nearly 30 years, the effects of an El Niño/La Niña can be investigated relative to a prevailing "cold-water" regime in the CCS. The last El Niño event of this nature occurred in 1973, more than 30 years ago, when El Niño had yet to be recognized as part of the natural climate cycle.

In addition, anthropogenic global warming represents a poorly understood threat to ocean processes and the California Current ecosystems (discussed in greater detail in Chapter 5). The ways in which human activities may influence these cycles need to be investigated. However, developing an understanding of the relative effects of anthropogenic factors and natural variability on ocean warming at multiple temporal scales remains a serious conservation challenge.

Functional relationships between seabird life history parameters, demographic traits, and environmental conditions have rarely been established (reviewed by Hamer et al. (*33*)); (*37*), yet knowledge of such relationships is critical. Marine wildlife and ocean managers are just beginning to understand that inherent environmental variability in the CCS is among the causes of marine bird population fluctuations, and management of marine bird resources and marine ecosystems will need to embrace this variability.

The need to both interpret population change and orient appropriate conservation actions in relation to climate variability and change is critical to effective seabird conservation in the CCS and will be equally important when assessing the potential for seabird restoration and recovery.

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