

The dangers of gill netting to seabirds

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Seabird mortality in gill nets has had significant biological and legal consequences

PUBLIC OUTCRY OVER THE MANY thousands of porpoises drowned annually in tuna purse seines during the 1960s and early 1970s spurred the passage of the Marine Mammal Protection Act in 1972. During this same period, the public was less aware of similar "incidental takes" of seabirds in nets set for other fish species. In fact, because so many different bird species are taken in a variety of gear types, the number of birds drowned far surpasses the mortality of marine mammals. Despite various migratory bird treaties, which are designed to provide legal protection for both landbirds and seabirds, the treaties and their implementing laws have not generally been applied.



Fishermen in the north Atlantic remove drowned shearwaters caught in their gill nets, June 1983. Photo/Tony DeGange.

This paper provides an overview of fishery/seabird conflicts in North American waters, and reviews the biological and legal aspects of two specific cases. The case studies are of two very different fisheries in which the taking of seabirds has been well-documented—the Japanese salmon mothership fishery in the North Pacific and the gill and trammel set net fisheries of central and northern California. The first is a large, offshore fishery conducted by a foreign country; the second, a coastal fishery consisting of numerous independent United States fishermen using small vessels.

SEABIRD/FISHERY CONFLICTS IN GREENLAND, CANADA, AND THE UNITED STATES

Alcids, shearwaters, albatrosses, waterfowl, cormorants, loons, and even Osprey have all reportedly been drowned in fishing operations. Birds are caught in nets, traps, and fishing line, but the gear that most frequently entangles them is gill nets which are used to target a variety of commercial fish species on the east and west coasts of North America (Croxall *et al.* 1984).

Research on various fisheries has demonstrated that bird entanglement in

gill nets is correlated with seabird densities and feeding methods (Ainley *et al.* 1981). For this reason, alcids, which dive for prey and often feed in large concentrations near breeding colonies, are commonly caught in gill nets. In western Greenland, salmon gill nets are estimated to have taken 200,000 or more Thick-billed Murres (*Uria lomvia*) annually in the early 1970s. Piatt and Reddin (1984) estimated that this rate was reduced by 80–90% in 1976–1980 when fishing efforts diminished and shifted. However, recent changes in the fishery may have resulted in significant mortality increases.

In Canada, seabird mortality in the Newfoundland salmon drift net and cod bottom-set fisheries is the best studied (Piatt *et al.* 1984; Piatt and Nettleship 1985, 1987). Species most affected were generally those that were abundant, formed large aggregations at breeding colonies and nearby feeding areas, fed heavily on capelin, and were capable of deep diving. Piatt and Nettleship estimated that from 1981–1984, 2% of Newfoundland's 800,000 Common Murres (*Uria aalge*) were drowned in nets each year. Local populations, however, suffered a mortality rate as high as 16.3% annually. The small Razorbill (*Alca torda*) population suffered an alarming 12.4% annual mortality, Northern Gannets (*Sula bassanus*) 2.1% (but over 9% at one of three breeding

sites in 1982), and Atlantic Puffins (*Fratercula arctica*) only 0.2%. Piatt and Nettleship suggest that a substantial reduction of these numbers, without closing the fisheries, is possible based on current knowledge of the fisheries and seabird behavior.

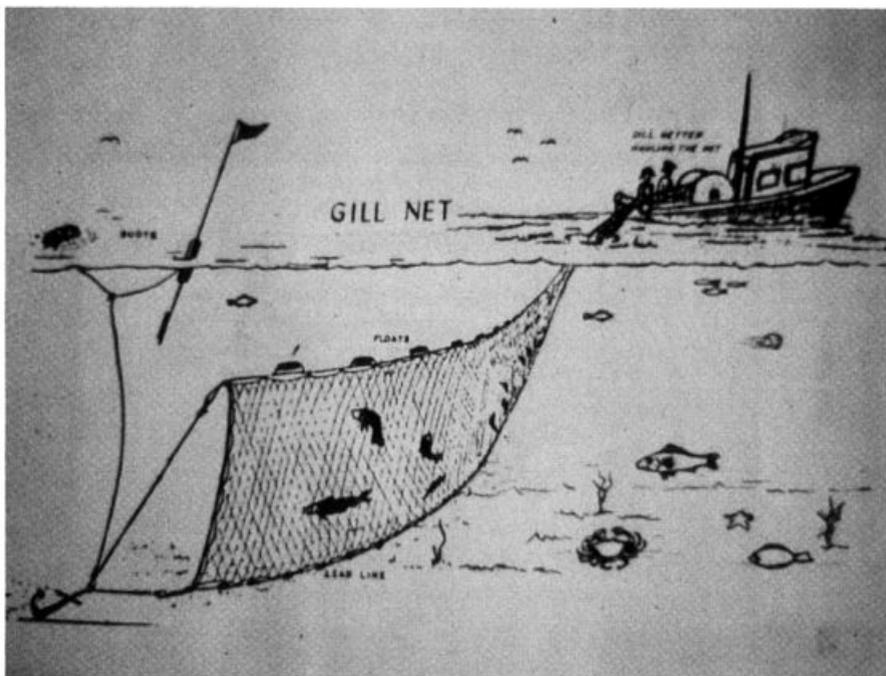
The recent discovery that bottom-set nets in deep water can still take significant numbers of seabirds is a result of the Newfoundland studies. Common Murres have routinely been observed in nets retrieved from depths as great as 180 meters and Atlantic Puffins are commonly seen in nets set in water 60 meters deep.

A salmon drift net fishery in Barkley Sound, British Columbia, was estimated to have killed more than 6% of the breeding population of Marbled Murrelets (*Brachyramphus marmoratus*) in 1980 (Carter and Sealy 1984).

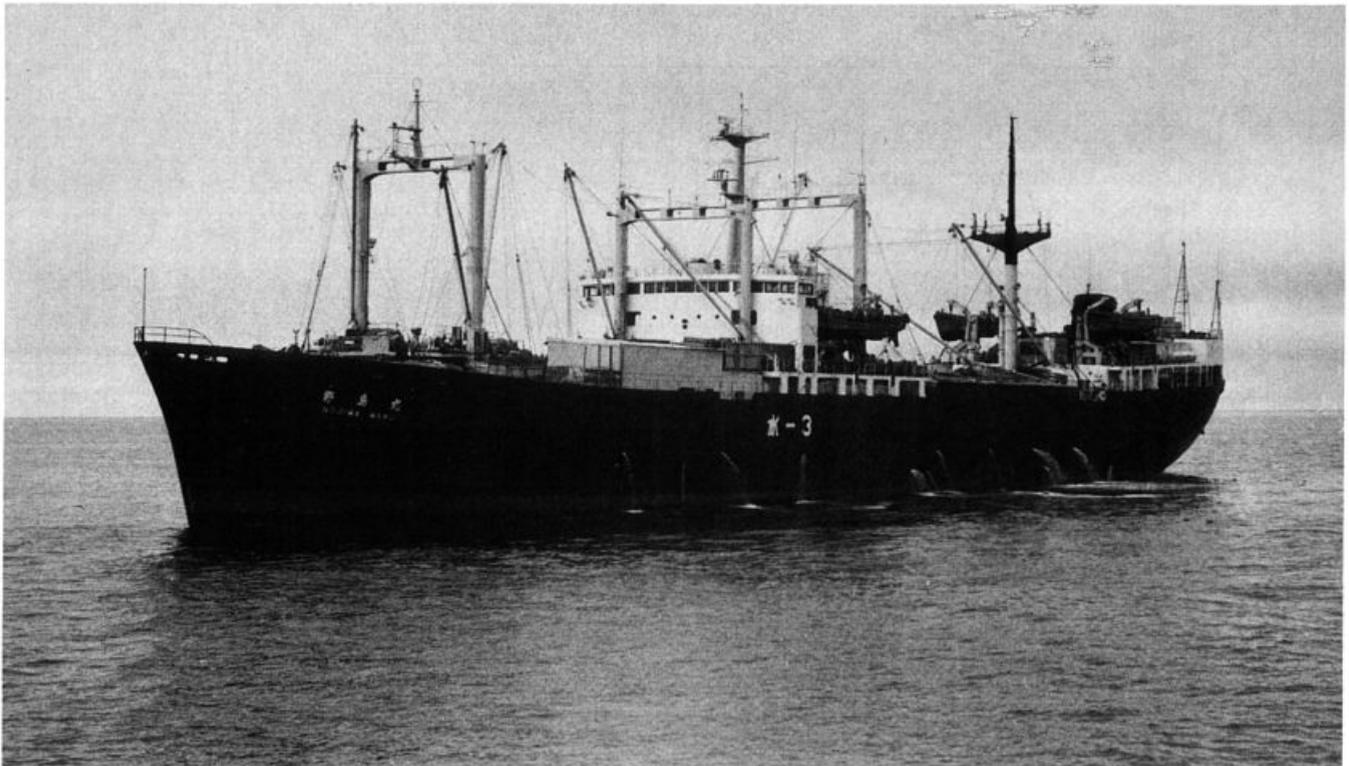
With the exception of Japanese salmon drift net fisheries and California set net fisheries, information on seabird mortality in gill and trammel-set net operations in United States waters is largely anecdotal. Salmon fishermen in Puget Sound, Washington, report catching birds in their nets, and Common Murre carcasses have washed up on beaches, but there are no data on the magnitude of the bycatch. In southeastern Alaska, Marbled Murrelet mortality in nets has been reported (Sealy and Carter 1984), and other species are likely taken as well.

The potential for seabird entanglement in gill nets along the Pacific coast is considerable. Uchida (1985) reports more than 7000 salmon gill net boats in United States waters and another 3800 boats that fish at least once each season off British Columbia.

Several fisheries on the east coast reportedly take several different bird species. Anecdotal information exists on the incidental catch of Northern Gannets, Northern Fulmars (*Fulmarus glacialis*), and Sooty Shearwaters (*Puffinus griseus*) in New England bottom fish fisheries (O'Hara, Atkins, and Iudicello 1986), and in Chesapeake Bay, gill nets have been observed entangling Ruddy Ducks (*Oxyura jamaicensis*), Canvasbacks (*Aythya valisineria*), and scaup (*Aythya* sp.) (O'Hara, Atkins, and Iudicello 1986). In South Carolina, waterfowl and loons are the primary bird species caught in 900–1200-foot-long gill nets used to catch shad. Loons are reportedly caught in Great Lakes gill nets as well.



This drawing of a gill net illustrates how the net is "set"—the net is anchored in place while floats keep the nets vertical in the water. Illustration/Paul Wild, Fish & Wildlife Service.



Japanese salmon mother ship. Photo/David Ainley.

NORTH PACIFIC DRIFT NET FISHERIES

Japanese salmon mothership fishery

The most controversial and perhaps best studied fishery, with respect to incidental bird take, is the very large Japanese salmon fishery off Alaska, the only foreign drift net fishing operation in United States waters. Originally, public attention focused on the bycatch of marine mammals, particularly Dall's Porpoises (*Phocoenoides dalli*), but the fishery's massive bird kills have recently become a key issue in the federal government's permit review and in legislation introduced in the United States Congress.

In 1983, the mothership fishery consisted of four processing vessels, or motherships, and 172 catcher boats. The fishery operates primarily in the United States Fishery Conservation Zone, off the western Aleutian Islands, during June and July. Drifting gill nets averaging 16.5 kilometers in length are fished at night. Fishing effort for 1983 was estimated to be 127,710 kilometers of net set (Shima 1985). Most nets have a stretched mesh size of 130 millimeters (Uchida 1985).

The first estimates of seabird mortality in the mothership fishery were

made from research nets with variable mesh size (Sano 1978; King *et al.* 1979). King *et al.* estimated an annual mortality of 75,000 to 250,000 birds. Ainley *et al.* (1981) determined that these estimates were conservative because they did not account for geographic variations in catch rates or the variability of catch rates depending upon mesh size, and because estimates did not include drowned birds that fell free of the nets during retrieval. They observed that catch rates varied logarithmically with distance from the Aleutians (where the birds nest) and were particularly high within 50–75 nautical miles of the islands. Bird mortality rates were also highest in the mesh sizes used in commercial nets. These observations led them to conclude that previous mortality rates should be at least doubled.

In 1981, the Japanese applied for a permit under the Marine Mammal Protection Act to take marine mammals in the course of fishing in the United States Federal Coastal Zone. Negotiations prior to the permit approval included a provision for direct observations to be made by United States personnel aboard the catcher boats. Earlier observations had been limited to Japanese research vessels whose net sets were designed to mimic those of the commercial fishing ships.

Data were collected by United States observers from 1981–1984 (DeGange *et al.* 1985). During this period, 21 species of seabirds were caught (Table 1). Shearwaters, particularly Short-tailed Shearwaters (*Puffinus tenuirostris*) and Tufted Puffins (*Fratercula cirrhata*) made up the bulk of the bycatch. Other species taken in appreciable numbers were Horned Puffins (*Fratercula corniculata*), Thick-billed Murres, and Crested Auklets (*Aethia cristatella*). DeGange *et al.* (1985) estimated that an average of 38,000 Tufted Puffins, 8249 Horned Puffins, and 101,500 Short-tailed Shearwaters were killed annually in the mothership fishery. Annual overall mortality ranged from 96,000 to 251,400, 80% of which occurred in United States waters.

DeGange *et al.* concluded that the removal of tens of thousands of birds annually would not have a significant impact on the overall population of a species, but that the impact on local breeding populations could be significant. In 1986, the United States Fish and Wildlife Service asserted that "local populations of a few nesting species in the western Aleutian Islands, particularly Tufted Puffins, have probably been negatively affected by the salmon fisheries" (Department of the Interior 1986).

Table 1. Number and percent composition of seabirds killed in gill nets of the Japanese salmon mothership fishery within the U.S. Fishery Conservation Zone, 1981–1984.

<i>Species</i>	<i>Number</i>	<i>Percent</i>
Laysan Albatross	14	0.1
Northern Fulmar	331	1.4
Sooty Shearwater	62	0.3
Short-tailed Shearwater	12,086	51.6
Unidentified shearwater	2,227	9.5
Fork-tailed Storm-Petrel	145	0.6
Leach's Storm-Petrel	12	0.1
Pomarine Jaeger	2	0.1
Black-legged Kittiwake	11	0.1
Dovekie	1	0.1
Common Murre	216	0.9
Thick-billed Murre	541	2.3
Unidentified murre	212	0.9
Pigeon Guillemot	2	0.1
Ancient Murrelet	211	0.9
Cassin's Auklet	39	0.2
Parakeet Auklet	95	0.4
Least Auklet	26	0.1
Crested Auklet	751	3.2
Unidentified small alcid	74	0.3
Rhinoceros Auklet	3	0.1
Tufted Puffin	5,124	21.9
Horned Puffin	1,107	4.7
Unidentified puffin	95	0.4
Unidentified bird	35	0.1

Source: DeGange, A. R., D. J. Forsell, and L. L. Jones 1985.

The Japanese renew their permit

In 1986, when the Japanese applied for a permit renewal allowing them to take marine mammals in United States waters, it appeared that the Marine Mammal Protection Act might also afford some protection to seabirds. The Marine Mammal Protection Act requires that full consideration be given to the effect of such a permit on the marine ecosystem and on existing international treaty obligations. "The health of marine bird populations affects, and is affected by, the health of fish stocks and marine mammal populations . . . Part of the reason seabirds are entangled is that they share some of the same food sources as marine mammals and fish" (Center for Environmental Education 1986).

During the permit hearing, although most of the testimony focussed on marine mammals, environmentalists also argued that the permit should be denied owing to the extent of incidental seabird mortality. Testimony emphasized that a bilateral agreement between the United States and Japan, The Convention for the Protection of Migratory Birds and Birds in Danger of Extinction

and Their Environment, prohibits the incidental taking of seabirds. Eighteen of the 21 species caught in the mothership fishery operation are protected by the Convention.

The Convention also recognizes the delicate ecological balance of island environments and provides that each party "shall endeavor to establish sanctuaries" and shall "seek means to prevent damage to such birds and their environment, including especially, damage resulting from pollution of the seas." The high catch rates of birds off the Aleutian Islands and the large quantity of discarded or lost drift net generated by the fishery appears to violate this clause.

One of the final arguments made by environmental groups at the hearing involved the Migratory Bird Treaty Act. Environmentalists argued that the taking of seabirds violated the Act, which implements the Convention with Japan. While the Department of the Interior acknowledged that the "incidental take of migratory birds by Japanese fishermen, as well as United States citizens, is a violation of the Migratory Bird Treaty Act," they contended that the Act's jurisdiction extends only as far

as the United States three-mile limit (Department of the Interior 1981). This opinion is disputed by environmental organizations (Center for Environmental Education 1986).

The Department of Commerce issued a permit to the Japanese in May 1987, allowing them to take marine mammals during their salmon fishing operations (Calio 1987). The permit contained no provisions dealing with seabirds. This decision was largely based on the recommendations of the agency's administrative law judge, who presided over the hearings.

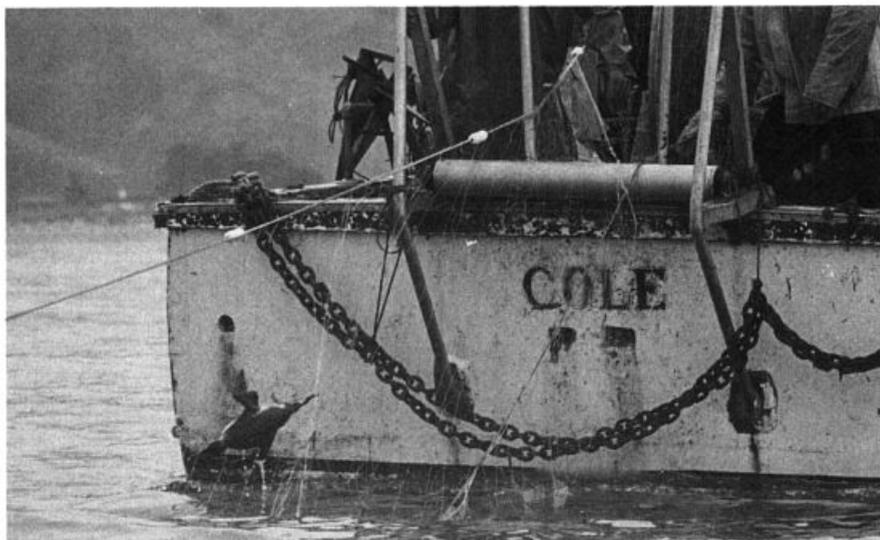
The judge asserted that while the taking of seabirds in such numbers is "unacceptable," the Department of Commerce has no jurisdiction to enforce regulations concerning seabirds under the Marine Mammal Protection Act. The judge also chose not to include seabirds in the ecosystem argument, claiming that the relationship between seabirds and marine mammals is too indirect and that seabirds are "more than one trophic link removed" from marine mammals (Dolan 1987).

If the Department of Commerce had accepted the responsibility for enforcing certain provisions of the Marine Mammal Protection Act, it could have included restrictive clauses protecting seabirds in the Japanese permit. For example, DeGange *et al.* (1985) estimated that modifying the nets by removing the lower portions could reduce alcid mortality 16% with only an 8% reduction in fishing efficiency.

The most effective way of reducing the impact of the fishery on seabirds would be to place geographical restrictions on it (Ainley *et al.* 1981). Reid (1986) calculated that banning the fishery from a 60-nautical-mile zone around the Aleutian Islands would significantly reduce its impact on breeding alcids without having a detrimental effect on the fishery. During the permit review, the Marine Mammal Commission had recommended the creation of a 60-mile net-free zone around the Aleutians. The administrative law judge, however, argued that since the zone would primarily benefit seabirds, it was not a "sufficient or appropriate" reason for him to support the recommendation (Dolan 1987).

In his final decision, the administrative law judge sought to establish who had jurisdiction under the Migratory Bird Act over the area in question. According to the judge, the United States

claims “sovereign rights for the purposes of exploring, exploiting, conserving, and managing natural resources, both living and non-living, within the Exclusive Economic Zone (EEZ),” which extends 200 miles. Therefore, the judge concluded that it would be “within the United States’ internationally recognized authority” for the Department of the Interior, which has statutory responsibility for seabirds, to exercise its jurisdiction beyond the three mile limit. The Department of Commerce, however, rejected the administrative law judge’s conclusion that the Department of the Interior has regulatory authority to limit the Japanese salmon fishery under the Migratory Bird Act (Calio 1987).



Halibut gill net boat with Common Murre drowned in net. June 1982, Stinson Beach, California. Photo/Burr Heneman.

Other North Pacific fisheries

The impact of all types of drift net fisheries is significantly greater, although more speculative, than just the mothership fishery operation. Japan also operates a land-based salmon fishery that deployed about 125,000 kilometers of net in 1983 (Shima). In offshore waters, fishing methods, fishing efforts, and the composition of the seabird bycatch are similar to those of the mothership fishery. Annual mortality in the offshore portion of the fishery has been estimated at 171,000 seabirds (Sano 1978) and 134,000 seabirds (DeGange *et al.* 1985). These estimates are probably low because they are derived from catches in research nets with variable mesh sizes (Ainley *et al.* 1981; DeGange *et al.* 1985).

The Japanese, Korean, and Taiwanese squid drift net fisheries in the North Pacific comprise the largest gill net fishery in the world. Compared to the combined mothership and land-based salmon fisheries, the squid fisheries have a season that lasts three times longer, uses twice the number of vessels, and deploy nets that are twice as long (approximately 30 kilometers average). In 1983, Japanese squid vessels *alone* set almost one million kilometers of net, almost four times that of the mothership and land-based fisheries combined (Shima 1985).

Unfortunately, information on seabird mortality in the squid fishery is very limited (DeGange *et al.* 1985; Ignell *et al.* 1986; L. L. Jones *pers. comm.*). In 1983, research vessels collected data from a few research nets set in the Jap-



This Laysan Albatross and immature Tufted Puffins eloquently illustrate the problems with ghost nets in the North Pacific. Photo/Tony DeGange.

anese squid fishing area and in 1985–1986, United States observers monitored a few commercial squid net sets, where seabird bycatch was almost exclusively shearwaters.

Consistent with the lower seabird densities observed in the squid fishing areas, mortality rates were much lower than in the salmon fisheries. It is unclear, however, whether these lower catch rates might be offset by the much greater level of effort in the squid fishery. If one extrapolates from the limited data—a highly speculative calculation, to be sure—anywhere from 30,000 to 400,000 seabirds may have been killed in each of the years in which net observations were made. This range illustrates the hazard of drawing conclusions from minuscule samples, in this case data collected in a few days or weeks of a several-month-long season, from a small area of the vast North Pacific squid fishery, and from, at most, 30 net sets in a fishery with over 30,000 sets each season. The data do suggest the need for a much more serious monitoring program.

“Ghost fishing” by lost or discarded nets is another cause of seabird mortality. Based on observations of birds retrieved in ghost nets and on loose estimates of lost net, roughly in the neighborhood of 68,000 seabirds might be killed during the first month of ghost fishing by unrecovered nets.

THE CALIFORNIA SET NET FISHERIES: A PROBLEM SOLVED

The gill net problem became obvious in California when thousands of Common Murres and Sooty Shearwaters began stranding on Monterey Bay beaches in 1981. A horrified public soon learned that the nets were also taking marine mammals, including the California Sea Otter (*Enhydra lutris*), a threatened species under the Endangered Species Act.

In 1982, the problem spread north to the Gulf of the Farallones (Sonoma, Marin, San Francisco, and San Mateo counties), where the most heavily affected species were Common Murres, Harbor Porpoises (*Phocoena phocoena*), and Harbor Seals (*Phoca vitulina*). Beaches littered with dead seabirds and marine mammals attracted media attention, caused public outcry, and generated a climate generally supportive of restricting the fisheries.

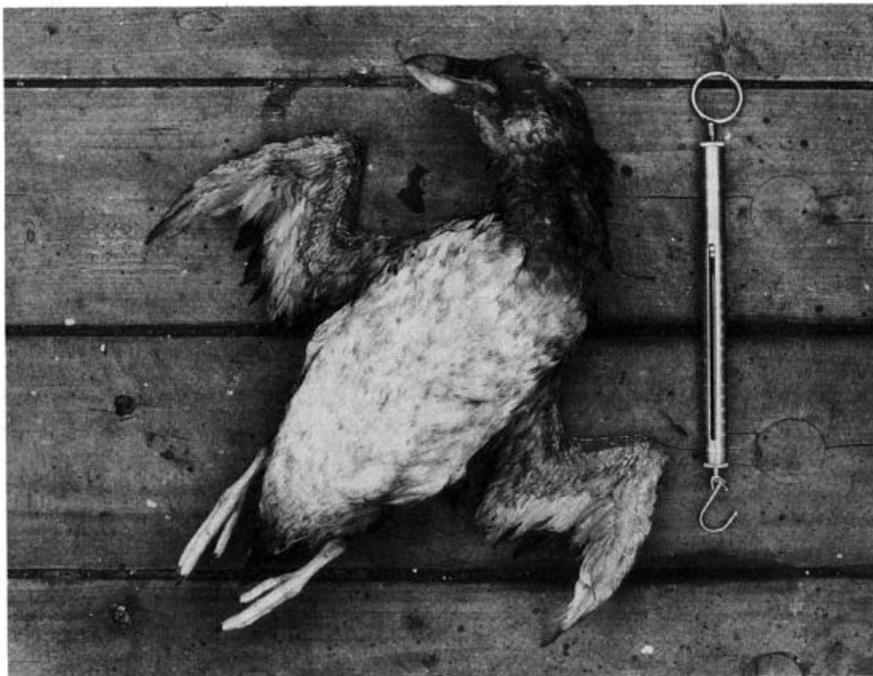
Factors contributing to the conflict between the fisheries and wildlife were a sharp increase in the number of gill net fishermen in the halibut/flounder fisheries and a new gill net fishery for White Croaker (*Genyonemus lineatus*), which contributed heavily to the seabird take. In some areas, the number of fishermen increased 400–500% and actual fishing effort increased even more since

many of the new fishermen not only used longer nets, but used them more intensively. In addition, a shift from twine to monofilament nets seemed to increase the number of birds and mammals taken.

The nets used in these fisheries are “set,” or anchored in place with the lead line resting on the bottom. The float line keeps the 10- to 20-foot-high net panels vertical in the water. The stretched mesh size is usually 8 inches for halibut/flounder and 2.75 inches for White Croaker. Fishermen prefer to use these nets in waters shallower than 10 fathoms (60 feet), but various regulations have caused them to fish in waters up to 15 fathoms (90 feet).

Between 1981 and 1986, estimates of gill netting impacts on wildlife became increasingly refined. In 1981, based on a modest at-sea monitoring program and beached bird data, the California Department of Fish and Game made a very rough estimate of seabird mortality in Monterey Bay—about 20,000 birds (40% Common Murres, 40% shearwaters, and 20% cormorants, scoters, and Pigeon Guillemots, *Cephus columba*).

In 1983, more intensive at-sea monitoring in the Gulf of the Farallones resulted in a mortality estimate of 25,000–30,000 Common Murres, about 12–14% of the breeding population in the Gulf. Although the California Department of Fish and Game estimated that the annual mortality had declined to 6000–8000 in 1984, 1985, and 1986, this reduction was almost matched by a precipitous drop in the breeding population. Despite the fact that this was empirically obvious in 1984, it was not documented until late 1986 when census data from the United States Fish and Wildlife Service and the Point Reyes Bird Observatory in California, indicated that the murre population in the Gulf of the Farallones had declined from approximately 210,000 in 1982 to about 90,000 in 1986. Therefore, even though absolute mortality was lower, it still represented 7–9% of the breeding population. By 1985, the California Department of Fish and Game estimated Harbor Porpoise mortality at 200–300/year, most of it occurring in the Gulf of the Farallones. Much less was known about the size of the Harbor Porpoise population than that of the murre population, but it was widely suspected that the mortality was greater than the population could sustain.



Immature Tufted Puffin taken in a salmon drift net. Photo/David G. Ainley.

The road to a solution

Prior to 1985, federal agencies with management responsibility played no role in solving the gill net problem. Neither the United States Fish and Wildlife Service nor the National Marine Fisheries Service would move to enforce provisions of the Migratory Bird Treaty Act or the Marine Mammal Protection Act, or, in the case of sea otters, the Endangered Species Act. Unofficially, the position of the management staff at these agencies was that since the fisheries were state-managed and conducted in state waters, the solution was up to the state. Enforcement staff also said that it was impossible to get convictions in cases of incidental takes.

The California Department of Fish and Game found itself in a difficult situation. Although the provisions of the Migratory Bird Treaty Act and the Marine Mammal Protection Act and the Endangered Species Act were incorporated into state law, the Department was not eager to enforce them if federal agencies were unwilling to do so. Short of closing down the fisheries, there seemed to be no way to use these protections. The Department's position was that gill netting was a legal activity; if there was a problem, it was willing to experiment to find the least restriction necessary to reduce incidental take to some undefined "acceptable level." These regulations, however, would require legislation.

Throughout the controversy, the role of non-governmental organizations such as Friends of the Sea Otter, Point Reyes Bird Observatory, the Monterey Peninsula, Marin, and Golden Gate Audubon societies, the Whale Center, and the California Marine Mammal Center, has been critical. They provided their own gill net impact data, helped interpret agency data, encouraged the California Department of Fish and Game to conduct an adequate monitoring program, raised private funds to supplement the Department's monitoring budget, negotiated regulations that were incorporated into several bills (all of which they lobbied successfully through the legislature and across the governor's desk), pressured federal agencies to become involved, and kept their members and the public informed through newsletters and the news media.



Bob Boekelheide examines murrens drowned in gill nets in Drakes Bay, California in the summer of 1982 to ascertain ages and sexes. Photo/Joanne Young

For three years, the non-governmental organizations accepted the reluctance of the federal agencies to get involved and acquiesced in their approach to reducing incidental take. This was partially successful, as reflected in the declining rates of incidental take. Credit for these initial successes goes to the two sets of regulations that were signed into law in 1982 and 1984.

The 1982 law permanently prohibited gill netting in Monterey Bay in waters shallower than 10 fathoms, virtually ending the taking of seabirds there. Conflicts with sea otters continued until 1985 when the gill net closure was extended out to 15 fathoms. In the Gulf of the Farallones, the wildlife/gill net

conflict continued, with seabird mortality higher than it had ever been in Monterey Bay. However, the 1982 law also gave the Director of California Fish and Game the authority to temporarily close areas to gill net fishing if he determined that "mortality in any local population of any species of seabird or marine mammal is occurring at a rate that threatens the viability of the local population, as a direct result of the use of gill nets."

Environmental organizations successfully persuaded the California Department of Fish and Game to impose closures for three seasons (1982-1984) in areas where the most obvious conflicts with mammals and seabirds were



Large numbers of Common Murres drowned in gill nets in summer 1980. These murrens, presumably removed from a net, had been tied together and weighted for disposal. When they washed up on a central California beach, they were discovered by Point Reyes Bird Observatory Beached Bird Survey volunteers. Photo/Burr Heneman.

occurring Data from the Point Reyes Bird Observatory and from the California Academy of Sciences, as well as the California Department of Fish and Game's monitoring program were used to justify the closures. However, these temporary closures were unsatisfactory. Everyone involved anticipated an endless cycle of temporary closures, followed by a massive bird kill, followed by a California Department of Fish and Game hearing, followed by another temporary closure. Negotiations between the California Department of Fish and Game, the fishermen, and environmental and scientific groups led to the 1984 law that created a permanent patchwork of seasonal and area closures in areas where high conflict between the fisheries and wildlife was predictable.

Commercial fishermen wanted to believe that the problem had been solved, but by early 1985, it was already apparent to the scientific and environmental groups that the new closures were inadequate. The California Department of Fish and Game wanted to wait for the results of a season or two of monitoring. For the scientific and environmental groups, documenting the disastrous decline in the murre population at the Farallon Islands and at nearby coastal breeding sites was a difficult and lengthy process. Fishermen were also doing a better job of disguising mortality: on several occasions, bags of dead murrens washed ashore on San Francisco area beaches. It was clear that a new approach was necessary to gain additional protection for seabirds and marine mammals.

In February 1985, five California congressional representatives wrote to the United States Fish and Wildlife Service and to the National Marine Fisheries Service expressing concern about the gill netting problem and asking what the federal agencies planned to do about it. A year later, when this correspondence had failed to elicit an adequate response, the environmental organizations enlisted legal help for the first time. After preparing an analysis of federal and state law, local organizations requested that the California Attorney General render an opinion to the California Department of Fish and Game on its legal responsibilities in regard to the incidental take of seabirds and Harbor Porpoises. At the same time, several local and national environmental organizations made a formal request to the secretaries of Interior and Com-

merce to enforce the provisions of the Migratory Bird Treaty Act and the Marine Mammal Protection Act in regard to the California gill net fisheries.

In 1986, the biological, political, and legal approaches all meshed. In August, the California Attorney General informed the Director of the Department of Fish and Game that there was "an unequivocal prohibition against taking [of seabirds and Harbor Porpoises] under State and federal law." The monitoring program conducted by the California Department of Fish and Game indicated that the murre bycatch continued in the 6000-8000/year range and an analysis of Point Reyes Bird Observatory and Fish and Wildlife Service data suggested that roughly 75% of the drastic decline in murrens could be attributable to gill netting. The California Department of Fish and Game estimated that Harbor Porpoise mortality continued at 200/year, mostly in the Gulf of the Farallones. The National Marine Fisheries Service studies on the Harbor Porpoise indicated that the population could not sustain such high mortality levels.

In September, the Fish and Wildlife Service met with representatives from the California Department of Fish and Game, the National Marine Fisheries Service, the Marine Mammal Commission, and non-governmental organizations to discuss the situation. Both the National Marine Fisheries Service and the Fish and Wildlife Service conceded the need for action based on the biological information and the legal requirements.

Despite this favorable turn of events, a protracted series of meetings between the various agencies, environmental groups, and sport and commercial fishing organizations was necessary to reach agreement on a new package of permanent regulations for the Gulf of the Farallones (January 1987). The difficulty was that the regulations had to survive the legislative process. Failure in the legislature left litigation as the unpleasant, expensive, and time-consuming alternative. Consequently, the environmental organizations put considerable effort into winning the support of the fishermen, primarily by negotiating provisions, such as low interest loans, that would help affected fishermen get into alternative fisheries.

The regulations in the 1987 bill, which the governor signed into law in September 1987, include: total prohi-

bition on gill netting north of Point Reyes, a 40-fathom closure from Point Reyes to Año Nuevo (just north of Santa Cruz), and a 3-mile closure around the Farallon Islands and Noonday Rock. These closures are year-round and permanent. All parties are confident that if the new regulations are observed and enforced, the problem of seabird and marine mammal incidental take in the Gulf of the Farallones will end.

CONCLUSION

California

Crucial to solving the problem of seabird and marine mammal mortality in gill nets in California was recognition on both the state and federal levels that the incidental take of seabirds and marine mammals violated the Migratory Bird Treaty Act as well as state law. The strict, unequivocal provisions of the Endangered Species Act (in regard to sea otters in Monterey Bay), and the Migratory Bird Treaty Act (in regard to seabirds in the Gulf of the Farallones), and equivalent state laws were critical to the final resolution in these two areas. However, without sound monitoring data demonstrating the existence of a biological as well as a legal problem, and without a serious effort to cushion the impact of regulations on the fishermen and fisheries, a satisfactory resolution would not have been possible without litigation.

The Marine Mammal Protection Act has been only moderately effective in addressing the incidental take of pinnipeds and cetaceans in offshore fisheries in the United States Federal Coastal Zone. Because of the provision for the incidental take of most marine mammals, it was a less effective conservation tool in California, although the National Marine Fisheries Service finally objected to the level of Harbor Porpoise bycatch.

Northern Pacific

Although it did not get the desired result during the Japanese permit review, provisions in the Migratory Bird Treaty Act may yet provide an avenue for solving the severe seabird/fishery conflict in the salmon mothership fishery. The Act clearly prohibits the taking

of seabirds Environmentalists still maintain that the Act is applicable within the 200-mile Federal Coastal Zone. Whether or not the Department of the Interior will exercise its discretion to prosecute over the seabird take or use its regulatory authority to control it still remains unresolved.

During the mothership fishery permit review, members of Congress became concerned with the driftnet problem. In 1986 and 1987, legislation was introduced specifically addressing the impact of drift nets on Alaskan seabirds. One of the bills, authored by Senator Ted Stevens of Alaska, would create a 60-mile drift-net-free zone around the western Aleutian Islands (as suggested by the research of Ainley *et al.*) and provide for the monitoring of drift nets outside of the United States Federal Coastal Zone.

As attention has increasingly focussed on the seabird bycatch in the salmon mothership fishery, that conflict has taken on the status of a major test case. In the meantime, it is becoming increasingly clear that if neither a legislative nor an administrative solution can be found, the answer might be determined in the courts. However, the California precedent allows some optimism that the legal alternative will not be necessary.

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LITERATURE CITED

- AINLEY, D. G., A. R. DeGANGE, L. L. JONES, and R. J. BEACH. 1981. Mortality of seabirds in high-seas salmon gillnets. *Fish. Bull.* 79:800-806.
- CALIO, A. J. 1987. In the matter of proposed regulations to govern the taking of marine mammals incidental to commercial salmon fishing operations. U.S. Department of Commerce, NOAA/NMFS, Docket No. MMPAH-1986-01. Decision of the Undersecretary. May 14, 1987.
- CARTER, H. and S. G. SEALY. 1984. Marbled murrelet mortality due to gillnet fishing in Barkley Sound, British Columbia. In D. N. Nettleship, G. A. Sanger, and P. F. Springer (eds.), Feeding ecology and commercial fisheries relationships of marine birds. Can. Wildl. Serv. Spec. Publ. pp. 212-220.
- CENTER FOR ENVIRONMENTAL EDUCATION 1986. In the matter of proposed regulations to govern the taking of marine mammals incidental to commercial salmon fishing operations. U.S. Department of Commerce, NOAA/NMFS, Docket No. MMPAH-1986-01. Testimony. December 3, 1986.
- CROXALL, J. P., P. G. H. EVANS, and R. W. SCHREIBER. 1984. Status and Conservation of the World's Seabirds. International Council for Bird Preservation Technical Publication No. 2.
- DeGANGE, A. R., D. J. FORSELL, and L. L. JONES. 1985. Mortality of seabirds in the high-seas Japanese salmon mothership fishery 1981-1984. Unpub. Rept. U.S. Fish and Wildl. Serv., Anchorage, AK.
- DEPARTMENT OF THE INTERIOR. 1981. Unpub. Memorandum from the Office of the Assistant Solicitor, Fish and Wildlife to Office of Migratory Bird Management, March 27, 1981.
- . 1986. In the matter of proposed regulations to govern the taking of marine mammals incidental to commercial salmon fishing operations. U.S. Department of Commerce, NOAA/NMFS, Docket No. MMPAH-1986-01. Comments on the draft environmental impact statement. November 28, 1986.
- DIAMOND, S. L., and D. A. HANAN. 1986. An Estimate of Harbor Porpoise mortality in California Set Net Fisheries, April 1, 1983 through March 31, 1984. National Marine Fisheries Service, Administrative Report SWR-86-15.
- DOLAN, H. J. 1987. In the matter of proposed regulations to govern the taking of marine mammals incidental to commercial salmon fishing operations. U.S. Department of Commerce, NOAA/NMFS, Docket No. MMPAH-1986-01. Recommended decision of the ALJ. March 6, 1987.
- HANAN, D. A., S. L. DIAMOND, and J. P. SCHOLL. 1986. An Estimate of Harbor Porpoise Mortality in California Set Net Fisheries, April 1, 1984 through March 31, 1985. National Marine Fisheries Service, Administrative Report SWR-86-16.
- . 1986. ms. A Preliminary Estimate of Harbor Porpoise Mortality in California Set Net Fisheries, April 1, 1985 through December 31, 1985.
- IGNELL, S., J. BAILEY, and J. JOYCE. 1986. Observations on High-Seas Squid Gill-Net Fisheries, North Pacific Ocean, 1985. U.S. Department of Commerce, NOAA Technical Memorandum NMFS F/NWC-105.
- KING, W. B., R. G. B. BROWN, and G. A. SANGER. 1979. Mortality to marine birds through commercial fishing. In J. C. Bartonek and D. N. Nettleship (eds.), Conservation of marine birds of northern North America. U.S. Fish and Wildl. Serv., Wildl. Res. Rept. No. 11, pp. 195-199.
- O'HARA, K., N. ATKINS and S. IUDICELLO 1986. Marine wildlife entanglement in North America. Center for Environmental Education, Washington, D.C.
- PIATT, J. F. and D. N. NETTLESHIP 1985. Diving Depths of Four Alcids. *Auk* 102:293-297.
- . 1987. Incidental Catch of Marine Birds and Mammals in Fishing Nets Off Newfoundland, Canada. *Marine Pollution Bulletin*, Vol. 18-6b.
- PIATT, J. F., D. N. NETTLESHIP, and W. THRELFALL. 1984. Net-mortality of common murres and Atlantic puffins in Newfoundland, 1941-1981. In D. N. Nettleship, G. A. Sanger, and P. F. Springer (eds.), Feeding ecology and commercial fisheries relationships of marine birds. Can. Wildl. Serv. Spec. Publ. pp. 196-206.
- PIATT, J. F., and D. G. REDDIN. 1984. Recent Trends in the West Greenland Salmon Fishery, and Implications for Thick-billed Murres. In D. N. Nettleship, G. A. Sanger, and P. F. Springer (eds.), Feeding ecology and commercial fisheries relationships of marine birds. Can. Wildl. Serv. Spec. Publ. pp. 208-210.
- REID, W. J. 1986. In the matter of proposed regulations to govern the taking of marine mammals incidental to commercial salmon fishing operations. U.S. Department of Commerce, NOAA/NMFS, Docket No. MMPAH-1986-01. Testimony. December 3, 1986.
- SANO, O. 1978. Seabirds entangled in salmon driftnets. *Enyo* 30:1-4.
- SEALY, S. G. and H. R. CARTER. 1984. In J. P. Croxall *et al.* (eds.), Status and Conservation of the World's Seabirds International Council for Bird Preservation Technical Publication No. 2 p. 737.
- SHIMA, K. 1985. Summary of Japanese net fisheries in the North Pacific ocean. In S. Shomura and H. O. Yoshida (eds.), Proceedings of the workshop on the fate and impact of marine debris, 26-29 November 1984, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-54. p. 252
- UCHIDA, R. N. 1985. Types and Estimated Amounts of Fish Net Deployed in the North Pacific. In S. Shomura and H. O. Yoshida (eds.), Proceedings of the workshop on the fate and impact of marine debris, 26-29 November 1984, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-54. p. 37.

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Broad-winged Hawk (Buteo platypterus). Illustration/Julie Zickefoose.