Seabird and Waterbird Bycatch in Fishing Gear: Next Steps in Dealing with a Problem[1]

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Abstract

Seabirds, a variety of related waterfowl species, and some wading birds and shorebirds (hereafter, "waterbirds") are accidentally captured, entangled, injured or killed in active or derelict fishing gear. Accidentally or intentionally lost or discarded gear can also continue to "ghost fish," often until the gear sinks or washes ashore. Seabirds are most affected by set and drifting gillnets and longlines – both the focus of this paper – while seines, trawls, traps, pots, and related equipment can capture and kill waterbirds. While estimates of local population mortality from site-specific gear use are prevalent, the effects of this 'bycatch' on populations, and the cumulative impacts of fishing gear on waterbirds are generally unknown or only crudely estimated, with but a few exceptions. This paper addresses several bycatch reduction initiatives, including a 1991 ban by the United Nations General Assembly of large-scale high-seas driftnetting worldwide and 1992 passage of implementing US legislation, unanimous approval by the U.N.'s Food and Agriculture Organization in 1998 of an international plan to reduce seabird bycatch in longline fisheries, development and implementation of a US national plan to reduce seabird bycatch in US longline fisheries in 2001, and efforts by the US Fish and Wildlife Service (USFWS) to address waterbird bycatch in all US commercial and recreational fisheries. Documented waterbird bycatch in both gillnets and longlines within US waters is reviewed, as are operational and technical measures to reduce or eliminate bycatch problems. Also discussed are efforts to address both problems by nations represented on the Arctic Circumpolar Council, the need for greater bycatch observer coverage on vessels at sea, and research. Jurisdiction of the Migratory Bird Treaty Act is reviewed.

Key words: bycatch, entanglement, Food and Agriculture Organization, gillnets, high seas, Interagency Seabird Working Group, longlines, Migratory Bird Treaty. Act, seabirds, technical and operational measures, territorial waters, waterbirds, Waterbird Bycatch Working Group.

Introduction

As the world's human population grows, and as the ever-increasing human demand for fish and shellfish continues, heightened fishing effort will invariably result in additional negative impacts to living marine resources including birds. Today, more than 70 percent of marine fish species worldwide need urgent attention to prevent population declines by overfishing, according to a recent United Nations report (Alverson 1998). This paper focuses primarily on the impacts of commercial fishing on seabirds, a variety of related waterfowl species, some wading birds, and even some shorebirds (hereafter "waterbirds") that are incidentally entangled and killed or injured by fishing gear that is actively fishing, or has been accidentally or intentionally lost or discarded. For purposes of discussion, the waterbirds taken by this gear are called "bycatch" – "wasted catch" that commercial and recreational fishers harm or kill although they don't intend to catch them. The problem is by no means unique to US waters. Globally, an estimated 44 billion pounds of fish are wasted, 25 percent of the entire world catch (Alverson 1998, Dobrzynski et al. 2002), along with estimates of hundreds of thousands or more of waterbirds. The offending gear includes gillnets, trammel nets, longlines, seines, trawls, traps, pots, and related equipment. Gillnets and longlines are the focus of this paper.

The literature is replete with estimates of fishery impacts to local waterbird populations generally from gear-specific fisheries. Alcids, shearwaters, albatrosses, waterfowl, cormorants, loons, and even osprey (*Pandion haliaetus*) have been reported drowned in fishing gear (Atkins and Heneman 1987). Unfortunately, the closer we look at the overall problem in the US, the less we seem to know about the extent of its impacts on waterbirds population-wide. In US waters, the overall level of mortality suffered population-wide and the cumulative impacts on populations of most waterbirds are generally unknown, crudely estimated, or largely anecdotal, with but a few exceptions (Brothers et al. 1998).

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Discussion

Gillnet Impacts

Gillnets are generally made of panels of monofilament or multifilament Nylon® or related plastic materials and are designed to capture fish whose gill plates become ensnared in the netting, the fish become entangled, they suffocate, and die. The nets can drift, with a float line at the sea or lake surface and lead line suspending vertical panels to varying depths; or they can be set, anchored in place with the lead line resting on the bottom and the float line suspending panels vertically in the water column (Atkins and Heneman 1987). Both types of gillnets have been shown to be deadly to birds (Manville 1988, 1991).

In US waters, mortality data from gillnet entanglement is generally anecdotal. Two exceptions include former fisheries – now both closed – in waters off the western Aleutian Islands and central California where monitoring was more extensive. In waters off Alaska's northern North Pacific and Bering Sea, a large Japanese mothership salmon (*Oncorhynchys* spp.) driftnet fishery in the late 1970s and early 1980s was estimated by King et al. (1979) to be killing from 75,000 to 250,000 seabirds annually, while Ainley et al. (1981) felt the estimates to be conservative, suggesting at least a doubling of annual mortality. King (1984) reassessed his estimates to include 250,000 to 750,000 seabirds killed annually – Short-tailed (*Puffinus tenuirostris*) and Sooty Shearwaters (*P. griseus*) comprising 60 percent of the mortality. DeGange et al. (1985) estimated an average of 38,000 Tufted Puffins (*Fratercula cirrhata*), 8,250 Horned Puffins (*F. corniculata*), and 101,500 Short-tailed Shearwaters were killed annually in this mothership fishery, likely having a negative impact on local breeding populations of birds in the western Aleutians. The fishery was closed in the mid-1980s.

In the California set gillnet fishery for halibut (*Hippoglossus stenolepis*), flounder (*Paralichthys* spp.) and croaker (family Sciaenidae), close monitoring between 1981 to 1986 at beaches on Monterey Bay and in the Gulf of the Farallones indicated declines in the population of Common Murres (*Uria aalge*) from 210,000 in 1982 to some 90,000 in 1986 (Atkins and Heneman 1987) – roughly 75 percent of the decline attributable to gillnetting. King (1984) estimated up to 10,000 birds per month killed during the summertime. By 1987, where murre populations in individual colonies declined by 47-100 percent, the California fishery was either totally closed or restricted to depths greater than 73m (40 fathoms; Atkins and Heneman 1987, Melvin et al. 1999).

Anecdotal information regarding gillnet take of waterbirds in US waters varies from fishery to fishery, with some estimates having higher levels of confidence than others. In the New England bottom fish fisheries, Northern Gannets (*Morus bassanus*), Northern Fulmars (*Fulmarus glacialis*), and Sooty Shearwaters have been reported taken, while in the Chesapeake Bay nearshore set shad (*Alosa sapidissima*) gillnet fishery, Ruddy Ducks (*Oxyura jamaicensis*), Canvasbacks (*Aythya valisineria*), Scaup (*Aythya* spp.), Red-throated (*Gavia stellata*) and Common Loons (*G. immer*), and others have been reported (O'Hara et al. 1986, Forsell 1999). Forsell (1999, D. Forsell pers. comm.) assessed nearshore mid-Atlantic shad gillnets and speculated that nets were having a significant impact on the wintering population of Red-throated Loons. During the first season of a survey in 1998, 68 percent (N = 1,633) of the birds observed dead in shad gillnets were Red-throated Loons, while 21 percent (N = 503) were Common Loons. An estimated 67,300 Red-throated Loons migrated past Cape May, New Jersey, during the fall 1997. Since much of the total mortality was likely unobserved, the population impact could be significant. D. Forsell continues to monitor this fishery and he recently reported a significant but untabulated take of scaup in the Mid-Atlantic region shad fishery (pers. comm.). In South Carolina waters, waterfowl and loons were reported to be the primary species caught in 0.3-0.4 km (900-1,200 ft.) long shad gillnets. Loons have been reported caught in Great Lakes gillnets as well (Atkins and Heneman 1987).

One problem in assessing waterbird bycatch in coastal gillnet and other fisheries has been inconsistent monitoring despite the fact that breeding colonies worldwide occur in coastal waters (Melvin et al. 1999). Diving seabirds of the family Alcidae, most especially the Common Murre, have been well documented as bycatch in coastal gillnets (Evans and Nettleship 1985). These long-lived birds have low levels of fecundity and delayed maturity, making their populations particularly sensitive to changes in adult mortality. Murres have been routinely observed in gillnets retrieved from depths as great as 180m (591 ft.) and Atlantic Puffins (*F. arctica*) are commonly seen in nets set to depths of 60m (197 ft.; Piatt and Nettleship 1985, Atkins and Heneman 1987, J. Piatt pers. comm.). Because Alcids are sensitive to climate change and vulnerable to oil spills, additional anthropogenic sources of mortality such as bycatch raise further conservation concerns for these species (Melvin et al. 1999).

Not only murres, but seabirds in general are long-lived, exhibit delayed maturity, and may produce only one egg annually or biannually. Populations can decline when adult survivorship decreases by as little as 3-5 percent annually. Population recovery is slow where mortality has been significant, e.g., from oil spills, El

Nino events, introduced predators, ingestion of plastic debris, fishing mortality or bycatch (Melvin and Parrish 2001). Many species of seabirds are exposed to several or all of these sources of mortality, and the cumulative effects on populations are of great concern.

Studies in Canadian and Greenland waters have also documented gillnet mortality. In Barkley Sound, British Columbia, more than 6 percent of the breeding population of Marbled Murrelets (*Brachyramphus marmoratus*) were estimated killed in the salmon drift gillnet fisheries (Carter and Sealy 1984). In Newfoundland, Piatt and Nettleship (1985, 1987) estimated from 1981-1984 that 2 percent of Newfoundland's 800,000 Common Murres were drowned in salmon (*Salmo salar*) drift and cod bottom-set gillnets with local murre populations suffering more than 16 percent annual mortality. Razorbills (*Alca torda*) suffered an alarming 12.4 percent average annual mortality during this period, while Northern Gannets and Atlantic Puffins suffered less mortality from bycatch. Gillnet mortality was first raised as an important marine conservation issue in 1972 when Tull et al. (1972) estimated the take of some 500,000 Thick-billed Murres (*U. lomvia*) in salmon gillnets offshore of West Greenland. Piatt and Reddin (1984) fine-tuned the estimate to 200,000 Thick-billed Murres taken annually in these gillnets. Between 1976-1980 when fishing effort diminished and shifted, they estimated mortality reduced by 80-90 percent.

In the 1980s, attention was focused on pelagic drift gillnet fishing on the "high seas" – waters beyond the jurisdiction of any nation (e.g., beyond territorial waters and Exclusive Economic Zones [EEZs], and for the United States, beyond our 12 nautical mile [NM] territorial seas). Research conducted in the 1980s and early 1990s in the North Pacific Ocean by scientists from the United States (including this author), Canada, Japan, Taiwan, Republic of Korea (ROK), and others indicated that large-scale high-seas drift gillnets were having significant impacts on well over 100 species of living marine resources including seabirds that were being captured as bycatch, and usually killed as a result of strangulation or drowning in this gear (Manville 1991). The problem was particularly egregious in the North Pacific Ocean where, at its peak, over 1,000 Japanese, Taiwanese and ROK vessels were deploying up to 64,000 km (40,000 mi) of gillnet per night – sometimes up to 64 km (40 mi) of net per vessel. These so-called "walls of death" were capturing non-target species, ensnaring undersized and under-aged target fish, and losing target fish to "fallout." In 1990, Safina (1995) estimated that 42 million seabirds and marine mammals were captured as bycatch in high-seas driftnets. Gear was often lost or discarded, sometimes in large quantities. This netting can then "ghost fish" conceivably for years until it degrades, sinks, or washes ashore (Manville 1990, 1992). Estimates of mortality of 500,000 seabirds per year in both the North Atlantic (Tull et al. 1972) and North Pacific oceans (DeGange et al. 1993) were factors that helped contribute to United Nations involvement with drift gillnets in international waters around the world (Alverson et al. 1994).

In 1989, the General Assembly of the United Nations (UNGA) unanimously adopted Resolution 44/225, calling for a moratorium on all large-scale driftnet fishing on the high seas by 1992, revocable if scientifically sound conservation and management measures could be implemented. By December 1991, non-binding UNGA Resolution 46/215 was unanimously approved calling for full implementation of a global moratorium on all large-scale pelagic driftnet fishing by December 1992. The US responded by implementing the U.N. moratoria in US waters and directed continued negotiations to permanently ban this destructive fishing practice by passing the United States' Driftnet Act Amendments of 1990 (§ 107, P.L. 101-627; expanding and incorporating provisions of the Driftnet Impact Monitoring, Assessment, and Control Act of 1987 [P.L. 100-220]) and the High Seas Driftnet Fisheries Enforcement Act of 1992 (P.L. 102-582). The latter law denies port entry to any large-scale driftnet vessel (deploying >2.5 km [1.55 mi] of net), implements mandatory sanctions on fish products from countries that continue large-scale pelagic driftnet fishing, and expands presidential authority under the Pelly Amendment (P.L. 92-219, 85 Stat. 786, 22 U.S.C. 1978) to the Fishermen's Protective Act of 1954 calling for sanctions on non-fisheries imports. By 1993, enforcement efforts had been expanded by the US Coast Guard, US Navy, and the National Marine Fisheries Service (NMFS); (Earthtrust 2002).

Through the early to mid-1990s, some large-scale driftnetting continued to varying degrees by vessels flagged by Italy, Taiwan, ROK, the Peoples Republic of China, France, Ireland, and Great Britain. Large-scale pelagic driftnetting was eventually phased out including by license revocation, re-license closure, compensation, buy backs, vessel conversion (e.g., longlining, jigging, trawling, and purse seining), and vessel sinking.

"Ghost fishing" from lost or discarded gillnets is yet another cause of waterbird mortality. Atkins and Heneman (1987) estimated 68,000 seabirds killed per month in unrecovered lost derelict gear in the North Pacific Ocean. Manville (1988), using 0.06 percent net loss estimate per night, calculated a 19 km (12 mi) nightly loss of net in the North Pacific pelagic gillnet fishery, with an estimated 1,028 km (639 mi) of nets lost per season in the 1980s. The estimates did not account for discarded nets or net fragments.

Gillnet Bycatch Mitigation

While large-scale pelagic driftnetting may no longer be a problem, gillnets continue to be used within our US 370 km (200 NM) EEZ, our Federal 6-22 km (3-12 NM) territorial waters, and within our 6 km (3 NM) state waters, bays, rivers, estuaries, and in some inland fisheries. Gillnets may be either drifting or bottom set. Other countries also use gillnets within their EEZs. To get a better handle on the impacts of these fisheries, sufficient assessment and sound monitoring – especially at breeding colonies and feeding areas during the nesting season – are absolutely critical if we are to demonstrate the existence of a biological problem. Monitoring must be consistent, well designed, and statistically significant if it is to be meaningful.

Efforts to reduce avian bycatch in gillnets will – like the problems created by using some other types of gear – require both technological and operational solutions. Modifications have been made in the design and use of other types of gear, e.g., turtle excluder or trawling efficiency devices have been deployed to reduce sea turtle bycatch in shrimp trawls (Renaud et al. 1997), tuna purse seines have been modified to reduce the capture of small cetaceans, operational procedures such as backdown allow dolphins to escape seines (Francis et al. 1992), and acoustic pingers have been installed in coastal gillnets (Kraus et al. 1997) and fish traps (Lien et al. 1992) to alert marine mammals. However, few modifications have been used successfully with gillnets to reduce avian bycatch. Hayase and Yatsu (1993) successfully altered the design of high-seas drift gillnets by submerging nets 2 m (7 ft.) below the sea surface, significantly reducing seabird entanglement, but also reducing fishing efficiency by up to 95 percent, making net use economically unfeasible. In a coastal salmon drift gillnet fishery in North Puget Sound, Washington, Melvin et al. (1999) identified three complimentary tools to significantly reduce bycatch of Common Murres and Rhinoceros Auklets (*Cerorhinca monocerata*) in salmon gillnets without compromising target fishing efficiency. These included gear modifications (specifically the use of pingers and upper net panel visual alerts), abundance-based fishery openings, and time-of-day restrictions (especially at dawn and dusk). The authors suggested these gillnet technologies and procedures had application in other coastal gillnet fisheries worldwide.

Longlines Impacts

With the global cessation of large-scale high seas driftnetting in the 1990s, concern was raised by some nations – including the United States – that longline fishing might soon replace large-scale driftnetting as the next major global killer of seabirds. Although longlining has been regarded as a species- and size-selective fishing technique known to be "environmentally friendly" (Manville 2000), longlining has been documented to kill at least 64 species of seabirds worldwide. These include albatrosses, petrels, shearwaters, gulls, skuas, gannets, cormorants, penguins, and boobies. At least 23 of these birds are currently listed as "threatened" (meaning vulnerable, endangered, or critically endangered) by the IUCN-World Conservation Union including 16 of the 21 albatross species (American Bird Conservancy [ABC] 2002).

Baited longlines are used in all the world's oceans and seas, ranging from small-scale artisanal fisheries to mechanized commercial operations comprising from 15-90 percent of the commercial fishing activities. Some types of commercial longliners can deploy up to 35,000 hooks per set from lines up to 97 km (60 mi) long (Brothers et al. 1998) with perhaps millions of hooks set each day globally. The catching success of baited hooks is based on the target fish's attraction to the baits. Typically, longlines are set from the stern of fishing vessels traveling at speeds of 6-11 km/hr (3-6 knots). Due to line tension and turbulence from the stern and propellers, baited hooks do not always sink immediately and the baits may be seized by seabirds, some becoming hooked and killed. Less frequently, still-baited hooks may be taken by seabirds during haul-in. In some Norwegian fisheries, up to 70 percent of the baits are consumed by seabirds (Lokkeborg 1998). Brothers (1996) reported 20 baits lost for every bird caught in the Southern Oceans. In some fisheries, more than 10 birds/1,000 hooks have been recorded killed, and in one South Atlantic fishery, that rate was 15 birds killed/1,000 hooks set (Brothers et al. 1998, Manville 1998). Brothers (1991), in fact, focused attention on the longline bycatch problem when he estimated annual albatross mortality in Japanese tuna (*Thunnus maccoyii*) longlines at 44,000 birds per year in the Southern Oceans. Today for some species, this level of incidental mortality is considered to be unsustainable and their populations are in decline. Many species of southern albatross lose from 1-6 percent of their annual breeding populations ostensibly due to bycatch (ABC 2002). A drop of as little as 3-5 percent in adult survivorship from all mortality factors can cause a population decline (Melvin and Parrish 2001). Fortunately, deep-diving and non-scavenging species such as penguins, cormorants, and auks are rarely caught in longlines, and smaller seabirds such as terns, storm petrels, and auklets are rarely captured since they generally are unable to swallow the large baits on longlines (Manville 1998).

All longline gear is based on four parts: the mainline, the snood, the hook, and the bait. Gear is set on the seabed (called demersal longlining), floated off the bottom at various depths (semipelagic longlining), or is suspended from line drifting freely at the sea surface

(pelagic longlining). There is considerable variation in the setting and hauling operations (FAO 1998a). Bycatch rates are influenced by the type of fishing gear set (e.g., pelagic, semipelagic, or demersal), bird species present, and temporal (i.e., year, season, time of day), spatial, and physical factors (Brothers et al. 1999, Melvin et al. 2001). Seabird bycatch is greatest – approaching or exceeding 10 birds/1,000 hook sets – at high latitudes in the cold-fish, bird-rich waters off the North and South Atlantic, North Pacific, and Southern Oceans. Little mortality has been documented in the tropical Atlantic, Indian, and Pacific oceans, but this may be due mostly to a lack of data. Mortality to Laysan (*Phoebastria immutabilis*) and Black-footed Albatross (*P. nigripes*) is the exception in the vicinity of Hawaii where bigeye tuna (*T. obesus*) and broadbill swordfish (*Xiphias gladius*) longlining occurs (Brothers et al. 1998).

Partly as a result of concerns over longline bycatch in the Southern Oceans, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) adopted mitigation measures in 1992 to reduce seabird bycatch by its 23 member nations. These measures included modifications to fishing practices and equipment designed to reduce the likelihood of incidental seabird take. Under authority of the Commission for the Conservation of Southern Bluefin Tuna, Australia, Japan, and New Zealand adopted policies in 1995 specifically targeted at data and information collection, use of mitigation measures, and dissemination of educational information about reducing seabird bycatch. One document used by both Commissions includes the CCAMLR (1996) publication, Fish the Sea Not the Sky, which has turned out to be an excellent educational tool.

As had been forecast with the closure of the high-seas driftnet fishery, some high-seas gillnet vessels were reflagging to avoid legitimate management controls. This was reported as a serious emerging problem in a number of high seas fisheries worldwide (U.N. Secretary General's 1992 Report in Earthtrust 2002). In part as an effort to address this problem, the U.N.'s Food and Agriculture Organization (FAO) developed a draft Code of Conduct for Responsible Fishing which was expanded, finalized, and published in 1995 (FAO 1995). Of particular note are two provisions within the Code that address conservation and bycatch issues. Section 6.12 addresses the need for nations to "... promote conservation and management, ensure responsible fishing and ensure effective conservation and protection of living aquatic resources..." while Section 7.6.9 calls for nations to take "...appropriate measures to minimize waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species, and negative impacts on associated or dependent species, in particular endangered species."

In 1997, the FAO's Committee on Fisheries (COFI) met at its 22nd meeting in Rome to discuss the global reduction of seabird bycatch in longline fisheries, overfishing in shark fisheries, and global overfishing. Subsequent to this meeting, the governments of the United States and Japan agreed to collaborate with the FAO to organize a technical consultation on these three issues in 1998 (FAO 1998b). In 1998, the International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries (IPOA-S) was unanimously approved by the FAO and implemented by the FAO Council in 1999. While a voluntary plan, it is to be implemented in a manner consistent with the Code of Conduct and consistent with any applicable rules of international law and rules of international organizations.

The IPOA-S tasks all FAO member-nations with a longline seabird bycatch problem – including the US – to develop and implement seabird national plans of action (NPOA-S). The US NPOA-S, for example, applies to US and foreign flagged vessels longline fishing in our EEZ, and to US flagged vessels longline fishing on the high seas and the EEZs of other nations. The FAO set a February 2001 deadline for submission of final NPOA-Ss to the COFI. Only the United States and Japan met that deadline with final documents. To produce and implement the Final United States National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries, an Interagency Seabird Working Group was created in 1999. The Working Group is co-chaired by the USFWS (this author) and NMFS, with representation from most of the Service's Regions, all of the NMFS regional offices, each of the eight Regional Fisheries Management Councils, and the Department of State. While some within the environmental community are not happy with the US NPOA-S in its present state – claiming the Plan is too weak and needs mandatory avoidance measures in all fisheries (ABC 2002) – the Plan is a voluntary one and mitigation measures are generally fishery, avian, and time specific, not universally applicable to all fisheries and for all waterbirds. There, unfortunately, is no single "silver bullet" that effectively resolves bycatch issues in all longline fisheries. One also needs to recognize that what works to reduce seabird bycatch may not necessarily work to reduce sea turtle bycatch (Dobrzynski et al. 2002).

The FWS acknowledges that the US Plan does need to be strengthened. In particular, we remain concerned about the timeline for implementation, including assessments and mitigation. The Plan called for national seabird bycatch assessments for all US longline fisheries to be completed and submitted to COFI by February 2003. The document was submitted on time but USFWS had little opportunity to comment. In those fisheries where bird bycatch is determined or continues to be a problem (e.g., Alaska and Hawaii), the Plan

calls for the development and implementation of mitigation measures within two years. Where mitigation needs to be taken, measures may be incorporated as part of NMFS' regional fishery management plans (FMP), as part of new FMPs, or as regulatory amendments that will subsequently be incorporated as regulations (see beyond). The USFWS is also concerned that fishery-specific mitigation measures which would have to be implemented by one or several of the Regional Fishery Management Councils might become mired in politics and delayed before being required in FMPs. Part of the role of the Interagency Seabird Working Group may be to resolve such possible problems.

Alaska Longline Impacts and Mitigation

The estuaries and offshore waters of Alaska contain one of the world's largest concentrations of seabirds, estimated at 100 million, of which 40 species breed. Alaska's breeding population is estimated to be 50 million birds, comprising some 96 percent of all seabirds breeding in the continental United States (Wohl et al. 1995). The waters are also highly productive for commercial trawl, pot and longline (also called "hook and line" gear) fisheries (Stehn et al. 2001). Unfortunately, seabirds are taken in large numbers in Alaska's groundfish and halibut longline fisheries where from 10,000 to 27,000 are hooked each year (Melvin et al. 2001). There may be more than 4,000 longline vessels that ply these waters. The commercial halibut fishery is currently unmonitored by NMFS observers. While bycatch can vary from year to year, it includes Northern Fulmars (66 percent), gulls (*Larus* spp.; 16 percent), albatross (9 percent [5 percent Laysan, about 4 percent Black-footed, and few Short-tailed (*P. albatrus*)]), and shearwaters (*Puffinis* spp.; 4 percent; Melvin et al. 2001, Stehn et al. 2001).

The worldwide population of the endangered Short-tailed Albatross numbers only some 1,800 and although it is increasing, longline mortality may be critical to population recovery (Melvin et al. 2001, H. Hasegawa pers. comm.). Under the requirements of ESA (§7), Federal agencies must consult with the USFWS (or NMFS for certain endangered or threatened species under their stewardship) for activities agencies undertake or regulate that affect endangered species. The outcome of the consultation between NMFS and USFWS over the take of Short-tailed Albatross in Alaska's demersal longline fisheries was a Biological Opinion, which stated that no more than six birds could be captured within each two-year period, including no more than two in the Pacific halibut fishery (USFWS 1998) and four in the groundfish fishery (USFWS 1999). The Opinion additionally requires bycatch reporting, salvage of dead birds, fisher education regarding bycatch avoidance, use of seabird bycatch avoidance measures, and a NMFS study to evaluate the effectiveness of bycatch deterrents (USFWS 1997). Take of more than six birds within a two-year period could trigger another ESA Section 7 consultation, likely interrupting or perhaps even closing Alaska's $300 million (ex-vessel value) fishery (Melvin et al. 2001).

In a two-year NMFS-mandated study conducted by Melvin et al. (2001) in Alaskan waters in 1999 and 2000, the researchers recommended use of a suite a bycatch mitigation measures with a goal of no loss of target catch or increase in bycatch of other living marine organisms. Paired streamer or tori (= bird) lines created a "moving fence" that precluded seabird attacks on baits and virtually eliminated both Laysan Albatross and Northern Fulmar bycatch. A line setting funnel that sets gear below the turbulence of propellers was favorably tested and suggested as a reliable method for this and other longline fisheries worldwide. Putting additional weights on lines to sink baits more rapidly had mixed results; vessel speed and vessel design were more important that weighting alone. Night setting was not recommended as an effective deterrent strategy for night-active seabird species – especially Northern Fulmars – in the North Pacific. Line shooter devices actually increased bird bycatch and were thus not recommended for Alaska.

In the mid-1990s, prior to release of the Service's first Biological Opinion – and seeing things likely to come – fishermen with the North Pacific Longliners Association began a concerted and proactive effort to address the Short-tailed Albatross bycatch problem by petitioning the North Pacific Fisheries Management Council – the Federal regulatory body in North Pacific waters – for emergency regulations (Matsen 1997). As a result, rules and regulations were put into place in 1997 in Alaska's groundfish longline fishery, and in 1998 in the halibut longline fishery (50 CFR Part 679.24(e)) which mandated use of at least one mitigation measure for vessels >7.9 m (26 feet) in length. These rules include using tori lines, towing buoys, using underwater lining tubes, night setting, and modifying discharge of offal. The research conducted by Melvin et al. (2001) recommends changes to current regulations. To assist fishers, the USFWS has been distributing free bird scaring streamers to Alaska's longline fishermen thanks to two $550,000 grants acquired through Federal appropriations in Fiscal Years 2001 and 2002. As of February 2004, vessels >17m (55ft.) are required by regulations to deploy paired streamer lines during line setting to reduce access of birds to baited hooks (Federal Register 69: 1930-1951).

Hawaii Longline Impacts and Mitigation

From 1990-1994, based on data provided by NMFS, the USFWS estimated that longliners in Hawaii's waters killed 32,500 Laysan and 23,382 Black-footed

Albatross. These take rates were comparable to or exceeded bird bycatch in the Southern Oceans (Environment Hawai'i 1996).

Black-footed Albatross number about 300,000 (and declining) comprised of some 62,000 pairs in 12 colonies, with 77 percent of the population nesting in three colonies on Laysan Island, Midway Atoll, and French Frigate Shoals in the northwestern Hawaiian Islands. Under IUCN criteria for identifying threatened status, Black-footed is listed as "vulnerable," showing a population decline of over 20 percent in three generations/45 years (Cousins and Cooper 1999). Most are taken in broadbill swordfish fishing operations around bird breeding colonies in the Hawaiian Archipelago, with much smaller numbers taken in bigeye tuna longlines. An estimated 1,600-2,000 are taken annually based on NMFS observer data collected since 1994. The NMFS Bycatch Report (1998) indicated that the Black-footed Albatross could not sustain the level of mortality caused by longline fishing at that time (Dobrzynski et al. 2002).

Laysan Albatross are generally more numerous but also susceptible to longline take in Hawaiian waters. Longlining has been implicated as the primary threat to this species particularly around their breeding colonies on Midway and Laysan Islands where more than 90 percent of the population breeds. A 30 percent decline in the breeding populations around these two islands has been reported since 1992 (ABC 2002).

In 1999, Garcia and Associates (1999) tested several mitigation measures specific to Hawaiian waters. The results of those studies suggest that blue-dyed squid (e.g., *Sepioteuthis lessoniana*) baits, line weighting with 80 g (2.8 ounce) weights, and night setting for swordfish reduced seabird bycatch significantly. In June 2001, NMFS issued regulations for longline fishing in Hawaiian waters (50 CFR Part 660.35) based in part on the research by Garcia and Associates (1999). The regulations require the following: thaw bait and dye it blue, discharge offal on the side opposite longline setting or hauling, remove all hooks from offal prior to discharge, use a line-setting machine or line shooter to set the main longline, use specified line weighting, and handle Short-tailed Albatross in a designated safe manner so they may be released alive. In addition to using these mitigation measures, court-ordered emergency closures within the Hawaiian Archipelago designed specifically to reduce sea turtle bycatch (50 CFR Parts 660.34 and 660.35) will certainly also benefit seabirds. At this writing, with a proposal to reopen the Hawaiian swordfish fishery, NMFS is reinitiating consultations with USFWS for the Short-tailed Albatross, which will amend the current Hawaiian Biological Opinion.

Longline Mitigation

The solution to the problem of seabird bycatch in longlines is – in theory – a simple one: deploy and rapidly sink longlines and baits, avoid bait stealing as a consequence, and increase bait availability, catchability, and profitability. During retrieval, avoid bait stealing. Recognizing that no single solution will eliminate seabird bycatch in all longline fisheries, the FAO appended two technical notes to the IPOA-S. The first note contains recommendations for developing NPOA-Ss for FAO member nations. This note describes how to conduct assessments to determine the extent and nature of a nation's seabird bycatch; why and when to use mitigation measures; the need for research, education and training in using deterrent devices; and the importance of data collection.

The second note lists examples of technical and operational measures which may be useful in reducing seabird bycatch. They are not considered mandatory nor are they exhaustive and as previously mentioned, some do not work in specific fisheries. Technical measures include such recommendations as: increase the sink rate of baits (e.g., add weights, thaw baits, use line setting machines); use below-the-water setting chutes, capsules, or funnels; properly position bird scaring (i.e., streamer or tori) lines over baited areas; deploy bird scaring curtains; use bait casting machines; use artificial lures or baits; modify hooks; assess acoustic and magnetic deterrents; and review the effectiveness of water cannons. Operational measures include the following recommendations: set baits at night to reduce bait availability to birds; reduce the attractiveness of vessels to seabirds (e.g., do not discard offal and garbage during setting and haul-in); review area and seasonal closures; give preferential licensing to vessels that use mitigation measures that do not require compliance monitoring; and release live birds. Brothers (1996) and CCAMLR (1996) also provide a list of technical and operational suggestions many of which are applicable to US fisheries, or are in fact being required by regulation.

United States Recreational Fisheries and Plastic Debris Concerns

This author is unaware of any concerted effort to assess the impacts of recreational fishing and its related gear on waterbirds within the US Lost and discarded fishing line, leaders, lures, hooks, nets, traps, pots and other equipment can entangle waterbirds, and the breakdown products from discarded finished plastic items are frequently ingested by waterbirds (Manville 1988). Birds apparently mistake the plastic pellets for food. Robards et al. (1995) examined stomach contents of 1,799 Alaskan seabirds of 24 species; 15 species were found to ingest plastic. Day et al. (1985) reported that

more than 50 of the 280 species of waterbirds are know to ingest plastics. These were generally surface feeders (shearwaters, petrels, gulls) or plankton-feeding divers (auklets and puffins). Manville (1988) reported 45 of 50 Laysan Albatross chicks were fed plastic debris by their parents. While the discard of plastic from any vessel within US waters (including the EEZ) is illegal under the Marine Plastic Pollution Research and Control Act of 1987 (P.L. 100-200, Title II), the law is rarely enforced. Education is key to alerting fishers of these problems and to the solutions.

CAFF Initiative

Representatives of the Arctic circumpolar nations (i.e., Canada, Finland, Greenland, Iceland, Norway, Russia, Sweden, and the United States) met in 2000 in Nova Scotia, Canada, to participate in a seabird bycatch workshop focused on problems and solutions with gillnets and longlines in the waters of Arctic countries. The Conservation of Arctic Flora and Fauna (CAFF), a working group of the Arctic Council, was established in 1991 to address the special needs of Arctic species and their habitats in the rapidly developing Arctic region (J. Hohn 2001 pers. comm.). The USFWS (this author) presented the US position on the then developing NPOA-S. Preliminary recommendations to reduce bycatch in gillnets and longlines were presented, some of which were discussed previously in this paper. In particular, the CAFF group recognized the need to apply both adaptive management and the precautionary approach in addressing seabird bycatch. Four specific needs were recognized: outreach and education, monitoring and assessment, mitigation, and implementing mechanisms. More monitoring through greater coverage by observers was recognized as an especially important need.

"Pirate" Fisheries

Despite United Nations Resolution 46/215 calling in 1991 for a worldwide ban and global moratorium on large-scale high-seas driftnetting, illegal fishing still occurs. Eleven vessels were reported fishing in the North Pacific in violation of the ban in 1999 alone (NMFS 2000). Increased surveillance by our military and US Coast Guard, as well as enforcement efforts of other nations, will help to curtail this problem. Of particular concern in the North Pacific is the bycatch of Short-tailed Albatross documented to have been taken in this "pirate" fishery. Since this is an unreported fishery, unless fishers can be caught with bird evidence in-hand, impacts remain unknown.

Of perhaps far greater concern is the take of seabirds and the unregulated over-harvest of the "Chilean Sea Bass" or Patagonian toothfish (*Dissostichus eleginoides*) "pirate" fishery in the Southern Oceans. Ryan et al. (2001) cautioned that the level of seabird mortality from this unsanctioned and illegal fishery was of grave concern since fishing effort is estimated at more than ten times the effort of the legal fishery with an almost certain greater rate of bird bycatch. CCAMLR and its Working Group on Incidental Mortality Arising from Longline Fishing recently adopted a catch documentation scheme for toothfish in an attempt to reduce unregulated and unreported activities of "pirate" fishing vessels in Antarctic waters (Cooper et al. 2001). The problem is a serious one since an estimated 50 percent of the world's toothfish comes from "pirate" fisheries where CCAMLR quotas and seabird avoidance measures are ignored, and where 0.33 million seabirds, including some 67,000 Albatross, were reported killed in this pirate fishery from 1997-2000 (ABC 2002). Citizen action is helping with this effort; Whole Food Markets in the US recently stopped selling this fish.

Jurisdiction of the Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA; 16 U.S.C. 703-712) is a strict liability statute; the killing of any protected migratory bird is not technically allowed under law unless permitted, and the FWS does not issue "incidental or accidental/unintentional" permits. Waterbirds are also included among the protected species. They include more than 150 species found primarily on or dependent upon our US extraterritorial waters (those waters more than 22 km [12 NM] from our shores).

One of the many challenges faced by nations in reducing bird bycatch, including first world nations such as the US, is a distinct lack of conservation law to protect seabirds in fisheries. Melvin and Parrish (2001) observed that where a legal framework does exist, such as in the US with the MBTA, it is rarely enforced, and where existing laws of one country are in force, they are rarely matched with similar laws in neighboring countries. The latter situation is represented by the US Endangered Species Act and its lack of comparable legislation in Canada, Mexico, Japan, or Russia.

At this writing, jurisdiction of the MBTA creates a particular challenge for the USFWS. In 1918 when the Act was passed, implementing what was later to become four bilateral treaties, the Act's intent was clear: conserve and protect migratory birds shared with our treaty partners. Today, 836 migratory bird species are protected, including waterbirds. However, what environmentalists call "...misguided and contrary to law" (Pacific Seabird Group April 1996 letter to US Government officials), the Assistant Solicitor for the Department of Interior (DOI) issued a 1980 legal opinion regarding enforcement of MBTA only to the US 22 km (12-NM) territorial sea, not the 371 km (200-NM) EEZ

(Department of Interior 1980). Representatives of the Pacific Seabird Group also pointed out that language in the negotiation report for the US delegation for the USA-Russia Migratory Bird Treaty of 1976, prepared by the Assistant Secretary of Interior for Fish, Wildlife and Parks, was clear. "...The intention of the American negotiators [was] to have this Convention apply to the 50 states (including the high seas out to the 200 mile limit)..." (Bohlen 1977). Requests from the Pacific Seabird Group and others to enforce the Act to the EEZ were submitted to DOI officials on various occasions in the 1990s. By the mid-1990s, DOI's Office of Solicitor began a new legal review. By 2000, a draft was distributed to other Federal agencies, and briefings were conducted with these agencies by the USFWS (this author) and a representative of the Department of State. The briefings were generally well received, with moderate support, but eventual concurrence by NMFS. However, when they were presented to Solicitors with the National Oceanic and Atmospheric Administration (NOAA; the legal advisors to NMFS), some disagreements developed. Suggested changes were added to the document and it was released as a DOI Solicitor's opinion for review by NOAA Solicitors in January 2001.

The legal opinion would apply to all US citizens and all persons on US-flagged vessels in US waters beyond 6 km (3 NM) from the US coastline and would extend into the international waters to the EEZs of other countries. Because the opinion is still being reviewed by NOAA Solicitors, it continues to be treated as privileged and confidential, not for distribution outside the Executive Branch. While some have argued that by extending MBTA jurisdiction the Service's intention is to shut down commercial fisheries, this could not be further from the truth. While the USFWS has been enforcing MBTA to the 22 km (12-NM) limit since the 1980s, no recreational or commercial fishery has been shut down as a result of any investigations or prosecutions to date. If the extension is approved, it would allow the Service to use its prosecutorial discretion, concentrating on intentional or egregious takes of migratory birds on the "high seas," especially in cases where take is shown to be harming a particular population of seabirds.

In *Humane Soc'y of the United States v. Glickman* (217 F.3d 882, 888 (D.C. Cir. 2000), the court determined that the MBTA applies to Federal agencies. In major part as a result of this and a previous court decision, President Clinton signed Executive Order (EO) 13186 in January 2001. The EO requires NMFS to develop and sign a memorandum of understanding (MOU) with USFWS that "shall promote the conservation of migratory bird populations." In the MOU, NMFS must identify principles and practices that will lessen the unintentional take of seabirds. At this writing, although those elements have yet to be identified, NMFS continues to develop an MOU which has yet to be shared with USFWS.

FWS Waterbird Bycatch Plan – a Look at Solutions

While Service representatives generally attend most meetings of the eight Regional Fishery Management Councils (FMCs) and the three Marine Fisheries Commissions, we do so particularly in regard to issues of special concern to USFWS. Based on the legislative design of the FMCs, the USFWS is not a voting member, although we certainly work to raise our concerns, especially in regard to seabirds in Alaska and Hawaii. The Service, however, does not currently have a Service-wide plan to deal with waterbird bycatch.

In late 1999, Service representatives met to develop a waterbird bycatch policy statement which was approved by the Director in 2000. In part, the statement reads,

"It is the policy of the [USFWS] that the Migratory Bird Treaty Act of 1918, as amended, legally mandates the protection and conservation of migratory birds... The goal of the [USFWS] is the elimination of waterbird bycatch in [commercial and recreational] fisheries. The Service will actively expand partnerships with Regional, national, and international organizations, States, tribes, industry, and environmental groups to meet this goal. The Service, in cooperation with interested parties, will aggressively promote public awareness of waterbird bycatch issues, and gather the scientific information to develop and provide guidelines for management, regulation, and compliance."

To develop an action plan to implement this policy statement, the Service created a Waterbird Bycatch Working Group (chaired by this author) in 2001 represented by all seven regional offices of the FWS. A draft of that plan is currently in the Crafting Subcommittee. While the plan will focus on commercial gillnet and longline impacts on waterbirds, the impacts of other gear – including in recreational fisheries – will also be discussed. The plan will be designed to address all fisheries where the USFWS has interaction, authority, or jurisdiction. The plan will also address assessments of waterbird bycatch in each of our Regions; review use of an at-sea monitoring database; discuss the roles of fisheries (both commercial and recreational) in each Region; assess Regional interaction with NMFS and the FMCs; develop a plan for in reach, outreach, and education; and suggest mitigation, implementation, and international involvement. Once released from the Crafting Subcommittee, the document will be reviewed by the full Waterbird Bycatch Working Group, and then released for regional and Washington office approval, with review anticipated to begin in February 2004.

In conclusion, it is clear that many challenges remain. We acknowledge that research will continue to provide significant breakthroughs which can be used to mitigate bycatch. The US, especially the USFWS, must continue to lead the charge to resolve these bycatch problems on both the national and international fronts. One way to accomplish this is by being proactive, and by encouraging our Federal partner, NMFS, to adopt a broader, conservation-oriented approach to resource management.

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